FLORA OF AUSTRALIA

Volume 17B
Proteaceae 3
Hakea to Dryandra

FLORA OF AUSTRALIA

This volume makes a major contribution to knowledge of Australian Proteaceae. It comprises *Hakea* from tribe Grevilleeae (*Grevillea*, the other Australian genus in this tribe, is described in volume 17A), and all of tribe Banksieae, a total of 5 genera and 322 species. Included are three major genera, *Hakea* (149 species), *Banksia* (76 species) and *Dryandra* (93 species) found mainly in the south-east and south-west of the continent, and two small rainforest genera from northern Queensland, *Musgravea* (2 species) and *Austromuellera* (2 species). All of these genera are endemic to Australia, with the exception of one species of *Banksia*.

The three large genera are conspicuous and important components of forests, woodlands and shrublands throughout much of Australia. They are important also in horticulture and floriculture, and widely grown both in Australia and overseas. In the cases of *Hakea*, *Dryandra*, *Musgravea* and *Austromuellera* this is the first time in nearly 130 years that a complete account of the species has been compiled.

Cover: *Hakea bakeriana* F.Muell. & Maiden, painted by David Mackay.

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FLORA OF AUSTRALIA

Hakea bakeriana F.Muell. & Maiden. Painting by David Mackay.

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FLORA OF AUSTRALIA

Volume 17B
Proteaceae 3
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INTRODUCTION

Volume 17B is the third of the books describing the Proteaceae. This part contains genera of the Tribes Grevilleeae (*Hakea*) and Banksieae (*Musgravea*, *Austromuellera*, *Banksia* and *Dryandra*). The other Australian genus in the tribe Grevilleeae is *Grevillea*, which is treated in volume 17A. Introductory chapters describing important features of the Proteaceae in Australia, including relationships, morphology, palaeobotany, pollination biology and uses, are contained in Volume 16.

This volume includes descriptions of five genera and 391 taxa at species and infraspecific level.

Hakea is the largest genus described in this volume, with 150 species all endemic in Australia. This is the first modern treatment to describe the entire genus. *Musgravea* and *Austromuellera*, with 2 species each, are rainforest trees confined to north eastern Queensland. *Banksia*, with 76 species, all but one endemic in Australia, has been the subject of a recent monograph (George, 1981), popular treatments (George, 1984, 2nd edn 1987, 3rd edn 1996) and a project, to be published in 3 volumes, to illustrate every species in watercolour (Rosser & George vol. 1, 1981; vol. 2, 1988; vol. 3, in press). *Dryandra*, with 93 species all endemic in south western Australia, has also been without a modern treatment until now.

Scope and Presentation of the *Flora*

The geographical area covered by the *Flora* includes the six Australian States, the Northern Territory, the Australian Capital Territory and immediate offshore islands. Other Australian and State-administered territories such as Christmas Is. and Lord Howe Is. are excluded, but the occurrence in those territories of species included in the *Flora* is added to the notes on distribution. Complete Floras of the oceanic islands are in Volumes 49 and 50.

Descriptions and discussion in the *Flora* are concise and supplemented by important references, synonymy, and information on type collections, chromosome numbers, distribution, habitat, and published illustrations. Descriptions are based on Australian material except for some taxa not confined to Australia for which the collections in Australian herbaria are inadequate. Synonymy is restricted to names based on Australian types or used in Australian literature. Misapplied names are given in square brackets together with an example of the misapplication. Alien taxa establised in one or more localities, other than under cultivation, are considered naturalised and are included and asterisked (*). Native species naturalised in Australia beyond their original range are indicated by a hash (#).

Families are arranged in the system of A.Cronquist, *An Integrated System of Classification of Flowering Plants* (Columbia University Press, New York, 1981). Within families, genera and species are arranged to show natural relationships as interpreted by contributors. Although relationships cannot be shown adequately in a linear sequence, such an arrangement in a *Flora* assists comparison of related taxa. Infraspecific taxa are keyed out under relevant species. Up to seven collections are cited for each species and infraspecific taxon.

Maps showing distribution in Australia are arranged in the same sequence as the descriptions and are grouped together at the end of the main text (pp. 365–392). The term 'Malesia' is sometimes used in the notes on geographical distribution for species with occur widely in the region covered by Flora Malesiana, i.e. Malaysia, Singapore, Indonesia, the Philippines, New Guinea and adjacent islands.

Type citations under taxa in the main body of the text reflect the authors' belief in their current status (holotype, isotype, syntype, etc) and where they are held. In cases where the

type specimen has not been examined, this is indicated by *n.v.* These type statements are not to be interpreted as lectotypifications. Where lectotypifications have been made previously, these are cited with *fide*, followed by a reference to the author and place of publication (or, sometimes, to a secondary reference). Any formal lectotypifications required for this volume, as in previous parts of the *Flora*, are confined to the Appendix.

New taxa and lectotypifications are included in an Appendix where they are formally published in accordance with the *International Code of Botanical Nomenclature* (Koeltz Scientific Books, Königstein, 1994). Abbreviations, contractions and notes on format are listed after the Appendix.

A key to families of flowering plants and a glossary of technical terms are provided in Volume 1 of the *Flora*. Supplementary glossaries are included in each volume as necessary.

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There are 5 contributors, 11 illustrators and 14 photographers for Volume 17B. Their co-operation is gratefully acknowledged.

The Australian National Botanic Gardens slide collection provided a number of the colour photographs used in this volume, and we wish to express our appreciation to Jan Wilson and Murray Fagg for their continued help and generosity. These slides are individually identified by the initials ANBG in the relevant figure captions.

ABRS is grateful for permission to reproduce figures of *Banksia* in this volume from *The Banksia Book* and the journal *Nuytsia*.

Catherine Jordan and Linda Harris, the Librarians at the Australian National Botanic Gardens, were as always cheerful and extremely helpful in assisting to locate references.

The co-operation of the referees, usually working to tight deadlines, is also acknowledged.

The production of this volume would not have been possible without the substantial assistance of the Australian Commonwealth, State and University Herbaria. Their willingness to provide staff time and resources for this project of national importance is an outstanding example of co-operation between the States and the Commonwealth. Overseas institutions have also assisted preparation of the Volume with loans of specimens and by making facilities available to contributors and illustrators.

The Executive Editor acknowledges with great pleasure the input by staff of the Australian Biological Resources Study. Their work, invisible in the final product, is onerous, often tedious, but essential in maintaining the high standards that this series has achieved. Volume management was the responsibility of Annette Wilson. Checking and bromiding of illustrations was undertaken by Jane Mowatt. Final typsetting and production of camera ready copy was the work of Helen Thompson. Most ABRS Flora Section staff were involved at various stages in editing, indexing and collating the text.

The co-operation of CSIRO Publishing in bringing this book to press is gratefully acknowledged.

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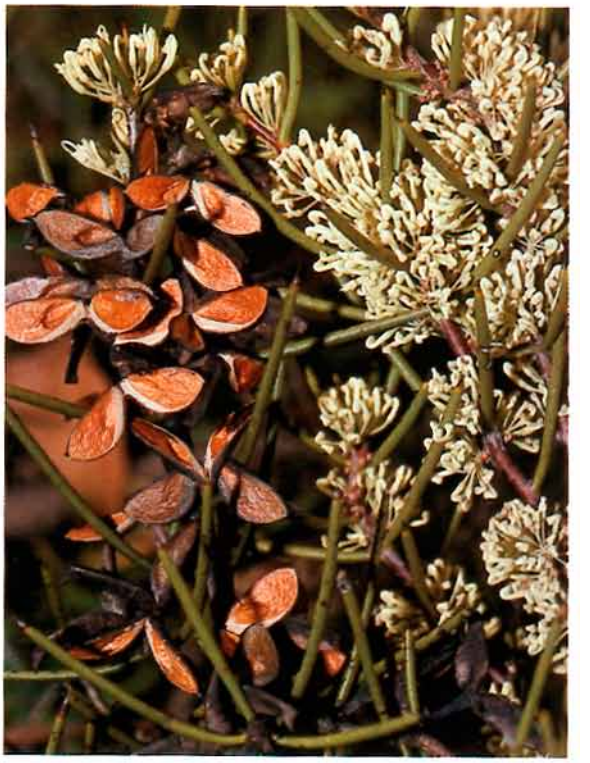

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INTRODUCTION TO HAKEA

W.R.Barker[1], *R.M.Barker*[1] *& L.Haegi*[1]

Hakea has not attracted the same level of attention as major related genera such as *Grevillea* and *Banksia* which have extensive accounts of the biology, taxonomy, phylogeny and morphology of species. Thus, the two aims of the following account are to provide for *Hakea*:

- information that balances to some extent the background data available for *Banksia* (George, 1984) and *Grevillea* (McGillivray & Makinson, 1993; Olde & Marriott, 1994). Included are a preliminary phylogeny of *Hakea* with a view of its historical biogeography, and a brief review of selected aspects of the biology and possible adaptive trends evident within the genus;
- a discussion of the diagnostic characters used in this account, and the conventions and terminology adopted.

History of the development of taxonomic knowledge

The first collections of *Hakea* were made by Banks and Solander in 1770. Seeds were sent to Kew, nurserymen, gardens and private collections in Europe. There was a great deal of competition in England and Europe to be the first to flower these and other strange novelties from the other side of the world (Cavanagh, 1990; Nelson, 1990).

Banks and Solander never published the results of their voyage although Solander identified and unofficially named the collection, the three species of *Hakea* being given names within 'Leucadendroides'. The name 'Leucadendroides' indicated a genus with affinities to *Leucadendron*, one of the few Proteaceous genera known at the time. *Embothrium* was described in 1776 and *Banksia* in 1781 and some of the earlier known *Hakea* species were placed in these genera. Additional species were described in *Banksia* by Gaertner, James Smith and Salisbury between 1788 and 1796. Ventenat in 1800 and Andrews in 1802 published species under *Embothrium*.

The genus *Hakea* was described in December 1797 by Schrader and Wendland (1797). It was named after Baron von Hake, a patron of botany, and included three species, *H. glabra*, *H. pubescens* and *H. sericea*. The material on which the descriptions were based was collected at Botany Bay.

In May of the following year Smith (1798) published a new genus, *Conchium*, derived from the Greek word for a bivalve shell in reference to the form of the fruit of *Hakea*. No species were described, just the characters of the genus. Smith later listed the species he considered to belong to *Conchium* in his account in *Rees' Cyclopaedia* of 1807 and in his slightly later paper in the *Transactions of the Linnean Society* (Smith, 1808). Although aware that *Conchium* was pre-dated by *Hakea* he decided to continue with its use since he was not sure of the circumscription of *Hakea*, and some of his contemporaries preferred his name. Smith's account included the first descriptions of *Hakea* species from Western Australia, based on collections made there by Menzies in 1791 on the Vancouver Expedition. Menzies had already recognised three of these species as different, referring to them as *Banksia spuria no. 6, 7* and *8* in the fashion of his time (Barker & Barker, 1990).

Knight's controversial account of the Proteaceae (Barker & Barker, 1990), said to have been written by Richard Salisbury and plagiarised from a series of lectures presented to the Linnean Society by Robert Brown, contained accounts of seven species of *Hakea*. None of these were new, although *H. nervosa* was proposed as a new name for *H. dactyloides*.

Robert Brown's dissertation on the Proteaceae (Brown, 1810a) in the *Transactions of the Linnaean Society* predated his *Prodromus* (Brown, 1810b) by two months. Descriptions of 35 species of *Hakea*, most of which he had collected himself on Flinders' voyage, are contained

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in both accounts. Brown grouped the species on leaf shape, whether filiform or flat. The filiform-leaved group was further subdivided on the presence or absence of horns on the fruits and the flat-leaved group on whether the leaves were toothed or not. Brown (1830) added a further 31 new *Hakea* species in his supplement to the *Prodromus*, based on collections from Cunningham, Fraser and Baxter, among others.

Lindley (1840) published five species from Western Australia, based on early Drummond collections. Further Drummond and Preiss collections from this State were the basis for most of the approximately 80 new taxa described by Meisner (1845, 1855, 1856) in his major publications on the genus. Meisner's arrangement of the species was similar to Brown's but with the addition of characters of venation and striation of the leaf. His informal divisions were as follows:

1. Leaves all terete, filiform
2. Leaves terete-filiform pinnatifid, or undivided terete or mixed
3. Leaves flat, spiny or laciniate
   a. capsule horned
   b. capsule not horned
4. Leaves flat, entire, many-nerved. Capsule not horned
5. Leaves flat, entire, 1-nerved. Capsule horned
6. Leaves flat, entire, 1-nerved. Capsule not horned.

Bentham (1870) treated the genus in *Flora Australiensis*, but the number of new taxa was small and mostly at varietal level. Bentham did, however, provide the first formal infrageneric groupings, dividing the 95 species into four Sections and 10 Series. These can be seen in Table 1 below, where they are related to the groupings used within this treatment.

Mueller described about 20 new species of *Hakea* in diverse publications between 1853 and 1893.

Since Bentham's work there has been no attempt at a revision of all of the species, although the genus has been treated in a number of State floras. Johnson published two new species (Johnson, 1962) from New South Wales and Blake (1963) reviewed the taxonomy of the corkwood group. Maconochie had published three new species (Maconochie, 1973) and gathered together protologues and information on *Hakea* before his death in a road accident in 1984. Lamont (1972; Lamont *et al*., 1987) published four new taxa including three new species from Western Australia, and George (1979) and Lee (1984) one new species each.

Two papers were published as precursors to the account of the South Australian species of *Hakea* (Barker, 1986) in the fourth edition of the *Flora of South Australia*. One paper (Haegi & Barker, 1985) elucidated the taxonomy of the South Australian species allied to *H. ulicina* and a remarkable new sterile species from Kangaroo Island. The other (Barker, 1985) dealt with the taxonomy of the corkwoods and of the needlewoods, including *H. leucoptera*, *H. sericea*, *H. vittata* and their allies.

Precursive papers to the *Flora of Australia* treatment have been published by R.M.Barker (1991a, 1991b, 1998), W.R.Barker (1989, 1996) and W.R.Barker & Morrison (1989).

Olde & Marriott (1994), in their account of the history of *Grevillea*, provide further detail on many of the collectors who also collected *Hakea*.

The distinction between *Hakea* and *Grevillea*

Without fruits many *Hakea* and *Grevillea* species are easily confused, especially in their flowers with four tepals, an erect or recurved limb in bud, and a similar range of leaf and pollen presenter shapes. Usually they can be distinguished readily by their fruits, generally woody and persistent in *Hakea* as opposed to non-woody and non-persistent in *Grevillea*. Other useful distinguishing characters include the leaf symmetry, the ovary and the style. In *Hakea* the upper and lower leaf surfaces usually appear very similar both superficially and in their epidermis (termed *isobilateral*); in *Grevillea* the upper and lower surfaces usually differ

(termed *dorsiventral*). The style and ovary of *Hakea* species are glabrous except in *H. arborescens* and *H. persiehana* where there are some short erect hairs on the style and in *H. horrida* and *H. ilicifolia* where there are papillae, possibly glandular, on the ovary. Styles and ovaries may be glabrous in *Grevillea* as well, but many *Grevillea* species possess hairs in these parts. Some *Grevillea* species develop distinct swellings or structures on the style, a characteristic unknown in *Hakea*. The length of the stipe supporting the ovary is also useful. The ovaries of all *Hakea* species, except the corkwoods, are sessile or only shortly stipitate. In the great majority of *Grevillea* species the ovary is stipitate; in those species which are sessile, the ovaries are densely hairy.

An informal infrageneric classification

In this treatment of *Hakea*, species have been treated within informal groups. Table 1 shows these groups, correlated with Bentham's earlier infrageneric classification. A formal classification will be established when the present preliminary cladistic analysis has been extended to a full analysis of all taxa, with characters refined and added (see below).

Table 1. Comparison of informal groups recognised in this treatment with the formal infra-generic groups of Bentham (1870); authorship of groups, and index to placement of species in the treatment

Informal Group in present treatment (author)	**Species number**	**Bentham's 1870 classification**	
		Section	**Series**
Trineura (WRB)	1–2	*Grevilleoides p.p.*	
Lorea (WRB)	3–11	*Grevilleoides p.p.*	
Pedunculata (RMB)	12–15	*Grevilleoides p.p.*	
Salicifolia (RMB & WRB)	16–17	*Hakea*	*Glabriflorae p.p.*
Sericea (WRB)	18–29	*Hakea*	*Glabriflorae p.p., Pubiflorae p.p.*
Nodosa (WRB)	30–32	*Hakea*	*Glabriflorae p.p.*
Strumosa (RMB & WRB)	33–40	*Hakea*	*Glabriflorae p.p., Pubiflorae p.p.*
Megalosperma (RMB)	41	*Hakea*	*? Pubiflorae p.p.*
Verrucosa (RMB)	42–46	*Hakea*	*Glabriflorae p.p.*
Prostrata (RMB)	47–52	*Hakea*	*Glabriflorae p.p.*
Cristata (RMB)	53	*Hakea*	*Glabriflorae p.p.*
Microcarpa (RMB & WRB)	54–57	*Hakea*	*Glabriflorae p.p.*
Eriantha (RMB)	58	*Hakea*	*Pubiflorae p.p.*
Trifurcata (RMB)	59–63	*Hakea*	*Pubiflorae p.p.*
Teretifolia (RMB)	64	*Hakea*	*Pubiflorae p.p.*
Rostrata (RMB & WRB)	65–69	*Hakea*	*Pubiflorae p.p., Obliquae p.p.*
Incrassata (RMB)	70–71	*Hakea*	*Pubiflorae p.p.*
Obliqua (RMB)	72–76	*Hakea*	*Obliquae p.p.*
Ceratophylla (RMB)	77–82	*Hakea*	*Pubiflorae p.p.*
Platysperma (RMB)	83–84	*Hakea*	*Pubiflorae p.p.*
Lissocarpha (RMB)	85–88	*Manglesioides*	
Varia (RMB)	89–95	*Conogynoides*	*Enerves p.p.*
Clavata (RMB)	96	*Hakea*	*? Pubiflorae p.p.*

Table 1 continued			
Linearis (RMB)	97	*Hakea*	*Glabriflorae p.p.*
Ruscifolia (RMB)	98–99	*Hakea*	*Glabriflorae p.p.*
Undulata (LH)	100–111	*Conogynoides*	*Petiolares p.p., Sessiles p.p., Nervosae p.p.*
Cucullata (LH)	112–114	*Conogynoides*	*Sessiles p.p.*
Petiolaris (LH)	115–117	*Conogynoides*	*Petiolares p.p., Longistylae p.p.*
Ulicina (LH)	118–138	*Conogynoides*	*Nervosae, Uninerves & Teretifoliae*
Multilineata (LH)	139–144	*Conogynoides*	*Longistylae p.p.*
Corymbosa (LH)	145–149	*Conogynoides*	*Longistylae p.p., Sessiles p.p.*

(RMB = R.M.Barker; WRB = W.R.Barker; LH = L.Haegi).

MORPHOLOGY

This section introduces many of the characters described in the account and their variability. A number of terms, particularly those used in a special sense in this treatment, are clarified. Examples are mentioned in terms of individual species and the informal groups, with reference to illustrations in the flora treatment. Occasional mention is made of a monophyletic set of groups (a *clade*) which are shown in Figure 1.

Dimensions of organs have been taken from dried material or rehydrated dried material.

Habit

Hakea is notorious for the pungency and toughness of the foliage of most species. Plants are usually single- or multi-stemmed shrubs. However, the *Lorea* group, and sometimes *H. archaeoides* (*Trineura* group), *H. oleifolia* (*Varia* group) and the *Multilineata* group are single- or multi-stemmed trees. A few other species, such as *H. costata* (*Ulicina* group) are small bushes, while *H. myrtoides* (*Ulicina* group) is a sprawling bush. Branches are generally ringed with leaves, and are sometimes divaricating (e.g. *H. lissocarpha*). Some species have a 'columnar habit' from long slender ascending branches ringed with rigid tough divided or simple leaves or, in the *Ruscifolia* and *Varia* groups, an envelope of short shoots.

Resprouting

Many *Hakea* species are capable of resprouting after fire or mechanical damage. Resprouting can be from a lignotuber, by suckering from often horizontal roots or, more rarely, by growth from epicormic shoots. While sprouting ability is sometimes noted by collectors, the mode of regeneration is not always documented. From limited field observations, lignotubers are sometimes very much larger than the stem above (e.g. *H. rostrata*, *H. florulenta*), but can sometimes be quite obscure (e.g. *H. aenigma*, *Lorea* group). Species which are non-sprouters are killed by fire. In general, species which are able to resprout from a lignotuber, or sucker from the base of the plant or horizontal roots are many-stemmed, while non-sprouting plants are single-stemmed. Terms used to cover these features are: *non-sprouting, lignotuberous, suckering from horizontal roots, resprouting from the base, resprouting epicormically, resprouting capacity unknown*.

Bark layer

Most *Hakea* species are shrubs and the bark is smooth. However in the *Lorea* group, commonly known as the 'corkwoods' (which develop into trees of some age), the bark is dark, very thick and deeply furrowed, though not spongy as in cork.

Branchlets

Branchlets may be smooth or variously ribbed. Ribs are decurrent from the leaf bases and may extend very shortly or be long-decurrent, giving branchlets a multi-ribbed appearance.

Indumentum

Indumentum in *Hakea* usually comprises eglandular 2-armed hairs characteristic of Tribe *Grevilleeae*. Young growth is frequently hairy and the type of hairs present can be useful in separating species (e.g. *H. erinacea*, *H. longiflora*). Hairs can be appressed, and either shiny (sericeous) or non-shiny (pubescent), or raised (tomentose). Where hairs are raised, the arms are often, at least in the *Multilineata* clade, significantly unequal in length. Hairs range in colour from all white, or a mixture of white and ferruginous to all ferruginous, and can occur on all exposed parts except the inner surface of the tepals, glands, stamens, pistil and fruit. A quickly deciduous layer of ferruginous hairs on branchlets often overlies a more persistent layer of white hairs (as sometimes in the *Sericea* group) on the branchlets and rachis. The young growth of *H. lissosperma* is distinctly white and shiny, while the young growth of the *Ceratophylla* group is always ferruginous.

On young shoots it is usual for the indumentum on the leaves to be lost very quickly, while that on the branchlets remains longer. In some groups, such as the *Ulicina* group, branchlet indumentum is variously deciduous or persistent, with the condition at the time of first flowering on the branchlets useful to distinguish species.

Indumentum in *H. smilacifolia* is unusual in its very long hirsute to villous layer of ferruginous hairs overtopping another tomentose layer. Hirsute-leaved *H. gibbosa* is unusual also in the persistence of its leaf indumentum often past flowering.

Eglandular indumentum is usually constant on vegetative parts within a taxon. However, in a number of species of the *Lorea* group which are normally hairy, some individual plants are completely devoid of eglandular hairs. In *H. leucoptera* two subspecies are distinguished on the degree of appression of hairs on the rachis.

Glandular hairs occur sporadically in a number of species of the *Lorea* group (*q.v.*), sometimes associated with the rare completely glabrous individuals, sometimes, as in *H. chordophylla*, more densely in plants of a particular region. Such hairs are very rare in the Proteaceae, occurring also in *Grevillea* (McGillivray & Makinson, 1993).

Leaves

The leaves of *Hakea* fall into three main types: simple and terete or subterete; simple and flat; and divided with flat or terete segments. These types break down in many ways: in differences between juvenile and adult foliage, across the annual growing season, between populations or even on the one plant. Despite this, it is useful to use these types as a basis for discussion of leaf variation.

A number of leaf anatomical studies, generally of limited coverage, have been carried out, for example by Hamilton (1927), Haegi (1973; Haegi & Barker, 1985), Lamont (1976), Lee (1984), and more recently by Catling (Catling & Gates, 1995a, 1995b, largely on vouchered material supplied by the authors), Groom, Lamont & Markey (1997) and Schubert (1996). Lisa Schimanski of the University of Tasmania has started extant leaf studies on vouchered material for defining environmental indicators in fossil leaf attributes. Distinctive macromorphological characters of prominent leaf venation, which distinguish the groups associated with the *Multilineata* clade (Fig. 1) from the rest of the genus, are confirmed anatomically. Unusual morphology in, for example, *H. trineura* and *H. pandanicarpa* has

also been discerned, but a rigorous specimen-vouchered systematic study defining diagnostic characters and states has yet to be produced.

In the *Trineura* group and *H. petiolaris* and *H. laurina* the long attenuate base is treated as a petiole, but in other *Hakea* species the leaves are sessile or subsessile without a definable petiole.

Variation on plants or within species

Leaf shape is extremely variable, ranging from needle-like and undivided (simple terete: as in *H. sericea*) or divided (compound terete: as in *H. drupacea*), flat and undivided (e.g. *H. pandanicarpa, H. victoria*), flat and divided (e.g. *H. ceratophylla*) or elliptic in cross-section and simple or divided (as in the *Varia* group). Simple and divided leaves may occur on the one plant (e.g. *H. preissii*, some species of the *Lorea* group including *H. ivoryi*, *H. lorea* subsp. *lorea* and *H. divaricata*). *Hakea divaricata* shows a north–south divergence in the number of segments in its compound terete leaves. *Hakea trifurcata* similarly often consists of both simple and divided terete leaves, but in this species flat leaves (visually similar to the fruits) also develop once the plant produces fruits. *Hakea varia* and *H. prostrata* both encompass considerable variation in leaf shape but the shape tends to be constant on the one plant. *Hakea carinata* and *H. mitchellii* show regional divergence in leaf width (Haegi & Barker, 1985); both can vary in leaf width on the one plant in some regions, with the latter species showing an annual decline in leaf width on a developing branch as the growing season advances. *Hakea orthorrhyncha* and *H. microcarpa* have terete leaves in some populations and flat leaves in others, while *H. candolleana* has trigonous- and flat-leaved populations.

Simple terete leaves

Within the apparently simple terete-leaved species, most are circular in cross-section (e.g. the *Sericea*, *Strumosa* and *Verrucosa* groups). An exception is the longitudinally grooved and/or 3–12-angled leaves of some species in the *Ulicina* group, including *H. sulcata, H. subsulcata, H. scoparia* and *H. invaginata* (Fig. 20N–P).

Some species of the *Sericea* group have a single longitudinal groove on the lower surface of the leaf. The groove is usually confined to near the base, but in a few species (e.g. *H. macraeana*) it usually extends over the whole length.

The apex of these leaves is erect or recurved. Species such as *H. fraseri, H. adnata* and *H. tephrosperma* almost always possess uncinate leaves. While sometimes occurring in allied species, this characteristic is not common.

Simple flat leaves

Margins of simple flat leaves can be entire (Trineura group, H. macrocarpa, H. cyclocarpa, H. pandanicarpa, H. ruscifolia, H. petiolaris, H. arborescens) or toothed. Teeth usually extend over the full length of the leaf (H. cristata, H. denticulata, H. victoria), but there are a few unusual leaf types, such as the fan-shaped leaves of H. baxteri and associated species (Fig. 12M) where the margin is entire but the broad convex apex is toothed. Some species such as H. linearis, H. nitida and H. florida have populations in which the leaves are usually toothed along the margin, rarely entire, while H. oleifolia has leaves which are usually entire, rarely toothed along the margins.

Sometimes the leaf base (*H. amplexicaulis, H. smilacifolia*) or the whole leaf (*H. cucullata, H. victoria*) can be cupped about the stem. Within the species with simple flat leaves, the venation can either be obscure (*H. cyclocarpa, H. pandanicarpa, H. eriantha*) or obvious (the *Multilineata* clade, e.g. *H. dactyloides, H. laurina, H. victoria*).

Some flat leaves have a twisted base (e.g. *H. repullulans, H. incrassata*) which brings the leaf into a vertical plane. *Hakea pandanicarpa* is unusual in that, while the leaf is in the vertical plane, it is laterally flattened, with the anatomy of the upper margin differing from the lower (Catling & Gates, 1995a).

Divided leaves

Divided leaves range from the clearly flat leaves which are lobed (*H. ceratophylla*) to the clearly terete leaves which are divided (*H. drupacea, H. erinacea, H. trifurcata, H. lissocarpha* and some populations of *H. purpurea* and *H. preissii*). In the latter case the number of ultimate segments can be useful to distinguish between species. Many of these species have a single longitudinal groove on the undivided basal portion. This groove can be on the upper (*Lissocarpha* and *Varia* groups) or the lower surface (some species of the *Trifurcata* group) of the leaf.

Between these extremes are a number of leaf types which are more difficult to classify. Most of these relate to the *Varia* group where the leaves are quite variable between populations, and sometimes on the same bush. They range from simple and elliptic in cross section through 3–5-lobed or 3–5-partite (usually in the apical half) to the pinnatisect leaves with segments similar in cross-section of *H. horrida.*

Seedling and juvenile leaves

The first seedling leaves of *Hakea* species may or may not resemble those on the mature plant. Some preliminary observational work has been done in this field, but seedling morphology remains to be documented systematically with properly vouchered material and could not be utilised in this study. However, it is known that many of the species producing broad flat seedling leaves (e.g. *H. cyclocarpa, H. prostrata*) also have similarly shaped, but thicker, adult leaves (Groom, Lamont & Markey, 1997). Similarly, many species with terete seedling leaves also produce terete adult leaves (e.g. *H. rostrata*, *fide* Haegi, 1973; *H. obliqua, H. recurva*). However, there is another group of species, including *H. drupacea* (see Heide-Jørgensen, 1990, for illustrations of cotyledons to mature leaf), *H. gilbertii*, *H. subsulcata* and *H. horrida*, in which the seedling leaves are broad, flat and often toothed but the adult foliage is either simple- or compound-terete. As the seedling develops, the leaves become narrower in successive nodes into the adult condition.

Juvenile leaves, differing from normal leaves on mature plants, have been observed in *H. ivoryi*. Adult trees often bear simple leaves, but leaves on suckers or young plants are often divided with many segments.

Involucral buds

Incipient vegetative shoots and inflorescences develop separately or sometimes together, surrounded by very similar involucres of overlapping bracts. It is not always possible to distinguish between a developing vegetative, floral or combined bud. The bracts surrounding an inflorescence are usually quickly lost but in the *Corymbosa* group and sometimes in *H. gilbertii* they persist at the base of the inflorescence. Only in the *Ceratophylla* and *Platysperma* groups do the flowers develop without an involucral covering.

Inflorescence

Inflorescences usually arise from buds in the axils of young leaves. They can also arise in older axils where the leaves may have been lost, or, in the *Strumosa* group and *H. bakeriana*, from buds developing from rachises of the previous year. Buds present at the base of the rachis can give rise to inflorescences in subsequent years or, in the *Lissocarpha* group and *H. linearis*, to a vegetative branch which develops at the same time as the inflorescence.

In the *Pedunculata* group flowers are borne at the apex of the rachis. The rachis below the flowers has been termed a *peduncle* for use in distinguishing the species in the *Pedunculata* group; in *H. pedunculata* the hairs on this part of the rachis are very sparse compared with those on the flower-bearing part. Generally, however, flowers are spread along the rachis. A somewhat intermediate condition is found in *H. leucoptera* among smaller flowered species, and in showy inflorescences of the *Lorea* and *Trineura* groups; in these species the flowers are more widely dispersed along the rachis but with a basal non-flower-bearing portion of some length.

Terminal inflorescences are found in a few species such as *H. commutata, H. circumalata* and the *Ruscifolia* group.

Flowers within an inflorescence are usually paired, although occasional species have single flowers (e.g. *H. denticulata*) particularly where the rachis is very short and the flowers small. Readily deciduous bracts which subtend the pairs of flowers are present in only a few parts of the genus, in the *Trineura, Lorea* and *Pedunculata* groups and in *H. rhombales*.

The number of flowers per inflorescence is variable, ranging from one (*H. denticulata*) to as many as 500 in the very floriferous *Multilineata* and *Lorea* groups.

Inflorescences are usually erect, but often in the corkwoods (*Lorea* group) and characteristically in *H. pendens* they are pendent.

Flowers

Hakea flowers are usually bisexual. Cryptic unisexuality is discussed under the section on breeding systems (p. 16). *Hakea aenigma* and *H. pulvinifera* are two species which are sterile, all flowers having sterile pollen, *H. aenigma* no ovules and *H. pulvinifera* a deformed pollen presenter. As a result neither species produces fruit.

In most species the flower buds are clearly recurved at the apex, with the subglobular, ovoid or ellipsoidal claw of the perianth pressed against the apex of the limb. In the *Lissocarpha* group, and also in *H. newbeyana* the claw is not recurved, and the buds are referred to as 'straight'.

Perianth length is measured in the mature bud (about to split) from the base of the torus to the apex of the limb or, if it is recurved, to its most distal part.

Indumentum on the pedicel and perianth is of great taxonomic importance. In many cases the pedicel and perianth share the same hair covering or lack of it (e.g. in the *Prostrata* and *Corymbosa* groups both pedicel and perianth are glabrous, while in the *Obliqua* and *Trifurcata* groups both pedicel and perianth have the same hair covering) but in some cases (e.g. the *Sericea* and *Undulata* groups) the hair covering of the pedicel does not extend on to the perianth. Hairs are usually white, cream, ferruginous or a mixture of these and their nature, whether raised or appressed, can be of importance diagnostically at the species level.

Despite Venkata Rao's (1971) suggestion that pollen in *Hakea* shows great uniformity, pollen is potentially of great taxonomic value at the species and particularly the infrageneric level, as indicated by Erdtman's (1952) limited light microscopic survey of the genus and Haegi's (1973) scanning electron microscope study of *H. ulicina* and its allies. Dr A.R.H.Martin (University of Sydney) has undertaken unpublished pollen studies, unfortunately not vouchered by herbarium specimens. Specimen-vouchered samples of most species were provided to Dr Sylvia Feuer (De Paul University, Chicago) and Mr Denis Gibbons (University of Sydney) but data are not available as yet.

A nectar-secreting gland is present adaxially at the base of the ovary in most species. Exceptions include *H. aenigma, H. dohertyi, H. horrida, H. ilicifolia* and *H. smilacifolia* in which the gland is absent and several species in the *Undulata* group (e.g. *H. anadenia, H. neurophylla*) where it is vestigial or absent. In shape the gland varies from large and U-shaped (*Lorea* and *Obliqua* groups), to small and U-shaped (*Multilineata, Pedunculata* and *Nodosa* groups), a small, sometimes somewhat curved, flap, ranging from rectangular (*Sericea* and *Undulata* groups) to subglobular (*Ulicina* group) to obovoid (*Corymbosa* group) or to triangular or obtriangular (*Petiolaris* and *Ulicina* groups).

Pistil length has been measured as if the style was straightened.

The ovary in all species of *Hakea* is glabrous. Only in *H. horrida* and *H. ilicifolia* are there some excrescences which are possibly glandular. In a number of groups the apex of the ovary is truncate and from an early stage after anthesis develop into the horns which are present on the mature fruit (*q.v.*).

In those species of *Hakea* with erect conical pollen presenters (e.g. those groups of the *Multilineata* clade) the style is usually erect. An exception is the style of *H. lissocarpha* which often forms a complete loop before again becoming erect. *Hakea* species with pollen presenters which are oblique or lateral discs invariably have decurved styles, sometimes looping.

The pollen presenter at the apex of the style is important diagnostically, particularly at an infrageneric level. The *Multilineata* and allied groups (e.g. *Undulata* and *Corymbosa* groups) have an erect, conical, sometimes almost cylindrical, pollen presenter with a slight dilation on the adaxial side of the base. Most other groups (e.g. the *Trineura, Lorea, Obliqua* and *Sericea* groups) have an oblique discoid pollen presenter, often centrally upwardly dilated into a stout cone encompassing all to only a small part of the discoid base. A few groups, including the *Trifurcata, Verrucosa* and *Platysperma* groups, have a broad disc inserted on one side of the very tip of the style (a *lateral* disc). The stigma is minute. In species with an erect pollen presenter the stigma is recessed at the apex of the cone or cylinder. In species with an oblique or lateral disc the stigma is at the apex of an erect filiform organ projecting from the disc or, where there is a conical dilation arising from the disc, either on a filiform organ or recessed at the apex of the dilation. On discoid pollen presenters without a conical dilation the stigma or filiform organ may or may not be centred.

Fruit

The majority of fruits are ovoid or obovoid, but shape ranges from globular in *H. incrassata*, sub-globular in *H. platysperma*, and flattened ellipsoidal in *H. trifurcata* to variations on S-shaped in the *Rostrata* group and *H. eriantha* due to differing degrees of recurvature and differential swelling of the stalk (developed from the flowering rachis, pedicel and gynophore), of the base, and of the beak towards the apex. Fruit shape and width is generally described in lateral view, often in terms of the inner face of the valve.

The beak is the narrowed portion distal to the swollen fruit body as seen in median view. It is usually well demarcated and marks the point where one or more layers of pale wood reach their distal limit. The extent of the beak is important in distinguishing fruits in the *Sericea* group; it is defined as tiny where less than 0.05 of the surface area of the fruit, small where up to 0.2, and moderately large where up to 0.5. The beak may have the same ornamentation as the rest of the fruit body, as in the *Lorea* group (Fig. 3P: fruit of *H. macrocarpa*, side view), *H. tephrosperma* (Fig. 4B), *H. multilineata* (Fig. 21D) and *H. erinacea*, or it may have a different ornamentation, as in *H. decurrens* and *H. macraeana* (Fig. 6D, F, S). It is sometimes placed obliquely to the rest of the fruit body and in *H. actites* extends down one side of the fruit body.

Horns are the paired hard points projecting obliquely forwards from just behind the apex of the fruit in many groups of *Hakea* (e.g. *H. linearis* and *H. clavata* (Fig. 10N–P), *H. verrucosa* (Fig. 8D) and *H. nitida* and *H. horrida* (Fig. 14 I, N)). In *H. actites* they are displaced a little further than usual below the fruit apex. They vary from sometimes present but obscure to obvious, and are most obvious on the developing fruit after fertilisation. Horns are absent from fruits of the *Trineura* and *Prostrata* groups and the groups of the *Multilineata* clade.

A small apiculum, derived from the style base, is present on the fruits of most species, but is more prolonged and prominent in species such as *H. meisneriana* and *H. pycnoneura* (Fig. 20H, K, L), *H. orthorrhyncha* and *H. teretifolia*. The apiculum in the two globular-fruited species, *H. incrassata* and *H. platysperma*, is laterally placed and defines the orientation of the circular seed in the valve (*q.v.*).

Features of the surface of the fruit body and beak such as corkiness (*Obliqua* group), ridges (*Sericea* group), pusticules (*H. nitida, H. drupacea*), extra crests and ridges (*H. rhombales, H. teretifolia, H. cristata*), spines (*H. lehmanniana, Prostrata* group) or pubescence (*Prostrata* group *p.p.*) are all important diagnostically. In the *Sericea* group the outer bark often breaks away from the underlying pale wood in older mature fruits, apparently through differential expansion.

Most species have fruits turning grey or grey brown, but in a few instances some remain green at maturity (*H. cristata* and some members of the *Prostrata* group).

The characteristic woodiness of the fruit is best observed in a dehisced fruit. The fruit opens into two woody valves, each with the inner face bearing a seed in the *seed cavity*. On either side of the seed cavity are two contrasting layers of wood, a *red-brown wood zone*, on the side of the fruit which first opens, and a *pale wood zone*, itself of two or more layers. The red-brown wood zone appears homologous with the wood of the fruits of *Grevillea.* The pale wood (a product of secondary thickening) is unique to *Hakea* in the Proteaceae (Johnson & Briggs, 1975).

Secondary thickening results from the continuous cambial layer, which produces distinctive layers of pale wood surrounding the seed except on one side of the valve face (Johnson & Briggs, 1975). The pale wood in the fruit plays an integral role in keeping the valves closed for long periods up to many years. Associated with this woodiness is the splitting of the fruit down both sides from the style base, not just one side as in the typical proteaceous follicle (Johnson & Briggs, 1975). This splitting down both sides occurs even in species with reduced wood.

The narrower the pale wood zone, the thinner the fruit in median view and the more prone it is to dehisce seasonally. These less woody fruits tend to open down both sides, sometimes even recurving and displaying the seed fully (e.g. *H. clavata*). The *Microcarpa*, *Trifurcata* and *Prostrata* groups lack any marked development of woodiness and their fruits do not persist for any length of time on the plant, and the branch supporting the fruit is not thickened as it is in those species which develop woody fruits. Plants of the *Lorea* group are characterised by green unopened fruits of the current season and old opened fruits from previous seasons. Seed of many of these species tends to occupy the whole surface of the valve face (see for example the *Prostrata* group in Fig. 9E, G, I), whereas in woody fruits the seed occupies only part of the valve face (*Sericea* group in Figs 4C, Q, R, 5G, J, L, 6E, G, S). In addition, the woodier fruits tend to open completely on the side supporting the red-brown layer but only partly on the other, as illustrated in *H. baxteri* (Fig. 12K).

The width of either wood zone in the fruit can be important taxonomically: the red-brown wood zone for example in the distinction between *H. baxteri* and *H. brownii* and the separation of the subspecies of *H. stenophylla* and *H. decurrens*; the pale wood zone in separating *H. decurrens* subsp. *decurrens* from two other subspecies and in separating species of the *Lorea* group.

The orientation of the seed and seed cavity with respect to the axis of the fruit (taken from the stalk to the apiculum) is also of diagnostic value. In *H. gibbosa* the seed is clearly oriented transversely with respect to the fruit stalk, as are the circular seeds of *H. incrassata* and *H. platysperma.*

Seed

All *Hakea* seeds consist of a seed body and a wing. The wing may be apical (*H. eriantha*, *H. erinacea*), or it may extend down one side only of the seed body, from only partly to almost completely (*Lorea* and *Pedunculata* groups), or down both sides (*Corymbosa* group) of the seed body, or it may completely encircle the seed body (*H. cygna*, *H. circumalata*, *H. platysperma*).

Body and wing colour may vary from pale yellow to black; the wing may be mottled. Only rarely is the seed body noticeably smooth and unornamented (*H. commutata*). It is usually sculptured in some way, commonly with raised irregular, more or less longitudinal ridges. However, in a number of species (e.g. *H. obliqua*, *H. platysperma*) the seed body has large outgrowths that are impressed into complementary depressions in the face of the seed cavity on the inner valve face.

A PRELIMINARY PHYLOGENY OF *HAKEA*

A consensus cladogram was generated using the computer program Hennig86 (Farris 1988), with 59 morphological characters scored in 88 of the 149 species (consistency index 0.19, retention index 0.68). Representation is not evenly spread across groups with, for example, six species scored of the five groups of the *Multilineata* clade. A reduced version of the cladogram is provided (Fig. 1) with terminal branches named in terms of the informal groups (Table 1).

The cladogram gives preliminary support to some informal groups recognised in these treatment (Table 1) and, on account of paraphyly and polyphyly, calls into question others.

Special character transformations were developed for some inter-related characters.

- The relationship between the leaf characters of cross-section and division were combined in a transformation allowing for the origin of terete compound leaves from a flat divided relative or a terete simple relative. Intermediate states where a taxon may show both states or intermediate morphology formed part of the character transformation tree. A character of mucro number may have caused the displacement of *H. hookeriana* from other members of the *Ceratophylla* group: this character in future may in some cases be better dealt with as a reiteration of the simple and divided state, with degree of incision of leaves being dealt with as a character instead. Studies of transformation in leaf division characters from seedling to adult stages may help resolve this.
- Pollen presenter type was represented by a transformation of the base orientation from oblique plesiomorphic state to both lateral and horizontal as actinomorphic, and a simple transformation from disc to conical with a basal flange to conical. The often slender pollen presenter common in the groups in the *Multilineata* clade will in future analyses need to be investigated for its homology with the stouter conical pollen presenter in other parts of the genus.

Hakea as a single phyletic group

The evidence we have at present suggests that the genus *Hakea* evolved as a result of one evolutionary event and is therefore monophyletic. Not only is the woodiness of the *Hakea* fruit universal (although variable in expression) in the genus and unique in the Proteaceae as a whole (Johnson & Briggs, 1975), but there are characters correlated with this attribute. The synapomorphic characters supporting the *Hakea* clade are:

- the presence of an involucre or cluster of bracts enclosing the young vegetative buds and inflorescences. The absence of these bracts from the *Ceratophylla* group appears to be a secondary loss rather than reflecting a plesiomorphous condition, as evidenced by its position high in the cladogram;
- the modified follicle, with secondary thickening and dehiscence down from either side of the style base, even in those species with reduced woodiness in the fruit;
- possibly the apical extension of the seed wing. Wings elsewhere in Tribe Grevilleeae (*Grevillea*) encircle the seed body. Encircling wings in a few *Hakea* species may be shown to be non-homologous (independently derived within the *Hakea* clade).

Grevillea glauca, a likely sister group to the *Hakea* clade, computes in this relationship with *Hakea* in the cladogram which was derived with *G. juncifolia* as the outgroup. *Grevillea glauca* has seeds apparently unique in *Grevillea*, with wings clasped between solid valves, a character shared with all species of *Hakea*. However, the fruits of *Hakea* are very different

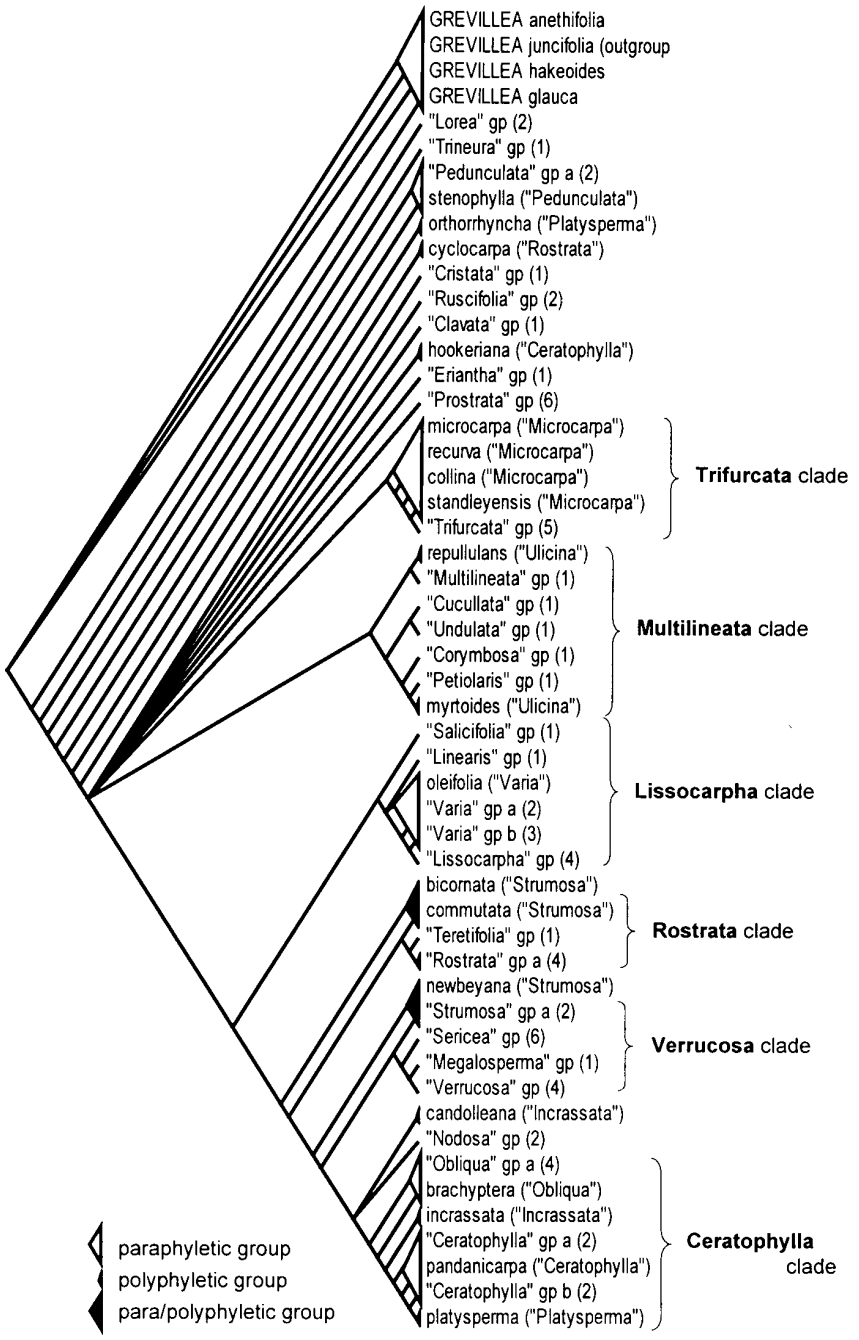

Figure 1. Summary of Nelson consensus tree of *Hakea* in terms of informal infrageneric groups, generated by Hennig86 based on scoring qualitative states of 59 morphological characters for 88 of the 149 species. It gives a preliminary view of the possible phylogeny of *Hakea*. Suffixes applied to group names reflect paraphyletic and polyphyletic subgroups. Bracketed numbers indicate number of species scored. Tree drawn using TreeView (Page, 1996).

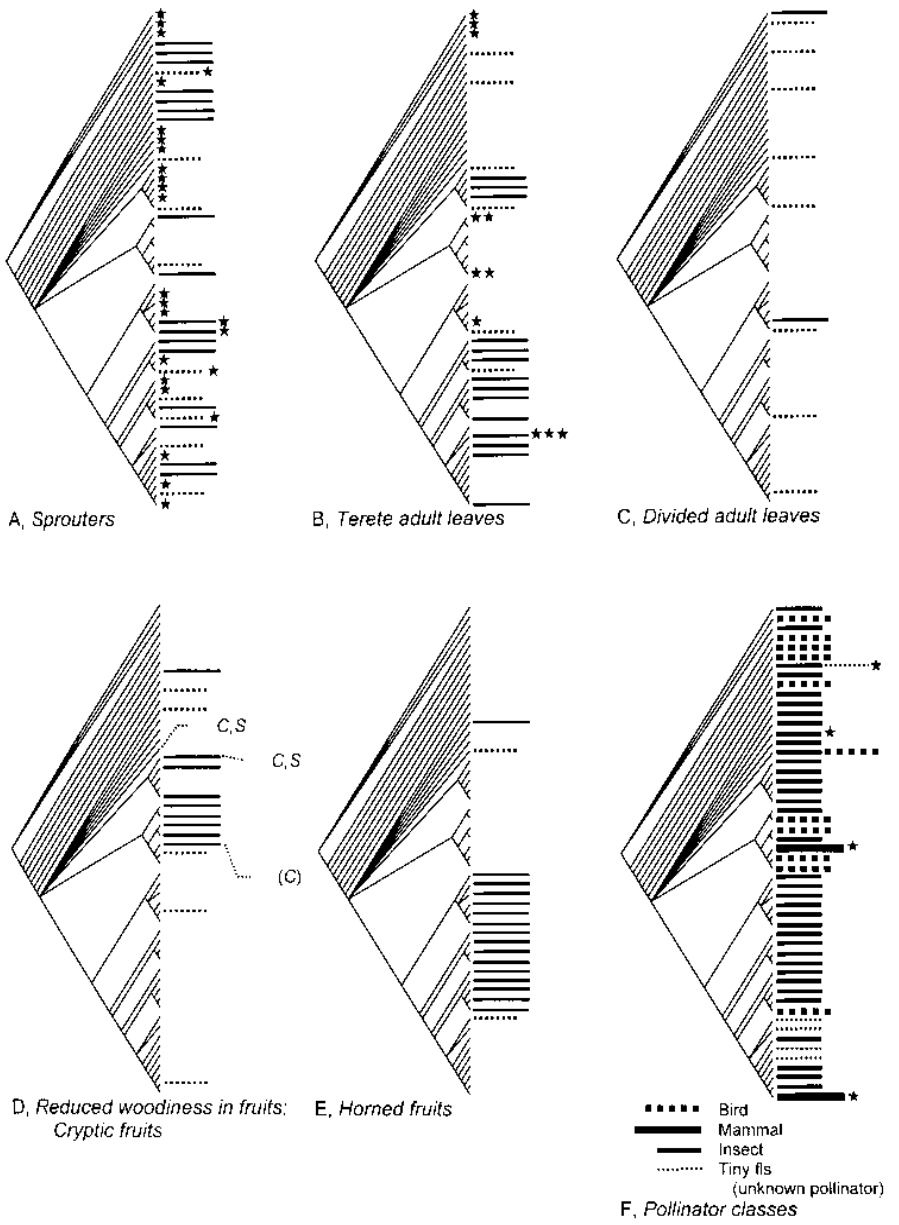

Figure 2. Occurrence of putatively adaptive traits in *Hakea*. **A,** sprouters, capable of resprouting from the base of plant (★, indicates some taxa unknown). **B,** terete adult leaves (★, indicates some or all taxa almost terete; ★★, other taxa, not scored, terete; ★★★, another taxon, not scored, sometimes flat). **C,** divided adult leaves. **D,** reduced woodiness in fruits; cryptic fruits indicated by: ***C***, via colour, ***S***, via spines (brackets indicate not in all taxa). **E,** horned fruits. **F,** pollinators in the four classes recognised in the text (★, indicates questionable). (**A–E,** longer solid lines ——— indicate characteristic of all taxa; shorter dotted lines ····· indicate characteristic of some taxa).

from *G. glauca*. This sister relationship needs additional confirmation with further characters for which leaf anatomy, pollen and molecular studies seem to be the most promising sources. As a result, whether *Hakea* is a clade arising out of *Grevillea* or whether the two genera are sister groups has yet to be determined. The doubt raised about the monophyly of *Grevillea* may have an impact in future on its generic circumscription.

The polytomous node in the cladogram indicates the inadequacy of the present character set in resolving the relationships between even the scored species. Future modifications of existing characters include:

- investigating the presence of horns on the developing fruit, rather than mature fruits where horns may become worn;
- testing the treatment of flat leaves with multiple mucros as divided leaves, and introducing the degree of fusion of segments of divided leaves into a character transformation tree for leaf shape;
- reviewing the homologies of conical pollen presenters in the *Multilineata* and *Lissocarpha* clades;
- reviewing seed wing morphology to ensure that a flange of the seed body is not treated in the same way as decurrence of the true wing tissue.

Potential additional characters lie in pollen morphology, leaf anatomy, the involucral bracts and seedlings. The value of anatomical study of the leaves is illustrated in the similarity of the obvious venation of the leaves of the members of the *Multilineata* clade to that of the basal *Trineura* group and *Grevillea glauca*. However, the separation of the *Multilineata* clade is vindicated by its different anatomy from *H. archaeoides* in the *Trineura* group (Catling & Gates, 1995a).

Towards a phyletic infrageneric classification of *Hakea*

The cladogram shows that Bentham's (1870) infrageneric classification of five sections of *Hakea* (Table 1) is untenable on a monophyletic basis. Only his Sect. *Manglesioides*, represented herein by the *Lissocarpha* group, remains a monophyletic terminal clade.

Bentham's other sections, nevertheless, do have some phyletic basis. Section *Grevilleoides*, while paraphyletic, corresponds to the basal clades, *Lorea*, *Trineura* and *Pedunculata*. Section *Conogynoides* is polyphyletic but nevertheless is represented by only the *Multilineata* clade and the paraphyletic *Varia* group which falls into the *Lissocarpha* clade. Section *Hakea*, however, represents the many remaining clades within the genus and has little phyletic basis.

The decision to recognise many infrageneric groups at the same level is supported by the cladogram. A formal classification will be founded on a cladistic analysis of all taxa and additional characters.

ASPECTS OF THE BIOLOGY OF *HAKEA*

Throughout much of its range *Hakea* is associated with sclerophyllous vegetation on poor soils, where it is subject to periodic fires of varying intensity, with seasonal dry and wet seasons, periodic floods and drought. The flora is diverse and interacts with an equally diverse fauna, particularly rich in small mammals, birds and insects (many of which are involved in pollination and dispersal), and reptiles. However, there is only limited browsing of plants by vertebrates (Dawson *et al*., 1989).

Certain features of *Hakea* can be related to its place in the Australian environment. These features include the large woody fruits which can take years to release their seed, the rigid dagger-like foliage which has led to *Hakea* being recommended as natural screening plants,

the horns on the young and mature fruits, the presence of lignotubers, and the propensity of some species to become weeds outside their natural range.

This account brings together some of the observations and hypotheses on the biology of *Hakea* from published material and from our own work in analysing variation on collected samples and in the field. There has been much work on the reproductive ecology, water relations and population dynamics of the Proteaceae, including *Hakea*, in Western Australia, particularly by Lamont's school at Curtin University (Lamont, 1985; Groom & Lamont, 1996a, 1996b; Groom, Lamont & Kupsky, 1994; Groom, Lamont & Markey, 1997 and Richards *et al*., 1997). South African scientists, sometimes in collaboration with Lamont, have also worked on the reproductive ecology of *Hakea* to control those species which have become disastrous weeds of the fynbos (Richardson *et al*., 1987; Midgley *et al*., 1991). Some of the ideas presented here will hopefully prompt further scientific study.

Some adaptative character traits are mapped in Figure 2 on the preliminary cladogram which has been developed for this account (Fig. 1).

It is suggested that studies of adaptation could usefully involve looking at differences in traits within species pairs or species complexes, rather than the usual approach to date of looking at all *Hakea* species in a region. This present systematic study should assist in promoting this approach.

Sprouters and non-sprouters: ways of coping with fire

Like *Banksia* and *Eucalyptus* and many other plant groups in Australia, *Hakea* has two basic strategies for regeneration. After a fire or following mechanical damage some species (known as *sprouters*) sprout from underground parts, sometimes a swollen base of the stem called a *lignotuber* (e.g. *H. bakeriana, H. decurrens, H. dactyloides, H. rostrata, H. brownii, H. obliqua*), or in aerial parts from below the bark (*epicormic sprouters*, e.g. *H. strumosa, H. platysperma, H. nitida, H. drupacea, H. oleifolia* and *H. florida*: Groom & Lamont, 1996b). Others known as *non-sprouters* (e.g. *H. sericea, H. ulicina, H. baxteri, H. psilorrhyncha*) are killed by fire. Non-sprouters are thus reliant solely on seed for regeneration, while existing plants of sprouters can survive fire by producing suckers as well as producing a new generation of seedlings. Resprouting capability is recorded in the species and subspecies descriptions. Stuckey (1985, 1987a) made observations of a number of lignotuberous species, while reproductive strategies of Western Australian *Hakea* species have been discussed by Lamont (1985) and Groom & Lamont (1996b).

Hakea pulvinifera and *H. aenigma* are unique in the genus in reproducing entirely by resprouting. They have sterile flowers and consequently produce no fruit or seed. *Hakea aenigma* regenerates after fire or mechanical damage (e.g. by graders) in long lines of suckers from horizontal roots; the single clone that presumably constitutes this species today occupies a now discontinuous area of about 30 × 15 km! In contrast, *H. pulvinifera* occupies just a small hillside. The two species are not alone in the Australian flora, with rare similar examples in *Zieria* (Rutaceae) (e.g. *Zieria sp. F* (Armstrong, 1991)), *Grevillea* (Bob Makinson, pers. comm. 1996) and *Lomatia* (Lynch *et al*., 1998).

Sprouters and non-sprouters are not confined to separate parts of the genus. It is clear that the traits have evolved on more than one occasion (Fig. 2A). Species pairs or complexes involving both traits are evident, examples being the respective sprouters and non-sprouters in *H. decurrens* and *H. sericea* (*Sericea* group), *H. obliqua* and *H. psilorrhyncha* (*Obliqua* group), different subspecies of *H. petiolaris* (*Petiolaris* group), *H. undulata* and *H. anadenia* (*Undulata* group), *H. repullulans* and *H. ulicina* (*Ulicina* group), *H. corymbosa* and *H. eneabba* (*Corymbosa* group), *H. rostrata* and *H. teretifolia* (*Rostrata* group), *H. nodosa* and *H. propinqua* (*Nodosa* group), and *H. baxteri* and *H. brownii* (*Ceratophylla* group).

Reproductive options, breeding systems and pollination syndromes

Breeding systems: producing the next generation

The way in which a species reproduces from generation to generation is determined by its breeding system. Reproduction that results from outcrossing between individuals provides genetic diversity that may detract from immediate fitness but favour the longevity of a species in the face of environmental change over geological time (Grant, 1958). By contrast, inbreeding may provide optimum immediate fitness, but it may detract from long-term viability of a species through reduced genetic variability. Loss of sexual reproduction is an evolutionary dead-end.

Hakea flowers appear bisexual with full and functional pollen presented at the end of the style and a pair of ovules in the ovary, and in fact they are usually so. However, microscopic examination has revealed that some species have cryptically unisexual flowers. This can be evident from populations containing plants on which fruits never form. Study shows them to be functionally male, while other plants may have bisexual or functionally female flowers. Examples are *H. repullulans* (Lee, 1984) in the *Ulicina* group, and *H. megadenia* and *H. epiglottis* (Lee, 1987; Barker, 1991) in the *Rostrata* group, which are cryptically polygamous with male, female and bisexual flowers. At least *H. epiglottis* is sometimes monoecious, but it usually has male and female flowers on different plants. This separation of sexes on different plants promotes crossing between plants, maximising variability. So obscure are the indicators of these features that it is possible that other species in *Hakea* may exhibit similar features.

The two species already mentioned as completely reliant on vegetative reproduction have reached evolutionary dead-ends. *Hakea aenigma* (*Ulicina* group) and *H. pulvinifera* (*Lorea* group) are both sterile. Flowers have sterile pollen, while *H. aenigma* has no ovules and *H. pulvinifera* has a deformed pollen presenter.

Seed load and available modes of reproduction

Seed load on a plant relates to the investment of a *Hakea* in sexual reproduction. There is a tendency for sprouters to bear a smaller number of seeds than non-sprouters (Groom & Lamont, 1996b), reflecting their energy investment in two modes of reproduction.

Pollination

What pollinates Hakea?

Very little is known about pollination of individual species of *Hakea*. From the size and arrangement of the flowers and their parts, we can suggest for each species its likely class of pollinator in terms of insects, birds and mammals, which are the main animal groups involved in pollination in the Australian flora (Armstrong, 1979), but apart from our own observations of both naturally occurring and cultivated plants there has been very little observational work published in this field. Denis Gibbons (pers. comm. 1990) of Sydney University has been investigating the relationship between floral morphology in *Hakea* and pollinator class. Some of the bee pollinators of *Hakea* are listed (without indication of the particular *Hakea* species) in the essay 'Pollinators of Australian Proteaceae' in volume 16 of the *Flora of Australia* (Maynard, 1995). Figure 2F shows the distribution of the flowers that we believe fall in each of these pollinator classes across the informal groups.

The larger flowered species with a large separation between pollen presenter and gland and often large glands producing much nectar are generally visited by birds. Sometimes flowers are developed on older wood below the leaves, possibly allowing for perching. We have observed birds in the cream-flowered inflorescences of the *Lorea* group in natural situations (three honey-eater species in *H. eyreana* in north-eastern South Australia, Lewin's Honeyeater (*Meliphaga lewinii*) in *H. fraseri*, the Yellow-throated Miner (*Manorina flavigula*) in *H. lorea* subsp. *lorea* in north-eastern South Australia) and in red-flowered inflorescences of *H. multilineata* in the *Multilineata* group (the Noisy Miner (*Manorina*

melanocephala) in a cultivated specimen in the Adelaide Botanic Garden, South Australia). Bird pollination is spread across a wide range of groups; other bird pollinated species are likely to include *H. orthorrhyncha*, the *Trineura* and *Verrucosa* groups, and at least some species in each group of the *Multilineata* clade (e.g. *H. cucullata* in the *Cucullata* group).

A few larger flowered species with exposed nectar and pollen presenters assembled in a brush are likely to be visited by mammals. The arrangement of flowers and leaves in *H. victoria* (*Corymbosa* group) suggests that it may be pollinated by honey-possums. The basal split of the fused tepals allows nectar to flow from the base of the flower. The inflorescence has a ring of large involucral bracts holding the nectar in a pool at the base of an open circle of flowers into which the possum inserts its muzzle. *Hakea platysperma*, with a spread-out ring of flowers with pollen presented above the large glistening red glands, is also possibly mammal- rather than bird-pollinated. Its flowers are borne at the base of the plant near ground level. The pollinator of *H. corymbosa* is obscure; its clusters of large greenish yellow flowers, while directed outwards, are shielded from above by a palisade of dense sharp foliage, with access from the ground through the maze of branchlets and leaves just as difficult.

Relatively small cream sickly- or sweet-scented flowers (with perianth ranging from about 5 to 10 mm long in bud) are the most common type in *Hakea* and spread throughout the genus. These, in our experience, (which includes *H. leucoptera*, *H. collina*, *H. carinata*, *H. costata*, *H. vittata* in the field *H. costata*, *H. varia* in cultivation) are visited by insects ranging from native and introduced bees to wasps, moths, butterflies and flies.

It is not clear what pollinates the yellow to red and yellow to white tiny-flowered species which occur in *H. brachyptera* (*Obliqua* group) and the *Nodosa* and *Incrassata* groups. Fruit set is not abundant despite some species being non-sprouters, so it seems likely that they have a biotic pollinator.

The foraging range of different pollinators may affect genetic heterogeneity in widespread species. Birds will be expected to range more widely than insects, for example. Genetic studies by Gary Starr (pers. comm. 1998; Starr & Carthew, in press) of the University of Adelaide are showing that, while morphological differences between the many populations of insect-pollinated *H. carinata* in the Mt Lofty Ranges are not apparent, variation being generally within populations and on a limited broad geographical basis (Haegi & Barker, 1985), isolation from gene flow, by both pollination and seed dispersal, has resulted in significant genetic differences between populations over distances as small as one kilometre.

Attracting pollinators, presenting rewards and ensuring pollination

Coloration in flowers varies from the norms cited above. Often flower colour can be modified from the tepal colour by the colour of overlying hairs or, in the *Lorea* group, of the deep purple-black gland. In opened flowers the inner surface of the tepals may be exposed to pollinators and differ in colour from the outer surface. *Hakea lehmanniana* is unusual in its greenish blue flowers. The pollen mass, which is clearly apparent on the pollen presenter, is usually yellow. However, a scatter of species have coloured pollen, our observations including: pink in *H. purpurea*, *H. varia*, *H. lissocarpha*, *H. drupacea* and *H. decurrens* subsp. *physocarpa*; pink-purple in *H. nitida*; white in *H. amplexicaulis*, *H. multilineata*, *H. decurrens* subsp. *physocarpa* and *H. lissocarpha*; and pale greenish white in *H. vittata*. Flower colour varies, particularly in the *Multilineata* and *Verrucosa* clades, often deepening with age from bud to pre-anthesis and post-anthesis stages. These various colour contrasts may give signals to pollinators as to the appropriate time to visit flowers for rewards.

Nectar is presented to pollinators in different ways in different species. Large glands characterise disparate groups, including the *Lorea*, *Platysperma* and *Obliqua* groups. Slits at the base of a perianth tube in the *Corymbosa* group provide an avenue for nectar to escape to other areas and accumulate for presentation, as described above in *H. victoria*. Whether there is a similarly functional split at the base of the perianth tube in the *Varia* and *Lissocarpha* groups needs to be confirmed.

Pollen presenter and tepal size, direction, fusion and relative size all function to provide for different blossom form. An oblique pollen presenter is characteristic of much of the genus, including the basal clades, but a conical pollen presenter has arisen in various clades, including single species in the *Pedunculata*, *Ruscifolia* and *Lorea* groups. The feature is, however, characteristic of the whole *Multilineata* clade, and the terminal part of the *Lissocarpha* clade (*Lissocarpha* and *Varia* groups). Lateral pollen presenters have arisen a number of times and occur in the *Eriantha*, *Verrucosa* and *Trifurcata* groups in particular.

Woody and not so woody fruits: fires, cockatoos and protecting the next generation

Seeds in the Australian environment are open to destruction by fire and by predation by many animal groups, both on the plant and after release from the fruit.

The woody fruits which are so characteristic of the majority of *Hakea* species remain closed on the bushes for many years, a property usually referred to as *serotiny*. We have even observed whole fruit in *H. pandanicarpa* and *H. carinata* almost completely envoloped within the trunk, indicative of development long before. Fruits open when the branch supporting the fruit dies, through incidental branch breakage or more commonly through bush fires.

The possible advantages of serotiny have been classed as '(i) maximising seed availability, (ii) minimising post-dispersal granivory, and (iii) ensuring seed release coincides with the presence of favourable (post-fire) microsites for germination and seedling growth' (Groom & Lamont, 1997). Serotiny does, however, expose fruits on the plants to loss of seed through both fire and predation. It is characteristic of not only many *Hakea* species, but also other major sclerophyllous groups such as *Banksia*, *Dryandra* and *Xylomelum* in the Proteaceae, *Eucalyptus*, *Melaleuca* and *Leptospermum* in the Myrtaceae, and Casuarinaceae. It enables mass germination of seed to take place in the open burnt sites created by the fire. During a fire seeds are protected within the closed fruit, but soon afterwards the fruits dehisce. As a result fire promotes release of a very large bank of seeds into the newly opened out burnt area. *Hakea neurophylla* is an exception; its fruits remain closed after fire, but open with the first rains (Stuckey 1987a). *Hakea* seeds germinate readily, requiring no special pre-treatment.

Some *Hakea* species, such as those of the *Trifurcata* clade, release their seed annually or seasonally through reduced woodiness in the fruit. This seems a derived trait in *Hakea*, not limited to a single phyletic element of *Hakea* but evolved on more than one occasion (Fig. 2D), and under different ecological circumstances. The species of the *Microcarpa* group occur in habitats less prone to fire. *Hakea microcarpa* occurs in swampy sites where floods may transport seed to open sites conducive to seedling establishment, while the other species in the group inhabit arid regions where fires may be less frequent and naturally open sites and sporadic flooding rains would provide conditions for establishment. *H. pedunculata* is unique in the *Pedunculata* group for its reduced fruit woodiness and swampy habitats. *Hakea nodosa* (*Nodosa* group), sometimes also in swampy sites, and possibly *H. gibbosa* (*Sericea* group: *q.v.*) are unique in the genus for producing both woody serotinous fruits and seasonally dehiscent fruits with little wood.

Fires do occur in arid regions and some species, such as the *Lorea* and *Multilineata* groups and *H. leucoptera* (*Sericea* group), have serotinous fruits.

Prior to release of seed

Fire

The woody serotinous fruits of *Hakea* seem generally adapted to most fires. In our experience newly dehisced fruits show the very outer bark or layers burnt and the white wood undamaged. The woody layers themselves must afford insulation to the seed, but in some species (*H. pandanicarpa, H. psilorrhyncha* and *H. obliqua* in particular) an outer corky layer develops on the fruits with time, possibly providing even greater protection against

fires. A few other species in different parts of the genus have fruits that are very large and woody (e.g. *H. bakeriana, H. constablei, H. platysperma, H. megalosperma*).

Granivory

Black cockatoos (*Calyptorhynchus* species) are known to forage woody fruits including *Hakea*, their target food being larvae of wood-boring insects and seed, both of which form a major part of their diet (Frith, 1976). *Hakea* species in which we have seen evidence of fruit damage by black cockatoos are *H. carinata*, *H. microcarpa*, *H. acuminata*, *H. prostrata*, *H. epiglottis* and *H. rostrata*. Loram (1994) observed similar fruit damage in *H. rugosa*, while foraging of *H. trifurcata* seeds by the Short-billed Black Cockatoo (*C. latirostris*) was investigated by Groom, Lamont & Duff (1994). The foraging of *Hakea* fruit may be restricted to black cockatoos. Richard Schodde (pers. comm. 1999) confirms that this is likely and notes from literature and personal observation that the Short-billed Black Cockatoo and the Yellow-tailed Black Cockatoo (*C. funereus*) actively predate, perching in the bushes to open up 'green' follicles with their bills. Schodde also notes that: 'Red-tailed Black Cockatoos (*C. banksii*) will also flock to feed on seed on the ground spilled from follicles after a fire.'

In the Mount Lofty Ranges of South Australia, in our experience, Yellow-tailed Black-Cockatoos show much greater preference for *H. carinata* over *H. rostrata*, *H. rugosa* and the introduced *H. decurrens* subsp. *physocarpa*. The fruits of *H. carinata* are more abundant and more accessible, with the plant providing feeding platforms for the birds. The pruning of fruiting branchlets associated with this foraging may function to remove spent fruits, but pruning can occur without foraging of the fruit.

The extinct megafauna must also be considered in any discussions of adaptations against seed predation (see page 23 below).

Features which may have been selected for in *Hakea* to enhance survival of seed in the face of predation while still borne on the plant include:

- increased fruit size and woodiness;
- fruit number;
- early release of seed through reduced woodiness;
- protection by spinose leaves;
- cryptic fruits;
- mimicry.

An increase in fruit size and/or numbers may be part of an adaptive strategy to minimise the effect of predation. Fruit number may also be a component of the reproductive strategy of a species (see above), but protection of fruits by increase in the thickness of the woody protective envelope of white wood and therefore fruit size may be more critical in some species with few fruits where energy is allocated to vegetative propagation (by resprouting) rather than just sexual (via seed).

The occurrence of reduced woodiness in the fruit in the various parts of the genus has been alluded to in the previous section. Where the seed is produced in less woody and not noticeably camouflaged fruits (*Lorea* group, *Microcarpa* group) there seems often a higher fruit set per inflorescence and possibly plant. Through lower insulation seeds remaining in the fruit are less likely to survive a fire (Bradstock *et al*., 1994), but presumably most seed is usually released before fire. However, while reducing exposure of seed to predation in the fruit, early release would increase exposure to this on the ground (see below).

The very rigidity and pungency of the leaves of *Hakea*, which is proposed as an evolutionary response to the browsing by elements of the extinct Australian megafauna (see below), may reduce the potential loss of fruits as well as other vital parts of the plant (flowers and shoots). It is suggested that *Hakea* has had an additional need to resist herbivory because of the retention of its fruits. Examples of protective foliage are given under the following section on the megafauna. One particularly pungent example already mentioned is *H. corymbosa*, with

its dense shield of rigid near-vertical hard spine-tipped leaves encircling the fruits, often the flowers and sometimes the shoots. We have observed the damage done to fruits by black cockatoos in the allied species, *H. acuminata*, in cultivation in Perth, Western Australia; its fruits are exposed between less rigid, less pungent leaves.

Camouflage of fruits seems a remarkable strategy evident in several groups of *Hakea* (Fig. 2D). Fruits can be camouflaged by the outer coat in varying ways:

- by retaining coloration to match the adjacent leaves (*Prostrata*, *Cristata*, *Trifurcata* groups). The leaves and fruits are generally green, but in *H. spathulata* old fruits even match grey leaves on older parts of the plant;
- by development of spines or outgrowths similar to those on the leaves (as in *H. cristata* and the *Prostrata* group) or to the rachises after flowering that lack fruits (*H. prostrata* and *H. amplexicaulis*: *Prostrata* group);
- by resemblance of the fruits to specialised flat leaves, the widely recognised example being *H. trifurcata*, studied by Groom, Lamont & Duff (1994);
- by banding of colour on the fruit matching the brown of the branchlets together with breaking up the fruit outline with a transverse row of spines, as in *H. teretifolia* (*Rostrata* group).

Finally we come to our speculatory proposal of mimicry involving the developing fruits. Usually the developing fruits at first are green or blue-grey like the leaves, but become brown or red-brown like the branchlets well before maturity. Horns are a characteristic of many *Hakea* fruits and are confined to a particular part of the preliminary cladogram (Fig. 2E); there would appear to have been a secondary loss of them in some of the species of the *Prostrata* group. They are particularly prominent on the developing fruits, and in mature ones in some species tend to wear away or break off, indicating that their functionality may be in the earlier stages.

We consider that there may be a link between the horns and other features on the developing fruits and the larvae of moths that feed on *Hakea* which may provide a defence against predation of *Hakea* seed. The larvae of most species of *Oenochroma* (a genus of Geometrid moth) feed on Proteaceae, with one species (*O. vinaria*) preferring *Hakea* and *Grevillea* (Nielsen & Common, 1991). These larvae have a pair of dorsal projections which in size, separation and orientation resemble the horns on young fruits. The resemblance, in our observations of *H. verrucosa* in cultivation in an Adelaide garden, was most striking when the larva, on disturbance, arches out from the twig, bringing its erect dorsal projections to the summit of the arch in an aggressive defensive posture. The asperations on the caterpillar also resemble the tubercles on the young fruit. Of interest would be the reaction of black cockatoos to these larvae. Do they avoid them? Mimicry of other larvae may be evident in the thick finely tuberculate young fruits of *H. constablei*. The apparent evolutionary loss of horns in the *Prostrata* and *Trifurcata* groups may arise from the development of camouflage as an alternative way of reducing predation.

The gall-like young fruits of *H. lehmanniana*, prominently covered in dense tubercles, may be another example of mimicry reducing granivory; gall-forming wasps are known to live on *Hakea* (Nauman, 1991). The green partially developed fruits of *H. propinqua* are enveloped in dense thick plate-like yellow tubercles (Fig. 5C); they are, however, also horned.

Seed after release

In most cases the dispersal of *Hakea* seeds occurs subsequent to fire. This means release in dry conditions, maximising the effectiveness of the seed wing. Seeds are usually light and released from a height. By reducing the time between seed release and germination serotiny reduces the extent of seed loss after release and presumably, in view of the apparent success of serotiny in protecting seed, overall.

Wing colour could be related to habitat at the time of seed dispersal. *Hakea leucoptera*, *H. ochroptera* and the *Lorea* group have pale wings which may match normal soil colour, but

most species have a blackish wing, which could relate to their normal release onto fire-blackened ground.

Dispersal of seeds in those species with less woody and non-persistent fruits may take place seasonally but over a wider period than seed held in serotinous fruit, with the seeds accumulating within litter. There is little indication as to whether these seeds, which are high in nitrogen and phosphorus (Kuo *et al*., 1982), are of any interest as a food source to ants or other foragers within litter (and thus subsequently secondarily dispersed). Feeding on ground seed after fire by Red-tailed Black Cockatoos is noted above, however. Groom & Lamont (1997) suggest that seedling recruitment only occurs from fresh seed and that dispersed seeds do not persist in soil-stored seed banks. However, if seed colour does match ambient soil colour, this would suggest some predation may have had some selective influence. Almost a year after release onto the ground from serotinous fruits of *H. sericea* after a spring burn, 70% of seed germinated (Whelan & York, 1998), indicating *Hakea* seed may be longer lived than Groom & Lamont suggest.

Burial may limit seed predation. Unlike many species of *Grevillea* (McGillivray & Makinson, 1993), *Hakea* lacks elaiosomes which promote burial of seed by ants into the soil. In species such as *H. platysperma* and *H. obliqua*, in which outgrowths are formed from the seed body, it was suggested by the late Ken Stuckey (pers. comm. 1987) that these could serve to capture sand particles and thus both anchor and accumulate soil over the seed. The body of the largest seeded species, *H. platysperma*, has particularly long linear projections that may reflect the greater weight of soil required to hold the seed down against winds. Most species in the *Platysperma*, *Ceratophylla* and *Obliqua* groups have similar prominent projections. The seed cavity on the inner face of the seed valve has pits and holes of complementary dimension that house the projections in the closed fruit. This may ensure that fruit must open wider than in other species to release the seed, thus prolonging retention of the seed on the plant. Elsewhere in the genus seed bodies may be smooth (e.g. *H. commutata*), but in most species sculpturing is present and of lower relief, often in the form of irregular ridges; these may function only in the separation of the seed from the seed cavity when it matures.

Providing food and shelter for insects and fungi

Insects

Much of the information about insects which feed on *Hakea* originated from work by South African biologists. Their aim was to find a method of control for introduced and very invasive *Hakea* species, particularly *H. sericea*. In the 1960s S.Neser of the South African Department of Agriculture conducted an investigation (while based in the Department of Zoology, Australian National University, Canberra) into those insects which specifically feed on *Hakea*. The following information has been gleaned from his thesis (Neser, 1968), still often quoted as a basic source of information, and other sources, but there is a need for closer collaboration between entomologists and botanists to document such plant-insect interactions. There are undoubtedly many more insects that feed on *Hakea* in a less specific fashion than those listed below.

Borers (Coleoptera)

Roots, stems and woody fruits of *Hakea* are home to the larvae of cerambycid beetles (Coleoptera: Cerambycidae). Adult beetles are usually referred to as long-horned beetles while the larvae are commonly known as round-headed borers. Because of their burrowing activities into the fruits of *Hakea* the larvae were investigated for control of *H. sericea* in South Africa.

The genus *Aphanosperma* (Cerambycinae: Aphanasiini), with two species, was first described by Britton (1969) from material collected by Neser. One of the species was described from fruits of *H. drupacea* and was thought to also occur in *H. elliptica, H. varia, H. undulata* and *H. cucullata*. The other species was found in fruits of an eastern species of *Hakea*. The closely related *Aphanasium*, from which *Aphanosperma* was split by Britton, has

also only been recorded from *Hakea* and *Grevillea* plants. Matthews (1997) recorded from South Australia another closely related and possibly new genus within this tribe, but the host is unknown.

Strongylurus and *Uracanthus* (also genera of subfamily *Cerambycinae*, but from different tribes) have been recorded from *Hakea* but they are not host-specific.

Larvae of Lepidoptera

Nielsen & Common (1991) have listed several cases of lepidopteran larvae feeding on *Hakea*. The parenchyma-eating larvae of *Stegommata leptomitella* (Lepidoptera: Lyonetiidae), commonly known as leaf miners, have been recorded from *H. salicifolia* leaves. The larvae of Geometrid moths (Lepidoptera: Geometridae), particularly of the genus *Oenochroma*, feed on Proteaceae, with *O. vinaria* feeding predominantly on *Hakea* and *Grevillea* foliage. Larvae of the moth *Carposina autologa* (Lepidoptera: Carposinidae) are known to feed on *Hakea* fruits. The larvae of *Xylorycta luteotactella* (Lepidoptera: Oecophoridae: Xyloryctinae), as well as being a pest of *Macadamia*, have been recorded from the twigs or woody fruits of *Banksia* and *Hakea*.

Sap-feeding bugs (Hemiptera)

Three shield bugs, *Buthumka transitionalis*, *Tepperocoris lofteyensis* and *Brizocoris dimorphicus* (all Pentatomidae: Pentatominae) have been recorded from *Hakea* as well as other native flora in South Australia (Gross, 1975).

Scale insects of the genus *Auloicerya* (Coccoidea: Margarodidae) feed on *Hakea* and *Acacia*, as do psyllids of the genera *Acizzia* (Psyllidae: Acizzinae) and *Acanthocnemus* (Psyllidae: Triozidae) (Carver *et al.*, 1991).

Wasps (Hymenoptera)

Solitary masarine wasps (Vespidae: Masarinae), which collect pollen and nectar to feed their larvae, are known to visit the flowers of *Hakea*.

Parasitic or gall-forming wasps, which include species of the cosmopolitan *Megastigmus* (Torymidae: Megastigminae), have been reared from galls on *Hakea*, while the endemic *Xenostigmus* (3 spp.), of the same family, causes gall formation on *Hakea* flowers (Naumann, 1991).

Weevils (Coleoptera)

Weevils are known to attack fruits, leaves and shoots of *Hakea*. Zimmerman (1993) reported the discovery of adults of *Aonychus hopei* on the foliage of *Hakea* and *Grevillea* (species unknown). He also (Zimmerman, 1994a) recorded the collection of *Pachyura australis* (Belidae: Pachyurinae) from *H. microcarpa* and *H. sericea* and (Zimmerman, 1994b) *Erytenna consputa* (Curculionidae: Curculioninae) from a young fruit of *H. gibbosa*. This last weevil was introduced into South Africa in the 1970s in an attempt to control *H. sericea* (Kluge, 1984).

Fungi

Proteaceae are particularly susceptible to the major root-attacking plant pathogens *Phytophthora* and *Armillaria* (Shearer, 1994). Among *Hakea* species in the coastal dunes of the south-west of Western Australia, it was found (Shearer *et al.*, 1998) that eight species, *H. ruscifolia, H. nitida, H. prostrata, H. varia, H. elliptica, H. laurina, H. oleifolia* and *H. trifurcata*, had been killed by *Armillaria luteobubalina*.

South African populations of *H. sericea* and *H. gibbosa* have reportedly been attacked by the anthracnose fungus, *Colletotrichum gloeosporioides*, causing cankers in the stems and branches followed by gum exudation (Richardson, 1989).

Ian Pascoe of Crop Health Services, Institute for Horticultural Development, Victoria (in litt., 1998) reported:

'Many fungal pathogens are recorded from *Hakea* spp. and many of these are specific to *Hakea*, while others occur on a number of different genera of Proteaceae. The most common and conspicuous leaf spotting fungus on *Hakea* is *Placoasterella baileyi* (Berkeley & Broome) von Arx, which causes a black, sooty spot. Less conspicuous but probably as common is *Vizella banksiae* Swart which causes a faint brownish blotch on *Hakea*, *Banksia* and *Grevillea* leaves. *Verrucisporota proteacearum* (D.E.Shaw & Alcorn) D.E.Shaw & Alcorn causes leaf spots on *Hakea* and other Proteaceae in southern Queensland. Only one rust fungus (*Uredo angiospermae* Thuemen) is known from *Hakea*, and that is only known from Western Australia. A number of *Phyllachora* species (*P. grevilleae* (Lev.) Sacc., *P. hakeicola* C.A.Pearce & K.D.Hyde, and *P. victoriensis* C.A.Pearce & K.D.Hyde) cause tar spot symptoms.'

Ancient browsers: was *Hakea* part of the diet of extinct Australian megafauna?

Australia had a marsupial megafauna which included a large diprotodontid family that flourished over much of Australia from the late Tertiary (Hope, 1982; Clemens *et al*., 1989; Dawson *et al*., 1989) at least until around 50 000 years ago (Dr R.Wells, pers. comm. 1999). This megafauna included large beasts such as *Diprotodon*, which apparently occupied extensive open habitats, and *Zygomaturus*, which inhabited wetter areas of southern and eastern Australia (Quirk & Archer, 1983). From characteristics such as dentition, the diprotodontids were browsers (Hope, 1982; Clemens *et al*., 1989), whereas today's herbivorous marsupials are principally grazers (Dawson *et al*., 1989). Two genera of short-faced kangaroos, *Sthenurus* and *Simosthenurus*, were also browsers showing patterns of late Cainozoic distribution and extinction similar to *Diprotodon* and *Zygomaturus* (Hope, 1982). The sclerophyllous leaf of Australian plants is notably tougher and spinier than a leaf from plants in parallel communities in southern Africa (Grubb, 1992). The rigid spine-tipped or -margined leaves which characterise not only *Hakea* but also many of the other groups which make up the heaths of Australia may have been selected for in response to browsing (Grubb, 1992). Janzen & Martin (1982) invoke specialisations of similarly extinct Pleistocene megafauna in Central American lowland forests to explain features of plant reproduction in the region; in that case the megafauna had a diet of fruits.

Papers dealing with the evolution and adaptive strategies in the sclerophyllous vegetation of Australia and of particular sclerophyllous groups are remarkably devoid of reference to this herbivorous fauna, which must have been a major influence on individual features of many plant groups and the physiognomy of the vegetation. The zoological literature and Grubb's (1992) paper seems largely to have been ignored, with only extant herbivores considered.

The production of rigid divided terete or subterete leaves or sharply multiply-mucronate serrate flat rigid leaves in *Hakea* at various stages of its life cycle (sometimes juvenile, sometimes adult) may relate to reducing browsing of young vegetative growth or of flowers or developing fruits. Terete (Fig. 2B) and deeply divided (Fig. 2C) leaves, often very rigid and particularly sharp-tipped, are characteristic of many groups, such as the *Sericea* group (known collectively as *needlewoods*), the *Obliqua* group and, in more arid regions, some representatives of the *Lorea* group. *Hakea corymbosa*, already described above, is a remarkable example in its group. Also arising from browsing pressure may have been the habit characteristic of some species in a scatter of groups, such as *H. teretifolia* (*Rostrata* group) and *H. psilorrhyncha* (*Obliqua* group), of long ascending branches ringed by sharp terete leaves. A further refinement of this is the 'columnar habit' with similar sparse long ascending branches ringed by an envelope of short shoots, as in the *Ruscifolia* and *Lissocarpha* groups, the latter with divided pungent leaves.

With a relaxation of browsing pressure following extinction of the megafauna it is possible that the balance of polymorphisms involving divided and simple leaves or their degree of division may have changed.

Cultivation

Both Wrigley & Fagg (1989) and Elliot & Jones (1990) give excellent accounts of the garden cultivation of each of the species of *Hakea*, while Young (1997) concentrates on native *Hakeas* which can be used in combating land degradation in the Avon Botanical District of Western Australian. As already indicated, most *Hakea* seeds germinate within a month and there seem to be no special requirements for germination.

The Society for Growing Australian Plants includes a *Hakea* study group which can be accessed through their World Wide Web page.

Because of their ability to store large amounts of seed in the canopy and the mass release of these seeds after fire, planting of locally non-indigenous *Hakea* species in areas adjacent to native bush should not be encouraged.

Weedy *Hakeas*

A number of *Hakea* species have become naturalised outside their natural range in Australia and overseas. *Hakea* species are usually favoured by fire, which causes a simultaneous release of all of the stored seed within the canopy of *Hakea* plants. Stuckey (1987b) gives a first hand account of the establishment of 12 *Hakea* species beyond from their places of planting in south-eastern South Australia following a devastating bushfire. He also warned of the weed potential of these plants (Stuckey, 1987a). In South Africa, in the south-western Cape, Kluge (1984) estimated that 7.5 million seeds per hectare of *H. sericea* were released after fire. Many species are also capable of resprouting after fire. Thus the introduction of *Hakea* to any area which is close to natural bush has the potential for creating an environmental weed problem.

Already the Western Australian species *H. laurina*, *H. drupacea* and *H. prostrata* have become naturalised in other States of Australia, the last two almost certainly as a result of the 1983 Ash Wednesday bushfires. Other localised species established in south-eastern Australia are *H. salicifolia* of eastern Australia in Victoria and South Australia, *H. decurrens* subsp. *physocarpa* in South Australia and Tasmania, and *H. sericea* in Victoria.

Overseas, several *Hakea* species have also become naturalised. Examples are *H. decurrens* subsp. *physocarpa* in Spain and Portugal and *H. sericea* in New Zealand. Of four species introduced into South Africa, for example as hedge plants, *H. gibbosa*, *H. sericea* and *H. drupacea* are now major problematic weeds (Wells *et al*., 1986). Fire has promoted the spread of these species into the Cape flora. Considerable effort has been made to control them. Initial attempts to find a biological control agent for *H. sericea* proved unsuccessful because foraging insects were sampled from Australian populations of *H. decurrens*, which had long been confused with *H. sericea*. Following our research, which has resolved the confusion, considerable success has been achieved (Kluge & Neser, 1991; Barker, 1996).

With the delay in release of seed into the soil, it is possible to remove possible pest plants before they become a problem. An example is *H. decurrens* subsp. *physocarpa* in the Mt Lofty Ranges, which was planted until recent times in a mistaken belief that it is a local native. Once the source plant has been burned (or fruiting branches killed), the opportunity to prevent spread into natural bushland will have been lost.

A PRELIMINARY VIEW OF THE BIOGEOGRAPHY OF *HAKEA*

Some aspects of the biogeography of *Hakea* are well-known to enthusiasts in the genus. It has by far its greatest concentration of species and most spectacular diversity in habit, leaf, flower and fruit morphology in the south-west of Western Australia, an area of great diversification in Australian plants. Lesser concentrations of species occur in eastern Australia. The preliminary cladogram (Fig. 1) shows that the groups which form the basal clades (together with *Grevillea glauca*, the sister group of *Hakea*) overlap in the Cape York region of north-eastern Australia in seasonal megatherm (subtropical: Nix, 1982) conditions

juxtaposed beside rainforests which are now a haven for ancestral Australian Proteaceae groups (Johnson & Briggs, 1975). The corkwoods, which form the basal *Lorea* clade, extend across arid Australia but, in general, subtropical and arid regions are poor in species.

The development of a proposed phylogeny of a monophyletic group such as *Hakea* enables its biogeographic history to be developed on the assumption that now sometimes disjunct present-day areas of occurrence have been linked continuously in time and space with no dispersal over long distances.

A preliminary analysis of geographical distribution confirms the above observations of basal clades. It also shows (for references to clades see Fig. 1):

- disjunct links from present-day occurrences in subtropical (megatherm) Cape York and eastern Queensland to present-day south-western temperate Australia (independently the *Multilineata*, *Lissocarpha*, *Rostrata* and *Ceratophylla* clades);
- disjunct links from subtropical Cape York and eastern Queensland to central eastern or south-eastern temperate Australia (independently the *Trifurcata*, *Lissocarpha*, *Rostrata*, *Verrucosa*, *Sericea* and *Ceratophylla* clades);
- two links across southern temperate Australia from east to west, one with intervening steps across the arid regions (the *Trifurcata* clade), the other disjunct (the *Verrucosa* clade);
- two links across southern temperate Australia from west to east, one via a southern corridor (the *Multilineata* clade), the other disjunct (the *Rostrata* clade).

Hakea appears to have evolved in a megatherm seasonal situation in sclerophyllous vegetation occupied today by components of each basal clade. From the plant fossil record such environments had developed in the Tertiary. Pollen of sclerophyllous groups from a central Australian deposit may be of mid Eocene age (Truswell & Harris, 1982); recorded from this site is pollen with affinities to *Grevillea* or the *Multilineata* clade of *Hakea*, as well as other extant sclerophyllous genera such as *Xylomelum, Petrophile* and *Persoonia* (Martin 1982). Leaves similar to Proteaceous sclerophyllous groups today, taken as indicators of growth on poorer soils, date from over 50 million years ago in late Palaeocene sediments in southeastern New South Wales, with occurrences in several Eocene fossil assemblages such as the Maslin Bay flora, South Australia (Hill *et al*., 1995; Hill, 1998). Changes to leaf morphology such as increased stomatal protection, which give evidence for the development of adapations to drier conditions associated with sclerophyllous mesotherm (temperate) heaths of the present day, appear later in the fossil record—no earlier than the late Eocene (Hill, 1998). No certain *Hakea* macrofossils have yet been identified (Dr R.S. Hill, pers. comm. 1999).

The fires so characteristic of the sclerophyllous vegetation occupied by *Hakea* species across the continent today must have been already in force to drive selection of the feature that defines *Hakea*: its woody fruit with its associated specialised mechanism for protecting, dispersing and germinating the seed. For example, Blackburn & Sluiter (1994) provide evidence for frequent fires in the sclerophyllous heath communities, similar to those in the Australasian region today, which are preserved in mid Miocene coal at Yallourn in Gippsland, Victoria.

From the common features of the basal clades, the early *Hakeas* may have resprouted after fire, borne sclerophyllous simple leaves and displayed showy many-flowered inflorescences adapted to bird pollination. However, less common features in the basal clades, including the occupation of arid environments, reduced woodiness and insect pollination, indicate that other scenarios are possible, if less likely.

Present day distribution of species is unlikely to match that attained during the long history of the genus (Nix, 1982). Conditions were wetter than today over much of the continent at least up to the early Pliocene (Truswell & Harris, 1982), and not so dry as to remove aquatic associated fauna in central Australia until after the Pliocene (Hope, 1982). From that time, in the Pleistocene, precipitation changed from summer to winter and climatic oscillations of increasing amplitude and frequency between warm wet periods and cold dry periods occurred (Bowler, 1982). From at least the Miocene conditions seem therefore conducive to phases of

radiation of *Hakea* across the continent together with other sclerophyllous plant groups. During this time selective forces would have influenced the development of further reproductive strategies which coped with fire and, possibly in the latter part, aridity, breeding systems which interacted with insect and mammal pollinators, and tougher, more rigid and more pungent protective foliage, sometimes of bizarre form, which reduced the impact of the large browsing megafauna which survived until at least around 50 000 years ago. Expansion of our cladistic analysis may shed further light on this.

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42. HAKEA

R.M.Barker[1], *L.Haegi*[1] *& W.R.Barker*[1]

Hakea Schrad. & J.C.Wendl., *Sert. Hannov.* 27 (Dec. 1797); named after Baron Christian Ludwig von Hake (1745–1818), a German patron of science and a Councillor in Hannover.

Type: *H. glabra* Schrad. & J.C.Wendl.

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[*Banksia auct. non* L.f.: R.A.Salisbury, *Prodr. Stirp. Chap. Allerton* 51 (1796), *p.p.* as to *Banksia teretifolia*; J.E.Smith, in J.White, *J. Voy. New South Wales* 224 (1790), *p.p.* only as to *Banksia gibbosa*]

[*Lambertia auct. non* Sm.: C.F. von Gaertner, *Suppl. Carp.* 2: 213 (1807), *p.p.* as to *Lambertia teretifolia*]

[*Embothrium auct. non* J.R.Forst. & G.Forst.: H.C.Andrews, *Bot. Repos.* 3: t. 215 (1802), *p.p.*, only with respect to *Embothrium salignum*]

[*Anadenia auct. non* R.Br.: J.Lindley, *Sketch Veg. Swan R.* 30 (1839), *p.p.* only with respect to *Anadenia hakeoides* (? = *H. undulata*)]

Shrubs or small trees with 2-armed hairs. Young growth glabrous or hairy; hairs persistent or quickly glabrescent. Leaves sessile, sometimes cupped about stem, or with attenuate base resembling petiole, simple or compound, flat or terete, longitudinally grooved or not, toothed or entire; both surfaces similar; venation conspicuous or obscure. Inflorescence developing within a cone of involucral bracts or not, usually axillary, rarely from older wood or terminal, few-flowered umbelliform racemes on short rachis, sometimes many-flowered on elongated rachis. Flowers pedicellate, usually paired, straight or curved in bud. Tepals splitting to base or remaining fused and splitting adaxially only. Hypogynous gland semicircular or a curved flap, rarely absent. Pistil glabrous; ovary stipitate or subsessile, 2-ovulate; pollen presenter erect, oblique or lateral, discoid or conical with narrow or broad basal flange. Fruit a modified follicle, variously woody, often beaked, sometimes horned, usually tardily dehiscent; valves splitting fully or partly down one or both sides. Seed occupying whole valve or marginal, collateral, flattened on one side, with a distal to encircling wing clasped between valves.

A genus of 149 species, all endemic to Australia and occurring throughout the continent, but particularly rich in south-western W.A and along the eastern coast of Australia.

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[1] State Herbarium of South Australia, Botanic Gardens, North Terrace, Adelaide, South Australia 5000.

1 Inflorescences pendent elongated racemes of 25–120 flowers on long rachises (fruits beaked for ⅓ to ½ of length, usually a number developing on each rachis, not noticeably woody and not persisting)

2 Leaves flat with obvious longitudinal venation, petiolate; many-stemmed trees or shrubs, lacking thick deeply fissured bark; rachis 4–7 cm long **Trineura Group** (p. 35)

2: Leaves simple- or compound-terete or, more rarely, flat with only marginal and midveins visible, sessile; usually single-stemmed; gnarled trees or large shrubs often with thick deeply fissured bark; rachis 2–25 cm long **Lorea Group** (p. 36)

1: Inflorescences not pendent, or if pendent, then rachis short and flowers less than 35

3 Inflorescence borne at apex of a bare peduncle 2–25 mm long (pedicel and perianth pubescent; involucre lacking, individual flower pairs subtended by early deciduous bracts; leaves flat or terete, with venation obscure (northern tropical Australia and W coast of W.A., N of Murchison R.) **Pedunculata Group** (p. 45)

3: Inflorescence not borne at apex of a bare peduncle

4 Pedicel and perianth evenly pubescent throughout

5 Fruits not distinctly woody, not retained on bush on a thickened branch; seed occupying almost whole valve; leaves flat or compound- or simple-terete

6 Pollen presenter lateral; leaves compound-terete (sometimes mixed with simple terete leaves and/or flat leaves in *H. trifurcata*) or flat; fruits either resembling flat leaves or with obliquely inserted beak, not horned (W.A.) **Trifurcata Group** (p. 90)

6: Pollen presenter oblique; leaves simple terete, rarely with some flattened leaves as well; fruit not resembling leaves, not obliquely beaked, often horned **Microcarpa Group** (p. 84)

5: Fruits distinctly woody, retained on bush on a thickened branch; seed not occupying whole valve; leaves flat or simple terete (mixed with occasional compound-terete leaves in *H. preissii*)

7 Fruits recurved at base and apex, ±S-shaped

8 Wing apical (*H. eriantha*) or down one side of seed body only; leaves terete or flat; perianth at least 2.5 mm long

9 Pollen presenter oblique or conical; leaves terete, except *H. cyclocarpa* from south-western W.A. which has flat leaves; fruit strongly S-shaped (southern Australia) **Rostrata Group** (p. 96)

9: Pollen presenter lateral; leaves flat; fruit not strongly S-shaped (eastern Australia) **Eriantha Group** (p. 89)

8: Wing encircling seed body; leaves narrowly linear, trigonous or terete; perianth less than 2.6 mm long **Incrassata Group** (p. 99)

7: Fruits not recurved basally and apically, not S-shaped

10 Leaves flat

11 Leaves lobed or unlobed, toothed at least partly, not twisted at base (W.A.) **Ceratophylla Group** (p. 104)

11: Leaves entire, twisted through 180° at base (W.A.) **Incrassata Group** (p. 99)

10: Leaves simple-terete or narrowly linear (*H. orthorhhyncha*), not toothed or lobed

12 Pollen presenter a lateral disc (W.A.) **Platysperma Group** (p. 110)

12: Pollen presenter an oblique disc

13 Mature fruit encircled with toothed crest in basal half, long-apiculate (eastern Australia) **Teretifolia Group** (p. 94)

13: Mature fruit lacking toothed crest in basal half; apiculum, if present, short or above corky outgrowths of fruit body

14 Mature fruit lacking horns, often with corky outgrowths; gland prominent, U-shaped (small in *H. brachyptera*) (W.A.) **Obliqua Group** (p. 101)

14: Mature fruit with horns, lacking corky outgrowths; gland a rectangular flap

15 At least some inflorescences arising from old rachises of previous years **Strumosa Group** (p. 68)

15: Inflorescences not arising from old rachises of previous years **Sericea Group** (p. 52)

4: Pedicel and perianth both glabrous or pedicel pubescent and perianth glabrous or with much sparser hair covering than pedicel

16 Leaves flat or simple- or compound-terete; flat leaves obscurely veined; simple-terete leaves lacking 3–12 longitudinal grooves (i.e. not 3–12-angled in cross-section); fruit with or without horns

17 Buds straight; pollen presenter conical; pedicel and perianth glabrous; fruit with horns (W.A.)

18 Fruit often on recurved stalk; new branchlets arising from rachis of inflorescence, glabrous or pubescent (sect. *Manglesioides*) **Lissocarpha Group** (p. 112)

18: Fruit erect; new branchlets not arising from rachis of inflorescence, pubescent **Strumosa Group** (p. 68)

17: Buds curved; pollen presenter an oblique or lateral disc, rarely (*Varia* and *Ruscifolia p.p.* Groups) conical and erect; pedicel glabrous or pubescent; perianth glabrous or with sparser hairs than pedicel; fruit with or without horns

19 Leaves simple-terete ('Needlewoods'), rarely (*H. preissii* and *H. purpurea*) some compound-terete also present

20 Fruit not markedly woody, opening fully down both sides and valves recurving, smooth, not on a thickened branch, often lost very quickly from plant; seed occupying almost whole valve **Microcarpa Group** (p. 84)

20: Fruit distinctly woody, not opening fully down both sides and valves not recurving, smooth to tuberculate, borne on a thickened branch and long persistent; seed not occupying whole valve

21 Tepals remaining fused, splitting to base only between upper pair of tepals; flowers pink or red; pistil more than 14 mm long (pedicel and perianth glabrous) **Verrucosa Group** (p. 74)

21: Tepals not remaining fused, splitting to base between all 4; flowers white, yellow, red or pink; pistil less than 14 mm long

22 Pedicel pubescent; perianth glabrous or with sparser hair covering than pedicel

23 Inflorescence terminal and axillary **Strumosa Group** (p. 68)

23: Inflorescence axillary only

24 Perianth 2.5–7.2 mm long; pistil 4–12 mm long **Sericea Group** (p. 52)

24: Perianth 1.5–2.2 mm long; pistil 3–4.5 mm long **Nodosa Group** (p. 65)

22: Pedicel glabrous; perianth glabrous

25 Fruits horned, not or obliquely beaked **Strumosa Group** (p. 68)

25: Fruits obscurely horned, distinctly beaked **Sericea Group** (p. 52)

19: Leaves flat or elliptic in cross-section, often dentate or divided into spine-tipped segments

26 Most leaves spine-toothed for at least part of length, rarely in some populations of *H. varia*, *H. florida* (*Varia* Group) and *H. linearis* (*Linearis* Group) the majority of leaves entire but some spine-toothed leaves present; *H. oleifolia* (*Varia* Group) usually has the majority of leaves entire but some spine-toothed leaves present

27 Pollen presenter conical; fruit clearly horned (leaves elliptic in cross-section, often with 1–8 mucronate segments or flat with regular or irregular marginal teeth, sometimes entire) **Varia Group** (p. 117)

27: Pollen presenter an oblique disc; fruit horned or not

28 Young shoots arising from base of inflorescence, glabrous; fruit not green, clearly horned, smooth **Linearis Group** (p. 123)

28: Young shoots not arising from base of inflorescence; fruit usually green, or at least of similar colour to subtending leaves, obviously horned or not, with prickles, protuberances or toothed ridge along sutures, the prickles sometimes scattered all over

29 Leaves often stem-clasping or cordate at base; fruit to 3.5 cm long, with scattered or dense prickles, obscurely horned **Prostrata Group** (p. 78)

29: Leaves not stem-clasping at base; fruit 3.5–4.8 cm long, with crested ridges along sutures and abaxially, obviously horned **Cristata Group** (p. 83)

26: Leaves entire

30 Fruit 7–8.5 cm long (flowers white or pink, becoming red, often on older wood below leaves) **Megalosperma Group** (p. 73)

30: Fruit less than 4 cm long

31 Inflorescences terminal; fruits not horned; leaves crowded into short cylindrical branches (south-western W.A.) **Ruscifolia Group** (p. 124)

31: Inflorescences axillary (*H. clavata* has some terminal as well); fruits horned; leaves openly spaced on branchlets

32 Leaves not noticeably thickened; fruit tuberculate or pusticulate; flowers white or cream, 14–28 per inflorescence (eastern Australia) **Salicifolia Group** (p. 49)

32: Leaves extremely thick, elliptic in cross-section; fruit ±smooth; flowers with claw pink, and limb grey outside, white inside, 60–80 per inflorescence (south-western W.A.) **Clavata Group** (p. 122)

16: Leaves flat or simple-terete; flat leaves prominently veined, terete leaves 3–12-grooved longitudinally (i.e. 3–12 angled in cross-section); fruit always without horns (pollen presenter erect, conical)

33 Fruit decurved on rachis; secondary venation visible between longitudinal veins

3

4 Leaves flat or undulate, entire, crenate or toothed; pistil 3–10.5 mm long **Undulata Group** (p. 125)

34: Leaves cupped or shell-like; margin entire or toothed; pistil 14–28 mm long (W.A.) **Cucullata Group** (p. 135)

33: Fruits not decurved on rachis; secondary venation usually obscure (visible in *H. victoria* and *H. acuminata* where longitudinal veins coalesce at base into a cream or red patch, and in *H. petiolaris* where flowers are on old wood and pink)

35 Leaves rigid, concave and usually whorled in flowering regions; margin entire or toothed; rachis knob-like; inflorescence subtended at base by persistent involucral bracts (W.A.) **Corymbosa Group** (p. 165)

35: Leaves not rigid, flat or terete, not whorled in flowering regions; margin entire; rachis knob-like or elongate; inflorescence not subtended at base by persistent involucral bracts

36 Leaves flat, appearing petiolate; inflorescence a spherical or subspherical umbelliform raceme of 40–200 flowers, often on old wood (perianth pink; pistil 14–21 mm long; W.A.) **Petiolaris Group** (p. 138)

36: Leaves flat, trigonous or terete, not petiolate; inflorescence an umbelliform or long simple raceme of 6–500 flowers, not spherical, rarely on old wood

37 Rachis knoblike; leaves flat or terete and then 3–12-grooved longitudinally (sulcate); seed wing encircling body or extending fully or partly down both sides of body **Ulicina Group** (p. 142)

37: Rachis elongate; leaves flat; seed wing extending down one side of seed body only **Multilineata Group** (p. 159**)**

Trineura Group

Hakea sect. *Grevilleoides* Benth., *Fl. Austral.* 5: 490, 495 (1870), *p.p.*

Shrubs or trees, without corky bark. Leaves simple, flat, petiolate, not stem-clasping, entire; venation obvious. Inflorescence axillary, long, simple, not resprouting from base; raceme developing within involucre; bracts not persisting at base of inflorescence; rachis 40–75 mm long. Flowers 60–110 per raceme; pedicel glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous or sparsely pubescent. Pistil 18–27 mm long; pollen presenter conical, oblique; gland U-shaped. Fruits many, pointing upwards on pendent rachis, retained on plant, woody, smooth, beaked, not or obscurely horned, dehiscing fully or partly down one or both sides. Seed occupying part of valve; wing extending up to halfway down one side of seed-body, not at all down other.

A group of two species in eastern Qld and N.S.W.

Tepals green; style red; fruit 1.5–2.2 cm long; shrub or multi-stemmed tree to 7 m high **1. H. archaeoides**

Tepals yellow; style green; fruit 2.5–3.5 cm long; shrub 1–3 m high **2. H. trineura**

1. Hakea archaeoides W.R.Barker, *Fl. Australia* 17B: 393 (1999)

T: 3 km E along Big Nellie Rd towards Burrawang Rd, near Coopernook, Lansdowne S[tate] F[orest], N.S.W., 4 Dec. 1986, *P.Hind 4662*; holo: NSW; iso: AD, BRI.

[*Hakea trineura auct. non* (F.Muell.) F.Muell.: S.W.L.Jacobs, *Pl. New South Wales* 180 (1983); G.J.Harden in G.J.Harden (ed.), *Fl. New South Wales* 2: 61 (1991) (as to N.S.W. occurrences)]

Illustration: G.J.Harden in G.J.Harden (ed.), *Fl. New South Wales* 2: opposite p. 26 (1991), as *H. trineura*.

Multi-stemmed shrub or tree to 7 m high, lignotuberous. Branchlets and young leaves densely ferruginous appressed-pubescent. Leaves: petiole 0.6–1.5 cm long; lamina narrowly elliptic, 7.5–28.5 cm long, 0.6–3 cm wide, narrowly attenuate, long-acuminate, with mucro 1–3 mm long; longitudinal veins pinnate, distally 3 or 5, with secondary veins between rarely obviously anastomosing. Inflorescence with 70–110 or more flowers; rachis 40–75 mm long, densely (rarely moderately) appressed-pubescent; pedicels 1.2–2 mm long, glabrous, reddening. Perianth 7–10 mm long, green, glabrous or with scattered hairs in bud. Pistil 23–27 mm long; style red. Fruit valves obliquely ovate, 1.5–2.2 cm long, 1.2–1.4 cm wide; red-brown wood zone 1–1.5 mm wide. Seed narrowly obovate, 14–20 mm long.

Restricted to uplands between Taree and Wauchope, north-eastern N.S.W. Occurs in a composite of wet sclerophyll forest and rainforest on hill slopes, on Triassic conglomerate. Flowers Oct.–Dec. Map 1.

N.S.W.: Broken Bago State Forest, Rollover Rd, *W.R.Barker 5653* (AD); Big Nellie Manning River Natl Forest, *A.G.Floyd 1091* (BRI, CANB, NSW).

Allied to *H. trineura*, and formerly confused with it. The two species are similar in their flat leaves with prominent longitudinal veins above and along margins, their long racemes, oblique pollen presenters, and fruit lacking horns, but *H. archaeoides* differs from *H. trineura* by its secondary venation not obviously anastomosing, by its more densely pubescent rachis, by its green tepals and red style, and by its smaller fruit and seed.

First collected in 1975, this species is recognised, under *Hakea sp. 9*, as 'Vulnerable' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

2. Hakea trineura (F.Muell.) F.Muell., *Fragm.* 6: 216 (1868)

Grevillea trineura F.Muell., *Fragm.* 3: 146 (1863) [*Hakea trineura* F.Muell., *Fragm.* 3: 146 (1863), *pro syn.*]. T: Broad Sound, *s.d.*, [*E.Bowman*] *s.n.*; holo: MEL 674142; ?iso: K *p.p.*

Multi-stemmed shrub 1–3 m tall, resprouting from base. Branchlets and young leaves appressed brown-pubescent, glabrescent. Leaves: petiole 1–2.5 (–3) cm long; lamina narrowly elliptic to obovate, (3.5–) 7–19.5 cm long, (0.8–) 1.3–7 cm wide, attenuate, obtuse to acute, with mucro 1–2 mm long; longitudinal veins 3, with secondary veins between conspicuously anastomosing. Inflorescence with c. 60–80 flowers; rachis 40–70 mm long, glabrous or sparsely appressed-pubescent at least in flower-bearing parts; pedicels 2.3–3 mm long, glabrous, mid-green. Perianth 7–8.5 mm long, ±deep yellow, glabrous or with scattered hairs in bud. Pistil 18–26 mm long; style mid-green. Fruit valves obliquely ovate, 2.5–3.5 cm long, 1.7–2 cm wide; red-brown wood zone 2–3.5 mm wide. Seed narrowly obovate, 18–25 mm long. Fig. 3G.

Restricted to the Marlborough and Rockhampton area of central coastal Qld, occurring in *Eucalyptus* open woodland over hummock grassland on hills. Flowers May–Sept. Map 2.

Qld: 1.6 km N of Marlborough HS, *M.Lazarides 6881* (CANB); Mt Slopeaway, near Marlborough, *N.H.Speck 1752* (BRI, CANB, NSW).

This species is recognised as 'Vulnerable' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

***Lorea* Group**

Hakea sect. *Grevilleoides* Benth., *Fl. Austral.* 5: 490, 495 (1870), *p.p.*

Trees, rarely shrubs, with thick corky bark. Leaves simple or compound, terete or flat, not conspicuously petiolate, not stem-clasping, entire, rarely grooved below; marginal veins and midrib visible. Inflorescence axillary, 1–few long racemes, sometimes arising from older leafless axils, not resprouting in subsequent years; bud involucre tiny; rachis 9–250 mm long. Flowers 25–120 per raceme; pedicel pubescent, rarely glabrous. Perianth curved or rarely almost straight in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 8.5–33 mm long; pollen presenter oblique disc, rarely conical on oblique basal flange; gland prominently U-shaped. Fruits many, pointing upwards on pendent rachis, varyingly retained on plant, not markedly woody, smooth, prominently to obscurely beaked, horned, dehiscing fully down both sides. Seed occupying part or most of valve; wing terminal only, or decurrent up to c. halfway down one side of seed body, not at all down other. *Corkwoods*, *Corkbark*.

A group of eight species found in all mainland States except Vic., mostly in arid and subtropical areas.

This treatment retains a traditional view of the species making up this distinctive group in the genus, with the exception of the application of the name *H. fraseri* to an unusual species occupying a restricted ridgetop habitat in the northern tablelands of N.S.W., and the treatment of *H. lorea* and its allies with long leaves and densely pubescent or tomentose inflorescences and branchlets. Three species formerly segregated from *H. lorea* have been

recombined with that species, since they are mostly distinguished from each other by few characters which often overlap in variation. This variation may occur within populations or in a geographical intergrade zone.

Simple erect hairs, sometimes 'crisped', occur quite often in the inflorescence and rarely extend onto the current season's branchlets. They have been referred to as 'glandular hairs' though they may in all species inconsistently bear the gland tips. The lack of a gland tip seems to reflect deciduousness of a gland in some cases (the hair tip is truncated, possibly caused by drying out) or a phenotypic variation, as on any given plant the simple hairs may vary in the possession of the gland. The corkwoods are the only group of *Hakea* which possess these hairs.

Corkwood species are distinctive in the arid and subtropical regions for their gnarled fissured stems, strap-like or divided leaves, long showy nectariferous cream or yellow inflorescences often visited by honeyeaters and conspicuous infructescences. The perianth base is dark-coloured from the large purple-black gland within.

The taxonomy of this group of species is particularly difficult compared with most of *Hakea*. While it is clear there are a number of species, the many characters varying across the group do so in parallel in a number of species. Apart from the porrect pollen presenter of *H. ednieana*, there are no unique diagnostic characters. The taxonomy, therefore, has been based on a knowledge of population and regional variation.

Completely glabrous plants or ones just possessing glandular hairs in the infloresence may occur rarely in a number of species other than *H. chordophylla*, namely *H. lorea*, *H. divaricata* and *H. eyreana*. They have been given formal names at a varietal or form level in the past, but there is no real benefit in maintaining these as it is likely, from limited observation, that they do not occur as separate populations.

Similarly, while most species have leaves typically either simple or compound, in most species there may be variation between plants or even on an individual plant. One or other variation is usually rare in most of the species, but is more common in *H. ivoryi* and *H. pulvinifera*.

1 Leaves simple or, if divided, with only 2 or 3 ultimate segments and greater than 13 cm long

2 Leaves flat, linear, 3–15 mm wide (semi-arid to arid W.A., N.T. & Qld; flowers May–Aug.) **3. H. macrocarpa**

2: Leaves terete

3 Indumentum on current season's branchlets absent, or sometimes of simple, often gland-tipped, sparsely to moderately dense hairs, and/or sometimes 2-armed eglandular hairs, confined to leaf nodes **5. H. chordophylla**

3: Indumentum on current season's branchlets 2-armed eglandular, extending between distal leaf nodes, dense, ±persistent

4 Leaves flexible, uncinate; rachis 0.9–2.5 cm long; fruit 10–12 mm wide; pale wood zone c. 4 mm wide (New England Tableland, N.S.W.) **6. H. fraseri**

4: Leaves ±rigid, usually straight; rachis (2–) 5–35 cm long; fruit (9–) 13–20 (–25) mm wide; pale wood zone 3–10 mm wide

5 Branchlets and young leaves densely appressed-pubescent to woolly-tomentose, sometimes with simple glandular hairs as well; hairs on branchlets ±persistent, ultimately glabrescent, on leaves quickly glabrescent; pollen presenter oblique (arid central, and subtropical Australia; flowers Apr.–Sept.) **4. H. lorea**

5: Branchlets red, glabrous or sometimes sparsely (rarely densely) pubescent, glabrescent; young leaves sparsely pubescent, quickly glabrescent; pollen presenter almost lateral (arid central Australia; flowers June–Nov.) **8. H. divaricata**

1: Leaves compound with 2–13 ultimate segments, less than 20 cm long, or, if simple, then less than 13 cm long

6: Perianth ±straight with limb slightly oblique in mate bud, 2–5 mm long at anthesis; pistil 8.5–11 mm long; style ±straight; pollen presenter ±erect (leaves with 1–14 ultimate segments; fruit valves 7–11 mm wide; red-brown wood zone 0.5–1 mm wide) **11. H. ednieana**

6: Perianth greatly bent below limb in mature bud, (4–) 5–12 mm long at anthesis; pistil 15–29 (–33) mm long; style curved to straight; pollen presenter oblique

7 Eglandular 2-armed hairs on branchlets of current season's growth dense, extensive

8 Fruit valves (9–) 13–20 (–25) mm wide **4. H. lorea**

8: Fruit valves 10–14 mm wide

9 Indumentum on current season's branchlets appressed-pubescent; fruit valves 11–14 mm wide; red-brown wood zone 1.0 mm wide **7. H. ivoryi**

9: Indumentum on current season's branchlets tomentose; fruit valves 10–12 mm wide; red-brown wood zone 1–1.5 (–2) mm wide **9. H. eyreana**

7: Eglandular 2-armed hairs on branchlets of current season's growth sparse or confined to leaf bases

10 Pollen presenter deformed, an asymmetrical cone with an upwardly extended flange on the longest side of the style; pollen shrivelled and empty; fruit never forming; perianth 9–12 mm long; pistil c. 20 mm long **10. H. pulvinifera**

10: Pollen presenter normal, a cone with a basal flange; pollen fully formed; fruit forming on every plant; perianth 6–9 mm long; pistil 21–29 mm long

11 Fruit valves 13–20 mm wide **5. H. chordophylla**

11: Fruit valves 8–14 mm wide **8. H. divaricata**

3. Hakea macrocarpa A.Cunn. ex R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 30 (1830)

T: Cygnet Bay, Point Cunningham, NW Australia [W.A.], 4th Voy., 9 July 1822, *A.Cunningham 83*; syn: BM, K.

Grevillea alphonsiana F.Muell., *Hooker's J. Bot. Kew Gard. Misc.* 9: 22 (1857). T: Sturts Ck, March 1856, *F.Mueller s.n.*; syn: MEL 1537941, K; Australia subcentralis, *s.d.*, *Dr M[ueller] s.n.*; syn: G-DC.

Hakea morrisoniana W.Fitzg., *J. & Proc. Roy. Soc. W. Australia* 3: 134 (1918). T: Hann River near junction of MacNamara Creek, W.A., June 1905, *W.V.Fitzgerald 1153*; syn: NSW, PERTH.

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 215 (1990).

Tree or shrub, 1–6 m high, resprouting from base; bark brown-black, furrowed. Branchlets densely appressed- to woolly-tomentose, finally glabrescent. Leaves: petiole c. 1–5 mm long; lamina narrowly linear, flat to concave above, straight to variously curved, thick, 5–35 cm long, 3–15 mm wide, narrowly attenuate, acute to obtuse, densely appressed-tomentose, glabrescent. Inflorescence with c. 40–200 flowers; rachis (30–) 60–200 mm long, densely appressed to woolly cream- or white-tomentose, rarely glandular-pubescent throughout, with similar indumentum on pedicels and perianth. Flowers cream to green-yellow; pedicels 4–10 mm long. Perianth 7–9 mm long. Pistil 18–26 (–30) mm long; style straight or curved; pollen presenter oblique. Fruit 2.2–4 cm long; valves 1.2–1.7 cm wide; beak curved. Seed occupying c. half valve, 1.8–3.7 cm long, 0.9–1.4 cm wide; wing c. 1/2–2/3 down one side only. Fig. 3 O–Q.

Occurs in semi-arid to arid northern W.A. and N.T. and western Qld; found in red sandplain, often with hummock grasses, sometimes also in woodland, less commonly in heavier soil. Flowers late May–Aug. (–Oct. in the Kimberley). Map 3.

W.A.: Fitzroy Crossing, *Mrs Guppy Q6* (PERTH). N.T.: near (S of) Newcastle Waters, *S.T.Blake 16019* (BRI); 69 km SW of Barrow Creek township, *M.Lazarides 5803* (AD, BRI, DNA, NSW). Qld: 29 km E of Urandangie, *L.Pedley 2024* (BRI).

Distinctive within the group for its flat leaves. Occasional very narrow-leaved specimens occur, which were given the name *H. morrisoniana*. There is no basis for considering these specimens as a separate taxon.

Developing fruits are glabrous after anthesis but, by the time they are over about 1 cm long, are often densely appressed-tomentose with apparently simple eglandular hairs. Rarely some specimens (e.g. *Blake 16019* and *Guppy Q6*) have the rachis, pedicels and outside of the perianth densely glandular-pubescent, the hairs simple and sometimes mixed with 2-armed appressed eglandular hairs. The developing ovaries may also be glandular-pubescent.

4. Hakea lorea (R.Br.) R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 25 (1830)

Grevillea lorea R.Br., *Trans. Linn. Soc. London* 10: 177 (1810). T: Shoalwater Bay, [Qld], 3 Sept. 1802, *R.Brown Iter Austral. 3385*; syn: BM, E, K, MEL, NSW, P.

Tree to 10 m high or shrub 1–5 m high, lignotuberous. Branchlets and leaves densely appressed-pubescent to woolly-tomentose, sometimes with simple glandular hairs as well, rarely these alone; branchlet hairs ±persistent, ultimately glabrescent; leaves quickly glabrescent. Leaves terete, erect to pendulous, either simple and (13–) 15–68 cm long and 0.9–2.5 mm wide, or compound and (13–) 14–35 cm long, with undivided base 4–18 cm long and 2–6 (–9) narrowly spreading segments 0.5–13 (–20) cm long, 1–2.4 mm wide. Inflorescence with (3–) 15–200 flowers; rachis (20–) 50–250 mm long, densely pubescent, rarely glabrous or with simple gland-tipped hairs, with indumentum similar on pedicels and perianth. Flowers white to yellow or greenish; pedicels (3–) 3.5–13 (–15) mm long. Perianth 5–11 (–12) mm long. Pistil 15–28 (–33) mm long; style straight or curved; pollen presenter oblique. Fruit 2.5–5.4 cm long, beaked for c. half length; valves obliquely ovate, (0.9–) 1.3–2 (–2.8) cm wide. Seed occupying c. half valve, 2.2–3.8 cm long, (0.7–) 0.8–1.7 cm wide; wing c. halfway down one side only.

Widespread over the northern and central arid and subtropical parts of Australia, in W.A., N.T., S.A. and Qld.

A polymorphic species varying in direction of hair arms, division of leaves and floral and fruit dimensions. S.T.Blake's 1963 classification of usually long and simple-leaved corkwood species (*Proc. Roy. Soc. Queensland* 73: 61–77), in which he distinguished as separate species *H. fraseri* (partially misapplied to south-eastern Qld plants), *H. lorea*, *H. cunninghamii* (encompassing northern Australian and Pilbara, W.A. populations) and *H. suberea* within the circumscription of this species, is untenable. A new classification is adopted returning to the concept of a single species, *H. lorea*, encompassing tomentose corkwoods with simple or sparingly divided, very long, leaves, and with the subspecific taxa redefined in circumscription.

Specimens from the Canning Stock Route in north-eastern arid W.A. are notable for their shrub rather than tree habit.

Forms with glabrous branchlets and inflorescences occur on the Blackwater Tableland area of eastern Qld. There is no evidence that they form a separate taxon or a narrow-leaved extension of range of *H. chordophylla*, as they occur with typical *H. lorea* subsp. *lorea* in the region and differ in no other attributes.

Fruit 2.5–4.2 (–4.4) cm long; valve (0.9–) 1.4–2 (–2.4 in Central Australia) cm wide; red-brown wood zone 1–5 mm wide; pale wood zone 4–10 mm wide; perianth 5–11 (–12) mm long to apex of curved limb — **4a.** subsp. **lorea**

Fruit 4–6 cm long; valve 1.8–2.8 cm wide; red-brown wood zone 3–6 mm wide; pale wood zone 7–10 mm wide; perianth 8.5–11 mm long to apex of curved limb — **4b.** subsp. **borealis**

4a. Hakea lorea (R.Br.) R.Br. subsp. **lorea**

Hakea cunninghamii R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 26 (1830). T: Bay of Rest, [W.A.], 16 Feb. 1818, *A.Cunningham 108*; syn: B, BM, K.

Hakea suberea S.Moore, *J. Linn. Soc., Bot.* 34: 223 (1899). T: Black Gin soak, between Goongarrie and Mt Margaret, northwards to... some high granite rocks fourteen miles north of Lake Darlot, *S.Moore s.n.*; syn: not located; Elder Expedition *[R.Helms]*; syn: K (not found); near Barrow Range, 17 Aug. 1891, *R.Helms s.n.*; isosyn: ?AD 96236037, MEL 643560 *p.p.*; near Camp 33 near Barrow Ranges, 4 Aug. 1891, *R.Helms s.n.*; isosyn: MEL 643577; near Everard Ranges, 29 May 1891, *R.Helms s.n.*; ?isosyn: MEL 643561; near Everard Ranges, 30 May 1891, *R.Helms s.n.*; ?isosyn: AD 96236037 *p.p.*, ?AD 96236036 *p.p.*, K.

Hakea lorea var. *mollis* Domin, *Biblioth. Bot.* 89: 591 (1921). T: collibus apricis ap. opp. Cloncurry, II [Feb.] 1910, *K.Domin 2903*; syn: PR; *K.Domin 2904*, as for *Domin 2903*; syn: PR.

[*Hakea fraseri auct. non* R.Br.: S.T.Blake, *Proc. Roy. Soc. Queensland* 73: 71 (1963), excl. type]

Illustrations: J.H.Maiden, *Forest Fl. New South Wales* 5: no. 179, pl. 183 (1912), as *H. lorea*; J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 384 (1989), as *H. fraseri* and *H. lorea*.

Branchlets appressed-pubescent to woolly-tomentose, sometimes with simple glandular hairs as well, rarely these alone. Leaves either simple and 0.9–2.3 mm diam., or compound with 2–6 segments each 1–2.4 mm diam. Rachis, pedicel and perianth densely woolly-tomentose or appressed-pubescent. Perianth 5–11 (–12) mm long to apex of curved limb. Pistil 15–28 mm long; gland 1.5–2.8 mm long (in lateral view); stipe 0.5–3.5 mm long. Fruit 2.5–4.2 (–4.4) cm long; valve (0.9–) 1.4–2.4 cm wide; red-brown wood zone 1–5 mm wide; pale wood zone 4–10 mm wide. Plate 1.

Widespread over the north-eastern and central arid and subtropical parts of Australia, from the Pilbara region in W.A. to the eastern uplands of Qld from southern Cape York Peninsula to the plains of Maranoa and Darling Downs regions, south to far north-western S.A. Occurs in sandy to clay or duplex soil, on sandstone, granite, basalt, laterite schist or alluvium, on plains or in ranges, in open, usually *Eucalyptus* dominated, mixed forest or woodland, sometimes over shrubs, with grass understorey, rarely in dunes. Flowers Apr.–Sept. Map 4.

W.A.: c. 30 km E of NW Coastal H[igh]way on road to Gascoyne Junction, *A.M.Ashby 3889* (AD, PERTH). N.T.: c. 100 km W of Harts Range Police Station, *J.R.Maconochie 386* (AD, DNA, NSW). S.A.: Carpamoongana Waterhole, Hamilton Stn, *F.J.Badman 246* (AD). Qld: Daunia HS, 67 km WSW of Nebo township, *Story & Yapp 129* (BRI, CANB).

Previously considered to comprise four species, H. lorea, H. suberea, H. cunninghamii and H. fraseri in the sense of S.T.Blake (1963), but the characters of seed position in the valve, indumentum, pedicel length and torus orientation break down in the much additional material collected since then.

4b. Hakea lorea subsp. **borealis** W.R.Barker, *Fl. Australia* 17B: 393 (1999)

T: 77 miles [123 km] N Wilton River-Bulmen Crossing, N.T., 15 June 1972, *J.R.Maconochie 1463*; holo: DNA; iso: K, NSW, PERTH.

Hakea longifolia A.Cunn. ex F.Muell., *Fragm.* 6: 190 (1868) *nom. illeg.* (*H. cunninghamii* in synonymy) *p.p.*, only with respect to Victoria R. specimens. T: terra Arnhemica usque sinum maris Nichol-Bay, ?*A.Cunningham*; syn: ?MEL, ?K.

Branchlets densely appressed-pubescent. Leaves simple, 1.4–2.1 mm diam. Rachis, pedicel and perianth appressed-pubescent. Perianth 8.5–11 mm long to apex of curved limb. Pistil 24–33 mm long; gland 2–4.3 mm long (in lateral view); stipe 2–5 mm long. Fruit 4–6 cm long; valve 1.8–2.8 cm wide; red-brown wood zone 3–6 mm wide; pale wood zone 7–10 mm wide.

Confined to the Kimberley region of W.A. and the northern part of N.T., growing in open woodland or open forest. Flowers Feb.–Mar., May–Sept., Nov. Map 5.

W.A.: 0.8 km SW of Mt House Stn, *J.R.Maconochie 1206* (DNA, NSW); 5.2 km from Gibb River Rd on road to Mt House, *D.J.McGillivray 3827 & A.S.George* (CANB, K, MEL, NSW, PERTH, US). N.T.: No. 12 Government Bore, 2 km off Buchanan Hwy, *R.M.Barker 202* (AD); Nutwood Downs Stn, *P.K.Latz 7417* (CANB, DNA).

Formerly combined by S.T.Blake with the north-western W.A. (Pilbara region) populations under the name *H. cunninghamii*, but differing in the much larger fruit. North Qld plants approach this subspecies sometimes in the wide red-brown wood zone, but differ in the generally smaller fruit.

The type material of *H. longifolia* A. Cunn. ex F.Muell. is a mixture of material of *H. lorea* subsp. *borealis*, (a good collection of Mueller's from the main camp of the Gregory Expedition on the Victoria R.), and a poor Cunningham specimen of *H. chordophylla* (*q.v.*).

5. Hakea chordophylla F.Muell., *Hooker's J. Bot. Kew Gard. Misc.* 9: 23 (1857)

T: prope remotissimas partes fluminis Sturt's Creek, N.T., [1856/7], *F.Mueller s.n.*; holo: K *p.p.*

Hakea digyna Ewart & O.B.Davies, *Fl. N. Terr.* 85, t. 9 (1917). T: Newcastle Waters, N.T., 17 July 1911, *G.F.Hill 471*; syn: MEL, NSW.

Hakea longifolia A.Cunn. ex F.Muell., *Fragm.* 6: 190 (1868) *nom. illeg.* (*H. cunninghamii* in synonymy). T: terra Arnhemica usque sinum maris Nichol-Bay [W.A.], ?*A.Cunningham*; syn: ?MEL, ?K.

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 194 (1990).

Shrub or small tree (1.5) 2–6 (–7.5) m high, apparently lignotuberous (resprouting from base). Branchlets often glaucous, sometimes glabrous, sometimes with sparsely to moderately dense simple glandular hairs, sometimes crisped, sometimes with appressed eglandular hairs only around leaf bases. Leaves terete, usually simple, (22–) 30–42 cm long, 1.6–2.9 mm diam., appressed eglandular-pubescent when very young; apex porrect. Inflorescence with c. 35–70 flowers; rachis 70–130 mm long, glabrous and usually glaucous, or with sparse to dense simple erect glandular hairs; pedicels 5–10 (–12) mm long; indumentum similar to rachis. Perianth recurved in bud, 6–9 mm long, cream- or green-yellow to golden yellow; indumentum similar to rachis, or of sparse sericeous appressed hairs particularly on limb and dilated base. Pistil 21–29 mm long; style straight or curved; pollen presenter oblique. Fruit (24–) 26–40 mm long, with long obscure to prominent beak 1/3–1/2 length of fruit; valves obliquely ovate, 13–20 mm wide; red-brown wood zone 1.5–3 mm wide, pale wood zone 4–7 (–8) mm wide. Seed occupying c. half valve, 23–35 mm long, 8–13 mm wide, wing 1/4–1/2 way down one side of seed body only.

Widespread across subtropical Australia in W.A., N.T. and Qld, in sandy or loamy soil, sometimes stony laterite, in grassland, shrubland or woodland. Flowers usually June–Sept., sporadically in other months. Map 6.

W.A.: Hamersley Range Natl Park, Yampire Gorge, *G.W.Carr 4756 & A.C.Beauglehole 48534* (NSW). N.T.: near Bore 29, Wavehill Stn, *R.A.Perry 2898* (AD, BRI, CANB, DNA, NSW). Qld: Oban Stn, c. 100 km SW of Mt Isa, *S.L.Everist 3346* (BRI).

This species is highly variable in indumentum, and it could be perceived as intergrading with *H. lorea*. However, where the species occur together in the Pilbara region of W.A., they flower at different times. in addition, the current season's branches in *H. lorea* are densely covered in 2-armed eglandular hairs, whereas those of *H. chordophylla* are sometimes glabrous, sometimes having at most a moderately dense patch of hairs around the leaf base.

A fragmentary duplicate from Nickol Bay, north-western W.A. was all that was seen by Mueller of Allan Cunningham's collection of *H. chordophylla* in publishing the manuscript name *H. longifolia* A.Cunn. ex F.Muell., *nom. illeg.* The major basis for Mueller's species was his own collection of *H. lorea* subsp. *borealis* from the Victoria R., N.T. (see under *H. lorea*).

6. Hakea fraseri R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 26 (1830)

T: N.S.W., prope fl. Hasting's, 1818, *C.Fraser 42* [*Oxley's 2nd Exped.*]; syn: A, BM.

Illustrations: J.H.Maiden, *Forest Fl. New South Wales* 6: no. 198, pl. 202 (1914); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 207 (1990).

Shrub or small tree 1–6 m high, with 1–3 or more stems, lignotuberous. Branchlets off-white appressed-pubescent; very young shoots with shiny ferruginous appressed hairs over shining white hairs. Leaves simple, terete, ascending, variable in length along branches, longest on a

branch (2–) 11–30 cm long, (0.8–) 0.9–1.4 mm wide, uncinate, ±glabrous. Inflorescence axillary, with c. 25–50 flowers; rachis 9–25 mm long, red-brown tomentose over off-white appressed hairs; pedicels 3.5–8 mm long, with dense appressed white hairs extending onto perianth in bud, sparser on claw, denser on limb with age. Perianth recurved in mature bud, 6–8 mm long, cream-white. Pistil 17–26 mm long; gland deep purple; style curved; pollen presenter oblique. Fruit 30–35 mm long, with long obscure beak c. 2/3 length of fruit; horns to 2 mm long; valves narrowly obovate-oblong, 10–12 mm wide; red-brown wood zone c. 1.2–2 mm wide; pale wood zone c. 4 mm wide. Seed occupying most of valve, 26–30 mm long, 8.5–10 mm wide; wing c. 1/3 way down one side of seed body only.

Confined to the Macleay R. watershed in the New England Tableland, N.S.W., on well-drained, very steep scree slopes or on vertical rock faces in gorges. Flowers Sept.–Oct. Map 7.

N.S.W.: Oxley Wild Rivers Natl Park, Ridge Trail, c. 1 km S of Wollomombi Falls, *W.R.Barker 5640, 5641 & I.R.Telford* (AD); Oxley Wild Rivers Natl Park, c. 100 m downstream from Dangars Falls, on S side of gorge, *W.R.Barker 5646 & H.Wissman* (AD); Tia Falls, Oct. 1900, *W.Forsyth s.n* (B, M, MEL, NSW, NY); Dangars Falls, SE of Armidale, a little below top of gorge, Mar. 1966, *H.Wissman s.n*. (NE, NSW *n.v.*).

H. fraseri is unusual within the corkwood group for its occurrence in a region of much higher rainfall than that experienced by its allies. Since it appears to be restricted to the steepest, least accessible slopes, its frequency is difficult to assess.

Most characters in *H. fraseri*, for instance the leaf length and width, pedicel length, perianth length and fruit length and width, overlap with the lowest range for its closest relative *H. lorea*. However, *H. fraseri* can be distinguished by its shorter mature rachis and the seed occupying most of the valve.

Previously confused with *H. lorea* subsp. *lorea* in south-eastern Qld, This species is recognised as 'Vulnerable' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

7. Hakea ivoryi F.M.Bailey, *Queensland Fl.* 1346, t. 59 (1901)

T: Bingara, Qld, 1896, *J.F.Bailey s.n.*; syn: BRI 11492; Charlotte Plains, Qld, 1901, *W.A.L.Ivory s.n.*; syn: BRI11491.

Illustrations: J.H.Maiden, *Forest Fl. New South Wales* 6: no. 185, pl. 190 (1913); G.M.Cunningham *et al.*, *Pl. W. New South Wales* 217 (1981).

Shrub or usually a small tree 2–12 m high, lignotuberous, resprouting from base. Branchlets white appressed-pubescent, at length glabrescent. Leaves terete, simple and (1.5–) 3–13 cm long, or compound with 2–4 (–8) segments 0.3–7 cm long and (–0.5) 0.6–1.2 (–1.4) mm diam., appressed-pubescent, quickly glabrescent. Inflorescence axillary with 20–50 flowers, white ±appressed-pubescent on rachis, pedicels and perianth, rarely with simple erect gland-tipped hairs especially on perianth; rachis 25–60 mm long; pedicels 3.5–5.5 mm long. Perianth recurved in mature bud, (4–) 4.5 mm long, cream-white. Pistil 20–24 mm long; style straight or curved; pollen presenter oblique. Fruit 33–35 mm long, with long obscure beak, glabrous or with dense simple erect glandular hairs when young; apiculum 0.8–1.5 mm long; horns obscure, to 1 mm long; valves obovate-oblong, 11–14 mm wide; red-brown wood zone 1 mm wide; pale wood zone 2.5–5 mm wide. Seed occupying most of valve; wing terminal or decurrent to 1/3 way down one side of seed body only.

Confined to south-western Qld and north-western N.S.W., in open arid woodland in sand or loam. Flowers Oct.–Jan., with one May record. Map 8.

Qld: c. 13 km by road N of Yowah Opal Field store, *W.R.Barker 4871 & R.Chinnock* (AD); c. 15 km NW of Charleville, *L.S.Smith 838 & S.L.Everist* (BRI, CANB, MEL, NY). N.S.W.: Wanaaring, Paroo R., *R.J.Dalton s.n*. (AD, BM, MEL, NSW)

A small tree far to the north-west of the range (211 km WNW of Mt Doreen, N.T., *G.Chippendale 3361*, BRI, DNA, NSW) with the short simple, rarely few-segmented slender leaves and persistent appressed-pubescent branchlets of *H. ivoryi* needs further study.

Young or 'juvenile' trees are noted as having often highly divided leaves.

8. Hakea divaricata L.A.S.Johnson, *Contr. New South Wales Natl. Herb.* 3: 93 (1962)

Based on *Hakea intermedia* Ewart & O.B.Davies, *Fl. N. Terr.* 86 (1917), *nom. illeg., non* Hook. (1842). T: 37 miles [59 km] E of Hermansburg, N.T., 21 Mar. 1911, *G.F.Hill 108*; syn: AD, MEL; Near Jay Gorge, Jay River, N.T., 21 Mar. 1911, *G.F.Hill 111*; syn: MEL; 60 miles [100 km] NE Camp 2, [Lander R., NE of Stuarts Bluff Ra.], N.T., *s.d., G.F.Hill 287a*; syn: AD, MEL.

Hakea ivoryi var. *glabrescens* J.M.Black, *Trans. & Proc. Roy. Soc. S. Australia* 61: 242 (1937). T: MacDonald Downs Stn, Fraser R., N.T., 4 Sept. 1930, *J.Cleland s.n.*; syn: AD; Crown Point, Finke R., N.T., 19 Aug. 1913, *[S.A.]White s.n.*; syn: AD.

[*Hakea ivoryi auct. non* F.M.Bailey: J.M.Black, *Fl. S. Australia* 2nd edn, 2: 264 (1948)]

[*Hakea eyreana auct. non* (S.Moore) McGill.: C.D.Boomsma, *Native Trees S. Australia* 261 (1981), *p.p.*]

Illustrations: W.R.Barker in J.P.Jessop & H.R.Toelken (eds), *Fl. S. Australia* 4th edn, 1: 146, fig. 75A (1986); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 383 (1989), as *H. eyreana*; W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 206 (1990).

Tree or shrub to 6 m high, resprouting from base. Branchlets red, glabrous or sometimes sparsely (rarely densely) pubescent, glabrescent. Leaves compound, sometimes some simple, 7–20 cm long, sparsely pubescent, quickly glabrescent; final segments (1–) 3–13 (–16), 0.3–12 cm long, 0.8–2.3 mm wide, spreading, ±rigid, straight, rarely uncinate; undivided base 2.5–9 cm long. Inflorescence axillary with 65–120 flowers; rachis 5–14 cm long, sparsely or sometimes densely pubescent with white or dirty brown hairs and/or glandular hairs, rarely glabrous, with indumentum similar on pedicel and perianth. Flowers cream to greenish yellow; pedicels 4–10 mm long. Perianth recurved in mature bud, 5.5–9 mm long. Pistil 21–26 mm long; style ±straight to slightly recurved; pollen presenter almost lateral. Fruit 2.3–4 cm long, glabrous; valves ovate-oblong to ovate, often obliquely so, 0.8–1.4 cm wide; red-brown wood zone 0.5–7.5 mm wide; pale wood zone 3.5–6 (–7) mm wide; beak long, often curved. Seed occupying most of valve, 19–32 cm long, 7–11 mm wide; wing decurrent up to halfway down one side only. Plate 3.

Occurs in arid central Australia, from far north-western S.A. into southern N.T. and neighbouring W.A., with outlying occurrences in the Pilbara and Great Sandy Desert, W.A., and south of Winton, central Qld; grows in woodland on red sand-plains around bases of hills and rockholes. Flowers June–Nov. Map 9.

W.A.: Warrabri Gorge 15 km NW of Giles, *R.H.Kuchel 200* (AD). N.T.: 200 yards [c. 180 m] N of Connor Well, Stuart Hwy, *D.J.Nelson 1506* (CANB, DNA). S.A.: c. 2 km by road NNE of Pipalyatjara-Putaputa road along road to Waltjitjata, Tomkinson Ra., *W.R.Barker 3334* (AD). Qld: Carisbrooke Stn on Corys Range, SW of Winton, *M.E.Ballingall* (AD).

Long confused with *H. ivoryi* of arid regions of southern Qld and northern N.S.W., this species is distinguished by its subglabrous branchlets and thicker more robust leaves. Plants south of Ayers Rock, particularly in the ranges of north-western S.A., and in central Qld have generally fewer leaf segments than those to the north in N.T., and are often relatively long.

9. Hakea eyreana (S.Moore) McGill., *Telopea* 1: 30 (1975)

Grevillea eyreana S.Moore, *J. Linn. Soc., Bot.* 45: 210 (1920). T: on sand hills, Lat. 27°30' [Lake Eyre District, S.A.], *s.d., Capt. Sturt s.n.*; syn: BM, NSW.

[*Hakea intermedia auct. non* Ewart & O.B.Davies: J.M.Black, *Fl. S. Australia* 2: 160 (1924), *p.p.*]

[*Hakea divaricata auct. non* L.A.S.Johnson: C.D.Boomsma, *Native Trees S. Australia* 197 (1972), *p.p.*]

[*Hakea ivoryi auct. non* F.M.Bailey: C.D.Boomsma, *Native Trees S. Australia* 2nd edn, 262 (1981), *p.p.*]

[*Hakea ednieana auct. non* Tate: G.M.Cunningham *et al., Pl. W. New South Wales* 216 (1981)]

Illustrations: W.R.Barker in J.P.Jessop & H.R.Toelken (eds), *Fl. S. Australia* 4th edn, 1: 146, fig. 75C (1986); G.M.Cunningham *et al., Pl. W. New South Wales* 216 (1981), as *H. ednieana*; W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 202 (1990).

Bushy to slender tree 2–4 (–7) m high, resprouting from base. Branchlets persistently densely white-tomentose. Leaves compound, terete, 1.5–9.5 cm long, persistently densely white-pubescent; final segments 4–15, 0.2–6 cm long, 0.9–1.5 mm wide, spreading, ±rigid, straight; undivided base 0.8–2.5 cm long. Inflorescence axillary with 35–105 flowers; rachis 55–160 mm long, white-pubescent, rarely glabrous, with similar indumentum on pedicel and

perianth. Flowers greenish yellow to yellow; pedicels 6–13 mm long. Perianth recurved in bud, 5.5–9.5 mm long. Pistil 19–26 mm long; style recurved at least initially or ±straight; pollen presenter oblique. Fruit 2.5–4.2 cm long, glabrous; valves (0.8–) 1–1.4 cm wide, ovate-oblong or narrowly so; red-brown wood zone 1–1.5 (–2) mm wide; pale wood zone (2–) 4–6 (–7) mm wide; beak very long. Seed occupying most of valve, 20–33 mm long, 7–10 mm wide; wing decurrent c. halfway on one side only. Fig. 3A–F.

Confined to the Simpson Desert and 'Channel Country' to the east in north-eastern S.A., south-eastern N.T., south-western Qld and north-western N.S.W.; in sand-dunes or nearby creeks, swales or gibber flats. Flowers May–Nov. Map 10.

N.T.: 61 km from Manners Creek Stn towards Tarlton Downs, *C.H.Gittins 1964* (BRI, NSW); 27 km NW of Andado Stn, *J.Must 110* (DNA). S.A.: 25 km E of Cordillo Downs HS, *F.J.Badman 216* (AD). Qld: c. 90 km WNW of Birdsville, *D.E.Boyland 317* (BRI). N.S.W.: Binerah Downs, c. 64 km NW of Tibooburra, *P.L.Milthorpe 914* (AD, NSW).

Hakea eyreana is characterised by its persistently woolly tomentose branchlets and highly divided leaves. It has been confused in the past with, or may be allied to, other corkwoods with similar branchlet indumentum. *Hakea ednieana* differs in its porrect pollen presenter and consistently small hardly woody fruit. A bridging population referred to *H. ednieana* at Bloods Ra., N.S.W. is discussed under that species. *Hakea ivoryi* differs in its often simple or few-segmented leaves and its appressed branchlet pubescence. Plants north-west of the Simpson Desert with few-segmented leaves of moderate length but shorter than few-segmented leaves in *H. lorea* subsp. *lorea* in central Australia (e.g. *P.K.Latz 12656*, Rodinga Ra., Simpson Desert, N.T.) need to be examined as to their relationships with the two species.

10. Hakea pulvinifera L.A.S.Johnson, *Contr. New South Wales Natl. Herb.* 3: 93 (1962)

T: near Keepit Dam, N.S.W., 9 Oct. 1950, *J.B.Heywood NSW54043*; holo: NSW.

Diffuse shrub or small tree to 4 m high, often with 2 or more main branches from near base, suckering apparently from horizontal roots. Branchlets sparsely appressed-sericeous, glabrescent. Leaves compound, rarely simple, terete, 4–12 cm long, rusty or white appressed-pubescent, soon glabrescent; final segments 2–9, (0.3–) 1.5–5 (–7) cm long, (1–) 1.2–1.8 (–2) mm wide, widely spreading, ±rigid; mucro porrect, 1–2 mm long; undivided base (1.7–) 2–4.5 (–6.5) cm long. Inflorescence axillary with 40–50 flowers; rachis 25–45 (–50) mm long, with sparse to moderately dense simple often gland-tipped hairs and usually appressed sericeous hairs as well, with similar but ±denser indumentum on pedicels and perianth. Flowers cream-white, mid-green on limb with purple flush; pedicels 8–10 mm long. Perianth recurved in mature bud, 9–12 mm long. Pistil c. 20 mm long; style recurved, cream-white; pollen presenter oblique, mid-green, malformed with thin cone and distorted flange. Fruit not formed.

Known from only one population on a hillside near Tamworth, N.S.W. Flowers Sept.–Nov. Map 11.

N.S.W.: Keepit State Forest Recreation Area, Little Klori Hill, *W.R.Barker 5649 et al.* (AD).

Plants are completely sterile and never form fruit; the pollen is shrivelled and empty. The species reproduces only by suckering and is likely to be a single clone. Its relationships are obscure, although it does resemble *H. divaricata* (W.R.Barker & S.P.Morrison, *Hakea pulvinifera* L.Johnson (Proteaceae): A rediscovered species under threat. *J. Adelaide Bot. Gard.* 11: 175–177, 1989).

This species is recognised as 'Endangered' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

11. Hakea ednieana Tate, *Trans. & Proc. Roy. Soc. S. Australia* 7: 70 (1885)

T: without locality [stony slopes of the Aroona Ra., bordering the Basin of L. Torrens on the east, S.A.], *s.d., Anon. [?R.Tate] 382*; holo: *n.v.*, probably lost.

Illustration: W.R.Barker in J.P.Jessop & H.R.Toelken (eds), *Fl. S. Australia* 4th edn, 1: 146, Fig. 75B (1986).

Shrub or small tree 2–5 m high, sometimes multi-stemmed probably indicating ability to sucker. Branchlets white-pubescent, glabrescent. Leaves compound, terete, 2–7 cm long, white-pubescent; final segments 1–14, 0.1–3.6 cm long, 0.7–1.8 mm wide, spreading; apex straight; undivided base 0.6–4 cm long. Inflorescence with 35–100 flowers; rachis 20–75 mm long, appressed white-pubescent, with indumentum similar on pedicel and perianth. Flowers white; pedicels 3–9 mm long. Perianth slightly bent in mature bud, 2–5 mm long. Pistil 8.5–11 mm long; style ±straight; pollen presenter porrect, conical. Fruit 20–28 (–34) mm long, often pubescent, glabrescent; valves 7–11 mm wide; red-brown wood zone 0.5–1 mm wide; pale wood zone (2–) 3–4 (–4.5) mm wide; beak very long, wide; horns rarely conspicuous and up to 2 mm long. Seed occupying most of valve, 19–26 mm long, 6–10 mm wide; wing terminal on seed body to decurrent c. 1/3 way down one side only. *Flinders Range Hakea*. Fig. 3M, N.

Occurs in the Flinders Ra., S.A., with a disjunct occurrence on Floods Creek Stn, north-western N.S.W. Found on rocky cliff faces and in creek lines. Flowers Sept.–early Dec. Map 12.

S.A.: Bibliando Stn, c. 50 km E of Hawker, West Bore Paddock, *M.D.Crisp 745* (AD, CANB); Mt Lyndhurst, *M.Koch 44* (BRI, HO, MEL, NSW). N.S.W.: Floods Creek Stn via Broken Hill, 18 Aug. 1975, *P.Cullen s.n.* (AD, NSW).

Distinctive within the section for its buds almost straight just prior to anthesis, shorter perianth and porrect pollen presenter. The N.S.W. population has a slightly more oblique pollen presenter and recurved bud which tend to place it intermediate with *H. eyreana*.

Pedunculata Group

Hakea sect. *Grevilleoides* Benth., *Fl. Austral.* 5: 490, 495 (1870), *p.p.*

Small trees, rarely shrubs, often with corky bark. Leaves simple, terete and not grooved below, or flat, not petiolate, not stem-clasping, entire; venation obscure. Inflorescence an axillary short simple raceme, lacking involucre, developing at apex of 2–25 mm long bare peduncle; rachis to 10 mm long. Flowers 10–50 per raceme; pedicel pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 1.5–13 mm long; pollen presenter conical or an oblique disc; gland small, U-shaped. Fruit usually solitary, erect, retained on plant, woody, roughened, without prickles, not beaked, not horned, dehiscing fully down one side, partly down other. Seed occupying part of valve (whole valve in *H. pedunculata*); wing partly down one side of seed body, not at all down other.

A group of four species found in northern Australia; two in northern Qld, another widespread above 21ºS and the fourth in W.A. between Cape Ra. and Murchison R.

R.M.Barker, The *Hakea pedunculata* group of species (Proteaceae) and a new subspecies of *Hakea stenophylla* from Western Australia, *Nuytsia* 12: 1–8 (1998).

1 Flowers with white hairs on pedicel and claw, ferruginous on limb apex; pollen presenter conical; pistil 1.5–2.5 mm long

2 Leaves flat, ranging from linear to narrowly obovate, 1–9 mm wide (N.T., Qld, W.A., tropical Australia; flowers Feb.–Mar.) **13. H. arborescens**

2: Leaves terete, 0.7–1 mm wide (Cape York Penin., N of, and including, Atherton region; flowers Nov.–Feb.) **12. H. persiehana**

1: Flowers with white hairs only, sometimes glabrous on pedicel and claw; pollen presenter oblique to lateral; pistil 7–13 mm long

3 Leaves narrowly to broadly obovate, 8–25 mm wide; peduncle subglabrous, not branched; branchlets ±glabrous; perianth with claw glabrescent and limb pubescent; fruit 2–3 cm long, 1–1.2 cm wide, not markedly woody; seed occupying whole valve (often in mangrove or swamp areas of Cape York Penin., N of Cooktown; flowers Apr.–Aug.) **14. H. pedunculata**

3: Leaves linear to narrowly obovate, 1–4 mm wide; peduncle white-pubescent, often branched; branchlets appressed-pubescent; perianth pubescent throughout; fruit 3–4.5 cm long, 2–2.6 cm wide, distinctly woody; seed not occupying whole valve (Cape Ra. to Carnarvon, W.A.; flowers June–July) **15. H. stenophylla**

12. Hakea persiehana F.Muell., *Australas. J. Pharm.* 1 (11): 430 (1886)

T: Endeavour River, Qld, 1883, *W.Persieh s.n.*; lecto: MEL 1536632, *fide* R.M.Barker, *Nuytsia* 12: 4 (1998); ?isolecto: B, MEL 1536628; remaining syn: Endeavour River, Qld, 1885, *W.Persieh 573*; syn: MEL; Endeavour River, Qld, 1886, *W.Persieh 573*; syn: MEL; Endeavour River, Qld, 1886, *W.Persieh 725*; isosyn: MEL 1537888; probable remaining syn: Endeavour River, Qld, 1886, *W.Persieh s.n.*; syn: MEL 1537930 *p.p.*, not including fruit; Endeavour River, Qld, 1886, *W.Persieh 757/725*; syn: MEL; Endeavour River, Qld, 1886, *W.Persieh s.n.*; BM, K *p.p.*; Endeavour River, Qld, 1886, *W.Persieh s.n.*; ?syn: MEL 1537930 *p.p.*, fruit only.

Tree 3–10 m high, with spreading crown; bark dark grey, deeply fissured. Branchlets densely white appressed-pubescent. Leaves simple, terete, 8–28 cm long, 0.7–1 mm wide, initially densely appressed-ferruginous, quickly glabrescent. Peduncle simple, 5–18 mm long, densely tomentose; rachis to 6 mm long, white-pubescent. Flowers c. 50–100 per inflorescence, cream-white to pale yellow; pedicels 4–6 mm long, densely white-tomentose. Perianth 2–2.5 mm long, white-tomentose on claw, ferruginous on limb apex. Pistil 1.5–2 mm long; style recurved, rarely ±straight; pollen presenter conical, obliquely inserted. Fruit obliquely ovate, 4.5–5.5 cm long, 2–2.7 cm wide, gradually attenuate into recurved apiculum c. 1–2 mm long. Seed occupying part of valve, c. 30 mm long, 10 mm wide. Fig. 3H–L.

Found on Cape York Peninsula as far south as the Atherton region, Qld. Occurs in open woodland usually with *Eucalyptus* or *Melaleuca*. Flowers usually Nov.–Feb., sometimes May–June. Map 13.

Qld: Portland Roads, *L.J.Brass 18958* (BRI, G); 7.5 km from Fairview on Fairview–Palmerville road, *J.R.Clarkson 3156* (BRI, DNA, K, NSW, PERTH); 'few' km S of Gunnawarra on the Wairuna road, *B.Hyland 7170* (BRI, MEL).

13. Hakea arborescens R.Br., *Trans. Linn. Soc. London* 10: 187 (1810)

T: Carpentaria, South Wellesley Islands, [Qld], Islands a [Sweers], b [Bentinck] and c [Allen], 17–27 Nov. 1802, *R.Brown no. 7 [Iter Austral. 3362]*; lecto: BM *p.p.*, *fide* R.M.Barker, *Nuytsia* 12: 3 (1998); isolecto: B, BM, E, K *p.p.*, MEL 108133 *p.p.*, P, NSW, NY; remaining syn: North coast, *s.d., R.Brown s.n.;* syn: MEL 108133 *p.p.*, K *p.p.*; The English Companys Is, Island y1 [Cotton], [N.T.], 20 Feb. 1803, *R.Brown s.n.*; syn: BM *p.p.*

Shrub 2–5 m high, or tree 3–7 m high; bark black or grey, deeply fissured. Branchlets patchily white appressed-pubescent. Leaves flat, linear, narrowly elliptic or narrowly obovate, 5–17 cm long, 1–9 mm wide, initially densely appressed-ferruginous, quickly glabrescent. Peduncle simple, 4–13 mm long, densely tomentose; rachis 2.5–9 mm long, ferruginous-pubescent. Flowers c. 50–60 per inflorescence, white or yellow; pedicels 3–4.5 mm long, densely white-tomentose. Perianth 2–2.5 mm long, white-tomentose on claw, ferruginous on limb. Pistil 1.5–2.5 mm long; style recurved, rarely ±straight; pollen presenter conical, obliquely inserted. Fruit obliquely ovate, 3–5.5 cm long, 1.6–3 cm wide, gradually or abruptly attenuate into recurved apiculum to 4 mm long. Seed occupying part of valve, 21–35 mm long, 7.5–13.5 mm wide; wing yellow. Fig. 3R, S.

Occurs across northern tropical Australia, north of 21°S in W.A., N.T. and Qld; found on sandstone, quartzite and limestone areas, often from creek banks or low-lying areas, but also from monsoon forest or *Eucalyptus* woodland. Flowers Jan.–June, but predominantly in earlier months. Map 14.

W.A.: Wolf Creek Crater, *A.S.George 15330* (PERTH); 100 km NE of Fitzroy Crossing township, *M.Lazarides 6475* (AD, CANB, DNA, NSW). N.T.: 6 km NW of Springvale Stn, *M.Lazarides 5065* (AD, BRI, CANB, DNA, MEL, NSW); 0.4 km SW of El Sharana, *P.Martensz & R.Schodde AE462* (BRI, CANB, DNA). Qld: Granada, 80 km N of Cloncurry, *S.L.Everist 5220* (AD, BRI).

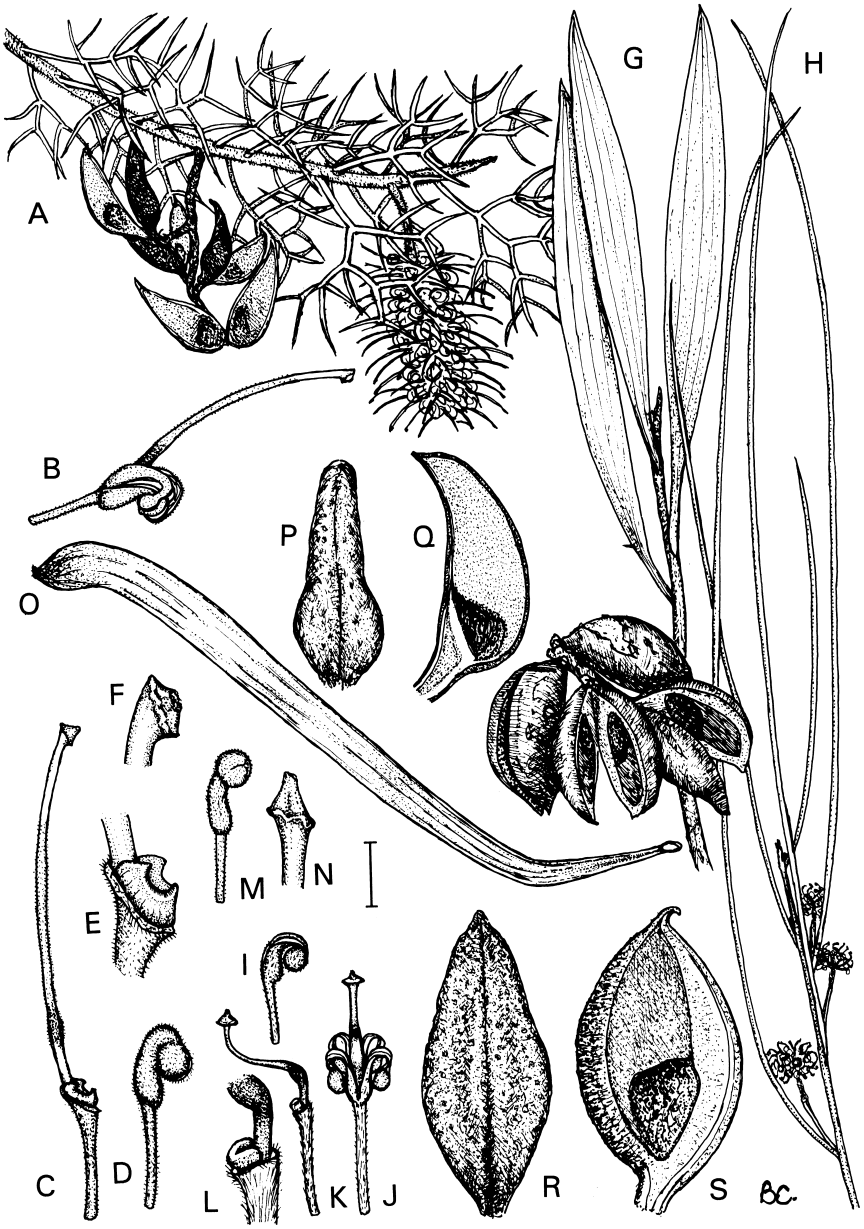

Figure 3. *Hakea*. **A–F**, *H. eyreana*. **A**, habit with fruit (S.Barker & T.Fatchen 72, AD); **B**, flower; **C**, flower without tepals; **D**, bud; **E**, gland; **F**, pollen presenter (**B–F**, W.R.Barker 4625, AD). **G**, *H. trineura*, leaves and fruit (C.T.White 12113, BRI). **H–L**, *H. persiehana*. **H**, habit; **I**, bud; **J**, flower with tepals; **K**, flowers without tepals; **L**, torus (**H–L**, J.R.Clarkson 5059, BRI). **M–N**, *H. ednieana*. **M**, bud; **N**, pollen presenter (**M–N**, D.J.Whibley 2216, AD). **O–Q**, *H. macrocarpa*. **O**, leaf (July 1971, J.R.Maconochie, DNA); **P**, fruits; **Q**, inside of fruit (**P–Q**, D.J.Nelson 1563, AD). **R–S**, *H. arborescens*. **R**, fruit; **S**, inside of fruit (**R–S**, July 1964, M.Schneider, AD). Scale bar: **A**, **G** = 2 cm; **B** = 7 mm; **C–D** = 5 mm; **E** = 2.5 mm; **F**, **J–K**, **N** = 2 mm; **H**, **P–S** = 1 cm; **I** = 3 mm; **L** = 1 mm; **M** = 4 mm; **O** = 1.3 cm. Drawn by Beth Chandler.

At least some populations of this species are capable of regenerating after fire according to a note on the specimen *George 15330*.

Hakea persiehana and *H. arborescens* are very closely related, differing predominantly in their leaf shape (terete in the former species, flat in the latter), but since no intermediate specimens have been encountered they have been maintained as species. They are unique in *Hakea* in often having short colourless hairs at the base of the style.

For a discussion of the differences between *H. arborescens* and *H. stenophylla* see under the latter species.

14. Hakea pedunculata F.Muell., *Australas. Chem. Druggist* 6(63): 23 (1883)

T: Endeavour River, Qld, 1883, *W.Persieh s.n.*; lecto: MEL 1537929, *fide* R.M.Barker, *Nuytsia* 12: 5 (1998); isolecto: BRI 259703, K; ?isolecto: BRI 260982, K.

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 222 (1990).

Shrub or small tree, often gnarled, 1–5 m high; bark dark, finely fissured. Branchlets red, ±glabrous. Leaves flat, narrowly to broadly obovate, 5–10 cm long, 8–20 (–25) mm wide, initially densely appressed shining-white-pubescent, very quickly glabrescent; apex rounded, blackened, sometimes very shortly mucronate. Peduncle simple, sometimes more than 1 per axil, 6.5–25 mm long, subglabrous; rachis 2–10 mm long, white-pubescent. Flowers up to 40 per inflorescence, greenish white to cream-white; pedicels 5.5–7.5 mm long, ±glabrous except at junction with perianth. Perianth 3.5–4 mm long, white-pubescent, quickly glabrescent on claw, persistently hairy on limb. Pistil 8.5–12 mm long; style recurved or ±straight; pollen presenter oblique to lateral. Fruit obliquely ovate or elliptic, 2–3 cm long, 1–1.2 cm wide, gradually attenuate into recurved apiculum c. 2–3 mm long. Seed c. 20 mm long, 7 mm wide, occupying whole valve.

Occurs north of Cooktown on Cape York Peninsula, Qld, and adjacent islands. Found in low open shrubland dominated by *Melaleuca*, often on the landward fringes of mangroves or in semi-swamp areas. Flowers Apr.–Aug. with occasional earlier records in Feb. Map 15.

Qld: Big Ck, Prince of Wales Is., Torres Strait, *E.Cameron 20318* (QRS); 10.8 km from Nutwood Crossing of Edward R. on track to Holroyd R., Edward River Aboriginal Reserve, *J.R.Clarkson 3528* (BRI, CANB, DNA, K, MO, NA, NSW, PERTH, QRS); 6 km from Cooktown on Cairns road, *L.A.Craven 3207* (BRI, CANB, MEL); Alligator Ck, S of Mapoon, Weipa, *A.Morton 1076* (MEL); Marrett R, Princess Charlotte Bay, *J.A.Elsol & T.D.Stanley 673* (BRI).

15. Hakea stenophylla A.Cunn. ex R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 30 (1830)

T: Bay of Rest, [W.A.], 16 Feb. 1818, *A.Cunningham 109*; lecto: BM, *fide* R.M.Barker, *Nuytsia* 12: 5 (1998); isolecto: B, K.

Shrub or tree to 4 m high; bark dark, ±smooth. Branchlets densely appressed-pubescent; hairs predominantly white, some ferruginous, quickly glabrescent. Leaves flat, linear to narrowly obovate, 6–12 cm long, 1–4 mm wide, initially densely appressed ferruginous-pubescent, quickly glabrescent; apex abruptly short-acuminate and uncinate. Peduncle simple or branched, 2–9 mm long, densely white-pubescent; rachis 1–1.5 mm long, white-pubescent. Flowers 10–16, white; pedicels 4–6 mm long, densely white appressed-pubescent. Perianth 1.6–4 mm long, white-pubescent, recurved to claw. Pistil 7–13 mm long; style recurved, rarely looped; pollen presenter oblique. Fruit obliquely obovate or elliptic, 3–4.5 cm long, 2–2.6 cm wide, abruptly attenuate into erect or recurved apiculum; beak black. Seed 17–29 mm long, 9.5–16 mm wide, not occupying whole of valve; wing entirely down one side of seed body, partly or fully down other.

Occurs between Cape Range and Murchison R., W.A. At present the two subspecies recognised here can only be definitely distinguished with fruiting material, but further collections and field observations are likely to confirm both habit and habitat differences, with subsp. *stenophylla* likely to be lignotuberous.

Hakea stenophylla and *H. arborescens* differ in flower size, branching of the peduncle, and pollen presenter morphology, but unless flowers are present it can be difficult to distinguish

them since they overlap in leaf size. *Hakea arborescens* usually flowers in the earlier months of the year (Jan. & Feb.), although it has been recorded as late as June, while *H. stenophylla* flowers May–Aug. There appears to be no overlap in distribution, with *H. arborescens* occurring north of 20°S and *H. stenophylla* well south of this.

Fruiting valve with red-brown wood zone 1.5–2.5 mm wide, pale wood zone 3–6 mm wide; seed covering c. ¾ valve surface; spreading shrub — **15a.** subsp. **stenophylla**

Fruiting valve with red-brown wood zone 2.5–4 mm wide, pale wood zone 8–10 mm wide; seed covering c. half valve surface; erect shrub or small tree — **15b.** subsp. **notialis**

15a. Hakea stenophylla A.Cunn. ex R.Br. subsp. **stenophylla**

Low spreading shrub, 0.5–2 (–5) m high, to 2 m wide. Peduncle simple or branched. Perianth 2.5–4 mm long. Fruit with apex erect or recurved away from red-brown wood zone (except for *Phillips 28*); valve with red-brown wood zone 1.5–2.5 mm wide and pale wood zone 3–6 mm wide. Seed covering c. ¾ valve surface.

Occurs from Cape Ra. to Minilya R. area of W.A., possibly also in the Murchison R area, in red sand hills or coastal sand dunes, usually with spinifex. Flowers June–July. Map 16.

W.A.: Exmouth to Minilya Hwy, c. 99.5 km by road N of Minilya roadhouse, c. 15.1 km by road N of turn-off to Coral Bay, *W.R.Barker 7402* (AD); 32 km S of Minilya R, North West Coastal Hwy, *A.S.George 1460* (PERTH); Cape Range Natl Park; Oil Well No. 2, at W end of Charles Knife Rd, c. 11 km by road WNW of Exmouth–Carnarvon road, *E.N.S.Jackson 3065* (AD); 15 km E of Onslow, *A.A.Mitchell 76/154* (PERTH); Murchison Bridge, 380 mile post [c. 608 km], North West Coastal Hwy, *G.Phillips 28* (CANB, DNA, MEL, PERTH).

15b. Hakea stenophylla subsp. **notialis** R.M.Barker, *Nuytsia* 12: 7 (1998)

T: Murchison sand plain, 320 mile post, North West Coastal Hwy, W.A., 20 July 1972, *G.Phillips 27*; holo: PERTH; iso: CANB, DNA, K, MEL, NSW, PERTH.

Erect shrub or small tree, 2–4 m high. Peduncle always 2- or 3-branched. Perianth 1.6–2.5 (?–4) mm long. Fruit with apex erect or recurved towards red-brown wood zone (except *Smith 1682*); valve with red-brown wood zone 2.5–4 mm wide and pale wood zone 6–10 mm wide. Seed covering c. half valve surface.

Occurs from Carnarvon to Murchison R., W.A., in sand plain or heath. Flowers May–Aug. Map 17.

W.A.: 35 km NE of Kalbarri, 19 May 1968, *J.Bannister s.n.* (PERTH); 20 km W of Hamelin HS, *T.J.Hawkeswood 59* (PERTH); Tamala Stn, May 1960, *R.W.Vollprecht s.n.* (PERTH).

Salicifolia Group

Shrubs or small trees, without corky bark. Leaves simple, flat, not stem-clasping, entire; venation obscure. Inflorescence axillary short umbels, sometimes also arising from old axils, resprouting or not in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 1–4 mm long. Flowers 14–28 per raceme; pedicel glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 6–11 mm long; pollen presenter an oblique disc; gland small U-shaped. Fruit 1–5 per axil, erect, retained on plant, woody, black-pusticulate or tuberculate, dehiscing ±completely down both sides, beaked, horned. Seed occupying part of valve; wing partly down one side of seed-body only.

A group of two species, native to eastern Qld and N.S.W.

Fruit 1.3–2.3 (–3) cm wide in median view, covered with blunt-topped warts more than 1 mm high; rachises 1 per axil, only within leaves, not (except possibly subsp. *angustifolia*) arising from old rachises; slender shrub or tree to 5 m high (in wet sclerophyll forest of coast and ranges of south-eastern Qld & N.S.W. from Springbrook S to Jervis Bay) — **16. H. salicifolia**

Fruit 0.6–1.2 mm wide in median view, covered with raised black pustules, rarely with blunt-topped warts less than 0.5 mm high; rachises often more than 1 per axil, arising in upper axils and on old wood, often from old rachises; shrubs, usually to 1.5 m high (open forest areas of south-eastern Qld and north-eastern N.S.W., from Bundaberg S to Grafton) **17. H. florulenta**

#16. Hakea salicifolia (Vent.) B.L.Burtt, *Bull. Misc. Inform.* 33 (1941)

Embothrium salicifolium Vent., *Desc. Pl. Nouv.* species 8, t. 8 (1800). T: ex horto D.Cels, 1799, Distr[ibuted] D.Ventenat 1800; syn: P-JU.

Conchium salicifolium C.F.Gaertn., *Suppl. Carp.* 217, t. 219 (1807). T: in Nova Hollandia prope Port Jackson [N.S.W.]. Ex collectione Banksiana; holo: not located.

Hakea salicifolia Sweet ex Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 416 (1856) *pro syn.* under *H. saligna*.

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 386 (1989).

Upright tall shrub or small tree 3–5 m high, ?non-lignotuberous. Branchlets with several prominent longitudinal ribs, ±deep red, lenticellate, glabrous. Leaves narrowly elliptic, 8–15 cm long, 4–17 (–27) mm wide, narrowly attenuate, usually acute or acuminate, more rarely obtuse, blackened apically but scarcely mucronate, moderately appressed-sericeous with white and ferruginous hairs when young, rapidly glabrescent; young leaves darker. Involucral buds 3 mm long, subglabrous externally. Inflorescence a single umbel of 16–28 white flowers in upper axils (possibly also on older wood in subsp. *angustifolia*); rachis 1–1.5 mm long; pedicels 4.5–7 mm long. Perianth 2–3.5 mm long, glabrous, glaucous; inner surface of tepals sometimes with dense glandular-verrucose covering above ovary. Pistil 6–6.5 mm long. Fruit obliquely ovate, 2.3–3.5 cm long, 1.3–2.3 (–3) cm wide in median view, basally attenuate, with raised black pusticules or 1–5 mm high blunt and black-topped warts; beak smooth or with blunt-topped warts; horns often eroded; red-brown wood zone 2.5 mm wide. Seed 17–20 mm long.

Widespread on the coast and ranges of N.S.W. from the Qld/N.S.W. border south to Jervis Bay, extending to Springbrook in the Macpherson Ra. in south-eastern Qld. Two subspecies are recognised.

Leaves more than 7 mm wide (coast and ranges of Qld & N.S.W. from Springbrook to Jervis Bay) **16a.** subsp. **salicifolia**

Leaves 4–7 mm wide (river systems between Hornsby and Helensburgh in the Sydney region) **16b.** subsp. **angustifolia**

#16a. Hakea salicifolia (Vent.) B.L.Burtt subsp. salicifolia

Embothrium salignum Andrews, *Bot. Repos.* 3: t. 215 (1802); C*onchium salignum* (Andrews) Sm., in A.Rees, *Cycl.* 9 (1807) pages unnumbered; *Hakea saligna* (Andrews) Knight, *Cult. Prot.* 108 (1809); *Banksia saligna* (Andrews) J.Parm., *Cat. Arbr. Parm.* 12 (1818). T: Hammersmith Nursery....first raised from seeds, in the year 1791; holo: not located.

Conchium salignum Donn, *Hortus Cantabrig.* 2nd edn, 14 (1800), *nom. nud.*; *Hortus Cantabrig.* 3rd edn, 21 (1804), *nom. nud.*

Illustrations: J.H.Maiden, *Forest Fl. New South Wales* 5: no. 167, pl. 171 (1912); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 386 (1989).

Tall shrub or small tree 2–5 m high. Leaves narrowly elliptic, 8–15 cm long, 7–17 (–27) mm wide, usually acute. Fig. 4I–K.

Widespread on the coast and ranges of N.S.W. from the Qld/N.S.W. border south to Jervis Bay, extending to Springbrook in the Macpherson Ra. in south-eastern Qld. Occurs in wet sclerophyll forest. Naturalised in the Melbourne area as early as the 1880s, in the Adelaide Hills, S.A., on Norfolk Is., N.S.W., the North Island of New Zealand and Cape Town, South Africa. Flowers Aug.–Nov. Maps 18, 19.

Qld: Springbrook, Macpherson Ra., *C.E.Hubbard 4231* (BRI). S.A. W side of Crafers, run-in onto Freeway, 2 Aug. 1991, *N.Lothian* (AD). N.S.W.: Lawson, Sept. 19104, *A.A.Hamilton s.n.* (NSW); Tianjara area, 7 km SSW of Porters Ck Reservoir, *K.Paijmans 4049* (CANB).

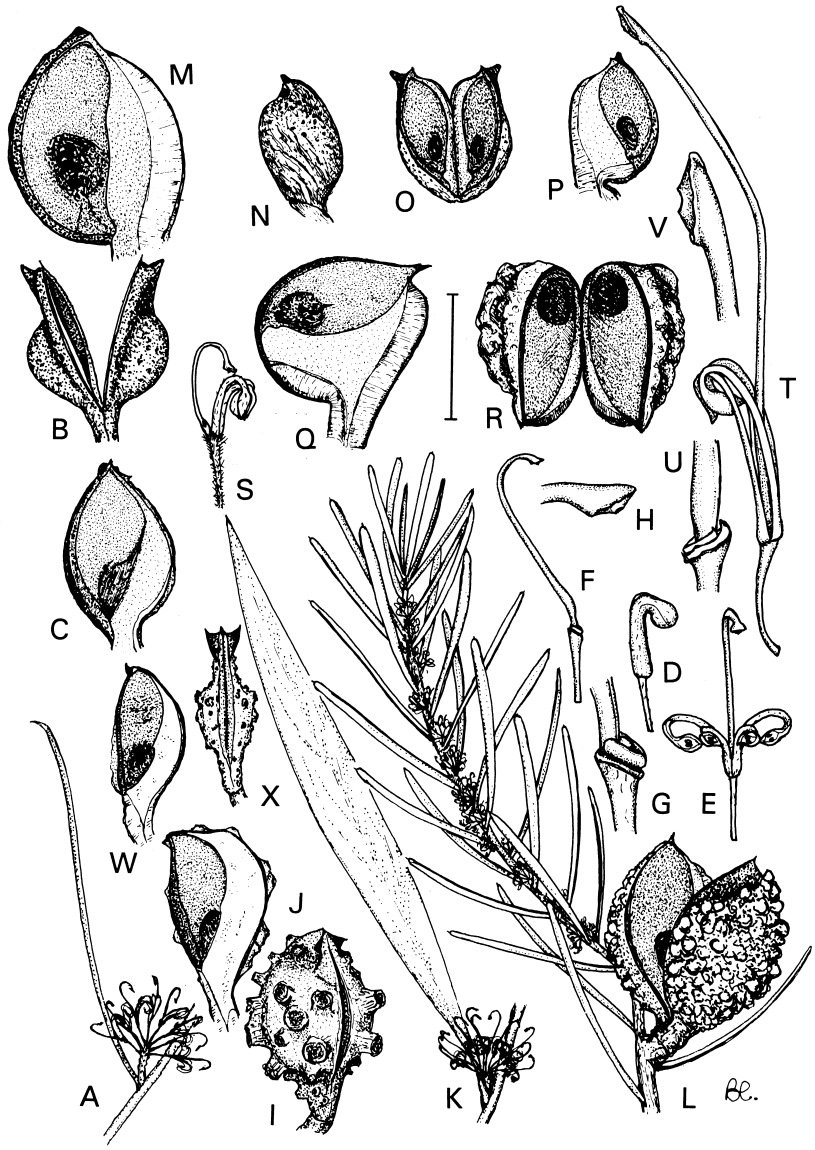

Figure 4. *Hakea*. **A–H**, *H. tephrosperma*. **A**, inflorescence and leaf (R.W.Purdie 5840, CANB); **B**, fruit; **C**, inside of fruit (**B–C**, E.H.Ising *s.n.*, AD966090454); **D**, bud; **E**, open flower; **F**, flower without tepals; **G**, torus; **H**, pollen presenter (**D–H**, R.W.Purdie 584D, BRI). **I–K**, *H. salicifolia* subsp. *salicifolia*. **I**, fruit; **J**, inside of fruit (**I–J**, B.Briggs *s.n.*, NSW182285); **K**, inflorescence and leaf (I.R.Telford 5071, CANB). **L**, *H. nodosa*, habit with flowers and fruit (I.B.Wilson 769, AD). **M**, *H. cycloptera*, inside of fruit (C.Alcock 578, AD). **N–P**, *H. vittata*. **N**, fruit; **O**, open fruit; **P**, inside of fruit (**N–P**, J.B.Cleland *s.n.*, AD9680795). **Q–S**, *H. gibbosa*. **Q**, inside of fruit; **R**, open fruit (**Q–R**, J.B.Cleland *s.n.*, AD97848283); **S**, flower (J.H.Camfield *s.n.*, NSW58167). **T–V**, *H. bakeriana*. **T**, flower; **U**, torus; **V**, pollen presenter (**T–V**, C.Burgess CBG009349, CANB). **W–X**, *H. florulenta*. **W**, inside of fruit; **X**, fruit (**W–X**, L.S.Smith & D.J.McGillivray 3075, AD). Scale bar: **A–C**, **I–R**, **W–X** = 2 cm; **D** = 7 mm; **E–F**, **S–T** = 1 cm; **G** = 3 mm; **H** = 2.2 mm; **U** = 4 mm; **V** = 3 mm. Drawn by Beth Chandler.

16b. Hakea salicifolia subsp. **angustifolia** (A.A.Ham.) W.R.Barker, *Fl. Australia* 17B: 393 (1999)

Hakea saligna var. *angustifolia* A.A.Ham., *Proc. Linn. Soc. New South Wales* 45: 261 (1920). T: Woronora R., Heathcote, N.S.W., Oct. 1915, *A.A.Hamilton s.n.*; holo: NSW.

Tall, usually slender, shrub 1.6–7 m high. Leaves narrowly elliptic, 8–15 cm long, 4–7 mm wide, usually acute, usually only present towards apex of branches.

A rhyophyte taxon confined to the river systems between Hornsby and Helensburgh in the Sydney region of N.S.W., in sand or sandstone. Flowers recorded in Aug., Oct. and Dec. Map 20.

N.S.W.: Cockle and Cowan Ck, Hornsby, *W.F.Blakely NSW182301* (NSW); Georges R., Casula, *E.F.Constable NSW47458* (NSW); Lane Cove R., Lane Cove Natl Park, *M.Gray 5662* (CANB); Flat Rock Ck, near Helensburgh, *T.M.Whaite 1193* (BRI, NSW).

This subspecies may be capable of producing new inflorescences from old rachises below the leaves, as does *H. florulenta*. The collection *Whaite 1193* has one inflorescence formed in this fashion.

17. Hakea florulenta Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 116 (1855)

T: about Moreton Bay, Qld, 1850–1851, *Mr Strange s.n.*; ?holo: NY; iso: CGE (Herb. Henslow), K.

Hakea mimosoides A.Cunn. ex Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 416 (1856). T: circa Redcliff Point, prope Moreton Bay, [Qld], Sept. 1824, *A.Cunningham s.n.*; syn: B, BM, K.

Hakea amplifolia Gand., *Bull. Soc. Bot. France* 66: 229 (1919). T: Woodburn, N.S.W., Oct. 1896, *W.Bäuerlen per R.T.Baker s.n.*; holo: LY; iso: NSW 112288.

Low erect shrub to 1.5 (–2) m high, lignotuberous. Leaves oblanceolate to narrowly oblanceolate, 6–13 cm long, (8–) 14–30 mm wide, usually obtuse, more rarely acute or acuminate, blackened apically but scarcely mucronate, moderately appressed-sericeous with white and ferruginous hairs when young, rapidly glabrescent. Involucral buds 1.5 mm long, externally pubescent. Inflorescence 1–4 umbels of 14–20 white flowers per axil, often arising on old rachises in lower axils; rachis 3–4 mm long; pedicels 4–7.5 mm long. Perianth 3.5–4 mm long. Pistil 7–10 mm long. Fruit obliquely elliptic, 2–2.6 cm long, 0.6–1.2 cm wide in median view, black-pusticulate; pusticules raised but rarely tuberculate, and if so, only to 1 mm high; beak pusticulate; red-brown wood zone 0.5–0.7 mm wide at widest point. Seed 16–18 mm long. Fig. 4W, X.

Occurs in coastal areas of south-eastern Qld and northern N.S.W., from Bundaburg south to Grafton; grows in open forest, often associated with *Melaleuca*, on sand or sandstone, sometimes in poorly drained flats. Flowers Sept.–Dec. Map 21.

Qld*:* Caloundra, *S.T.Blake 4188* (BRI); near W shore of L. Weyba, 5 km S of Noosaville, *W.E.Fisher 176* (BRI, CANB); 10 km N of Helidon, *B.Muffet M5/308* (CANB). N.S.W.: 30 km N of Grafton on Coaldale Rd, *J.B.Williams s.n.* (NE).

Where the ranges of *H. florulenta* and *H. salicifolia* overlap in the north-eastern corner of N.S.W., leaf width, fruit woodiness and the presence or absence of tubercules on the fruit are usually good guides to distinguishing the two species. Multiple umbels in the axils, and their development on old rachises, also distinguish *H. florulenta* from *H. salicifolia*.

Sericea Group

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Hakea sect. *Hakea* ser. *Glabriflorae* Benth., *Fl. Austral.* 5: 492, 509 (1870), *p.p.*

Shrubs or, more rarely, small trees, without corky bark. Leaves simple, terete, non-petiolate, not stem-clasping, grooved below at base or not, entire; venation obscure. Inflorescence an axillary umbelliform raceme on simple short or knob-like rachis, occasionally resprouting in

subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 1–4 mm long. Flowers 1–12 per raceme; pedicel pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent or glabrous. Pistil 4–12 mm long; pollen presenter an oblique disc; gland small, curved, flat. Fruit usually solitary (rarely 2), variously directed, retained on plant, prominently woody, rugose, verrucose or pusticulate, rarely smooth, usually beaked down one side of fruit body, horned, sometimes obscurely so dehiscing fully down one side, partly down other. Seed occupying part of valve; wing halfway to fully decurrent down one side, not or briefly decurrent or (often in *H. actites*) more narrowly fully decurrent down other; seed body sometimes narrowly flanged.

A group of 12 species, found in all States and Territories.

1 Branchlets and leaves densely villous; fruit with seed borne at right-angles to direction of stalk **29. H. gibbosa**

1: Branchlets and leaves often pubescent when young, usually glabrescent, but not villous; fruit with seed borne in same direction as stalk or directed obliquely forward from it

2 Perianth hairy

3 Leaves not grooved below

4 Fruit body coarsely rugose or tuberculate

5 Fruit beak long-triangular, smooth except for small dense round pusticules; pistil 6.5–8 mm long; perianth 3–3.8 mm long; fruit 35–45 mm long **24. H. macrorrhyncha**

5: Fruit beak transverse, decurrent shortly down one side of fruit; pistil 8–10.5 mm long; perianth 3.5–6 mm long; fruit 23–27 mm long **22. H. lissosperma**

4: Fruit body smooth, sometimes pusticulate

6 Perianth 2.5–3 mm long; pistil 7–7.5 mm long; pedicel sparsely appressed-pubescent (rachis 3–6.5 mm long, densely brown-pubescent, sometimes mixed with sparse white hairs; leaf mucro uncinate; fruit obscurely horned; seed wing grey-yellow) **20. H. kippistiana**

6: Perianth 3–6 mm long; pistil 7–11 mm long; pedicel sparsely to densely appressed- or raised-pubescent

7 Rachis 1–3 (–4) mm long, brown-pubescent; leaf mucro strongly uncinate; fruit usually clearly horned; seed wing grey-yellow to blackish **19. H. tephrosperma**

7: Rachis 6–14 mm long, white-woolly-pubescent or with an appressed layer of white and brown hairs; leaf mucro porrect or uncinate; fruit often obscurely horned; seed wing cream to brown-white, sometimes darker at base **18. H. leucoptera**

3: Leaves grooved below

8 Branchlets tomentose, with hairs persistent to flowering; fruit body rugulose-reticulate; beak long; horns obscure, less than 1 mm long; perianth moderately to densely shortly tomentose **24. H. macrorrhyncha**

8: Branchlets appressed-pubescent, with hairs persistent to flowering or glabrescent; fruit body pusticulate; beak short; horns prominent, 1–3 mm long; perianth sparsely appressed-sericeous **25. H. macraeana**

2: Perianth glabrous or glabrescent by anthesis

9 Rachis 6–14 mm long **18. H. leucoptera**

9: Rachis 0.5–4 mm long

10 Fruit 4.3–5.5 cm long, 3–3.5 cm wide; flowers 6–12 (pistil 8–12 mm long) **21. H. constablei**

10: Fruit 1.8–4 cm long, 1–3 cm wide; flowers 1–6 (–8 in *H. lissosperma*)

11 Pistil 8.5–12 mm long

12 Horns on fruit 1–5 mm long; seed wing decurrent fully down both sides of seed body, more narrowly on one side **28. H. decurrens**

12: Horns on fruit obscure or absent; seed wing decurrent partly down one side of seed body, fully down other

13 Seed wing light brown (young?) to off-white; flowers 1–6 **26. H. ochroptera**

13: Seed wing black to dark brown; flowers 6–8 **22. H. lissosperma**

11: Pistil 4–8 mm long

14 Pedicels villous; horns on fruit 1–3 mm long; seed wing broadly and fully down one side only, sometimes narrowly down other **27. H. sericea**

14: Pedicels appressed-sericeous; horns on fruit obscure; seed wing decurrent fully down both sides of seed body **23. H. actites**

18. Hakea leucoptera R.Br., *Trans. Linn. Soc. London* 10: 180 (1810)

T: Flinders Land, ad margines sylvarum prope radices montium, [Bay XII, S.A.], *R.Brown*; syn: BM, E, K.

Hakea stricta F.Muell. ex Meisn., *Linnaea* 26: 360 (1854). T: North-West Ba[e]nd, Murray River, *s.d.*, *F.Mueller s.n.*; holo: NY; iso: BM, MEL.

Hakea florigera Gand., *Bull. Soc. Bot. France* 66: 229 (1919). T: Mt Lyndhurst, S.A., *M.Koch 80*; lecto: LY, *fide* D.J.McGillivray, *Contr. New South Wales Natl. Herb.* 4: 341 (1973); isolecto: AD, BRI, LY, NSW.

?*Hakea leucocephala* R.Br. ex D.Dietr., *Syn. Pl. Enum. Syst.* 1: 531 (1839), ?misreading of *leucoptera*. T: 'in Nov. Holl.'; holo: not located.

[*Hakea glabriflora auct. non* Gand.: M.Gandoger, *Bull. Soc. Bot. France* 66: 229 (1919), *p.p.* (as to specimens marked A, C & D on lectotype sheet in LY)]

[*Hakea kippistiana auct. non* Kippist & Meisn.: J.M.Black, *Fl. S. Australia* 2nd edn, 2: 265 (1948)]

[*Hakea leucoptera* var. *kippistiana auct. non* (Kippist & Meisn.) F.Muell.: J.M.Black, *Fl. S. Australia* 2nd edn, 2: 265 (1948), *pro syn.*]

Illustration: G.M.Cunningham *et al.*, *Pl. W. New South Wales* 217 (1981).

Small shrub or tree 1–8 m high, resprouting from base. Branchlets pubescent, glabrescent. Leaves terete, not grooved, 3.5–10 cm long, 1.3–2 mm wide, white-pubescent, glabrescent; apex porrect or uncinate, with mucro 1.5–5.5 mm long. Inflorescence of 18–45 flowers; rachis simple, or with 1 or 2 basal buds, 6–14 mm long, white woolly-pubescent or white or sometimes also brown appressed-pubescent; pedicels 2–6.5 mm long; pedicel and perianth glabrous or sparsely to moderately densely short-tomentose. Perianth 3–4.5 mm long. Pistil 7–11 mm long. Fruit 1.7–3.2 cm long, 1–2 cm wide, smooth, sometimes sparsely pusticulate; horns obscure. Seed with wing decurrent half to fully down one side, not to very shortly down other, cream to brown-white, sometimes darker at base. *Needle Bush, Silver Needlewood, Needle Hakea, Water Tree Kulua, Pin Bush.*

Occurs in drier areas of all mainland States and Territories, excluding A.C.T. Two geographically distinct subspecies are recognised, based on indumentum characters. See W.R.Barker, *J. Adelaide Bot. Gard.* 17: 180 (1996) for discussion.

Hakea leucoptera and *H. tephrosperma* are often confused. Initially they can often be distinguished by the mucro, curved in *H. tephrosperma* and usually porrect in *H. leucoptera*. *Hakea tephrosperma* also has a shorter floral rachis with rust-coloured hairs, and the pedicel and perianth are densely appressed-pubescent with rust and white hairs, while *H. leucoptera* has a longer floral rachis, often persistent after the flowers have fallen, and the pedicel and perianth are often glabrous. Pubescent flowers in *H. leucoptera* seem to be confined to S.A. and N.T., and even there in mature flowers it is often only the pedicel and limb of the perianth which have sparse or moderately dense raised white hairs; buds are covered all over with hairs.

Rachis white-woolly-pubescent **18a.** subsp. **leucoptera**

Rachis white-, sometimes also brown-appressed-pubescent **18b.** subsp. **sericipes**

18a. Hakea leucoptera R.Br. subsp. **leucoptera**

Hakea virgata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 26 (1830). T: Harrington's Plains, Lachlan River, N.S.W., [28 June] 1817, *A.Cunningham ?32*; syn: BM, K.

Rachis white-woolly-pubescent.

Occurs in central and south-eastern arid and semi-arid Australia in all mainland States and Territories except W.A. and A.C.T., in a wide range of grasslands, shrublands and woodlands, in sandy to clay soil. Flowers predominantly Oct.–Dec., more sporadic records in other months. Map 22.

N.T.: 32 km SE of Longwood HS, *R.E.Winkworth 663* (BRI, CANB, DNA). S.A.: 18 km E of Curdimurka, L. Eyre South, *F.Badman 219* (AD, HO, LSU, MEL, SIU). Qld: c. 95 km S of Nappamerry HS, 16 Aug. 1962, *G.E.Gardiner s.n.* (AD). N.S.W.: Yamba Stn, 78 km by road W of Wanaaring, *E.F.Constable 4586* (DNA, NSW). Vic.: S shore of Rocket L., SW of Mildura, *D.J.Cummings 172 et al.* (CANB, MEL).

18b. Hakea leucoptera subsp. **sericipes** W.R.Barker, *J. Adelaide Bot. Gard.* 17: 181 (1996)

T: c. 16 km by road NE of Hungerford on road to Eulo, Warrego district, Qld, 26 Aug. 1988, *W.R.Barker 5587*; holo: AD; iso: to be distributed.

Hakea longicuspis Hook., in T.L.Mitchell, *J. Exped. Trop. Australia* 397 (1848). T: subtropical New Holland, 10 Dec. 1846, *T.L.Mitchell 449*; syn: CGE, K, NY.

?Hakea acacioides Domin, *Biblioth. Bot.* 89: 592 (1921). T: prope Barcaldine, Queensland, III [Mar.] 1910, *K.Domin 2923*; syn: PR; *K.Domin 2921*, as for Domin 2923; syn: PR; *K.Domin 2922*, as for Domin 2923; syn: PR.

Rachis white-, sometimes also brown-appressed-pubescent.

Occurs in dry areas of central W.A., southern and central Qld, and northern N.S.W., usually in heavy soil. Flowers Nov.–Dec. Map 23.

W.A.: 3 km S of Agnew, *H.Demarz 7251* (PERTH). Qld: 2 km E of Malvernton (40 km W of Blackall), Yaraka to Blackall road, *R.W.Johnson 3025* (BRI); Enniskillen, *C.T.White 12413* (BRI). N.S.W.: Moor Ck, Tamworth, Nov. 1909, *M.B.E.Sampson* (AD, NSW, PERTH).

Specimens of *H. leucoptera* subsp. *sericipes* from central W.A. have hairs on the rachis which are not as appressed as those from the eastern States.

19. Hakea tephrosperma R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 26 (1830)

T: New South Wales, [June] 1817, *A.Cunningham 33 & C.Fraser s.n. (Oxley's 1st Expedition*); syn: BM, ?K; Field's Plains, [Lachlan River], N.S.W., *s.d.* [1817], *A.Cunningham s.n.*; ?isosyn: K; Harrington's Plains, Lachlan River, N.S.W., 28 June 1817, *A.Cunningham s.n.*; ?isosyn: K.

[*Conchium drupaceum auct. non* C.F.Gaertn.: C.D.F.Meisner, in A.L.P.P. de Candolle, *Prodr.* 14: 402 (1856) *pro syn.*]

[*Hakea leucoptera auct. non* R.Br.: G.Bentham, *Fl. Austral.* 5: 515 (1870)]

[*Hakea pampliniana auct. non* Kippist: G.Bentham, *Fl. Austral.* 5: 507 (1870), *p.p.* at least as to specimens from Murray desert in Herb. Mueller; J.H.Maiden, *Forest Fl. New South Wales* 6: 83 (1915) *pro syn.*]

[*Hakea vittata auct. non* R.Br.: J.H.Maiden, *Forest Fl. New South Wales* 6: 83, pl. 206 (1915); J.H.Willis, *Handbook Pl. Victoria* 2: 50 (1973)]

Illustrations: J.H.Maiden, *Forest Fl. New South Wales* 6: no. 202, pl. 206 (1915); G.M.Cunningham *et al.*, *Pl. W. New South Wales* 218 (1981), as *H. vittata*.

Shrub or small tree 1–8 m high, resprouting from base. Branchlets ferruginous appressed-pubescent to ±woolly-ferruginous over white-tomentose. Leaves terete, not grooved, 3–8 cm long, 1–1.5 (–1.8) mm wide, wholly glabrescent; apex strongly uncinate, with mucro 0.8–2 mm long. Inflorescence of 6–22 flowers; rachis simple, 1–3 mm long, densely ferruginous appressed-pubescent; pedicels 3.5–7 mm long; pedicel and perianth white and ferruginous appressed-pubescent. Perianth 5–6 mm long. Pistil 7–10 mm long. Fruit 2–3 cm long, 1.5–2 cm wide, smooth, sometimes pusticulate; horns blunt, usually conspicuous, to

2 mm long. Seed 14–20 mm long, 7–8.5 mm wide; wing decurrent c. ½–⅔ way down one side only, grey-yellow to blackish. *Hooked Needlewood*. Fig. 4A–H.

Occurs in drier areas of S.A., Qld, N.S.W. and Vic., in open spinifex and blue-bush shrubland. Flowers Sept.–Oct. Map 24.

S.A.: between Canopus Stn & Morgan Vale, 30 Sept. 1973, *F. van der Sommer s.n.* (AD). Qld: 66 km SE of Charleville, *G.W.Trapnell & K.Williams 268* (BRI). N.S.W.: Blighty, E of Deniliquin, *G.M.Cunningham & P.L.Milthorpe 2418* (NSW); 24 km from Bourke towards Cobar, *C.R.Dunlop 1127* (CANB). Vic.: Kulkyne State Forest, W of L. Hattah, *H.I.Aston 110* (MEL).

For distinctions between *H. tephrosperma* and the closely related *H. leucoptera* see notes under the latter. A specimen from Dubbo District (*J.L.Boorman*, BRI 1259538, NSW) has glabrous pedicels and perianth, but matches *H. tephrosperma* in slender short uncinate leaves, short ferruginous haired rachis, and fruit.

20. Hakea kippistiana Kippist & Meisn., *Hooker's J. Bot. Kew Gard. Misc*. 7: 115 (1855)

Hakea leucoptera var. *kippistiana* (Kippist & Meisn.) F.Muell. ex J.M.Black, *Fl. S. Australia* 161 (1924). T: [Mullean, Mt Stirling and Mt Caroline area, S of Tammin], Swan River Colony, [W.A.], *s.d., J.Drummond V, Suppl. no. 14*; syn: B, BM, CGE, G, K, MEL, NSW, P.

[*Hakea tephrosperma auct. non* R.Br.; C.D.F.Meisner, *Hooker's J. Bot. Kew Gard. Misc*. 207 (1852)]

[*Hakea leucoptera auct. non* R.Br.: F.J.H. von Mueller, *Fragm*. 6: 219 (1868)]

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 15, 56 (1997).

Spreading multi-stemmed woody shrub 1–3 m high, or single-stemmed to 5 m high, lignotuberous. Branchlets appressed-pubescent, with white and ferruginous hairs, quickly glabrescent apart from white appressed hairs at leaf bases. Leaves terete, not grooved, 2.5–7.5 cm long, 1–1.5 mm wide, initially with white and ferruginous appressed hairs, quickly glabrescent; apex usually somewhat uncinate (not quite as markedly as *H. tephrosperma*). Inflorescence of 8–26 flowers; rachis 3–6.5 mm long, simple but with potential to branch from ferruginous bud on rachis, densely appressed- to ±raised-pubescent with ferruginous hairs, sometimes mixed with white hairs; pedicels 2.5–3 mm long, sparsely appressed-pubescent, with hairs predominantly white. Perianth 2.5–3 mm long; claw glabrous except at very base; limb with sparse white-appressed hairs. Pistil 7–7.5 mm long. Fruit 19–23 mm long, 7–12.5 mm wide, ±smooth, grey or grey-black; beak oblique, comprising c. ⅓ length of fruit; horns eroded. Seed 14–16.5 mm long, 6–7 mm wide; wing decurrent ½–¾ way down one side of seed body only, light brown to grey-yellow.

Occurs in central-southern W.A. from Cowcowing and Cunderdin to Lake Bryde and east to near Rawlinna and Madura, usually in sandy areas associated with salt lakes. Flowers Nov.–Feb. Map 25.

W.A.: c. 16 km ESE of Mt Buraminya, *W.Archer 206903* (AD); Cowcowing, *M.Koch 980* (NSW, PERTH).

Hakea leucoptera occurs further to the north than *H. kippistiana* and can be distinguished from the latter by its much longer and thicker leaves, larger flowers and fruit and the white hairs on the rachis.

21. Hakea constablei L.A.S.Johnson, *Contr. New South Wales Natl. Herb.* 3: 94 (1962)

T: Bowens Ck, Bilpin–Mt Irvine road, 1750 ft [533 m], N.S.W., 6th Oct. 1950, *E.F.Constable NSW16415*; holo: NSW; iso: ?AD, K, MEL, PERTH.

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 366 (1989).

Slender to bushy shrub or small tree, 1.8–6 m high, not resprouting. Branchlets densely tomentose or appressed-pubescent, persistent until flowering. Leaves not widely divergent, terete, not grooved, 3–11 cm long, 1–1.6 mm wide, sparsely to densely appressed-sericeous, quickly glabrescent or persistent; apex porrect with mucro 1–2.5 mm long. Inflorescence of 6–12 flowers; rachis simple, 0.8–4 mm long, densely white-tomentose; pedicels 3.8–6.7 mm long, hairs white-appressed, sericeous or not. Perianth 3–4.2 mm long, cream-white, with

white appressed-sericeous hairs, soon glabrescent. Pistil 8.2–12 mm long. Fruit obliquely elliptic, 4.3–5.5 cm long, 3–3.5 cm wide, coarsely rugose, often also verrucose or pusticulate; beak tiny, with similar surface to rest of fruit; horns 0.5–1.8 mm long, often broken. Seed 27–37 mm long; wing decurrent fully down one side of seed-body only, dark brown. Fig. 5F–H.

Confined to the Blue Mtns and the Wollondilly catchment, N.S.W., where it occurs on rocky sandstone outcrops in dry sclerophyll forest, at altitudes of 500–1100 m. Flowers Sept.–Nov. Map 26.

N.S.W.: Du Faurs Rocks, Blue Mtns Natl Park, *W.R.Barker 3669* (AD); Kings Tableland (Blue Mtns), 26 Oct. 1962, *C.Burgess s.n.* (CANB); 1.5 km S of Bulli, 24 Aug. 1952, *L.A.S.Johnson & T.Clifford s.n.* (MEL); c. 4 km N of 'Ben Hur' property, Wanganderry Rd, off Wombeyan Caves Rd, *M.Kennedy et al. 446* (NSW); Mount Wilson, Oct. 1899, *J.H.Maiden s.n.* (AD, B, BM, NSW).

This species is recognised as 'Rare' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

22. Hakea lissosperma R.Br., *Trans. Linn. Soc. London* 10: 180 (1810)

Hakea acicularis var. *lissosperma* (R.Br.) Benth., *Fl. Austral.* 5: 515 (1870); *Hakea tenuifolia* var. *lissosperma* (R.Br.) Domin, *Biblioth. Bot.* 89: 592 (1921); *Hakea sericea* var. *lissosperma* (R.Br.) Ewart, *Fl. Victoria* (1931) 407. T: in montibus inter fl. Derwent & Huon, insulae Diemen [Tas.], 1804, *R.Brown s.n.*; ?holo: BM.

[*Hakea vittata* var. *glabriflora auct. non* J.M.Black ex J.H.Willis: J.M.Black ex J.H.Willis, *Victorian Naturalist* 73: 150 (1957), *p.p.* (*French* collection, *MEL 643057* erroneously labelled as from a Wimmera region locality: W.R.Barker, *J. Adelaide Bot. Gard.* 7: 245 (1985))]

[*Hakea macraeana auct. non* F.Muell.: J.H.Ross, *Census Vasc. Pl. Victoria* 4th edn, 93 (1993)]

Dense rounded shrub or slender pyramidal tree 1–5 m high. Branchlets initially densely sericeous, with hairs ±persistent at flowering. Leaves narrowly divergent to widely spreading, terete, not grooved, 5–8 (–13) cm long, 1.1–1.6 mm wide, densely appressed-sericeous with white hairs, or rarely tomentose with brownish hairs, quickly glabrescent; apex porrect, with mucro 1–1.5 mm long. Inflorescence axillary umbel of 6–8 flowers; rachis knob-like, simple, 1–2 mm long, densely white-tomentose; pedicels 3.5–5.5 mm long, moderately appressed-sericeous with white hairs, these sometimes extending sparsely onto perianth. Perianth 3.5–6 mm long, white or cream, not glaucous. Pistil 8–10.5 mm long. Fruit 2.3–2.7 cm long, 1.7–2 cm wide, coarsely rugose, tuberculate or pusticulate; beak transverse, decurrent shortly down one side of fruit, with surface similar to rest of fruit; horns and apiculum obscure. Seed 15–16.5 mm long, 6–7 mm wide; wing decurrent ½–¾ way down one side of seed-body only, black or dark brown. Plate 4; Fig. 5K–M.

Occurs in subalpine areas of south-eastern N.S.W. and Vic., and in Tas. from near sea-level to 1300 m. Flowers Oct.–Dec. in alpine areas, earlier at lower altitudes. Map 27.

N.S.W.: Snowy R. at Island Bend, Kosciuszko Natl Park, *R.Coveny 5385* (MEL, NSW). Vic.: Mt Buffalo Natl Park, Mt Macleod Track, 3 km N of Junction with Reservoir Rd, *N.G.Walsh 753* (MEL). Tas.: Sandy flats above Clytie Bight, Cape Pillar, *A.M.Buchanan 3314* (HO); Dundas, near Zeehan, 7 Nov. 1980, *L.Procter s.n.* (HO).

A variable species in relation to habit, leaf thickness and flexibility and, rarely, hair covering, with much of the variability apparently related to habitat and exposure of the site. Collections from the Cape Pillar area of Tas. (e.g. *Buchanan 3314*) have much thicker leaves than usual (c. 2 mm wide) while some from the west coast (e.g. *Procter s.n.*) have leaves which are consistently c. 1.1 mm wide, but they appear not to differ in any other feature. Floral measurements are based predominantly on Tas. material since the majority of material collected from Vic. and N.S.W. has only fruit present.

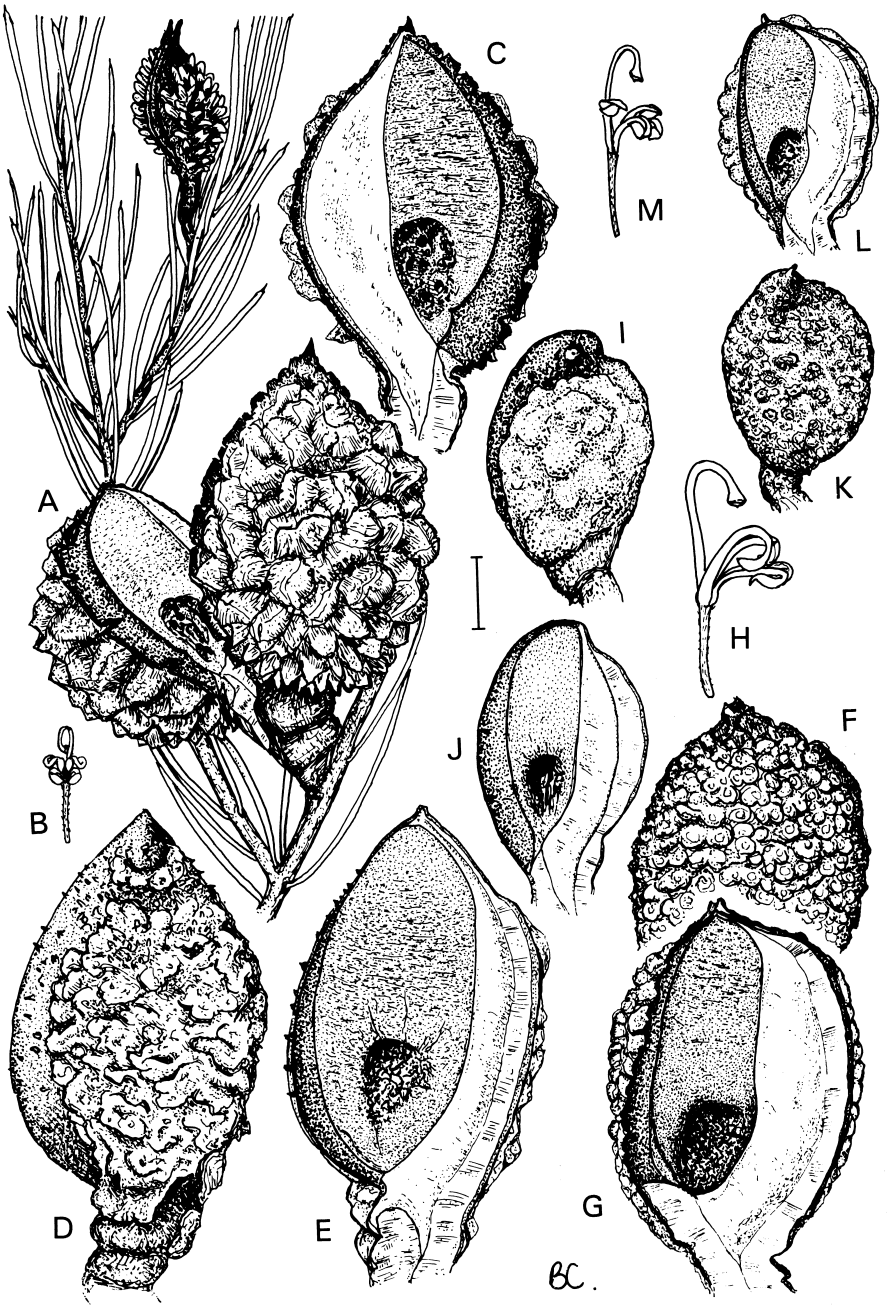

Figure 5. *Hakea*. **A–C**, *H. propinqua*. **A**, habit (J.Seur 391, NSW); **B**, flower; **C**, fruit (**B–C**, Hj.Eichler 17010, AD). **D–E**, *H. bakeriana*. **D**, outside of fruit; **E**, inside of fruit (**D–E**, R.Coveny 6052, NSW). **F–H**, *H. constablei*. **F**, outside of fruit; **G**, inside of fruit (**F–G**, L.Johnson *s.n.*, NSW54034); **H**, flower (J.Foster *s.n.*, NSW54031). **I–J**, *H. actites*. **I**, outside of fruit; **J**, inside of fruit (**I–J**, L.Johnson 54025, NSW). **K–M**, *H. lissosperma*. **K**, outside of fruit; **L**, inside of fruit (**K–L**, F.H.Long 360, HO); **M**, flower (F.H.Long 941, HO). Scale bar: **A**, **C–G**, **I–L** = 1 cm; **B** = 3 mm; **H**, **M** = 5 mm. Drawn by Beth Chandler.

23. Hakea actites W.R.Barker, *J. Adelaide Bot. Gard.* 17: 183 (1996)

T: northern boundary of Angourie, c. 1 km N of town centre by main road, N.S.W., 9 Sept. 1988, *W.R.Barker 5626 et al.*; holo: AD; iso: AD, to be distributed.

Hakea sp. 2, E.M.Ross in T.D.Stanley & E.M.Ross, *Fl. SE Queensland* 2: 22 (1986).

Hakea sp. aff. propinqua, N.C.W.Beadle, *Stud. Fl. NE New South Wales* 247 (1972), *p.p.*, as to coast plants.

Hakea sp. A aff. propinqua, S.W.L.Jacobs & J.Pickard, *Pl. New South Wales* 180 (1981), *p.p.*, as to north coast N.S.W. and some Qld occurrences.

[*Hakea gibbosa auct. non* (Sm.) Cav.: F.M.Bailey, *Queensland Fl.* 4: 1349 (1901); F.M.Bailey, *Comp. Cat. Queensland Pl.* 454 (1913)]

Shrub or rarely small tree, 0.3–5 m tall, lignotuberous. Branchlets densely pale-lenticellate, ribbed, densely tomentose to densely appressed-pubescent or -sericeous, glabrescent by flowering or not. Leaves narrowly divergent, somewhat rigid to flexible, terete, usually not grooved, rarely grooved at very base below, (3.5–) 5.5–10.5 (–13.5) cm long, 0.8–1.3 mm wide, smooth or densely longitudinally wrinkled, moderately appressed-pubescent or moderately to densely appressed-sericeous, quickly glabrescent; mucro porrect, (0.8–) 0.9–1.4 (–2.2) mm long. Inflorescence axillary umbel of 1–6 flowers; rachis elongated or knob-like, simple, 0.6–1 mm long, densely woolly-tomentose with ferruginous hairs; pedicels 1.8–3 mm long, sparsely to densely appressed-sericeous, with white and ferruginous hairs. Perianth 3.1–4.3 mm long, white, glabrous, often glaucous. Pistil 6.7–8 mm long. Fruit ovate to obovate, usually obliquely so, 2.2–3.4 cm long, 1.6–2.5 cm wide, smooth, minutely to finely lenticellate, or moderately to coarsely pustulate or with ruptured crests; beak transverse or oblique and long-decurrent down one side of fruit body; horns and apiculum obscure. Seed 1.6–2.5 cm long, (0.8–) 0.9–1.1 mm wide; wing decurrent usually fully down both sides, narrower on pale wood zone side, rarely absent, black or dark blackish brown sometimes with yellow patches. *Mulloway Needle Bush.* Fig. 5 I, J.

Occurs between Hervey Bay, south-eastern Qld, and just north of Coffs Harbour in north-eastern N.S.W. Found in sand, in swampy low lying areas, in open heath (wallum) and in *Eucalyptus* forest. Flowers May–Sept. Map 28.

Qld: Toolara State Forest c. 40 km NE of Gympie, *S.L.Everist 7910* (BRI, CANB); 1.6 km NE of Landsborough, *J.H.Ross 3182* (BRI, CANB). N.S.W.: Arrawarra, c. 6 km N of Woolgoolga, *D.B.Foreman 964* (AD, MEL); 1.6 km NW of Brooms Head on coast SE of Maclean, *D.J.McGillivray 2219* (AD, NSW).

Within the *Sericea* Group this species has very distinctive smooth-walled fruit with a smooth long-decurrent beak and horns displaced well down from the fruit apex. It differs from *H. sericea* by its appressed-sericeous pedicels, shorter horns, and different fruit shape, and from *H. lissosperma* by its ferruginous tomentum on the young branchlets, shorter pedicels and pistil, more prominent and oblique beak, and the long decurrent seed wing.

24. Hakea macrorrhyncha W.R.Barker, *J. Adelaide Bot. Gard.* 17: 185 (1996)

T: c. 3 km E of Ranger Station at Castle Rock camping area, SW of Dr Roberts Waterhole, Girraween Natl Park, Darling Downs region, Qld, 7 Sept. 1988, *W.R.Barker 5611 & I.R.Telford*; holo: AD; iso: CANB, others to be distributed.

Hakea sp. A aff. propinqua, S.W.L.Jacobs & J.Pickard, *Pl. New South Wales* 180 (1981), *p.p.*, as to northern tablelands N.S.W. and some Qld occurrences.

Hakea sp. aff. propinqua, N.C.W.Beadle, *Stud. Fl. NE New South Wales* 247 (1972), *p.p.*, as to tablelands plants.

Erect, single-stemmed or forked close to base, shrub or small tree, 1.8–6 m high; resprouting capacity unknown. Branchlets densely white-tomentose, with hairs persistent until flowering. Leaves terete, often grooved below, (3–) 4.5–9 cm long, 0.9–1.5 mm wide, initially white-tomentose, quickly glabrescent and smooth; apex porrect, with mucro 0.8–1.5 mm long. Inflorescence axillary umbel of c. 3 or 4 flowers; rachis knob-like, 0.5–0.7 mm long, white woolly-pubescent; pedicels 4–5.5 mm long, moderately densely white short-tomentose. Perianth 3–3.8 mm long, cream-white, moderately to densely white short-tomentose. Pistil 6.5–8 mm long, recurved. Fruit laterally broad ovate, 35–45 mm long, 21–25 (–30) mm wide, rugose-reticulate; beak long-triangular, smooth but for small dense round pusticules,

decurrent down one side for much of length, very shortly down other; apiculum ±absent; horns obscure. Seed 30–34 mm long, 9–13 mm wide; wing decurrent ½–¾ way down one side of body only, black throughout; seed body flanged on pale wood side.

Restricted to the Torrington area of north-eastern N.S.W. and nearby Girraween Natl Park and environs in south-eastern Qld. Very localised in hilly granitic areas of layered open forest or low closed woodland. Flowers (2 records) Aug.–Sept. Map 29.

Qld: N side of Girraween Natl Park, *W.J.F.McDonald 278* (BRI). N.S.W.: Torrington, Jan. 1916, *J.L.Boorman s.n.* (NSW 182514); Blatherarm Ck, 10 km NE of Torrington, 5 Nov. 1969, *H.J.Wissmann s.n.* (NE).

The bases of the leaves of *H. macrorrhyncha* are deep pink-red (*Barker 5611 & Telford*), and they lack the sharp flange found in *H. propinqua*; the pollen presenter is also pink-red from bud stage. *Hakea macrorrhyncha* can be distinguished from its closest relatives, *H. macraeana, H. ochroptera, H. decurrens* and *H. sericea*, by its longer beak. *Hakea lissosperma*, which it superficially resembles, differs by the lack of a groove in the leaf, as well as by its smaller fruit and sparsely pubescent or glabrous perianth.

25. Hakea macraeana F.Muell., *Australas. J. Pharm.* 1: 430 (1886)

T: sources of the Clyde [R.], N.S.W., 4000 ft [1219 m], Oct. 1886, *W.Bäuerlen s.n.*; lecto: MEL, *fide* W.R.Barker, *J. Adelaide Bot. Gard.* 17: 206 (1996); isolecto: BM, K; remaining syntypes: Monga, near Braidwood, N.S.W., Sept. 1886, *W.Bäuerlen s.n.*; syn: NSW; near Mt Currockbilly, N.S.W., Oct. 1886, *W.Bäuerlen s.n.*; syn: MEL; Braidwood district, N.S.W., Sept. 1884, *W.Bäuerlen 206*; syn: MEL; Braidwood district, N.S.W., Feb. 1885, *W.Bäuerlen 206*; syn: MEL.

Illustration: J.H.Maiden, *Forest Fl. New South Wales* 6: no. 190, pl. 194 (1913).

Small tree or erect or spreading shrub, 1–7.5 m tall, resprouting capacity unknown. Branchlets appressed-pubescent, quickly glabrescent or persistent. Leaves narrowly divergent, terete, grooved below, (3–) 5.5–15 cm long, 0.7–1.2 mm wide, densely cream appressed-sericeous, covered by more quickly caducous ferruginous hairs; apex porrect or rarely uncinate, with mucro 1.4–2.7 mm long. Inflorescence axillary umbel of 1–6 flowers; rachis obscure, simple, 0.8–1.5 mm long, densely tomentose with white and/or ferruginous hairs; pedicels 3.2–6.8 mm long, usually appressed-sericeous, with hairs usually white. Perianth 3–5.2 mm long, white or cream-white, sparsely appressed-sericeous with white shining hairs. Pistil c. 7–10 mm long. Fruit elliptic to obovate, 2.8–4 cm long, 1.8–2.4 cm wide, pale-pusticulate on brown-black bark; beak small, ±smooth; horns 1–3 mm long, fragile. Seed 2.2–2.7 mm long; wing extending ½–¾ way down one side only, blackish brown. Fig. 6R–T.

Confined to the south coast and southern tablelands of N.S.W., found in understorey of wet or dry sclerophyll forest in skeletal soil on rocky ground from near sea-level to 1060 m. Flowers Aug.–Oct. Map 30.

N.S.W.: Egan Peaks Nature Reserve, unnamed spur on the W side of Jingera Rock, *D.Albrecht 853* (MEL, NSW); Bumbo Fire Trail, Dampier State Forest, 16 km c. NW of Bodalla, *E.F.Constable 4431* (MEL, NSW); Budawang Ra., N of Currockbilly Mtn, 24 km c. NE of Braidwood, *E.F.Constable 7454* (MEL, NSW); track to Mt Imlay, c. 20 km SW of Eden, *R.Coveny 5794 & J.Armstrong* (DNA, MEL, NSW).

A collection from c. 21 km WNW of Nerrigundah (*M.P.Austin 138*) differs from *H. macraeana* in the leaves usually lacking a groove along the lower side. More collections from the area, with flowers and fruit, are needed to establish its taxonomic significance.

26. Hakea ochroptera W.R.Barker, *J. Adelaide Bot. Gard.* 17: 187 (1996)

T: c. 1.2 km by road from and c. 250 m direct N of the summit of Mt Moombil, N.S.W., 10 Sept. 1988, *W.R.Barker 5636 & I.R.Telford*; holo: AD; iso: AD, to be distributed.

[*Hakea macraeana auct. non* F.Muell.: W.R.Barker in G.J.Harden (ed.), *Fl. New South Wales* 2: 61 (1991), *p.p.*, as to northern populations]

Tall shrub or small tree to 10 m tall; lignotuber apparently absent. Branchlets densely tomentose with persistent ferruginous hairs and some white-appressed hairs underneath.

Leaves narrowly divergent, grooved below, 1.5–13.5 cm long, 0.75–1.1 mm wide, appressed-pubescent, quickly glabrescent; apex porrect, with mucro 1.1–2.2 mm long. Inflorescence axillary umbel of 1–6 flowers; rachis simple, obscure, 0.5–1.2 mm long, densely and shortly woolly-tomentose with ferruginous hairs tardily glabrescent; pedicels 4.5–7.5 mm long, sparsely appressed-sericeous with hairs white. Perianth c. 4.2–5 mm long, white, glabrous, not glaucous. Pistil c. 9.5 mm long. Fruit 3.2–4 cm long, 2.1–2.3 cm wide; pustules coarse, black or same colour as bark; beak small, transverse, ±smooth; horns obscure or absent; apiculum obscure or absent. Seed 23–27 mm long; wing extending ½–¾ way down one side only, light brown to off-white.

Occurs in the north-eastern highlands of N.S.W. in the Dorrigo area. Common on hillsides, in skeletal soil between rock sheets in light brush or depauperate warm-temperate rainforest. Flowers Sept.–Oct. Map 31.

N.S.W.: 1 km NW of Dibbs Head, Dorrigo Natl Park, *A.G.Floyd 964* (NE, NSW); Mt Moonbill-Dorrigo Plateau, *L.J.Webb & J.G.Tracey 13628* (BRI).

Distinguished from its closest ally, *H. macraeana*, by its glabrous perianth, its light-coloured seed and the arms of the hairs on the branches ascending to suberect, not ±appressed.

#**27. Hakea sericea** Schrad. & J.C.Wendl., *Sert. Hannov*. 3: 27 (1797)

T: not designated, presumably a plant grown in the Hannover Garden.

?Banksia tenuifolia Salisb., *Prodr. Stirp. Chap. Allerton* 50 (1796); *Hakea tenuifolia* (Salisb.) Britten, *J. Bot.* 54: 59 (1916), *nom. illeg. non* Dum.-Cours. (1805); *H. tenuifolia* var. *tenuifolia* Domin, *Biblioth. Bot.* 89: 592 (1921), *p.p., nom. illeg.* T: Port Jackson, N.S.W., *Jac. Lee*; holo: not found.

Conchium aciculare Sm. ex Vent., *Jard. Malmaison* 2: 111, t. 111 (1805), *non* Donn; *Hakea acicularis* (Sm. ex Vent.) Knight, *Cult. Prot.* 107 (1809); *Banksia acicularis* (Sm. ex Vent.) J.Parm., *Cat. Arbr. Parm.* 111 (1818). T: cultivated, Malmaison, Paris, *s.d.*, *Anon s.n.*, [*Herb. Ventenat*]; holo: G.

Conchium aciculare Donn., *Hortus Cantabrig.* 2nd edn (1800), *nom. nud.*; *Hortus Cantabrig.* 3rd edn, 21 (1804), *nom. nud.*

Conchium compressum Sm., in A.Rees, *Cycl.* 9, no. 5 (1807), pages unnumbered; *Hakea acicularis* var. *smithii* Endl., *Gen. Pl.* Suppl. 4: 85 (1848), based on *C. compressum* Sm. T: near Port Jackson, N.S.W., *Dr White*; holo: not found.

?*Hakea sp. 1*, E.M.Ross in T.D.Stanley & E.M.Ross, *Fl. SE Queensland* 2: 21 (1986).

Divaricate shrub to 4 m high; lignotuber absent. Branchlets ash-white to ash-grey, densely woolly-tomentose, persistent. Leaves spreading, grooved below, 1.3–7.2 cm long, 0.7–1.3 mm wide, moderately appressed-sericeous, quickly glabrescent; apex porrect, with mucro 1–2 mm long. Inflorescence axillary umbel of 1–6 flowers; rachis simple, 0.5–1.5 (–2.5) mm long, densely woolly-tomentose, with hairs white, ferruginous towards base. Flowers pinkish in bud, white at maturity; pedicels 2–4 mm long, moderately to densely white-villous. Perianth 2.5–4.7 mm long, glabrous. Pistil 4–7.5 mm long. Fruit (2–) 2.5–3 (–4) cm long, (1.5–) 1.7–2.2 (–3) cm wide, coarsely rugose-reticulate, abruptly obliquely broadly beaked; horns prominent but fragile, to 3 mm long. Seed 16–31 mm long, 6–11.5 mm wide; wing ½ way to ±fully down one side, not or briefly down other, black; seed body flanged down particularly the pale wood side. *Silky Hakea*. Fig. 6 I.

Found in coastal regions and adjacent ranges from south-eastern Qld to south-eastern N.S.W. and (probably naturalised) at Anglesea, Vic. It is also naturalised on Norfolk Is., N.S.W., in New Zealand and South Africa, where it can be a particularly troublesome weed. Occurs in dry sclerophyll forest and heaths. Flowers July–Oct. Maps 32, 33.

Qld: Mt Barney, *C.T.White 7862* (BRI, NY). N.S.W.: Audley, near Port Hacking, *S.T.Blake 19037* (BRI, NSW); Pigeon House Ra., along road from Nerriga to Nowra, c. 3.2 km E of Endrick R., *R.D.Hoogland 10029* (A, B, BISH, CANB, G, K, L, NSW, P, PH, TNS, US); New North Rothbury, on road to Branxton, *M.E.Phillips 357* (CANB, DNA); Nerriga, between Nerriga and Towga above The Jumps, *Walker ANU1148* (CANB, NSW, K). Vic.: Anglesea, *H.M.Lee 353* (AD).

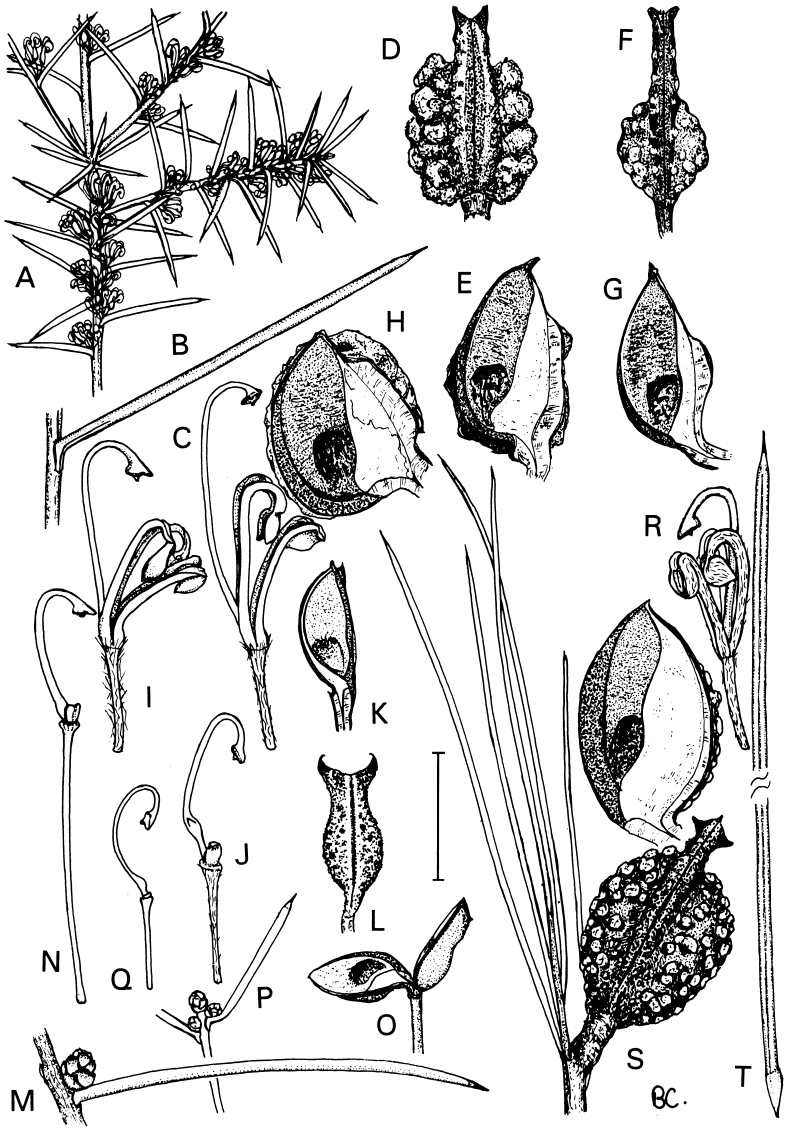

Figure 6. *Hakea*. **A–E**, *H. decurrens* subsp. *physocarpa*. **A**, habit; **B**, leaf; **C**, flower (**A–C**, A.C.Beauglehole 28152, MEL); **D**, fruit; **E**, inside of fruit (**D–E**, A.C.Beauglehole 30817, AD). **F–G**, *H. decurrens* subsp. *decurrens*. **F**, fruit; **G**, inside of fruit (**F–G**, E.F.Constable 5026, NSW). **H**, *H. decurrens* subsp. *platytaenia*, inside of fruit (P.K.Smith MEL1537502, MEL). **I**, *H. sericea*, flower (no specimen details). **J–L**, *H. preissii*. **J**, flower without tepals; **K**, inside of fruit (**J–K**, P.S.Short 2394 & L.Haegi, AD); **L**, fruit (A.George 14274, PERTH). **M–O**, *H. recurva* subsp. *recurva*. **M**, bud and leaf (L.Haegi 2559, AD); **N**, flower without tepals (R.W.Purdie 5175, CANB); **O**, fruit (R.J.Cranfield 5227, PERTH). **P–Q**, *H. recurva* subsp. *arida*. **P**, bud plus leaf (July 1931, C.A.Gardner, PERTH); **Q**, flower without tepals (A.R.Fairall 1811, PERTH). **R–T**, *H. macraeana*. **R**, flower (E.F.Constable *s.n.*, NSW25757); **S**, fruit and leaf; **T**, leaf (**R–T**, M.Parris *s.n.*, NSW190768). Scale bar: **A** = 2.6 cm; **B** = 1 cm; **C** = 4 mm: **D–H**, **K–M**, **O–P**, **S** = 2 cm; **I**, **R** = 4.4 mm; **J**, **N**, **Q**, **T** = 6.7 mm. Drawn by Beth Chandler.

#**28. Hakea decurrens** R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 27 (1830)

Hakea tenuifolia var. *decurrens* (R.Br.) Domin, *Biblioth. Bot.* 89: 592 (1921). T: Barren Lands of the Western Interior, *s.d.* [1818], *C.Fraser 41* [*Oxley 2nd Expedition*]; lecto: BM, *fide* W.R.Barker, *J. Adelaide Bot. Gard*. 17: 189 (1996); remaining syntype: Oxley's 2nd Expedition, *s.d.* [1818], [*C.Fraser*] *46*; syn: BM; ?isosyn: G-DC.

Hakea brachyrrhyncha F.Muell., *First Gen. Report* 17 (1853), *nom. nud.*; Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 401 (1856), *pro syn*. under *H. acicularis*.

[*Hakea acicularis* var. *lissosperma auct. non* (R.Br.) Benth.: G.Bentham, *Fl. Austral*. 5: 515 (1870), *p.p.*]

[*Hakea sericea auct. non* Schrad. & J.C.Wendl.: A.J.Ewart, *Fl. Victoria* 407 (1931), *p.p.*; N.T.Burbidge, *Fl. Austral. Cap. Terr*. 146 (1970), *p.p.*; J.H.Willis, *Handbook Pl. Victoria 2. Dicot*. 51 (1973), *p.p.*]

Small trees or shrubs, 0.3–5 m tall, lignotuberous. Branchlets appressed-sericeous or tomentose, persistent or quickly glabrescent. Leaves widely spreading, grooved below to varying extents, 1.5–8 cm long, 0.7–1.6 mm wide, glabrous or rapidly glabrescent; apex porrect, with mucro 1–3.5 mm long. Inflorescence axillary umbel of 1–6 flowers; rachis simple, 0.5–2.8 mm long, with tomentose or appressed white and/or ferruginous hairs, extending onto pedicels; pedicels 1.2–4.8 mm long. Perianth 4.2–7.2 mm long, glabrous. Pistil 8.5–12.2 mm long. Fruit 1.8–3.5 cm long, 1–3 cm wide, finely or coarsely tuberculate, obliquely ovate to broadly ovate; beak small to moderately large, sparsely pustulate or smooth; horns 1–5 mm long; valves with pale wood extending c. ¾ way to style base. Seed 17–23 mm long, 6.5–10.5 mm wide; wing ¾ to fully down one side only, dark blackish brown with hyaline network of minute areoles.

A widespread species, found from eastern N.S.W. to Vic. and Tas., also naturalised in S.A. and Portugal. Three subspecies are recognised, separated predominantly on branchlet and pedicel indumentum and fruit size.

1 Branchlets with tomentose hairs, often persisting for several seasons; red-brown wood zone of valve 3–5 mm wide near seed base (small shrubs in coastal windswept heaths of south-eastern N.S.W., E Vic. and Bass Strait Is.) **28b.** subsp. **platytaenia**

1: Branchlets with appressed hairs, usually quickly glabrescent, sometimes persisting until flowering; red-brown wood zone of valve 1–2.5 mm wide near seed base

2 Fruit in median view ovate to obovate, 1.4–1.9 cm wide; pale wood zone 3.5–6 mm wide, 2-layered, with outer layer 1–2.5 (–3) mm wide **28c.** subsp. **decurrens**

2: Fruit in median view ovate to elliptic or broadly so, 1.5–3.6 cm wide; pale wood zone (4.5–) 6–12 mm wide, 2-layered, with outer layer 2.5–5.5 mm wide **28a.** subsp. **physocarpa**

#**28a. Hakea decurrens** subsp. **physocarpa** W.R.Barker, *J. Adelaide Bot. Gard*. 17: 193 (1996)

T: Black Ra., extreme N end, E side of Picnic Rocks, Grampians, Vic., 23 Apr. 1969, *A.C.Beauglehole 30817*; holo: AD; iso: MEL.

Hakea longispina Gand., *Bull. Soc. Bot. France* 66: 229 (1919). T: Victoria, *s.d.*, *C.Walter s.n.*; holo: LY; probable iso: BR.

Hakea vittata var. *glabriflora* J.M.Black ex J.H.Willis, *Victorian Naturalist* 73: 150 (1957), *p.p.* (excluding *French* collection, *MEL 643057* from Wimmera); *Hakea vittata* var. *glabriflora* J.M.Black, *Fl. S. Australia* 2nd edn, 2: 265 (1948), *nom. inval*. T: near Stirling East School, S.A., Aug. 1944, *J.B.Cleland s.n.*; holo: AD; iso: AD, ?MEL, ?NSW.

Hakea sp. aff. acicularis: J.H.Maiden, *Proc. Linn. Soc. New South Wales* 28: 747 (1904).

[*Hakea sericea auct. non* Schrad. & J.C.Wendl.: A.J.Ewart, *Fl. Victoria* 407 (1931), *p.p.*; W.M.Curtis, *Student's Fl. Tasmania* 3: 610 (1967); W.R.Barker, *J. Adelaide Bot. Gard*. 7: 245 (1985), *p.p.*]

Small tree or shrub, 0.8–5 m tall. Branchlets sparsely to densely appressed-sericeous, quickly glabrescent or persistent to flowering. Leaves quickly glabrescent. Pedicels sparsely to densely tomentose to appressed-sericeous. Fruit 2.1–3.2 cm long, 1.3–2.5 cm wide; red-brown wood zone 1–2.5 mm wide; pale wood zone (4.5–) 6–12 mm wide. Fig. 6A–E.

Occurs in south-eastern N.S.W., the Grampians, central and eastern Vic., Bass Strait, and possibly northern Tas. Naturalised in S.A. (Lofty Ra.), Blackheath near Sydney, N.S.W., and probably southern Tas.; also in Portugal. Found in eucalypt forest, damp heath or dry scrubland in hilly areas in sand, clay, granite, basalt or sandstone, from sea-level to 300 m. Flowers June–Sept. Maps 34, 35.

S.A.: Watiparinga Natl Trust Reserve, Belair, *W.R.Barker 1894* (AD). N.S.W.: 16 km N of Timbillica on Princes Hwy, c. 29 km S of Eden, *R.Coveny 2930* (NSW). Vic.: 6 km directly ENE of Gembrook, 4 km E along Black Snake Creek Rd from Whites Corner, *M.D.Crisp 7127* (CANB, MEL); Grampians, Pomonal Rd, c. 2.5 km from Halls Gap, *T.B.Muir 1206* (MEL, UPS). Tas.: Sulphur Ck, Sept. 1915, *L.Rodway s.n.* (HO).

28b. Hakea decurrens subsp. **platytaenia** W.R.Barker, *J. Adelaide Bot. Gard.* 17: 196 (1996)

T: Ben Boyd Natl Park, South Coast Region, N.S.W., 23 July 1990, *M.Parris 9714*; holo: AD; iso: AD, CANB, others to be distributed.

Small shrubby tree or erect shrub, 0.3–2 m tall. Branchlets moderately to densely tomentose, rarely appressed-sericeous, persistent at least until well after flowering. Leaves sparsely tomentose with some hairs appressed, quickly glabrescent. Fruit 2.6–3.5 cm long, 2.6–3.5 cm wide; red-brown wood zone 3–5 mm wide; pale wood zone 8–15 mm wide. Fig. 6H.

Coastal, occurring in south-eastern N.S.W., eastern Vic., and Bass Strait islands, in windswept heath. Flowers May–Sept. Map 36.

N.S.W.: c. 0.3 km W by track from Saltwater Creek camping ground, S of Eden, *D.E.Albrecht 410* (AD, MEL); Quoraburagam Point, *J.Pully 479* (CANB). Vic.: Howe Hill, *s.d., Anon. (F.Mueller herb.) 132* (MEL); Oberons Foot, Wilsons Promontory, 10 June 1965, *P.K.Smith* (MEL). Tas.: Flinders Is., summit of Mt Tanner, *B.S.Crisp 459* (CANB, HO).

28c. Hakea decurrens R.Br. subsp. **decurrens**

Semi-prostrate to erect, bushy to scrambling shrub, 0.4–2.4 m tall. Branchlets sparsely to densely appressed-pubescent or -sericeous. Leaves sparsely to moderately appressed-sericeous, quickly glabrescent. Fruit 1.8–3 cm long, 1–1.8 cm wide; red-brown wood zone 1.2–2 mm wide; pale wood zone 3.5–6 mm wide. Fig. 6F, G.

Found only on the western slopes and adjacent tablelands of the Great Dividing Ra. in N.S.W. and A.C.T. Occurs in thick scrub to open *Eucalyptus* woodland or forest, often in hilly country, at an altitude of 430–900 m. Flowers May–Sept., usually July. Map 37.

N.S.W.: the Mullions Ra., 22.5 km NNE of Orange, *R.Coveny 4189* (DNA, NSW); 19 km N of Rylstone, 11 Apr. 1953, *L.A.S.Johnson s.n.* (AD, NSW); Pilliga Scrub, June 1967, *N.Perry s.n.* (NSW). A.C.T.: Black Mtn, *W.R.Barker 5681* (AD).

29. Hakea gibbosa (Sm.) Cav., *Anales Hist. Nat.* 1: 214 (1800)

Banksia gibbosa Sm., in J.White, *J. Voy. New South Wales* 224, t. 22, fig. 2 (1790); *Conchium gibbosum* Donn, *Hortus Cantabrig.* 3rd edn, 21 (1804), *nom. inval.*; *Conchium gibbosum* (Sm.) Donn ex Sm., in A.Rees, *Cycl.* 9, no. 1 (1807), pages unnumbered; *Banksia pinifolia* Salisb., *Prod. Stirp. Chap. Allerton* 51 (1796), *nom. illeg.* (*B. gibbosa* in synonymy); *Hakea pinifolia* Knight, *Cult. Prot.* 107 (1809), *nom. illeg.* T: t. 22, fig. 2 in J.White, *J. Voy. New South Wales* 224, (1790); lecto: *fide* W.R.Barker, *J. Adelaide Bot. Gard.* 17: 207 (1996).

Conchium sphaeroideum Sm., in A.Rees, *Cycl.* 9, no. 2 (1807), pages unnumbered. T: Port Jackson, N.S.W., *Anon.*; holo: not located.

Conchium cornutum C.F.Gaertn., *Suppl. Carp.* 216, t. 219 (1807). T: Port Jackson, [N.S.W.], 1770, [*J.Banks & J.Solander*]; syn: B.

Hakea tamminensis C.A.Gardner, *J. Roy. Soc. W. Australia* 47: 57 (1964). T: near Tammin, W.A., *s.d., C.A.Gardner 11997*; holo: PERTH.

Hakea lanigera Ten., *Fl. Napol.* 1: 22, t. vi (1811). T: 'Questo bell'albero e coltivato da molti anni al Real Giardino di Caserta, d'onde e passato en quello delle piante'; holo: not located.

?Hakea pubescens Schrad. & J.C.Wendl., *Sert. Hannov.* 27 (1798). T: not cited.

Shrub, 0.9–3 m tall, not lignotuberous. Branchlets persistently densely brown-villous. Leaves narrowly divergent to widely spreading, usually grooved below, 2.5–8.5 cm long, 0.9–1.5 mm wide, densely villous, with hairs usually persistent until flowering; apex porrect, with mucro (1–) 1.8–2.3 mm long. Inflorescence axillary umbel of (1–) 2–4 flowers; rachis simple, 0.7–1.6 mm long, obscured by densely villous indumentum of persistent pale brown or ferruginous hairs much longer than rachis; pedicels 1.8–4.5 mm long, densely villous with white to ferruginous hairs. Perianth 3.8–5.3 mm long, cream-yellow, sparsely to moderately tomentose with some hairs appressed, or sparsely to moderately villous; hairs white to pale brown. Pistil 8.7–11.5 mm long. Fruit 2.6–4.5 cm long, 2–3 cm wide, often compressed when immature, coarsely rugose-reticulate and (in immature fruit) pusticulate; beak small, decurrent down one side, finely or coarsely black-pusticulate or tessellated; horns fragile, c. 0.3 mm long. Seed 20–33 mm long, 9–14 mm wide; wing almost fully decurrent down one side of seed-body only, with seed body flanged on the other side, dark-brown. Fig. 4Q–S.

Occurs near the central coast and adjacent ranges of N.S.W.; naturalised on Norfolk Is., N.S.W., in New Zealand and South Africa. Grows in dry sclerophyll forest, in heath on Hawkesbury sandstone or in sandy soil on ridges, most common in windswept scrub on coastal cliffs. Flowers Apr.–July. Map 38.

N.S.W.: Pacific Hwy, 8 km E of Kariong, *R.Coveny 4879* (DNA, NSW).

The species is unique within the *Sericea* Group in having its seed oriented transversely to the direction of the fruit stalk.

Compressed fruit with under-developed pale wood occur among the fully developed sclerotinous fruit. Whether these release viable seeds seasonally, as apparent in *H. nodosa*, needs confirmation.

Hakea tamminensis, a rare species from near Tammin, W.A., sought by many fanciers for 20 years, was shown by W.R.Barker (*Nuytsia* 7: 1–3, 1989) to be a case of mistaken identity of a mislabelled specimen of *H. gibbosa*.

Nodosa Group

Hakea sect. *Hakea* ser. *Glabriflorae* Benth., *Fl. Austral*. 5: 492, 509 (1870), *p.p.*

Shrubs or more rarely, small trees, without corky bark. Leaves simple, terete (sometimes flattened in *H. nodosa*), not petiolate, not stem-clasping, sometimes grooved below; venation obscure. Inflorescence an axillary umbel, rarely resprouting in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 0.6–2.5 mm long. Flowers 1–11 per umbel; pedicel pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent or glabrous. Pistil 3–4.5 mm long; pollen presenter an oblique disc; gland minute, U-shaped or rectangular. Fruit usually solitary, erect, retained on plant, woody (except sometimes in *H. nodosa*), tuberculate, beaked, horned or not, dehiscing fully down one side, mostly down other. Seed occupying part of valve; wing ½ way to ±fully down one side (red-brown wood) of seed body, not at all on other; seed body flanged on pale wood side or on both sides proximal to the wing.

A group of three species, found in S.A., N.S.W., Vic. and Tas.

1 Fruit 3.5–4.5 cm long; flowers white; conifer-like tree or shrub, 1–5 m high (Sydney region to Blue Mtns, N.S.W.; flowers May–July) **30. H. propinqua**

1: Fruit 1.3–3.5 cm long; flowers cream-white to deep yellow; spreading to upright tree or shrub, not conifer-like

2 Leaves often flattened, flexible; fruit dimorphic, woody and less woody; rachis simple or with up to 6 sessile rachises on previous year's rachis; flowers cream-white to deep yellow; seed marginal; seed wing dark grey to grey-yellow (closed heath and swampy areas, south-eastern S.A., Vic., Tas.; flowers May–Aug.) **31. H. nodosa**

2: Leaves always terete, sometimes rigid; plants with woody fruit only; rachis simple; flowers yellow; seed displaced from centre, not marginal; seed wing deep brown (in sandstone at higher altitudes (c. above 800 m) Blue Mtns, N.S.W.; flowers Oct.) **32. H. pachyphylla**

30. Hakea propinqua A.Cunn., in B.Field, *Geogr. Mem. New South Wales* 327 (1825)

T: near Caley's Repulse, Blue Mtns, N.S.W., Oct. 1822, *A.Cunningham s.n.*; lecto: K, *fide* W.R.Barker, *J. Adelaide Bot. Gard.* 17: 202 (1996); probable isolecto: BR, G-DC, ?K; possible remaining syntypes: Blue Mtns, N.S.W., 1822, *A.Cunningham 33 or 195*: syn; BM, K; Blue Mtns, N.S.W., *s.d.*, *Anon. 33*; syn: MEL.

[*Hakea verrucosa auct. non* F.Muell.: F.J.H. von Mueller, *Fragm.* 5: 25 (1865), *p.p.*]

Small conifer-like tree or shrub to c. 1–5 m high, not lignotuberous. Branchlets longitudinally multi-ribbed, deep red, moderately to densely raised-tomentose, quickly glabrescent to persistent in grooves. Leaves terete, somewhat flexible, not grooved, (1.5–) 2.5–7 (–8.5) cm long, 1–1.3 mm wide, glabrous; mucro 0.7–1.6 mm long. Inflorescence with (4–) 6–10 flowers; rachis simple, (0.6–) 1.5–2.5 mm long, densely white-tomentose; flowers white; pedicels 2–3.8 mm long, sparsely to moderately densely white-tomentose. Perianth 1.5–2.2 mm long, glabrous except for sparse white hairs on limb. Pistil 4–4.5 mm long; gland minute, U-shaped. Fruit woody, long remaining closed, broadly ovate-elliptic, 3.5–4.5 cm long, 2.5–3 (–3.8) cm wide, densely sharply to bluntly, very coarsely tuberculate, deep brown-black; beak smooth or sparsely tuberculate, short and broad, decurrent down red-brown wood zone side only; horns to 1–2 mm long, often worn. Seed ±central in valve, obliquely elliptic, 24–38 mm long, 11–15 mm wide; wing decurrent ½–¾ way down one side only, brown-black. Fig. 5A–C.

Occurs from the Sydney region to the Blue Mtns, N.S.W., in *Eucalyptus* woodland, open forest, sclerophyllous scrub or shrubland in shallow sandy or loamy soil on sandstone. Flowers May–July. Map 39.

N.S.W.: Artillery Hill, Royal Natl Park, *J.Armstrong 895* (NSW); 11 km NNE of Leura on Mt Hay road, *E.F.Constable 4979* (DNA, NSW); Darkes Forest, 14 Oct. 1977, *R.Fitzharding s.n.* (NSW); 2 km SSW of Glen Davis, *R.Coveny 9454 & I.Telford* (CANB, NSW).

The young fruit of *H. propinqua* are bluntly yellow-tuberculate. This species is often confused with *H. pachyphylla* which differs in its high Blue Mtns distribution, low bushy habit, spring flowering, yellow flowers and smaller fruit with more irregular and blunt warty outgrowths.

31. Hakea nodosa R.Br., *Trans. Linn. Soc. London* 10: 179 (1810)

T: Port Phillip Bay, [Vic.], 1 May 1802, *R.Brown s.n.*; lecto: BM, *fide* W.R.Barker, *J. Adelaide Bot. Gard.* 17: 201 (1996); isolecto: E, K, P.

Hakea flexilis R.Br., *Trans. Linn. Soc. London* 10: 180 (1810). T: Arthur's Seat, Port Phillip, [Vic.], 24–25 Jan. 1804, *R.Brown Iter. Austral. 3375*; lecto: BM, *fide* W.R.Barker, *J. Adelaide Bot. Gard.* 17: 201 (1996); isolecto: BM, E, K.

Hakea semiplana F.Muell. ex Meisn., *Linnaea* 26: 359 (1854). T: Brighton, Australia felix, [Vic.], Oct. 1852, *F.Mueller*; lecto: NY, *fide* W.R.Barker, *J. Adelaide Bot. Gard.* 17: 201 (1996); remaining syntypes: Gippsland, Vic., 1853, *Anon. s.n.*; syn: NY; interior of New Holland, *Anon.* [*Major Mitchell's Exped.*] *s.n.*; syn: NY.

Hakea semiplana F.Muell., *First Gen. Report* 17 (1853), *nom. nud.*

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 385 (1989).

Spreading, upright or rounded shrub, 2 (–4) m high, ?lignotuberous or not. Branchlets ribbed, soon or tardily glabrescent. Leaves terete to flattened, flexible, 0.8–5 cm long, 0.7–2.5 mm wide, glabrous, sometimes grooved below; mucro c. 0.2–0.9 mm long. Inflorescence with 2–11 flowers; rachis simple, 0.5–1 mm long, rarely up to 6 rachises developing on previous year's rachis, densely pubescent with appressed brown and/or white raised hairs. Flowers cream-white to deep yellow; pedicels 1.5–3.3 mm long, white-pubescent. Perianth 1.3–2.2 mm long, glabrous. Pistil 3–4.5 mm long; gland curved-rectangular. Fruit dimorphic, remaining closed if woody, opening if less woody, broadly

ovate, 1.3–3.5 cm long, 0.9–3 cm wide, densely coarsely warty or almost smooth; beak short, oblique and broad, or sometimes narrow, decurrent down red-brown wood zone side only; horns absent. Seed marginal, obliquely elliptic, 12–23 mm long, 5.5–11 mm wide; wing decurrent broadly 2/3 to whole way down one side only, dark-grey to grey-yellow. Fig. 4L.

Occurs in south-eastern S.A., Vic. and Tas., in closed heath and in swampy areas. Flowers May–Aug. Map 40.

S.A.: c. 60 km N of Kingston, *B.Copley 3317* (AD, DNA); W Dairy Ra., 2.5 km ESE of 'Sugarloaf Hill', 22 km E of Robe, *M.D.Crisp 3817* (AD, CANB). Vic.: Coranderrk Aquaduct road, S of Healesville, 3 Apr. 1979, *D.Parkes & P.Gullan s.n.* (MEL); Corinella West, *J.D.M.Pearson 626* (MEL). Tas.: Swampy Bay, *A.Moscal 2650* (AD, MEL).

Unique within *Hakea* for producing two fruit types often on the same plant. One type is similar to that found in the *H. recurva* group (not developing any marked woodiness, opening while still attached to the bush and with a smooth surface), the other is woody, remaining closed while attached to the bush and with a rough tuberculate surface. The smooth-surfaced fruit was the basis for Robert Brown's *H. flexilis*, which he described at the same time as *H. nodosa*. The woody fruit is sharply coarsely tuberculate when young, the tubercles a contrasting lighter colour.

32. Hakea pachyphylla Sieber ex Spreng., *Syst. Veg.* 16th edn, 4(2) Cur. Post. 46 (1827)

Hakea pachyphylla Schult. & Schult.f., *Mant.* 3: 282 (July–Dec. 1827), *nom. illeg., non* Sieber ex Spreng. (Jan.–June 1827). T: New Holland, 1825, *F.W.Sieber 11*; lecto: MEL, *fide* W.R.Barker, *J. Adelaide Bot. Gard.* 17: 204 (1996); isolecto or remaining syn: B, BR, G, G-DC, K, L, M, MEL, MO, NY.

[*Hakea propinqua auct. non* A.Cunn.: G.Bentham, *Fl. Austral.* 5: 513 (1870), *p.p.*]

Compact to spreading or depauperate single-stemmed shrub, 0.3–2 m high, non-lignotuberous. Branchlets ribbed, densely appressed-pubescent, quickly glabrescent or persistent to flowering, mid-red when young. Leaves rigid, terete, sometimes grooved below, (1–) 1.8–3.5 (–5.5) cm long, 1.1–1.8 mm wide, sparsely appressed-pubescent, quickly glabrescent; mucro c. 0.5–1.5 mm long. Inflorescence with (1–) 3–6 (–7) flowers; rachis simple, 0.5–1.2 mm long, densely white woolly-tomentose. Flowers yellow; pedicels 1.8–3.3 mm long, moderately densely woolly-tomentose. Perianth 1.5–2 mm long, glabrous or sparsely tomentose. Pistil (3.5–) 4.2–4.5 mm long; gland minute. Fruit woody, remaining closed, elliptic, coarsely bluntly tuberculate, 2.9–3.5 cm long, 2.3–2.6 cm wide; beak tuberculate, short and broad, decurrent unequally down both sides of fruit body; horns obscure or absent. Seed displaced from centre, not marginal, elliptic to obliquely obovate, 22–25 mm long, 10–12 mm wide; wing decurrent broadly 1/2–3/4 way down one side only, deep brown.

Occurs in the Blue Mtns, N.S.W., in a variety of habitats from swamp to heath or mallee-heath, sometimes on sandstone. Flowers Aug.–Sept. (–Oct.). Map 41.

N.S.W.: Du Faurs Rocks, Blue Mtns, *W.A.Barker 5672* (AD); L. Medlow, 5 km NNW of Katoomba, *E.F.Constable 6107* (NSW); Kings Tableland, S of Wentworth Falls, *R.Melville 646 & L.A.S.Johnson* (AD, BRI, MEL).

Three specimens resembling *H. pachyphylla* come from the northern Budawang Ra. (*Pulley & Telford BR75*, *Carolin 7055*) and the adjacent Little Forest Plateau (*Mills NSW223475*). The specimens match *H. pachyphylla* in fruit surface, shape and beak, and in the robust leaves, but population samples, including flowers, are required to confirm the identification.

Strumosa Group

Hakea sect. *Hakea* ser. *Glabriflorae* Benth., *Fl. Austral.* 5: 492, 509 (1870), *p.p.*

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Shrubs, rarely small trees, without corky bark. Leaves simple (rarely with some leaves branched apically in *H. preissii*), terete, not petiolate, not grooved below; venation obscure. Inflorescence an axillary or terminal umbelliform raceme, if axillary then inflorescence resprouting in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis to 4 mm long. Flowers 4–12 (–28 in *H. preissii*) per raceme, yellow, white or red or a combination of these; pedicel glabrous, rarely pubescent. Perianth curved in bud (straight in *H. newbeyana*), splitting to base into 4 distinct tepals, glabrous, rarely pubescent. Pistil 3.8–12 mm long; pollen presenter conical or an oblique to almost lateral disc; gland a curved flap. Fruit 1 (–3) per axil, erect, retained on plant, woody, smooth and pusticulate or tuberculate, beaked or not, horned, dehiscing fully; wing encircling seed body, or down one or both sides.

A group of eight species, mostly in W.A., with two species in S.A.

1 Pedicel and perianth pubescent throughout; fruit horned

2 Plants with witches broom galls; prostrate or straggly or dense shrub to 2 m high; leaves never divided apically, 0.8–1.5 mm wide; fruit remaining unsplit on pale wood side, obliquely beaked, 0.9–1.5 cm wide (Eyre Penin. to south-eastern S.A., including Kangaroo Is.; flowers Aug.–Nov.) **34. H. vittata**

2: Plants without witches broom galls; erect tree to 8 m or compact shrub 2–3 m high; leaves sometimes divided apically, 1.5–2.5 mm wide; fruit opening both sides, not beaked, 0.7–1.1 cm wide (drier areas of W.A. S & E of Onslow and the Fortescue R. to Cape Arid Natl Park; flowers Aug.–Dec.) **33. H. preissii**

1: Pedicel and perianth glabrous, or pedicel sparsely hirsute and perianth glabrous except for sparsely hirsute limb in *H. circumalata* (which has terminal as well as axillary inflorescences); fruit horned or not

3 Buds straight; pollen presenter a ±porrect cone; flowers yellow (rounded shrub 1–3 m tall; branchlets and young leaves with appressed ferruginous hairs; Nyabing-Newdegate area, southern W.A.; flowers (June–) Sept. & Oct.) **37. H. newbeyana**

3: Buds curved; pollen presenter oblique or lateral disc

4 Inflorescences terminal and axillary

5 Leaves all on one side of branch; young growth glabrous; pedicels glabrous, red; fruit obliquely beaked; wing partly down one side of seed body only (Esperance-Ravensthorpe area, W.A.; flowers Sept.–Nov.) **40. H. commutata**

5: Leaves not all to one side of branch; young growth pubescent; pedicels hirsute with white hairs; fruit not beaked; wing encircling seed body (Perth to Geraldton area, inland to Tammin, W.A.; flowers July–Sept.) **39. H. circumalata**

4: Inflorescences all axillary, sometimes on old wood as well

6 Fruit 1.5–2.2 cm long, 1.2–1.5 cm wide, not beaked; horns 5–6 mm long; flowers cream-white; pistil 4–4.5 mm long (Esperance to Cape Arid, W.A.; flowers Mar., May & Aug.) **38. H. bicornata**

6: Fruit more than 2.5 cm long, more than 1.5 cm wide, obliquely beaked; horns 0–5 mm long; flowers red and yellow or pink or white; pistil more than 6.5 mm long

7 Flowers red and yellow; perianth 3–4.2 mm long; fruit 3.5–5 cm long; branchlets ferruginous or glabrous (Tammin to Ravensthorpe area, W.A.; flowers Sept.–Nov.) **36. H. strumosa**

7: Flowers white or pink; perianth 4–6.5 mm long; fruit 2.5–4 cm long; branchlets white-pubescent (Eyre Penin., S.A.; flowers Dec.–Aug.) **35. H. cycloptera**

33. Hakea preissii Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 557 (1845)

T: in limoso-glareosis sylvae prope oppidum York, W.A., 9 Sept. 1839, *L.Preiss 617b*; syn: B, G-DC, L, LD, LE *p.p.*, NY. [excluding specimens erroneously labelled *Preiss 617b* in BR, LE and M (= *Grevillea paniculata* Meisn. based on *Preiss 617a*)]

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 20, 21, 84 (1997).

Erect tree to 8 m or compact shrub 2–3 m high; lignotuber unknown. Branchlets moderately to densely appressed-pubescent on new growth, quickly glabrescent, and glaucous in second year. Leaves simple, or rarely divided apically into 2 or 3 segments, 1–6 cm long, 1.5–2.5 mm wide, rigid, initially densely (very quickly sparsely) appressed-pubescent; mucro porrect, 1–2.3 mm long. Inflorescence axillary with 4–28 flowers; rachis obscure, persistent; pedicels 3.5–7 mm long, appressed-pubescent with white, rarely ferruginous hairs continuing onto perianth; buds curved. Perianth 3.5–4.2 mm long, pale yellow. Pistil 7–10 mm long; gland 0.7 mm high. Fruit obliquely ovate or elliptic, dilated apically, 1.9–2 (–2.7) cm long, (0.7–) 0.9–1.1 cm wide, smooth and grey or black with black pusticules, dehiscing fully down both sides; beak absent; horns 1–1.5 mm long; apiculum c. 1 mm long. Seed ovate, c. 17 mm long; wing broadly and partly down one side only, brown or yellow. Fig. 6J–L.

Found in drier areas of W.A. from Onslow and the Fortescue R. through to Cape Arid Natl Park. Occurs in sandy or clay soil in open shrublands, sometimes on the edges of salt lakes. Flowers Aug.–Oct. (Dec.). Map 42.

W.A.: Pallarup Rocks, SE of Lake King, *A.S.George 2261* (PERTH); salt lake just W of Lake Grace, *K.Paijmans 3748* (CANB); L. Moore, E edge, 15 km SE of Paynes Find, *K.Paijmans 3929* (CANB); 83 km SSE of Carnarvon along North West Coastal Hwy, *I.R.Telford 6637 & D.Verdon* (CANB, PERTH).

The variation in *H. preissii* appears to be of a clinal nature, with northern specimens being much more open, the leaves longer and narrower and much less crowded, and the fruit somewhat larger than those from further south. Southern plants have ferruginous hairs on the young growth, compared with white hairs further north, and the leaves tend to absciss more readily, leaving prominent pale scars which are very obvious against the dark bark. To some extent the variation within this species resembles that found in the two subspecies of *H. recurva*, although in the latter species the variation tends to be more an east-west cline. Typical *H. preissii* belongs with the southern form of this species.

34. Hakea vittata R.Br., *Trans. Linn. Soc. London* 10: 182 (1810)

T: Bay X, [Port Lincoln, S.A.], Mar. 1802, *R.Brown s.n.*; syn: BM, E, K.

Prostrate, straggly or dense shrub, 0.1–2 m tall, ?lignotuberous. Branchlets white-pubescent. Leaves simple, 2–8 cm long, 0.8–1.5 mm wide, glabrescent; mucro 1–2.5 mm long. Inflorescence axillary with 1–8 (–14) flowers; involucre 2–2.5 mm long; rachis 0.5–3 mm long, ferruginous appressed-pubescent with hairs continuing onto pedicel and perianth; pedicels 2.5–4.8 mm long. Perianth 4–6.5 mm long, white. Pistil 9.2–11.5 mm long; pollen presenter oblique, 0.7–0.85 mm long; gland semi-annular, 0.2–0.35 mm long laterally. Fruit ovate to broadly ovate, 1.3–2.4 cm long, 0.9–1.5 cm wide, smooth or rugose, obliquely beaked; horns usually prominent, 0–3.3 mm long; apiculum obscure. Seed obliquely oblong-elliptic, 10–17 mm long; wing encircling seed body, black. Fig. 4N–P.

Occurs in the southern regions of S.A. from Kangaroo Is. and Fleurieu Peninsula to the upper South East. Found in sand, usually in limestone areas in mallee scrub. Flowers Aug.–Nov. Map 43.

S.A.: c. 2 km NE of Cape Jervis, 27 Dec. 1942, *H.M.Cooper s.n.* (AD); c. 45 km SE of Streaky Bay along Flinders Hwy, c. 3.5 km SE of turn-off to Seal Bay, *Hj.Eichler 19504* (AD); c. 0.5 km W of Remarkable Rocks on road to Cape du Couedic, Kangaroo Is., *L.Haegi 2319* (AD); near Keith, *D.Kraehenbuehl 462* (AD).

Hakea vittata is unusual in the genus in two characters: the presence of witches broom galls resembling tight clusters of small leaves on most plants in collections, and the splitting of the fruit past the seed tip only on the side of the red-brown wood zone.

In the Murray region of Vic. and N.S.W. the name *H. vittata* was wrongly applied to variants of *H. tephrosperma* (*q.v.*).

35. Hakea cycloptera R.Br., *Trans. Linn. Soc. London* 10: 182 (1810)

T: Bay X, [Port Lincoln, S.A.], Mar. 1802, *R.Brown s.n.*; syn: BM, E, K, P.

Straggly bush or shrub 0.3–1.3 m tall; resprouting capacity unknown. Branchlets and young leaves white-pubescent. Leaves simple, 1.5–14.5 cm long, 1.1–1.9 mm wide, white-pubescent, glabrescent; mucro 1–2.8 mm long. Inflorescence axillary with 1–14 flowers; rachis 0.5–3 mm long, with white appressed hairs; pedicels 2.5–6 mm long, glabrous; buds curved. Perianth 4–6.5 mm long, white or pink, glabrous, glaucous. Pistil 7–12 mm long; pollen presenter oblique, 0.6–0.9 mm long; gland slightly curved, 0.15–0.3 mm long laterally. Fruit broadly elliptic to circular, 2.5–4 cm long, 2–3.4 cm wide, coarsely verrucose or rugose, with short oblique beak; horns to 5 mm long; apiculum obscure. Seed obliquely oblong-elliptic, 24–38 mm long; wing encircling seed body, brown to brown-black. *Elm-seed Hakea*. Fig. 4M.

Occurs on Eyre Peninsula, S.A., found in sandy soil in mallee scrubs. Flowers Dec.–Aug. Map 44.

S.A.: Thurlga Stn, Gawler Ra., *B.Copley 2748* (AD); 15 km S of Kimba, *M.D.Crisp 772* (AD); coastal sand-dunes, Port Neill, *A.E.Orchard 2991* (AD).

36. Hakea strumosa Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 402 (1856)

T: Swan R., W.A., *J.Drummond 4: 289*; syn: BM, G, K, NY, OXF, P.

[*Hakea leucoptera auct. non* R.Br.; C.D.F.Meisner, *Hooker's J. Bot. Kew Gard. Misc*. 4: 207 (1852); C.D.F.Meisner, in A.L.P.P. de Candolle, *Prodr*. 14: 396 (1856), both references with respect to *Drummond V, Suppl. n. 13*.]

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 23, 100 (1997).

Compact or diffuse shrub, 0.5–1 m tall. Branchlets and young leaves glabrous or appressed-sericeous, with hairs ferruginous. Leaves simple, 2.5–11 cm long, 1.3–1.8 mm wide, sometimes granular papillose; mucro 1–4.8 mm long. Inflorescence axillary with 4 (rarely 6–10) flowers; involucre 2–2.5 mm long; rachis 0.7–2 mm long, hirsute; pedicels 2–3.5 mm long, glabrous; buds curved. Perianth 3–4.2 mm long, yellow and red, glabrous, glaucous. Pistil 6.5–8 mm long; pollen presenter oblique disc. Fruit obliquely obovate, 3.5–5 cm long, 1.9–3.4 cm wide, rugose, obliquely beaked, obscurely apiculate; horns 2 mm long. Seed 20–34 mm long; wing encircling seed body, off-white with black lines. Fig. 7 O.

Occurs in the Tammin to Merredin area of south-western W.A., through to Bremer Bay and Esperance area. Found in sand, often over laterite, in low heath. Flowers Sept.–Nov. Map 45.

W.A.: near Narembeen, 72 km S of Merredin, *W.E.Blackall s.n*. (PERTH); Swamp Rd, N of Bremer Bay, *J.M.Laws s.n*. (PERTH); 26.5 km N of Ravensthorpe, *F.Lullfitz 5514* (PERTH); Charles Gardner Flora Reserve, South Tammin, *P.Roberts 390* (PERTH).

Although the flowers are much smaller, the perianth parts of *H. strumosa* splay open in a similar fashion to those of *H. platysperma*, exposing the nectar source.

Groom & Lamont (1996b) record this species as an epicormic resprouter.

37. Hakea newbeyana R.M.Barker, *J. Adelaide Bot. Gard*. 13: 103 (1990)

T: c. 21 km NW of Holt Rock P.O. on track to Hyden, Coolgardie District, W.A., 5 Oct. 1976, *L.Haegi 1202*; holo: AD; iso: HO, NSW, PERTH.

Hakea oldfieldii Benth., *Fl. Austral*. 5: 530 (1870), *p.p.* (only with respect to Roe syntype, see note under *H. oldfieldii*).

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 18, 74 (1997).

Spreading rounded shrub, 1–3 m tall, non-lignotuberous. Branchlets and young leaves appressed-sericeous, ferruginous. Leaves simple, 2.5–7.5 cm long, 1–2.2 mm wide; mucro 1–3 mm long. Inflorescence axillary with 6–8 flowers; involucre 4–4.5 mm long; rachis 1–4 mm long, hirsute; pedicels 2.5–3.5 mm long, glabrous; buds straight. Perianth 2–3 mm long, yellow, glabrous. Pistil 3.8–4.5 mm long; pollen presenter a ±porrect cone. Fruit

obliquely broadly elliptic or elliptic, 2.5–3.5 cm long, 1.5–2.5 cm wide, smooth, not beaked, black-pusticulate; apiculum 1–3 mm long; horns 1.5–2 mm long. Seed 14–20 mm long; wing broadly down one side of seed body, narrowly down other, black. Fig. 7A–E.

Occurs in sandy loam, in mallee or Salmon Gum woodland, in the Nyabing to Newdegate area of southern W.A., and a single collection from Neridup, east of Esperance. Flowers (June–) Sept.–Oct. Map 46.

W.A.: Parker Ra., *J.S.Beard 5934* (PERTH); c. 16 km S of Kulin, *R.H.Kuchel 2035* (PERTH); 5 km N of Nyabing, *K.Newbey 981* (PERTH); 115 km E of Lake King on road to Daniell, *P.G.Wilson 5736* (PERTH).

A species previously confused with *H. oldfieldii* of the *Lissocarpha* Group. Both species have the straight buds of that group, but they can be distinguished by the pubescent branchlets and rachis of *H. newbeyana* compared with the glabrous branchlets and rachis of *H. oldfieldii*. The fruit of *H. newbeyana* are much larger (2.5–3.5 cm long, 1.5–2.5 cm wide) than the fruit of *H. oldfieldii* (1.6–2.3 cm long, 0.8–1 cm wide).

38. Hakea bicornata R.M.Barker, *J. Adelaide Bot. Gard.* 13: 104 (1990)

T: 10.5 km NW of Clyde Hill, 37 km ENE of Mt Heywood, W.A., 26 May 1990, *W.Archer 2605901*; holo: AD; duplicates to be distributed.

Multi-stemmed, much-branched shrub, 1–1.3 m tall, lignotuberous. Branchlets appressed-pubescent, ferruginous. Leaves simple, 7–13 cm long, 1.2–1.5 mm wide, appressed-sericeous, ferruginous, quickly glabrescent; mucro 1.5–2.5 mm long. Inflorescence axillary with 8 flowers; involucre 1–1.5 mm long; rachis obscure; pedicels 3.5–4.5 mm long, glabrous; buds curved. Perianth c. 2.5 mm long, cream-white, glabrous. Pistil 4.0–4.5 mm long; pollen presenter oblique, ±conical. Fruit obliquely broadly elliptic or obovate, 1.5–2.2 cm long, 1.2–1.5 cm wide, black-pusticulate on pale grey bark, not beaked, obscurely apiculate; horns 5–6 mm long, very narrow. Seed obovate, 11 mm long, 5.5 mm wide; wing broadly down one side of seed-body only, black or dark brown. Fig. 7F–K.

Rarely collected species from Cape Arid Natl Park through to the Esperance area, W.A. Occurs on lateritic clay or clay loam over granite in shrubland. Flowers have been recorded in Mar., May and Aug. Map 47.

W.A.: c. 30 km SSW of Mt Ragged, *A.S.George 2079* (PERTH); NW base of Mt Ney, *A.S.George 15853* (PERTH); c. 3 km NE of Howick Hill, *A.E.Orchard 1102* (AD, PERTH); 10 km E of Scaddan on Scaddan Rd, *P. van der Moezel 493* (PERTH).

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

39. Hakea circumalata Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 114 (1855)

T: interior, north of Swan R. between Moore and Murchison R., W.A., 1850–51, *J.Drummond 6: 192*; syn: B, BM *p.p.*, E, G-DC, K, NY, OXF, P; south-western W.A., *J.Drummond 4: 290*; syn: BM *p.p.*, G, K *p.p.*, TCD.

Illustration: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 34 (1997).

Low spreading or compact shrub, 0.3–1.5 m tall, non-lignotuberous. Branchlets and young leaves tomentose, with ferruginous and glandular hairs. Leaves simple, 1–5 cm long, 0.9–1.7 mm wide; mucro 1–3 mm long. Inflorescence axillary or terminal, with 6–12 flowers; involucre 3–5 mm long; rachis 1.5–2 mm long, villous; pedicels 2.5–7 mm long, hirsute and sparsely glandular, with hairs white; buds curved. Perianth 3–4.5 mm long, white suffused pink, glabrous to hirsute, glandular externally, papillose internally, glaucous. Pistil 8–11.5 mm long; pollen presenter oblique or ±lateral. Fruit obliquely ovate, 1.8–2.5 cm long, 1.2–1.7 cm wide, tuberculate, not beaked, obscurely apiculate; horns 5–6 mm long. Seed obliquely ovate, 14–20 mm long; wing encircling seed body, off-white. Fig. 7P–R.

Occurs on the sand plain heaths from Perth to just north of Geraldton, and as far east as Tammin, W.A. Flowers July–Sept. Map 48.

W.A.: between Moora and Coorow, *W.E.Blackall 3704* (PERTH); 4 km W along Greenhead road off Brand Hwy, *R.J.Cranfield 1473* (PERTH); 25 km W of Three Springs towards Dongara, at turnoff to Mingenew,

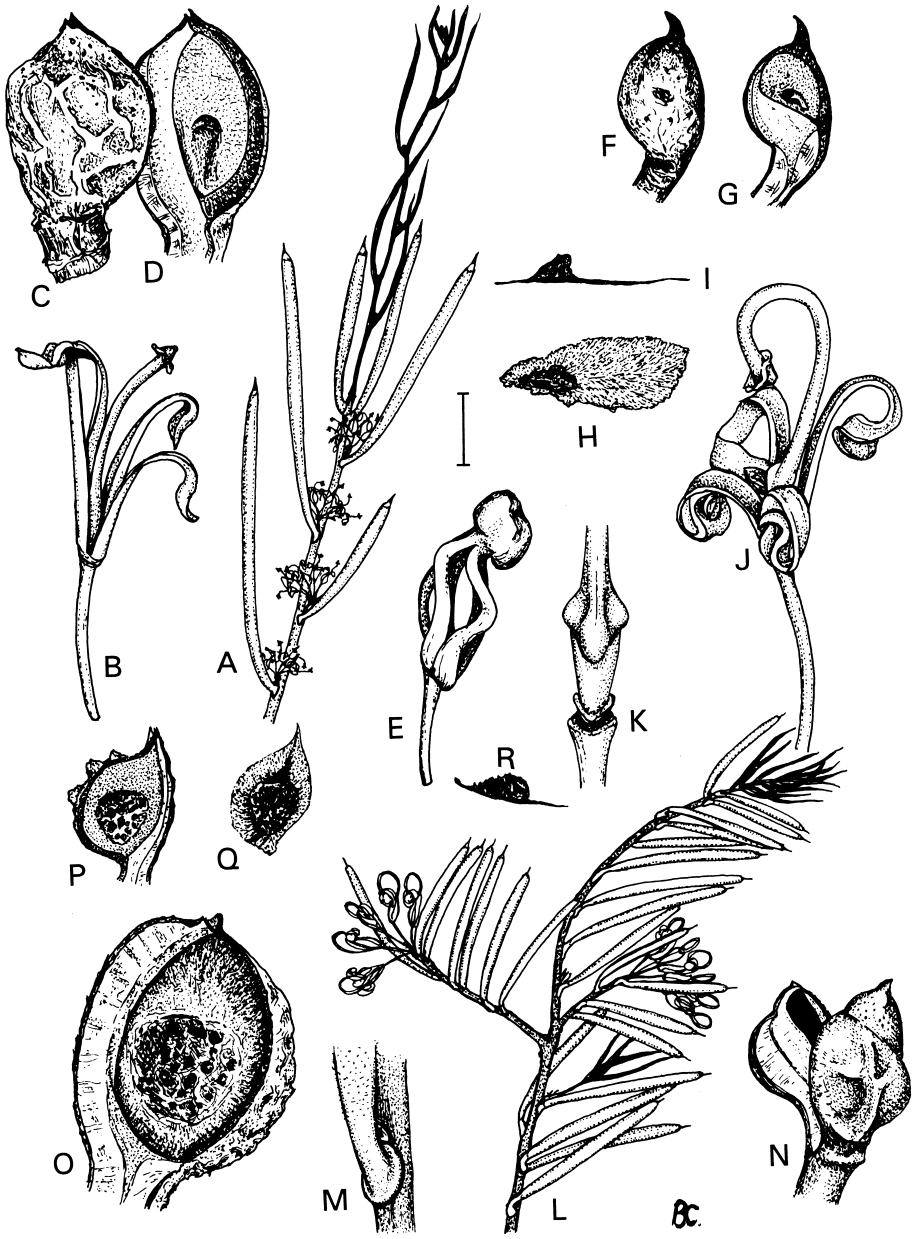

Figure 7. *Hakea*. **A–E**, *H. newbeyana*. **A**, habit; **B**, flower; **C**, outside of fruit; **D**, inside of fruit (**A–D**, L.Haegi 1202, AD); **E**, bud (R.H.Kuchel 2035, AD). **F–K**, *H. bicornata.* **F**, outside of fruit; **G**, inside of fruit (**F–G**, P.van der Moezel 493, PERTH); **H**, seed; **I**, side view of seed (**H–I**, A.E.Orchard 1102, AD); **J**, flower; **K**, ovary and gland (**J–K**, A.George 15853, PERTH). **L–N**, *H. commutata*. **L**, habit (Hj.Eichler 20353, AD); **M**, leaf base at point of attachment; **N**, fruit (**M–N**, N.Donner 3036, AD). **O**, *H. strumosa*, fruit (H.Demarz 4664, PERTH). **P–R**, *H. circumalata*. **P**, fruit; **Q**, seed; **R**, side view of seed (**P–R**, H.Demarz 3369, PERTH). Scale bar: **A**, **C–D**, **F–G**, **L**, **N–R** = 1 cm; **B** = 1.5 mm; **E** = 1.2 mm; **H–I** = 5 mm; **J** = 1 mm; **K** = 0.5 mm; **M** = 2.5 mm. Drawn by Beth Chandler.

E.A.Griffin 1619 (PERTH); 46 km N of Northampton, *K.Newbey 2200* (PERTH); 3.2 km S of Tammin, *K.Newbey 9422* (PERTH).

A distinctive species with its uniquely shaped seed. *Hakea circumalata* is also unique in the group for its glandular hairs on the young leaves and the outside of the perianth. The internal perianth and the style are densely papillose.

40. Hakea commutata F.Muell., *Fragm.* 5: 26 (1865)

Based on *Hakea nodosa* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 555 (1845), *nom. illeg. non* R.Br. T: prope planitiem arenosam Quangen Victoria [near Wongamine], W.A., 20 Mar. 1840, *L.Preiss 606*; syn: G-DC, LD, LE, NY *p.p.*; Swan R., *s.d., J.Drummond 5: 412*; syn: BM *p.p.*, G, K *p.p.*, LE, MEL, NY *p.p.*, TCD; without locality, *s.d., J.Gilbert s.n.*; syn: NY *p.p.*

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 14, 36 (1997).

Straggly or dense rigid shrub, 0.6–3 m tall, lignotuberous. Branchlets glabrous. Leaves 1–3.5 cm long, 1–1.7 mm wide, glabrous or sparsely hirsute, papillose, glaucous; mucro 0.7–1.4 mm long. Inflorescence predominantly terminal, occasionally axillary, with 8–12 flowers; involucre c. 2.5 mm long; rachis 1–3 mm long, white-hirsute; pedicels 2.5–6.2 mm long, red, glabrous; buds curved. Perianth 3.3–5 mm long, cream-white to yellow, ?tinged red at base, glabrous. Pistil 7.5–11.5 mm long; pollen presenter oblique. Fruit obliquely elliptic, 2–3.2 cm long, 1.1–1.7 cm wide, finely rugose, obliquely beaked; apiculum c. 1 mm long; horns obscure. Seed 13.5–19 mm long; wing broadly and partly down one side of seed body only, black or dark brown. Fig. 7L–N.

Occurs in south-western W.A. in the Toodyay and Jitarning areas to Fitzgerald River Natl Park and east to Cape Arid Natl Park, in mallee heaths or mallee on laterite, sand, clay or granite. Flowers Sept.–Nov. (–Dec). Map 49.

W.A.: between Rabbit Fence and Newdegate, *W.E.Blackall 1273* (PERTH); Phillips R., Nov. 1944, *C.A.Gardner s.n.* (PERTH); 11 km N of Mt Madden, *A.S.George 7284* (PERTH); on Balladonia road, S of Mt Ragged, *R.D.Royce 10089* (PERTH); 3.2 km NW of Ongerup, *K.Newbey 3018* (PERTH).

The flowers of *H. commutata* are unpleasantly scented, described as smelling like dirty socks. The leaves are all arranged on one side of a branch, and have a narrowed yellow base.

Megalosperma Group

Hakea sect. *Hakea* ?ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Shrubs, without deeply fissured bark. Leaves simple, flat, not petiolate, not stem-clasping, entire; venation obscure. Inflorescence an axillary umbelliform raceme, sometimes resprouting from old rachises in subsequent years, sometimes developing on old wood, developing within involucre; bracts not persisting at base of inflorescence; rachis 2–7 mm long. Flowers 8 or 10; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 7–8.5 mm long; pollen presenter an oblique disc; gland a curved flap. Fruit solitary, erect, retained on plant, woody, smooth, pusticulate, obscurely beaked, horned, dehiscing fully down one or both sides. Seed occupying much of valve; wing encircling seed body.

Bentham (*loc. cit.*) included *H. megalosperma* under ser. *Pubiflorae* (characterised by a pubescent perianth) even though it has a glabrous perianth.

A monotypic group from W.A.

41. Hakea megalosperma Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 117 (1855)

T: Mt Lesueur, W.A., *J.Drummond 6: 194*; holo: NY; iso: B, BM, CGE, G-DC, K, MEL, OXF, P; ?iso: MEL 1536077 (*J.Drummond s.n.*), MEL 1536181 (*J.Drummond 6: 154* — 154 is probably a misprint for 194 as this number is not clear on the isotype in MEL).

Erect multi-stemmed shrub, 0.45–1.2 m tall, to 2 m diam., lignotuberous. Branchlets and young leaves glabrous. Leaves narrowly obovate to obovate, 3.7–8.2 cm long, 11–27 mm wide, attenuate, entire, rounded, rarely emarginate; mucro 0.1 mm long. Inflorescence axillary, sometimes from old wood; involucre 2–3 mm long; rachis glabrous; pedicels 3.5–4.5 mm long, glabrous. Perianth 3–4 mm long, white or pink, deep red with age, glabrous. Pistil 7–8.5 mm long. Fruit obliquely obovate, 7–8.5 cm long, 3.5–4 cm wide, smooth, black-pusticulate; apiculum 2–7 mm long; horns 8–10 mm long. Seed obliquely elliptic, 40–60 mm long; wing encircling seed body, dark or mid-brown.

An endangered and rare species from the Jurien Bay area of W.A. Occurs on lateritic sand plain with low heath. Flowers May–June. Map 50.

W.A.: Mt Lesueur, *C.A.Gardner* (PERTH); 110 km N of Regans Ford, *A.S.George 9317* (PERTH); 14 km W of Brand Hwy, Gairdner R., *E.A.Griffin 1032* (PERTH); 15 km SE of Eneabba, *E.A.Griffin 2164* (PERTH).

Bentham included *H. megalosperma* under ser. *Pubiflorae* (characterised by a pubescent perianth) even though it has a glabrous perianth. The species is discussed further in B.Rye & S.Hopper, *A Guide to the Gazetted Rare Flora of Western Australia*, pp. 122–123 (1981). It is recognised as 'Vulnerable' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

Verrucosa Group

Hakea sect. *Hakea* ser. *Glabriflorae* Benth., *Fl. Austral.* 5: 492, 509 (1870), *p.p.*

Shrubs, without deeply fissured bark. Leaves simple (sometimes compound in *H. purpurea*), terete, not grooved below; venation obscure. Inflorescence an axillary umbelliform raceme, sometimes arising from older leafless axils, developing within involucre; bracts not persisting at base of inflorescence; rachis 1–30 mm long. Flowers 6–16; pedicels glabrous. Perianth curved in bud, only splitting to base abaxially with tepals remaining fused together, glabrous. Pistil 14–32 mm long; pollen presenter ±lateral disc or rarely ±conical; gland U-shaped. Fruit solitary, erect, retained on plant, woody, smooth and black-pusticulate or deeply wrinkled, beaked or not, often apiculate, obscurely or distinctly horned, dehiscing fully down one side, partly down other. Seed occupying part of valve; wing encircling seed body or broadly down one side and narrowly down other, or down one side only.

A group of five species from W.A., N.T., Qld and N.S.W.

1 Pollen presenter conical; pistil 14–15.5 mm long (flowers pink with white limb, 6 or 8 per axil; inflorescence pendent, on apex of old branched rachises; Parker Ra., WA; flowers Sept.) **42. H. pendens**

1: Pollen presenter ±lateral; pistil more than 20 mm long

2 Perianth more than 10.5 mm long; pistil more than 40 mm long; fruit 4.5–7 cm long, 3.3–4.5 cm wide, densely and deeply wrinkled (some inflorescences from old wood; Newcastle to Sydney, N.S.W.; flowers May.–Sept.) **46. H. bakeriana**

2: Perianth to 10 mm long; pistil less than 40 mm long; fruit less than 5 cm long, black-pusticulate or smooth with toothed crest either side of suture

3 Leaves 6.5–23 cm long, always simple; fruit with toothed crest either side of suture (inflorescences axillary, often from old wood; arid areas from Murchison R. to Petermann Ra., W.A. & N.T.; flowers Apr.–Sept.) **45. H. rhombales**

3: Leaves to 9.5 cm long, simple or compound; fruit lacking any toothed crest

4 Leaves always simple; pistil 21–25 mm long; pedicels 2.5–4 mm long; rachis branched; fruit distinctly horned; seed wing partly down one side of seed body only (Ravensthorpe area, W.A.; flowers May–Aug.) **43. H. verrucosa**

4: Leaves simple or compound; pistil 29–32 mm long; pedicels 8–14 mm long; rachis not branched; fruit obscurely horned; seed wing encircling seed body (south-eastern Qld, north-eastern N.S.W.; flowers Aug.–Oct.) **44. H. purpurea**

42. Hakea pendens R.M.Barker, *J. Adelaide Bot. Gard.* 13: 100 (1990)

T: near Marvel Loch, W.A., 1 Sept. 1978, *P.Luscombe s.n.*; holo: PERTH.

Hakea sp. 5 (Parker Range), J.D.Briggs & J.H.Leigh, *Rare or Threatened Austral. Pl.* 123 (1988).

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 238 (1990).

Shrub, 1.9–2.7 m tall, 2.5–3.1 m wide. Branchlets and young leaves appressed-sericeous, ferruginous, quickly glabrescent. Leaves simple, 2–4 cm long, 1.9–2 mm wide; mucro 1–2.5 mm long. Inflorescence pendent from apex of old branched rachises, with 6 or 8 flowers; rachis hirsute; pedicels 6.5–7.5 mm long, cream-white, pink distally. Perianth c. 7–8 mm long, light pink at base, darker above; limb white inside and out. Pistil 14–15.5 mm long; pollen presenter conical. Fruit obliquely obovate, 2.8–3.1 cm long, 1.4–1.8 cm wide, black-pusticulate; apiculum c. 2 mm long; horns obscure. Seed 17 mm long; wing broadly down one side of seed body, narrowly down other. Fig. 8K–P.

Only known from the Parker Ra. in W.A. where it occurs on ironstone or stony ridges in stony loam of mixed scrub. Flowers Sept. Map 51.

W.A.: Parker Ra., on summit ridge, *J.S.Beard 5934* (KPBG); Mt Caudan, Parker Ra., c. 48 km SE of Southern Cross, *K.Newbey 9218* (PERTH); Reserve SW of Southern Cross, 19 May 1969, *Kennecott Explorations s.n.* (PERTH).

This species, distinguishable by its large glabrous pink flowers in pendent inflorescences, had been known for some time in cultivation before its formal recognition as a species.

Probably closest to *H. verrucosa* from which it varies in its unbranched rachis, longer pedicels, shorter pistil length, conical pollen presenter and broader leaves. Similar in fruit to *H. newbeyana*, from which it varies in flower size and leaf width and orientation, and also to *H. purpurea* from Qld. Occasional compound leaves (usually tripartite) occur on a plant in cultivation in Wittunga Botanic Gardens, S.A., but it is not known whether they occur in natural populations.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

43. Hakea verrucosa F.Muell., *Fragm.* 5: 25 (1865), *p.p.*

T: Western Australia, *s.d., Anon. s.n.*; lecto: MEL 675664, *fide* R.M.Barker, *Fl. Australia* 17B: 393 (1999); ?isolecto: B *p.p.* (herb. Bernhardi, excluding fruit), BR (2 sheets, excluding fruit on one sheet), CANB (ex herb. Lawson), L, MEL 675673, NY (Torrey herb.), NY; possible remaining syn: Ex horto MEL, *s.d.*, ?*F.Mueller s.n.*; syn: BR, L, MEL 1537947, MEL 675665, NY (Torrey herb.); Western Australia (cultivated), *s.d., Anon. [F.Mueller] s.n.*; syn: MEL.

Excluded syntypes (flowering specimens of *H. propinqua* labelled as *H. verrucosa* F.Muell.): Western Australia, *s.d., Anon. s.n.*; syn: BM (herb. Hance 19556), BR (herb. F.Mueller), DBN, E, G-DC, L (ex herb. F.Mueller), P (ex herb. van Heurck).

Excluded syntypes (fruiting specimens of *H. propinqua* labelled as *H. verrucosa* F.Muell.): Western Australia, *s.d., Anon. s.n.*; syn: B *p.p.* (herb. Bernhardi, fruit only), BR *p.p.* (fruit only).

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 238 (1990).

Rounded rarely semi-prostrate shrub, 0.8–2.6 m tall, c. half as wide as high, non-lignotuberous. Branchlets appressed-pubescent, ferruginous. Leaves simple, 2–6.3 cm long, 1–1.5 mm wide, appressed-sericeous, quickly glabrescent; mucro 1–2 mm long. Inflorescence erect or ?pendent in older axes, with 7–14 flowers; rachis branched, 3–16 mm long,

tomentose; pedicels 2.5–4 mm long. Perianth 6–9 mm long, cream-white turning pink, deeper with age. Pistil 21–25 mm long; pollen presenter a ±lateral disc. Fruit obliquely obovate, 2.2–3.1 cm long, 1.2–1.4 cm wide, pusticulate; apiculum 2–3 mm long; horns 2.5–5 mm long. Seed 13–22 mm long; wing broadly and partly down one side of seed body. Fig. 8A–D.

Occurs in the Ravensthorpe area of south-western W.A. Found in clay, clay-loam, sandy loam, gravelly laterite, granite, ironstone or sand in mallee scrub or in Myrtaceous/Proteaceous heath. Flowers May–Aug.; cult. specimens from Qld flowering in Sept. Map 52.

W.A.: 11 km E of Ravensthorpe, *H.Demarz D7942* (PERTH); Mainnerup Rocks, W of Ravensthorpe, *A.S.George 157* (PERTH); Ravensthorpe–Hopetoun road, *W.Rogerson 335* (PERTH); Fitzgerald River Reserve, *R.D.Royce 8962* (PERTH).

Leaves on dried specimens frequently have oval c. 3–5 mm long brownish patches of the fungus *Vizella* (I.Pascoe, pers. comm.) along their length. There is also a tendency for leaves along a branch in this species to all point in one direction.

Typification of *H. verrucosa* is complex as Mueller mixed the fruit of *H. propinqua* with the flowers of what we know as *H. verrucosa*; the epithet '*verrucosa*' really refers to the verrucose fruit of *H. propinqua* (Fig. 5C). See p. 383 for details of the lectotypification.

44. Hakea purpurea Hook., in T.L.Mitchell, *J. Exped. Trop. Australia* 348 (1848)

T: Warrego R. near Mount Faraday, Qld, 10 Oct. 1846, *T.Mitchell 399*; syn: BM, CGE, K, NY, TCD.

Grevillea trisecta F.Muell., *First Gen. Report* 17 (1853), *nom. nud.*; *G. trisecta* F.Muell., *Linnaea* 26: 358 (1853), *nom. nud.*

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 385 (1988); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 226 (1990).

Dense multi-stemmed erect shrub, narrowly spreading, 0.3–2.6 m tall. Branchlets glabrous or appressed-pubescent. Leaves simple- or compound-terete with 2–7 ultimate segments, 1.6–9.5 cm long, 0.8–1.5 mm wide, tomentose, with ferruginous and white hairs, quickly glabrescent; mucro 1–2 mm long. Inflorescence erect, with 4–10 flowers; rachis simple, 1–2.5 mm long, tomentose; pedicels 8–14 mm long. Perianth 5.5–10 mm long, pink, white at base. Pistil 29–32 mm long; pollen presenter a ±lateral disc. Fruit obliquely ovate, 2.8–3.5 cm long, 1.6–2.2 cm wide, black-pusticulate; apiculum 3–5 mm long; horns 2–3 mm long. Seed 15–24 mm long; wing encircling seed body. Fig. 8E, F.

Occurs in southern Qld and N.S.W. Found in forest, woodland or heathland associated with *Eucalyptus, Callitris* or *Casuarina* and sometimes *Triodia*, in sandy soil or, more rarely, laterite. Flowers (June–) Aug.–Oct. and some cultivated material from Canberra in Dec. Map 53.

Qld: 44 km N of Chinchilla in Barakula State Forest on Auburn Rd, *M.E.Ballingall 2284* (AD); 18 km by road SE of Downfall Ck on road to Miles, *L.A.S.Johnson 7198 & B.G.Briggs* (NSW); Portion 17, Parish of Samuel, County of Arrawatta, adjoining Bebo State Forest, *L.G.Rutley NSW182234* (NSW); Miles, *G.Ward NSW182239* (NSW). N.S.W.: Yetman, Nov. 1975, *Pasterfield s.n.* (NSW).

Leaves in this species can be simple- or compound-terete. Usually only one sort of leaf occurs on a bush but there are enough cases where both forms occur not to recognise these differences taxonomically. The type material is the divided leaved form. Material in NY labelled as *H. hodgsonii* (*Hodgson 301, s. loc.*) by Meisner in 1867 is the entire leaved form of *H. purpurea*, but Meisner did not publish this name. As with *H. verrucosa* the leaves of this species show some tendency to all point in one direction along a branch.

A cultivated specimen from Myall Park near Glenmorgan, Qld, (*B.Ballingall 2577*) most closely resembles this species but has sterile pollen and reproduces by root suckering. It may be a hybrid as the flowers are somewhat smaller than usual and sparsely sericeous.

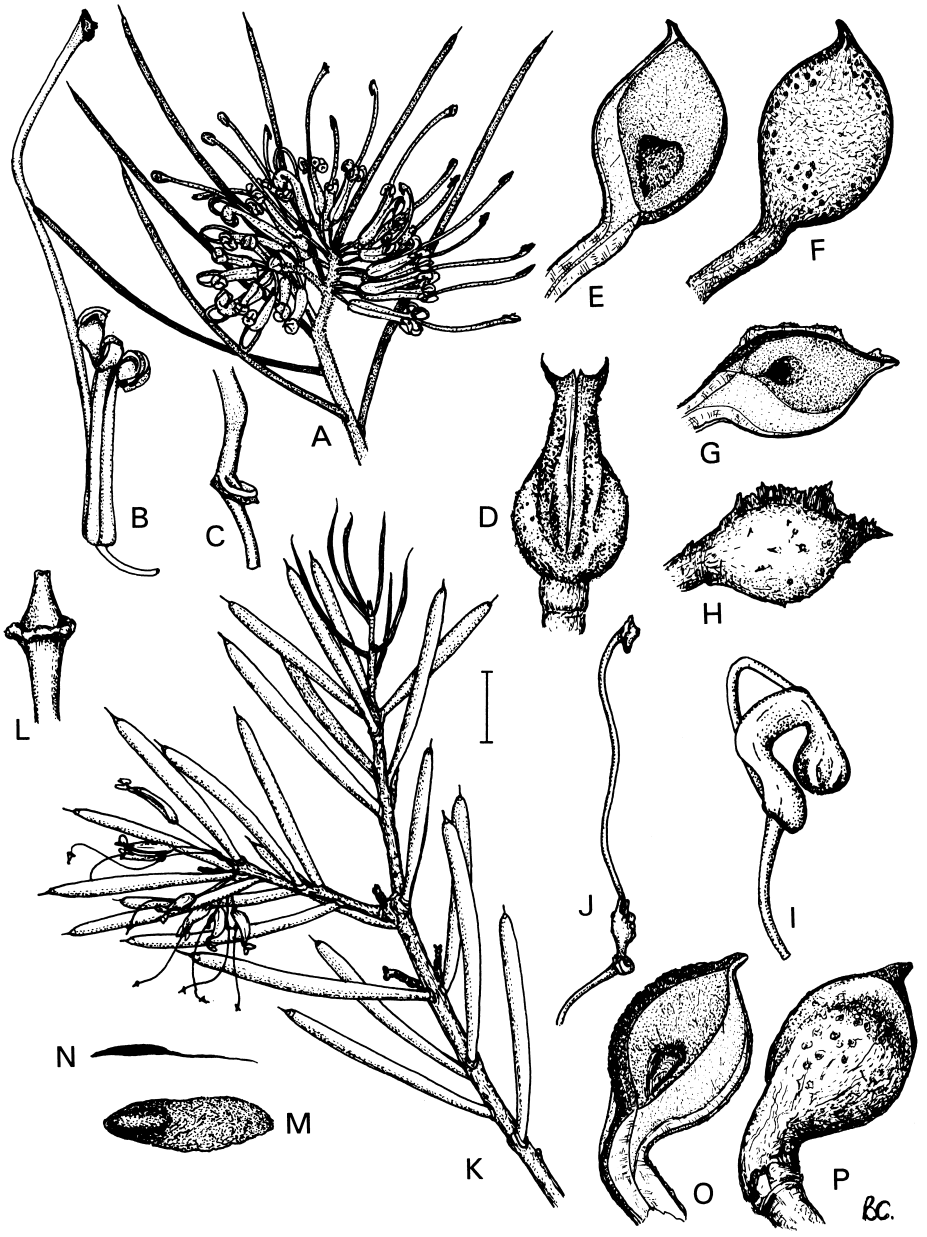

Figure 8. *Hakea*. **A–D**, *H. verrucosa*. **A**, inflorescence; **B**, flower; **C**, gland; **D**, fruit (**A–D**, cult. Adelaide Botanic Garden). **E–F**, *H. purpurea.* **E**, inside of fruit; **F**, outside of fruit (**E–F**, R.Johnson 575, BRI). **G–J**, *H. rhombales.* **G**, inside of fruit; **H**, outside of fruit (**G–H**, A.George 4919, PERTH); **I**, opening bud (J.R.Maconochie 1377, AD); **J**, flower without tepals (B.G.Lay 878, AD). **K–P**, *H. pendens.* **K**, habit; **L**, pollen presenter; **M**, seed; **N**, side view of seed; **O**, inside of fruit; **P**, outside of fruit (**K–P**, 1 Sept. 1978, P.Luscombe, PERTH). Scale bar: **A**, **D–H**, **K**, **O–P** = 1 cm; **B** = 3 mm; **C** = 2 mm; **I** = 2.5 mm; **J**, **M–N** = 5 mm; **L** = 0.9 mm. Drawn by Beth Chandler.

45. Hakea rhombales F.Muell., *Fragm.* 10: 90 (1876)

T: sources of the Ashburton R., W.A., *s.d., E.Giles s.n.*; syn: MEL 1537937 & MEL 1537938. (The protologue describes flowers but there are none on either of these sheets.)

Bushy shrub, 0.7–2.3 m tall, at least as wide as tall; root suckering. Branchlets and young leaves appressed-pubescent, with ferruginous hairs, glabrescent. Leaves simple, 6.5–23 cm long, 1.6–1.9 mm wide; mucro 2–3 mm long. Inflorescence erect, sometimes from old wood, with 10–16 flowers; rachis simple, 7–11 mm long, glabrous or appressed-pubescent; pedicels 5.5–6.5 mm long. Perianth 6–7.5 mm long, deep pink-red. Pistil 20–24.5 mm long; pollen presenter a ±lateral disc. Fruit obliquely obovate, 2.2–3.5 cm long, 1.6–2.3 cm wide, black-pusticulate with a toothed crest either side of suture; apiculum 2–5 mm long; horns 1.5–5 mm long. Seed 15–20 mm long; wing broadly down one side of seed body, narrowly down other. Plate 2; Fig. 8G–J.

Occurs from Wiluna, W.A., to the Petermann Ra., N.T., on scree slopes, stony ridges or sand plains between ridges, frequently associated with quartzite or with gravel in creek lines. Flowers Apr.–Sept. Map 54.

W.A.: 58 km N of Wiluna, *J.S.Beard 6558* (PERTH); 22.5 km W of Mt William Lambert, Gunbarrel Hwy, *A.S.George 5458* (PERTH); SW of Warburton, Gibson Desert, *A.S.George 12011* (PERTH). N.T.: 29 km E of Docker River Settlement, *J.R.Maconochie 677* (DNA); Rowley R., *J.R.Maconochie 1919* (DNA).

The flowers of *H. rhombales* are subtended by minute bracts. They are also unusual in shape, almost forming a U-shape in bud, the apex of the bud being distinctly 4- or 8-angled. They are very unpleasantly scented.

46. Hakea bakeriana F.Muell. & Maiden, *Macleay Mem. Vol. Linn. Soc. New South Wales* 226, t. 30 (1893)

T: without locality, 1892 [sent by Maiden on 15 Sept. 1892], *Anon. per Maiden s.n.*; syn: MEL 671957; Wallsend, N.S.W., Sept. 1892, *Mr Thornton s.n.*; syn: B, NSW 190799; Newcastle District, Lower Hunter River, N.S.W., 1892 [prior to 6 Sept. 1892], *Anon. per Maiden s.n.*; syn: K, MEL 108130, MEL 672148; Wallsend, N.S.W., May 1893, *Anon. [Thornton] s.n.*; syn: AD 98714080, BRI 259159, E, K, MEL 671958, NSW 190800.

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 365 (1989).

Bushy dense low shrub, 1–2 m tall, lignotuberous. Branchlets densely shiny appressed-pubescent. Leaves simple, 3.2–11.5 cm long, 0.8–1.5 mm wide, ±glabrous; mucro 0.7–1 mm long. Inflorescence erect, often arising from old wood, with 4–10 flowers; rachis 4–30 mm long, sparsely to densely pubescent; pedicels 4–11 mm long. Perianth 10.5–12 mm long, pink to crimson. Pistil 40–45 mm long; pollen presenter a lateral disc. Fruit obliquely ovate, sometimes broadly so, 4.5–7 cm long, 3.3–4.5 cm wide, roughly and deeply wrinkled, whitish-pusticulate; beak smooth, tuberculate; apiculum obscure or to 1 mm long; horns to 4 mm long, often obscure. Seed 38–55 mm long; wing encircling seed body asymmetrically. *Frontispiece*; Plate 5; Figs 4T–V, 5D, E.

Restricted to the near coastal area between Newcastle and Hawkesbury R., N.S.W. Occurs in dry sclerophyll forest or windswept heath. Flowers May–Sept. Map 55.

N.S.W.: Doyalson, *A.C.Beauglehole 8140* (AD, NSW); 8 km NW of Wisemans Ferry, *J.Campbell & J.Pickard 1645a* (AD, NSW); Wyee-Morisset, 10 July 1965, *L.H.Williams s.n.* (CANB).

Prostrata Group

Hakea sect. *Hakea* ser. *Glabriflorae* Benth., *Fl. Austral.* 5: 492, 509 (1870), *p.p.*

Shrubs or more rarely small trees, without deeply fissured bark. Leaves simple, flat, usually stem-clasping at base, toothed; venation obscure. Inflorescence an axillary umbelliform raceme, not resprouting from old rachises in subsequent years, rarely arising from older leafless axils, developing within involucre; bracts not persisting at base of inflorescence; rachis 0.5–10.5 mm long. Flowers 1–42; pedicels glabrous. Perianth curved in bud, splitting

to base into 4 distinct tepals, glabrous. Pistil 7–14.5 mm long; pollen presenter an oblique disc; gland usually a flap, rarely U-shaped. Fruit solitary, rarely paired, obliquely erect, retained on plant, not markedly woody, smooth and green with occasional blunt-topped prickles or densely prickly all over, beaked or not, obscurely horned, dehiscing fully down both sides and recurving. Seed occupying almost whole valve; wing encircling seed body or partly down one or both sides.

A group of six species, all occurring in W.A.

1 Leaves amplexicaul, to 18 cm long (flowers white, often pink-tinged; Jarrah forests of south-western W.A.; flowers Aug.–Oct.) **47. H. amplexicaulis**

1: Leaves not amplexicaul but often auriculate, less than 6.5 cm long

2 Leaves dimorphic; upper leaves tricuspidate apically, much narrower and spinier than lower leaves (fruit pubescent, moderately to densely covered with tuberculate prickles, not green; flowers greenish white, cream or pink, sandy heaths N of Perth, W.A.; flowers June–Oct.) **51. H. auriculata**

2: Leaves not dimorphic; upper leaves not tricuspidate apically

3 Leaves often brown in older parts of plant, narrowly obovate to obovate; fruit pubescent, with scattered to dense tuberculate prickles; flowers red, usually within lower axils among older leaves (sand heaths, Perth to Mt Lesueur, W.A.; flowers June–Oct.) **52. H. spathulata**

3: Leaves green in all parts of plant, obovate, elliptic or broadly ovate; fruit glabrous with occasional truncate prickles; flowers various colours, including red, within upper axils

4 Compact rounded shrub; flowers 1, 3 or 5 in axils, mid-yellow or orange with red-black on limb and tepal margins, unpleasantly scented; very young leaves with appressed sericeous hairs (Stirling Ra. to Esperance, W.A.; flowers July–Oct.) **50. H. denticulata**

4: Spreading, erect or sprawling shrubs or small trees; flowers 4–16 in axils, cream-white or pink to red-purple, not unpleasantly scented; very young leaves glabrous or with non-sericeous hairs

5 Erect or sprawling tree or shrub; flowers cream-white, pink or red; perianth 3.5–5.5 mm long (widespread and variable in area bounded by Geraldton, Kalgoorlie and Israelite Bay, south-western W.A.; flowers July–Oct.) **49. H. prostrata**

5: Spreading erect shrub; flowers deep red-purple; perianth 3–4 mm long (Stirling Ra., W.A.; flowers July–Oct.) **48. H. pritzelii**

47. Hakea amplexicaulis R.Br., *Trans. Linn. Soc. London* 10: 184 (1810)

T: Observatory Hill, Princess Royal Harbour, [W.A.], Dec. 1801, *R.Brown 23*; ?holo: BM (*Iter Austral*. 3353 — no other Brown duplicates found).

Hakea triformis Lindl., *Sketch Veg. Swan R.* xxxxi (1840). T: Swan R., W.A., 1839, *J.Drummond s.n.*; syn: BM (2 collections on the 1 sheet), CGE.

Hakea amplexicaulis var. *latifolia* Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 566 (1845). T: Swan R., W.A, *s.d., J.Drummond s.n.*; holo: G-DC (microfiche seen); iso: CGE; ?iso: K.

Hakea amplexicaulis var. *angustifolia* Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 566 (1845). T: from Greenmountain [Greenmount] to Halfwayhouse, W.A., 13 Sept. 1839, *L.Preiss 548*; syn: B, BR, CGE, G-DC (microfiche seen), HBG, L, LD, LE, M, MEL, NY, TCD (anomalous no. *Preiss 844*), W; W.A., *s.d., J.Drummond 1: 610*; syn: BM, CGE, G, K, LE, OXF, P, W; W.A., Plantagenet district [between Lake Matilda, Albany and Two Peoples Bay], Nov. 1840, *L.Preiss 549*; syn: LD.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 67, pl. 95 (1984); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 365 (1988).

Straggling or erect, single or few-stemmed shrub, 1–3 m tall, lignotuberous. Branchlets glabrous. Leaves narrowly ovate or ovate throughout, 3–18 cm long, 20–65 mm wide, amplexicaul, dentate with 12–30 2–6 mm long teeth per side, glabrous, glaucous. Inflorescence on short glabrous axillary peduncle, with c. 36–42 flowers; involucre

11–14 mm long; rachis 5–10.5 mm long, villous; pedicels 6–14 mm long, glabrous. Perianth 4–6 mm long, white, often pink-tinged. Pistil 8–14.5 mm long. Fruit obliquely ovate, 3–3.5 cm long, smooth apart from small protuberances along valve, glabrous. Seed obliquely ovate, 26–30 mm long, 9–11 mm wide; wing partly down one side of seed body only if at all. *Prickly Hakea*. Plate 6; Fig. 9H–J.

Occurs in south-western W.A. from Perth to Albany, in Jarrah forest in sand or ironstone gravel. Usually flowers (July–) Aug.–Oct. (–Dec.). Map 56.

W.A.: Meelup Beach Rd, c. 1 km from turnoff from Dunsborough to Cape Naturaliste road, *L.Haegi 2527 & P.Short* (AD, MEL); Mundaring, *R.Helms s.n.* (PERTH); Gooseberry Hill, Darling Ra., *A.Morrison s.n.* (BRI); Helena Valley, *J.Seabrook* (PERTH).

The glabrous short shoot or peduncle in the leaf axil, on which the inflorescence sits, enables easy separation of this species from *H. auriculata* with which it has often been confused.

48. Hakea pritzelii Diels, *Bot. Jahrb. Syst.* 35: 163 (1904)

T: Cranbrook, W.A., Sept. 1901, *E.Pritzel 691*; syn: B, BM, K, L, M, NSW, PERTH, W; Cranbrook, W.A., 24 Sept. 1901, *L.Diels 4401*; syn: B, ?PERTH; western foot, Stirling Ra., W.A., *s.d., L.Diels 2996*; syn: B; south-western W.A., *s.d., J.Drummond 3: 278*; ?syn: K, MEL, PERTH, W; south-western W.A., *J.Drummond 43*; ?syn: NSW.

Illustration: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 86 (1997).

Spreading erect shrub, 1–2.5 m tall. Branchlets villous or glabrous. Leaves obovate throughout, 1.7–4 cm long, 10–20 mm wide, cordate or auriculate (auricles toothed or entire), entire or denticulate with 1–7 teeth per side, sparsely appressed-pubescent or glabrous, glaucous. Inflorescence in upper axils, with (4–) 10–12 flowers; involucre 2.5–3 mm long; rachis 2–4.5 mm long, glabrous or villous, glaucous; pedicels 3.5–6.5 mm long, glaucous. Perianth 3–4 mm long, deep red-purple. Pistil 8–11 mm long. Fruit obliquely ovate, 2 cm long, smooth with scattered truncate prickles, glabrous. Seed c. 17 mm long; wing partly down one side of seed body only. Fig. 9M, N.

A rare species, found in the Stirling Ra. of W.A. (and perhaps further south) in *Banksia* heath in sand or sandy clay, sometimes over laterite. Flowers July–Oct. Map 57.

W.A.: 45 km E of Cranbrook, *B.Lamont s.n.* (PERTH); Toll Ck, Stirling Ra., *A.Morrison s.n.* (E, PERTH); just S of Stirling Ra., c. 20 km NNE of Mount Barker, *P.Wilson 3327* (AD).

Maintained at species level because of its smaller flower size, although there appears to be no other character to separate it from the red-flowered form of *H. prostrata* with which it overlaps in distribution. *Preiss 538* and *Preiss 542* from the Darling Ra., treated below as *H. prostrata*, may also belong here. Field studies are required to clarify whether there are two distinct taxa.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

49. Hakea prostrata R.Br., *Trans. Linn. Soc. London* 10: 184 (1810)

T: Bald Head, near King George Sound, [W.A.], Dec. 1801, *R.Brown 24*; syn: AD, BM, K *p.p.*

Hakea glabella R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 28 (1830). T: Swan R., [W.A.], 1827, *C.Fraser 15*; syn: A, BM, E, ?K.

Hakea glabella var. *paucidentata* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 564 (1845), *p.p.* (as to *Preiss 539, 541, 544 & 545, Drummond 1*), *nom. illeg.* (includes *H. glabella* in synonymy).

Hakea glabella subsp. *prostrata* (R.Br.) Ewart & Jean White, *Proc. Roy. Soc. Victoria* 22: 320 (1910), *nom. inval.*

[*Hakea glabella* ß *denticulata auct. non* (R.Br.) Meisn.: C.D.F.Meisner, in J.G.C.Lehmann, *Pl. Preiss.* 1: 564 (1845), *p.p.* (as to *Preiss 538 & 542, Drummond 612 & coll. 1*, but excluding *H. denticulata R.Br.*)]

Illustrations: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 226 (1990); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 21, 88 (1997).

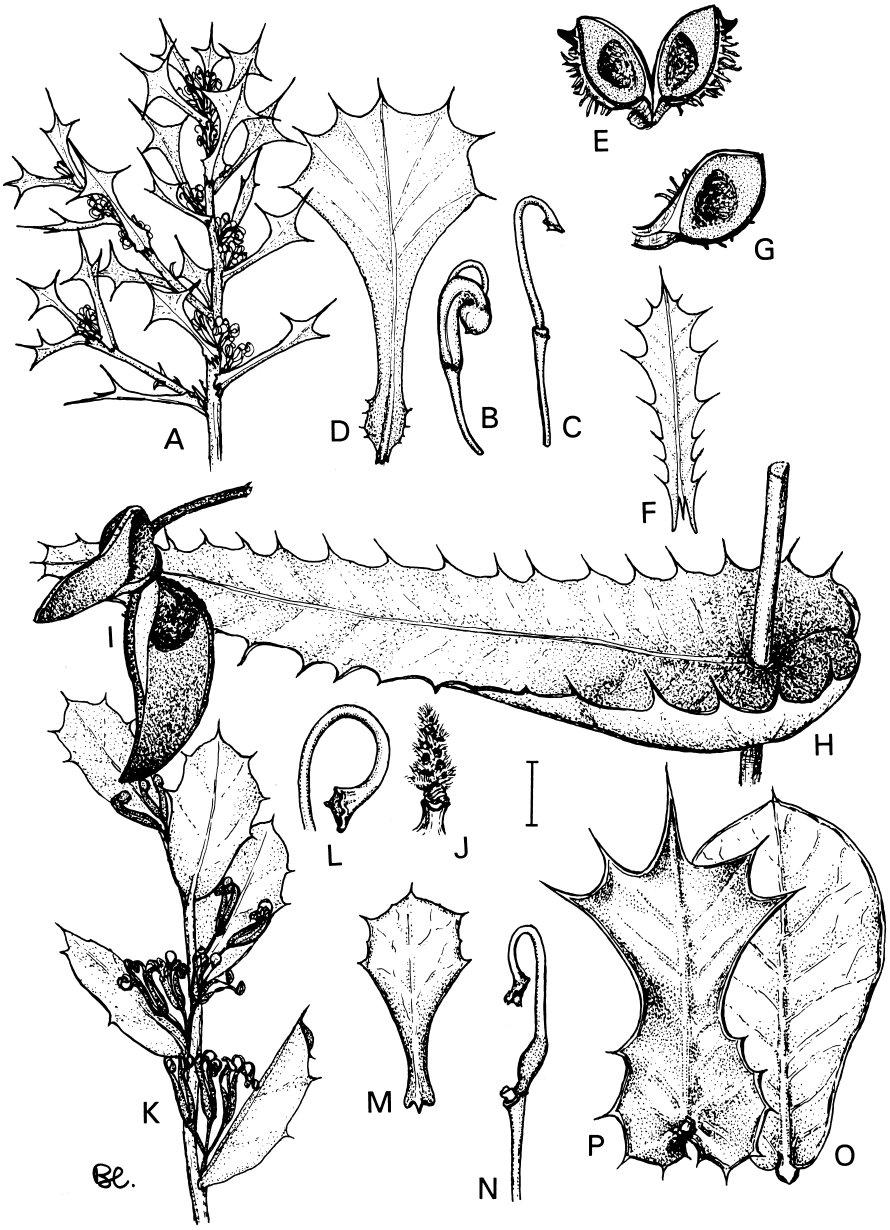

Figure 9. *Hakea*. **A–E**, *H. auriculata*. **A**, habit; **B**, bud; **C**, flower without tepals (**A–C**, Oct. 1961, S.M.Harvey, PERTH); **D**, leaf (C.A.Gardner 2031, PERTH); **E**, open fruit (J.S.Beard 7229, PERTH). **F–G**, *H. spathulata*. **F**, leaf; **G**, fruit (**F–G**, A.George 14600, PERTH). **H–J**, *H. amplexicaulis*. **H**, leaf (W.R.Barker 2272, AD); **I**, open fruit (L.Haegi 2527, AD); **J**, rachis (G.Hos 23/4b, PERTH). **K–L**, *H. denticulata.* **K**, habit; **L**, pollen presenter (**K–L**, N.G.Walsh 1038, PERTH). **M–N**, *H. pritzelii*. **M**, leaf; **N**, flower without tepals (**M–N**, A.Morrison, Tolls Creek, PERTH). **O–P**, *H. prostrata*. **O**, leaf (J.W.Green 471, PERTH); **P**, leaf (24 Oct. 1968, J.W.Wrigley *s.n.*, PERTH). Scale bar: **A**, **D–K**, **M**, **O–P** = 1 cm; **B–C**, **N** = 3 mm; **L** = 1 mm. Drawn by Beth Chandler.

Erect prostrate or sprawling shrub or small tree, 0.3–4 m tall, 1.5–2 m wide, lignotuberous. Branchlets glabrous or villous. Leaves elliptic to broadly obovate throughout, 1.5–5.5 cm long, 10–35 mm wide, cordate or auriculate (auricles toothed or entire), dentate whole length or in upper half only, with 1–13 1–5 mm long teeth per side, woolly-tomentose or glabrous when young; mucro 1.5–3 mm long. Inflorescence in upper axils, with 10–16 flowers; involucre 2–3 mm long; rachis 4.5–9.5 mm long, villous or glabrous; pedicels 6–10.5 mm long. Perianth 3.5–5.5 mm long, cream-white, pink or red. Pistil 8.5–13 mm long. Fruit ovate, 2.3–3.8 cm long, 1–1.6 cm wide, smooth with scattered truncate prickles, glabrous. Seed 18–20 mm long; wing partly down one or both sides of seed body. Fig. 9 O, P.

A common species of south-western W.A. in an area bounded by Geraldton, Kalgoorlie and Israelite Bay. Found on white or grey sand, gravel or sandy clay in low dense heath, *Eucalyptus* woodland, coastal heath or Jarrah woodland. *Hakea prostrata* has become weedy in some areas of south-eastern S.A. following the 1983 Ash Wednesday bushfires. Flowers July–Oct. Map 58.

W.A.: c. 9 km E of turnoff to Walpole on Muir Hwy, E of N end of L. Muir, *W.R.Barker 2351* (AD, NSW, PERTH); 38 km S of the Geraldton Hwy turnoff on the Eneabba road, *R.J.Chinnock 3211* (AD, PERTH); Boyatup Hill, *A.S.George 16160* (PERTH). S.A.: edge of Caroline Woods and Forest Reserve, *R.Bates 40495* (AD).

A polymorphic species, separable into sprawling vs erect and glabrous vs pubescent forms. There is also variation in flower colour from white, cream-white, and pink to red.

50. Hakea denticulata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 28 (1830)

Hakea glabella var. *denticulata* (R.Br.) Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 564 (1845), *p.p.* (excluding Preiss & Drummond specimens). T: south west coast of New Holland, King George Sound, [W.A.], 1828, *W. Baxter s.n.*; ?holo: BM; ?iso: E.

Hakea rubriflora Lamont, *J. Roy. Soc. W. Australia* 55: 97, f. 1 (1973). T: 45 km east of Cranbrook, north Stirling Ra., 21 Oct. 1971, *B.Lamont UWA1034*; holo: PERTH; iso: AD, K, MEL, PERTH.

Illustration: B.Lamont, *J. Roy. Soc. W. Australia* 55: 97, f. 1 (1973), as *H. rubriflora*.

Compact rounded shrub, 1–2 m tall, 1–2 m wide, non-lignotuberous. Branchlets and young leaves appressed-pubescent. Leaves flat, elliptic or obovate throughout, 1.5–4.6 cm long, 10–25 mm wide, cuneate or cordate, dentate for whole length with 2–10 1–2 mm long teeth per side. Inflorescence in upper axils, with 1, 3 or 5 flowers; involucre 1–1.5 mm long; rachis 0.5 mm long; pedicels 2.5–5.5 mm long. Perianth 8.5–11.5 mm long, mid-yellow or orange, red-black on limb and margins of tepals, glaucous. Pistil 10–13 mm long; gland 0.4 mm high. Fruit obliquely ovate, 2.3–2.8 cm long, smooth with scattered truncate prickles along suture, glabrous. Seed 1.8–2.2 mm long; wing partly down one side of seed body only. Fig. 9K, L.

Occurs on southern coastal strip of W.A. from Albany to east of Esperance and inland to Stirling Ra.; grows in sand, sandy gravel, gravel, lateritic sand, sandy clay or red clay loam in heath or mallee scrub. Flowers July–Oct. Map 59.

W.A.: Bremer Bay Rd, 20 km W of Bremer Bay, *R.Filson 9117* (MEL, PERTH); lower W slope of Middle Mt Barren, *A.S.George 10079* (PERTH); 8 km S Chillinup Pool, Pallinup R., *B.Lamont & K.Newbey 3A* (PERTH); Boat Harbour, *K.Newbey 822* (PERTH).

According to notes on specimens and Lamont, *loc. cit.*, the flowers of *H. denticulata* are unpleasantly scented. Young seedling leaves have an appressed indumentum and a large number of marginal teeth, 10–20 per cm, with alternating 1 mm and 0.5 mm long teeth. They are similar in appearance to the seedling leaves of *H. cristata*.

51. Hakea auriculata Meisn. & Kippist, *Hooker's J. Bot. Kew Gard. Misc.* 7: 116 (1855)

T: Interior, north of Swan R., W.A., *s.d., J.Drummond 6: 197*; holo: NY; iso: BM, CGE, G-DC (microfiche seen), K, MEL, OXF, PERTH (wrongly labelled as *Drummond 6: 196*).

Erect compact shrub, 0.4–1.5 m tall, ?lignotuberous. Branchlets glabrous or with upright hairs, glaucous. Leaves spathulate with tricuspidate apex, 2–5.5 cm long, 8–36 mm wide,

usually auriculate, dentate for whole length or on auriculate base with teeth 1–10 mm long, glabrous, glaucous, narrower and spinier apically. Inflorescence in upper axils, with 8–16 flowers; involucre 2 mm long; rachis 2–3 mm long, glabrous; pedicels 3–7 mm long, pink, not glaucous. Perianth 2.5–4.5 mm long, greenish white, cream-white or pink, glaucous. Pistil 7–10 mm long. Fruit obliquely ovate, 1.5–2.5 cm long, pubescent, with scattered to moderately dense prickles. Seed 1.7–1.9 mm long; wing broad on one side, narrow on other or encircling seed body. Plate 7; Fig. 9A–E.

Occurs in sandy heaths (sometimes with laterite present) between Perth and Kalbarri, W.A., possibly as far north as Hamelin. Flowers June–Oct. (–Nov.). Map 60.

W.A.: Mt Adams (W of Yandanooka), *J.S.Beard 7229 (*PERTH); 11 km E of Kalbarri on road to Ajana, *M.J.Corrick 8253* (MEL); 7.6 km NW along Burma Rd from junction with Strawberry North-East Rd, *A.S.George 16836* (PERTH); Western Titanium Leases, 8 km S of Eneabba, 13 Sept. 1977, *R.Hnatiuk s.n.* (PERTH); 7 km NW of Badgingarra, *P.Wilson 3811* (PERTH).

52. Hakea spathulata (Benth.) R.M.Barker, *J. Adelaide Bot. Gard.* 13: 107 (1990)

Hakea auriculata var. *spathulata* Benth., *Fl. Austral.* 5: 510 (1870). T: Swan R., W.A., 1839, *J.Drummond 1: 615*; syn: B, BM, G, G-DC (microfiche seen), K, MEL, NY *p.p.*, TCD.

Hakea sp. nov. aff. auriculata, in J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 411 (1988).

[*Hakea attenuata auct. non* R.Br.: C.D.F.Meisner, in J.G.C.Lehmann, *Pl. Preiss.* 1: 563 (1845); C.D.F.Meisner, in A.L.P.P. de Candolle, *Prodr.* 14: 406 (1856), both references at least as to *Drummond coll. 1: 615* and *Preiss 590.*]

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 403 (1988), as *H. sp. nov. aff. auriculata*.

Several-stemmed dense shrub, 0.3–1 m tall, lignotuberous. Branchlets glabrous or with erect hairs. Leaves narrowly obovate to obovate, 2–6.5 cm long, 8–16 mm wide, attenuate, rarely auriculate, dentate, with teeth 0.7–7 mm long, glabrous, glaucous or not (lower leaves often brown); mucro 1.5–2 mm long. Inflorescence usually in lower axils, occasionally within upper axils, with 6–14 flowers; involucre c. 2 mm long; rachis 2–3 mm long; pedicels 3–5.5 mm long, glaucous. Perianth 1.5–4.5 mm long, crimson or purplish with ?yellow limb, glaucous. Pistil 3.5–7.5 mm long. Fruit obliquely ovate, 1.8–3 cm long, 1.3–2 cm wide, smooth with scattered or dense truncate prickles, pubescent. Seed 1.4–2.3 mm long; wing broadly down one side and narrowly down other, or encircling seed body. Fig. 9F, G.

Occurs in sand heaths between Perth and Mt Lesueur in south-western W.A. Flowers June–Oct. Map 61.

W.A.: Moora-Badgingarra, *J.S.Beard 1859* (PERTH); source of Hill R., 23 Aug. 1948, *C.A.Gardner s.n.* (PERTH); 6 km W of Mt Lesueur, 17 June 1977, *A.S.George 14600* (PERTH); Watheroo Natl Park, SW corner, *R.D.Royce 9618* (PERTH); near Moore R., 2.5 km from intersection with Brand Hwy on road to Mogumber, *A.Strid 20624* (PERTH).

Cristata Group

Hakea sect. *Hakea* ser. *Glabriflorae* Benth., *Fl. Austral.* 5: 492, 509 (1870), *p.p.*

Shrubs, without deeply fissured bark. Leaves simple, flat, subpetiolate, not stem-clasping, toothed; venation obscure. Inflorescence an axillary umbelliform raceme, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 8.5–15 mm long. Flowers 24–42; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 6.5–7.5 mm long; pollen presenter an oblique disc; gland a flap. Fruit solitary, erect, retained on plant, woody, smooth apart from toothed crests along sutures, not beaked, horned, dehiscing partly down both sides, not recurving. Seed occupying part of valve; wing encircling seed body or broadly down one side, narrowly down other.

A monotypic group from W.A.

53. Hakea cristata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 28 (1830)

T: summit of peak, Darlings Ra., W.A., [1827], *C.Fraser 21*; syn: BM *p.p.*, K *p.p.* (unnumbered); without locality, *s.d., C.Fraser 34*; syn: BM *p.p.*

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 63, pl. 88 (1984).

Straggly shrub to 2 m tall, lignotuberous. Branchlets glabrous, glaucous. Leaves subpetiolate, obovate, 4.5–8 cm long, 2–5 cm wide, attenuate, dentate with teeth mucronate, glabrous, red and glaucous when young. Inflorescence with 24–42 flowers; involucre c. 5 mm long; rachis 8.5–15 mm long, hirsute, with hairs white or pale brown; pedicels 4–9 mm long. Perianth 2–3 mm long, cream-white, faintly scented, not glaucous. Fruit obliquely ovate, 3.5–4.8 cm long, 2.3–3 cm wide, smooth, green, with toothed crest along sutures and abaxially; horns 5–8 mm long. Seed elliptic, 30–34 mm long; wing encircling seed body or broadly down one side, narrowly down other.

Occurs in the Perth and Darling Ra. area of W.A., in loam or clay soil in lateritic or granitic areas with open Wandoo woodland. Flowers May–Aug. Map 62.

W.A.: near top of Red Hill, Toodyay Rd, *A.S.George 875* (PERTH); Darlington, Darling Ra., 4 June 1904, *A.Morrison s.n.* (E); Helena Valley, *J.Seabrook 15* (PERTH); Wooroloo Brook Area, *F.G.Smith 1756* (PERTH).

The fruit of *H. cristata* is very distinctive with its toothed crest along either side of and above the suture, with two other ridges abaxially; the horns are decurrent with the crest. Mature fruit often remain green in colour and are frequently glaucous. Because of the crests, which resemble the margins of the leaves, they are well-camouflaged among the foliage. Seedling leaves of *H. cristata* are flat and denticulate, resembling those of *H. denticulata*.

Microcarpa Group

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Hakea sect. *Hakea* ser. *Glabriflorae* Benth., *Fl. Austral.* 5: 492, 509 (1870), *p.p.*

Shrubs, more rarely trees, without deeply fissured bark. Leaves simple, terete (rarely some flattened in *H. microcarpa*), not stem clasping, grooved or not grooved below; venation obscure. Inflorescence an axillary umbelliform raceme, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis obscure or to 5 mm long. Flowers 6–40; pedicels glabrous or pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous or pubescent. Pistil 6–11 mm long; pollen presenter an oblique disc; gland U-shaped. Fruit solitary or otherwise, obliquely erect, retained on plant when woody, but usually not markedly woody and lost early, smooth, beaked, sometimes horned, dehiscing fully down both sides and recurving. Seed occupying whole valve; wing apical only or down one side of seed body only.

A group of four species, in all States except S.A.

1 Pedicel and perianth glabrous

2 Leaves 1.5–3.2 mm wide, recurved or straight, always terete; fruit blackened at position of horns but horns obscure; involucre 4.5–9 mm long (Murchison R. to Gt Victoria Desert, W.A.; flowers July–Oct.) **54. H. recurva**

2: Leaves 0.9–1.6 mm wide, not recurved, terete, but sometimes mixed with flattened leaves to 3.5 mm wide; fruit usually clearly horned, particularly when young; involucre 2.5–3 mm long (E coast, Qld to Tas.; flowers Sept.–Feb.) **55. H. microcarpa**

1: Pedicel and perianth pubescent

3 Perianth 2.7–4.5 mm long; leaves 1.5–4.5 cm long, straight (laterite pavements of dissected tablelands in Quilpie area, Qld; flowers May–July) **56. H. collina**

3: Perianth 5.5–7 mm long; leaves 2–9.5 cm long, usually curved (cliff faces of Macdonnell Ra., N.T.; flowers Sept.–Oct.) **57. H. standleyensis**

54. Hakea recurva Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 394 (1856)

T: in collibus Swan R., W.A., *s.d., J.Drummond 4: 288*; syn: BM, K, LE, NY *p.p.*, OXF, P, TCD.

Erect shrub, 1–6 m tall, non-lignotuberous. Branchlets sparsely appressed-sericeous or tomentose, quickly glabrescent, glaucous. Leaves terete, straight or recurved, rigid, not grooved, sparsely appressed-sericeous, quickly glabrescent. Inflorescence with 20–40 flowers; rachis 1.5–3.5 mm long, villous, with white, cream-yellow or pale brown hairs; pedicels 4.5–13 mm long, glabrous, glaucous. Perianth 2.7–4.8 mm long, cream, white, or yellow, ?pink in bud, glabrous, glaucous or not. Pistil 6.5–11 mm long. Fruit obliquely ovate, 1.7–2.3 cm long, smooth, not apiculate; beak short and broad; horns obscure but apex always blackened. Seed c. 15 mm long; wing extending fully down one side of seed body.

Occurs in W.A. in area bounded by Murchison R., Laverton and Israelite Bay. Found in granitic loam, gravel, laterite, sand, sandy clay loam or sandy loam in open scrub or mulga.

A polymorphic species, apparently with two distinctive taxa, based on leaf length, width and orientation, involucral bud characters and gland size. There are specimens in which these characters break down (e.g. the PERTH collections of *Blackall s.n.* from Bardoc have the leaf length and width of subsp. *arida* but the gland size and involucral bud characteristics of subsp. *recurva*), and so the two taxa have been reduced to subspecies. Some specimens with narrower leaves than the normal 2–3.2 mm wide for subsp. *recurva* also have a gland size intermediate between the two taxa (0.5–0.7 mm high) and further work is required on the complex before an understanding of the variation can be achieved.

Distinction of *H. recurva* from many of the simple needle-leaved species may well prove difficult, particularly when dealing with subsp. *arida*, unless flowers are present. Fruit are very quickly lost in this species and are rarely to be found on herbarium collections.

Leaves 5–12 cm long, 2–3.2 mm wide; involucre 4–7.5 mm long, pubescent, the bracts pale with darker acuminate rim; pedicels 8–13 mm long; gland 0.8–1 mm high **54a.** subsp. **recurva**

Leaves usually to 4 cm long, 1.2–1.6 mm wide; involucre 2–3.5 mm long, glabrous, the bracts reddish with pale brown rounded rim; pedicels 4.5–8 mm long; gland 0.2 mm high **54b.** subsp. **arida**

54a. Hakea recurva Meisn. subsp. **recurva**

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 21, 92 (1997), as *H. recurva*.

Shrubs to 6 m high. Leaves straight and erect or recurved, 5–12 cm long, 2–3.2 mm wide; mucro 3.7–5.5 mm. Involucre 4–7.5 mm long; bracts pale with darker acuminate or rounded rim, usually pubescent, sometimes glabrous. Pedicels 8–13 mm long. Perianth 4–4.5 mm long. Pistil 6.5–11 mm long; gland 0.8–1 mm high. Fruit 1–1.3 cm wide. Fig. 6M–O.

Widespread in W.A. from Murchison R. south-east to near Hyden and east to the Great Victoria Desert. Map 63.

Flowers July–Oct.

W.A.: near Booran Siding, *A.M.Ashby 995* (AD); c. 40 km N of Bullfinch on Mt Jackson Rd, *L.Haegi 2559 & P.Short* (AD, MEL, PERTH); 69 km SE of Mileura HS, *N.Speck 704* (AD, CANB).

Specimens with particularly thick down-curved leaves have a tendency to be found closer to the coast and those with thinner straight erect leaves are usually to be found in more inland areas.

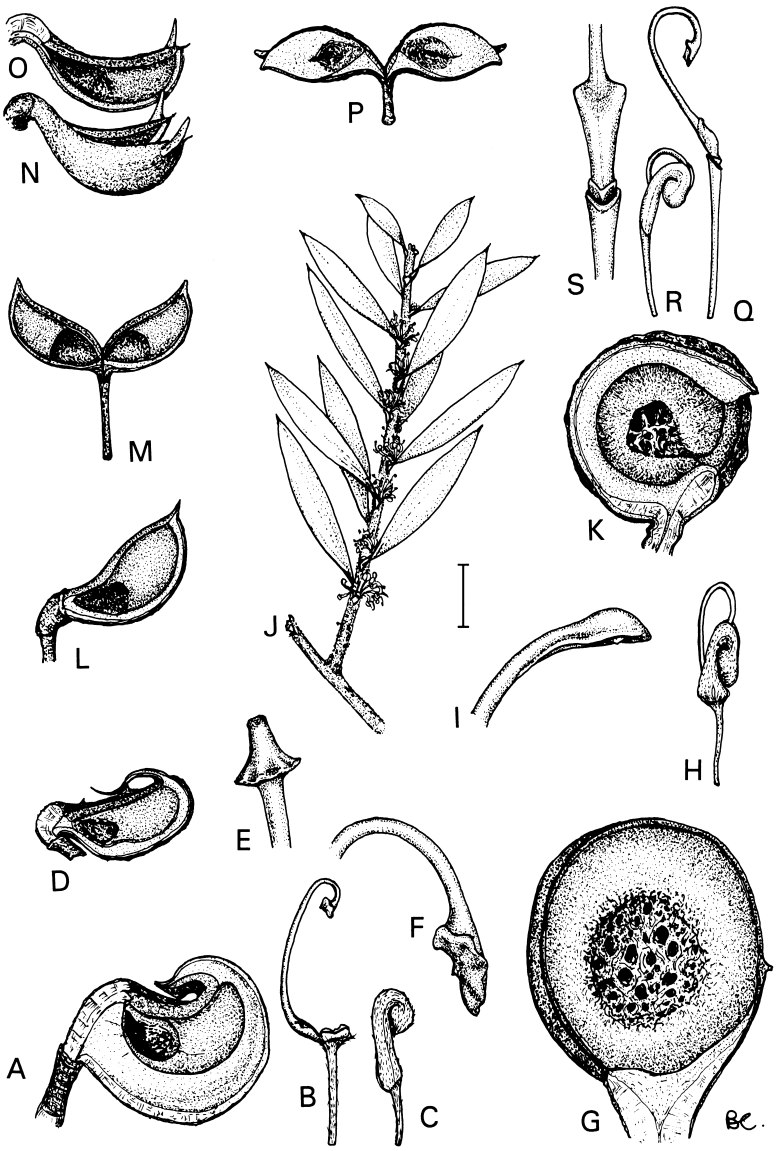

Figure 10. *Hakea*. **A–C**, *H. cyclocarpa*. **A**, inside of fruit; **B**, flower without tepals; **C**, bud (**A–C**, R.A.Saffrey 120, PERTH). **D–E**, *H. rugosa*. **D**, inside of fruit; **E**, pollen presenter (**D–E**, Hj.Eichler 14224, AD). **F**, *H. epiglottis*, pollen presenter (Dec. 1912, L.Rodway, HO). **G–I**, *H. platysperma*. **G**, inside of fruit (R.Hnatiuk 760772, PERTH); **H**, bud (H.Demarz 9281, PERTH); **I**, pollen presenter (W.E.Blackall 3701, PERTH). **J–K**, *H. incrassata*. **J**, habit; **K**, inside of fruit (**J–K**, T.R.N.Lothian 7, AD). **L**, *H. collina*, fruit (L.S.Smith 6093, BRI). **M**, *H. standleyensis*, open fruit (P.K.Latz 6621, DNA). **N–O**, *H. linearis*. **N**, open fruit; **O**, inside of fruit (**N–O**, R.D.Royce 69, PERTH). **P**, *H. clavata*, open fruit (K.Newbey 6696, PERTH). **Q–S**, *H. microcarpa*. **Q**, flower without tepals; **R**, bud; **S**, torus (**Q–S**, O.Rodway 74, CANB). Scale bar: **A**, **G**, **P** = 1 cm; **B–C**, **H**, **J–K** = 5 mm; **D**, **L–O** = 7 mm; **E** = 0.7 mm; **F**, **S** = 1 mm; **I** = 1.5 mm; **Q** = 2.5 mm; **R** = 1.6 mm. Drawn by Beth Chandler.

54b. Hakea recurva subsp. **arida** (Diels) W.R.Barker & R.M.Barker, *Fl. Australia* 17B: 394 (1999)

Hakea arida Diels, *Bot. Jahrb. Syst.* 35: 162 (1904). T: Yalgarn and Murchison goldfields, July 1901, *E.Pritzel 437*; syn: B, BM, BR, E, G, G-DC, L, MEL, MO, NSW, PERTH *p.p.*; Murchison goldfields west of Cue, July 1901, *L.Diels 3284*; syn: B; in distr. Irwin pr. Mingenew, Sept., *L.Diels 6022*; syn: not located.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 13, 28 (1997), as *H. arida*.

Erect shrubs 1.7–5 m high. Leaves straight, erect, 2.5–4 (–5.5) cm long, 1.2–1.6 mm wide; mucro 2.8–4.5 mm long. Involucre 2–3.5 mm long; bracts reddish with pale brown rounded rim, usually glabrous, rarely pubescent. Pedicels 4.5–8 mm long. Perianth 2.7–3 mm long. Pistil 7–8.5 mm long; gland 0.2 mm high. Fruit 0.7–1 cm wide. Fig. 6P, Q.

Occurs in inland areas of W.A. from Mt Augustus south to Wubin. Recorded from sandstone slopes, from floodout areas and from red clay with quartzite and laterite. Flowers June–Sept. Map 64.

W.A.: 35 km S of Moorarie HS, on road to Mileura, *T.E.H.Aplin 2506* (PERTH); between Mt Magnet and Cue, *C.A.Gardner & W.Blackall 74* (PERTH); 86 km N of Mullewa, *J.W.Green 1573* (PERTH).

Confused in the past with *H. commutata* which can be distinguished by its leaves all pointing in the one direction, both terminal and axillary inflorescences and woody, non-recurving fruit which persist on the bush. It is also easily confused with *H. preissii* (distinguished by its pubescent flowers, horned, non-recurving fruit which persist on the bushes and by the occasional apically divided leaves), *H. leucoptera* and *H. kippistiana*; the latter two species can be distinguished by their persistent woody fruit and by the longer rachis in *H. leucoptera* and the ferruginous rachis in *H. kippistiana.*

55. Hakea microcarpa R.Br., *Trans. Linn. Soc. London* 10: 182 (1810)

T: Van Diemen's Land: Port Dalrymple, [Tas.], 10 Jan. 1804, *R.Brown 15*; syn: B, BM, E, G, K, MEL.

Hakea patula R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 27 (1830); *Hakea microcarpa* var. *patula* (R.Br.) Domin, *Biblioth. Bot.* 89: 593 (1921). T: ora orient., mont. Port Jackson, [Blue Mountains? N.S.W.], *s.d., C.Fraser s.n.*; ?holo: BM.

Hakea microcarpa var. *bathurstiana* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 400 (1856). T: Lower Monero, N.S.W., *s.d., J.Lhotsky 315*; syn: NY *p.p.*; Cox's R., Bathurst, N.S.W., 1822, *A.Cunningham 51*; syn: BM *p.p.*, NY *p.p.*; Bathurst, N.S.W., *s.d., Col. W.Paterson s.n.*; syn: NY; New South Wales, western interior, 1817, *A.Cunningham s.n.* (Oxley's 1st Exped.); syn: BM, NY; Australian Alps, *s.d., F.Mueller s.n.*; syn: L.

Hakea bifrons Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 400 (1856). T: in collibus ... promontorii Wilsoni, [Vic.], May 1853, *F.Mueller s.n.*; ?holo: MEL 674175.

Hakea glabriflora Gand., *Bull. Soc. Bot. France* 66: 229 (1919). T: Oxley Plains, ?N.S.W., Dec. 1885, *G.Betche s.n.*; lecto: LY *p.p., fide* D.J.McGillivray, *Contr. New South Wales Natl. Herb.* 4: 342 (1973).

Hakea microcarpa var. *tasmannica* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 400 (1856). T: ad fretum d'Entrecasteaux, *s.d., coll. unknown*; syn: G-DC; van Diemen's Land, [Tas.], *s.d., R.Gunn 20*; syn: NY (Torrey herb.); Tasmania, *s.d., R.Gunn 210*; ?syn: OXF; Glen Leith, 2 Feb. 1840, *R.C.Gunn 20/1842*; ?isosyn: HO.

Shrub 0.6–2 m tall, often wider than high. Branchlets and young leaves appressed-pubescent, glabrescent by flowering. Leaves terete and/or flat; flat leaves rigid, narrowly elliptic, 3–11 cm long, 1.5–3.5 mm wide, cuneate, entire, rounded or sometimes terete at apex, with mucro 1–3.5 mm long; terete leaves 1–14 cm long, 0.9–1.6 mm wide, not grooved. Inflorescence with 6–12 flowers; involucre 2.5–3 mm long; rachis 1.5–2 mm long, with tomentose and appressed ferruginous hairs; pedicels 2.5–7 mm long, glabrous. Perianth 2.5–3.5 mm long, white, glabrous. Pistil 6–9 mm long. Fruit obliquely elliptic, 1.1–1.9 cm long, 5–9 mm wide, smooth or rugose; apiculum obscure; horns 2–3 mm long. Seed 7–12 mm long; wing partly down one side of seed body only. Plate 8; Fig. 10Q–S.

Common along the east coast of Australia from Stanthorpe in Qld to Tas. Occurs in subalpine bogs or woodland. Flowers Sept.–Feb. Map 65.

Qld: near Eukey, 20 km SW of Stanthorpe, *L.Pedley 1543* (BRI). N.S.W.: lower W slopes of Tinderry Mtns, *T.G.Hartley* 13489 (BRI, CANB). Vic.: 7 km NE of Slippery Pinch signpost, Omeo–Mt Hotham road, *E.H.Norris 365* (NSW). Tas.: 5 km from Great L. on Bronte road, *N.T.Burbidge 3428* (CANB, HO).

There are two races, one including the type (thin-walled fruit and terete leaves) and the other including var. *bathurstiana* or *H. patula* (thicker-walled fruit and terete leaves) which are possibly worth recognising. It is also true that specimens from New England and Qld are predominantly flat-leaved and thicker-fruited. However, while the extremes are easily recognisable, the vast majority of specimens are not readily classifiable. Field studies are desirable before any attempt is made to delineate taxa within the species. Mr Alf Salkin (pers. comm.) suggests that the flat leaves of the New England populations only exist in young plants (a fact supported by notes on collections), and that adult leaves of plants from this area are terete and longer and wider spaced than those of southern populations. He also maintains New England populations are much more spectacular in their flowering.

56. Hakea collina C.T.White, *Proc. Roy. Soc. Queensland* 55: 79 (1944)

T: Dynevor Downs, E of Thargomindah, on sandstone tableland, Warrigo District, Qld, 22 May 1939, *S.T.Blake 14088*; holo: BRI; iso: K.

Intricately branched often gnarled shrub, 1–2.6 m tall. Branchlets and young leaves appressed-pubescent, with hairs persistent until flowering. Leaves crowded at branchlet ends, terete, 1.5–4.5 cm long, 1.2–1.7 mm wide, straight, grooved on lower side or not. Inflorescence with 2–12 flowers; involucre 4.5–5 mm long; rachis obscure; pedicels 2.5–5 mm long, tomentose to appressed-pubescent, with hairs white, extending onto perianth. Perianth 2.7–4.5 mm long, white. Pistil 8.5–9 mm long. Fruit obliquely obovate, 1.4–1.8 cm long, 6.5–8.5 mm wide, finely rugose, glaucous; apiculum 2–4 mm long; horns lacking. Seed 11–13.5 mm long; wing broadly and partly down one side of seed body only. Fig. 10L.

Occurs in south-western Qld, on lateritic pavement in open *Acacia* shrubland. Flowers May–July. Map 66.

Qld: 45 km E of Adavale, *L.Pedley 2497* (BRI); 77.5 km NW of Quilpie, *D.E.Boyland 3115* (BRI); 1–2 km N of Mayne R., Tonkoro–Winton road, *R.W.Purdie 1587* (BRI); 40 km N of Jundah, *G.Trapnell E67* (BRI).

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

57. Hakea standleyensis Maconochie, *Trans. & Proc. Roy. Soc. S. Australia* 97: 127, fig. 1 (1973)

T: Standley Chasm, 53 km W of Alice Springs, N.T., 19 Sept. 1967, *D.J.Nelson 1556*; holo: DNA; iso: AD, BRI, K, NSW.

Twisted multi-stemmed spindly shrub, 0.9–2 m tall, to 1 m wide. Branchlets and young leaves appressed-sericeous, quickly glabrescent. Leaves crowded at branchlet ends, terete, 2–9.5 cm long, 1.2–1.7 mm wide, usually curved, not grooved. Inflorescence with 6–12 flowers; involucre 4–5 mm long; rachis 0.5–1.5 mm long; pedicels 5.5–8 mm long, white-tomentose, with some hairs appressed; hairs extending onto perianth. Perianth 5.5–7 mm long, white. Pistil 8.5–11 mm long. Fruit obliquely obovate, 1.3–1.5 cm long, 4.5–6 mm wide, rugose, glaucous; apiculum to 1 mm long; horns lacking. Seed c. 10.5 mm long; wing apical only. Fig. 10M.

Confined to the Macdonnell Ra., N.T., where it is found in skeletal soil in ledges of quartzite cliff faces. Flowers Sept.–Oct. Map 67.

N.T: Mt Giles, *P.K.Latz 6621* (DNA); Ormiston Gorge, *P.K.Latz 9423* (DNA); Hugh Gorge, Chewings Ra., *P.K.Latz 9961* (DNA); Standley Chasm, *J.R.Maconochie 464* (DNA).

Not markedly different from *H. collina*, from which it differs in leaf and perianth length, pubescence type and also flowering time and habitat. The two taxa do not overlap geographically.

This species is recognised as 'Rare' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

Eriantha Group

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Shrub or small tree, without deeply fissured bark. Leaves simple, flat, subpetiolate, not stem-clasping, entire; venation obscure apart from midrib. Inflorescence an axillary umbel, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis obscure. Flowers 6–10; pedicels pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 7–8.5 mm long; pollen presenter a lateral disc; gland a curved flap. Fruit 1 (–4) per axil, obliquely erect, retained on plant, woody, ±smooth, not beaked, not horned, dehiscing fully down one side, not recurving. Seed occupying part of valve; wing apical only.

A monotypic group from eastern Australia.

58. Hakea eriantha R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 29 (1830)

T: prope fl. Hastings (Oxley's 2nd expedition), N.S.W., 1818, *C.Fraser 40*; syn: B, BM; prope fl. Hastings (Oxley's 2nd expedition), N.S.W., 1818, *C.Fraser 47*; syn: BM; prope fl. Hastings (Oxley's 2nd expedition), N.S.W., 1818, *C.Fraser s.n.*; syn: K *p.p.*

Hakea glaucina Gand., *Bull. Soc. Bot. France* 66: 230 (1919). T: near Buchan, Vic., Sept. 1910, *J.W.Audas s.n.*; holo: LY.

Hakea cymbaecarpa Gand., *Bull. Soc. Bot. France* 66: 230 (1919). T: near Harrietville, Vic., 31 May 1910, *J.W.Audas s.n.*; holo: LY.

Hakea eucalyptiformis Gand., *Bull. Soc. Bot. France* 66: 230 (1919). T: Sydney, N.S.W., June 1893, *R.T.Baker s.n.*; holo: LY.

Hakea recondita Gand., *Bull. Soc. Bot. France* 66: 230 (1919). T: Queensland, 1902, *C.Walter s.n.*; holo: LY.

Hakea betchei Gand., *Bull. Soc. Bot. France* 66: 230 (1919). T: Tenterfield, N.S.W., Oct. 1886, *E.Betche s.n.*; holo: LY; iso: NSW.

Illustration: J.H.Maiden, *Forest Fl. New South Wales* 5: no. 171, pl. 175 (1912).

Small tree or dense shrub, 1–5 m tall, ?lignotuberous. Branchlets and young leaves appressed-pubescent, glabrescent. Leaves linear, narrowly elliptic or obovate, 8–18.5 cm long, 1–30 mm wide, attenuate, acute; mucro 0.5–1.5 mm long. Inflorescence axillary with 6–10 flowers; involucre c. 2.5–3.5 mm long; pedicels 2.5–6 mm long, densely pubescent with hairs white, extending onto perianth. Perianth 3.5–6.5 mm long, white. Pistil 7–8.5 mm long; pollen presenter lateral below style apex, 1.2–1.5 mm long; gland 0.2 mm high. Fruit obovate, somewhat sigmoidal, 1.9–3.2 cm long, 1.2–1.6 cm wide, smooth, brown-pusticulate; apiculum 3.5–4.5 mm long. Seed obliquely narrowly obovate, 19.5–20.5 mm long; wing apical only.

Occurs along the east coast of Australia from Gladstone, Qld, to Gippsland, Vic., with an apparent disjunction in the Central Coast region of N.S.W. Found at altitudes up to 1300 m in wet or sclerophyll *Eucalyptus* woodland or forest, edges of beech forest and rainforest. Flowers (July–) Aug.–Nov. Map 68.

Qld: Mt Byron, D'Aguilar Ra., 9 km WSW of Mt Mee, *P.Young 786* & *J.Elsol* (BRI). N.S.W.: slopes of Mt Budawang, near Mongarlowe, *L.G.Adams 1411* (CANB, G, NY); Parkers Gap, 8 km SE of Captains Flat on the Captains Flat–Majors Creek road, *M.Evans 2643* (AD, BRI, CANB, MEL); Palerang R., c. 16 km SE of Hoskintown, *R.Pullen 3875* (AD, BRI, CANB, MEL, NSW). Vic.: Snowy River Track, 3.2 km NNW of Armstrong Track junction, *N.G.Walsh 271* (AD, MEL).

Easily confused with *H. florulenta* which has similarly shaped fruit. However *H. eriantha* has pubescent flowers while *H. florulenta* has glabrous flowers. Some variation in flower size is encountered, but this is apparently not linked with any other factor.

W.M.Molyneux has sent specimens from Yambulla Peak track on the upper reaches of the Genoa R., Vic., which have leaves that are consistently up to 30 mm wide. I [RMB] have seen no other specimens in which the leaves are consistently as wide as this, the usual width being between 10 and 20 mm, rather than the extremes given in the description. Lignotubers

have been recorded on some collections e.g. *Ballingall 2546*, but Molyneux notes that neither the broad-leaved form from Yambulla Peak nor the more usual narrow-leaved form, which also occurs there, is lignotuberous. Molyneux has also documented the following differences between the two forms. The narrow-leaved form is a larger plant with a neat semi-weeping habit and brown plating bark, vigorous and free-fruiting in cultivation and is not predated by parrots. The broad-leaved form is an upright untidily open plant with smooth grey bark, setting few fruit in cultivation, and is predated by parrots.

Trifurcata Group

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Shrubs, rarely small trees, without deeply fissured bark. Leaves compound-terete, rarely mixed with simple-terete (*H. trifurcata*), or flat, non-petiolate but compound leaves with an undivided basal region, not stem-clasping, entire, not grooved below; venation obscure. Inflorescence an axillary umbel, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis obscure. Flowers 1–10; pedicels pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 6–10 mm long; pollen presenter a lateral disc; gland a curved flap. Fruit solitary, erect to laterally inserted on stalk, not retained on plant, not markedly woody, smooth, sometimes beaked, not horned, dehiscing fully down both sides. Seed occupying whole valve; wing apical or extending partly down one side of seed body only.

A group of five species all occurring in W.A.

1 Plants with mixed simple- and compound-terete leaves, as well as flat leaves once flowering is initiated (fruit resembling the flat leaves; widespread from Murchison R. to Esperance, south-western W.A.; flowers Apr.–Oct.) **59. H. trifurcata**

1: Plants with flat leaves or compound-terete leaves, not both

2 Leaves flat; fruit leaf-like, not beaked, not pusticulate; seed not boomerang-shaped

3 Hairs on young leaves appressed-sericeous; leaves 3–11.5 mm wide; hairs on pedicel and perianth concolorous (Jarrah forests of south-western W.A.; flowers Sept.–Nov.) **60. H. lasianthoides**

3: Hairs on young leaves woolly-tomentose; leaves 7–17 mm wide; hairs on pedicel ferruginous, on perianth cream-white or yellow-brown (mallee scrub, Albany area, W.A.; flowers Mar.–Sept.) **61. H. lasiantha**

2: Leaves compound-terete; fruit not leaf-like, with long obliquely inserted beak, pusticulate; seed boomerang-shaped

4 Lower surface of leaf grooved at base; pollen presenter 1.6–2.5 mm long (Perth to Jurien Bay, W.A.; flowers May–Nov.) **62. H. erinacea**

4: Lower surface of leaf not grooved at base; pollen presenter 3.5–4.5 mm long (Mt Lesueur area, W.A.; flowers June–Sept.) **63. H. longiflora**

59. Hakea trifurcata (Sm.) R.Br., *Trans. Linn. Soc. London* 10: 183 (1810)

Conchium trifurcatum Sm., in A.Rees *Cycl.* 9 (1807), pages unnumbered; *Trans. Linn. Soc. London* 9: 122 (1808). T: King George Sound, [W.A.], 1803, *A.Menzies s.n.*; holo: LINN; iso: BM, K *p.p.*

Hakea trifurcata var. *eriantha* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 558 (1845), *nom. illeg.* (*H. trifurcata* in synonymy).

Hakea trifurcata var. *sericantha* Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 559 (1845). T: Guildford, W.A., 14 Sept. 1839, *L.Preiss 591*; syn: G-DC, LD *p.p.*, LE, ?NY.

Hakea mixta Lindl., *Sketch Veg. Swan R.* xxxvi (1840). T: Swan R. district, W.A., *s.d., J.Drummond s.n.*; syn: BM *p.p.*, CGE, CGE *p.p.*, G, K *p.p.*

Hakea tricruris Lindl., *Sketch Veg. Swan R.* xxxvi (1840). T: south-western W.A., *s.d., J.Drummond s.n.*; holo: CGE.

Hakea boucheana Kunth, *Pl. Nov. Hort. Berol.* 9 (1844); *Linnaea* 18: 499 (1844). T: Hort. Berol., Apr. 1843, *Anon. s.n.*; ?holo: B.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 67, pl. 94 (1984); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 403 (1988); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 23, 106 (1997).

Dense or open shrub, 0.4–2.5 m tall, to 2 m diam., non-lignotuberous. Branchlets appressed-pubescent or appressed-sericeous, ferruginous. Leaves terete and/or flat, appressed-sericeous, with hairs ferruginous and white, quickly glabrescent; flat leaves elliptic or obovate, 2–5 cm long, 6–19 mm wide, attenuate or cuneate, entire, rounded apically; terete leaves simple or compound, 2.2–7.5 cm long, 0.8–1.3 mm wide, grooved on lower side. Inflorescence with up to 10 flowers; involucre 4.5–5.5 mm long; pedicels 3–4 mm long, tomentose or appressed-sericeous, with hairs cream or ferruginous, extending onto perianth. Perianth 6.5–8.5 mm long. Pistil 8.5–10 mm long; pollen presenter 0.9–1.1 mm long; gland c. 0.3 mm high. Fruit leaf-like, obliquely obovate, 1.5–2.3 cm long, 0.5–0.8 cm wide, smooth, not beaked. Seed narrowly obovate, 13 mm long; wing apical only. *Two-leaf Hakea*. Fig. 11G, H.

Common throughout the south-western corner of W.A. south from Murchison R. to east of Cape Arid. Found in sand or laterite in low open heath or mallee. Flowers Apr.–Oct.; a form with white or pale styles may flower in the earlier part of this range. Map 69.

W.A.: between Katanning and Kojonup, *W.E.Blackall 3127* (PERTH); Cape Le Grand Natl Park, between Rossiter Bay car park and the Bird Sanctuary, *M.Carter 203* (PERTH); 20 km E of Geraldton road on road to Calingiri, *G.J.Keighery 1349* (PERTH); Yorkrakine Rock Reserve, 24 km N of Tammin, *B.G.Muir 449(3.7)* (PERTH); Strawberry Hill, Irwin R. area, *F.G.Smith 1703* (PERTH).

Flowers of *H. trifurcata* possess a strong smell, sometimes described as fetid, and bees and blowflies have been seen visiting them. The fruit are cryptic and closely resemble the flat leaves which are only produced once the plants reach sexual maturity.

Hakea trifurcata varies with respect to hair covering on the perianth and pedicel. Specimens from Dryandra, York, Lake King, Kulin and Tutanning Nature Reserve, equivalent to Meisner's var. *sericantha*, have a mixture of ferruginous and white appressed-sericeous hairs on the pedicel and perianth. Specimens with white hairs on both pedicel and perianth, or with ferruginous hairs on the pedicel contrasting with the white or brown hairs of the perianth, occur north of Perth. Populations with pale brown hairs, either tomentose on pedicel and perianth or more usually tomentose on the limb and appressed on the claw, occur throughout the range of distribution of the species.

There are a number of PERTH collections with pale styles compared with the more normal red style, e.g. *R.Hnatiuk 770273, A.S.George 6317, E.Scrymgeour 870, M.Carter 203*. These are found in the more arid and more easterly localities and usually have mainly pale brownish tomentose hairs on the whole perianth.

60. Hakea lasianthoides Rye, *Nuytsia* 5: 27 (1984)

T: Bow R., W.A., Nov. 1912, *S.W.Jackson s.n.*; holo: PERTH; iso: BM *p.p.*, CANB, K *n.v.*, NSW, ?PERTH.

Hakea lasiantha var. *angustifolia* Benth., *Fl. Austral.* 5: 502 (1870). T: W.A., *s.d., J.Drummond 21*; syn: BM *p.p.*, K, MEL, PERTH? *n.v.*

Illustration: B.L.Rye, *op. cit.* 26, fig. 1 (1984).

Small tree or upright spreading shrub, 1–5 m tall, non-lignotuberous. Branchlets and young leaves appressed-sericeous, ferruginous. Leaves flat, linear to narrowly elliptic or obovate, 3–11.5 cm long, 3–11 mm wide, attenuate, entire, acute. Inflorescence with 2–8 flowers; involucre 4–5 mm long; pedicels 5.5–10 mm long, woolly-tomentose, with hairs cream, extending onto perianth. Perianth 4.5–7 mm long. Pistil 7.5–8 mm long; pollen presenter 1.1–1.4 mm long; gland 0.2 mm high. Fruit leaf-like, obliquely transversely elliptic, 2.5–3.1 cm long; 0.7–0.9 cm wide, smooth, not beaked. Seed obliquely narrowly elliptic or obovate, 14.5–20 mm long; wing partly down only one side of seed body or apical only. Fig. 11N, O.

Occurs in south-western W.A., from just north of Perth to Denmark, in Jarrah forest, often in marshy conditions, in sand, clay or laterite. Flowers Sept.–Nov. Map 70.

W.A.: near Augusta, *A.M.Ashby 2373* (NSW, PERTH); between Shannon and Northcliffe, *J.S.Beard 7783* (NSW); 1 km E of Chittering, *G.J.Keighery 13518* (PERTH); Nannup-Busselton, *R.D.Royce 2395* (PERTH).

Very closely related to *H. lasiantha*. There are some specimens from Bullsbrook and Collie area which erode the differences between these species, particularly by having ferruginous hairs on the pedicel and perianth. There is also an undated collection from Geraldton (*Lucas*, NSW 98150), but this may be a mistaken locality rather than a real record from that area.

61. Hakea lasiantha R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 29 (1830)

T: interior of King George Sound, [W.A.], 1828/9, *W.Baxter s.n.*; syn: BM, K, NY.

Erect branched shrub, 0.6–3 m tall, non-lignotuberous. Branchlets and young leaves woolly-tomentose, ferruginous. Leaves flat, elliptic or obovate, sometimes narrowly so, 2.8–6.3 cm long, 7–17 mm wide, attenuate or rounded, entire, rounded apically. Inflorescence with 3–8 flowers; involucre 5 mm long; pedicels 4–8 mm long, ferruginous woolly-tomentose. Perianth 5.5–9 mm long, cream-white or yellow-brown woolly-tomentose. Pistil 7.5–9.5 mm long; pollen presenter 1–1.4 mm long; gland 0.2 mm high. Fruit leaf-like, obliquely narrowly elliptic, 2.6–3.2 cm long, 1–1.1 cm wide, smooth, not beaked. Seed obliquely narrowly obovate, 20–23 mm long; wing partly down only one side of seed body, or apical only. *Woolly-flowered Hakea*. Fig. 11 I–M.

Occurs in area bounded by Gordon R., the Stirling Ra., Cape Riche and Albany in W.A., in mallee scrub on sand, sandy gravel or sandy clay. Flowers Mar.–Sept. Map 71.

W.A.: W foot of Mt Manypeaks, *R.Melville 4443* (CANB, NSW, PERTH); Stirling Ra., c. 3 km NW of Bluff Knoll, *A.Strid 22480* (G, M, PERTH).

Specimens with cream-white hairs on the perianth from the Stirling Ra. (and one specimen from Albany) are not separable in any other way from the more typical specimens with yellow-brown hairs from more southerly regions.

62. Hakea erinacea Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 559 (1845)

T: near Cataracts at head of Swan R. [Susannah Brook], W.A., 25 July 1839, *L.Preiss 601*; syn: B, BR, G, G-DC (microfiche seen), HBG, K *p.p.*, L, LD, LE (as *Preiss 261*), M, MEL, NY, P, TCD (as *Preiss 261*); W.A., *s.d., J.Drummond 601*; syn: BM *p.p.*, G, K, LE, MEL, OXF, P.

Erect open non-lignotuberous shrub, 0.2–1.6 m tall. Branchlets and young leaves villous; hairs dense, suberect, 0.2–0.3 mm long. Leaves compound-terete; undivided base 8–16 mm long, grooved on lower surface; ultimate segments 2–8, 2–13 mm long, 0.9–1.3 mm wide, ungrooved. Inflorescence with 4, 6 or 8 flowers; involucre 2 mm long; pedicels 7–12 mm long, villous, with hairs cream-yellow. Perianth 4–7.5 mm long, villous; hairs mainly white, some ferruginous. Pistil 6–9 mm long; pollen presenter 1.6–2.5 mm long; gland 0.4–0.5 mm high. Fruit not leaf-like, obliquely narrowly ovate, 1.7–2 cm long, 5–6 mm wide, smooth with circular white pusticles; beak long, obliquely inserted. Seed boomerang-shaped, 15–17 mm long; wing apical only. *Hedgehog Hakea*. Fig. 11P, Q.

Occurs in south-western W.A. in Perth to Jurien Bay area, and inland to Toodyay, in low open or mixed heath on sandy clay, granite, laterite or sandstone. Flowers May–Nov. Map 72.

W.A.: Gooseberry Hill, Kalamunda, *R.J.Cranfield 1310/80* (PERTH); 2.5 km E of Mt Peron, NE of Jurien, *E.A.Griffin 2742* (PERTH); Wongamine Reserve, 18 km ENE of Toodyay, *G.J.Keighery 6870* (PERTH); Helena Valley, *J.Seabrook 61* (PERTH).

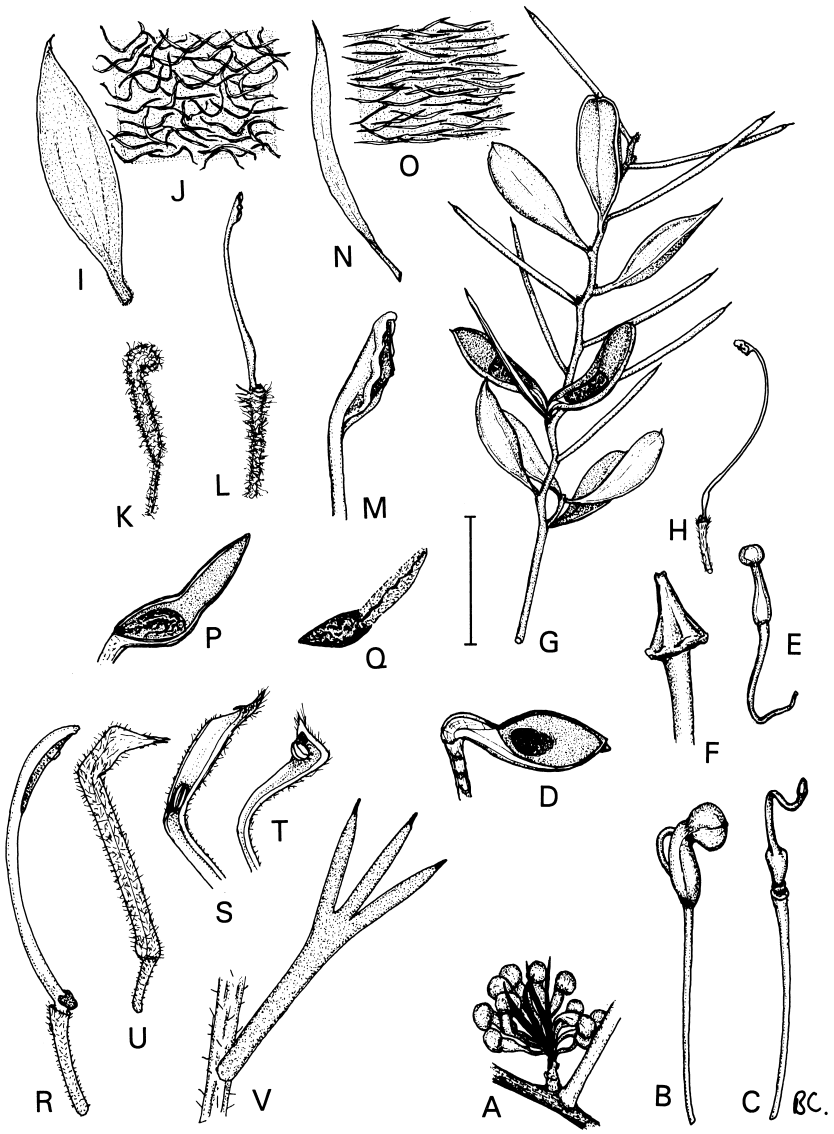

Figure 11. *Hakea*. **A–C**, *H. oldfieldii*. **A**, leaf axil with inflorescence and young developing shoot (R.D.Royce 4512, PERTH); **B**, bud; **C**, flower without perianth (**B–C**, G.J.Keighery 6702, PERTH). **D–F**, *H. lissocarpha*. **D**, fruit; **E**, bud; **F**, pollen presenter (**D–F**, N.Hoyle 130, PERTH). **G–H**, *H. trifurcata*. **G**, habit (K.Newbey 255, PERTH); **H**, flower without tepals (G.J.Keighery 1349, PERTH). **I–M**, *H. lasiantha*. **I**, leaf; **J**, leaf surface hairs (**I–J**, H.Demarz 4236, PERTH); **K**, bud; **L**, flower without tepals; **M**, pollen presenter (**K–M**, B.T.Goadby 2348, PERTH). **N–O**, *H. lasianthoides*. **N**, leaf; **O**, leaf surface hairs (**N–O**, G.J.Keighery 7335, PERTH). **P–Q**, *H. erinacea.* **P**, fruit; **Q**, seed (**P–Q**, G.J.Keighery 6870, PERTH). **R–V**, *H. longiflora*. **R**, flower without tepals; **S–T**, inside of limb of posterior and anterior tepal showing anther placement and relative lengths (**R–T**, E.A.Griffin 2741, PERTH); **U**, bud; **V**, leaf (**U–V**, E.A.Griffin 2736, PERTH). Scale bar: **A**, **E**, **S–T**, **V** = 5 mm; **B–C** = 2.5 mm; **D**, **G**, **I**, **N** = 2 cm; **F** = 1 mm; **H**, **L**, **R** = 7 mm; **J**, **O** = 0.8 mm; **K** = 1 cm; **M** = 1.3 mm; **P–Q** = 1.3 cm; **U** = 4 mm. Drawn by Beth Chandler.

63. Hakea longiflora (Benth.) R.M.Barker, *J. Adelaide Bot. Gard.* 13: 106 (1990)

Hakea erinacea var. *longiflora* Benth., *Fl. Austral.* 5: 505 (1870). T: Swan R., [W.A.], *s.d., J.Drummond s.n.*; ?holo: K; iso: B, L, MEL 1537917, PERTH.

Dense erect shrub, 0.6–0.75 m tall, lignotuberous. Branchlets and young leaves villous; hairs moderately dense, suberect, 0.6–0.9 mm long, mixed with shorter hairs. Leaves compound-terete, rigid; undivided base 3–10 mm long, not grooved on lower surface; ultimate segments (2–) 3, 1–10 mm long, 0.8–1.5 mm wide, ungrooved. Inflorescence with 2 flowers; involucre 5–6.5 mm long; pedicels 2–5 mm long, white-villous. Perianth 6.5–12 mm long, white-tomentose. Pistil 12–14 mm long; pollen presenter 3.5–4.5 mm long; gland 0.7–0.9 mm high. Fruit not leaf-like, obliquely narrowly ovate, 1.8–2.5 cm long, 6–7 cm wide, smooth, black-pusticulate; beak long, obliquely inserted. Seed boomerang-shaped, 22 mm long; wing apical only. Fig. 11R–V.

Occurs only in the Mt Lesueur to Dandaragan area, north of Perth, W.A., in low open heath in gravelly sand over sandstone. Although restricted in distribution it is apparently reasonably common (S.D.Hopper, pers. comm.). Flowers June–Sept. Map 73.

W.A.: near Dandaragan, *W.E.Blackall 3674* (PERTH); near Badgingarra, *A.S.George 2610* (PERTH); 8 km W of Brand Hwy, off Coorow–Green Head road, *E.A.Griffin 2754* (PERTH).

Hakea longiflora is distinctive in its unusually long lateral pollen presenter. All species with lateral pollen presenters have a slight difference in size between the adaxial and abaxial pair of tepals, but the difference is very marked in this species, and the anthers are also different in size between the tepal pairs. *Hakea longiflora* is very close to *H. erinacea* and the two overlap in distribution; the former is lignotuberous, the latter not.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

Teretifolia Group

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Shrubs, without deeply fissured bark. Leaves simple, terete, not grooved below; venation obscure. Inflorescence an axillary umbel, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis obscure. Flowers 4–8; pedicels pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 7.5–17 mm long; pollen presenter an oblique disc; gland a curved flap. Fruit solitary, erect, retained on plant, woody, smooth apart from toothed ridges, not beaked, not horned, dehiscing almost fully down one or both sides. Seed occupying part of valve; wing apical only.

A monotypic group from eastern coastal Austalia from N.S.W. to Tas.

64. Hakea teretifolia (Salisb.) Britten, *J. Bot.* 54: 60 (1916)

Banksia teretifolia Salisb., *Prodr. Stirp. Chap. Allerton* 51 (1796). *Lambertia teretifolia* (Salisb.) C.F.Gaertn., *Suppl. Carp.* 213, t. 217, fig. 7 (1807). T: 'Ex Port Jackson auct. Jac. Lee'. holo: *n.v.*, apparently lost.

?Hakea longifolia Dum.Cours., *Bot. Cult.* 5: 106 (1805). T: no specimen cited and Dumont de Courset's herbarium not located.

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 356, 386 (1988).

Shrub. Leaves rigid, terete, sometimes flattened when young, 0.5–7.7 cm long, 0.8–1.7 mm wide. Inflorescence with 4, 6 or 8 flowers; involucre 4.5–6.5 mm long; pedicels 2.5–4 mm long. Perianth 3.7–5.5 mm long, white or cream-white. Pistil deflexed. Fruit narrowly ovate to lanceolate with an obliquely transverse, irregularly-toothed crest c. ⅓ distance from base, 1.6–2.7 cm long, 0.5–0.9 cm wide, finely black-pusticulate or smooth, dark brown-streaked,

long-apiculate (often broken); apiculum 6–9 mm long. Seed narrowly elliptic, 11–15 mm long; wing light or dark brown. *Dagger Hakea*.

Common along the east coast of Australia from Coffs Harbour in N.S.W. to Tas. Two subspecies are recognised.

Pedicel and perianth with densely appressed-sericeous hairs, some suberect **64a.** subsp. **teretifolia**

Pedicel and perianth with densely tomentose hairs, some appressed **64b.** subsp. **hirsuta**

64a. Hakea teretifolia (Salisb.) Britten subsp. teretifolia

Hakea glabra Schrad. & J.C.Wendl., *Sert. Hannov.* 27, t. XVII (1797). T: without locality [in Novae Hollandiae sinu Botany-bay, N.S.W.], *s.d., [? Schrader] Herb. Willdenow 2470*; ?syn: B; without locality, *s.d., Anon. s.n.*; ?syn: B, M.

Conchium longifolium Donn, *Hortus Cantabrig.* 2nd edn, 14 (1800), *nom. nud.*; *C. longifolium* Donn ex Sm., in A.Rees, *Cycl.* 9 (1807), pages unnumbered, *nom. illeg.* (*Banksia teretifolia* in synonymy).

Hakea pugioniformis Cav., *Anales Hist. Nat.* 1: 213, t. 11 (1800), *nom. illeg.* (*H. glabra* in synonymy); *Conchium pugioniforme* (Cav.) Sm., in A.Rees, *Cycl.* 9 (1807), pages unnumbered, *nom. illeg.*; *Banksia pugioniformis* (Cav.) J.Parm., *Cat. Arbr. Parm.* 12 (1818), *nom. illeg.* T: Port Jackson, [N.S.W.], *s.d.* [Mar. 1793], *L. Née* (Malaspina expedition); syn: MA (photo seen).

Hakea glauca Salisb., in J.Knight, *Cult. Prot.* 106 (1809), *nom. illeg.* (number of earlier names in synonymy).

Conchium corniculatum Sm. ex Willd., *Enum. Pl.* 141 (1809). T: without locality, *s.d., [?Schrader] Herb. Willd. 2470*; syn: B.

Hakea pugioniformis Cav. α R.Br., *Trans. Linn. Soc. London* 10: 179 (1810); *Hakea pugioniformis* α *sericea* Endl., *Gen. Pl. Suppl.* 4(2): 85 (1848), *nom. illeg.* (type variety).

Low spreading shrub, 0.3–2.6 m tall. Branchlets moderately to densely appressed-sericeous. Pedicels densely white-appressed-sericeous, with some hairs suberect; hairs extending onto perianth. Pistil 7.5–11 mm long; pollen presenter 0.5–0.7 mm long.

Found in sandy heath plains or sandstone formations from Coffs Harbour to the Sydney region, N.S.W. Flowers Sept.–Feb. (rarely June–July). Map 74.

N.S.W.: Budawang Ra., c. 6 km S of Sassafras, *M.P.Austin & J.Duggan 6* (CANB, NSW); 12.9 km ESE of Nerriga, *J.Pickard 1314* (NSW); North Curl Curl headland, *M.J.Taylor 160* (NSW).

T.D.Auld & D.A.Morrison, *Austral. J. Bot.* 40: 1–11 (1992), record that some, but not all, populations in the Sydney region produce lignotubers. Whether this correlates with the two taxa recognised here is not known.

64b. Hakea teretifolia subsp. hirsuta (Endl.) R.M.Barker, *J. Adelaide Bot. Gard.* 13: 105 (1990)

Hakea pugioniformis ß R.Br., *Trans. Linn. Soc. London* 10: 179 (1810); *Hakea pugioniformis* ß *hirsuta* Endl., *Gen. Pl. Suppl.* 4(2): 85 (1848). T: Port Dalrymple, [Tas.], 1804, *R.Brown Iter Austral. 381*; syn: BM *p.p.*

Hakea parilis Salisb., in J.Knight, *Cult. Prot.* 106 (1809). T: 'Comm. Sir Thomas Gage. Grows wild near Port Dalrymple.... Discovered by Colonel Paterson'; holo: not located.

Erect, much-branched or compact and spreading shrub, 1–4 m tall. Young axillary branchlets densely tomentose, some hairs appressed; hairs white or dirty brown; terminal branchlets more quickly glabrous, while remaining densely pubescent at their base, glabrescent by flowering. Pedicel and perianth densely tomentose, with some hairs appressed; hairs white or cream-yellow. Pistil 9–17 mm long; pollen presenter 0.8–1 mm long.

Damp areas in mainly coastal heaths from Sydney N.S.W. to Tas. with a disjunct occurrence in the Grampians in western Vic. Flowers Nov.–Feb. Map 75.

N.S.W.: c. 5 km W of Majors Ck, *L.A.S.Johnson NSW98419* (NSW); Jervis Bay, *F.A.Rodway s.n.* (NSW). Vic.: Moora Rd, Grampians, *D.E.Symon 1833* (AD, NE). Tas.: between Douglas R. and Bicheno, *N.T.Burbidge 3121* (CANB, HO).

Rostrata Group

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Hakea sect. *Hakea* ser. *Obliquae* Benth., *Fl. Austral.* 5: 491, 498 (1870), *p.p.*

Shrubs, without deeply fissured bark. Leaves simple, terete, not grooved below or flat, subpetiolate, not stem-clasping, entire; venation obscure. Inflorescence an axillary umbel, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis obscure. Flowers 1–18, white; pedicels pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 4.5–11.5 mm long; pollen presenter an oblique disc, rarely conical; gland a curved flap. Fruit solitary, recurved at base, retained on plant, woody, smooth or wrinkled, not beaked, obscurely horned, dehiscing fully down one side. Seed occupying part of valve; wing ±apical only or partly (to halfway) down one side only.

A group of five species in southern Australia, from W.A., S.A., Vic. and Tas.

1 Leaves flat, entire (south-western W.A.; flowers Aug.–Oct.) **69. H. cyclocarpa**

1: Leaves terete

2 Pollen presenter conical; pistil erect (Eyre Penin., S.A. to western Vic.; flowers Aug.–Oct.) **65. H. rugosa**

2: Pollen presenter an oblique disc; pistil recurved

3 Fruit 2.2–4.5 cm long; seed 13–22 mm long; flowers bisexual; gland V-shaped; pistil 7.8–11.5 mm long (northern Lofty to south-eastern S.A., Vic.; flowers July–Nov.) **68. H. rostrata**

3: Fruit 1.4–2.6 cm long; seed less than 13 mm long; flowers usually unisexual, male and female on different plants; gland a slightly curved rectangular flap; pistil to 8 mm long

4 Compact shrub to 3 m high; gland in male, female and bisexual flowers less than 0.5 mm high (coastal to alpine areas in shrubbery in all but NE coast of Tas.; flowering Aug.–Dec.) **66. H. epiglottis**

4: Erect shrub or small tree to 5 m high; gland in male and female flowers 0.5–1 mm high (forest at low altitude on E coast of Tas., higher altitudes on islands of Furneaux Group; flowering Feb.–July) **67. H. megadenia**

65. Hakea rugosa R.Br., *Trans. Linn. Soc. London* 10: 179 (1810)

T: South Coast, Bay X, [Port Lincoln, S.A.], Mar. 1802, *R.Brown Iter Austral. 2*; syn: AD, BM, DBN, E, G, K, MEL.

Dense divaricate hermaphrodite shrub, 0.7–2 m tall. Branchlets and young leaves white appressed-pubescent. Leaves rigid, terete, 1.5–6 cm long, 0.9–1.3 mm wide, not grooved, glaucous. Inflorescence with 6–10 flowers; involucre 3.5–4.5 mm long; rachis knob-like; pedicels 2–3.5 mm long, appressed-pubescent, with hairs white or ferruginous; white hairs extending onto perianth. Flowers bisexual. Perianth 3–3.5 mm long. Pistil erect, 4.5–6 mm long; pollen presenter conical, 0.3–0.4 mm high; gland V-shaped, 0.2–0.4 mm high. Fruit sigmoidal, 1.5–2.2 cm long, 0.7–1.6 cm wide, coarsely rugose; apiculum 3–7 mm long. Seed 9.5–15 mm long; wing ±apical only. *Dwarf Hakea*. Fig. 10D, E.

Occurs from Eyre Penin. in S.A. to western Vic., in mallee scrub or coastal heath, usually on sand or loam. Flowers Aug.–Oct. Map 76.

S.A.: roadside near Birchmore Lagoon, c. 20 km SW of Kingscote, *Hj.Eichler 15442* (AD); c. 15 km E of Meningie, *D.Kraehenbuehl 4544* (AD, CANB, MEL); 5 km S of Coulta, Port Lincoln-Elliston, *M.E.Phillips s.n.* (AD, CANB); Marble Ra., E face W of Marble Range Stn, *D.E.Symon 11643* (AD). Vic.: c. 5 km E of Casterton to Dartmoor road along Moonlight Rd, c. 22 km S of Casterton, *P.S.Short 1348* (AD, MEL).

Specimens from the western end of Kangaroo Is. need to be investigated further as they tend to have larger fruit (2.5–2.8 cm long), and the leaves are not always short and straight as in

typical *H. rugosa*. The most marked specimen of this (*J.B.Cleland*, Snake Lagoon, AD) does not have any flowers.

A collection by Mueller from rocky declivities towards the source of the Macallister R., Vic., also appears to represent this species.

66. Hakea epiglottis Labill., *Nov. Holl. Pl.* 1: 30, t. 40 (1805)

Conchium epiglottis (Labill.) Willd., *Enum. Pl.* 1: 141 (1809). T: Capite Van Diemen, [Tas.], *J.Labillardière s.n.*; syn: FI *n.v.*, G, G-DC, K *p.p.*, OXF, P, TCD (label only).

Conchium teretifolium C.F.Gaertn., *Suppl. Carp.* 3: 217, t. 219 (1807). T: Labillardière collection; holo: not located, probably one of the duplicates of the type of *H. epiglottis*.

[*Hakea rostrata auct. non* F.Muell. ex Meisn.: W.Curtis, *Students Fl. Tasmania* 3: 609 (1967), *p.p.*]

[*Hakea rugosa auct. non* R.Br.: W.Curtis, *Students Fl. Tasmania* 3: 609 (1967), *p.p.*]

Functionally unisexual shrub, rarely hermaphrodite, compact, to 3 m high. Leaves terete, 1.5–7.5 (–11) cm long, 1–2 mm wide. Inflorescence on male plants with 2–8 flowers, on female plants with 1–3 flowers; involucre 3–4 mm long; rachis c. 1 mm long; pedicels 3.5–5 mm long, densely white appressed-sericeous, with hairs extending on to perianth. Perianth 2.5–4 mm long, pale yellow inside. Pistil recurved, 5.5–6.5 mm long; pollen presenter an oblique disc, 0.5–0.6 mm long, concave in male flowers, with a conical protuberance in female flowers; gland a slightly curved rectangular flap, 0.1–0.3 mm high. Fruit sigmoidal, 1.4–2.6 cm long, 0.6–1.2 cm wide. Seed 9–12 mm long; wing partly down one side of seed body only. Fig. 10F.

An endemic species in Tas.; it occurs on all but the north-east coast where it is replaced by the closely related *H. megadenia*. There are two subspecies.

Many populations consist of unisexual plants, i.e. either male plants or female plants. Unisexual plants in populations can be detected by examining the plants for fruit. Plants producing fruit (female) usually have no pollen within the flower, while those plants lacking fruit may be immature or male with the flowers producing pollen only. Plants on which fruit occur together with flowers producing pollen are bisexual. A number of populations of bisexual plants have been documented in Lee (1987), and the problem is discussed in more detail in Barker (1991).

H.M.Lee, The biology of *Hakea epiglottis*, *Austral. J. Bot.* 35: 689–699 (1987); R.M.Barker, Towards a revision of the *Hakea epiglottis* Labill. (Proteaceae) complex of Tasmania, in M.R.Banks *et al.* (eds), *Aspects of Tasmanian Botany: a Tribute to Winifred Curtis*, pp. 79–84 (1991).

Perianth with concolorous hairs throughout claw and limb — **66a.** subsp. **epiglottis**

Perianth with yellowish white hairs on claw, ferruginous hairs on limb — **66b.** subsp. **milliganii**

66a. Hakea epiglottis Labill. subsp. **epiglottis**

Perianth with concolorous hairs on claw and limb.

Found throughout Tas. except for the north-eastern coast; grows in shrubby heaths, often at higher altitudes, but also known from coastal areas. Flowers Aug.–Dec. Map 77.

Tas.: road into L. St Clair, 18 Oct. 1971, *M.Allan s.n.* (HO); 1 km S of Barnes Hill, 3 Oct. 1985, *H.J.Bayly-Stark s.n.* (HO); Wombat Moor, Mt Field Natl Park, *A.M.Gray 577* (HO, MEL); Longley, Dec. 1912, *L.Rodway s.n.* (HO).

66b. Hakea epiglottis subsp. **milliganii** (Meisn.) R.M.Barker, *Fl. Australia* 17B: 394 (1999)

Hakea milliganii Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 395 (1856). T: in Ins. Diemen, occidentali, [Tas.], circa Macquarie harbour, 10 Oct. 1846, *J.Milligan 737*; lecto: NY, *fide* R.M.Barker *loc. cit.*; isolecto: BM, HO (as *Gunn 737*), K, W.

Perianth claw with yellowish white hairs; limb with contrasting ferruginous hairs.

Apparently confined to the west coast of Tas. in the Zeehan to Macquarie Harbour area, probably in shrubby heaths of the hilltops. Flowers Sept.–Oct. Map 78.

Tas.: Zeehan, Sept. 1893, *Anon. (Herb. Weindorfer) s.n.* (MEL 571278); 2 km S of Mt Darwin, *P.Collier 4373* (HO); near Remine, Sept. 1893, *W.V.Fitzgerald NSW182384* (NSW).

67. Hakea megadenia R.M.Barker, in M.R.Banks *et al.* (eds), *Aspects of Tasmanian Botany: a Tribute to Winifred Curtis* 83 (1991)

T: scenic lookout on road to Swansea, Tas., 17th May 1976, *J.Armstrong 867 & J.Powell*; holo: HO; iso: NSW.

[*Hakea rostrata auct. non* F.Muell. ex Meisn.: W.Curtis, *Students Fl. Tasmania* 3: 609 (1967), *p.p.*]

[*Hakea rugosa auct. non* R.Br.: W.Curtis, *Students Fl. Tasmania* 3: 609 (1967), *p.p.*]

Upright unisexual shrub or small tree, to 5 m tall. Branchlets densely appressed-pubescent, with hairs persistent until flowering. Leaves terete, 3.5–13.5 cm long, 1–1.8 mm wide. Inflorescence on male plants with 3–14 flowers, on female plants with 1–8 flowers; involucre 1.5–2 mm long; rachis 1–3 mm long, ferruginous-hairy; pedicels 2–5 mm long, with hairs white appressed-sericeous, extending onto perianth. Perianth 3–5 mm long, white or cream-white internally. Pistil curved, 5–8 mm long; pollen presenter an oblique disc, 0.8–1 mm long; gland a slightly curved rectangular flap, 0.7–1 mm high in female flowers, 0.5–0.8 mm high in male flowers. Fruit sigmoidal, 1.8–2.5 cm long; 0.9–1.2 cm wide. Seed 10.5 mm long; wing partly down one side of seed body only.

Confined to the east coast of Tas. and the Furneaux Group in the eastern Bass Strait. Found in river scrub or dry open forest, at low altitude and coastal on the mainland but at higher altitudes on the islands. Flowers Feb.–July. Map 79.

Tas.: Apsley R., *M.J.Brown 193* (HO); 1 km SW of Cherry Tree Hill, *A.M.Buchanan 3605* (HO); Survey Hill, Flinders Is., *H.Lee 114* (MEL); Cape Barren Is., *J.S.Whinray 43* (MEL); halfway up Strzelecki Peak, Flinders Is., 10 Apr. 1954, *J.H.Willis s.n.* (MEL).

No evidence has been found at this stage to indicate that bisexual populations occur within this species as they do in *H. epiglottis*. Island populations of this species appear to be more robust than those on the mainland; they usually have longer leaves, slightly longer perianths and slightly larger fruit.

68. Hakea rostrata F.Muell. ex Meisn., *Linnaea* 26: 359 (1854)

T: Lofty Ranges, [S.A.], Feb. 1849, *F.Mueller s.n.*; syn: NY *p.p.*; in regionibus sterilibus inter frutices versus Macclesfield, [S.A.], 26 Sept. 1848, *F.Mueller s.n.*; syn: MEL 674149; in campis inter frutices versus Hawkes' place, [S.A.], 21 Sept. 1848, *F.Mueller s.n.*; syn: MEL 674148; Lofty & Bugle Range, [S.A.], *s.d., F.Mueller s.n.*; syn: MEL 674152; Scrub of Concorara, Guichen-bay, [S.A.], *s.d., F.Mueller s.n.*; syn: MEL 674151; inter Gawler-town & Lyndock valley [S.A.], Sept., *F.Mueller s.n.*; syn: MEL 674150; Lofty Ranges, [S.A.], *s.d., F.Mueller s.n.*; isosyn: MEL 1537939; Lofty Ranges [S.A.], *s.d., Anon.* [*F.Mueller*] *s.n.*; ?isosyn: MEL 1537940.

Hakea rostrata F.Muell., *First Gen. Report* 17 (1853), *nom. nud.*

Hakea pampliniana Kippist, in C.D.F.Meisner, *Hooker's J. Bot. Kew Gard. Misc.* 7: 115 (1855). T: Port Adelaide, *s.d., Anon., s.n.* [?Mrs Grey presented by W.Pamplin A.L.S.]; syn: K; South Australia?, *s.d., Sir George Grey s.n.*; syn: NY (herb. Meisner); South Australia, 1845, *Mrs Capt. Grey s.n.*; ?isosyn: BM.

Hakea lurida Gand., *Bull. Soc. Bot. France* 66: 229 (1919). T: Grampians, Vic., Oct. 1901, *H.B.Williamson s.n.*; holo: LY.

[*Hakea vittata auct. non* R.Br.: G.Bentham, *Fl. Austral.* 5: 507 (1870), *p.p.* (only with respect to flowers mentioned by Bentham)]

Spreading or rounded shrub, 1–5 m tall; lignotuberous. Branchlets and young leaves white appressed-pubescent. Leaves terete, 2–15 cm long, 0.8–1.7 mm wide, ascending, not grooved, glaucous. Inflorescence with 1–10 flowers; involucre 2–3 mm long; rachis knob-like; pedicels 2.5–6.5 mm long, white appressed-pubescent, with hairs extending onto perianth. Flowers bisexual. Perianth 3.5–5.5 mm long. Pistil recurved, 7.8–11.5 mm long; pollen presenter oblique with cone 0.15–0.3 mm high; gland V-shaped, 0.1–0.3 mm high. Fruit sigmoidal, 2.2–4.5 cm long, 1.8–3.2 cm wide, coarsely wrinkled; beak reflexed, narrow,

7–14 mm long. Seed 13–22 mm long; wing decurrent halfway down one side of seed body only.

Occurs in southern S.A., from Fleurieu Penin. to the South-East, including Kangaroo Is., to the Grampians and Wimmera region in Vic. Found in a variety of soils in sclerophyllous woodland or forest. Flowers July–Nov. Map 80.

S.A.: Upper Sturt, c. 15 km SSE of Adelaide, *W.R.Barker 92* (AD); 8 km E of Penneshaw, *H.M.Lee 94* (MEL); 24 km from Frances towards Naracoorte, *M.E.Phillips 372* (AD, CANB). Vic.: Weecurra Forest Reserve, c. 22 km SSW of Casterton, *W.R.Barker 5526* (AD); Lawloit Ra., top of hill on Western Hwy, c. 20 km E of Kaniva, *R.Melville 1175* (BRI, NSW).

Previous Tas. records of this species represent part of the variation of the *H. epiglottis* complex.

69. Hakea cyclocarpa Lindl., *Sketch Veg. Swan R.* xxxvi (1840)

T: Swan R., W.A., 1839, *J.Drummond s.n.*; syn: BM, CGE, CGE *p.p.*, E, G, K.

Erect open shrub, 1–2.5 m tall, lignotuberous. Branchlets and young leaves appressed-pubescent, with hairs white and ferruginous. Leaves flexible, flat, narrowly obovate, 7–17 cm long, 7–40 mm wide, attenuate, entire, rounded, obtuse or acute. Inflorescence with 10–18 flowers; involucre 8–8.5 mm long; rachis obscure; pedicels 6–9 mm long, tomentose, with some hairs appressed; hairs white, extending onto perianth. Flowers bisexual. Perianth 7.5–10 mm long. Pistil 13–14 mm long; pollen presenter an oblique disc, 0.9–1.2 mm long; gland U-shaped, 1.5–1.7 mm high. Fruit sigmoidal, 3.5–4 cm long, 1.8–2.2 cm wide, black-pusticulate. Seed 23–29 mm long; wing narrowly down one side of seed body only. *Rams Horn, Curved Fruit Hakea, Wild Bean.* Fig. 10A–C.

Occurs in the Perth region and Darling Ra. to as far south as Nannup, W.A. Uncommon on granite, laterite, loam, gravel or sand in forest and heath. Flowers Aug.–Oct. Map 81.

W.A.: Power Lines SE of Gosnells Quarries, *R.J.Cranfield 2275* (PERTH); Nannup, *D.McVicar 429* (PERTH); Smiths Mill, Darling Ra., 22 Sept. 1904, *A.Morrison s.n.* (E); Helena Valley, *J.Seabrook 590* (PERTH); Serpentine, Nov. 1905, *J.Staer s.n.* (E).

Florally and vegetatively *H. cyclocarpa* is very similar to *H. pandanicarpa*. However, unlike *H. pandanicarpa*, the flowers of *H. cyclocarpa* develop within a large involucral bud, the scars of which are visible at the base of the rachis.

Incrassata Group

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Shrubs, without deeply fissured bark. Leaves simple, terete and not grooved below, trigonous or flat, subpetiolate, not stem-clasping, entire; venation obscure. Inflorescence an axillary umbel, sometimes arising from older leafless axils, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis obscure. Flowers 6–16; pedicels pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 1.9–3.2 mm long; pollen presenter an oblique disc; gland U-shaped. Fruit solitary, erect, retained on plant, woody, smooth or wrinkled, not beaked, not horned, dehiscing fully down one side. Seed occupying part or most of valve; wing encircling seed body.

A group of two species in south-western W.A.

Leaves flat, trigonous or terete, 1–4 mm wide, not twisted at base; fruit sigmoidal (Tammin to Kalbarri, W.A.; flowers June–Sept.) **70. H. candolleana**

Leaves flat, 3–11 mm wide, twisted at base; fruit globular (Tammin to Newdegate area, W.A.; flowers June–Nov.) **71. H. incrassata**

70. Hakea candolleana Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 2: 262 (1848)

Hakea falcata var. *?subuninervis* Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 572 (1845), replaced synonym. T: Canning River, W.A., 15 Jan. 1841, *L.Preiss 603*; syn: B, BR, G, HBG, LD, LE, M, MEL, ?MO, NY, P; south-western W.A., *s.d.*, *J.Drummond 605*; syn: ?BM *p.p.*, G, K, LE, MEL, P.

Hakea candolleana Meisn. var. *campylorrhyncha* F.Muell. ex Benth., *Fl. Austral.* 5: 504 (1870). T: Murchison R., W.A., *s.d.*, *A.Oldfield s.n.*; syn: B, MEL 108129, MEL 108126.

Shrub 0.15–1.6 m tall, usually wider than high, lignotuberous. Branchlets tomentose or appressed-pubescent, with hairs ferruginous or white, sometimes quickly glabrous and glaucous. Leaves flexible, flat or trigonous, rarely terete, narrowly linear, 2.5–13 cm long, 1–4 mm wide, not twisted at base, attenuate, entire, rounded apically, tomentose, quickly glabrescent. Inflorescence axillary with 6–8 flowers; involucre 2–3 mm long; pedicels 1.5–4 mm long, woolly-tomentose or appressed-sericeous, with hairs white or cream-yellow, extending onto perianth. Perianth 2–2.6 mm long, cream-white. Pistil 3–3.2 mm long. Fruit sigmoid, 1.8–4.2 cm long, 1.2–2.5 cm wide, black-pusticulate. Seed 13.5–30 mm long; wing encircling seed body.

Occurs from Kalbarri to south of Perth and inland to Tammin in W.A., in sand in low heath with *Dryandra* or *Banksia prionotes* and *Thryptomene prolifera* or in *Melaleuca* shrubland or on clay flats with *Kingia*, *Xanthorrhoea* and *Melaleuca*. Flowers June–Sept. Map 82.

W.A.: near Arrowsmith R. on the Dongarra road, c. 50 km W of Mingenew, *A.M.Ashby 3250* (AD); 21 km W of Kalbarri turn-off from North West Coastal Hwy, 8 km NW of Mt View, *A.C.Beauglehole 1927* (PERTH); 3.2 km S of Tammin, *K.Newbey 1958* (PERTH); 11 km SE of Irwin, *K.Newbey 2113* (PERTH).

Vegetatively this species is easily confused with *H. stenophylla*, but the latter is usually a small tree and lacks involucral buds in the axils. Flowers are also much larger in *H. stenophylla* and occur at the apex of a branched peduncle.

The detection of any pattern in the variability of this species will require further collections and field investigations. Specimens from the Tammin to Moora area have terete leaves and small fruit c. 2 cm long (*Newbey 1958*) while those from the rest of the range usually have flat leaves with variable fruit size. Fruit of *Newbey 2113* are particularly large (to 4 cm long).

71. Hakea incrassata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 29 (1830)

T: S of Swan R., [W.A.], 1827, *C.Fraser 19 & 32*; syn: BM, CGE (*C.Fraser s.n., p.p.*).

Hakea leucadendron Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 572 (1845). T: cataracts at head of Swan River, W.A., 25 July 1839, *L.Preiss 578*; syn: BR, CGE *p.p.* (as *Preiss 241*), G, G-DC *p.p.*, HBG, L, LD *p.p.*, NY *p.p.*, NY, M, MEL, MO, P, TCD (as *Preiss 241*); Quangen, [near Wongamine, E of Toodyay, W.A.], *L.Preiss 568*; syn: G, G-DC *p.p.*, LD, LE, MEL, NY; Victoria district, W.A., 25 Apr. 1840, *L.Preiss 572*; syn: LD *p.p.*; Swan R. to King George Sound, 1843, *J.Drummond 1: 603*; syn: BM, G, K, LE, MEL, NY *p.p.*, OXF, P.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 72, pl. 103 (1984); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 16, 52 (1997).

Low compact shrub, 0.2–1.6 m tall, lignotuberous. Branchlets white-tomentose. Leaves rigid, flat, narrowly obovate, 1.1–8.5 cm long, 3–11 mm wide, usually twisted at base, attenuate above dilated base, entire, rounded or acute apically, appressed-sericeous, quickly glabrescent. Inflorescence axillary, often arising from old wood, with 6–16 flowers; involucre 4 mm long; pedicels 4–9 mm long, villous, with hairs white or pale brown. Perianth 2 mm long, hirsute, with hairs white or pale brown. Pistil 1.9–2.5 mm long. Fruit globular with tiny lateral apiculum, 1.7–3.3 cm long, 1.5–3.2 cm wide, smooth or black-pusticulate. Seed 12–20 mm diam.; wing encircling seed body. Fig. 10J, K.

Occurs in south-western W.A., between Northampton and Ravensthorpe, north of c. 34ºS; usually found in low open heath in sand or sand over quartzite, laterite or gravel. Flowers June–Nov. Map 83.

W.A.: Geraldton highway, 70 mile peg [112 km] from Perth, *T.E.H.Aplin 17* (PERTH); Kulin, *A.Ashby 149* (PERTH); top of Mt Bakewell, York, *A.S.George 3064* (PERTH); 27 km by road SW of Three Springs on Eneabba road, *P.S.Short 2412 & L.Haegi* (AD, MEL, PERTH).

The twisting through 180° of the base of the leaves is usually sufficient to distinguish this species from *H. candolleana*.

Obliqua Group

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Hakea sect. *Hakea* ser. *Obliquae* Benth., *Fl. Austral.* 5: 491, 498 (1870), *p.p.*

Shrubs, without deeply fissured bark. Leaves simple, terete, not grooved below; venation obscure. Inflorescence an axillary umbel, sometimes arising from older leafless axils, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis obscure. Flowers 1–20, white or yellowish; pedicels pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 3–11 mm long; pollen presenter an oblique disc; gland U-shaped (rarely a V-shaped flap in *H. brachyptera*). Fruit solitary, erect, retained on plant, woody, wrinkled, often with corky surface, not or obscurely beaked, not horned, dehiscing fully down one side. Seed occupying part or most of valve; wing encircling seed body.

A group of five species, all occurring in south-western W.A.

1 Mucro at leaf apex bent (Norseman, Hopetoun, Israelite Bay area, W.A.; flowers Aug.–Oct.) **75. H. adnata**

1: Mucro at leaf apex erect

2 Hairs white or yellow on claw, ferruginous on limb; fruit not noticeably corky with age, if at all; seed occupying most of valve

3 Leaves 2.5–5.5 mm long; perianth 3.5–4.2 mm long; fruit erect (sand plains S of Geraldton, W.A.; flowers Aug.–Sept.) **74. H. polyanthema**

3: Leaves 3–9.5 mm long; perianth 2–2.3 mm long; fruit inserted at right angles to stalk (sand in Nyabing, Pingrup & Ongerup area of W.A.; flowers Sept.) **76. H. brachyptera**

2: Hairs on perianth all white or yellow; fruit with conspicuous corky outgrowths with age; seed occupying part of valve

4 Non-lignotuberous straggling shrub to 4 m tall; perianth 6.5–9 mm long; pistil 10–11 mm long; disc of pollen presenter 1.5–1.8 mm long (Perth to Geraldton, W.A.; flowers Sept.–Oct.) **73. H. psilorrhyncha**

4: ?Lignotuberous dense shrub to 2 m tall; perianth 4.5–7.5 mm long; pistil 6–10 mm long; disc of pollen presenter 0.8–1 mm long (sand plains from Coorow to Israelite Bay, W.A.; flowers Aug.–Oct.) **72. H. obliqua**

72. Hakea obliqua R.Br., *Trans. Linn. Soc. London* 10: 180 (1810)

T: Hort. Kew, 1809, *R.Brown Iter Austral. 7*; syn: BM; South Coast, Bay I, [Lucky Bay, W.A.], 1802, *R.Brown Iter Austral. 12*; syn: BM.

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 219 (1990).

Erect dense shrub, 1–2 m tall, non-lignotuberous. Branchlets and young leaves ferruginous. Leaves terete, 1–7 cm long, 1.1–2.5 mm wide, not grooved; mucro erect. Inflorescence with 2–8 flowers; involucre 1.3–5 mm long; pedicels 3.5–6 mm long, appressed-sericeous, with hairs white, extending onto perianth. Perianth 4.5–7.5 mm long. Pistil 5.5–10 mm long; disc of pollen presenter 0.8–1 mm long; gland 1.2–1.5 mm long. Fruit erect, obliquely broadly ovate or obovate, 2–4.5 cm long, 1.3–4 cm wide, initially smooth, with large stout corky projections when mature; beak smooth; apiculum straight or curved, 1–6 mm long. Seed 23–28 mm long, occupying part of valve; wing encircling seed body.

Found in W.A. from Coorow to Albany area and east to Israelite Bay.

There are two taxa within this species, one confined to sand plains between the Stirling Ra. and Israelite Bay and the other from more northerly localities and overlapping in distribution with *H. psilorrhyncha* (and possibly *H. obliqua* subsp. *obliqua* at its most easterly distribution, although this remains to be confirmed).

Pedicels 3.5–6 mm long; perianth 5.5–7.5 mm long; pistil 6.5–10 mm long; leaves 1.1–2.5 mm wide; fruit 3–4.5 cm long, 2.1–3.5 cm wide, at least in older fruit with a thick corky layer **72a.** subsp. **obliqua**

Pedicels 1.5–2.5 mm long; perianth 4.5–5.5 mm long; pistil 5.5–6.5 mm long; leaves 1.2–1.5 mm wide; fruit (1.7–) 2.7–3.5 cm long, 1.3 cm wide **72b.** subsp. **parviflora**

72a. Hakea obliqua R.Br. subsp. **obliqua**

Hakea brookeana F.Muell., *Australas. J. Pharm.* 1(11): 430 (1886). T: Israelite Bay, 'At or towards Mt Ragged', W.A., *s.d.*, *Miss S. Brooke s.n.*; syn: MEL 108085.

Hakea obliqua var. *brooksiana* W.E.Blackall & B.J.Grieve, *How to Know W. Australian Wildfl.* 2nd edn, 1: 116 (1974), *nom. inval.*? (basionym not cited).

Leaves 1.1–2.5 mm wide. Involucre 3.5–5 mm long. Pedicels 3.5–6 mm long. Perianth 5.5–7.5 mm long. Pistil 6.5–10 mm long; gland 1.2–1.5 mm long. Fruit 3–4.5 cm long, 2.1–3.5 cm wide, covered with stout corky projections with age. Fig. 13P–S.

Occurs on the south coastal plain between Stirling Ra. and Israelite Bay, W.A., inland as far as Pingrup; grows in sand plain heaths. Flowers Sept.–Oct. Map 84.

W.A.: Truslove, between Salmon Gums and Esperance, *W.E.Blackall 1034* (PERTH); between Pingrup and Lake Grace, *W.E.Blackall 3056* (PERTH); Bremer Bay Rd, 3.2 km W of Bremer Bay, *R.Filson 9110* (MEL); c. 55 km E of Condingup on Fisheries Rd, *D.B.Foreman 1319* (MEL); Cape Le Grand Natl Park, by Rossiter Bay, *A.Strid 21232* (PERTH).

Fruit from more easterly locations in the distributional range of this subspecies show a more marked corkiness in contrast to collections from westerly locations. This characteristic is also exhibited by fruit of *H. pandanicarpa*. Specimens from Esperance are noticeably much more corky than those from Ravensthorpe, and this led to Mueller describing *H. brookeana*. There is no other character to support recognition of this taxon.

The correct spelling of the name of collector of the type material is apparently Brooks and thus the species should have been named *brooksiana*. Mueller changed the spelling to *brooksiana* in his second Systematic Census (1889).

72b. Hakea obliqua subsp. **parviflora** R.M.Barker, *J. Adelaide Bot. Gard.* 13: 99 (1990)

T: 20 km W of Coorow, W.A., 28 Aug. 1973, *E.C.Nelson 17237*; holo: PERTH; iso: CANB.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 19, 76 (1997).

Leaves 1.2–1.5 mm wide. Involucre 2–3 mm long. Pedicels 1.5–2.5 mm long. Perianth 4.5–5.5 mm long. Pistil 5.5–6.5 mm long; gland 0.5–0.7 mm long. Fruit (1.7–) 2.7–3.5 cm long, 1.3 cm wide, ±smooth apart from sparse corky projections.

Occurs in south-western W.A. from about Coorow to Fitzgerald River Natl Park; grows in sand heaths. Flowers Aug.–Sept. Map 85.

W.A.: 5 km S of Namban R., *J.S.Beard 7847* (NSW); between Watheroo and Coorow, *W.E.Blackall 2583* (PERTH); Dragon Rock Nature Reserve, 75 km E of Kulin, *J.M.Brown 088* (PERTH); Wongan Hills, *K.F.Kenneally 5822* (PERTH).

73. Hakea psilorrhyncha R.M.Barker, *J. Adelaide Bot. Gard.* 13: 98 (1990)

T: c. 25 km NW of Badgingarra, W.A., 1 Nov. 1965, *P.G.Wilson 3878*; holo: PERTH; iso: AD.

[*Hakea obliqua auct. non* R.Br.: A.S.George, *Introd. Proteaceae W. Australia* 68, pl. 96, 97 (1984)]

Illustrations: A.S.George, *loc. cit.*, as *H. obliqua*.

Erect shrub, 1–4 m tall, non-lignotuberous. Branchlets and young leaves ferruginous. Leaves 2–9.6 cm long, 1.5–2.5 mm wide, grooved or not basally on lower side; mucro erect. Inflorescence with 6 or 8 flowers; involucre 5–5.5 mm long; pedicels 6–8 mm long, densely appressed-sericeous; hairs cream-white or golden, extending onto perianth. Perianth 6.5–9 mm long. Pistil 10–11 mm long; disc of pollen presenter 1.5–1.8 mm long; gland

1.6–1.7 mm long. Fruit erect, obliquely ovate, 3.5–5 cm long, 1.5–2.3 cm wide, with stout corky projections; beak smooth; apiculum 5–10 mm long. Seed 24–28 mm long, occupying part of valve; wing encircling seed body. Fig. 13 I–O.

Occurs in sand or clay in mallee or open heath between Geraldton and Perth, W.A. Flowers Sept.–Oct. Map 86.

W.A.: 10 km S of Moore R., *P.Armstrong 80* (PERTH); 7 km S of Eneabba, *E.A.Griffin 958* (PERTH); 15 km N of Cataby Ck, *R.J.Hnatiuk 760080* (PERTH); 27 km by road SW of Three Springs on Eneabba road, *P.S.Short 2411 & L.Haegi* (AD, PERTH); c. 25 km NW of Badgingarra, *P.G.Wilson 3878* (PERTH).

74. Hakea polyanthema Diels, *Bot. Jahrb. Syst.* 35: 161 (1904)

T: Greenough R. Crossing, W.A., 10 Sept. 1901, *L.Diels 6017*; ?holo: B.

Dense much-branched shrub, 0.7–1.3 m tall, non-lignotuberous. Branchlets and young leaves appressed-pubescent, ferruginous. Leaves 2.5–5.5 cm long, 0.8–1.2 mm wide, ungrooved; mucro erect. Inflorescence with 2, 4 or 6 flowers; involucre 1.3 mm long; pedicels 1.5–2.5 mm long, densely appressed-sericeous, with hairs white or cream-yellow, continuing onto claw. Perianth 3.5–4.2 mm long, with hairs white or cream-yellow on claw, ferruginous on limb. Pistil c. 5 mm long; disc of pollen presenter 0.9–1 mm long; gland 1 mm long, erect. Fruit erect, ovate or obliquely ovate, 2.5–3.5 cm long, 1.5–1.9 cm wide, rugose-reticulate, somewhat corky; beak absent; apiculum 3.5 mm long. Seed 25 mm long, occupying almost whole valve; wing encircling seed body.

Occurs in sand plains south of Geraldton, W.A., in open shrubland. Flowers Sept. Map 87.

WA: c. 20 km S of Cliff Head, *H.Demarz 1510* (PERTH); On Burma Rd, 16–18 km NW from Midlands Rd, *D.B.Foreman 585* (MEL); c. 29 km SE of Walkaway, *A.S.George 7862* (PERTH); 7 km S of Eneabba, *E.A.Griffin 955* (PERTH); Western Titanium leases, 8 km S of Eneabba, *R.Hnatiuk 771279* (PERTH); 11 km S of Irwin, *K.Newbey 2111* (PERTH).

Only known by a few collections, *H. polyanthema* is distinguished from *H. obliqua* by its smaller flowers in which the limb has a rusty tomentum contrasting with white hairs on the claw, and the seed occupies the whole valve. It resembles *H. brachyptera* in fruit and flowers, but can be distinguished from it by its larger gland and erect fruit.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

75. Hakea adnata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 26 (1830)

T: south west coast of New Holland, [W.A.], 1823, *W.Baxter 160*; syn: BM, K *p.p.*

Hakea lativalvis F.Muell., *Fragm.* 6: 219 (1868). T: west end of Russel R., W.A., *s.d.*, *Anon. s.n.*; syn: MEL 108056; Esperance, W.A., 17 Sept.?, *G.Maxwell s.n.*; syn: K *p.p.*, MEL 108055; without locality, *s.d.*, *Anon. s.n.*; syn: MEL 108057; Sand plains N of Cape Arid, W.A., *s.d.*, *Anon. s.n.*; syn: MEL 108058.

Upright stiff broom-like shrub, 1–3.5 m tall, non-lignotuberous. Branchlets and young leaves ferruginous. Leaves 2.5–13 cm long, 1–1.5 mm wide, constricted basally, ungrooved; mucro bent. Inflorescence with 2, 4 or 6 flowers; involucre c. 3 mm long; pedicels 2–2.5 mm long, densely appressed-sericeous, with hairs white, extending onto perianth. Perianth 4.5–5.5 mm long. Pistil 7.5–10 mm long; disc of pollen presenter 0.8–0.9 mm long; gland 1.2–1.4 mm long, ±erect. Fruit erect or inserted at angle to stalk, obliquely obovate, 2.5–3.8 cm long, 2–3 cm wide, finely black-pusticulate or smooth; beak decurrent down one side; apiculum 1–2 mm long. Seed 16–23 mm long, occupying part of valve; wing encircling seed body.

Occurs in south western W.A. between Hopetoun, Norseman and Israelite Bay; grows in sand in *Banksia speciosa* heathland or shrub mallee. Flowers Aug.–Oct. Map 88.

W.A.: 13.5 km N of Mt Ridley, *W.Archer 1808902* (AD, HO, PERTH); 16 km N of Esperance, *J.S.Beard 2325* (PERTH); c. 10.5 km W of Israelite Bay, *A.S.George 2139* (PERTH); c. 20 km N of Israelite Bay, *R.Hnatiuk 761233* (PERTH); 5 km N of Gibson, *R.D.Royce 3568* (PERTH).

Hakea adnata is usually easily distinguished from other terete-leaved species in the region by its bent, rather than upright, mucro.

76. Hakea brachyptera Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 396 (1856)

T: Swan R., W.A., 1848, *J.Drummond 4: 291*; syn: B, BM, CGE, G, K, MEL, MO, NSW, NY *p.p.*, OXF, P, PERTH, TCD; ?syn: K, MEL 675018, MEL 675017.

Hakea brachyptera Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 4: 208 (1852), *nom. nud.*

Dense shrub, 0.4–1 m tall, ?non-lignotuberous. Branchlets and young leaves ferruginous. Leaves 3–9.5 cm long, 0.7–1.3 mm wide, not grooved, tomentose to appressed-pubescent, glabrescent; mucro erect. Inflorescence with 1–5 flowers; involucre c. 2.5 mm long; pedicels 1.5–2.5 mm long, white appressed-pubescent. Perianth 2–2.3 mm long; hairs white on claw, ferruginous on limb. Pistil 3–3.4 mm long; disc of pollen presenter 0.5–0.6 mm long; gland 0.1–0.2 mm high. Fruit inserted at right angles to stalk, obliquely ovate, 2–2.8 cm long, 1.7–2 cm wide, rugose-reticulate, ?sparsely pubescent, obscurely apiculate. Seed 17–20 mm long, occupying almost whole valve; wing encircling seed-body. *Short-winged Hakea*.

Occurs in south-western W.A. from Wagin to L. Magenta and south to near the Stirling Ra., in sand. Flowers Aug.–Sept. Map 89.

W.A.: Lake Magenta Rd, *H.Demarz 10551* (PERTH); Nyabing to Pingrup, *N.L.McKenzie 602* (PERTH); c. 25.5 km N of Ongerup, *K.Newbey 1202 & 1202D* (PERTH).

Hakea brachyptera approaches very closely in habit and fruit some of the specimens of *H. polyanthema*. in addition to its different distribution, it has smaller flowers and a small gland to distinguish it from *H. polyanthema*, as well as the fruit inserted at right angles to the stalk. in the open state the fruit valves remain joined along one side for much of their length, while in the fruit of *H. polyanthema* the valves separate almost fully down both sides.

Ceratophylla Group

Hakea sect. *Hakea* ser. *Obliquae* Benth., *Fl. Austral.* 5: 491, 498 (1870), *p.p.*

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Shrubs, rarely small trees, without deeply fissured bark. Leaves unlobed or lobed, flat, non-petiolate, not stem-clasping, entire or toothed along apical margin; venation obscure. Inflorescence an axillary umbel, rarely a short raceme, sometimes arising from older leafless axils, not resprouting from old rachises in subsequent years, not developing within involucre; rachis obscure or to 10 mm long. Flowers 2–14; pedicels pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 7–16 mm long; pollen presenter an oblique disc; gland U-shaped or a curved flap. Fruit solitary, erect, retained on plant, woody, wrinkled, rarely with corky outgrowths, obscurely beaked, not horned, dehiscing fully down one side. Seed occupying part of valve; wing encircling seed body or broadly down one side, partially or fully down other or on one side only.

A group of six species, all occurring in south-western W.A.

1 Leaves flabelliform, toothed on broad distal apex, with margins otherwise entire

2 Leaf apex truncate; shrub less than 1 m tall; gland a small flap (sand heaths of Jurien Bay area, W.A.; flowers Oct.–Nov.) **80. H. flabellifolia**

2: Leaf apex rounded; erect shrub usually more than 1 m tall; gland U-shaped

3 Hairs on perianth raised, not sericeous; mature buds 7–9 mm long; red-brown wood zone adjacent to seed and on side of fruit which opens fully, broad at base, narrowing towards apex (Stirling Ra. to Albany, W.A.; flowers Oct.–Nov.) **77. H. baxteri**

3: Hairs on perianth appressed-sericeous; mature buds 5–7 mm long; red-brown wood zone adjacent to seed and on side of fruit which opens fully, narrow and of similar width from base to apex (sand plains and sand heaths from Three Springs to Ongerup, possibly S to Stirling Ra. and Albany, W.A.; flowers Sept.–Nov.) **78. H. brownii**

1: Leaves linear, elliptic, obovate or 3–5-lobed, not flabelliform

4 Hairs on pedicel white or cream-yellow, on perianth ferruginous; perianth 2–3.5 mm long; gland a curved flap (fruit 5–5.5 cm long; Fitzgerald R. area, W.A.; flowers Sept.–Jan.) **81. H. hookeriana**

4: Hairs on pedicel and perianth of similar colour throughout; perianth more than 4.5 mm long; gland U-shaped

5 Fruit 4.5–5.5 cm long, sometimes with corky outgrowths; seed body with slender dagger-like projections; inflorescence racemose on 1–10 mm long rachis; perianth 6–11 mm long (Stirling Ra. to Israelite Bay, W.A.; flowers Sept.–Nov.) **82. H. pandanicarpa**

5: Fruit 2–3.5 cm long, lacking corky outgrowths; seed body lacking projections; inflorescence umbelliform on obscure rachis; perianth 4.5–6 mm long (Perth to Albany, W.A.; flowers Sept.–Dec. (–Feb.)) **79. H. ceratophylla**

77. Hakea baxteri R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 28 (1830)

T: King George Sound, W.A., 1829, *W.Baxter s.n.*; syn: BM, K.

Hakea salisburioides Hort. ex Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 409 (1856), as *H. salisburyoides*, *pro. syn.* under *H. baxteri*. T: not designated.

Erect shrub, 1–5 m tall, non-lignotuberous. Branchlets and young leaves densely appressed-ferruginous, glabrescent by flowering. Leaves flabelliform with deeply concave margins, 4–8 cm long, 3–9 cm wide, narrowly cuneate, entire; apex broadly rounded, spinose. Inflorescence umbelliform with 4–8 flowers; rachis obscure; pedicels 3–4 mm long, densely ferruginous, with hairs raised, not sericeous, continuing onto perianth. Perianth 7–9 mm long. Pistil 7.5–10 mm long; gland U-shaped. Fruit obliquely ovate or obovate, 3–4.5 cm long, 2–3.5 cm wide, rugose-reticulate. Seed obliquely elliptic or obovate, 20–30 mm long; wing broadly down one side of seed body, narrowly down other. *Fan Hakea*. Fig. 12J–N.

Occurs in south-western W.A. between the Stirling Ra., Albany and Bremer Bay, in heath scrub on rocky quartzitic slopes. Flowers Oct.–Nov. Map 90.

W.A.: 32 km E of Cranbrook, Chester Pass Rd, *A.S.George 403* (PERTH); Red Gum Pass, *A.Morrison s.n.* (PERTH); Stirling Ra., upper W part of Modurup Peak, *A.Strid 21541* (PERTH).

A poorly collected species distinguishable from its sister species, *H. brownii*, by its larger flowers with woolly non-appressed indumentum, different wood structure in the fruit with a very broad red-brown wood zone basally, the seed wing very narrow on only one side of the seed body, the lack of a lignotuber, its habit (erect shrub) and locality.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

Salisburiae adiantifolia Sm. is a later name for *Gingko biloba* L., and the name *Hakea salisburioides* was presumably used in horticultural circles because of the resemblance of the leaves of *Hakea baxteri* to those of *Gingko*.

78. Hakea brownii Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 569 (1845)

T: between R. Gordon and Warrcup [Warriup] Hills, W.A., 6 Nov. 1840, *L.Preiss 552*; syn: B, G, G-DC (microfiche seen), MEL, NY, P.

[*Hakea baxteri auct. non* R.Br.: A.S.George, *Introd. Proteaceae W. Australia* 66 (1984)]

Illustrations: A.S.George, *loc. cit.*; J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 366 (1988), both as *H. baxteri*; J.Young, *Hakeas of W. Australia, Botanical District of Avon* 13, 30 (1997).

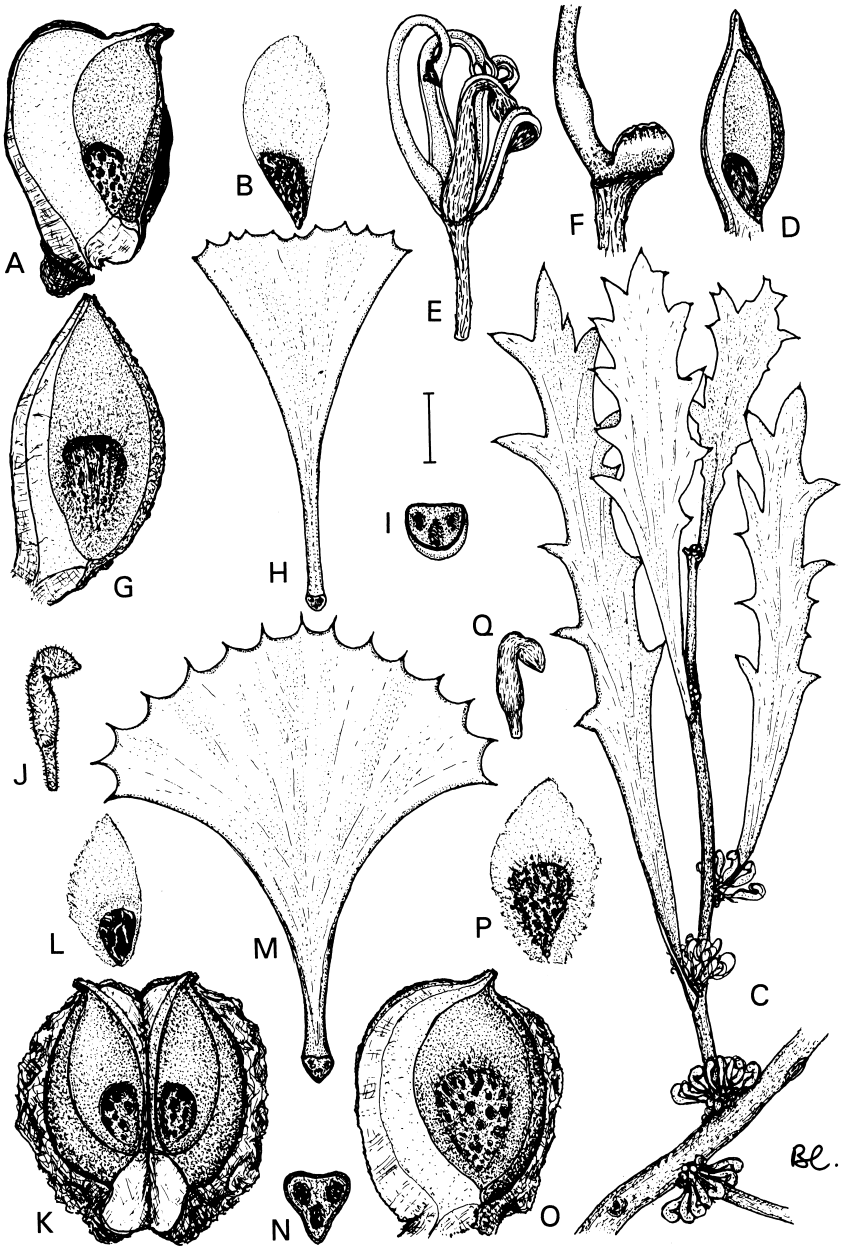

Figure 12. *Hakea*. **A–B**, *H. hookeriana*. **A**, fruit; **B**, seed (**A–B**, B.Barnsley 518, CANB). **C–F**, *H. ceratophylla*. **C**, habit; **D**, inside of fruit (**C–D**, Dec. 1912, E.N.S.Jackson, AD); **E**, flower; **F**, torus (**E–F**, R.A.Saffrey 1774, PERTH). **G–I**, *H. flabellifolia*. **G**, inside of fruit (H.Demarz 3511, PERTH); **H**, leaf; **I**, leaf scar (**H–I**, R.D.Royce 7716, PERTH). **J–N**, *H. baxteri*. **J**, bud (A.George 403, PERTH); **K**, open fruit with seeds inside; **L**, seed; **M**, leaf; **N**, leaf scar (**K–N**, M.Phillips *s.n.*, CANB016644). **O–Q**, *H. brownii*. **O**, fruit; **P**, seed; **Q**, bud (**O–Q**, R.W.Purdie 5313, CANB). Scale bar: **A–B**, **D**, **G**, **K–L**, **O–P** = 1.3 cm; **C**, **H**, **M** = 1 cm; **E** = 2.5 mm; **F** = 2 mm; **I**, **N** = 3 mm; **J**, **Q** = 5 mm. Drawn by Beth Chandler.

Spreading or erect shrub, 0.4–2.5 m tall, lignotuberous. Branchlets and young leaves densely appressed-ferruginous, glabrescent by flowering. Leaves flabelliform with deeply concave margins, 2.8–6.5 cm long, 2.3–7 cm wide, narrowly cuneate, entire, broadly rounded apically, spinose. Inflorescence umbelliform with 6–10 flowers; rachis obscure; pedicels 2–6 mm long, densely appressed-sericeous, with hairs ferruginous, continuing onto perianth. Perianth 5–7 mm long. Pistil 7–9 mm long; gland U-shaped. Fruit obliquely broadly obovate to obovate, 3.5–5 cm long, 4–4.5 cm wide, coarsely rugose or rugose-reticulate. Seed elliptic or obovate, 25–30 mm long; wing encircling seed body. *Fan Hakea*. Fig. 12 O–Q.

Occurs on sand plains and in sandy heaths from Three Springs south to Ongerup, with possibly erroneous old records from Stirling Ra. and Albany, W.A. Flowers Sept.–Nov. Map 91.

W.A.: between Pingrup and Ongerup, *W.E.Blackall 3119* (PERTH); 11 km NW of Jitarning, *D.B.Foreman 1130* (AD, MEL, PERTH); 8 km W of Mogumber township, *A.S.George 11212* (AD, PERTH); 27 km by road SW of Three Springs on Eneabba road, *P.S.Short 2409* & *L.Haegi* (AD, MEL, PERTH).

79. Hakea ceratophylla (Sm.) R.Br., *Trans. Linn. Soc. London* 10: 184 (1810)

Conchium ceratophyllum Sm., in A.Rees *Cycl.* 9 (1807), pages unnumbered. T: King George Sound, [W.A.], 1792, *A.Menzies s.n.*; syn: BM, LINN.

?*Hakea cervina* Dum.Cours., *Bot. Cult.* 2nd edn, 2: 633 (1811); 7: 110 (1814), *nom. illeg.* (*Conchium ceratophyllum* Sm. in synonymy). T: 'New Holland'; holo: not located.

?*Hakea acanthophylla* Link, *Enum. Hort. Berol. Alt.* 1: 118 (1821). T: 'in Australia'; holo: not located.

Hakea myricaefolia A.Cunn. ex Don, in R.Sweet, *Hort. Brit.* 3rd edn, 768 (1839), *nom. nud.*

Hakea ceratophylla var. *subintegrifolia* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 570 (1845). T: Nelson district [near Capel], W.A., 26 Dec. 1839, *L.Preiss 579*; syn: B, BR, G, G-DC (microfiche seen), HBG, L, LD, LE (and as *Preiss 890*), M, MEL, ?MO, NY, P, TCD (as *Preiss 890*).

Hakea ceratophylla var. *tricuspis* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 570 (1845). T: in region interior Australiae merid.-occid., [W.A.], Oct. 1840, *L.Preiss 588*; syn: LD, LE, ?NY (label for *Preiss 588* on same sheet as *Preiss 579* (see above) but no specimen with it).

Hakea ceratophylla var. *laciniata* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 570 (1845), *nom. illeg.* (*H. ceratophylla* (Sm.) R.Br. in synonymy). T: Wuljenup, Plantagenet [Willyung Hill], W.A., *s.n.*, *L.Preiss 580*; syn: B, Br, G, HBG, LE, MEL, NY; Wuljenup, Plantagenet [Willyung Hill], W.A., *s.n.*, *L.Preiss 581*; syn: BR, LE.

Hakea laciniosa F.Muell., *Fragm.* 4: 49 (1863). T: Lake Leven [not located], W.A., *s.d.*, *G.Maxwell s.n.*; syn: K *p.p.*, MEL 108088.

Hakea ceratophylla var. *elongata* Benth., *Fl. Austral.* 5: 502 (1870). T: south-western W.A., *s.d.*, *J.Drummond 4: 297*; syn: G, K, MEL, P, TCD; ?syn: LE, MEL 111860, OXF (as *Drummond 291*).

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 366 (1988).

Rigid multi-stemmed shrub, 0.5–2 m tall, ?lignotuberous. Branchlets and young leaves ferruginous, with hairs appressed or raised, glabrescent. Leaves linear to narrowly obovate, 4.5–23 cm long, entire and 0.2–1.4 cm wide, or 3–5-lobed and 3.5–8.5 cm wide, narrowly cuneate at base; lobes 1–26 mm long, apically rounded or acute. Inflorescence umbelliform with 2–10 flowers; rachis obscure; pedicels 2–5 mm long, tomentose or appressed-pubescent, with hairs white, ferruginous or mixed, the ferruginous hairs extending onto perianth. Perianth 4.5–6.mm long. Pistil 7.5–9.5 mm long; gland U-shaped. Fruit obliquely ovate, 2–3.5 cm long, 0.9–1.3 cm wide, black-pusticulate. Seed obliquely elliptic, 12–20 mm long, broadly flanked by red-brown wood zone; wing narrowly down one side only. *Horned Leaf Hakea*. Fig. 12C–F.

Occurs in south-western W.A. between Perth and Albany, including the Stirling Ra. Found in swampy areas in sand plain, heath or paperbark *Melaleuca*, or in sandy ground near sea. Flowers Sept.–Dec. (–Feb.). Map 92.

W.A.: Hardy Rd, Forrestfield, *R.J.Cranfield 130* (PERTH); Ruabon, Busselton to Capel, *G.Keighery 7402* (PERTH); 13 km W of Denmark, *K.Newbey 2982* (PERTH); Cowaramup, *R.D.Royce 1415* (PERTH); 6 km off South Coast Hwy along Nanarup Rd, *A.Strid 21634* (PERTH).

Although there are a number of varieties already described for this species, predominantly based on leaf shape, these seem to be untenable. Modern collections with unlobed leaves

(equivalent to var. *subintegrifolia*) predominate from paperbark swamps near Busselton. However, there are older collections (*Gilbert 233*, BM) which match this variety from paperbark swamps north of Perth, and other collections from paperbark swamps (*R.A.Saffrey 1774*) which exhibit the more typical lobed leaves of the species. Similarly var. *elongata* Benth. (leaves 2–4 mm wide) seems to be restricted to the Denmark/Stirling Ra. area, and, although very distinctive, there are specimens in which the elongated leaves broaden into lobed leaves towards the apex. Other differences occur between specimens with respect to the colour of the hairs on the pedicel and perianth and their appression. in some collections the hairs are almost approaching appressed-sericeous, while in others they are more 'woolly' in appearance.

80. Hakea flabellifolia Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 116 (1855)

T: interior, North of Swan R. between Moore and Murchison R., W.A., *s.d., J.Drummond 6: 196*; holo: NY *p.p.*; iso: ?B, BM, CGE, K, MEL, OXF, P, PERTH.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 66 (1984); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 206 (1990).

Several-stemmed shrub, 0.2–1 m tall, lignotuberous. Branchlets and young leaves appressed-sericeous, ferruginous, quickly glabrescent. Leaves flabelliform with shallowly concave margins, 3.8–6.7 cm long, 18–48 mm wide, narrowly cuneate, entire; apex ±truncate, irregularly 5–15-toothed. Inflorescence umbelliform with 2–6 flowers; rachis obscure; pedicels 2–3 mm long, densely appressed-pubescent, with hairs white or ferruginous or a mixture of both, continuing onto perianth. Perianth 4–5 mm long. Pistil 8–12 mm long; gland a curved flap. Fruit obliquely broadly ovate, 4.5–5.5 cm long, 3–3.2 cm wide, coarsely rugose, black-pusticulate. Seed obliquely ovate or elliptic, 45–48 mm long; wing encircling seed body. *Wedge Hakea*. Plate 9; Fig. 12G–I.

Occurs in sand heaths in the Jurien Bay to Eneabba area, north of Perth, W.A. Flowers Oct.–Nov. (?buds in Feb. on one collection). Map 93.

W.A.: 26 km S of Eneabba, 10 Aug. 1979, *R.J.Cranfield s.n.* (PERTH); 64 km W of Coorow, *H.Demarz 3511* (PERTH); near Mt Lesueur, *C.A.Gardner 15996* (PERTH); Cockleshell Gully, *E.A.Griffin 2428* (PERTH); Jurien Bay, *R.D.Royce 7716* (PERTH).

81. Hakea hookeriana Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 412 (1856)

T: Swan R., W.A., *s.d., J.Drummond 5, 413*; syn: B, BM, CGE, G, K, MEL, NY, OXF, P, PERTH, TCD.

Hakea hookeriana Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 4: 208 (1852), *nom. nud.*

Erect open shrub, 1–5 m tall, non-lignotuberous. Branchlets and young leaves densely appressed-pubescent, ferruginous, quickly glabrescent. Leaves narrowly obovate or obovate, 7–13 cm long, 10–25 mm wide, narrowly attenuate, entire, abruptly short-acuminate, truncate or rounded, blackened at apex. Inflorescence umbelliform with 5, 7 or 9 flowers; rachis obscure; pedicels 2 mm long, densely appressed-pubescent with white or cream-yellow hairs. Perianth 2–3.5 mm long, densely appressed-pubescent, ferruginous. Pistil 5–5.5 mm long; gland a curved flap. Fruit obliquely obovate, 5–5.5 cm long, 2.7–3.3 cm wide, finely rugose. Seed obliquely obovate, 30–33 mm long; wing broadly and partly down one side of seed body only. Fig. 12A, B.

Found only in the eastern part of Fitzgerald River Natl Park, but apparently common there (K.Newbey, in *litt.*). Occurs in rocky quartzite gullies or cliff tops in scrub including *Dryandra quercifolia*. Flowers Sept.–Jan. Map 94.

W.A.: Middle Mt Barren, Whoogarup Ra., *C.A.Gardner 2969* (PERTH); cliff-top below East Mt Barren, *A.S.George 585* (PERTH); Thumb Peak Ra., SW of Ravensthorpe, *A.S.George 7156* (PERTH); Eyre Ra., *A.S.George 7240* (PERTH).

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

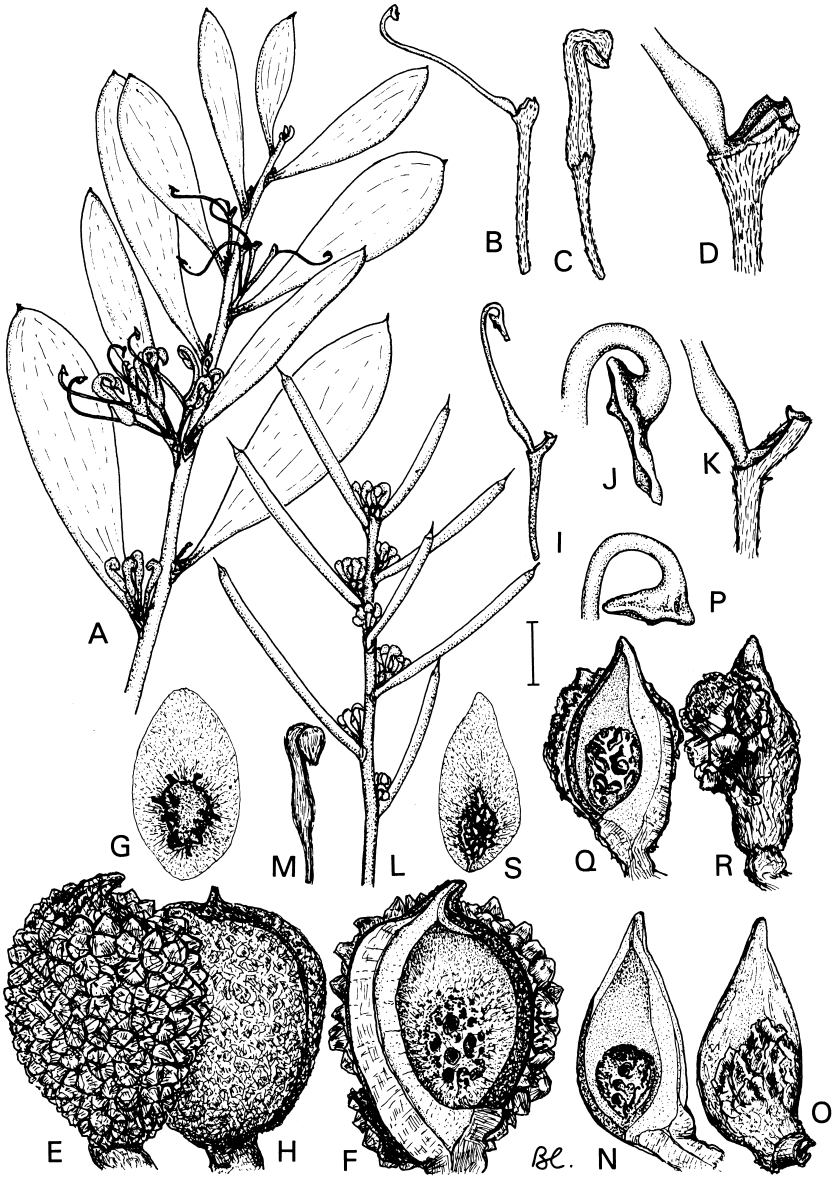

Figure 13. *Hakea*. **A–G**, *H. pandanicarpa* subsp. *pandanicarpa.* **A**, habit; **B**, flower without tepals; **C**, bud; **D**, gland (**A–D**, J.W.Green 4520, PERTH); **E**, outside of fruit (cult. Wittunga Botanic Garden, S.A.); **F**, inside of fruit (May 1924, C.A.Gardner, PERTH); **G**, seed (R.Hnatiuk 761045, PERTH). **H**, *H. pandanicarpa* subsp. *crassifolia*, outside of fruit (cult. Wittunga Botanic Garden, S.A.). **I–O**, *H. psilorrhyncha*. **I**, flower without tepals; **J**, pollen presenter; **K**, gland; **L**, habit (E.A.Griffin 958, PERTH); **M**, bud (E.M.Bennett 1368, PERTH); **N**, inside of fruit; **O**, outside of fruit (**I–K**, **N–O**, P.G.Wilson 3878, PERTH). **P–S**, *H. obliqua* subsp. *obliqua*. **P**, pollen presenter (T.E.H.Aplin 4217, PERTH); **Q**, inside of fruit; **R**, outside of fruit (**Q–R**, cult. Adelaide Botanic Garden); **S**, seed (P.G.Wilson 3878, PERTH). Scale bar: **A**, **L**, **N**, **O**, **Q–S** = 1 cm; **B–C** = 5 mm; **D**, **K** = 2 mm; **E–H** = 1.3 cm; **I**, **M** = 5 mm; **J**, **P** = 0.8 mm. Drawn by Beth Chandler.

82. Hakea pandanicarpa R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 29 (1830)

T: inter Cape Arid et Lucky Bay, W.A., [1824], *W.Baxter s.n.*; ?holo: BM.

Hakea roei Benth., *Fl. Austral.* 5: 499 (1870). T: int. S.W. Australia, *s.d.*, *J.S.Roe s.n.*; ?holo: K.

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 385 (1988); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 222 (1990).

Small tree or shrub, rounded or erect, 1–4 m high, non-lignotuberous. Branchlets and young leaves appressed-pubescent, ferruginous. Leaves simple, narrowly elliptic or obovate, 3–12 cm long, 0.3–3 cm wide, attenuate, entire, rounded, rarely truncate. Inflorescence a raceme with 4–14 flowers; rachis 1–10 mm long, tomentose; pedicels 5–7.5 mm long, densely appressed-pubescent with hairs ferruginous and white, extending onto perianth. Perianth 6–11 mm long, cream-white inside. Pistil 13–16 mm long; gland U-shaped. Fruit obliquely obovate, 4.5–5.5 cm long, 3.7–4.5 cm wide, coarsely rugose or with large corky tubercles. Seed broadly ovate, elliptic or obovate, 25–36 mm long; wing encircling seed body.

Occurs from the Stirling Ra. to Israelite Bay, W.A., in sand plain with low shrubland or heath, sometimes mallee. Two subspecies are recognised.

Fruit surface with distinctly raised corky tetrahedral projections	**82a.** subsp. **pandanicarpa**
Fruit surface with rugose-reticulate pattern but lacking any corky tetrahedral projections	**82b.** subsp. **crassifolia**

82a. Hakea pandanicarpa R.Br. subsp. **pandanicarpa**

Leaves 0.3–1.6 mm wide; rachis 3–10 mm long. Fruit with corky tetrahedral protuberances of ±uneven size. Plate 11; Fig. 13A–G.

Occurs from Ravensthorpe to Israelite Bay, near the south coast of W.A. Flowers Oct.–Nov. Map 95.

W.A.: near Grasspatch, May 1924, *C.A.Gardner s.n.* (PERTH); near Gibson, *C.A.Gardner & W.E.Blackall 1116* (PERTH); Ravensthorpe Ra., highest point on road N of Elverdton Copper Mine, *J.W.Green 4520* (PERTH); SE of Boyatup Hill, *L.Haegi 1243* (PERTH); between the Hamersley R. and East Mount Barren, *B.R.Maslin 888* (PERTH).

82b. Hakea pandanicarpa subsp. **crassifolia** (Meisn.) R.M.Barker, *J. Adelaide Bot. Gard.* 13: 105 (1990)

Hakea crassifolia Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 570 (1845). T: Konkoberup, [Mt Melville near Cape Riche], W.A., 19 Nov. 1840, *L.Preiss 550*; syn: G, G-DC, HBG, LD, LE, M, MEL, MO, NY *p.p.*, P.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 18, 19, 78 (1997).

Leaves 0.6–3.3 mm wide; rachis 1–6.5 mm long. Fruit rugose-reticulate, somewhat corky but protuberances not distinct. Fig. 13H.

Found in an area bounded by Newdegate, Albany and Ravensthorpe, south-western W.A. Flowers (Aug.–) Sept.–Nov. Map 96.

WA: Mt Short, Ravensthorpe, *E.M.Bennett 2493* (PERTH); Kalgan Plains, *C.A.Gardner 777* (PERTH); 37 km S of Borden, *J.W.Green 392* (PERTH); S of Kulin, *R.D.Royce 6678* (PERTH); NW corner of Fitzgerald River Reserve, *R.A.Saffrey 1490* (PERTH).

Platysperma Group

Hakea sect. *Hakea* ser. *Pubiflorae* Benth., *Fl. Austral.* 5: 491, 500 (1870), *p.p.*

Shrubs, without deeply fissured bark. Leaves simple, terete, rarely flattened, sometimes grooved below; venation obscure. Inflorescence an axillary umbelliform raceme, sometimes arising from older leafless axils, sometimes resprouting from old rachises in subsequent years, not developing within involucre; rachis obscure or to 2.5 mm long. Flowers c. 20,

cream-white or red; pedicels pubescent. Perianth curved in bud, splitting to base into 4 distinct tepals, pubescent. Pistil 15–22 mm long; pollen presenter a lateral disc; gland U-shaped. Fruit solitary, erect, retained on plant, woody, smooth, not beaked, not horned, dehiscing fully down one side. Seed occupying part or most of valve; wing encircling seed body, or broadly down one side only, or broadly one side, narrowly the other.

A group of two species, both from W.A.

Flowers cream-white to pink internally; inflorescences not on old wood; leaves terete, not grooved; fruit globose, 3.8–6.5 cm wide, with tiny lateral apiculum; seed circular, 33–46 mm diam. (Three Springs to Boorabbin and S to Hyden, W.A.; flowers July–Oct.) **83. H. platysperma**

Flowers red, becoming black with age; inflorescences often on old wood; leaves flat or terete, the latter grooved on underside; fruit obliquely ovate, 1.5–2.6 cm wide, with very long apiculum at apex; seed obliquely ovate, 22–27 mm long (Murchison R., W.A.; flowers May–Sept.) **84. H. orthorrhyncha**

83. Hakea platysperma Hook., *Icon. Pl.* 5: t. 433 (1841)

T: Swan R. Colony, W.A., *J.Drummond s.n.*; holo: not located.

Illustrations: W.J.Hooker, *Icon. Pl.* 5: t. 433 (1841); A.S.George, *Introd. Proteaceae W. Australia* 76, pl. 112 (1984); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 20, 82 (1997).

Single-stemmed spreading shrub, 1–2 m tall, often slightly wider than high. Branchlets and young leaves appressed-pubescent, ferruginous. Leaves terete, 3–15.5 cm long, 1.4–3 mm wide, constricted at base and yellowish for c. 5 mm, ungrooved; mucro 1–4.5 mm long. Inflorescence axillary with 1–7 flowers; rachis obscure; pedicels 4.5–8 mm long, densely appressed-pubescent, with hairs dark brown. Perianth 5.5–6.5 mm long, cream-white becoming pink internally, appressed-pubescent, with white and ferruginous hairs externally. Pistil 15–17.5 mm long; pollen presenter 3–3.5 mm long. Fruit globose, 4.5–7.5 cm long, 3.8–6.5 cm wide, smooth; beak absent; apiculum obscure, lateral. Seed circular, 33–46 mm diam.; wing encircling seed body. *Broad Seeded Hakea, Cricket Ball Hakea*. Plate 10; Fig. 10G–I.

Occurs in W.A. from Three Springs east to Koolyanobbing and Boorabbin and south to Hyden; grows in sandy heaths, the sand white or yellow and often over laterite. Flowers July–Oct. Map 97.

W.A.: Tammin Reserve, *H.Demarz 9281* (PERTH); c. 30 km E of Emu Hill, on Emu Hill East Rd, *D.B.Foreman 1159* (AD, MEL, NSW); Mortlock Flora Reserve, c. 2.5 km E of St Leonards, N of Wongan–Piawanning road, *K.F.Kenneally 5839* (MEL, PERTH); 67 km E of Hyden, *K.Newbey 1137* (PERTH).

Groom & Lamont (pers. comm.) noted that this species sprouts epicormically.

84. Hakea orthorrhyncha F.Muell., *Fragm.* 6: 214 (1868)

T: R. Murchison, W.A., *s.d., A.F.Oldfield s.n.*; syn: B, K, MEL 108075, MEL 108073, MEL 108074; south-western W.A., *s.d., J.Drummond s.n.*; syn: BRI, K, L, MEL 108021, MEL 108017, ?MEL 675307, P.

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 62, pl. 87 (1984).

Much-branched, straggly shrub, 1–3 m tall, lignotuberous. Branchlets and young leaves densely appressed-pubescent. Leaves terete or flat; mucro erect or bent. Inflorescence axillary or on old wood with c. 20 flowers; rachis 0.5–2.5 mm long; pedicels 4.5–5.5 mm long, moderately appressed-pubescent, with white or ferruginous hairs. Perianth 3.5–6 mm long, mid- to deep red, black with age, sparsely appressed-pubescent on limb, denser on claw, hairs white throughout except for ferruginous limb apex. Pistil 21–22 mm long, red; pollen presenter 1–1.4 mm long. Fruit obliquely ovate, 4–5 cm long, 1.5–2.6 cm wide, smooth; apiculum 8–10 mm long. Seed obliquely ovate, 22–27 mm long; wing broadly down one side of seed body only, or broadly down one side and narrowly down other. *Bird Beak Hakea*.

Occurs on sand, sandstone or loam in high shrubland in the Murchison R. area of W.A.

There have been two varieties described under this species, purely on the basis of terete vs flat leaves. For the present they have been maintained because there is no indication that flat and terete leaves occur on the same bush or in the same locality. Field studies may indicate this not to be so, in which case the variety would become untenable. The terete-leaved variety is the more common.

Leaves flat, 1.3–2.3 mm wide **84a.** var. **orthorrhyncha**

Leaves terete, 0.9–1.3 mm wide **84b.** var. **filiformis**

84a. Hakea orthorrhyncha F.Muell. var. **orthorrhyncha**

Leaves flat, narrowly linear, 7–18 cm long, 1.3–2.3 mm wide, grooved below, attenuate or cuneate, entire; mucro 0.5–1.5 mm long.

Apparently confined to the Kalbarri region, W.A. Flowers May–Sept. Map 98.

W.A.: Murchison R., *C.A.Gardner 13235* (PERTH); 7 km S of Kalbarri, *P.G.Wilson 6578* (PERTH).

84b. Hakea orthorrhyncha var. **filiformis** F.Muell. ex Benth., *Fl. Austral.* 5: 504 (1870)

T: south-western W.A., *s.d.*, *J.Drummond s.n.*; syn: BRI, K, L, MEL108021, MEL675307, MEL108017, P.

Leaves terete, 7–14.5 cm long, 0.9–1.3 mm wide, grooved on lower side; mucro 1–2 mm long.

Found in Murchison R. to Mingenew area of W.A. Flowers May–Sept. Map 99.

W.A.: 12 km W of Mingenew, S of Irwin R., *M.G.Corrick 9804* (AD, MEL); 25.5 km N of Northampton, *K.Newbey 2198* (PERTH); near Ross Graham Lookout, Murchison R. gorge, Kalbarri Natl Park, *P.G.Wilson 6631* (PERTH).

Lissocarpha Group

Hakea sect. *Manglesioides* Benth., *Fl. Austral.* 5: 495, 530 (1870)

Shrubs, rarely small trees, without deeply fissured bark. Leaves simple- or compound-terete, sometimes grooved basally above, or flat, subpetiolate, not stem-clasping, toothed or entire; venation obscure. Inflorescence an axillary or terminal umbelliform raceme (with vegetative shoot arising from base of rachis, below raceme), not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 2–26 mm long. Flowers 8–84; pedicels glabrous. Perianth straight in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 3–4.5 mm long; pollen presenter conical; gland a curved flap. Fruit solitary, (rarely to 3 per inflorescence), often on recurved stalk, retained on plant, woody, pusticulate, not beaked, horned, dehiscing fully down one side. Seed occupying part of valve; wing very variable, encircling seed body or fully or partly down one or both sides.

A group of four species in south-western W.A.

One feature of this group which can be very useful diagnostically is the development of vegetative buds, at the base of the inflorescence, into glabrous or pubescent shoots. In the majority of *Hakea* species vegetative shoots are not formed at the base of the inflorescence until after flowering has taken place, if they occur there at all.

1 Leaves flat, usually spine-toothed (Busselton to Eucla, W.A.; flowers July–Sept., rarely May) **86. H. nitida**

1: Leaves simple- or compound-terete

2 Leaves flexible; young growth pubescent; rachis 17–26 mm long; flowers pale pink turning white (granite areas, Albany to Esperance and islands of Recherche Archipelago, W.A.; flowers Mar.–June) **87. H. drupacea**

2: Leaves rigid; young growth usually glabrous; rachis less than 10 mm long; flowers white, yellow or pink

3 Leaves usually simple, if compound then with 2 or 3 segments, not grooved; rachis glabrous; perianth 1.5–2.5 mm long (from Busselton to Stirling Ra., south-western W.A.; flowers Aug.–Oct.) **88. H. oldfieldii**

3: Leaves compound with up to 14 segments, grooved or not; rachis tomentose; perianth 2.5–4 mm long (widespread in south-western W.A.; flowers May–Sept.) **85. H. lissocarpha**

85. Hakea lissocarpha R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 27 (1830)

T: Swan R., towards source, [W.A.], 1827, *C.Fraser 16*; syn: BM *p.p.*, K (without number); without locality, *s.d., Anon. (?Fraser) 27*; ?syn: BM *p.p.* (on same sheet as *Fraser 16* and matching Fraser type at K).

Hakea bipinnatifida R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 28 (1830). T: occident u meridion, Nov. Holl., [W.A.], received 1826, *Anon. (ex Herb. Mus. Paris) s.n.*; holo: BM (according to the protologue the collector was *Baudin*).

Hakea intricata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 27 (1830). T: between Cape Arid and Lucky Bay, [W.A.], *s.d.* (1829 in the protologue, but the specimen is labelled by Brown as having been received on Jan. 7th, 1825), *W.Baxter s.n.*; ?holo: BM.

?Mercklinia rosea Regel, *Index Sem. Hortus Bot. Petrop.* 25 (1856). T: not located.

?Mercklinia petrophiloides Regel, *Index Sem. Hortus Bot. Petrop.* 25 (1856). T: not located.

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 384 (1988); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 17, 62 (1997).

Dense shrub, erect or spreading, 0.25–3 m tall. Branchlets glabrous, villous or appressed-pubescent. Leaves rigid, compound-terete, 0.9–4 cm long, grooved above or not; ultimate segments up to 14, 0.4–1.3 mm wide. Inflorescence axillary or terminal on short shoots with 20–30 flowers; involucre 3–6 mm long; rachis 2.5–7 mm long, tomentose, with hairs white or cream-yellow; pedicels 3–9 mm long. Perianth 2.5–4 mm long, white, pale yellow or pink. Pistil 3–4 mm long. Fruit obliquely ovate, 1.5–2.5 cm long, 0.7–1.4 cm wide, smooth, black-pusticulate, obscurely apiculate; horns 2–3 mm long. Seed ovate, 9–20 mm long; wing narrowly down one or both sides or encircling seed-body. *Honey Bush, Duck and Drake Bush*. Fig. 11D–F.

A common species in south-western W.A., from Kalbarri (possibly as far north as Hamelin) to Israelite Bay. It is usually associated with laterite, often within *Eucalyptus wandoo* forest, but has also been recorded from granite, sand and clay and from mallee heaths. Flowers May–Sept. Map 100.

W.A.: 24 km E of Jurien, *J.S.Beard 7863* (NSW, PERTH); between Moora and Watheroo, *W.E.Blackall 2556* (PERTH); 3.5 km E of Mt Peron, *E.A.Griffin 2753* (PERTH); Mt Short, c. 15 km E of Ravensthorpe, *G.J.Keighery 6065* (PERTH).

A variable species with respect to pubescence on the leaves and the rachis and also with respect to leaf width and flower colour. The type of *H. bipinnatifida* falls within that group of specimens from coastal localities with very narrow leaves grooved on the upper surface. At least some forms of the species are apparently lignotuberous (*Hnatiuk 760533*), but particularly the smaller bushes, often with pink flowers, of the Esperance district (Bernie Norris pers. comm.).

Pollination biology studies of this species could prove to be rewarding. The red apices of some pollen presenters and the production of pink pollen seen in cultivated specimens at Wittunga Botanic Garden, Adelaide, need further investigation.

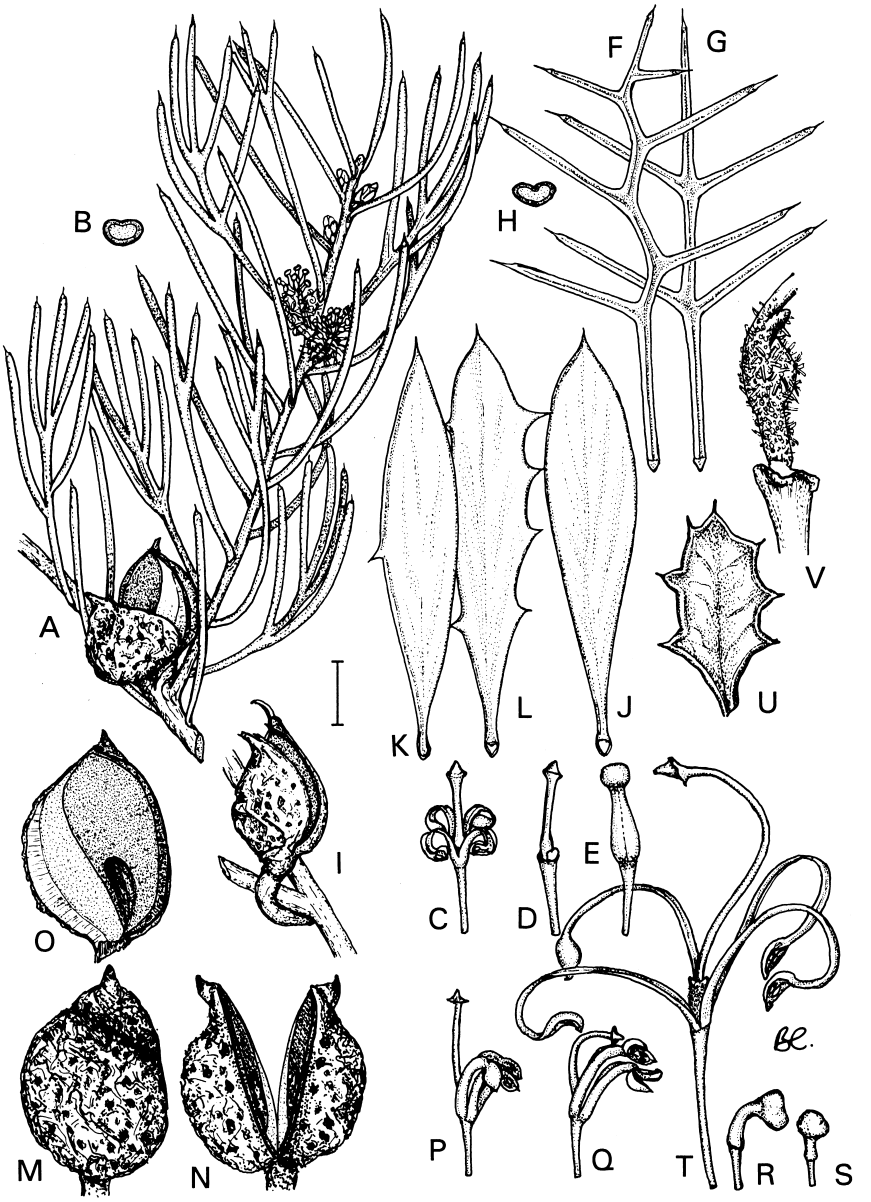

Figure 14. *Hakea*. **A–E**, *H. drupacea*. **A**, habit showing fruit; **B**, 5-section of leaf; **C**, flower with tepals; **D**, flower without tepals; **E**, bud (**A–E**, W.R.Barker 5085, AD, fruit on **A** from May 1924, C.A.Gardner, PERTH). **F–I**, *H. horrida*. **F–G**, leaves; **H**, 5-section of leaf (**F–H**, P.G.Wilson 5758, PERTH); **I**, fruit (D.Monk 296, PERTH). **J–O**, *H. nitida*. **J**, leaf (G.J.Keighery 6921, PERTH); **K–L**, leaves (**K–L**, H.Demarz 1082, PERTH); **M**, fruit; **N**, open fruit; **O**, inside of fruit (**M–O**, M.Burgman 1823 & S.McNee, PERTH). **P–S**, *H. florida*. **P–Q**, flowers; **R–S**, buds (**P–S**, A.George 10586, PERTH). **T–V**, *H. ilicifolia*. **T**, open flower (Oct. 1928, C.A.Gardner & W.E.Blackall, PERTH); **U**, leaf; **V**, ovary (**U–V**, 18 Oct. 1964, K.Newbey, PERTH). Scale bar: **A** = 2 cm; **B** = 3.3 mm; **C–E**, **P–S** = 2.5 mm; **F–G**, **I–O**, **U** = 1 cm; **H** = 2.9 mm; **T** = 2 mm; **V** = 1 mm. Drawn by Beth Chandler.

86. Hakea nitida R.Br., *Trans. Linn. Soc. London* 10: 184 (1810)

T: Bay I, South Coast, [Lucky Bay, W.A.], 1802, *R.Brown s.n.*; syn: BM, K *p.p.*; Hort. Kew, Apr. 1808, *?R.Brown s.n.*; ?syn: BM.

Hakea pycnobotrys F.Muell., *Fragm.* 5: 72 (1865). T: Gardner R., W.A., *s.d., G.Maxwell s.n.*; syn: MEL 674363; Esperance, W.A., *s.d., G.Maxwell s.n.*; ?syn: B, K *p.p.*; South West Bay, W.A., *s.d., A.F.Oldfield s.n.*; syn: MEL 674364.

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 384 (1988).

Shrub, 0.25–3 m tall, lignotuberous or not. Branchlets glabrous, not glaucous. Leaves subpetiolate, flat, rigid, narrowly elliptic to obovate, 1.5–9 cm long, (4–) 10–30 mm wide, narrowly cuneate, usually with 1–6 mucronate teeth 1–4 mm long per side, rarely entire, glabrous or appressed-sericeous, glaucous. Inflorescence axillary or terminal on short shoots with 16–36 flowers; involucre 6.5 mm long; rachis 6–16 mm long, tomentose or appressed-pubescent, with hairs white; pedicels 4–8 mm long. Perianth 2.5–3.5 mm long, white or pale yellow. Pistil 3.5–4 mm long. Fruit obliquely ovate, 2.5–3.5 cm long, 1.5–2.5 cm wide, black-pusticulate, not apiculate; horns 4–6 mm long. Seed narrowly obovate, c. 24 mm long; wing broadly down one side of seed body, narrowly down other. *Shining Hakea*. Plate 12; Fig. 14J–O.

Occurs in southern W.A. from Mt Randall and Busselton to Eucla. Found in mallee woodland or heath, usually on sand or sandy clay. Flowers (May–) July–Sept. Map 101.

W.A.: 29 km due N of Clyde Hill, *M.A.Burgman & S.McNee MAB1823* (PERTH); 10 km on N road to Jerdacuttup, *H.Demarz 1082* (PERTH); South Dongolocking Reserve, *G.J.Keighery 6921* (PERTH); 8 km N of Israelite Bay, *E.C.Nelson ANU16515* (CANB).

Hakea nitida apparently displays a number of different vegetative reproductive strategies. Groom & Lamont (1996) record the species as being both a lignotuberous resprouter and an epicormic resprouter, while Stuckey (pers. comm.) noted that it was normally killed by fire, implying that a lignotuber is not present.

87. Hakea drupacea (C.F.Gaertn.) Roem. & Schult., *Syst. Veg.* 3: 426 (1818)

Conchium drupaceum C.F.Gaertn., *Suppl. Carp.* 3: 217, t. 219 (1807). T: without locality, *s.d., J.Labillardiere s.n.*; ?holo: TUB *n.v.*; ?iso: ?FI, G, G-DC (microfiche seen), ?TCD.

Hakea suaveolens R.Br., *Trans. Linn. Soc. London* 10: 182 (1810). T: Bay II, Goose Island Bay, Middle Island, [W.A.], 5 Jan. 1802, *R.Brown s.n.*; syn: BM, K *p.p.*, E; South Coast, [W.A.], *s.d., R.Brown s.n.*; syn: BM, E, MEL 1537945; South Coast, [W.A.], May 1803, *R.Brown s.n.*; syn: K *p.p.*, ?MEL.

Hakea pectinata Dum.Cours., *Bot. Cult.* 2nd edn, 2: 424 (1811). T: not located.

Banksia pinnata Hort. Cels ex Roem. & Schult., *Syst. Veg.* 3: 444 (1818), *nom. nud.*; *Hakea pinnata* Hort. Cels ex Roem. & Schult., *Syst. Veg.* 3: 444 (1818), *nom. nud.*

Hakea lambertii Sweet, *News Lit. Fashion* 2: 346 (1825). T: 'Raised at the nursery of Mr Colvill, from seeds given by A.B.Lambert esq. who received them from King Georges Sound in New Zealand'; syn: B, BR, P *p.p.*

Banksia heterophylla Hort. ex Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 466 (1856), *nom. nud.*

[*Hakea gibbosa auct. non* (Sm.) Cav.: J.H.H. de Labillardière., *Nov. Holl. Plant.* 1: 31(1805)]

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 386 (1988).

Dense spreading or erect shrub or tree, 1–4 m tall. Branchlets appressed-pubescent. Leaves simple- or compound-terete, 3–13 cm long, 1–1.6 mm wide, flexible, grooved above or not, glabrous or appressed-pubescent; ultimate segments 2–8. Inflorescence axillary raceme with 46–84 flowers; involucre 4.5–12 mm long; rachis 17–26 mm long, appressed-pubescent, with hairs white or pale brown; pedicels 4–10 mm long. Perianth 3–4 mm long, pale pink ageing white. Pistil 3.5–4.5 mm long. Fruit obliquely ovate, 2–2.5 cm long, 1.6–1.9 cm wide, black-pusticulate; apiculum to 1.5 mm long; horns 2–4 mm long. Seed ovate or elliptic, 16–20 mm long; wing partly down one side of seed body only. Fig. 14A–E.

Occurs from Albany to Point Malcolm, east of Cape Arid Natl Park on the south coast of W.A. and also on the islands of the Recherche Archipelago. Almost always associated with granite hillsides, more rarely quartzite areas or coastal limestone cliffs, in open heath or low

shrubland or on Middle Island as a rare understorey plant in *Eucalyptus platypus* var *heterophylla* forest. Naturalised in South Africa and Vic. Flowers Mar.–June. Map 102.

W.A.: c. 58 km W of Port Malcolm, *R.Hnatiuk 761182* (PERTH); E end of Wharton Beach, W of Duke of Orleans Bay, *N.G.Marchant 80/56* (PERTH); 16 km SW of East Mount Barren, *K.Newbey 2419* (PERTH); Observatory Is., *A.S.Weston 9380* (PERTH).

Young plants appeared after a fire in 1977 on Middle Is. (*Weston 10756*), and so it is likely that the species is not lignotuberous, a fact supported by literature from South Africa, where it is a troublesome weed. Groom & Lamont (1996) record it as an epicormic resprouter. Naturalised in Victoria after the 1983 Ash Wednesday fires and with the potential to do so in other States.

As with *H. lissocarpha*, this species produces pink pollen.

88. Hakea oldfieldii Benth., *Fl. Austral.* 5: 530 (1870)

T: Champion Bay, W.A., *A.F.Oldfield s.n.*; syn: MEL 108007, PERTH.

Excluded syntype: in the interior, W.A., *s.d., J.S.Roe s.n.*; syn: K (= *H. newbeyana*)

Hakea sp. 'Williamson' (B.J.Keighery & N.Gibson 226), WA Herbarium census.

Shrub with branches erect, 1–3 m tall. Branchlets glabrous, glaucous. Leaves simple- or rarely compound-terete, 1–7 cm long, 0.7–1.8 mm wide, constricted basally, rigid, not grooved, glabrous, not glaucous; ultimate segments (when leaf compound) 2 or 3. Inflorescence axillary raceme with 8–20 flowers; involucre 3–6 mm long; rachis 2–3 mm long, glabrous; pedicels 2.5–9.5 mm long. Perianth 1.5–2.5 mm long, cream-white. Pistil 3–4.5 mm long. Fruit obliquely ovate, 1.6–2.3 cm long, 0.8–1 cm wide, finely and sparsely black-pusticulate, obscurely apiculate; horns 5 mm long. Seed obliquely narrowly obovate, 14–17 mm long; wing partly down one side of seed body only. Fig. 11A–C.

Occurs in south-western WA from Bunbury and Busselton to Stirling Ra. The type, perhaps erroneously labelled, represents a disjunct old collection from Champion Bay (north side of Geraldton). Found in winter-wet areas in *Hakea/Melaleuca* scrub in sand, well-drained gravelly loam, pebbly loam or red clay over ironstone. Flowers Aug.–Oct. Map 103.

W.A.: Mt Wells, *H.Demarz 1688* (PERTH); 16 km NE of Twin Peaks, Porongorup Ra., *K.Newbey 9424* (PERTH); Chester Pass, Stirling Ra., *R.D.Royce 3700* (PERTH); Ruabon, Busselton District, *R.D.Royce 4512* (PERTH).

The type collections by Oldfield and Roe represent two different species, that of Oldfield representing the species usually referred to as *H. oldfieldii*, while the Roe collection is *H. newbeyana*. The only material found to have been annotated by Bentham is the Roe collection at K, but this is at variance with the protologue since it is not glabrous in all parts and does not have a glabrous rachis of 1–2 lines long. The Oldfield collection is in keeping with the protologue, but there is apparently no specimen at K. The only Oldfield collection seen in MEL has not been annotated by Bentham, suggesting that there may be a specimen still to be located in K. The fragment in PERTH must come from either this as yet to be located K specimen or from the MEL specimen. Because the Oldfield collection agrees best with the protologue, and also agrees with current usage, it should be chosen as the lectotype. However, this cannot be done until a more thorough search has been made at K.

Judging by collections, *H. oldfieldii* is a relatively rare species, while *H. newbeyana* is more common. Both species have straight buds. *Hakea oldfieldii* can be distinguished by its glabrous branchlets and leaves, cream-white flowers and smaller (1.6–2.3 cm long) fruit. *Hakea newbeyana* has appressed-ferruginous hairs on the branchlets and young leaves, yellow flowers and larger (2.5–3.5 cm long) fruit.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

Varia Group

Hakea sect. *Conogynoides* ser. *Enerves* Benth., *Fl. Austral.* 5: 494, 527 (1870)

Shrubs, rarely small trees, without deeply fissured bark. Leaves simple or compound, elliptic in cross-section, sometimes flat, not stem-clasping, usually toothed, basally grooved above; venation obscure. Inflorescence an axillary or terminal umbelliform raceme, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 2–5 mm long. Flowers 16–40; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 4–8 mm long, rarely 23–25 mm long; pollen presenter conical; gland a curved flap or absent. Fruit solitary, usually on recurved stalk, retained on plant, woody, tuberculate or black-pusticulate, rarely smooth, not beaked, horned, dehiscing fully down one side. Seed occupying part of valve; wing encircling seed body, or broadly down one side and narrowly down other, or partly down one side only.

A group of seven species in south-western W.A.

1 Leaves pinnatisect, 4–10 cm long, of 5–14 segments (ovary glandular; gland absent; fruit pubescent; Lake King to Newdegate area, W.A.; flowers Aug.–Oct.) **90. H. horrida**

1: Leaves entire, toothed or lobed, not pinnatisect

2 Fruit pubescent; ovary glandular; gland absent (Cape Riche to Cape Le Grand, W.A.; flowers Aug.–Oct.) **91. H. ilicifolia**

2: Fruit glabrous; ovary glabrous; gland present

3 Leaves to 6 mm wide, entire or divided in 2–8 mucronate segments towards apex; fruit to 10 mm wide

4 Buds c. 8 mm long; pistil 23–25 mm long (Kalgan R. area, W.A.; flowers May– July) **89. H. lasiocarpha**

4: Buds to 3.5 mm long; pistil 4–5.5 mm long

5 Branchlets densely hirsute with ferruginous hairs persistent until flowering; shrubs with columnar habit (winter-wet areas on ironstone, Augusta to Albany, W.A.; flowers Mar.–Apr. (–?July)) **95. H. tuberculata**

5: Branchlets appressed-sericeous, quickly glabrescent; shrubs not with columnar habit (Eneabba to Israelite Bay, W.A.; flowers July–Nov.) **94. H. varia**

3: Leaves more than 6 mm wide or if less, either toothed for whole length or fruit more than 12 mm wide

6 Shrub or small tree, 0.4–10 m tall; leaves usually entire with occasional leaves with single, or rarely to 4 teeth per side, elliptic; branchlets and young leaves appressed-pubescent (coastal areas or within Jarrah forest, Busselton to Bremer Bay, W.A.; flowers Aug.–Oct.) **92. H. oleifolia**

6: Shrub, 1–3 m tall; leaves usually with 1–10 teeth per side, occasionally entire, narrowly elliptic or obovate; branchlets and young leaves densely villous (Stirling Ra. to Fitzgerald River Natl Park, W.A.; flowers Nov.–Jan.) **93. H. florida**

89. Hakea lasiocarpha R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 27 (1830)

T: between the two ranges of mountains inland from King George Sound, [W.A.], 1828, *W.Baxter s.n.*; probable holo: BM.

Hakea dolichostyla Diels, *Bot. Jahrb. Syst.* 35: 166 (1904). T: plantaganet: ostlich des Green Ridge [Green Range? between King George Sound and Cape Riche], W.A., 18 July 1901, *L.Diels 3510*; ?holo: B.

Spreading shrub, c. 0.75 m tall. Branchlets densely villous. Leaves rigid, elliptic in cross-section, narrowly obovate, 1.2–4 cm long, 1–2 mm wide, usually with 3 (–6) irregularly inserted mucronate segments towards apex, rarely entire, initially densely tomentose; mucro 3–4.5 mm long. Inflorescence with c. 30 flowers; involucre 6–10 mm long; rachis 4–5 mm

long, densely villous; pedicels 3–7 mm long. Perianth c. 8 mm long, white. Pistil 23–25 mm long; ovary glabrous; gland present. Fruit 2–2.3 cm long, c. 1 cm wide, glabrous, tuberculate, with tubercles black-pusticulate at apex; horns 0.5 mm long. Seed narrowly ovate or elliptic, 10–11 mm long; wing narrowly down one side of seed body only. Fig. 15 I–L.

Occurs in the Kalgan R. area, between the Stirling Ra. and the coast, W.A.; recorded from shallow sand over clay loam in winter-wet areas. Flowers May–July. Map 104.

W.A.: 17 km NNE Mt Manypeaks townsite, *G.J.Keighery 8066* (PERTH); c. 6 km SSW of Kalgan R. crossing along the Albany–Borden road, *P.Short 2274 & L.Haegi* (AD).

This species is easily separable from the rest of the *Varia* Group by the much longer pistil.

A poorly collected species, the only other specimens seen, besides the types and those cited, being cultivated specimens grown at Wittunga Botanic Gardens and Mt Alma, Inman Valley in S.A. Both of the cultivated specimens originated from W.A. plants introduced by Miss Alison Ashby. It was noted on the Short & Haegi collection that the species was common along the roadside, and this is supported by Jennifer Young (pers. comm.) who says that the species 'ranges widely along the south coast from west of Albany to east of Ravensthorpe'.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

90. Hakea horrida C.A.Gardner ex R.M.Barker, *J. Adelaide Bot. Gard.* 13: 102 (1990)

T: 32 km E of Lake King township, W.A., 16 Sept. 1964, *P.Wilson 3249*; holo: AD; iso: B, L, PERTH, UC *n.v.*

Hakea sp. nov. aff. lissocarpha, in J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 412 (1988)

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 403 (1988), as *Hakea sp. nov. aff. lissocarpha*.

Spreading or dense rigid shrub, 0.6–2 m tall, 0.7–2 m diam., non-lignotuberous. Branchlets appressed-pubescent, red. Leaves rigid, 4–10 cm long, pinnatisect, grooved basally above, appressed-pubescent, quickly glabrescent; segments 5–14, 1–2.5 mm wide; mucro 2–3.5 mm long. Inflorescence with 18–22 flowers; involucre 6.5–8 mm long; bracts densely woolly-tomentose, with white hairs on lower bracts, ferruginous hairs on upper bracts; rachis 2.5–4 mm long, villous; pedicels 3–6 mm long. Perianth 2–4 mm long, white to yellow. Pistil 5.5–8 mm long; ovary ?glandular-pubescent; gland absent. Fruit obliquely ovate, 1.5–2 cm long, 1–1.5 cm wide, black-pusticulate, pubescent; horns 3.5–4.5 mm long. Seed obliquely obovate, 9–13 mm long; wing broadly down one side, narrowly down other or encircling seed body. Fig. 14F–I.

Occurs in drier areas of south-western W.A. from north-east of Kondinin to Frank Hann Natl Park and south to near Jerramungup and Ravensthorpe. Recorded from gravel loam, sand, sandy loam with lateritic gravel or pebbles, in scrub, closed heath, open *Eucalyptus eremophila* mallee or *Casuarina acutivalvis* shrubland. Flowers Aug.–Oct. Map 105.

W.A.: Frank Hann Natl Park, *D.Monk 296* (PERTH); 16 km E of Ongerup, *K.Newbey 390* (PERTH); 2 km NW of 90 Mile Tank, Norseman to Lake King road, *K.Newbey 6490* (PERTH); 10 km S of Lake Grace, *R.D.Royce 6682* (PERTH); 16 km W of Lake King township, *P.G.Wilson 5758* (PERTH).

The gland was not found on any herbarium sheets, but cultivated *H. horrida* at Wittunga was found to have a small white upright gland present in most flowers. Some of the flowers from Wittunga had pale pink pollen presenters.

Hakea horrida may grade into *H. ilicifolia* (see below) and might, therefore, be better treated as a subspecies.

91. Hakea ilicifolia R.Br., *Trans. Linn. Soc. London* 10: 184 (1810)

T: South Coast, Bay I, [Lucky Bay, W.A.], Jan. 1802, *R.Brown Iter Austral. 21*; syn: B, BM, K *p.p.*

Hakea ilicifolia var. *minor* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 406 (1856). T: without locality, W.A., *s.d., J.Drummond 299*; syn: BM, CGE, G, TCD; Cape Riche, W.A., 19 Nov. 1840, *L.Preiss 561*; syn: G-DC (microfiche seen), NY.

Hakea ilicifolia var. *major* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 406 (1856). T: without locality, W.A., *s.d., J.Drummond 173*; ?syn: K, not annotated.

Hakea intermedia Hook., *Icon. Pl.* 5: t. 445 (1842). T: King George Sound, [W.A.], *s.d., W.Baxter s.n.*; holo: not located.

Shrub, 1–3 m tall; branching 'corymbose', with foliage most dense at apex. Branchlets ferruginous to white woolly-tomentose. Leaves subpetiolate, rigid, flat, elliptic, 1.5–5 cm long, 5–20 mm wide, attenuate or cuneate, coarsely dentate with teeth 1–2.5 mm long, acute, tomentose, ferruginous, glabrescent; mucro 1–2.5 mm long. Inflorescence with c. 16 flowers; involucre 6 mm long; bracts appressed-pubescent in upper half; rachis 2.5–4 mm long, villous; pedicels 3.5–6.5 mm long. Perianth 3–3.5 mm long, cream or yellow. Pistil 7.5–8.5 mm long; ovary glandular-pubescent; gland absent. Fruit obliquely ovate, 2–2.2 cm long, 1.5–1.6 cm wide, black-pusticulate, pubescent; horns 3.5–4.5 mm long. Seed obliquely obovate, 11–12 mm long; wing partly down one side of seed body only. Fig. 14T–V.

Occurs in south-western W.A. from Cape Riche to north-east of Ravensthorpe and inland to near Lake Grace. Flowers Aug.–Oct. Map 106.

W.A.: Cape Riche, *C.A.Gardner 2160* (PERTH); near Twertup Ck, Fitzgerald River Natl Park, *A.S.George 10932* (PERTH).

The leaves of *H. florida* and *H. ilicifolia* can be indistinguishable in the areas where the two species overlap, at the eastern end of the *H. florida* range. While those of *H. ilicifolia* tend to be thicker and much more rigid and the teeth are usually somewhat longer, it is usually necessary to confirm the differences by the presence (*H. ilicifolia*) or absence (*H. florida*) of glandular hairs on the ovary or by the differences in the size of the fruit. *Hakea florida* flowers later than *H. ilicifolia* in November to January, rarely as late as April.

Hakea ilicifolia appears to intergrade into *H. horrida* with the obovate and prickly toothed leaves of the Cape Riche area gradually converting to the pinnatisect leaves of *H. horrida* in the Lake King area. Specimens from the Pingrup, Ongerup and Fitzgerald R. area all exhibit leaves of an intermediate type, eg. *H.Demarz 482* (PERTH) and *W.E.Blackall 3089* (PERTH). Field studies may well show that it would be better to treat these species at an infraspecific level.

Groom & Lamont (1996) record *H. ilicifolia* as suckering from the roots while *H. horrida* is recorded as a nonsprouter (i.e. fire-killed).

92. Hakea oleifolia (Sm.) R.Br., *Trans. Linn. Soc. London* 10: 185 (1810), *non Banksia oleaefolia* Salisb. 1796 (= *H. dactyloides*)

Conchium oleifolium Sm., in A.Rees, *Cycl.* 9 (1807) pages unnumbered. T: King George Sound, [W.A.], 1803 [?1791], *A.Menzies s.n.*; syn: BM, LINN.

Hakea ligustrina Salisb., in J.Knight, *Cult. Prot.* 108 (1809). T: 'Shrub introduced by Lee & Kennedy from Port Jackson and exceedingly like Conchium oleaefolium of Dr Smith from King Georges Sound.'; holo: not located.

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 222 (1990).

Small tree or shrub, sometimes dwarfed, 0.4–10 m tall. Branchlets and young leaves appressed-pubescent. Leaves flat, elliptic, 2.7–8.5 cm long, 5–25 mm wide, narrowly attenuate to cuneate, usually entire, rarely dentate with 1 (–4) teeth 1 mm long per side; mucro 0.5–1.5 mm long. Inflorescence with 22–28 flowers; involucre 5–6.5 mm long; bracts densely tomentose, ferruginous; rachis 3.5–4 mm long, villous; pedicels 3–5 mm long. Perianth 2.5–3 mm long, white. Pistil 5–6.5 mm long; ovary glabrous; gland present. Fruit obliquely ovate, 2–3 cm long, 1.3–2 cm wide, glabrous, pusticulate; horns to 6 mm long. Seed obliquely obovate, 11–16 mm long; wing partly down one side of seed body only.

Occurs in the Busselton to Bremer Bay area of south-western W.A.; often in exposed coastal areas in low shrubbery or within Jarrah forest. Flowers Aug.–Oct. Map 107.

W.A.: L. Wombellup, 16 km NW of Mount Barker, *W.A.Atkins B8* (PERTH); Cape Augusta, *A.R.Fairall 800* (PERTH); Walpole-Nornalup Natl Park, Knoll Drive, *S.Paust 356* (PERTH); Yallingup, *R.D.Royce 3217* (PERTH).

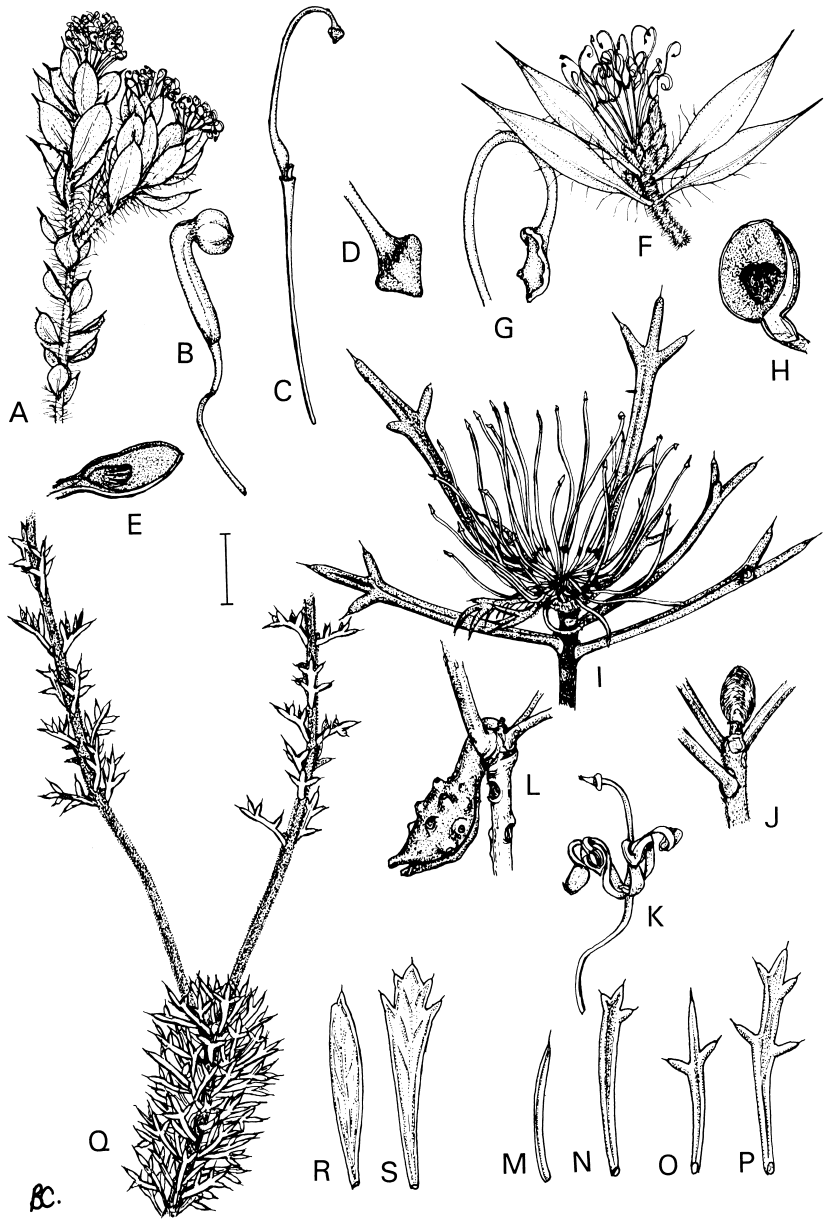

Figure 15. *Hakea*. **A–E**, *H. ruscifolia*. **A**, habit (T.J.Hawkeswood 209, PERTH); **B**, bud (F.G.Smith 1637, PERTH); **C**, flower without tepals; **D**, pollen presenter (**C–D**, Mar. 1902, C.Andrews, PERTH); **E**, inside of fruit (T.J.Hawkeswood 209, PERTH). **F–H**, *H. aculeata.* **F**, habit; **G**, pollen presenter; **H**, fruit (**F–H**, A.George 14960, PERTH). **I–L**, *H. lasiocarpha*. **I**, habit; **J**, axillary or involucral bud; **K**, flower with tepals; **L**, fruit (**I–L**, cult. Wittunga Botanic Garden, S.A.). **M–P**, *H. varia*, four leaves from one plant (**M–P**, E.M.Bennett 1999, PERTH). **Q–S**, *H. tuberculata.* **Q**, habit; **R–S**, two leaves from one plant (**Q–S**, W.Baxter *s.n.*, NSW106073). Scale bar: **A**, **E–F**, **H–P**, **R–S** = 1 cm; **B** = 1.2 mm; **C** = 4 mm; **D** = 0.5 mm; **G** = 0.9 mm; **Q** = 1.3 cm. Drawn by Beth Chandler.

Differences between *H. oleifolia* and *H. florida* are not marked, and field studies may indicate that they are not specifically distinct. *Hakea florida* usually has shorter and narrower toothed leaves, villous pubescence on the branchlets, flowers Nov.–Jan. and occurs within rocky gorges or gullies of higher and more inland areas. *Hakea oleifolia* usually has larger rarely toothed leaves, flowers Aug.–Oct., and appears to occur in coastal areas or within Jarrah forest. Groom & Lamont (1996) record both species as epicormic resprouters.

93. Hakea florida R.Br., *Trans. Linn. Soc. London* 10: 183 (1810)

T: hills between Bald Head and Princess Royal Harbour (King George Sound), [W.A.], *s.d., R.Brown s.n.*; syn.: ?BM (*Iter Austral. 3356*), BM, NSW, K; Hort. Kew, June 1808, *Anon. (?R.Brown) s.n.*; syn: BM *p.p.*, K.

Hakea florida var. *latifolia* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 562 (1845). T: montis Wuljenup [Willyung Hill, near Albany], W.A., 20 Oct. 1840, *L.Preiss 586*; syn: LD, LE *p.p.*, NY *p.p.*; in region. interior. Australiae merid.-occid, W.A., Oct. 1840, *L.Preiss 589*; syn: LD *p.p.*, LE *p.p.*, NY *p.p.*

Stiff divaricately-branched shrub, 1–3 m tall. Branchlets densely villous. Leaves flat, narrowly elliptic, rarely obovate, 1.5–5 cm long, 3–25 mm wide, attenuate or cuneate, usually dentate with 1–10 teeth 1–2 mm long per side, rarely entire, appressed-pubescent, glabrescent; mucro 1–2.5 mm long. Inflorescence with 22–28 flowers; involucre 4–6 mm long; bracts densely appressed-pubescent; rachis 3.5–4 (–8.5) mm long, villous; pedicels 3–5 mm long. Perianth 2.5–3 mm long, white. Pistil 4.5–5.5 mm long; ovary glabrous; gland present. Fruit obliquely ovate, 2.4–4 cm long, 1.5–2.3 cm wide, glabrous, black-pusticulate; horns 3–5 mm long. Seed obliquely obovate, 16–20 mm long; wing partly down one side of seed body only. Fig. 14P–S.

Occurs in south-western W.A. from the Denmark area and Stirling Ra. through to Fitzgerald River Natl Park; found on cliff faces, gorges and gullies of higher areas usually in rocky soil (gravelly clay or loam) or sand in *Eucalyptus* woodland with thick scrub strata. Flowers Nov.–Jan. Map 108.

W.A.: Albany, road to Whaling Stn, *H.Demarz 4242* (PERTH); Whoogarup R., near Middle Mount Barren, *C.A.Gardner 2974* (PERTH); summit of Nancys Peak, W end of Porongorup Ra., *N.Marchant 70/97* (PERTH).

Hakea florida is sometimes difficult to distinguish from *H. oleifolia* (*q.v.*). Specimens from the Stirling Ra. often have a longer rachis, 6.5–8.5 mm long.

94. Hakea varia R.Br., *Trans. Linn. Soc. London* 10: 183 (1810)

T: King George Sound, [W.A.], Dec. 1801, *R.Brown s.n.*; syn: AD, BM, ?E, K *p.p.*

Hakea attenuata R.Br., *Trans. Linn. Soc. London* 10: 183 (1810). T: Bay I, South Coast [Lucky Bay, W.A.], Jan. 1802, *R.Brown Iter Austral. 18*; ?holo: BM.

Hakea heterophylla Hook., *Icon. Pl.* t. 437 (1841). T: Swan R., W.A., *s.d., C.Fraser 40*; ?holo: K *p.p.*

[*Hakea lasiocarpha auct. non* R.Br.: C.D.F.Meisner, in J.G.C.Lehmann, *Pl. Preiss.* 1: 560 (1845) with respect to *Preiss 594* seen in NY on a sheet of *H. lissocarpha*.]

Illustration: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 110 (1997).

Small tree or shrub, 0.8–4 m tall, lignotuberous. Branchlets and young leaves appressed-sericeous, quickly glabrescent. Leaves rigid, elliptic in cross-section, narrowly linear, -elliptic or -obovate, 1–4 cm long, 2–5 mm wide, narrowly attenuate, entire or dentate with 3–5 teeth or segments per side towards apex; mucro 1–2 mm long. Inflorescence with 16–36 flowers; involucre 4.5 mm long; internal bracts densely ferruginous apically; rachis 2.5–4 mm long, hirsute; pedicels 2–4 mm long. Perianth 2.5–3.5 mm long, white. Pistil 4–5 mm long; ovary glabrous; gland present. Fruit obliquely ovate, 1.6–2 cm long, 0.7–1 cm wide, glabrous, coarsely tuberculate or smooth; horns to 3.5 mm long. Seed obliquely elliptic, 11–14 mm long; wing partly down one side of seed body only. *Variable-leaved Hakea*. Plate 13; Fig. 15M–P.

A common species of south-western W.A. from Arrowsmith L. (near Eneabba) south to Israelite Bay, usually within 100 km of the coast. Occurs in swampy, winter-wet areas, often

with *Melaleuca* or with *Viminaria juncea* shrubland, or in low shrubland or heath in sand or sandy loam. Flowers July–Nov. Map 109.

W.A.: 60 km SW of Israelite Bay ruins, *B.Barnsley 376* (CANB); 16 km W of Yarloop, *R.J.Cranfield 113* (MEL, NSW, PERTH); N of Arrowsmith L., *A.S.George 9774* (PERTH); Lower Helena Valley, *J.Seabrook 131* (PERTH).

The form with attenuate leaves (sometimes informally known as 'var. *attenuata*') and based on *H. attenuata*, has not been recognised here. It appears to be somewhat distinctive in its ecology (it tends to come from low heaths), its fruit shape (symmetrical vs asymmetrical) and to some extent the position of the flowers, i.e. whether axillary or terminal. However, there is too much overlap between the two forms to give it recognition without some field studies.

95. Hakea tuberculata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 28 (1830)

T: south west coast of New Holland (King George Sound), [W.A.], 1828/9, *W.Baxter s.n.*; syn: BM, K *p.p.*, NSW 106073.

Shrub to 2.5 m high; branches ascending, columnar. Branchlets densely hirsute, with hairs ferruginous, persistent. Leaves rigid, elliptic in cross-section, narrowly elliptic to obovate, 1–2 cm long, 2–6 mm wide, narrowly attenuate, with 3–8 teeth or segments towards apex, sparsely or moderately appressed-sericeous; hairs ferruginous, quickly glabrescent; mucro 1–2 mm long. Inflorescence with 18–26 flowers; involucre 5 mm long; bracts densely white-villous apically; rachis 2–4 mm long, densely hirsute; pedicels 3–5.5 mm long. Perianth 2.8–3.5 mm long, white. Pistil 5–5.5 mm long; ovary glabrous; gland present. Fruit obliquely ovate, 1.7–1.8 cm long, 0.8–0.9 cm wide, glabrous, coarsely tuberculate or smooth; horns c. 3 mm long. Seed not seen. Fig. 15Q–S.

Only known from Augusta to Albany in W.A.; usually found in winter-wet areas associated with ironstone. Flowers Mar.–Apr. (July). Map 110.

W.A.: creekline beside Hunton Rd, c. 500 m N of Nanarup Rd, c. 15 km WNW of Albany, *N.Gibson 2502* (AD, PERTH); between King George Sound and Cape Riche, Mar. 1854, *W.H.Harvey s.n.* (TCD *p.p.*); King River Rd, Albany, 18 Apr. 1904, *A.Morrison s.n.* (PERTH); near Albany, *F.M.C.Schock 165* (PERTH).

Clavata Group

Low shrubs, without deeply fissured bark. Leaves simple, flattened, elliptic in cross-section, non-petiolate, not stem-clasping, entire, not grooved below; venation obscure. Inflorescence an axillary and terminal umbelliform raceme, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 7–17 mm long. Flowers 60–80; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil c. 9 mm long; pollen presenter an oblique disc; gland a flap. Fruit 1–7, recurving, not retained on plant, not markedly woody, ±smooth, not beaked, horned, dehiscing fully. Seed occupying whole valve; wing broadly and fully down one side of seed body, narrowly and partly down other.

A monotypic group, occurring along the south coast of W.A.

96. Hakea clavata Labill., *Nov. Holl. Pl.* 1: 31, t. 41 (1805)

Conchium clavatum (Labill.) Willd., *Enum. Pl.* 141 (1809). T: in terra van-Leeuwin, [W.A.], *s.d.*, *J.Labillardière s.n.*; syn: B (*herb. Willdenow 2476*), FI *n.v.*, G-DC (microfiche seen), P (microfiche seen), TCD.

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 195 (1990).

Spreading shrub, often windswept, 0.2–2 m tall, 1–2.7 m diam., lignotuberous. Branchlets and young leaves appressed-sericeous. Leaves flattened, very thick, narrowly elliptic or obovate, 2–8 cm long, 4–11 mm wide, attenuate, widening at attachment, entire, rounded; mucro 1–3.5 mm long. Inflorescence of 60–80 flowers; involucre c. 3 mm long; rachis 7–17 mm long, tomentose; pedicels 3–6 mm long, glabrous or rarely sparsely tomentose.

Perianth 3.5–6 mm long, claw pink, limb grey, white inside. Pistil c. 9 mm long; gland 0.2 mm high. Fruit obliquely ovate or obovate, 1.5–2.5 cm long, 0.9–1 cm wide, finely rugose; horns 3–5 mm long. Seed obliquely obovate, 16 mm long; wing broadly and fully down one side of seed body, narrowly and partly down other. Fig. 10P.

Occurs in coastal areas and islands, more rarely further inland, between Esperance and Israelite Bay in W.A., with a single record from Hopetoun to the west; on granite, often in windswept localities. Flowers Jan.–Oct. Map 111.

W.A.: Mt Merivale, Esperance, *J.S.Beard 2304* (PERTH); c. 22 km SW of Mt Ragged, *A.S.George 2040* (PERTH); c. 58 km W of Point Malcolm, *R.J.Hnatiuk 761178* (PERTH); NW Penin., Middle Is., Recherche Archipelago, *A.S.Weston & M.E.Trudgen 8709* (PERTH); Observatory Is., *A.S.Weston 9377* (PERTH).

Hakea clavata is notable for its very thick leaves which are elliptic in cross-section, and the large number of flowers per inflorescence. A number of fruits may develop from any one inflorescence, and these are borne on the thickened rachis. The flowers of *H. clavata* are unpleasantly scented.

Linearis Group

Hakea sect. *Hakea* ser. *Glabriflorae* Benth., *Fl. Austral.* 5: 492, 509 (1870), *p.p.*

Shrubs or small trees, without deeply fissured bark. Leaves simple, flat, subpetiolate, not stem-clasping, entire or toothed; venation obscure. Inflorescence of axillary and terminal umbelliform racemes, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 4–6 mm long. Flowers 16–20, white; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 8–11 mm long; pollen presenter an oblique disc; gland a curved flap. Fruit usually solitary, usually on recurved stalk, retained on plant, woody, ±smooth, not beaked, horned, dehiscing ±fully down both sides but not recurving. Seed occupying most of valve; wing apical or partly down one side of seed body only.

A monotypic group from south-western W.A.

97. Hakea linearis R.Br., *Trans. Linn. Soc. London* 10: 183 (1810)

T: King George Sound, [W.A.], Feb. 1801, *R.Brown Iter Austral. 19*; syn: BM.

Erect or straggling shrub or small tree, 0.6–4 m tall. Branchlets glabrous. Leaves linear or narrowly elliptic, 2–8 cm long, 2–7 mm wide, thin, cuneate, entire or 1–5-toothed, acute, glabrous; mucro 1.5–2 mm long. Inflorescence with 16–20 flowers; involucre 5.5–7.5 mm long; rachis glabrous; pedicels 2.5–4.5 mm long, glabrous. Perianth 3–5 mm long, white, glabrous. Fruit obliquely obovate with recurved apex, 1.5–2.5 cm long, 0.7–1 cm wide, finely rugose, sometimes scattered black-pusticulate; horns 2.5–4 mm long. Seed obliquely obovate, c. 12 mm long; wing apical or partly down one side of seed body. Fig. 10N, O.

Occurs in the south-western corner of W.A. in an area bounded by Busselton, Albany and Wagin, in sandy heaths or tall *Eucalyptus* woodland, often associated with swamps. Flowers Oct.–May. Map 112.

W.A.: Red Gum Pass, Stirling Range Natl Park, *A.C.Beauglehole 12922* (PERTH); Scott R. plains, *A.S.George 11775* (PERTH); 21 km N of Albany, *K.Newbey 1228* (PERTH); Albany area, 6 km off South Coast Hwy along Nanarup Rd, *A.Strid 21635* (G, PERTH).

Frequently confused with *H. varia* and related species, *H. linearis* can be distinguished by its glabrous floral rachis, distinctive pollen presenter and glabrous young shoots. P.Groom (*in litt.*) reports that the populations of *H. linearis* in the Stirling Range do not have lignotubers.

Ruscifolia Group

Hakea sect. *Hakea* ser. *Glabriflorae* Benth., *Fl. Austral.* 5: 492, 509 (1870), *p.p.*

Dense, sometimes columnar, shrubs, without deeply fissured bark. Leaves simple, flat, subpetiolate, not stem-clasping, entire; venation obscure. Inflorescence a terminal umbelliform raceme, not resprouting from old rachises in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 2–4 mm long. Flowers 18–36; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 4–10 mm long; pollen presenter conical or an oblique disc; gland a curved flap. Fruit solitary, erect, not retained on plant, not markedly woody, smooth, sometimes black-pusticulate, beaked, not horned, dehiscing fully or partly down one or both sides. Seed occupying almost whole valve; wing encircling seed body or narrowly and fully down both sides.

A group of two species from south-western W.A.

Pollen presenter a ±lateral disc; fruit glabrous (rare, in Cunderdin and Merredin area, W.A.; flowers Sept.–Oct.) **98. H. aculeata**

Pollen presenter conical; fruit glabrous or pubescent (common species, Jurien Bay to Cape Arid, W.A.; flowers Dec.–Jan., sporadically in other months) **99. H. ruscifolia**

98. Hakea aculeata A.S.George, *Nuytsia* 2: 375 (1979)

T: 14 km SSW of Cunderdin, W.A., 5 Oct. 1977, *A.S.George 14960*; holo: PERTH; iso: CANB, NSW, PERTH.

Illustrations J.Young, *Hakeas of W. Australia, Botanical District of Avon* 13, 24 (1997).

Shrub, to 3 m tall with columnar branches, lignotuberous. Branchlets densely villous below sparser longer hairs. Leaves crowded, particularly towards branchlet apex, erect, arranged in cylindrical whorl about stem, narrowly elliptic to oblanceolate, 2–4 cm long, 3–9 mm wide, attenuate or broadly cuneate, hirsute, mixed with short pubescence, longer hairs persisting near base, glaucous. Inflorescence with 18–24 flowers; involucre 9–10 mm long; rachis 2–3 mm long, villous; pedicels 7–13 mm long. Perianth 2.5–3 mm long, mid-yellow. Pistil 7–10 mm long; pollen presenter a ±lateral disc. Fruit obliquely broadly ovate, 1.3–2 cm long, 1.1–1.4 cm wide, smooth, glabrous. Seed obliquely elliptic, c. 15 mm long; wing encircling seed body. Plate 15; Fig. 15F–H.

A rare species from the Cunderdin and Merredin area of south-western W.A. Found in sandy loam or clay in tall shrubland or roadsides. Flowers Sept.–Oct. Map 113.

W.A.: near Hines Hill, 21 km W of Merredin, Sept. 1929, *W.E.Blackall s.n.* (PERTH); 4 km E of Youndegin Hill, SE of Cunderdin, *A.S.George 15770* (PERTH); 27.5 km S of Cunderdin, 4 Nov. 1983, *L.J.Silvester s.n.* (PERTH); c. 9 km SSW of Cunderdin, along verge of road to York, 5 Oct. 1977, *J.H.Willis s.n.* (PERTH).

Closely related to and easily confused with *H. ruscifolia*, from which it differs in its lateral pollen presenter, glabrous fruit and wing encircling the seed body.

An endangered species known only from c. 19 populations. For a discussion of its endangered status see F.H.Mollemans *et al.* (1993), *Declared rare flora and other plants* in *need of special protection* in *the Merredin district* p. 53. Dept of Conservation & Land Management, W.A. This species is also recognised as 'Endangered' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

99. Hakea ruscifolia Labill., *Nov. Holl. Pl.* 1: 30, t. 39 (1805)

Conchium ruscifolium (Labill.) Willd., *Enum. Pl.* 141 (1809). T: in terra Van-Leuwin, [W.A.], *s.d.*, *J.Labillardière s.n.*; syn: FI *n.v.*, P (microfiche seen), W.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 73, pl. 105 (1984); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 230 (1990); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 22, 97 (1997).

Shrub, 1–2 m tall, lignotuberous. Branchlets densely villous. Leaves very crowded, erect, arranged in cylindrical whorls about stem, oblanceolate or spathulate, 1.2–3.2 cm long, 3–10 mm wide, attenuate or rounded, entire, densely velutinous with longer hairs or densely hirsute, becoming scabrous above. Inflorescence with 20–36 flowers; involucre 6–7 mm long; rachis 2–3.5 mm long, densely villous; pedicels 5–8 mm long. Perianth 2.2–3.5 mm long, white. Pistil 4–7 mm long; pollen presenter an erect cone. Fruit ovate, 1.5–2 cm long, 0.7–0.9 cm wide, finely rugose, glabrous or pubescent. Seed elliptic, 15–18 mm long; wing narrowly and fully down both sides of seed body. *Candle Hakea, Spike Hakea*. Fig. 15A–E.

A common species in south-western W.A. from Jurien Bay south to Cape Arid. Occurs in coastal sand heath, *Banksia attenuata* sand plain, open heath on laterite and Jarrah forest. Flowers mainly Dec.–Jan., sporadically in other months. Map 114.

W.A.: N of Gingin, *J.S.Beard 2478* (PERTH); on cliff-top, Windy Harbour, *A.S.George 2326* (PERTH); Tuttanning Reserve, SE of Pingelly, *A.S.George 9803* (PERTH); 3.2 km W of Jarrahwood, *J.W.Green 405* (PERTH); Coomallo Ck, *R.Hnatiuk 761406* (PERTH).

This species is variable in leaf shape, as shown by Meisner annotating material in his own herbarium as 'petiolata' (*Preiss 613*), 'vulgaris' (*Preiss 611*) with sessile leaves and 'obovata' (*Preiss 614*), all based on the leaf shape. However, these were apparently not published and there appear to be no supporting characters to justify their recognition.

Undulata Group

Hakea sect. *Conogynoides* ser. *Petiolares* Benth., *Fl. Austral*. 5: 493, 520 (1870), *p.p.*

Hakea sect. *Conogynoides* ser. *Sessiles* Benth., *Fl. Austral*. 5: 494, 521 (1870), *p.p.*

Hakea sect. *Conogynoides* ser. *Nervosae* Benth., *Fl. Austral*. 5: 494, 523 (1870), *p.p.*

Shrubs or, rarely, small trees, without corky bark. Leaves simple, flat or undulate, non-petiolate, not stem-clasping, entire or toothed; venation longitudinal with 3–7 veins, prominent above and below, with pinnate or reticulate venation between. Inflorescence an axillary umbelliform raceme, not resprouting in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis knob-like. Flowers 10–40 (–70); pedicels glabrous (or pubescent in *H. dactyloides* and *H. laevipes* subsp. *laevipes*). Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 3–10.5 mm long; pollen presenter conical; gland small, an oblique depressed trigonous-obovoid curved flap, sometimes vestigial or absent. Fruit 1–3 (–6) per axil, decurved, retained on plant, woody, ±smooth, usually beaked, not horned, dehiscing fully down both sides, rarely fully down one side and partly down other (*H. elliptica*). Seed occupying part of valve; wing extending fully or partly down one side of seed body only, rarely down both, and around base (*H. plurinervia*).

A group of 11 species, widespread in southern and eastern Australia.

1 Leaf margin spinulose-dentate

2 Erect shrub; leaves 20–65 mm wide, longitudinal veins 3–7; flowers cream-white; pistil 3–4 mm long; fruit 2.3–3 cm long, 1–1.4 cm wide, often more than 3 per axil (Darling Ra. to Albany, W.A.; flowers July–Oct.) **107. H. undulata**

2: Bushy shrub; leaves 6–20 mm wide, longitudinal veins 1–3; flowers white to pink; pistil 4–6 mm long; fruit 1.7–2.3 cm long, 0.8–1.1 cm wide, never more than 3 per axil (Eneabba to Moore R. area and Pingelly/Narrogin area, W.A.; flowers July–Oct.) **108. H. anadenia**

1: Leaf margin entire or crenate

3 Leaves cordate or rounded at base, with secondary venation between main longitudinal veins very prominent

4 Leaves 20–55 mm wide; branchlets densely tomentose, with hairs reddish brown (Albany to Nornalup and offshore islands, granite outcrops, W.A.; flowers Dec.) **100. H. elliptica**

4: Leaves 9–27 mm wide; branchlets tomentose or appressed-pubescent, with hairs colourless

5 Leaves with 3–5 main longitudinal veins above and below; pistil 6.5–10.5 mm long; fruit 21–31 mm long, with apex sometimes recurved (Albany to Esperance and inland to Stirling Ra., W.A.; flowers July–Nov.) **101. H. ferruginea**

5: Leaves with 1–3 main longitudinal veins above and below; pistil 4.5–6 mm long; fruit 16–20 mm long, with apex not recurved (between Pingelly and Katanning, W.A.; flowers Sept.–Oct.) **102. H. hastata**

3: Leaves attenuate or narrowly cuneate at base, with secondary venation between main longitudinal veins prominent or obscure

6 Perianth pink; pistil 9–10.5 mm long; fruit remaining closed on death of a branch or on herbarium specimens (Mt Lesueur to Eneabba, W.A.; flowers Aug.) **105. H. neurophylla**

6: Perianth white, cream or yellow; pistil less than 9 mm long; fruit opening on death of a branch or on herbarium specimens

7 Pedicels pubescent

8 Erect single-stemmed nonsprouting shrub or small tree, 2.4–4.5 m tall; leaves narrowly elliptic to linear, 5–14.5 mm wide (forest areas in coastal areas and tablelands of N.S.W., extending to north-eastern Vic.; flowers Oct.–Jan.) **109. H. dactyloides**

8: Erect bushy lignotuberous shrub, 0.6–2 m tall; leaves obovate-spathulate, sometimes narrowly so, 7–30 mm wide (heaths of central and south coast and tablelands of N.S.W.; flowers Nov.–Jan.) **110. H. laevipes**

7: Pedicels glabrous

9 Branchlets in flowering region glabrous or sparsely appressed-pubescent

10 Leaves elliptic to obovate with attenuate base and acuminate apex; flowers 10–16 per inflorescence (Avon Valley to Beverley, W.A.; flowers Aug.–Sept.) **106. H. loranthifolia**

10: Leaves narrowly obovate-elliptic to almost linear with narrowly cuneate base and acute to obtuse apex; flowers 40–70 per inflorescence (Great Dividing Ra. from Daintree to Brisbane, Qld; flowers May–Sept.) **111. H. plurinervia**

9: Branchlets in flowering region tomentose, often patchily glabrescent

11 Fruit prominently beaked; seed wing extending down one side of seed body only; non-sprouting shrubs

12 Flowers with pedicel shorter than perianth; gland present, functional; leaves not curved (usually in heath or woodland – heath vegetation, Stirling Ra., W.A.; flowers Sept.–Oct.) **103. H. ambigua**

12: Flowers with pedicel longer than perianth; gland absent or vestigial; leaves curved (usually in *Eucalyptus marginata* woodland, S & W of Stirling Ra., W.A.; flowers Aug.–Sept.) **104. H. falcata**

11: Fruit not or obscurely beaked, but apiculate; seed wing extending at least partly down both sides of seed body; resprouting shrubs (north-eastern N.S.W. and south-eastern Qld in higher parts of Great Dividing Ra.; flowers Oct.–Dec.) **110. H. laevipes**

100. Hakea elliptica (Sm.) R.Br., *Trans. Linn. Soc. London* 10: 187 (1810)

Conchium ellipticum Sm., in A.Rees, *Cycl.* 9 (1807), pages unnumbered. T: King George Sound, [W.A.], 1803 [26 Sept.–15 Oct. 1791], *A.Menzies s.n.*; holo: LINN; iso: BM, ?K *p.p.*

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 203 (1990).

Erect shrub, 2–4 m tall, non-sprouting. Branchlets densely tomentose with reddish brown hairs at flowering. Leaves elliptic to broadly elliptic, ±flat, 4.5–9.5 cm long, 15–55 mm wide, cuneate to almost rounded at base, finely crenate, obtuse and blunt, short-acuminate or emarginate; longitudinal veins 3–5 above and below; secondary veins reticulate, prominent. Inflorescence solitary with 35–40 flowers; pedicels glabrous. Perianth cream-white. Pistil 6–7.5 mm long; gland present. Fruit obliquely elliptic, 3–3.7 cm long, 1.8–2.2 cm wide, not curved apically, not or obscurely beaked. Seed obliquely ovate, 20–25 mm long; wing extending broadly down one side of body, narrowly and partly down other, blackish brown, sometimes with paler patches.

Occurs at a few localities along the south coast of south-western W.A., from Nornalup to just east of Albany, and on nearby offshore islands. Found in association with granite outcrops in heath. Flowers Dec. Map 115.

W.A.: Nornalup, 11 Sept. 1965, *A.F.Davies & A.C.Beauglehole s.n.* (NSW, PERTH); Bald Is., off S coast ENE of Albany, 13 Dec. 1963, *A.R.Main s.n.* (PERTH); near Ledge Beach, c. 7 km ENE of Albany, *A.Strid 21825* (PERTH).

Occasionally grown as an ornamental, when noted for its striking bronze new shoots.

101. Hakea ferruginea Sweet, *Fl. Australas.* t. 45 (1828)

T: 'Drawing was taken... from specimens communicated to us, from the collection of Robert Barclay, Esq. where it was raised from seeds received from New Holland', without locality, ?1826, *R.Sweet s.n.*; syn: G-DC (2 specimens).

Hakea repanda R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 30 (1830). T: King George Sound, W.A., 1818 (Capt. King's first Voyage), *A.Cunningham 36*; syn: B, BM, K.

Hakea repanda Sweet, *Hort. Brit.* 491 (1826), *nom. nud.*

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 383 (1989).

Erect rounded or sprawling shrub, 1–4.5 m tall, non-sprouting. Branchlets densely tomentose with colourless hairs at flowering. Leaves narrowly to broadly ovate or elliptic, ±flat, 1.5–8.5 cm long, 12–27 mm wide, cordate to broadly cuneate at base, crenate to ±entire, acute, pale green; longitudinal or palmate veins 3, rarely 5; secondary veins reticulate, prominent. Inflorescence solitary with 16–20 flowers; pedicels glabrous. Perianth cream-white. Pistil 6.5–10.5 mm long; gland present. Fruit obliquely ovate, 2–3.1 cm long, 1.1–1.8 cm wide, sometimes with recurved apex, beaked. Seed narrowly ovate or elliptic, 14–18 mm long; wing extending narrowly and fully or partly down one side of body only, blackish brown throughout. Plate 14; Fig. 16C.

Occurs in the southern coastal region of south-western W.A., from Albany to Esperance and inland to the Stirling Ra. Found in mallee-heath or open forest, usually in lateritic sand. Flowers July–Nov. Map 116.

W.A.: E of Cranbrook, *T.E.H.Aplin 2032* (PERTH); Fitzgerald River Natl Park, c. 2 km along road W of Ranger's residence, *L.Haegi 2614 & P.Short* (AD, MEL, PERTH); 28 km NE of Manypeaks along South Coast Hwy, *A.Strid 20500* (PERTH).

Very close to *H. hastata* (*q.v.*).

102. Hakea hastata Haegi, *Fl. Australia* 17B: 394 (1999)

T: Tuttanning Nature Reserve, Avon District, W.A., 5 Nov. 1971, *Hj.Eichler 20971*; holo: AD; iso: K, PERTH.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 15, 50 (1997), as *H. ferruginea*.

Sparingly branched sprawling shrub, 1.5–3 m tall; resprouting capacity unknown. Branchlets densely tomentose with pale rust-brown hairs at flowering. Leaves narrowly to broadly ovate,

±flat, 2–4.7 cm long, 9–24 mm wide, cordate to rounded at base, crenate to ±entire, acute to acuminate, pale green; veins longitudinal, 1–3, in broad leaves also palmate, prominent above and below; secondary venation reticulate. Inflorescences solitary with 18–22 flowers; pedicels glabrous. Perianth cream-white. Pistil 4.5–6 mm long; gland present. Fruit obliquely ovate to broadly ovate, 1.6–2 cm long, 0.9–1.2 cm wide, not curved at apex, obscurely beaked. Seed obliquely ovate or elliptic, 11–14 mm long; wing extending fully or partly down one side of body only, sometimes notched near base, blackish brown throughout.

Known from only a few locations between Pingelly, Kulin and Katanning in the Avon District of south-western W.A., in eucalypt woodland or mallee with heathy understorey, in sand or sandy loam over laterite. Rare. Flowers Sept.–Oct. Map 117.

W.A.: Tuttanning Reserve, E of Pingelly, *G.Heinsohn 12* (PERTH); c. 10 km S of Toompup, *K.Newbey 1436* (PERTH); 14 km N of Tarin Rock along road to Kulin, *R.Purdie 5339* (CANB).

This taxon was previously not recognised as distinct from *H. ferruginea*, which differs in its larger flowers, relatively shorter pedicels, larger and more prominently beaked follicles and its more southerly distribution.

103. Hakea ambigua Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 2: 260 (1848)

T: Swan River [?Stirling Ra.], [W.A.], *s.d.* [1843–44], *J.Drummond 3: 277*; syn: BM, G, G-DC, K, LE *p.p.*, MEL, NY, OXF, P, TCD; probable syn: K (Herb. Hooker, *Drummond s.n.*).

Hakea trinervis Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 414 (1856). T: Swan River Colony [Swan River to Cape Riche, W.A.], *s.d.* [1848], *J.Drummond 5: 408*; syn: BM, CGE *p.p.*, G, K, LE *p.p.*, NY, OXF, P, TCD.

Hakea trinervis Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 4: 209 (1852), *nom. nud.*

Illustration: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 27 (1997).

Erect bushy shrub, 1–3 m tall, non-sprouting. Branchlets tomentose, sometimes patchily glabrescent at flowering. Leaves narrowly elliptic to almost linear, flat, 2–11 cm long, 4–20 mm wide, narrowly cuneate at base, entire or slightly crenate, acute to acuminate; longitudinal veins 3 (–7); secondary veins reticulate, visible. Inflorescence solitary with 20–30 flowers; pedicels shorter than perianth, glabrous. Perianth pale yellow to cream. Pistil 5.5–8.5 mm long, cream or white; gland present. Fruit obliquely ovate, 2.3–4 cm long, 1.1–1.5 cm wide, slightly curved at apex, prominently beaked. Seed narrowly ovate, concave towards base abaxially, 13–20 mm long; wing extending fully or partly down one side of body only, black. Fig. 16E.

Restricted to the Stirling Ra., south-western W.A., where it is widespread on slopes and ridges in rocky quartzitic sandy soil, in woodland-heath. Flowers Sept.–Oct. Map 118.

W.A.: c. 6.5 km from Red Gum Springs toward Cranbrook, *E.M.Canning 6199* (CANB); The Arrows (N side), E end of Stirling Ra., *A.S.George 10421* (PERTH); E slopes of Mt Toolbrunup, Stirling Ra., *P.G.Wilson 4232* (AD, PERTH).

The flowers of *H. ambigua* are faintly sweetly scented and the perianth generally dries dark brown. It is close to and at times difficult to distinguish from *H. falcata* (*q.v.*). A possible disjunct occurrence of *H. ambigua* well to the east of its otherwise recorded range is based on the single specimen *E.Mullins 64* (CANB), the collecting locality of which (64 km from Esperance to Ravensthorpe) may be erroneous.

104. Hakea falcata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 29 (1830)

T: south west coast of New Holland, [W.A.], 1828/9, *W.Baxter s.n.*; ?holo: BM.

Erect shrub, 2–4 m tall, non-sprouting. Branchlets patchily tomentose with pale rust-brown hairs to glabrescent at flowering. Leaves curved, linear to narrowly obovate, flat, 5–14 cm l ong, 3–9 mm wide, narrowly cuneate at base, entire, acute to acuminate; longitudinal veins 3 (rarely 4), above and below; secondary veins pinnate, inconspicuous to obscure. Inflorescence solitary with 25–40 flowers; pedicels longer than perianth, glabrous. Perianth cream. Pistil 4.5–6.5 mm long, cream; gland vestigial or absent. Fruit obliquely narrowly ovate, curved, 2–2.5 cm long, 0.7–1 cm wide, prominently beaked. Seed narrowly ovate,

Figure 16. *Hakea*. **A**, *H. undulata*, habit (H.Demarz 7497, PERTH). **B**, *H. anadenia*, habit (H.Demarz 3907, PERTH). **C**, *H. ferruginea*, habit (T.E.H.Aplin 2032, PERTH). **D**, *H. loranthifolia*, habit (G.J.Keighery 7079, PERTH). **E**, *H. ambigua*, flower (A.Strid 20551, PERTH). **F**, *H. falcata*, flower (A.George 14968, PERTH). Scale bar: **A–D** = 2 cm; **E–F** = 2.5 mm. Drawn by Beth Chandler.

concave towards base abaxially, 17–20 mm long; wing extending fully or partly down one side of body only, blackish brown to black. Fig. 16F.

Occurs in south-western W.A., between about Busselton and Augusta and east to the Stirling Ra. Usually found in Jarrah (*Eucalyptus marginata*) woodland or open forest in lateritic loam soil, or in sand on poorly drained sites. Flowers Sept.–Nov. Map 119.

W.A.: Boxwood Hills–Toompup road, 13 km NW of Chillilup Pool turnoff, *B.Barnsley 635* (CANB, PERTH); c. 0.75 km W of Karri Bank, Porongorup Ra., *A.S.George 14946* (AD, PERTH); Denmark road, 20 km S of junction with Muir Hwy, *A.S.George 15086* (CANB, K, PERTH).

Hakea falcata has heavily sweetly scented flowers, a feature which distinguishes it from the closely related *H. ambigua*. The former also differs in having pedicels longer (not shorter) than the perianth, in lacking or with only a vestigial gland, flowers which generally pale on drying, pale rather than dark involucres and its occurrence in Jarrah forest rather than other woodland-heath vegetation. See B.Lamont *et al*., A numeric, geographic and structural analysis of the *Hakea falcata* group (Proteaceae), *Bot. J. Linn. Soc*. 94: 433–451 (1987).

105. Hakea neurophylla Meisn., *Hooker's J. Bot. Kew Gard. Misc*. 7: 117 (1855)

T: Swan River Colony [Dandaragan to Champion Bay], W.A., *s.d.* [1850–51], *J.Drummond 6: 195*; syn: BM, G-DC, K, LD, MEL, NY, OXF, P, PERTH; possible syn: B *p.p.*

Erect shrub, 0.6–2 m tall, non-sprouting. Branchlets glabrous by flowering. Leaves obovate to elliptic, sometimes undulate, 5–11.2 cm long, 16–43 mm wide, narrowly cuneate at base, entire, acute to acuminate; longitudinal veins 3 above and below; secondary veins reticulate, equally or less conspicuous. Inflorescence solitary with 12–18 flowers; pedicels glabrous. Perianth pale to deep pink. Pistil 9–10.5 mm long; gland vestigial or absent. Fruit obliquely ovate, 3–4 cm long, 1.5–1.9 cm wide, obscurely beaked, with a dorsal longitudinal ridge on each valve. Seed obliquely ovate, c. 28 mm long; wing extending narrowly and partly down one side of body only, blackish brown.

Rare and restricted to the Mt Lesueur–Eneabba area north of Perth, W.A.; grows in heathland in sand over laterite, usually near ridge tops. Flowers Aug. Map 120.

W.A.: E summit of Mt Lesueur, *C.A.Gardner 9079* (PERTH); 32 km S of Eneabba on Coorow–Leeman road, 15 Aug. 1987, *E.McCrum s.n*. (CANB, PERTH).

Among other characters *H. neurophylla* is distinguished by its vestigial or absent gland. Unlike most other *Hakea* species, the fruit usually remain closed after the branch dies and on herbarium specimens.

This species is recognised as 'Rare' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

106. Hakea loranthifolia Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 574 (1845)

T: in lapidosis illustribus sylvae haud longe ab urbicula York, W.A., 11 Sept. 1839, *L.Preiss 567*; syn: NY; isosyn: B, G, G-DC, L, LD, LE *p.p.*, MEL, MO, P, TCD (as *Preiss 555*); Swan River colony, [W.A.], *s.d.* [1841 or before], *J.Drummond 1: 606*; syn: NY; isosyn: BM, G, K, LE *p.p.*, MEL, OXF, P, PERTH.

Illustration: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 64 (1997).

Erect sparingly branched shrub, 2–3 m tall; resprouting capacity unknown. Branchlets glabrous by flowering. Leaves elliptic to obovate, sometimes undulate, 4.2–8.5 cm long, 13–23 mm wide, attenuate at base, entire, acuminate; longitudinal veins 1–3 above (sometimes obscure), 3–5 below; secondary veins pinnate, visible or obscure. Inflorescences 1–3 per axil with 10–16 flowers per raceme; pedicels glabrous. Perianth white. Pistil 5–6.3 mm long; gland present. Fruit obliquely ovate, 1.6–2.5 cm long, 0.9–1.8 cm wide, beaked. Seed obliquely elliptic, 13–16 mm long; wing extending broadly and partly down one side of body only, notched near base, blackish brown. Fig. 16D.

Restricted to the upper Avon R. valley from south-east of Toodyay to Tuttanning Reserve, south-western W.A.; apparently rare. Occurs in open woodland (often of *Eucalyptus wandoo*

or *E. accedens*) above and on breakaways, in sandy to gravelly lateritic loam soil. Flowers Aug.–Sept. Map 121.

W.A.: Hoddywell Reserve, Toodyay to Clackline, *G.J.Keighery 7079* (CANB, K, PERTH); Boyagin Reserve, 21 km NW of Pingelly, *S.Patrick 96* (PERTH).

107. Hakea undulata R.Br., *Trans. Linn. Soc. London* 10: 185 (1810)

T: Observatory Hill, King George Sound, [W.A.], *s.d.* [Dec. 1801], *R.Brown Iter Austral. 3349*; syn: BM, E, K.

Anadenia hakeoides Lindl., *Sketch Veg. Swan R.* xxxi (1839). T: Swan River, [W.A.], *s.d.* (received in 1839 or before), *J.Drummond s.n.*; syn: BM, G, K; Swan River, [W.A.], *s.d.* (received July 1839), *J.Drummond 613*; ?syn: BM, G.

Hakea undulata ß *subintegerrima* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 566 (1845). T: in regionib. interior Australiae meridionali-occid. [W.A.], Oct. 1840, *Preiss 569*; holo: NY; iso: LD, LEP.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 23, 108 (1997).

Erect shrub, 1–2 m tall, non-sprouting. Branchlets glabrescent by flowering. Leaves obovate to elliptic, shallowly concave, undulate towards margins, 4–11.5 cm long, 20–65 mm wide, narrowly attenuate at base, spinulose-dentate, acuminate to rounded, slightly greyish green; longitudinal veins 3–7, prominent above and below; secondary venation reticulate, prominent. Inflorescence solitary with 12–21 flowers; pedicels glabrous. Perianth cream-white. Pistil 3–4 mm long; gland vestigial. Fruit obliquely ovate, 2.3–3 cm long, 1–1.4 cm wide, not curved at apex, beaked. Seed ±elliptic, 15–18 mm long; wing extending fully or partly down one side of body only, notched near base, blackish brown. Fig. 16A.

Occurs in south-western W.A. from Moore R. north of Perth, to just east of Albany. Found in *Eucalyptus* (often *E. wandoo*) open forest and woodland, in sandy to gravelly clay soil over laterite or sometimes in association with granite outcrops. Flowers July–Oct. Map 122.

W.A.: Pages Way, Gosnells, *R.J.Cranfield 525* (AD, PERTH); Karragullen, *J.D'Alonzo 30* (CANB, K, PERTH); Greenmount, 25 Aug. 1897, *R.Helms s.n.* (MEL, PERTH); 4.5 km N of Ellen Peak, *K.Newbey 304* (PERTH); Mt Manypeaks, *S.P.Pfeiffer 25* (PERTH).

Very close to *H. anadenia* (*q.v.*). Within the *Undulata* Group, *H. undulata* is the only species in which more than 3 fruits per axil have been observed, but this condition occurs in fewer than 20 percent of specimens seen.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

108. Hakea anadenia Haegi, *Fl. Australia* 17B: 394 (1999)

T: 28 km E of Jurien on road to Brand Hwy at 30°14'S, 115°18'E, W.A., 15 Nov. 1983, *L.Haegi 2673 & P.S.Short*; holo: PERTH; iso: AD, MEL.

Bushy shrub, 0.3–2 m tall, ?lignotuberous. Branchlets patchily appressed-pubescent with colourless hairs at flowering. Leaves narrowly elliptic to obovate, shallowly concave, undulate towards margins, 2.7–8.5 cm long, 6–20 mm wide, narrowly attenuate at base, spinulose-dentate, acute to acuminate; longitudinal veins 1–3, prominent above and below; secondary venation reticulate, prominent. Inflorescences 1 or 2 per axil, with 14–20 flowers per raceme; pedicels glabrous. Perianth white to pink. Pistil 4–6 mm long; gland vestigial or absent. Fruit obliquely narrowly ovate, 1.7–2.3 cm long, 0.8–1.1 cm wide, usually beaked. Seed obliquely ovate, 12–15 mm long; wing extending unevenly fully or partly down both sides of seed body, sometimes notched near base, black. Fig. 16B.

Occurs in the Eneabba to Moore R. area near the west coast of W.A., and in the Pingelly–Narrogin area east of the Darling Ra.; grows in scrub-heath, sometimes with mallee or low woodland, in sandy soil. Flowers July–Oct. Map 123.

W.A.: Alexander Morrison Natl Park, 7 km S of junction of Green Head Rd and Tootbardi Rd, *B.Barnsley 895* (CANB, PERTH); c. 59 km from Moora towards Jurien Bay, *W.E.Blackall 3551* (PERTH); N from Dandaragan, *C.A.Gardner 9286* (PERTH); 40–67 mile peg [64–108.3 km] on Geraldton Hwy, *E.McCrum 67* (PERTH).

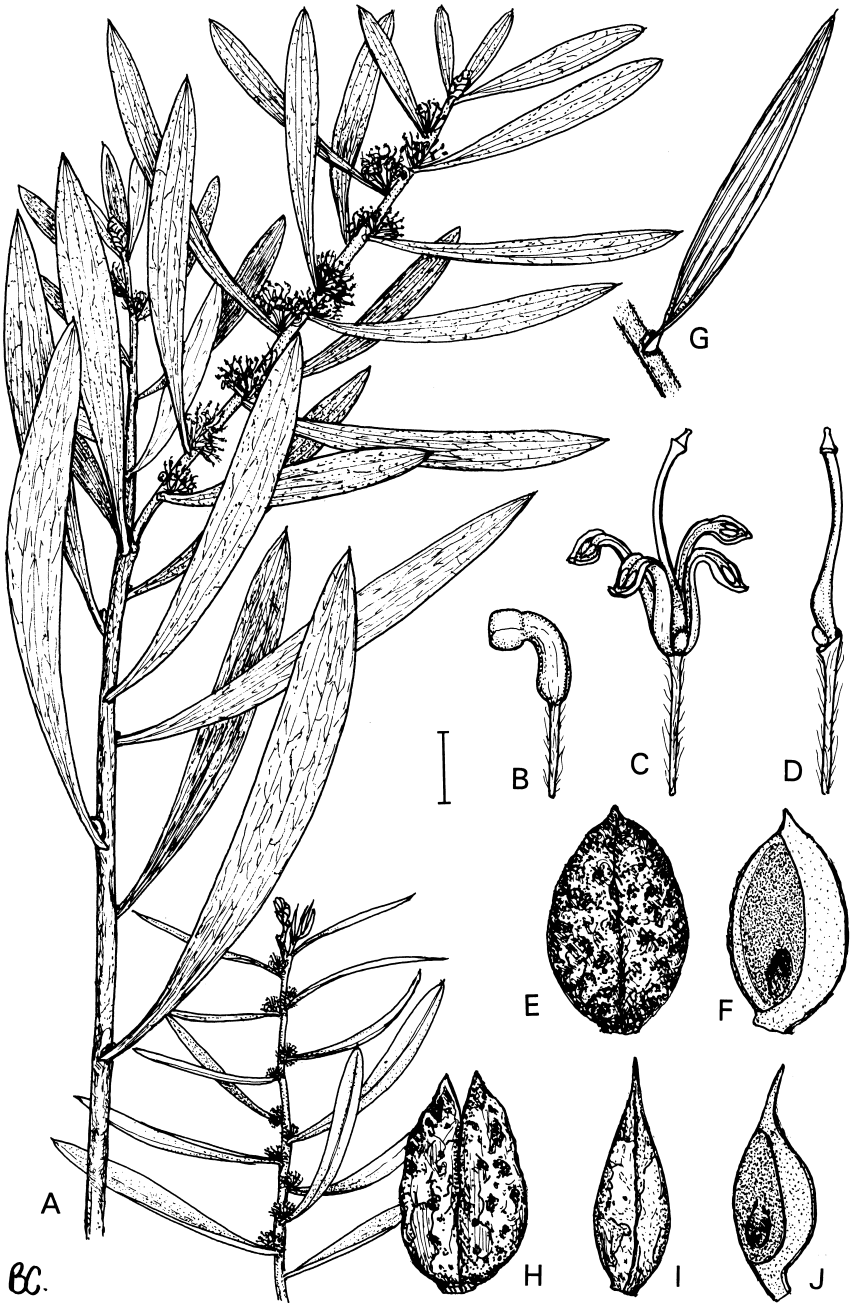

Figure 17. *Hakea*. **A–F**, *H. dactyloides*. **A**, habit; **B**, bud; **C**, flower; **D**, style with tepals removed (**A–D**, E.N.S.Jackson 2220, AD); **E**, fruit; **F**, inside of fruit (**E–F**, E.N.S.Jackson 2208, AD). **G–H**, *H. repullulans*. **G**, single leaf with twisted base; **H**, fruit (**G–H**, N.Donner 9251, AD). **I–J**, *H. carinata*. **I**, fruit; **J**, inside of fruit (**I–J**, E.H.Ising *s.n.*, AD96149042). **K**, *H. mitchellii*, branch (E.N.S.Jackson 1732, AD). Scale bar: **A**, **G** = 1 cm; **B–D** = 2 mm; **E–F**, **H–J** = 7 mm; **K** = 1.3 cm. Drawn by Beth Chandler.

Very close to, and formerly included under, *H. undulata* which differs by having smaller flowers (pistil 3–4 mm long vs 4–6 mm long), proportionally longer pedicels (1–1.7 times pistil length vs 0.5–0.8 times) and proportionally broader leaves (length:breadth 2–3.1 vs 3.4–6.7). They also possibly differ in *H. anadenia* being lignotuberous. in both species the gland is vestigial or absent.

109. Hakea dactyloides (Gaertn.) Cav., *Anales Hist. Nat.* 1: 215, t. 12 (1800)

Banksia dactyloides Gaertn., *Fruct. Sem. Pl.* 1: 221, t. 47, fig. 2 (1788); *Conchium dactyloides* (Gaertn.) Vent., *Jard. Malmaison* 2: t. 110 (1805). T: New Holland, [N.S.W.], 1770, *J.Banks & D.Solander s.n.*; holo: t. 47, *loc. cit*.

Banksia oleaefolia Salisb., *Prodr. Stirp. Chap. Allerton* 54 (1796). T: ex Port Jackson [N.S.W.], *auct.* Jac. Lee; holo: not located.

Conchium nervosum Donn, *Hortus Cantabrig.* 2nd edn, 14 (1800), *nom. nud.*; *Hortus Cantabrig.* 3rd edn, 21 (1804), *nom. nud.*; *Conchium nervosum* Donn ex Sm., *Trans. Linn. Soc. London* 9: 123 (1808), *pro syn.*; *Hakea nervosa* (Donn ex Sm.) Knight, *Cult. Prot.* 108 (1809), *nom. illeg.* (*Banksia dactyloides* in synonymy).

Hakea dactyloides α, R.Br., *Trans. Linn. Soc. London* 10: 186 (1810); *H. dactyloides* α *latifolia* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 415 (1856), *nom. inval.* (incl. type of *Banksia dactyloides*).

Hakea dactyloides ß R.Br., *Trans. Linn. Soc. London* 10: 187 (1810); *H. dactyloides* ß *angustifolia* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 415 (1856). T: not located.

Hakea incrassans Gand., *Bull. Bot. Soc. France* 66: 230 (1919). T: Port Jackson, N.S.W., Nov. 1902, *N.Michael s.n.*; holo: LY.

Hakea leucopoda Gand., *Bull. Bot. Soc. France* 66: 230 (1919). T: N.S.W., 1902, *C.Walker s.n.*; holo: LY.

[*Hakea ferruginea auct. non* Sweet: C.Loddiges, *Bot. Cab.* t. 1501 (1829); J.H.Maiden, *Forest Fl. New South Wales* 5: 149 (1912)]

Illustration: J.H.Maiden, *Forest Fl. New South Wales* 5: no. 175, pl. 179A–K (1912).

Erect single-stemmed bushy shrub or small tree, 2.4–4.5 m tall, non-sprouting. Branchlets glabrescent or sparsely pale (rarely dark) appressed-pubescent at flowering. Leaves narrowly elliptic to almost linear, rarely narrowly obovate, sometimes falcate, 3.9–13 cm long, 5–14.5 mm wide, narrowly cuneate at base, entire, acute to acuminate; longitudinal veins 3 above and below, usually more prominent below; secondary veins reticulate, conspicuous or obscure. Inflorescence solitary with 20–38 flowers; pedicels appressed-pubescent with white and (rarely) ferruginous hairs. Perianth cream-white. Pistil 4–6.5 mm long; gland present. Fruit obliquely elliptic, slightly curved, 2.5–3.5 cm long, 1.7–2.3 cm wide, not beaked, apiculate. Seed obliquely obovate to obliquely elliptic, 18–23 mm long; wing extending down adaxial side of body only, notched. Plate 16; Fig. 17A–F.

Widespread in the Central and South Coast and Tablelands of N.S.W., extending to the Central Western Slopes and north-eastern Vic.; usually grows on sandstone in sclerophyll forest, on slopes, ridges and along watercourses, frequently in deeper soil. Flowers Oct.–Nov. Map 124.

N.S.W.: Lees Pinch, *M.D.Crisp 2277 & I.R.Telford* (AD, CANB, PERTH); near Carrington Falls on Robertson–Jamberoo road, *M.Evans 2673* (AD, CANB, K, MEL, NSW); 1.8 km from Berowra Water ferry crossing along Arcadia–Galston road, *L.Haegi 3533* (AD, BRI, MEL, NSW); 0.8 km WSW of Zig Zag Rly turnoff on Bell–Lithgow road, *L.Haegi 3540* (AD, BRI, MEL, NSW). Vic.: Mt Kay, E Gippsland, *N.A.Wakefield 3224* (MEL).

An attempt has been made here to clarify what is known as the '*H. dactyloides* species complex', in which several morphological variants have been informally recognised for some time, in particular resprouting and non-sprouting forms. This feature, supported by others such as branchlet indumentum and flowering time, provides the basis for recognition of a distinct taxon at species level (see *H. laevipes* below), but for many specimens for which these features are not evident or are unrecorded, assignment to the taxa recognised remains difficult. Further collecting of flowering material and field observation is expected to improve resolution of the complex.

110. Hakea laevipes Gand., *Bull. Soc. Bot. France* 66: 230 (1919)

T: Australia, N.S.Wales ad Bundanoon, Dec. 1897, *R.T.Baker s.n.*; holo: LY (herb. Gandoger).

[*Hakea dactyloides auct. non* (Gaertn.) Cav.: S.W.L.Jacobs & J.Pickard (eds), *Pl. New South Wales* 180 (1981)]

Erect much-branched bushy shrub, 0.3–3 m tall, lignotuberous. Branchlets densely dark brown tomentose or pubescent at flowering. Leaves almost linear to obovate-spathulate, sometimes falcate, 5–12.5 cm long, 4.5–30 mm wide, narrowly cuneate to attenuate at base, entire, acute or gradually to abruptly acuminate; longitudinal veins 3–5 above and below, usually more prominent below; secondary veins reticulate, conspicuous. Inflorescence solitary with 28–46 flowers; pedicels glabrous or appressed-pubescent with white or ferruginous hairs. Perianth cream-white. Pistil 4.5–6.5 mm long; gland present or absent. Fruit obliquely broadly elliptic to ovate, sometimes slightly curved, 2–3 cm long, 1.3–2.1 cm wide, not or obscurely beaked, apiculate. Seed obliquely broadly elliptic or obovate, 15–20 mm long; wing extending down both sides of body, more broadly and only partly or notched abaxially, blackish brown.

Widespread in the North, Central and South Coast and Tablelands regions of N.S.W., extending to the North Western Plains (near Yetman) and south-eastern Qld; grows in sandy soil in sclerophyll forest or heath.

Formerly not generally distinguished from *H. dactyloides*, but distinct primarily in being lignotuberous and also in the branchlets having a dark brown tomentum usually persistent to flowering time and beyond. Two subspecies are recognised.

Pedicels pubescent	**110a.** subsp. **laevipes**
Pedicels glabrous	**110b.** subsp. **graniticola**

110a. Hakea laevipes Gand. subsp. **laevipes**

Flowers with pubescent pedicels.

Of wide occurrence in coastal regions of N.S.W. from Green Cape north to Grafton, and in the Great Dividing Ra. from Bombala to Rylstone; grows in sandy soil, at times on poorly drained ridgetops, in sclerophyll forest or heath. Flowers Nov.–Jan. Map 125.

N.S.W.: near Charleyong, c. 21 km NNE of Braidwood, 18 Dec. 1967, *L.G.Adams s.n.* (CANB, K, L, NSW, US); Wingello, Dec. 1917, *J.L.Boorman* (NSW 126449); 0.8 km WSW of Zig Zag Railway turnoff on Bell–Lithgow road, *L.Haegi 3538* (AD, MEL, NSW); top of Judge Dowling Ra., c. 5 km SW of Bucketty, *D.J.McGillivray 1225* (NSW).

110b. Hakea laevipes subsp. **graniticola** Haegi, *Fl. Australia* 17B: 395 (1999)

T: 68 km E of Armidale on Grafton road, N.S.W., 20 Oct. 1989, *W.Molyneux s.n.*; holo: AD; iso: NSW.

Hakea dactyloides var. *angustifolia* Maiden, *Forest Fl. New South Wales* 5: 147, 149 (1912), *nom. illeg. non* A.L.P.P. de Candolle. T: Emmaville, N.S.W., 10.1901, 6.1904, *J.L.Boorman s.n.*; syn: NSW.

[*Hakea dactyloides auct. non* (Gaertn.) Cav.: G.J.Harden, in G.J.Harden (ed.), *Fl. New South Wales* 2: 61 (1991), *p.p.* (with respect to taxon with glabrous pedicels)]

Illustration: J.H.Maiden, *Forest Fl. New South Wales* 5: no. 175, pl. 179L–M (1912), as *H. dactyloides* var. *angustifolia* Maiden.

Flowers with glabrous pedicels.

Occurs in north-eastern N.S.W. and south-eastern Qld, usually in higher parts of the Great Dividing Ra., extending to the slopes (Warialda) and possibly the plains (Yetman). Usually found in association with granite outcrops in coarse sandy soil, in heathy forest, sometimes near streams. Flowers Oct.–Dec. Map 126.

Qld: Wyberba, 1961, *F.D.Hocking s.n.* (BRI); Pozieres Rd, 0.4 km W of Cottonvale, 10 Oct. 1970, *K.Williams s.n.* (BRI). N.S.W.: Torrington, Oct. 1911, *J.L.Boorman s.n.* (NSW).

Distinguished readily from subsp. *laevipes* and the closely related species *H. dactyloides* by its glabrous pedicels. The record for the North Western Plains of N.S.W. is based on a non-

flowering specimen from the Bebo State Forest near Yetman, close to the boundary with the North Western Slopes. This is tentatively placed with subsp. *graniticola* on the basis of the identity of the nearest populations (at Warialda and Torrington), but flowering material is required for confirmation.

111. Hakea plurinervia F.Muell. ex Benth., *Fl. Austral.* 5: 523 (1870)

T: Rockingham Bay, [Coast Range, Qld], 15th Sept. 1869, *J.Dallachy s.n.*; syn: K, MEL; isosyn: B, BM, BR, MEL; Rockingham Bay, [Coast Range, Qld], 23rd Mar. 1869, *J.Dallachy s.n.*; syn: K, L, MEL.

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 385 (1989); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 226 (1990).

Erect to spreading shrub, 0.5–3 m tall, ?non-sprouting. Branchlets glabrous or sparsely appressed-pubescent at flowering. Leaves narrowly obovate-elliptic, rarely almost linear, often falcate, 8–21 cm long, 9–35 mm wide, narrowly cuneate at base, entire, sometimes undulate, acute or obtuse; longitudinal veins 5–9 above and below; secondary veins reticulate, conspicuous, rarely ±obscure. Inflorescence solitary with 40–70 flowers; pedicels much longer than perianth, glabrous. Perianth cream-white. Pistil 4.8–5.8 mm long; gland present. Fruit obliquely ovate-elliptic, ±straight or slightly sigmoidal, 2.5–3.5 cm long, 1.2–1.5 cm wide, obscurely beaked, prominently apiculate. Seed obliquely rhombic-obovate, 20–24 mm long; wing extending narrowly down both sides and around base of body. Plate 17.

Extends along the Great Dividing Ra. in Qld, reaching the coast in some areas, occurring near Brisbane, on the Blackdown Tableland, in the Cardwell area on the Atherton Tableland and reaching as far north as the Daintree R. Found in eucalypt forest, often on rocky sites, in sandy soil. Flowers May–Sept. Map 127.

Qld: 7 km W of Herberton, 1 km by road N of Herberton–Irvinebank road, *B.J.Conn & J. De Campo 1270* (AD, BRI, MEL); Mt Gravatt Cemetery Reserve, Brisbane, *J.Gillicatt 541* (BRI); Atherton–Herberton road, *A.K.Irvine 733* (BRI).

Flowers dry pale to dark brown. The pedicels are usually cream-white like the perianth but are pink in some specimens.

Cucullata Group

Hakea sect. *Conogynoides* ser. *Sessiles* Benth., *Fl. Austral.* 5: 494, 521 (1870), *p.p.*

Shrubs, without corky bark. Leaves simple, non-petiolate, initially flat, eventually cupped or shell-like about stem, or folded in half longitudinally and obscuring stem but not clasping, entire or toothed; venation conspicuous, longitudinal, palmate and reticulate. Inflorescence an axillary umbelliform raceme, not resprouting in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis knob-like. Flowers 5–30; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 14–28 mm long; pollen presenter erect, conical; gland depressed small, trigonous-obovoid, sometimes lacking. Fruit 1–5 per axil, decurved, retained on plant, woody, ±smooth, not or obscurely beaked, not horned, dehiscing fully down both sides. Seed occupying part of valve; wing extending broadly or narrowly down one side of seed body only, or narrowly down both sides.

A group of three species in southern W.A.

1 Leaves ascending, not folded almost in half along midrib, in flowering region cordate to depressed-circular, overlapping and cupped about stem; flowers deep pink (Stirling Ra. to Barren Ra., W.A.; flowers May–Nov.) **112. H. cucullata**

1: Leaves downturned, folded almost in half along midrib, in flowering region very broadly ovate to cordate or broadly ovate-acuminate; margins entire or sharply toothed; flowers white, rarely pale pink

2 Leaf margin entire or almost so (often very finely denticulate or crenulate); leaves elliptic to ovate in non flowering region, broadly ovate-acuminate in flowering region, 1.2–5 cm wide; apex narrowly acute; fruit 11–13 mm long (sand plains Perth to Geraldton and Ravensthorpe to Esperance, W.A.; flowers Aug.–Sept.) **114. H. smilacifolia**

2: Leaf margin sharply crenate-denticulate; leaves very broadly ovate to cordate, 3–7 cm wide; apex acuminate; fruit to 2 cm long (sand plains Gingin to Dongara, N of Perth, W.A.; flowers June–Aug.) **113. H. conchifolia**

112. Hakea cucullata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 30 (1830)

T: Mount Gardner, near the entrance to King George Sound, [W.A.], 1823, *W.Baxter*; syn: BM *p.p.*, K; possible syn: DBN (Baxter, undated).

Hakea cucullata Sweet, *Hort. Brit.* 491 (1826), *nom. nud.*

Hakea cucullata var. *vulgaris* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 567 (1845), *nom. inval.* (includes type variety).

Hakea cucullata var. *typica* Domin, *Vest. Král. České Spolcn. Nauk. Tr. Mat. Prír.* 2 (1923), *nom. inval.* (includes type variety).

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* pl. 90 (1984); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 383 (1989).

Erect sparingly branched shrub, 1–4 m tall, non-sprouting. Branchlets densely tomentose and sparsely hirsute with dark red-brown hairs at flowering. Leaves in lower parts broadly obovate, flat, in flowering region cordate to depressed circular, oblique, concave, ±overlapping, ascending and cupped about stem, 3.7–7.5 cm long, 38–90 mm wide, crenulate or denticulate, sometimes undulate, acuminate, rarely obtuse, pale green. Inflorescence axillary or at leafless nodes, with 25–30 flowers; pedicels 5.5–8 mm long, glabrous. Perianth deep pink. Pistil 17–25 mm long; gland present. Fruit 1–5 per axil, obliquely ovate, 2.2–2.8 cm long, 1.4–1.7 cm wide. Seed obliquely elliptic, 16–19 mm long; wing extending broadly down one side of body only, blackish brown throughout. Plate 20; Fig. 18A–F.

Occurs in the Stirling Ra., south-western W.A., on the plains to the south of them and east to the Whoogarup Ra.; grows in mallee-heath in sandy sometimes gravelly lateritic soil. Flowers May–Nov. Map 128.

W.A.: Red Gum Pass, c. 4 km S of Salt River Rd, Stirling Range Natl Park, *W.R.Barker 2439* (AD, COLO, NSW, PERTH); N side of Mondurup, Stirling Ra., *C.Gardner 16199* (PERTH); 6 km SSW of Kalgan R. Crossing on Albany–Borden road, *P.S.Short 2277 & L.Haegi* (AD, MEL, PERTH); Whoogarup Ra., Fitzgerald River Natl Park, *A.S.Weston 6322* (PERTH).

There appear to be two forms of *H. cucullata*, but as yet they cannot be reliably distinguished. Plants from the Stirling Ra. (e.g. *Gardner 16199* and *Barker 2439* cited above) have leaves with crenulate flat margins and shortly acuminate to obtuse apices. Plants from the remainder of the distribution (e.g. *Short 2277*) have larger leaves with denticulate undulate margins and long acuminate apices, together with longer fruit. Intermediate forms (e.g. *Weston 6322*) occur, and no correlated floral differences have been found.

One specimen (*D.Gibbon s.n.*, AD) of a possible hybrid involving *H. cucullata* as one parent (the other parent obscure) has been seen.

113. Hakea conchifolia Hook., *Icon. Pl.* 5: t. 432 (1841)

Hakea cucullata ß *conchifolia* (Hook.) Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 567 (1845). T: Swan River, W.A., *s.d.* [Nov. 1839 despatch to Hooker], *J.Drummond 611*; syn: BM, G, K, MEL.

[*Hakea cucullata auct. non* R.Br.: C.D.F.Meisner, in J.G.C.Lehmann, *Pl. Preiss.* 1: 566 (1845); G.Bentham, *Fl. Austral.* 5: 521 (1870)]

Illustration: A.S.George, *Introd. Proteaceae W. Australia* pl. 113 (1984).

Rounded shrub, 0.5–1 m tall, lignotuberous. Branchlets villous, hirsute and tomentose with fading red-brown hairs at flowering. Leaves of similar shape throughout, very broadly ovate to cordate, patent to decurved, folded adaxially almost in half along midrib (with curved

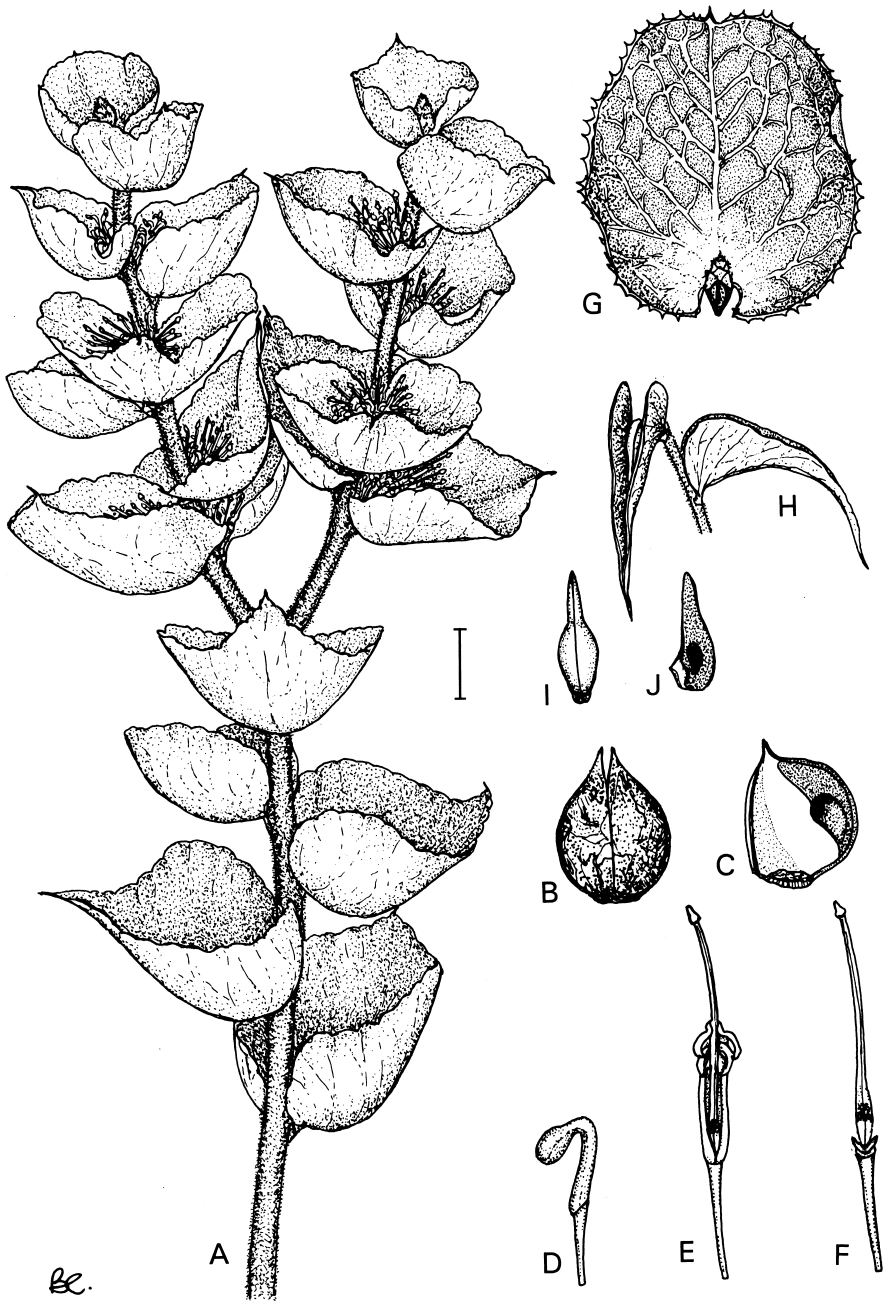

Figure 18. *Hakea*. **A–F**, *H. cucullata*. **A**, habit (A.M.Ashby 77, AD + cult. Wittunga Botanic Garden, S.A.); **B**, fruit; **C**, inside of fruit (**B–C**, W.R.Barker 2439, AD); **D**, bud; **E**, flower; **F**, flower with tepals removed (**D–F**, A.M.Ashby 77, AD). **G**, *H. victoria*, leaf (cult. Wittunga Botanic Garden, S.A.). **H–J**, *H. smilacifolia*. **H**, leaf; **I**, fruit; **J**, inside of fruit (**H–J**, P.S.Short 2410 & L.Haegi, AD). Scale bar: **A**, **G–H** = 2 cm; **B–C** = 1 cm; **D–F** = 5 mm; **I–J** = 7 mm. Drawn by Beth Chandler.

sides), at times overlapping and obscuring stem, 3–7.5 cm long, 30–70 mm wide when spread open, sharply crenate-denticulate, acuminate, grey-green. Inflorescences axillary with 15–18 flowers; pedicels 2.7–3 mm long, glabrous. Perianth creamy white, rarely pale pink. Pistil 24–28 mm long; gland present. Fruit solitary, obliquely ovate to elliptic, 2–2.5 cm long, 1–1.2 cm wide. Seed obliquely elliptic to obovate, indented at base, 18–20 mm long; wing extending narrowly down one side of body only, blackish brown throughout. Plate 18.

Occurs on the coastal sand plains from Perth to Dongara, W.A. Usually in low open myrtaceous heath on white sand over laterite. Flowers June–Aug. Map 129.

W.A.: 102 mile peg [164.2 km] on road to Eneabba, *K.M.Allan 23* (PERTH); Palm Terrace, Forrestfield, *R.J.Cranfield 34* (NSW, PERTH); 28 km E of Jurien on road to Brand Hwy, *L.Haegi 2672* & *P.S.Short* (AD, MEL, PERTH).

114. Hakea smilacifolia Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 567 (1845)

T: in planitie arenosa Quangen, Victoria, [near Wongamine, E of Toodyay, W.A.], 20 Mar. 1840, *L.Preiss 535*; syn: LD *p.p.*, LE *p.p.*, NY *p.p.*; in regionibus interioribus Australiae meridionali-occidentalis, [W.A.], Oct. 1840, *L.Preiss 536*; syn: LD *p.p.*, LE *p.p.*, NY *p.p.*

Sprawling shrub, 0.3–1.5 m tall, non-sprouting. Branchlets moderately villous to hirsute, and densely tomentose with pale rust-brown hairs at flowering. Leaves in lower parts elliptic to ovate, in flowering region broadly ovate-acuminate (markedly narrowed in distal half), decurved, folded adaxially almost in half along midrib (sides almost erect), at base almost obscuring stem, 2.2–6 cm long, 1.2–5 cm wide when spread open, entire or almost so (often finely denticulate or crenulate), narrowly acute, grey-green. Inflorescence axillary with 5 or 6 flowers; pedicels 1.2–2 mm long, glabrous. Perianth white. Pistil 14–15 mm long; gland absent. Fruit 1 or 2 per axil, obliquely narrowly ovate in lateral view, 1.1–1.3 cm long, 4–6 mm wide. Seed obliquely narrowly ovate, indented at base, 11–15 mm long; wing extending narrowly down both sides of body, blackish brown throughout. Fig. 18H–J.

Occurs in south-western W.A., on the coastal plain from Perth north to Geraldton, and along the south coast between Ravensthorpe and the Lort R.; grows in heath or mallee-heath on sand plain, in sandy soil over laterite. Flowers Aug.–Sept. Map 130.

W.A.: 100 km W of Esperance, 32 km W of Lort R. crossing, *B.Barnsley 413* (CANB, PERTH); 35 km W of Watheroo, *K.Newbey 2292* (PERTH); 27 km SW of Three Springs on road to Eneabba, *P.S.Short 2410* & *L.Haegi* (AD, MEL, PERTH).

Petiolaris Group

Hakea sect. *Conogynoides* ser. *Petiolares* Benth., *Fl. Austral*. 5: 493, 520 (1870), *p.p.*

Hakea sect. *Conogynoides* ser. *Longistylae* Benth., *Fl. Austral*. 5: 493, 518 (1870), *p.p.*

Shrubs or small trees, without corky bark. Leaves simple, flat, ±petiolate or sessile at base, not stem-clasping, entire; venation conspicuous above and below, longitudinal, sometimes with reticulate venation between. Inflorescence an axillary spherical or subspherical umbelliform raceme, sometimes arising from older leafless axils, not or sometimes resprouting in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis knob-like. Flowers 40–200; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 14–21 mm long; pollen presenter erect conical; gland oblique, depressed-trigonous-obovoid, concave. Fruit 1–10, usually curved at base, retained on plant, woody, ±smooth, usually beaked, not horned, dehiscing fully down both sides. Seed occupying part of valve; wing extending down both sides of seed body and usually narrowly around base.

A group of three species in southern W.A.

1 Fruit not flanged adaxially; leaves 2.3–6 cm wide, acuminate; secondary venation between main longitudinal veins prominent (inflorescence axillary or on bare wood below leaves; granite outcrops, Wongan Hills to Darling Ra. and SE beyond Hyden, W.A.; flowers Mar.–July) **115. H. petiolaris**

1: Fruit flanged (sometimes only narrowly) adaxially; leaves 0.6–2.9 cm wide, obtuse to acute; secondary venation between main longitudinal veins usually obscure

2 Leaf base narrowly attenuate; leaves 7–21 cm long, with 3–7 veins; inflorescence in axils of current growth; branchlets glabrous by flowering (Dumbleyung to Stirling Ra., E to Mt Ragged, W.A.; flowers Apr.–Aug.) **116. H. laurina**

2: Leaf base narrowly cuneate; leaves 3–10 cm long, with 3 longitudinal veins; inflorescence on bare nodes below leaves, rarely axillary; branchlets densely appressed-sericeous at flowering (Fitzgerald R. area, W.A.; flowers May–Sept.) **117. H. obtusa**

115. Hakea petiolaris Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 577 (1845)

T: montis 'Currie' (York), [W.A.], 15 Apr. 1840, *L.Preiss 557*; syn: B, BR (rec'd 1847), G, G-DC, HBG, L, LD, LE *p.p.*, M, MEL, NY, P.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* pl. 110 (1984); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 19, 80 (1997).

Erect shrub or small tree with ascending branches, 2–9 m tall, resprouting or non-sprouting. Branchlets densely appressed-sericeous or glabrescent by flowering. Leaves spathulate to narrowly elliptic, 5.5–15 cm long (including petiole 0–1.8 cm), 2.3–6 cm wide, narrowly cuneate to attenuate at base, acuminate, pale grey-green, quickly glabrescent or moderately appressed-sericeous at flowering; longitudinal veins usually (1–) 3 (–4); reticulate veins prominent above and below. Inflorescence axillary or at leafless node, sometimes resprouting in subsequent years, with 120–200 flowers; pedicels 8–9.5 mm long, glabrous. Pistil 14–18 mm long, cream-white; gland a V-shaped flap, 0.5–0.6 mm high. Fruit ±obliquely ovate-elliptic, 2.2–3.6 cm long, 1.1–1.9 cm wide, curved at base, obscurely or not beaked, not flanged. Seed obliquely ovate, 14–22 mm long; wing extending broadly down both sides of body (narrower on one side), sometimes narrowly around base also, blackish brown to black. Fig. 21E, F.

Occurs in south-western W.A. from Wongan Hills south to the Darling Ra. and south-east beyond Hyden, in small populations associated with granite outcrops. Flowers Mar.–July.

There are three subspecies from distinct geographical areas. Subsp. *petiolaris* has been observed to be a resprouter and subsp. *trichophylla* a non-sprouter (S.D.Hopper, pers. comm.).

1 Leaves (including petiole 8–18 mm long) spathulate, rarely narrowly so; leaf apex ±abruptly acuminate

2 Leaves 5.5–8.6 cm long (including petiole); leaf surfaces glabrescent but minutely papillose, sometimes patchily appressed-pubescent at flowering; fruit 3.1–3.6 mm long **115a.** subsp. **petiolaris**

2: Leaves 8–11.2 cm long (including petiole); leaf surfaces with appressed pubescence persisting until flowering; fruit 2.2–2.5 cm long **115b.** subsp. **trichophylla**

1: Leaves (including petiole 0–5 mm long) elliptic to narrowly so; leaf apex gradually long-acuminate **115c.** subsp. **angusta**

115a. Hakea petiolaris Meisn. subsp. **petiolaris**

Hakea crassinervia Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 578 (1845). T: montis N[H]ardy prope praedium rusticum Cl. Whitfield at ad Ronan's well [York/Toodyay area], W.A., 16 Mar. 1840, *L.Preiss 559*; syn: B, G-DC, L, LD, LE *p.p.*, MEL, NY *p.p.*

Resprouting shrub 1.6–3.6 m tall. Leaves spathulate, 5.5–8.6 cm long (including petiole 0.8–1.8 cm long), 2.4–4.6 cm wide, ±abruptly acuminate; surfaces glabrescent but minutely papillose, sometimes patchily appressed-pubescent at flowering time. Perianth pinkish red. Fruit ovate, 3.1–3.6 cm long, 1.8–1.9 cm wide.

Occurs from the Darling Ra. east to near York (early collections) in Jarrah forest. Flowers May–July. Map 131.

W.A.: Helena Valley, slopes of Gooseberry Hill, *J.Seabrook 37* (CANB, PERTH); The Rock, Brookton Hwy, *A.S.George 887* (PERTH); Bickley, *A.S.George 3719* (PERTH).

The name *H. crassinervia*, a taxonomic synonym and out of use since the middle of the last century, has been used for some specimens of subsp. *petiolaris* in recent times. *Hakea crassinervia* has recently been misapplied also in horticulture, much more widely, to an apparently sterile hybrid (putatively *H. myrtoides* × *H. petiolaris*) known otherwise under the cultivar name *Hakea* 'Burrendong Beauty'.

115b. Hakea petiolaris subsp. **trichophylla** Haegi, *Fl. Australia* 17B: 395 (1999)

T: Dingo Rock Reserve, 7 miles [11.2 km] W of Manmanning, W.A., 12 June 1985, *B.H.Smith 582*; holo: AD; iso: CANB, HO, NSW, PERTH.

Non-sprouting large shrub or small tree 3–9 m tall. Leaves spathulate, 8–11.2 cm long (including petiole 1–1.6 cm long), 3.2–6 cm wide, abruptly acuminate; surfaces evenly appressed-pubescent at flowering time. Perianth cream turning mauve to maroon. Fruit elliptic to ovate-elliptic, 2.2–2.5 cm long, 1.2–1.6 cm wide.

Occurs in the Wongan Hills, W.A., with outliers to the east of Kununoppin and to the south at Tuttanning Reserve; grows in shrubland associated with granite outcrops. Flowers Apr.–June. Map 132.

W.A.: Kununoppin, 1961, *W.H.Butler* (PERTH); Tuttanning Reserve, SE of Pingelly, *A.S.George 7750* (CANB, PERTH); 7 km S of Wongan Hills township, *M.E.Trudgen 1660* (PERTH).

Hakea petiolaris is moderately common in cultivation; most specimens of cultivated plants are subsp. *trichophylla*.

115c. Hakea petiolaris subsp. **angusta** Haegi, *Fl. Australia* 17B: 395 (1999)

T: 38 miles [60.8 km] E of Pingaring, W.A., 29 May 1969, *A.S.George 9341*; holo: PERTH; iso: BRI, CANB, K, MEL, NSW.

Shrub or small tree 2.5–5 m tall; resprouting capacity unknown. Leaves elliptic to narrowly so, 7.2–15 cm long (including petiole 0.2–0.5 cm long), 2.3–4 cm wide, gradually long-acuminate; surfaces glabrescent but minutely papillose by flowering time. Perianth cream turning pinkish mauve. Fruit elliptic, 2.3–2.5 cm long, 1.1–1.3 cm wide.

Known from a small number of collections from granite outcrops at and to the east of Pingaring, W.A. Flowers Mar. and May. Map 133.

W.A.: Pingaring Rock, *K.Newbey 2807* (PERTH).

#116. Hakea laurina R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 29 (1830)

T: between Cape Arid and Lucky Bay, [W.A.], 1824, *W.Baxter s.n.*; ?holo: BM.

Hakea eucalyptoides Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 573 (1845). T: in glareosis sterilibus inter frutices densos ad radices collium Konkoberup hills, promontorii Cape Riche, W.A., 19 Nov. 1840, *L.Preiss 565* (*Sem. n. 87*); syn: B, G-DC, MEL, NY.

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 384 (1989); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 214 (1990); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 16, 58 (1997).

Erect shrub or small tree, frequently with finally pendulous branches, 3–6 m tall, non-sprouting. Branchlets glabrous by flowering. Leaves narrowly obovate-elliptic, 7–21 cm long (including petiole 1–2 cm long), 6–29 mm wide, narrowly attenuate at base, bluntly acute, olive-green, quickly glabrescent; longitudinal veins 3–7; secondary veins sometimes visible. Inflorescence axillary with 120–190 flowers; pedicels 5.5–9.5 mm long, glabrous. Perianth deep pinkish red. Pistil 14–19.5 mm long, cream-white, rarely deep pink-red; gland a V-shaped flap, 0.6–1.2 mm high. Fruit 1–10 per axil, ±obliquely ovate-elliptic, 2.2–3.8 cm long, 1.6–2.2 cm wide, sometimes curved at base, shortly beaked, flanged adaxially. Seed ovate, 15–24 mm long; wing extending broadly down both sides of body and narrowly around base, blackish brown to black. Plate 19; Fig. 22G.

Occurs in south-western W.A. from Wagin south to Denmark and east to Israelite Bay. Naturalised at least in S.A., in the Mount Lofty Ra. and on Kangaroo Is. Grows in mallee-heath in sandy to gravelly, sometimes clay, granitic or lateritic soil. Flowers Apr.–Aug. Maps 134, 135.

W.A.: SW side of Howick Hill, *L.Haegi 2606 & P.S.Short* (AD, MEL, PERTH); 1 km E of Warrungup, Stirling Ra., *G.J.Keighery 4830* (PERTH). S.A.: Hardys Scrub, c. 6 km N of McLaren Flat, *A.W.Bell 281* (AD).

Well known in cultivation and probably the most widely grown species of *Hakea*. Prized for the 'pincushion' inflorescence of cream pin-like styles emerging from a contrasting deep pinkish red 'cushion' of perianths; colour variants occur.

117. Hakea obtusa Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 411 (1856)

T: Swan River colony, [vicinity of Mt Barren Ra., W.A.], *s.d.* [1848], *J.Drummond 5: 409*; syn: BM, G, K, LE, OXF, MEL, P, PERTH, TCD.

Illustration: A.S.George, *Introd. Proteaceae W. Australia* pl. 100 (1984).

Rounded cauliflorous shrub, 1–3 m tall, non-sprouting. Branchlets densely appressed-sericeous at flowering (woody flowering branches glabrous). Leaves narrowly oblong-elliptic, 3–10 cm long, 9–23 mm wide, narrowly cuneate at base, obtuse to acute, bright green, quickly glabrescent; longitudinal veins 3; secondary veins not visible. Inflorescences at nodes on bare wood below leafy parts, rarely axillary, with 40–50 flowers; pedicels 3.5–4.5 mm long, glabrous. Perianth (and pistil) opening white, soon deep pink. Pistil 18.2–20.7 mm long; gland a V-shaped flap, 0.5–0.7 mm high. Fruit 1–7 per node, often fused together, obliquely ovate-elliptic, 1.8–2.8 cm long, 0.1–1.3 cm wide, curved at base, shortly beaked, narrowly flanged adaxially. Seed obliquely narrowly ovate, 13–17 mm long; wing extending down both sides of body and very narrowly around base, notched on one side, blackish brown. Plate 21; Fig. 22H, I.

Confined to the Fitzgerald R. area and Mt Short, near Ravensthorpe, in south-western W.A. Occurs in mallee-heath in lateritic, sometimes clay, loam. Flowers May–Sept. Map 136.

W.A.: N side of Fitzgerald R., *K.M.Allen 306* (AD, PERTH); 3 km S of Ravensthorpe, *E.M.Bennett 2191* (PERTH); lower slopes of Mt Short, *R.W.Purdie 5376* (CANB).

Sparingly cultivated. This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

Ulicina Group

Hakea sect. *Conogynoides* ser. *Nervosae* Benth., *Fl. Austral*. 5: 494, 523 (1870), *p.p.*

Hakea sect. *Conogynoides* ser. *Uninerves* Benth., *Fl. Austral*. 5: 494, 525 (1870), *p.p.*

Hakea sect. *Conogynoides* ser. *Teretifoliae* Benth., *Fl. Austral*. 5: 495, 528 (1870), *p.p.*

Shrubs, without corky bark. Leaves simple, flat or apparently terete (but 3–12-angled in cross-section) with longitudinal veins at each angle to give sulcate appearance, non-petiolate, not stem clasping, entire, with at least marginal veins and midvein visible below. Inflorescence an axillary umbelliform or moderately elongate raceme, rarely arising from older leafless axils and 1 or 2 per axil, developing within involucre; bracts not persisting at base of inflorescence; rachis knob-like to elongated. Flowers 6–80; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil 3–18 mm long; pollen presenter erect, conical; gland a small flap to ±globular, or absent. Fruit usually more than 1 per axil, erect, retained on plant, woody, smooth to prickly, usually beaked, not horned, usually shortly apiculate, dehiscing fully or partly down one or both sides. Seed occupying part of valve; wing encircling seed body or extending fully or partly down both sides, usually more broadly on one side, rarely down one side only.

A group of 21 species, occurring mostly in southern W.A., with a few in S.A., Vic. and N.S.W., extending to islands of Bass Strait, Tas.

1 At least some leaves terete or subterete

2 Terete or subterete leaves with at least 5 angles, grooves or striations longitudinally (thick flat leaves sometimes also present)

3 Leaves finely striated with 12 longitudinal veins all around; inflorescences borne on bare wood below leafy parts (rarely among leaves); perianth mauve (inland south-western W.A.) **135. H. subsulcata**

3: Leaves with fewer than 12 longitudinal veins, angles or grooves; inflorescences borne among leaves

4 Leaves 10-sided at least in distal half, flat or shallowly concave between the angles (hexagonal in proximal half) (inland south-western W.A.) **136. H. meisneriana**

4: Leaves with fewer than 10 longitudinal veins, angles or grooves

5 Leaves with 5 deep narrow longitudinal grooves (much narrower than the broad intervening faces they separate) (inland south-western W.A.) **134. H. invaginata**

5: Leaves with 5 or more shallow to deep but broad longitudinal grooves or concavities (broader than the angles they separate)

6 Leaves with convex faces or shallowly grooved longitudinally, pentagonal to heptagonal in cross-section

7 Fruit scarcely woody, 0.8 cm or less in length, 0.35 cm or less in width; inflorescences with 14 or fewer flowers (thick flat leaves sometimes also present) (south-western W.A.) **138. H. sulcata**

7: Fruit woody, at least 1.7 cm long and 0.8 cm wide; inflorescences with at least 18 flowers

8 Inflorescences with 50–70 flowers; perianth cream, ageing pink to orange-pink; pistil 13–15 mm long (Mt Ragged, W.A.) **132. H. scoparia**

8: Inflorescences with 18–20 flowers; perianth bright pink; pistil 6.5–8 mm long (inland south-western W.A.) **133. H. rigida**

6: Leaves deeply but openly grooved longitudinally, stellate-pentagonal or hexagonal in cross-section

9 Leaves with longitudinal veins 5 all around; inflorescences umbelliform racemes with 50–70 flowers; pistil 13–15 mm long; fruit 1.7–2.6 cm long (inland south-western W.A.) **132. H. scoparia**

9: Leaves with longitudinal veins 6 all around; inflorescences moderately elongate racemes with 24–34 flowers; pistil 8.5–9.5 mm long; fruit 1.1–1.4 cm long (sand plains N of Perth and scattered inland, W.A.) **137. H. gilbertii**

2: Terete or subterete leaves with obscure longitudinal venation or obscurely 3-angled (trigonous or flat leaves sometimes also present)

10 Flowers opening steel blue; fruit covered with prickles; pistil 10.5–11.8 mm long (south-western W.A.) **128. H. lehmanniana**

10: Flowers opening cream-white; fruit without prickles; pistil 7 mm long or less

11 Branchlets densely sericeous at flowering time; fruit 12–20 mm wide; seed 12–20 mm side; wing encircling ±centred seed body (Lake King, W.A.) **123. H. cygna**

11: Branchlets glabrous by flowering time; fruit 2–13 mm wide; seed 3.5–6 mm wide; wing extending relatively narrowly down both sides of body (which is not centred) (southern S.A. and western Vic.) **127. H. mitchellii**

1: Leaves flat, trigonous or otherwise angular in cross-section; no terete leaves present

12 Branchlets villous (sometimes additionally appressed-pubescent) or tomentose (hairs not appressed)

13 Branchlets moderately to densely villous; (sometimes additionally appressed-pubescent)

14 Branchlets densely villous; leaves flat to trigonous, linear, rigid; perianth cream-white; pistil 6.5–9 mm long (sand plains N of Perth, W.A.) **119. H. costata**

14: Branchlets moderately villous and appressed-pubescent; leaves flat, elliptic to broadly elliptic, not markedly rigid; perianth deep pinkish-red; pistil 13–18 mm long (near Perth, and scattered localities to the N & E, W.A.) **118. H. myrtoides**

13: Branchlets tomentose

15 Flowers opening steel-blue; fruit covered with prickles; pistil 10.5–11.8 mm long; leaves not twisted at base (south-western W.A.) **128. H. lehmanniana**

15: Flowers opening cream; fruit without prickles; pistil 4–6 mm long; leaves twisted through 90º at base

16 Plant non-sprouting; leaves 1.5–4 mm wide with 1–3 prominent longitudinal veins; inflorescences with 6–18 flowers (Vic. to southern N.S.W. and islands of Bass Strait) **126. H. ulicina**

16: Plant resprouting from a lignotuber and often suckering from horizontal roots; leaves 3–12 mm wide with 3–5 (rarely 7) prominent longitudinal veins; inflorescences with 10–36 flowers (south-eastern S.A. to Vic.) **125. H. repullulans**

12: Branchlets sericeous or appressed-pubescent, sometimes (evenly or patchily) glabrescent to glabrous by flowering time

17 Flowers 50–80 per inflorescence; pistil 13–16 mm long; pedicels mauve or purple (south-western W.A.) **131. H. pycnoneura**

17: Flowers fewer than 40 per inflorescence; pistil less than 12 mm long; pedicels cream-white, pink or blue but not mauve or purple

18 Pistil 10.5–11.8 mm long; fruit with prickles 1–6 mm long; flowers opening steel-blue, fading almost white (south-western W.A.) **128. H. lehmanniana**

18: Pistil less than 10 mm long; fruit without prickles (or fruit not formed (*H. aenigma*)); flowers variously coloured, never blue

19 Branchlets glabrous or almost so by flowering time

20 Leaves twisted at base and often spirally twisted or curled along their length; fruit obliquely narrowly ovate to almost linear, 2.8–3 cm long (south-western W.A.) **121. H. stenocarpa**

20: Leaves not twisted at base or distally, not curled; fruit ellipsoidal to ovoid, 1.2–2.5 cm long (southern S.A., and western Vic.) **127. H. mitchellii**

19 Branchlets with sericeous or appressed pubescence persisting at least patchily until flowering time

21 Plant resprouting and suckering from a horizontal root system; flowers sterile (though fully formed); fruit not formed (restricted to W plateau of Kangaroo Is., S.A.) **124. H. aenigma**

21: Plant non-sprouting or resprouting but without a suckering horizontal root system; flowers generally fertile; fruit generally formed

22 Leaves 20 cm long or more

23 Flowers 4–6 per inflorescence; gland absent; fruit obliquely elliptic (southern Blue Mtns, N.S.W.) **130. H. dohertyi**

23: Flowers 8–24 per inflorescence; gland present; fruit obliquely narrowly ovate-elliptic (Flinders & Mt Lofty Ra. & SE Region, S.A.) **129. H. carinata**

22: Leaves less than 20 cm long

24 Fruit scarcely woody, 0.8 cm long or less, 0.35 cm wide or less **138. H. sulcata**

24: Fruit woody, at least 1.2 cm long, at least 0.5 cm wide

25 Leaves twisted through 90º at base

26 Leaves oblong elliptic to narrowly obovate, with only marginal vein and midvein prominent (above & below); perianth cream-white **120. H. marginata**

26: Leaves linear to narrowly obovate, with 2 lateral longitudinal veins prominent at least below, in addition to marginal veins and midvein; perianth pink or white **122. H. erecta**

25: Leaves not twisted through 90º at base

27 Branch supporting fruit markedly thickened; fruit obliquely ovate-elliptic; longitudinal veins (excluding prominent marginal veins) only faintly visible on underside of leaf; seed with wing encircling the ±centred body **123. H. cygna**

27: Branch supporting fruit not markedly thickened; fruit obliquely narrowly ovate-elliptic or obovate-elliptic; at least the midvein, and sometimes further longitudinal veins, prominent on underside of leaf; seed with terminal wing extending only ±narrowly down each side of body

28 Perianth bright pink; pistil 6.5–8 mm long; fruit obovate-elliptic, 1.0–1.2 cm wide (Campion–Wialki–Kalgoorlie, W.A.) **133. H. rigida**

28: Perianth cream-white; pistil 3–6 mm long; fruit obliquely narrowly ovate-elliptic, 0.6–1.1 cm wide (Flinders & Mt Lofty Ra. & SE Region, S.A.) **129. H. carinata**

118. Hakea myrtoides Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 577 (1845)

T: in limoso-arenosis ad flum. Cygnorum, prope villam Cl. Mitchell [Swan R.], W.A., 28 June 1839, *L.Preiss 534* (*Sem. n. 76*); syn: B, BR, CGE (as *Preiss 562*) *p.p.*, G, G-DC, K *p.p.*, L, LD, LE *p.p.*, M, MEL, MO, NY, P, TCD (as *Preiss 562*); Swan River colony, W.A., *s.d.* [1841 or before], *J.Drummond 1: 608*; syn: BM *p.p.*, G, K, LE *p.p.*, MEL, P.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* pl. 106 (1984); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 219 (1990).

Sprawling multi-stemmed shrub, 0.2–0.5 m tall, lignotuberous. Branchlets moderately villous and appressed-pubescent at flowering. Leaves elliptic-acuminate to broadly elliptic-acuminate, flat, 1–1.7 cm long, 5–10 mm wide, glabrescent; midvein and marginal veins prominent above and below; secondary veins scarcely visible. Inflorescence a solitary axillary umbelliform raceme, clustered into subterminal brushes, with 6–10 flowers per axil; pedicels deep pinkish red, glabrous, glaucous. Perianth deep pinkish red. Pistil 13–18 mm long; gland a small flap. Fruit obliquely broadly ovate, 1–1.1 cm long, 0.6–0.8 cm wide, obscurely beaked. Seed obliquely broadly elliptic, 6–8 mm long; wing narrowly encircling seed body at sides and base, blackish brown, sometimes with paler patches. Plate 23; Fig. 19A–D.

Occurs in the coastal plains and Darling Ra. near Perth, W.A., and at a few localities to the north (Calingiri, Dandaragan, Wongan Hills) and east (Youndegin). Grows in lateritic sandy clay soil, often in *Eucalyptus wandoo* woodland-heath in association with granite outcrops. Flowers July–Aug. Map 137.

W.A.: Gooseberry Hill Natl Park, 18 km E of Perth, *M.Crisp 6707* (CANB); c. 6 km N of Calingiri road on Geraldton Hwy, *R.J.Garraty 164* (AD, PERTH); Maddington, Darling Ra., 6 Aug. 1904, *A.Morrison s.n.* (BRI, PERTH).

Very distinctive on account of its large deep pinkish red flowers clustered into long subterminal brushes. Popular in cultivation but difficult to grow. The cultivar *Hakea* 'Burrendong Beauty', to which the name *H. crassinervia* is widely misapplied, is a putative hybrid between *H. myrtoides* and *H. petiolaris*.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

119. Hakea costata Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 575 (1845)

T: in planitie arenosa Quangen, Victoria, [near Wongamine, E of Toodyay], W.A., 20 Mar. 1840, *L.Preiss 533*; syn: G, G-DC, LD, LE *p.p.*, NY *p.p.*; Swan River, W.A., *s.d.* or 1839 [1841 or before], *J.Drummond I*; syn: BM, G, G-DC, ?K.

Hakea costata α *linearis* Meisn., *op. cit*. 576, *nom. illeg*. (type variety).

Hakea costata ß *lanceolata* Meisn., *op. cit*. 576. T: in planitie arenosa Quangen, Victoria, [near Wongamine, E of Toodyay] W.A., *L.Preiss 532*; syn: LD, LE *p.p.*, NY *p.p.*

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* pl. 109 (1984); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 383 (1989).

Erect shrub, 0.3–1.5 m tall, non-sprouting. Branchlets densely villous at flowering. Leaves below flowering parts flat, narrowly obovate to elliptic, 2–5.5 mm wide, in flowering region usually trigonous, linear, rigid, 0.8–1.6 cm long, 1–2.5 mm wide, glabrescent; marginal veins prominent; upper surface venation absent or obscure; lower surface with midvein only prominent. Inflorescence a solitary axillary umbelliform raceme, clustered into elongate brushes, with 8–12 flowers per axil, strongly perfumed; pedicels glabrous. Perianth cream-white. Pistil 6.5–9 mm long; gland a small obtriangular flap, 0.3–0.4 mm high. Fruit scarcely woody, subsessile, obliquely broadly ovate, slightly curved, 0.9–1 cm long, 0.6–0.8 cm wide, shortly beaked, apiculate. Seed obliquely broadly elliptic, 6.7–9.3 mm long, acuminate; wing extending more broadly down one side of body, narrowly down other, and sometimes narrowly around base, blackish brown, sometimes with paler patches. Fig. 19E, F.

Found on the sand plains north of Perth, W.A., from Kalbarri to Yanchep, in heath. Flowers July–Oct. Map 138.

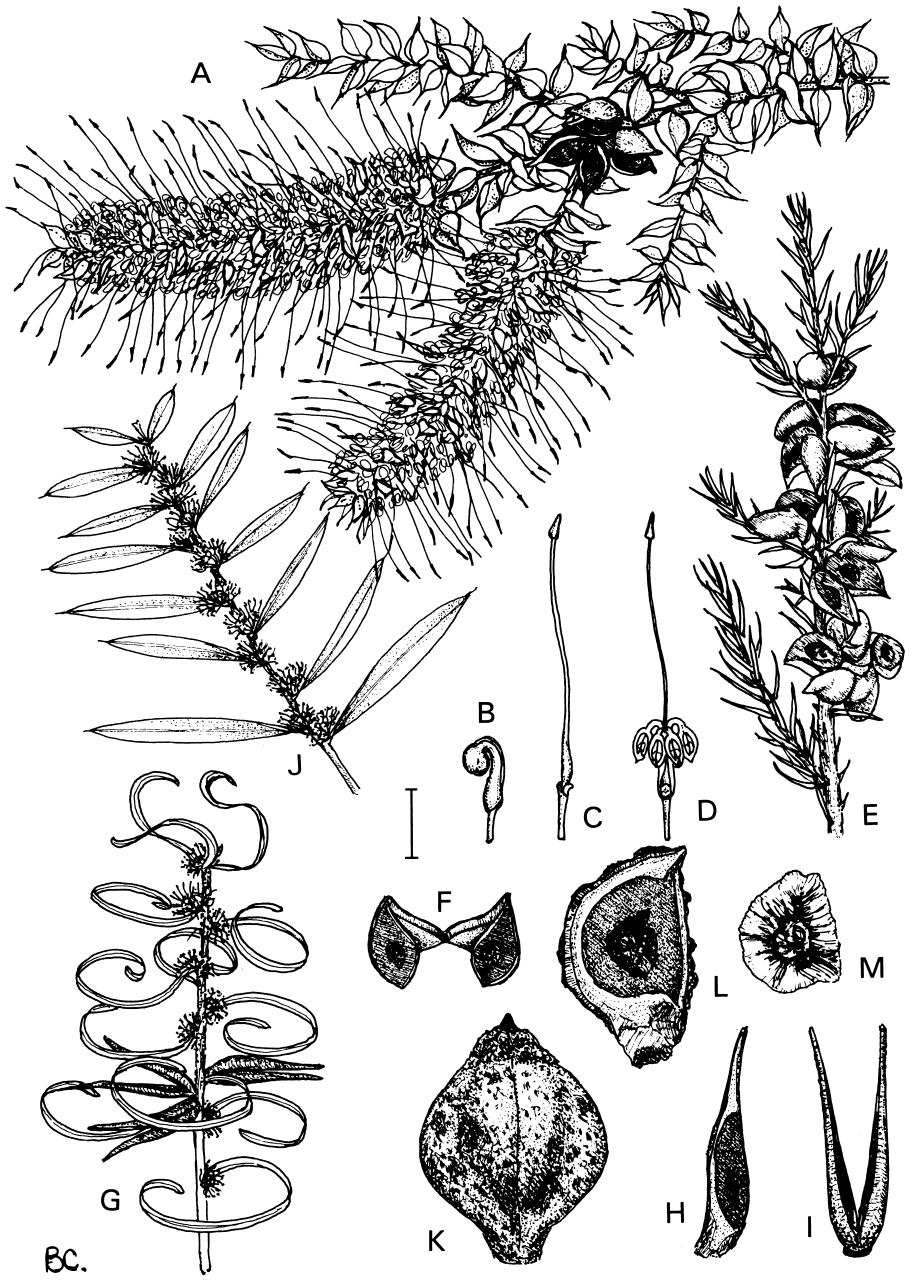

Figure 19. *Hakea*. **A–D**, *H. myrtoides*. **A**, habit (R.J.Garraty 164, PERTH); **B**, bud (R.J.Cranfield 1265, PERTH); **C**, flowers with tepals; **D**, flowers without tepals (**C–D**, R.J.Garraty 164, PERTH). **E–F**, *H. costata*. **E**, habit with fruits; **F**, fruit (**E–F**, Sept. 1963, A.Kessell, PERTH). **G–I**, *H. stenocarpa*. **G**, habit; **H**, inside of fruit; **I**, fruit (**G–I**, J.Seabrook 405, PERTH). **J**, *H. marginata*, habit (P.Roberts 329, PERTH). **K–M**, *H. cygna* subsp. *cygna*. **K**, fruit; **L**, inside of fruit; **M**, seed (**K–M**, T.C.Daniell, Aug. 1972, PERTH). Scale bar: **A**, **E**, **H–M** = 1 cm; **B–D** = 5 mm; **F** = 7 mm; **G** = 2 cm. Drawn by Beth Chandler.

W.A.: 38.5 km NW of Kalbarri turnoff from North West Coastal Hwy, *A.C.Beauglehole 11967* (MEL, NSW, PERTH); 5 km N of Yanchep, *A.S.George 4254* (PERTH); c. 8 km N of Cataby Ck on Brand Hwy, *R.Hnatiuk 760092* (PERTH); 46.5 km from Gingin towards Regans Ford, 28 Sept. 1968, *M.E.Phillips s.n.* (DNA, NSW).

120. Hakea marginata R.Br., *Trans. Linn. Soc. London* 10: 185 (1810)

T: in ericetis versus Montem conicam graniticam, Lucky Bay, [Bay I, W.A.], [9–14] Jan. 1802, *R.Brown s.n.*; syn: BM, E, K *p.p.*, MEL 1537923.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 17, 66 (1997).

Spreading dense shrub, 0.5–2 m tall; resprouting capacity unknown. Branchlets sericeous at flowering. Leaves rigid, oblong-elliptic to narrowly obovate, flat, 2–4.8 cm long, 4–8 mm wide, twisted at base, glabrescent; marginal veins prominent; midvein prominent above and below; venation otherwise obscure. Inflorescence a solitary axillary umbelliform raceme, with 9–16 flowers; pedicels cream-white, glabrous. Perianth cream-white. Pistil 4.2–5.5 mm long; gland a small flap, c. 0.5 mm high. Fruit shortly stalked, obliquely narrowly ovate-elliptic, ±straight, 1.2–2 cm long, 0.5–0.9 cm wide, scarcely beaked but shortly apiculate. Seed obliquely narrowly ovate, sometimes slightly sigmoid, 9.5–13 mm long; wing extending more broadly down one side of seed body, narrowly down other, blackish brown. Plate 22; Fig. 19J.

Widespread in south-western W.A., in the area bounded by Jurien Bay, Kalgoorlie and Cape Arid. Grows in heathy shrubland, sometimes in woodland, in sandy to clayey sometimes waterlogged soil, at times in association with granite or quartzite outcrops. Flowers May–Oct. Map 139.

W.A.: 0.5 km N of Desmond township, Ravensthorpe area, *B.Barnsley 460* (CANB, PERTH); NW of Wongan Hills, *P.Roberts 329* (PERTH); W of Harvey, *R.D.Royce 2657* (PERTH); c. 6 km SSW of Kalgan R. crossing on Albany–Borden road, *P.S.Short 2275 & L.Haegi* (AD, MEL, PERTH).

Two geographically distinct races of this species seem to exist. The northernmost has proportionally narrower fruit (length:breadth = 2.4–2.6), and is possibly a resprouter. The southern population has broader fruit (length:breadth = 2–2.5), and is apparently fire-killed. Further investigation may demonstrate these to be distinct subspecies.

121. Hakea stenocarpa R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 29 (1830)

T: Swan River, towards the source, [W.A.], 1827, *C.Fraser 20*; probable holo: BM (received May 1828 from Mr Macleay); iso: CGE *p.p.*, ?K.

Illustration: A.S.George, *Introd. Proteaceae W. Australia* pl. 104 (1984).

Bushy shrub, 0.5–1 m tall, resprouting from base. Branchlets ±glabrous at flowering. Leaves flexible, linear, flat, twisted at base and often spirally twisted or curled along length, 6–11 cm long, 2–7 mm wide, ±glabrous but papillose; marginal veins prominent; midvein prominent above and below; pinnate secondary veins scarcely visible. Inflorescence a solitary axillary umbelliform raceme, with 14–20 flowers; pedicels cream-white, glabrous. Perianth cream-white. Pistil 4.4–5 mm long; gland a small flap, c. 0.5 mm high. Fruit subsessile, obliquely narrowly ovate to almost linear, slightly to markedly curved, 2.8–3 cm long, 0.6–0.8 cm wide, with long narrow beak grading into a fragile slender apiculum. Seed obliquely narrowly elliptic, 16–17.5 mm long; wing extending more broadly or only down adaxial side of body, blackish brown. Plate 24; Fig. 19G–I.

Occurs in south-western W.A., from the Darling Ra. and foothills south-east of Perth to the sand plains north of Perth, as far north as the Greenough R. Scattered populations occur east to Koorda and Merredin and south to Busselton. Grows in sandy soil, sometimes over laterite, in low open scrub heath. Flowers Sept.–Oct. Map 140.

W.A.: between Toodyay and Bindoon, *C.A.Gardner 8705* (PERTH); Helena Valley, *J.Seabrook 405* (PERTH); near Moore R., 2.5 km from intersection with Brand Hwy along road to Mogumber, *A.Strid 20614* (PERTH).

122. Hakea erecta Lamont, in B.Lamont *et al*., *J. Linn. Soc., Bot*. 94: 440 (1987)

T: 4 km SE of Pingrup, W.A., 18 Sept. 1975, *K.Newbey 4802*; holo: PERTH *n.v*.; iso: MEL.

[*Hakea falcata auct. non* R.Br.: C.D.F.Meisner, *Hooker's J. Bot. Kew Gard. Misc*. 4: 209 (1852); C.D.F.Meisner, in A.L.P.P. de Candolle, *Prodr*. 14: 414 (1856), only with respect to *Drummond 2: 333*]

[*Hakea roei auct. non* Benth.: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 398 (1989)]

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 385 (1989), as *H. roei*; J.Young, *Hakeas of W. Australia, Botanical District of Avon* 15, 44 (1997).

Erect rounded shrub, 0.9–2.6 m tall, non-sprouting. Branchlets sericeous at flowering. Leaves flat, twisted at base, linear to narrowly obovate, 4–9.7 cm long, 2.5–5 mm wide, glabrescent or sparsely sericeous; marginal veins prominent; longitudinal veins 1 (rarely 3) above, 3 below. Inflorescences a solitary axillary umbelliform raceme, with 16–24 flowers; pedicels pink, glabrous. Perianth pink or white. Pistil 6.5–8 mm long; gland a small flap, 0.3–0.5 mm high. Fruit ovate-elliptic, 1.2–3 cm long, 0.9–1.4 cm wide, scarcely beaked but apiculate. Seed obliquely ovate, 8.5–13 mm long; wing extending broadly down one side of body, narrowly down other, dark greyish brown with black patches and streaks.

Occurs widely in inland south-western W.A., from Mingenew and Perenjori south to Hyden and Kulin and east towards Coolgardie; grows in sandy loam or deep sandy soil, sometimes over laterite, in heath or heathy mallee. Flowers Sept.–Oct. Map 141.

W.A.: Tammin, *R.J.Cranfield 581* (MEL, NSW, PERTH); c. 128 km W of Coolgardie along Great Eastern Hwy to Southern Cross, and c. 1 km W of State Vermin Proof Fence, *L.Haegi 2683* (AD, MEL); Cowcowing, *M.Koch 1047* (AD, HO, MEL, NSW).

The 'needle-leaved form' of *H. erecta* recognised by Lamont *et al*., *loc. cit*., appears to be based on a specimen of *H. rigida* (*q.v*.). *Hakea rigida* is similar in flower size, colour and number per inflorescence but differs in having leaves pentagonal in cross-section and evenly black seed wings.

The specimens referred to by Wrigley & Fagg, *op. cit*. p. 411, under *Hakea sp. nov. aff. falcata* R.Br. appear to be forms of *H. erecta*.

A typographical error occurs in the citation of the holotype of *H. erecta* by Lamont *et al*., *loc. cit*., with the collecting number of the Newbey specimen being given incorrectly as 4902. This is a specimen of *Astroloma*. The holotype of *H. erecta* is *K.Newbey 4802*.

123. Hakea cygna Lamont, in B.Lamont *et al*., *J. Linn. Soc., Bot*. 94: 439 (1987)

T: 13.6 km S of Lake Grace, W.A., 29 Sept. 1972, *B.Lamont s.n*.; holo: PERTH *n.v*.

Erect shrub, 0.4–2 m tall, non-sprouting. Branchlets densely sericeous at flowering. Leaves flat and thick and narrowly obovate to linear, or ±terete to trigonous, 2–7.5 cm long, 1.2–9 mm wide, glabrous; marginal veins prominent; longitudinal veins 1–3, obscure above, faintly visible below. Inflorescences a solitary axillary umbelliform raceme, with 6–14 flowers; pedicels cream white, glabrous, rarely appressed-pubescent. Perianth cream-white. Pistil 5.5–7 mm long; gland a small flap, c. 0.5 mm high. Fruit shortly stalked, with supporting branch usually markedly thickened, obliquely ovate-elliptic, 2.1–3.7 cm long, 1.2–2 cm wide, scarcely beaked but ±prominently apiculate. Seed obliquely broadly ovate (almost triangular) to obliquely circular, 12–20 mm long; wing encircling the ±centred body, pale brown with blackish brown radiating streaks.

Of wide occurrence in inland south-western W.A., from near Geraldton south-east to Ravensthorpe and east to Cape Arid; grows in sand to sandy loam soil often of lateritic origin, in heath or mallee-heath.

Two subspecies have been recognised but the status of subsp. *needlei*, virtually differing only in its narrow needle-shaped leaves and confined to a small area south of Lake King, requires further evaluation.

Leaves linear to narrowly obovate, flat and thick, 2.5–9 mm wide — **123a.** subsp. **cygna**

Leaves narrowly linear, terete or trigonous, 1.2–2 mm wide — **123b.** subsp. **needlei**

123a. Hakea cygna Lamont subsp. **cygna**

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 14, 42 (1997).

Leaves flat and thick, linear to narrowly obovate, 2.5–9 mm wide. Fig. 19K–M.

Occurs across the full range of the species, and in the full range of habitats. Flowers July–Oct. Map 142.

W.A.: c. 31 km by road due E of Pedarah on road to Holt Rock, *W.R.Barker 2476* (AD, MEL, PERTH); 17 km from Bindi Bindi along road to Piawaning, *B.Barnsley 932* (CANB, L, PERTH); N of Wongan Hills, 13 Sept. 1968, *E.M.Canning s.n.* (CANB, PERTH); c. 26 km N of Hyden along road to Anderson Rocks, *L.Haegi 2634* (AD, MEL, PERTH); Kukerin, *M.Koch 2196* (NSW, PERTH).

The white-flowered 'first collection' referred to by Wrigley & Fagg, *op. cit.* p. 411, under *H. sp. nov. aff. falcata* appears to be *H. cygna* subsp. *cygna*.

123b. Hakea cygna subsp. **needlei** Lamont, in B.Lamont *et al.*, *J. Linn. Soc., Bot.* 94: 440 (1987)

T: 23 km S of Lake King, then 5 km W, W.A., 29 Sept. 1972, *B.Lamont s.n.*; holo: PERTH.

Leaves terete or trigonous, narrowly linear, 1.2–2 mm wide.

Restricted to a small area with populations spread over c. 10 km just south of Lake King, W.A. Flowers Aug.–Sept. Map 143.

W.A.: near Pallarup Rocks, S of Lake King, *K.Newbey 2638* (AD, PERTH); between Lake King and Ravensthorpe, *D.J.Whibley 5385* (AD, PERTH).

By citing *H. ulicina* R.Br. as a synonym of this taxon, Lamont *et al.*, *loc. cit.*, *prima facie* rendered *H. cygna* illegitimate. However, it seems from the introduction to their paper that what was intended was merely to draw attention to Bentham's (1879) misapplication of the name *H. falcata* to a specimen of *H. ulicina* in K. in the interests of nomenclatural stability the intent in the introduction has been preferred over the unintentional formal synonymy.

124. Hakea aenigma W.R.Barker & Haegi, *J. Adelaide Bot. Gard.* 7: 261 (1985)

T: Shackle Rd c. 2.8 km S of Playford Hwy, Kangaroo Is., S.A., 6 Oct. 1982, *W.R.Barker 4479 & L.Haegi*; holo: AD; iso: CANB, K, MEL, NSW, PERTH.

Rounded bushy shrub, 1.5–2.5 m tall, suckering from horizontal roots. Branchlets densely appressed-pubescent or sometimes patchily glabrescent at flowering. Leaves flat, linear, not twisted, 5–35 cm long, 3–10 mm wide, glabrescent or patchily appressed-pubescent; marginal veins prominent; longitudinal veins prominent, 1–7 above and 4–9 below. Inflorescence a solitary axillary umbelliform raceme, with 16–33 fully developed but sterile flowers; pedicels cream-white, glabrous. Perianth cream-white. Pistil 4.5–7.2 mm long; gland absent. Fruit not formed.

Rare and confined to the higher parts of the lateritic plateau system at the west end of Kangaroo Is., S.A. Grows in dense mallee-heath in sandy to clayey loam soil. Flowers Sept.–Nov. Map 144.

S.A.: Flinders Chase Conservation Park, Kangaroo Is., *L.Haegi 2287 & W.R.Barker* (AD, MEL, MO, PERTH); Waters' mail box near sources of Western R., Kangaroo Is., *L.Haegi 2288 & W.R.Barker* (AD, BRI, CANB, DNA, NSW, PERTH).

The closest relative of *H. aenigma* seems to be *H. repullulans*, but the two are amply distinct. This remarkable species appears to consist of a single clone which must have spread over its current range, occupying an area of c. 30 km by 15 km, by suckering from vigorous horizontal roots.

This species is recognised as 'Rare' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

125. Hakea repullulans H.M.Lee, *Austral. J. Bot.* 32: 681 (1984)

T: Chimney Pot Gap, 40 km SW of Halls Gap, Grampians, Vic., 15 Oct. 1983, *H.M.Lee 137*; holo: MEL.

Hakea ulicina γ *macrocarpa* Meisn., in A.L.P.P. de Candolle *Prodr.* 14: 415 (1856). T: Grampians, Vic., *s.d., F.Mueller s.n.*; syn: MEL, NY *p.p.*

Hakea ulicina var. *latifolia* J.M.Black, *Trans. & Proc. Roy. Soc. S. Australia* 54: 59 (1930). T: Ninety Mile Desert, near the Coorong, S.A., *E.Ashby s.n.*; holo: AD98132246.

[*Hakea ulicina auct. non* R.Br.: J.H.Willis, *Fl. Victoria* 2: 49 (1972), *p.p.*, as to western localities cited but excluding S.A. populations now referred to *H. carinata*]

Erect shrub, 1.2–4 m tall, resprouting from lignotuber and often suckering from horizontal roots. Branchlets densely tomentose to glabrescent at flowering. Leaves narrowly obovate to linear, flat, twisted through 90° at base, 4–14 cm long, 3–12 mm wide, glabrous; marginal veins prominent; longitudinal veins prominent, with 3–5 (rarely 7) above and below; secondary venation obscure. Inflorescence a solitary axillary umbelliform raceme, with 10–36 flowers; pedicels cream-white, glabrous or rarely ±sparsely appressed-pubescent. Perianth cream-white. Pistil 4–5.7 mm long; gland a small flap, 0.3–0.4 mm high. Fruit subsessile, ±obliquely ovate, slightly curved towards apex, 1.5–2.6 cm long, 0.8–1.3 cm wide, scarcely beaked but shortly apiculate. Seed obliquely narrowly ovate-elliptic, 10–16 mm long; wing extending partly or fully down both sides of body, more broadly on adaxial side, blackish brown. Fig. 17G, H.

Occurs from south-eastern S.A. to the Grampians and western mallee regions of Vic. and east to the Otway Ra. with an apparent outlier 250 km to the east, near Sale in South Gippsland. Found in sclerophyll forest and, frequently in scattered populations, in mallee-heath, in acidic sandy soil. Flowers Sept.–Oct. Map 145.

S.A.: Mt Shaugh, *E.N.S.Jackson 3508* (AD); Messent Conservation Park, c. 170 km SE of Adelaide, *A.G.Spooner 5380* (AD). Vic.: Montys track, 7 km S of Carlisle R. on Gillibrand R. road, *R.J.Chinnock 6412* (AD); Holey Plains State Park c. 9 km SE of Rosedale, South Gippsland, 20 Oct. 1992, *W.Molyneux s.n.* (AD, MEL); 27 km S of Nhill, towards Goroke, *M.E.Phillips 438* (CANB, DNA).

Hakea repullulans is close to and previously confused with *H. ulicina*. The latter differs principally in being non-sprouting but also in the usually much narrower leaves (1.5–4 mm wide) and the usually fewer flowers in the inflorescence (6–18). The specimen from South Gippsland cited above (*Molyneux s.n.*) represents a significant disjunct occurrence for *H. repullalans*, but its identity does not seem in doubt as the plants are recorded as resprouters (root-suckering) and there are 24–26 flowers per inflorescence (compare with *H. ulicina* in this region, a nonsprouter, with only 6–18 flowers per inflorescence).

126. Hakea ulicina R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 29 (1830)

T: Wilson's Promontory, [Vic.], 1826, *W.Baxter s.n.*; syn: BM (mixed collection on one sheet).

Hakea ulicina ß *angustifolia* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 415 (1856). T: Twofold Bay, [N.S.W.], *s.d., W.Baxter s.n.*; syn: K *p.p.*, NY; cult. in Horto quodam Anglico, 1832, *Roeper s.n.*; syn: K *p.p.*, NY.

Erect shrub, 2–5 m tall, non-sprouting. Branchlets sparsely to moderately tomentose at flowering. Leaves narrowly linear, flat or trigonous, twisted through 90° at base, 3–18 cm long, 1.5–4 mm wide, glabrous; marginal veins prominent; longitudinal veins prominent, 1–3 above and below; secondary veins obscure. Inflorescence a solitary axillary umbelliform raceme, with 6–18 flowers; pedicels cream-white, glabrous. Perianth cream-white. Pistil 4–6 mm long; gland a small flap, 0.2–0.3 mm high. Fruit shortly stalked, ovate or obliquely ovate, 1.6–2.5 cm long, 8–11 mm wide, shortly beaked, shortly apiculate. Seed obliquely narrowly obovate-elliptic, 10–16 mm long, 3.5–6 mm wide; wing extending partly down both sides of body, more broadly on adaxial side, blackish brown.

Extends east from the Otway Ra. in southern Vic. to far south-eastern N.S.W. and to Flinders, Cape Barren and Clarke Is. in Bass Strait, Tas. A common understorey shrub in sclerophyll forest on the southern slopes of the Great Dividing Ra. and as a component of coastal heathlands, growing in acidic sandy to sandy loam soil. Flowers Aug.–Sept. Map 146

N.S.W.: Bulls Ck, Green Cape Rd, 16 km S of Eden, 13 June 1960, *E.F.Constable s.n.* (BRI, DNA, NSW); Ben Boyd Natl Park, c. 1 km from Duckhole Rd along turnoff to Salt Water Ck, *E.Mullins 491* (CANB, US). Vic.: 6 km from Anakie Junction towards Ballan (Brisbane Ra.), 7 Sept. 1966, *E.J.Carroll* (CANB); swamp 1.1 km S of Carrick Marsh, 17 km E of Stradbroke, *P.K.Gullan 530* & *N.G.Walsh* (MEL). Tas.: Flinders Is., road N from Whitemark end of Darling Ra., 12 Dec. 1975, *D.I.Morris* (HO).

Hakea ulicina was cited erroneously by Lamont *et al*. (1987) as a synonym of *H. cygna* subsp. *needlei q.v*.

127. Hakea mitchellii Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 398 (1856)

T: without locality, [Pyramid Hill, Vic.], 29 June 1836, *Major Mitchell's Expedition n. 208*; ?holo: NY.

Hakea mitchelli Meisn., *Hooker's J. Bot. Kew Gard. Misc*. 4: 208 (1852), *nom. nud*.

Hakea muelleriana J.Black, *Fl. S. Australia* 2nd edn, 2: 267 (1948), replacement name for: *Hakea flexilis* F.Muell. ex Meisn., *Linnaea* 26: 359 (1854), *nom. nud*.; *H. flexilis* F.Muell. ex Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 396 (1856), as *flexibilis*, *nom. illeg. non* R.Br.; *H. ulicina* R.Br. var. *flexilis* (F.Muell. ex Meisn.) C.Moore & Betche, *Handb. Fl. New South Wales* 243 (1893), *nom. illeg*. T: ad flum. Murray, 1847, *C.Stuart s.n*.; holo: MEL (herb. Sonder); iso: MEL 642275 *p.p.* (L.H.S. only).

Erect rounded shrub, 1–4 m tall, non-sprouting. Branchlets glabrous by flowering. Leaves uniform or seasonally heteromorphic, subterete to linear and trigonous, rarely obovate-linear, concave, 3.5–12 cm long, 1–10 mm wide, glabrous; venation not visible in terete leaves; longitudinal veins prominent and 3 at angles (marginal veins and midvein on underside) in trigonous and flat leaves; intermediate veins sometimes visible below, usually not visible above. Inflorescence a solitary axillary umbelliform raceme, with 16–36 flowers; pedicels pink, glabrous. Perianth cream-white. Pistil 4.5–6.2 mm long; gland a small flap, c. 0.5 mm high. Fruit ellipsoidal to ovoid, ±straight, 1.2–2.5 cm long, 0.2–1.3 cm wide, not beaked but usually gibbous towards apex, shortly apiculate. Seed obliquely elliptic, 8–15 mm long, 3.5–6 mm wide; wing extending down both sides of body, more broadly and further down adaxial side, sepia with blackish brown streaks and patches. Fig. 17K.

Occurs in S.A. on Eyre and Yorke Peninsulas, on Kangaroo Is., and in the mallee south of the Murray R. as far south as Naracoorte, extending into western Vic. Found in dry regions, bounded approximately by the 250 mm and 500 mm rainfall isohyets, in mallee-heath vegetation in calcareous sandy soil. Flowers Oct.–Jan. Map 147.

S.A.: 1 km by road W towards Cape du Couedic from Remarkable Rocks, *L.Haegi 402* (AD); at base of Carappee Hill Ra., c. 1.5 km NE of summit, *L.Haegi 1321* (AD, DNA, NSW); S shore of Nepean Bay, *P.C.Heyligers 80056* (AD, CANB); Scorpion Springs Conservation Park, S of Pinnaroo, *D.E.Symon 8767b* (AD, B, CANB, NSW). Vic.: Red Bluff, Big Desert, c. 53 km (direct line) N of Adelaide to Melbourne highway, *R.V.Smith 59/185* (AD, MEL).

Flat leaves are confined to Kangaroo Is. populations. For a discussion of the complicated nomenclatural history of this species see Haegi & Barker, *J. Adelaide Bot. Gard.* 7: 268 (1985).

128. Hakea lehmanniana Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 557 (1845)

T: in solo glareoso sterili inter frutices sylvae cis flum. Gordon, Hay, W.A., 7th Nov. 1840, *L.Preiss 604* (*Sem. n. 86*); syn: B, G, LD, LE *p.p.*, MEL, NY; excluded syn: *Preiss 604* in P which is *H. sericea* or *H. decurrens*.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 16, 60 (1997).

Rounded often sprawling shrub, 0.6–1.6 m tall, resprouting or non-sprouting. Branchlets moderately to densely tomentose at flowering. Leaves almost terete to trigonous, 2–7 cm long, 1–1.5 mm wide or diam., 1.5–2 mm deep when trigonous, glabrous; longitudinal veins 3 at angles (including marginal veins) or not visible. Inflorescence a solitary axillary umbelliform raceme, grouped to form long brushes, with 12–16 flowers per axil; pedicels grey-blue, glabrous. Perianth opening steel-blue, soon almost white. Pistil 10.5–11.8 mm long; gland a small flap, c. 0.5 mm high. Fruit 1 or 2 per axil, stalked, obliquely broadly elliptic, 2.2–3 cm long, 1.4–2 cm wide, covered with prickles 1–6 mm long, scarcely beaked. Seed obliquely elliptic, 18–20 mm long, 8–9 mm wide; wing extending down both sides of body and narrowly at base, not notched, dark brown with black patches or streaks. Fig. 20A–G.

Occurs in south-western W.A. from York to Manjimup and east to Jerramungup, including in the Porongorup and Stirling Ra.; grows in heath or mallee-heath, in sandy often gravelly lateritic loam soil. Flowers June–Aug. Map 148.

W.A.: Tuttanning Reserve, E of Pingelly, *K.M.Allen 34* (AD, PERTH); 24 km from Chester Pass Rd along Stirling Range Drive towards Red Gum Pass, *E.M.Canning WA/68 6646* (CANB); Wagin, July 1924, *C.A.Gardner s.n.* (PERTH).

Sparingly grown in cultivation, especially for the unusual striking bluish flowers grouped into long brushes; a closer inspection reveals a bright pink pollen presenter loaded with bright yellow pollen. Fruit in this species are distinctive in being covered with prickles 1–6 mm long.

129. Hakea carinata F.Muell. ex Meisn., *Linnaea* 26: 360 (1854)

T: Lofty Range, Adelaide, [S.A.], 1851–52, *F.Mueller s.n.*; lecto: NY *p.p.*, *fide* L.Haegi & W.R.Barker, *J. Adelaide Bot. Gard.* 7: 269 (1985); isolecto: MEL *p.p.*; remaining syntypes: Lofty Range, Adelaide, S.A., 1851–52, *F.Mueller s.n.*; syn: NY *p.p.*, ?MEL *p.p.*; Mt Lofty, S.A., 2 Mar. 1848, *F.Mueller s.n.*; possible isosyn: MEL 55913; Australia felix, [S.A.], *s.d.*, *F.Mueller s.n.*; ?syn: BM, MEL 55892, MEL 55907; St Vincents Gulf, S.A., *s.d.*, *F.Mueller s.n.*; possible isosyn: BR; Port Adelaide, S.A., *s.d.*, [*F.Mueller*] *s.n.*; possible isosyn: K.

Hakea carinata α *planifolia* Meisn., *op. cit.* 26: 361. T: Lofty Range, Adelaide, S.A., 1851–52, *F.Mueller s.n.*; syn: MEL 55911, NY *p.p.*

Hakea carinata ß *trigonophylla* Meisn., *op. cit.* 26: 361, *nom. illeg.* (type variety). T: Lofty Range, Adelaide, S.A., 1851–52, *F.Mueller s.n.*; syn: G (annotated 'hills nr Adelaide'), MEL 55908 (herb. Sonder L.H.S. and middle), NY.

[*Hakea ulicina auct. non* R.Br.: R.Tate, *Trans. Roy. Soc. S. Australia* 3: 68 (1880); J.M.Black, *Fl. S. Australia* 2nd edn, 266 (1948), *p.p.*]

Erect shrub, 1.5–3 m tall, non-sprouting. Branchlets appressed-pubescent at flowering, often patchily glabrescent. Leaves ±flexible, broadly to narrowly linear, flat, concave or trigonous, 5–24 cm long, 1–12 mm wide, ±glabrous; marginal veins prominent; midvein only or sometimes 3 longitudinal veins prominent below, not or scarcely visible above; secondary veins sometimes faintly visible below. Inflorescence a solitary axillary umbelliform raceme, with 8–24 flowers; pedicels pink, glabrous or rarely sparsely pubescent. Perianth cream-white. Pistil 3–6 mm long; gland a small flap, 0.4–0.8 mm high. Fruit shortly stalked, obliquely narrowly ovate-elliptic, straight or slightly curved towards apex, 1.3–2.6 cm long, 0.6–1.1 cm wide, scarcely beaked but narrowed into a long fragile apiculum. Seed obliquely narrowly ovate-elliptic, 10–18 mm long, 4–6.5 mm wide; wing extending narrowly down both sides of body, blackish brown. Fig. 17 I, J.

Occurs in S.A., in the Mt Lofty Ra., southern Flinders Ra. and at a few sites in the South-East as far south as Padthaway; sometimes grows as a common component in the heathy understorey of dry sclerophyll forest and in scrub-heath, in sandy to loamy soil. Flowers Sept.–Oct. Map 149.

S.A.: Padthaway Conservation Park, 23 Oct. 1980, *P.Canty s.n.* (AD); Eagle on The Hill, Adelaide–Mount Barker road, *L.Haegi 552–554* (AD); 0.5 km WSW of Gladstone on main road to Port Pirie, *L.Haegi 896* (AD, PERTH); Mambray Ck, Flinders Ra., *P.Martinsen 57* (AD).

Populations of *H. carinata* typically exhibit a high degree of variation in leaf width even at a single site. Trigonous and flat-leaved plants frequently occur together, and the nature of this polymorphism is under investigation (G.Starr, pers. comm.). Superimposed is a geographical trend, with the broadest-leaved plants occurring in the southern part of the distribution.

Hakea carinata is sometimes confused with *H. mitchellii*, but that species differs in having more robust fruits which are apically gibbous, sepia-coloured seeds with dark markings and a later flowering season (late Oct.–Jan.). It is also found in different ecological situations, occurring in communities in calcareous rather than acidic soil. The distributions of the two species are largely mutually exclusive. For a detailed account of nomenclature and other aspects see L.Haegi & W.R.Barker, *op. cit.* 7: 249–271 (1985).

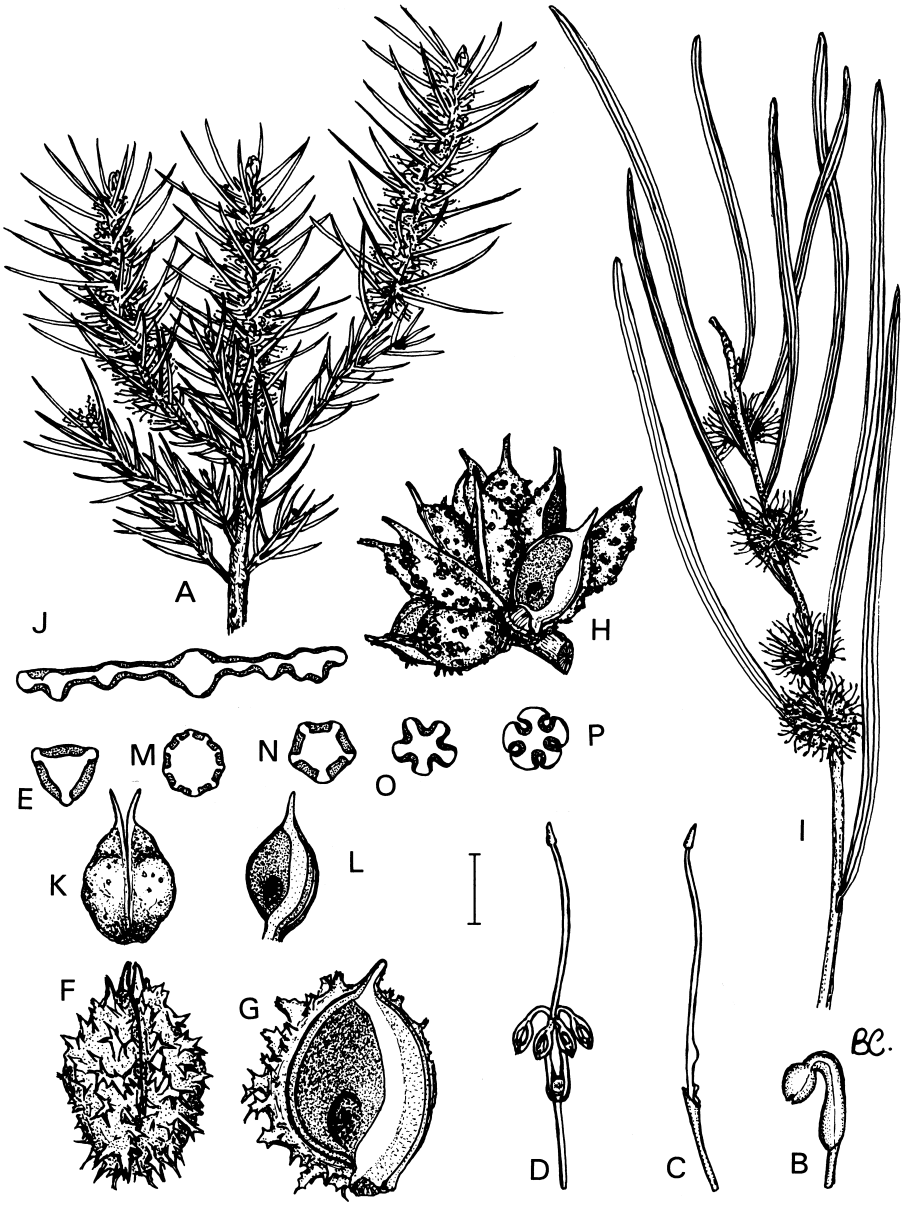

Figure 20. *Hakea*. **A–G**, *H. lehmanniana*. **A**, habit (July 1924, C.A.Gardner, PERTH); **B**, bud (June 1920, C.A.Gardner, PERTH); **C**, flower with tepals removed; **D**, flower (**C–D**, July 1924, C.A.Gardner, PERTH); **E**, 5-section of leaf; **F**, fruit; **G**, inside of fruit (**E–G**, Mar. 1967, F.Rowe, PERTH). **H–J**, *H. pycnoneura*. **H**, fruit cluster (R.Hnatiuk 760318, PERTH); **I**, habit; **J**, 5-section of leaf (**I–J**, A.Burns 13, PERTH). **K–M**, *H. meisneriana*. **K**, fruit; **L**, inside of fruit; **M**, 5-section of leaf (**K–M**, B.Knox 65, PERTH). **N**, *H. sulcata*, 5-section of leaf (5 Sept. 1978, R.J.Cranfield, PERTH). **O**, *H. scoparia* subsp. *scoparia*, 5-section of leaf (L.Haegi 1001, PERTH). **P**, *H. invaginata*, 5-section of leaf (K.Newbey 5786, PERTH). Scale bar: **A**, **I** = 2 cm; **B–D** = 3 mm; **E**, **J**, **M–P** = 1.2 mm; **F–G** = 1 cm; **H**, **K–L** = 8 mm. Drawn by Beth Chandler.

130. Hakea dohertyi Haegi, *Fl. Australia* 17B: 395 (1999)

T: Blue Mountains, N.S.W., 17 Nov. 1984, *M.Doherty NSW 167553*; holo: NSW; iso: AD.

Slender erect shrub, 3–4 m tall, non-sprouting. Branchlets densely sericeous at flowering. Leaves almost filiform, trigonous, straight or slightly curved, 20–30 (–40) cm long, 1.8–2.2 mm wide and deep, glabrescent (but minutely papillose); longitudinal veins 3 (including marginal veins), at angles of lamina. Inflorescence a solitary axillary umbelliform raceme, with 4–6 flowers; pedicels ?cream-white, glabrous. Perianth cream-white. Pistil 3.8–4 mm long; gland absent. Fruit shortly stalked, obliquely elliptic, 2.3–2.8 cm long, 1–1.6 cm wide, scarcely beaked; apiculum 2–4 mm long. Seed obliquely elliptic, c. 12 mm long, c. 5.5 mm wide; wing extending narrowly and fully down both sides of body, blackish brown.

A recently discovered very rare and restricted species, known from only a few localities in the southern Blue Mtns, N.S.W. Occurs on sandstone outcrops in eucalypt open forest. Flowers Sept.–Oct. Map 150.

No specimen localities cited in view of rarity.

This species is recognised, under *Hakea sp. 2* (Kowmung River; M.Doherty 17–24), as 'Endangered' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995). It is also listed in N.S.W. as *Hakea* 'sp. B' in M.Fisher *et al.*, The natural vegetation of the Burragorang 1:100,000 Map sheet, *Cunninghamia* 4(2): 143–215 (1995).

131. Hakea pycnoneura Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 117 (1855)

T: Swan River colony, [Dandaragan to Champion Bay, W.A.], *s.d.* [1851], *J.Drummond 6: 193*; syn: BM, CGE, K, MEL, NY, OXF, P.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* pl. 108 (1984); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 385 (1989); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 21, 90 (1997).

Rounded shrub, 0.8–2.5 m tall, non-sprouting. Branchlets densely appressed-pubescent at flowering, sometimes patchily glabrescent. Leaves thick, linear, flat, 9–20 cm long, 1.5–7 mm wide, glabrescent; prominently veined with longitudinal veins 1–3 or obscure above, 3–5 below. Inflorescence a solitary axillary umbelliform raceme, with 50–80 flowers; pedicels glabrous, mauve or purple. Perianth cream to orange-pink. Pistil 13–16 mm long; gland an obtriangular flap, 0.5–0.7 mm high. Fruit 1–9 per axil, stalked, obliquely elliptic, ±straight, 1.5–2.5 cm long, 0.8–1.2 cm wide, acuminate, scarcely beaked but with a prominent weak apiculum. Seed obliquely elliptic, 11–14.5 mm long, 5.5–7 mm wide; wing extending fully down both sides of body but more broadly down one side and narrowly around base, sometimes notched adaxially near base, blackish brown, sometimes with paler patches. Fig. 20H–J.

Occurs in south-western W.A. from near Kalbarri south-east to near Morawa, with a curious disjunct occurrence at Mt Ragged, nearly 900 km to the south-east; grows in heath or shrubland, sometimes abundantly, in sandy loam over laterite, sandstone or quartzite. Flowers May–Aug. Map 151.

W.A.: Z Bend, Murchison R., Kalbarri Natl Park, *A.C.Burns 9* (AD, PERTH); East Yuna Reserve, *A.C.Burns 13* (PERTH); Mt Ragged, 190 km E of Esperance, *R.J.Donovan 1* (PERTH); 27 km E of Mingenew, *K.Newbey 2123* (PERTH).

Hakea pycnoneura is variable with respect to leaf width. The lateral longitudinal veins on the underside of the leaf are very close to the prominent marginal veins and somewhat distant from the midvein, almost giving the appearance of a dual marginal vein. Specimens apparently intermediate between *H. scoparia* and *H. pycnoneura* occur on Mt Ragged. This location is considerably disjunct for both species but especially so for *H. pycnoneura*. Further investigations are required to determine the correct placement of these specimens.

Hakea pycnoneura is occasionally cultivated as an ornamental.

132. Hakea scoparia Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 556 (1845)

Hakea sulcata var. *scoparia* (Meisn.) Benth., *Fl. Austral.* 5: 529 (1870). T: Swan River Colony, [W.A.], *s.d.* [c. 1841], *J.Drummond 1: 600*; syn: ?B, BM, G, K, LE *p.p.*, MEL, NY, P, PERTH.

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 386 (1989); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 230 (1990).

Rounded shrub with ascending branches, 1–3.5 m tall, non-sprouting. Branchlets tomentose to appressed-pubescent at flowering, sometimes patchily glabrescent. Leaves ±terete, sometimes compressed, stellate or pentagonal in cross-section, deeply but openly grooved longitudinally or shallowly concave between angles, 12–27 cm long, 1.5–2 mm diam., glabrescent; longitudinal veins 5 all around, at angles. Inflorescence a solitary axillary umbelliform raceme, with 50–70 flowers; pedicels glabrous. Perianth cream, ageing pink or orange-pink. Pistil 13–15 mm long; gland an obtriangular flap, 0.5–0.7 mm high. Fruit 1–8 per axil, stalked, obliquely ovate-elliptic, ±straight, 1.7–2.5 cm long, 0.8–1.7 cm wide, acuminate, scarcely beaked but with prominent readily broken apiculum. Seed obliquely ovate, 10–15 mm long, 5–6 mm wide; wing extending (broadly and fully) down one side of body only, sometimes notched, blackish brown.

Occurs in inland south-western W.A. from Yuna south through Wongan Hills, Bruce Rock and Kulin and east to Hyden and Frank Hann Natl Park, with an outlying occurrence at Mt Ragged. Found on yellow sand plain in mallee heath or in lateritic sand, sometimes on breakaways or on hills, or in association with granite outcrops. There are two subspecies.

Fruit 1.7–2 cm long; leaves deeply (but openly) grooved between angles
132a. subsp. **scoparia**

Fruit 2.2–2.5 cm long; leaves very shallowly concave between angles, sometimes ±compressed
132b. subsp. **trycherica**

132a. Hakea scoparia Meisn. subsp. **scoparia**

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 22, 98 (1997), as *H. scoparia*.

Leaves deeply but openly grooved between angles. Fruit 1.7–2 cm long, 8–10 mm wide, with prominent black-pusticulate tubercles. Seed 10–12 mm long, not notched adaxially near base. Fig. 20 O.

Occurs over the range of the species excluding Mt Ragged in the far south-east of the distribution. Flowers May–Sept. Map 152.

W.A.: 6.5 km E of Brookton on Corrigin road, *M.I.H.Brooker 1872* (CANB, MEL, PERTH); 115 km NE of Lake King on track to Norseman, *L.Haegi 1001* (AD, PERTH); 6 km S of Cadoux on Amery road, *B.H.Smith 574* (AD, CANB, HO, MEL, NSW, PERTH).

The leaves are frequently galled, usually with a single swelling occurring at any point along the leaf. Sometimes grown as an ornamental, often wrongly under the name *H. sulcata*.

132b. Hakea scoparia subsp. **trycherica** Haegi, *Fl. Australia* 17B: 395 (1999)

T: S end of Mt Ragged, W.A., *A.S.George 14309;* holo: PERTH; iso: AD.

Leaves shallowly concave between angles, sometimes compressed. Fruit 2.2–2.5 cm long, 12–17 mm wide, ±smooth to coarsely pusticulate. Seed 13–15 mm long, notched adaxially near base.

Restricted to the lower slopes of Mt Ragged, W.A., at the western end of the Great Australian Bight. Occurs among quartzite rocks in closed heath. Flowers Apr.–July. Map 153.

W.A.: base of Mt Ragged, SW side, *P.G.Wilson 5841* (PERTH).

133. Hakea rigida C.A.Gardner ex Haegi, *Fl. Australia* 17B: 395 (1999)

T: Campion, W.A., 28 Sept. 1931, *C.A.Gardner 2761*; holo: PERTH; iso: PERTH.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 22, 94 (1997).

Erect to spreading shrub, 0.6–2.7 m tall; root-system unknown. Branchlets densely appressed-pubescent at flowering. Leaves variable, ±terete to almost flat, linear; ±terete leaves equilaterally to compressed pentagonal in cross-section, convex to shallowly concave between angles, 3.5–14 cm long, 1–2 mm diam., sparsely appressed-pubescent, often twisted near base, with longitudinal veins 5 all around, at angles, or sometimes 9 in all in distal half with prominent veins on all faces but adaxial one; almost flat leaves ±thick, concave with 5 prominent longitudinal veins, 2 marginal and 3 on underside (venation on upper side obscure). Inflorescence a solitary axillary umbelliform raceme, with 18–20 flowers; pedicels pink, glabrous. Perianth bright pink. Pistil 6.5–8 mm long; gland triangular-obovoid, 3 mm high. Fruit 1 or 2 per axil, subsessile, obovate-elliptic, ±straight, 2–2.2 cm long, 1–1.2 cm wide, acuminate, scarcely beaked but with prominent readily broken apiculum. Seed obliquely ovate, 11–12 mm long, 5–6 mm wide; wing extending down both sides of body, not notched, pale brown with black streaks, black at base.

Uncommon in the central wheatbelt and south-western interzone regions of W.A., from Lake Campion near Merredin north to Wialki and east towards Kalgoorlie. Occurs in open sand plain mallee-shrubland in sandy to gravelly soil. Known from only a few specimens. Flowers Sept.–Oct. Map 154.

W.A.: 16 km N of Warrachuppin, *H.Demarz 10329* (CANB, PERTH); sand plain scrub S of Yanneymooning, *P. de Rebeira 174* (PERTH); 2 km E of Wallaroo Rock, c. 70 km WNW of Coolgardie, *K.Newbey 8822* (CANB, PERTH); 3.2 km NW of Wialki, *G.M.Storr s.n.* (PERTH 01891235).

For a discussion of the current conservation status of this taxon see F.H.Mollemans *et al.* (1993), Declared rare flora and other plants in need of special protection in the Merredin District. p. 207 (W.A. Wildlife Management Program No. 9, ANPWS, Canberra, ACT & CALM, Como, W.A.). It is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995). C.A.Gardner used the manuscript name *H. rigida* on specimens of his collection no. 2761 in PERTH, and this is taken up here. It appears that the specimen thought by Lamont *et al.* (1987) to represent a needle-leaved form of *H. erecta* belongs to *H. rigida*.

134. Hakea invaginata B.L.Burtt, *Hooker's Icon. Pl.* ser. 5, 5: t. 3428 (1943)

Hakea sulcata var. *intermedia* Ewart & Jean White, *Proc. Roy. Soc. Victoria* 23: 293 (1911). T: Cowcowing, W.A., 1904, *M.Koch 1056*; holo: MEL; iso: AD, HO, K, NSW, PERTH.

Hakea invaginata var. *pachycarpa* B.L.Burtt, *Hooker's Icon. Pl.* ser. 5, 5: t. 3428 (1943). T: cultivated at Blackwood, S.A., from seed from Pithara, W.A., Oct. 1932, *E.Ashby 95*; holo: K.

Illustrations: B.L.Burtt, *loc. cit.*; W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 211 (1990); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 16, 54 (1997).

Erect shrub, 1.3–4 m tall, non-sprouting. Branchlets densely tomentose and appressed-pubescent at flowering. Leaves terete, with 5 deep narrow grooves running entire length, 7–22 cm long, 1.2–1.5 mm diam., glabrous to sparsely sericeous on faces, moderately sericeous in grooves; longitudinal veins 5 (= the broad faces separated by grooves). Inflorescence a solitary axillary umbelliform raceme, grouped to form elongate brushes, with 60–80 flowers per axil; pedicels glabrous. Perianth usually pink, sometimes white ageing deep pink. Pistil 10–12.5 mm long; gland subglobular. Fruit 1–6 per axil, stalked, obliquely elliptic-acuminate, sometimes curved, 1.6–2.2 cm long, 0.8–1.1 cm wide, scarcely beaked but often abruptly narrowed into a short apiculum. Seed obliquely ovate-elliptic, acute, 11–14 mm long, 5–6 mm wide; wing extending fully down both sides of body, more broadly down one side than other, usually notched near base adaxially, sepia to dark brown with blackish brown patches towards base. Fig. 20P.

Occurs in inland south-western W.A. from between Kellerberrin and Southern Cross along the Great Eastern Hwy, north to Yuna and Mt Magnet; grows in *Acacia*- or *Melaleuca*-dominated shrubland on sand plain. Flowers July–Sept. Map 155.

W.A.: Bunjil area, July 1971, *C.Chapman s.n.* (MEL, NSW, PERTH); 70 km W of Yalgoo, *H.Demarz 6851* (CANB, PERTH); 80 km NW of Bullfinch, *P.G.Wilson 6194* (AD, PERTH).

While there is some variation in the fruit as seen in median view (some are abruptly narrowed into the apiculum while others are more gradually narrowed), there is a more or less continuous gradation. Variation in fruit size is not correlated. Recognition of a distinct var. *pachycarpa* is, therefore, not warranted.

This species is sometimes confused with *H. scoparia*, *H. meisneriana* or *H. subsulcata*. *Hakea invaginata* is distinct from all of them because the apparent striations on the leaves are in fact extremely narrow deep grooves much narrower than the flattened ridges. in *H. meisneriana* and *H. subsulcata*, the striations are the veins which protrude at the angles. In *H. scoparia*, the leaves are deeply but openly and broadly grooved, the grooves as wide as the ridges. The differences are readily apparent in cross-sections, as seen in Figs 20M, O, P.

Hakea invaginata has been grown in cultivation, sometimes as '*H. sulcata*', and the forms with especially bright pink flowers make excellent garden subjects where well-drained soils are available.

135. Hakea subsulcata Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 1: 555 (1845)

T: in glareosis illustribus sylvae inter praedia rustica Dom. Barker & Lennard [between holdings of Mr Barker, probably near York, and Mr Lennard, near Guildford, W.A.], 12 Apr. 1840, *L.Preiss 607*, (*Sem. n. 72*); syn: B, G, ?G-DC, LD, LE *p.p.*, MEL, NY.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 22, 102 (1997).

Erect to spreading cauliflorous shrub, 1–3 m tall, non-sprouting. Branchlets densely appressed-pubescent at flowering (woody flowering branches glabrescent). Leaves ±terete, finely striated, 3–12.5 cm long, 0.8–1 mm diam., sparsely appressed-pubescent to glabrous; longitudinal veins 12 all around, from near base for entire length. Inflorescence a ±spherical umbel, 1 or 2 per node on bare wood below leafy parts, rarely axillary, with c. 50 flowers per umbel; pedicels purple, glabrous. Perianth mauve. Pistil 10–13.5 mm long, cream; gland rounded obtriangular. Fruit 1–20 per node, shortly stalked, obliquely oblong-elliptic, slightly curved at apex, 1.4–1.8 cm long, 7–9 mm wide, not beaked but shortly apiculate. Seed obliquely obovate, 10.5–14 mm long, 4–6 mm wide; wing extending broadly down one side of body only, sometimes notched, blackish brown.

Occurs in inland south-western W.A. from near Southern Cross south to Ravensthorpe and west to Pingrup and Corrigin. Grows in lateritic gravelly loam, sometimes in association with ranges, in scrub-heath. Flowers May–Aug. Map 156.

W.A.: Mt Short, N of Ravensthorpe, *A.S.George 4438* (PERTH); Parker Ra., SE of Southern Cross, *G.J.Keighery 6487* (CANB, PERTH); North Ironcap, *K.Newbey 5209* (PERTH).

Among the terete-leaved W.A. species, *H. subsulcata* is distinctive particularly in being cauliflorous, but also in having very slender leaves.

136. Hakea meisneriana Kippist, *Hooker's J. Bot. Kew Gard. Misc*. 7: 114–115 (1855)

T: Swan River Colony, [Dandaragan to Champion Bay, W.A.], *s.d.* [c. 1851], *J.Drummond 6: 191*; syn: BM *p.p.*, CGE, E, G-DC, K, LE *p.p.*, MEL, P; Swan River Colony, [Mullean, granite area about Mt Caroline & Mt Stirling, W.A.], *s.d.* [c. Sept. 1847], *J.Drummond 5: suppl. 16*; syn: BM, CGE *p.p.*, G, K, LE *p.p.*, MEL, P, PERTH, TCD; Swan River Colony, [Bolgart, Coorow, E of Hawthornden as well as trip to Albany and Cape Riche, W.A.], *s.d.* [1843–44], *J.Drummond 3: 272*; syn: BM *p.p.*, CGE *p.p.*, G, G-DC, K, LE *p.p.*, NY, P, TCD.

[*Hakea sulcata auct. non* R.Br.: C.D.F.Meisner, in J.G.C.Lehmann, *Pl. Preiss*. 2: 260 (1848), *p.p.*, only with respect to *Drummond 3: 272*; C.D.F.Meisner, *Hooker's J. Bot. Kew Gard. Misc*. 4: 208 (1852), *p.p.*, only with respect to *Drummond 3: 272* and *5: Suppl. 16*]

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 16, 17, 68 (1997).

Erect broom-like shrub, 1–3 m tall, non-sprouting. Branchlets ±glabrous at flowering. Leaves ±terete, hexagonal in cross-section in proximal half, 10-sided in distal half, flat or shallowly concave between angles, 3–12 (–15) cm long, 1–1.5 mm diam., glabrous; longitudinal veins 6 all around at angles in proximal half, 10 in distil half. Inflorescence a solitary axillary moderately elongated raceme, with 36–44 flowers; pedicels glabrous. Perianth cream-white. Pistil 8–10.5 mm long; gland broadly obovoid. Fruit 1–4 on usually enlarged rachis,

subsessile, obliquely ovate-elliptic, slightly curved, 0.9–1.9 cm long, 0.6–1.2 cm wide, acuminate, scarcely beaked but with prominent readily broken apiculum. Seed acutely obliquely ovate- to obovate-elliptic, 8–11 mm long, 3–4 mm wide; wing extending down both sides of body, more broadly down one side than other, usually notched near base adaxially, blackish brown with black streaks and patches. Fig. 20K–M.

Occurs in inland south-western W.A. from Dalwallinu to Coolgardie and south to Dumbleyung and Norseman; an outlying occurrence to the north-west is located 25 km west of Three Springs. Found in sand plain heath, almost without exception on well-drained gravelly sand. Flowers Sept.–Nov. Map 157.

W.A.: Quairading–Corrigin road, just NW of 135 mile peg [217 km], *A.S.George 12918* (AD, PERTH); 25 km W of Three Springs towards Dongara, *E.A.Griffin 1612* (PERTH); 74 km W of Kumarl, which is c. 122 km N of Esperance, *P.G.Wilson 5714* (PERTH).

The comparatively elongate conspicuous flowering racemes of this species, 4.5–6 mm long, distinguish it readily from other terete-leaved species in W.A., except *H. gilbertii*, which differs in having densely appressed-pubescent branchlets at flowering time.

137. Hakea gilbertii Kippist, *Hooker's J. Bot. Kew Gard. Misc.* 7: 115 (1855)

Hakea sulcata var. *gilbertii* (Kippist) Benth., *Fl. Austral.* 5: 529 (1870). T: without specific locality, [W.A.], *s.d., J.Gilbert s.n.*; holo: K.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 15, 48 (1997).

Erect to narrowly erect shrub, 0.6–2 m tall, non-sprouting. Branchlets densely appressed-pubescent at flowering, rarely glabrescent. Leaves ±terete, slightly compressed, stellate in cross-section, deeply but openly grooved longitudinally, 2–9.5 cm long, 0.9–1.1 mm diam., glabrous; longitudinal veins 6 all around, at angles. Inflorescence a solitary axillary moderately elongate raceme, with 24–34 flowers; pedicels glabrous or sparsely hirsute. Perianth deep pink in bud, white at anthesis. Pistil 8.5–9.5 mm long; gland obtriangular. Fruit 1–3 per axil, shortly stalked, obliquely elliptic, slightly curved, 1.1–1.4 cm long, 8–10 mm wide, acuminate, scarcely beaked but with weak apiculum. Seed obliquely elliptic, 9–10.5 mm long, 4.5–5 mm wide; wing extending broadly down one side of body, where broadly notched at base, narrowly down other, where lacerated, sepia to dark brown with blackish brown streaks.

Occurs in south-western W.A. especially in the heathlands to the north of Perth, as far as Three Springs, with scattered populations south-east to Katanning and Kulin. Grows in sandy or clay, usually gravelly, lateritic soil. Flowers Aug.–Sept. Map 158.

W.A.: c. 16 km SW of Three Springs, *R.Berg 118A* (PERTH); c. 21 km W of Woodanilling, *A.S.George 14929* (PERTH); 7 km SSW of Eneabba, *E.A.Griffin 990* (CANB, PERTH).

Hakea gilbertii is similar to *H. sulcata*; see under that species for distinguishing features. The lower leaves on each branchlet in *H. gilbertii* are characteristically bent back, and the inflorescences are usually grouped distally on the branchlets. The involucral bracts are sometimes persistent during flowering.

138. Hakea sulcata R.Br., *Trans. Linn. Soc. London* 10: 180 (1810)

T: Bay I, South Coast, [Lucky Bay, W.A.], Jan. 1802, *R.Brown 8*; holo: BM.

Illustrations: J.Young, *Hakeas of W. Australia, Botanical District of Avon* 23, 104 (1997).

Erect or spreading shrub, 0.5–1.5 m tall, non-sprouting. Branchlets sparsely to densely appressed-pubescent at flowering, sometimes patchily glabrescent. Leaves usually subterete, thick, slightly to markedly compressed-pentagonal to -heptagonal in cross-section, shallowly grooved longitudinally, 2–9 (–12.5) cm long, 1–2 mm diam., glabrous; longitudinal veins 6 or 7 all around (2 marginal, 3 below and 1 or 2 above), alternating with grooves. Leaves rarely flat or concave, linear to very narrowly obovate, 2–6 mm wide, with prominent marginal veins and longitudinal veins 3 below, 1 above (sometimes upper vein obscure). Inflorescence a solitary axillary umbelliform raceme, with 8–14 flowers; pedicels cream-white, glabrous. Perianth cream-white. Pistil 5–9.5 mm long; gland subglobular,

±compressed, 0.2 mm high. Fruit 1–3 per axil, scarcely woody, sessile, obliquely ovate-acuminate (almost straight abaxially), usually slightly recurved, 0.6–0.8 cm long, 0.3–0.35 cm wide, scarcely beaked but with prominent readily broken apiculum. Seed ±elliptic-rhombic, 4.8–5.5 mm long, very shortly winged; wing extending very narrowly down both sides and around base of body, sometimes notched, dark blackish brown. Plate 25; Fig. 20N.

Extends from near Jurien Bay to Israelite Bay, and inland as far as about Katanning, including the Stirling Ra., W.A. Usually grows in seasonal swamps in white or grey lateritic sand with clay subsoil, in swamp heath surrounded by mallee-heath or forest. Flowers Aug.–Nov. Map 159.

W.A.: c. 15 km W of Woodanilling, *A.S.George 14928* (PERTH); Brixton Rd, Beckenham, 15 km E of Perth, *G.J.Keighery 7444* (PERTH); 8 km E of Cape Le Grand, *P.G.Wilson 5635* (PERTH).

Hakea sulcata is moderately uniform in leaf morphology throughout its range, having narrow 5–7-angled leaves, but unusually broad-leaved populations occur in the Scott R. district east of Augusta and in the vicinity of the Hay R., east of Denmark. *Hakea gilbertii* is similar to *H. sulcata* but differs in its much larger fruit, slightly more slender leaves with exceptionally long-acuminate needle-sharp mucro, elongate racemes and paler seeds with a much larger wing.

The name *H. sulcata* has been widely misapplied to related species with terete furrowed leaves, notably *H. invaginata* and *H. scoparia* when these species have been grown as ornamentals. *Hakea sulcata* is quite distinct, especially in its inconspicuous tiny fruit, the smallest in the genus.

Multilineata Group

Hakea sect. *Conogynoides* ser. *Longistylae* Benth., *Fl. Austral*. 5: 493, 518 (1870), *p.p.*

Shrubs or small trees, without corky bark. Leaves simple, flat, non-petiolate, not stem-clasping, entire; venation obvious, of fine longitudinal veins giving striated or ribbed appearance. Inflorescence an axillary long simple raceme, not resprouting in subsequent years, developing within involucre; bracts not persisting at base of inflorescence; rachis 1.2–13.5 cm long. Flowers 50–500; pedicels glabrous. Perianth curved in bud, splitting to base into 4 distinct tepals, glabrous. Pistil (4.6–) 13–23.5 mm long; pollen presenter erect conical; gland U-shaped or a triangular flap. Fruit 1–15 per axil, erect, retained unopened on plant, woody or scarcely woody and opening on maturity (*H. maconochieana*), reticulately fissured, pusticulate or rarely rugose-tuberculate, smooth, usually beaked, not horned, often apiculate, dehiscing fully down one or both sides. Seed occupying part of valve; wing extending broadly or narrowly down one side of seed body only.

A group of six species found from Shark Bay and Geraldton in W.A. east through central Australia to more arid parts of S.A. and Qld.

1 Leaves less than 3 mm wide

2 Rachis 3–3.5 cm long, densely hirsute; flowers c. 100; pedicel and perianth sparsely pubescent; gland obovoid (Ambathala Ra. area, south-western Qld; flowers Apr.) **144. H. maconochieana**

2: Rachis 8.5–13.5 cm long, glabrous; flowers 250–450; pedicel and perianth glabrous; gland a semi-annular collar (Geraldton area, W.A.; flowers May–Oct.) **143. H. bucculenta**

1: Leaves more than 3 mm wide

3 Flowers cream (fruit prominently beaked; rachis 2–6 cm long, glabrous; Merredin, south-western W.A. to ranges of central Australia; flowers Sept.–Oct.) **142. H. minyma**

3: Flowers red or pink

4 Rachis 5–9 cm long; flowers 150–500 (fruit prominently beaked; sand areas from Geraldton to Hyden in W.A. across to Eyre Penin. and Birksgate Ra., S.A.; flowers July–Oct.) **141. H. francisiana**

4: Rachis 1–5 cm long; flowers 50–150

5 Rachis glabrous; leaf veins 9–25; pistil 17–22 mm long; fruit doubly keeled along ventral suture, usually prominently beaked (area bounded by Wongan Hills, Esperance and Coolgardie, W.A.; flowers June–Sept.) **139. H. multilineata**

5: Rachis densely tomentose; leaf veins 5–9; pistil 13–16 mm long; fruit not keeled along ventral suture, not or scarcely beaked (Macdonnell Ra., N.T.; flowers Mar.–Aug.) **140. H. grammatophylla**

139. Hakea multilineata Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 2: 262 (1848)

T: Swan River Colony, W.A., [Watheroo: information in Drummond's hand on one of the specimens in G], *s.d.* [Feb. 1845], *J.Drummond 3: 275*; holo: NY; iso: BM, G, G-DC, K *p.p.*, MEL, OXF, ?PERTH (labelled erroneously as *M.Koch 975* from Cowcowing).

Illustrations: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 218 (1990); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 18, 72 (1997).

Erect shrub or small tree, 2.5–5 m tall, non-sprouting. Branchlets ±glabrous at flowering. Leaves flat, linear to narrowly oblanceolate, sometimes slightly falcate, 7–20.5 cm long, 3.5–26 mm wide, finely striated, obtuse to acute, broadly and sharply or bluntly mucronate, glabrous; veins 9–20 (–25), between prominent marginal veins. Inflorescence with 50–120 flowers; rachis 1.2–3 cm long, glabrous; pedicels glabrous. Perianth bright pale to deep pink, glabrous. Pistil 17–22 mm long; gland broadly triangular. Fruit 1–5 on thickened (but not elongated) rachis, stalked, woody, ±obliquely ovate-elliptic, 1.5–2.6 cm long, 1.2–1.8 cm wide, prominently (rarely obscurely) beaked, shortly apiculate, doubly keeled along ventral suture. Seed obliquely obovate-rhombic, 14–22 mm long, 7–12.5 mm wide; wing extending down one side of body only, often with laciniate margin, black to blackish brown. Plate 28; Fig. 21A–D.

Occurs in south-western W.A. from the Wongan Hills area east to the Coolgardie area and south-east towards Kulin and Esperance. Grows in well-drained sites on laterite in ranges (Wongan Hills) or in sand plain mallee-heath in deep loamy sand. Flowers June–Sept. Map 160.

W.A.: 115 km NE of Lake King, *L.Haegi 1000* (AD, PERTH); 15 km SE of Kulin, *R.Hnatiuk 770408* (PERTH); Monks Well Gully, S end of Wongan Hills, *K.F.Kenneally 1303* (PERTH).

Geographically-correlated almost clinal variability in *H. multilineata* requires further study to determine its taxonomic significance. Broad-leaved plants with larger flowers and inflorescences occur in the Wongan Hills and Brookton areas, while narrow-leaved plants with smaller flowers and inflorescences are found in the eastern part of the distribution. Intermediate forms occur in the intervening area (Kondinin–Pingrup–Ravensthorpe). *Hakea multilineata* is occasionally grown as a garden shrub.

140. Hakea grammatophylla (F.Muell.) F.Muell., *Fragm*. 6: 214 (1868)

Grevillea grammatophylla F.Muell., *Fragm*. 5: 25 (1865); *H. multilineata* var. *grammatophylla* (F.Muell.) Benth., *Fl. Austral.* 5: 518 (1870). T: 'Scrub near Forsters range', Central Mount Stuart, [N.T.], *s.d.* [1861/2], *J.McD. Stuart s.n.*; probable holo: MEL 1010236.

Illustration: W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 210 (1990).

Erect shrub or small tree, 1–3.5 m tall, possibly resprouting. Branchlets densely, sometimes patchily, appressed-pubescent to ±glabrous at flowering. Leaves flat, linear, sometimes widened distally, falcate, 8–20 cm long, 5–11 cm wide, finely striated, acute, bluntly mucronate, moderately to sparsely appressed-pubescent; veins 5–9 between prominent marginal veins. Inflorescence with 100–150 flowers; rachis 2–5 cm long, densely tomentose; pedicels glabrous. Perianth bright pink, glabrous. Pistil 13–16 mm long; gland ±flat,

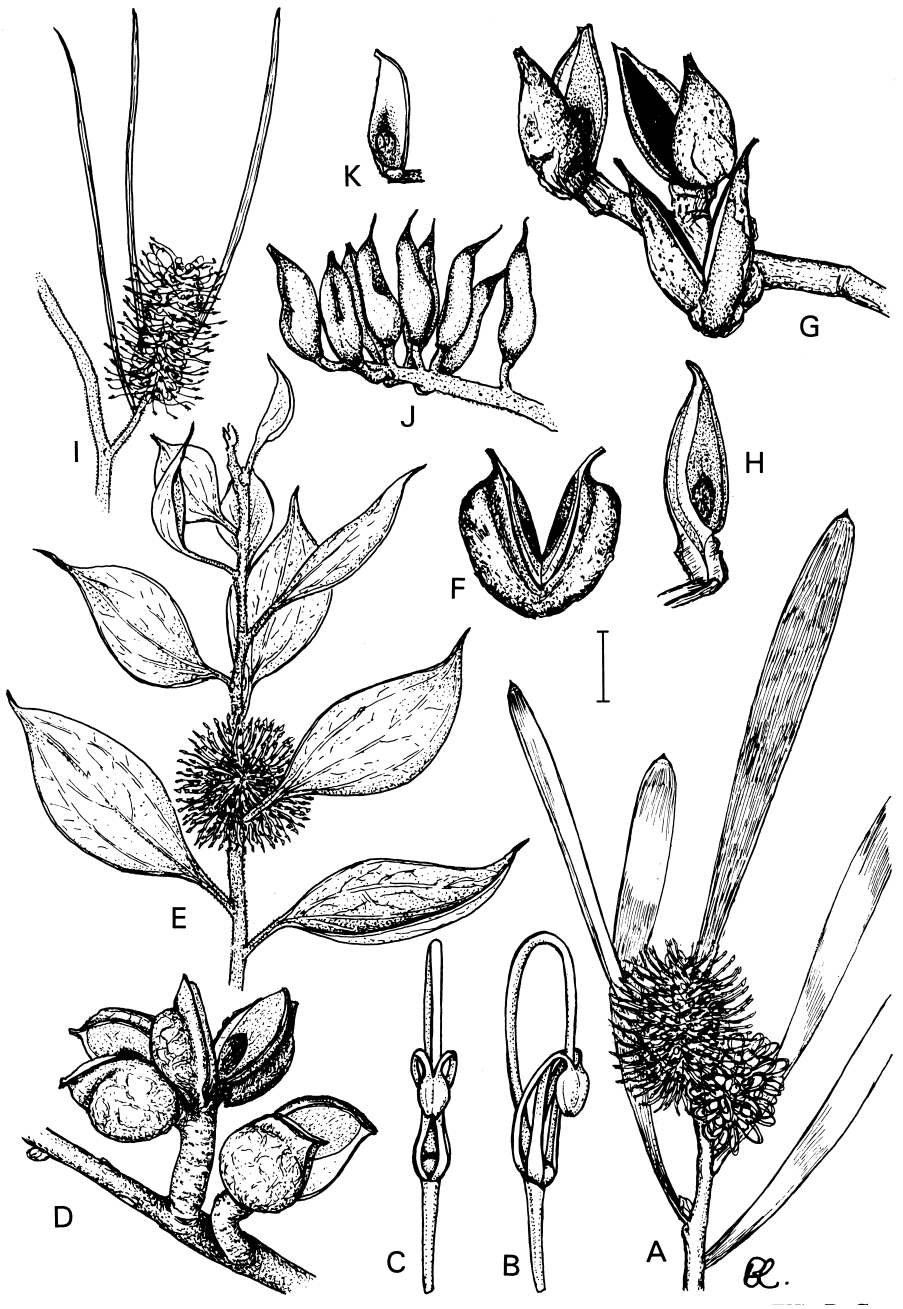

Figure 21. *Hakea*. **A–D**, *H. multilineata*. **A**, habit (K.F.Kenneally 1303, PERTH); **B–C**, two views of flower showing early exposure of the gland (**B–C**, cult. Adelaide Botanic Garden); **D**, fruits (J.M.Koch N40, PERTH). **E–F**, *H. petiolaris*. **E**, habit; **F**, open fruit (**E–F**, B.H.Smith 582, AD). **G–H**, *H. grammatophylla*. **G**, group of fruit; **H**, inside of fruit (**G–H**, A.E.Orchard 843, AD). **I–K**, *H. maconochieana*. **I**, inflorescence; **J**, fruits; **K**, inside of fruit (**I–K**, R.W.Purdie 2121, CANB). Scale bar: **A**, **E**, **I** = 2 cm: **B–C** = 5 mm; **D**, **F–H**, **J–K** = 1 cm. Drawn by Beth Chandler.

±obtriangular, centrally depressed. Fruit 1–15 on elongated rachis, stalked or subsessile, woody, ovate to ovate-oblong, 1.7–2.6 cm long, 0.8–1.3 cm wide, scarcely or not beaked, at first acuminate, enlarging and becoming more woody and obtuse, although still shortly apiculate with age, not keeled on ventral suture. Seed ovate-elliptic to ±elliptic-oblong, 11–16 mm long, 3.5–6 mm wide; wing extending partly down one side of body only, blackish brown. Plate 26; Fig. 21G, H.

Confined to the Macdonnell Ra., N.T., extending from the George Gill Ra. in the west to the White Ra. in the east. Occurs in soil pockets on rocky ridges and upper slopes of steep hillsides and river gorges. Flowers Mar.–Aug. Map 161.

N.T.: 1 km N of Kings Canyon, *P.K.Latz 8729* (CANB, DNA); Serpentine Gorge, Macdonnell Ra., *J.R.Maconochie 1066* (DNA); Standley Chasm, Macdonnell Ra., *A.E.Orchard 843* (AD, DNA).

Maconochie (*Maconochie 1066*) noted 'plants regenerating at base', presumably after fire or a disturbance, indicating that this species is probably lignotuberous. He also noted that in the desert environment the fruit appear to mature quickly, but then enlarge and increase in woodiness as they age.

This species is recognised as 'Rare' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

Mueller described *Grevillea grammatophylla*, and cited the Stuart specimen from 'scrub near Forsters range' as type. When he subsequently transferred the species to *Hakea* he cited two further specimens (Gawler Ra., *Sullivan*, and Port Lincoln, *Weidenbach*). These latter specimens belong with *H. francisiana*.

141. Hakea francisiana F.Muell., *Fragm.* 1: 20 (1858)

T: ad partem occid. sinus Spencer's Gulf, S.A., *s.d., G.Francis s.n.*; syn: NY.

Hakea coriacea Maconochie, *Trans. & Proc. Roy. Soc. S. Australia* 97: 132 (1973). T: between Perenjori and Jibberding, W.A., Nov. 1953, *C.A.Gardner 12155*; holo: PERTH.

?Hakea multilineata var. *graminea* A.R.Fairall, *W. Austral. Nat. Pl. Cult.* 155 (1970), *nom. nud.*

[*Hakea multilineata auct. non* Meisn.: C.D.F.Meisner, in A.L.P.P. de Candolle, *Prodr.* 14: 410 (1856), *p.p.* (only with respect to *Drummond 5: Suppl. 18*); G.Bentham, *Fl. Austral.* 5: 518 (1870), *p.p.* (only with respect to *Drummond 5: Suppl. 18*)]

[*Hakea grammatophylla auct. non* (F.Muell.) F.Muell.: F.J.H. von Mueller, *Fragm.* 6: 214 (1867), *p.p.* (with respect to *Sullivan* and *Weidenbach* specimens)]

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* pl. 99 (1984); W.R.Elliot & D.L.Jones, *Encycl. Austral. Pl.* 5: 198, 207 (1990), as *H. coriacea*; J.Young, *Hakeas of W. Australia, Botanical District of Avon* 15, 46 (1997).

Erect shrub or small tree, 2.5–8 m tall, non-sprouting. Branchlets patchily appressed-pubescent to ±glabrous at flowering. Leaves flat, linear, 8–26 cm long, 3–16 mm wide, finely striate, acute, bluntly mucronate, sparsely pubescent to glabrous; veins 5–13 between prominent marginal veins. Inflorescence with 150–500 flowers; rachis 5–9 cm long, basally tomentose, otherwise glabrous; pedicels glabrous. Perianth pale to deep pink or red to orange-red, sometimes brownish, glabrous. Pistil 16.5–23.5 mm long, coloured as perianth or paler, sometimes cream; gland a thick semi-annular collar. Fruit 1–12 on enlarged rachis, subsessile or stalked, woody, ±obliquely ovate-elliptic, 1.4–2.6 cm long, 1–1.4 cm wide, prominently beaked, shortly apiculate, not keeled on ventral suture. Seed obliquely obovate-rhombic, 10–22 mm long, 5.5–9 mm wide; wing extending down one side of body only, sometimes laciniate apically, black to blackish brown. Fig. 22A–C.

Extends from Geraldton and Wiluna, south to Hyden, W.A., east to the Birksgate Ra. in S.A., and from there south-east to the northern Eyre Peninsula. Always found in sandy soil in dunes or on sand plain, in shrubland or woodland. Flowers July–Oct. Map 162.

W.A.: 8 km E of Piawaning, 9 Sept. 1959, *T.E.H.Aplin s.n.* (PERTH); 168 mile post [c. 250 km] on Great Eastern Hwy, *E.M.Bennett 693* (PERTH). S.A.: white sand ridge 20 km SW of Yardea HS, Gawler Ra., *N.N.Donner 3383* (AD); c. half way along track from Vokes to Serpentine Lakes, *G.Jackson 1410* (AD).

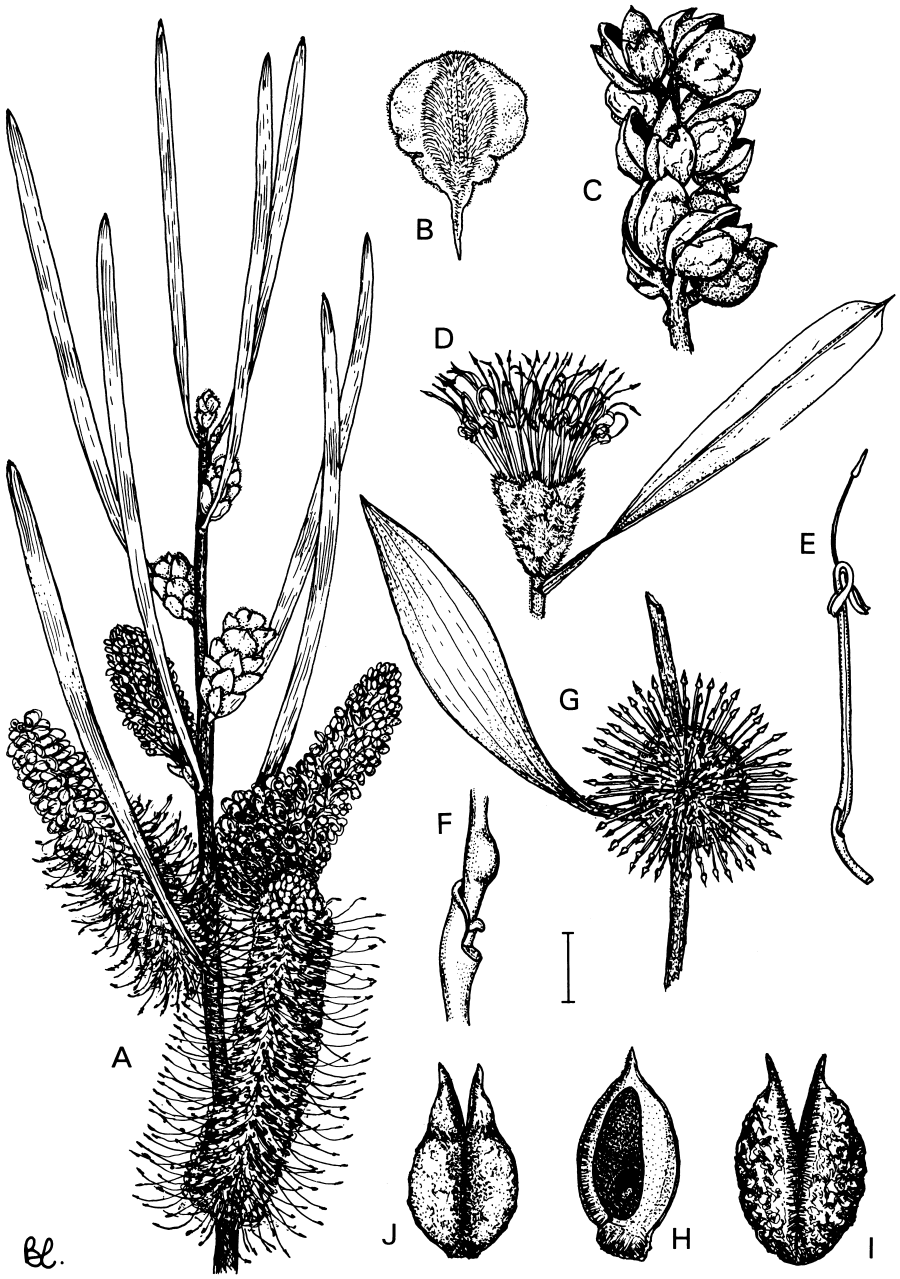

Figure 22. *Hakea*. **A–C**, *H. francisiana*. **A**, habit; **B**, inside bract (**A–B**, B.J.Muir 140, PERTH). **C**, fruit cluster (N.Donner 3383, AD). **D–F**, *H. cinerea*. **D**, inflorescence plus leaf (J.D'Alonzo 76, PERTH); **E**, flower with tepals; **F**, torus (**E–F**, A.M.Ashby 1600, AD). **G**, *H. laurina*, inflorescence and leaf (May 1961, P.Roberts, PERTH). **H–I**, *H. obtusa*. **H**, fruit; **I**, inside of fruit (**H–I**, E.M.Bennett 2191, PERTH). **J**, *H. minyma*, fruit (C.R.Dunlop 2010, DNA). Scale bar: **A**, **C**, **G** = 2 cm; **B**, **D**, **H–J** = 1 cm; **E** = 5 mm; **F** = 2 mm. Drawn by Beth Chandler.

Hakea coriacea, described from broad-leaved many-veined pink-flowered populations in the far west of the species distribution, has here been placed in synonymy with *H. francisiana*, from which it cannot be reliably distinguished. Some variation in these characteristics occurs without correlation in other parts of the range of *H. francisiana*.

142. Hakea minyma Maconochie, *Trans. & Proc. Roy. Soc. S. Australia* 97: 130 (1973)

T: about 84 km W of Musgrave Park Stn, S.A., *J.R.Maconochie 846*; holo: DNA; iso: AD, BRI, CANB, K, MEL, NSW, PERTH.

Hakea microneura C.A.Gardner ex A.R.Fairall, *W. Austral. Nat. Pl. Cult.* 154 (1970), *nom. nud.*

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 384 (1989); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 17, 18, 70 (1997).

Erect shrub or tree, 2–6 m tall, non-sprouting. Branchlets ±glabrous at flowering. Leaves flat, linear, slightly falcate, 4–16 cm long, 3.5–8 mm wide, finely striated, narrowly acute, bluntly mucronate, glabrous; veins 12–17 (–20) between prominent marginal veins. Inflorescence with 50–110 flowers; rachis 2–6 cm long, glabrous; pedicels glabrous. Perianth cream, glabrous. Pistil 4.6–8 mm long; gland broadly obovoid. Fruit 1–7 on elongated rachis, stalked, woody, obliquely ovate-acuminate, 1.7–3 cm long, 0.9–1.8 cm wide, prominently beaked (tip fragile, often broken), not keeled on ventral suture. Seed ±angular, obliquely obovate, 12–21 mm long, 6–9 mm wide; wing extending down one side of body only, blackish brown to black. Plate 29; Fig. 22J.

Found in W.A. in an area bounded by Kalbarri, Wiluna, Merredin and Kalgoorlie, with an apparent disjunction to central Australia where found near Giles (W.A.), in the Petermann and Macdonnell Ra. (N.T.), and the Birksgate, Mann and Tomkinson Ra. (S.A.). Occurs in tussock grassland, mulga or mallee woodland, on sand dunes or sand plains. Flowers Aug.–Nov. Map 163.

W.A.: Cowcowing, Sept. 1904, *M.Koch s.n.* (MEL, NSW, PERTH). N.T.: 48 km NE of Mt Davies Camp, Mann Ra., *C.Dunlop 2010* (AD, CANB, DNA). S.A.: between Mt Harriet and Musgrave Park HS, *Hj.Eichler 17285* (AD).

Sparingly cultivated.

143. Hakea bucculenta C.A.Gardner, *J. Roy. Soc. W. Australia* 22: 123 (1936)

T: 30 miles [50 km] north of the Murchison River to the south of Shark Bay, W.A., 29 Aug. 1931, *W.E.Blackall & C.A.Gardner 2571*; holo: PERTH.

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 366 (1989); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 13, 32 (1997).

Rounded bushy shrub, 1.5–4 m tall, non-sprouting. Branchlets patchily appressed-pubescent to glabrescent at flowering. Leaves biconvex, narrowly linear, usually slightly falcate, 10–20 cm long, 1.9–2.8 mm wide, c. 1 mm deep, finely ribbed, narrowly acute with a weakly pungent mucro, glabrous; veins prominent, with midvein visible above and below and 2 usually fused veins along each margin. Inflorescence with 250–450 flowers; rachis 8.5–13.5 cm long, glabrous; pedicels glabrous. Perianth bright red, glabrous. Pistil 18–21 mm long; gland a thick semi-annular collar. Fruit 3–16 on elongated rachis, stalked or subsessile, woody, ovate, 1.7–2.5 cm long, 1–1.5 cm wide, distinctly divided into thick body and ±flat beak, scarcely or not apiculate, not keeled on ventral suture. Seed obliquely obovate, concave abaxially in lower half, 16–18 mm long, 7–9 mm wide; wing extending ±broadly down one side of body only, blackish brown to black. Plate 27.

Occurs in south-western W.A., extending from Wannoo (near Hamelin Pool) south to Geraldton and inland to Mullewa. Grows in sand plain heath or mallee-heath in sand or clayey sand soil. Flowers May–Oct. Map 164.

W.A.: Yuna, c. 35 km E of Northampton, *A.M.Ashby 1001* (AD); Indarra Siding, between Geraldton and Mullewa, *W.E.Blackall 2779* (PERTH); 32 km S of Wannoo Roadhouse, *C.H.Gittins 1550* (NSW, PERTH); East Yuna Reserve, c. 70 km NE of Geraldton, *B.G.Muir 392* (PERTH).

One of the more commonly cultivated species of *Hakea*, but the brightly coloured inflorescences tend to be hidden as they are frequently borne in leaf axils on growth more than one season old. in cultivation *H. bucculenta* may hybridise with *H. francisiana*.

144. Hakea maconochieana Haegi, *Fl. Australia* 17B: 396 (1999)

T: Ambathala Range, 50 km E of Adavale, Qld, 5 Apr. 1981, *C.Sandercoe 507*; holo: BRI, iso: AD.

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 403 (1989), as *Hakea sp. nov.* (Quilpie).

Erect or spreading shrub, 0.5–1.5 m tall, non-sprouting. Branchlets patchily appressed-pubescent at flowering. Leaves patchily sericeous, flat, thick, c. one-third as deep as wide, narrower across underside, narrowly linear, 7–13.5 cm long, 1.5–2.7 cm wide, 0.4–0.8 mm deep, finely ribbed, narrowly acute with ±blunt mucro, sericeous; veins prominent, 3–5 on upper side including marginal veins, 2 or 3 on underside. Inflorescence with c. 100 flowers; rachis 3–3.5 cm long, densely hirsute; pedicels sparsely to moderately pubescent. Perianth red, sparsely appressed-pubescent. Pistil 15–18 mm long; gland obovoid. Fruit 2–8 on elongated rachis, stalked, scarcely woody, obliquely narrowly ovate to elliptic, 1.4–1.7 cm long, 0.6–0.7 cm wide, slightly curved apically, not beaked, shortly apiculate, not keeled on ventral suture. Seed not seen; seed scar on valve angularly obliquely narrowly elliptic, 14–16 mm long, 6–7 mm wide; wing extending narrowly and partly down one side of body only. Fig. 21 I–K.

A very rare species known from scattered localities in the Ambathala Ra. and south-east of Quilpie, far south-western Qld. Grows in stony clay soil in scattered *Acacia stowardii* community. Flowers Apr. Map 165.

Qld: Ambathala Ra., *R.W.Purdie 2121* (CANB).

This species is recognised, under *Hakea sp. 1* (Mariala Scientific Reserve; C.Sandercoe), as 'Vulnerable' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

Corymbosa Group

Hakea sect. *Conogynoides* ser. *Longistylae* Benth., *Fl. Austral.* 5: 493, 518 (1870), *p.p.*

Hakea sect. *Conogynoides* ser. *Sessiles* Benth., *Fl. Austral.* 5: 494, 521 (1870), *p.p.*

Shrubs, without corky bark. Leaves simple, initially flat, often becoming concave about stem and inflorescences, non-petiolate, not stem-clasping, entire or toothed; venation longitudinal or (*H. victoria*) palmate and reticulate. Inflorescence an axillary corymbose umbelliform raceme, not resprouting in subsequent years, developing within involucre; bracts persisting at base of inflorescence; rachis knob-like. Flowers 12–56; pedicels glabrous. Perianth curved in bud, only splitting to base abaxially (except in *H. cinerea* which splits into 4 distinct tepals), glabrous. Pistil 22–37 mm long; pollen presenter erect, conical; gland obovoid or U-shaped. Fruit 1–5 per axil, erect, retained on plant, woody, smooth, pusticulate or fissured, sometimes becoming corky, not or shortly beaked, not horned, sometimes shortly apiculate, dehiscing fully down both sides. Seed occupying part of valve; wing extending down both sides of seed body.

A group of five species, all occurring in south-western W.A.

1 Leaf margin spinulose-dentate; apex rounded or emarginate; leaves flat and narrowly elliptic in lower parts, almost circular and with cream and red patches in flowering parts, 4–13 cm wide (Fitzgerald River Natl Park, W.A.; flowers July–Oct.) **149. H. victoria**

1: Leaf margin entire or minutely denticulate; apex acute or acuminate to rounded-mucronate; leaves narrowly obovate or elliptic to linear, less than 4 cm wide

2 Perianth splitting to base between all 4 tepals; flowers 40–56 per inflorescence; pistil 22–23 mm long; gland U-shaped (longitudinal veins 1–3 above, 3–6 below; Ravensthorpe to Israelite Bay, W.A.; flowers Aug.–Nov.) **145. H. cinerea**

2: Perianth splitting to base abaxially only; flowers 12–18 per inflorescence; pistil more than 28 mm long; gland obovoid

3 Veins coalescing at base into a cream patch which may turn red with age; leaves narrowly obovate to elliptic, 9–38 mm wide; secondary (non-longitudinal) veins conspicuous (Ravensthorpe area, W.A.; flowers July) **148. H. acuminata**

3: Veins not coalescing into a cream or red patch; leaves narrowly obovate, to 14 mm wide; secondary venation obscure

4 Flowers pale yellowish green proximally, deep yellow distally; multi-stemmed, lignotuberous shrub (sand heaths N of Perth, W.A.; flowers July–Sept.) **146. H. eneabba**

4: Flowers pale yellowish green throughout; ?single-stemmed, non-sprouting shrub (Stirling Ra. to Israelite Bay, inland to Lake King, W.A.; flowers May–Sept.) **147. H. corymbosa**

145. Hakea cinerea R.Br., *Trans. Linn. Soc. London* 10: 186 (1810)

T: Lewins land in arenosis prope littora, Bay I, [Lucky Bay, W. A.], [?7 Jan. 1802], *R.Brown Iter Australe. 31*; syn: B, BM, E, G, K *p.p.*, P.

?Hakea canescens Link, *Enum. Pl. Hort. Reg. Berol.* 1: 118 (1821). T: 'in Australia', not located.

Hakea tricostata R.Br. ex Hook., *Icon. Pl.* 5: t. 436 (1842). T: King George Sound, [W.A.], *s.d., W.Baxter s.n.*; syn: K.

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 366 (1989).

Erect shrub, 0.7–2.4 m tall, possibly lignotuberous. Leaves ±uniform, alternate, ±rigid, flat or shallowly concave, narrowly obovate to linear, 6–16 cm long, 8–18 mm wide, entire, acute to acuminate, grey-green; longitudinal veins prominent, 1–3 above, 3–6 below; pinnate veins visible but often obscure. Inflorescence with 40–56 flowers; pedicels 4–6 mm long, glabrous. Perianth yellow, splitting into 4 free segments. Pistil 22–23 mm long; gland U-shaped. Fruit 1–5 per axil, obliquely narrowly ovate, 2.2–2.5 cm long, 0.6–0.9 cm wide, not beaked, not apiculate, not corky. Seed obliquely narrowly ovate, 12–13 mm long, 4–5 mm wide; wing extending narrowly down both sides of body, dark grey-brown, sometimes with blackish patches. Plate 30; Fig. 22D–F.

Occurs along the southern coastal region of W.A. from Ravensthorpe to Israelite Bay and up to c. 70 km inland, with a slightly disjunct occurrence at Point Culver at the west end of the Great Australian Bight. Generally found in mallee-heath or low heath communities in white or pale sandy soil, sometimes in swampy situations. Flowers Aug.–Nov. Map 166.

W.A.: scenic lookout, Hopetoun, *E.M.Bennett 2563* (PERTH); c. 80 km E of Esperance, *R.H.Kuchel 1645* (AD, L, PERTH, UC, W); c. 3 km NE of Howick Hill, *A.E.Orchard 1115* (AD, CANB, PERTH).

146. Hakea eneabba Haegi, *Fl. Australia* 17B: 396 (1999)

T: 2.8 km E of Brand Hwy on Tootbardi Rd, W.A., *A.S.George 16817*; holo: PERTH; iso: AD, CANB.

Multi-stemmed densely branched shrub, 0.3–1.3 m tall, lignotuberous. Leaves alternate in lower parts, usually whorled in flowering parts, shallowly concave, narrowly obovate, very rigid, 4.5–12 cm long, 5–14 mm wide, entire, acuminate to rounded-mucronate, midgreen; longitudinal veins prominent at least on underside, 1 above (sometimes obscure) and 1–3 below; pinnate veins visible but obscure. Inflorescence with 14–18 flowers; pedicels 2–3 mm long, glabrous. Perianth pale yellowish green proximally, deep yellow distally, split to base abaxially only. Pistil 28–31 mm long; gland obovoid. Fruit 1 or 2 per axil, obliquely ovate to obovate in lateral view, 2.2–2.4 cm long, 1.1–1.4 cm wide, shortly beaked and apiculate, not

corky. Seed obliquely ovate, 15–17 mm long, 8–10 mm wide; wing extending down both sides of body, blackish brown, sometimes with paler streaks. Plate 32.

Occurs in the sand heaths north of Perth, W.A., from Jurien Bay north to Three Springs, with a distribution centred on Eneabba, and an isolated record from south of Gingin. Generally found on deep sand in open heath to low open heath, apparently infrequent. Flowers July–Sept. Map 167.

W.A.: intersection of Green Head Rd and Brand Hwy, *B.Barnsley 853* (CANB); Mt Lesueur Reserve, 1 km W on track which intersects Banovich Rd at 6 km N of Jurien Rd, *J.D'Alonzo 76* (PERTH); 59 km W of Coorow, *C.H.Gittins 1689* (NSW).

In the past this newly recognised species was confused with *H. corymbosa* and *H. cinerea*. It is distinct from the former mainly in being lignotuberous, in its more conspicuously ciliate involucral bracts and in its bright yellow flowers, and from the latter mainly in the whorled arrangement of its branchlets, its bright green foliage and its broader fruits and seeds. Reportedly widely planted on tailings after sandmining at Eneabba (B.Lamont, pers. comm.).

147. Hakea corymbosa R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 28 (1830)

T: King George Sound, [W.A.], 1823 [1828/9], *W.Baxter*; syn: BM, K, NY *p.p.*

Illustrations: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 366 (1989); J.Young, *Hakeas of W. Australia, Botanical District of Avon* 14, 40 (1997).

Single-stemmed, usually very densely branched flat-topped shrub, 0.3–2 m tall, non-sprouting. Leaves in lower parts alternate, flat and linear, usually whorled in flowering parts, concave, narrowly obovate, extremely rigid, 2.8–12 cm long, 2.5–10 mm wide, entire, acuminate, mid-green; longitudinal veins prominent at least on underside, 1 above (sometimes obscure), 1–3 below; pinnate veins visible but obscure. Inflorescence with 12–18 flowers; pedicels 3.5–5 mm long, glabrous. Perianth pale yellowish green, split to base abaxially only. Pistil 30–35 mm long; gland obovoid. Fruit 1–3 per axil, obliquely broadly ovate in lateral view, 2–2.7 cm long, 1.3–1.8 cm wide, shortly apiculate, not or shortly beaked, not corky. Seed obliquely ovate, 12–17 mm long, 6.5–11 mm wide; wing extending down both sides of body, blackish brown, sometimes with paler streaks.

Widespread in south-western W.A. from Mt Caroline south to Wagin and Denmark and east to Israelite Bay. Sometimes a common component of heath and scrub-heath in sandy often gravelly soil. Flowers May–Sept. Map 168.

W.A.: between Mt Bland and Middle Mt Barren, *G.Keighery 497* (PERTH); Frank Hann Natl Park, *Monk 298* (PERTH); near base of Mt Gibbs, c. 35 km NE of Lake King, *K.Newbey 5488* (PERTH); 8 km NE of Kalgan R. along Albany–Borden road, *P.Short 2281 & L.Haegi* (AD, MEL, PERTH).

Considerable variation in leaf width occurs in this species, but as yet a pattern suggesting taxonomic correlation has not been recognised. Broad-leaved populations are restricted in occurrence but appear not to occur to the exclusion of narrow-leaved plants. Plants from the sand plain region north of Perth previously included under *H. corymbosa* have been recognised as the distinct species, *H. eneabba*.

148. Hakea acuminata Haegi, *Fl. Australia* 17B: 396 (1999)

T: north slope of One Tree Hill, S of Ravensthorpe, W.A., 14 July 1979, *Pearce s.n.*; holo: PERTH; iso: AD.

Erect densely branched shrub, 0.5–1.8 m tall; resprouting capacity unknown. Leaves alternate in lower parts, almost flat, obovate, almost whorled in flowering parts, concave, narrowly obovate to elliptic, very rigid, 3–10 cm long, 9–38 mm wide, entire or minutely denticulate, gradually acuminate; longitudinal veins prominent, with 1–3 above and below, at base coalescing into a cream patch often turning reddish with age; pinnate veins conspicuous. Inflorescence with 16–24 flowers; pedicels 5.5–6 mm long, glabrous. Perianth cream-yellow, split to base abaxially only. Pistil 34–37 mm long; gland obovoid. Fruit 1 or 2 per axil, obliquely ovate, 2.5–3.1 cm long, 1.6–2.1 cm wide, not or shortly beaked, shortly apiculate, becoming corky with age. Seed obliquely ovate, 18–21 mm long, 9–10 mm wide; wing extending down both sides of body, blackish brown, sometimes with paler streaks.

This species has been discovered only in recent years and to date is known from only five localities between Jerramungup and Ravensthorpe near the south coast of W.A. Occurs in shrub-mallee or scrub-heath in deep white sand or loamy sand; apparently rare. Flowers July. Map 169.

W.A.: 6 km due SSE of junction of Old Ongerup Rd and West River Rd, 4 km N of Fitzgerald River Natl Park boundary, *J.M.Fox 152* (CANB); No Tree Hill, Hopetoun area, 14 May 1981, *G.J.Keighery s.n.* (KPBG); 23 km S of Ravensthorpe, *K.Newbey 8265* (PERTH).

The venation of the leaves, whitish involucres and corky follicles of *H. acuminata* indicate a close relationship to *H. victoria*, while the almost whorled rigid acuminate leaves and the flowers indicate some affinity to *H. corymbosa*. It is distinct from both in numerous features.

This species is recognised, under *Hakea* sp. *6* (Fitzgerald River; *K.Newbey 8265*), as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

149. Hakea victoria J.Drumm., *The Inquirer*, without page number (1847); J.Drumm., *Companion Bot. Mag.* (n.s.) *Suppl. Bot. Mag.* 74: 2–3 (1848)

T: West Mount Barren.....between it and Mount Barren, W.A., *s.d.* [1846], *J.Drummond s.n.* [*4: 300*]; syn: MEL 108118, NY *p.p.*

Hakea drummondii G.Don, in J.C.Loudon, *Encycl. Pl., 2nd Additional Suppl.* 1296 (1855), *nom. nud.*

Illustrations: R.Erickson *et al.*, *Fl. & Pl. of W. Australia* 90, 91 (1973).

Erect sparingly-branched shrub, 1.3–3.5 m tall, non-sprouting. Leaves alternate, flat and narrowly elliptic in lower parts, concave and almost circular in flowering parts, rigid, 4–11.5 cm long, 40–130 mm wide, undulate, spinulose-dentate, rounded to emarginate, mucronate; veins palmate and reticulate, prominent above and below, coalescing at base into a cream patch often turning reddish with age. Inflorescence with 26–42 flowers; pedicels 6–11 mm long, glabrous. Perianth cream, split to base abaxially only. Pistil 33–37 mm long; gland obovoid. Fruit 2–4 per axil, obliquely broadly elliptic, 2.3–2.8 cm long, 1.5–2 cm wide, not or shortly beaked, shortly apiculate, becoming corky with age. Seed obliquely broadly ovate, 18–20 mm long, 9–12 mm wide; wing extending narrowly down both sides of body, blackish brown throughout. *Royal Hakea*. Plate 31; Fig. 18G.

Restricted to the Barren Ra., south-west of Ravensthorpe on the south coast of W.A., where in places it is a common and sometimes dominant shrub emergent from scrub-heath in quartzitic or lateritic sand, often in rocky situations. Flowers July–Oct. Map 170.

W.A.: Fitzgerald River Natl Park, 39 km S of Ravensthorpe on road to Hamersley Estuary, *B.Barnsley 513* (CANB, PERTH); Mt Bland, Fitzgerald River Natl Park, *A.S.George 10068* (AD, CANB, K, PERTH).

The conflorescence in *H. victoria* is annular when viewed from above, a feature of possible significance in its pollination ecology. See R.M.Barker, *Nuytsia* 11: 1–9 (1996), for a discussion of the publication of this species by James Drummond in the W.A. newspaper *The Inquirer*.

This species is recognised as 'Poorly Known' in J.D.Briggs & J.H.Leigh, *Rare or Threatened Australian Plants* (1995).

Doubtful names

Hakea breviflora Wawra, in H.Wawra & G.Beck, *Itin. Princ. S. Coburgi* 2: 73 (1888)

T: Western Australia, 'coll. I. 618 (Herb. F.V.Muell.)', *n.v.*

Type material was not located in W, and so the identity of this species is unknown. According to A.D.Chapman, *Australian Plant Name Index* (1991) the holotype is in MEL, but no collection was found there.

Hakea canescens Link, *Enum. Hort. Berol. Alt.* 1: 118 (1821)

T: Australia, *n.v.*

Description inadequate.

Hakea angustifolia Sweet, *Hort. Brit.* 491 (1826), *nom. nud.*

Description not given.

Hakea angustifolia Forbes, *Hort. Woburn.* 22 (1833)

T: New Holland, *n.v.*

Description inadequate.

Hakea echinata Sweet, *Hort. Brit.* 491 (1826), *nom. nud.*

The brief description states that the fruit is bristly-podded, and that some leaves are filiform while others are flat. Thus it is likely that this name is referable to *H. lehmanniana* rather than *H. auriculata* or *H. spathulata*.

Hakea flexilis Sweet, *Hort. Brit.* 490 (1826), *nom. nud.*

The brief description states that all leaves are filiform, while the 'capsule' is ecalcarate. This is insufficient for identification.

Hakea petrophiloides Sweet, *Hort. Brit.* 491 (1826), *nom. nud.*

The brief description states that all leaves are filiform, while the 'capsule' is ecalcarate. This is insufficient for identification.

Hakea subulata Sweet, *Hort. Brit.* 491 (1826), *nom. nud.*

The brief description states that all leaves are filiform, while the 'capsule' is ecalcarate. This is insufficient for identification.

Excluded names

Hakea salisburiifolia Huegel ex Ettingsh., *Denkschr. Kaiserl. Akad. Wiss. Math.-Naturwiss. Kl.* 15: 259, t. 40, f. 6 (1858), as *Salisburiaefolia*

A fossil species, *fide* A.Chapman, *Australian Plant Name Index* 1518 (1991).

Hakea stenocarpoides F.Muell. ex Benth., *Fl. Austral.* 5: 511 (1870)

Diploptera stenocarpoides (F.Muell. ex Benth.) C.A.Gardner, *J. Proc. Roy. Soc. W. Australia* 19: 80 (1933). T: locality not known, [W.A.], *J.Drummond 5?: Suppl. 15*; syn: MEL, PERTH.

This is *Strangea stenocarpoides* (F.Muell. ex Benth.) C.A.Gardner; see R.J.Hnatiuk, *Fl. Australia* 16: 363 (1995).

Hakea pyriformis (Gaertn.) Cav., *Icon.* 25: t. 536 (1800), as '*pyriformis*'

Banksia pyriformis Gaertn., *Fruct. Sem. Pl.* 220: t. 47, fig. 1 (1788); *Conchium pyriforme* (Gaertn.) Willd., *Enum. Pl.* 141 (1809). T: New Holland, 1770, *J.Banks & D.Solander s.n.*; holo: BM.

This is *Xylomelum pyriforme* (Gaertn.) Knight; see D.B.Foreman, *Fl. Australia* 16: 402 (1995).

Hakea rubricaulis Colla, *Hortus Ripul*. 63 (1824); *Hortus Ripul. Appendice* 1: 114, t. 3 (1824)

T: N. Holl: ... Hoc titula ab H. Cels. anno 1822 accepta; ?syn: MEL.

This is *Stenocarpus salignus* R.Br.; see D.B.Foreman, *Fl. Australia* 16: 368 (1995).

Hakea pilulifera Lindl., *Sketch. Veg. Swan R.* xxxvi (1840)

This is *Grevillea pilulifera* (Lindl.) Druce.

Trib. 7. BANKSIEAE

Proteaceae trib. *Banksieae* Rchb., *Consp*. 82 (1828)

Type: *Banksia* L.f.

Juvenile leaves usually simple. Peduncles present or absent. Floral bracts present, rarely absent. Flowers usually zygomorphic, sometimes only slightly so, orientation various. Pollen presenter well developed. Hypogynous glands 3 or 4, free, usually ±elongated. Ovules 1 or 2, lateral or basal and anatropous. Fruit folliculate, often woody. Seeds 1 or 2. $n = 14$.

A tribe of four genera almost entirely confined to Australia, with one species extending to New Guinea and Aru Island.

SubTrib. 1. MUSGRAVEINAE

Proteaceae subtrib. *Musgraveinae* L.A.S.Johnson & B.G.Briggs, *Bot. J. Linn. Soc*. 70: 174 (1975)

Type: *Musgravea* F.Muell.

Inflorescence lax, raceme-like or panicle-like. Peduncles present. Hypogynous glands 3. False dissepiment scarcely formed between seeds.

A subtribe of two genera endemic in rainforest in north-eastern Qld.

43. MUSGRAVEA

B.P.M.Hyland[1]

Musgravea F.Muell., *Proc. Linn. Soc. New South Wales* Ser. 2, 5: 186 (1890); named after Sir Anthony Musgrave, Governor of Queensland (1883–1888).

Type: *M. stenostachya* F.Muell.

Trees. Leaves alternate. Conflorescence raceme-like or paniculately branched, ±erect, terminal and axillary. Flowers bisexual or male, slightly zygomorphic, paired, sessile on a common peduncle; common and floral bracts present at anthesis. Tepals valvate, coiled and reflexed at anthesis, dilated at apex, densely pubescent abaxially, sparsely so adaxially. Hypogynous glands 3, linear-subulate. Stamens 4; anthers bilocular, basifixed, dehiscing by longitudinal slits. Ovary sessile; ovules 1 or 2; style linear, subulate; pollen presenter filiform to cylindrical-clavate; stigmatic surface terminal. Fruit a 1- or 2-seeded follicle. Seeds flat, elliptic-ovate, with a marginal wing. $n = 14$; L.A.S.Johnson & B.G.Briggs, *Austral. J. Bot*. 11: 24 (1963).

A genus of two species confined to north-eastern Qld.

[1] Tropical Forest Research Centre, Australian National Herbarium, CSIRO, PO Box 780, Atherton, Queensland 4883.

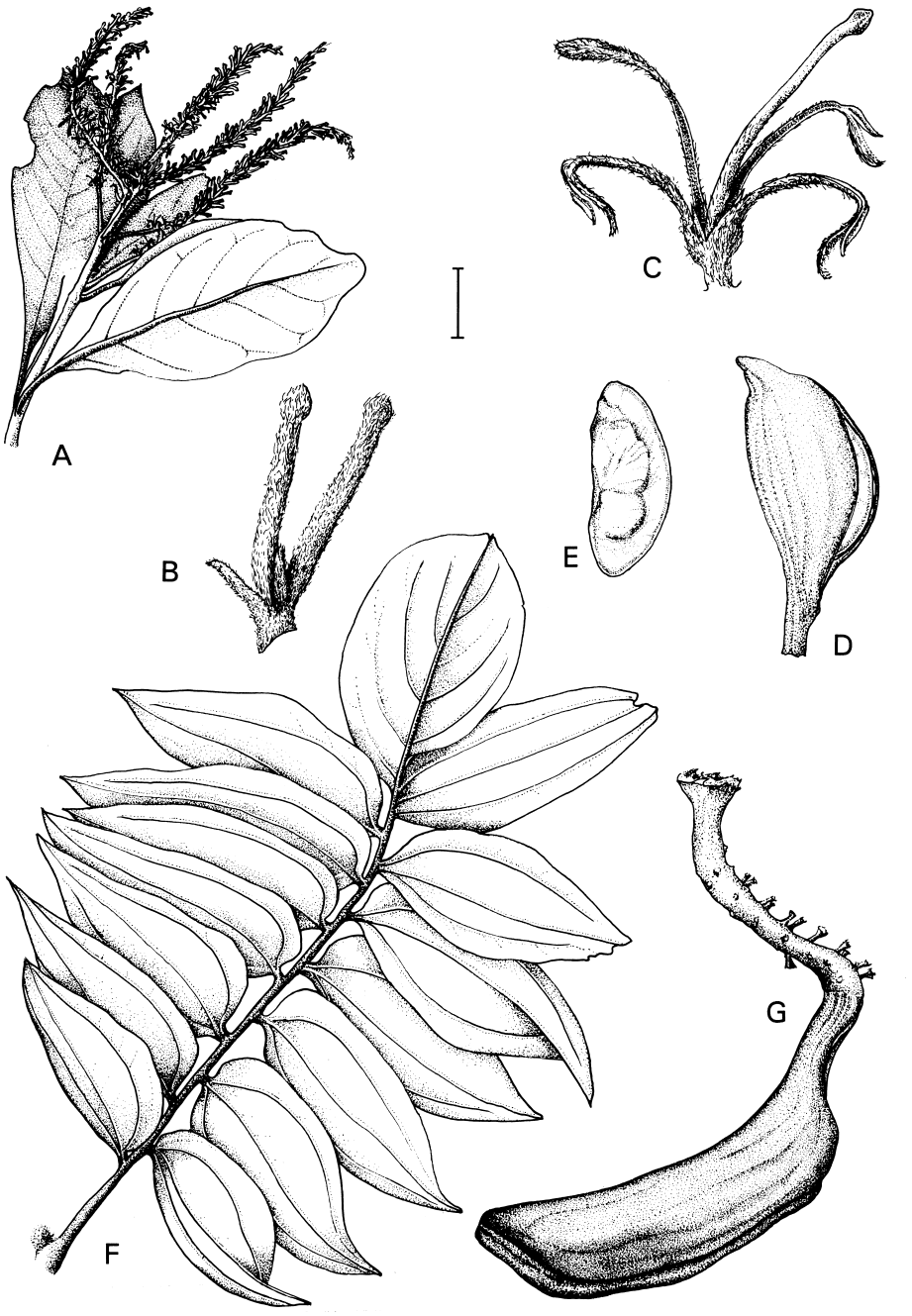

Figure 23. **A–E**, *Musgravea stenocarpa*. **A**, flowering branchlet; **B**, inflorescence showing pair of buds and bracteoles; **C**, flower (**A–C**, B.Hyland 11435, CANB); **D**, fruit; **E**, seed (**D–E**, B.Hyland 7910, CANB). **F–G**, *Austromuellera trinervia*. **F**, leaf; **G**, fruit (**F–G**, L.S.Smith 10159, CANB). Scale bar: **A** = 2 cm; **B** = 2 mm; **C** = 1 mm; **D–G** = 1 cm. Drawn by D.Boyer.

F.M.Bailey, *Queensland Fl.* 4: 1353 (1901); W.D.Francis, *Austral. Rain-forest Trees* 4th edn, 394 (1982); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 460–462 (1989).

Conflorescence more than 12 cm long; fruits 7.5–8.5 cm long	**1. M. heterophylla**
Conflorescence less than 12 cm long; fruits 4.4–7 cm long	**2. M. stenostachya**

1. Musgravea heterophylla L.S.Smith, *Contr. Queensland Herb.* 6: 12 (1969)

T: c. 1 mile [1.6 km] WSW of Kuranda, Qld, Mar. 1961, *S.J.Dansie* AFO/2015; holo: BRI.

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 456 (1989).

Large tree, to 30 m tall. Leaves with petiole 1.5–4 cm long; lamina narrowly elliptic, 8–20 cm long, 3.5–7.5 cm wide, attenuate at base, entire, occasionally lobed, obtuse to acuminate, glabrous above except for midrib, densely appressed-pubescent below; veins 8–20 pairs. Conflorescence terminal and axillary, 14–21 cm long. Tepals 4–5 mm long, cream (brown towards apex). Anthers 0.5–0.6 mm long with mucro less than 0.1 mm long; filaments 0.1–0.2 mm long. Hypogynous glands 0.8–0.9 mm long. Ovary 0.7–0.8 mm long; style 3.5–4.5 mm long; pollen presenter filiform to narrowly clavate, 0.3–0.5 mm long. Fruits 7.5–8.5 cm long, 2.5–3.6 cm wide, ±ferruginous just prior to maturity. Seeds 7–7.5 cm long, 2–2.6 cm wide; wing 3–18 mm wide; embryo 3–4 cm long, 1–1.7 cm wide. *Briar Silky Oak, Briar Oak.*

Occurs between Cooktown and Tully, Qld, from near sea-level to about 1100 m. Flowers Mar.–Apr. Map 171.

Qld: Timber Reserve 176, Monkhouse, *B.P.M.Hyland 12126* (QRS); Mt Lewis, North Mary L.A., *T.Risley 86* (QRS); Natl Park Reserve 394, *B.Gray 2828* (QRS); Wyvuri Holding, *B.P.M.Hyland 6021* (QRS); Mission Beach, *F.Crome 339* (QRS).

2. Musgravea stenostachya F.Muell., *Proc. Linn. Soc. New South Wales* ser. 2, 5: 186 (1890)

T: Mt Bellenden Ker, Qld, June 1889, *W.Sayer*; lecto: MEL, *fide* L.S.Smith, *Contr. Queensland Herb.* 6: 11 (1969).

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 461 (1989).

Large tree to 20 m or more tall. Leaves with petiole 0.5–2 cm long; lamina narrowly elliptic, 5.5–10 cm long, 1.9–3.5 cm wide, attenuate at base, entire (even on seedling leaves), usually obtuse, occasionally acute, almost glabrous at maturity; veins 5–13 pairs. Conflorescence terminal and axillary, 4–8 cm long. Tepals 4–5 mm long, cream. Anthers 0.3–0.5 mm long with mucro less than 0.1 mm long; filaments c. 0.2 mm long. Hypogynous glands c. 0.5 mm long. Ovary 0.5–0.7 mm long; style 2.2–3.1 mm long; pollen presenter cylindrical-clavate, 0.2–0.3 mm long. Fruits 4.4–7 cm long, 2–3 cm wide, ±greyish-tomentose just prior to maturity. Seeds 5–6 cm long, 2–2.5 cm wide; wing c. 5–10 mm wide; embryo c. 3 cm long, 1.5 cm wide. *Crater Silky Oak, Grey Oak, Crater Oak.* Plate 33; Fig. 23A–E.

Occurs between Cooktown and Innisfail, Qld, at elevations ranging from 200–1500 m, but usually above 750 m. Flowers Dec.–Jan. Map 172.

Qld: Timber Reserve 145, Tableland L.A., *B.P.M.Hyland RFK3215* (QRS); Natl Park Reserve 164, Thornton Peak, *B.P.M.Hyland 7090* (QRS); State Forest Reserve 143, Riflemead, Carbine L.A., *B.Gray 4259* (QRS); State Forest Reserve 185, Robson L.A., *B.Gray 1231* (QRS); summit of Mt Bartle Frere, *M.Godwin C2873* (QRS).

44. AUSTROMUELLERA

B.P.M.Hyland[1]

Austromuellera C.T.White, *Bull. Misc. Inform. Kew* 1930: 234 (1930); named after the celebrated Australian botanist and explorer, Baron Ferdinand Jacob Heinrich von Mueller (1825–1896), Victorian Government Botanist (1857–1896).

Type: *A. trinervia* C.T.White

Trees. Leaves alternate. Conflorescence raceme-like, pendulous, axillary and borne on the branches. Flowers bisexual or male, slightly zygomorphic, shortly pedicellate on a common peduncle; common and floral bracts present at anthesis. Tepals valvate, coiled and reflexed at anthesis, dilated at apex, densely pubescent abaxially, glabrous adaxially. Hypogynous glands 3, turgid. Stamens 4; anthers bilocular, basifixed, dehiscing by longitudinal slits. Ovary sessile; ovules 1 or 2; style linear, subulate, scarcely swollen at apex; pollen presenter fusiform to clavate; stigmatic surface terminal. Fruit a 1- or 2-seeded follicle, ±green until maturity. Seeds flat, narrowly elliptic, with a marginal wing.

A genus of two species confined to north-eastern Qld.

J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 78–79 (1989).

Leaves imparipinnate; leaflet pairs more than 6; conflorescence 30–70 cm long; tepals 17–25 mm long **1. A. trinervia**

Leaves simple, occasionally trifoliate or pinnate, with c. 2 or 3 leaflet pairs; conflorescence 17–30 cm long; tepals 14–17 mm long **2. A. valida**

1. Austromuellera trinervia C.T.White, *Bull. Misc. Inform. Kew* 1930: 234 (1930)

T: Boonjie, Atherton Tableland, Qld, Jan. 1923, *C.T.White s.n.*; holo?: BRI.

Illustrations: C.White, *op. cit.* 234, t. VII; K.A.W.Williams, *Native Plants of Queensland* Vol. 2, 49 (1984); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 78, 84 (1989).

Tree to 10 m tall. Leaves to 50 cm long, imparipinnate, with more than 6 leaflet pairs; petiole 5–16 cm long; leaflets entire, acute to acuminate, ±glabrous at maturity; terminal leaflet 8–14.5 cm long, 3–7 cm wide, oblique at base, very unequal-sided, with 4–8 pairs of veins and petiolule 0–35 mm long; lateral leaflets 8–19 cm long, 1.5–5.5 cm wide, 3-veined, with petiolule 3–10 mm long. Conflorescence 30–70 cm long. Tepals 17–25 mm long, cream to brown. Anthers 1.7–2.4 mm long with mucro 0.1–0.3 mm long; filaments 0.5–1.3 mm long. Ovary 1–1.5 mm long; style 13–21 mm long; pollen presenter clavate, 1.2–2 mm long. Fruit 14–21 cm long, 5.5–6 cm wide. Seeds 13–16 cm long, 3.5–4.5 cm wide; embryo 4.5–6 cm long, 1.5–2 cm wide. n = 14; L.A.S.Johnson & B.G.Briggs, *Austral. J. Bot.* 11: 24 (1963). *Mueller's Silky Oak*. Plate 34; Fig. 23F, G.

Occurs in rainforest in two apparently discrete populations, one on the Atherton Tableland at 700–800 m near Mt Bartle Frere and the other N of the Daintree R. Qld. Flowers Nov.–Jan. Map 173.

Qld: Timber Reserve 146, Tableland L.A., *B.P.M.Hyland RFK3217* (QRS); Vacant Crown Land, Parish of Noah, near Oliver Ck, *B.P.M.Hyland 6619* (QRS); Butchers Ck–Topaz road, *R.Phelps 13* (QRS).

2. Austromuellera valida B.Hyland, *Fl. Australia* 17B: 396 (1999)

T: 1 mile [1.6 km] past E/P18, North Mary Logging Area, Qld, 7 Feb. 1974, *K.Sanderson 549*; holo: QRS.

Tree to 10 m tall. Leaves usually simple, sometimes trifoliate or pinnate, with c. 2 or 3 leaflet pairs, ±glabrous at maturity; petiole 4–10.5 cm long; lamina 9–12 cm long, 5–8 cm wide, rounded at base (oblique and unequal-sided only on lateral leaflets of compound leaves); margin smooth, penninerved; acute; veins 6–8 pairs. Conflorescence 17–30 cm long. Tepals 14–17 mm long, cream to rusty brown. Anthers 1.5–1.7 mm long with mucro c. 0.2 mm long;

[1] Tropical Forest Research Centre, Australian National Herbarium, CSIRO, PO Box 780, Atherton, Queensland 4883.

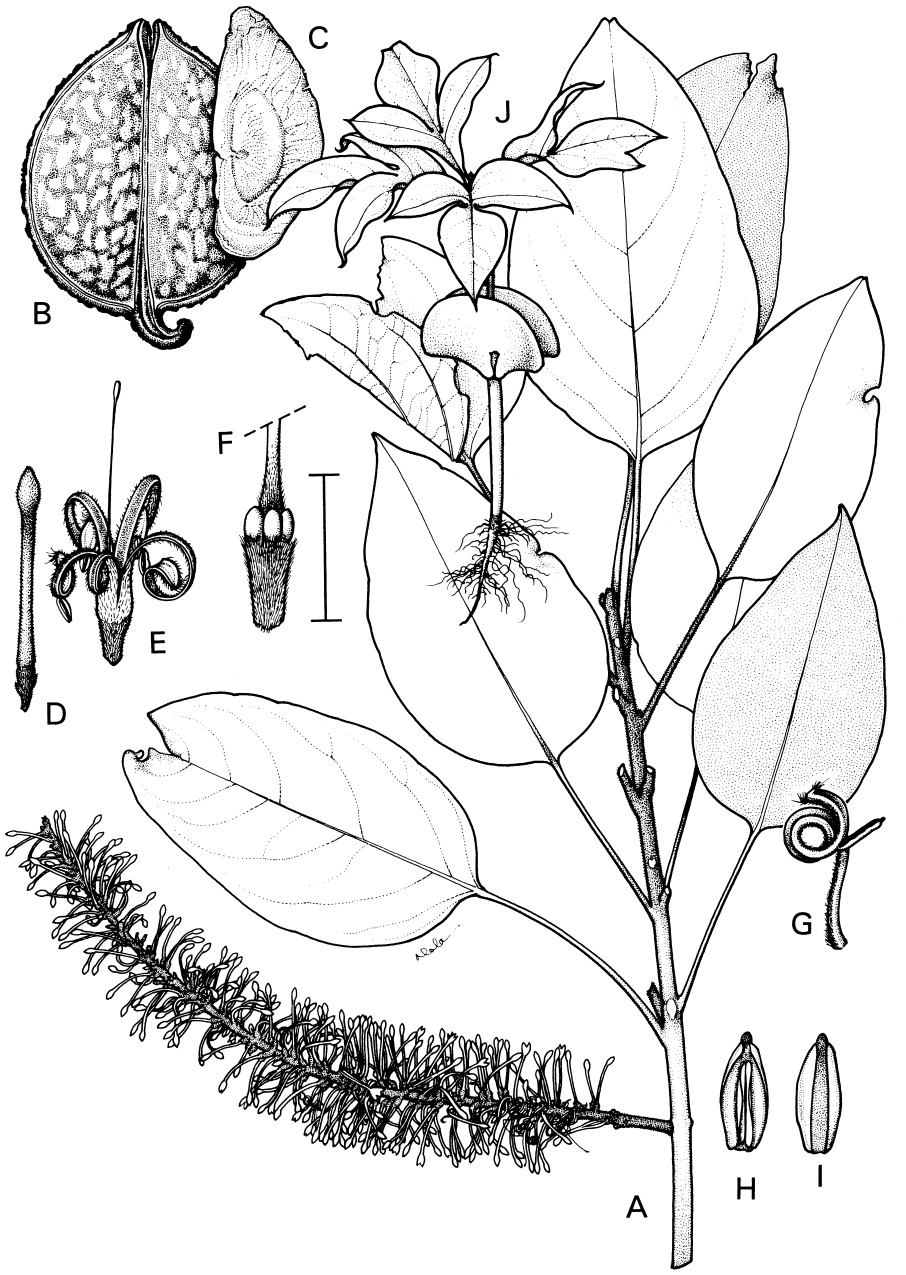

Figure 24. *Austromuellera valida*. **A**, habit (K.Sanderson 549, QRS); **B**, fruit; **C**, seed (**B–C**, B.Gray 824, QRS); **D**, flower bud; **E**, flower; **F**, ovary showing hypogynous glands at base; **G**, perianth segment; **H**, front view of anther; **I**, back view of anther (**D–I**, K.Sanderson 549, QRS); **J**, seedling (B.Gray 824, QRS). Scale bar: **A**, **J** = 4 cm; **B–C** = 6.5 mm; **D–E** = 11 mm; **F** = 5 mm; **G** = 4.5 mm; **H–I** = 2.5 mm. Drawn by T.Nolan.

filaments 0.2–0.4 mm long. Ovary 1–1.4 mm long; style 11–12.5 mm long; pollen presenter fusiform to almost clavate, 1.3–1.7 mm long. Fruit 10–15 cm long, 4–6 cm wide. Seeds 9–12 cm long, 4.5–5 cm wide; embryo 3.5–5.5 cm long, 2–3 cm wide. Fig. 24.

Occurs in rainforest in the Mt Lewis area, north-eastern Qld, at altitudes of 1000–1300 m. Flowers Jan.–Feb. Map 174.

Qld: State Forest Reserve 143, North Mary L.A., *B.Gray 2540* (QRS).

SubTrib. 2. BANKSIINAE

Proteaceae subtrib. *Banksiinae* L.A.S.Johnson & B.G.Briggs, *Bot. J. Linn. Soc*. 70: 174 (1975)

Type: *Banksia* L.f.

Inflorescence dense, cone-like or capitate. Peduncles absent. Hypogynous glands 4, sometimes obscure. False dissepiment, 1 or 2 layered, formed between seeds.

A subtribe of two genera, endemic in Australia, with the exception of one species of *Banksia* which extends to New Guinea and Aru Island.

45. BANKSIA

A.S.George[1]

Banksia L.f., *Suppl. Pl.* 15 (1782), *nom. cons. non* J.R.Forst. & G.Forst. (1775); named for Joseph Banks (1743–1820), first European collector of banksias (in 1770), patron of science and President of the Royal Society (1778–1820).

Type: *Banksia serrata* L.f.; lecto, *fide* T.A.Sprague, *Bull. Misc. Inform.* 98 (1940).

Isostylis (R.Br.) Spach, *Hist. Nat. Veg. Phan.* 10: 402 (1841); *Banksia* subg. *Isostylis* R.Br., *Prodr.* 396 (1810). T: based on *Banksia ilicifolia* but the combination not published in *Isostylis*.

Sirmuellera Kuntze, *Revis. Gen. Pl.* 2: 581 (1891), based on *Banksia* L.f. T: *S. serrata* (L.f.) Kuntze.

Trees or shrubs, some with prostrate stems. Leaves alternate, sometimes whorled. Flowers many in a dense cylindrical, ovoid or spherical inflorescence, in 3 species reduced and head-like, with a basal involucre of narrow, usually hairy bracts that commonly fall by anthesis; flowers in pairs, each flower subtended by a bract and each pair by a larger 'common bract'. Perianth of 4 ±equal tepals. Pistil usually wiry; pollen presenter scarcely delimited to markedly modified, commonly ribbed. Ovules 2. Fruit a woody follicle. Seeds 1 or 2, with an intermediary 2-winged plate of similar outline and size. Cotyledons with acute basal auricles.

A genus of 76 species endemic in Australia except *B. dentata* which also occurs on islands to the north; 60 species are endemic in south-western W.A.

As noted by George (1988), the correct date of publication for the name *Banksia* L.f. is April 1782, not 1781 as given by George (1981) and other authors. in the descriptions below, leaf characters refer to adult leaves. Overall follicle shape is described from a perspective directly above the follicle. The valves are then described in side view. Because the outline is given, plane shapes are used.

The infrageneric classification and systematic sequence presented here are modified from that of George (1981) and take into account new data revealed in the work of Thiele & Ladiges (1996). Series *Bauerinae* and ser. *Quercinae* are grouped with sect. *Coccinea* and all three placed next to sect. *Oncostylis*. *Banksia tricuspis* is placed in a new monotypic series. Within ser. *Salicinae*, *B. canei* and *B. saxicola* are now placed at the end, since I believe that, if we accept that *Banksia* had a tropical origin, their typically subalpine distribution indicates a

[1] 'Four Gables', 18 Barclay Road, Kardinya, Western Australia 6163.

recent origin. I believe that *B. dentata* is the most primitive extant species because of its relatively simple morphology and tropical habitat. From there my arrangement generally follows increasing diversity of form and tries to take account of distribution and habitat, although the straitjacket of a linear sequence cannot show a presumed real picture of the various lines evolving during the same time frame (a drawback also for presenting cladistic results).

Thiele & Ladiges (1996) proposed a classification based on subgenera, series and subseries, but I believe that, in subg. *Banksia*, it is more useful to recognise sections to distinguish the straight-styled from the hooked-styled species and, with the recent work of Maguire *et al*. (1996), accept *B. coccinea* at the same rank.

I disagree with Thiele & Ladiges' placement of a number of taxa, notably: placement of *B. elderiana* in ser. *Tetragonae*; placement of the four orange-styled species of my ser. *Crocinae* in subser. *Cratistylis*; with their allocation of species to subser. *Acclives* and *Integrifoliae* (*B. dentata* is clearly allied to *B. integrifolia*, not to the very distinctive *B. robur*); and in their recognition of subser. *Longistyles* which remains heterogeneous by inclusion of such diverse species as *B. violacea*, *B. tricuspis*, *B. pulchella* and *B. meisneri*.

I prefer to group the hooked-styled species (sect. *Oncostylis*) and not insert the straight-styled ser. *Quercinae* among them. Until further data tell us otherwise, I prefer a broader grouping than that offered by Thiele & Ladiges (1996). in their systematic sequence, the placement of subg. *Isostylis* at the beginning is due to its resemblance to the related genus *Dryandra*, but it may be argued just as validly that this subgenus is advanced and that *Dryandra* may have evolved from it; I believe that the resemblance of *Isostylis* to *Dryandra* may be more superficial than is now thought. Thiele & Ladiges then place a number of series early in their sequence as being related to or derived from subg. *Isostylis*, before placing ser. *Salicinae* (which I consider the most primitive extant group) well along the line. Apart from ser. *Quercinae* as mentioned above, the two systems then generally agree in placing the hooked-styled species after the straight-styled ones (except that my system places subg. *Isostylis* at the end).

R.Brown, *Trans. Linn. Soc. London* 10: 202–211 (1810); R.Brown, *Prodr.* 391–396 (1810); R.Brown, *Suppl. Prodr. Fl. Nov. Holl.* 34–37 (1830); C.D.F.Meisner, in A.L.P.P. de Candolle, *Prodr.* 14: 451–467 (1856); G.Bentham, *Fl. Austral.* 5: 541–562 (1870); A.S.George, The genus *Banksia* L.f. (Proteaceae), *Nuytsia* 3: 239–474 (1981); A.S.George, New taxa and notes on *Banksia* L.f. (Proteaceae), *Nuytsia* 6: 309–317 (1988); A.S.George, Notes on *Banksia* L.f. (Proteaceae), *Nuytsia* 11: 21–24 (1996); A.S.George, *The Banksia Book* (1984, 2nd edn 1987, 3rd edn 1996); C.E.Rosser & A.S.George, *Banksias* vol. I (1981), vol. II (1988), vol. III (in press); A.Taylor & S.Hopper, *The Banksia Atlas* (1988); M.Sedgley, M.Sierp, M.A.Wallwork, A.M.Fuss & K.Thiele, Pollen presenter and pollen morphology of *Banksia* L.f. (Proteaceae), *Austral. J. Bot.* 41: 439–464 (1993); K.R.Thiele & P.Y.Ladiges, A cladistic analysis of *Banksia* (Proteaceae), *Austral. Syst. Bot.* 9: 661–733 (1996); T.L.Maguire, M.Sedgley & J.G.Conran, *Banksia* sect. *Coccinea* (Proteaceae), a new section, *Austral. Syst. Bot.* 9: 887–891 (1996); A.R.Mast, Molecular systematics of subtribe Banksiinae (*Banksia* and *Dryandra*; Proteaceae) based on cpDNA and nrDNA sequence data: implications for taxonomy and biogeography, *Austral. Syst. Bot.* 11: 321–342 (1998).

KEY TO INFRAGENERIC TAXA

1	Inflorescence head-like, containing up to c. 100 flowers; axis ovoid, less than 1 cm long; perianth opening widely along adaxial suture, the other sutures not splitting or only very shortly so below limb; valves of follicles in side view obliquely ovate	subg. 2. **Isostylis** (p. 247)
1:	Inflorescence cylindrical, ovoid or spherical, containing 200–5000 flowers; axis to 30 cm long, commonly more than 2 cm; perianth in most species opening ±equally and deeply between all tepals; valves of follicles in side view commonly semi-elliptic, semi-circular or oblong, rarely obliquely ovate	subg. 1. **Banksia** (p. 184)
2	Pistil after anthesis straight or gently curved, in some species kinked or sigmoid but the pollen presenter always erect; leaves usually flat but often with recurved margins	sect. 1. **Banksia** (p. 184)
3	Pistil before anthesis straight, or curved and then with pollen presenter vertical; pollen oblong or crescentic	
4	Follicle not beaked after opening	
5	Tepals awned	ser. 9. **Quercinae** (p. 225)
5:	Tepals not awned	
6	Leaves entire, dentate or serrate; seed obovate, less than 20 mm long	ser. 1. **Salicinae** (p. 185)
6:	Leaves deeply triangular-lobed; seed cuneate, 20–40 mm long	ser. 2. **Grandes** (p. 195)
4:	Follicle with a lateral beak after opening	
7	Tepals awned	ser. 8. **Bauerinae** (p. 225)
7:	Tepals not awned	
8	Plant with prostrate, commonly underground stems	ser. 5. **Prostratae** (p. 207)
8:	Plant erect or spreading with aerial stems	
9	Inflorescence pendulous; perianth glabrous; pistil not laterally exserted between tepals before anthesis; tepals separating around pollen presenter but not immediately relaxing at anthesis; pollen presenter 4–8 mm long, muricate	ser. 7. **Tetragonae** (p. 222)
9:	Inflorescence erect (pendulous in *B. elderiana*); perianth hairy at least in part; pistil usually laterally exserted between tepals before anthesis; tepals usually relaxed after anthesis; pollen presenter commonly less than 3 mm long, rarely to 5 mm	
10	Perianth and pistil orange; perianth white-villous outside	ser. 4. **Crocinae** (p. 203)
10:	Perianth and pistil other colours, if orange then perianth not white-villous outside	
11	Pollen presenter usually fusiform with a basal swelling, if not then small and ovoid; perianth robust; pistil hairy or papillose, prominently curved before anthesis	ser. 3. **Banksia** (p. 197)
11:	Pollen presenter only slightly thickened, without a basal swelling; perianth slender; pistil glabrous, rarely hirsute, straight or gently curved before anthesis	ser. 6. **Cyrtostylis** (p. 214)
3:	Pistil strongly and horizontally twisted so that the pollen presenter is horizontal, with upper part of style prominently curved before anthesis, afterwards straightened; pollen elongate-cylindrical	sect. 2. **Coccinea** (p. 227)
2:	Pistil after anthesis clearly hooked below pollen presenter; leaves commonly narrowly linear with strongly recurved or revolute margins	sect. 3. **Oncostylis** (p. 229)
12	Inflorescence cylindrical; axis usually 8–20 cm long	

13 Inflorescence sessile at apex of annual increment, subtended by whorl of branchlets; buds retaining regular pattern during development; perianth limb horizontal before anthesis; follicle mesocarp hard — ser. 10. **Spicigerae** (p. 229)

13: Inflorescence on short lateral branchlet; buds losing regular pattern during development; perianth limb vertical before anthesis; follicle mesocarp spongy — ser. 11. **Tricuspidae** (p. 235)

12: Inflorescence spherical or ovoid; axis usually 2–10 cm long

14 Leaves pinnatipartite — ser. 12. **Dryandroideae** (p. 237)

14: Leaves linear, entire — ser. 13. **Abietinae** (p. 238)

KEY TO SPECIES

1 Style after anthesis hooked just below apex

2 Inflorescence cylindrical; axis 6–20 cm long

3 Leaves pinnatipartite — **58. B. brownii**

3: Leaves entire or dentate

4 Leaves narrowly linear with revolute margins, entire or shortly dentate towards apex

5 Leaves 9–20 mm long — **53. B. ericifolia**

5: Leaves 3–13 cm long

6 Leaves entire except an obtuse tooth each side of apical mucro; flowers soon falling; follicles 8–16 mm high — **59. B. tricuspis**

6: Leaves usually spinulose to serrate or dentate at least along upper margins; flowers persistent or soon falling; follicles 3–7 mm high

7 Leaves alternate; perianth 23–29 mm long; follicles flattened or rounded along suture (eastern Australia) — **52. B. spinulosa**

7: Leaves in whorls; perianth 13–18 mm long; follicles ±acute along suture (W.A.) — **57. B. occidentalis**

4: Leaves broadly linear, oblong or narrowly elliptic with flat to recurved margins

8 Leaves elliptic, entire, leathery — **54. B. verticillata**

8: Leaves linear or oblong, usually dentate to some extent, not leathery

9 Leaves linear with recurved margins

10 Leaves 10–23 cm long; perianth 25–27 mm long; style yellow — **56. B. littoralis**

10: Leaves 4–13 cm long; perianth 17–18 mm long; style metallic red — **57. B. occidentalis**

9: Leaves broadly linear to oblong, with recurved or almost flat margins

11 Perianth limb pubescent (eastern Australia) — **52. B. spinulosa**

11: Perianth limb glabrous (W.A.) — **55. B. seminuda**

2: Inflorescence spherical or ovoid; axis 2–6 cm long

12 Leaves with many triangular lobes; pistil 14–15 mm long — **60. B. dryandroides**

12: Leaves entire; pistil more than 16 mm long

13 Flowers opening from base of spike upwards; inflorescence pendulous — **73. B. nutans**

13: Flowers opening from apex of spike downwards; inflorescence erect

14 Leaves pubescent above, becoming scabrid — **67. B. scabrella**

14: Leaves smooth when mature

15 Perianth glabrous inside

16 Perianth 17–25 mm long; pollen presenter ovoid

17 Leaves 1.5–2 mm wide; perianth limb mostly glabrous; follicles wide, ±flattened across top — **69. B. incana**

17: Leaves c. 0.8 mm wide; perianth limb pubescent all over; follicle valves with an enlarged, thin vertical ridge — **70. B. laricina**

16: Perianth 7–10 mm long; pollen presenter turbinate

18 Stems sparsely hirsute, soon glabrous; perianths soon falling — **71. B. pulchella**

18: Stems tomentose; perianths persistent for some years — **72. B. meisneri**

15: Perianth hairy inside

19 Perianth 17–27 mm long

20 Common bracts 7–8 mm long; perianth limb 4 mm long; follicles 4–7 mm wide, hirsute — **64. B. telmatiaea**

20: Common bracts 2.5–4 mm long; perianth limb 2–3 mm long; follicles 8–23 mm wide, ±flattened, closely pubescent becoming glabrous

21 Flowers pale yellow, the uppermost sometimes purplish; limb almost glabrous; follicles not sticky — **62. B. micrantha**

21: All flowers violet, sometimes green at base, rarely yellowish; limb pubescent; follicles ±sticky, at least when young — **68. B. violacea**

19: Perianth 30–55 mm long

22 Common and floral bracts white; new growth reddish pink — **66. B. lanata**

22: Common and floral bracts rusty brown; new growth rusty brown

23 Leaves commonly 1.8–2.8 mm wide — **63. B. grossa**

23: Leaves 1–1.5 mm wide (rarely wider)

24 Branchlets tomentose; leaves soft; common bracts 7–10 mm long; follicles commonly 6–10 mm long, with valves smooth but hirsute; lignotuber absent — **65. B. leptophylla**

24: Branchlets pubescent, soon glabrous; leaves ±stiff, pungent; common bracts 6–7 mm long; follicles 10–25 mm wide, with lateral shoulders, hirsute, glabrescent; lignotuber present — **61. B. sphaerocarpa**

1: Style remaining straight or gently curved, occasionally S-shaped below apex but pollen presenter always erect

25 Inflorescence head-like, the axis compressed-ovoid, 5–30 mm long

26 Leaves obovate to cuneate, acutely dentate, deep green above

27 Leaves 3–10 cm long; pistil 27–35 mm long — **74. B. ilicifolia**

27: Leaves 1–4 cm long; pistil 19–25 mm long

28 Leaves shining green above; flowers 20–35 per head — **75. B. oligantha**

28: Leaves dull green above; flowers 55–65 per head — **76. B. cuneata**

26: Leaves broadly linear, with many triangular dentate teeth, dull blue-green **43. B. elegans**

25: Inflorescence cylindrical or spherical, the axis elongate, usually more than 3 cm long

29 Tepals awned

30 Perianth 58–65 mm long; style kinked below apex **48. B. baueri**

30: Perianth 20–29 mm long; style not kinked

31 Perianth ferruginous; leaves ±regularly prominently serrate, undulate; follicles 4–6 mm wide **49. B. quercifolia**

31: Perianth pale mauve to pink; leaves entire to sparsely serrate, ±flat; follicles 10–18 mm wide **50. B. oreophila**

29: Tepals not awned

32 Style prominently S-shaped below apex **21. B. sceptrum**

32: Style straight or gently curved

33 Stems prostrate, rarely erect and then no more than 20 cm long

34 Leaves dentate

35 Mature leaves white-tomentose below; perianth pink or reddish with cream limb **31. B. petiolaris**

35: Mature leaves glabrous below except in stomatal pits; perianth ferruginous

36 Leaf teeth usually irregular; involucral bracts 2–4 cm long, long-hirsute **26. B. goodii**

36: Leaf teeth regular; involucral bracts 1–3 cm long, tomentose or shortly hirsute **27. B. gardneri**

34: Leaves pinnatipartite

37 Stems underground; leaf lobes ±cuneate, obtusely dentate **30. B. repens**

37: Stems on surface, rarely underground; leaf lobes triangular, oblong or linear, entire

38 Leaves bluish green; perianth 28–32 mm long, reddish pink; claws loosely pubescent with short curled hairs **29. B. blechnifolia**

38: Leaves deep or pale green; perianth 17–30 mm long, ferruginous, or cream and pink; claws hirsute with spreading hairs

39 Leaves divided ½–¾ of way to midrib; lobes 1–3 cm long (W.A., Collie to Ravensthorpe) **27. B. gardneri**

39: Leaves divided almost to midrib; lobes 3–8 cm long (W.A., Mogumber to Eneabba) **28. B. chamaephyton**

33: Stems erect or spreading, never all prostrate

40 Perianth glabrous

41 Inflorescence pendulous

42 Leaf lobes ±obtuse, 1–3 mm long **45. B. lemanniana**

42: Leaf lobes pungently acute, 4–10 mm long

43 Leaf margins ±recurved, with lobes 4–6 mm long with rounded sinuses; perianth deep pink to red in upper half **46. B. caleyi**

43: Leaf margins ±flat, with lobes 5–10 mm long with angular sinuses; perianth reddish pink in lower half, grading to cream, including limb **47. B. aculeata**

41: Inflorescence erect

44 Leaves cuneate, 2–6 cm long, with a few obtuse teeth; perianth red-maroon where exposed, otherwise pale greenish yellow — **33. B. praemorsa**

44: Leaves broadly linear, 6–10 cm long, with many teeth; perianth yellow

45 Perianth 15–22 mm long; styles curled against axis after flowering — **36. B. attenuata**

45: Perianth 35–43 mm long; styles remaining erect from axis, wiry — **44. B. lindleyana**

40: Perianth hairy at least on claws

46 Style hairy at least in lowest third

47 Pistil 23–35 mm long

48 Inflorescence pendulous — **41. B. elderiana**

48: Inflorescence erect

49 Perianth pubescent outside, glabrous inside; follicles smooth, 2.5–5 cm high; leaves 15–40 cm long with flat margins — **20. B. candolleana**

49: Perianth hirsute both sides; follicles warted, 15–20 mm high; leaves 5–16 cm long with recurved margins — **35. B. pilostylis**

47: Pistil 40–50 mm long

50 Leaves with 4–7 lobes each side of midrib; margins flat — **17. B. baxteri**

50: Leaves with 15–30 lobes each side of midrib; margins recurved — **18. B. speciosa**

46: Style glabrous or papillose (excluding any hairs on ovary)

51 Leaves 4–10 cm wide, rarely narrower

52 Leaves shortly dentate with many teeth

53 Leaves broadly oblong, cordate or obcordate, 3–9 cm long; perianth 30–32 mm long, villous outside; style scarlet, rarely orange or dark red; follicles 1–2 mm high — **51. B. coccinea**

53: Leaves narrowly obovate or elliptic, 9–30 cm long; perianth 22–32 mm long, closely pubescent; style yellow or cream; follicles 3–8 mm high

54 Leaves undulate, white-tomentose below, with teeth ±irregular and 5–10 mm long; follicles opening within a year; (northern Australia) — **1. B. dentata**

54: Leaves ±flat, pale green-tomentose below, with teeth ±regular and 2–3 mm long; follicles remaining closed for several years or until burnt (Atherton to Wollongong) — **6. B. robur**

52: Leaves with large, triangular lobes

55 Leaf lobes rounded; perianth brownish purple — **13. B. solandri**

55: Leaf lobes angular; perianth pale yellow or orange

56 Leaves 3–11 cm wide, pinnatisect with 8–12 lobes each side; perianth pale yellow; limb glabrous; follicles scarcely exserted from massive cone; old flowers soon falling — **12. B. grandis**

56: Leaves 2.5–4 cm wide, pinnatipartite with 16–20 lobes each side; perianth orange, tomentose throughout; follicles exserted from axis but hidden by persistent old flowers — **25. B. victoriae**

51: Leaves commonly less than 3 cm wide

57 Perianth white- or pink-villous, orange inside; style orange

58 Leaves dentate, with teeth 1–2 mm long — **23. B. burdettii**

58: Leaves triangular-lobed, with lobes 2–15 mm long

59 Leaves ascending, 6–16 cm long, 5–12 mm wide — **24. B. hookeriana**

59: Leaves spreading, 15–27 cm long, 10–40 mm wide

60 Leaf lobes 2–5 mm long; new leaves and involucral bracts pubescent to hirsute; old flowers soon falling — **22. B. prionotes**

60: Leaf lobes 10–15 mm long; new leaves and involucral bracts woolly; old flowers persistent in fruit — **25. B. victoriae**

57: Perianth pubescent, silky or hirsute, or if villous then not white or pink; style variously coloured

61 Leaves usually entire

62 Leaves alternate

63 Leaves pungent, 2–5 cm long; follicles villous, glabrescent, most remaining closed for several years — **10. B. canei**

63: Leaves acute to truncate or emarginate, 1.5–20 cm long; follicles closely tomentose or loosely hirsute, commonly opening when mature

64 Leaves narrowly elliptic, narrowly obovate or lanceolate, 10–20 cm long, acute or obtuse; perianth 22–29 mm long (Qld)

65 New growth pale rusty-pubescent; leaves with a row of short, stiff brown hairs each side of abaxial midrib; flowers pale yellow; follicles erect, 8–12 mm long (Townsville to Cooktown) — **2. B. aquilonia**

65: New growth red-velvety; leaves without short, stiff brown hairs each side of abaxial midrib; flowers commonly pale blue-grey to mauve in late bud, dull yellow after anthesis; follicles turned upwards, 12–16 mm long (Hinchinbrook Is. and adjacent mainland) — **4. B. plagiocarpa**

64: Leaves linear, oblong or narrowly cuneate, 3–6 cm long, commonly truncate or emarginate, sometimes obtuse, rarely acute; perianth 16–24 mm long (S.A., N.S.W., Vic., Tas.) — **9. B. marginata**

62: Leaves whorled

66 Involucral bracts 10–20 mm long; perianths persistent in fruit (south-eastern Qld and adjacent N.S.W.) — **7. B. conferta**

66: Involucral bracts 2–10 mm long; perianths soon falling

67 Perianth 19–22 mm long; follicles remaining closed for several years, with lip 2–3 mm wide (Vic., The Grampians and Wilsons Promontory) — **11. B. saxicola**

67: Perianth 22–25 mm long; follicles opening within a year or so of anthesis, with lip 0.5–1.5 mm wide (widespread, eastern Australia from Mackay to Melbourne) — **3. B. integrifolia**

61: Leaves usually serrate or lobed

68 Flowers orange

69 Leaves 2–7 cm long; perianth limb densely hirsute **39. B. audax**

69: Leaves 10–30 cm long; perianth limb pubescent

70 Leaves 5–10 mm wide; lobes separated by shallow sinuses parallel to midrib; perianth pubescent outside, 20–24 mm long (W.A., Mullewa to Kulja) **38. B. benthamiana**

70: Leaves 20–40 mm wide; lobes triangular with V- or U-shaped sinuses; perianth 26–34 mm long (North West Cape to Mullewa) **37. B. ashbyi**

68: Flowers other colours, not orange

71 Perianth 29–45 mm long

72 Perianth limb glabrous; follicles ±rugose

73 Inflorescence ±spherical; pistil straight; old flowers falling; follicles rare **43. B. elegans**

73: Inflorescence cylindrical; pistil curved; old flowers persistent; follicles many

74 Perianth 32–38 mm long; limb 3–4 mm long; pollen presenter c. 0.75 mm long; common and floral bracts brown **32. B. media**

74: Perianth 40–44 mm long; limb 4.5–5.5 mm long; pollen presenter 1.5–1.8 mm long; common and floral bracts green **34. B. epica**

72: Perianth limb pubescent, silky, hirsute or tomentose; follicles not rugose

75 At least some leaves more than 25 cm long, with widely spaced teeth (S & E of Southern Cross) **40. B. lullfitzii**

75: Leaves not or rarely more than 20 cm long, with closely spaced teeth

76 Leaves oblong, shallowly dentate; flowers various shades of red or pink, sometimes yellow or brown, soon falling; follicles mottled (W.A.) **19. B. menziesii**

76: Leaves narrowly elliptic to obovate, serrate; flowers creamy grey or greenish cream, persistent; follicles not mottled (eastern Australia)

77 Most leaves 3–10 cm long; perianth 30–35 mm long including limb of 3–4 mm (S.A., western Vic.) **16. B. ornata**

77: Leaves commonly 10–20 cm long; perianth 35–45 mm long including limb of 5–8 mm (south-eastern Qld to eastern Vic.)

78 Leaves commonly 2–4 cm wide; pollen presenter fusiform with thickened base, 2–3 mm long **14. B. serrata**

78: Leaves commonly 1–2 cm wide; pollen presenter clavate-conical, 1 mm long **15. B. aemula**

71: Perianth 15–26 mm long

79 Leaf margins recurved; inflorescence cylindrical (eastern Australia; *B. canei* rarely naturalised in W.A.)

80 Leaves obovate, narrowly obovate, oblong, elliptic or lanceolate

81 Flowers openly arranged in inflorescence; perianth 15–18 mm long — **8. B. paludosa**

81: Flowers closely arranged in inflorescence; perianth 20–26 mm long

82 Leaves whorled; branchlets villous, glabrescent within a year; common bracts penicillate (Blue Mtns) — **7. B. conferta**

82: Leaves alternate; branchlets remaining closely tomentose for 2–3 years; common bracts not penicillate

83 Leaves lanceolate to narrowly obovate, coarsely lobed to entire; follicles upturned; valves obliquely triangular (Qld, Hinchinbrook Is. and adjacent mainland) — **4. B. plagiocarpa**

83: Leaves oblong to obovate-oblong, commonly all finely serrate; follicles erect; valves semicircular (Bundaberg, Qld, to Ulladulla, N.S.W.) — **5. B. oblongifolia**

80: Leaves linear to narrowly oblong

84 Leaves pungent; perianths soon falling; most follicles remaining closed for several years — **10. B. canei**

84: Leaves truncate to acute; perianths commonly persistent; follicles usually opening within a year of anthesis — **9. B. marginata**

79: Leaf margins ±flat; inflorescence spherical (W.A.) — **42. B. laevigata**

Subg. 1. BANKSIA

Banksia L.f. subg. **Banksia**

Eubanksia Endl., *Gen. Pl*. Suppl. 4, 2: 88 (1847); *Banksia* sect. *Eubanksia* (Endl.) Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 452 (1856), *nom. inval*.

Stems sympodial or monopodial and then lateral buds below inflorescence suppressed. Inflorescence cylindrical, ovoid or appearing spherical; axis cylindrical, rarely ovoid, 2–30 cm long, rarely shorter; flowers c. 200 to c. 5000 per inflorescence. Tepals typically all separating to basal tube. Follicle valves semi-elliptic, semi-circular or oblong, rarely (*B. elegans*) obliquely ovoid.

By far the larger subgenus, with 73 species in three sections.

Sect. 1. Banksia

Banksia L.f. sect. **Banksia**

Leaves flat, rarely channelled below; margins recurved or flat. Development of inflorescence usually acropetal. Pistil straight or curved, or in some taxa kinked or S-shaped below apex, never hooked; pollen presenter erect; pollen ovoid, crescent-shaped or cylindrical. Follicles with or without a split from stylar point. Cotyledons commonly broadly obovate or cuneate, sometimes emarginate or crenulate.

A section of nine series and 50 species, occurring throughout the geographic range of the genus.

Ser. 1. Salicinae

Banksia ser. **Salicinae** Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 454 (1856)

Type: *B. integrifolia* L.f.; lecto, *fide* A.S.George, *Nuytsia* 3: 274 (1981).

Banksia subser. *Acclives* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot*. 9: 721 (1996). T: *B. dentata* L.f.

Banksia subser. *Integrifoliae* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *loc. cit*. T: *B. integrifolia* L.f.

Shrubs or trees, erect or spreading. Leaves alternate or whorled, entire, dentate or serrate; margins flat or recurved. Inflorescence erect, cylindrical; buds usually losing their regular pattern well before anthesis. Involucral bracts slender, tomentose or villous, commonly falling before anthesis. Perianth closely pubescent or hirsute; tepals not awned. Pistil straight, or very gently curved; pollen presenter scarcely thickened; pollen ovoid. Follicles not split from stylar point. Seed wing not notched.

A series of 11 species of eastern and northern Australia, with one species extending to New Guinea and the Aru Isles.

1. Banksia dentata L.f., *Suppl. Pl.* 127 (1782)

Sirmuellera dentata (L.f.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891); *Isostylis dentata* (L.f.) Britten, in J.Banks & D.Solander, *Ill. Austral. Pl. Cook's Voy.* 3: 84 (1905). T: Endeavour R., [Qld], June–July 1770, *J.Banks & D.Solander*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 275 (1981); isolecto: B, BM, MEL, NSW.

Banksia procumbens Dum.-Cours., *Bot. Cult*. 2nd edn, 7: 107 (1814), *nom. inval.* — in synonymy under *B. dentata*.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 4 (1981); A.S.George, *Banksia Book* 47, 48, fig. 1, pl. 18 (1984).

Tree to 7 m tall, fire tolerant. Bark roughly tessellated. Stems tomentose, at length glabrescent. Leaves alternate, scattered; petiole 5–10 mm long; lamina undulate, narrowly obovate, 9–22 cm long, 2–9 cm wide, acute; margins slightly recurved, irregularly dentate; upper surface velvety, glabrescent; lower surface closely white-tomentose. Inflorescence 5–15 cm long; involucral bracts narrowly triangular to subulate on thick base, tomentose, persistent. Flowers cream to pale yellow, including style. Perianth 25–32 mm long including limb of 5 mm, closely pubescent to hirsute outside, sparsely hirsute inside above middle. Pistil slightly recurved, 31–46 mm long, glabrous; pollen presenter 1 mm long, scarcely distinguishable from style. Old flowers soon falling. Follicles commonly 30–60 but sometimes to 100, narrowly elliptic, 15–20 mm long, 4–8 mm high; valves semi-elliptic, smooth, velvety, glabrescent. Seed obovate, 18–21 mm long; seed body obliquely obovate, 10–12 mm long, 5–8 mm wide. *Tropical Banksia.*

In Australia, from Bedford Downs and the Isdell Ra., W.A., through the 'Top End' of the N.T. to Cape York Peninsula, Qld, extending south to the Bloomfield R.; apparently absent south of the Gulf of Carpentaria. Also in Papua New Guinea, Irian Jaya and the Aru Is. Usually on seasonally moist sandy flats, sometimes among sandstone or quartzite rocks, in woodland; sometimes by creeks and in gorges. Flowers Nov.–June. Map 175.

W.A.: 79 km N of Drysdale Stn, *D.E.Symon 7100* (AD, PERTH). N.T.: Black Jungle, near Darwin, Mar. 1956, *N.G.Eddy* (DNA); Little Lagoon, Groote Eylandt, *R.L.Specht 214* (BRI, PERTH). Qld: Horn Is., Torres Strait, *E.Cameron 2126* (QRS); NE of Iron Ra., 12 Apr. 1944, *H.Flecker* (BRI, JCT).

This is the only species of *Banksia* that occurs naturally outside Australia. Follicles opening within a year.

2. Banksia aquilonia (A.S.George) A.S.George, *Nuytsia* 11: 22 (1996)

Banksia integrifolia var. *aquilonia* A.S.George, *Nuytsia* 3: 283 (1981); *B. integrifolia* subsp. *aquilonia* (A.S.George) K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot*. 7: 406 (1994). T: Crystal Creek Natl Park, S of Ingham, Qld, 12 Apr. 1975, *A.S.George 12973*; holo: BRI; iso: CANB, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 3rd edn, 52, 53, fig. 2C, pl. 21 (1996); C.E.Rosser & A.S.George, *Banksias* III: pl. 76 (in press).

Tall shrub or tree to 8 m tall, fire tolerant. Bark hard, fissured, grey. Stems pale rusty-pubescent, glabrescent. Leaves alternate, often crowded; petiole 5–12 mm long; lamina narrowly elliptic, 5–20 cm long, 6–12 mm wide, acute; margins slightly recurved, entire; upper surface glossy; lower surface pale, with a row of short, stiff brown hairs each side of midrib. Inflorescence 6–10 cm long; involucral bracts ovoid to linear, to 5 mm long, persistent until flowering, ferruginous-velvety. Flowers pale yellow, including styles. Perianth 25–29 mm long including limb of c. 4 mm, closely pubescent outside, glabrous inside. Pistil straight or slightly curved, 30–34 mm long, glabrous; pollen presenter scarcely thickened. Old flowers soon falling. Follicles up to c. 50, narrowly elliptic, 8–12 mm long, 5–9 mm high, 4–5 mm wide; valves semi-elliptic, smooth, tomentose, glabrescent. Seed obovate, 14–16 mm long; seed body cuneate, 8–10 mm long, 2–3 mm wide.

Occurs in northern Qld, in coastal and montane areas from Mt Finnigan Natl Park to the Paluma Ra. and on Hinchinbrook Is. Usually on hillsides but also on creek banks and flats; in sand, usually granitic, in woodland and forest. Flowers Mar.–June. Map 176.

Qld: Mareeba, *L.K.Bates 122* (BRI); Windin Ck, Windin L.A., *A.W.Dockrill 77* (BRI, QRS); 26 km N of Cardwell, *A.S.George 12981* (BRI, PERTH); Little Ramsay Bay, Hinchinbrook Is., *P.Sharpe 1591* (BRI); Mt Spurgeon, *C.T.White 10692* (BRI).

Fire-tolerant, sprouting by epicormic shoots. New growth pale brown. Differs from *B. integrifolia* in its scattered, narrowly obovate to lanceolate acute leaves 5–20 cm long and 6–12 mm wide, which are glossy above and have a row of short, stiff brown hairs each side of the midrib abaxially. The follicles are typically larger than those of *B. integrifolia*, usually opening when mature.

3. Banksia integrifolia L.f., *Suppl. Pl.* 127 (1782)

Sirmuellera integrifolia (L.f.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891); *Isostylis integrifolia* (L.f.) Britten, in J.Banks & D.Solander, *Illustr. Austral. Pl. Cook's Voy.* 3: 83 (1905). T: Botany Bay, [N.S.W.], Apr.–May 1770, *J.Banks*; lecto: LINN 162.5, *fide* A.S.George, *Nuytsia* 3: 277 (1981); isolecto: B, BM, C, K, MEL, NSW, US.

Tree to 25 m tall, fire tolerant. Bark roughly tessellated. Stems pubescent and pilose, glabrescent, pale brown. Leaves in whorls of 3–5; petiole 4–10 mm long; lamina narrowly obovate to narrowly elliptic, 4–20 cm long, 10–26 mm wide, obtuse or emarginate; margins not or slightly recurved, entire; upper surface dull green, pubescent, glabrescent; lower surface closely white-woolly. Inflorescence 5–12 cm long; involucral bracts 2–10 mm long, tomentose. Flowers pale yellow, including styles. Perianth 22–25 mm long including limb of 3.5–4.5 mm, closely pubescent outside, glabrous inside. Pistil straight or slightly curved, 27–32 mm long, glabrous; pollen presenter 0.5–1 mm long, scarcely thickened. Old flowers soon falling. Follicles up to c. 60, narrowly elliptic, 7–15 mm long, 3–10 mm high, 3–6 mm wide; valves semi-elliptic, smooth, tomentose, glabrescent. Seed obovate, 10–20 mm long; seed body ±cuneate, 6–10 mm long, ±smooth.

Widespread along the east coast and inland to the nearby mountains, from Proserpine, Qld, to Port Phillip Bay, Vic.

Follicles usually opening when mature, within a year of flowering. Related most closely to *B. aquilonia* from northern Qld which differs mainly in its scattered (or alternate) but crowded leaves, and to *B. dentata* which has large, alternate, dentate leaves and occurs across tropical Australia.

There are three subspecies.

1 Most adult leaves 17–26 mm wide

2 Most leaves 4–10 cm long, ±flat, dull green above — **3a.** subsp. **integrifolia**

2: Most leaves 10–20 cm long, ±undulate, shining green above — **3b.** subsp. **compar**

1: Most adult leaves 10–18 mm wide — **3c.** subsp. **monticola**

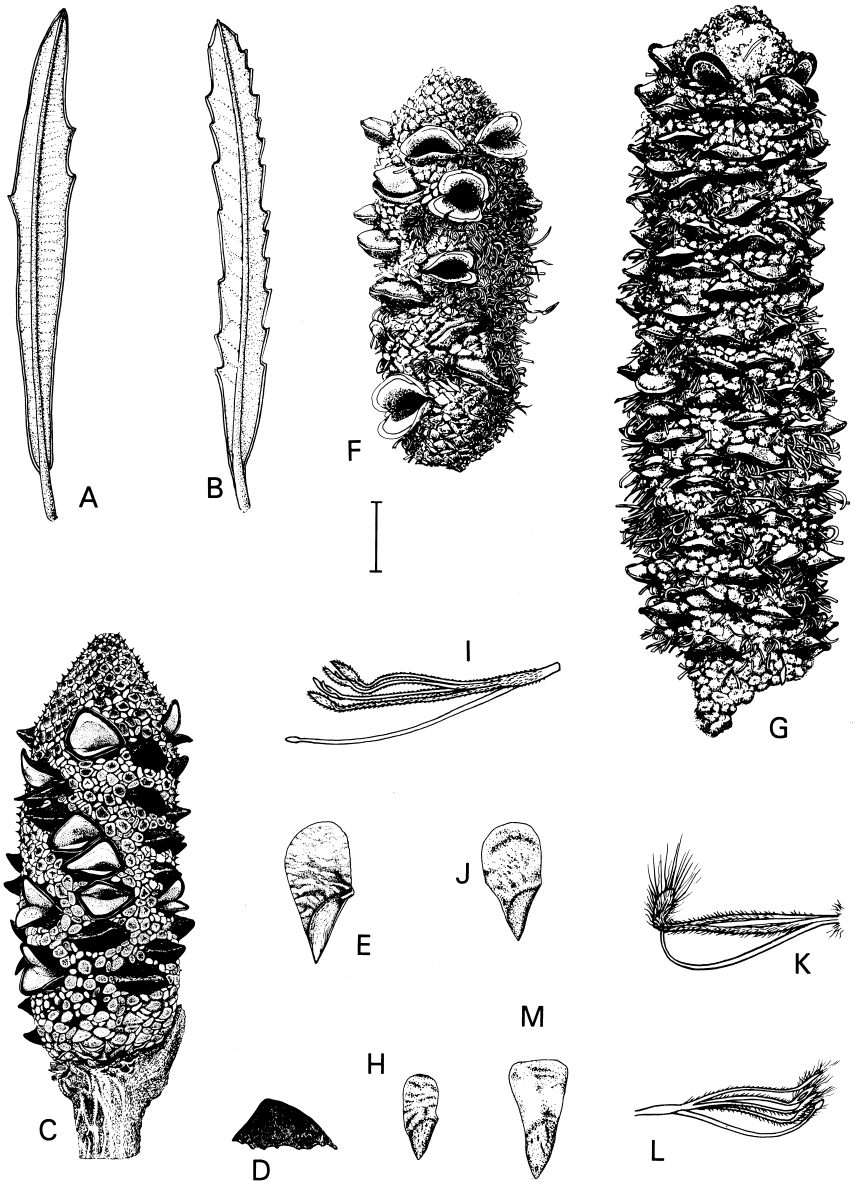

Figure 25. *Banksia*. **A–E**, *B. plagiocarpa*. **A–B**, leaves, adaxial face (**A–B**, I.Telford 9273, 9244, CANB); **C**, infructescence; **D**, detail of exserted part of follicle; **E**, seed, adaxial face (**C–E**, not recorded). **F**, *B. marginata*, infructescence (not recorded). **G–H**, *B. conferta* subsp. *penicillata*. **G**, infructescence (N of Clarence, N.S.W., A.George, PERTH); **H**, seed, adaxial face (A.George 14387, PERTH). **I**, *B. integrifolia* subsp. *integrifolia*, open flower (cult. Mount Barker, W.A.). **J**, *B. saxicola*, seed (not recorded). **K–M**, *B. solandri*. **K**, bud just before anthesis, **L**, open flower (**K–L**, cult. Mount Barker, W.A.); **M**, seed, adaxial face (not recorded). Scale bar: **A–B** = 2 cm; **C**, **I**, **K–L** = 7 mm; **D**, **H**, **M** = 1.3 cm; **E** = 1.6 mm; **F–G** = 7.5 mm; **J** = 1 cm. Drawn by: **A–B**, D.Boyer; **C–D**, B.Osborne; **F–G**, P.Nikulinsky; **I**, **K–L**, M.Wilson; **E**, **H**, **J**, **M**, A.George. **C**, **E**, **F**, **G**, **J**, **M**, reproduced with permission from *The Banksia Book* (1996).

3a. Banksia integrifolia L.f. subsp. **integrifolia**

Banksia spicata Gaertn., *Fruct. Sem. Pl.* 1: 221, t. 48 fig. 2 (1788). T: without details, presumably from Botany Bay, N.S.W., *collector unknown*; neo: TUB, *fide* A.S.George, *Nuytsia* 3: 280 (1981).

Banksia oleaefolia Cav., *Anales Hist. Nat.* 1: 228 (1800). T: near Port Jackson, N.S.W., Mar. 1793, *L.Née*; lecto: MA, *fide* A.S.George, *loc. cit*.

Banksia glauca Cav., *Anales Hist. Nat.* 1: 230 (1800). T: near Botany Bay, N.S.W., Mar. 1793, *L.Née*; lecto: MA, *fide* A.S.George, *loc. cit*.

Banksia integrifolia var. *major* R.Br. ex Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 457 (1856). T: Port Phillip, [Vic.], 1802, *R.Brown*; lecto: K, *fide* A.S.George, *loc. cit*.; isolecto: BM.

Banksia integrifolia var. *typica* Domin, *Biblioth. Bot*. 89: 44 (1921), *nom. illeg*.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 2 (1981); A.S.George, *op. cit*. 278, fig. 19E, F (1981); A.S.George, *Banksia Book* 3rd edn, 48, pl. 19 (1996).

Juvenile leaves cuneate, 3–6 cm long. Adult leaves narrowly obovate to narrowly elliptic, commonly 4–10 cm long, 17–25 mm wide, obtuse to cuneate, ±flat, dull green above. Perianth 22–25 mm long. Pistil 27–32 mm long. *Coast Banksia*. Fig. 25 I.

Wide Bay and Fraser Is., Qld, to Port Phillip Bay, Vic. Usually on coastal sand dunes and by inlets; common. Flowers mainly Jan.–July. Map 177.

Qld: near Freshwater Ck, Cooloola, 3 Oct. 1971, *A.G.Harrold* (BRI); Fraser Is., May 1964, *L.J.Webb & J.G.Tracey* (BRI). N.S.W.: Broulee Beach, c. 8 km NE of Moruya, *E.F.Constable NSW138179* (NSW); Wallaga L., N of Bermagui, *L.A.S.Johnson NSW138180* (NSW). Vic.: Waterloo Bay Beach, Wilsons Promontory, 13 Nov. 1908, *J.W.Audas & P.R.H.St John* (MEL).

Sprouts by epicormic shoots after fire. There is a record dated 1876 from King Is., Bass Strait, collected by *E.N.Spong* (MEL, NSW), but the species appears extinct there now. There is a 1968 record from Long Is. in the Hogan Group, Bass Strait, collected by *N.Scarlett* (MEL).

3b. Banksia integrifolia subsp. **compar** (R.Br.) K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot.* 7: 406 (1994)

Banksia compar R.Br., *Trans. Linn. Soc. London* 10: 207 (1810); *B. integrifolia* var. *compar* (R.Br.) F.M.Bailey, *Comp. Cat. Queensland Pl.* 455 (1913). T: just S of Keppel Bay, [Qld], Aug. 1802, *R.Brown*; holo: BM.

Illustrations: A.S.George, *Banksia Book* 3rd edn, 50, 51, fig. 2B, pl. 20 (1996).

Differs from subsp. *integrifolia* in its larger, undulate leaves commonly 10–20 cm long, 20–26 mm wide, shining green above.

Common along the coast between Proserpine and Brisbane, Qld, on sand dunes, and a short distance inland on hills in sand, loam or basaltic soil in woodland or forest. Flowers mainly Jan.–June. Map 178.

Qld: near Bundaberg, *S.T.Blake 11301* (BRI); Tin Can Bay, 17 Sept. 1946, *M.S.Clemens* (BRI); Tibrogargon, Glass House Mtns, 23 July 1972, *F.D.Hockings* (BRI); S of Bustard Head, SE of Gladstone, May 1968, *J.P.Stantone* (BRI).

Some collections are intermediate between subsp. compar and subsp. integrifolia, e.g. Tamborine Mtn, S of Brisbane, C.E.Hubbard 2506 (S). Thiele & Ladiges (op. cit. 404) recorded a collection from the Kroombit Tablelands, Qld, intermediate with subsp. monticola.

3c. Banksia integrifolia subsp. **monticola** K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot.* 7: 406 (1994)

T: Mount Wilson, Blue Mtns, N.S.W., 3 Nov. 1979, *A.S.George 15794*; holo: CANB; iso: NSW, PERTH.

Illustration: A.S.George, *Banksia Book* 3rd edn, 51, pl. 20A (1996).

Leaves narrowly elliptic, commonly 10–13 cm long, 17–19 mm wide, acute, shining above.

Endemic in N.S.W. between New England Natl Park and Mount Wilson in the Blue Mtns.

Grows in soil derived from igneous rocks, in forest. Flowers May–July. Map 179.

N.S.W.: Gloucester Tops, SW of Gloucester Falls, 17 Apr. 1965, *B.G.Briggs* (NSW); Mount Wilson, Blue Mtns, *E.F.Constable 19329* (NSW); Barrington Tops, *A.S.George 16938* (BRI, CANB, NSW, PERTH); Point Lookout, SE of Ebor, 2 Nov. 1951, *L.A.S.Johnson* (NSW).

Collections from New England commonly have less acute leaves than those farther south. The perianth sometimes has a pink tinge.

4. **Banksia plagiocarpa** A.S.George, *Nuytsia* 3: 467 (1981)

T: Mt Bowen, Hinchinbrook Island, Qld, 15 June 1981, *A. & M.Thorsborne & M.Godwin C1833*; holo: BRI; iso: CANB, K, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 64, 65, fig. 7, pl. 27 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 65 (in press).

Shrub to 5 m, fire tolerant? Bark fissured, corky, grey-brown. Stems red-velvety, glabrescent after 2–3 years. Leaves alternate; petiole 5–20 mm long; lamina lanceolate to narrowly obovate, 8–20 cm long, 6–17 mm wide, obtuse; margins recurved, obtusely serrate to entire; upper surface tomentose, rusty, glabrescent; lower surface tomentose, glabrescent on nerves. Inflorescence 7–14 cm long; involucral bracts thick, tomentose, persistent. Flowers pale blue-grey to mauve in late bud, with limb pale pink-brown in upper half, all becoming dull yellow when open; style pale yellow. Perianth 22–25 mm long including limb of 4–5 mm, appressed-pubescent outside, glabrous inside. Pistil straight or gently curved, 26–28 mm long, glabrous; pollen presenter 0.5–0.7 mm long, scarcely thicker than style. Old flowers soon falling. Follicles up to c. 60, turned somewhat upwards, narrowly elliptic, 12–16 mm long, 5–10 mm high, 5–8 mm wide; valves obliquely triangular, obtuse, smooth, closely tomentose. Seed obovate, 15–17 mm long; seed body obovate, 8–9 mm long, 3–4 mm wide, slightly rugose or smooth. *Dallachy's Banksia*. Fig. 25A–E.

Occurs in Qld, on Hinchinbrook Is. and the adjacent mainland. Grows in sandy loam or clay-loam on rocky, granite slopes, in closed shrubland and low shrubland. Flowers Feb.–July. Map 180.

Qld: Coast Ra., 21 Feb. 1868, *J.Dallachy* (K, MEL); E spur of Bishop Peak, Cardwell Ra., *I.R.Telford 9244 & G.Butler* (CANB, NSW).

Probably fire-tolerant, sprouting by epicormic shoots. Some follicles open after 2–3 years; the others remain closed until burnt. New growth bright rusty red, velvety. Related to *B. oblongifolia* which is a shrub with several slender stems arising from a lignotuber, smaller leaf serrations, yellower flowers, and smaller, evenly rounded follicles.

5. **Banksia oblongifolia** Cav., *Anales Hist. Nat.* 1: 225 (1800)

Banksia integrifolia var. *oblongifolia* (Cav.) Domin, *Biblioth. Bot.* 89: 598 (1921). T: Port Jackson (Sydney), N.S.W., Mar.–Apr. 1793, *L.Née*; lecto: MA, *fide* A.S.George, *Nuytsia* 3: 300 (1981) as to vegetative specimen; the inflorescence on the sheet is here (*Fl. Australia* Vol. 17B) excluded, being *Banksia marginata*.

Banksia salicifolia Cav., *Anales Hist. Nat.* 1: 231 (1800). T: near Botany Bay, N.S.W., Mar.–Apr. 1793, *L.Née*; lecto: MA, *fide* A.S.George, *Nuytsia* 3: 301 (1981).

Banksia latifolia var. *minor* Maiden & Camfield, *Proc. Linn. Soc. New South Wales* 23: 265 (1898); *B. robur* var. *minor* (Maiden & Camfield) Maiden & Betche, *Census New South Wales Pl.* 63 (1916); *B. oblongifolia* var. *minor* (Maiden & Camfield) Conran & Clifford, *Brunonia* 10: 186 (1987). T: Kogarah, N.S.W., June 1897, *J.H.Camfield*; neo: NSW 138266, *fide* A.S.George, *loc. cit.*

[*Banksia asplenifolia auct. non* Salisb.; N.C.W.Beadle *et al., Fl. Sydney Region* revised edn 220 (1972)]

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 8 (1981); A.S.George, *Banksia Book* 3rd edn, 66–68, fig. 8, pl. 28 (1996).

Shrub to 3 m tall, with lignotuber. Bark smooth, grey-brown. Stems tomentose, rusty becoming grey. Leaves alternate; petiole 2–5 mm long; lamina oblong to obovate, commonly 5–11 cm long, 1.5–2 cm wide, obtuse or truncate; margins slightly recurved, commonly serrate with teeth 1–2 mm long; upper surface densely rusty-tomentose, glabrescent; lower surface tomentose, with nerves glabrescent and pits woolly. Inflorescence terminal to a

1–5-year-old branchlet, 5–15 cm long; involucral bracts densely tomentose, persistent. Flowers pale yellow, often with blue-grey tinge; style cream. Perianth 21–26 mm long including limb of 4 mm, pubescent-hirsute outside, glabrous inside. Pistil straight, 20–28 mm long, glabrous; pollen presenter narrowly ovoid, 0.7–0.8 mm long. Old flowers soon falling. Follicles up to 80, narrowly elliptic, 10–18 mm long, 2–7 mm high, 3–7 mm wide; valves semi-circular, smooth, velvety, glabrescent. Seed obovate, 12–18 mm long; seed body oblong to semi-elliptic, 7–11 mm long, 3–7 mm wide, smooth or slightly rugose.

Occurs in Qld and N.S.W., between Bundaberg and Ulladulla, mostly near the coast, but also on the Blackdown Tableland, Qld. On flats and swamp margins in sandy clay or clay-loam, in open forest, woodland and tall shrubland (Wallum); also on sandstone or granite ridges in open forest. Flowers Mar.–June. Map 181.

Qld: Coolum, *S.T.Blake 19213* (BRI); c. 8 km ENE of Tangalooma, Moreton Is., *L.Durrington 231* (BRI); c. 8 km NE of Kin Kin, Como State Forest, *V.K.Moriarty 122* (BRI). N.S.W.: Coffs Harbour, *J.L.Boorman NSW138292* (NSW); c. 3.5 km S of Wattamolla, Royal Natl Park, *R.Coveny 2895* (MEL, NSW).

Fire-tolerant, sprouting from the lignotuber. Follicles typically open with fire. Related to *B. robur* which has much larger leaves, metallic green buds, and flowers with a very short indumentum. Also related to *B. plagiocarpa* which has longer, coarsely serrate to entire leaves, blue-grey buds and obliquely triangular follicles. Var. *minor* is not accepted (George, 1996; Thiele & Ladiges, 1996). in cultivation some Qld forms produce multiple flower spikes on lower stems.

6. **Banksia robur** Cav., *Anales Hist. Nat.* 1: 226 (1800)

Banksia dilleniaefolia Knight, *Cult. Prot.* 113 (1809), *nom. superfl.*; *B. latifolia* R.Br., *Trans. Linn. Soc. London* 10: 207 (1810), *nom. superfl.*; *Sirmuellera robur* (Cav.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: between Port Jackson and Botany Bay, N.S.W., Mar.–Apr. 1793, *L.Née*; lecto: MA, *fide* A.S.George, *Nuytsia* 3: 304 (1981); probable syntypes: MA.

Banksia uncigera Knight, *Cult. Prot.* 112 (1809). T: 'in... the Duke of Northumberland's at Sion House'; *n.v.*

Banksia macrophylla Link, *Enum. Hort. Berol. Alt.* 1: 116 (1821); *B. integrifolia* var. *dentata* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 457 (1856), based on *B. macrophylla* Link. T: none cited.

Banksia fagifolia Hoffmanns., *Verz. Pfl. Kult.* 2: 66 (1826). T: none cited.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 9 (1981); A.S.George, *Banksia Book* 3rd edn, 69–72, fig. 9, pl. 29 (1996).

Shrub to 3 m tall, often straggly, with lignotuber. Bark smooth. Stems rusty-tomentose, becoming glabrous and grey. Leaves alternate; petiole 10–20 mm long; lamina obovate or elliptic, 12–30 cm long, 5–17 cm wide, truncate; margins slightly recurved, shortly serrate with many small teeth; upper surface tomentose, glabrescent; lower surface tomentose, with veins glabrescent. Inflorescence 10–17 cm long; involucral bracts 3–8 mm long, tomentose, persistent. Flowers crowded, metallic green in bud, becoming golden when open; style pale yellow. Perianth 22–26 mm long including limb of 3–4 mm, closely pubescent outside, glabrous inside. Pistil slender, straight, 28–33 mm long, glabrous; pollen presenter narrowly ovoid, 0.75 mm long. Old flowers persistent. Follicles up to c. 100 or more, narrowly elliptic, 10–16 mm long, 5–8 mm high, 4–6 mm wide; valves semi-elliptic, smooth, tomentose. Seed obovate, 15–20 mm long; seed body triangular, oblique, 10–11 mm long, 4–5 mm wide, smooth to slightly rugose.

Occurs in Qld between Cooktown and Mareeba, near Bowen and between Shoalwater Bay and Coolangatta, and in N.S.W. between Kempsey and Wollongong. Grows in sand or peaty sand, usually swampy, in low woodland and in sedge-heathland. Flowers Jan.–July. Map 182.

Qld: c. 1.5 km N of Beerwah, *L.S.Smith & D.J.McGillivray 3064* (BRI, NSW); Euluma Ck road, c. 4 km from Julatten, *V.K.Moriarty 2187* (BRI, QRS). N.S.W.: Bombah Point, L. Myall, *E.F.Constable 19364* (NSW); Calga, near Gosford, *D.J.McGillivray 1677* (NSW); between Cordeaux Dam and Mt Kiera, *L.A.S.Johnson NSW138307* (NSW).

Follicles typically opening only with fire. Related to *B. oblongifolia* which is a more spreading shrub with smaller leaves, yellow hirsute flowers and broader follicles. Presumed natural hybrids between the two have been recorded, e.g. Kogarah road, *J.H.Camfield 26349* (NSW). in cultivation some Qld forms produce multiple flower spikes on lower stems.

7. Banksia conferta A.S.George, *Nuytsia* 3: 284 (1981)

T: Mt Tibrogargon, Glass House Mtns, Qld, 25 Apr. 1975, *A.S.George 13000*; holo: BRI; iso: CANB, MEL, NSW, PERTH.

Shrub to 4 m, rather irregular; without lignotuber. Bark roughly tessellated, grey. Stems villous, glabrescent, orange, red or brown. Leaves whorled; petiole 5–10 mm long; lamina somewhat undulate, elliptic to obovate, 3.5–12 cm long, 0.7–4 cm wide, obtuse; margins recurved, entire or serrate; upper surface hirsute and pubescent, glabrescent; lower surface hirsute and white-tomentose, glabrescent on nerves. Inflorescence 7–19 cm long; involucral bracts 10–20 mm long, tomentose, persistent. Flowers crowded, yellowish green to pinkish brown in bud, golden when open; styles pale yellow. Perianth 20–26 mm long including limb of 3–4 mm, closely pubescent outside, glabrous inside. Pistil slightly curved, 22–26 mm long, slender, glabrous; pollen presenter less than 1 mm long, scarcely thickened. Old flowers persistent for several years. Follicles many, commonly more than 100, narrowly elliptic, 8–15 mm long, 2–6 mm high, 3–5 mm wide; valves semi-elliptic, smooth, hirsute, glabrescent where exposed. Seed obovate, 14–17 mm long; seed body lunate, 8–9 mm long, 2–3.5 mm wide, smooth.

Occurs in south-eastern Qld and the Blue Mtns, N.S.W.

Follicles mostly remaining closed until burnt. Related to *B. integrifolia* which is usually a tree and has pale yellow, less crowded flowers that soon fall from the developing fruit, and follicles that open when mature.

There are two subspecies.

Adult leaves entire	**7a.** subsp. **conferta**
Adult leaves serrate	**7b.** subsp. **penicillata**

7a. Banksia conferta A.S.George subsp. **conferta**

Illustrations: A.S.George, *Nuytsia* 3: 285, fig. 22, 287, fig. 23 (1981); A.S.George, *Banksia Book* 3rd edn, 54, 55, fig. 3A, pl. 22 (1996); C.E.Rosser & A.S.George, *Banksias* III: pl. 72 (in press).

Bark tessellated. Adult leaves entire. Apex of common bracts closely pubescent. Most follicles 8–12 mm long.

Occurs on the Lamington Plateau and the Glass House Mtns, Qld, on steep rocky slopes (granite and sandstone) in scrub. Flowers late Apr.–July. Map 183.

Qld: Mt Beerwah, Glass House Mtns, 23 Apr. 1972, *F.D.Hockings* (BRI); Picnic Ck, Lamington Natl Park, *L.A.S.Johnson NSW138219* (NSW); East Peak, McPherson Ra., *I.R.Telford 10919* (CANB).

New growth reddish or reddish brown, silky.

7b. Banksia conferta subsp. **penicillata** (A.S.George) A.S.George, *Nuytsia* 11: 22 (1996)

Banksia conferta var. *penicillata* A.S.George, *Nuytsia* 3: 289 (1981); *B. penicillata* (A.S.George) K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot.* 9: 719 (1996). T: N of Clarence on Newnes Tunnel road, N.S.W., 6 Apr. 1971, *R.Coveny 3537*; holo: NSW; iso: PERTH.

Illustrations: A.S.George, *Nuytsia* 3: 285, fig. 22D, E, 288, fig. 24 (1981); A.S.George, *Banksia Book* 56, 57, fig. 3B, pl. 23 (1984).

Differs from subsp. *conferta* in having smooth bark, typically serrate adult leaves, villous new growth, tufts of hairs on the apices of the common bracts subtending flower-pairs, and slightly larger follicles 11–15 mm long. Fig. 25G, H.

Occurs in the Blue Mtns north-west of Sydney, among or close to sandstone rocks, usually by cliffs, in open forest. Flowers Mar.–June. Map 184.

N.S.W.: Green Gully, Glen Davis, c. 40 km N of Lithgow, *E.F.Constable 5142* (NSW); c. 8 km NE of the Natural Bridge, c. 25 km N of Bell, *J.Pickard 1243* (NSW); c. 1.5 km NNW of Mt Coricudgy, E of Rylstone, *A.N.Rodd & D.J.McGillivray 1108* (NSW).

Besides the close relationship with subsp. *conferta*, this subspecies resembles *B. paludosa* subsp. *astrolux* in habit, but the latter has openly-spaced brown or golden brown flowers with a shorter perianth and pistil. Near Newnes Tunnel, subsp. *penicillata* appears to have hybridised with *B. marginata* which also occurs there. A number of plants appear intermediate between the two in their morphology.

Thiele (Thiele & Ladiges, 1996) raised this to specific rank on the basis that it differed from var. *conferta* in habit, bark, leaf shape, indumentum and flower colour but without elaborating on the differences. Both are non-lignotuberous shrubs; bark is tessellated in subsp. *conferta*, smooth in subsp. *penicillata*; both have villous new growth but the indumentum is longer in subsp. *penicillata*; leaf shape is similar in the two but typically entire in subsp. *conferta*, serrate in subsp. *penicillata*; flower colour is somewhat variable in each. The differences are not sufficient to justify specific rank for subsp. *penicillata*.

8. Banksia paludosa R.Br., *Trans. Linn. Soc. London* 10: 207 (1810)

Banksia integrifolia var. *paludosa* (R.Br.) Benth., *Fl. Austral.* 5: 554 (1870). T: Port Jackson, N.S.W., 1802, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 307 (1981); isolecto: BM, E, K.

Shrub with lignotuber, to 1.5 m tall, or without lignotuber and to 5 m tall. Bark smooth. Stems tomentose, soon glabrous, red-brown. Leaves alternate or whorled; petiole 5–13 mm long; lamina narrowly lanceolate to obovate, 4–13 cm long, (0.5–) 1–2.5 (–3.5) cm wide, obtuse; margins recurved, dentate to entire; tomentose, glabrescent above, hirsute on nerves below, glabrescent but white-woolly in pits. Inflorescence 7–13 cm long; involucral bracts to 12 mm long, tomentose, persistent. Flowers openly spaced, pale brown to golden brown. Perianth 15–18 mm long including limb of 2.5–3 mm, closely pubescent outside, glabrous inside. Pistil slender, straight, 17–20 mm long, glabrous; pollen presenter not thickened, 1 mm long. Old flowers persistent. Follicles up to c. 60, narrowly elliptic, 9–18 mm long, 1–5 mm high, 3–7 mm wide; valves semi-elliptic, smooth, tomentose, glabrescent. Seed obovate, 13–18 mm long; seed body falcate, 8–9 mm long, 3–4 mm wide, smooth.

Endemic in N.S.W. between Glen Davis and Nadgee.

Follicles typically remaining closed until burnt. The open spacing of the flowers in the late bud stage is unique in ser. *Salicinae*.

There are two subspecies.

Plant with lignotuber	**8a.** subsp. **paludosa**
Plant without lignotuber	**8b.** subsp. **astrolux**

8a. Banksia paludosa R.Br. subsp. **paludosa**

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 23 (1981); A.S.George, *Banksia Book* 3rd edn, 73, 74, fig. 10, pl. 30 (1996).

Shrub to 2 m, with lignotuber. Swamp Banksia.

Occurs on the coastal plain and nearby mountains from Glen Davis to Nadgee, N.S.W., grows in sandy loam or loam in woodland, often near swamps, and in rocky (sandstone) loam near creeks or on ridges, in woodland or low shrubland. Flowers Apr.–July. Map 185.

N.S.W.: Fitzroy Falls, *A.S.George 14393* (NSW, PERTH); Nadgee Nature Reserve, *D.Hope & D.J.McGillivray 3032* (NSW); N of Cordeaux Dam, *L.A.S.Johnson NSW138237* (NSW); c. 16 km NNE of Mongarlowe, *D.J.McGillivray 1463* (NSW); Jervis Bay, *L.Rodway 1366* (NSW).

The record at Hat Head near Kempsey (George, 1981) was based on incorrect label data.

8b. Banksia paludosa subsp. **astrolux** A.S.George, *Nuytsia* 11: 23 (1996)

T: near beginning of Starlight's Trail, near Hilltop, N.S.W., 29 June 1990, *A.S.George 16930*; holo: NSW; iso: AD, BRI, CANB, K, MEL, PERTH.

Illustrations: A.S.George, *Banksia Book* 3rd edn, 75, 76, fig. 10A, pl. 30A (1996).

Openly branched shrub to 5 m, without lignotuber. Fig. 26A.

Confined to a small area near Hilltop, north of Mittagong, N.S.W. Grows in sandy loam over sandstone in eucalypt woodland on the plateau and valley slopes. Flowers May–July. Map 186.

N.S.W.: 17 km N of Mittagong, Jan. 1987, *B.Walters* (NSW).

In habit this subspecies resembles *B. conferta* subsp. *penicillata* which has larger leaves and longer flowers that are more crowded in the inflorescence, and which also has villous new growth.

9. Banksia marginata Cav., *Anales Hist. Nat.* 1: 227 (1800)

Banksia microstachya var. *marginata* (Cav.) Domin, *Biblioth. Bot.* 89: 44 (1921). T: between Port Jackson and Parramatta, N.S.W., Mar.–Apr. 1793, *L.Née*; lecto: MA, *fide* A.S.George, *Nuytsia* 3: 291 (1981).

Banksia microstachya Cav., *Anales Hist. Nat.* 1: 224 (1800); *B. marginata* var. *microstachya* (Cav.) Sims, *Bot. Mag.* 45: t. 1947 (1818); *Sirmuellera microstachya* (Cav.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: between Port Jackson and Parramatta, N.S.W., Mar.–Apr. 1793, *L.Née*; lecto: MA, *fide* A.S.George, *op. cit.* 292.

Banksia australis R.Br., *Trans. Linn. Soc. London* 10: 205 (1810). T: Port Dalrymple, [Tas.], Jan. 1804, *R.Brown*; lecto: BM, *fide* A.S.George, *op. cit.* 291.; possible syn: BM.

Banksia depressa R.Br., *Trans. Linn. Soc. London* 10: 205 (1810); *B. australis* var. *depressa* (R.Br.) Hook.f., *Fl. Tasman.* 329 (1857). T: 'Anna Maria's R.', [Tas.], ?1804, *R.Brown*; lecto: BM, *fide* A.S.George, *loc. cit.*

Banksia insularis R.Br., *Trans. Linn. Soc. London* 10: 206 (1810). T: King Is., Bass Strait, [Tas.], Apr. 1802, *R.Brown*; lecto: BM, *fide* A.S.George, *op. cit.* 292.

Banksia patula R.Br., *Trans. Linn. Soc. London* 10: 205 (1810). T: Bay X [Port Lincoln, S.A.], Mar. 1802, *R.Brown*; lecto: BM, *fide* A.S.George, *loc. cit.*; syn: E, S, UPS.

Banksia marcescens Bonpl., *Descr. Pl. Malmaison* 116, t. 48 (1816), *nom. illeg. non* R.Br. T: A.J.A.Bonpland, *Descr. Pl. Malmaison* 116, t. 48, *fide* A.S.George, *loc. cit.*

Banksia ferrea Vent. ex Spreng., *Syst. Veg.* 1: 485 (1824), *nom. inval.* – in synonymy under *B. marginata*.

Banksia marginata var. *diffusa* Endl., *Gen. Pl. Suppl.* 4, 2: 88 (1848), *nom. nud.*

Banksia marginata var. *humilis* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 455 (1856), based on *B. marginata* var. γ R.Br., *Trans. Linn. Soc. London* 10: 204 (1810). T: Port Jackson, N.S.W., *R.Brown*; lecto: BM, *fide* A.S.George, *loc. cit.*

Banksia gunnii Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 456 (1856). T: George Town, [Tas.], 28 Jan. 1843, *R.C.Gunn 1233*; lecto: K, *fide* A.S.George, *loc. cit.*

Banksia depressa var. *subintegra* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 456 (1856). T: Mt Wellington, [Tas.], 8 May 1839, *R.C.Gunn 1234*; lecto: K, *fide* A.S.George, *Nuytsia* 3: 291 (1981); syn: K.

Banksia marginata var. *cavanillesii* Endl., in A.L.P.P. de Candolle, *Prodr.* 14: 455 (1856), *nom. illeg.*, based on *B. marginata*.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 10 (1981); A.S.George, *Banksia Book* 58, 59, fig. 4, pl. 24 (1984).

Shrub or tree 1–12 m tall, with or without lignotuber, sometimes suckering. Bark smooth becoming finely tessellated, grey. Stems hirsute and tomentose, glabrescent. Leaves alternate; petiole 2–5 mm long; lamina linear, oblong or narrowly cuneate, 15–60 mm long, 3–13 mm wide, commonly truncate or emarginate, sometimes obtuse, rarely acute; margins slightly recurved to revolute, entire or occasionally serrate; upper surface hirsute to tomentose, glabrescent; lower surface white-tomentose. Inflorescence commonly 5–10 cm long; involucral bracts to 10 mm long, tomentose, commonly persistent. Flowers pale yellow, often grey-tinged in late bud; style pale yellow. Perianth 16–24 mm long including limb of 2.5–3.5 mm, pubescent outside, glabrous inside. Pistil straight or curved downwards, slender, 20–31 mm long, glabrous; pollen presenter 0.7–1 mm long, scarcely thickened. Old flowers

usually persistent, sometimes falling. Follicles up to 150, narrowly elliptic, 7–17 mm long, 2–5 mm high, 2–4 mm wide; valves semi-elliptic, rather thin, smooth, hirsute, glabrescent. Seed obovate-cuneate, 9–15 mm long; seed body cuneate-falcate, 5–8 mm long, 3–4 mm wide, smooth to finely rugose on both sides. *Silver Banksia*. Fig. 25F.

Widespread in south-eastern Australia from Eyre Peninsula, S.A., through Vic. and eastern N.S.W. north to Baradine and Guyra; throughout Tas.; also on Kangaroo Is. and the islands of Bass Strait. Often locally common. Grows in sandy loam, clay loam, shale, peaty loam and rocky soil (quartzite, sandstone, limestone and granite); occurs in shrubland, woodland and forest, sometimes in swamps and on coastal dunes. Flowers mainly Feb.–July. Map 187.

S.A.: Waitpinga, Fleurieu Penin., *H.M.Cooper AD97323130* (AD). N.S.W.: Mt Coricudgy, E of Rylstone, *E.F.Constable 27332* (NSW, W). A.C.T.: Gibraltar Falls, *H.Reeve 659* (CANB). Vic.: Mt Beckworth, c. 6 km SW of Clues, 13 Jan. 1955, *J.H.Willis* (MEL). Tas.: near L. Dobson, Mt Field Natl Park, *A.S.George 14256* (PERTH).

Follicles typically opening when mature but in some variants needing fire. Closely related to *B. integrifolia* which differs in its larger, whorled leaves and larger flowers; also resembles *B. canei* which has pungent leaves, stouter flowers and larger follicles that remain closed for some years and from which the spent flowers fall very early. Presumed hybrids with *B. conferta* subsp. *penicillata* have been recorded near the Clarence–Newnes road, N.S.W. (George, 1981). A highly variable species that should be studied more thoroughly.

10. #Banksia canei J.H.Willis, *Muelleria* 1: 118 (1967)

T: Mt Seldom Seen track, near Wulgulmerang, Vic., 27 Nov. 1962, *J.H.Willis*; holo: MEL; iso: AD, K, MEL, NSW.

Illustrations: A.S.George, *Banksia Book* 60, 61, fig. 5, pl. 25 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 61 (in press).

Shrub to 3 m tall, without lignotuber. Bark smooth. Stems villous, rusty, glabrescent. Leaves alternate; petiole 2–4 mm long; lamina narrowly elliptic, obovate, cuneate or linear, commonly 2–5 cm long, 5–20 mm wide, acute or obtuse, pungent; margins recurved, entire to serrate; upper surface hirsute, glabrescent; lower surface hirsute on nerves, glabrescent, with tomentose pits. Inflorescence 5–15 cm long; involucral bracts to 10 mm long, tomentose, commonly falling by flowering. Flowers pale pink-mauve in bud, pale yellow at flowering; limb often grey or blue; style pale yellow. Perianth usually 18–20 mm long including limb of 3–4 mm, silky-pubescent outside, glabrous inside. Pistil gently curved, slender, 17–28 mm long, glabrous; pollen presenter 1 mm long, scarcely thickened. Old flowers soon falling. Follicles up to 150, elliptic, 12–18 mm long, 3–8 mm high, 4–9 mm wide; valves semi-elliptic, smooth, villous, glabrescent. Seed obovate, 13–18 mm long; seed body lunate, 6–8 mm long, 2–4 mm wide, slightly rugose. *Mountain Banksia*. Plate 35.

Eastern Vic. and south-eastern N.S.W., in subalpine areas between the Snowy Ra., Gippsland, and the Tuross R., usually between 750 and 1500 metres. Grows in rocky, granitic or sandstone soil on slopes and in gullies, in low open-woodland and open heath. Naturalised near Albany, W.A. Flowers Jan.–June. Maps 188, 189.

W.A.: 4.5 km N of Napier R. bridge on road to Jerramungup, *G.J.Keighery 11031* (PERTH). N.S.W.: Talbingo, 15 Feb. 1974, *G.W.Althofer* (NSW); Bumberry Ck, c. 14 km SE of Countegany, *L.A.S.Johnson 7060 & A.N.Rodd* (NSW); Kydra Peak, SE of Cooma, 11 Jan. 1970, *J.H.Willis* (MEL). Vic.: between Mt Wellington & Mt Selma, Gippsland, 9 Jan. 1963, *W.Cane* (MEL); Brumby Point, Nunniong Plateau, E Gippsland, 13 Nov. 1964, *J.H.Willis & K.C.Rogers* (MEL).

Some follicles open spontaneously after several years but most remain closed until burnt. Related to *B. saxicola* which is easily distinguished by its larger, whorled leaves and larger habit, and to *B. marginata* which usually has truncate or emarginate leaves, finer persistent styles and smaller follicles. Highly variable especially in leaf morphology (A.Salkin & N.D.Hallam, *Austral. J. Bot.* 26: 707–721, 1978). The naturalised occurrence in W.A. was already established in 1988 and is the first record of an indigenous species of Proteaceae becoming established in Australia outside its natural range. in the mild, near-coastal climate, the seeds would rarely be stratified, a stage needed for germination in its natural range.

11. Banksia saxicola A.S.George, *Nuytsia* 3: 297 (1981)

T: Mt William, The Grampians, Vic., 17 Feb. 1977, *A.S.George 14398*; holo: MEL; iso: AD, BRI, HO, K, MEL, NSW, PERTH.

[*Banksia integrifolia auct. non* L.f.: J.H.Willis, *Handb. Pl. Victoria* II: 58 (1973)]

Illustrations: A.S.George, *Banksia Book* 62, 63, fig. 6, pl. 26 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 64 (in press).

Shrub without lignotuber, to 3 m tall and very spreading or, in sheltered situations, erect and to 13 m tall. Bark smooth becoming somewhat rough, grey. Stems densely tomentose, pink, becoming glabrous and brown. Leaves whorled, coriaceous; petiole 5–10 mm long; lamina lanceolate, elliptic or obovate, 4–10 cm long, 1–3.5 cm wide, obtuse; margins recurved, entire or with a few short lobes; upper surface dark green and shining, hirsute, glabrescent; lower surface white-tomentose. Inflorescence 3.5–8 cm long; involucral bracts 5–10 mm long, velvety, persistent. Flowers yellow, often grey-tinged; styles yellow. Perianth 19–22 mm long including limb of 3.5–4 mm, closely pubescent outside, glabrous inside. Pistil gently curved, slender, 23–31 mm long, glabrous; pollen presenter 1.5 mm long, slightly thickened. Old flowers soon falling. Follicles up to c. 60, elliptic, 12–20 mm long, 4–7 mm high, 5–7 mm wide; valves semi-elliptic, smooth, velvety, glabrescent. Seed obovate, 14–19 mm long; seed body lunate-obovate, 9–11 mm long, 3–4 mm wide, smooth to slightly rugose. *Grampians Banksia*. Fig. 25J.

Occurs in Vic., in The Grampians among sandstone rocks on exposed upper slopes in scrub and in sheltered gullies in woodland, and on Wilsons Promontory among granite boulders in forest. Flowers Jan.–Mar. Map 190.

Vic.: near Mt Thackeray, Victoria Ra., The Grampians, *A.S.George 11814* (MEL, PERTH); inland from Sealer Cove, Wilsons Promontory, 14 Mar. 1968, *B.Greer* (MEL, NSW); Jimmy Ck, The Grampians, *R.Melville 1979* (K, MEL).

Killed by fire and regenerates from seed. Most follicles remain closed until burnt. Related to *B. canei* which has scattered, smaller, pungent leaves, and *B. integrifolia* which is a coastal tree with thick bark, thinner leaves, pale yellow flowers in autumn and winter, and smaller, thinner follicles that all open spontaneously within a year of flowering.

Ser. 2. Grandes

Banksia ser. **Grandes** A.S.George, *Nuytsia* 3: 308 (1981)

Type: *B. grandis* Willd.

Trees or shrubs, erect or spreading. Leaves alternate, pinnatisect or pinnatipartite with large lobes; margins recurved. Inflorescence erect, cylindrical; buds losing their regular pattern well before anthesis. Perianth hirsute; tepals not awned. Pistil slender, gently curved; pollen presenter slightly thickened, small, smooth; pollen ovoid. Follicles not split at stylar point. Seed wing not notched.

A series of two species endemic in south-western W.A.

12. Banksia grandis Willd., *Sp. Pl.* 1: 535 (1798)

Sirmuellera grandis (Willd.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: cultivated in Europe, from seed probably collected at King George Sound, [W.A.], Oct.–Nov. 1791, *A.Menzies*; lecto: B, *fide* A.S.George, *Nuytsia* 3: 309 (1981).

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 6 (1981); A.S.George, *Banksia Book* 77–79, fig. 11, pl. 31 (1984).

Tree to 10 m, in coastal areas sometimes a shrub, fire tolerant. Bark thick, rugose. Stems stout, tomentose, glabrescent. Leaves: petiole 10–35 mm long; lamina pinnatisect with 8–12 large, triangular lobes each side, obovate-cuneate, 10–45 cm long, 3–11 cm wide, truncate; margins recurved; upper surface tomentose, glabrescent; lower surface tomentose,

glabrescent except fine wool in pits. Inflorescence 10–40 cm long, 7–9 cm wide at flowering; involucral bracts to 25 mm long, tomentose, falling after flowering. Flowers pale yellow; upper flowers often with turquoise or grey tinge; styles cream. Perianth 26–35 mm long including limb of 4–5 mm, hirsute both sides with glabrous limb. Pistil 35–40 mm long, glabrous; pollen presenter slightly thickened, 1–1.5 mm long. Old flowers soon falling. Follicles many in a massive cone, elliptic, 17–25 mm long, 3–10 mm high, 6–12 mm wide; valves smooth but groove wrinkled, tomentose. Seed obovate-cuneate, 32–38 mm long; seed body obovate, 12–16 mm long, 7–9 mm wide, smooth inside, somewhat rugose outside. *Bull Banksia, Mangite.*

Widespread in W.A. from Mt Lesueur to Cape Leeuwin, east to Cape Riche and inland to Woodanilling. Grows in sand on the coastal plain, in woodland and kwongan; common in laterite in the Jarrah forest of the Darling Plateau. Flowers Oct.–Jan. Map 191.

W.A.: Cape Leeuwin, *A.C.Beauglehole 13517* (NSW); c. 48 km SE of Karagullen, Brookton Hwy, *A.S.George 11214* (AD, BRI, CANB, K, MEL, NSW, PERTH); Bow R., Oct. 1912, *S.W.Jackson* (NSW, PERTH); Bushmead, NE of Perth, *R.A.Saffrey 139* (PERTH); 10.5 km NNE of Muchea turnoff on Great Northern Hwy, *A.Strid 20663* (PERTH).

Follicles usually opening spontaneously when mature. Relatively consistent except near the south coast, especially in the Albany district, where the plants are of shorter, more spreading stature. *Banksia solandri* differs in its shrubby habit, smaller leaves and smaller brownish purple flowers that persist in the fruit.

13. Banksia solandri R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 36 (1830)

Sirmuellera solandri (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: Stirling Ra., [W.A.], 1829, *W.Baxter*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 311 (1981); isolecto: BM, NSW.

Banksia hookeri J.Drumm., *Bot. Mag.* 74: *Appendix – Comp. Bot. Mag.* 1 (1848), *nom. inval.* – in synonymy under *B. solandri*.

Banksia solandri var. *major* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 464 (1856). T: Mondurup, Stirling Ra., W.A., *J.Drummond s.n.*; lecto: K, *fide* A.S.George, *Nuytsia* 3: 311 (1981).

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 33 (1981); A.S.George, *Banksia Book* 80, 81, fig. 12, pl. 32 (1984).

Shrub to 4 m, without lignotuber. Bark thin, smooth or lightly fissured. Stems hirsute-pubescent, glabrescent. Leaves: petiole 1–4 cm long; lamina pinnatipartite with 2–9 rounded-triangular lobes each side, obovate-cuneate, 10–30 cm long, 4–12 cm wide, truncate; margins recurved; both sides hirsute and tomentose, glabrescent except wool in pits on lower surface. Inflorescence 4–16 cm long; involucral bracts to 15 mm long, villous, persistent. Flowers heavily scented, brownish purple; styles cream. Perianth 20–24 mm long including limb of 2–3 mm, hirsute outside, hirsute inside in upper half; limb woolly, glabrescent. Pistil 23–28 mm long, glabrous; pollen presenter conical, c. 0.2 mm long. Old flowers persistent. Follicles many, elliptic, 10–18 mm long, 3–8 mm high, 4–8 mm wide; valves smooth, hirsute. Seed cuneate, 20–23 mm long; seed body obovate, 9–12 mm long, 5–6 mm wide, smooth inside, slightly rough outside; wing 10–12 mm wide. *Stirling Range Banksia*. Fig. 25K–M.

Restricted to the Stirling Ra., W.A., growing in rocky soil (metasandstone) on steep slopes and in gullies in kwongan, sometimes in woodland. Flowers Oct.–Nov. Map 192.

W.A.: Mt Toolbrunup, *A.M.Ashby 1617* (AD); near summit, Bluff Knoll, *A.S.George 425* (PERTH); Mondurup, *A.Strid 21450* (PERTH).

Related to *B. grandis* which has larger leaves, yellow closely pubescent flowers and larger fruit, the old flowers falling. Follicles usually opening with fire.

Ser. 3. Banksia

Banksia L.f. ser. **Banksia**

Banksia ser. *Orthostylis* (Benth.) A.S.George, *Nuytsia* 3: 319 (1981), *nom. illeg.*; *B.* sect. *Orthostylis* Benth., *Fl. Austral.* 5: 543 (1870).

Banksia subser. *Cratistyles* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot.* 9: 720 (1996). T: *B. menziesii* R.Br.

Trees or shrubs, erect or spreading. Leaves alternate, serrate, dentate or deeply lobed, tomentose; margins recurved or flat. Inflorescence erect, cylindrical or ovoid; buds retaining regular pattern until anthesis. Perianth pubescent, silky or hirsute; tepals not awned. Pistil curved, sometimes sigmoid below apex; pollen presenter usually narrowly fusiform, with a small basal swelling, finely ribbed; pollen crescent-shaped or ovoid. Follicles split from stylar point. Seed wing notched.

A series of eight species, three in eastern Australia, five in the south-west. The small conical pollen presenter of *B. aemula* is anomalous.

14. Banksia serrata L.f., *Suppl. Pl.* 126 (1782)

Banksia conchifera Gaertn., *Fruct. Sem. Pl.* 1: 221 (1788), *nom. superfl.*; *B. mitis* Knight, *Cult. Prot.* 112 (1809), *nom. superfl.*; *Sirmuellera serrata* (L.f.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891); *Isostylis serrata* (L.f.) Britten, in J.Banks & D.Solander, *Ill. Austral. Pl. Cook's Voy.* 3: 83 (1905). T: Botany Bay, [N.S.W.], Apr.–May 1770, *J.Banks*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 320 (1981); isolecto: B, C, NSW.

Banksia serraefolia Knight, *Cult. Prot.* 112 (1809), *nom. superfl.* based on *B. serrata* 'Andr.' = *B. serrata* L.f. and *B. serratifolia* Salisb.

Banksia undulata Lindl., *Edward's Bot. Reg.* t. 1316 (1830). T: cultivated, *Comte de Vandes*; lecto: CGE, *fide* A.S.George, *loc. cit.*

Banksia serrata var. *hirsuta* R.T.Baker, *Proc. Linn. Soc. New South Wales* 21: 462 (1896). T: Kelgoola, N.S.W., *?R.Baker*; *n.v.*

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 1 (1981); A.S.George, *Banksia Book* 91–93, fig. 16, pl. 36 (1984).

Tree to 16 m, sometimes a robust shrub of 1–3 m, fire-tolerant. Bark thick, verrucose, friable, grey-brown. Stems tomentose and hirsute. Leaves: petiole commonly 1–2 cm long; lamina broadly oblong to narrowly obovate, 7–22 cm long, usually 2–4 cm wide, truncate, serrate; margins slightly recurved; both surfaces tomentose, glabrescent except pits in lower surface. Inflorescence terminal, 7–15 cm long; involucral bracts tomentose, falling early. Flowers creamy grey; styles cream. Perianth 38–42 mm long including limb of 7–8 mm, pubescent outside, glabrous inside. Pistil curved, 47–60 mm long, glabrous, or papillose towards base; pollen presenter fusiform with thickened base, 2.5–3 mm long, finely 8-ribbed. Old flowers persistent. Follicles up to 30, prominent, broadly elliptic, 25–35 mm long, 20–25 mm high, 15–22 mm wide, smooth, tomentose. Seed obovate, 30–34 mm long; seed body obovate, 10–12 mm long, 9–11 mm wide, shallowly pitted outside, verrucose inside. *Saw Banksia*. Fig. 26F, G.

A common, near-coastal species in eastern Australia, extending from Cooloola, Qld, south to Wilsons Promontory, Vic., with an outlying population at Sisters Ck in north-western Tas. Grows on consolidated coastal dunes and in sand over sandstone on the coastal plain and in the Blue Mtns; usually in woodland, but also as a low shrub in tall shrubland. Flowers Jan.–June. Map 193.

Qld: Cooloola, *A.G.Harrold 270* (BRI); Bribie Is., 21 Mar. 1972, *B.A.Lebler* (BRI). N.S.W.: near Salt Ash, Hunter valley, *R.Story 6550* (NSW). Vic.: 18 km W of Orbost, *A.S.George 13084* (CANB, MEL, PERTH). Tas.: Two Sisters Reserve, W of Boat Harbour, *A.S.George 14245* (HO, PERTH).

Follicles opening spontaneously or with fire. Related to *B. aemula*, a shrub or tree of similar aspect but with narrower leaves, creamy yellow flowers, a club-shaped pollen presenter and larger follicles. Fire-tolerant, sprouting by epicormic shoots.

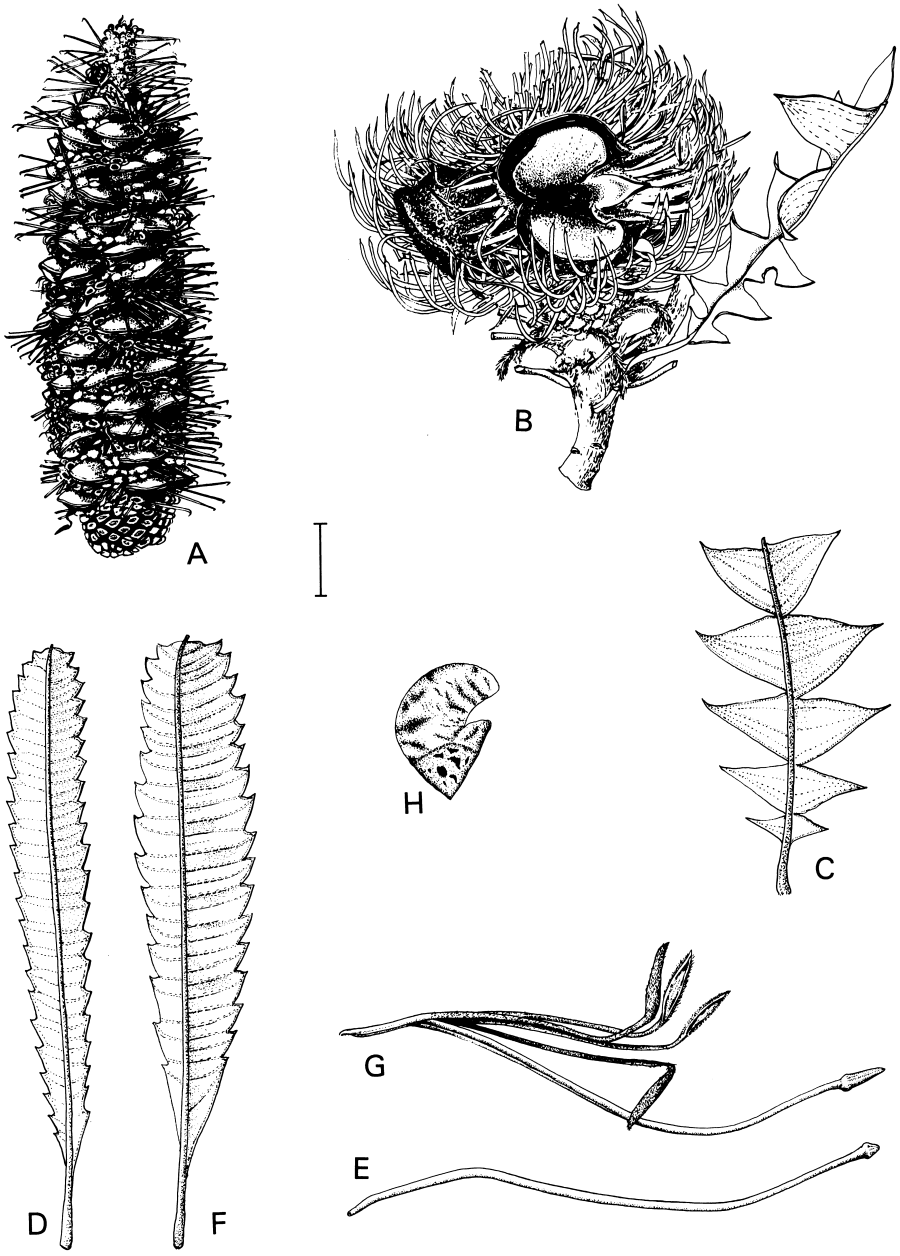

Figure 26. *Banksia*. **A**, *B. paludosa* subsp. *astrolux*, infructescence (A.George 16930, PERTH). **B–C**, *B. baxteri*. **B**, infructescence (not recorded); **C**, leaf, abaxial face (J.Wrigley 4911, CANB). **D–E**, *B. aemula*. **D**, leaf, abaxial face; **E**, pistil (**D–E**, cult. Australian National Botanic Garden (ANBG)). **F–G**, *B. serrata*. **F**, leaf, abaxial face; **G**, open flower (**F–G**, cult. ANBG). **H**, *B. ornata*, seed, abaxial face (A.George 13116, PERTH). Scale bar: **A–D**, **F** = 2 cm; **E**, **G** = 5 mm; **H** = 1.2 cm. Drawn by: **A–B**, P.Nikulinsky; **C–G**, D.Boyer; **H**, A.George. **H**, reproduced with permission from *The Banksia Book* (1996).

15. Banksia aemula R.Br., *Trans. Linn. Soc. London* 10: 209 (1810)

T: Port Jackson, N.S.W., June 1801, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 323 (1981); isolecto: BM, E, K.

Banksia elatior R.Br., *Trans. Linn. Soc. London* 10: 209 (1810). T: Sandy Cape, [Qld], *R.Brown*; holo: BM.

[*Banksia serratifolia auct. non* Salisb.; N.C.W.Beadle *et al., Fl. Sydney Region* revised edn 220 (1972)]

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 24 (1981); A.S.George, *Banksia Book* 95–97, fig. 17, pl. 37 (1984).

Robust shrub or tree to 8 m tall, fire tolerant. Bark thick, verrucose, orange-brown. Stems tomentose, glabrescent. Leaves: petiole 0.5–1.5 cm long; lamina narrowly obovate to oblong, 3–22 cm long, usually 1–2 cm wide, truncate; margins not recurved, serrate; upper surface tomentose, rusty, glabrescent; lower surface tomentose, with nerves glabrescent, and pits woolly. Inflorescence terminal, 4–20 cm long; involucral bracts tomentose, soon falling. Flowers pale yellow to greenish cream, including styles. Perianth 35–45 mm long including limb of 5 mm, appressed-pubescent outside, glabrous inside. Pistil curved, 35–45 mm long, papillose in lowest third, otherwise glabrous; pollen presenter clavate-conical, 1 mm long, faintly ribbed. Old flowers persistent. Follicles up to 25, massive, elliptic, 30–45 mm long, 20–35 mm high, 20–35 mm wide; valves semi-circular, smooth, tomentose. Seeds obovate, 40–47 mm long; seed body cuneate, 10–15 mm long, 11–16 mm wide, smooth both sides or the outside pitted; wing curved, 20–32 mm wide. *Wallum Banksia*. Fig. 26D, E.

Occurs from Bundaberg, Qld, south to Sydney, N.S.W., on near-coastal consolidated sand dunes, in swales, on flats and sometimes on sandstone, in low woodland or tall shrubland (Wallum). Flowers Mar.–June. Map 194.

Qld: Sunshine Beach, ESE of Noosa Heads, 21 May 1968, *B.A.Lebler & P.Baxter* (BRI); 2 km N of Coolum Beach, *P.R.Sharpe 1975* (BRI); mouth of Burrum R., Traverston, *C.T.White 6386* (BRI). N.S.W.: 6.4 km SE of Nabiac, *R.Coveny 6027* (NSW); Hat Head, *L.A.S.Johnson NSW138349* (NSW).

Follicles opening spontaneously or with fire. Very similar to *B. serrata* which is easily distinguished by the longer, narrow pollen presenter and which has broader leaves, longer hairs on the branchlets, creamy grey flowers and smaller follicles.

16. Banksia ornata F.Muell. ex Meisn., *Linnaea* 24: 352 (1854)

Sirmuellera ornata (F.Muell. ex Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: 'Villnugam' [Willunga], S.A., 1851, *F.Mueller*; lecto: MEL, *fide* A.S.George, *Nuytsia* 3: 326 (1981); Marble Ra., Eyre Peninsula, S.A., Feb. 1852, *F.Mueller*; syn: MEL.

Banksia ornata var. *rufa* Ashby, *Express & Journal (Adelaide)* 27 July 1935, *nom. nud.*

Illustrations: A.S.George, *Banksia Book* 98, 99, fig. 18, pl. 38 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 37 (1988).

Shrub to 3 m tall, usually bushy, without lignotuber. Bark thin, finely fissured, grey. Stems hirsute and pubescent, glabrescent. Leaves: petiole 5–10 mm long; lamina narrowly obovate to cuneate, 3–10 cm long, 4–25 mm wide, obtuse; margins recurved, serrate; both surfaces hirsute and pubescent, glabrescent except pits in lower surface. Inflorescence on short lateral branchlet on older stem, 5–11 cm long; involucral bracts hirsute, falling early. Flowers cream with greyish cream limb, sometimes pale rusty; styles cream with deep pink pollen presenter. Perianth 30–35 mm long including limb of 3–4 mm, hirsute outside, glabrous inside. Pistil slightly curved, 35–38 mm long, glabrous except a few short hairs above ovary; pollen presenter narrowly ovoid, 1.5–2 mm long, finely ribbed. Old flowers persistent. Follicles up to 50, elliptic, 15–20 mm long, 4–8 mm high, 10–15 mm wide, smooth, tomentose. Seed obovate, 21–25 mm long; seed body cuneate, 8–11 mm long, 10–11 mm wide, pitted and rugose outside, smooth inside. Fig. 26H.

Occurs in S.A. on Kangaroo Is. and southern Eyre Peninsula and through the south-east to The Grampians and the Big and Little Deserts, western Vic. Grows in deep sand in heath, mallee shrubland or sometimes in low woodland; sometimes in quartzitic sandy loam. Flowers mainly winter–spring, with a few flowers sometimes at other seasons. Map 195.

S.A.: S end of Marble Ra., Eyre Penin., *A.S.George 13116* (AD, BRI, CANB, MEL, NSW, PERTH); near Finniss, Mount Lofty Ra., 4 Apr. 1926, *E.H.Ising* (AD); 8 km from American R., Kangaroo Is., *M.E.Phillips 020985* (AD). Vic.: Black Ra., The Grampians, 5 Mar. 1948, *J.H.Willis* (MEL); W of L. Albacutya, Big Desert, 25 Sept. 1959, *H.Wilson* (MEL).

Related to *B. serrata* and *B. aemula*, both taller species of near-coastal areas from south-eastern Qld to eastern Vic., which have larger leaves, flowers and fruit. Follicles typically opening with fire. Killed by fire and regenerates from seed.

17. Banksia baxteri R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 36 (1830)

Sirmuellera baxteri (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: near King George Sound, [W.A.], 1829, *W.Baxter*; lecto: BM, *fide* A.S.George *Nuytsia* 3: 331 (1981); isolecto: K, NSW.

Illustrations: A.S.George, *Banksia Book* 108, 109, fig. 21, pl. 41 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 30 (1988).

Shrub to 4 m, without lignotuber. Bark smooth to lightly fissured, grey-brown. Stems hirsute, glabrescent. Leaves: petiole 5–15 mm long; lamina stiff, pinnatisect with 4–7 large triangular flat lobes on each side, cuneate, 7–17 cm long, 25–75 mm wide, truncate; margins not recurved; both surfaces tomentose, glabrescent except pits in lower surface. Inflorescence terminal, 3–4 cm long; involucral bracts villous, most falling early. Flowers lemon-yellow, including style. Perianth 39–43 mm long including limb of 9–11 mm, hirsute outside, glabrous inside. Pistil curved, 42–49 mm long, stiff, hirsute; pollen presenter 3–4 mm long, slightly swollen near base. Old flowers persistent. Follicles few, prominent, elliptic, 35–42 mm long, 17–22 mm high, 15–20 mm wide, very convex, beaked at style-base, velvety. Seeds obovate, 30–32 mm long; seed body broadly obovate, 12–14 mm long, 11–13 mm wide, smooth outside, covered with thin processes on inner face. *Baxter's Banksia*. Fig. 26B–C.

Near the south coast of W.A., from the Stirling Ra. to the Oldfield R. in deep white or grey sand on plains and dunes, in tall shrubland. Flowers Dec.–May, mainly Jan.–Mar. Map 196.

W.A.: c. 14 km E of mouth of Oldfield R., *H.Eichler 20215* (PERTH); c. 24 km W of Bremer Bay, *R.B.Filson 9122* (MEL, PERTH); 24 km E of Hopetoun, *R.J.Hnatiuk 761277* (PERTH).

Related to *B. speciosa* which has longer leaves with more numerous smaller lobes that are whitish beneath, larger inflorescences with pale flowers, and larger follicles. Follicles typically opening with fire. Killed by fire and regenerates from seed.

18. Banksia speciosa R.Br., *Trans. Linn. Soc. London* 10: 210 (1810)

Sirmuellera speciosa (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: Lucky Bay, [W.A.], Jan. 1802, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 329 (1981); isolecto: BM, K, NSW.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 20 (1981); A.S.George, *Banksia Book* 105–107, fig. 20, pl. 40 (1984).

Shrub to 8 m tall, without lignotuber. Bark smooth, grey. Stems velvety. Leaves: petiole 5–10 mm long; lamina broadly linear, truncate, divided into 15–30 triangular lobes each side, 20–45 cm long, 2–4 cm wide; margins recurved; upper surface tomentose, glabrescent; lower surface white-tomentose. Inflorescence terminal, conspicuous, 4–12 cm long; involucral bracts velvety, falling early. Flowers cream to pale yellow; styles cream. Perianth 40–45 mm long including limb of 5–6 mm, hirsute outside, glabrous inside. Pistil curved, 40–50 mm long, hirsute; pollen presenter oblong, 4–5 mm long, kinked at middle, deep red. Old flowers persistent. Follicles up to 20, prominent, elliptic, 35–50 mm long, 20–30 mm high, 20–30 mm wide, with a thick suture, densely velvety. Seed obovate, 37–45 mm long; seed body obovate-cuneate, 10–14 mm long, 9–12 mm wide, smooth outside, muricate inside. *Showy Banksia*. Plate 36; Fig. 27B.

Occurs in W.A., along the south coast from East Mt Barren to Israelite Bay, with outliers near Point Culver. Grows in deep white sand on consolidated dunes, in tall shrubland; often dominant. Flowers throughout the year, with a peak in summer and autumn. Map 197.

W.A.: Gibson Soak, *L.Diels 5328* (B); c. 8 km W of Israelite Bay, *N.N.Donner 2831* (AD, PERTH); Culham Inlet turnoff, Ravensthorpe–Hopetoun road, *R.B.Filson 9207* (MEL, PERTH); Duke of Orleans Bay, *P.G.Wilson 8090 & K.Allan* (PERTH).

Related to *B. baxteri*, another south-western coastal species, which has short leaves with large, flat triangular lobes, squat flower spikes and smaller follicles. Follicles usually opening with fire. Killed by fire and regenerates from seed.

19. Banksia menziesii R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 36 (1830)

Sirmuellera menziesii (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: Swan River, [W.A.], Mar. 1827, *C.Fraser*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 327 (1981); isolecto: BM, K.

Illustrations: A.S.George, *Banksia Book* 101–103, fig. 19, pl. 39 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 28 (1988).

Tree to 10 m with fire tolerant stems, or shrub to 3 m with lignotuber. Bark thick, verrucose, friable, greyish pink or pale brown. Stems pubescent, glabrescent. Leaves: petiole 8–17 mm long; lamina oblong, 8–25 cm long, 1–4 cm wide, truncate; margins recurved, shallowly dentate; both surfaces tomentose, glabrescent except pits in lower surface. Inflorescence terminal, 4–12 cm long; involucral bracts tomentose, falling early. Flowers pale to deep pink or red with silvery indumentum, sometimes cream or brown; style similar to perianth but pale in lower half. Perianth 29–38 mm long including limb of 5–6 mm, silky pubescent outside, glabrous inside. Pistil curved, 37–41 mm long, glabrous but minutely papillose in upper half; pollen presenter narrowly fusiform, 2–2.5 mm long, 8-ribbed. Old flowers usually soon falling. Follicles up to 25, prominent, narrowly obovate, 25–35 mm long, 10–15 mm high, 10–15 mm wide, beaked, smooth, closely pubescent, mottled. Seed obovate, 23–30 mm long; seed body obovate, 10–11 mm long, 11–14 mm wide, pitted near margin outside, muricate inside. *Menzies' Banksia*, *Firewood Banksia*. Fig. 27A.

Occurs in W.A. near the west coast from the Murchison R. to Pinjarra, mostly on the coastal plain but with a few outliers farther inland, e.g. near Brookton; grows in deep sand in low woodland and tall shrubland. Flowers Feb.–Aug. Map 198.

W.A.: Jandakot, 10 May 1961, *A.S.George s.n.* (PERTH); c. 25 km SW of Eneabba, *A.S.George 14419* (CANB, PERTH); 17 km due NE of Brookton, *R.J.Hnatiuk 790124* (PERTH); Watheroo Natl Park, *G.J.Keighery 6963* (PERTH); c. 10 km ESE of Kalbarri, *P.G.Wilson 6758* (PERTH).

No species closely resembles *B. menziesii*. The nearest relative appears to be *B. speciosa* from the south coast of W.A. which has long leaves with deep triangular lobes, pale yellow flowers and large, unmottled follicles with the old flowers persisting. Follicles usually opening when mature. Fire-tolerant, sprouting from the trunk or lignotuber.

20. Banksia candolleana Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 118 (1855)

Sirmuellera candolleana (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: W of Dandaragan, W.A., 1850–51, *J.Drummond 6: 201*; lecto: NY, *fide* A.S.George, *Nuytsia* 3: 333 (1981); isolecto: B, BM, CGE, E, FI, K, LD, MEL, NSW, P, U.

Illustrations: A.S.George, *Banksia Book* 110–112, fig. 22, pl. 42 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 39 (1988).

Many-stemmed shrub to 1.3 m tall and 2.5 m wide, with lignotuber. Stems closely tomentose, glabrescent. Leaves: petiole 1–2 cm long; lamina pinnatisect with many triangular lobes, linear, 15–40 cm long, 6–20 mm wide, truncate; margins flat; both surfaces closely tomentose, glabrescent except pits in lower surface. Inflorescence on short lateral branchlet on older stem, 1.5–4 cm long; involucral bracts short, closely tomentose, falling early. Flowers golden yellow including styles. Perianth 20–27 mm long including limb of 3–4 mm, pubescent outside, glabrous inside. Pistil curved, 25–35 mm long, appressed-pubescent in lower third, glabrous above; pollen presenter narrowly ovoid, 2–2.5 mm long, 8-ribbed. Old flowers persistent. Follicles 1–5 (–15), prominent, obliquely obovate, curved, 2–6.5 cm long, 2.5–5 cm high, 1.7–3.5 cm wide, smooth, closely tomentose, grey-mottled. Seed curved-obovate, 3–6 cm long; seed body broadly obovate, 10–12 mm long, 12–17 mm wide, rugose with thin plates inside, rugose outside. *Propeller Banksia*. Plate 37; Fig. 27C–E.

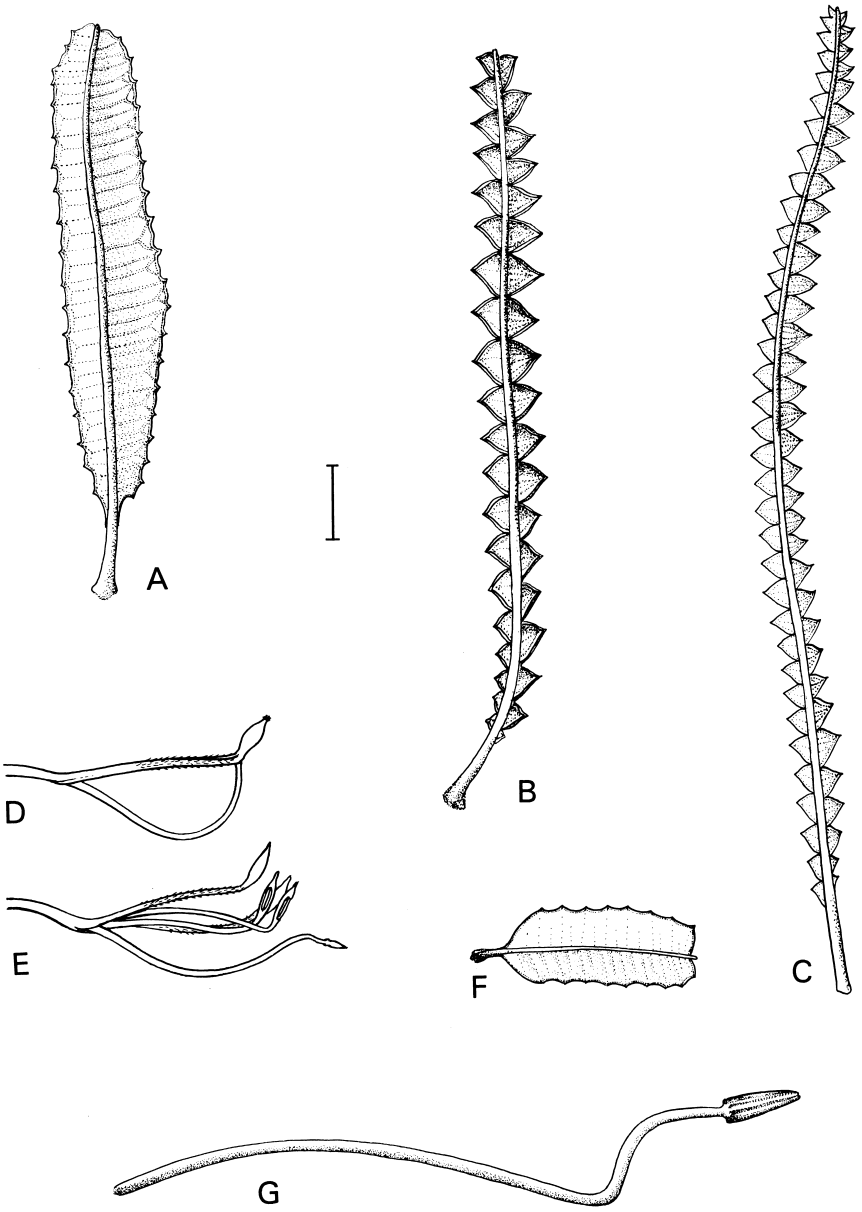

Figure 27. *Banksia*. **A**, *B. menziesii*, leaf, abaxial face (E.Canning 3402, CANB); **B**, *B. speciosa*, leaf, abaxial face (B.Mullins 359, CANB). **C**–**E**, *B. candolleana*. **C**, leaf, abaxial face (M.Phillips 1095, CANB); **D**, bud just before anthesis; **E**, open flower (**D**–**E**, cult. Perth, W.A.). **F**–**G**, *B. sceptrum*. **F**, leaf, abaxial face; **G**, pistil (**F**–**G**, M.Phillips, CANB). Scale bar: **A**–**C**, **F** = 2 cm; **D**–**E** = 7 mm; **G** = 5 mm. Drawn by: **A**–**C**, **F**–**G**, D.Boyer; **D**–**E**, M.Wilson.

Occurs near the west coast between the Arrowsmith R. and Gingin, W.A., in sand over laterite or in deep sand, in low kwongan, sometimes in tall shrubland; often common. Flowers Apr.–July. Map 199.

W.A.: Cockleshell Gully, *B.Evans WE574* (PERTH); 17 km N of Gingin, *A.S.George 7763* (PERTH); 35 km SW of Three Springs, *K.Newbey 2266* (PERTH).

This species has no close relatives but on the basis of leaf, flower and fruit morphology this species belongs to ser. *Banksia*. Fire-tolerant, sprouting from the lignotuber; follicles opening with fire. Flowers sometimes pink-tinged.

21. Banksia sceptrum Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7:120 (1855)

Sirmuellera sceptrum (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: N of the Hutt R., W.A., 1850–51, *J.Drummond 6: 206*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 335 (1981); isolecto: CGE, FI, K, LD, MEL, NSW, NY, P, U.

Illustrations: A.S.George, *Banksia Book* 113–115, fig. 23, pl. 43 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 44 (1988).

Shrub to 5 m tall and 4 m wide, without lignotuber. Bark smooth or slightly tessellated, grey. Stems tomentose, glabrescent. Leaves: petiole 5–8 mm long; lamina oblong, 4–9 cm long, 1–3 cm wide, truncate or emarginate; margins flat, very shortly and obtusely dentate; both surfaces densely tomentose, glabrescent except fine pits in lower surface. Inflorescence terminal, showy, 7–21 cm long; involucral bracts tomentose, falling early. Flowers yellow including styles. Perianth 28–32 mm long including limb of 6–8 mm, hirsute outside, glabrous inside. Pistil markedly S-shaped below apex, 40–50 mm long, shortly pubescent in lower half, glabrous above; pollen presenter fusiform with basal swelling, 3.5–4 mm long, 8-ribbed. Old flowers persistent. Follicles up to 50, broadly elliptic, 15–25 mm long, 8–18 mm high, 10–16 mm wide, smooth, pubescent, mottled. Seed obovate, 30–35 mm long; seed body obovate, 11–14 mm long, 7–9 mm wide, muricate inside, slightly rugose outside. *Sceptre Banksia*. Fig. 27F, G.

Occurs in W.A. near the central west coast, between Hamelin Pool and Geraldton, extending inland almost to Mullewa. Grows in deep yellow or pale red sand in tall shrubland, commonly on dunes. Flowers Dec.–Jan. Map 200.

W.A.: The Loop Rd, Kalbarri Natl Park, *M.I.H.Brooker 2383* (PERTH); c. 40 km N of Murchison R., North West Coastal Hwy, *R.B.Filson 8594* (MEL); Wicherina, E of Geraldton, 23 Dec. 1959, *M.C.George* (PERTH).

A distinctive species especially in the S-shaped upper part of the pistil and the oblong, very shortly dentate leaves. Killed by fire and regenerates from seed. Follicles usually opening with fire, splitting from stylar point. The inflorescence takes about 7 months to develop from beginning of elongation of the axis to anthesis.

Ser. 4. Crocinae

Banksia ser. **Crocinae** A.S.George, *Nuytsia* 3: 337 (1981)

Type: *B. prionotes* Lindl.

Erect trees or shrubs. Leaves alternate, dentate or triangular-lobed; margins flat or recurved. Inflorescence erect, cylindrical; buds retaining regular pattern until anthesis. Perianth villous; tepals not awned. Pistil curved; pollen presenter narrow with small median swelling, finely ribbed; pollen cylindrical or ovoid. Follicles split at stylar point. Seed wing notched.

A closely knit series of four species in south-western W.A. Follicles opening with fire, or (in *B. prionotes*) when mature.

22. Banksia prionotes Lindl., *Sketch Veg. Swan R.* xxxiv (1839)

Sirmuellera prionotes (Lindl.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: near the Swan River, W.A., late 1830s, *J.Drummond s.n.*, lecto: CGE, *fide* A.S.George, *Nuytsia* 3: 338 (1981).

Illustrations: A.S.George, *Banksia Book* 116–118, fig. 24, pl. 44 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 35 (1988).

Shrub or tree to 10 m without lignotuber. Bark smooth or horizontally grooved, thin, grey. Stems tomentose. Leaves: petiole 4–15 mm long; lamina commonly undulate, broadly linear, 15–27 cm long, 1–2 cm wide, obtuse; margins not recurved, dentate with triangular lobes; both surfaces pubescent to hirsute, glabrescent except pits in lower surface. Inflorescence conspicuous, 7–15 cm long; involucral bracts hirsute, persistent. Flowers cream with orange limb; indumentum white; styles cream, orange towards apex. Perianth 34–37 mm long including limb of 6–7 mm, tomentose-hirsute outside, glabrous inside. Pistil curved, 39–45 mm long, glabrous; presenter 4–6 mm long, fusiform, constricted above base, finely ribbed. Old flowers soon falling. Follicles up to 60, elliptic-oblong, 14–20 mm long, 3–6 mm high, 6–11 mm wide, smooth, tomentose, mottled. Seed cuneate-obovate, 16–19 mm long; seed body cuneate, 8–10 mm long, 5–6 mm wide, smooth inside, ridged outside. *Acorn Banksia*. Plate 38; Fig. 28H, I.

Widespread in W.A. from near Shark Bay to Perth, with populations inland to Wongan Hills, Quairading, Wagin and Newdegate. Grows in deep yellow or white sand, in tall shrubland and low woodland; locally common. Flowers Feb.–Aug. Map 201.

W.A.: Regans Ford, *R.B.Filson 8422* (MEL, PERTH); c. 46 km SE of Quairading on road to Babakin, *A.S.George 834* (PERTH); 192 km SE of Perth near Arthur R., Albany Hwy, *A.S.George 6352* (PERTH); E boundary, Murchison House Stn, *C.H.Gittins 1643* (NSW); L. Indoon, *R.Hnatiuk 780084* (PERTH).

Most closely related to *B. burdettii* which differs in having shorter dentate leaves with close lateral veins, larger follicles and persistent old flowers. Killed by fire and regenerates from seed. Presumed hybrids have been reported with *B. lindleyana* by A.S.George, *Nuytsia* 6: 316 (1988) and *B. hookeriana* by G.J.Keighery, *Banksia Atlas Newsletter* 3: 13 (1985).

23. Banksia burdettii Baker f., *J. Bot.* 72: 281 (1934)

T: near Watheroo, W.A., c. 1930, *W.Burdett*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 343 (1981); isolecto: BM.

Illustrations: A.S.George, *Banksia Book* 124, 125, fig. 27, pl. 47 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 55 (in press).

Shrub to 4 m without lignotuber. Stems tomentose, at length glabrous. Leaves: petiole 5–20 mm long; lamina narrowly cuneate-oblong, 10–16 cm long, 15–25 mm wide, truncate; margins slightly recurved, shortly dentate; both surfaces tomentose. Inflorescence 6–10 cm long; involucral bracts tomentose, mostly falling early. Flowers bright orange inside, pale outside with white hairs; styles orange. Perianth 34–35 mm long including limb of 5–6 mm, hirsute outside, glabrous inside. Pistil 35–38 mm long, curved, glabrous; pollen presenter narrow with swelling at centre and constriction below, 4–5 mm long. Old flowers persistent. Follicles up to 20, narrowly elliptic, 20–25 mm long, 5–10 mm high, 8–10 mm wide, smooth, hirsute. Seed obliquely obovate, 14–16 mm long; seed body broadly elliptic, 9–10 mm long, 12 mm wide, shallowly pitted outside, muricate inside. *Burdett's Banksia*. Fig. 28B, C.

Occurs between Eneabba and Mogumber, W.A., in deep white or yellow sand, in tall shrubland; sometimes locally common. Flowers late Jan.–May but mainly Feb.–Mar. Map 202.

W.A.: 17 km S of Eneabba–Carnamah road on Willis Rd, *A.S.George 14425* (PERTH); 35 km W of Mogumber, *T.J.Hawkeswood 224* (PERTH).

Related to *B. hookeriana* which has narrow leaves with many triangular lobes and which flowers in winter and spring. The leaves of *B. burdettii* resemble those of *B. menziesii* in the short teeth and close parallel lateral veins at almost 90º to midrib. Killed by fire and regenerates from seed.

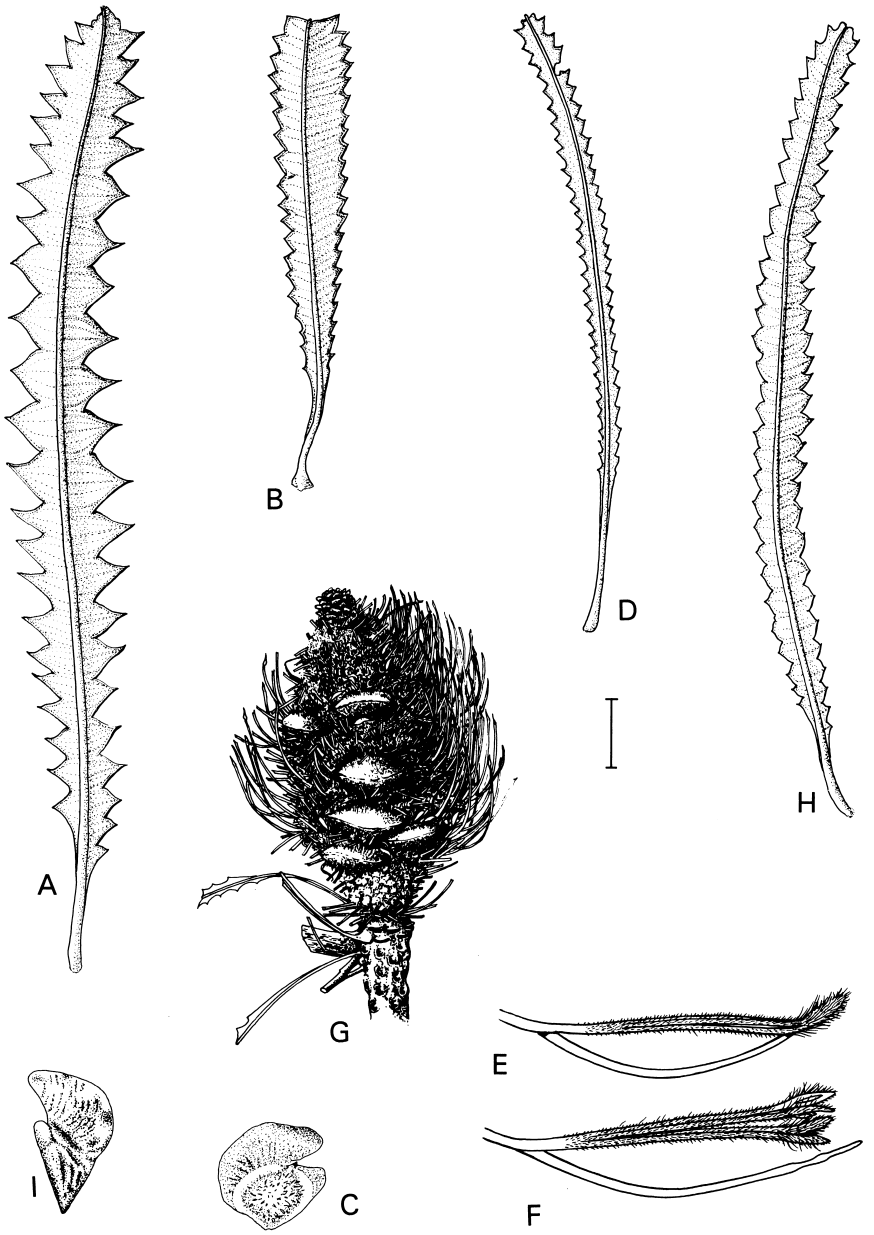

Figure 28. *Banksia*. **A**, *B. victoriae*, leaf, abaxial face (M.Phillips, 28 Sept. 1962, CANB). **B–C**, *B. burdettii*. **B**, leaf, abaxial face (B.Barnsley 915, CANB); **C**, seed, adaxial face (cult. Perth, W.A.). **D**–**G**, *B. hookeriana*. **D**, leaf, abaxial face (M.Phillips 1230, CANB); **E**, bud just before anthesis; **F**, open flower (**E**–**F**, cult. Perth, W.A.); **G**, infructescence (not recorded). **H**–**I**, *B. prionotes*. **H**, leaf, abaxial face (E.Canning 2387, CANB); **I**, seed, abaxial face (not recorded). Scale bar: **A–B**, **D**, **G**, **H** = 2 cm; **C**, **I** = 1 cm; **E–F** = 7 mm. Drawn by: **A**, **B**, **D**, **H**, D.Boyer; **E**, **F**, M.Wilson; **G**, P.Nikulinsky; **C**, **I**, A.George. **C**, **G**, **I**, reproduced with permission from *The Banksia Book* (1996).

24. Banksia hookeriana Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 119 (1855)

Sirmuellera hookeriana (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: S of Irwin R., W.A., 1850–51, *J.Drummond 6: 202*; lecto: NY, *fide* A.S.George, *Nuytsia* 3: 342 (1981); isolecto: BM, CGE, FI, K, LD, MEL, NSW, P, U.

Illustrations: A.S.George, *Banksia Book* 121–123, fig. 26, pl. 46 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 42 (1988).

Shrub to 3 m tall and broad, without lignotuber. Bark smooth. Stems tomentose. Leaves: petiole 5–15 mm long; lamina linear but gradually widening upwards, 6–16 cm long, 5–12 mm wide, truncate; margins ±flat, deeply lobed; both surfaces tomentose, glabrescent except pits in lower surface. Inflorescence 7–12 cm long; involucral bracts densely hirsute, persistent. Flowers orange with pale pink hairs; styles golden orange. Perianth 32–35 mm long including limb of 6–7 mm, pubescent to hirsute outside, glabrous inside. Pistil curved, 39–45 mm long, glabrous; pollen presenter narrow with slight swelling at centre, 4–5 mm long. Old flowers persistent, concealing follicles. Follicles up to 20, narrowly elliptic, c. 20 mm long, 5–7 mm high, 10 mm wide, smooth, hirsute. Seed obovate, c. 24 mm long; seed body cuneate, 8–14 mm long, 8–12 mm wide, smooth inside, rugose or pitted outside. *Hookers' Banksia*. Fig. 28D–G.

Restricted to an area between Arrowsmith Lake and Eneabba, W.A. Grows in deep white or yellow sand, in tall shrubland; locally common. Flowers Apr.–Oct. Map 203.

W.A.: near Eneabba, *A.M.Ashby 1663* (AD, PERTH); N of Arrowsmith L., *A.S.George 9776* (PERTH); Allanooka, 25 Aug. 1965, *A.Kessell* (PERTH).

Related to *B. burdettii* which has broader, shortly dentate leaves and flowers in late summer and autumn. Killed by fire and regenerates from seed. A presumed hybrid with *B. menziesii* has been reported by K.Dixon, *Protea News* 4: 35 (1986).

25. Banksia victoriae Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 119 (1855)

Sirmuellera victoriae (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: probably near the Hutt R., W.A., 1850–51, *J.Drummond 6: 203*; lecto: NY, *fide* A.S.George, *Nuytsia* 3: 340 (1981); isolecto: BM, CGE, FI, LD, MEL, NSW, OXF, P, U.

Illustrations: A.S.George, *Banksia Book* 119, 120, fig. 25, pl. 45 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 45 (1988).

Shrub to 7 m without lignotuber. Bark smooth, grey. Stems densely hirsute. Leaves: petiole 15–30 mm long; lamina broadly linear, 15–35 cm long, 2.5–4 cm wide, truncate; margins flat, deeply triangular-lobed; both surfaces woolly, glabrescent except pits in lower surface. Inflorescence 7–12 cm long; involucral bracts prominent, villous, persistent. Flowers orange with pale pink hairs; styles orange, cream at base. Perianth 38–40 mm long including limb of 8–9 mm, tomentose outside, glabrous inside. Pistil 37–43 mm long, curved, glabrous; pollen presenter 5–6 mm long, fusiform, constricted near base, finely 8-ribbed. Old flowers persistent, concealing follicles. Follicles up to 30, elliptic, 22–28 mm long, 10–15 mm high, 13–15 mm wide, hirsute. Seed obliquely obovate, 23–29 mm long; seed body triangular, 9–12 mm long, 7–9 mm wide, somewhat tuberculate on both sides, with a ridge across inner upper margin. *Woolly Orange Banksia*. Fig. 28A.

Restricted to a small area between the lower Murchison R. and Northampton, W.A. Grows in deep yellow or pale red sand, in tall shrubland. Flowers Jan.–Feb. Map 204.

W.A.: Murchison R., *C.A.Gardner 12057* (PERTH); c. 11 km NW of Ajana, *K.Newbey 2228* (PERTH).

The villous involucral bracts and woolly new growth are distinctive. Related to *B. prionotes* which has less-deeply lobed leaves, a shorter indumentum, shorter bracts under the flowers, smaller follicles and the old flowers falling. Killed by fire and regenerates from seed. Follicles usually opening with fire.

Ser. 5. Prostratae

Banksia ser. **Prostratae** A.S.George, *Nuytsia* 3: 367 (1981)

Type: *B. repens* Labill.

Shrubs; stems prostrate, rarely (*B. goodii*) erect and up to 20 cm tall. Leaves alternate, large, on long erect petioles, dentate or deeply lobed; margins flat or slightly recurved. Inflorescence erect, cylindrical; buds losing most pattern before anthesis. Perianth hirsute or pubescent; tepals not awned. Pistil curved; pollen presenter small, slightly swollen; pollen crescent-shaped. Follicles split from stylar point. Seed wing notched.

A series of six species endemic in south-western W.A., distinctive in their prostrate habit and large leaves.

26. Banksia goodii R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 36 (1830)

Sirmuellera goodii (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: near King George Sound, [W.A.], 1829, *W.Baxter*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 368 (1981); isolecto: BM, G, K, L, NSW, PERTH.

Banksia barbigera Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 2: 265 (1848). T: Swan River colony, 1840s, *J.Drummond 3: 290*; lecto: K, *fide* A.S.George, *loc. cit.*; isolecto: FI, G, K, MEL, P, PERTH.

Illustrations: A.S.George, *Banksia Book* 154, 155, fig. 40, pl. 61 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 29 (1988).

Shrub with lignotuber, prostrate or stems sometimes to 20 cm high. Stems densely tomentose, with linear bracts among leaves. Leaves: petiole 5–18 cm long; lamina very undulate, oblong-obovate, 15–30 cm long, 3–8 cm wide; margins not recurved, irregularly dentate; both surfaces densely hirsute, glabrescent except pits in lower surface. Inflorescence 8–15 cm long; involucral bracts prominent, hirsute. Flowers rusty brown; styles cream. Perianth 24–26 mm long including limb of 3 mm, hirsute outside, and inside in upper half; limb hirsute, glabrescent. Pistil 29–31 mm long, gently curved, glabrous; pollen presenter ovoid, 0.3–0.4 mm long. Old flowers persistent. Follicles up to 15, elliptic, 25–32 mm long, 10–15 mm high, 10–12 mm wide, smooth, densely hirsute. Seed obovate, 25–32 mm long; seed body triangular, 9–12 mm long, 14–16 mm wide, smooth inside, irregularly ridged outside. Figs 29G, 30F–G.

Between Albany and the Porongurup Ra., W.A. Grows in sand over laterite, in low forest and woodland. Listed as 'Vulnerable' in the ANZECC Threatened Flora List 1997. Flowers Nov.–Dec. Map 205.

W.A.: N of Millbrook Rd, *A.S.George 6331* (PERTH).

Fire-tolerant, sprouting from the lignotuber. Related to *B. gardneri*, which has regularly lobed or dentate leaves, smaller less hirsute bracts and usually smaller inflorescences.

27. Banksia gardneri A.S.George, *Nuytsia* 3: 369 (1981)

Based on *B. prostrata* R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 36 (1830), *nom. illeg. non* J.R.Forst. & G.Forst. (1775); *Sirmuellera prostrata* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891), *nom. illeg.* T: near King George Sound, [W.A.], 1823, *W.Baxter*; lecto: BM, *fide* A.S.George, *loc. cit.*; isolecto: BM, K, PERTH.

Shrub with lignotuber. Stems on surface, rarely underground, tomentose. Leaves: petiole 4–12 cm long; lamina pinnatipartite or dentate, oblong to narrowly obovate, 10–28 cm long, 2–6 cm wide; lobes regular, triangular to oblong, obtuse or acute, entire; margins flat; both surfaces villous, glabrescent except pits in lower surface. Inflorescence 3.5–10 cm long; involucral bracts 1–3 cm long, tomentose or shortly hirsute. Flowers rusty brown, rarely pink with pale brown limb; styles cream. Perianth 17–26 mm long including limb of 3–4 mm, densely hirsute outside, hirsute in upper half inside; limb hirsute, glabrescent except at apex. Pistil 18–30 mm long, gently curved, glabrous; pollen presenter ovoid, 0.4–0.5 mm long; ovary with hairs at apex. Old flowers persistent. Follicles up to 25, elliptic, 23–40 mm long, 5–20 mm high, 8–15 mm wide, densely hirsute. Seed broadly obovate, 22–37 mm long; seed body cuneate, 9–12 mm long, 11–21 mm wide, smooth inside, irregularly ridged outside.

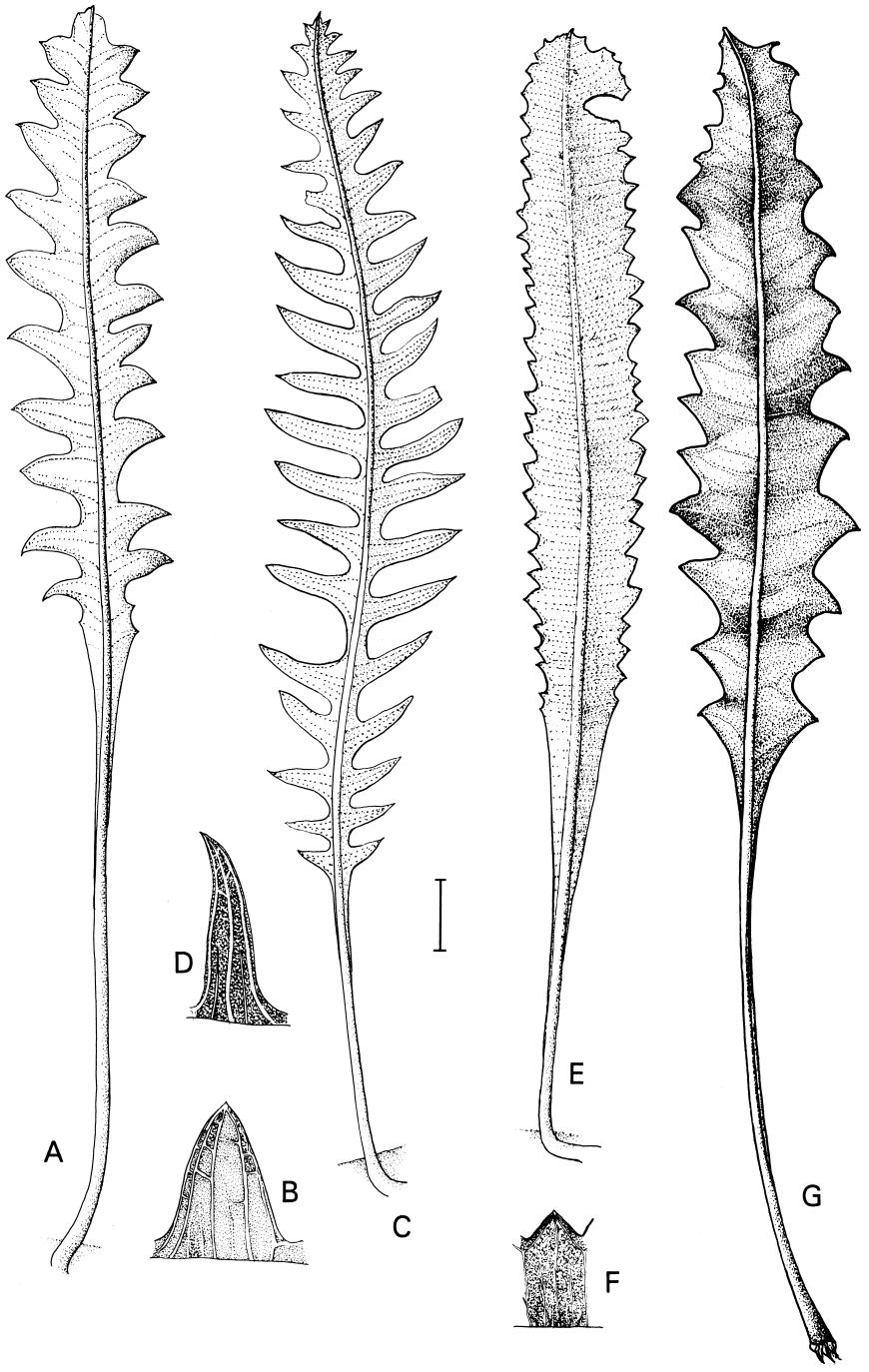

Figure 29. *Banksia* leaves, abaxial face (vouchers not recorded). **A**–**B**, *B. gardneri* var. *gardneri*. **A**, leaf; **B**, detail of leaf. **C**–**D**, *B. gardneri* var. *hiemalis*. **C**, leaf; **D**, detail of leaf. **E**–**F**, *B. gardneri* var. *brevidentata*. **E**, leaf; **F**, detail of leaf. **G**, *B. goodii*. Scale bar: **A**, **C**, **E** = 2.4 cm; **B**, **D**, **F** = 1.2 cm; **G** = 1.6 cm. Drawn by D.Boyer.

Occurs in W.A., from Cranbrook to Ravensthorpe, inland to Harrismith, and south towards the coast, with an outlier on Mt Lindesay. in sand, sandy loam or gravel, in shrubland, low woodland or kwongan.

Fire-tolerant, sprouting from the lignotuber; follicles opening with fire, splitting from stylar point. Related to *B. goodii*, a rare species with large, unevenly dentate leaves and long villous bracts at the base of the flower spike. The argument for raising var. *brevidentata* and var. *hiemalis* to specific rank (Thiele in Thiele & Ladiges, 1996) is not strong, the habit and floral morphology being virtually the same, and var. *brevidentata* differing from var. *gardneri* only in the toothed rather than lobed leaves — leaf lobing is variable in the species.

There are three varieties.

1	Leaves shortly dentate	**27b.** var. **brevidentata**
1:	Leaves pinnatipartite	
2	Flowers rusty brown, mainly in spring	**27a.** var. **gardneri**
2:	Flowers pink with pale brown limb, mainly in winter	**27c.** var. **hiemalis**

27a. Banksia gardneri A.S.George var. **gardneri**

Illustrations: A.S.George, *Banksia Book* 156, fig. 41A, pl. 62 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 26 (1988).

Leaves pinnatipartite. Flowers rusty brown. Plate 39; Figs 29A, B, 30E.

Occurs from Cranbrook east through the Stirling Ra. towards Bremer Bay and south to Albany, with an outlier on Mt Lindesay. Grows in sand or gravel in tall or low shrubland and in low open woodland. Flowers Sept.–Nov. Map 206.

W.A.: Mt Warrungup, Stirling Ra., 21 Oct. 1963, *A.M.Ashby s.n.* (AD); c. 31 km E of Manypeaks, *R.B.Filson 9084* (MEL); c. 22 km SE of Borden on Bremer Bay road, *A.S.George 1707* (PERTH); Mt Lindesay, 1882, *W.Webb* (MEL); c. 25 km E of Cranbrook, *P.G.Wilson 3314* (AD).

27b. Banksia gardneri var. **brevidentata** A.S.George, *Nuytsia* 3: 372 (1981)

Banksia brevidentata (A.S.George) K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot.* 9: 719 (1996). T: near Bluff Knoll, Stirling Ra., W.A., 7 July 1969, *A.S.George 9393*; holo: PERTH; iso: CANB, K, NSW.

Illustrations: A.S.George, *Banksia Book* 158, 159, fig. 41B, pl. 63 (1984).

Differs from var. *gardneri* in having shortly dentate leaves and flowers opening in winter. Fig. 29E, F.

Restricted to the Stirling Ra., W.A. except a single population near Albany. in white sand, often with schistose rocks, in low woodland and tall shrubland. Flowers Apr.–July. Map 207.

W.A.: Millbrook Rd, N of Albany, Dec. 1963, *F.W.Humphreys* (PERTH); Mt Trio, 22 July 1952, *N.H.Speck* (CANB); near Mt Hassell, 13 Oct. 1961, *J.H.Willis* (MEL).

27c. Banksia gardneri var. **hiemalis** A.S.George, *Nuytsia* 3: 372 (1981)

Banksia hiemalis (A.S.George) K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot.* 9: 719 (1996). T: 31 km W of Ravensthorpe, W.A., 5 Sept. 1976, *A.S.George 14354*; holo: PERTH; iso: CANB, K.

Illustration: A.S.George, *Banksia Book* 159, pl. 64 (1984).

Differs from the other two varieties in having pale green leaves and the flowers pink with pale brown limb; leaves pinnatipartite; flowers opening in winter. Fig. 29C, D.

Occurs between Harrismith, West Mt Barren and Ravensthorpe, W.A. in sand or sandy loam, usually over laterite, in kwongan and mallee kwongan. Flowers June–Aug. Map 208.

W.A.: c. 41 km E of Jerramungup, *A.S.George 4404* (PERTH); c. 16 km E of Harrismith, *A.S.George 9900* (PERTH); between Hamersley R. and East Mt Barren, *B.R.Maslin 866* (PERTH).

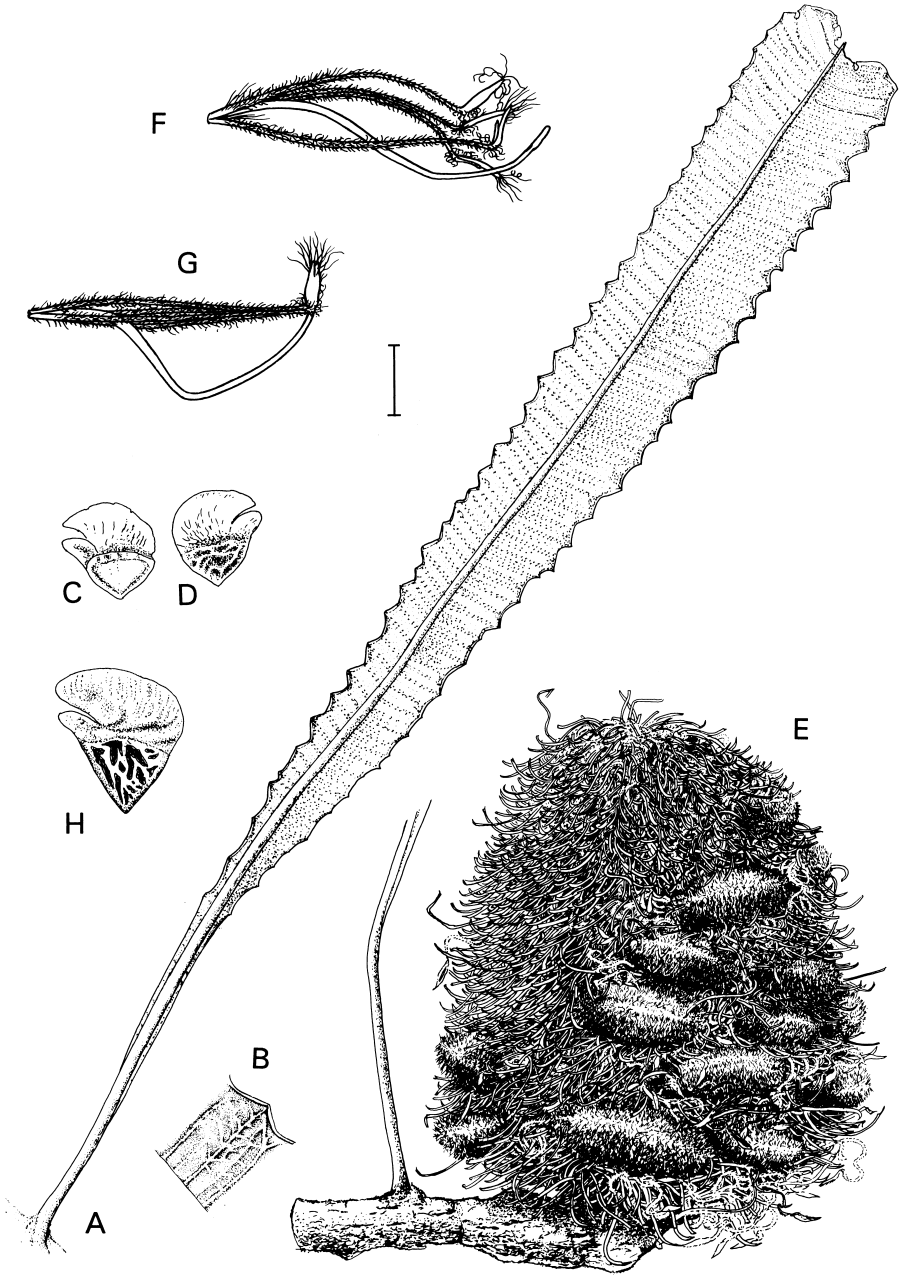

Figure 30. *Banksia*. **A**–**D**, *B. petiolaris*. **A**, leaf, abaxial face; **B**, detail of leaf, abaxial face; **C**, seed, adaxial face; **D**, seed, abaxial face (**A**–**D**, not recorded). **E**, *B. gardneri* var. *gardneri*, infructescence, (not recorded); **F**–**G**, *B. goodii*. **F**, bud just before anthesis; **G**, open flower (**F**–**G**, cult. PERTH). **H**, *B. blechnifolia*, seed, abaxial face (A.George 10499, PERTH). Scale bar: **A**, **C**–**D** = 2 cm; **B** = 1 cm; **E** = 7.5 mm; **F**–**G** = 5 mm; **H** = 1.3 cm. Drawn by: **A**, **B**, D.Boyer; **C**–**D**, **H**, A.George; **E**, P.Nikulinsky; **F**–**G**, M.Wilson. **C**, **D**, **E**, **H**, reproduced with permission from *The Banksia Book* (1996).

28. Banksia chamaephyton A.S.George, *Nuytsia* 3: 375 (1981)

T: W of Mogumber, W.A., 15 Nov. 1971, *A.S.George 11204*; holo: PERTH; iso: AD, BRI, CANB, K, MEL, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 160, 161, fig. 42, pl. 65 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 70 (in press).

Shrub with lignotuber. Stems underground, velvety. Leaves: petiole 5–21 cm long; lamina pinnatipartite with 10–30 linear lobes each side, 15–30 cm long, 4–16 cm wide; margins flat; both surfaces tomentose, glabrescent except pits in lower surface. Inflorescence 6–12 cm long; involucral bracts velvety. Flowers cream with brown limb and pale brown to white hairs; upper buds pink; styles cream. Perianth 23–30 mm long including limb of 2.5–3 mm, hirsute outside, glabrous inside except a few hairs in upper half; limb hirsute, glabrescent. Pistil curved, 25–35 mm long, glabrous; pollen presenter ovoid, 0.5–0.8 mm long. Old flowers persistent. Follicles up to 15, elliptic, 25–40 mm long, 12–20 mm high, 15–20 mm wide, smooth, tomentose. Seed obovate, 27–36 mm long; seed body cuneate, 11–17 mm long, 14–22 mm wide, smooth inside, pitted outside. Fig. 31C, D.

Occurs near the west coast of W.A. between Eneabba and Mogumber. in sand over laterite, in kwongan. Flowers late Oct.–early Dec. Map 209.

W.A.: W of Winchester on Green Head Rd, Dec. 1970, *C.Chapman* (PERTH); E of Mt Peron, 26 Aug. 1949, *F.A.Grigson* (PERTH); Badgingarra, 5 Nov. 1966, *G.E.Lang* for *A.M.Ashby* (AD).

Fire-tolerant, regenerating from the lignotuber. Related to *B. gardneri*, which has shorter, broader leaf lobes, usually rusty brown flowers and grows near the south coast.

29. Banksia blechnifolia F.Muell., *Fragm.* 4: 108 (1864)

T: near the south coast of W.A., 1861, *G.Maxwell*; lecto: MEL, *fide* A.S.George, *Nuytsia* 3: 378 (1981).

Banksia pinnatisecta F.Muell., *Fragm.* 7: 58 (1869), *nom. nud.*

Illustrations: A.S.George, *Banksia Book* 164, 165, fig. 44, pl. 67 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 49 (in press).

Shrub without lignotuber. Stems on surface, woolly. Leaves: petiole 5–18 cm long; lamina pinnatipartite, 20–30 cm long, 4–10 cm wide; lobes linear to narrowly triangular, acute, entire, bluish green; margins flat; both surfaces tomentose-hirsute, glabrescent except pits in lower surface. Inflorescence 6–16 cm long; involucral bracts woolly. Flowers reddish pink; styles cream. Perianth 28–32 mm long including limb of 3.5–5 mm, straight, pubescent inside and outside; limb densely hirsute. Pistil gently curved, 30–38 mm long, glabrous; pollen presenter slightly swollen, 0.5–1 mm long. Old flowers persistent. Follicles up to 25, elliptic, 20–30 mm long, 5–10 mm high, 10–15 mm wide, villous. Seed cuneate-obovate, 20–25 mm long; seed body cuneate, 9–12 mm long, 12–17 mm wide, smooth inside, irregularly pitted outside. Plate 40; Figs 30H, 31A, B.

Occurs between Jerramungup and Gibson, W.A. Grows in white sand, in kwongan or mallee kwongan. Flowers late Sept.–mid-Nov. Map 210.

W.A.: NE of Jerramungup, *A.S.George 7025* (PERTH); c. 17 km SE of Lake King, *A.S.George 10499* (PERTH); c. 56 km SSE of Newdegate, *J.W.Green 4900* (PERTH); c. 30 km N of Esperance, *R.H.Kuchel 1725* (AD, PERTH).

Killed by fire and regenerates from seed. Related to *B. repens* which has irregularly lobed leaves, creamy pink flowers and underground stems from a lignotuber, and to *B. petiolaris* which has dentate leaves with a tomentose underside and a creamy yellow perianth limb and style. Mueller cited no type in the protologue but in *Additamenta ad Volumen Quartum* of the *Fragmenta* he cited 'In Nova Hollandia austro-occidentali'.

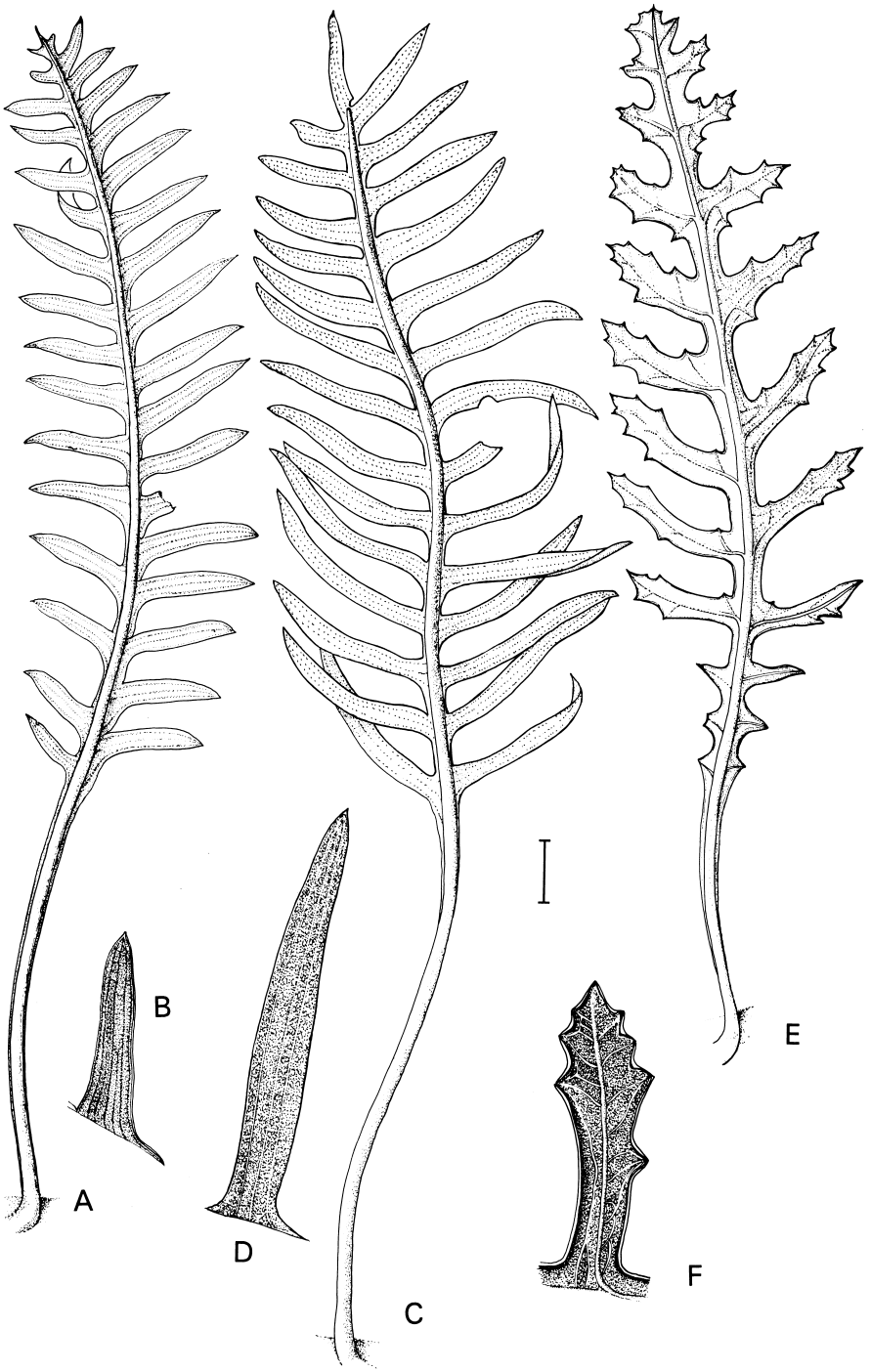

Figure 31. *Banksia* leaves, abaxial face (vouchers not recorded). **A–B**, *B. blechnifolia*. **A**, leaf; **B**, detail of leaf. **C–D**, *B. chamaephyton*. **C**, leaf; **D**, detail of leaf. **E–F**, *B. repens*. **E**, leaf; **F**, detail of leaf. Scale bar: **A**, **C**, **E** = 2 cm; **B**, **D**, **F** = 1 cm. Drawn by D.Boyer.

30. Banksia repens Labill., *Voy. Rech. Pérouse* 1: 411, t. 23 (1800)

Sirmuellera repens (Labill.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891); *B. polypodiifolia* Knight, *Cult. Prot.* 113 (1809), *nom. illeg*. T: Esperance Bay, [W.A.], Dec. 1792, *J.J.H. de Labillardière*; lecto: FI, *fide* A.S.George, *Nuytsia* 3: 377 (1981); isolecto: FI.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 7 (1981); A.S.George, *Banksia Book* 162, 163, fig. 43, pl. 66 (1984).

Shrub with fire-tolerant underground, velvety stems. Leaves scattered, erect; petiole 5–15 cm long; lamina pinnatipartite, 18–40 cm long, to 18 cm wide; lobes ±cuneate, truncate; margins flat, obtusely dentate; both surfaces tomentose, glabrescent except pits in lower surface. Inflorescence commonly arising well beyond leaves, 6–10 cm long; involucral bracts tomentose. Flowers cream and pink; styles pale pink or cream. Perianth 26–29 mm long including limb of 2.5–3 mm, hirsute outside including limb, glabrous inside. Pistil 28–33 mm long, gently upcurved, glabrous; pollen presenter slightly swollen, 0.5 mm long. Old flowers persistent. Follicles few, elliptic, 20–40 mm long, 10–30 mm high, 12–15 mm wide, tomentose. Seed obovate, 30–40 mm long; seed body cuneate, 14–17 mm long and wide, smooth inside, pitted outside. *Creeping Banksia*. Fig. 31E, F.

Near the south coast of W.A., from Cranbrook to Israelite Bay, in sand or sandy loam, sometimes with gravel, in kwongan; sometimes on coastal dunes. Flowers Oct.–Nov. Map 211.

W.A.: Hopetoun, Oct. 1903, *C.Andrews* (PERTH); c. 25 km W of Israelite Bay, *N.N.Donner 2832* (AD); c. 3 km W of Bremer Bay, *R.B.Filson 9108* (PERTH); Duke of Orleans Bay, *A.E.Orchard 1325* (AD); near Cranbrook, *C.T.White 5413* (B, BRI).

Easily recognised by the cuneate-dentate leaf lobes and underground stems. Fire-tolerant, sprouting from a lignotuber. Related to *B. blechnifolia* which has red-pink flowers and is fire-sensitive, and to *B. chamaephyton* which has creamy brown flowers.

31. Banksia petiolaris F.Muell., *Fragm.* 4: 109 (1864)

Sirmuellera petiolaris (F.Muell.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: between Cape le Grand and Cape Arid, W.A., probably in 1861, *G.Maxwell*; holo: MEL; iso: PERTH (fragments).

Illustrations: A.S.George, *Banksia Book* 166, 167, fig. 45, pl. 68 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 50 (in press).

Shrub, spreading to 2 m across, without lignotuber. Stems on surface, tomentose. Leaves: petiole 6–15 cm long; lamina oblong to narrowly cuneate, 20–40 cm long, 2–4 cm wide, obtuse; margins recurved, obtusely dentate; upper surface velvety, glabrescent; lower surface closely white-tomentose. Inflorescence 9–16 cm long; involucral bracts tomentose. Flowers pink or reddish with cream limb; styles cream. Perianth 24–27 mm long including limb of 3.5–4 mm, loosely hirsute outside, glabrous or almost so inside; limb hirsute. Pistil gently curved, 31–34 mm long, glabrous; pollen presenter scarcely swollen, 0.5–0.8 mm long. Old flowers persistent. Follicles up to 20, elliptic, 28–38 mm long, 15–20 mm wide, densely tomentose. Seed obovate, 25–28 mm long; seed body cuneate, 10–15 mm long, 14–20 mm wide, smooth inside, pitted outside. Fig. 30A–D.

Near the south coast of W.A., from Munglinup to Israelite Bay. in deep white sand, in kwongan or mallee-kwongan. Flowers mid-Oct.–mid-Dec. Map 212.

W.A.: Munglinup, Oct. 1968, *G.H.Burvill* (PERTH); Gibson Soak, *L.Diels 5336* (B); c. 48 km SW of Mt Ragged, *A.S.George 2030* (PERTH); Israelite Bay, 27 Nov. 1950, *J.H.Willis* (MEL).

Killed by fire and regenerates from seed. May be recognised easily by the dentate leaves that are white-tomentose below. Related to *B. blechnifolia* which has deeply lobed leaves and reddish pink flowers.

Ser. 6. Cyrtostylis

Banksia ser. **Cyrtostylis** (Benth.) A.S.George, *Nuytsia* 3: 344 (1981)

Banksia sect. *Cyrtostylis* Benth., *Fl. Austral*. 5: 542, 549 (1870). T: *B. media* R.Br.; lecto, *fide* A.S.George, *loc. cit*.

Banksia ser. *Lindleyana* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot*. 9: 719 (1996). T: *B. lindleyana* Meisn.

Banksia ser. *Ochraceae* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *loc. cit*. T: *B. benthamiana* C.A.Gardner

Erect or spreading trees or shrubs. Leaves alternate, serrate, dentate or lobed; margins flat or recurved. Inflorescence erect or (*B. elderiana*) pendulous, cylindrical, ovoid or spherical; buds typically losing regular pattern before anthesis. Perianth closely hairy to villous or glabrous; tepals not awned. Pistil straight or gently curved; pollen presenter only slightly thickened, smooth or finely ribbed; pollen usually crescent-shaped. Follicles split from stylar point. Seed wing notched.

A rather heterogeneous series of 13 species endemic in W.A. Thiele & Ladiges (1996) have proposed dividing it into three series.

32. Banksia media R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 35 (1830)

Sirmuellera media (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: between Cape Arid and Lucky Bay, [W.A.], 1824, *W.Baxter*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 343 (1981); isolecto: BM, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 126, 127, fig. 28, pl. 48 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 27 (1988).

Shrub or tree to 10 m, without lignotuber, usually much-branched. Bark roughly fissured, grey. Stems tomentose. Leaves alternate; petiole 5–10 mm long; lamina narrowly cuneate, 4–12 cm long, 7–20 mm wide, truncate; margins slightly recurved, shortly serrate; both surfaces pubescent or hirsute, glabrescent except pits in lower surface. Inflorescence usually on short lateral branchlet, sometimes terminal, 6–16 cm long; involucral bracts tomentose, falling early. Flowers golden yellow, with limb often brown; styles cream. Perianth 32–38 mm long including limb of 3–4 mm, pubescent outside with glabrous limb, glabrous inside. Pistil gently curved, 33–40 mm long, glabrous; pollen presenter ovoid, less than 1 mm long, obscurely ribbed. Old flowers long-persistent. Follicles up to 70, often concealed, elliptic, 15–25 mm long, 8–14 mm high, 8–11 mm wide, warted, sparsely hirsute, glabrescent. Seed obovate, 25–34 mm long; seed body obovate, 10–12 mm long, 5–7 mm wide, slightly rugose on both sides. *Southern Plains Banksia*.

Widespread in southern W.A. from near the eastern end of the South Stirling plain to Israelite Bay, with outlying populations at Point Culver and Toolinna Cove; extends inland to Lake Cronin. Grows in sand, loam and clay, sometimes over limestone or granite, in kwongan, shrubland or open woodland. Flowers mainly Mar.–Aug. Map 213.

W.A.: S end, Mt Ragged, *B.Barnsley 331* (CANB, PERTH); near Point Irby, *A.S.George 6155* (PERTH); c. 17 km SE of Lake King crossroads, *A.S.George 9332* (AD, CANB, K, MEL, NSW, PERTH).

Variable in habit (notably a population of prostrate plants at Point Ann) and in leaves: populations east of Ravensthorpe have longer, narrower leaves than those to the west. Related to *B. praemorsa* which has flat leaves with short, blunt teeth and glabrous dark red and green flowers, and to *B. epica*, which has longer flowers, a longer pollen presenter and typically shorter leaves. Killed by fire and regenerates from seed. Follicles usually opening with fire, splitting from stylar point.

33. Banksia praemorsa Andrews, *Bot. Repos.* 4: t. 258 (1802)

Banksia marcescens R.Br., *Trans. Linn. Soc. London* 10: 208 (1810), *nom. superfl.*; *B. marcescens* var. *praemorsa* (Andrews) Colla, *Hortus. Ripul.* 18 (1824), *nom. illeg.*; *Sirmuellera praemorsa* (Andrews) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: cultivated at the Royal [Botanic] Gardens, Kew, 1802, raised from seed collected at King George Sound, [W.A.], Sept.–Oct. 1791, *A.Menzies*; neo: BM, *fide* A.S.George *Nuytsia* 3: 347 (1981).

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 11 (1981); A.S.George, *Banksia Book* 129, 130, fig. 29, pl. 49 (1984).

Shrub to 4 m, without lignotuber. Bark rough, flaking. Stems tomentose. Leaves scattered; petiole 2–5 mm long; lamina narrowly cuneate, 2–6 cm long, 7–21 mm wide, truncate; margins flat, obtusely serrate; both surfaces tomentose-hirsute, glabrescent except fine pits in lower surface. Inflorescence on short lateral branchlet or terminal, 10–27 cm long; involucral bracts tomentose-hirsute. Flowers red-maroon where exposed, otherwise pale greenish yellow, pink inside; limb greenish; rarely all yellow. Perianth 29–39 mm long including limb of 4–5 mm, glabrous. Pistil curved, 30–40 mm long, glabrous; pollen presenter cylindrical, 1 mm long, obscurely ribbed. Old flowers long-persistent. Follicles narrowly elliptic, 18–20 mm long, 6–9 mm high, 7–10 mm wide, warted, glabrous. Seed obliquely obovate, 20–22 mm long; seed body 10–11 mm long, 6–8 mm wide, slightly rugose on both sides.

Restricted to the south coast between Albany and Bald Is., W.A., on coastal dunes, sometimes overlying granite or limestone, in kwongan. Flowers Aug.–Nov. Map 214.

W.A.: Isthmus Bay, Torndirrup Natl Park, *A.S.George 14380* (PERTH); Bald Is., May 1963, *G.M.Storr* (PERTH).

Killed by fire and regenerates from seed. Follicles mostly opening with fire, splitting from stylar point. Related most closely to *B. media* which has serrate leaves with somewhat recurved margins, gold and brown flowers and pubescent perianth claws.

34. Banksia epica A.S.George, *Nuytsia* 6: 310 (1988)

T: Point Culver, W.A., May 1986, *J.Falconer*; holo: PERTH; iso: CANB, MEL.

Illustrations: A.S.George, *Banksia Book* 2nd edn, 128, fig. 28A, pl. 48A (1987); C.E.Rosser & A.S.George, *Banksias* III: pl. 76 (in press).

Shrub to 3 m, without lignotuber. Bark fissured, grey. Stems hoary. Leaves: petiole 2–8 mm long; lamina obovate to narrowly cuneate, 15–50 mm long, 6–15 mm wide, truncate; margins flat or gently recurved, obtusely serrate; upper surface rusty-tomentose becoming scurfy; lower surface glabrous except pits in lower surface. Inflorescence on short lateral branchlet, 9–17 cm long; flowers crowded; involucral bracts linear, 8–10 mm long, villous, falling early. Flowers cream including styles. Perianth 40–44 mm long including limb of 4.5–5.5 mm; claws appressed-pubescent in upper half, glabrous below and inside; limb glabrous. Pistil gently curved, 39–43 mm long, glabrous; pollen presenter 1.5–1.8 mm long, obscurely ribbed. Old flowers persistent in fruit. Follicles up to 50, elliptic, 13–20 mm long, 7–10 mm high, 6–9 mm wide, warted, sparsely hairy. Seed 22–24 mm long; seed body obovate, 11–13 mm long, 7–8 mm wide, with scattered small ridges each side. Plate 41; Fig. 32A.

Restricted to clifftops of the western Great Australian Bight, at Point Culver and Toolinna Cove, W.A. Grows in deep white sand over limestone, emergent above low kwongan. Flowers Apr.–June. Map 215.

W.A.: Toolinna, *A.S.George 16932* (CANB, K, MEL, NSW, PERTH).

This species is unusual in having bright green tips to the common and floral bracts. Flowers strongly scented. Closely related to *B. media* and *B. praemorsa* but with longer flowers and larger pollen presenter. *Banksia praemorsa* has a glabrous perianth. *Banksia media* has larger, more undulate leaves.

35. Banksia pilostylis C.A.Gardner, *J. Roy. Soc. W. Australia* 47: 57 (1964)

T: near the Young R., W.A., 18 Oct. 1960, *C.A.Gardner 12891*; lecto: PERTH, *fide* A.S.George, *Nuytsia* 3: 348 (1981).

Illustrations: A.S.George, *Banksia Book* 131, 132, fig. 30, pl. 50 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 57 (in press).

Shrub to 4 m, without lignotuber. Bark fissured, hard, grey. Stems tomentose. Leaves: petiole 4–6 mm long; lamina narrowly cuneate, 5–16 cm long, 5–20 mm wide, truncate; margins recurved, serrate; both surfaces densely tomentose-hirsute, glabrescent on upper surface. Inflorescence usually on short lateral branchlet, sometimes terminal, 5–10 cm long; flowers firmly packed; involucral bracts tomentose to villous, many persistent to flowering. Flowers pale yellow, those at apex commonly pale brown; styles cream. Perianth 20–24 mm long including limb of 2–2.5 mm, hirsute outside and inside. Pistil curved, 23–27 mm long, hirsute; pollen presenter not thickened, 1 mm long, finely ribbed. Old flowers persistent. Follicles up to 25, elliptic, 22–35 mm long, 15–20 mm high, 10–16 mm wide, warted, tomentose, glabrescent. Seed broadly obovate, 25–30 mm long; seed body obovate-cuneate, 9–10 mm long, 10–11 mm wide, smooth inside, somewhat rugose outside. Fig. 33D–F.

Occurs near the south coast between Ravensthorpe and Israelite Bay, W.A., in white sand or sandy loam, commonly on the edges of depressions, in kwongan and low open woodland. Flowers Oct.–Jan. Map 216.

W.A.: N of Scaddan, *A.M.Ashby 2778* (AD); c. 55 km E of Ravensthorpe, *A.S.George 15271* (AD, CANB, K, MEL, NSW, PERTH); Cape Arid Natl Park, *A.S.George 16000* (PERTH); Wittenoom Hills, *A.E.Orchard 1367* (AD, PERTH).

Flowers tightly packed in the inflorescence. Related to *B. media* which is usually a larger shrub or tree and has shorter leaves with less recurved margins, larger gold and brown flowers with glabrous limbs, glabrous styles and smaller follicles. Killed by fire and regenerates from seed. Most follicles opening with fire, splitting from stylar point.

36. Banksia attenuata R.Br., *Trans. Linn. Soc. London* 10: 209 (1810)

Sirmuellera attenuata (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: King George Sound, [W.A.], Dec. 1801, *R.Brown*; holo: BM.

Banksia cylindrostachya Lindl., *Sketch Veg. Swan R.* xxxiv (1840). T: Swan R. colony, [W.A.], late 1830s, *J.Drummond s.n.*; lecto: CGE, *fide* A.S.George, *Nuytsia* 3: 350 (1981).

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 12 (1981); A.S.George, *Banksia Book* 133–135, fig. 31, pl. 51 (1984).

Shrub to 2 m or tree to 10 m tall, with lignotuber or fire-tolerant trunk. Bark thick, verrucose, friable, pale grey-orange. Stems pubescent. Leaves narrowed to petiole up to 1 cm long; lamina linear, 4–27 cm long, 5–16 mm wide, truncate; margins slightly recurved, obtusely and shortly serrate; upper surface hirsute, glabrescent; lower surface tomentose. Inflorescence terminal, 5–26 cm long; involucral bracts hirsute, viscid, persistent. Flowers bright yellow including styles. Perianth 15–22 mm long including limb of 3–4.5 mm, glabrous. Pistil gently curved, 15–22 mm long, glabrous; pollen presenter narrow, 1 mm long, smooth. Old flowers persistent, with styles curled against axis. Follicles broadly elliptic, 20–35 mm long, 10–15 mm high, 14–20 mm wide, smooth, densely hirsute, often darkly mottled. Seed obovate, 22–26 mm long; seed body cuneate, 12–14 mm long, 13–14 mm wide, smooth inside, rugose outside. *Slender Banksia*.

Widespread in south-western W.A. from Kalbarri to Cape Leeuwin and east to the Fitzgerald R., extending inland to Wongan Hills and Lake Grace. Grows in deep sand, sometimes over limestone or laterite, in kwongan, shrubland and woodland. Flowers mainly Oct.–Feb. Map 217.

W.A.: Spalding Park, N of Geraldton, *A.C.Burns 22* (PERTH); 24 km W of Bremer Bay, *R.B.Filson 9123* (MEL, PERTH); 47 km E of Dumbleyung, *A.S.George 15266* (PERTH); L. Joondalup, *J.Havel 333* (PERTH); Cape Naturaliste, Oct. 1909, *J.H.Maiden NSW119893* (NSW).

Related to *B. lindleyana*, a shrubby plant with flat, shortly dentate leaves, much larger

flowers and smaller follicles, the old styles stiff and spreading. Fire-tolerant, sprouting from the branches, trunk and lignotuber. Follicles opening with or without fire; splitting from stylar point.

37. Banksia ashbyi Baker f., *J. Bot.* (1934)

T: near Yuna, W.A., about 1930, *E.Ashby, Herb. A.Morris 2537*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 355 (1981).

Illustrations: A.S.George, *Banksia Book* 138, 139, fig. 33, pl. 53 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 56 (in press).

Shrub or tree to 8 m, with or without lignotuber. Bark smooth, grey. Stems tomentose-hirsute, glabrescent. Leaves: petiole 1–3 cm long; lamina broadly linear, 10–30 cm long, 2–4 cm wide, obtuse or acute; margins flat, deeply serrate; both surfaces tomentose, glabrescent except pits in lower surface. Inflorescence terminal, 6–15 cm long, 6–8 cm wide; involucral bracts tomentose, falling early. Flowers bright orange, including styles. Perianth 26–34 mm long including limb of 4–6 mm, closely pubescent outside, glabrous inside. Pistil straight or curved, 28–42 mm long, glabrous; pollen presenter somewhat thickened, 2.5–3 mm long, obscurely ribbed. Old flowers persistent for some years. Follicles numerous, elliptic to round, 8–15 mm long, 3–8 mm high, 5–11 mm wide, smooth, closely tomentose. Seed obovate, 15–20 mm long; seed body cuneate, 7–9 mm long, smooth or slightly rugose. Fig. 33A–C.

Widespread in W.A. near the central west coast from North West Cape to Coorow in deep red sand on dunes and plains, in shrubland, but apparently now extinct south of Mullewa; also in the Kennedy Ra. east of Carnarvon on red dunes. Flowers chiefly winter. Map 218.

W.A.: SE of 5 Mile Well, Cape Ra., *Y.Chadwick 2287* (PERTH); c. 50 km N of Murchison R., North West Coastal Hwy, *R.B.Filson 8605* (MEL, PERTH); Peron Penin., *C.A.Gardner & W.E.Blackall 549* (PERTH); c. 8 km W of Indarra, *K.Newbey 2163* (PERTH); Quobba, *R.A.Saffrey 668* (PERTH).

Related somewhat distantly to *B. benthamiana* which has shorter, narrower leaves with few short teeth and golden orange flowers in shorter spikes. Follicles usually opening with fire. Plants north of Carnarvon have a lignotuber from which they sprout after fire; those from Shark Bay southwards are killed by fire and regenerate from seed. There is sometimes a small secondary leaf lobe.

38. Banksia benthamiana C.A.Gardner, *J. Roy. Soc. W. Australia* 47: 57 (1964)

T: Dalwallinu, W.A., Jan. 1940, *C.A.Gardner s.n.*; lecto: PERTH, *fide* A.S.George, *Nuytsia* 3: 357 (1981); isolecto: PERTH.

Illustrations: A.S.George, *Banksia Book* 140, 141, fig. 34, pl. 54 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 58 (in press).

Shrub to 4 m tall, without lignotuber. Bark roughly flaking, grey. Stems tomentose. Leaves: petiole 5–15 mm long; lamina linear, 10–25 cm long, 5–10 mm wide, acute; margins flat, shortly serrate to entire; both surfaces densely pubescent, glabrescent. Inflorescence on short lateral branchlet, 5–10 cm long; involucral bracts tomentose, persistent. Flowers golden orange to orange-brown, including styles. Perianth 20–24 mm long including limb of 4–5 mm, pubescent outside, hirsute inside along margins. Pistil curved, 23–26 mm long, glabrous; pollen presenter narrow, 1.5 mm long, finely ribbed. Old flowers persistent. Follicles up to 130, narrowly elliptic, 10–15 mm long, 3–5 mm high, 3–5 mm wide, smooth, tomentose. Seed obovate, 17–19 mm long; seed body cuneate, 7–8 mm long, 4–5 mm wide, smooth inside, rugose outside. Fig. 33G, H.

Occurs between Mullewa and Kulja, W.A., in brownish yellow sandy loam or clay-loam, sometimes over laterite, on plains in shrubland. Flowers late Nov.–Jan. Map 219.

W.A.: ENE of Kulja, *A.S.George 11177* (PERTH); just S of Buntine, *A.S.George 17200* (CANB, MEL, PERTH); 16 km SSE of Mullewa, *B.G.Muir 348* (PERTH).

Related to *B. ashbyi*, a larger shrub with larger, more deeply-lobed leaves, bright orange flowers and wider, more rounded follicles. Probably related also to *B. audax*, a much smaller species with pubescent-hirsute perianth. Killed by fire and regenerates from seed. Follicles usually opening with fire.

39. Banksia audax C.A.Gardner, *J. Roy. Soc. W. Australia* 13: 63 (1928)

T: near Bronti, between Southern Cross and Coolgardie, W.A., Dec. 1926, *C.A.Gardner s.n.*; holo: PERTH; iso: CANB, K, MEL, PERTH.

Illustrations: A.S.George, *Banksia Book* 142, 143, fig. 35, pl. 55 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 54 (in press).

Shrub to 1 m tall, with lignotuber. Bark fissured, grey. Stems tomentose. Leaves: petiole less than 10 mm long; lamina narrowly cuneate, 2–7 cm long, 8–20 mm wide, truncate, concave to flat; margins serrate; both surfaces tomentose-hirsute, glabrescent except fine pits in lower surface. Inflorescence on short lateral branchlet, 3–5 cm long; involucral bracts tomentose, persistent. Flowers golden orange including styles, those at apex rusty brown. Perianth 20–23 mm long including limb of 3.5–4 mm, pubescent-hirsute outside, glabrous inside. Pistil gently curved, 19–23 mm long, glabrous; ovary hairy; pollen presenter narrow, 1 mm long, obscurely ribbed. Old flowers persistent. Follicles up to 40, elliptic, 8–13 mm long, 4–5 mm high, 4–6 mm wide, smooth, hirsute. Seed obovate, 18–22 mm long; seed body cuneate-obovate, 10–12 mm long, 6–8 mm wide, smooth or slightly rugose.

Occurs in W.A. in the inland region between Southern Cross, Pingaring, the Johnston Lakes and Bullabulling, in yellow sandy loam sometimes with gravel, in open kwongan. Flowers Nov.–Jan. Map 220.

W.A.: Boorabbin, 15 Dec. 1961, *C.A.Gardner s.n.* (PERTH); c. 109 km E of Hyden, *A.S.George 4315* (PERTH); 19 km E of Southern Cross, *A.S.George 17197* (CANB, MEL, PERTH).

Fire-tolerant, sprouting from the lignotuber. Follicles usually opening with fire, splitting from stylar point. No species closely resembles *B. audax*. The nearest relative is *B. benthamiana*, which is a larger shrub without lignotuber and with larger leaves, flowers and follicles. Also related is *B. laevigata* which is a tall, non-lignotuberous shrub with spherical inflorescences of yellow or creamy grey flowers.

40. Banksia lullfitzii C.A.Gardner, *W. Austral. Naturalist* 10: 68 (1966)

T: near Koorarawalyee, E of Southern Cross, W.A., Mar. 1966, *C.A.Gardner 16411*; holo: PERTH.

Illustrations: A.S.George, *Banksia Book* 148, 149, fig. 37, pl. 58 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 60 (in press).

Shrub to 1.5 m, with lignotuber. Bark flaking. Stems tomentose. Leaves: petiole 1–3 cm long; lamina flexuose, linear, 20–45 cm long, 8–18 mm wide, pungent; margins flat, dentate with widely spaced pungent lobes; both surfaces tomentose, glabrescent except pits in lower surface. Inflorescence on short lateral branchlet, 4–13 cm long; involucral bracts tomentose. Flowers golden orange to orange-brown including styles. Perianth 34–49 mm long including limb of 5–6 mm, shortly villous outside, glabrous inside. Pistil curved, 33–48 mm long, appressed-pubescent just above ovary, otherwise glabrous; pollen presenter narrowly fusiform, 2–3 mm long, finely ribbed. Old flowers persistent. Follicles up to 30, elliptic, 15–25 mm long, 8–12 mm high, 8–10 mm wide, smooth, villous. Seed obovate, 20–23 mm long; seed body cuneate, 7–10 mm long, 8–19 mm wide, smooth inside, rugose outside.

Occurs between Southern Cross, Coolgardie and Ravensthorpe, W.A., apparently rare. Grows in yellow sand, in kwongan on plains. Flowers Mar.–May. Map 221.

W.A.: 20 km W of Boorabbin, *R.B.Filson 8937* (MEL).

Related most closely to *B. elderiana* which has similar swordfish-like leaves but pendulous flower spikes with yellow flowers and a glabrous perianth limb. Fire-tolerant, sprouting from the lignotuber. Follicles usually opening with fire, splitting from stylar point.

41. Banksia elderiana F.Muell. & Tate, *Bot. Centralbl.* 55, 10: 317 (1893)

T: NE of Queen Victoria Spring, Great Victoria Desert, W.A., 17 Sept. 1891, *R.Helms*, on the Elder Exploring Expedition; lecto: MEL, *fide* A.S.George, *Nuytsia* 3: 364 (1981); isolecto: K, MEL, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 150, 151, fig. 38, pl. 59 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 52 (in press).

Shrub to 3 m, much-branched and bushy, with lignotuber. Stems tomentose. Leaves: petiole 1–2 cm long; lamina, rigid linear, 15–40 cm long, 12–20 mm wide, pungent; margins not recurved, pungently serrate; both surfaces tomentose, glabrescent except pits in lower surface. Inflorescence pendulous on short lateral branchlet, sometimes terminal, 4–6 cm long; involucral bracts tomentose. Flowers yellow, including styles. Perianth 27–29 mm long including limb of 4–5 mm, pubescent outside with glabrous limb, glabrous inside. Pistil straight, 24–28 cm long, pubescent on lower ¼ to ½, otherwise glabrous; pollen presenter narrow, 2.5 mm long, smooth. Old flowers persistent. Follicles up to 30, broadly elliptic, 15–25 mm long, 8–14 mm high, 10–18 mm wide, smooth, velvety. Seed obovate, 23–27 mm long; seed body triangular, 10–12 mm long, 9–12 mm wide, smooth inside, rugose outside. *Swordfish Banksia*. Fig. 33 I.

Occurs in inland south-western W.A., between Narembeen, Lake King, Peak Charles and Bullabulling, with outliers in the south-western Great Victoria Desert. Grows in yellow sand, or in sandy loam over laterite, in kwongan or spinifex shrubland. Flowers Jan.–Mar., sometimes into winter. Map 222.

W.A.: 50 km E of Hyden, *B.Barnsley 985* (PERTH); c. 53 km SW of Queen Victoria Rock, SW of Coolgardie, *R.B.Filson 8899* (MEL, PERTH); c. 10 km W of Bodallin, *A.S.George 17205* (AD, CANB, K, NSW, PERTH); c. 3 km S of Queen Victoria Spring, *R.D.Royce 5289* (PERTH).

Fire-tolerant, sprouting from the lignotuber after fire. Closely resembles *B lullfitzii* which has large, erect flower spikes with golden brown, velvety flowers.

42. Banksia laevigata Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 458 (1856)

Sirmuellera laevigata (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: probably near the Fitzgerald R., W.A., late 1848, *J.Drummond 5: 414*; lecto: NY, *fide* A.S.George, *Nuytsia* 3: 360 (1981); isolecto: B, BM, FI, G, K, MEL, NSW, OXF, P.

Shrub to 3.5 m tall, without lignotuber. Bark roughly flaky, grey. Stems hirsute-tomentose, glabrescent. Leaves: petiole 5–10 mm long; lamina broadly linear to narrowly cuneate, 5–14 cm long, 4–20 mm wide, acute or truncate; margins flat, serrate to almost entire; both surfaces hirsute, glabrescent. Inflorescence on short lateral branchlet, occasionally terminal, spherical, 7–8 cm wide; involucral bracts villous, persistent. Perianth 20–26 mm long including limb of 3–3.5 mm, hirsute outside, sparsely hirsute on margin inside. Pistil curved, 30–32 mm long, very fine, glabrous; pollen presenter scarcely thickened, 1 mm long, finely ribbed. Old flowers persistent. Follicles up to 100, linear-elliptic, 10–18 mm long, 3–7 mm high, 4–7 mm wide, smooth, villous. Seed narrowly obovate, 12–18 mm long; seed body cuneate, 7–8 mm long, 3–4 mm wide, slightly rugose.

Occurs between the Fitzgerald R. and Barker L., W.A.

Killed by fire and regenerates from seed. Follicles usually opening with fire. No species closely resembles *B. laevigata*. Probably the nearest relative is *B. audax*, a small shrubby species with short, narrowly wedge-shaped leaves and small, hirsute, orange flowers.

There are two subspecies.

Perianth hirsute including limb, creamy grey with grey indumentum	**42a.** subsp. **laevigata**
Perianth hirsute on claws, bright yellow with rusty indumentum, the limb glabrous	**42b.** subsp. **fuscolutea**

42a. Banksia laevigata Meisn. subsp. laevigata

Illustrations: A.S.George, *Banksia Book* 144, 145, fig. 36A, pl. 56 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 48 (1988).

Perianth hirsute including limb, creamy grey with grey hairs; styles cream. Fig. 32B–E.

Occurs along the lower Fitzgerald R. and in the Ravensthorpe Ra., W.A., in rocky soil (spongolite or laterite) in shrubland and open woodland. Flowers Oct.–Dec. Map 223.

W.A.: Mt Desmond, SE of Ravensthorpe, *T.E.H.Aplin 2693b* (PERTH); Fitzgerald R. above Roes Rock, *A.S.George 10553* (NSW, PERTH).

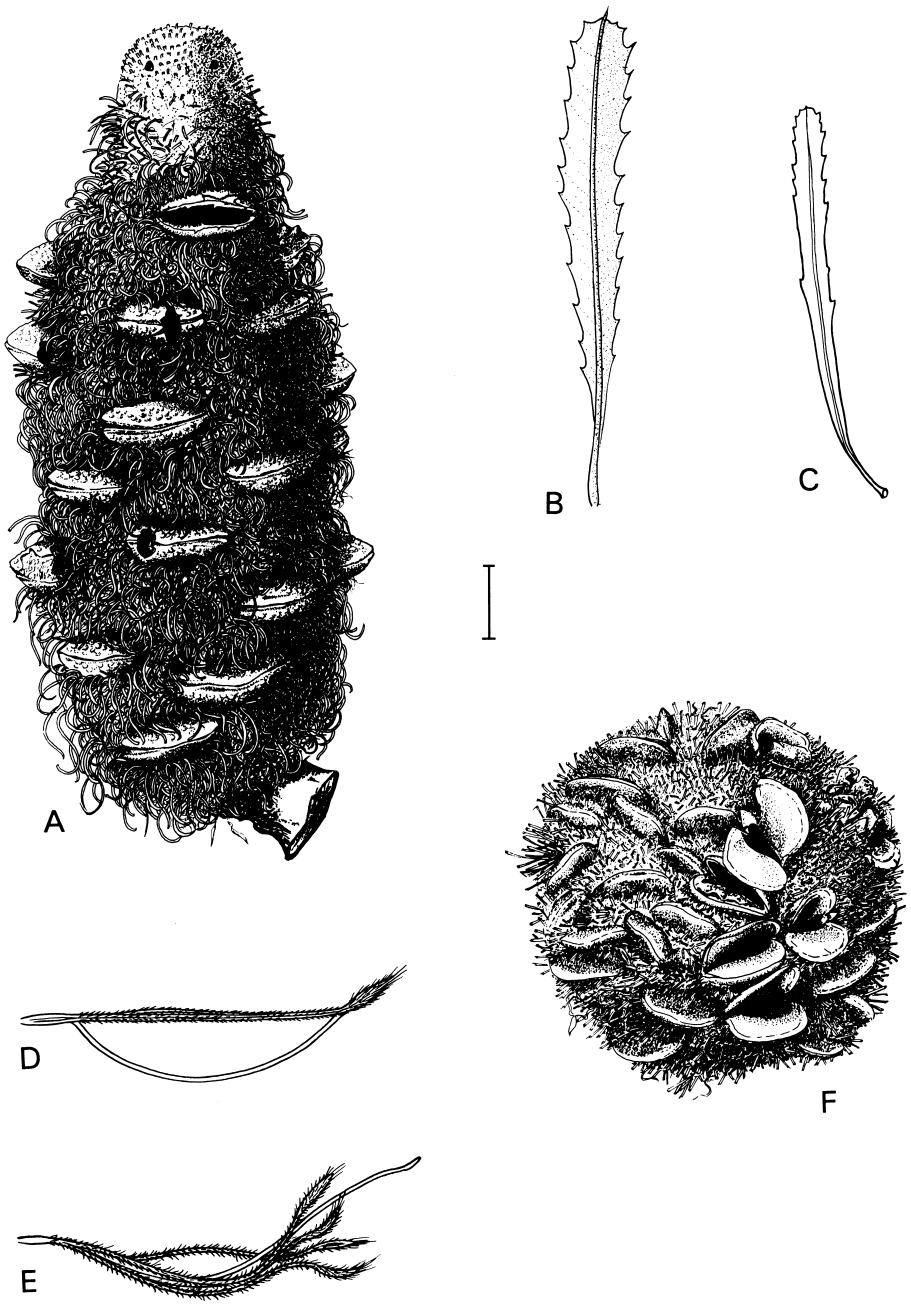

Figure 32. *Banksia*. **A**, *B. epica*, infructescence (not recorded). **B**–**E**, *B. laevigata* subsp. *laevigata*. **B–C**, leaves, abaxial face, **B**, Ravensthorpe Ra. variant (J.Wrigley 5051, CANB), **C**, typical variant; **D**, bud just before anthesis; **E**, open flower (**C**–**E**, cult. PERTH). **F**, *B. laevigata* subsp. *fuscolutea*, infructescence (A.George 6053, PERTH). Scale bar: **A**, **F** = 7.5 mm; **B–C** = 2 cm; **D–E** = 5 mm. Drawn by: **A**, **F**, P.Nikulinsky; **B**, D.Boyer; **C–E**, M.Wilson. **F**, reproduced with permission from *The Banksia Book* (1996).

There are 2 variants, one along the Fitzgerald R. with rather obtuse leaf teeth, the other in the Ravensthorpe Ra. with larger, acute teeth similar to those of subsp. *fuscolutea*. The former is represented by the type.

42b. Banksia laevigata subsp. **fuscolutea** A.S.George, *W. Austral. Naturalist* 10: 32 (1966)

T: E of Hyden, W.A., 1 Jan. 1964, *A.S.George 6053*; holo: PERTH; iso: K, MEL, PERTH.

Illustrations: A.S.George, *Banksia Book* 146, 147, fig. 36B, pl. 57 (1984).

Perianth hirsute on claws, glabrous on limb, bright yellow, with rusty brown hairs. Plate 42; Fig. 32F.

Occurs between Barker Lake, Hyden, Frank Hann Natl Park and Mt Day, W.A., in sandy loam, commonly over laterite, on plains and low hills, in shrubland. Flowers Dec.–Jan. Map 224.

W.A.: 80 km W of Kumarl on Lake King road, *R.B.Filson 9344* (MEL); near Hatter Hill, *H.Steedman* (NSW).

43. Banksia elegans Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 119 (1855)

Sirmuellera elegans (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: between Moore and Murchison Rivers, W.A., 1850–51, *J.Drummond 6: 200*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 366 (1981); isolecto: CGE, K, LD, MEL, P, U.

Illustrations: A.S.George, *Banksia Book* 152, 153, fig. 39, pl. 60 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 43 (1988).

Shrub to 4 m tall, with fire-tolerant rootstock and stout trunk, suckering. Bark tessellated, grey. Stems tomentose-hirsute, glabrescent. Leaves: petiole 2–4 cm long; lamina flexuose, broadly linear, 20–45 cm long, 12–18 mm wide, acute; margins flat, dentate with many triangular teeth; both surfaces tomentose-hirsute, glabrescent except fine pits on lower surface. Inflorescence terminal, ±spherical, 6–7 cm wide; involucral bracts villous, falling early. Flowers pale yellow, including styles. Perianth 32–33 mm long including limb of 4–5.5 mm, closely pubescent outside, pubescent on margins inside; limb glabrous. Pistil straight, 31–32 mm long, glabrous except a few hairs on ovary; pollen presenter narrow, 1 mm long, usually not properly formed, irregularly ribbed and muricate. Old flowers soon falling. Follicles 1–5, obliquely ovate, curved, 20–25 mm long, 9–13 mm high, 11–14 mm wide, warted, tomentose, glabrescent. Seed obliquely ovate, 17–20 mm long; seed body ±triangular, 7–10 mm long and wide, rugose.

Occurs in W.A. near the west coast between Walkaway and Mt Peron. in deep yellow sand in low woodland and in tall shrubland. Flowers Oct.–Nov. Map 225.

W.A.: near Walkaway, *C.Burns 27* (PERTH); Three Springs, N of Diamond of the Desert, *C.A.Gardner 8486* (PERTH); N of Arrowsmith Lake, *A.S.George 9775* (PERTH).

Fire-tolerant, sprouting from the stems and rootstock; follicles usually opening with fire, splitting from stylar point; foliage dull blue-green. No close relative. It is uncertain where the relationships of *B. elegans* lie.

44. Banksia lindleyana Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 120 (1855)

Sirmuellera lindleyana (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: near the lower Murchison R., W.A., 1850–51, *J.Drummond 6: 204* ; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 353 (1981); isolecto: CGE, FI, K, LD, MEL, P, U.

Illustrations: A.S.George, *Banksia Book* 136, 137, fig. 32, pl. 52 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 46 (1988).

Shrub to 3 m tall, with lignotuber. Bark fissured, grey. Stems closely tomentose, glabrescent. Leaves: petiole 5–10 mm long; lamina linear, 4–13 cm long, 4–12 mm wide, obtuse; margins flat, serrate with small obtuse teeth; both surfaces tomentose, glabrescent except small pits in lower surface. Inflorescence on short, lateral branchlet on older stem, 5–9 cm long; flowers rather openly arranged; involucral bracts small, tomentose, falling early. Flowers yellow

including style. Perianth 35–43 mm long including limb of 9–10 mm, glabrous. Pistil straight, 35–43 mm long, sparsely hairy in lower third, glabrous above; pollen presenter narrow, 4–5 mm long, finely ribbed. Old styles persistent and wiry; perianths usually falling. Follicles up to 70, elliptic, 15–20 mm long, 5–10 mm high, 8–12 mm wide, convex, tomentose. Seeds narrowly obovate, 19–23 mm long; seed body narrowly obovate, 9–11 mm long, 3–4 mm wide, smooth on both sides. *Porcupine Banksia*.

Occurs between Northampton and Shark Bay, W.A., growing in deep yellow sand on plains, in tall open shrubland. Flowers Jan.–Mar. Map 226.

W.A.: 48 km W of North West Coastal Hwy on Kalbarri Rd, *A.S.George 3232* (PERTH); c. 12 km WSW of Cooloomia Stn HS, *S.D.Hopper 1349* (PERTH); near Binnu, Mar. 1962, *F.Lullfitz* (PERTH).

Related to *B. attenuata* which has more deeply serrate leaves with recurved margins, much smaller, more crowded flowers and larger follicles with the old styles curled. Fire-tolerant, regenerating from lignotuber. Follicles usually opening with fire, splitting from stylar point. in the long, ribbed pollen presenter and large, openly spaced flowers the species shows a relationship to ser. *Tetragonae*. A presumed hybrid with *B. prionotes* has been recorded (Taylor & Hopper, 1988).

Ser. 7. Tetragonae

Banksia ser. **Tetragonae** A.S.George, *Nuytsia* 3: 381 (1981)

Type: *B. lemanniana* Meisn.

Erect shrubs. Leaves alternate, dentate or serrate; margins flat or shortly recurved. Inflorescence pendulous, broadly cylindrical; buds retaining regular pattern until anthesis. Perianth glabrous; tepals not awned. Pistil straight, glabrous; pollen presenter narrow, finely ribbed and muricate; pollen crescent-shaped. Follicles split from stylar point. Seed wing notched.

A series of three species in southern W.A.

45. Banksia lemanniana Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 462 (1856)

Sirmuellera lemanniana (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: south-western W.A., early 1847, *J.Drummond 4: 302*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 382 (1981); isolecto: B, BM, CGE, FI, G, K, MEL, NSW, NY, P.

Illustrations: A.S.George, *Banksia Book* 168, 169, fig. 46, pl. 69 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 47 (1988).

Shrub to 5 m tall, without lignotuber. Bark thin, finely fissured, grey. Stems tomentose, glabrescent. Leaves: petiole 5–10 mm long; lamina cuneate to obovate, 3–9 cm long, 12–35 mm wide, truncate; margins not recurved, shortly and obtusely serrate, with lobes 1–3 mm long; both surfaces densely tomentose, glabrescent except pits in lower surface. Inflorescence 5–11 cm long; involucral bracts tomentose and hirsute, persistent. Flowers lemon-yellow or pale yellow including styles, honey-scented. Perianth 36–41 mm long including limb of 7–9 mm, glabrous. Pistil straight, 36–41 mm long, glabrous; pollen presenter narrowly fusiform, 4–5 mm long, minutely muricate. Old flowers persistent. Follicles up to 20, rounded-oblong, 30–45 mm long, 20–30 mm high, 20–30 mm wide; valves semi-circular, very thick, somewhat rugose, tomentose. Seed obovate, 40–47 mm long; seed body cuneate, 12–15 mm long, 10–13 mm wide, smooth inside, slightly ridged outside.

Occurs in W.A., near the south coast from West Mt Barren to Ravensthorpe and a short distance eastwards. in rocky sand (quartzite) or rocky loam (laterite) on hillsides and plains, in tall shrubland or low woodland. Flowers Oct.–Jan. Map 227.

W.A.: Middle Mt Barren, Sept. 1925, *C.A.Gardner & W.E.Blackall* (PERTH); 31 km E of Ravensthorpe, *A.S.George 15270* (CANB, K, NSW, PERTH); Ravensthorpe, 28 Sept. 1964, *H.A.Morrison* (MEL).

Killed by fire, regenerating from seed. Related to *B. caleyi* which is a smaller shrub with longer, narrower leaves, red flowers and smooth follicles. The specific name (which honours an English botanist, Charles Morgan Lemann) is sometimes wro1ngly spelt *lehmanniana* and attributed to the German J.Lehmann.

46. Banksia caleyi R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 35 (1830)

Sirmuellera caleyi (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: inland from King George Sound, [W.A.], 1829, *W.Baxter*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 383 (1981); isolecto: BM, K, L, NSW.

Banksia caleyi var. *sinuosa* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 462 (1856). T: south-western W.A., *J.Drummond 4: 301*; lecto: NY, *fide* A.S.George, *loc. cit.*; isolecto: BM, CGE, FI, G, K, P.

Illustrations: A.S.George, *Banksia Book* 171–173, fig. 47, pl. 70 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 32 (1988).

Shrub to 2 m tall, without lignotuber. Bark finely fissured, grey. Stems tomentose, glabrescent. Leaves: petiole 5–10 mm long; lamina undulate, narrowly cuneate, 5–14 cm long, 13–24 mm wide, truncate; margins ±recurved, pungently dentate-serrate with many teeth, teeth 4–6 mm long; both surfaces tomentose, glabrescent except wool in pits in lower surface. Inflorescence 5–9 cm long; involucral bracts tomentose, persistent. Flowers cream at base, deep pink to red in upper half; styles cream. Perianth 30–33 mm long including limb of 8–9 mm, glabrous on both sides. Pistil straight, 30–32 mm long, glabrous; pollen presenter narrowly fusiform, c. 6 mm long, finely ribbed, muricate. Old flowers persistent. Follicles up to 25, elliptic-ovate, 35–40 mm long, 22–25 mm high, 15–25 mm wide; valves convex, slightly rugose, tomentose. Seed obovate, 43–47 mm long; seed body cuneate, 14–15 mm long, 16–17 mm wide, smooth inside, ridged outside. Fig. 34E–H.

Near the south coast of W.A., from South Stirling to the West R. and inland to Pingrup. in white-grey sandy loam on plains, in mallee shrubland. Flowers late Oct.–Dec. Map 228.

W.A.: SW of Pingrup, *A.M.Ashby 2745* (AD); Fitzgerald R., Feb. 1959, *C.A.Gardner s.n.* (PERTH); c. 125 km W of Ravensthorpe, *A.S.George 1864* (PERTH); c. 1 km S of Jerramungup, *A.S.George 16209* (PERTH).

Killed by fire, regenerating from seed. Related to *B. aculeata* which has channelled leaves with larger, triangular lobes and angular sinuses, larger flowers that are red in the lower half and cream above, and larger follicles. *Banksia aculeata* occurs only in the Stirling Ra. and flowers in late summer. Also related to *B. lemanniana*, a larger shrub with shorter, dentate leaves, all-yellow flowers and rugose follicles.

47. Banksia aculeata A.S.George, *Nuytsia* 3: 386 (1981)

T: E of Cranbrook, Stirling Range Natl Park, W.A., 20 Mar. 1972, *A.S.George 11299*; holo: PERTH; iso: AD, BRI, CANB, K, MEL, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 174, 175, fig. 48, pl. 71 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 63 (in press).

Shrub to 2 m tall, without lignotuber. Bark finely fissured, grey. Stems densely tomentose, rusty, becoming glabrous and grey. Leaves: petiole 4–10 mm long; lamina broadly linear to narrowly cuneate, 4–9 cm long, 8–30 mm wide, pungently acute, channelled; margins not recurved, rigidly and pungently serrate, with lobes 5–10 mm long; both surfaces densely tomentose, glabrescent except pits in lower surface. Inflorescence 6–9 cm long; involucral bracts tomentose, persistent. Flowers reddish pink at base grading to cream including limb; style cream. Perianth 30–43 mm long including limb of 10–12 mm, glabrous. Pistil straight, 30–42 mm long, glabrous; pollen presenter narrow, 6–8 mm long, finely ribbed, minutely muricate. Old flowers persistent. Follicles up to 20, massive, broadly elliptic, 30–45 mm long, 25–30 mm high, 20–25 mm wide; valves semicircular, rugose, tomentose. Seed obovate, 40–50 mm long; seed body cuneate, 10–12 mm long, 15–18 mm wide, smooth inside, slightly rugose outside. Fig. 33J, K.

Endemic in the Stirling Range Natl Park, W.A. in gravelly sand or shaly soil on plains and low rises, in open to closed shrubland. Flowers Feb.–Mar. Map 229.

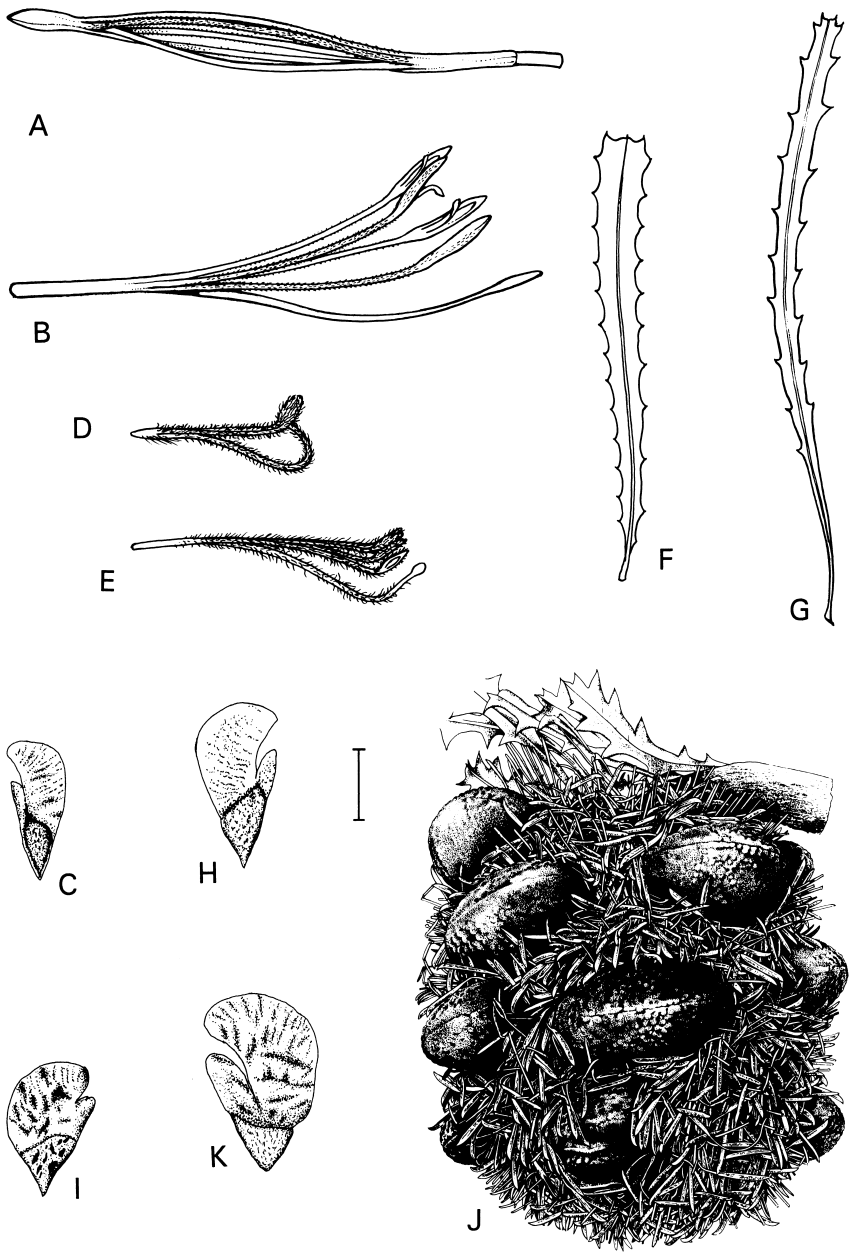

Figure 33. *Banksia*. **A**–**C**, *B. ashbyi*. **A**, bud just before anthesis; **B**, open flower (**A–B**, cult. PERTH); **C**, seed, adaxial face (A.George *s.n.*, PERTH). **D**–**F**, *B. pilostylis*. **D**, bud before anthesis; **E**, open flower; **F**, leaf (**D–F**, cult. PERTH). **G–H**, *B. benthamiana*. **G**, leaf (cult. PERTH); **H**, seed, abaxial face (not recorded). **I**, *B. elderiana*, seed, abaxial face (not recorded). **J–K**, *B. aculeata*. **J**, infructescence (A.George 6110, PERTH); **K**, seed, abaxial face (not recorded). Scale bar: **A–B** = 4 mm; **C** = 1 cm; **D–E** = 7 mm; **F–G**, **J–K** = 2 cm; **H** = 9 mm; **I** = 1.4 cm. Drawn by: **A–B**, **D–G**, M.Wilson; **C**, **H–I**, **K**, A.George; **J**, S.Genovese. **C**, **H**, **I**, **J**, **K**, reproduced with permission from *Nuytsia* 3: 387 (1981).

W.A.: Red Gum Pass turnoff, *A.S.George 14239* (PERTH); Cranbrook–Chester Pass road, 5 Mar. 1967, *F.W.Humphreys* (PERTH).

Killed by fire, regenerating from seed. Related to *B. caleyi* which has the leaf margins recurved and shortly dentate–serrate, shorter perianths that are dull red in the upper half, and smaller follicles. *Banksia caleyi* flowers late Oct.–Dec.

Ser. 8. Bauerinae

Banksia ser. **Bauerinae** A.S.George, *Nuytsia* 6: 309 (1988)

Type: *B. baueri* R.Br.

Erect or spreading shrubs. Leaves alternate, dentate or serrate; margins recurved. Inflorescence erect, cylindrical; buds losing regular pattern well before anthesis. Perianth pubescent or hirsute; tepals awned. Pistil curved; pollen presenter narrow, finely ribbed; pollen crescent-shaped. Follicles split from stylar point. Seed wing notched.

A monotypic series from south-western Australia.

48. Banksia baueri R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 35 (1830)

Sirmuellera baueri (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: near the Stirling Range, [W.A.], 1829, *W.Baxter*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 317 (1981); isolecto: BM, K.

Illustrations: A.S.George, *Banksia Book* 87–89, fig. 15, pl. 35 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 31 (1988).

Shrub to 2 m tall, to 3 m wide, much-branched, without lignotuber. Bark thin, lightly fissured, grey. Stems tomentose to hirsute, pale brown, becoming glabrous and grey. Leaves: petiole 5–10 mm long; lamina narrowly obovate-oblong, 4–13 cm long, 0.5–3.5 cm wide, obtuse; margins recurved or not, dentate or serrate; upper surface tomentose, glabrescent; lower surface hirsute with woolly pits, glabrescent on nerves. Inflorescence 7–17 cm long; involucral bracts fine, woolly, persistent. Flowers cream or rusty with grey or grey-brown limb and mauve or rusty awn; styles cream. Perianth 58–65 mm long including limb of 3–4 mm and awn of 15–17 mm, pubescent to hirsute outside, glabrous inside. Pistil 45–55 mm long, gently curved, kinked below apex, glabrous; pollen presenter erect, narrow, 2–4 mm long, finely ribbed. Old flowers persistent. Follicles up to 60, narrowly elliptic, 22–29 mm long, 12–17 mm high, 8–12 mm wide; valves slightly rugose, tomentose. Seed obovate, 32–40 mm long; seed body obovate, 12–15 mm long, 7–8 mm wide, smooth inside, pitted and ridged outside. *Woolly Banksia*. Fig. 34J.

Occurs in W.A. from Kweda and Toolibin railway siding to Bremer Bay and east to Munglinup; also on the South Stirling plains. Grows in deep white or grey sand and in shallow sand over laterite or quartzite, in low shrubland and mallee shrubland. Flowers May–July. Map 230.

W.A.: South Stirling Rd, c. 40 km E of Albany–Borden road, *A.S.George 6241* (PERTH); 10 km WNW of Jitarning, *R.J.Hnatiuk 78061* (PERTH); East Mt Barren, *B.R.Maslin 955* (PERTH).

Very distinctive in the large, very hairy inflorescence and long perianth awn. Quite variable in size of inflorescence and flower colour. Typically the flowers are pale cream with a grey or mauve limb and awn, but populations in the Fitzgerald River Natl Park usually have rusty-coloured perianths.

Ser. 9. Quercinae

Banksia ser. **Quercinae** Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 459 (1856)

Type: *B. quercifolia* R.Br.; lecto, *fide* A.S.George, *Nuytsia* 3: 312 (1981).

Erect shrubs. Leaves alternate, serrate to almost entire; margins not recurved. Inflorescence

erect, cylindrical; buds retaining much of regular pattern until anthesis. Perianth pubescent or hirsute; tepals awned. Pistil straight; pollen presenter cylindrical; pollen ovoid. Follicles not split at stylar point. Seed wing not notched.

A series of two species from W.A. Distinguished by the short stiff flowers, the prominent apical awn of the tepals and unnotched seed wing.

49. Banksia quercifolia R.Br., *Trans. Linn. Soc. London*. 10: 210 (1810)

Sirmuellera quercifolia (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: King George Sound, [W.A.], Dec. 1801, *R.Brown*; holo: BM.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 16 (1981); A.S.George, *Banksia Book* 82, 83, fig. 13, pl. 33 (1984).

Shrub to 3 m tall, without lignotuber. Bark smooth, greenish brown, becoming lightly tessellated and grey. Stems glabrous, red or reddish brown. Leaves thin; petiole 1–4 mm long; lamina undulate, narrowly cuneate, 3–15 cm long, 1–4 cm wide, truncate; margins not recurved, serrate; both surfaces glabrous except wool in pits in lower surface. Inflorescence 2–10 cm long; involucral bracts subulate, 5–10 mm long, glabrous with pubescent tips. Flowers yellow, orange or brown with rusty indumentum; styles cream. Perianth 23–27 mm long including limb of 3–3.5 mm and awn of 4–5 mm, pubescent outside, hirsute inside in upper half; awn downturned. Pistil 17–21 mm long, gently curved, stiff, glabrous; pollen presenter 0.8–1 mm long. Old flowers persistent. Follicles up to 35, broadly linear, undulate, 15–20 mm long, 11–15 mm high, 4–6 mm wide; valves semi-circular, slightly rugose, shortly pubescent. Seed obovate, 20–21 mm long; seed body cuneate, 8–9 mm long, 5–6 mm wide, somewhat ridged inside, ridged outside. *Oak-leaved Banksia*. Plate 43; Fig. 34 I.

Occurs near the south coast of W.A. from Windy Harbour to Cheyne Beach, in sand, often peaty, in depressions and on swamp margins, in shrubland-sedge formations, sometimes in low woodland. Flowers Apr.–July. Map 231.

W.A.: 20 km WSW of Walpole, *B.Barnsley 790* (CANB, PERTH); c. 22 km NNW of Albany, *A.C.Beauglehole 12873* (MEL); Northcliffe, *A.R.Fairall 854* (PERTH); 16 km NW of Cheyne Beach, *A.S.George 6302* (PERTH); ENE of Narrikup, *A.S.George 14582* (PERTH).

Closely related to *B. oreophila* which has thicker, less serrated pale green leaves, mauve-pink flowers and larger follicles; it grows on the hills of the Stirling Ra. and the Barrens. Follicles usually opening only when burnt.

50. Banksia oreophila A.S.George, *Nuytsia* 3: 316 (1981)

Based on *B. quercifolia* var. *integrifolia* F.Muell., *Fragm.* 7: 57 (1869). T: Mt Toolbrunup, Stirling Ra., W.A., 1867, *F.Mueller*; lecto: MEL, *fide* A.S.George, *loc. cit.*

Illustrations: A.S.George, *Banksia Book* 84, 85, fig. 14, pl. 34 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 51 (in press).

Shrub to 3 m tall, without lignotuber. Bark thin, smooth, grey or pale brown. Stems glabrous, orange or pink. Leaves: petiole 2–4 mm long; lamina cuneate to narrowly obovate, 2–11 cm long, 5–25 mm wide, truncate; margins not recurved, entire or sparsely serrate; both surfaces glabrous, except white wool in pits in lower surface. Inflorescence 2–9 cm long; involucral bracts subulate, 5–10 mm long, glabrous with pubescent tips. Flowers pale mauve to pink, rarely pale rusty; limb greyish; styles cream. Perianth 20–29 mm long including limb of 3–4 mm and awn of 3–10 mm, pubescent to hirsute outside, glabrous inside. Pistil gently curved, 15–21 mm long, wiry, glabrous; pollen presenter narrow, 1.3–1.4 mm long. Old flowers persistent. Follicles up to 20, elliptic to broadly oblong, 20–28 mm long, 10–12 mm high, 10–18 mm wide; valves semi-circular, swollen, smooth, pubescent, glabrescent. Seed obovate, 22–25 mm long; seed body semi-elliptic, 10–11 mm long, 6 mm wide, smooth or almost so. *Western Mountain Banksia*. Fig. 34P–R.

Occurs in the Stirling Range and Fitzgerald River Natl Parks, W.A. Grows in rocky or shale soil, quartzite or metasandstone, in shrubland, usually on hillsides and peaks. Flowers June–July. Map 232.

W.A.: East Mt Barren, 24 May 1959, *A.S.George s.n.* (PERTH); summit, West Mt Barren, *A.S.George 1782* (PERTH); Bluff Knoll, Stirling Range Natl Park, *R.J.Hnatiuk 761483* (PERTH); near Red Gum Spring, Stirling Range Natl Park, *G.J.Keighery 1209* (PERTH).

Leaves pale green. Killed by fire and regenerates from seed; follicles open with fire. Closely resembles *B. quercifolia*, which differs in its thin, always serrate, deep green leaves, rusty flowers and narrow follicles and which always grows on swamp margins.

Sect. 2. Coccinea

Banksia sect. **Coccinea** (A.S.George) T.L.Maguire, Sedgley & Conran, *Austral. Syst. Bot.* 9: 890 (1996)

Banksia ser. *Coccineae* A.S.George, *Nuytsia* 3: 389 (1981). T: *B. coccinea* R.Br.

Leaves flat; margins not or slightly recurved. Development of inflorescence acropetal. Pistil looped horizontally before anthesis, afterwards erect; pollen presenter straight; pollen elongate-cylindrical. Follicles split from stylar point. Cotyledons cuneate with oblique upper margin.

A monotypic section occurring in W.A., allied to sect. *Oncostylis*.

51. Banksia coccinea R.Br., *Trans. Linn. Soc. London* 10: 207 (1810)

Sirmuellera coccinea (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: King George Sound, [W.A.], Dec. 1801, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 389 (1981); isolecto: BM, MEL.

Banksia purpurea Schnizl., *Iconogr. Fam. Regn. Veg.* 2: t. 113, figs 33–36, 38 (1849). T: not cited.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 15 (1981); A.S.George, *Banksia Book* 176, 177, fig. 49, pl. 72 (1984).

Erect shrub or small tree to 8 m tall, without lignotuber. Bark ±smooth, thin, grey. Stems tomentose. Leaves: petiole 3–5 mm long; lamina broadly oblong, cordate or obcordate, 3–9 cm long, 2–7 cm wide, truncate; margins shortly dentate, not or slightly recurved; upper surface tomentose, glabrescent; lower surface white-tomentose. Inflorescence erect, cylindrical but squat, 3–6 cm long; bud pattern retained until anthesis; involucral bracts hirsute, persistent. Flowers grey or hairs in upper flowers brown; style scarlet, rarely dark red or orange. Perianth 30–32 mm long including limb of 3–4 mm, densely villous outside, glabrous inside; tepals not awned. Pistil looped before anthesis, afterwards straight, 40–48 mm long, glabrous; pollen presenter narrowly conical, 1.5 mm long. Old flowers soon falling. Follicles elliptic, 6–8 mm long, 1–2 mm high, 2–3 mm wide, tomentose. Seed 11–14 mm long; seed body cuneate, 5–7 mm long, 4–7 mm wide, rugose inside and outside; wing notched. *Scarlet Banksia*. Fig. 34K–O.

Occurs in W.A., from Albany to the Stirling Ra. and east to the Young R. in deep white or grey sand, in tall shrubland and in low woodland; locally common. Flowers June–Jan. Map 233.

W.A.: road to East Mt Barren from Hopetoun, *E.M.Bennett 2554* (PERTH); c. 8 km W of Young R., Ravensthorpe–Esperance road, *N.N.Donner 2815* (PERTH); c. 3 km E of King R. on Albany–Manypeaks road, *R.Melville 4421* & *R.D.Royce* (BRI, MEL, NSW); Chester Pass, 4 Sept. 1947, *J.H.Willis* (MEL).

A distinctive species with no close relatives. Killed by fire and regenerates from seed. A number of populations have been destroyed by *Phytophthora* (dieback disease).

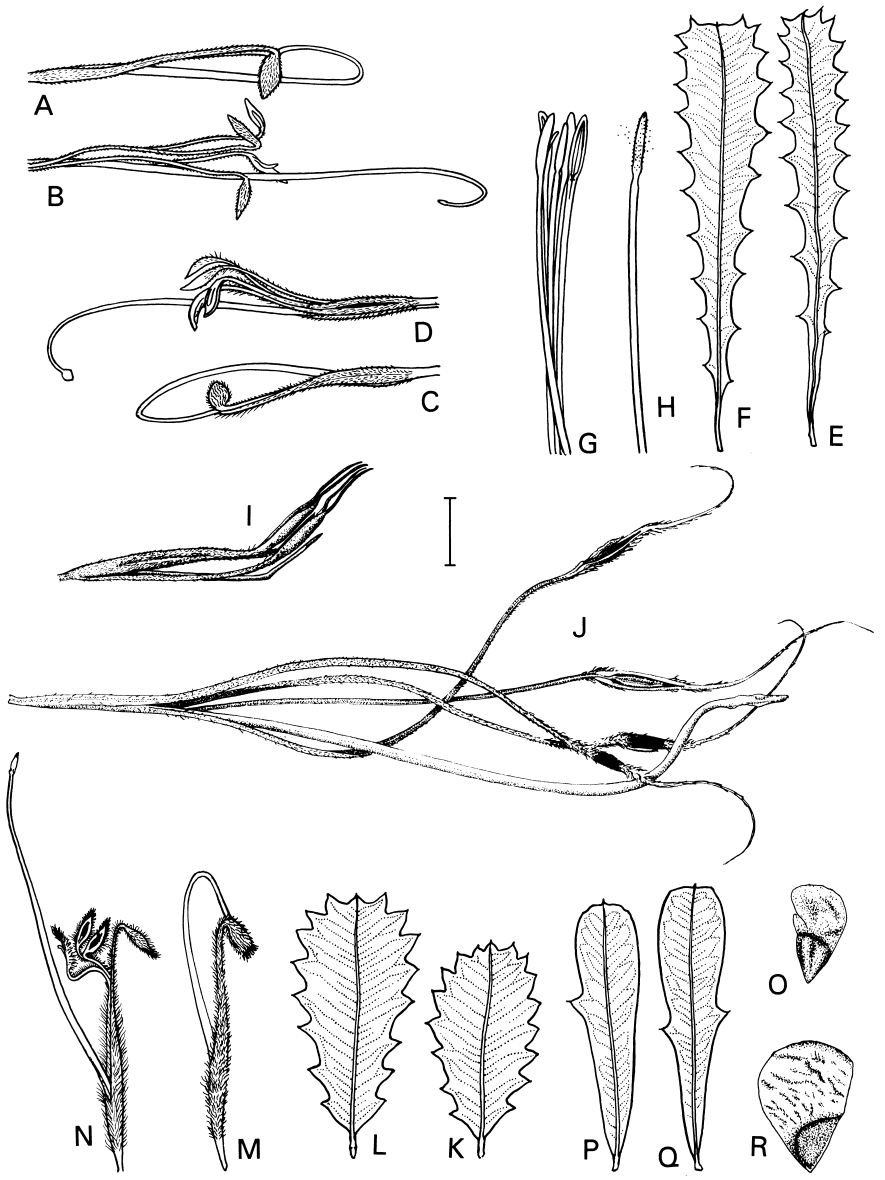

Figure 34. *Banksia*. **A–B**, *B. spinulosa* var. *spinulosa*. **A**, bud just before anthesis; **B**, open flower (**A–B**, cult. Mount Barker, W.A.). **C–D**, *B. ericifolia* subsp. *ericifolia*. **C**, bud just before anthesis; **D**, open flower (**C–D**, cult. Mount Barker, W.A.). **E–H**, *B. caleyi*. **E–F**, leaves, abaxial face; **G**, open flower; **H**, pistil (**E–H**, cult. PERTH). **I**, *B. quercifolia*, open flower (not recorded). **J**, *B. baueri*, open flower (not recorded). **K–O**, *B. coccinea*. **K–L**, leaves, abaxial face; **M**, bud just before anthesis; **N**, open flower (**K–N**, cult. Mount Barker, W.A.); **O**, seed, abaxial face (not recorded). **P–R**, *B. oreophila*. **P–Q**, leaves (cult. Mount Barker, W.A.); **R**, seed, adaxial face (not recorded). Scale bar: **A–D**, **M–N** = 7 mm; **E–H**, **J–L**, **P–Q** = 2 cm; **I** = 5 mm; **O** = 8 mm; **R** = 1.25 cm. Drawn by: **A–H**, **K–N**, **P–Q**, M.Wilson; **I–J**, D.Boyer; **O**, **R**, A.George. **O**, **R**, reproduced with permission from *The Banksia Book* (1996).

Sect. 3. Oncostylis

Banksia sect. **Oncostylis** Benth., *Fl. Austral.* 5: 542, 544 (1870)

Type: *B. sphaerocarpa* R.Br.; lecto, *fide* A.S.George, *Fl. Australia* 17B: 397 (1999).

Leaves narrow; margins revolute or recurved, in several taxa almost flat. Development of inflorescence basipetal or in *B. nutans* acropetal. Pistil hooked below apex, remaining so after anthesis; pollen ovoid. Follicles not split from stylar point. Cotyledons commonly narrowly spathulate.

A section of four series and 21 species characterised by the hooked pistil and follicles that do not split from the stylar point.

Ser. 10. Spicigerae

Banksia ser. **Spicigerae** A.S.George, *Nuytsia* 3: 391 (1981)

Type: *B. spinulosa* Sm.

Banksia subser. *Ericifoliae* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot.* 9: 721 (1996). T: *B. ericifolia* L.f.

Banksia subser. *Occidentales* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *loc. cit.* T: *B. occidentalis* R.Br.

Banksia subser. *Spinulosae* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *loc. cit.* T: *B. spinulosa* Sm.

Erect or spreading trees or shrubs. Leaves alternate or whorled, entire, dentate or serrate; margins recurved or revolute, occasionally almost flat. Inflorescence subtended by whorl of branchlets, erect, cylindrical; buds retaining regular pattern until anthesis. Perianth at anthesis rupturing ventrally, pubescent or hirsute; limb horizontal before anthesis; tepals not awned. Style twisting laterally; pollen presenter ovoid or conical. Mesocarp of follicles hard. Seed wing not notched.

A series of six species, two in eastern Australia, four in south-western W.A. Thiele & Ladiges (1996) have proposed dividing it into three subseries.

52. Banksia spinulosa Sm., *Spec. Bot. New Holl.* 13, t. 4 (1793)

Sirmuellera spinulosa (Sm.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: near Sydney, N.S.W., probably in 1792, *J.White*; lecto: LINN 162.2, *fide* A.S.George, *Nuytsia* 3: 392 (1981).

Shrub to 3 m tall, with or without lignotuber. Bark smooth with lenticels or becoming tessellated. Stems tomentose or hirsute, glabrescent. Leaves alternate; petiole 1–3 mm long; lamina narrowly to broadly linear, 3–12 mm long, obtuse; margins revolute, recurved or almost flat, shortly serrate to entire; upper surface hirsute, glabrescent; lower surface closely woolly. Inflorescence 6–12 cm long; involucral bracts fine, tomentose, persistent. Flowers golden or yellow; style golden, orange, red or black. Perianth 23–29 mm long including limb of 3–3.5 mm, pubescent outside, also inside in upper part. Pistil hooked, 30–40 mm long, glabrous except a few hairs on ovary; pollen presenter narrowly ovoid, 0.5 mm long. Old perianths usually persistent; styles soon falling. Follicles up to 100, elliptic to rhombic, 10–24 mm long, 5–7 mm high, 3–14 mm wide, flattened or rounded along suture, usually shouldered, slightly wrinkled, pubescent. Seed obovate, 12–20 mm long; seed body obovate, oblique, 6–10 mm long, 3–5 mm wide, smooth. *Hairpin Banksia*.

Widespread in eastern Australia from Atherton, Qld, to Melbourne, Vic.

Follicles usually opening with fire. Related to *B. ericifolia* which has short, narrow leaves with 3 terminal teeth, and the western species *B. occidentalis* which has whorled leaves, metallic-red styles and narrow follicles.

There are four varieties.

1	Mature leaves narrow with revolute margins	**52a.** var. **spinulosa**
1:	Mature leaves ±flat or with margins slightly recurved	
2	Leaves with prominent reticulation on upper surface when dried, white-tomentose below; pistil red or gold	**52b.** var. **collina**
2:	Leaves ±smooth on upper surface when dried, pale brown-tomentose below; pistil black	
3	Plant with lignotuber	**52c.** var. **neoanglica**
3:	Plant without lignotuber	**52d.** var. **cunninghamii**

52a. Banksia spinulosa Sm. var. **spinulosa**

Banksia incognita Anon., *Naturalist's Pocket Mag.* 1, 18: sp. 3 (1798). T: plate, *loc. cit.*

Banksia denticulata Dum.Cours., *Bot. Cult.*, 2nd edn, 7: 108 (1814). T: none cited.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 5 (1981); A.S.George, *Banksia Book* 178, 179, fig. 50, pl. 73 (1984).

Shrub with lignotuber. Stems tomentose, or if also hirsute then the long hairs wearing off within a year or so. Leaves narrowly linear, usually finely serrate towards apex; margins revolute; venation of upper surface not prominent when dried; indumentum of lower surface white. Pistil red or gold. Fig. 34A, B.

Occurs in Qld between Mossman and Ravenshoe and in the south-east from Coria Bay southwards, and N.S.W. from the Colo and Hawkesbury Rivers south almost to the Vic. border. Grows in sand, loam and clay-loam, commonly over sandstone or granite, on flats and hillsides in open forest and woodland. Occurs both on the coastal plain and on adjacent ranges. Flowers mainly Apr.–July. Map 234.

Qld: Wallum Mtn, W of Atherton, *A.S.George 12976* (AD, BRI, CANB, MEL, NSW, PERTH); Eluma Ck road, c. 4 km NE of Julatten, *V.K.Moriarty 2099* (QRS); Blackdown Tableland, Sept. 1937, *H.G.Simmons* (BRI). N.S.W.: Womboyn, *E.F.Constable NSW32210* (NSW); near Mt Banks, Blue Mtns, *A.S.George 11791* (CANB, NSW, PERTH).

Populations on the Atherton Tableland have longer, narrower leaves and smaller follicles than are found elsewhere. Appears to hybridise with *B. ericifolia* subsp. *ericifolia*: see under that taxon for details.

52b. Banksia spinulosa var. **collina** (R.Br.) A.S.George, *Nuytsia* 3: 394 (1981)

Banksia collina R.Br., *Trans. Linn. Soc. London* 10: 204 (1810); *Sirmuellera collina* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: Newcastle, N.S.W., early 1800s, *G.Caley*; neo: BM, *fide* A.S.George, *loc. cit.*

Banksia guentheri Regel, *Ind. Sem. Hort. Petrop.* 37 (1857). T: subtropical Australia, *coll. unknown*; neo: K, *fide* A.S.George, *loc. cit.*

Illustration: A.S.George, *Banksia Book* 180, pl. 74 (1984).

Shrub with lignotuber. Stems tomentose or hirsute, usually soon glabrescent on upper surface. Leaves linear to narrowly obovate, serrate almost to base; margins recurved; lateral veins evident when dried; indumentum white-tomentose below. Pistil red or gold. Plate 44.

Occurs in south-eastern Qld, including Carnarvon Natl Park, and in N.S.W., from Nambour to the Hawkesbury R. Grows in sand, loam or shale, usually over sandstone, in open forest, woodland and low shrubland. Flowers mainly Apr.–July. Map 235.

Qld: Egg Rock, Numinbah valley, *S.L.Everist 1074* (BRI); between Beerwah and Landsborough, *C.E.Hubbard 3144* (BRI). N.S.W.: South Brother, Johns R., *J.L.Boorman NSW138032* (NSW); Minyon Falls, Whian Whian State Forest, *E.F.Constable 22219* (NSW); Pacific Hwy between Moonee Ck and Somersby turnoff, *A.S.George 13061* (AD, BRI, CANB, MEL, NSW, PERTH).

52c. Banksia spinulosa var. **neoanglica** A.S.George, *Nuytsia* 6: 315 (1988)

T: 1 km N of turnoff to New England Natl Park, Ebor–Armidale road, N.S.W., 6 Apr. 1986, *S.C.Clemesha*; holo: NSW; iso: BRI, CANB, MEL, PERTH.

Illustrations: A.S.George, *Banksia Book* 3rd edn, 184, 189, pl. 75Aa, b (1996).

Shrub with lignotuber. Leaves broadly linear; margins recurved, entire to serrate; nerves obscure on upper surface when dried; lower surface closely brown-tomentose. Pistil usually black.

Occurs in the Macpherson Ra., south-eastern Qld, and on the New England Tableland, north-eastern N.S.W. Grows in granitic or basaltic soil in heath and low woodland. Flowers Apr.–Aug. Map 236.

Qld: NE of Wallangarra, *M.Fagg 585* (CANB). N.S.W.: Lookout Point, Gibraltar Ra., *E.F.Constable NSW37323* (NSW); near turnoff to Boonoo Boonoo Falls, N of Tenterfield, *A.S.George 16937* (CANB, K, NSW, PERTH).

Very similar to var. *cunninghamii* in morphology of leaves, flowers and fruit.

52d. Banksia spinulosa var. **cunninghamii** (Sieber ex Rchb.) A.S.George, *Nuytsia* 3: 396 (1981)

Banksia cunninghamii Sieber ex Rchb., *Iconogr. Bot. Exot.* 58, t. 81 (1827). T: Mt York, Blue Mtns, N.S.W., 1823, *F.W.Sieber 6*; lecto: K, *fide* A.S.George, *Nuytsia* 3: 396 (1981); isolecto: AWH, B, BM, MEL, OXF, P, S.

Banksia lamberti Hort. ex Courtois, *Mag. Hort. (Liége)*, Suppl. 1: 295 (1833). T: not designated.

Banksia prionophylla F.Muell. ex Meisn., *Linnaea* 26: 353 (1853). T: 'Australia felix', [Vic.], *coll. unknown*, possibly *Mueller*; lecto: MEL, *fide* A.S.George, *loc. cit.*

Banksia ledifolia Meisn., in A.L.P.P. de Candolle, Prodr. 14: 454 (1856), *nom. inval.* – in synonymy under *B. cunninghamii*.

[*Banksia littoralis auct. non* R.Br.: J.Lindley, *Edward's Bot. Reg.* 16: t. 1363 (1830)]

Illustration: A.S.George, *Banksia Book* 181, pl. 75 (1984).

Shrub to 6 m tall, without lignotuber. Leaves broadly linear; margins recurved, entire to serrate; nerves obscure on upper surface when dried; lower surface closely brown-tomentose. Pistil usually black.

Occurs in south-eastern Qld and in N.S.W. along the Great Dividing Ra. from Glen Davis to near Jervis Bay and south of Eden, extending into Vic. as far west as Wilsons Promontory and the Dandenongs. in loam, clay-loam and sand, sometimes in sandstone, on hillsides in forest and woodland. Flowers Apr.–July. Map 237.

Qld: MacPherson Ra., Lamington Natl Park, *S.T.Blake 15849* (BRI). N.S.W.: 5 km N of Mt Coricudgy, 4 Sept. 1948, *L.A.S.Johnson* (NSW); summit, Mt Warning, *F.A.Rodway 2976* (NSW). Vic.: 25 km NE of Warburton on road to Woods Point, Dandenongs, *A.S.George 11652* (MEL, PERTH); road to Wingan Inlet, c. 1.5 km S of Princes Hwy, 20 Feb. 1965, *J.H.Willis* (MEL).

Killed by fire and regenerates from seed. Presumed hybrids with *B. ericifolia* subsp. *ericifolia* have been reported (Taylor & Hopper, 1988). The name *B. cunninghamii* based on Seiber's collection and name was also published later in 1827 by Sprengel and Schultes & Schultes f.

53. Banksia ericifolia L.f., *Suppl. Pl.* 127 (1782) as *B. ericaefolia*

Banksia phylicaefolia Salisb., *Prodr. Stirp. Chap. Allerton* 51 (1796), *nom. superfl.*; *Sirmuellera ericifolia* (L.f.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891); *Isostylis ericifolia* (L.f.) Britten, in J.Banks & D.Solander, *Ill. Austral. Pl. Cook's Voy.* 3: 83 (1905). T: Botany Bay, [N.S.W.], Apr.–May 1770, *J.Banks*; lecto: LINN 162.5, *fide* A.S.George, *Nuytsia* 3: 398 (1981); isolecto: E, NSW, US.

Shrub to 6 m tall, without lignotuber, sometimes a small tree. Bark smooth with lenticels, becoming corky. Stems sparsely hairy. Leaves alternate, crowded; petiole 1–2 mm long; lamina narrowly linear, 9–20 mm long, 0.7–1 mm wide, truncate but mucronate; margins revolute, with a tooth each side of apex; upper surface sparsely hirsute, glabrescent; lower

surface tomentose. Inflorescence 7–22 cm long; involucral bracts narrow, pubescent, persistent. Flowers golden brown to pale yellow, often mauve at base; styles golden, orange or orange-red. Perianth 19–22 mm long including limb of 2.5–3 mm, pubescent outside, hirsute inside along margins. Pistil hooked, 30–35 mm long, glabrous; pollen presenter ovoid, 0.5 mm long. Old perianths persistent but styles soon falling. Follicles numerous, oblong to rhombic, 13–22 mm long, 6–10 mm high, 4–13 mm wide, ridged along each side and convex on top, hirsute. Seed obovate, 17–20 mm long; seed body cuneate, 9–10 mm long, 4–5 mm wide, smooth outside, swollen and somewhat ridged inside.

Occurs in N.S.W. in two disjunct areas; one on the north coast of N.S.W., the other on the central coast and adjacent ranges.

Killed by fire and regenerates from seed. Follicles usually opening with fire. Distinguished by the short, entire adult leaves, short perianth and broad follicles. Related to *B. spinulosa* which has longer, less crowded leaves, a longer perianth and smaller follicles.

There are two subspecies.

Seedling leaves with 2–6 teeth on each margin; perianth 19–22 mm long; pistil 30–35 mm long **53a.** subsp. **ericifolia**

Seedling leaves with 1, rarely 2, teeth on each margin; perianth 26–28 mm long; pistil 46–48 mm long **53b.** subsp. **macrantha**

53a. Banksia ericifolia L.f. subsp. **ericifolia**

Banksia ericifolia L.f. var. *ericifolia*, *Nuytsia* 3: 399 (1981).

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 3 (1981) as var. *ericifolia*; A.S.George, *Banksia Book* 3rd edn, 183, 184, fig. 51 *p.p.*, pl. 76 (1996).

Seedling leaves with 2–6 teeth on each margin. Perianth 19–22 mm long. Pistil 30–35 mm long. Plate 45; Fig. 34C, D.

Occurs near the central coast of N.S.W. and on adjacent ranges between Collaroy and Jervis Bay. in deep sand, sandy loam, or sand over sandstone, in shrubland and woodland; sometimes in semi-swampy places. Flowers Apr.–Aug. Map 238.

N.S.W.: 'Artillery Hill', Royal Natl Park, *R.Coveny 2890* (NSW, W); Bulls Camp near Linden, Blue Mtns, *A.S.George 13042* (CANB, NSW, PERTH); near summit, Mt Pindari, Kanangra Tops, *L.A.S.Johnson NSW137972* (NSW); Merula State Forest, near Moss Vale, *D.J.McGillivray 888* (NSW); Wentworth Falls, Blue Mtns, *R.Melville 627* (MEL).

Appears to hybridise with *B. spinulosa* var. *spinulosa*, e.g. Pigeon House Ra., 27 Aug. 1952, *J.E.Gauba* (MEL).

53b. Banksia ericifolia subsp. **macrantha** (A.S.George) A.S.George, *Nuytsia* 11: 22 (1996)

Banksia ericifolia var. *macrantha* A.S.George, *Nuytsia* 3: 400 (1981). T: 3 km NW of Byron Bay, N.S.W., 28 Apr. 1975, *A.S.George 13011*; holo: NSW; iso: CANB, PERTH.

Illustrations: A.S.George, *Banksia Book* 3rd edn, 183, 185, fig. 51 *p.p.*, pl. 77 (1996).

Differs from subsp. *ericifolia* in the more crowded, narrower leaves, the perianth 26–28 mm long with hirsute limb, and the pistil 46–48 mm long. Seedling leaves with 1, rarely 2 teeth on each margin.

Occurs along the north coast of N.S.W. between Murwillumbah and Hawke. in deep sand in shrubland, commonly in semi-swampy situations. Flowers Apr.–Aug. Map 239.

N.S.W.: c. 5 km N of Evans Head, *C.O.Boyd & D.J.McGillivray 1916* (NSW); c. 2 km NW of Lennox Head, 12 June 1957, *L.A.S.Johnson & E.F.Constable NSW42348* (NSW); Kingscliff, near Murwillumbah, Nov. 1964, *J.Liddy* (NSW).

Killed by fire and regenerates from seed. The leaves are more crowded than in subsp. *ericifolia* and the perianth limb is more hairy.

54. Banksia verticillata R.Br., *Trans. Linn. Soc. London* 10: 207 (1810)

Sirmuellera verticillata (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: King George Sound, [W.A.], Dec. 1801, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 411 (1981); isolecto: BM, K, NSW.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 14 (1981); A.S.George, *Banksia Book* 194, 195, fig. 56, pl. 82 (1984).

Shrub, rarely a tree, to 5 m tall, much-branched and spreading, without lignotuber. Bark roughly fissured, grey. Stems pubescent, glabrescent. Leaves whorled, sometimes alternate; petiole 5–11 mm long; lamina leathery, elliptic, 3–9 cm long, 7–12 mm wide, obtuse; margins recurved, entire; upper surface loosely hirsute, glabrescent; lower surface white-matted. Inflorescence 8–20 cm long; involucral bracts narrow, hirsute, persistent. Flowers golden; styles yellow. Perianth 25–30 mm long including limb of 3.5–4 mm, pubescent outside, also inside along upper margins. Pistil hooked, 30–35 mm long, glabrous; pollen presenter ovoid, 0.5 mm long. Old flowers persistent but finally falling. Follicles up to c. 100, elliptic, 11–15 mm long, 2–3 mm high, 3–4 mm wide, smooth, tomentose. Seed obovate-cuneate, 18–20 mm long; seed body narrowly cuneate, 10–11 mm long, smooth, with inner face slightly rugose. *Granite Banksia*.

Occurs near the south coast of W.A. at Walpole and from Albany to Two Peoples Bay. On or beside granite outcrops, usually exposed, sometimes in tall shrubland. Listed as 'Vulnerable' in the ANZECC Threatened Flora List 1997. Flowers Jan.–Apr. Map 240.

W.A.: c. 2 km WNW of Cheyne Beach, *S.D.Hopper 1184* (PERTH); Mermaid Point, E of Albany, 7 Mar. 1979, *B.Wells* (PERTH); Woolbale Rock, NW of Walpole, 6 Jan. 1980, *T.G.Wilson* (PERTH).

Probably killed by fire and regenerates from seed. Follicles mostly opening without fire after several years. Related to *B. littoralis* which is usually a tree with longer, serrate adult leaves, the perianth more hirsute inside but the limb appressed-pubescent, and the follicles more exserted from a narrower axis. *Banksia littoralis* grows in damper habitats and flowers later than *B. verticillata*. Also closely related to *B. seminuda*, a tree with thin, usually serrate leaves, strongly recurved styles and perianths with glabrous limb; it flowers in winter.

55. Banksia seminuda (A.S.George) Rye, *Nuytsia* 5: 25 (1984)

Banksia littoralis var. *seminuda* A.S.George, *Nuytsia* 3: 408 (1981). T: Nanga Brook, S of Dwellingup, W.A., 15 May 1973, *A.S.George 11655*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Banksia seminuda subsp. *remanens* Hopper, *Nuytsia* 7: 16 (1989). T: 1 km due W of Conspicuous Beach carpark, Walpole–Nornalup Natl Park, W.A., 31 July 1987, *S.D.Hopper 5920*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 191, 192, fig. 55, pl. 81 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 73 (in press).

Tree to 25 m tall, usually straight-trunked, sometimes irregular, fire-sensitive. Bark fissured, hard. Stems tomentose. Leaves whorled; petiole 2–5 mm long; lamina thin, broadly linear, 5–12 cm long, commonly 10–18 mm wide, obtuse; margins slightly recurved, commonly serrate; upper surface appressed-pubescent, glabrescent; lower surface closely white-tomentose. Inflorescence 10–15 cm long; involucral bracts rusty-tomentose, persistent. Flowers golden; styles usually yellow, sometimes deep red. Perianth 21–24 mm long including limb of 3 mm; claws pubescent both sides; limb glabrous with prominent central nerve. Pistil hooked, 32–38 mm long, glabrous; pollen presenter narrowly ovoid, 0.5 mm long. Old flowers mostly soon falling. Follicles many, broadly linear to narrowly elliptic, 10–15 mm long, 3–7 mm high, 3–5 mm wide, smooth, tomentose. Seed obovate, 16–18 mm long; seed body cuneate, 8–9 mm long, 3–5 mm wide, smooth or slightly rugose. *River Banksia*. Fig. 35C–E.

Occurs in W.A., from Banksiadale to Broke Inlet and east to Two Peoples Bay. in red loam or gravelly loam along rivers and creeks in Jarrah-Marri forest; occasionally on sandy flats and coastal dunes. Flowers Apr.–July. Map 241.

W.A.: Camfield, Broke Inlet, *A.S.George 11789* (PERTH); Bow R., Dec. 1912, *S.W.Jackson* (NSW); Big Brook, *M.Koch 2576* (BRI, MEL); Napier Ck, c. 24 km N of Albany, Nov. 1909, *J.H.Maiden NSW119887* (NSW).

Killed by fire and regenerates from seed. Follicles usually opening when mature. Closely related to *B. littoralis* which is always an irregular tree or shrub with friable bark, narrow leaves, a tomentose perianth limb and the style less strongly curved; it is fire-tolerant. Also related to *B. verticillata*, a broad shrub with thick entire leaves and pubescent flowers. Subsp. *remanens* is considered to lie within the considerable variation in habit and leaf size and is not accepted as a distinct taxon (George, 1996).

56. Banksia littoralis R.Br., *Trans. Linn. Soc. London* 10: 204 (1810)

Sirmuellera littoralis (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891) as *litoralis*. T: King George Sound, [W.A.], Dec. 1801, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 407 (1981); isolecto: BM, K, NSW.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 17 (1981); A.S.George, *Banksia Book* 190, 191, fig. 54, pl. 80 (1984).

A tree to 12 m tall, rarely a low shrub, fire-tolerant. Bark rough, friable. Stems tomentose. Leaves whorled or sometimes alternate; petiole 5–10 mm long; lamina linear, 10–23 cm long, to 10 mm wide, obtuse; margins recurved, serrate towards apices or almost entire; upper surface pubescent, glabrescent; lower surface closely tomentose. Inflorescence 7–20 cm long; involucral bracts tomentose, persistent until flowering. Flowers yellow, including styles. Perianth 25–27 mm long including limb of 2.5–3 mm, pubescent outside (including limb) and inside. Pistil hooked, 29–35 mm long, glabrous; pollen presenter narrowly ovoid, 0.5 mm long. Old flowers soon falling. Follicles up to 200, broadly linear to narrowly elliptic, 11–22 mm long, 2.5–8 mm high, 4–8 mm wide, smooth or sometimes with a ridge across valves, tomentose. Seed obovate, 15–18 mm long; seed body cuneate, 5–8 mm long, 4–5 mm wide, smooth to rugose. *Swamp Banksia*.

Occurs in W.A. from Mt Lesueur to Cape Leeuwin and east to Two Peoples Bay and the Stirling Ra. in low-lying, winter-damp areas, in sand or peaty sand, usually in low woodland and often with *Melaleuca preissiana* (paperbark); also in *Eucalyptus gomphocephala* (Tuart) forest, rarely in low coastal kwongan. Flowers mainly Mar.–July. Map 242.

W.A.: near junction of Chester Pass Rd and Stirling Ra. Drive, *A.M.Ashby 4483* (PERTH); Helena R. near Mundaring Weir, 25 June 1925, *C.A.Gardner s.n.* (PERTH); near Moses Rock, S of Yallingup, *A.S.George 14235* (PERTH); SE of Mt Lesueur, *E.A.Griffin 2656* (PERTH).

Sprouts from the trunk and branches after fire. Follicles usually opening when mature. Similar to *B. seminuda* which has broader leaves and a glabrous perianth limb. Also related to *B. verticillata*, a shrubby species with thicker entire leaves, and *B. occidentalis*, also a shrub but with narrower leaves and red styles.

57. Banksia occidentalis R.Br., *Trans. Linn. Soc. London* 10: 172 (1810)

Sirmuellera occidentalis (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: near King George Sound, [W.A.], 24 Dec. 1801, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 404 (1981); isolecto: BM, K.

Banksia occidentalis subsp. *formosa* Hopper, *Nuytsia* 7: 21 (1989). T: Black Point, proposed Shannon-D'Entrecasteaux Natl Park, W.A., 2 Aug. 1987, *S.D.Hopper 5937*; holo: PERTH; iso: AD, CANB, K, MEL, NSW, PERTH.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 19 (1981); A.S.George, *Banksia Book* 188, 189, fig. 53, pl. 79 (1984).

Shrub or small tree to 7 m tall, without lignotuber. Bark smooth with lenticels, grey-brown. Stems pubescent, glabrescent. Leaves whorled; petiole 1–5 mm long; lamina linear, 4–13 cm long, 2–3 (–6) mm wide, truncate; margins recurved, sparsely serrate; upper surface pubescent, glabrescent; lower surface white-tomentose. Inflorescence 4–14 cm long; involucral bracts narrow, tomentose, persistent. Flowers golden, green in bud; styles metallic red. Perianth 17–18 mm long including limb of 3–3.5 mm, slender, pubescent inside and outside. Pistil hooked, 29–35 mm long, glabrous; pollen presenter ovoid, 0.3 mm long. Old flowers persistent. Follicles up to 60, elliptic, 10–18 mm long, 4–7 mm high, 3–7 mm wide, transversely ridged on valves, ±acute along suture, hirsute. Seed obovate, 12–13 mm long; seed body triangular, 5–6 mm long, 3 mm wide, smooth. *Red Swamp Banksia*. Fig. 35F.

Occurs along the south coast of W.A. from Augusta to Cape Arid. in sand or peaty sand,

usually on swamp margins in tall shrubland or paperbark woodland; sometimes in coastal seepages and on coastal dunes. Listed as 'Vulnerable' in the ANZECC Threatened Flora List 1997. Flowers mainly Dec.–Mar., with some flowers in late spring and winter. Map 243.

W.A.: W end of Scott R. plain, *A.S.George 14232* (PERTH); Cape Arid Natl Park, *R.D.Royce 9885* (PERTH); Cheyne Beach, 27 May 1959, *G.M.Storr* (PERTH); 11 km N of Esperance, 2 Nov. 1968, *J.Wrigley s.n.* (CANB, NSW).

Killed by fire and regenerates from seed; follicles usually opening with fire. Some populations have been eliminated by too-frequent fire. Related to *B. brownii* which has finely lobed leaves and thinner follicles. Also related to *B. littoralis* and to the eastern species *B. spinulosa*.

The character states said to distinguish *B. occidentalis* subsp. *formosa* are not clear-cut when all the available material is studied. The Black Point population grades from broad-leaved at its seaward margin to typically linear inland. The taxon is here considered a coastal variant (George, 1996).

58. Banksia brownii Baxter ex R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 37 (1830)

Sirmuellera brownii (Baxter ex R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891), as *S. Brownei*. T: near King George Sound, [W.A.], 1829, *W.Baxter*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 401 (1981); isolecto: BM, K.

Illustrations: A.S.George, *Banksia Book* 186, 187, fig. 52, pl. 78 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 34 (1988).

Shrub to 4 m tall, without lignotuber, sometimes a small tree to 6 m. Bark smooth with lenticels. Stems pubescent, glabrescent. Leaves whorled; petiole 2–5 mm long; lamina pinnatipartite, broadly linear (in outline), 3–11 cm long, 5–12 mm wide, retuse; lobes linear, obtuse, rather soft; margins revolute; upper surface pubescent, glabrescent; lower surface woolly. Inflorescence 6–9 cm long; involucral bracts narrow, pubescent, persistent. Flowers pale brown with grey-brown limb; styles metallic red with cream apex. Perianth 27–31 mm long including limb of 3 mm, slender, hirsute outside, glabrous inside except hairs on margins in upper half. Pistil hooked, 31–40 mm long, glabrous; pollen presenter narrowly ovoid, 0.3 mm long. Old flowers persistent. Follicles up to 60, narrowly elliptic, 17–25 mm long, 5–10 mm high, 4–7 mm wide, slightly rugose on valves, pubescent. Seed obovate, 19–20 mm long; seed body cuneate, 8–9 mm long, 5–6 mm wide, irregularly rugose.

W.A., from Albany to the Stirling Ra. in shallow sand over laterite, in woodland; in shale in gullies, in woodland; and among rocks on mountains, in kwongan. Flowers Apr.–July. Map 244.

W.A.: near Millbrook, c. 30 km N of Albany, *A.S.George 14584* (PERTH); summit, Bluff Knoll, *K.F.Kenneally 6953* (PERTH); Mt Trio, Stirling Ra., 22 July 1952, *N.H.Speck* (CANB).

Killed by fire and regenerates from seed; follicles usually opening with fire. Related to *B. occidentalis* which has smaller, deep red flowers and narrow, sparsely serrate leaves.

Ser. 11. Tricuspidae

Banksia ser. **Tricuspidae** A.S.George, *Fl. Australia* 17B: 397 (1999)

Type: *B. tricuspis* Meisn.

Erect small trees. Leaves alternate but crowded, each margin with a short obtuse tooth just below apex; margins tightly revolute. Inflorescence on short lateral branchlet, erect, cylindrical; buds losing regular pattern well before anthesis. Perianth at anthesis rupturing dorsally, pubescent; limb pointing vertically downwards before anthesis; tepals not awned. Style not laterally twisted; pollen presenter ovoid. Mesocarp of follicle spongy. Seed wing not notched.

A single species in south-western W.A. George (1981) included this in ser. *Spicigerae* on the basis of its cylindrical inflorescence but stated that it 'is rather isolated from other members

Figure 35. *Banksia*. **A–B**, *B. tricuspis*. **A**, bud just before anthesis; **B**, pistil (**A–B**, cult. Nedlands, W.A.). **C**–**E**, *B. seminuda*. **C**, bud just before anthesis; **D**, open flower (**C**–**D**, cult. Mount Barker, W.A.); **E**, infructescence (A.George 11655, PERTH). **F**, *B. occidentalis*, seed, abaxial face (not recorded). **G**, *B. sphaerocarpa* var. *sphaerocarpa*, seed, adaxial face (Mt Willyung, A.George *s.n.*, PERTH). **H–I**, *B. grossa*. **H**, infructescence and leaves (A.George 6750, PERTH); **I**, seed, abaxial face (not recorded). Scale bar: **A–B** = 4 mm; **C–D**, **F** = 7 mm; **E** = 7.5 mm; **G** = 1.3 cm; **H** = 2 cm; **I** = 1.7 cm. Drawn by: **A–D**, M.Wilson; **E**, P.Nikulinsky; **F–G**, **I**, A.George; **H**, S.Genovese. **H**, reproduced with permission from *Nuytsia* 3: 428 (1981); **E–G**, **I**, reproduced with permission from *The Banksia Book* (1996).

of the series'. Thiele and Ladiges (1996) transferred it to ser. *Abietinae* on the basis of its inflorescence insertion, floral development, floral and fruit morphology and entire seedling leaves. I agree that the character states uncovered in Thiele's research preclude placement in ser. *Spicigerae* but prefer to keep it apart from the *Abietinae* because of its arborescent habit and cylindrical inflorescence.

59. Banksia tricuspis Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 118 (1855)

Sirmuellera tricuspis (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: probably at or near Mt Lesueur, W.A., 1850–51, *J.Drummond 6: 205*; lecto: NY, *fide* A.S.George, *Nuytsia* 3: 412 (1981); isolecto: B, BM, CGE, FI, K, LD, MEL, P, PERTH.

Illustrations: A.S.George, *Banksia Book* 196, 197, fig. 57, pl. 83 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 41 (1988).

Shrub or small tree to 4 m tall, with stout trunk, often of irregular form, fire-tolerant. Bark tessellated or rugose, grey. Leaves alternate but crowded near branchlet tips; petiole 2–5 mm long; lamina narrowly linear, 5–13 cm long, 1–1.5 mm wide, entire except an obtuse tooth each side of apex; margins revolute; upper surface hirsute, glabrescent; lower surface woolly. Inflorescence 7–15 cm long; involucral bracts closely tomentose, soon falling. Flowers golden, drying dark red-brown; style bright yellow. Perianth 23–26 mm long including limb of 2.5 mm, appressed-pubescent outside, glabrous inside. Pistil hooked, 32–37 mm long, glabrous; pollen presenter ovoid, 1 mm long. Old flowers soon falling. Follicles up to 35, prominent, elliptic, 15–28 mm long, 8–16 mm high, 8–14 mm wide, slightly rugose, glabrous. Seed obovate, 23–28 mm long; seed body obovate, 11–17 mm long, 9–12 mm wide, rugose. *Lesueur Banksia*. Fig. 35A, B.

Occurs around Mt Lesueur, near Jurien, W.A. in rocky, lateritic soil, sometimes at breakaway edges, in shrubland. Flowers late Mar.–July. Map 245.

W.A.: Mt Lesueur, 10 June 1931, *C.A.Gardner s.n.* (PERTH).

Fire-tolerant, sprouting by epicormic shoots. Follicles opening with fire. No close relatives. Thiele & Ladiges (1996) considered this misplaced in ser. *Spicigerae* and transferred it to ser. *Abietinae* but the latter is here restricted to those taxa with entire leaves and spherical inflorescences.

Ser. 12. Dryandroideae

Banksia ser. **Dryandroideae** Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 464 (1856)

Type: *B. dryandroides* Baxter ex Sweet; lecto, *fide* A.S.George, *Nuytsia* 10: 414 (1981).

Erect or spreading shrubs. Leaves alternate, pinnatipartite; margins revolute. Inflorescence erect, ovoid; buds losing much of regular pattern before anthesis. Perianth tomentose; tepals not awned. Pollen presenter turbinate. Seed wing not notched.

A monotypic series in W.A.

60. Banksia dryandroides Baxter ex Sweet, *Fl. Australas.* 56 (1828)

Sirmuellera dryandroides (Baxter ex Sweet) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891), as *S. dryandrodes*. T: near King George Sound, [W.A.], 1823, W.Baxter; neo: BM, *fide* A.S.George, *Nuytsia* 3: 414 (1981).

Illustrations: A.S.George, *Banksia Book* 198, 199, fig. 58, pl. 84 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 25 (1988).

A shrub to 1 m tall, without lignotuber, intricately branched. Stems hirsute and tomentose, reddish. Leaves: petiole 1–2 mm long; lamina linear, flexuose, pinnatipartite with many triangular, acute lobes, 5–17 cm long, 7–15 mm wide, truncate; upper surface hirsute, glabrescent; lower surface tomentose. Inflorescence 2–3 cm long; involucral bracts small, villous. Flowers pale brown to dull orange, with pale hairs; style cream. Perianth 15–16 mm long including limb of 1.5–2 mm, tomentose outside, glabrous or almost so inside. Pistil

hooked, 14–15 mm long, glabrous; pollen presenter turbinate, 0.5 mm long. Old flowers persistent. Follicles up to 25, linear to narrowly elliptic, undulate, 15–30 mm long, 5–12 mm high, 3–9 mm wide, hirsute in lower half, glabrous above. Seed broadly obovate, 20–28 mm long; seed body obovate-falcate, 9–10 mm long, 3 mm wide, smooth or slightly rugose.

Occurs near the south coast of W.A. between Narrikup and Beaufort Inlet. in clay-loam and sandy loam, sometimes over gravel, on low-lying flats, in shrubland and low woodland; also on sandstone hills in kwongan. Flowers Oct.–Jan. Map 246.

W.A.: Cape Riche, *C.A.Gardner 2159* (PERTH); near Point Irby, Beaufort Inlet, *A.S.George 6153* (PERTH); near Narrikup, *A.S.George 6222* (PERTH).

Killed by fire and regenerates from seed. Follicles usually opening with fire. No close relative but allied to the other hooked-style species.

Ser. 13. Abietinae

Banksia ser. **Abietinae** Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 452 (1856)

Type: *B. sphaerocarpa* R.Br.; lecto: A.S.George, *Nuytsia* 3: 416 (1981).

Banksia subser. *Leptophyllae* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot.* 9: 720 (1996). T: *B. leptophylla* A.S.George

Banksia subser. *Longistyles* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *loc. cit.* T: *B. pulchella* R.Br.

Banksia subser. *Nutantes* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *loc. cit.* T: *B. nutans* R.Br.

Banksia subser. *Sphaerocarpae* K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *loc cit.* T: *B. sphaerocarpa* R.Br.

Erect or spreading shrubs. Leaves alternate, entire; margins revolute. Inflorescence erect or (in *B. nutans*) pendulous, cylindrical, ovoid or spherical; buds usually losing regular pattern before anthesis. Perianth pubescent or hirsute; tepals not awned. Pollen presenter ovoid. Seed wing not notched.

A series of 13 species endemic in south-western W.A. Thiele & Ladiges (1996) proposed dividing it into five subseries.

61. Banksia sphaerocarpa R.Br., *Trans. Linn. Soc. London.* 10: 203 (1810)

Sirmuellera sphaerocarpa (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: just north of King George Sound, [W.A.], Dec. 1801, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 417 (1981); isolecto: BM (fruit).

Shrub to 2 m tall, with lignotuber. Stems pubescent, glabrescent, usually orange-brown. Leaves: petiole 2–3 mm long; lamina stiff, narrowly linear, 2.5–10 cm long, 1–1.5 (–2) mm wide, pungent, dark green or slightly glaucous; upper surface hirsute, glabrescent. Inflorescence 3–6 cm long; involucral bracts tomentose with glabrous apices. Flowers rusty or purplish brown including styles, rarely golden. Perianth 24–39 mm long including limb of 3–5 mm, hirsute outside, pubescent inside. Pistil hooked, 29–46 mm long, glabrous; pollen presenter narrow, 0.5–1.5 mm long. Old flowers persistent. Follicles up to 60, elliptic, 15–30 mm long, 5–8 mm high, 10–25 mm wide, smooth but with lateral shoulders, hirsute, glabrescent, shining brown or orange-brown. Seed cuneate, 20–26 mm long; seed body cuneate, 10–14 mm long, 5–13 mm wide, smooth. *Fox Banksia.*

Widespread in W.A. between Eneabba, Albany and Hyden.

Fire-tolerant, sprouting from the lignotuber. Follicles usually opening with fire. The lateral shoulders of the follicle valves assist to distinguish this species. Among the *Abietinae* probably most closely related to *B. micrantha* which has much smaller flowers and large flattened follicles, and to *B. grossa* which has coarser leaves and flowers and large velvety follicles without shoulders on the valves.

There are three varieties.

1 Pistil 29–46 mm long

2 Leaves green or slightly glaucous; follicles 15–30 mm long, 10–25 mm wide **61a.** var. **sphaerocarpa**

2: Leaves glaucous; follicles commonly 8–17 mm long, 10–12 mm wide **61b.** var. **caesia**

1: Pistil 50–65 mm long **61c.** var. **dolichostyla**

61a. Banksia sphaerocarpa R.Br. var. sphaerocarpa

Banksia sphaerocarpa var. *latifolia* F.Muell. ex Benth., *Fl. Austral.* 5: 546 (1870). T: Porongurup Ra., *G.Maxwell*; lecto: MEL, *fide* A.S.George, *Nuytsia* 3: 418 (1981); isolecto: MEL.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 18 (1981); A.S.George, *Banksia Book* 200, 201, fig. 59A, pl. 85 (1984).

Shrub 0.5–2 m high. Leaves green, rarely slightly glaucous. Perianth 24–39 mm long. Pistil 29–46 mm long. Follicles 15–30 mm long, 5–8 mm high, 10–25 mm wide. Fig. 35G.

Common between Eneabba and Mogumber, W.A., between the Stirling Ra. and Cape Riche, at scattered intervening localities, and as far south-west as the Whicher Ra. in sandy loam over laterite, in shrubland or low woodland; in laterite or sandy loam over laterite in Jarrah open forest; and on lateritic rises in kwongan. Flowers Jan.–July. Map 247.

W.A.: Red Gum Pass, Stirling Ra., *C.A.Gardner 14705* (PERTH); 6 km N of Badgingarra, *A.S.George 6185* (PERTH); Yoongarillup, Whicher Ra., *A.S.George 6211* (PERTH); Chittering valley, *A.S.George 7768* (AD, CANB, K, MEL, NSW, PERTH).

A variable taxon that should be studied in more detail.

61b. Banksia sphaerocarpa var. caesia A.S.George, *Nuytsia* 3: 419 (1981)

T: 6 km E of Popanyinning, W.A., 20 Feb. 1964, *R.D.Royce 8118*; holo: PERTH; iso: K, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 202, 203, fig. 59B, pl. 86 (1984).

Differs from var. *sphaerocarpa* in its larger habit (up to 4 m tall and broad), glaucous leaves, golden flowers, smaller follicles (commonly 8–17 mm long, 4–7 mm high, 10–12 mm wide, rarely larger) and narrower seed body (5–7 mm wide).

Occurs in the central and southern wheatbelt of W.A. between Piawaning, Kojonup, Newdegate and Corrigin. in laterite or shallow sandy loam over laterite, in kwongan and Wandoo open woodland. Flowers Jan.–July. Map 248.

W.A.: 16 km E of Newdegate, *A.S.George 6093* (PERTH); 4 km E of Piawaning, *K.F.Kenneally 5889* (PERTH); 11 km E of Wagin, *M.D.Tindale 147 & B.R.Maslin* (NSW, PERTH).

61c. Banksia sphaerocarpa var. dolichostyla A.S.George, *Nuytsia* 3: 422 (1981)

Banksia dolichostyla (A.S.George) K.R.Thiele, in K.R.Thiele & P.Y.Ladiges, *Austral. Syst. Bot.* 9: 719 (1996). T: just SSE of South Ironcap, E of L. Varley, W.A., 14 March 1978, *A.S.George 15106*; holo: PERTH; iso: CANB, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 202, 203, fig. 59C, pl. 87 (1984).

Differs from the other two varieties in the longer perianth (49–55 mm long) and the longer pistil (50–65 mm long). Has the large habit, glaucous foliage, golden flowers and small follicles of var. *caesia*.

Restricted to a small area from Mt Holland to South Ironcap, east of Hyden, W.A. in laterite, in shrubland and open woodland. Listed as 'Vulnerable' in the ANZECC Threatened Flora List 1997. Flowers Mar.–May. Map 249.

W.A.: North Ironcap, *G.J.Keighery 1644* (PERTH); near Mt Holland, 1 Sept. 1978, *P.Luscombe* (PERTH).

Thiele (Thiele & Ladiges, 1996) raised this to specific rank on the basis of its larger flowers and old styles that are 'stouter and do not curl around [the infructescence]'. in material that I have seen the old styles curl to varying degrees, sometimes approaching the condition in the other varieties of *B. sphaerocarpa*. I do not consider this a character strong enough to justify specific rank. The variety is similar to var. *caesia* in all respects except the larger flower size. I have not seen the material studied by Thiele.

62. Banksia micrantha A.S.George, *Nuytsia* 3: 422 (1981)

T: c. 5 km W of Mt Lesueur, W.A., 27 Mar. 1977, *A.S.George 14415*; holo: PERTH; iso: K, NSW, PERTH.

Illustrations: A.S.George, *Banksia Book* 204, 205, fig. 60, pl. 88 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 69 (in press).

Shrub to 60 cm tall and 1.2 m wide, with lignotuber. Branches often at first horizontal and subterranean before emerging. Stems pubescent. Leaves: petiole 1.5–2 mm long; lamina linear, 1–3 cm long, 1–1.5 mm wide, pungent; upper surface sparsely hairy. Inflorescence 1.5–3 cm long; involucral bracts 2.5–4 mm long, pubescent, persistent. Flowers pale yellow, with uppermost flowers sometimes purplish, greenish in bud; style pale yellow or purple. Perianth 17–20 mm long including limb of 2–3 mm, closely pubescent outside and inside, with limb almost glabrous. Pistil hooked, 19–24 mm long, glabrous; pollen presenter ovoid, 0.6–0.7 mm long. Old flowers persistent. Follicles up to 25, ovate-elliptic, 23–27 mm long, 7–15 mm high, 20–23 mm wide, rather flattened but with low median ridge, smooth, pubescent, glabrescent. Seed broadly obovate, 20–24 mm long; seed body obovate, 12–14 mm long, 7–9 mm wide, smooth.

Occurs between Eneabba and Cervantes, W.A. in shallow grey or white sand over laterite, in low kwongan. Flowers Jan.–May. Map 250.

W.A.: between Cockleshell Gully and Mt Lesueur, *W.E.Blackall 3611* (PERTH); S of Eneabba, *A.S.George 11782* (PERTH).

Fire-tolerant, sprouting from the lignotuber. Related to *B. sphaerocarpa* which has larger flowers and, usually, smaller follicles that are more flattened. The underground lateral branches of *B. micrantha* are unique in the *Abietinae*.

63. Banksia grossa A.S.George, *Nuytsia* 3: 426 (1981)

T: 76 km N of Regans Ford, W.A., 14 May 1969, *A.S.George 9316*; holo: PERTH; iso: CANB, K, NSW.

Illustrations: A.S.George, *Banksia Book* 206, 207, fig. 61, pl. 89 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 71 (in press).

Shrub to 1 m tall, with lignotuber. Bark flaky, pale brown. Stems tomentose. Leaves: petiole 3–5 mm long; lamina linear, 4–12 cm long, commonly 1.8–2.8 mm wide, obtuse; upper surface pubescent, glabrescent. Inflorescence 5–7 cm long; involucral bracts tomentose, persistent. Flowers rusty brown to golden brown; styles where exposed dark red to purple. Perianth 34–45 mm long including limb of 5–6 mm, hirsute outside and inside. Pistil hooked, 38–48 mm long, glabrous; pollen presenter ovoid, 1 mm long. Old flowers persistent, curled against follicles. Follicles elliptic, usually 25–35 mm long, 10–18 mm high, 10–18 mm wide, smooth, very hirsute. Seed unevenly obovate, 28–39 mm long; seed body narrowly cuneate, 14–18 mm long, 4–9 mm wide, smooth. Fig. 35H, I.

Occurs from just north of Eneabba almost to Regans Ford and inland towards Coorow, W.A. in shallow white or grey sand over laterite, in kwongan; sometimes in deep sand. Flowers Mar.–Sept. Map 251.

W.A.: NE of Mt Lesueur, *A.S.George 14429* (PERTH); 8 km S of Eneabba, *R.J.Hnatiuk 770025* (PERTH); Cadda Rd., 30 May 1965, *F.W.Humphreys* (PERTH).

Fire-tolerant, sprouting from the lignotuber; follicles usually opening with fire. Inflorescence commonly on short lateral branch towards base of main stem. Related to *B. sphaerocarpa* which has finer leaves and flowers and smaller, loosely hirsute or glabrous follicles with a ridge across each valve.

64. Banksia telmatiaea A.S.George, *Nuytsia* 3: 436 (1981)

T: c. 45 km N of Regans Ford, W.A., 14 May 1969, *A.S.George 9303*; holo: PERTH; iso: CANB.

Illustrations: A.S.George, *Banksia Book* 214, 215, fig. 65, pl. 93 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 62 (in press).

Shrub to 2 m tall, usually taller than wide, without lignotuber. Stems tomentose. Leaves: petiole 1.5–2 mm long; lamina narrowly linear, commonly 1.5–3 cm long, 1–1.3 mm wide,

obtuse to acute; upper surface pubescent, glabrescent. Inflorescence 3–5 cm long; involucral bracts 3–4 mm long, tomentose. Flowers golden brown to pale brown; styles cream. Perianth 22–25 mm long including limb of 4 mm, hirsute outside and inside. Pistil hooked, 25–29 mm long, glabrous; pollen presenter narrow, 1 mm long. Old flowers persistent. Follicles up to 65, narrowly elliptic, 12–20 mm long, 4–9 mm high, 4–7 mm wide, smooth, hirsute. Seed obovate, 19–23 mm long; seed body oblong, 10–13 mm long, 2–3 mm wide, smooth. *Swamp Fox Banksia*. Fig. 36E–H.

Occurs near the lower west coast of W.A. between Badgingarra and Serpentine. in deep grey sandy loam, often wet in winter, in scrub, occasionally in low woodland. Flowers May–Aug. Map 252.

W.A.: Serpentine, *L.Diels & E.Pritzel 411* (PERTH); University Reserve, Cannington, *R.Melville 7 & R.D.Royce* (K, MEL).

Killed by fire and regenerates from seed; follicles usually opening with fire. in the late bud stage the inflorescence assumes a shortly cylindrical aspect. Related to *B. leptophylla* which has longer leaves and larger flowers, and the inflorescence rounded through all stages.

65. Banksia leptophylla A.S.George, *Nuytsia* 3: 429 (1981)

Based on *B. pinifolia* Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 118 (1855), *nom. illeg. non* Salisb. (1796). T: between Perth and Geraldton, W.A., 1850–51, *J.Drummond 6: 209*; lecto: K, *fide* A.S.George, *Nuytsia* 3: 429 (1981); isolecto: BM, CGE, G, K, LD, MEL, P.

Banksia sphaerocarpa var. *major auct. mult.*: e.g. A.R.Fairall, *W. Australian Nat. Pl. Cult.* 67 (1970), *nom. inval.*

Banksia sphaerocarpa var. *pinifolia auct. mult.*: e.g. W.E.Blackall, *How to Know W. Australian Wildflowers* 1: 130 (1954), *nom. inval.*

Shrub to 2 m tall and 3 m wide, without lignotuber, usually much-branched. Stems tomentose. Leaves: petiole 1–2 mm long; lamina relatively soft, narrowly linear, 4–10 cm long, 1–1.5 mm wide, acute; upper surface hirsute, glabrescent. Inflorescence on short lateral branchlet, 3–10 cm long; involucral bracts 5–10 mm long, tomentose, persistent. Flowers pale to medium yellow or pale brown; style yellow, sometimes purple. Perianth 33–45 mm long including limb of 3–5 mm, slender, pubescent to hirsute inside and outside. Pistil hooked, 34–58 mm long, glabrous; pollen presenter slightly thickened, 0.9–1.2 mm long. Old flowers persistent. Follicles up to 80 or more, elliptic, 15–30 mm long, 5–12 mm high, commonly 6–10 mm wide, rarely larger, smooth, hirsute. Seed broadly obovate, 25–29 mm long; seed body oblong, 12–15 mm long, 3–4 mm wide, smooth.

Common between Kalbarri and the Moore R., south-western W.A.

Killed by fire and regenerates from seed; follicles usually opening with fire. Related to *B. lanata* which has cream flowers with purple styles, white floral and common bracts, and pink new leaves, and to *B. telmatiaea* which has shorter leaves, a somewhat cylindrical inflorescence and a shorter perianth.

There are two varieties.

Perianth 42–47 mm long; pistil 56–62 mm long — **65a.** var. **leptophylla**

Perianth 30–36 mm long; pistil 34–44 mm long — **65b.** var. **melletica**

65a. Banksia leptophylla A.S.George var. leptophylla

Illustrations: A.S.George, *Banksia Book* 209, pl. 90b (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 40 (1988).

Perianth 42–47 mm long. Pistil 56–62 mm long.

Occurs between Tathra Natl Park and Moora, W.A., in deep white, yellow or grey sand or sandy clay, often in depressions, in shrubland and kwongan, rarely on laterite. Flowers mainly summer. Map 253.

W.A.: W of Moora, *T.E.H.Aplin 1301* (PERTH); Watheroo Natl Park, *N.Hoyle 837* (PERTH); 20 km W of Mogumber, *K.R.Newbey 2671* (PERTH).

65b. Banksia leptophylla var. **melletica** A.S.George, *Nuytsia* 6: 314 (1988)

T: c. 13 km N of Gingin turnoff on Perth–Lancelin road, W.A., 10 June 1966, *A.S.George 7761*; holo: PERTH; iso: CANB, K, MEL, NSW.

Illustrations: A.S.George, *Banksia Book* 3rd edn, 208, 209, fig. 62, pl. 90a (1996).

Perianth 30–36 mm long. Pistil 34–44 mm long.

Occurs near the lower west coast between Kalbarri and Guilderton, W.A., in deep sand, sometimes on limestone or in depressions, in kwongan. Flowers mainly winter. Map 254.

W.A.: Burma Rd, *A.C.Burns 7* (PERTH); c. 5 km E of Jurien, *R.B.Filson 8451* (MEL); Yerina Spring, NW of Northampton, *N.G.Marchant 255* (PERTH).

66. Banksia lanata A.S.George, *Nuytsia* 3: 432 (1981)

T: E of Eneabba, W.A., 14 Nov. 1971, *A.S.George 11191*; holo: PERTH; iso: CANB, NSW.

Illustrations: A.S.George, *Banksia Book* 210, 211, fig. 63, pl. 91 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 67 (in press).

Spreading shrub to 1 m tall, without lignotuber. Stems tomentose. Leaves rather crowded; petiole 3–4 mm long; lamina relatively soft, narrowly linear, 3–10 cm long, 0.75–1 mm wide, acute; upper surface hirsute, glabrescent. Inflorescence 3–5 cm long; involucral bracts to 10 mm long, not crowded, tomentose. Flowers pale cream, rarely pale brown; style usually purple. Perianth 32–38 mm long including limb of 3–4.5 mm, hirsute inside and outside. Pistil hooked, 38–48 mm long, glabrous; pollen presenter narrowly conical, c. 1 mm long. Old flowers persistent. Follicles up to 50, elliptic, 12–30 mm long, 4–11 mm high, 6–12 mm wide, smooth, hirsute. Seed obovate, 17–25 mm long; seed body falcate to semi-circular, 9–13 mm long, 5–6 mm wide, smooth.

Occurs near the lower west coast of W.A. between Arrowsmith L. and Coomallo Ck. in deep white sand, sometimes over laterite, in kwongan. Flowers late Oct.–Jan. Map 255.

W.A.: between L. Logue and Arrowsmith R., *C.A.Gardner 9114* (PERTH); Coomallo Ck, *R.J.Hnatiuk 761397* (PERTH); 65 km SW of Three Springs, 16 Dec. 1964, *F.W.Humphreys* (PERTH).

The common and floral bracts are distinctive in being almost white, and the new growth is reddish pink, incontrast to the rusty brown of related species. Killed by fire and regenerates from seed; follicles usually opening with fire. Related to *B. leptophylla* which has golden brown flowers and brown floral bracts.

67. Banksia scabrella A.S.George, *Nuytsia* 3: 433 (1981)

T: SE of Walkaway, W.A., 4 Sept. 1966, *A.S.George 7860*; holo: PERTH; iso: AD, CANB, K, NSW.

Illustrations: A.S.George, *Banksia Book* 212, 213, fig. 64, pl. 92 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 66 (in press).

Shrub to 2 m tall, without lignotuber; lateral branches spreading and often resting on ground. Stems white-tomentose. Leaves crowded; petiole 1–2 mm long; lamina narrowly linear, 8–35 mm long, 1 mm wide, acute; upper surface pubescent, becoming scabrid. Inflorescence 3–6 cm long; involucral bracts to 8 mm long, tomentose. Flowers cream to pale yellow; upper flowers and styles purple. Perianth 27–35 mm long including limb of 3–5 mm, hirsute inside and outside. Pistil hooked, 34–45 mm long, glabrous except a few hairs on ovary; pollen presenter narrow, c. 1 mm long. Old flowers persistent. Follicles up to 80, narrowly elliptic, 18–28 mm long, 5–9 mm high, 6–8 mm wide, smooth, hirsute. Seed broadly obovate, 24–28 mm long; seed body obovate-falcate, 13–15 mm long, 4–5 mm wide, slightly rugose. *Burma Road Banksia*.

Restricted to small areas east of Walkaway and near Mt Adams, W.A., in deep white or yellow sand in kwongan. Flowers Sept.–Jan. Map 256.

W.A.: E of Allanooka, Oct. 1961, *S.M.Harvey* (PERTH); W of Mt Adams, *S.D.Hopper 1538* (PERTH).

Killed by fire and regenerates from seed; follicles usually opening with fire. Related to *B. lanata* which has longer smooth leaves, white bracts among the flowers and a smaller habit of growth.

68. Banksia violacea C.A.Gardner, *J. Roy. Soc. W. Australia* 13: 62 (1928)

T: Lake Grace, W.A., 14 Dec. 1926, *C.A.Gardner s.n.*; holo: PERTH; iso: K, PERTH.

Banksia sphaerocarpa R.Br. var. *violacea auct. mult.*: e.g. W.E.Blackall, *How to Know W. Australian Wildflowers* 1: 130 (1954), *nom. inval.*

Illustrations: A.S.George, *Banksia Book* 220, 221, fig. 68, pl. 96 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 53 (in press).

Shrub to 1.5 m tall, without (rarely with) lignotuber. Stems pubescent, glabrescent. Leaves: petiole 1–2 mm long; lamina linear, obtuse, usually 1–2 cm long, 1.5 mm wide, rarely acute; upper surface loosely hirsute, glabrescent. Inflorescence 2–3 cm long; involucral bracts small, tomentose or partly glabrous. Flowers violet, sometimes green at base, rarely yellowish; style green or purple. Perianth 21–27 mm long including limb of 2–3 mm, pubescent outside, hirsute inside in lower half. Pistil hooked, 28–38 mm long, glabrous; pollen presenter narrowly ovoid, 0.7 mm long. Old flowers persistent mainly at base of spike. Follicles elliptic to rhombic, flattened, 10–25 mm long, to 6 mm high, 8–22 mm wide, pubescent, ±glabrescent, green and sticky at least when young, later brownish yellow. Seed cuneate, 20–25 mm long; seed body falcate, 12–18 mm long, 2–2.5 mm wide. *Violet Banksia*. Plate 46.

Occurs in southern regions of W.A. between Corrigin, Woodanilling, the Barrens, Forrestania and eastwards to Esperance. in white sand or sandy loam over laterite, clay or quartzite, in kwongan and shrubland. Flowers mainly Nov.–Feb. Map 257.

W.A.: 25 km W of Lake Grace, *W.E.Blackall 1317* (PERTH); c. 38 km E of Newdegate, *R.B.Filson 9376* (PERTH); 33 km E of Ravensthorpe, *A.S.George 6089* (PERTH); c. 15 km E of Wickepin, *A.S.George 16548* (PERTH).

Non-lignotuberous plants killed by fire and regenerating from seed. Follicles usually opening with fire. No obviously close relative, but among the *Abietinae* loosely allied to *B. sphaerocarpa* and *B. telmatiaea*.

69. Banksia incana A.S.George, *Nuytsia* 3: 441 (1981)

T: Mogumber, W.A., 2 Feb. 1967, *A.S.George 8644*; holo: PERTH; iso: AD, BRI, CANB, K, MEL, NSW, PERTH, RSA.

Banksia sphaerocarpa var. *glabrescens* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 453 (1856). T: south-western W.A., 1840s, *J.Drummond 2: 337*; lecto: NY, *fide* A.S.George, *loc. cit.*; isolecto: BM, CGE, G, K, LD, MEL, OXF, P.

Illustrations: A.S.George, *Banksia Book* 218, 219, fig. 67, pl. 95 (1984); C.E.Rosser & A.S.George, *Banksias* II: pl. 38 (1988).

Shrub to 70 cm tall, with lignotuber. Stems tomentose. Leaves: petiole 1–2 mm long; lamina narrowly linear, 1–6 cm long, 1.5–2 mm wide, acute; upper surface pubescent, glabrescent, somewhat glaucous. Inflorescence 2–3 cm long; involucral bracts to 3 mm long, tomentose, persistent. Flowers bright yellow, with apical ones sometimes reddish; style yellow. Perianth 21–23 mm long including limb of 2–2.5 mm long, pubescent outside, glabrous inside except a few hairs on limb. Pistil hooked, 30–35 mm long, glabrous; pollen presenter ovoid, 0.5 mm long. Old flowers soon falling. Follicles up to 36, prominent, elliptic to rhombic, 18–33 mm long, 4–16 mm high, 10–30 mm wide, ±flattened across top; valves thick, smooth, grey-hoary. Seed obovate, 25–30 mm long; seed body cuneate-oblong, 10–15 mm long, 4–6 mm wide, smooth or with small ridges. Fig. 36A.

Occurs between the Arrowsmith R. and Perth, W.A. in deep sand or sand over laterite, in kwongan, tall shrubland or low woodland. Flowers Nov.–Mar. Map 258.

W.A.: Orange Grove, Perth, *A.S.George 11259* (CANB, PERTH); S of Eneabba, *E.A.Griffin 1381* (PERTH); Coomallo Ck, *R.J.Hnatiuk 761395* (PERTH).

Sprouts from lignotuber after fire; follicles typically opening with fire. Probably related most closely to *B. laricina* which has no lignotuber and has greener leaves, smaller flowers appearing in autumn and winter and follicles with expanded, plate-like valves.

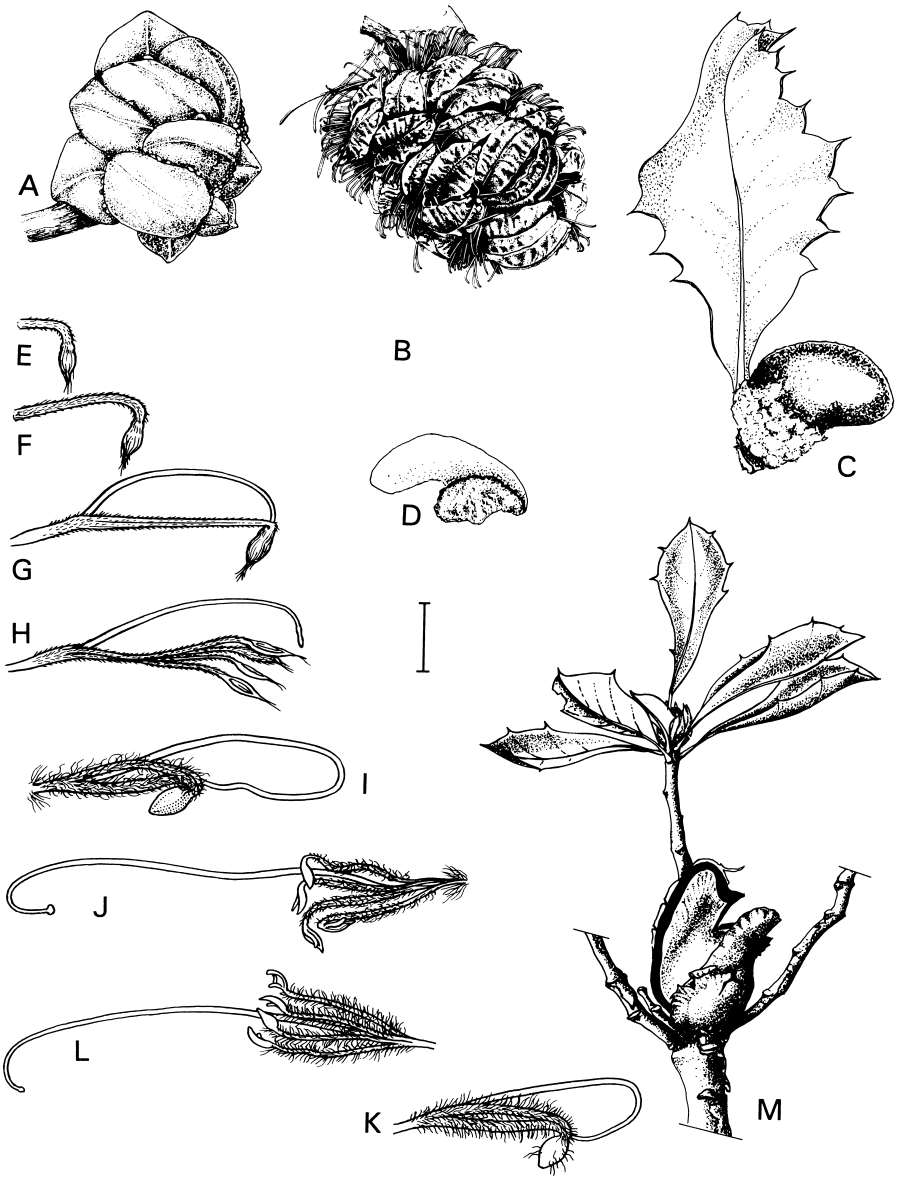

Figure 36. *Banksia.* **A**, *B. incana*, infructescence (A.Burns 14, PERTH). **B**, *B. nutans* var. *cernuella*, infructescence (A.George 15091, PERTH). **C–D**, *B. ilicifolia*. **C**, follicle and leaf; **D**, seed, adaxial face (**C–D**, not recorded). **E–H**, *B. telmatiaea*. **E–G**, three stages of bud development; **H**, open flower (**E–H**, from Orange Grove, W.A.). **I–J**, *B. meisneri* subsp. *meisneri*. **I**, bud just before anthesis; **J**, open flower (**I–J**, cult. Mount Barker, W.A.). **K–L**, *B. pulchella*. **K**, bud just before anthesis; **L**, open flower (**K–L**, cult. Mount Barker, W.A.). **M**, *B. oligantha*, fruit with open follicle (K.Wallace 9098, PERTH). Scale bar: **A–B** = 2 cm; **C** = 7.5 mm; **D**, **M** = 1 cm; **E–H** = 7 mm; **I–L** = 3 mm. Drawn by: **A**, C.A.Gardner; **B**, S.Genovese; **C**, **M**, P.Nikulinsky; **D**, A.George; **E–L**, M.Wilson. **B**, reproduced with permission from *Nuytsia* 3: 451 (1981); **C**, **D**, reproduced with permission from *The Banksia Book* (1996).

70. Banksia laricina C.A.Gardner, *J. Roy. Soc. W. Australia* 47: 57 (1964)

T: Beermullah, W.A., July 1958, *C.A.Gardner 12840*; lecto: PERTH, *fide* A.S.George, *Nuytsia* 11: 21 (1996); isolecto: PERTH; Moore R., W.A., July 1958, *C.A.Gardner s.n.*; syn: PERTH.

Illustrations: A.S.George, *Banksia Book* 216, 217, fig. 66, pl. 94 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 59 (in press).

Shrub to 1.7 m tall, without lignotuber. Stems sparsely tomentose-hirsute, glabrescent. Leaves crowded; petiole 1–1.5 mm long; lamina narrowly linear, 5–15 mm long, c. 0.8 mm wide, pungent; upper surface sparsely hirsute, glabrescent. Inflorescence 1.5–2.5 cm long; involucral bracts small, tomentose except glabrous apices, falling early. Flowers pale yellow drying red-brown; styles yellow. Perianth 17–19 mm long including limb of 2–2.5 mm, closely pubescent outside, glabrous inside. Pistil hooked, 27–30 mm long, glabrous; pollen presenter ovoid, c. 0.3 mm long. Old flowers soon falling. Follicles prominent, 22–30 mm long, 19–27 mm high, 14–18 mm wide, with enlarged thin vertical ridge, somewhat undulate, closely tomentose on base. Seed obovate, 27–35 mm long; seed body cuneate, 9–11 mm long, 3–4 mm wide, slightly rugose. *Rose Banksia*.

Restricted to a small area north and south of the Moore R. near Regans Ford, W.A. in deep sand on flats or in slight depressions, in *Banksia* low woodland. Flowers Apr.–July. Map 259.

W.A.: 39 km N of Gingin, *A.S.George 1697* (PERTH).

Killed by fire and regenerates from seed; follicles usually opening with fire. *Banksia laricina* has very distinctive follicles unlike any other species. in its flowers it is similar to *B. incana*.

71. Banksia pulchella R.Br., *Trans. Linn. Soc. London* 10: 202 (1810)

Sirmuellera pulchella (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: Lucky Bay, [W.A.], Jan. 1802, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 448 (1981); isolecto: BM, K.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 22 (1981); A.S.George, *Banksia Book* 224, 225, fig. 70, pl. 99 (1984).

Shrub to 1 m tall, without lignotuber. Bark smooth, grey. Stems sparsely hirsute, soon glabrous. Leaves: petiole 1–1.5 mm long; lamina linear, 4–13 mm long, c. 1 mm wide, obtuse; upper surface sparsely hirsute, but soon glabrous. Inflorescence 2–2.5 cm long; involucral bracts small, partly tomentose. Flowers golden brown; styles bright yellow. Perianth 8–10 mm long including reflexed limb of 1–1.5 mm, densely hirsute outside but with glabrous limb, glabrous inside. Pistil hooked, 17–24 mm long, glabrous; pollen presenter broadly turbinate, c. 0.2 mm long. Old flowers soon falling. Follicles inconspicuous, elliptic, 8–17 mm long, to 3 mm high, to 7 mm wide, smooth, hirsute, grey. Seed cuneate, 12–20 mm long; seed body cuneate-oblong, 7–11 mm long, 2–3.5 mm wide, smooth. *Teasel Banksia*. Fig. 36K, L.

Occurs along the south coast of W.A. from Culham Inlet to Israelite Bay. in deep white sand, in tall shrubland and kwongan. Flowers all year, with a peak from summer to early winter. Map 260.

W.A.: c. 2 km N of Hopetoun, 24 May 1959, *A.S.George s.n.* (PERTH); c. 54 km E of Ravensthorpe, 15 Oct. 1961, *J.H.Willis* (MEL); c. 30 km W of Mt Ragged, *P.G.Wilson 2950* (AD, CANB, PERTH).

Killed by fire and regenerates from seed; follicles usually opening with fire. Related to *B. meisneri* which has narrower, bright green leaves (short and reflexed in subsp. *meisneri*) and larger follicles in a loose cone. The two species have very short perianths and broad pollen presenters.

72. Banksia meisneri Lehm., *Pl. Preiss.* 1: 582 (1845)

Sirmuellera meisneri (Lehm.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: near the Gordon and Hay Rivers, probably on the old Perth–Albany road, W.A., Oct. 1840, *L.Preiss 488*; lecto: LD, *fide* A.S.George, *Nuytsia* 3: 446 (1981); isolecto: B, L, MEL.

Shrub to 2 m tall, without lignotuber, much-branched. Stems tomentose. Leaves crowded, reflexed, ascending or sometimes spreading; petiole 0.5–1 mm long; lamina linear to narrowly elliptic, 3–15 mm long, 1–1.5 mm wide, mucronate; upper surface hirsute, glabrescent. Inflorescence 2–3 cm long; involucral bracts small, tomentose. Flowers golden brown; style yellow. Perianth 7–9 mm long including limb of 1.5 mm, hirsute outside with glabrous limb, glabrous inside. Pistil hooked, 18–26 mm long, glabrous; pollen presenter turbinate, 0.3–0.4 mm long and wide. Old flowers persistent for 1–2 years, then falling except style bases. Follicles narrow, 12–22 mm long, 1–7 mm high, 3–4 mm wide, rather undulate, tomentose, loosely packed among enlarged floral bracts. Seed obovate, 20–24 mm long; seed body oblong-obovate, 8–10 mm long, 2–3 mm wide, smooth.

Occurs in W.A., between Augusta, Busselton and Pingrup.

Killed by fire and regenerates from seed; follicles usually opening with fire. Related to *B. pulchella* which has larger, erect leaves and smaller grey follicles with the old flowers falling.

There are two subspecies.

Leaves reflexed, 3–7 mm long; pistil 18–21 mm long	**72a.** subsp. **meisneri**
Leaves ascending or sometimes spreading, 8–15 mm long; pistil 24–26 mm long	**72b.** subsp. **ascendens**

72a. Banksia meisneri Lehm. subsp. **meisneri**

Illustrations: A.S.George, *Banksia Book* 3rd edn, 222, 223, fig. 69, pl. 97 (1996); C.E.Rosser & A.S.George, *Banksias* II: pl. 36 (1988).

Leaves reflexed, 3–7 mm long. Pistil 18–21 mm long. Fig. 36 I, J.

Occurs between Collie, Pingrup and Tenterden, W.A. in deep white sand on low-lying flats, usually in shrubland. Flowers Apr.–Aug. Map 261.

W.A.: Pingrup, *W.E.Blackall 3095* (PERTH); Muja, E of Collie, *C.A.Gardner 1314* (PERTH); near Haddleton Springs, between Boyup Brook and Darkan, 3 Oct. 1971, *A.S.George s.n.* (PERTH); c. 32 km NE of Wilga, *A.S.George 11666* (CANB, NSW, PERTH).

72b. Banksia meisneri subsp. **ascendens** (A.S.George) A.S.George, *Nuytsia* 11: 22 (1996)

Banksia meisneri var. *ascendens* A.S.George, *Nuytsia* 3: 448 (1981). T: S of Tutunup, W.A., 26 June 1973, *A.S.George 11659*; holo: PERTH; iso: CANB, K, NSW, PERTH.

Illustration: A.S.George, *Banksia Book* 3rd edn, 222, pl. 98 (1996).

Leaves ascending or sometimes spreading, 8–15 mm long. Pistil 24–26 mm long.

Occurs in the far south-west of W.A. near Busselton and on the Scott R. plain, on winter-wet sandy flats in scrub and low open woodland. Flowers Apr.–Aug. Map 262.

W.A.: Swan R. [colony], *J.Drummond 2: 338* (BM, G, K, L, MEL); Scott R. plain, E of Augusta, *R.D.Royce 2973* (PERTH).

73. Banksia nutans R.Br., *Trans. Linn. Soc. London* 10: 203 (1810)

Sirmuellera nutans (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: Lucky Bay, [W.A.], Jan. 1802, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 449 (1981); isolecto: BM, FI, K, P.

Shrub to 1 m tall, without lignotuber. Bark peeling in thin, red and grey flakes. Stems glabrous except a few hairs in leaf axils. Leaves usually crowded; petiole 2–3 mm long; lamina linear, 10–20 mm long, 0.5–1.5 mm wide, acute; upper surface glabrous. Inflorescence pendent, 4–7 cm long; flowering basipetal; involucral bracts narrow, pubescent at base, persistent. Flowers onion-scented, pinkish purple in bud, purplish brown; style cream. Perianth 22–33 mm long including limb of 2.5–3.5 mm, slender, pubescent outside, pubescent inside along margins. Pistil hooked, 22–36 mm long, glabrous except a few hairs on ovary; pollen presenter narrowly ovoid, c. 1 mm long. Old flowers persistent. Follicles prominent, oblong to elliptic, 18–40 mm long, 8–15 mm high, 8–38 mm wide, flattened,

often flanged, rugose to smooth. Seed cuneate to obovate, 15–27 mm long; seed body semi-orbicular, oblique, 7–12 mm long, 4–7 mm wide, smooth. *Nodding Banksia*.

Occurs near the south coast of W.A., from Albany to Israelite Bay.

Killed by fire and regenerates from seed; follicles opening with fire. No close relatives, but clearly belonging with series *Abietinae*. This is the only species in the series with a pendent inflorescence, but its development is acropetal.

There are two varieties.

Perianth 25–33 mm long; follicles commonly 25–40 mm long, prominently rugose **73a.** var. **nutans**

Perianth 22–24 mm long; follicles 18–30 mm long, smooth to slightly rugose **73b.** var. **cernuella**

73a. Banksia nutans R.Br. var. nutans

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 21 (1981); A.S.George, *Banksia Book* 226, 227, fig. 71 *p.p.*, pl. 100 (1984).

Perianth 25–33 mm long including limb of 3–3.5 mm. Pistil 28–36 mm long. Follicles commonly 25–40 mm long, 10–15 mm high, 15–38 mm wide, prominently rugose.

Occurs from the east side of the Pallinup R. to Israelite Bay, W.A., in deep sand, sometimes over gravel, sometimes on coastal dunes, in kwongan or tall shrubland. Flowers Nov.–Feb. Map 263.

W.A.: 3 km WSW of Israelite Bay ruins, *B.Barnsley 347* (CANB, PERTH); Gibson, *C.F.Davies 191* (PERTH); NE of West Mt Barren, *A.S.George 11761* (PERTH).

Variable in the sculpturing of the follicles, those of western populations being less deeply rugose than those farther east. Generally flowers earlier than var. *cernuella*.

73b. Banksia nutans var. cernuella A.S.George, *Nuytsia* 3: 452 (1981)

T: SW of the lower Pallinup R., W.A., 28 Jan. 1978, *A.S.George 15902*; holo: PERTH; iso: CANB, K.

Illustrations: A.S.George, *Banksia Book* 227, 228, fig. 71 *p.p.*, pl. 101 (1984).

Differs from var. *nutans* chiefly in having the perianth 22–24 mm long including limb of 2.5–3 mm; pistil 22–25 mm long; follicles 18–30 mm long, 8–12 mm high, 8–15 mm wide, flattened but convex, smooth to slightly rugose. Plate 47; Fig. 36B.

Occurs from the Stirling Ra. to Albany, W.A., and east almost to the Pallinup R., with outlying populations near Woodanilling. in deep white or grey sand, often in depressions, in tall shrubland and open woodland. Flowers late Jan.–Apr. Map 264.

W.A.: W of Woodanilling, *A.S.George 15093* (AD, BRI, CANB, DNA, K, MEL, NSW, PERTH); Gull Rock Rd, E of Albany, *A.S.George 15799* (PERTH); Chester Pass, Stirling Ra., 2 July 1957, *A.R.Main* (PERTH).

Subg. 2. Isostylis

Banksia subg. **Isostylis** R.Br., *Prodr.* 396 (1810)

Banksia sect. *Isostylis* (R.Br.) Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 589 (1845). T: *B. ilicifolia* R.Br.

Erect shrubs or trees. All stems monopodial. Leaves alternate, serrate, rarely entire; margins not recurved. Inflorescence centripetal, head-like; axis ovoid, less than 1 cm long; flowers c. 100 per inflorescence. Perianth pubescent. Tepals separating to basal tube along adaxial suture only, otherwise remaining coherent almost to limb, not awned. Pistil straight; pollen presenter conical; pollen cylindrical. Follicles split from stylar point; valves obliquely ovate. Seed wing notched. Cotyledons transversely elliptic or rounded-cuneate.

A subgenus of three closely-related species, all occurring in W.A.

74. Banksia ilicifolia R.Br., *Trans. Linn. Soc. London* 10: 211 (1810)

Sirmuellera ilicifolia (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 582 (1891). T: King George Sound, [W.A.], Dec. 1801, *R.Brown*; lecto: BM, *fide* A.S.George, *Nuytsia* 3: 455 (1981); isolecto: BM, K.

Banksia aquifolium Lindl., *Sketch Veg. Swan R.* xxxiv (1840). T: Swan R. colony, W.A., 183-, *J.Drummond s.n.*; lecto: CGE, *fide* A.S.George, *loc. cit.*

Banksia ilicifolia var. *integrifolia* Benth., *Fl. Austral.* 5: 562 (1870). T: Swan R., W.A., 13 Apr. 1839, *L.Preiss 482*; lecto: MEL, *fide* A.S.George, *loc. cit.*; isolecto: B, LD, MEL.

Illustrations: C.E.Rosser & A.S.George, *Banksias* I: pl. 13 (1981); A.S.George, *Banksia Book* 229, 230, fig. 72, pl. 102 (1984).

Tree to 10 m tall, fire tolerant. Bark thick, fibrous, fissured or tessellated, grey. Stems hirsute and tomentose, glabrescent. Leaves: petiole 3–10 mm long; lamina obovate-elliptic, undulate, truncate or obtuse, 3–10 cm long, mucronate; margins not recurved, serrate or sometimes entire; both surfaces hirsute-tomentose, glabrescent, shining except pits in lower surface. Inflorescence 7–9 cm wide, with 60–100 flowers; involucral bracts short, tomentose, persistent. Flowers cream and pink becoming dull red; style cream with green pollen presenter. Perianth 32–40 mm long including limb of 2.5–4 mm, shortly pubescent outside, glabrous inside; limb glabrous. Pistil straight, 27–35 mm long, glabrous except a few hairs above ovary; pollen presenter scarcely thickened, 1–1.5 mm long. Old flowers soon falling. Follicles 1–3, ovate, curved, 14–20 mm long, 13–24 mm high, 10–16 mm wide, smooth, tomentose. Seed transversely elliptic, oblique; seed body elliptic, often irregular, 5–7 mm high, 9–12 mm wide, rugose inside, smooth outside. *Holly-leaved Banksia*. Plate 48; Fig. 36C, D.

Occurs within 70 km of the coast of W.A. from Mt Lesueur to Cape Leeuwin and east to Albany and the Stirling Ra., in deep white or grey sand on consolidated dunes and low-lying flats, in woodland; near the south coast sometimes in tall shrubland. Flowers mainly from late winter to early summer, but along the south coast in most months. Map 265.

W.A.: South Perth, *A.S.George 15779* (PERTH); Margaret R., Oct. 1909, *J.H.Maiden* (NSW); near Gingin, *M.E.Phillips CBG012382* (CANB, NSW); c. 6 km E of Nornalup, 5 Sept. 1947, *J.H.Willis* (MEL).

Fire-tolerant, sprouts by epicormic shoots following fire. Near the south coast plants are usually of lower, spreading habit than those farther north. Larger in leaves, inflorescences and flowers than the following two species.

75. Banksia oligantha A.S.George, *Nuytsia* 6: 312 (1988)

T: NW of Wagin, W.A., 18 Nov. 1984, *A.Taylor*; holo: PERTH; iso: CANB, K, NSW.

Illustrations: A.S.George, *Banksia Book* 2nd edn, 231 fig. 72A, pl. 102A (1987); C.E.Rosser & A.S.George, *Banksias* III: pl. 75 (in press).

Shrub to 3 m tall, without lignotuber. Bark smooth, becoming lightly fissured. Stems hirsute and pubescent, glabrescent. Leaves: petiole 2–3 mm long; lamina obovate to angular-obovate, 1.5–3.7 cm long, 4–20 mm wide, obtuse, mucronate, deep green and shining above, pale below; margins with 2–4 teeth each side; both sides tomentose, glabrescent except wool in pits in lower surface. Inflorescence terminal, with 20–35 flowers; involucral bracts 2–4 mm long, tomentose and pubescent. Flowers red in lower half, grading to cream above with pale yellow limb; styles cream. Perianth 21–23 mm long including limb of 3–3.5 mm; claws appressed-pubescent outside, glabrous inside; limb glabrous. Pistil 19–24 mm long, straight, glabrous; pollen presenter slightly thickened, c. 1 mm long. Old flowers soon falling. Follicles 1–6, ovate, somewhat curved, 14–19 mm long, 10–15 mm high, 8–9 mm wide; valves smooth, closely tomentose. Seed obliquely ovate; seed body ±cuneate, 4 mm long and wide, crinkled outside, with a few ridges inside. Fig. 36M.

Restricted to two localities near Wagin, W.A., growing in white sand in tall open shrubland. Listed as 'Vulnerable' in the ANZECC Threatened Flora List 1997. Flowers Oct.–Nov. Map 266.

W.A.: NW of Wagin, *G.J.Keighery 7405* (PERTH).

In leaf and flower colour resembles *B. ilicifolia* but smaller in all respects. Killed by fire, regenerates from seed.

76. Banksia cuneata A.S.George, *Nuytsia* 3: 457 (1981)

T: E of Quairading, W.A., 20 Nov. 1971, *A.S.George 11205*; holo: PERTH; iso: AD, BRI, CANB, K, MEL, NSW.

Illustrations: A.S.George, *op. cit.* 458, fig. 110, 459, fig. 111; A.S.George, *Banksia Book* 232, pl. 103 (1984); C.E.Rosser & A.S.George, *Banksias* III: pl. 68 (in press).

Shrub or small tree to 5 m tall, without lignotuber. Bark smooth, grey. Stems hirsute, glabrescent. Leaves: petiole 2–3 mm long; lamina cuneate-obovate, 1–4 cm long, 5–15 mm wide, obtuse or acute, pungent; margins serrate with 1–5 teeth each side; both surfaces hirsute, glabrescent (pits on lower surface woolly), dull green above. Inflorescence 3–4 cm wide, with 55–65 flowers; involucral bracts 4–7 mm long, tomentose. Flowers cream, pink towards base, becoming pink throughout; style cream turning red; pollen presenter green. Perianth 24–25 mm long including limb of 3–4 mm, pubescent outside, glabrous inside; limb glabrous. Pistil straight, 24–25 mm long, glabrous; pollen presenter ovoid, 1 mm long. Old flowers soon falling. Follicles usually 1–5, obliquely ovate, 17–21 mm long, 10–13 mm high, 9–12 mm wide, smooth, tomentose, mottled grey. Seed obliquely ovate, 17–20 mm long; seed body unevenly triangular, 4–5 mm high, 7–8 mm wide, wrinkled outside, ridged inside. *Matchstick Banksia.*

Occurs between Brookton and Bruce Rock, W.A. in deep sand in kwongan or low woodland, with *Banksia prionotes* and *Xylomelum angustifolium*. Listed as 'Endangered' in the ANZECC Threatened Flora List 1997. Flowers Sept.–Dec. Map 267.

W.A.: W of Yoting, *J.S.Beard 8089* (PERTH); near L. Mears, *A.S.George 11208* (PERTH).

Differs from *B. ilicifolia* in its smaller habit, and from both *B. ilicifolia* and *B. oligantha* in its dull leaves and more brightly coloured buds and flowers. Killed by fire, regenerates from seed.

Excluded names and names of uncertain application

Many names were given under *Banksia* J.R.Forst. & G.Forst. (1775), *nom. rej.* = *Pimelea* Banks & Sol. ex Gaertn.; these were treated by B.L.Rye, *Fl. Australia* 18: 134–211 (1990).

Banksia asplenifolia Salisb., *Prodr. Stirp. Chap. Allerton* 51 (1796)

T: 'Ex Port Jackson auct. Jac. Lee.'; *n.v.*

Insufficiently described; see discussion in A.S.George, *Nuytsia* 3: 302–304 (1981).

Banksia corniculata Balbis, *Cat. Stirp. Horti Acad. Tauriensis* 1813 (App. 1): 8 (1814)

T: *n.v.*

This is either *Hakea teretifolia* (Salisb.) Britten or *H. gibbosa* (Sm.) Cav.

Banksia cuneifolia Hoffmanns., *Verz. Pfl.-Kult. Nachtr.* 2: 64 (1826)

T: not cited.

Insufficiently described; based on cultivated material. A sheet at K bearing this name is *B. spinulosa* Sm.; attributed to this species by Meisner (1856).

Banksia eugelii Hort. ex Jacques, *Ann. Fl. Pomone* 215 (1843)

T: New Holland, *coll. unknown*; *n.v.*

Insufficiently described.

Banksia floribunda J.Drumm., *Hooker's J. Bot. Kew Gard. Misc.* 1: 375 (1849)

T: not cited.

Insufficiently described; possibly *B. occidentalis* R.Br. or *B. seminuda* (A.S.George) Rye.

Banksia grandidentata Dum.Cours., *Bot. Cult.* 2nd edn, 7: 108 (1814)

T: not cited.

Insufficiently described; based on cultivated material. Attributed to *B. speciosa* R.Br. by Steudel (*Nomencl. Bot.* 2nd edn, 184, 1840).

Banksia heterophylla Colla, *Hort. Ripul.* 1: 18 (1824)

T: *n.v.*

This is possibly *Hakea drupacea* (C.F.Gaertn.) Roem. & Schult.

Banksia hugelii R.Br. ex Sweet, *Hort. Brit.* 3rd edn, 768 (1839), *nom. nud.*

Swan River, W.A., 1837, *coll. unknown*; *n.v.*

There is a specimen at BM, of vegetative material only, labelled '*Banksia heugelii*' by Brown. It is probably *B. oblongifolia* Cav.

Banksia hypoleuca Hoffmanns., *Verz. Pfl.-Kult. Nachtr.* 2: 66 (1826)

T: Australia, *coll. unknown*; *n.v.*

Insufficiently described.

Banksia ilicifolia Dum.Cours., *Bot. Cult.* 2nd edn, 2: 422 (1811); *op. cit.* 7: 108 (1814), *nom. illeg. non* R.Br. (1810)

T: New Holland, *coll. unknown*; *n.v.*

Insufficiently described.

Banksia integerrima Dum.Cours., *Bot. Cult.* 2nd edn, 2: 421 (1811)

T: cultivated?

Insufficiently described.

Banksia intermedia Sweet ex Courtois, *Mag. Hort. (Liége)*, Suppl. 1: 295 (1833)

T: 'in Nova Hollandia [Australia], introduced to Britain in 1824' (R.Sweet, *Hort. Brit.* 2nd edn 2: 349 (1827), *nom. nud.*); *n.v.*

Possibly *B. oblongifolia* Cav.

Banksia longifolia Donn ex F.Dietr., *Vollst. Lex. Gäertn.* 2: 150 (1802)

T: cultivated?

Banksia mimosoides Hort. ex F.Dietr., *Vollst. Lex. Gäertn.* 2: 150 (1802), *nom. inval.* – in synonymy under *B. longifolia*.

Insufficiently described.

Banksia longifolia var. *pubescens* (Willd.) Breiter, *Hort. Breiter.* 282 (1817)

Conchium pubescens Willd., *Enum. Pl.* 141 (1809). T: 'In Nova Hollandia' [Australia], *coll. not known*; *n.v.*

Probably a *Hakea*.

Banksia musculiformis Gaertn., *Fruct. Sem. Pl.* 1: 221 (1788)

T: not cited.

This is probably a species of Asclepiadaceae.

Banksia nervosa Filla, *Flora* 120: t. 1 (1926), *non* (Meisner) Kuntze, *nom. nud.*

Insufficiently described.

Banksia praemorsa Dum.Cours., *Bot. Cult.* 2nd edn, 7: 107 (1814), *nom. illeg. non* Andrews

T: not cited.

Insufficiently described.

Banksia pubescens Roem. & Schult., *Syst. Veg.* 3: 444 (1818), *nom. nud.*

Insufficiently described.

Banksia reticulata Hoffmanns., *Verz. Pfl.-Kult. Nachtr.* 2: 67 (1826)

T: Australia, *coll. unknown*; *n.v.*

Insufficiently described.

Banksia rosmarinifolius G.Benn., *Wanderings* in *New South Wales, etc.* 1: 108 (1834)

T: not given.

Insufficiently described, possibly referable to *B. marginata* Cav.

Banksia serrata var. *latifolia* Raf., *Autik. Bot.* 142 (1840)

T: Australia, *coll. unknown*; *n.v.*

Insufficiently described.

Banksia tomentosa F.Muell., *Hooker's J. Bot. Kew Gard. Misc.* 8: 327 (1856), *nom. nud.*

From the region of the Victoria River, N.T., and therefore probably *B. dentata*.

46. DRYANDRA

A.S.George[1]

Dryandra R.Br., *Trans. Linn. Soc. London* 10: 211 (1810), *nom. cons.*; after Jonas Dryander (1748–1810), first librarian of the Linnean Society and curator of Joseph Banks' collections.

Type: *D. formosa* R.Br.

Josephia R.Br. ex Knight, *Cult. Prot.* 110 (1809). T: *J. sessilis* Knight; lecto, *fide* A.S.George, *Nuytsia* 10: 327 (1996).

Hemiclidia R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 40 (1830). T: *H. baxteri* R.Br.

Shrubs or small trees, many prostrate. Leaves serrate to pinnatifid or pinnatipartite, sometimes almost pinnatisect, sometimes bipinnatifid, sometimes entire, hairy becoming glabrous adaxially, closely tomentose or woolly between nerves abaxially. Inflorescence terminal, axillary or on short lateral branchlet, commonly sessile, capitate; receptacle concave, flat or convex; involucre usually prominent, of many imbricate flat or subulate bracts, persistent; flowering usually centripetal; flowers 15–250 per head; floral bracts usually enlarged after flowering. Perianth straight or curved; tepals separating almost to base at anthesis. Pistil straight or curved, with style often exserted to one side before anthesis; pollen presenter usually erect, narrower, as wide as or wider than style. Follicles few per

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head, woody but not massively so, commonly striate, in 2 species cartilaginous. Seed usually with a terminal wing, rarely elliptic with an annular wing and then without a separator but with 2 supplementary outer wings.

A genus of 93 species and 34 infraspecific taxa endemic in south-western W.A., mostly within the South-West Botanical Province. Distinguished from *Banksia* by the capitate inflorescence with concave, flat or convex receptacle, by the less crowded floral bracts that usually elongate markedly in fruit, and by the thinner follicles that are indurated but not as woody. The leaves of *Dryandra* are more pungently lobed than those of most species of *Banksia*, and the involucre consists of larger, usually flat bracts that are almost always longer persistent. in many species the follicles are relatively easily detached.

Two growth forms common in *Dryandra* do not occur in *Banksia*, viz. the dense columnar habit with short lateral branchlets crowded along the main branches, and the low rounded habit with short divaricate branches hidden within dense foliage. The leaves of most species are extremely varied in form and size, between seedling or regrowth leaves, stem leaves, those of short lateral branchlets and those subtending the inflorescence. in the following account, 'typical' leaves of mature stems are described, the length of the lamina being measured from where it ends on the petiole, and the width across the full extent of the widest lobes or teeth. Length of the involucral bracts is that of the longest (usually innermost); indumentum of these bracts is given for the outer surface and margins only. Floral bracts are present in all taxa except *D. sessilis*. At anthesis the flowers are evenly spaced in the head except in ser. *Niveae* and ser. *Acuminatae* in which they form a circle around a central hollow. Perianth length includes the limb, which is then given separately; pistil length includes the pollen presenter, which likewise is then given separately. in all taxa, the base of the perianth where enclosed within the floral bracts is glabrous; in the descriptions, 'above base' refers to the exserted part. Unless otherwise stated, the curvature of the pistil is described just before anthesis. The relative lengths of the perianth and pistil are most easily observed immediately before anthesis; afterwards, the perianth in many species relaxes, making its measurement difficult.

To observe and measure characters such as the floral bracts and perianth it is essential to dissect an inflorescence. This is done relatively easily in the fresh state by cutting an inflorescence from the base upwards with a pair of secateurs. With practise a cut through the middle will result in two halves that, for herbarium purposes, may be pressed more easily than an intact head. A similar approach is useful for cutting fruiting heads.

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R.Brown, *Trans. Linn. Soc. London* 10: 211–215 (1810); R.Brown, *Suppl. Prodr. Fl. Nov. Holl.* 37–40 (1830); C.D.F.Meisner, in A.L.P.P. de Candolle, *Prodr.* 14: 467–482 (1856); G.Bentham, *Fl. Austral.* 5: 562–584 (1870); A.S.George, *Introd. Proteaceae W. Australia* 30–45 (1984); R.M.Sainsbury, *Field Guide to Dryandra* (1985); A.S.George, New taxa and a new infrageneric classification in *Dryandra* R.Br. (Proteaceae: Grevilleoideae), *Nuytsia* 10: 313–408 (1996); M.Pieroni & A.S.George, *Illustrated Key to Dryandra*, Dryandra Study Group Newsletter 30: iii–vi, 1–19 (1996); A.R.Mast, Molecular systematics of subtribe Banksiinae (*Banksia* and *Dryandra*; Proteaceae) based on cpDNA and nrDNA sequence data: implications for taxonomy and biogeography, *Austral. Syst. Bot.* 11: 321–342 (1998).

KEY TO INFRAGENERIC TAXA

1 Separator absent; seed wing annular, and with a large supplementary wing each side and attached at the base — subg. 3. **Diplophragma** (p. 361)

1: Separator present between seeds (often only 1 seed fertile); seed wing terminal or absent

2 Seed not winged

3 Follicle ±cartilaginous — subg. 2. **Hemiclidia** (p. 360)

3: Follicle woody — ser. 15. **Ionthocarpae** (p. 316)

2: Seed winged — subg. 1. **Dryandra** (p. 263)

4 Pistil exceeding perianth by 1 mm or more

5 Perianth straight or the limb inflexed centripetally before anthesis; pistil similarly straight or curved inwards, rarely outwards

6 Pollen presenter markedly swollen; perianth lobes flared widely at apex of basal tube; flowers fewer than 20 per head — ser. 22. **Pectinatae** (p. 349)

6: Pollen presenter not or scarcely enlarged; perianth not flared but in some species succulent near base; flowers 30–250 per head

7 Perianth swollen and succulent above base (appears thick but irregularly shrivelled in dried specimens) — ser. 12. **Runcinatae** (p. 302)

7: Perianth not swollen or succulent

8 At least some leaves bipinnatifid; hairs of perianth claws sticky — ser. 23. **Acuminatae** (p. 349)

8: No leaves bipinnatifid; hairs of perianth claws not sticky

9 Flowers at anthesis forming a circle leaving a central hole — ser. 24. **Niveae** (p. 351)

9: Flowers at anthesis ±evenly spaced in head

10 Leaves pinnatisect with large triangular lobes — ser. 13. **Triangulares** (p. 307)

10: Leaves otherwise

11 Follicle 5–6 mm long; seed wing obscure; flowers fewer than 45 per head — ser. 6. **Capitellatae** (p. 289)

11: Follicle 6–24 mm long; seed wing prominent; flowers typically more than 50 per head

12 Longest involucral bracts as long as flowers

13 Leaves pinnatipartite; lamina usually 20–45 cm long and 5–14 cm wide with linear lobes — ser. 14. **Aphragma** (p. 310)

13: Leaves cuneate, dentate or serrate, or linear with widely spaced short recurved teeth; lamina usually less than 12 cm long, or if longer, then linear

14 Leaves cuneate, less than 12 cm long; involucral bracts narrow, tomentose and plumose; pistil 41–52 mm long — ser. 7. **Ilicinae** (p. 291)

14: Leaves linear, to 35 cm long; involucral bracts broad, sparsely pubescent to glabrous except hairy margins; pistil 27–29 mm long — ser. 10. **Decurrentes** (p. 299)

12: Longest involucral bracts shorter than flowers

15 Leaves pinnatisect

16 Follicles loosely attached; style evenly curved; pollen presenter scarcely thickened — ser. 3. **Marginatae** (p. 283)

16: Follicles firmly attached; style geniculate below pollen presenter which is narrowly conical — ser. 4. **Folliculosae** (p. 284)

15: Leaves not pinnatisect

17 Flowers golden orange or reddish pink — ser. 8. **Dryandra** (p. 293)

17: Flowers pale to deep yellow, occasionally creamy white, rarely golden orange

18 Involucral bracts almost as long as flowers — ser. 9. **Foliosae** (p. 296)

18: Involucral bracts usually much shorter than flowers

19 Follicles tomentose — ser. 7. **Ilicinae** (p. 291)

19: Follicles sparsely hairy or glabrous, in 1 species silky

20 Follicles ovate to obovate; seed wing not or shortly decurrent — ser. 2. **Armatae** (p. 267)

20: Follicles typically transversely elliptic to transversely obovate; seed wing decurrent almost to base of seed — ser. 5. **Acrodontae** (p. 286)

5: All perianths and pistils in head markedly curved downwards or upwards

21 Involucral bracts prominently hirsute, with longest hairs to 3–5 mm long — ser. 19. **Plumosae** (p. 339)

21: Involucral bracts tomentose, velvety or shortly hirsute, with longest hairs less than 2 mm long

22 Follicles oblique, ovate, elliptic or oblong, firmly attached; pollen presenter 0.3–0.8 mm long — ser. 20. **Concinnae** (p. 341)

22: Follicles erect, ovate, obovate, cuneate or transversely elliptic, loosely attached; pollen presenter 1–1.8 mm long — ser. 21. **Obvallatae** (p. 344)

4: Pistil shorter than or as long as perianth

23 Leaves subtending inflorescence reduced, rigid, entire, pungent, scabrous — ser. 17. **Subulatae** (p. 328)

23: Leaves subtending inflorescence lobed, or if entire then not rigid or scabrous

24 Involucre of broad brown bracts, usually shining

25 Involucral bracts cartilaginous, very hairy or almost glabrous; flowers gold, orange or pinkish; seed wing entire

26 At least some leaves 20 mm or more wide, with large triangular to linear lobes; involucral bracts villous, hirsute, tomentose or pubescent all over — ser. 14. **Aphragma** (p. 310)

26: Leaves less than 6 mm wide, shortly pinnatifid, serrate or entire; involucral bracts appressed-pubescent to glabrous except shortly pubescent margins — ser. 11. **Tenuifoliae** (p. 300)

25: Involucral bracts papery, cobwebby; flowers red and white; seed wing notched — ser. 16. **Inusitatae** (p. 318)

24: Involucre of narrow, hairy bracts, usually dull

27 Leaves cuneate to flabelliform; margins flat — ser. 1. **Floribundae** (p. 264)

27: Leaves linear; margins recurved to revolute — ser. 18. **Gymnocephalae** (p. 328)

KEY TO SPECIES

1 Pistil exceeding perianth by 1 mm or more

2 Involucral bracts shorter than pistil (of outer flowers in taxa in which inner flowers are shorter than outer ones)

3 Pistil crook-shaped, 68–79 mm long; pollen presenter prominent, ovoid; tepals flared widely at apex of basal tube; flowers 12–17 per head (Badgingarra district) **82. D. nana**

3: Pistil straight to curved but not crook-shaped, usually less than 60 mm long; pollen presenter narrowly cylindrical; tepals not flared; flowers 20–250 per head

4 Receptacle prominently convex; flowers at anthesis forming a circle leaving a central hole

5 Leaves pinnatipartite, usually with at least some lobes also pinnatipartite; involucral bracts acuminate; perianth loosely hirsute with sticky hairs (between Woodanilling, Cranbrook & Collie) **83. D. preissii**

5: Leaves simply pinnatipartite; involucral bracts obtuse to shortly acute; perianth villous, hirsute or pubescent with non-sticky hairs

6 Leaf lobes linear

7 Leaf lobes not twisted, held vertically (Kojonup to Ongerup, Stirling Ra. & Albany) **84. D. arctotidis**

7: Leaf lobes twisted so that apical half of lobe is ±horizontal (Eneabba to Cataby) **85. D. tortifolia**

6: Leaf lobes oblong or triangular

8 Leaf lobes oblong or narrowly triangular

9 Plant with underground stems, fire-tolerant; leaf lobes 15–35 each side (Bannister and Wandering to Manjimup) **88. D. lindleyana**

9: Plant with stems above ground, fire-sensitive; leaf lobes 40–75 each side (Albany to Stirling Ra. & E to Fitzgerald R.) **89. D. brownii**

8: Leaf lobes broadly triangular

10 Plant with underground stems, fire-tolerant

11 Leaf lobes 1–3 mm wide at base, the lower (basal) margin more revolute than the upper, slightly overlapping the lobe below (near Badgingarra) **86. D. stenoprion**

11: Leaf lobes 2–8 mm wide at base, both margins slightly and ±equally recurved to revolute, not overlapping; widespread

12 Leaves usually markedly convex (lobes recurved towards apex) (W of Arrino to Alexander Morrison Natl Park) **87. D. cypholoba**

12: Leaves not or slightly convex (Geraldton to Cape Naturaliste and E to Corrigin and Traysurin) **88. D. lindleyana**

10: Plant with above-ground stems, fire-sensitive (Lake Indoon to Nyabing & E to Cape Arid, on the Scott R. plain & E of Busselton) **90. D. nivea**

4: Receptacle gently concave, or flat, or gently convex; flowers ±equally-spaced in head at anthesis

13 At least some leaves more than 20 cm long; mostly low shrubs with short stems

14 Leaves pinnatipartite usually only in lowest third to half, with subulate lobes, otherwise entire (Pingelly to Tambellup) **19. D. subpinnatifida**

14: Leaves prominently pinnatipartite or pinnatifid throughout

15 Leaves 4–20 mm wide

16 Pistil pilose in lower half (Kamballup) **58. D. ionthocarpa**

16: Pistil glabrous except hairs on ovary

17 Perianth 17–19 mm long; pistil 18–21 mm long; leaf lobes markedly twisted (Stirling Ra.) **71. D. montana**

17: Perianth lobes more than 20 mm long; pistil more than 25 mm long; leaf lobes not twisted

18 Leaves with 60–110 lobes each side (near Busselton, Stirling Ra. to Albany) **37. D. baxteri**

18: Leaves with fewer than 50 lobes each side

19 Flowers 150–250 per head (Esperance to Mt Ragged) **20. D. longifolia**

19: Flowers fewer than 120 per head

20 Pistil 42–56 mm long; at least some leaves more than 10 mm wide (Eneabba to Katanning) **34. D. nobilis**

20: Pistil 30–40 mm long; leaves 4–8 mm wide (Tarin Rock, Ravensthorpe) **38. D. foliosissima**

15: Most leaves more than 20 mm wide

21 Leaf lobes linear

22 Prostrate shrub with lignotuber; involucral bracts to 2 cm long; pistil 38–53 mm long (Badgingarra to Moore R., Perth, Gairdner R. to Cape le Grand) **49. D. pteridifolia**

22: Bushy shrub without lignotuber; involucral bracts 4.5–5.5 cm long; pistil 58–74 mm long (Cadoux to Hyden) **51. D. shanklandiorum**

21: Leaf lobes triangular, usually broadly so

23 Involucral bracts 30–40 mm long (Newdegate to Ravensthorpe) **42. D. ferruginea**

23 Involucral bracts 25 mm or less long

24 Leaves less than 25 mm wide (Eneabba to Katanning) **34. D. nobilis**

24: Leaves 25–75 mm wide

25 Stems with recurved, ovate-oblong tomentose prophylls (near Badgingarra) **48. D. catoglypta**

25: Stems with appressed, lanceolate, villous prophylls

26 Leaf lobes acute, with margins straight to gently curved; perianth limb 8–11 mm long; flowers 50–85 per head (Nyabing to Hyden) **47. D. octotriginta**

26: Leaf lobes obtuse, with margins prominently curved in to apex; perianth limb 11–14 mm long; flowers 60–100 per head (Mogumber to Bremer Bay) **46: D. drummondii**

13: Leaves usually less than 20 cm long, in several species some longer

27 Leaves pinnatipartite with at least some lobes also pinnatipartite; perianth claws loosely hirsute with sticky hairs (Woodanilling to Cranbrook & Collie) **83. D. preissii**

27: Leaves simply divided or lobed; perianth hairs not sticky

28 Pistil c. 15 mm longer than perianth; leaves 3–4 mm wide (Wongan Hills) **22. D. pulchella**

28: Pistil usually no more than 10 mm longer than perianth, if longer than 15 mm then leaves at least 6 mm wide

29 Leaf lamina excluding lobes cuneate to obovate, commonly with more than 5 teeth each side

30 Leaves white-tomentose below

31 Leaves sessile or almost so, commonly more than 25 mm wide; involucral bracts to 12–15 mm long; floral bracts 2 mm long (Clackline to Dwellingup) **30. D. praemorsa**

31: Leaves petiolate, 12–22 mm wide; longest involucral bracts to 20–25 mm long; floral bracts 15–17 mm long (Stirling Ra.) **32. D. anatona**

30: Leaves glabrous below except pits

32 Follicles 6–7 mm long, not indurated; perianth limb glabrous or sparsely hairy

33 Leaves bright green; flowers ±bright yellow (Stirling Ra. to Israelite Bay) **91. D. falcata**

33: Leaves glaucous; flowers pale yellow (Eneabba to Mogumber) **92. D. glauca**

32: Follicles 9–14 mm long, indurated; perianth limb hairy

34 Involucral bracts pale; pistil 24–40 mm long; pollen presenter 1–1.3 mm long, pale red; flowers 35–100 per head (Narrogin to Albany & Israelite Bay) **2. D. cuneata**

34: Involucral bracts dark brown; pistil 22–26 mm long; pollen presenter 1 mm long, dark brown; flowers 180–190 per head (Gillingarra) **3. D. fuscobractea**

29: Leaf lamina excluding lobes linear, oblong, lanceolate, elliptic, or narrowly obovate to narrowly cuneate and then with fewer than 5 teeth per side, or pinnatipartite to pinnatisect with large triangular lobes

35 Leaf lamina narrowly obovate to narrowly cuneate with no or 1–4 teeth each side

36 Heads terminal, conspicuous; pistil 16–23 mm long; perianth creamy-white, often pink-tinged; shrub without lignotuber (Geraldton to Gingin) **26. D. carlinoides**

36: Heads on short branchlet near base of stem, inconspicuous; pistil 30–40 mm long; perianth yellow; many-stemmed shrub with lignotuber (Arrowsmith to Hill R.) **27. D. tridentata**

35: Leaf lamina linear, oblong, lanceolate or elliptic, sometimes narrowly cuneate or narrowly obovate, usually with more than 5 teeth or lobes each side, or pinnatipartite to pinnatisect with large triangular lobes

37 Pistils within head straight or incurved or outcurved

38 Leaves 2.5–7 cm wide; perianth limb 8–14 mm long

39 Stems with ±straight lanceolate villous prophylls; perianth limb 8–11 mm long; flowers 50–85 per head (Nyabing to Hyden) **47. D. octotriginta**

39: Stems with recurved, ovate-oblong tomentose prophylls; perianth limb 12–15 mm long; flowers 85–110 per head (near Badgingarra) **48. D. catoglypta**

38: Leaves commonly less than 2.5 cm wide; perianth limb less than 7 mm long

40 Leaves pinnatisect

41 Pistil 16–19 mm long (New Norcia to Bindoon) **18. D. polycephala**

41: Pistil 28–42 mm long (Kalbarri to Cranbrook) **23. D. fraseri**

40: Leaves serrate, pinnatifid or pinnatipartite

42 Leaf lobes linear or lanceolate

43 Flowers 15–26 per head; stem covered with prophylls (Kulin to Nyabing & E to Forrestania) **62. D. erythrocephala**

43: Flowers 30–120 per head; prophylls few or none on mature stem

44 Perianth 29–34 mm long; pistil 32–42 mm long; shrub without lignotuber (Stirling Ra. to Munglinup) **10. D. cirsioides**

44: Perianth 20–27 mm long; pistil 22–33 mm long; shrub with lignotuber, usually suckering

45 Flowers c. 80–100 per head; leaves 40–55 mm wide; sinuses 10–25 mm across (Kulin & L. Magenta to Hyden & Frank Hann Natl Park) **9. D. xylothemelia**

45: Flowers c. 35 per head; leaves 10–25 mm wide; sinuses 3–7 mm across (Kulin to Nyabing) **29. D. meganotia**

42: Leaf lobes or teeth triangular

46 Flowers orange or pink

47 Perianth 19–23 mm long; shrub to 50 cm (Badgingarra, Mogumber) **28. D. serratuloides**

47: Perianth 25–42 mm long; shrub to 3 or 4 m

48 Leaves soft; floral bracts glabrous (Busselton to Two Peoples Bay & Stirling Ra.) **33. D. formosa**

48: Leaves rather leathery; floral bracts hirsute or villous

49 Leaves divided more than half way to midrib, usually dark green above; at least some leaf laminas 15–20 cm long; follicles 16–19 mm long (Eneabba to Katanning) **34. D. nobilis**

49: Leaves divided less than half way to midrib, usually bluish green above; leaves never more than 15 cm long; follicles 9–11 mm long (York to Broomehill) **35. D. stuposa**

46: Flowers yellow, commonly with deep yellow or golden limb

50 Leaves 3–9 mm wide

51 Pistil loosely hirsute, at least in lower quarter

52 Pollen presenter 3–5 mm long; leaf lobe margins flat or equally recurved

53 Perianth 25–39 mm long; pistil 28–42 mm long; flowers yellow (widespread, Mt Lesueur to Albany & E to Israelite Bay) **4. D. armata**

53: Perianth 19–23 mm long; pistil 22–29 mm long; flowers pink and greenish cream (rare, Badgingarra, Mogumber) **28. D. serratuloides**

52: Pollen presenter 0.9–1.3 mm long; leaf lobes revolute but the upper margin much less so than the lower

54 Pollen presenter noticeably thicker than apex of style; perianth 12–20 mm long; pistil markedly looped before anthesis (Eneabba to Armadale) **25. D. kippistiana**

54: Pollen presenter scarcely thicker than apex of style; perianth 19–22 mm long; pistil gently bowed before anthesis (Eneabba to Badgingarra) **24. D. sclerophylla**

51: Pistil glabrous except a few hairs on ovary

55 Pistil 37–49 mm long

56 Involucral bracts appressed-pubescent, shining brown; leaves with 10–25 teeth each side (Ravensthorpe) **43. D. corvijuga**

56: Involucral bracts glabrous at base, plumose above, pale; leaves with 3–8 teeth each side (Pingelly to Woodanilling) **61. D. cynaroides**

55: Pistil 22–31 mm long

57 Pistil 27–31 mm long; perianth limb hirsute (Three Springs to Badgingarra) **16. D. stricta**

57: Pistil 22–26 mm long; perianth limb glabrous or with a few basal hairs (New Norcia to Regans Ford and Gingin) **17. D. echinata**

50: Leaves 10–35 mm wide

58 At least some leaves 15 cm or more long

59 Involucral bracts 40–50 mm long (Ravensthorpe) **43. D. corvijuga**

59: Involucral bracts to 30 mm long

60 Flowers 150–250 per head; involucral bracts 14–30 mm long; perianth limb hairy at least in lower half (Esperance to Mt Ragged) **20. D. longifolia**

60: Flowers 35–65 per head; involucral bracts to 12 mm long; perianth limb glabrous

61 Pistil 29–33 mm long (Wongan Hills) **14. D. wonganensis**

61: Pistil 23–27 mm long

62 Perianth limb c. 2.5 mm long; involucral bracts pubescent with densely ciliate margins; pollen presenter 1–1.5 mm long (Moora to New Norcia and Cataby) **13. D. hewardiana**

62: Perianth limb 3–4 mm long; involucral bracts glabrous or scurfy, with shortly ciliate margins; pollen presenter 1.8–2 mm long (Three Springs) **15. D. trifontinalis**

58: Leaves less than 13.5 cm long (juvenile leaves may be longer)

63 Leaves with subulate teeth on petiole and base (Woodanilling to Katanning) **11. D. acanthopoda**

63: Leaves without teeth on petiole and base

64 Perianth limb 10–11 mm long; flowers 15–20 per head (Pingelly to Woodanilling) **61. D. cynaroides**

64: Perianth limb less than 9 mm long; flowers more than 40 per head

65 Perianth limb 7–8.5 mm long; involucral bracts 30–35 mm long, obtuse (Kalbarri to Three Springs) **21. D. borealis**

65: Perianth limb 2–6.5 mm long; involucral bracts commonly less than 20 mm long, if longer then tomentose

66 Pistil 45–48 mm long; involucral bracts 22–32 mm long (Stirling Ra.) **6. D. hirsuta**

66: Pistil 20–42 mm long; involucral bracts less than 20 mm long

67 Pistil glabrous

68 Perianth 25–27 mm long; limb hirsute (Kulin to Nyabing & Frank Hann Natl Park) **7. D. pallida**

68: Perianth 17–23 mm long; limb glabrous or almost so (Regans Ford to New Norcia & Gingin) **17. D. echinata**

67: Pistil hirsute in lower quarter to half

69 Pollen presenter 0.8–1.5 mm long

70 Pistil 20–26 mm long; involucral bracts usually recurved; leaf teeth up to 10 each side (Bindoon to Albany; Whicher Ra.) **12. D. squarrosa**

70: Pistil 28–32 mm long; involucral bracts all erect; leaf teeth 1–6 each side (N of Southern Cross) **5. D. arborea**

69: Pollen presenter 2.5–6 mm long

71 Perianth 25–39 mm long; limb 4–4.5 mm long; floral bracts glabrous (Mt Lesueur to Albany & E to Israelite Bay) **4. D. armata**

71: Perianth 22–24 mm long; limb 4.5–6.5 mm long; floral bracts hirsute at base (Tathra Natl Park to Bendering) **8. D. purdieana**

37: All pistils within head curved downwards or downwards and with the apex upturned

72 Pistils curved downwards then up

73 Leaf lamina excluding lobes elliptic; involucral bracts silky-villous; floral bracts hirsute both sides (Stirling Ra., Albany) **72. D. concinna**

73: Leaf lamina excluding lobes linear; involucral bracts appressed-pubescent; floral bracts hirsute one side, glabrous the other (Bow R. to Mt Manypeaks) **73. D. serra**

72: Pistil curved ±evenly downwards, in *D. columnaris* curved up but then downwards in upper half

74 Leaf lamina excluding lobes oblong or oblanceolate; lobes obliquely ovate

75 Leaf lobes 10–35 each side; involucral bracts ovate to lanceolate (Stirling Ra.) **74. D. foliolata**

75: Leaf lobes 8–11 each side; involucral bracts linear to subulate (Darling Plateau SE of Perth) **81. D. insulanemorecincta**

74: Leaf lamina excluding lobes linear; lobes linear to narrowly triangular; involucral bracts linear to subulate

76 Leaf lobes strongly twisted (Stirling Ra.) **71. D. montana**

76: Leaf lobes not twisted

77 Involucral bracts with glandular as well as non-glandular hairs (Brookton to Narrogin) **77. D. columnaris**

77: Involucral bracts without glandular hairs

78 Floral bracts 5–6 mm long; pollen presenter 1.5–1.8 mm long (Miling to South Stirling) **76. D. conferta**

78: Floral bracts 3.5–4 mm long; pollen presenter 1 mm long

79 Leaf lobes 10–25 each side; follicles transversely ovate (Eneabba to Mogumber) **78. D. platycarpa**

79: Leaf lobes 2–5 each side; follicles narrowly ovate (Stirling Ra.) **79. D. seneciifolia**

2: Involucral bracts as long as or exceeding pistil

80 Pistil straight or gently curved outwards or inwards

81 Involucral bracts 80–90 mm long (near Kulin) **44. D. epimicta**

81: Involucral bracts 30–75 mm long

82 Involucral bracts broad, obtuse or acute, dark red-brown, often shining

83 Perianth not swollen at apex of basal tube; limb usually 5–7 mm long, occasionally to 7.5 mm

84 Pollen presenter 5–5.5 mm long; pistil 35–38 mm long; leaf lobes obtuse (Fitzgerald R. to Israelite Bay) **41 D. obtusa**

84: Pollen presenter 2.8–3 mm long; pistil 27–29 mm long; leaf teeth acute, pungent (Wongan Hills) **39. D. comosa**

83: Perianth swollen and succulent at apex of basal tube; limb 7–9 mm long

85 Leaves serrate; erect shrubs

86 Longest involucral bracts 40–50 mm long (Ravensthorpe) **43. D. corvijuga**

86: Longest involucral bracts 50–75 mm long (Toodyay to Narrogin) **45. D. proteoides**

85: Leaves pinnatifid or pinnatipartite, rarely almost entire; low or prostrate shrubs (Pingelly to Stirling Ra. & E to Forrestania) **42. D. ferruginea**

82: Involucral bracts acute or acuminate, plumose, silky, villous or tomentose, pale to dark brown

87 Leaves cuneate or obovate, serrate (Gairdner R. to Ravensthorpe) **31. D. quercifolia**

87: Leaves linear, pinnatifid or pinnatipartite

88 Perianth 15–20 mm long

89 Involucral bracts abruptly narrowed but acute, silky, villous or tomentose; leaf lobes 40–60 each side (Stirling Ra. area) **36. D. mucronulata**

89: Involucral bracts tapering, long-villous; leaf lobes 15–31 each side (Stirling Ra. area) **70. D. pseudoplumosa**

88: Perianth 25–30 mm long (Tarin Rock, Ravensthorpe) **38. D. foliosissima**

80: Pistil curved down, at least in upper half

90 Involucral bracts softly plumose, villous or woolly, with longest hairs 3–5 mm long (Stirling Ra. to West Mt Barren) **69. D. plumosa**

90: Involucral bracts pubescent, tomentose, hirsute or silky-villous, with longest hairs less than 2 mm long

91 Leaves pinnatifid; involucral bracts with glandular hairs (Pingelly) **77. D. columnaris**

91: Leaves serrate or dentate; involucral bracts silky-villous, without glandular hairs

92 Style yellow with red pollen presenter; pistil 23–31 mm long (Corrigin to Kukerin) **75. D. fasciculata**

92: Style red with green pollen presenter; pistil 18–22 mm long (Woodanilling to Nyabing & Tarin Rock) **80. D. rufistylis**

1: Pistil as long as or slightly shorter than perianth

93 Leaves cuneate to flabelliform, sometimes almost oblong, serrate (Kalbarri to Bremer Bay) **1. D. sessilis**

93: Leaves linear or narrowly cuneate, or deeply divided

94 Leaves bipinnatipartite (Eneabba to Manjimup) **93. D. bipinnatifida**

94: Leaves serrate, pinnatifid or pinnatipartite, sometimes entire

95 Involucral bracts broad, obtuse, glabrous to appressed-pubescent, dark brown, shining (Darkin to Cape Arid) **40. D. tenuifolia**

95: Involucral bracts not as above

96 Leaves entire

97 Leaves subtending inflorescence not or little reduced, pliable; involucral bracts 40–50 mm long, spreading-hirsute; leaf lamina 5–10 cm long; perianth 24–30 mm long; erect, bushy shrub with flowers on upper branches (Tathra Natl Park to Badgingarra; Tammin) **67. D. speciosa**

97: Leaves subtending inflorescence short, rigid, pungent; involucral bracts 10–12 mm long, appressed-hirsute; leaf lamina 15–35 cm long; perianth 22–24 mm long; low shrub with flowers almost at ground level (Eneabba to Badgingarra) **60. D. subulata**

96: Leaves dentate, serrate, pinnatifid or pinnatipartite

98 All or most leaves more than 15 mm wide

99 Involucral bracts papery, the outer almost glabrous, the inner rusty-pubescent along midrib, with upper margins cobwebby; flowers red and white (Newdegate) **59. D. idiogenes**

99: Involucral bracts firm, tomentose, silky-villous or villous; flowers various shades of yellow, pink, brown or orange

100 Pistil 49–52 mm long (Dumbleyung to Lake Grace & Harrismith) **50. D. fililoba**

100: Pistil 31–45 mm long

101 Longest involucral bracts 9–15 mm long

102 Leaf lobes triangular; stems with scattered prophylls (Tenterden to Albany and Wellstead) **56. D. calophylla**

102: Leaf lobes linear; stems covered with prophylls (Woodanilling) **57. D. lepidorhiza**

101: Longest involucral bracts 20–42 mm long

103 Bushy shrub with erect stems; perianth limb 13–15 mm long (Stirling Ra. to Lort R.) **52. D. nervosa**

103: Shrub with prostrate, usually underground stems; perianth limb 8–13 mm long

104 Leaves 50–130 mm wide (Stirling Ra.) **53. D. blechnifolia**

104: Leaves 20–45 mm wide

105 Flowers 20–30 per head; perianth tomentose above base, golden; pistil 37–40 mm long; leaf lobes 30–40 each side (Woodanilling to Ongerup & Mount Barker) **54. D. porrecta**

105: Flowers c. 80 per head; perianth villous above base, orange-pink; pistil 33–36 mm long; leaf lobes 18–28 each side (E of Mundaring Weir) **55. D. aurantia**

98: All or most leaves less than 15 mm wide

106 Leaves with 15–75 teeth each side (usually more than 20)

107: Involucral bracts to 60 mm long, viscid; pistil 54–55 mm long (E of Hyden) **65. D. viscida**

107: Involucral bracts 15–40 mm long, not viscid; pistil 24–35 mm long

108 Shrub with above-ground stems to 70 cm tall; involucral bracts 30–40 mm long; perianth cream and dull purple (Geraldton to Gingin) **68. D. shuttleworthiana**

108: Shrub with underground stems; involucral bracts to 22 mm long; perianth yellow (Mogumber, Perth, Whicher Ra.) **66. D. mimica**

106: Leaves with 2–12 teeth each side

109 Pistil 37–49 mm long; pollen presenter 6–7 mm long (Pingelly to Woodanilling) **61. D. cynaroides**

109: Pistil 22–36 mm long; pollen presenter 3–4 mm long

110 Flowers 15–26 per head (Kulin to Nyabing & E to Forrestania) **62. D. erythrocephala**

110: Flowers 30–60 per head

111 Leaves narrowly linear with revolute margins; branchlets hirsute (Tammin to Corrigin & Narembeen) **63. D. horrida**

111: Leaves broadly linear with recurved margins; branchlets tomentose (Eneabba to Lake Grace) **64. D. vestita**

Subg. 1. Dryandra

Dryandra R.Br. subg. **Dryandra**

Dryandra sect. *Eudryandra* Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 589 (1845), *nom. inval.*

Follicle woody. Separator present between seeds (often only 1 seed fertile). Seed black; wing terminal, rarely absent.

By far the largest of the three subgenera, with 89 species in 24 series.

Ser. 1. Floribundae

Dryandra ser. **Floribundae** Benth., *Fl. Austral.* 5: 564, 568 (1870)

Type: *D. floribunda* R.Br. = *D. sessilis* (Knight) Domin

Erect shrubs or small trees, without lignotuber. Leaves sessile or almost so, cuneate to flabelliform, sometimes almost oblong, serrate; margins ±flat. Inflorescence terminal, ±conspicuous; involucral bracts shorter than flowers; receptacle gently convex; floral bracts apparently absent. Perianth straight, slender. Pistil straight, slightly shorter than perianth; pollen presenter not or slightly enlarged, cylindrical to ellipsoidal above neck, smooth. Flowers soon falling, as a tuft. Follicles ovoid, firmly attached, usually opening as soon as mature. Seed wing notched.

Monospecific, a variable species widespread in south-western Australia.

1. Dryandra sessilis (Knight) Domin, *Věstn. Král. Ceské Společn. Nauk. Tř. Mat. Přír.* 2: 19 (1923)

Josephia sessilis Knight, *Cult. Prot.* 110 (1809). T: King George Sound, [W.A.], Oct. 1791, *A.Menzies*; lecto: BM; isolecto: BM, *fide* A.S.George, *Nuytsia* 10: 327 (1996).

Shrub or tree to 6 m, without lignotuber. Leaves sessile or on petiole to 5 mm long; lamina cuneate to flabelliform, sometimes almost oblong, 2–6 cm long, 8–40 mm wide, obtuse to acute, mucronate, sparsely hairy on upper surface and nerves but soon glabrous except pits in lower surface; margins ±flat, serrate with up to 9 teeth each side. Inflorescence terminal; involucral bracts ovate passing to linear; outer bracts ±glabrous except densely ciliate margins; inner bracts hirsute, to 10–11 mm long, pale; flowers 55–125 per head. Perianth straight, 20–32 mm long, pale yellow; claw pubescent; limb 3–4 mm long, glabrous. Pistil straight, 19–30 mm long, cream, glabrous; pollen presenter cylindrical to ellipsoidal, 1–1.5 mm long, smooth. Follicles 1–4 per head, ovoid, 10–15 mm long, appressed-pubescent, glabrescent, opening when mature.

Occurs widely in south-western W.A. from Kalbarri to Cape Leeuwin and east to Bremer Bay, inland to Wongan Hills and Kulin. Four varieties are recognised.

1	Leaves commonly no more than 3 cm long, less than 20 mm wide; stems pubescent	**1d.** var. **cygnorum**
1:	At least some leaves more than 3 cm long, 15–40 mm wide; stems hirsute, soon glabrescent, rarely pubescent	
2	Leaves flabelliform, not auriculate	**1b.** var. **flabellifolia**
2:	Leaves cuneate to oblong, commonly auriculate	
3	Pistil 25–29 mm long; leaves commonly 2–3 cm long but sometimes to 5 cm long, to 25 mm wide	**1a.** var. **sessilis**
3:	Pistil 29–32 mm long; leaves to 6 cm long and 40 mm wide	**1c.** var. **cordata**

1a. Dryandra sessilis (Knight) Domin var. sessilis

Dryandra floribunda R.Br., *Trans. Linn. Soc. London* 10: 212 (1810). T: King George Sound, [W.A.], Dec. 1801, *R.Brown Iter Austral. 3418*; holo: BM; iso: K.

Illustrations: R.M.Sainsbury, *Field Guide Dryandra* 93 (1985); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 155 (1989).

Shrub or tree to 6 m tall. Stems long-hirsute, soon glabrous or a few hairs persisting. Leaves sessile, cuneate to almost oblong, usually at least some broad at base, commonly 2–3 cm long but sometimes to 5 cm long, 15–25 mm wide, commonly auriculate. Flowers 70–120 per head. Perianth 27–31 mm long. Pistil 25–29 mm long; pollen presenter 1.2–1.4 mm long. Follicles 14 mm long. Fig. 37A.

Widespread in south-western W.A. from Regans Ford and Moora to Collie and south-east to Bremer Bay, extending inland to near Wongan Hills, Pingelly and Kulin, and in the Stirling

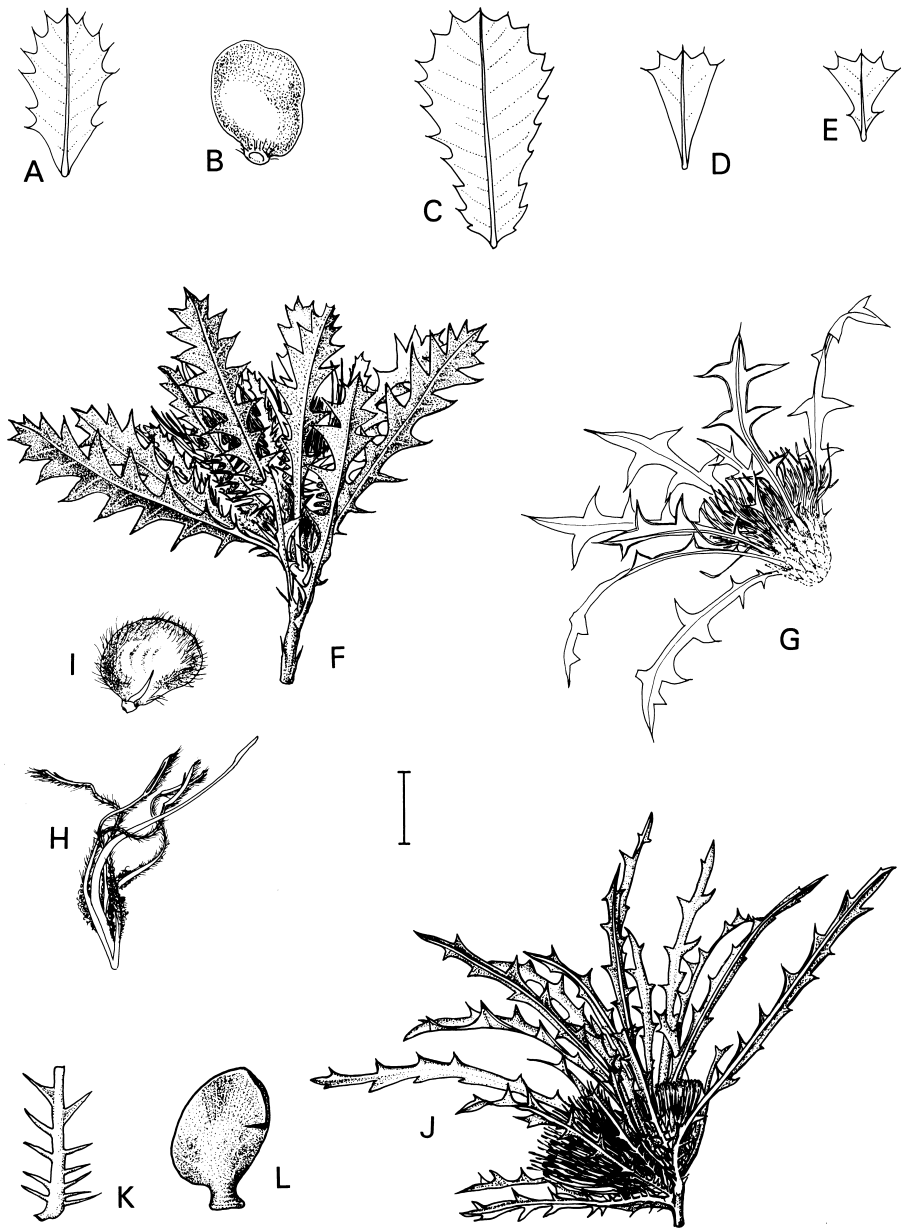


Figure 37. *Dryandra.* **A**, *D. sessilis* var. *sessilis*, leaf (R.Cranfield 1191, PERTH). **B**, *D. sessilis* var. *flabellifolia*, follicle (A.George 16758, PERTH). **C**, *D. sessilis* var. *cordata*, leaf (T.Aplin 6537, PERTH). **D–E**, *D. sessilis* var. *cygnorum*, leaves (**D**, R.Davis 842, PERTH; **E**, A.George 14382, PERTH). **F**, *D. hirsuta*, inflorescence (A.George 10874, PERTH). **G–I**, *D. pallida*. **G**, inflorescence; **H**, flower; **I**, follicle (**G–I**, A.George 9280, PERTH). **J–L**, *D. acanthopoda*. **J**, inflorescence; **K**, leaf; **L**, follicle (**J–L**, A.George 16647, PERTH). Scale bar: **A, C–G, J** = 2 cm; **B, H–I** = 7 mm; **K–L** = 8 mm. Drawn by: **A–E**, P.Dundas; **G–I**, P.Nikulinsky; **F, J–L**, D.Boyer.

Ra. Common in the drier Jarrah forest. Grows in lateritic soil and in sand, in open forest, woodland and tall shrubland, often locally dominant. Flowers late May–Nov. Map 268.

W.A.: Greenmount, May 1901, *C.Andrews* (PERTH); Millbrook Nature Reserve, *E.A.Griffin 4128* (PERTH); 17 km due NE of Brookton, *R.J.Hnatiuk 790135* (PERTH); W end of Stirling Range Drive, *N.G.Walsh 1063* (MEL, PERTH).

Plants on the south coast usually are of more spreading habit and have more robust leaves than those elsewhere.

1b. Dryandra sessilis var. **flabellifolia** A.S.George, *Nuytsia* 10: 328 (1996)

T: West Binnu Rd, 4.4 km E of junction with Yeringa South Rd, NNW of Northampton, W.A., 11 Aug. 1993, *A.S.George 17026*; holo: PERTH; iso: CANB.

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 32, t. 43 (1984), as *D. sessilis*.

Shrub to 5 m tall. Stems glabrous, rarely sparsely pubescent. Leaves flabelliform, commonly on petiole to 5 mm long; lamina mostly 2–4 cm long, 17–35 mm wide, markedly narrowed to base. Flowers c. 90 per head. Perianth 26–29 mm long. Pistil 25–28 mm long; pollen presenter 1–1.2 mm long. Follicles 10–11 mm long. Fig. 37B.

Occurs between Geraldton and Kalbarri and inland to Northampton, and with scattered records south almost to Moora, W.A. Grows in deep sand and in lateritic soil, in tall shrubland. Flowers June–Oct. Map 269.

W.A.: S boundary, Kalbarri Natl Park, *J.S.Beard 7128* (PERTH); Marchagee track, E of Dewar Rd, *E.A.Griffin 3470* (PERTH); Mt Fairfax, Moresby Ra., *C.M.Lynch 84* (PERTH); 32 km N of Geraldton, *R.A.Saffrey 1540* (PERTH).

Leaves often glaucous. Very similar to var. *sessilis*, but the leaves are usually more flabelliform with concavely curved lower margins, abruptly narrowed at base but not auriculate. *N.Hoyle 548* from Kalbarri Natl Park (PERTH), with leaves to 3 cm long and 20 mm wide but glabrous stems, is this variety with small leaves.

1c. Dryandra sessilis var. **cordata** (Meisn.) A.S.George, *Nuytsia* 10: 329 (1996)

Dryandra floribunda var. *cordata* Meisn., in J.G.C.Lehmann, *Pl. Preiss*. 2: 265 (1848). T: south-western W.A., 1840s, *J.Drummond 2: 344*; holo: NY; iso: BM, K, MEL.

Dryandra floribunda var. *major* Benth., *Fl. Austral*. 5: 569 (1870). T: Cape Naturaliste, W.A., *A.Oldfield*; holo: K; iso: MEL.

Shrub to 3 m tall. Stems pubescent and long-hirsute, glabrescent. Leaves sessile or gradually narrowed to petiole to 3 mm long; lamina cuneate to oblong, 3–6 cm long, 20–40 mm wide, serrate to base or across top only, commonly auriculate; margins in lower half straight to convex. Flowers c. 125 per head. Perianth 30–33 mm long; limb 3 mm long. Pistil 29–32 mm long; pollen presenter 1.3–1.5 mm long. Follicles 13–14 mm long. Fig. 37C.

Occurs from Cape Naturaliste to Cape Leeuwin and east to Walpole, W.A. Grows in sand over limestone, in coastal heath. Flowers July–Oct. Map 270.

W.A.: Cape Leeuwin, *A.C.Beauglehole 12511* (PERTH); Crystal L., *J.W.Green 1047* (PERTH); Mandalay Beach Rd, Walpole–Nornalup Natl Park, *S.D.Hopper 5742* (PERTH); Cape Naturaliste, *G.J.Keighery 3416* (PERTH).

Differs from var. *sessilis* in its usually larger leaves and larger flowers. Leaves usually darker green than in other varieties.

1d. Dryandra sessilis var. **cygnorum** (Gand.) A.S.George, *Nuytsia* 10: 329 (1996)

Dryandra cygnorum Gand., *Bull. Soc. Bot. France* 66: 230 (1919). T: Melville (Park) [suburb of Perth], W.A., 31 July 1897, *A.Morrison*; holo: LY, photo seen.

Dryandra quinquedentata Gand., *Bull. Soc. Bot. France* 66: 230 (1919). T: Swan River, W.A., 1902, *A.Lea*; holo: LY, photo seen.

Illustration: E.M.Bennett, *Bushland Plants Kings Park W. Australia* 63 (1988), as *D. sessilis*.

Shrub to 5 m tall. Stems pubescent. Leaves sessile or almost so, commonly cuneate, mostly 2–3 cm long, 8–17 mm wide; lower half with concave margins narrowing ±evenly to base, occasionally auriculate, entire or with 1 or 2 basal teeth; apical margin with 4–7 teeth, with lateral teeth at c. 90°. Flowers 55–65 per head. Perianth 23–27 mm long; limb 2.6–3 mm long. Pistil 22–26 mm long; pollen presenter 1 mm long. Follicles 10–12 mm long. Plate 49; Fig. 37D, E.

Occurs between Dongara and Fremantle, W.A., inland to L. Indoon and Kings Park. Grows in sand over limestone in kwongan and tall shrubland, rarely in laterite in kwongan. Flowers July–Nov. Map 271.

W.A.: Kings Park, *C.A.Gardner 124* or *624* (PERTH); W of L. Indoon, *E.A.Griffin 848* (PERTH); Cadda Rd, W of Munbinea Rd, *E.A.Griffin 3457* (PERTH); Mt Adams Rd, just E of Brand Hwy, *E.A.Griffin 3502* (PERTH); Yanchep, *A.M.James 207* (PERTH).

Southern populations tend to have larger leaves. Two collections from south of Mandurah appear intermediate between this variety and var. *sessilis* — Dawesville, Aug. 1976, *R.Tinetti*, and Australind, *F.M.C.Shock 30* (both at PERTH). They have leaves to 4 cm long and 2.2–2.8 cm wide, but pubescent stems.

Ser. 2. Armatae

Dryandra ser. **Armatae** Benth., *Fl. Austral.* 5: 563, 566 (1870)

Type: *D. armata* R.Br.

Mostly erect shrubs or small trees, with or without lignotuber. Leaves petiolate or sessile; lamina linear, lanceolate, elliptic, cuneate or obovate, serrate, pinnatifid or pinnatipartite; margins flat, recurved or revolute. Inflorescence terminal or on short branchlet, or axillary, conspicuous; involucral bracts shorter than flowers; receptacle flat to gently convex. Perianth straight, slender; limb inflexed before anthesis. Pistil straight or curved, longer than perianth; pollen presenter not or slightly thickened, smooth or finely ribbed. Flowers usually persisting for some years. Follicles ovate to obovate, commonly notched on one side near base, easily detached (in *D. arborea* firmly attached), usually opening as soon as mature. Seed wing notched.

A series of 20 species widespread throughout south-western W.A.

2. **Dryandra cuneata** R.Br., *Trans. Linn. Soc. London* 10: 212 (1810)

Josephia cuneata (R.Br.) Poir., *Dict. Sci. Nat.* 24: 246 (1822). T: Lucky Bay, [W.A.], Jan. 1802, *R.Brown Iter Austral. 3417*; lecto: BM, *fide* A.S.George, *Nuytsia* 10: 330 (1996); isolecto: K, MEL.

Dryandra cuneata var. *brevifolia* Hereman, *Paxton's Bot. Dict.* 201 (1868), *nom. inval.*

Dryandra cuneata var. *longifolia* Hereman, *loc. cit.*, *nom. inval.*

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 29 (1985).

Shrub to 2 m, without lignotuber. Stems hirsute and tomentose, becoming white-tomentose, with ovate to linear prophylls on base of annual increment. Leaves: petiole to 1.5 cm long, tomentose; lamina cuneate to obovate, 2.5–6.5 cm long, 1–3 cm wide, obtuse to acute, pungent, hirsute but glabrescent above, tomentose in open pits below; margins undulate, not or shortly recurved, serrate; teeth 4–12 each side. Inflorescence terminal or on short lateral branchlet; involucral bracts ovate to linear, obtuse to acute, to 12 mm long; outer bracts tomentose; inner bracts silky, pale; flowers c. 35–100 per head. Perianth 23–38 mm long, pale yellow, hirsute; limb 2.5–4 mm long, the hairs coarse. Pistil straight or gently curved, 24–40 mm long, hirsute on ovary, glabrous above; pollen presenter not thickened, 1–1.3 mm long, obscurely ribbed, pale red. Follicles obliquely obovate, 10–14 mm long, loosely hirsute.

Occurs in the south coastal region of W.A. from near Narrogin to Albany, including the Stirling Ra., and east to Israelite Bay and Mt Ragged; grows in white sand or clay-loam,

sometimes over gravel, and in rocky shale, in kwongan, sometimes with mallees; flowers throughout the year, but mainly Apr.–Nov. Map 272.

W.A.: 3 km W of Israelite Bay ruin, *M.D.Crisp 4889* (CANB, PERTH); c. 60 km W of Bremer Bay, *A.S.George 6127* (PERTH); Hopkins Reserve, ESE of Kulin, *A.S.George 16745* (PERTH); 37 km E of Jerramungup, *N.G.Marchant 80/59* (PERTH); 20 km E of Scaddan, *P. van der Moezel 233* (PERTH).

Rather variable in size. Typical material has a perianth 25–30 mm long and occurs from Jerramungup eastwards. To the west, the perianth is usually 30–38 mm long. *Tindale 3839* (NSW) has deeply lobed leaves with acutely pungent teeth to 9 mm long.

3. **Dryandra fuscobractea** A.S.George, *Nuytsia* 10: 330 (1996)

T: [South-east of] Gillingarra, W.A., 25 July 1994, *M.Pieroni 94/5*; holo: PERTH; iso: CANB.

Shrub to 1 m, without lignotuber. Stems closely tomentose. Leaves: petiole 5–10 mm long; lamina cuneate, 4–7 cm long, 1–3 cm wide (those about the involucre narrower), obtuse but prominently mucronate, glabrous above and below except pits; margins flat to slightly recurved, pungently serrate with 4–9 teeth each side. Inflorescence terminal or on short lateral branchlet; involucral bracts linear, obtuse to almost acute, villous; outer bracts squarrose, grey; innermost bracts 8–11 mm long, dark brown towards apex; flowers 180–190 per head. Perianth 20–23 mm long, pale yellow, villous above base, hirsute distally; limb 2.5 mm long, hirsute, dark grey, with apical hairs white. Pistil 22–26 mm long, cream, glabrous; pollen presenter narrow, 1 mm long, smooth, rusty brown. Follicles 3 or 4 per head, obliquely obovate, 9–12 mm long, loosely hirsute.

Occurs south-east of Gillingarra, W.A. Grows in lateritic gravel and in sand over laterite, in low kwongan. Almost extinct. Flowers July–Oct. Map 273.

W.A.: [South-east of Gillingarra], *E.A.Griffin 3434* (PERTH); SE of Dandaragan, *E.A.Griffin 5371* (CANB, PERTH).

Differs from *D. cuneata* in the dark brown involucral bracts (the outermost squarrose) and the heads with more flowers that are smaller, with a grey perianth limb and small, dark pollen presenter. Flowers not scented. Follicles loosely attached.

4. **Dryandra armata** R.Br., *Trans. Linn. Soc. London* 10: 213 (1810)

Josephia armata (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: King George Sound, [W.A.], Dec. 1801, *R.Brown Iter Austral. 3416*; holo: BM; iso: K, MEL.

Shrub to 1.5 m, with or without lignotuber, often sprawling. Stems hirsute and pubescent, glabrescent. Leaves: petiole 3–5 mm long, glabrescent; lamina pinnatifid, narrowly cuneate to narrowly obovate, linear, oblong or elliptic, 2–8 cm long, 8–25 mm wide, acute, pungent, tomentose only in pits; margins flat, deeply serrate; lobes 5–13 each side, obliquely triangular, slightly falcate, pungent, to 9 mm long. Inflorescence on short branchlet; involucral bracts ovate to linear, obtuse, to 15–25 mm long, tomentose, pubescent or hirsute in upper half, glabrous or almost so below; floral bracts glabrous; flowers c. 45–70 per head. Perianth ±straight, 25–39 mm long, yellow, with short crisped hairs immediately above base, hirsute distally; limb glabrous in upper ½ or throughout; limb 4–5 mm long. Pistil straight to curved, 28–42 mm long, cream to yellow, hirsute in lower ¼–⅓; pollen presenter narrow, 2.5–4.5 mm long, ribbed. Follicles obliquely ovate, 9–10 mm long, hirsute at base.

A widespread, variable species in W.A., occurring from Mt Lesueur to Albany and east to Israelite Bay. Forms a close-knit group with *D. arborea*, *D. hirsuta* and *D. purdieana*. Also similar to *D. borealis q.v.* Two varieties are recognised but a more detailed study is needed.

Shrub to 1.5 m (usually below 1 m), with lignotuber; leaf lamina 8–20 mm wide; stem leaves with 6–13 lobes each side; all involucral bracts tomentose in upper half; perianth 25–32 mm long; limb 4–4.5 mm long; pistil 28–39 mm long	**4a.** var. **armata**
Shrub to 3 m, without lignotuber; leaf lamina 20–25 mm wide; stem leaves with 5–8 lobes each side; outer involucral bracts hirsute in upper half, inner bracts hirsute or pubescent; perianth 30–39 mm long; limb 5 mm long; pistil 35–42 mm long	**4b.** var. **ignicida**

4a. **Dryandra armata** R.Br. var. **armata**

Dryandra favosa Lindl., *Sketch Veg. Swan R.* xxxiii (1840). T: Swan River [colony], W.A., per *Toward*; holo: CGE.

Dryandra gilbertii S.Moore, *J. Linn. Soc., Bot.* 45: 211 (1920). T: south-western W.A., *J.Gilbert s.n.*; holo: BM.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 7 (1985).

Shrub to 1.5 m (usually below 1 m), with lignotuber, often sprawling. Leaf lamina 2–8 cm long, 8–20 mm wide; lobes 6–13 each side. Involucral bracts to 15–25 mm long, all tomentose in upper half; flowers c. 45–70 per head. Perianth 25–32 mm long; limb 4–4.5 mm long. Pistil 28–39 mm long; pollen presenter 2.5–4 mm long.

Widespread in south-western W.A. from Mt Lesueur to Walpole and east to Mt Ragged; usually in rocky soil, especially granite and quartzite, in open woodland and kwongan. Flowers July–Sept. Map 274.

W.A.: below N side of Bluff Knoll, Stirling Ra. Natl Park, *R.B.Filson 8989* (MEL); NW of Lucky Bay, Cape le Grand Natl Park, *D.B.Foreman 1281* (CANB, MEL, NSW, PERTH); Reserve 15801, W of Woodanilling, *A.S.George 14924* (PERTH); c. 10 km E of Katanning, *R.H.Kuchel 1901* (AD, PERTH); Gooseberry Hill, *J.Seabrook 25* (CANB, PERTH).

Outer bracts brown with greyish indumentum in upper half, inner grey-brown to blackish in upper half. Most Darling Ra. specimens have narrow leaf lobes. Specimens from the Mt Lesueur–Badgingarra area tend to have smaller leaves and flowers than those from farther south.

4b. **Dryandra armata** var. **ignicida** A.S.George, *Nuytsia* 10: 331 (1996)

T: Paterson Rd, W of Junction with Balls Rd, E of Woodanilling, W.A., *A.S.George 16636*; holo: PERTH; iso: CANB, K, MEL, NSW.

Erect shrub to 3 m, without lignotuber. Leaf lamina 6–8 cm long, 20–25 mm wide; lobes 5–8 each side, at c. 90°. Involucral bracts to 20 mm long; outer bracts hirsute in upper half; inner bracts pubescent. Perianth 30–39 mm long; limb 5 mm long. Pistil 35–42 mm long; pollen presenter 3–4.5 mm long.

Widespread from Pingelly to Katanning and east to Mt Ragged, W.A. Grows in sandy loam, granitic, quartzitic or lateritic soil in tall shrubland, often with emergent eucalypts. Flowers July–Sept. Map 275.

W.A.: c. 12 km SW of Woodanilling, *A.S.George 9497* (PERTH); Tutanning Nature Reserve, *G.Heinsohn 23* (PERTH); Mt Manypeaks, *R.Melville 4440 & R.D.Royce* (K, MEL).

Occasionally sympatric with var. *armata*, e.g. at Tutanning Nature Reserve (south-east of Pingelly) and near Woodanilling.

5. **Dryandra arborea** C.A.Gardner, *J. Roy. Soc. W. Australia* 47: 59 (1964)

T: Koolyanobbing Ra., W.A., Oct. 1959, *C.A.Gardner 12217*; holo: PERTH.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 41, t. 55, 56 (1984).

Tree to 6 m, with stout trunk. Leaves: petiole 3–7 mm long, glabrous; lamina elliptic to lanceolate, 3–6 cm long, 14–22 mm wide, pungent, usually strongly curved, woolly in small pits below; margins flat or gently recurved, serrate; teeth triangular, 1–6 each side. Inflorescence terminal; involucral bracts ovate to narrowly lanceolate; outer bracts subulate; inner bracts acute, to 15 mm long, appressed-pubescent in upper half, densely ciliate; flowers 110–180 per head. Perianth 22–28 mm long, yellow, shortly villous; limb 3 mm long, villous. Pistil incurved, 28–32 mm long, yellow, pubescent in lowest ¼, glabrous above; pollen presenter scarcely thickened, 1 mm long, ±smooth, pale green. Follicles obliquely ovate to obovate, 8–15 mm long, ±glabrous, ±firmly attached, opening when mature.

Occurs on hills north of Southern Cross, W.A. Grows among ironstone rocks in open shrubland. Flowers at all seasons. Map 276.

W.A.: Bungalbin Hill, *J.J.Alford 1048* (PERTH); Die Hardy Ra., *J.S.Beard 4656* (PERTH); near Mt Jackson, *M.I.H.Brooker 2448* (NSW, PERTH); Koolyanobbing Ra., *P.G.Wilson 6148* (PERTH).

The most inland species of the genus and the most robust. Involucral bracts enlarged in fruit. Fire response unknown.

6. **Dryandra hirsuta** A.S.George, *Nuytsia* 10: 332 (1996)

T: Red Gum Pass Rd, just S of junction with Salt R. Rd, Stirling Ra. Natl Park, W.A., 27 July 1986, *A.S.George 16657*; holo: PERTH; iso: CANB, K.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 115 (1985), as *Dryandra* sp. aff. *falcata*.

Shrub to 2 m, without lignotuber. Stems tomentose and hirsute with spreading hairs. Leaves: petiole 5–12 mm long, hirsute; lamina ±lanceolate to narrowly obovate, 5–13 cm long, 15–35 mm wide, acute, pungent, deeply serrate to pinnatipartite, loosely hirsute, glabrescent except pits in lower surface; margins recurved; lobes 5–10 each side, obliquely triangular, acuminate, pungent. Inflorescence terminal or on short lateral branchlet; involucral bracts lanceolate to linear, obtuse to acute, erect, 22–32 mm long, tomentose; outer bracts with hirsute margins in upper half; flowers c. 90–110 per head. Perianth 40–41 mm long, pale yellow, curled-pubescent above base, hirsute distally; limb 5.5–6.5 mm long, hirsute at base, otherwise glabrous. Pistil incurved, 45–48 mm long, cream, hirsute just above ovary, otherwise glabrous; pollen presenter narrow, 4–5 mm long, ribbed. Follicles somewhat angular-ovate to obovate, 9–11 mm long, sparsely hirsute, shining. Fig. 37F.

Restricted to the central and western parts of the Stirling Ra., W.A. Grows in rocky sandy loam, in tall shrubland and low open woodland. Flowers May–Oct. Map 277.

W.A.: Talyuberlup, *J.S.Beard 7601* (PERTH); lower E slope of Mt Toolbrunup, Stirling Range Natl Park, *A.S.George 10874* (PERTH); Wedge Hill, *G.Keighery 4848* (PERTH); Mt Warrungup, *K.Newbey 1793* (PERTH); Mt Trio, 22 July 1952, *N.H.Speck* (PERTH).

Resembles *D. armata* var. *ignicida* but has larger, more coarsely lobed leaves with recurved margins, larger inflorescence and fruit, and is generally more hairy, especially when young.

7. **Dryandra pallida** A.S.George, *Nuytsia* 10: 333 (1996)

T: 20 miles [32 km] E of Pingaring, W.A., 29 May 1969, *A.S.George 9346*; holo: PERTH; iso: CANB, K, MEL, NSW.

Columnar shrub to 2 m, without lignotuber. Stems densely tomentose, at length glabrescent. Leaves: petiole 5–10 mm long, tomentose; lamina broadly linear, usually 5–8 cm long, 20–30 mm wide, acuminate, white-tomentose below with glabrous venation; margins flat to slightly recurved, serrate; lobes 3–5 each side, obliquely triangular, to 15 mm long. Inflorescences sessile, axillary; involucral bracts narrowly lanceolate, 10–12 mm long, ±acute, densely silky, glabrous inside; flowers 65–80 per head. Perianth 25–27 mm long, pale yellow, densely hirsute including limb; limb 4 mm long. Pistil strongly outcurved, 29–31 mm long, cream, glabrous; pollen presenter narrow, 1.5 mm long, smooth, red. Follicles obovate to transversely elliptic, 8–10 mm long, loosely hirsute. Fig. 37G–I.

Locally common in the southern central wheatbelt from Nyabing to Frank Hann Natl Park and north to Kulin and Holt Rock, W.A. Grows in lateritic soil, sometimes somewhat sandy, in kwongan; flowers May–June. Map 278.

W.A.: 5 km E of Lake Grace, *A.S.George 9280* (PERTH, CANB); c. 26 km S of Forrestania crossroads, *A.S.George 9445* (PERTH); c. 15 km SE of Kulin, *R.J.Hnatiuk 770384* (PERTH); c. 5 km WNW of Mt Sheridan, Dragon Rocks Nature Reserve, *S.D.Hopper 5245* (PERTH); 10 km E of Pingrup, *K.Newbey 3031* (PERTH).

May be recognised by the few-lobed leaves with flat margins, pale yellow flowers, hirsute perianth (including limb) and glabrous pistil with small pollen presenter.

8. Dryandra purdieana Diels, *Bot. Jahrb. Syst.* 35: 174 (1904)

T: Victoria Plains [Toodyay district], W.A., 29 Aug. 1901, *L.Diels 3972*; lecto: B, *fide* A.S.George, *Nuytsia* 10: 334 (1996); isolecto: B, MEL.

Columnar or bushy shrub to 2 m. Stems pubescent to closely tomentose, glabrescent. Leaves: petiole 5–10 mm long, glabrescent; lamina broadly linear, pinnatipartite, curved, 5–11 cm long, 25–35 mm wide, pungent, closely tomentose below in pits; margins flat; lobes triangular, 4–7 each side. Inflorescence axillary or on short branchlet; involucral bracts elliptic to linear, obtuse to acute, to 16 mm long, appressed-pubescent; flowers c. 80 per head. Perianth 22–24 mm long, pale to medium yellow, densely hirsute; limb 4.5–6.5 mm long, hirsute with glabrous apex. Pistil outcurved, 25–27 mm long, cream, hirsute in lowest third, glabrous distally; pollen presenter narrow, 3–4 mm long, ribbed. Follicles obliquely ovate with basal lateral notch, 8–11 mm long, loosely hirsute, shining.

Occurs in the central and north-eastern agricultural districts, from Tathra Natl Park to Mogumber and inland to Cadoux, Moorine Rock and south to Bendering, W.A.; grows in white or pale sand, sometimes with laterite outcropping, in kwongan. Flowers July–Oct. Map 279.

W.A.: 36 km W of Moorine Rock, *E.M.Canning WA/68 2694* (CANB); Bendering, *C.A.Gardner 1944* (PERTH); Tathra Natl Park, *E.A.Griffin 2191* (PERTH); 15 km NW of Wongan Hills township, *K.F.Kenneally 7454* (PERTH); E of Manmanning, *B.H.Smith 232* (BRI, CANB, HO, MEL).

Indumentum of involucral bracts very dark. Very variable and appears to grade into *D. cirsioides* south of the Great Eastern Hwy, e.g. 6 km W of Corrigin, *K.Alcock 546* (MEL, PERTH) which has narrow but flat leaf lobes (*D. cirsioides* has revolute margins).

9. Dryandra xylothemelia A.S.George, *Nuytsia* 10: 334 (1996)

T: 14 km N of Newdegate–Lake King road on Holt Rock South Rd, W.A., 11 Oct. 1994, *A.S.George 17238*; holo: PERTH; iso: CANB, K, NSW.

Shrub to 1 m, often sprawling, with lignotuber, commonly suckering. Stems obscured by leaf bases, tomentose. Leaves crowded; petiole 5–10 mm long; lamina pinnatipartite, 7–12 cm long, 40–55 mm wide, glabrous above, tomentose below; margins revolute; lobes 5–9 each side, linear, pungent, widely divergent to somewhat recurved. Inflorescence sessile or on short lateral branchlet, on older stems; involucral bracts lanceolate, to 15–22 mm long, acute to obtuse, not spreading, glabrous with pubescent apex; flowers 80–100 per head. Perianth 20–27 mm long, pale yellow, villous above base, hirsute distally; limb 5–6.5 mm long, sparsely hirsute to almost glabrous. Pistil straight then strongly curving outwards, 22–33 mm long, cream, hirsute above base, glabrous distally; pollen presenter narrow, 2.5–4 mm long, ribbed. Follicles oblong but contracted near base, 9 mm long, loosely hirsute, glabrescent, striate. Plate 50; Fig. 38D.

Occurs between Kulin, L. Magenta and Frank Hann Natl Park and Hyden, W.A. Grows in sand over laterite and in gravelly loam in kwongan, sometimes with mallee eucalypts. Flowers Oct. Map 280.

W.A.: Dragon Rocks Nature Reserve, 9 Dec. 1993, *R.Buehrig* (PERTH); Hopkins Nature Reserve, *A.S.George 16744* (PERTH); 16 km W of Lake King township, *P.G.Wilson 5762* (PERTH).

Very similar to *D. cirsioides* but may be distinguished by the low, often suckering habit and narrow, widely spaced leaf lobes. Superficially resembles *D. meganotia* but distinguished especially by the larger, less hairy fruit.

10. Dryandra cirsioides Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 476 (1856)

Josephia cirsioides (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891), as *cirsiodes*. T: south-western W.A., 1840s, *J.Drummond 4: 308*; holo: NY; iso: BM, K, MEL, PERTH (fragments).

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 40, t. 54 (1984).

Shrub to 1.5 m, often columnar, without lignotuber. Stems hirsute and tomentose. Leaves: petiole 2–5 mm long; lamina pinnatipartite, 5–9 cm long, 15–28 (–50) mm wide, pungent,

appressed-pubescent above, soon glabrous, tomentose below, ±reticulate; margins shortly recurved; lobes to 11 each side, linear or lanceolate, pungent. Inflorescence terminal or on short branchlet, ±sessile; involucral bracts lanceolate to linear, obtuse, to 25 mm long, tomentose-hirsute; flowers c. 100–120 per head. Perianth 29–34 mm long, yellow with pink base, hirsute, with limb pubescent, sometimes glabrous at apex; limb 6–8 (–10) mm long. Pistil curved, 32–42 mm long, pale yellow, hirsute below middle; pollen presenter 3–6 mm long, ribbed. Follicles obliquely elliptic with basal lateral notch, 7–11 mm long, glabrous except a few caducous hairs.

Occurs in southern W.A. between the Stirling Ra. and Munglinup, in lateritic soil in kwongan; flowers May–Aug. Map 281.

W.A.: 44 km E of Lake King, *K.Alcock 436* (MEL); c. 57 km E of Ravensthorpe, *A.S.George 10987* (CANB, PERTH); Salt River Rd, 17.5 km E of Red Gum Pass turnoff, Stirling Range Natl Park, *A.S.George 16661* (PERTH); near Dempster Inlet, *E.C.Nelson ANU 16721* (CANB); 32 km E of Gnowangerup, *J.W.Wrigley 4849* (CANB, PERTH).

Distinguished by the densely-leaved (often columnar) habit, linear leaf lobes with prominent mid-nerve below and gently recurved margins. The indumentum of the leaf underside is pale brown becoming white with age. The pistil curls strongly after anthesis. *A.S.George 16681* from S of Toompup (PERTH) has involucral bracts to 25 mm long, the perianth 38 mm long with a limb of 7 mm and the pistil 46–47 mm long. *Dryandra cirsioides* somewhat resembles *D. meganotia q.v.* Some collections to the north of the given range appear to be intermediate with *D. purdieana*. *Dryandra cirsioides* hybridises with *D. quercifolia* on Mt Desmond, near Ravensthorpe.

11. Dryandra acanthopoda A.S.George, *Nuytsia* 10: 335 (1996)

T: Wingedine Nature Reserve, W of Woodanilling, W.A., 26 July 1986, *A.S.George 16647*; holo: PERTH, iso: CANB, MEL, NSW, PERTH.

Shrub to 2 m, with many spreading branches, without lignotuber. Stems appressed-pubescent, soon glabrous. Leaves: petiole to 15 mm long, with 3–6 subulate teeth; lamina linear, curved, 5–13 cm long, 10–15 mm wide, acuminate, white-tomentose below; margins recurved, serrate, with 5–10 triangular teeth each side. Inflorescences on short lateral branchlets, crowded; involucral bracts lanceolate, to 15 mm long; outer bracts subulate and squarrose; inner bracts acute, appressed-pubescent outside; flowers 50–65 per head. Perianth straight, 26–30 mm long, pale yellow, curled-tomentose above base, silky on claws; limb 3–3.5 mm long, glabrous. Pistil straight, 30–33 mm long, cream, glabrous except ovary; pollen presenter 1 mm long, smooth. Follicles up to 6 per head, obliquely ovate, 9–13 mm long, sparsely hairy. Fig. 37J–L.

Restricted to the Woodanilling–Katanning area, W.A. Grows in lateritic soil in tall closed kwongan, sometimes with emergent *Eucalyptus wandoo* and *E. drummondii*. Flowers July–Sept. Map 282.

W.A.: c. 12 km SW of Woodanilling, *A.S.George 9496* (AD, CANB, K, PERTH); between Katanning and Kwobrup, 21 Dec. 1964, *F.W.Humphreys* (PERTH); E of Katanning, *K.Newbey 2654* (PERTH).

Closely related to *D. polycephala* but more bushy in habit, the leaves broader with fewer main lobes but many subulate lobes on the petiole and the flowers larger. Follicles firmly attached, opening when dried. New growth viscid. A collection from near Woodanilling (7 Oct. 1986, *R.Garstone*, PERTH) has small flowers, with the involucral bracts 9–10 mm long, perianth c. 18 mm long and pistil 22–23 mm long.

12. Dryandra squarrosa R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 38 (1830)

Josephia squarrosa (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: near King George Sound, [W.A.], 1829, *W.Baxter*; holo: BM; iso: K.

Shrub to 4 m, without lignotuber. Stems appressed-pubescent, very soon glabrous. Leaves ±sessile, broadly linear to narrowly lanceolate, recurved, 3–9 cm long, 5–12 mm wide, obtuse to acute, pungent, glabrous above, closely tomentose below; margins slightly

Figure 38. *Dryandra*. **A–C,** *D. squarrosa* subsp. *squarrosa*. **A**, flowering branch; **B**, leaf; **C**, follicle (**A–C**, A.George 10881, PERTH). **D**, *D. xylothelemelia*, leaf (A.George 16711, PERTH). Scale bar: **A–B** = 1 cm; **C** = 5 mm; **D** = 1.6 cm. Drawn by: **A–C**, P.Nikulinsky; **D,** P.Dundas.

recurved, serrate almost to leaf base; teeth to 10 each side, triangular. Inflorescence on short lateral branchlet; involucral bracts narrowly triangular to linear, acute, 10–13 mm long, usually recurved; outer bracts glabrous, grading to appressed-pubescent inner bracts; flowers c. 50–70 per head. Perianth 18–24 mm long, pale yellow, curled-hirsute above base, hirsute distally; limb 2–3.5 mm long, coarsely hirsute or glabrous. Pistil gently incurved, 20–26 mm long, cream, glabrous except long hairs above ovary; pollen presenter slightly thickened, 0.8–1.5 mm long, obscurely ribbed. Follicles to 7 per head, ovate-oblong, 8–13 mm long, ±glabrous.

Occurs widely in south-western W.A. from Bindoon south to the Whicher Ra. and east almost to Albany. Grows in lateritic soil, rarely in sand or clay-loam, in eucalypt forest and woodland. New growth viscid. There are two subspecies.

Perianth limb hirsute; perianth 21–24 mm long	**12a.** subsp. **squarrosa**
Perianth limb glabrous; perianth 18–19 mm long	**12b.** subsp. **argillacea**

12a. Dryandra squarrosa R.Br. subsp. squarrosa

Dryandra carduacea Lindl., *Sketch Veg. Swan R.* xxxiii (1840); *Josephia carduacea* (Lindl.) Kuntze, *Revis. Gen. Pl.* 2: 278 (1891). T: Swan R., W.A., 183-, *J.Drummond s.n.*; holo: CGE.

Dryandra carduacea var. *angustifolia* Hook., *Bot. Mag.* 73: t. 4317 (1847). T: cultivated at Royal Botanic Gardens, Kew, from seed collected in south-western W.A. by J.Drummond; holo: K.

Illustrations: R.Erickson *et al.*, *Fls Pls W. Australia* 42, t. 93 (1973); R.M.Sainsbury, *Field Guide Dryandra* 99 (1985); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 138 (1989).

Most leaves 8–12 mm wide; teeth 5–10 each side. Perianth 21–24 mm long; limb 2.5–3.5 mm long, coarsely hirsute. Pistil 22–26 mm long; pollen presenter 0.7–1.5 mm long. *Pingle.* Fig. 38A–C.

Occurs throughout the range of the species except near the Whicher Ra., W.A. Grows in lateritic soil, rarely in sand, in Jarrah-Marri forest and Wandoo woodland. Flowers June–Sept. Map 283.

W.A.: Darkan, *A.R.Fairall 738* (PERTH); Millbrook Nature Reserve, *A.S.George 10881* (PERTH); Boyagin Nature Reserve, *A.S.George 14377* (PERTH); c. 15 km W of Kojonup, *K.Newbey 2655* (PERTH); Julimar State Forest, *F.G.Smith 1726* (PERTH).

Flowers sickly-scented. Lower and juvenile/seedling leaves are up to 12 cm long and 18 mm wide. Northern specimens are larger in the perianth limb, pollen presenter and follicles, and the leaves are often more coarsely serrate than those from southern districts, but there is no morphological disjunction. Hybridises with *D. subpinnatifida* var. *imberbis q.v.*

12b. Dryandra squarrosa subsp. argillacea A.S.George, *Nuytsia* 10: 336 (1996)

T: near Tutunup, W.A., 26 June 1973, *A.S.George 11657*; holo: PERTH; iso: CANB, K.

Most leaves 5–9 mm wide; teeth 3–6 each side. Perianth 18–19 mm long; limb 2 mm long, glabrous. Pistil 22–24 mm long; pollen presenter 0.8–1 mm long.

Occurs on the coastal plain close to the western base of the Whicher Ra., east of Busselton, W.A., growing in winter-wet clay over ironstone in open to dense tall shrubland. Flowers June–Nov. Map 284.

W.A.: Smith Rd, Whicher Ra., *A.Cochrane 261* (PERTH); Ruabon, *R.D.Royce 4869* (PERTH); Tutunup, *R.D.Royce 5463* (PERTH).

Differs consistently from subsp. *squarrosa* in the smaller perianth with a glabrous limb. The leaves are usually smaller and more slender than those of subsp. *squarrosa.*

13. Dryandra hewardiana Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 477 (1856)

Josephia hewardiana (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 4: 315;* holo: NY; iso: B, BM, CGE, K, MEL, NSW, PERTH.

Dryandra patens Benth., *Fl. Austral.* 5: 578 (1870); *Josephia patens* (Benth.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 2: 341*; syn: BM, CGE, K, NY, PERTH; possible iso: NSW.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 34, t. 45 (1984); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 155 (1989).

Openly branched shrub to 3 m, without lignotuber. Stems sparsely pubescent, glabrescent. Leaves: petiole to 5 mm long; lamina linear, gently curved, 4–20 cm long, 10–24 mm wide, acute, sparsely pubescent but soon glabrous above, closely tomentose below; margins recurved, serrate; teeth 5–15 each side, obliquely triangular, pungent. Inflorescence on lateral branchlet to 2 cm long; involucral bracts lanceolate, to 10 mm long, obtuse or outer bracts acute, appressed-pubescent, densely ciliate; flowers 35–60 per head. Perianth 21–26 mm long, lemon-yellow with golden limb, crisped-pubescent above base, becoming silky on claws; limb 2.5 mm long, glabrous. Pistil ±straight, 23–27 mm long, cream, glabrous except ovary; pollen presenter 1–1.5 mm long, smooth. Follicles oblong-obovate, 8–10 mm long, sparsely hairy, with sinuately radiating veins. Fig. 39A–E.

Occurs between Cataby, Moora and the New Norcia area, W.A. Grows in sandy and lateritic soil in eucalypt woodland and in health; flowers sweetly scented. Flowers July–Nov. Map 285.

W.A.: Caren Caren Brook, Brand Hwy, *A.S.George 16274 & P.Nikulinsky* (CANB, PERTH); 15 km S of Regans Ford, Brand Hwy, *R.J.Hnatiuk 770902* (PERTH); Walebing, *R.D.Royce 4983* (PERTH).

Varies greatly in leaf lobing and involucral bracts, typically having acute, somewhat squarrose involucral bracts. *Dryandra patens* is included as a synonym, although its type has erect, obtuse involucral bracts and less crowded, more finely lobed leaves. Similar to *D. stricta q.v.*

14. Dryandra wonganensis A.S.George, *Nuytsia* 10: 337 (1996)

T: NW of Wongan Hills on Piawaning road, W.A., 4 Aug. 1986, *A.S.George 16763;* holo: PERTH; iso: AD, CANB, K, MEL, NSW, PERTH.

[*Dryandra hewardiana auct. non* Meisn.: R.M.Sainsbury, *Field Guide Dryandra* 49 (1985)]

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 49 (1985), as *D. hewardiana*.

Sprawling to erect shrub to 3 m, without lignotuber. Stems with a few appressed hairs, soon glabrous. Leaves: petiole to 15 mm long, broad and prominent on floral leaves; lamina pinnatifid, linear, often strongly curved, 4–16 cm long, 9–18 mm wide, acuminate, closely tomentose below; margins revolute; lobes 4–9 each side, narrowly triangular, often slightly falcate. Inflorescence on lateral branchlet to 10 mm long; involucral bracts lanceolate, to 12 mm long, acute; outer bracts glabrous with shortly ciliate margins; inner bracts pubescent towards apex; flowers 45–50 per head. Perianth 28–31 mm long, pale yellow, curled-hirsute above base, silky distally; limb 3–3.5 mm long, glabrous. Pistil straight, 29–33 mm long, pale yellow, glabrous except a few hairs on ovary; pollen presenter 1.8–2 mm long, smooth. Follicles ovate-oblong, 7–8 mm long, sparsely hairy, striate.

Restricted to the Wongan Hills and nearby low rises, W.A. Grows in lateritic soil with open woodland and dense scrub. Flowers Aug.–Oct. Map 286.

W.A.: Wongan Hills, Oct. 1903, *A.Morrison* (PERTH); Monks Well Gully, Wongan Hills, *N.Moyle 71* (PERTH).

Similar to *D. trifontinalis* and *D. hewardiana* but differs in the narrow leaf lobes, prominent yellowish petiole and larger flowers. Flowers not scented.

15. Dryandra trifontinalis A.S.George, *Nuytsia* 10: 337 (1996)

T: W of Three Springs on Nebru Rd, W.A., 6 Aug. 1986, *A.S.George 16789*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Openly branched shrub to 2 m, without lignotuber. Stems sparsely hirsute, soon glabrous. Leaves sessile or with petiole to 10 mm long; lamina broadly linear, 3–16 cm long, 10–18 mm wide, acute, pungent, closely tomentose below; margins recurved, coarsely

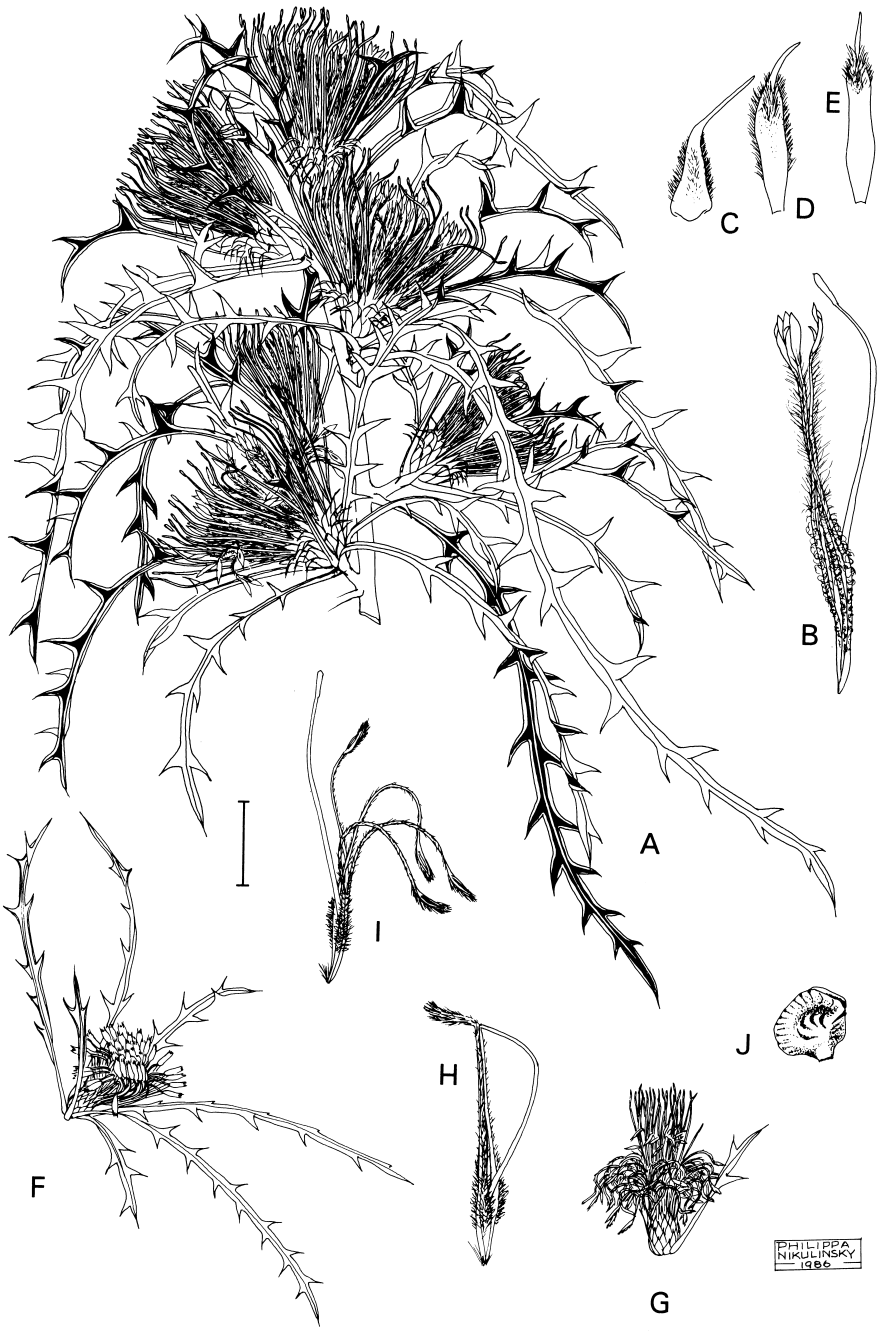


Figure 39. *Dryandra*. **A–E,** *D. hewardiana*. **A**, flowering branch; **B**, flower; **C–E**, involucral bracts (**A–E**, A.George 11704, PERTH). **F–J**, *D. stricta*. **F**, flowering branch; **G**, inflorescence; **H**, unopened flower; **I**, open flower; **J**, follicle (**F–J**, not recorded). Scale bar: **A** = 2 cm; **B–E** = 5 mm; **F** = 2.4 cm; **G** = 1.6 cm; **H–I** = 6 mm; **J** = 8 mm. Drawn by P.Nikulinsky.

serrate; teeth 5–10 each side, broadly obliquely triangular, pungent. Inflorescence on lateral branchlet to 1 cm long, occasionally terminal; involucral bracts ovate to lanceolate, acute, to 10 mm long, glabrous or scurfy, shortly ciliate; flowers 55–65 per head. Perianth 24–25 mm long, pale yellow, curled-tomentose above base, hirsute distally; limb 3–4 mm long, glabrous. Pistil ±straight, 25–26 mm long, pale yellow, glabrous except silky apex of ovary; pollen presenter 1.8–2 mm long, smooth. Follicles oblong to ovate, 6–9 mm long, sparsely hairy, striate.

Restricted to a few populations near Three Springs, W.A. Grows in lateritic soil in low woodland. Flowers Aug.–Sept. Map 287.

W.A.: W of Three Springs, *J.S.Beard 7251* (PERTH); Three Springs, *W.E.Blackall 4878* (PERTH).

Most closely related to *D. wonganensis*, differing in the coarsely-lobed leaves and smaller flowers. Also similar to *D. hewardiana* which has the inflorescences on longer branchlets, pubescent involucral bracts with densely ciliate margins, a smaller perianth limb and smaller pollen presenter. Flowers not scented.

16. Dryandra stricta A.S.George, *Nuytsia* 10: 338 (1996)

T: Bunny Rd, N of junction with Skipper Rd (NE of Eneabba), W.A., 6 Aug. 1986, *A.S.George 16793*; holo: PERTH; iso: CANB, K.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 113 (1985), as *Dryandra* sp.

Bushy shrub to 3 m, without lignotuber. Stems glabrous. Leaves: petiole to 5 mm long; lamina linear, ±straight, 5–20 cm long, 4–9 mm wide, acute, pungent, white-tomentose below; margins revolute, serrate; teeth 8–18 each side, obliquely triangular, pungent. Inflorescence sessile, axillary, rarely on branchlet to 5 mm long; involucral bracts lanceolate to narrowly triangular, acute to obtuse, to 13 mm long, appressed-pubescent, densely ciliate; flowers 45–85 per head. Perianth 23–25 mm long, pale yellow, curled-tomentose above base, hirsute distally; limb 2.5–3 mm long, hirsute. Pistil straight, 27–31 mm long, cream, glabrous except for ovary; pollen presenter 1.2–1.5 mm long, obscurely ribbed. Follicles obovate to orbicular, 6–8 mm long, sparsely hairy, striate. Fig. 39F–J.

Occurs between Three Springs and Badgingarra, W.A., growing on lateritic hills in kwongan, occasionally in sand over gravel or clay. Flowers Aug.–Oct. Map 288.

W.A.: Willis Rd, 9 km N of junction with Coorow–Green Head Rd, *K.Alcock 508* (MEL); c. 40 km SW of Eneabba, *A.S.George 7837* (PERTH); Mooladarra Spring, 33 km W of Three Springs on road to Dongara, *E.A.Griffin 1507* (PERTH); c. 40 km E of Jurien, *M.E.Phillips CBG036109* (CANB, PERTH).

Related to *D. hewardiana* but recognised by the densely leaved branches, ±straight, narrow leaves, sessile inflorescence and hirsute perianth limb.

17. Dryandra echinata A.S.George, *Nuytsia* 10: 339 (1996)

T: near Red Gully Rd turnoff, Brand Hwy, W.A., 7 Aug. 1986, *A.S.George 16829*; holo: PERTH; iso: CANB, K, MEL.

Shrub to 3 m, without lignotuber. Stems sparsely glandular-tomentose, glabrescent. Leaves: petiole 8–10 mm long; lamina linear, recurved, 3–15 cm long, 6–15 mm wide, acuminate, sparsely glandular-pubescent above and on midrib below but soon glabrous there, closely tomentose below; margins recurved, serrate, with 9–25 triangular teeth each side. Inflorescence sessile, axillary or on short branchlet, crowded towards branch apex; involucral bracts narrowly lanceolate, to 10 mm long, acuminate, appressed-tomentose outside, ciliate, glabrous towards apex; flowers 45–55 per head. Perianth 17–23 mm long, pale yellow with deeper limb, crisped-hirsute above base, becoming silky distally; limb 2–2.5 mm long, glabrous or with a few hairs near base. Pistil straight, 22–26 mm long, pale yellow, glabrous except ovary; pollen presenter slightly swollen at base, 0.8 mm long, smooth. Follicles obovate to rounded-oblong, 6–9 mm long, sparsely hairy, striate.

Occurs between Regans Ford, New Norcia and Gingin, W.A.; grows in lateritic soil and sand, in kwongan and open woodland. Flowers July–Oct. Map 289.

W.A.: c. 5 km E on Regans Ford–Mogumber road [from Brand Hwy], *J.S.Beard 7924* (PERTH); between Gillingarra and New Norcia, *A.S.George 11703* (PERTH); near source of Gingin Brook, *A.S.George 15234* (PERTH); N of New Norcia, *R.D.Royce 4932* (PERTH).

Related to *D. polycephala* but differs in the smaller, compact habit, broader leaves with larger lobes, and larger flowers. The glandular indumentum of the new growth is unusual. Variable in size of leaves and their lobes and the flowers. *K.Newbey 2317* (PERTH) has larger flowers (perianth 25 mm long, pistil 29 mm).

18. Dryandra polycephala Benth., *Fl. Austral*. 5: 570 (1870)

Josephia polycephala (Benth.) Kuntze, *Revis. Gen. Pl*. 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 2: 342*; lecto: K, *fide* A.S.George, *Nuytsia* 10: 340 (1996); isolecto: BM, MEL, NY.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 30, t. 40, 31, t. 41 (1984); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 155 (1989).

Bushy shrub to 4 m, without lignotuber. Stems appressed-tomentose, glabrescent. Leaves: petiole 1–2 mm long, with 1 or 2 short teeth; lamina linear, pinnatisect, 5–20 cm long, 3–6 mm wide, obtuse, mucronate; margins recurved; teeth 10–25 each side, triangular, mucronate. Inflorescence on lateral branchlet to 3 cm long; involucral bracts lanceolate, to 7 mm long, acuminate, appressed-pubescent with glabrous ±recurved tips; flowers 60–70 per head. Perianth 13–15 mm long, bright yellow, hirsute with glabrous limb; limb 2 mm long. Pistil incurved, 16–19 mm long, yellow, glabrous except a few hairs above ovary; pollen presenter ellipsoidal, 1 mm long, smooth. Follicles to 3 per head, obovate, 7–9 mm long, swollen, sparsely hairy.

Restricted to an area between New Norcia and Bindoon, W.A.; locally common but much reduced through clearing. Grows in lateritic soil in *Eucalyptus wandoo* open woodland. Flowers Aug.–Oct. Map 290.

W.A.: Bindoon, *C.A.Gardner 7700* (PERTH); Walebing, *R.D.Royce 4984* (PERTH); E of Great Northern Hwy on Hay Flat Rd, *P.S.Short 3871* (MEL, PERTH).

Distinguished by the narrow leaves, small flowers and ellipsoidal pollen presenter. Buds green, flowers yellow, with strong, sweet but slightly spicy scent. Style exserted adaxially before anthesis. Similar to *D. acanthopoda* and *D. echinata q.v*.

19. Dryandra subpinnatifida C.A.Gardner, *J. Roy. Soc. W. Australia* 47: 58 (1964)

T: W of Popanyinning, W.A., Oct. 1962, *F.Lullfitz s.n.*; holo: PERTH; iso: PERTH.

Shrub to 1.6 m, without lignotuber. Stems appressed-pubescent, glabrescent. Leaves: petiole to c. 2 cm long; lamina ±linear but broadened upwards, pinnatipartite usually only in lowest 1/3–1/2, otherwise entire, 5–35 cm long, 2–16 mm wide; margins recurved; teeth to c. 15 each side, widely spreading, narrowly triangular, subulate-pungent, with lowest teeth spine-like. Inflorescence on short lateral branchlet, often crowded; involucral bracts acute, 11–20 mm long, glabrous except ciliate margins or appressed-puberulous towards apex; outermost bracts broad-based, long-subulate, ±glabrous; inner bracts lanceolate to broadly linear; flowers 40–60 per head. Perianth 25–28 mm long, golden, curled-woolly above base, hirsute distally, glabrous inside; limb c. 2.5 or 3.2–3.7 mm long, widest above middle, densely hirsute with longer hairs towards apex, or almost glabrous. Pistil gently curved, 34–41 mm long, cream, glabrous except hirsute ovary, swollen above ovary; pollen presenter cylindrical, sometimes swollen at base, 0.9–1.4 mm long, finely ribbed. Follicles obliquely elliptic but constricted at base, 9–13 mm long, glabrous.

Occurs between Pingelly and Tambellup, W.A. This species may be recognised by the bushy habit, the long leaves that are pungently pinnatifid mainly in the lower third, and the golden flowers with filiform pubescent to hirsute claws. There are two varieties.

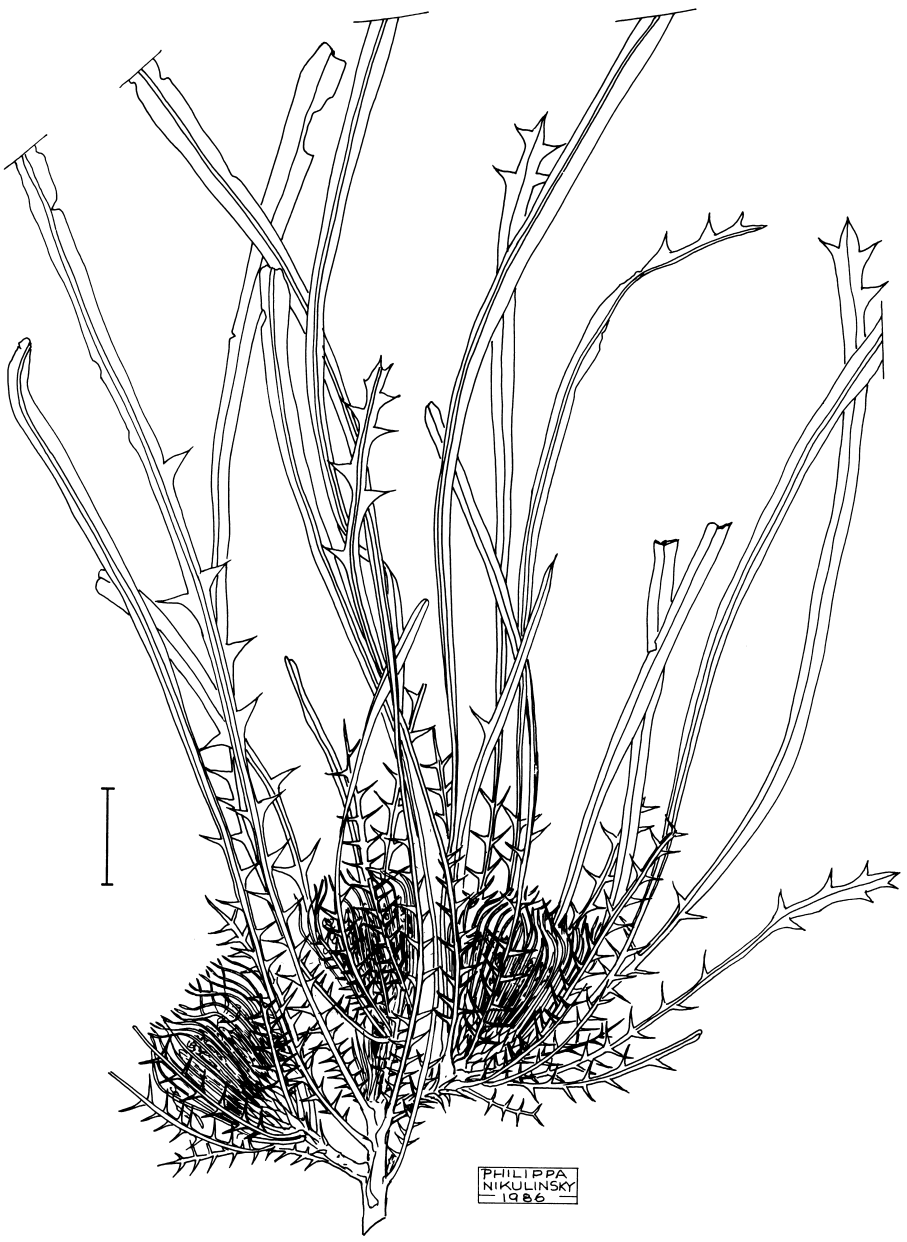


Figure 40. *Dryandra subpinnatifida* var. *imberbis*, flowering branch (A.George 11068, PERTH). Scale bar = 2 cm. Drawn by P.Nikulinsky.

Flowers 40–50 per head; involucral bracts to 20 mm long; pistil 37–41 mm long; limb 3.2–3.7 mm long, densely hirsute with hairs longer towards apex; pollen presenter noticeably thickened at base — **19a.** var. **subpinnatifida**

Flowers c. 60 per head; involucral bracts to 12 mm long; pistil 34–36 mm long; limb 2.5 mm long, glabrous except a few hairs at base; pollen presenter scarcely thickened — **19b.** var. **imberbis**

19a. Dryandra subpinnatifida C.A.Gardner var. subpinnatifida

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 103 (1985).

Involucral bracts to 20 mm long; flowers 40–50 per head; floral bracts linear, 1 mm long, obtuse, hirsute. Perianth 27–28 mm long; limb 3.2–3.7 mm long, hirsute, with hairs longer towards apex. Pistil 37–41 mm long; pollen presenter cylindrical to narrowly ovoid, noticeably thickened at base, 1–1.2 mm long.

Occurs between Pingelly and Narrogin, W.A. Grows in gravelly loam over laterite in thick scrub, sometimes with emergent *Eucalyptus drummondii*. Flowers July–Aug. Map 291.

W.A.: just E of Dryandra settlement, *A.S.George 16622* (PERTH); W of Pingelly, *F.Lullfitz 1800* (PERTH); Narrogin, Oct. 1944, *A.J.Milesi* (PERTH); Dryandra State Forest, *D.M.Rose 270* (PERTH).

19b. Dryandra subpinnatifida var. imberbis A.S.George, *Nuytsia* 10: 340 (1996)

T: W of Peringillup, W.A., 30 Sept. 1971, *A.S.George 11068*; holo: PERTH; iso: CANB, K.

Involucral bracts 11–12 mm long; flowers c. 60 per head; floral bracts linear, 3.5 mm long, obtuse, hirsute on upper margins and apex. Perianth 25–26 mm long, curled-woolly above base, hirsute distally; limb 2.5 mm long, glabrous except for a few hairs at base. Pistil 34–36 mm long; pollen presenter cylindrical with slightly swollen base, hardly thicker than style, 1–1.4 mm long. Fig. 40.

Occurs between Boddington and Broomehill, W.A. Grows in gravelly red loam in wattle – sheoak – Wandoo association. Flowers Oct. Map 292.

W.A.: 10 km S of Boddington, *K.J.Atkins 242* (PERTH); near Mt Saddleback, 15 Nov. 1904, *A.Morrison* (PERTH); c. 41 km W of Kojonup, *K.Newbey 2656* (PERTH); E of Bowelling, *M.Pieroni 95/4* (PERTH); c. 13 km W of Broomehill, *R.D.Royce 4804* (PERTH).

The glabrous or mostly glabrous perianth limb readily distinguishes the variety, but it varies in its habit. The collections from Boddington, Mt Saddleback and Bowelling are low (to 50 cm tall) mounded plants. At Bowelling the involucral bracts are red, and the population has hybridised extensively with *D. squarrosa* subsp. *squarrosa* which is common there.

20. Dryandra longifolia R.Br., *Trans. Linn. Soc. London* 10: 215 (1810)

Josephia longifolia (R.Br.) Poir., *Dict. Sci. Nat.* 24: 245 (1822). T: Lucky Bay, [W.A.], Jan. 1802, *R.Brown Iter Austral. 3424*; holo: BM; iso: K, MEL, PERTH.

Shrub to 3 m, without lignotuber. Stems appressed-tomentose or -pubescent. Leaves: petiole 5–30 mm long; lamina linear, pinnatifid or serrate, 11–30 cm long, 12–18 mm wide, pungently acute; margins recurved to shortly revolute; teeth 6–21 each side, curved-triangular, almost at 90°, pungent. Inflorescence terminal or on short lateral branchlet, closely subtended by leaves; involucral bracts lanceolate, straight or recurved, 14–30 mm long, acute or acuminate, hirsute outside and sometimes ±viscid, glabrous inside; flowers 150–250 per head. Perianth 23–40 mm long, yellow, curled-tomentose above base, pubescent to hirsute distally; limb 2.5–5.5 mm long, hairy with coarse hairs mainly in lower half, often glabrescent. Pistil incurved, 28–48 mm long, yellow, glabrous except long hairs on ovary; pollen presenter cylindrical, narrowing slightly upwards, 1.2–3.5 mm long, obscurely ribbed. Follicles obovate, 8–12 mm long, sparsely hairy.

Occurs near the south coast of W.A., from Esperance to Cape Arid Natl Park, including Mondrain Is. in the Recherche Archipelago. This species is distinguished by the bushy habit, narrow sparsely pinnatifid leaves and large flower heads. The species is placed tentatively in

ser. *Armatae* although it has far more flowers per head than the other taxa. There are three subspecies.

1 Perianth 37–40 mm long; limb 4.6–5.5 mm long; pistil 38–48 mm long; pollen presenter 2.8–3.5 mm long; involucral bracts 25–30 mm long (Cape le Grand to Cape Paisley and on Mondrain Is.) **20a.** subsp. **longifolia**

1: Perianth 23–29 mm long; limb 2.5–4 mm long; pistil 28–35 mm long; pollen presenter 1.2–2 mm long; involucral bracts to 20 mm long

2 Perianth limb 2.5–3 mm long; pollen presenter 1.2–1.6 mm long; involucral bracts straight (W of Esperance Bay) **20b.** subsp. **calcicola**

2: Perianth limb 3.5–4 mm long; pollen presenter 2 mm long; involucral bracts recurved (Mt Ragged) **20c.** subsp. **archeos**

20a. Dryandra longifolia R.Br. subsp. **longifolia**

Shrub to 3 m. Involucral bracts straight or slightly recurved, 25–30 mm long, acute, hirsute and ±viscid outside. Perianth 37–40 mm long; limb 4.6–5.5 mm long. Pistil 38–48 mm long; pollen presenter 2.8–3.5 mm long.

Occurs from Cape le Grand to Cape Paisley and on Mondrain Is., W.A. Grows in coarse sandy loam by granitic slopes, in scrub. Flowers June–Oct. Map 293.

W.A.: Mondrain Is., Recherche Archipelago, Feb. 1976, *I.Abbott* (MEL); near Cape Paisley, *C.A.Gardner 12935* (PERTH); Cape Arid, *G.J.Keighery 7644* (PERTH).

The only *Dryandra* on the Recherche islands.

20b. Dryandra longifolia subsp. **calcicola** A.S.George, *Nuytsia* 10: 343 (1996)

T: W of Twilight Beach, W of Esperance, W.A., 13 Oct. 1994, *A.S.George 17243*; holo: PERTH; iso: AD, CANB, K, MEL, NSW.

Shrub to 1.5 m. Involucral bracts straight, 14–20 mm long, ±acute, appressed-hirsute outside, ?viscid. Perianth 23–27 mm long, spreading-hirsute; limb 2.5–3 mm long. Pistil 28–35 mm long; pollen presenter 1.2–1.6 mm long.

Occurs to the west of Esperance Bay, W.A. Grows in sandy soil over limestone, in scrub. Flowers July–Sept. Map 294.

W.A.: near Dempster Head, Esperance, *A.S.George 17242* (AD, MEL, PERTH); S side of Esperance Bay, *R.H.Kuchel 1706* (AD, PERTH); near Esperance, *K.Newbey 2468* ((PERTH).

Has a smaller perianth limb and pollen presenter, and usually also involucre, than the other subspecies. Often has small leaves crowded about the inflorescence.

20c. Dryandra longifolia subsp. **archeos** A.S.George, *Nuytsia* 10: 342 (1996)

T: S end, Mt Ragged, W.A., 1 July 1976, *A.S.George 14308*; holo: PERTH; iso: CANB, K.

Shrub to 2 m. Involucral bracts recurved, c. 20 mm long, acuminate, appressed-hirsute, ?not viscid. Perianth 27–29 mm long; limb 3.5–4 mm long. Pistil 33–34 mm long; pollen presenter 2 mm long.

Confined to Mt Ragged, W.A. Grows among quartzite boulders on slopes, in dense scrub. Flowers Apr.–June. Map 295.

W.A.: Tower Peak, Mt Ragged, *A.S.George 16127* (NSW, PERTH); Mt Ragged, *P.G.Wilson 5853* (PERTH).

Differs from the other subspecies in having the perianth with sparser, more appressed hairs, and in the involucral bracts being more hairy, with a more acuminate, recurved tip, ?and not viscid. The pollen presenter is smaller than that of subsp. *longifolia* but larger than that of subsp. *calcicola*. The new leaves are sparsely appressed-hirsute but very soon glabrous above.

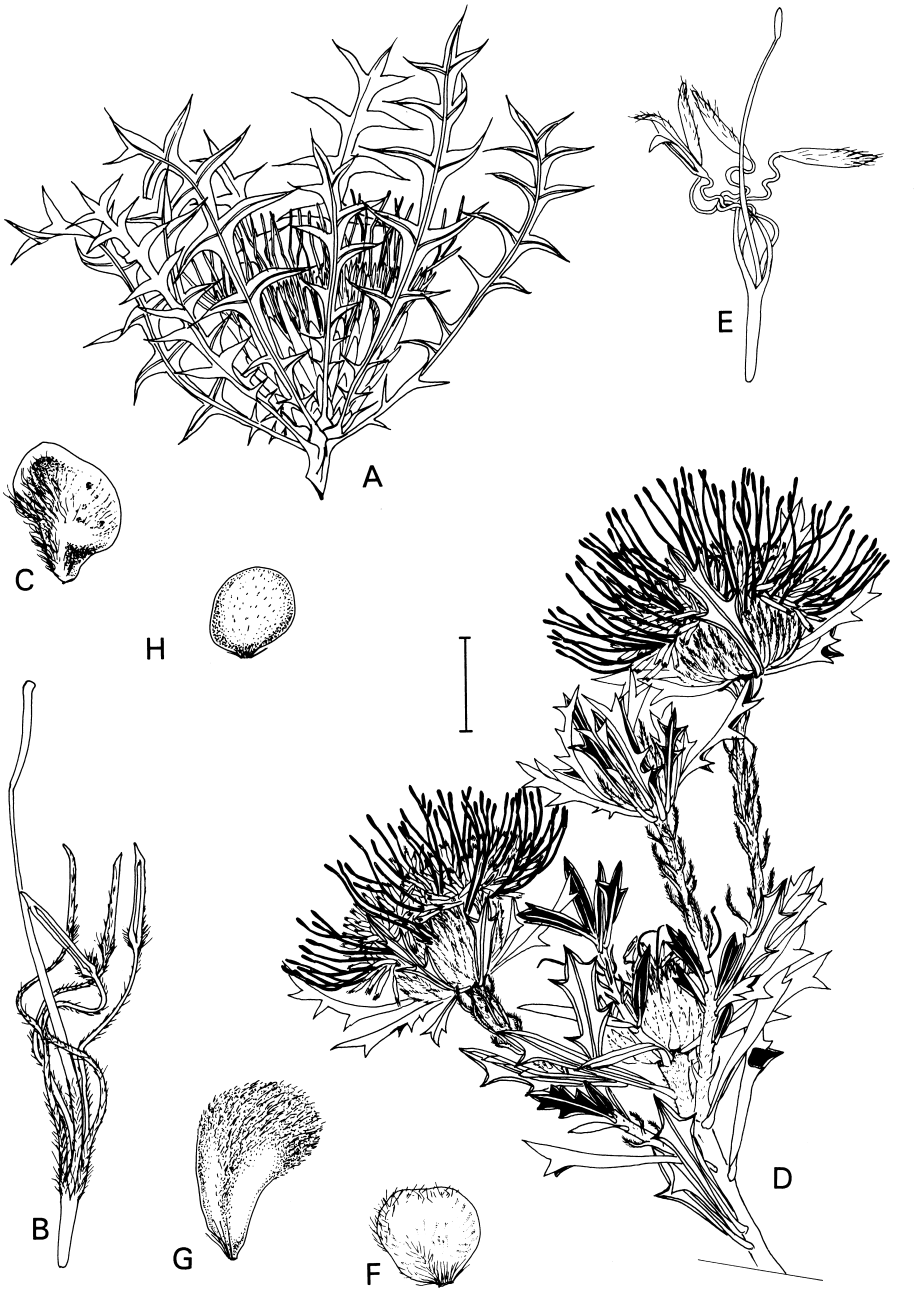


Figure 41. *Dryandra*. **A–C**, *D. borealis* subsp. *elatior*. **A**, flowering branch; **B**, flower; **C**, follicle (**A–C**, A.George 11680, PERTH). **D–F**, *D. carlinoides*. **D**, flowering branch; **E**, flower; **F**, follicle (**D–F**, A.George 10377, PERTH). **G**, *D. pulchella*, follicle (A.George 16764, PERTH). **H**, *D. fraseri* var. *oxycedra*, follicle (A.George 16788, PERTH). Scale bar: **A, D** = 2 cm; **B** = 7 mm; **C, G–H** = 8 mm; **E** = 5 mm; **F** = 1 cm. Drawn by: **A–F**, P.Nikulinsky; **G–H**, P.Dundas.

21. Dryandra borealis A.S.George, *Nuytsia* 10: 343 (1996)

T: 27 miles [c. 35 km] E of Kalbarri on road to Ajana, W.A., 8 Sept. 1966, *A.S.George 7930*; holo: PERTH; iso: CANB, MEL.

Sprawling shrub to 1 m with lignotuber, or erect to 2.5 m without lignotuber. Stems closely pubescent. Leaves sessile or with petiole to 2 mm long; lamina broadly linear, pinnatipartite, 4–9 cm long, 12–30 mm wide, acute, pungent, glabrous below except fine pits; margins flat to slightly recurved; lobes 5–12 each side, triangular, slightly falcate, pungent. Inflorescence on short lateral branchlet or terminal; involucral bracts ovate to linear, 30–35 mm long, obtuse; outer bracts ±glabrous; inner bracts appressed-pubescent, ciliate; flowers 30–60 per head. Perianth 32–35 mm long, deep yellow, hirsute; limb 7–8.5 mm long, glabrescent towards apex. Pistil straight to gently incurved, 39–47 mm long, yellow, hirsute in lower third; pollen presenter 4.5–6 mm long, finely ribbed. Follicles ovate to obovate, 8–13 mm long, loosely hirsute.

Occurs in two disjunct areas in south-western W.A., one centred on the lower Murchison River, the other in the Three Springs area; represented by a subspecies in each area. Differs from *D. armata* in the narrower leaf lobes, larger, less hairy involucral bracts and larger flowers, especially the long perianth limb.

Sprawling shrub with lignotuber; perianth limb 7.5–8.5 mm long **21a.** subsp. **borealis**

Erect shrub without lignotuber; perianth limb 7–7.5 mm long **21b.** subsp. **elatior**

21a. Dryandra borealis A.S.George subsp. **borealis**

Illustration: M.K.Morcombe, *Australia's W. Wildfl.* 28 (1968), as *Dryandra* sp.

Sprawling shrub to 1 m, with lignotuber. Perianth limb 7.5–8.5 mm long.

Relatively common between Kalbarri, Northampton and Yuna, W.A. Grows in pale yellow sand and in sand over laterite or sandstone, in kwongan. Flowers Aug.–Sept. Map 296.

W.A.: between Northampton and Lynton, *W.E.Blackall 2685* (PERTH); Ajana, *C.A.Gardner 8597* (PERTH); Yuna, *W.Rogerson 348* (PERTH).

The collection *W.E.Blackall 2685* has unusually small flowers (pistil 31 mm long) and may have been collected in a dry season. One by *J.Long 38* (PERTH) has leaves to 11 cm long and 35 mm wide and the perianth limb 9.5–10 mm long.

21b. Dryandra borealis subsp. **elatior** A.S.George, *Nuytsia* 10: 344 (1996)

T: SW of Three Springs, W.A., 6 Aug. 1986, *A.S.George 16787*; holo: PERTH; iso: CANB, K, MEL.

Erect, bushy shrub to 2.5 m, without lignotuber. Perianth limb 7–7.5 mm long. Fig. 41A–C.

Restricted to several small populations west and north of Three Springs, W.A. Grows on lateritic rises in tall scrub and low open woodland. Flowers Aug. Map 297.

W.A.: between Three Springs and Mingenew, *J.S.Beard 1680* (PERTH); S of Mingenew, *A.S.George 11680* (CANB, MEL, NSW, PERTH).

Distinguished from subsp. *borealis* mainly by the larger, non-lignotuberous habit but also by the usually fewer leaf lobes, fewer flowers per head and the pistil hirsute for a shorter distance.

Ser. 3. Marginatae

Dryandra ser. **Marginatae** (Meisn.) A.S.George, *Nuytsia* 10: 345 (1996)

Dryandra § *Marginatae* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 473 (1856). T: *D. pulchella* Meisn.

Bushy shrubs, without lignotuber. Leaves petiolate; lamina linear, closely pinnatisect; margins revolute. Inflorescence ±sessile, on old stems, not conspicuous; involucral bracts

shorter than flowers; receptacle convex. Perianth straight; limb incurved in bud. Pistil incurved, geniculate below pollen presenter, much longer than perianth; pollen presenter narrowly conical, ribbed. Flowers persistent. Follicles obovate to almost orbicular, loosely attached, usually remaining closed until burnt. Seed wing notched.

Monotypic, restricted to the Wongan Hills area of south-western W.A.

22. Dryandra pulchella Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 473 (1856)

Josephia pulchella (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 4: 312*; holo: NY; iso: BM, K, MEL.

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 39, t. 52 (1984).

Bushy shrub, to 3 m, without lignotuber. Stems curled-pubescent and hirsute, glabrescent. Leaves crowded on lateral branchlets; petiole to 2 cm long, hirsute to pubescent; lamina linear, pinnatisect, 6–20 cm long, 3–4 mm wide, emarginate, mucronate, white-tomentose below; margins revolute; lobes c. 35 each side, triangular-falcate, overlapping, to 1.8 mm long. Inflorescence almost sessile on older stems, surrounded by leaves; involucral bracts linear-subulate from broad base, to 14 mm long, glabrous at base, then pubescent, then plumose; flowers 30–50 per head. Perianth c. 24 mm long, yellowish green, sparsely spreading-pubescent; limb 4 mm long, loosely hirsute. Pistil incurved, geniculate below pollen presenter, 38–42 mm long, yellow, glabrous; pollen presenter narrowly conical, 1.5–2 mm long, obscurely ribbed. Follicles 1 or 2 per head, almost orbicular to broadly obovate, with short obtuse lateral beak when open, 6–8 mm long, hirsute. Fig. 41G.

Occurs near Wongan Hills, W.A. Grows in gravelly soil in tall shrubland and low open woodland. Flowers Oct. Map 298.

W.A.: Wongan Hills, *K.F.Kenneally 2394* (CANB).

This species is recognised by its fine, many-lobed glaucous leaves and its perianth claws coiled after anthesis.

Ser. 4. Folliculosae

Dryandra ser. **Folliculosae** A.S.George, *Nuytsia* 10: 345 (1996)

Type: *D. fraseri* R.Br.

Shrubs, with or without lignotuber. Leaves petiolate; lamina pinnatisect; margins revolute. Inflorescence terminal or on short lateral branchlet, conspicuous; involucral bracts shorter than flowers; receptacle very convex. Perianth straight (inner) or curved (outer); limb inflexed before anthesis. Pistil incurved, exceeding perianth; pollen presenter slightly thickened, ribbed. Flowers persistent. Follicles cuneate, firmly attached, opening when mature. Seed wing large, notched.

A single, variable species, found from Kalbarri to Cranbrook and inland to Kellerberrin, W.A. Follicles usually prominent.

23. Dryandra fraseri R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 39 (1830)

Josephia fraseri (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: Swan R., [W.A.], 1827, *C.Fraser*; holo: BM; iso: K.

Sprawling shrub to 1 m with lignotuber, or erect to 6 m without lignotuber. Stems hirsute and tomentose, glabrescent. Leaves: petiole to 3 cm long; lamina broadly linear, pinnatisect, 5–10 cm long, 8–40 mm wide, acute to obtuse but mucronate; margins revolute; lobes 4–18 each side, linear to narrowly triangular, decurrent, acute, pungent, glabrous. Inflorescence on short lateral branchlet or terminal; involucral bracts subulate to narrowly triangular, to 16 mm long, variably tomentose-hirsute to ±glabrous, with hairs often black or dark brown; flowers 80–100 per head. Perianth 24–28 mm long, curved (outer) or straight (inner), pink to cream, glabrous, sparsely appressed-pubescent, pubescent or hirsute; limb 3.5–4 mm long,

cream-green, loosely hirsute to almost glabrous. Pistil incurved to straight, 30–42 mm long, cream, hirsute at very base, glabrous above; pollen presenter slightly thickened, 2–2.5 mm long, finely ribbed. Follicles several to many, ±cuneate, commonly curved, 14–20 mm long, loosely hairy.

Occurs from Kalbarri to Cranbrook and inland to Kellerberrin, W.A. The follicles are prominent, remaining closed for some years. The prominent glabrous apices of the floral bracts are distinctive. A variable species, here divided into three varieties.

1	Perianth claws pubescent to hirsute; sprawling shrub to 1 m, with lignotuber	**23a.** var. **fraseri**
1:	Perianth claws glabrous or sparsely pubescent	
2	Pistil 30–35 mm long; sprawling shrub to 1 m, with lignotuber	**23b.** var. **ashbyi**
2:	Pistil 38–42 mm long; erect shrub to 6 m, without lignotuber	**23c.** var. **oxycedra**

23a. Dryandra fraseri R.Br. var. **fraseri**

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 47 (1985).

Sprawling shrub to 1 m, with lignotuber. Involucral bracts pubescent at least in upper ½–⅓. Perianth claws pubescent to hirsute. Pistil 30–37 mm long. Plate 51.

Widespread from near Geraldton to Cranbrook and inland to Manmanning, Kellerberrin and Corrigin, W.A. Grows in gravelly clay, sandy loam and granitic soil, in kwongan and woodland. Flowers July–Sept. Map 299.

W.A.: 5 km E of Darkan, *B.Barnsley 832* (CANB, PERTH); 14.9 km W of Yandanooka, *E.A.Griffin 3518* (PERTH); c. 22 km N of Kojonup, Albany Hwy, 20 July 1962, *F.Lullfitz* (PERTH); S of New Norcia, *F.G.Smith 1714* (PERTH); c. 3 km NE of Dumbleyung, *M.D.Tindale 163* (NSW).

Northern populations, e.g. W of Ellendale, *R.A.Saffrey 1549* (PERTH), have leaves with 5–10 lobes each side that tend to be broader at the base. Populations from Wongan Hills and to the east and south, e.g. Cullinbin Reserve, E of Manmanning, *B.H.Smith 233* (HO, MEL, PERTH), have leaves usually 5–9 cm long with 10–18 rather fine lobes each side; the perianth claws are very hirsute with hairs tending to be curled, and the involucral bracts usually have long, fine tips; the hairs of the involucral bracts vary from pale to dark. From Moora to Geraldton, the perianth claws tend to be less hairy and the hairs are straighter. In an area bounded roughly by Three Springs, Marchagee and Dalwallinu, e.g. *M.D.Tindale 2666* (PERTH), the perianth claws are sparsely hairy, showing a tendency towards var. *ashbyi*. In the Mt Lesueuer area (e.g. *A.S.George 17420*, PERTH) plants tend to be small, to 30 cm tall and 70 cm wide, but otherwise fall within the range of variation in the variety. Leaves of regrowth after fire have broader lobes with less revolute margins.

23b. Dryandra fraseri var. **ashbyi** (B.L.Burtt) A.S.George, *Nuytsia* 10: 346 (1996)

Dryandra ashbyi B.L.Burtt, *Bull. Misc. Inform. Kew* 1939: 183 (1939). T: cultivated at Blackwood, S.A., from seed collected at Yuna, 30–40 miles [48–62 km] NE of Geraldton, W.A., 1934, *E.Ashby 39*; holo: K; possible iso: NSW.

Sprawling shrub to 1 m, with lignotuber. Involucral bracts glabrous to prominently pubescent. Perianth claws glabrous or sparsely pubescent. Pistil 30–35 mm long.

Occurs from the Geraldton area north to Kalbarri and inland to Yuna, W.A. Grows in sandy loam or rocky loam in open shrubland and kwongan. Flowers May–July. Map 300.

W.A.: East Yuna Reserve, *A.C.Burns 12* (PERTH); 22 km S of Northampton, *R.J.Cranfield 2703* (PERTH); 3–5 km N of Naraling, *A.S.George 2352* (PERTH).

Differs from var. *fraseri* in the glabrous or almost glabrous perianth claws. The leaf lobes are fewer (4–8 each side) than in southern, typical populations of var. *fraseri* but similar to populations of the latter from the Yandanooka–Arrowsmith area. The involucral bracts tend to be wider and vary from almost glabrous to prominently pubescent, the hairs usually very dark. A sheet at AD (97812203) is labelled 'W.A. 14.7.34 E.A. Type bush' and presumably

represents the plant from which seed was collected to grow the plant that was the source of the type material.

23c. Dryandra fraseri var. **oxycedra** A.S.George, *Nuytsia* 10: 347 (1996)

T: 8.5 km SW of Three Springs, W.A., 1986, *A.S.George 16788*; holo: PERTH; iso: CANB, K, PERTH.

Erect shrub to 6 m, without lignotuber. Leaves 25–40 mm wide. Involucral bracts glabrous except short appressed dark hairs on tips. Flowers 50–60 per head. Perianth claws glabrous or sparsely pubescent. Pistil 38–42 mm long. Fig. 41 H.

Restricted to a few populations near Three Springs W.A. Grows in gravelly loam in thick scrub. Flowers July–Aug. Map 301.

W.A.: 9 km W of Three Springs, *H.Demarz 8561* (PERTH); N of Arrino, Sept. 1962, per *C.A.Gardner* (PERTH).

Sometimes sympatric with var. *fraseri*. This variety has longer leaf lobes than in the other two varieties (4–6 each side), and the fruit are not curved (commonly curved in the other subspecies).

Ser. 5. Acrodontae

Dryandra ser. **Acrodontae** (Meisn.) A.S.George, *Nuytsia* 10: 347 (1996)

Dryandra § *Acrodontae* Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 479 (1856). T: *D. carlinoides* Meisn.

Small erect shrubs, with or without lignotuber. Leaves shortly petiolate; lamina narrowly obovate or cuneate and sparsely serrate to entire, or linear and pinnatifid; margins recurved or revolute. Inflorescence terminal or on short lateral branchlet; involucral bracts shorter than flowers; receptacle flat or convex. Perianth straight; limb incurved before anthesis. Pistil incurved, longer than perianth; pollen presenter small, narrow. Old flowers persistent. Follicles transversely elliptic to obovate, usually remaining closed until burnt. Seed wing notched.

A series of 4 species in the kwongan from Geraldton to Perth, W.A.

24. Dryandra sclerophylla Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 123 (1855)

Josephia sclerophylla (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1850–51, *J.Drummond 6: 209*; holo: NY; iso: BM, CGE, K, MEL, PERTH.

Shrub to 60 cm, with lignotuber. Stems spreading, hirsute and tomentose, glabrescent. Leaves: petiole 2–5 mm long, glabrescent; lamina linear, pinnatifid, 6–13 cm long, 4–6 mm wide, obtuse or emarginate, mucronate, closely white-tomentose below; margins revolute with the upper margin of the lobe less so than the lower; lobes triangular, 10–30 each side. Inflorescence terminal; involucral bracts lanceolate, to 15 mm long, acuminate, hirsute and tomentose, pale and ferruginous; flowers 40–70 per head. Perianth 19–22 mm long, cream, spreading-hirsute; limb 4 mm long, hirsute. Pistil gently incurved, 25–27 mm long, cream, loosely hirsute; pollen presenter 1–1.3 mm long, obscurely ribbed, pale or dark. Follicles transversely elliptic, 7–9 mm long, 8–10 mm wide, sparsely hirsute.

Occurs between Alexander Morrison Natl Park, Mt Lesueur and Badgingarra, W.A. Grows in sand over laterite in kwongan. Flowers Sept.–Oct. Map 302.

W.A.: junction of Willis and Tootbardi Rds, *K.Alcock 504* (PERTH); S of Eneabba, 29 Aug. 1986, *J.M.Browne* (PERTH); 5 km S of Cataby on Brand Hwy, *A.S.George 16277* (PERTH); Mt Lesueur, *E.A.Griffin 1930* (PERTH).

Differs from *D. kippistiana* especially in the thicker pistil, narrower pollen presenter and longer involucral bracts. Pistil bowed outwards but not looped before anthesis. Follicles loosely attached, the old flowers persistent.

Figure 42. *Dryandra kippistiana* var. *kippistiana*. **A**, flowering branch; **B**, flower; **C**, follicle (**A–C**, A.George 7838, PERTH). Scale bar: **A** = 2 cm; **B** = 5 mm; **C** = 7 mm. Drawn by P.Nikulinsky.

25. Dryandra kippistiana Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 473 (1856)

Josephia kippistiana (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 4: 343*; holo: NY; iso: BM, CGE, K, MEL, PERTH.

Shrub to 1.5 m, with or without lignotuber. Stems hirsute and tomentose, glabrescent. Leaves: petiole 1–3 mm long, glabrescent; lamina linear, pinnatifid, 4–8 cm long, 4–6 mm wide, emarginate, mucronate, white-tomentose below; margins revolute with the upper margin of the lobe less so than the lower; lobes 10–20, triangular. Inflorescence terminal, often several together on short branchlets; involucral bracts ovate, 6–10 mm long, acute, hirsute and closely tomentose, dark brown in upper half; flowers c. 50–80 per head. Perianth 12–20 mm long, pale yellow, hirsute with fine spreading hairs; limb 3.5 mm long, hirsute, with apical hairs erect, coarser. Pistil prominently looped before anthesis, afterwards gently incurved, 19–26 mm long, cream, loosely hirsute; pollen presenter 0.9–1.2 mm long, slightly thickened, smooth, dark. Follicles transversely elliptic, 4–5 mm long, 7–8 mm wide, sparsely hirsute to glabrous.

Occurs in south-western W.A., from near Eneabba to Mt Lesueur and at scattered localities south to Wungong (south-east of Perth). This species closely resembles *D. sclerophylla* but typically has smaller flowers with a more slender pistil that is markedly looped before anthesis and a thicker pollen presenter. The flowers are fragrant. There are two varieties.

Perianth 12–17 mm long; pistil 19–22 mm long; involucral bracts to 6–9 mm long; lignotuber absent — **25a.** var. **kippistiana**

Perianth 18–20 mm long; pistil 24–26 mm long; involucral bracts to 10 mm long; lignotuber present — **25b.** var. **paenepeccata**

25a. Dryandra kippistiana Meisn. var. **kippistiana**

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 36, t. 48 (1984).

Shrub without lignotuber. Involucral bracts to 6–9 mm long. Perianth 12–17 mm long. Pistil 19–22 mm long. Fig. 42.

Occurs from Eneabba south to Mogumber and New Norcia, W.A. Grows in sand, in sand over laterite and in laterite, and near Mogumber on schistose hills, in kwongan. Flowers mainly Aug.–Oct. Map 303.

W.A.: 8–10 km S of New Norcia, *C.A.Gardner 8682* (PERTH); c. 40 km SW of Eneabba, *A.S.George 7838* (PERTH); Marchagee Track, 12.5 km E of Brand Hwy, *E.A.Griffin 3467* (PERTH); c. 18 km W of Great Northern Hwy on Mogumber road, *E.M.Scrymgeour 1323* (PERTH).

25b. Dryandra kippistiana var. **paenepeccata** A.S.George, *Nuytsia* 10: 348 (1996)

T: N of Coorow–Greenhead Rd along Willis Rd, W.A., 31 Oct. 1986, *A.S.George 16866*; holo: PERTH; iso: CANB, K.

Shrub with lignotuber. Involucral bracts to 10 mm long. Perianth 18–20 mm long. Pistil 24–26 mm long.

Occurs in localities scattered over the range of the species, including Armadale and Wungong, SE of Perth, W.A. Flowers Oct.–Nov. Map 304.

W.A.: Boonanarring Brook, *J.J.Alford 224* (PERTH); Mt Peron, *E.A.Griffin 2451* (PERTH); Rogers Rd, Gillingarra, *E.A.Griffin 5375* (PERTH); Armadale, Darling Ra., 21 Dec. 1901, *A.Morrison* (CANB).

The leaves are usually straighter, more erect and more coarsely lobed than in var. *kippistiana*. and flowering is later. Vegetatively similar to *D. sclerophylla* but can be distinguished easily by the slender pistil that is prominently looped just before anthesis.

26. Dryandra carlinoides Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 2: 267 (1848)

Josephia carlinoides (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891), as *carlinodes*. T: south-western W.A., 1840s, *J.Drummond 2: 345*; holo: NY; iso: BM, CGE, K, MEL.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 37, t. 49 (1984); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 138 (1989).

Shrub to 1.3 m, without lignotuber. Stems hirsute and tomentose, glabrescent. Leaves: petiole 1–2 mm long; lamina narrowly obovate to narrowly cuneate, incurved, 1–3.5 cm long, 3–9 mm wide, acute, pungent, tomentose below; margins recurved, sparsely serrate; teeth 1–4 each side in upper third, to 3 mm long. Inflorescence terminal; involucral bracts narrowly triangular to subulate above thick base, to 13 mm long, tomentose-plumose; inner bracts almost glabrous in lower half; flowers 75–100 per head. Perianth 10–20 mm long, creamy white, often tinged pink, glabrous, sometimes with coarse erect hairs on limb; limb 4–5.5 mm long. Pistil gently incurved, 16–23 mm long, almost white, glabrous; pollen presenter cylindrical, 1.5–2 mm long, obscurely ribbed. Follicles transversely elliptic to obovate, 8–11 mm long, densely silky but glabrescent. Fig. 41 D–F.

Widespread and locally common between Geraldton and Gingin, extending inland to Piawaning, south-western W.A.; grows in lateritic soil and in sand in low kwongan. Flowers Sept.–Oct. Map 305.

W.A.: towards The Casuarinas, *E.M.Canning WA/68 3163* (CANB); 4.3 km E of Regans Ford, *M.L.Clark 206* (CANB, MEL, NSW, PERTH); 10 km E of Eneabba, *D.B.Foreman 517* (MEL, PERTH); Irwin R, *C.A.Gardner* 7714 (PERTH); c. 13.5 km E of Carani, *B.H.Smith 1223* (BRI, HO, MEL).

Very distinctive in the conspicuous cream and pink flowers and the narrowly obovate to narrowly cuneate leaves with few teeth. Southern populations (south of Regans Ford) usually have narrow leaves and smaller flowers with caducous hairs on the perianth limb. Young plants may have entire leaves. Follicles remaining closed but easily detached. New growth unusual in having white indumentum.

27. Dryandra tridentata Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 120 (1855)

Josephia tridentata (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1850–51, *J.Drummond 6: 207*; holo: NY; iso: BM, CGE, K, MEL, NSW, PERTH.

Illustrations: R.Erickson *et al.*, *Fls Pls W. Australia* 100, t. 293 (1973); R.M.Sainsbury, *Field Guide Dryandra* 109 (1985); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 156 (1989).

Shrub with several stems to 45 cm, with lignotuber. Stems hirsute and tomentose, glabrescent. Leaves: petiole 1–3 mm long; lamina narrowly obovate, 1.5–4.5 cm long, 2.5–5 mm wide, obtuse to acute, mucronate; margins 1-toothed near apex or entire, glabrescent. Inflorescence on short branchlet usually near base of stem, sometimes terminal; involucral bracts linear-subulate from broad base, to 15 mm long, pubescent and with scattered long hairs; flowers 85–125 per head. Perianth 25–28 mm long, yellow, sparsely hirsute with viscid hairs; limb 4 mm long, coarsely hirsute. Pistil incurved or straight, 30–40 mm long, yellow, hirsute on ovary, glabrous above; pollen presenter narrow, 2 mm long, obscurely ribbed. Follicles transversely elliptic to obovate, 11–15 mm long, sparsely hirsute. Plate 52.

Occurs between the Arrowsmith and Hill Rivers, south-western W.A. Grows in sand and sand over laterite in low kwongan. Flowers Aug.–Sept. Map 306.

W.A.: Cockleshell Gully, *W.E.Blackall 3578* (PERTH); c. 24 km N of Eneabba, *A.C.Burns 129* (PERTH); c. 2 km E of L. Indoon, *R.J.Hnatiuk 771033* (PERTH).

This species is somewhat anomalous in the series in its large follicles. It is also distinguished by its very conical receptacle and the pistils that become wiry and persist in the old head.

Ser. 6. Capitellatae

Dryandra ser. **Capitellatae** A.S.George, *Nuytsia* 10: 349 (1996)

Type: *D. serratuloides* Meisn.

Sprawling shrubs, with lignotuber. Leaves petiolate; lamina linear, pinnatipartite; margins recurved or revolute. Inflorescence sessile, axillary, or on short branchlet from older stems, sometimes terminal; involucral bracts shorter than flowers; receptacle ±flat. Perianth straight;

limb incurved before anthesis. Pistil straight, incurved or outcurved, longer than perianth; pollen presenter slightly thickened, ribbed. Old flowers persistent. Follicles ellipsoidal, small, hirsute, loosely attached, opening when burnt. Seed wing very small.

A series with two species between Eneabba and Nyabing, W.A.

28. Dryandra serratuloides Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 123 (1855)

Josephia serratuloides (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891), as *serratulodes*. T: south-western W.A., 1850–51, *J.Drummond 6: 213*; holo: NY; iso: B, BM, CGE, K, MEL, NSW, PERTH.

Shrub to 50 cm, with lignotuber. Stems tomentose and hirsute. Leaves: petiole 1–2 cm long; lamina linear, pinnatipartite, 3–9 cm long, 7–15 mm wide, tardily glabrescent above, tomentose below with midrib and reticulum tardily glabrescent; margins recurved; lobes narrowly triangular-lanceolate, 6–15 or 20–33 each side, with upper ones directed forward at c. 60° and lowest almost at 90°. Inflorescence sessile, axillary or on short branchlet; involucral bracts ovate (outer) to lanceolate or oblong (inner), obtuse, not recurved, 11–25 mm long, shining brown, hirsute-silky on margins and towards apex, glabrous inside; flowers 35–40 per head. Perianth 19–23 mm long, pink with greenish cream limb, hirsute outside except glabrous apex of limb; limb 4.5–6 mm long, keeled. Pistil gently incurved, 22–29 mm long, pink, sparsely hirsute in lowest third; pollen presenter slightly thickened at base, 3–3.8 mm long, prominently ribbed, dark green, with slightly flattened apex. Follicles ellipsoidal, 5–6 mm long, densely hirsute, wrinkled.

Occurs in south-western W.A. in two disjunct areas between Eneabba and Mogumber. After anthesis the pistil is exserted centrifugally but then curves upwards and straightens below the pollen presenter, in contrast to *D. meganotia* in which it curves evenly outwards. There are two subspecies.

Leaves with 6–15 lobes each side; involucral bracts 11–12 mm long	**28a.** subsp. **serratuloides**
Leaves with 20–33 lobes each side; involucral bracts 22–25 mm long	**28b.** subsp. **perissa**

28a. Dryandra serratuloides Meisn. subsp. **serratuloides**

Leaves with 6–15 lobes each side. Involucral bracts 11–12 mm long; floral bracts 3.5 mm long. Perianth 19–20 mm long; limb 4.5–5 mm long. Pistil 25–27 mm long; pollen presenter 3 mm long. Fig. 43G.

Occurs around Gillingarra and Mogumber, W.A. Grows in loam over laterite, in clay-loam over laterite and in sandy gravel, in low kwongan or open scrub, sometimes with emergent *Eucalyptus wandoo*. Listed as 'Vulnerable' in the ANZECC Threatened Flora List 1997. Flowers July–Sept. Map 307.

W.A.: N of Mogumber, 21 Sept. 1984, *C.Chapman* (PERTH); Gillingarra Nature Reserve, *S.Patrick 675* (PERTH).

The leaf lamina is rarely more than 5 cm long; in subsp. *perissa* it is commonly up to 9 cm long.

28b. Dryandra serratuloides subsp. **perissa** A.S.George, *Nuytsia* 10: 350 (1996)

T: 11 km E of Brand Hwy on Tootbardi Rd, W.A., 7 Aug. 1986, *A.S.George 16820*; holo: PERTH; iso: CANB, K.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* cover, 91 (1985), as *D. serratuloides*.

Leaves with 20–33 narrowly triangular lobes each side. Involucral bracts 22–25 mm long; floral bracts 2.8–3 mm long. Perianth 20–23 mm long; limb 5–6 mm long. Pistil 22–25 mm long; pollen presenter 3–3.8 mm long. Fig. 43H.

Occurs from Alexander Morrison Natl Park south to Badgingarra and Boothendarra Hill, W.A. Grows in lateritic gravelly loam, in mallee-kwongan with *Eucalyptus drummondii*. Listed as 'Vulnerable' in the ANZECC Threatened Flora List 1997. Flowers Aug.–Sept. Map 308.

W.A.: Marchagee Track, *E.A.Griffin 3464* (NSW, PERTH); Alexander Morrison Natl Park, *S.J.Patrick 901B* (PERTH); Boothendarra Hill, *S.J.Patrick 1025* (PERTH).

Easily distinguished from subsp. *serratuloides* by the greater number of lobes to the leaves. The involucral bracts are also longer and tend to be more hairy.

29. Dryandra meganotia A.S.George, *Nuytsia* 10: 351 (1996)

T: Dongolocking Nature Reserve, W.A., 14 Oct. 1994, *A.S.George 17247*; holo: PERTH; iso: CANB, K, MEL, NSW.

Shrub to 1 m, with lignotuber. Stems shortly tomentose, later developing flaky bark. Leaves: petiole 5–10 mm long; lamina linear, pinnatipartite, 3–7 cm long, 10–25 mm wide; midrib usually curved; margins revolute; lobes linear, 6–10 each side, at c. 80°–90°, acute, pungent. Inflorescence on short branchlet; involucral bracts ovate to lanceolate, 17–20 mm long, obtuse, silky on margins, otherwise glabrous except a few short hairs towards apex outside; flowers 30–40 per head. Perianth 22–23 mm long, yellow, densely silky; limb 5–6.2 mm long. Pistil straight or incurved, but afterwards strongly recurved, 26–30 mm long, yellow, hirsute in lower third, glabrous distally; pollen presenter narrowly cylindrical, 3–4 mm long, finely ribbed. Follicles 5 mm long.

Occurs in the Great Southern region, W.A., from Kulin to Nyabing. Grows in clay-loam or sandy loam over gravel, in kwongan, sometimes with Wandoo. Flowers Oct. Map 309.

W.A.: 12 km NW of Jitarning, *J.M.Browne 003* (PERTH); c. 5 km NW of Nyabing, *K.Newbey 3014* (PERTH); 7 km N of Harrismith, *E.Wittwer 2039* (PERTH).

Sometimes resembles *D. cirsioides* and *D. xylothemelia* but may be distinguished by the smaller flowers and fruit. The old styles are also strongly recurved.

Ser. 7. Ilicinae

Dryandra ser. **Ilicinae** (Meisn.) A.S.George, *Nuytsia* 10: 352 (1996)

Dryandra § *Ilicinae* Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 467 (1856). T: *D. praemorsa* Meisn.

Mostly erect shrubs or small trees, without lignotuber. Leaves petiolate; lamina cuneate, serrate; margins recurved or almost flat. Inflorescence terminal or on short lateral branchlet, large, conspicuous; involucral bracts shorter than or longer than flowers; receptacle gently convex or prominently conical. Perianth straight. Pistil curved, prominently exserted adaxially before anthesis, longer than perianth; pollen presenter narrow, ribbed. Old flowers soon falling. Follicles obovate to elliptic, loosely or firmly attached, usually opening when mature. Seed wing large, notched.

A series of three species occurring between Perth and Hopetoun, W.A.

30. Dryandra praemorsa Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 2: 265 (1848)

Josephia praemorsa (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 2: 339*; syn: K.

Shrub to 3 m, without lignotuber. Stems hirsute and tomentose, glabrescent. Leaves sessile or very shortly petiolate; lamina cuneate, 2.5–11 cm long, 1–6 cm wide truncate, mucronate, white-tomentose below except on nerves; margins undulate, not or slightly recurved, serrate, with 4–9 ±irregular teeth each side. Inflorescence terminal or on short lateral branchlet; involucral bracts ovate to narrowly lanceolate, to 12–15 mm long, acute, hirsute and tomentose; flowers 80–160 per head. Perianth 30–38 mm long, pale yellow or pink-tinged, hirsute; limb 4–7.5 mm long, pubescent. Pistil incurved but after anthesis the apex turned outwards, 31–52 mm long, cream, glabrous; pollen presenter ellipsoidal, angular at base, 2–5 mm long, ribbed. Follicles up to 8 per head, obovate to elliptic, 12–15 mm long, tomentose, glabrescent.

Occurs on the Darling Plateau from Clackline to Dwellingup and east to Bannister, W.A.

May be recognised especially by the undulate leaves with white undersurface and the large inflorescence of pale flowers. Involucral bracts recurved in fruit. Receptacle conical. Floral bracts c. 2 mm long. The follicles are not easily detached. There are two varieties.

Pistil 31–38 mm long; leaves commonly 2.5–6 cm long, 1–4 cm wide **30a.** var. **praemorsa**

Pistil 47–52 mm long; leaves commonly 4–11 cm long, 2.5–6 cm wide **30b.** var. **splendens**

30a. Dryandra praemorsa Meisn. var. **praemorsa**

Dryandra praemorsa var. *elongata* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 467 (1856). T: south-western W.A., 1840s, *J.Drummond 5: 422*; syn: BM, K, MEL, NY.

Leaves commonly 2.5–6 cm long, 1–4 cm wide. Pistil 31–38 mm long; pollen presenter 2–2.5 mm long.

Occurs between Clackline and Dwellingup, W.A. Grows in lateritic and granitic soil in Jarrah-Marri forest. Flowers Sept.–Oct. Map 310.

W.A.: Mt Cooke, *M.G.Corrick 8387* (MEL); summit, Mt Randall, 31 July 1932, *C.A.Gardner s.n.* (PERTH); Clackline, Nov. 1929, *B.T.Goadby* (PERTH); Oakley Dam, Dwellingup, 29 Sept. 1979, *T.J.Hawkeswood* (PERTH).

30b. Dryandra praemorsa var. **splendens** A.S.George, *Nuytsia* 10: 353 (1996)

T: c. 10 km E of Albany Hwy on road from North Bannister to Wandering, W.A., 14 Oct. 1994, *A.S.George 17251*; holo: PERTH; iso: CANB, K, NSW.

Illustration: R. Erickson et al., *Fls Pls W. Australia* t. 105 (1973), as *D. praemorsa*.

Leaves commonly 4–11 cm long, 2.5–6 cm wide. Pistil 47–52 mm long; pollen presenter 4–5 mm long. Fig. 43C.

Occurs from the Brookton Hwy south to Bannister, W.A. Grows in lateritic loam, in Jarrah and Jarrah–Wandoo forest. Map 311.

W.A.: c. 64 km SE of Perth, Brookton Hwy, *J.S.Beard 1795* (PERTH); near Bannister R., *C.A.Gardner 2084* (PERTH).

The leaf teeth are usually coarser than in var. *praemorsa*. There are two intermediate collections: Beraking, 1934, *coll. unknown* (PERTH) has leaves 4–9.5 cm long and 2.5–4 cm wide, pistil 37–40 mm long; Bannister R., Nov. 1962, *F.Lullfitz* (PERTH), has pistils 44–45 mm long.

31. Dryandra quercifolia Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 467 (1856)

Josephia quercifolia (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 4: 307*; holo: NY; iso: BM, CGE, K, MEL.

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 33, t. 44 (1984).

Shrub to 3 m, without lignotuber. Stems hirsute and tomentose. Leaves: petiole to 1 cm long, closely pubescent; lamina obovate to cuneate, 5–9 cm long, 22–50 mm wide, ±truncate, mucronate, glabrous below except in pits; margins undulate, not or slightly recurved, serrate, with 5–15 pungent teeth to 6 mm long each side. Inflorescence terminal; involucral bracts subulate to linear, acute, to 5 cm long, plumose-tomentose; flowers 140–160 per head. Perianth 35–41 mm long, golden, hirsute above base, then appressed-tomentose; limb 8–9 mm long, hirsute. Pistil incurved, 41–52 mm long, yellow, glabrous; pollen presenter narrow, 5–6 mm long, finely ribbed. Follicles up to 14 per head, obliquely obovate, 15–20 mm long, woolly in upper half. Plate 53.

Common on rocky hills near the south coast from the Gairdner R. to East Mt Barren, extending inland to the Ravensthorpe Ra., W.A.–Nov. Grows in laterite and quartzite, in dense kwongan; flowers mainly Aug. Map 312.

W.A.: 10.5 km SSW of Annie Peak, *S.J.Forbes 1081* (MEL); Elverdton, *N.G.Marchant 80/23* (PERTH); E end, Devils Creek Rd, *M.D.Tindale 3835* (PERTH); 25 km S of Ravensthorpe, *D.J.E.Whibley 5389* (PERTH).

Distinguished especially by the broad, dentate leaves and the large inflorescence with prominent brown bracts; flowers sometimes pink-tinged; follicles very loosely attached. Hybridises with *D. cirsioides*, *D. foliosissima* and *D. corvijuga* on Mt Desmond near Ravensthorpe.

32. Dryandra anatona A.S.George, *Nuytsia* 10: 353 (1996)

T: SSE of Mt Magog, Stirling Ra. Natl Park, W.A., 5 Nov. 1986, *A.S.George 16886*; holo: PERTH; iso: CANB.

Shrub to 5 m with 1 main stem and short laterals, without lignotuber. Stems tomentose and hirsute. Leaves: petiole 3–7 mm long, hirsute; lamina cuneate, undulate, 3–7 cm long, 12–22 mm wide, obtuse to acute, mucronate, hirsute and glabrescent above, white-tomentose below; margins recurved, irregularly serrate; teeth 10–12 each side. Inflorescence terminal or on short lateral branchlet; involucral bracts linear-lanceolate, acute to acuminate, 20–25 mm long; outer bracts squarrose, pubescent with hirsute margins; flowers c. 170 per head. Perianth 39–40 mm long, pale yellow, hirsute above base, pubescent distally; limb 5.5–6 mm long, acute, hirsute, with apical hairs coarser. Pistil incurved, 49–50 mm long, pale yellow, glabrous; ovary long-hirsute; pollen presenter narrow above slender neck, 2–3 mm long, ribbed. Follicles obovate, pubescent, 23–24 mm long, hirsute. Fig. 43 I–M.

Known from two localities in the Stirling Range Natl Park, W.A. Grows on slopes, in sandy soil over gravelly shale, in thick kwongan. Listed as 'Endangered' in the ANZECC Threatened Flora List 1997. Flowers Jan. Map 313.

W.A.: SE of Moongoongoonderup Hill, Stirling Range Natl Park, *B.Barnsley 735* (CANB, PERTH).

Remarkable for its tall, spindly habit. Juvenile leaves obovate to cuneate, shortly serrate. Resembles *D. falcata* but more hairy, with long (15–17 mm) floral bracts and a very different fruit. At both localities the populations have been much reduced by *Phytophthora*.

Ser. 8. Dryandra

Dryandra R.Br. ser. **Dryandra**

Type: *D. formosa* R.Br.

Dryandra ser. *Formosae* Benth., *Fl. Austral.* 5: 564, 572 (1870). T: *D. formosa* R.Br.

?*Josephia* § *Dryandra* Kuntze, in T.E. von Post & C.E.O.Kuntze, *Lex. Gen. Phan.* 299 (1903), as *Dryandera*. T: not cited.

Erect shrubs, without lignotuber. Leaves petiolate; lamina broadly linear, pinnatifid or pinnatipartite; margins flat to recurved. Inflorescence terminal or on short lateral branchlet, conspicuous; involucral bracts broad, obtuse, shorter than flowers; receptacle flat. Perianth straight, with limb inflexed before anthesis. Pistil incurved, longer than perianth; pollen presenter narrow, finely ribbed. Flowers soon falling. Follicles several, obovate, usually firmly attached, commonly opening when mature. Seed wing notched.

A series of three species occurring between Eneabba and Albany, south-western W.A.

33. Dryandra formosa R.Br., *Trans. Linn. Soc. London* 10: 213, t. 3 (1810)

Josephia formosa (R.Br.) Kuntze, *Revis. Gen. Pl.* 578 (1891). T: King George Sound, [W.A.], Dec. 1801, *R.Brown Iter Austral. 3419*; holo: BM; iso: K.

Illustrations: M.Morcombe, *Australia's Wildfl.* 97 (1970); R.M.Sainsbury, *Field Guide Dryandra* 45 (1985); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 152 (1989).

Shrub to 4 m, often bushy, without lignotuber. Stems hirsute and tomentose. Leaves: petiole 2–3 mm long; lamina broadly linear, pinnatipartite, 7–16 cm long, 6–11 mm wide, obtuse, mucronate, closely tomentose below, relatively soft; margins recurved; lobes 30–45 each side, ±triangular, acute, curved with lower margin convex. Inflorescence terminal; involucral bracts ovate, obovate or oblong, abruptly narrowed, to 16–20 mm long, obtuse, silky-villous;

floral bracts glabrous; flowers 100–220 per head. Perianth 25–39 mm long, golden orange, loosely crisped-villous above base; claw hirsute; limb 4–5 mm long, long-hirsute. Pistil bowed, 29–55 mm long, yellow, glabrous except long hairs on ovary; pollen presenter narrowly cylindrical, 2–4 mm long, ribbed. Follicles to 16 per head, ±obovate, 11–13 mm long, glabrous. Plate 54; Fig. 43A, B.

Occurs in south-western W.A. from the Whicher Ra. near Busselton to Two Peoples Bay; locally common in the Albany district and the Stirling Ra.; grows in loam, gravelly loam and on granite and metasandstone rocky slopes, in tall kwongan and open forest. Flowers late winter to spring. Map 314.

W.A.: Marine Drive, Albany, *A.R.Fairall 583* (PERTH); Granite Peak, N of Walpole, *A.S.George 11119* (PERTH); Two Peoples Bay, *S.Paust 476* (PERTH); 14 km S of Mount Barker, *R.D.Royce 4237* (PERTH); Red Gum Spring, 10 Oct. 1968, *J.W.Wrigley* (CANB, NSW).

A distinctive species with relatively soft leaves and conspicuous flowers. Pistil commonly 30–40 mm long, but in some Stirling Ra. collections 50–55 mm long. Western populations have small flowers, e.g. Whicher Ra., *A.S.George 11743* (PERTH) — perianth 25–26 mm long, pistil 29–30 mm long, follicles 13–14 mm long; Stewart Rd, S of Nannup, *J.W.Wrigley* (CANB) — pistil 35–36 mm long.

34. Dryandra nobilis Lindl., *Sketch Veg. Swan R.* xxxiii (1840)

Josephia nobilis (Lindl.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: Swan R., W.A., 183-, *J.Drummond s.n.*; neo: K, *fide* A.S.George, *Nuytsia* 10: 354 (1996) (none at CGE).

Shrub to 4 m, without lignotuber. Stems tomentose and hirsute. Leaves: petiole 5–15 mm long, tomentose; lamina broadly linear, pinnatipartite, 8–22 cm long, 5–25 mm wide, acute, mucronate, rather leathery, closely tomentose below; margins slightly recurved; lobes 14–32 each side, triangular, concave. Inflorescence on short lateral branchlet; involucral bracts ovate (inner bracts oblong), to 2 cm long, obtuse, silky-tomentose; floral bracts hirsute or villous; flowers 80–110 per head. Perianth 34–42 mm long, golden or reddish pink, densely curled-tomentose above base with claws shortly hirsute; limb 6.5–7 mm long, hirsute, greenish cream. Pistil bowed, 42–56 mm long, yellow, glabrous; pollen presenter narrowly cylindrical to fusiform, 2.5–4 mm long, ribbed. Follicles to 5 per head, obovate, 16–19 mm long, villous, soon glabrescent.

Occurs between Eneabba and Katanning, W.A. Very similar to *D. stuposa q.v.* There are two subspecies.

Leaf lobes commonly 14–24 each side; lamina 8–25 mm wide; sinuses 6–15 mm across; flowers not scented; perianth golden including limb	**34a.** subsp. **nobilis**
Leaf lobes commonly 20–32 each side; lamina 5–9 mm wide; sinuses 3–7 mm across; flowers strongly and sweetly scented; perianth reddish pink with greenish limb	**34b.** subsp. **fragrans**

34a. Dryandra nobilis Lindl. subsp. **nobilis**

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 34, t. 46 (1984); R.M.Sainsbury, *Field Guide Dryandra* 65 (1985); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 155 (1989).

Leaf lobes commonly 14–24 each side; lamina 8–25 mm wide; sinuses 6–15 mm across. Flowers not scented; perianth golden including limb. Fig. 43D, E.

Occurs between Walebing and Katanning, W.A. Grows on lateritic rises in eucalypt woodland and tall shrubland. Flowers July–Oct. Map 315.

W.A.: c. 3 km E of Katanning, *W.E.Blackall 2980* (PERTH); Narrogin, *R.J.Cranfield 342* (CANB, PERTH); Babilion Hills, Mogumber, *C.A.Gardner 1972* (PERTH); Yornaning Reserve, *B.G.Muir 478(3-1)* (PERTH).

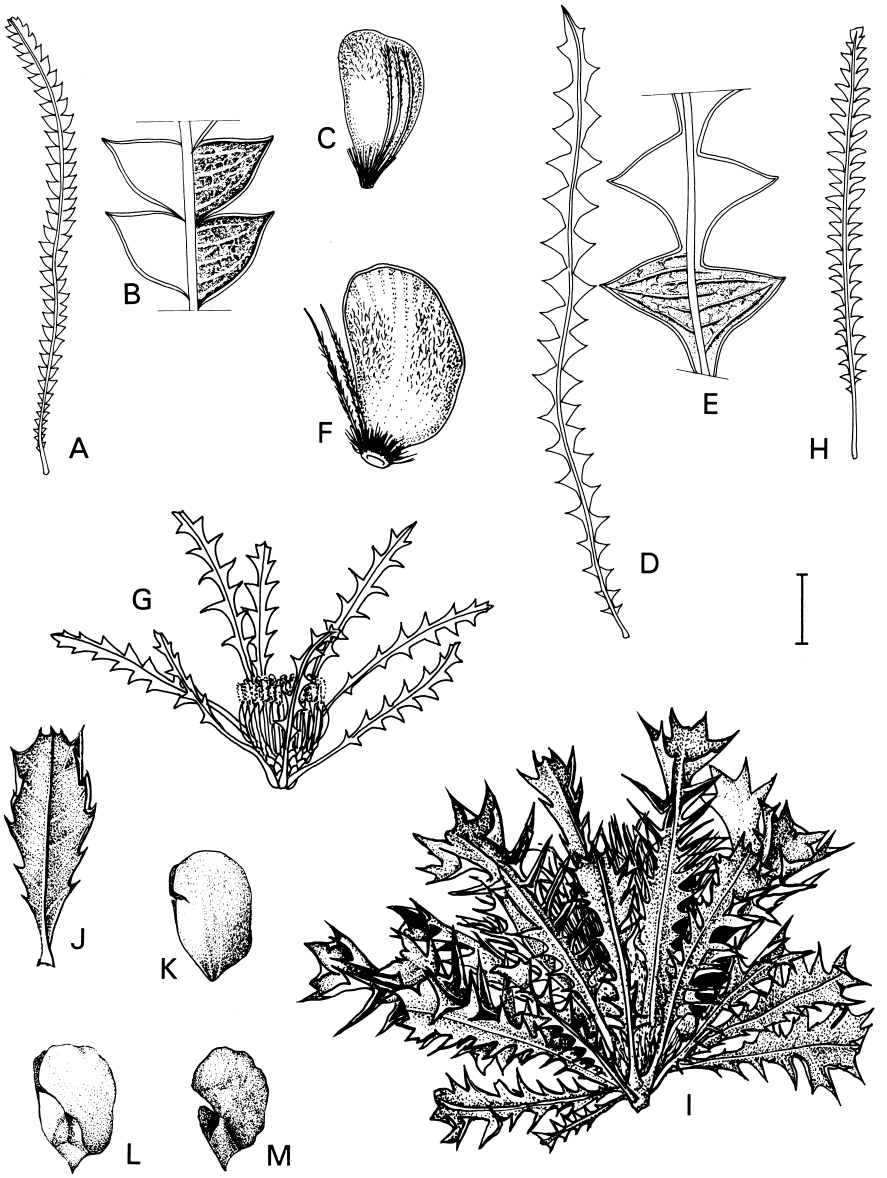


Figure 43. *Dryandra*. **A–B**, *D. formosa*. **A**, leaf; **B**, detail of lower surface of leaf (**A–B**, A.George 11119, PERTH). **C**, *D. praemorsa* var. *splendens*, follicle and subtending bracts (A.George 16613, PERTH). **D–E**, *D. nobilis* subsp. *nobilis*. **D**, leaf; **E**, detail of lower surface of leaf (**D–E**, A.George 9495, PERTH). **F**, *D. nobilis* subsp. *fragrans*, follicle with subtending bracts (A.George 16786, PERTH). **G**, *D. serratuloides* subsp. *serratuloides*, inflorescence and subtending leaves (A.George 16914, PERTH). **H**, *D. serratuloides* subsp. *perissa*, leaf (29 Sept. 1983, A.Popplewell, PERTH). **I–M**, *D. anatona*. **I**, inflorescence and subtending leaves (C.Alcock 471, PERTH); **J**, leaf (A.George 16886, PERTH); **K,** follicle; **L**, separator (plate between seeds); **M**, seed (**K–M**, C.Alcock 247, PERTH). Scale bar: **A, D, H** = 2 cm; **B–C, E–F** = 7 mm; **G, I–J** = 1.4 cm; **K–M** = 1.3 cm. Drawn by: **A–B, D–E,** P.Nikulinsky; **C, F–G**, **H**, P.Dundas; **I–M**, D.Boyer.

34b. Dryandra nobilis subsp. **fragrans** A.S.George, *Nuytsia* 10: 355 (1996)

T: Willis Rd, N of Coorow–Greenhead Rd, W.A., 5 Aug. 1986, *A.S.George 16786*; holo: PERTH; iso: CANB, K, NSW.

Leaf lobes commonly 20–32 each side; lamina 5–9 mm wide; sinuses 3–7 mm across. Flowers strongly and sweetly scented; perianth reddish pink with greenish limb. Fig. 43F.

Occurs between Eneabba and Badgingarra, W.A. Grows on lateritic rises, in thick kwongan. Flowers July–Sept. Map 316.

W.A.: c. 24 km NW of Badgingarra, *A.S.George 6769* (PERTH, NSW); 14.5 km N of Badgingarra, on Brand Hwy, *A.S.George 16824* (PERTH).

Differs from subsp. *nobilis* in having narrower leaves with usually smaller lobes, in the scented flowers and in the perianth being reddish pink with a green limb.

35. Dryandra stuposa Lindl., *Sketch Veg. Swan R.* xxxiii (1840)

Josephia stuposa (Lindl.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891), as *stupposa*. T: Swan R., W.A., 183-, *J.Drummond s.n.*; holo: CGE.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 101 (1985).

Shrub to 3 m, without lignotuber. Stems tomentose and hirsute. Leave: petiole 5–8 mm long, tomentose; lamina broadly linear, pinnatifid, 5–15 cm long, 7–14 mm wide, obtuse to acute, rather leathery, usually bluish, closely tomentose below; margins flat to slightly recurved; lobes 15–30 each side, triangular. Inflorescence terminal or on short lateral branchlet; involucral bracts ovate-lanceolate, to 15 mm long, obtuse, silky-woolly; floral bracts hirsute or villous; flowers 100–130 per head. Perianth 30–40 mm long, golden, densely woolly above base, shortly hirsute on claws; limb 6 mm long, hirsute. Pistil curved, 35–50 mm long, yellow, glabrous; pollen presenter narrowly fusiform, 3–3.5 mm long, ribbed. Follicles obovate, 9–11 mm long, villous, soon glabrescent. Fig. 44E, F.

Occurs between York and Broomehill, south-western W.A. Grows in lateritic soil with mallee-kwongan and eucalypt low open woodland. Flowers mainly summer. Map 317.

W.A.: Boyagin Nature Reserve, *A.S.George 9812* (CANB, PERTH); near Dryandra, *A.S.George 16620* (PERTH); Dryandra, *G.J.Keighery 7341* (PERTH); 13 km W of Broomehill, *R.D.Royce 4805* (PERTH).

Closely related to *D. nobilis* but differs in the much smaller fruit and the usually shorter, less deeply lobed leaves that are distinctly bluish. May be seen in flower at any season but peaks in summer.

Ser. 9. Foliosae

Dryandra ser. **Foliosae** A.S.George, *Nuytsia* 10: 356 (1996)

Type: *D. mucronulata* R.Br.

Mostly erect shrubs, without lignotuber. Leaves petiolate, crowded, linear, pinnatifid; margins recurved to revolute. Inflorescence usually on short lateral branchlet from old stem, concealed, occasionally terminal; involucral bracts c. as long as or slightly shorter than flowers; receptacle convex or flat. Perianth straight to gently curved; limb inflexed before anthesis. Pistil incurved, longer than perianth; pollen presenter narrow, ribbed. Flowers persistent. Follicles large, curved-obovate or obliquely elliptic, firmly attached, usually remaining closed until burnt. Seed wing large, notched.

A series of three species of shrublands and kwongan between Busselton and Ravensthorpe, W.A.

36. Dryandra mucronulata R.Br., *Trans. Linn. Soc. London* 10: 213 (1810)

Josephia mucronulata (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: between Princess Royal Harbour and [West] Cape Howe, [W.A.], Dec. 1801, *R.Brown Iter Austral. 3420*; holo: BM; iso: K, MEL, PERTH.

Shrub to 2 m, without lignotuber. Stems spreading-hirsute and tomentose. Leaves: petiole to 1 cm long; lamina linear, deeply pinnatifid, 15–25 cm long, 4–12 mm wide, obtuse but ±mucronate, closely tomentose below; margins slightly recurved; lobes c. 40–60 each side, ±triangular but usually slightly recurved, mucronate; leaves passing through smaller leaves to involucral bracts. Inflorescence lateral on short branchlet or terminal; involucral bracts oblong, abruptly narrowed, 20–25 mm long, acute, silky, villous or tomentose, striate at apex and inside, pale or rusty brown; flowers 80–110 or 150–180 per head. Perianth 15–20 or 27–30 mm long, pale yellow with greenish limb, curled-villous above base, appressed-pubescent distally; limb 3–4 mm long, appressed-pubescent to hirsute. Pistil curved, 20–25 or 34–38 mm long, cream, often reddish in upper half, glabrous; pollen presenter 1.5–2 mm long, ribbed. Follicles ±curved-ovate or slightly obliquely elliptic, 14–20 mm long, glabrous to sparsely hirsute.

Occurs from Broomehill and Cranbrook through the Stirling Ra. to Albany and Cheyne Beach, W.A. Distinguished from the closely related *D. baxteri* by the broad, abruptly acuminate silky involucral bracts, the smaller flowers and the slightly thickened, ribbed pollen presenter. There are two subspecies.

Leaves 5–12 mm wide; sinuses V-shaped; teeth of leaves subtending inflorescence straight; perianth 15–20 mm long; pistil 20–25 mm long — **36a.** subsp. **mucronulata**

Leaves 4–7 mm wide; sinuses ±U-shaped; teeth of leaves subtending inflorescence often retrorse; perianth 27–30 mm long; pistil 34–38 mm long — **36b.** subsp. **retrorsa**

36a. Dryandra mucronulata R.Br. subsp. **mucronulata**

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 59 (1985); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 155 (1989).

Leaves 5–12 mm wide; teeth of leaves subtending inflorescence straight; sinuses V-shaped, 3–6 mm across. Flowers 80–110 per head. Perianth 15–20 mm long; limb 3 mm long. Pistil 20–25 mm long; pollen presenter 1.5 mm long. Fig. 44G.

Occurs in the western and central parts of the Stirling Range Natl Park and south to Albany and Cheyne Beach, W.A. in the Stirling Ra. it grows in gravelly loam in mallee-kwongan and in rocky shale in tall shrubland, elsewhere in sand in kwongan. Flowers May–July. Map 318.

W.A.: North Point, Two Peoples Bay, *A.S.George 6281* (PERTH); Mt Toolbrunup, *A.S.George 10873* (PERTH); near junction of Salt River Rd and Red Gum Pass, *A.S.George 16656* (PERTH); 60 km NE of Albany on Hassell Hwy, *D.J.E.Whibley 5233* (PERTH).

36b. Dryandra mucronulata subsp. **retrorsa** A.S.George, *Nuytsia* 10: 357 (1996)

T: SW of Cranbrook, W.A., 20 May 1995, *A.S.George 17254*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Leaves 4–7 mm wide; teeth of leaves subtending inflorescence often retrorse; sinuses ±U-shaped, 2–5 mm across. Flowers 150–180 per head. Perianth 27–30 mm long; limb 3.5–4 mm long. Pistil 34–38 mm long; pollen presenter 2 mm long.

Known from 3 localities in south-western W.A.: the type locality; one north-west of Cranbrook (where apparently now extinct); and one south-west of Broomehill (where probably now cleared). Grows in clay in *Eucalyptus wandoo* woodland and in laterite in tall scrub. Flowers July–Aug. Map 319.

W.A.: NW of Cranbrook, *A.S.George 9492* (PERTH); SW of Broomehill, *K.Newbey 709D* (PERTH).

Heads and flowers larger than those of subsp. *mucronulata*, leaves narrower with scalloped margins. A collection labelled King George Sound, July 1858 (MEL), exact locality and collector unknown, is this subspecies with almost all leaf lobes retrorse.

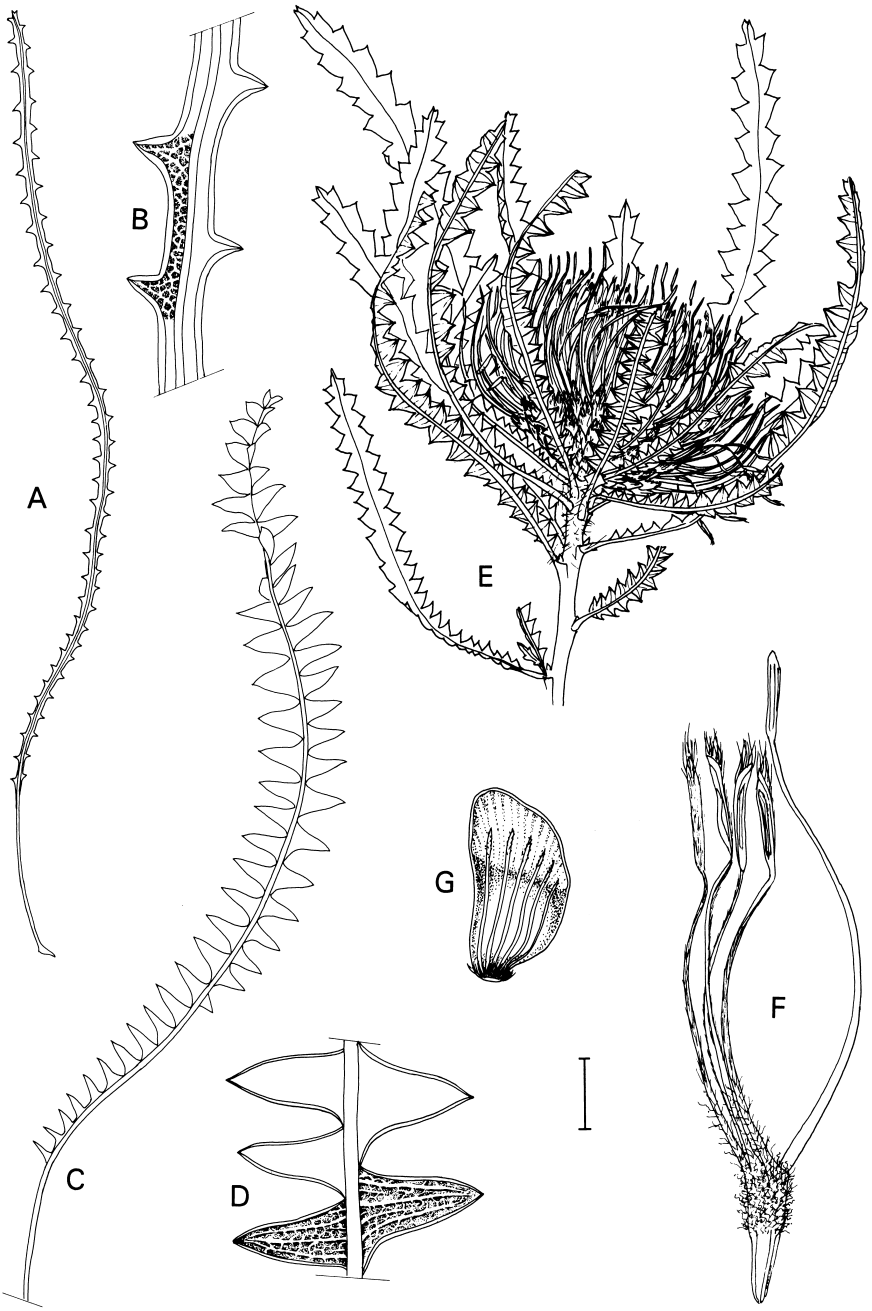


Figure 44. *Dryandra*. **A–B**, *D. foliosissima*. **A**, leaf; **B**, detail of lower surface of leaf (**A–B**, A.George 4430, PERTH). **C–D**, *D. porrecta*. **C**, leaf; **D**, detail of lower surface of leaf (**C–D**, K.Newbey 3009, PERTH). **E–F**, *D. stuposa*. **E**, inflorescence and subtending leaves; **F**, flower (**E–F**, A.George 9353, PERTH). **G**, *D. mucronulata* subsp. *mucronulata*, follicle with subtending bracts (A.George 16656, PERTH). Scale bar: **A**, **C** = 2 cm; **B** = 3 mm; **D, G** = 7 mm; **E** = 1.4 cm; **F** = 5 mm. Drawn by: **A–F**, P.Nikulinsky; **G**, P.Dundas.

37. Dryandra baxteri R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 38 (1830)

Josephia baxteri (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: near King George Sound, [W.A.], 1823, *W.Baxter*; holo: BM; iso: K, MEL; possible iso: PERTH.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 11 (1985).

Shrub to 2.5 m, without lignotuber. Stems hirsute and tomentose. Leaves: petiole to 1.5 mm long with a thick base, hirsute; lamina linear, deeply pinnatifid, 15–35 cm long, 4–6 mm wide, obtuse to emarginate, tomentose below including midrib; margins revolute; lobes 60–110 each side, triangular. Inflorescence on short lateral branchlet; involucral bracts lanceolate, to 25 mm long, acuminate, silky-villous, pale to dark brown; flowers 150–200 per head. Perianth 25–27 mm long, golden, curled-villous above base, appressed-silky distally, with a few long apical hairs; limb 4 mm long, purple-brown. Pistil incurved, 28–30 mm long, cream, glabrous except hairs on ovary; pollen presenter narrow, 2.5 mm long, ribbed. Follicles curved-obovate, 15 mm long, sparsely pubescent.

Occurs near Busselton, and from the Stirling Ra. to Albany, W.A., in scattered populations; grows in gravelly soil in eucalypt woodland and in rocky soil in montane kwongan. Flowers autumn. Map 320.

W.A.: Mt Success, Stirling Ra., *G.J.Keighery 2270* (PERTH); 14 km N of Albany, *K.Newbey 2482* (PERTH); Tutunup, 26 Apr. 1969, *E.Wittwer* (PERTH).

Very similar to *D. mucronulata q.v.* May be recognised by the bushy habit, finely lobed leaves and narrow, densely villous involucral bracts. in the Whicher Ra. flowers are golden throughout.

38. Dryandra foliosissima C.A.Gardner, *J. Roy. Soc. W. Australia* 47: 58 (1964)

T: Mt Desmond, near Ravensthorpe, W.A., 19 Oct. 1960, *C.A.Gardner 12886*; syn: PERTH.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 43 (1985).

Shrub 1 m, without lignotuber. Stems closely tomentose, with prophylls. Leaves crowded; petiole to 4 cm long; lamina narrowly linear, pinnatifid, 15–27 cm long, 4–8 mm wide, acute, closely tomentose below; margins strongly recurved; teeth 25–45 each side, triangular. Inflorescence sessile or on short branchlet; involucral bracts oblong to lanceolate, to 30 mm long, acute, tomentose or villous with hirsute margins, dark brown; flowers 90–100 per head. Perianth 27–30 mm long, golden, crisped-tomentose above base and claws appressed-pubescent; limb 5–6 mm long, shortly silky. Pistil incurved, 30–40 mm long, cream, glabrous except for long hairs on ovary; pollen presenter narrowly fusiform, 2–2.5 mm long, ribbed. Follicles up to 6, obovate, ±truncate, 18–21 mm long, tomentose. Fig. 44A, B.

Occurs in two disjunct areas of south-western W.A., one about Tarin Rock, the other the Ravensthorpe district. Grows in lateritic soil in dense kwongan. Flowers winter. Map 321.

W.A.: 31 km W of Lake Grace, *A.S.George 16706* (CANB, K, PERTH); Ravensthorpe Ra., 5 km NE of Ravensthorpe, *K.Newbey 8274* (PERTH).

May be recognised by the dense habit, narrow leaves with small teeth and broad sinuses, golden flowers and large, tomentose, firmly attached follicles. Hybridises with *D. quercifolia q.v.*

Ser. 10. Decurrentes

Dryandra ser. **Decurrentes** (Meisn.) A.S.George, *Nuytsia* 10: 357 (1996)

Dryandra § *Decurrentes* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 476 (1856). T: *D. comosa* Meisn.

Bushy shrubs, without lignotuber. Leaves petiolate; lamina linear, sparsely serrate; margins revolute. Inflorescence sessile or on short branchlet, on older stem; involucral bracts as long as or exceeding flowers, shining; receptacle gently convex. Perianth straight; limb often inflexed before anthesis. Pistil incurved, longer than perianth; pollen presenter small, narrow,

ribbed. Flowers persistent. Follicles broadly obovate, fairly firmly attached, usually remaining closed until burnt. Seed wing notched.

A monotypic series, confined to the Wongan Hills district, W.A.

39. Dryandra comosa Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 478 (1856)

Josephia comosa (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 4: 313*; syn: CGE, K, MEL, PERTH.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 22 (1985).

Dense bushy shrub to 3 m, without lignotuber. Stems appressed-tomentose. Leaves: petiole to 2 cm long; lamina linear, often flexuose, 10–35 cm long, 4–8 mm wide, acute to obtuse, white-tomentose below; margins revolute, distantly serrate; teeth 8–15 each side, narrowly triangular, acute, recurved, pungent, to 3 mm long. Inflorescence sessile or on short branchlet on older stem; involucral bracts lanceolate to oblong and spathulate, to 35 mm long, acute to obtuse, dark red-brown; outer bracts sparsely pubescent; inner bracts pubescent towards base, then glabrous except hairy margins; flowers 110–150 per head. Perianth 25–27 mm long, yellow, hirsute at base with claws appressed-pubescent; limb 5–6 mm long, silky-pubescent. Pistil incurved, 27–29 mm long, cream, hirsute in lower third; pollen presenter narrow, 2.8–3 mm long, ribbed, green. Follicles several, broadly obovate, 11–15 mm long, glabrous except a few hairs towards base. Plate 55; Fig. 45J.

A rare species known only from the Wongan Hills, W.A. Grows in lateritic soil in mallee-kwongan. Flowers Aug.–Oct. Map 322.

W.A.: Mt O'Brien, *A.S.George 16765* (AD, CANB, K, MEL, NSW, PERTH); c. 15 km N of Wongan Hills township, *K.F.Kenneally 7455* (PERTH); c. 8 km NW of Wongan Hills township, 17 Sept. 1963, *J.H.Willis & R.Erickson* (MEL).

Distinguished by the long, narrow leaves with few short curved teeth and the small but many-flowered inflorescence with broad brown involucral bracts. Flowers strongly scented like bad honey. Indumentum appressed in new growth.

Ser. 11. Tenuifoliae

Dryandra ser. **Tenuifoliae** A.S.George, *Nuytsia* 10: 358 (1996)

Type: *D. tenuifolia* R.Br.

Erect or prostrate shrubs, without lignotuber. Leaves petiolate; lamina linear, pinnatifid, serrate or entire; margins revolute. Inflorescence on short lateral branchlet or terminal; involucral bracts longer than flowers, shining; receptacle convex. Perianth straight; limb erect. Pistil straight or gently incurved, shorter or longer than perianth; pollen presenter not thickened, ribbed. Flowers persistent. Follicles obovate, glabrous or pubescent but glabrescent, loosely attached, opening when burnt. Seed wing entire or notched.

A series with two species widespread between Arthur R. and Esperance, W.A. Differs from ser. *Decurrentes* in having the pistil shorter than the perianth, and from ser. *Runcinatae* in the non-succulent perianth. The petiole of *D. tenuifolia* is remarkably slender, 0.1–0.2 mm wide. *Dryandra obtusa* has a more robust follicle than *D. tenuifolia* and a notched seed wing and perhaps does not belong in this series.

40. Dryandra tenuifolia R.Br., *Trans. Linn. Soc. London* 10: 215 (1810)

Josephia tenuifolia (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: Bay I [Lucky Bay, W.A.], Jan. 1802, *R.Brown Iter Austral. 3425*; holo: BM; iso: K, MEL.

Dryandra uncata Cunn. ex Lehm., *Pl. Preiss.* 1: 597 (1845), *nom. inval.* – in synonymy under *D. tenuifolia*.

Shrub, without lignotuber, either mat-like to 3 m diam. or bushy to 1.5 m tall. Stems appressed-pubescent, glabrescent. Leaves with slender petiole to 5 cm long; lamina linear,

pinnatifid or serrate to entire, flexuose, 6–26 cm long, 2–5 mm wide, obtuse to mucronate, white-tomentose below; margins revolute; teeth if present up to 20 each side, curved-triangular with decurrent base, obtuse to acute. Inflorescence on short lateral branchlet; involucral bracts ovate to oblong, obtuse, to 4–4.5 cm long, appressed-pubescent; outer bracts ±glabrous, red-brown; flowers 45–65 per head. Perianth 27–33 mm long, golden brown, villous above base, becoming tomentose or glabrous distally; claws filiform; limb 5–6 mm long, glabrous. Pistil gently curved to straight, 23–31 mm long, cream, glabrous; pollen presenter not thickened, 3–3.5 mm long, ribbed, green. Follicles obovate, 14–17 mm long, glabrous.

Widespread in southern W.A. from near Darkan and the Beaufort R. (south of Williams) to Cape Arid, east of Esperance. There are two varieties.

Plant bushy, erect to spreading; leaves pinnatifid to serrate for all or most of their length — **40a.** var. **tenuifolia**

Plant mat-like or procumbent; leaves entire, or serrate only in upper part — **40b.** var. **reptans**

40a. Dryandra tenuifolia R.Br. var. **tenuifolia**

Dryandra elegans Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 473 (1856); *D. tenuifolia* var. *elegans* (Meisn.) Benth., *Fl. Austral.* 5: 582 (1870). T: south-western W.A., 1840s, *J.Drummond 4: 317*; holo: NY; iso: BM, CGE, K, MEL.

Plant bushy, to 1.5 m tall; branches erect or spreading. Leaves pinnatifid or serrate for all or most of their length. Plate 56.

Occurs from Kamballup to Cape Arid, including parts of the Stirling Ra., W.A. Grows in sand over gravel, clay-loam and gravel, in kwongan, often with emergent mallees. Flowers Mar.–June. Map 323.

W.A.: Boyatup Hill, *M.A.Clements 2065* (CANB); c. 40 km S of Ravensthorpe, *H.Demarz 144* (PERTH); near Point Irby, Beaufort Inlet, *A.S.George 6152* (PERTH).

Some collections are intermediate between the varieties.

40b. Dryandra tenuifolia var. **reptans** A.S.George, *Nuytsia* 10: 359 (1996)

T: c. 54 km S of Williams, W.A., 28 July 1953, *R.Melville 4359 & R.D.Royce*; holo: PERTH; iso: HO, K, MEL, NSW.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 107 (1985), as *D. tenuifolia*.

Plant mat-like or procumbent, to 3 m diam. Leaves entire, or serrate only in upper part.

Occurs from near Darkan and the Beaufort R. to Jerramungup, with an outlier farther east towards Ravensthorpe, W.A. Grows in sand over clay or laterite, in kwongan with emergent mallees. Flowers July. Map 324.

W.A.: Toompup Rd, 6.1 km S of Gnowangerup–Ongerup road, *A.S.George 16676* (PERTH); c. 16 km E of Ongerup, *K.Newbey 881* (PERTH); c. 28 km W of Ravensthorpe and 12 km N of the Ravensthorpe–Ongerup road, *P.G.Wilson 7130* (PERTH).

41. Dryandra obtusa R.Br., *Trans. Linn. Soc. London* 10: 214 (1810)

Josephia obtusa (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: Lucky Bay, [W.A.], Jan. 1802, *R.Brown Iter Austral. 3422*; holo: BM; iso: K.

Dryandra multiserialis F.Muell., *Fragm.* 5: 185 (1866). T: near Cape le Grand, W.A., *G.Maxwell*; lecto: MEL, *fide* A.S.George, *Nuytsia* 10: 360 (1996).

Illustrations: R.M.Sainsbury, *Field Guide Dryandra* 67 (1985); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 155 (1989).

Shrub with underground stems forming open tufts to 60 cm diam., without lignotuber. Stems with triangular, thickened prophylls. Leaves: petiole robust, 2–4 cm long, glabrescent; lamina erect, broadly linear, pinnatifid, 15–30 cm long, 6–17 mm wide, obtuse but mucronate, tomentose below; midrib prominent; margins revolute, with 30–60 lobes each

side; lobes triangular, obtuse. Inflorescence terminal, usually subtended by several leaves; involucral bracts ovate to oblong, to 45 mm long, obtuse, dark red-brown, shining, ±glabrous except pubescent to hirsute margins; flowers 55–70 per head. Perianth 26–30 mm long, pale yellow-green, sparsely pubescent-hirsute; limb 6–7.5 mm long, glabrous or appressed-pubescent. Pistil gently curved to straight, 35–38 mm long, cream, sparsely pubescent in lower half, glabrous distally; pollen presenter not thickened, 5–5.5 mm long, ribbed. Follicles ±obovate, 18 mm long, pubescent, glabrescent, shining.

Occurs from the Fitzgerald River Natl Park east almost to Israelite Bay and Mt Ragged, W.A., growing in sand and sandy loam in kwongan and mallee shrubland. Flowers Sept.–Nov. Map 325.

W.A.: Middle Mt Barren, *W.E.Blackall 1897* (PERTH); Mt Ragged turnoff, E of Boyatup, *A.S.George 15978* (PERTH); c. 3 km NE of Howick Hill, *A.E.Orchard 1119* (CANB); c. 5 km N of Gibson, *R.D.Royce 3583* (PERTH); c. 11 km S of Ravensthorpe, *E.Wittwer 446* (PERTH).

Recognised by the small obtuse leaf lobes, large shining involucral bracts with pubescent margins and large pubescent follicle. Placed in ser. *Tenuifoliae* but may form a link with ser. *Runcinatae* since it resembles *D. ferruginea* but is smaller in all respects and the perianth is not succulent.

Ser. 12. Runcinatae

Dryandra ser. **Runcinatae** (Meisn.) A.S.George, *Nuytsia* 10: 360 (1996)

Dryandra § *Runcinatae* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 468 (1856). T: *D. runcinata* Meisn. = *D. ferruginea* Kippist ex Meisn. subsp. *ferruginea*

Small erect or prostrate shrubs, with or without lignotuber. Leaves large, petiolate; lamina linear, pinnatipartite, pinnatifid or serrate; margins recurved to revolute. Inflorescence terminal or axillary, often on older stems, sessile or on short branchlet; involucral bracts as long as or longer than flowers, usually broadly linear, red-brown and commonly shining; receptacle convex. Perianth straight, swollen and succulent for a short distance above base; limb large, erect. Pistil incurved or straight, longer than perianth; pollen presenter narrow, ribbed. Flowers persistent. Follicles obovate or elliptic with notch above base, shining, usually remaining closed until burnt. Seed wing notched or entire.

A series of four species, widespread from Toodyay south to the Stirling Ra. and east to Forrestania and Raventhorpe, W.A. The large leaves, large heads with prominent brown bracts and perianths with succulent, swollen lower claws characterise this series.

42. Dryandra ferruginea Kippist ex Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 123 (1855)

Dryandra proteoides Lindl. var. *ferruginea* (Kippist ex Meisn.) Benth., *Fl. Austral.* 5: 582 (1870). T: south-western W.A., 1840s, *J.Drummond 5: 416*; syn: BM, CGE, K, NY.

Shrub prostrate or to 1 m, with or without lignotuber. Stems short, divaricate, tomentose, often covered with imbricate prophylls. Leaves: petiole up to 15 cm long, glabrescent; lamina broadly linear, pinnatifid or pinnatipartite, 8–35 cm long, 7–30 (–45) mm wide, acute, mucronate, rusty-tomentose when young; lobes 5–20 each side, at 60°–90°, triangular or linear, sometimes falcate, acute, pungent; margins recurved to revolute. Inflorescence sessile, axillary or on very short lateral branchlet with imbricate bracts but no floral leaves; involucral bracts ovate to oblong, 35–66 mm long, obtuse; outermost bracts often recurved, glabrous with villous margins or appressed-pubescent to hirsute in upper part, rich brown; flowers 40–115 per head. Perianth 27–50 mm long, succulent above base, cream and yellow; claws appressed-pubescent; limb 7–15 mm long, silky. Pistil gently curved, 30–66 mm long, cream, sparsely hirsute at base, glabrous above; pollen presenter scarcely thickened above narrow neck, 4–9 mm long, finely ribbed. Follicles obovate, 12–15 mm long, glabrous, striate.

Widespread and often locally common from near Pingelly to the Stirling Ra. and east to Forrestania, W.A. A variable species here divided into six subspecies.

Figure 45. *Dryandra*. **A–B**, *D. ferruginea* subsp. *flavescens*. **A**, inflorescence (in section); **B**, leaves (**A–B**, A.George 16727, PERTH). **C**, *D. ferruginea* subsp. *tutanningensis*, leaf (A.George 6443, PERTH). **D**, *D. ferruginea* subsp. *chelomacarpa*, leaf (K.Newbey 1839, PERTH). **E–F**, *D. ferruginea* subsp. *pumila*. **E**, leaf; **F**, detail of lower surface of leaf (**E–F**, C.Alcock 472, PERTH). **G–I**, *D. ferruginea* subsp. *obliquiloba*. **G**, leaf; **H**, detail of lower surface of leaf; **I**, follicle (**G–I**, A.George 16751, PERTH). **J**, *D. comosa*, follicle (A.George 16765, PERTH). Scale bar: **A–E** = 2 cm; **F, H–J** = 7 mm; **G** = 3 cm. Drawn by: **A–B**, D.Boyer; **C–J**, P.Dundas.

1 Stems erect

2 Leaf lobes at c. 70°–90°

3 Pistil 50–66 mm long; involucral bracts 50–66 mm long (SE of Pingelly) **42b.** subsp. **tutanningensis**

3: Pistil 30–45 (–50) mm long; involucral bracts 30–50 mm long, rarely longer

4 Leaf lamina 15–35 cm long, 10–28 (–40) mm wide; margins revolute (Wickepin to Nyabing and Lake Grace) **42a.** subsp. **ferruginea**

4: Leaf lamina 8–15 cm long, 18–35 mm wide; margins almost flat (Stirling Ra.) **42c.** subsp. **pumila**

2: Leaf lobes ascending at c. 60°–70° (Corrigin) **42d.** subsp. **obliquiloba**

1: Stems prostrate

5 Leaves 20–45 mm wide; lobes usually falcate, sometimes reflexed (Newdegate–Ravensthorpe) **42e.** subsp. **chelomacarpa**

5: Leaves 7–15 mm wide; lobes triangular, at c. 90° (E of Lake King) **42f.** subsp. **flavescens**

42a. Dryandra ferruginea Kippist ex Meisn. subsp. **ferruginea**

Dryandra runcinata Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 469 (1856); *Josephia runcinata* (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 4: 318*; holo: NY; iso: BM, K, MEL, PERTH.

Illustrations: M.Morcombe, *Australia's Wildfl.* 106 (1970), as *D. runcinata*; J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 138 (1989).

Bushy shrub to 70 cm, without lignotuber. Leaves: petiole 5–15 cm long; lamina 15–35 cm long, 10–28 (–40) mm wide; margins moderately revolute; lobes 5–10 each side, at 80°–90°, triangular, acute. Involucral bracts 38–50 mm long; floral bracts 8–11 mm long. Perianth 35–40 (–50) mm long. Pistil 38–43 (–48) mm long. Follicles 12–13 mm long.

Occurs from Wickepin and Kulin to Nyabing and east to Lake Grace, W.A. Grows in sandy loam over lateritic gravel in kwongan. Flowers Sept.–Oct. Map 326.

W.A.: c. 8 km E of Kukerin, *J.S.Beard 2137* (PERTH); 16 km SE of Kulin, *R.J.Hnatiuk 780037* (PERTH); c. 3 km N of Nyabing, *K.Newbey 427* (PERTH); c. 21 km W of Newdegate, 8 Nov. 1968, *J.W.Wrigley* (CANB).

Very variable in size of heads and flowers and in indumentum of involucral bracts, some being quite hairy, others almost glabrous except at tips and margins. *Newbey 3044*, 1 km W of Tarin Rock (PERTH), has leaves with few or no leaf lobes but is otherwise typical. Flowers rarely pale with cream and brown involucral bracts. Three collections (e.g. *A.S.George 16699*, N of Nyabing, PERTH) have large heads and flowers as in subsp. *tutanningensis* but leaves of subsp. *ferruginea*; these populations require further study. A hybrid with *D. preissii* (*q.v.*) has been recorded.

42b. Dryandra ferruginea subsp. **tutanningensis** A.S.George, *Nuytsia* 10: 361 (1996)

T: Tutanning Nature Reserve, SE of Pingelly, W.A., 7 Oct. 1973, *A.S.George 11713*; holo: PERTH; iso: CANB, K, NSW.

Bushy shrub to 1 m, without lignotuber. Leaves: petiole 3–10 cm long; lamina 15–35 cm long, 15–27 mm wide; margins shortly recurved; lobes 15–20 each side, triangular to broadly so, acute, at 80°–90° but lower margin at more acute angle than upper. Involucral bracts 50–66 mm long; floral bracts 9–10 mm long. Perianth 45–50 mm long; limb 14–15 mm long. Pistil 50–66 mm long; pollen presenter 8–9 mm long. Follicles obovate, 13–16 mm long. Fig. 45C.

Restricted to Tutanning Nature Reserve, SE of Pingelly, W.A., but there locally common. Grows in massive laterite with *Eucalyptus accedens* and thick scrub. Flowers Oct. Map 327.

W.A.: Tutanning Reserve, *G.Heinsohn 25* (PERTH).

Distinguished by the large leaves and inflorescence. Leaf lobes more numerous and wider and with less recurved margins than in subsp. *ferruginea*.

42c. Dryandra ferruginea subsp. **pumila** A.S.George, *Nuytsia* 10: 362 (1996)

T: scenic lookout between Mt Talyuberlup and Mt Magog picnic sites, Stirling Ra. Scenic Drive, W.A., 28 Sept. 1986, *K.Alcock 472*; holo: PERTH; iso: MEL.

Shrub to 30 cm tall, without lignotuber. Leaves: petiole 3–5 cm long; lamina 8–15 cm long, 18–35 mm wide; margins shortly recurved; lobes 8–12 each side, at c. 70°–80°, triangular, acute. Involucral bracts 45–50 mm long; floral bracts 7 mm long. Perianth 27–32 mm long; limb 9 mm long. Pistil 36–38 mm long; pollen presenter 6 mm long. Follicles broadly obovate with slight basal notch, 15 mm long. Fig. 45E, F.

Endemic in the Stirling Range Natl Park, W.A., known from two populations. Grows on rocky shale slopes in low open kwongan and mallee-kwongan. Flowers Sept.–Oct. Map 328.

W.A.: NW slope of Little Mondurup, *G.J.Keighery 9190* (PERTH).

Essentially smaller in habit than subsp. *ferruginea*, the leaves shorter, usually with narrower sinuses and the margins less recurved.

42d. Dryandra ferruginea subsp. **obliquiloba** A.S.George, *Nuytsia* 10: 363 (1996)

T: reserve by Scenic Lookout, c. 2 km W of Corrigin, W.A., 8 Oct. 1994, *A.S.George 17224*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Bushy shrub to 1 m, without lignotuber. Leaves: petiole 10–15 cm long, lamina pinnatipartite, 10–30 cm long, 20–40 mm wide; margins scarcely recurved; lobes 10–17 each side, at 60°–70°, linear to narrowly triangular, acute. Involucral bracts 40–45 mm long; flowers 90–115 per head; floral bracts 4–5 mm long. Perianth 30–34 mm long; limb 8–9.5 mm long. Pistil 35–42 mm long; pollen presenter 5–7 mm long. Follicles broadly obovate, 13–14 mm long. Fig. 45G–I.

Occurs in the Corrigin area, W.A., in lateritic gravel in dense kwongan. Flowers Sept.–Oct. Map 329.

W.A.: 1.5 km E of Dudinin on Kulin Rd, *K.Alcock 484* (MEL); Middleton Rd, S of Corrigin, *A.S.George 17228* (AD, BRI, PERTH); c. 4 km W of Corrigin, *R.Spjut et al. 7362* (PERTH).

Typically has longer, narrower leaf lobes than the other subspecies.

42e. Dryandra ferruginea subsp. **chelomacarpa** A.S.George, *Nuytsia* 10: 363 (1996)

T: Creek Rd, off Old Ravensthorpe [–Newdegate] Rd, W.A., 31 July 1986, *A.S.George 16714*; holo: PERTH; iso: CANB, NSW.

Shrub with underground prostrate stems, to 1 m diam., with? lignotuber. Leaves: petiole 3–6 cm long; lamina pinnatipartite, 15–20 cm long, 20–45 mm wide; margins shortly recurved; lobes 10–15 each side, narrowly triangular, commonly falcate, sometimes reflexed, at 80°–90°, acute, pungent. Involucral bracts 30–40 mm long; flowers 40–65 per head; floral bracts 7 mm long. Perianth 32–35 mm long, yellow; limb 9–11 mm long. Pistil 35–45 mm long; pollen presenter 4–8 mm long. Follicles obovate, with prominent basal notch, 15 mm long. Fig. 45D.

Occurs between Newdegate and Ravensthorpe, W.A. Grows in sandy loam over gravel, in low kwongan. Flowers July–Sept. Map 330.

W.A.: c. 16 km W of Lake King, *K.Newbey 1839* (PERTH); S of Newdegate, *M.Pieroni 11* (MEL, PERTH).

Distinguished by the prostrate stems; leaf lobes much longer than in subsp. *flavescens*.

42f. Dryandra ferruginea subsp. **flavescens** A.S.George, *Nuytsia* 10: 364 (1996)

T: E of Lake King crossroads, W.A., 31 July 1986, *A.S.George 16727*; holo: PERTH; iso: CANB, PERTH.

Shrub with prostrate stems, sometimes underground, to 1 m diam., with? lignotuber. Leaves: petiole 3–6 mm long; lamina pinnatifid, 12–30 cm long, 7–15 (–25) mm wide; margins strongly revolute; lobes 5–20 each side, triangular, acute, pungent, at c. 90°. Involucral bracts 45–55 mm long; flowers c. 75 per head; floral bracts 5–9 mm long. Perianth 31–40 mm long, pale yellow, cream at base; limb 7–8.5 mm long, sparsely hirsute to almost glabrous, greenish. Pistil 43–50 mm long; pollen presenter 4.5–6 mm long. Follicles obovate, with prominent basal notch, 15 mm long. Fig. 45A, B.

Occurs to the east of Lake King, including the western part of Frank Hann Natl Park, and north to Forrestania, W.A. Grows in sandy loam with some gravel, in low kwongan. Flowers Aug. Map 331.

W.A.: 33 km E of Forrestania crossroads, *J.M.Brown 215* (PERTH); 9 km S of Mt Gibbs, *K.Newbey 5432* (PERTH); Jackson Nature Reserve, 13 July 1993, *D.Plumb* (PERTH).

Leaves drying yellowish, with much smaller lobes than in subsp. *chelomacarpa*.

43. Dryandra corvijuga A.S.George, *Nuytsia* 10: 365 (1996)

T: Mt Short, N of Ravensthorpe, W.A., 2 Oct. 1986, *K.Alcock 494*; holo: PERTH; iso: CANB, MEL.

Shrub to 1.3 m, without lignotuber, densely leaved. Leaves with slender petiole, 2–6 cm long; lamina broadly linear, 10–20 cm long, 5–13 mm wide, acute, serrate; margins revolute; teeth 10–25 each side, triangular, oblique, acute, pungent. Inflorescence on short lateral branchlet; involucral bracts ovate (outer) to broadly linear (inner), 4–5 cm long, obtuse, appressed-pubescent, shining dark red-brown; flowers c. 60 per head. Perianth 38–41 mm long, yellow, succulent and shortly hirsute above base, glabrous distally; limb 7–9 mm long, loosely hirsute. Pistil 44–46 mm long, yellow, glabrous; pollen presenter narrow, 5–6 mm long, ribbed. Follicles elliptic-obovate, 15 mm long, glabrous. Fig. 46A, B.

Occurs in the Ravensthorpe Ra., W.A. Grows in lateritic gravel, in mallee-kwongan. Flowers Sept.–Oct. Map 332.

W.A.: Elverdton, *A.S.George 1641* (PERTH); Mt Short, *A.S.George 16721* (NSW, PERTH).

Distinguished by the erect, densely leaved habit and shortly serrate leaves. Hybridises with *D. quercifolia q.v.*

44. Dryandra epimicta A.S.George, *Nuytsia* 10: 365 (1996)

T: Hopkins Reserve, SE of Kulin, W.A., 4 Sept. 1986, *M.Pieroni s.n.*; holo: PERTH.

Shrub with prostrate stems, with lignotuber. Stems ±on surface, tomentose, with broadly linear prophylls at base of annual growth. Leaves crowded; petiole to 3 cm long; lamina erect, linear, pinnatifid, 11–33 cm long, 7–14 mm wide, acute, pungent, white-tomentose below; margins revolute; lobes 10–35 each side, broadly falcate, to 6 mm long, pungent, with upper margin less prominent than lower. Inflorescence terminal, ascending; involucral bracts ovate to broadly linear, to 8–9 cm long, acute, appressed-pubescent, dull brown; flowers c. 45–70 per head. Perianth 43–52 mm long, creamy white with pale yellow limb, succulent and curled-villous above base, glabrous distally; limb 7–8 mm long, sparsely hirsute to glabrous. Pistil gently curved, 45–58 mm long, cream, pubescent above base; pollen presenter narrow, 4–5 mm long, ribbed. Follicles several, ±unilaterally obovate with constricted base, 18–19 mm long, almost glabrous, striate. Plate 57.

Known from only three sites in a nature reserve south-east of Kulin, W.A., with a total of c. 100 plants. Grows in sandy loam in low kwongan and tall open shrubland. Flowers late Aug.–Sept. Map 333.

W.A.: Hopkins Reserve, SE of Kulin, *A.S.George 17232* (CANB, PERTH).

A distinctive species in its prostrate habit, large conflorescence with acuminate, ±soft, mid-brown involucral bracts and unpleasantly scented flowers.

45. Dryandra proteoides Lindl., *Sketch Veg. Swan R.* xxxiii (1840)

Josephia proteoides (Lindl.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891), as *proteodes*. T: south-western W.A., 183-, *J.Drummond s.n.*; neo: K, *fide* A.S.George, *Nuytsia* 10: 366 (1996); isoneo: K.

Illustrations: M.Morcombe, *Australia's Wildfl.* 100, 108 (1970); R.M.Sainsbury, *Field Guide Dryandra* 77 (1985).

Shrub to 2 m, without lignotuber, much-branched. Leaves crowded; petiole 2–5 mm long; lamina broadly linear, 20–26 cm long, 10–20 mm wide, pungent; margins recurved, serrate; lobes 5–20 each side, triangular with decurrent base, pungent. Inflorescence on short lateral branchlet covered with scale-like bracts, concealed; involucral bracts broadly ovate to oblong, 50–75 mm long, obtuse or acute, appressed-pubescent below apex and on upper margins, otherwise glabrous, shining dark red-brown; flowers 70–120 per head, not scented. Perianth 40–50 mm long, pale yellow, succulent and curled-hirsute above base, glabrous distally; limb 8 mm long, glabrous. Pistil incurved to ±straight, 42–60 mm long, cream, glabrous; pollen presenter scarcely thickened, 5–7 mm long, finely ribbed, green. Follicles obovate with narrow base, 22–24 mm long, glabrous, dark brown, shining.

Occurs from near Toodyay to Dryandra State Forest, W.A. Grows on lateritic slopes in Wandoo or Powderbark low woodland. Flowers June–Aug. Map 334.

W.A.: Tutanning Nature Reserve, *A.S.George 7785* (PERTH); 18 km W of Pingelly, *K.Newbey 1934* (PERTH); c. 10 km W of Narrogin, *S.Paust 1122* (PERTH).

Recognised by the bushy habit, pungently serrate leaves and concealed, very large inflorescences.

Ser. 13. Triangulares

Dryandra ser. **Triangulares** A.S.George, *Nuytsia* 10: 366 (1996)

Type: *D. drummondii* Meisn.

Small erect shrubs, usually densely leaved, without lignotuber. Leaves petiolate, large; lamina pinnatisect with large ±triangular lobes; margins flat to slightly recurved. Inflorescence on short lateral branchlet or terminal; involucral bracts shorter than flowers, usually narrow on thick base, hairy; receptacle gently convex. Perianth straight with large erect quadrangular limb. Pistil incurved, longer than perianth or that of central flowers about as long; pollen presenter narrow, ribbed. Flowers soon falling. Follicles elliptic to broadly obovate or almost orbicular, usually remaining closed until burnt. Seed wing entire.

A series of three species from south-western W.A. Although the heads are large as in ser. *Runcinatae*, the involucral bracts are much smaller and more hairy and the perianth is not succulent above the base.

46. Dryandra drummondii Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 2: 267 (1848)

T: south-western W.A., 1840s, *J.Drummond 3: 299*; syn: BM, K, MEL.

Shrub to 1.5 m tall, without lignotuber. Stems erect, with appressed, lanceolate, villous prophylls. Leaves: petiole 5–15 cm long; lamina pinnatifid to pinnatisect, 15–90 cm long, 2.5–7.5 cm wide, rusty-tomentose, glabrescent except pits in lower surface; margins slightly recurved; lobes 10–22 each side, triangular to oblong, with margins curved in to obtuse apex and in lower ⅛–¼ to sinus, somewhat twisted so that upper surface is uppermost, prominently nerved below, bluish green above. Inflorescence terminal, with a few lanceolate, entire or pinnatifid leaf-like bracts 5–7 cm long around involucre; involucral bracts ovate-lanceolate, to 15 mm long, rusty-villous; flowers 60–100 per head. Perianth 37–56 mm long, pale yellow, commonly rusty on limb; claws slender, curled-tomentose; limb 11–14 mm long, acute, silky, with longer terminal tuft. Pistil incurved, 43–69 mm long, stout, cream or red, glabrous; pollen presenter ±fusiform, 6.5–10 mm long, prominently ribbed. Follicles offset-elliptic to obovate, 16–20 mm long, glabrous.

Occurs from New Norcia to South Stirling and Wellstead, W.A. Similar to *D. octotriginta* and *D. catoglypta q.v.* Variable in morphology and flowering time. The pistil of the central flowers is about the same length as the perianth and less curved than that of the outer flowers. Three subspecies are recognised.

1 Pistil 60–69 mm long, red **46c.** subsp. **macrorufa**

1: Pistil 43–54 mm long, cream

2 Perianth limb 11–13 mm long; pollen presenter 7.5–10 mm long; flowers in summer **46a.** subsp. **drummondii**

2: Perianth limb 9 mm long; pollen presenter 6.5–7 mm long; flowers in winter **46b.** subsp. **hiemalis**

46a. Dryandra drummondii Meisn. subsp. **drummondii**

Dryandra calophylla var. *acaulis* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 481 (1856). T: south-western W.A., 1840s, *J.Drummond 2: 300*; syn: BM, K, MEL.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 43, pls 58, 59 (1984); R.M.Sainsbury, *Field Guide Dryandra* 33 (1985).

Shrub to 1 m. Leaves: petiole 5–15 cm long; lamina 20–90 cm long. Perianth 40–42 mm long; limb 11–13 mm long. Pistil 47–53 mm long, yellow; pollen presenter 7.5–10 mm long. Follicles 16–18 mm long.

Occurs in the Stirling Ra., south to Kendenup and South Stirling and north-east towards Ongerup, W.A. Grows in sandy loam over gravel in mallee-kwongan. Flowers Nov.–Jan. Map 335.

W.A.: near Kalgan R., *C.A.Gardner 13881* (PERTH); c. 52 km SE of Borden, *A.S.George 1722* (PERTH); Stirling Range Drive, 24 km W from Chester Pass Rd, *W.Greuter 23162* (PERTH); 1 km W of Kamballup on road to Mount Barker, *G.J.Keighery & J.J.Alford 1739* (CANB).

46b. Dryandra drummondii subsp. **hiemalis** A.S.George, *Nuytsia* 10: 367 (1996)

T: 5 km N of Calingiri turnoff, Great Northern Hwy, W.A., 1 June 1984, *A.S.George 16300 & P.Nikulinsky*; holo: PERTH; iso: CANB, K, MEL, NSW.

Shrub to 50 cm tall. Leaves: petiole 6–9 cm long; lamina 17–30 cm long. Perianth 37–42 mm long; limb 9 mm long. Pistil 43–54 mm long, yellow; pollen presenter 6.5–7 mm long. Follicles 17–20 mm long, glabrous. Fig. 46G.

Occurs between New Norcia and Wickepin, W.A. Grows in lateritic gravel in Jarrah-Marri open forest and Wandoo woodland. Flowers May–June. Map 336.

W.A.: Coffin Rock [SW of York], *H.Demarz 1297* (PERTH); S of North Rd, near Bindoon, Great Northern Hwy, *M.Pieroni 93/5* (PERTH); S of Wickepin, 16 May 1979, *K.Wallace* (PERTH).

Flowers faintly scented.

46c. Dryandra drummondii subsp. **macrorufa** A.S.George, *Nuytsia* 10: 368 (1996)

T: SE of Nyabing, W.A., 5 Jan. 1992, *M.Pieroni 92/1*; holo: PERTH; iso: CANB, K.

Shrub to 1.5 m tall and 2 m wide. Leaves: petiole 4–15 cm long; lamina 15–36 cm long. Perianth 55–56 mm long; limb 14 mm long. Pistil 60–69 mm long, red; pollen presenter 9.5 mm long. Follicles not seen. *Big Red*.

Known only from the type locality, south-east of Nyabing, W.A. Grows in sand over gravel, in low kwongan. Flowers Jan.–Feb. Map 337.

Distinguished from the other subspecies in the larger flowers with red styles.

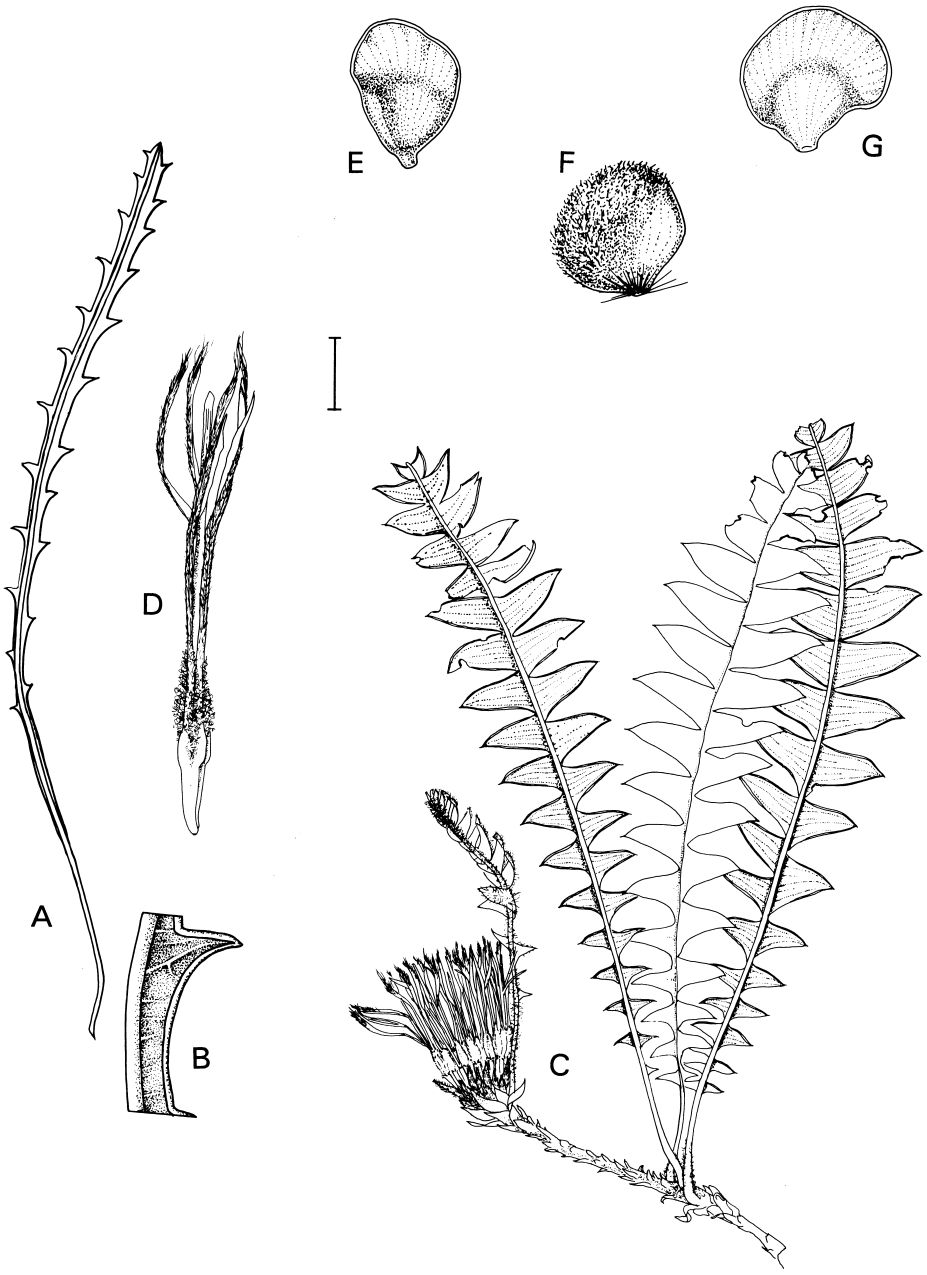


Figure 46. *Dryandra*. **A–B**, *D. corvijuga*. **A**, leaf; **B**, detail of lower surface of leaf (**A–B**, A.George 16721, PERTH). **C–D**, *D. calophylla*. **C**, flowering branch; **D**, flower (**C–D**, A.George 16514, PERTH). **E**, *D. octotriginta*, follicle (A.George 16719, PERTH). **F**, *D. pteridifolia* subsp. *pteridifolia*, follicle (A.George 16720, PERTH). **G**, *D. drummondii* subsp. *hiemalis*, follicle (A.George 16449, PERTH). Scale bar: **A** = 3 cm; **B, E–G** = 7 mm; **C** = 2 cm; **D** = 3 mm. Drawn by: **A–B**, D.Boyer; **C–D**, P.Nikulinsky; **E–G**, P.Dundas.

47. Dryandra octotriginta A.S.George, *Nuytsia* 10: 369 (1996)

T: Manuel Rd, S of Nyabing, W.A., 30 July 1986, *A.S.George 16695*; holo: PERTH; iso: CANB, K, MEL.

Shrub to 1 m, without lignotuber. Stems erect, with thick, ±appressed, lanceolate, villous prophylls. Leaves bluish green; petiole 3–6 cm long; lamina deeply pinnatipartite to almost pinnatisect, 10–25 cm long, 3–6 cm wide; margins almost flat to shortly recurved; lobes 10–18 each side, triangular, usually narrow and ±straight-sided, decurrent, at 70°–80°; pits on undersurface indistinct, shallow. Inflorescence terminal, with linear, leaf-like bracts around involucre; involucral bracts ovate-lanceolate, to 10–20 mm long, rusty-villous; flowers 50–85 per head. Perianth 35–43 mm long, pale gold; claws curled-villous to tomentose; limb 8–11 mm long, appressed-silky with long terminal tuft. Pistil bowed, 40–48 mm long, very thick towards base, cream, glabrous; pollen presenter narrowly fusiform, 5–7.5 mm long, ribbed, green. Follicles obovate, 13 mm long, 12 mm wide, sparsely hairy, striate, shining, ±viscid. Fig. 46E.

Occurs from Woodanilling to Nyabing and east to Newdegate and Dragon Rocks, W.A. Grows in gravelly loam in kwongan, often with mallee eucalypts. Flowers July–Aug. Map 338.

W.A.: N of Nyabing, *A.S.George 9395* (PERTH); Creek Rd, SE of Newdegate, *A.S.George 16718* (PERTH); c. 5 km WNW of Mt Sheridan, Dragon Rocks Nature Reserve, *S.D.Hopper 5255* (PERTH).

Variable in flower size. Closely related to *D. drummondii*, differing in the longer stems, more floriferous habit and the more acute leaf lobes with straighter margins and usually has more small leaves below the inflorescence. Especially similar to *D. catoglypta q.v.*

48. Dryandra catoglypta A.S.George, *Nuytsia* 10: 369 (1996)

T: N of Badgingarra, W.A., 22 July 1993, *M.Pieroni 93/7*; holo: PERTH; iso: CANB, K, MEL, NSW.

Shrub to 1 m tall and 1 m wide, without lignotuber. Prophylls on stems recurved, broadly ovate-oblong, tomentose outside, glabrous inside. Leaves: petiole 1.5–1.8 cm long; lamina pinnatisect, 15–30 cm long, 2.5–7 cm wide; margins flat; lobes 10–15 each side, triangular, acute, pungent, at 80°–90°, with upper margin ±straight to gently curved and lower margin more convex; pits in lower surface indistinct, shallow. Inflorescence terminal on short branchlet, with several linear, leaf-like bracts around involucre; involucral bracts broadly ovate-oblong, to 25 mm long, silky-villous; flowers 85–110 per head. Perianth 44–56 mm long, golden brown, villous with pale hairs becoming silky towards limb; limb very narrow, 12–15 mm long, appressed-silky with pale hairs and a terminal rusty-red tuft. Pistil bowed, 46–64 mm long, cream, glabrous; pollen presenter narrow, 8–9 mm long, ribbed, dull reddish pink. Follicles broadly obovate, 15–17 mm long, 17–20 mm wide, loosely hirsute, glabrescent, striate, shining.

Occurs in the Gairdner Ra. and north of Badgingarra, W.A. Grows on lateritic breakaways, in kwongan. Flowers June–July. Map 339.

W.A.: Tootbardi Rd, N of Badgingarra, *K.Alcock 507* (PERTH); Gairdner Ra., July 1980, *D.Lievense* (PERTH).

Closely related to *D. drummondii* and especially *D. octotriginta*, differing mainly in the prominent, usually recurved bracts on the stems, the longer perianth limb, and longer, very narrow pollen presenter. Follicles loosely attached. Seed offset to one side.

Ser. 14. Aphragma

Dryandra ser. **Aphragma** (R.Br.) A.S.George, *Nuytsia* 10: 370 (1996)

Dryandra sect. *Aphragma*, R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 37 (1830); *Josephia* sect. *Aphragma* (R.Br.) Kuntze, in T.E. von Post & C.E.O.Kuntze, *Lex. Gen. Phan.* 299 (1903). T: *D. nervosa* R.Br.

Prostrate or erect shrubs, with or without lignotuber. Leaves large, petiolate; lamina pinnatifid, pinnatipartite or pinnatisect; margins flat to revolute. Inflorescence terminal or on

short lateral branchlet, usually subtended by long leaves; involucral bracts shorter than flowers, densely hairy; receptacle ±flat. Perianth straight, with long limb. Pistil curved, shorter or in 2 species longer than perianth; pollen presenter elongated, narrow, ribbed. Flowers soon falling. Follicles rather large, obovate or orbicular, rather loosely attached, usually remaining closed until burnt. Seed wing shortly notched.

A series of nine species in south-western W.A. Similar to ser. *Triangulares* but with much narrower leaf lobes.

49. Dryandra pteridifolia R.Br., *Trans. Linn. Soc. London* 10: 215 (1810)

Josephia pteridifolia (R.Br.) Poir., *Dict. Sci. Nat.* 245 (1822). T: Bay I [Lucky Bay, W.A.], Jan. 1802, *R.Brown Iter Austral. 3426*; holo: BM; iso: K.

Dryandra pteridifolia var. *blechnifolia* Hereman, *Paxton's Dict.* 201 (1868), *nom. illeg. non* R.Br.

Shrub with short underground stems, to 1 m across, with lignotuber. Stems curled-tomentose; prophylls scattered, short, broad. Leaves: petiole 3–6 cm long; lamina deeply pinnatipartite, 17–50 cm long, 5–12 cm wide; midrib spirally twisted; margins revolute; lobes 20–34 each side at c. 90°, linear, often twisted, 1.5–5 mm wide, abruptly acute, pungent, villous but glabrescent above. Inflorescence terminal, surrounded by leaves; involucral bracts broadly ovate, obtuse, rusty-tomentose with hirsute margins; innermost bracts to 20 mm long; flowers 90–100 per head. Perianth 36–39 mm long, pink, curled-villous above base, becoming pubescent distally; limb 9–12 mm long, cream, pink or rusty, appressed-hirsute or -pubescent. Pistil bowed to straight, 38–53 mm long, cream, glabrous; pollen presenter narrow, 4.5–8 mm long, ribbed. Follicles to 5 per head, obovate, 17–18 mm long, striate, glabrous.

Occurs mainly in two disjunct areas, one between the Gairdner R. and Cape le Grand Natl Park, the other from Badgingarra to the Moore R., with a small population near Perth, W.A. Grows in sand over laterite in low kwongan and mallee-kwongan. One of two species in this series in which the pistil is longer than the perianth. There are two subspecies. A recent collection from near Brookton (*R.Davis 6397*, PERTH) is intermediate between the subspecies morphologically, geographically and phenologically.

Leaf lobes usually twisted; pollen presenter 4.5–5 mm long; autumn-flowering (south coast) **49a.** subsp. **pteridifolia**

Leaf lobes not or little twisted; pollen presenter 8 mm long; spring-flowering (N of Perth) **49b.** subsp. **vernalis**

49a. Dryandra pteridifolia R.Br. subsp. **pteridifolia**

Leaf lobes usually twisted. Perianth 36–39 mm long. Pistil 38–53 mm long; pollen presenter 4.5–5 mm long. Fig. 46F.

Occurs from the Gairdner R. to Cape le Grand Natl Park and inland to Newdegate, W.A. Grows in sandy loam, sometimes over clay or laterite, in kwongan. Flowers Mar.–May. Map 340.

W.A.: c. 25 km W of Ravensthorpe, *A.S.George 9475* (CANB, MEL, NSW, PERTH); 27.5 km E of Lake Grace, *A.S.George 16712* (PERTH); SW of Roes Rock, Fitzgerald River Natl Park, *G.J.Keighery 7670* (PERTH); Lucky Bay, Cape le Grand Natl Park, *I.Solomon 200* (PERTH).

49b. Dryandra pteridifolia subsp. **vernalis** A.S.George, *Nuytsia* 10: 371 (1996)

T: Alexander Morrison Natl Park, W.A., 25 Sept. 1994, *A.S.George 17215*; holo: PERTH; iso: AD, CANB, K, MEL, NSW, PERTH.

Leaf lobes not or little twisted. Perianth 39 mm long. Pistil 40–45 mm long; pollen presenter 8 mm long.

Occurs between Eneabba and the Moore R. and near Perth, W.A. Grows in sandy loam over gravel in low kwongan, and in sand in banksia low open-woodland. Flowers Sept. Map 341.

W.A.: junction of Willis Rd and Tootbardi Rd with Coorow Rd, *K.Alcock 505* (PERTH); Marchagee Track, *E.A.Griffin 3475* (PERTH); Bundarra Nature Reserve, *E.A.Griffin 5425* (PERTH); Forrestfield, 26 Sept. 1989, *M.Pieroni* (PERTH).

50. Dryandra fililoba A.S.George, *Nuytsia* 10: 372 (1996)

T: 29 km W of Lake Grace, W.A., 30 July 1986, *A.S.George 16709*; holo: PERTH; iso: CANB, NSW, PERTH.

Tangled shrub to 1 m, without lignotuber. Stems tomentose and hirsute. Leaves: petiole 5–15 cm long; lamina deeply pinnatipartite, 15–30 cm long, 7–14 cm wide; margins recurved to revolute; lobes 10–17 each side at 70°–90°, linear, acute, pungent; several to many small leaves 5–15 cm long with filiform lobes subtending inflorescence. Inflorescence terminal; involucral bracts ovate to oblong, obtuse, rusty-silky-villous and densely ciliate; innermost bracts to 25–42 mm long; flowers 55–80 per head. Perianth 50–53 mm long, pale yellow with pale gold limb, densely curled-villous above base, curled-tomentose distally; limb 15–18 mm long, acute, silky with long apical tuft. Pistil 49–52 mm long, cream, glabrous; pollen presenter narrowed, 12–15 mm long, ribbed. Follicles obovate, somewhat oblique across upper margin, 17 mm long, somewhat villous but hairs wearing off.

Occurs from near Woodanilling to Lake Grace and north to Harrismith, W.A. Grows in sandy loam over gravel or in gravel, in kwongan, occasionally in *Eucalyptus wandoo* woodland. Flowers mainly May–July. Map 342.

W.A.: River Rd, ENE of Woodanilling, *A.S.George 16632* (PERTH); 0.3 km E of Harrismith, *R.Hnatiuk 78003* (PERTH); Carter Rd, S of Woodanilling West Rd, *M.Pieroni 32* (MEL).

May usually be distinguished by the bushy, non-lignotuberous habit and large flowers with very long perianth limb. Leaf lobes generally fewer, flatter than those of *D. pteridifolia*; branchlets below inflorescence usually longer, up to 5 cm.

51. Dryandra shanklandiorum Randall, *Bot. Jahrb. Syst.* 109: 485, fig. 1 (1988)

T: McKay Rd, Dowerin, W.A., 30 July 1985, *R.P.Randall s.n.*; holo: PERTH; iso: CANB, MEL.

Shrub to 1.5 m, densely bushy, without lignotuber. Stems rusty-velvety. Leaves: petiole 10–17 cm long; lamina pinnatipartite to pinnatisect, 6–46 cm long, (1.5–) 2–14 cm wide; margins flat; lobes 9–16 each side, linear, acute, pungent, ascending. Inflorescence on short lateral branchlet from older stems; involucral bracts lanceolate, acuminate, rusty-villous; innermost bracts 4.5–5.5 cm long; flowers c. 100 per head. Perianth 48–58 mm long, pink to gold, curled-villous above base, with claws pubescent; limb 9–10 mm long, gold, appressed-pubescent with longer apical tuft. Pistil incurved, 58–74 mm long, cream, glabrous; pollen presenter not or slightly thickened, 4.5–5 mm long, faintly ribbed, green. Follicles obovate, 12–15 mm long, hirsute in lower half, shining.

Occurs between Cadoux and Hyden, W.A. Grows in sandy loam over laterite, in tall shrubland. Flowers July–Aug. Map 343.

W.A.: c. 25 km SE of Merredin on Braint Rd, *F.H. & M.P.Mollemans 3293* (PERTH); c. 4 km from Koonadgen on Korbel Rd, *B.H.Smith 664* (MEL, PERTH); c. 1 km SW of Holleton, *B.H.Smith 705* (HO, MEL, PERTH).

One of two species of the series with the pistil longer than the perianth; also distinguished by the very large inflorescence with acuminate involucral bracts and by the leaves with oblique lobes.

52. Dryandra nervosa R.Br., in R.Sweet, *Fl. Australas.* t. 22 (1827)

T: raised at the nursery of Mr Mackay at Clapton, England, from seed collected probably near King George Sound by *W.Baxter*; neo: BM, *fide* A.S.George, *Nuytsia* 10: 372 (1996).

Dryandra nervosa Sweet, *Hort. Brit.* 350 (1826), *nom. nud.*

[*Dryandra pteridifolia auct. non* R.Br.: R.M.Sainsbury, *Field Guide Dryandra* 78 (1985), *p.p.*]

Illustration: R.M.Sainsbury, *op. cit.* 78, lower photograph, as *D. pteridifolia p.p.*

Figure 47. *Dryandra nervosa*. **A**, flowering branch; **B**, flower (**A–B**, A.George 11285, PERTH). Scale bar: **A** = 2 cm; **B** = 5 mm. Drawn by P.Nikulinsky.

Shrub forming large clump to 2 m across, without lignotuber. Stems erect; prophylls narrowly ovate, to 5 mm long. Leaves: petiole 7–20 cm long; lamina deeply pinnatipartite, 20–45 cm long, 6–13 cm wide, rusty-tomentose and glabrescent above, sometimes ±rusty below; margins slightly recurved; lobes 12–23 each side, linear to narrowly triangular, acute to pungent, not twisted, at c. 90° or slightly ascending, prominently 3-nerved below. Inflorescence terminal, subtended by leaves; involucral bracts ovate to oblong, medium to deep rusty tomentose with villous margins; innermost bracts to 35 mm long; flowers 70–95 per head. Perianth 35–40 mm long, cream, closely curled-tomentose above base, with upper claw and limb appressed-pubescent with straight hairs; limb 13–15 mm long, golden brown. Pistil incurved to straight, 34–39 mm long, cream, glabrous except hairs on ovary; pollen presenter narrow, 11–12 mm long, ribbed, pale yellow. Follicles obovate, slightly oblique, 15–20 mm long, with long hairs at base, otherwise glabrous, striate, shining brown. Fig. 47.

Occurs in the Stirling Ra., south to Manypeaks and east to Ongerup and Boxwood Hill, with outliers to the Lort R., W.A. Grows in clay-loam or sandy loam in open mallee-kwongan. Flowers Dec.–Mar. Map 344.

W.A.: South Stirling road, c. 56 km E of Albany–Borden road, *A.S.George 6245* (PERTH); between Middle Mt Barren and Thumb Peak, *A.S.George 11285* (PERTH); c. 73 km E of Ravensthorpe, *A.S.George 17245* (PERTH); Pullitup Swamp area, c. 10 km NE of Bremer Bay, *R.Pullen 10047* (CANB, MEL, NSW).

Flowers with onion-like scent. The long petiole and lack of filiform leaf lobes are distinctive among the non-lignotuberous related taxa. There appears to be a second variant, winter-flowering, with pale involucral bracts overtopping the flowers, smaller pale flowers and white floral bracts, but further material is needed to check this.

53. Dryandra blechnifolia R.Br., *Trans. Linn. Soc. London* 10: 215 (1810)

Josephia blechnifolia (R.Br.) Poir., *Dict. Sci. Nat.* 24: 246 (1822); *Dryandra pteridifolia* var. *blechnifolia* (R.Br.) R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 38 (1830), *non D. pteridifolia* var. *blechnifolia* Hereman (1868). T: near King George Sound, [W.A.], Sept. 1791, *A.Menzies*; lecto: BM, *fide* A.S.George, *Nuytsia* 10: 372 (1996); isolecto: BM, K.

Shrub to 1.7 m across, with fire-tolerant underground stems. Stems rusty-tomentose; prophylls many but not imbricate, broadly ovate, to 6 mm long. Leaves: petiole 2–4 cm long, tomentose; lamina deeply pinnatipartite, pinnatisect in lower part of lamina, 20–35 cm long, 5–13 cm wide; margins revolute; lobes 20–30 each side, linear, acute, pungent, twisted so that adaxial surface is uppermost, closely curled-tomentose below where prominently 3-nerved and reticulate. Inflorescence terminal, subtended by leaves; involucral bracts ovate to lanceolate, acute, dark rusty-villous; innermost bracts 35–40 mm long; flowers c. 65 per head. Perianth 40–47 mm long, pale pink at base, creamy brown above, curled-tomentose above base, grading to appressed-pubescent with straight hairs in upper claw and limb; limb 11–13 mm long, acute. Pistil 39–45 mm long, cream, sparsely hairy at base; pollen presenter narrower than style, 8–11 mm long, ribbed, yellow. Follicles obliquely obovate, 18–19 mm long, sparsely hairy.

Occurs in the Stirling Range Natl Park and north-east towards Ongerup, W.A. Grows in gravelly loam, in mallee-kwongan. Flowers in winter. Map 345.

W.A.: Gnowellen Rd, E of Stirling Ra., *A.S.George 14283* (PERTH); Salt River Rd E of Red Gum Pass turnoff, *A.S.George 16659* (PERTH); Toompup Rd, SW of Ongerup, *A.S.George 16680* (PERTH).

Leaves dark green above. Regrowth leaves with broadly elliptic to oblong lobes. No filiform lower lobes.

54. Dryandra porrecta A.S.George, *Nuytsia* 10: 373 (1996)

T: Bibiking Reserve, ENE of Woodanilling, W.A., 26 July 1986, *A.S.George 16629*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

[*Dryandra preissii auct. non* Meisn.: R.M.Sainsbury, *Field Guide Dryandra* 74 (1985)]

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 74 (1985), as *D. preissii*.

Stems prostrate, underground, tomentose; prophylls imbricate on leafy branchlets, sparse elsewhere. Leaves immediately below but not surrounding flowers; petiole 2–3.5 cm long, tomentose; lamina pinnatipartite 15–30 cm long, 2–3 cm wide; margins slightly recurved; lobes 30–40 each side, narrowly triangular, to 16 mm long, somewhat twisted at base, acute, tomentose and with evident nerves below. Inflorescence terminal; involucral bracts ovate to oblong, to 25 mm long, obtuse, rusty-villous outside; flowers 20–30 per head. Perianth 37–40 mm long, golden, curled-tomentose above base, pubescent distally; limb 9–10 mm long, appressed-hirsute. Pistil straight or gently curved, 37–40 mm long, cream, glabrous; pollen presenter narrow, 5–6 mm long, ribbed. Follicles 1 or 2, obovate, 11–15 mm long, almost glabrous, striate, shining. Plate 58; Fig. 44C, D.

Occurs at scattered localities from Woodanilling to Tenterden, W.A. Grows on sandy and loamy flats in low kwongan, often with Cyperaceae, Restionaceae and mallee eucalypts. Flowers July. Map 346.

W.A.: near W end of Stirling Range Natl Park, Salt River Rd, *A.S.George 16651* (PERTH); N of Tenterden, Albany Hwy, *A.S.George 16895* (PERTH); c. 2 km N of Kojonup, *K.Newbey 3054* (PERTH); Hamilla Hill, *J.W.Wrigley CBG030285* (NSW).

Closely related to *D. blechnifolia* but smaller in all parts and with fewer flowers per head. Also related to *D. calophylla* but has more numerous, narrower, often twisted leaf lobes, larger involucral bracts and a much shorter perianth limb and pollen presenter. For differences between this species and *D. aurantia* see notes under the latter.

55. Dryandra aurantia A.S.George, *Nuytsia* 10: 373 (1996)

T: Little Darkin Swamp, W.A., 26 Apr. 1994, *A.S.George 17206 & M.Pieroni*; holo: PERTH; iso: AD, CANB, K, MEL, NSW, PERTH.

Stems underground, rusty-villous, with triangular to ovate villous prophylls. Leaves: petiole 4–10 mm long; lamina deeply pinnatipartite, 12–25 cm long, 2.5–4.5 cm wide, acute, mucronate, decurrent almost to base, margins revolute; lobes 18–28 each side, linear, tapering, acute, straight to curved, at c. 90°, rusty-villous, glabrescent except pits in lower surface; reticulation prominent below. Inflorescence terminal; involucral bracts ovate to lanceolate, obtuse, red-rusty villous; innermost bracts to 20–23 mm long; receptacle flat; flowers c. 80 per head. Perianth 34–37 mm long, pale orange-pink, rusty curled-villous above base, with claws curled-tomentose; limb 8–10 mm long, tomentose with straight hairs and an apical rusty tuft. Pistil 33–36 mm long, cream, glabrous; pollen presenter narrowed, 5–8 mm long, ribbed. Follicles broadly obovate, 15–16 mm long, 10–14 mm wide, sparsely hairy on margin, striate, somewhat shining.

Known only from two populations east of Mundaring Weir, W.A. Grows in deep white sand in low kwongan with scattered *Hakea prostrata* and *Banksia attenuata*. Flowers Apr. Map 347.

Close to *D. porrecta* but differs in the more numerous flowers per head, the orange perianth that is very woolly above the base and the autumn flowering period. The flowers have a strong, onion-like scent.

56. Dryandra calophylla R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 40 (1830)

Josephia calophylla (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: near King George Sound, [W.A.], 1829, *W.Baxter*; holo: BM; iso: K.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 15 (1985).

Shrub with underground, fire-tolerant stems; prophylls scattered, villous, pale brown. Leaves: petiole 2–4 cm long, tomentose and hirsute; lamina pinnatifid, 15–35 cm long, 2–5.5 cm wide, white-tomentose below with nerves evident; margins slightly recurved; lobes 15–20 each side, triangular, to 28 mm long, acute, flat. Inflorescence terminal beyond or at base of leaves; involucral bracts ovate to lanceolate, to 10–15 mm long, villous outside, glabrous inside; flowers 30–45 per head, scented. Perianth 40–41 mm long, brown, curled-villous above base, appressed-pubescent on claws; limb 15 mm long, hirsute. Pistil straight,

38–39 mm long, cream, glabrous; pollen presenter narrowed, 11–12 mm long, finely ribbed. Follicles obovate to orbicular, 9–10 mm long, glabrous. Fig. 46C, D.

Occurs from the Tenterden area south to Albany and east to Wellstead, W.A. Grows in sand, in shrubland and open woodland. Flowers Oct.–Nov. Map 348.

W.A.: c. 100 km NE of Albany on Hassell Hwy, *E.M.Canning WA/68 7443* (CANB); Knight Rd, N of Porongurup Ra., *A.S.George 16514* (CANB, PERTH).

Distinguished by the underground stems with pale brown prophylls, broadly triangular leaf lobes (smaller than in *D. drummondii*) and small flowers. The receptacle is gently convex. Floral bracts appear to be few. Similar to *D. porrecta q.v.*

57. **Dryandra lepidorhiza** A.S.George, *Nuytsia* 10: 374 (1996)

T: W of Woodanilling, W.A., 4 Nov. 1986, *A.S.George 16879*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Shrub to 1.5 m diam., with underground prostrate stems and lignotuber. Stems covered with ovate, obtuse, villous prophylls 4–6 mm long. Leaves dull green; petiole 3–4 cm long; lamina pinnatipartite, 15–30 cm long, 2–7 cm wide; margins revolute; lobes 15–25 each side, linear, 2–3 mm wide, acute, pungent, rusty-tomentose below. Inflorescence terminal, not subtended by leaves; involucral bracts narrowly lanceolate, acute, rusty-villous, glabrous inside; innermost bracts 9–10 mm long; flowers 25–30 per head. Perianth 32–34 mm long, dull deep pink, almost white at base, villous above base, with claws pubescent; limb 10 mm long, hirsute, with apical hairs longer. Pistil 31–33 mm long, cream at base, dull yellow above, glabrous; pollen presenter narrow, 6 mm long, ribbed. Follicles broadly obovate, 10–15 mm long, glabrous, moderately shining. Fig. 48A, B.

Restricted to the type locality, W.A. Grows in sandy loam over laterite, in low kwongan. Flowers Oct.–Nov. Map 349.

W.A.: W of Woodanilling, *K.Newbey 2771* (PERTH).

New growth rusty-red. Flowers ±scentless. A distinctive species characterised by the underground stems covered with bracts, the narrowly lobed pinnatisect leaves and the heads with a short involucre. Flowering stems extend well beyond previous season's foliage.

Ser. 15. Ionthocarpae

Dryandra ser. **Ionthocarpae** A.S.George, *Nuytsia* 10: 375 (1996)

Type: *D. ionthocarpa* A.S.George

Small erect bushy shrubs, without lignotuber. Leaves petiolate; lamina pinnatifid; margins flat. Inflorescences terminal, crowded; involucral bracts shorter than flowers; receptacle flat. Perianth straight; limb large. Pistil curved, longer than perianth; pollen presenter elongate, ribbed. Flowers soon falling. Follicles obovate with a prominent terminal tuft of rusty hairs, loosely attached, usually remaining closed until burnt. Seed obovate, without wing.

A monotypic series confined to one population north of Albany, W.A. Flowers similar to ser. *Triangulares* but the fruit is distinctive.

58. **Dryandra ionthocarpa** A.S.George, *Nuytsia* 10: 376 (1996)

T: near Kamballup, W.A., 11 Oct. 1988, *P.Luscombe*; holo: PERTH; iso: AD, CANB, K, MEL, NSW, PERTH.

Shrub to 60 cm wide; stems prostrate, short, ±underground, villous; prophylls many, linear, tomentose. Leaves: petiole 4–6 cm long, ±glabrous; lamina pinnatifid, 8–25 cm long, 5–20 mm wide; margins flat; lobes 15–35 each side, triangular, obtuse, ±flat, rusty-villous when young, glabrescent except pits. Inflorescence terminal, subtended by leaves, closely successive; involucral bracts linear-subulate; inner bracts narrowly lanceolate, to 2 cm long,

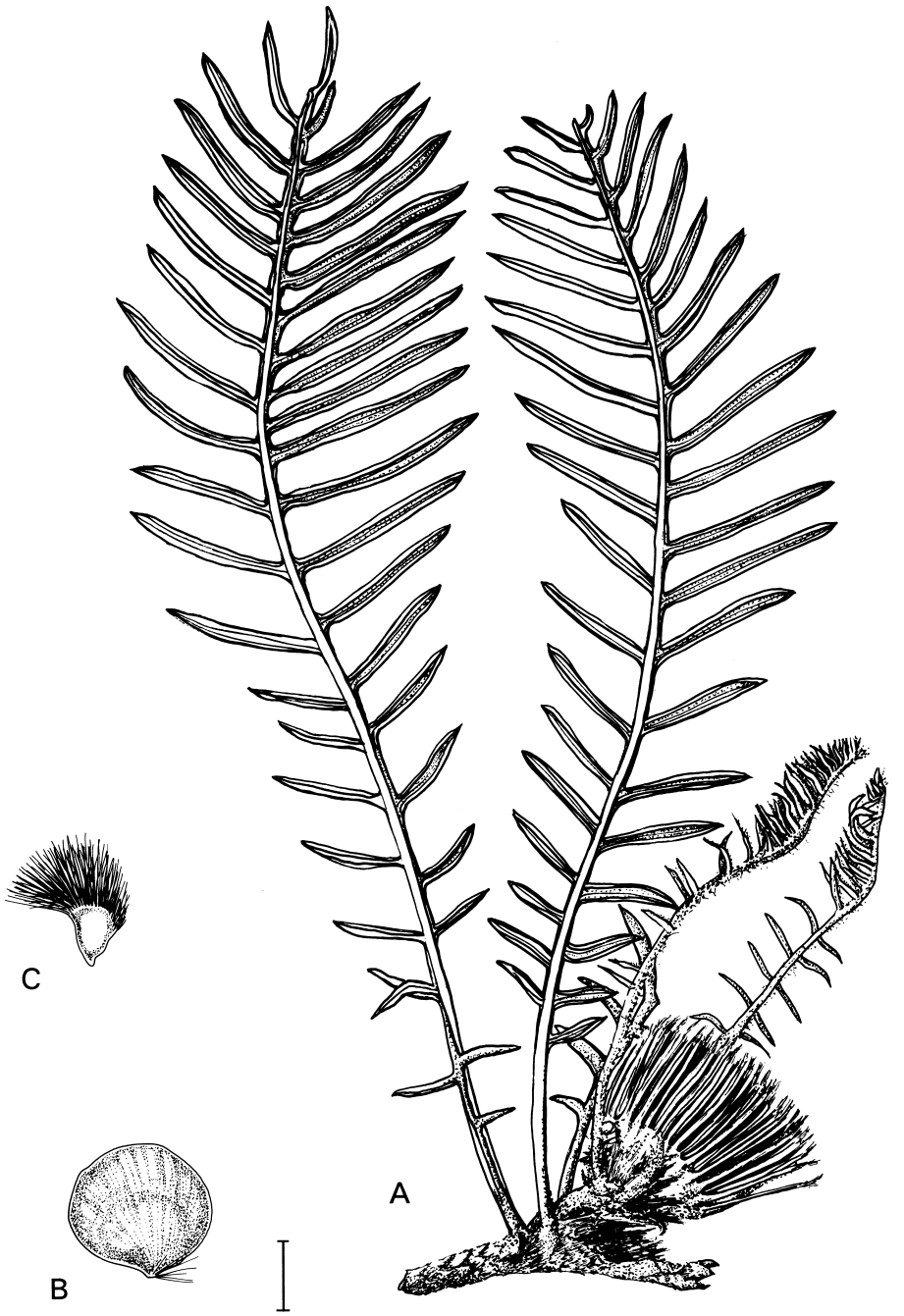


Figure 48. *Dryandra*. **A–B**, *D. lepidorhiza*. **A**, inflorescence and subtending leaves (A.George 16879, PERTH); **B**, follicle (A.George 16644, PERTH). **C**, *D. ionthocarpa*, follicle (11 Oct. 1988, P.Luscombe, PERTH). Scale bar: **A** = 1.4 cm; **B–C** = 7 mm. Drawn by: **A**, D.Boyer; **B–C**, P.Dundas.

dark rusty-tomentose; flowers 40–60. Perianth 39–43 mm long, pink-mauve with pale yellow limb, curled-tomentose in lower third, pubescent distally; limb 7–8 mm long, keeled, appressed-puberulous. Pistil incurved before anthesis then strongly outcurved, 43–44 (–57) mm long, cream, pilose in lower half; pollen presenter 3.5–4.8 mm long, ribbed, green. Follicles ±obovate, 5–6 mm long, with an apical tuft of long rusty hairs, glabrous below. Fig. 48C.

Known only from the type locality near Kamballup, W.A. and a small population near Brookton. Grows in spongolitic gravel, in low kwongan. Listed as 'Endangered' in the ANZECC Threatened Flora List 1997. Flowers Sept.–Oct. Map 350.

W.A.: near Brookton, *R.Davis 1350 et al*. (PERTH); near Kamballup, 1987, *P.Luscombe* (PERTH); near Kamballup, 20 Sept. 1988, *M.Pieroni* (PERTH).

Easily recognised by the fruit. Unusual in having floral bracts that do not elongate as the fruits develop. Pistil very strongly incurved before anthesis, afterwards recurving strongly.

Ser. 16. Inusitatae

Dryandra ser. **Inusitatae** A.S.George, *Nuytsia* 10: 377 (1996)

Type: *D. idiogenes* A.S.George

Small bushy shrubs without lignotuber. Leaves large, petiolate; lamina deeply pinnatifid; margins flat or slightly recurved. Inflorescences terminal, closely successive; involucral bracts exceeding flowers, ±papery, with cobwebby indumentum; receptacle gently convex. Perianth straight including limb. Pistil straight, shorter than perianth; pollen presenter elongated, not thickened. Flowers falling. Follicles obovate, glabrous, easily detached, opening when burnt. Seed winged, notched.

Monotypic, restricted to the Newdegate area, W.A. The involucral bracts are unusual in their texture and indumentum. Foliage similar to that of ser. *Triangulares* and ser. *Ionthocarpae*, flowers similar to those of ser. *Gymnocephalae.*

59. Dryandra idiogenes A.S.George, *Nuytsia* 10: 377 (1995)

T: South Burngup Rd, SW of Newdegate, W.A., 30 Aug. 1986, *A.S.George 16713*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Tufted shrub to 70 cm diam., without lignotuber. Stems hirsute, covered with thin brown prophylls to 3 cm long. Leaves: petiole to 9 cm long; lamina deeply pinnatifid, 15–37 cm long, 12–38 mm wide, acute or truncate, tomentose in pits below; margins flat or slightly recurved; lobes 20–25 each side, triangular, to 19 mm long, acute, smaller and ±recurved towards base, prominently nerved and reticulate below. Inflorescences terminal, closely successive; involucral bracts linear to narrowly lanceolate, acute, papery, to 45 mm long; outer bracts almost glabrous; inner bracts rusty-pubescent along midrib with upper margins cobwebby; flowers c. 80 per head. Perianth 36–44 mm long, white in lower half, deep red above, curled-tomentose above base, appressed-tomentose distally; limb 10–11 mm long, with long apical hairs, otherwise glabrous. Pistil straight, 35–39 mm long, cream, hirsute at base, glabrous above; pollen presenter 6–7 mm long, not thickened, obscurely ribbed. Follicles several, obovate, unequally constricted towards base, 12–13 mm long, glabrous. *It*. Plate 59; Fig. 49.

Endemic in a small area south-west of Newdegate, W.A., growing in sandy loam over gravel in kwongan and mallee-kwongan. Flowers Aug. Map 351.

W.A.: South Burngup Rd, SW of Newdegate, *A.S.George 16732* (AD, CANB, PERTH).

A distinctive species with striking red and white flowers surrounded by papery involucral bracts that are cobwebby on the upper margins. Flowers strongly scented.

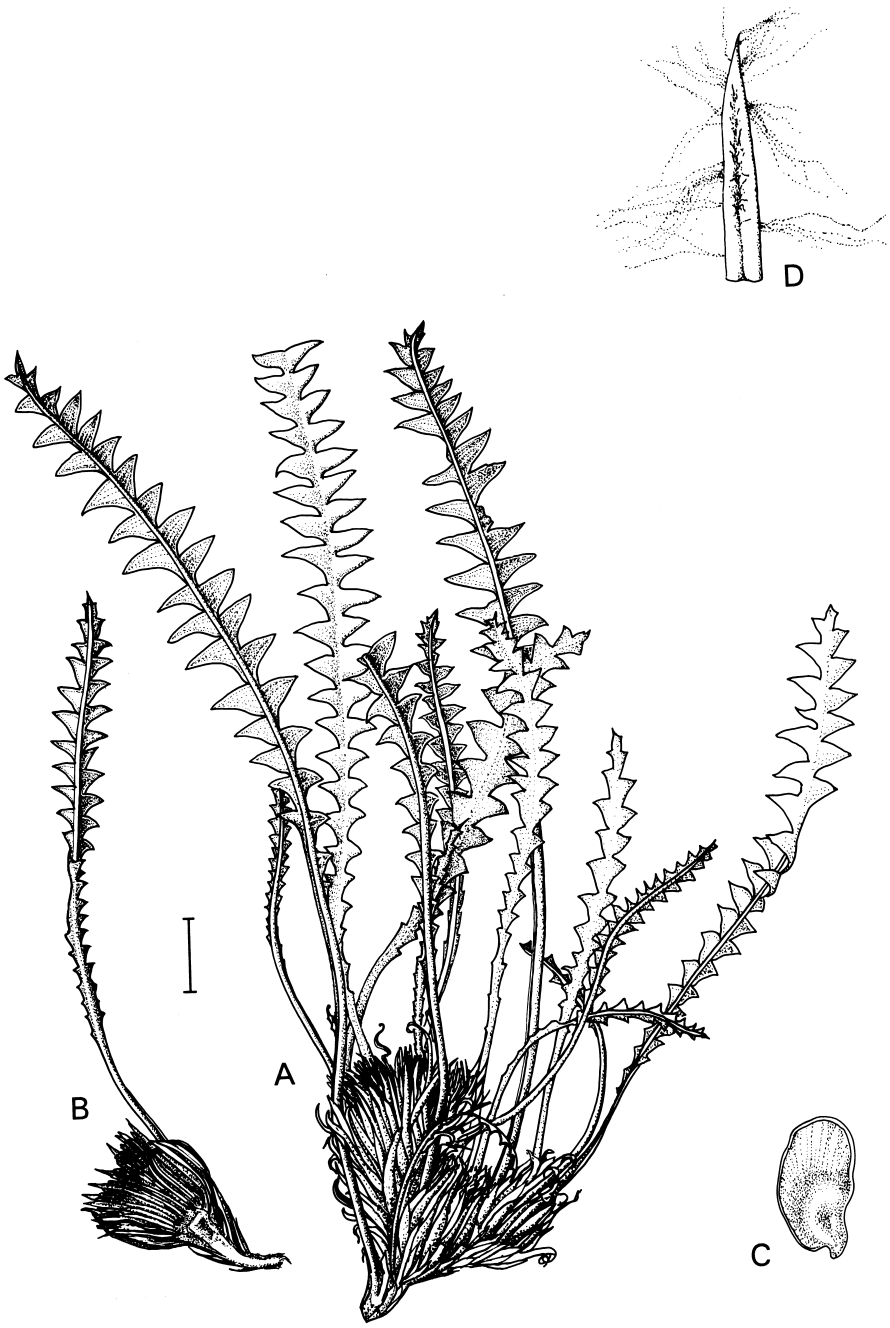


Figure 49. *Dryandra idiogenes*. **A**, inflorescence and subtending leaves; **B**, section through inflorescence; **C**, follicle; **D**, inner involucral bract with cobwebby indumentum (**A–D**, A.George 16713, PERTH). Scale bar: **A–B** = 3 cm, **C** = 1.5 cm; **D** = 3 mm. Drawn by: **A–B**, **D**, D.Boyer; **C**, P.Dundas.

Plate 33. *Musgravea stenostachya.*
Photograph — R.Jensen.

Plate 34. *Austromuellera trinervia.*
Photograph — B.Gray.

Plate 35. *Banksia canei.*
Photograph — A.Lyne (ANBG).

Plate 36. *Banksia speciosa.*
Photograph — K.Thiele (ANBG).

Plate 37. *Banksia candolleana.*
Photograph — ANBG.

Plate 38. *Banksia prionotes.*
Photograph — A.E. de Jong.

Plate 39. *Banksia gardneri* var. *gardneri*
Photograph — D.L.Jones.

Plate 40. *Banksia blechnifolia.*
Photograph — D.Greig (ANBG).

Plate 41. *Banksia epica.*
Photograph — A.S.George.

Plate 42. *Banksia laevigata subsp. fuscolutea.*
Photograph — F.W.Humphreys (ANBG).

Plate 43. *Banksia quercifolia.*
Photograph — K.Thiele (ANBG).

Plate 44. *Banksia spinulosa* var. *collina*
Photograph — M.Fagg (ANBG).

Plate 45. *Banksia ericifolia* subsp. *ericifolia*.
Photograph — F.W.Humphreys (ANBG).

Plate 46. *Banksia violacea*.
Photograph — F.W.Humphreys (ANBG).

Plate 47. *Banksia nutans* var. *cernuella*.
Photograph — K.Thiele (ANBG).

Plate 48. *Banksia ilicifolia*.
Photograph — A.E. de Jong.

Plate 49. *Dryandra sessilis* var. *cygnorum*
Photograph — M.Crisp (ANBG).

Plate 50. *Dryandra xylothemelia*
Photograph — A.S.George.

Plate 51. *Dryandra fraseri* var. *fraseri.*
Photograph — K.Thiele (ANBG).

Plate 52. *Dryandra tridentata.*
Photograph — M.Fagg (ANBG).

Plate 53. *Dryandra quercifolia.*
Photograph — D.Mead-Hunter.

Plate 54. *Dryandra formosa*
Photograph — M.Fagg (ANBG).

Plate 55. *Dryandra comosa.*
Photograph — A.S.George.

Plate 56. *Dryandra tenuifolia var. tenuifolia.*
Photograph — A.S.George.

Plate 57. *Dryandra epimicta.*
Photograph — A.S.George.

Plate 58. *Dryandra porrecta*
Photograph — A.S.George.

Plate 59. *Dryandra idiogenes*
Photograph — A.S.George.

Plate 60. *Dryandra speciosa* subsp. *macrocarpa*
Photograph — A.S.George.

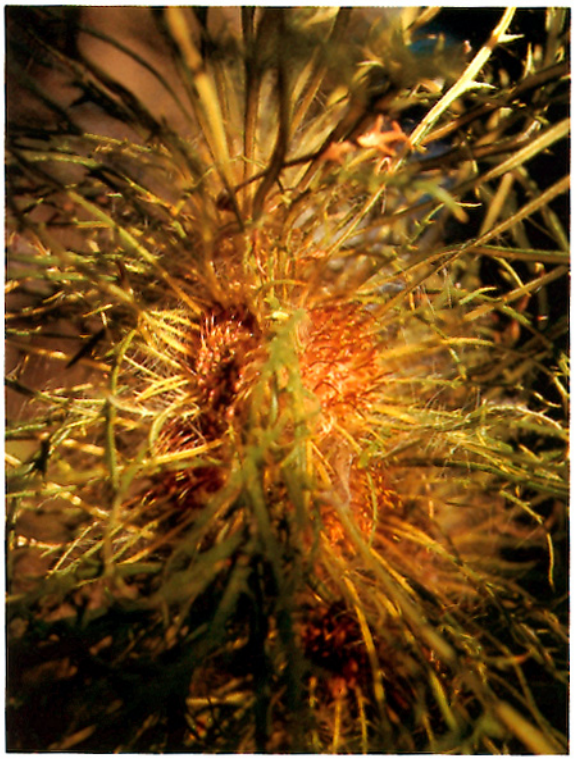


Plate 61. *Dryandra columnaris*
Photograph — A.S.George.

Plate 62. *Dryandra tortifolia.*
Photograph — A.S.George.

Plate 63. *Dryandra nivea* subsp. *nivea.*
Photograph — M.Fagg (ANBG).

Plate 64. *Dryandra glauca.*
Photograph — A.S.George.

Ser. 17. Subulatae

Dryandra ser. **Subulatae** A.S.George, *Nuytsia* 10: 378 (1996)

Type: *D. subulata* C.A.Gardner

Small shrubs, without lignotuber. Leaves shortly petiolate; lamina linear, entire; margins closely revolute. Inflorescence terminal on short branchlet arising immediately below that of previous season, surrounded by short, rigid, pungent leaves passing into involucre; involucral bracts shorter than flowers; receptacle gently convex. Perianth straight, including limb. Pistil straight, slightly shorter than perianth; pollen presenter scarcely thickened, finely ribbed. Old flowers persistent. Follicles orbicular with basal notch, loosely attached, usually remaining closed until burnt. Seed not seen.

Monotypic, in the kwongan north of Perth, W.A. A very distinct species without obvious close relatives.

60. Dryandra subulata C.A.Gardner, *J. Roy. Soc. W. Australia* 47: 59 (1964)

T: near Hill R., W.A., 17 Sept. 1959, *C.A.Gardner 12175*; holo: PERTH.

Illustrations: R.Erickson *et al.*, *Fls Pls W. Australia* 101, t. 296 (1973); R.M.Sainsbury, *Field Guide Dryandra* 105 (1985).

Prostrate shrub to 0.5 m across, without lignotuber. Stems ±glabrous. Leaves: petiole to 1 mm long; lamina linear, 15–35 cm long, 2–2.5 mm wide, entire, obtuse but mucronate, loosely appressed-hirsute with upper surface becoming finely scabrid-verrucose; margins closely revolute. Inflorescence sessile, with many leaf-like, subulate, sparsely hirsute 'bracts' 3–8 cm long, passing into involucral bracts; involucral bracts lanceolate, acuminate, appressed-hirsute; innermost bracts 10–12 mm long; flowers 65–75 per head. Perianth 22–24 mm long, pale yellow-green, villous above base; claws filiform, glabrous; limb 4–4.5 mm long, smooth, reddish, glabrous except loose curled hairs that fall before anthesis. Pistil 22–24 mm long, cream, with hairs above ovary, otherwise glabrous; pollen presenter scarcely thickened, 1.7–2 mm long, finely ribbed, purple. Follicles orbicular with basal notch, 11 mm long, ?glabrous.

Occurs between Eneabba and the Hill R., south-western W.A. Grows in sand over laterite in low kwongan. Flowers Sept.–Oct. Map 352.

W.A.: Alexander Morrison Natl Park, *B.Barnsley 899* (CANB, PERTH); junction of Coorow–Greenhead road and Tootbardi Rd, *A.S.George 16778* (NSW, PERTH); c. 3 km W of Dinner Hill, *K.Newbey 2864* (PERTH); Badgingarra, 11 Sept. 1960, *L.Steenbohm* (PERTH).

Very distinctive in the long entire leaves, rigid pungent 'bracts' subtending the inflorescence, and perianth with villous base and filiform glabrous claws. At the late bud stage the perianth limb is deep red. The flowers are almost at ground level.

Ser. 18. Gymnocephalae

Dryandra ser. **Gymnocephalae** Benth., *Fl. Austral.* 5: 565, 579 (1870)

Type: *D. shuttleworthiana* Meisn.; lecto, *fide* A.S.George, *Nuytsia* 10: 379 (1996).

Dryandra § *Haplophyllae* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 479 (1856). T: *D. speciosa* Meisn.

Mostly erect or spreading shrubs, with or without lignotuber. Leaves petiolate; lamina linear, serrate, pinnatifid, pinnatisect or in 1 species entire; margins recurved to revolute. Inflorescence terminal or axillary, sometimes on old stems; involucral bracts shorter or longer than flowers, usually narrow and very hairy; receptacle flat or concave. Perianth straight including limb, not relaxed at anthesis. Pistil straight or slightly incurved, shorter than perianth; pollen presenter narrow, smooth or ribbed. Flowers persistent or soon falling. Follicles ovate, obovate-oblong or semi-elliptic, sometimes oblique, usually hairy, firmly attached, usually remaining closed until burnt. Seed wing with or without notch.

A series of eight species, mostly in the kwongan between Eneabba and Lake King, W.A. Just before anthesis the flowers are rather openly spaced in the head.

Figure 50. *Dryandra cynaroides*. **A**, inflorescence and subtending leaves; **B**, flower (**A–B**, A.George 9808, PERTH). Scale bar: **A** = 1 cm; **B** = 2 cm. Drawn by P.Nikulinsky.

61. Dryandra cynaroides C.A.Gardner, *J. Roy. Soc. W. Australia* 47: 58 (1964)

T: near Yeanilling Rock, SE of Pingelly, W.A., Dec. 1963, *C.A.Gardner 14255;* holo: PERTH.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 31 (1985).

Shrub to 1.7 m, with lignotuber. Stems erect, with many prophylls. Leaves crowded about inflorescences; petiole to 1 cm long; lamina linear but widened upwards, pinnatifid, 4–8 cm long, 7–13 mm wide, acute, pungent, closely tomentose below; margins strongly recurved; lobes 3–8 each side, obliquely triangular, pungent. Inflorescences terminal or axillary, often clustered; involucral bracts subulate, to 35 mm long, glabrous at base, plumose above; flowers 15–20 per head. Perianth 39–51 mm long, white and dull gold, silky villous above base, curled-pubescent distally, becoming glabrous near limb; limb 10–11 mm long, prominently ribbed, with a few caducous hairs. Pistil straight, 37–49 mm long, cream, glabrous; pollen presenter not thickened, 6–7 mm long, ribbed. Follicles few, obliquely curved-obovate, 10–13 mm long, sparsely pubescent. Fig. 50.

Occurs in south-western W.A. from Pingelly to Woodanilling. Grows in sand over laterite in kwongan; flowers summer and autumn. Map 353.

W.A.: Tutanning Nature Reserve, 2 Jan. 1970, *N.T.Burbidge s.n.* (CANB); Boyagin Nature Reserve, *A.S.George 9814* (CANB, PERTH); E of Dryandra settlement, *A.S.George 16624* (PERTH); Paterson Rd, S of L. Dumbleyung, *A.S.George 16637* (PERTH); c. 12 km W of Woodanilling, *K.Newbey 2773D* (PERTH).

Distinguished from *D. erythrocephala* by the broader, triangular-lobed leaves, villous inflorescence clusters and larger flowers and fruit. The long hairs on the apex of the perianth fall very early.

62. Dryandra erythrocephala C.A.Gardner, *J. Roy. Soc. W. Australia* 13: 63, fig. 25A–H (1927)

T: E of Pingrup and S of Newdegate, W.A., 15 Dec. 1926, *C.A.Gardner s.n.*; syn: MEL, PERTH.

Shrub to 1.7 m, with lignotuber. Stems erect, covered with prophylls. Leaves: petiole to 1 cm long; lamina linear, pinnatifid, 6–11 cm long, 10–16 mm wide, gently curved, pungent, woolly below; margins revolute; lobes 2–6 each side, linear, to 9 mm long. Inflorescences axillary and terminal, often clustered; involucral bracts linear-subulate, to 28 mm long, villous with plumose apex; flowers 15–26 per head. Perianth 23–40 mm long, cream with dull red-black limb or all yellow, villous above base, closely curled-tomentose distally, becoming glabrous below limb; limb 6–9 mm long, keeled. Pistil straight or gently incurved, 22–36 mm long, cream, glabrous except ovary; pollen presenter narrower than style, tapering, 3.5–4 mm long, ±smooth. Follicles ±ovate, 8–11 mm long, sparsely pubescent.

Widespread in the southern wheatbelt of W.A. from Kulin to Nyabing and east to Forrestania. There are two varieties.

Perianth 32–40 mm long, red-black in upper third — **62a.** var. **erythrocephala**

Perianth 23–28 mm long, yellow throughout — **62b.** var. **inopinata**

62a. Dryandra erythrocephala C.A.Gardner var. **erythrocephala**

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 35 (1985)

Perianth 32–40 mm long, red-black in upper third. Pistil 31–36 mm long. Fig. 51A–C.

Distribution as for the species, W.A. Grows in sandy loam over laterite, in open mallee-kwongan. Flowers mainly summer to early winter. Map 354.

W.A.: Dunn Rock Nature Reserve, *D.J.Backshall 113* (PERTH); c. 22 km S of Hyden, *A.S.George 9889* (CANB, PERTH); c. 17 km W of Lake King, *J.W.Wrigley WA/68 5547* (CANB).

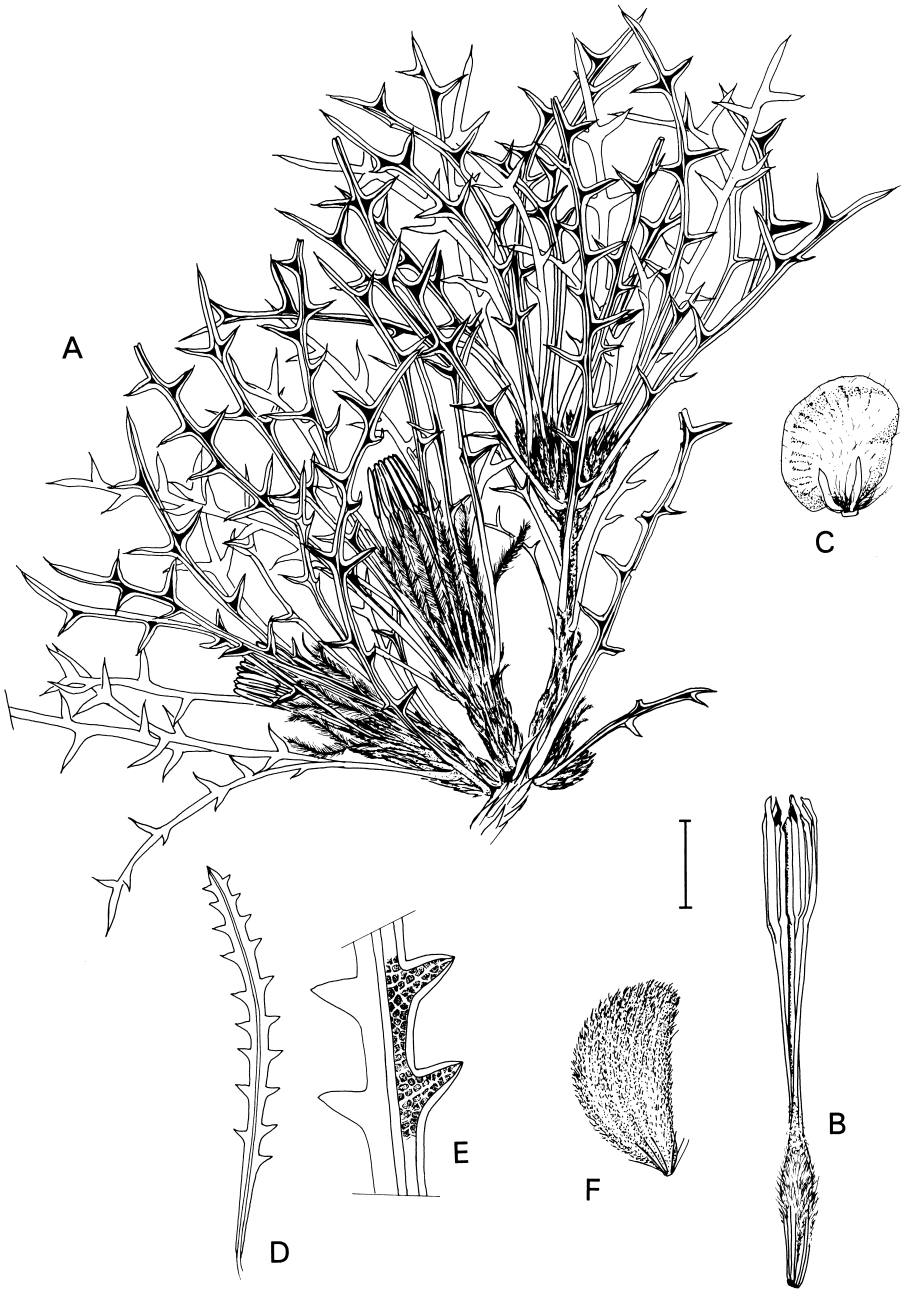


Figure 51. *Dryandra.* **A–C**, *D. erythrocephala* var. *erythrocephala*. **A,** flowering branch; **B**, flower; **C**, follicle (**A–C**, A.George 9889, PERTH). **D–E**, *D. vestita*. **D**, leaf; **E**, detail of lower surface of leaf (**D–E**, A.George 16296, PERTH). **F**, *D. speciosa* subsp. *speciosa*, follicle (A.George 16758, PERTH). Scale bar: **A** = 2 cm; **B** = 5 mm; **C** = 7 mm; **D** = 2.4 cm; **E–F** = 8 mm. Drawn by: **A–E**, P.Nikulinsky; **F**, P.Dundas.

62b. Dryandra erythrocephala var. **inopinata** A.S.George, *Nuytsia* 10: 379 (1996)

T: Hopkins Reserve, SE of Kulin, W.A., 1 Aug. 1986, *A.S.George 16743*; holo: PERTH; iso: CANB, K, MEL, NSW.

Perianth 23–28 mm long, yellow throughout. Pistil 22–27 mm long.

Recorded near Dumbleyung, Kulin and Nyabing, south-western W.A. Grows in sand over laterite, in kwongan. Flowers Mar.–July. Map 355.

W.A.: North Kukerin–Tarin Rock road, 10 km SE of intersection with Muller and Springhurst/Boundary and unnamed road, *K.Alcock 345* (MEL); S of Nyabing, *A.S.George 16697* (PERTH).

63. Dryandra horrida Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 476 (1856)

Josephia horrida (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 4: 314*; holo: NY; iso: BM, CGE, K, MEL, PERTH.

Shrub to 2 m, probably with lignotuber. Stems hirsute, with many subulate prophylls. Leaves: petiole to 15 mm long; lamina narrowly linear, pinnatifid, 4–14 cm long, 5–10 mm wide, acute, pungent, white-tomentose below; margins revolute; teeth 5–12 each side, narrowly and obliquely triangular, to 4 mm long, pungent. Inflorescences sessile, axillary or on short lateral branchlets, often closely successive, occasionally terminal; involucral bracts linear, to 3 cm long, acute, densely hirsute; flowers 35–60 per head. Perianth 24–32 mm long, yellow, villous above base, becoming glabrous in upper half; limb 5-6 mm long. Pistil straight, 23–31 mm long, cream, pubescent at base, glabrous above; pollen presenter narrow, tapering, 3–3.5 mm long, smooth. Follicles several, broadly and obliquely obovate, 11–12 mm long, hirsute. Fig. 52.

Occurs in a few localities in the central wheatbelt, W.A., between Tammin, Corrigin and Narembeen; grows in gravelly clay and sand in kwongan; flowers Mar.–June. Map 356.

W.A.: Tammin, *C.A.Gardner 12328* (PERTH); near Corrigin, *A.S.George 7757* (CANB, PERTH); 6 km NW of Yoting, 22 Oct. 1964, *K.Newbey s.n.* (PERTH); 1.6 km W of Culbarting Rock, *B.H.Smith 342* (HO, MEL).

Distinguished from its close relatives by the linear leaves with small teeth and by the small flowers. Usually much more bushy and densely-leaved than *D. vestita*.

64. Dryandra vestita Kippist ex Meisn., *Hooker's J. Bot. Kew Gard. Misc*. 7: 121 (1855)

Josephia vestita (Kippist ex Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 5, suppl.: 20*; syn: BM, CGE, K, MEL, PERTH.

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 37, t. 50 (1984).

Shrub to 1.5 m, with lignotuber. Stems tomentose, covered in subulate, hirsute prophylls. Leaves: petiole 5–15 mm long; lamina broadly linear, pinnatifid, 8–15 cm long, 7–13 mm wide, pungent, closely white-tomentose and reticulate below; margins recurved; teeth 4–12 each side, obliquely triangular, pungent, to 5 mm long. Inflorescences on short lateral branchlets, often clustered, occasionally terminal; involucral bracts linear-subulate, to 35 mm long, pubescent and densely ciliate; flowers 30–40 per head. Perianth 27–32 mm long, yellow, villous above base, becoming glabrous in upper half, with a tuft of long caducous hairs on limb apex; limb 5–6.5 mm long. Pistil straight, 26–31 mm long, pale yellow, glabrous; pollen presenter narrow, c. 3 mm long, finely ribbed. Follicles few, obliquely broadly obovate, 10–14 mm long, sparsely pubescent. Fig. 51D, E.

Occurs widely from Eneabba to Lake Grace, south-western W.A., growing in sand over laterite in kwongan. Flowers Jan.–Apr. Map 357.

W.A.: Charles Gardner Flora Reserve, S of Tammin, *B.Barnsley 948* (CANB, PERTH); c. 14 km S of Quairading, *J.S.Beard 3900* (PERTH); Eneabba, 28 Feb. 1971, *C.Chapman* (PERTH).

Flowers mainly in summer. Leaves broader, usually with larger lobes, than *D. horrida*, clustered towards the top of an annual increment, the stem below leafless or almost so but covered in prophylls.

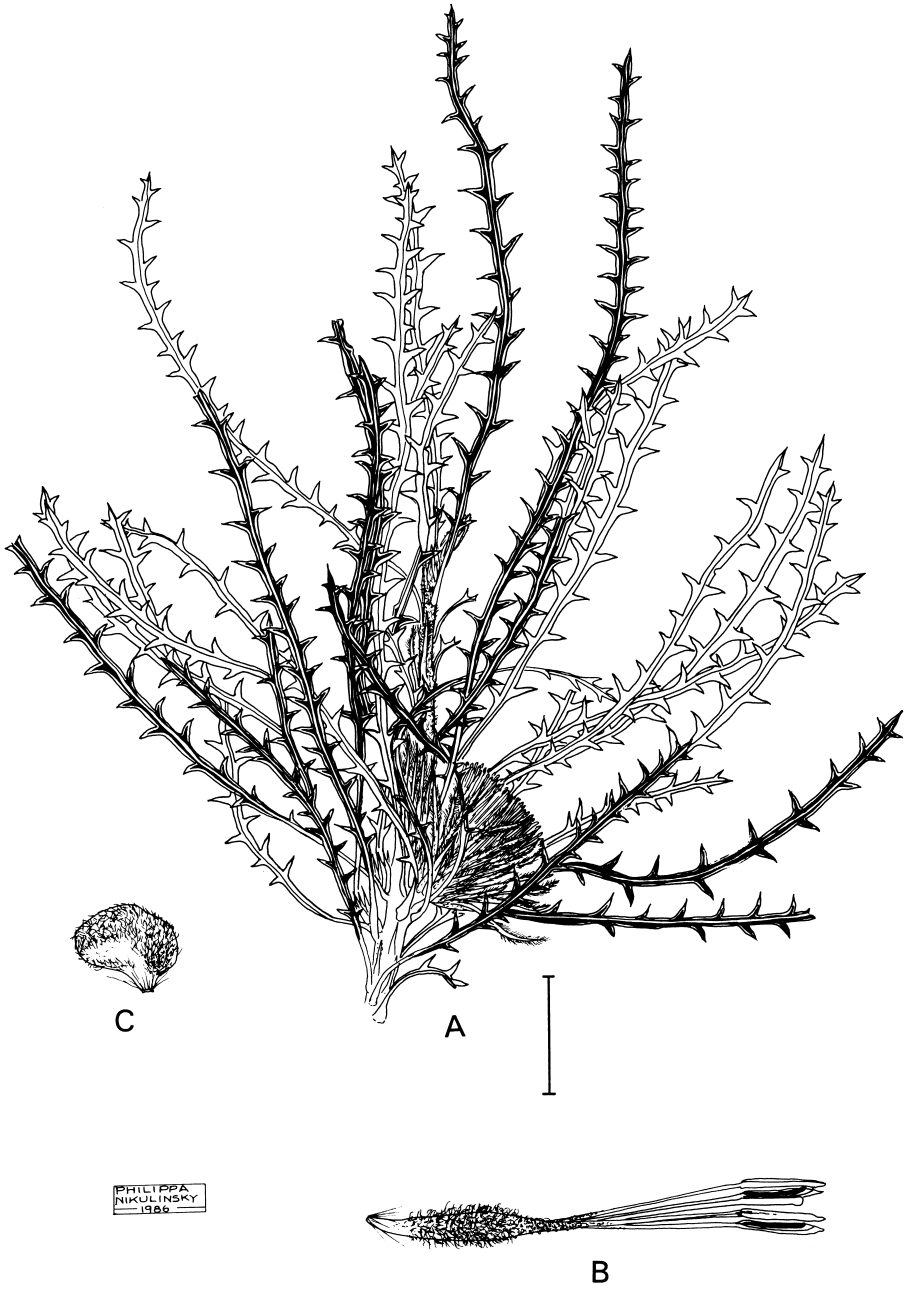


Figure 52. *Dryandra horrida*. **A**, inflorescence and subtending leaves; **B**, flower; **C**, follicle (**A–C**, A.George 7757, PERTH). Scale bar: **A, C** = 1 cm; **B** = 2.5 mm. Drawn by P.Nikulinsky.

Figure 53. *Dryandra viscida*. **A**, inflorescence and subtending leaves; **B**, detail of lower surface of leaf; **C**, follicle (**A–C**, C.Alcock 493, PERTH). Scale bar: **A** = 2.5 cm; **B** = 2 mm; **C** = 1.1 cm. Drawn by D.Boyer.

65. Dryandra viscida A.S.George, *Nuytsia* 10: 380 (1988)

T: Hatter Hill, W.A., 30 July 1969, *A.S.George 9446*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Dense, rounded shrub to 1 m, without lignotuber. Stems hirsute, densely leaved and with many prophylls. Leaves: petiole to 5 mm long; lamina linear, pinnatifid, 15–35 cm long, 5–10 mm wide, acute, pungent, rusty-tomentose in pits below; margins revolute; lobes 25–75 each side, triangular, to 4 mm long, pungent. Inflorescences terminal, closely successive; involucral bracts linear, to 6 cm long, acuminate, rather soft; outer bracts viscid-hirsute; inner bracts hirsute on upper margin; flowers 40–55 per head. Perianth 55–56 mm long, golden yellow, hirsute above base, glabrous distally except coarse hairs on limb until anthesis; limb 14–15 mm long. Pistil straight or slightly incurved, 54–55 mm long, yellow, sparsely hirsute above ovary, glabrous distally; pollen presenter gradually narrowed, c. 10 mm long, obscurely ribbed. Follicles several, ±oblong with narrowed base, 15–16 mm long, sparsely hairy, viscid. Fig. 53.

Restricted to Digger Rocks, Middle and South Ironcap and Hatter Hill, W.A., growing in laterite in thick scrub. Flowers Aug.–Sept. Map 358.

W.A.: South Ironcap, *K.Alcock 439* (CANB, MEL, PERTH); W of Digger Rocks, *S.D.Hopper 5300* (PERTH).

A distinctive species with viscid involucral and floral bracts and perianth bases; tepals very slender with long limb; pollen presenter not clearly demarcated at base and the follicles large and also somewhat viscid.

66. Dryandra mimica A.S.George, *Nuytsia* 5: 49 (1984)

T: corner of Brentwood Rd & Crystal Brook Rd, Wattle Grove, W.A., 17 Dec. 1972, *A.S.George 11648*; holo: PERTH; iso: AD, CANB, K, MEL, NSW, PERTH.

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 44, t. 60 (1984).

Prostrate shrub, with lignotuber. Stems short, underground, covered with linear, rusty-tomentose prophylls. Leaves: petiole 4–6 cm long; lamina narrowly cuneate, 13–35 cm long, 5–15 mm wide, pungent, tomentose below; margins recurved, dentate; teeth 20–60 each side, 1–2 mm long. Inflorescence terminal, succeeding ones closely successive; involucral bracts linear, 17–22 mm long, attenuate, villous in lower $^2/_3$, distally hirsute and tomentose; flowers 20–50 per head. Perianth 25–30 mm long, yellow, villous with curled hairs above base, glabrous above except an apical tuft of long twisted hairs; limb 6–8 mm long. Pistil 24–27 mm long, yellow, glabrous; pollen presenter tapering, scarcely delimited at base, 3–4 mm long, smooth. Follicles ±oblong, with upper margin oblique, 13–20 mm long, 8–10 mm wide, appressed-hairy. *Summer Honeypot*. Fig. 54.

Occurs in three disjunct areas of south-western W.A. — near Mogumber, Perth and in the Whicher Ra. Grows in sandy soil, near Mogumber in kwongan, near Perth on a winter-damp flat in low kwongan with *Kingia*, and in the Whicher Ra. in *Banksia* low open woodland. Listed as 'Endangered' in the ANZECC Threatened Flora List 1997. Flowers Dec.–Jan. Map 359.

W.A.: Acton Park Rd, Whicher Ra., *G.S.McCutcheon 823* (PERTH); W of Mogumber Siding, *A.S.George 14165* (Perth).

A distinctive member of the series in its short underground stems, many leaf teeth and large follicles. Old flowers persistent for several years. Superficially resembles *D. lindleyana*. A rare species, now cleared at the type locality and threatened by clearing at one location near Mogumber but conserved in State Forest in the Whicher Ra. A further population has been found near Mogumber.

67. Dryandra speciosa Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 479 (1856)

Josephia speciosa (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 5, suppl.: 19*; holo: NY; iso: BM, CGE, K, MEL, NSW, PERTH.

Shrub to 2 m, much-branched, without lignotuber. Stems appressed-tomentose. Leaves: petiole 2–5 mm long; lamina linear, 5–10 cm long, 1–1.5 mm wide, pungent, appressed-

Figure 54. *Dryandra mimica*. **A**, inflorescence and subtending leaves; **B**, flower (**A–B**, not recorded). Scale bar: **A** = 2 cm; **B** = 5 mm. Drawn by P.Nikulinsky.

hirsute and glabrescent above, woolly below; margins entire, closely revolute. Inflorescence terminal or on short lateral branchlet, nodding; involucral bracts linear-subulate; outermost bracts ±filiform, not rigid, 4–5 cm long, spreading-hirsute outside, closely tomentose towards base; flowers 65–115 per head. Perianth 24–30 mm long, cream in lower half, maroon or yellow above, villous near base, glabrous above; limb 6–7 mm long, ribbed when dried. Pistil 23–29 mm long, cream, glabrous; pollen presenter not thickened, tapering, 5–5.5 mm long, pale red. Follicles to 8 per head, obliquely obovate, 18–25 mm long, tomentose.

Occurs in two disjunct areas in south-western W.A., one from Tathra Natl Park south to Badgingarra, the other around Tammin.

A distinctive species in its entire, linear leaves and nodding heads surrounded by many narrow, hirsute bracts. Flowers with pungent sweetish scent similar to that of many species of *Banksia*, openly spaced at anthesis. There are two subspecies, with both yellow- and maroon-flowered plants occurring in each.

Flowers 85–115 per head; follicles 18–21 mm long; Tammin **67a.** subsp. **speciosa**

Flowers 65–75 per head; follicles 24–25 mm long; Tathra–Badgingarra **67b.** subsp. **macrocarpa**

67a. Dryandra speciosa Meisn. subsp. **speciosa**

Illustrations: M.Morcombe, *Australia's Wildfl.* 98, 106 (1970); A.S.George, *Introd. Proteaceae W. Australia* 38, t. 51 (1984); R.M.Sainsbury, *Field Guide Dryandra* 97 (1985).

Flowers 85–115 per head, pale gold through pink to red or maroon. Follicles 18–21 mm long. Fig. 51 F.

Occurs near Tammin, W.A. Grows in sand in kwongan. Flowers July–Aug. Map 360.

W.A.: Tammin, Nov. 1920, *C.A.Gardner s.n.* (PERTH).

67b. Dryandra speciosa subsp. **macrocarpa** A.S.George, *Nuytsia* 10: 381 (1996)

T: N of Coorow–Greenhead road on Willis Rd, W.A., 5 Aug. 1986, *A.S.George 16784*; holo: PERTH; iso: CANB, K, MEL, NSW.

Flowers 65–75 per head, pale gold through pink to red or maroon. Follicles 24–25 mm long. Plate 60.

Occurs from Tathra Natl Park to Badgingarra, W.A., growing in sandy loam in kwongan. Flowers July–Aug. Map 361.

W.A.: Tathra Natl Park, *J.Coleby-Williams 292* (PERTH); Alexander Morrison Natl Park, *E.A.Griffin 1554* (CANB, PERTH).

68. Dryandra shuttleworthiana Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 122 (1855)

Josephia shuttleworthiana (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1850–51, *J.Drummond 6: 208*; holo: NY; iso: BM, CGE, K, MEL, PERTH.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 39, t. 53 (1984); R.M.Sainsbury, *Field Guide Dryandra* 95 (1985).

Shrub to 70 cm, with lignotuber. Stems slender, tomentose, usually with slender prophylls at base and undeveloped inflorescences. Leaves: petiole to 5 mm long; lamina linear, pinnatisect, 3–14 cm long, 4–7 mm wide, emarginate with obtuse recurved mucro, white-tomentose below; margins revolute; teeth 15–50 each side, triangular, obtusely mucronate. Inflorescence on old stem, occasionally terminal; involucral bracts subulate; outer bracts slender, 3–4 cm long, hirsute-plumose; flowers 30–45 per head. Perianth 25–35 mm long, cream in lower half, dull purple above, densely hirsute above base; limb 8–13 mm long, with a few caducous long hairs at apex, otherwise glabrous. Pistil straight, 24–35 mm long, cream, pubescent at base, glabrous above; pollen presenter not thickened, 6–10 mm long, obscurely ribbed. Follicles few, obovate, 16–24 mm long, tomentose. Fig. 55A, B.

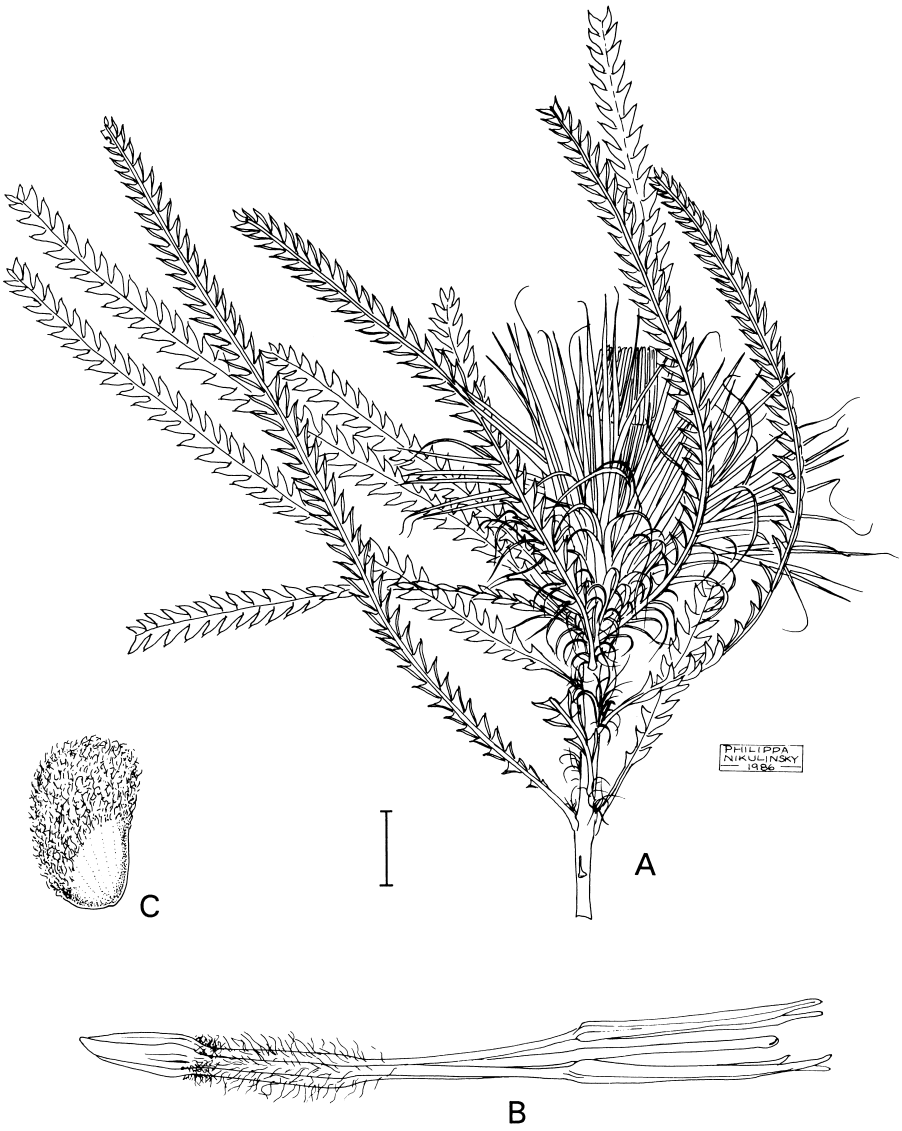


Figure 55. *Dryandra*. **A–B**, *D. shuttleworthiana*. **A**, inflorescence and subtending leaves; **B**, flower (**A–B**, not recorded). **C**, *D. pseudoplumosa*, follicle (A.George 16660, PERTH). Scale bar: **A** = 9 mm; **B** = 4 mm; **C** = 7 mm. Drawn by: **A–B**, P.Nikulinsky; **C**, P.Dundas.

Occurs between Geraldton and Gingin, south-western W.A. Grows in lateritic soil and in sand over laterite, in kwongan. Flowers July–Sept. Map 362.

W.A.: Burma Rd, *A.C.Burns 10* (PERTH); Mogumber, July 1936, *C.A.Gardner s.n.* (PERTH); Cockleshell Gully, *C.A.Gardner 8432* (PERTH); junction of Coorow–Greenhead road and Tootbardi Rd, *A.S.George 16780* (PERTH); 15 km N of Cataby Ck, Brand Hwy, *R.J.Hnatiuk 760060* (PERTH).

Flowers with a strong musky scent. Fruit firmly attached, most persisting unopened until burnt. Many inflorescences do not develop to flowering.

Ser. 19. Plumosae

Dryandra ser. **Plumosae** A.S.George, *Nuytsia* 10: 382 (1996)

Type: *D. plumosa* R.Br.

Shrubs without lignotuber. Leaves petiolate; lamina pinnatifid, pinnatipartite or pinnatisect, with 20–60 lobes each side; margins recurved to revolute. Inflorescence axillary, sessile or on short branchlet, usually below current season's foliage and hidden; involucral bracts linear-filiform or lanceolate, long-hirsute or villous, as long as or somewhat shorter than flowers; receptacle flat or convex. Perianth short, usually curved, the limb turned downwards before anthesis or in *D. pseudoplumosa* curved centripetally. Pistil longer than perianth, curved downwards or in *D. pseudoplumosa* centripetally; pollen presenter not or slightly thickened, ribbed. Flowers ?falling. Follicles obliquely ovate, hairy or almost glabrous, firmly attached, opening when burnt. Seed wing not notched.

A series of three species in the Stirling Ra.–Fitzgerald R. region, south-western W.A.

69. Dryandra plumosa R.Br., *Trans. Linn. Soc. London* 10: 214 (1810)

Josephia plumosa (R.Br.) Poir., *Dict. Sci. Nat.* 24: 247 (1822). T: Lucky Bay, [W.A.], Jan. 1802, *R.Brown Iter Austral. 3421*; syn: BM, K, MEL.

Shrub to 2.5 m, without lignotuber. Stems tomentose and hirsute, with linear, villous prophylls. Leaves: petiole 5–20 mm long; lamina broadly linear, pinnatifid to pinnatipartite, 8–30 cm long, 7–18 mm wide, obtuse or truncate, mucronate, rusty-villous above and on midrib below, glabrescent above, remaining tomentose below; margins recurved; lobes 25–40 each side, triangular, obtuse or acute. Inflorescence axillary, sessile, often clustered, with many small leaf-like bracts; involucral bracts linear to terete with filiform apex, long-hirsute; innermost bracts to 30 mm long, pale brown; flowers 45–80 per head. Perianth 16–20 mm long, cream, white at base, curled-villous above base, long-hirsute on claws; limb 2.7–3 mm long, broadest just above middle, ±obtuse, openly hirsute, with apical hairs longer. Pistil curved downwards, 19–27 mm long, cream, glabrous; pollen presenter not or scarcely thickened, 0.9–1 mm long, ribbed, pale green. Follicles 1–3 per head, curved-obovate, 10–15 mm long, 7–15 mm wide, openly hirsute, glabrescent. Seed wing greatly expanded to 1 side.

Occurs from Albany to the Stirling Ra. and east to the Fitzgerald R., W.A. Although Brown's type is labelled Lucky Bay (near Esperance), the species has not been recorded again so far east and it seems likely that the correct locality is the Albany district where Brown collected in Dec. 1801. There are two subspecies.

Leaves pinnatifid to pinnatipartite; lobe margins (at least the lower) concave, prominently recurved; lamina relatively thick — **69a.** subsp. **plumosa**

Leaves almost pinnatisect; lobe margins usually gently convex, slightly recurved; lamina relatively thin — **69b.** subsp. **denticulata**

69a. Dryandra plumosa R.Br. subsp. plumosa

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 69 (1985), as *D. plumosa*.

Leaves pinnatifid to pinnatipartite; lobe margins (at least the lower) concave, prominently recurved; lamina relatively thick. Follicles 11–15 mm long, 12–15 mm wide.

Occurs in W.A. from Cape Riche to West Mt Barren and inland to Chillinup and, according to the type, at Lucky Bay but not recorded there again. Grows in sandy loam or clay-loam over gravel and gravelly loam, in kwongan, often also with mallees. Flowers recorded in most months. Map 363.

W.A.: near Cape Riche, *C.A.Gardner 13809* (PERTH); Pallinup R. near Chillinup, *C.A.Gardner 13814* (PERTH); West Mt Barren, *A.S.George 10036* (PERTH).

Old flowers soon falling. A collection from the Pallinup R. (*C.A.Gardner s.n.*, PERTH) has a less hirsute perianth 18–21 mm long, the pistil 27–33 mm long and the follicle 11 mm long, 10 mm wide.

69b. Dryandra plumosa subsp. **denticulata** A.S.George, *Nuytsia* 10: 383 (1996)

T: NW slope of Bluff Knoll, W.A., 12 Dec. 1982, *K.H.Rechinger 60427*; holo: PERTH; iso: W *n.v.*

Leaves almost pinnatisect; lobes margins usually gently convex, slightly recurved; thinner in texture than subsp. *plumosa*. Follicles 10–12 mm long, 7–11 mm wide.

Endemic in the Stirling Range Natl Park, W.A. Grows in rocky or gravelly sand, in Jarrah–Marri woodland and in lower montane tall shrubland. Flowers Dec. Map 364.

W.A.: Kojaneerup Spring, *G.J.Keighery 4921* (PERTH).

Outermost involucral bracts usually minutely denticulate and leaf lobes commonly more acute than those of subsp. *plumosa*.

70. Dryandra pseudoplumosa A.S.George, *Nuytsia* 10: 383 (1996)

T: 17 km E of Red Gum Pass turnoff on Salt River Rd, Stirling Range Natl Park, W.A., 25 Nov. 1986, *M.Pieroni 26*; holo: PERTH; iso: CANB, NSW, PERTH.

Shrub to 1.8 m, without lignotuber. Stems villous. Leaves: petiole 1–2 cm long; lamina broadly linear, pinnatipartite, 8–17 cm long, 6–15 mm wide; margins revolute; lobes 15–31 per side, triangular, acute, pungent, with lower edge concave and upper edge convex. Inflorescence sessile, axillary, subtended by small 'involucral' leaves; involucral bracts broadly linear, tapering, with longest to 20 mm long, acute, villous; outermost bracts denticulate; flowers c. 90–100 per head. Perianth 16–18 mm long, golden, villous-hirsute; limb 3 mm long, sparsely pubescent and with terminal, long, twisted caducous hairs. Pistil strongly incurved, 23–25 mm long, cream, glabrous except long hairs on ovary; pollen presenter narrowly ellipsoidal, 1–1.1 mm long, ribbed, brown. Follicles 1–3 per head, broadly oblong-ovate, gently curved, 16–18 mm long, densely tomentose. Fig. 55C.

Occurs in the Stirling Range Natl Park and south-east of Ongerup, W.A. Grows in sandy gravel in open mallee shrubland and Jarrah-Marri woodland. Flowers Nov.–Dec. Map 365.

W.A.: between Chillinup and Ongerup, *C.A.Gardner 13814* (PERTH); Salt River Rd, 16.9 km E of Red Gum Pass turnoff, *A.S.George 16660* (PERTH); Red Gum Pass, 7 Oct. 1902, *A.Morrison* (PERTH); between Yetemerup and Warrungup, 15 Oct. 1902, *A.Morrison* (PERTH).

Differs from *D. plumosa* in having shorter, thicker involucral bracts without filiform tips, more flowers per head, the pistils bowed ±equally around head, and the larger, densely tomentose follicles.

71. Dryandra montana C.A.Gardner ex A.S.George, *Nuytsia* 10: 384 (1996)

T: Bluff Knoll, Stirling Ra., W.A., 16 Jan. 1966, *K.Newbey 2226*; holo: PERTH; iso: CANB.

Shrub to 2.5 m, without lignotuber. Stems rusty-villous. Leaves: petiole 10–30 mm long; lamina linear, pinnatisect, 8–25 cm long, 6–11 mm wide, hirsute, glabrescent above, closely tomentose below but reticulum evident and midrib prominent; margins revolute; lobes 35–60 each side, obliquely triangular, slightly overlapping at base, strongly curved adaxially and twisted so that the underside faces apex of leaf. Inflorescence sessile on branchlet 1 or 2 years old; involucral bracts linear to lanceolate, obtuse to acute, woolly-villous outside, glabrous inside; innermost bracts c. 15 mm long; flowers 50–60 per head. Perianth

17–19 mm long, yellow, villous grading to hirsute on claws; limb 3 mm long, closely pubescent and with a few long hairs towards apex. Pistil gently curved downward, 18–21 mm long, pale yellow, glabrous except long hairs at apex of ovary; pollen presenter scarcely thickened, 0.8–1 mm long, ribbed. Follicles obliquely ovate, 9–11 mm long, sculptured, sparsely hairy, dark red-brown.

Confined to the higher slopes of Bluff Knoll, Stirling Range Natl Park, W.A. Grows in rocky soil in kwongan. Listed as 'Endangered' in the ANZECC Threatened Flora List 1997. Flowers Jan. Map 366.

W.A.: Bluff Knoll, *F.Lullfitz 3267* (PERTH).

Almost extinct in the wild. The twisted leaf lobes are distinctive.

Ser. 20. Concinnae

Dryandra ser. **Concinnae** Benth., *Fl. Austral.* 5: 564, 570 (1870)

Type: *D. concinna* R.Br.

Dryandra § *Serratae* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 470 (1856). T: *D. serra* R.Br.

Tall shrubs, without lignotuber. Leaves petiolate; lamina dentate, serrate or pinnatifid; margins flat to slightly revolute. Inflorescences small, on short lateral branchlets or axillary; involucral bracts much shorter than flowers; receptacle ±flat. Perianth curved upwards in 1 species, the limb inflexed in the second and turned downwards in the third. Pistil longer than perianth, curved downwards, or downwards and with apex upturned; pollen presenter short, ovoid or cylindrical, smooth or obscurely ribbed. Flowers falling or persistent. Follicles 1 or few, ovate to elliptic or oblong, oblique, firmly attached, opening when burnt. Seed wing with small notch.

A series of three species near the south coast from Walpole to Albany and in the Stirling Ra., W.A.

72. Dryandra concinna R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 38 (1830)

Josephia concinna (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: near King George Sound, [W.A.], 1829, *W.Baxter*; syn: BM, K.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 25 (1985).

Shrub to 4 m, without lignotuber; stems 1 or few, erect. Stems glabrescent. Leaves: petiole 3–6 mm long; lamina elliptic, 3–15 cm long, 10–30 mm wide, obtuse to truncate, mucronate, closely tomentose below; margins flat to slightly revolute, dentate; teeth 5–20 each side, obliquely triangular, 5–7 mm long. Inflorescence on short lateral branchlet; involucral bracts narrowly ovate to linear, to 8 mm long, silky-villous; floral bracts hirsute both sides; flowers 32–36 per head. Perianth gently upcurved, 13–17 mm long, pale yellow, curled-villous in lower half, hirsute distally, with long hairs on limb; limb 1.8–2 mm long. Pistil bowed downwards with upturned apex, 17–20 mm long, pale yellow, silky above ovary, glabrous distally; pollen presenter narrowly ovoid, 0.3 mm long. Follicles 1 or 2, very obliquely ovate, 10–13 mm long, hirsute mainly on lower outer margin. Fig. 57D.

Occurs in the Stirling Range Natl Park and near Albany, W.A., on rocky shale slopes in dense kwongan and shrubland. Flowers Aug.–Nov. Map 367.

W.A.: Mt Toolbrunup, *A.M.Ashby 1621* (PERTH); Talyuberlup, *J.S.Beard 7597* (PERTH); near summit, Bluff Knoll, Stirling Range Natl Park, *S.J.Forbes 1126* (MEL).

Distinguished by the open habit, elliptic dentate leaves, small inflorescences with upturned flowers, small pollen presenter and very oblique follicles. Old flowers soon falling.

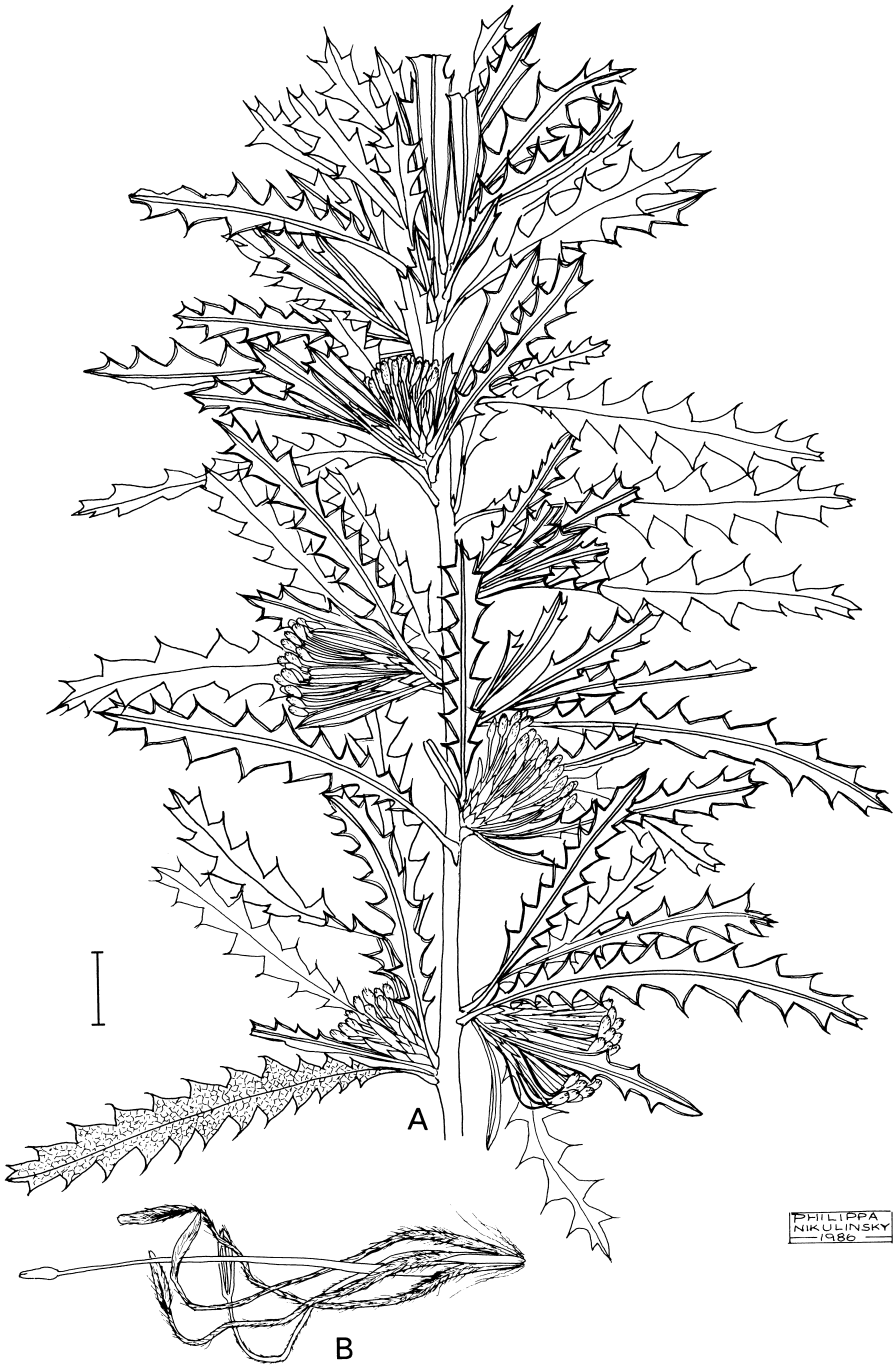


Figure 56. *Dryandra serra*. **A**, inflorescence and subtending leaves; **B**, flower (**A**–**B**, A.George 9486, PERTH). Scale bar: **A** = 8 mm; **B** = 1.5 mm. Drawn by P.Nikulinsky.

73. Dryandra serra R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 38 (1830)

Josephia serra (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: mountains [possibly Mt Willyung] near King George Sound, [W.A.], 1829, *W.Baxter*; holo: BM; iso: K, MEL, NSW.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 89 (1985).

Shrub to 6 m with 1–several slender, erect stems, without lignotuber. Stems tomentose, soon glabrescent except in axils. Leaves: petiole 4–10 mm long; lamina broadly linear, 3–15 cm long, 5–15 mm wide, acute or obtuse, mucronate, glabrous above, closely tomentose and ±nerveless below except midrib; margins slightly recurved, serrate; lobes 8–20 each side, broadly triangular, mucronate. Inflorescence on short, leafy, lateral branchlet; involucral bracts narrowly ovate to lanceolate, erect, obtuse to acute, appressed-pubescent (inner ones only on margins); innermost bracts 6–8 mm long; floral bracts hirsute one side, glabrous the other; flowers 20–36 per head. Perianth ±straight with upturned limb, 16–19 mm long, pale yellow, silky-villous above base with ±straight hairs; claw slender, pubescent; limb 2–2.3 mm long, silky-hirsute. Pistil curved downwards with gently upturned apex, 19–21 mm long, cream, hirsute above ovary, glabrous distally; pollen presenter narrowly ovoid, 0.5 mm long, not ribbed, green. Follicles ovate but strongly curved to one side, 12–18 mm long, pubescent but glabrescent, firmly attached. Fig. 56.

Occurs from Bow R. to Mt Manypeaks, W.A. Grows in granitic clay or lateritic loam, in woodland and forest and in mallee-kwongan. Flowers July–Oct. Map 368.

W.A.: Hunwick Rd, Redmond State Forest, *J.A.Cochrane 406* (PERTH); N of South Coast Hwy on Nornalup Rd, *A.S.George 16578* (PERTH); W slope of Mt Manypeaks, *G.J.Keighery 8257* (PERTH).

A distinctive species in its tall, slender habit with widely-spaced leaves on the main stems, small heads of pale yellow flowers with unusual floral bracts and conspicuous follicles. The juvenile leaves are up to 20 cm long and the old flowers are persistent.

74. Dryandra foliolata R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 38 (1830)

Josephia foliolata (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: mountains near King George Sound, [W.A.], 1829, *W.Baxter*; syn: BM, K, NSW.

Dryandra mutica Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 471 (1856); *Josephia mutica* (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 4: 309*; syn: BM, CGE, K, MEL, NSW.

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 41 (1985).

Shrub to 3 m, without lignotuber. Stems tomentose and hirsute. Leaves: petiole 5–40 mm long; lamina ±oblong, pinnatifid, 6–20 cm long, 1–2 cm wide, obtuse or emarginate, shortly mucronate, villous but glabrescent above, closely tomentose below with prominent midrib; margins shortly recurved; lobes 10–35 each side, obliquely ovate, obtuse to acute. Inflorescence axillary, sessile, crowded in groups; involucral bracts ovate-lanceolate, rusty or pale villous, somewhat sticky; innermost bracts to 13 mm long; floral bracts hirsute one side; flowers 50–60 per head. Perianth 17 mm long, cream, closely curled-villous above base, hirsute distally; limb 1.6–2.5 mm long, pale green, hirsute. Pistil curved evenly downwards, 20–24 mm long, maroon in upper half, glabrous; pollen presenter cylindrical to narrowly ovate, 0.5–0.8 mm long, obscurely ribbed, maroon. Follicles oblong to obliquely elliptic, 11–14 mm long, loosely hirsute in upper half, glabrous below.

Endemic in the Stirling Range Natl Park, from Mondurup westwards, W.A. Grows on rocky slopes in dense shrubland. Flowers Oct.–Nov. Map 369.

W.A.: Scenic Drive, below N side of Mondurup, *A.S.George 16884* (PERTH); Peak Donnelly, *F.Lullfitz 2307* (PERTH); Mt Ross, *K.Newbey 918* (PERTH); Mondurup, *A.Strid 21534* (PERTH).

Flowers all ±down-turned; old flowers soon falling. Usually has small leaves with ±retrorse lobes surrounding the flower heads.

Ser. 21. Obvallatae

Dryandra ser. **Obvallatae** Benth., *Fl. Austral.* 5: 564, 576 (1870)

Type: *D. conferta* Benth.

Erect shrubs, often columnar, without lignotuber. Leaves crowded, petiolate; lamina pinnatifid, serrate or dentate; margins recurved to revolute. Inflorescence small, sessile or on short lateral branchlet, hidden or partly so within foliage; involucral bracts shorter or longer than pistil; receptacle convex. Perianth straight or downcurved, with limb prominently downcurved before anthesis. Pistil prominently downcurved (in *D. columnaris* curved up then down), longer than perianth; pollen presenter small, not or scarcely thickened. Flowers falling or persistent. Follicles erect, 1–few, usually ovate, obovate, cuneate or transversely elliptic, hairy, opening when burnt. Seed wing with or without notch.

A series of seven species in south-western W.A. Characterised especially by the columnar habit and small inflorescences typically with downcurved flowers.

75. Dryandra fasciculata A.S.George, *Nuytsia* 10: 386 (1996)

T: 23 miles [c. 37 km] E of Harrismith, W.A., 28 May 1969, *A.S.George 9330*; holo: PERTH; iso: AD, BRI, CANB, K, MEL, NSW, PERTH.

Shrub to 1.5 m, without lignotuber, columnar. Stems villous. Leaves crowded, with overlapping petioles; petiole 1–4 cm long, rusty hirsute; lamina linear, decurved, 6–18 cm long, 7–10 mm wide, acute, pungent, closely tomentose below; margins recurved, dentate or serrate; teeth 5–15 each side, to 4 mm long. Inflorescence sessile or on short branchlet; involucral bracts many, narrow, 25–33 mm long, rusty brown, silky-villous; flowers 40–60 per head. Perianth ±straight with downturned limb, 18–22 mm long, creamy yellow, curled-villous in lower half, silky distally; limb 2.5–3 mm long, sparsely hirsute. Pistil downcurved, 23–31 mm long, yellow, glabrous except hirsute ovary; pollen presenter not thickened, 1.5 mm long, ribbed, red. Follicles obovate, 6–9 mm long, hirsute. Fig. 57E.

Occurs between Corrigin and Kukerin, W.A. Grows in gravel and sand over gravel, in mallee-kwongan. Flowers late May–Aug. Map 370.

W.A.: c. 13 km SE of Yealering, *A.S.George 9403* (PERTH); 31 km W of Lake Grace, *A.S.George 16707A, B* (CANB, PERTH); 2 km W of Corrigin, *A.S.George 16750* (CANB, K, MEL, NSW, PERTH); 9 km E of Dudinin, *M.Pieroni 28* (MEL).

Differs from *D. rufistylis* in the yellow style and red pollen presenter, the larger flowers, the silky-villous upper half of the perianth claws and the obovate follicles. The species may be recognised especially by the numerous, narrow involucral bracts, the crowded overlapping petioles, and the usually dentate leaves.

76. Dryandra conferta Benth., *Fl. Austral.* 5: 578 (1870)

Josephia conferta (Benth.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1840s, *J.Drummond 3: 295*; lecto: K, *fide* A.S.George, *Nuytsia* 10: 387 (1996); isolecto: BM, CGE, K, MEL, PERTH.

Shrub to 2.5 m, without lignotuber, columnar, rarely spreading. Leaves: petiole to 1 cm long, hirsute or pubescent; lamina linear, deeply serrate to pinnatifid, 5–15 cm long, 8–15 mm wide, pungent, closely tomentose below, sometimes remaining puberulous above with curled hairs; margins recurved to revolute; lobes 8–13 each side, to 9 mm long, linear to narrowly triangular. Inflorescence on short branchlet or sessile; involucral bracts linear, to 15 mm long, rusty-villous or velvety; flowers 40–75 per head. Perianth ±straight with limb downturned before anthesis, 15–18 mm long or 21–25 mm long, creamy yellow including limb, woolly above base, villous distally; limb 3–4 mm long, hirsute. Pistil downcurved, 16–26 mm long or 25–30 mm long, yellow, glabrous except hirsute ovary; pollen presenter not thickened, 1.5–1.8 mm long, smooth, green. Follicles obliquely obovate or elliptic, 9–13 mm long, hirsute.

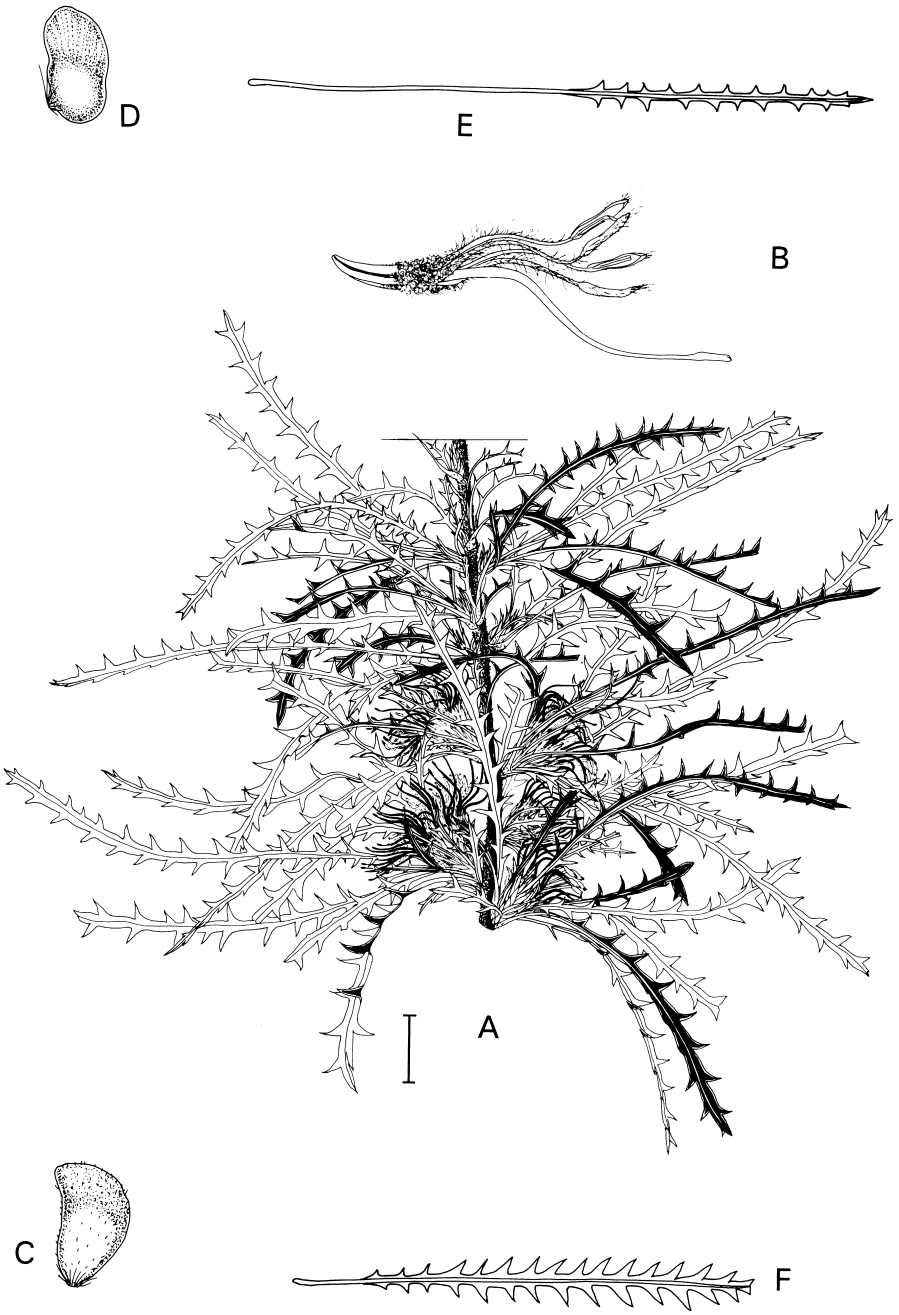


Figure 57. *Dryandra*. **A–C**, *D. conferta* var. *conferta*. **A**, flowering branch; **B**, flower (**A–B**, A.George 9394, PERTH); **C**, follicle (A.George 16754, PERTH). **D**, *D. concinna*, follicle (17 July 1971, A.George *s.n.*, PERTH). **E**, *D. fasciculata*, leaf (R.Davis 3133, PERTH). **F**, *D. platycarpa*, leaf (Aug. 1962, F.Humphreys, PERTH). Scale bar: **A** = 2 cm; **B** = 5 mm; **C–D** = 6 mm; **E–F** = 1.8 cm. Drawn by: **A–B**, P.Nikulinsky; **C–F**, P.Dundas.

Widespread in inland south-western W.A. from Miling and Cadoux to the Porongurup Ra. and east to Bodallin and Mt Holland. Differs from other species of ser. *Obvallatae* in the larger, all-yellow flowers and obliquely obovate or elliptic fruit. There are two varieties.

Perianth 21–25 mm long; pistil 25–30 mm long; involucral bracts villous **76a.** var. **conferta**

Perianth 15–18 mm long; pistil 16–26 mm long; involucral bracts velvety **76b.** var. **parva**

76a. Dryandra conferta Benth. var. **conferta**

Shrub to 2.5 m. Involucral bracts villous. Perianth 21–25 mm long. Pistil 25–30 mm long. Fig. 57A–C.

Occurs from Miling and Cadoux south to Ongerup and east to Bodallin and Mt Holland, W.A. Grows in lateritic loam and sandy loam in kwongan and low open-woodland. Flowers late June–Sept. Map 371.

W.A.: 26 km SW of Bodallin, *R.J.Cranfield 2315* (PERTH); c. 22 km SE of Nyabing, *A.S.George 14289* (CANB, MEL, PERTH); 4 km E of Cadoux, *A.S.George 16762* (AD, CANB, K, MEL, NSW, PERTH); 9 km SW of Lake Cronin, *K.Newbey 5810* (MEL, PERTH).

Flowers with mouse- or honey-like scent. A variable taxon. Typical var. *conferta* has linear leaf teeth and is of spreading habit. The more common form has broad teeth and is columnar. *A.S.George 14289* has a somewhat cuneate follicle. *K.R.Newbey 912* from near Neeralin Pool (PERTH) has narrow leaves mostly less than 9 mm wide. A specimen from Miling (Aug. 1972, *Seymour* (PERTH)) has coarsely lobed leaves.

76b. Dryandra conferta var. **parva** A.S.George, *Nuytsia* 10: 388 (1996)

T: South Fence Rd, 7 km NW of Albany–Lake Grace Rd, SE of Nyabing, W.A., 30 July 1986, *A.S.George 16694*; holo: PERTH; iso: CANB, PERTH.

Differs from var. *conferta* in the smaller flowers, more velvety involucral bracts, and more oblique (almost transversely obovate) follicles. Perianth 15–18 mm long. Pistil 16–26 mm long.

Occurs from the Nyabing area to the western Stirling Ra. and south of Ongerup, with a record at the east end of the Porongurup Ra., W.A. Grows in gravelly clay, clay loam and sandy loam, in kwongan and tall shrubland. Flowers June–Aug. Map 372.

W.A.: N end of Red Gum Pass, Stirling Range Natl Park, *A.S.George 16655* (PERTH); E end, Porongurup Ra., *K.Newbey 3414* (CANB, NSW, PERTH); S of Ongerup, *M.Pieroni 33* (MEL, PERTH).

77. Dryandra columnaris A.S.George, *Nuytsia* 10: 388 (1996)

T: Boyagin Nature Reserve, SW of Brookton, W.A., 29 May 1969, *A.S.George 9354;* holo: PERTH; iso: CANB, MEL, NSW, PERTH.

[*Dryandra seneciifolia auct. non* R.Br.: R.M.Sainsbury, *Field Guide Dryandra* 87 (1985)]

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 87 (1985), as *D. seneciifolia*.

Columnar shrub to 2 m, without lignotuber. Stems tomentose and hirsute. Leaves: petiole to 4 cm long, hirsute and tomentose; lamina linear, pinnatifid, 5–15 cm long, 3–15 mm wide, mucronate, white-tomentose below with long sparse hairs on midrib, sparsely hirsute and pubescent above; margins revolute; lobes 5–18 each side, triangular-falcate, to 8 mm long. Inflorescence sessile, surrounded by leaves; involucral bracts linear-subulate, to 20 mm long, glandular-pubescent, hirsute on lower margins; flowers 25–35 per head;. Perianth curved downwards, 11–14 mm long (lower flowers), 16 mm long (upper flowers), pale yellow to purple with grey-brown limb, villous with curled hairs above base, sparser distally; limb 2–2.5 mm long, sparsely hirsute. Pistil curved up then down, 13–16 mm long (lower flowers) or 19–20 mm long (upper flowers), red-brown, glabrous except hirsute ovary; pollen presenter 1.2 mm long, smooth. Follicles 1 or 2, broadly obovate or cuneate, 10–12 mm long, pubescent. Plate 61.

Localised in a few areas between Brookton and Narrogin, south-western W.A. Grows in lateritic soil in low woodland and kwongan. Flowers May–June. Map 373.

W.A.: Tutanning Nature Reserve, *A.S.George 7786* (PERTH); Dryandra, *A.S.George 16623* (CANB, PERTH).

Differs from *D. seneciifolia* in the taller habit, in having shorter, more numerous leaf lobes, in the glandular hairs of the involucral bracts, the curled hairs of the perianth and the larger fruit. The first seedling leaves are linear and entire.

78. Dryandra platycarpa A.S.George, *Nuytsia* 10: 389 (1996)

T: junction of Coorow–Greenhead Rd and Tootbardi Rd, Alexander Morrison Natl Park, W.A., 5 Aug. 1986, *A.S.George 16781*; holo: PERTH; iso: CANB, MEL.

Shrub to 80 cm, with 1–several columnar branches, without lignotuber. Stems villous and tomentose. Leaves: petiole usually 2–6 mm long, villous, glabrescent; lamina broadly linear, pinnatipartite, spreading, 4–12 cm long, 6–15 mm wide, acute to obtuse, pungent, closely tomentose below; margins revolute; lobes 10–25 each side, linear to narrowly triangular, to 8 mm long, pungent. Inflorescence on short branchlet or sessile; involucral bracts many, linear, mostly to 12 mm long, silky-villous with white hairs; flowers 60–75 per head. Perianth straight to curved with downturned limb, 13–16 mm long, cream, curled tomentose in lower half, silky-villous above; limb 2.5 mm long, gold or brown, pilose. Pistil prominently downcurved, 16–19 mm long, cream, glabrous except silky ovary; pollen presenter not thickened, 1 mm long, smooth, green or cream. Follicles transversely ovate, 9 mm long, 11–13 mm wide, sparsely pilose. Fig. 57F.

Occurs from north of Eneabba to Mogumber, W.A. Grows in deep sand or gravelly sand in low or tall kwongan. Flowers May–July. Map 374.

W.A.: c. 16 km W of Winchester, *A.C.Beauglehole 12090* (PERTH); 10 km W of Mogumber township, *A.S.George 7766* (CANB, MEL, NSW, PERTH); c. 37 km NNE of Eneabba on First North Rd, *A.S.George 16798* (CANB, PERTH); Dinner Hill, Aug. 1962, *F.W.Humphreys* (PERTH).

The only species of ser. *Obvallatae* in the kwongan north of Perth. May be recognised by the pinnatipartite leaves, short involucral bracts, small cream and brown flowers and broad follicles. Possibly should be divided into two subspecies. Plants from the Mogumber area have broader leaf lobes than those further north, and there is some variation in size of flowers.

79. Dryandra seneciifolia R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 39 (1830)

Josephia seneciifolia (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891), as *J. senecionifolia*. T: near King George Sound, [W.A.], 1829, *W.Baxter;* holo: BM; iso: K.

Dryandra cryptocephala Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 596 (1845). T: near Mt Wuljenup [= Mt Willyung], W.A., Oct. 1840, *L.Preiss 514;* holo: NY; iso: G, MEL.

Columnar shrub to 70 cm, without lignotuber. Stems hirsute. Leaves: petiole to 15 mm long, hirsute, glabrescent; lamina linear, pinnatifid, 3–5 cm long, 5–15 mm wide, mucronate, white tomentose below and sparsely hirsute in lower part; margins revolute; lobes 2–5 each side, linear, to 9 mm long. Inflorescence sessile or on short lateral branchlet, surrounded by leaves; involucral bracts linear-subulate, to 17 mm long, hirsute with spreading hairs; flowers c. 25 per head. Perianth curved downwards, 12–14 mm long, cream to pink with brown-green limb, villous with slightly crisped to straight hairs; limb 2–2.5 mm long, sparsely hirsute. Pistil curved downwards, 17–19 mm long, reddish, glabrous; pollen presenter not thickened, 1 mm long, smooth, green. Follicle 1, narrowly ovate, 7–9 mm long, sparsely hirsute.

Occurs from Albany to the Stirling Range Natl Park, W.A., but all records this century are from the Stirling Ra. Grows in gravelly clay-loam, in mallee-kwongan. Flowers July–Aug. Map 375.

W.A.: Hamilla Hill, *A.Cochrane JAC466* (PERTH); Red Gum Pass road, Stirling Range Natl Park, *A.S.George 16654* (PERTH); near Mt Talyuberlup, *V.Mann 144 & A.S.George* (K, PERTH); E end of the Porongurup Ra., *G.Maxwell* (PERTH).

This species is the smallest in habit of ser. *Obvallatae*, typically remaining single-stemmed. For differences from *D. columnaris*, see notes under that species.

80. Dryandra rufistylis A.S.George, *Nuytsia* 10: 390 (1996)

T: c. 8 miles [c. 13 km] SW of Woodanilling, W.A., 3 Aug. 1969, *A.S.George 9498*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Shrub to 1.5 m, columnar, without lignotuber. Leaves: petiole to 15 mm long, hirsute; lamina linear, recurved, 5–15 cm long, 4–10 mm wide, acute, pungent, closely tomentose below; margins slightly recurved, serrate; teeth 5–10 each side, to 5 mm long. Inflorescence sessile; leaves passing into involucral bracts; bracts numerous, subulate, to 20 mm long, rusty-villous; flowers 35–40 per head. Perianth ±straight with limb downturned before anthesis, 14–18 mm long, creamy yellow with yellow or pink-brown limb, woolly; limb 2.5 mm long, sparsely hirsute. Pistil downcurved, 18–22 mm long, red, glabrous except hirsute ovary; pollen presenter not or slightly enlarged, c. 1 mm long, obscurely ribbed, green. Follicles ovate with flattened apex, erect, 7–9 mm long, sparsely hirsute.

Occurs from the Woodanilling district east to Nyabing and north towards Tarin Rock; grows in gravelly loam, in kwongan and eucalypt low open woodland. Flowers July–Aug. Map 376.

W.A.: River Rd, NE of Woodanilling, *A.S.George 16631* (CANB, MEL, PERTH); 47 km N of Nyabing, *A.S.George 16701* (PERTH).

The red style is distinctive. Distinguished from *D. seneciifolia* by the serrate leaves and flower colours. Resembles *D. conferta* but differs especially in the woolly perianth, red style and small ovoid fruit, and *D. columnaris* from which it is separated by the serrate leaves. For differences from *D. fasciculata*, see notes under that species. A population near Corrigin (*A.S.George 16750*, PERTH) has slightly larger flowers (perianth 19–20 mm long, pistil 23–24 mm long), a cream style and more spreading leaf teeth than typical plants. It is placed tentatively with this species.

81. Dryandra insulanemorecincta A.S.George, *Fl. Australia* 17B: 397 (1999)

T: off Brookton Hwy, Darling Plateau, W.A., c. 32°17'S, 116°25'E, 22 June 1998, *A.S.George 17419*; holo: PERTH; iso: AD, CANB, K, MEL, NSW.

Bushy shrub to 1 m, without lignotuber. Leaves: petiole to 10 mm long, hirsute, glabrescent; lamina oblanceolate, broader in upper third, erect, 10–20 cm long, 10–24 mm wide, acute, pungent, closely tomentose below; margins slightly recurved, serrate; teeth 8–11 each side, to 6 mm long. Inflorescence sessile, with leaves much smaller around heads; involucral bracts linear to subulate, to 15 mm long, sparsely hirsute; flowers 40–50 per head. Perianth ±straight, with limb downturned before anthesis, 16–19 mm long, cream with dull brown limb, woolly above base, then long-hirsute; limb 3 mm long, sparsely hirsute. Pistil downcurved, 19–24 mm long, cream with green pollen presenter, glabrous except long hairs on ovary; pollen presenter not or slightly enlarged, c. 1 mm long, obscurely ribbed. Follicles elliptic with one margin ±flattened, erect, 10–13 mm long, hirsute.

Known from several populations on the Darling Plateau W of Brookton, W.A., growing in lateritic or granitic soil in areas of low heath surrounded by Jarrah forest. Flowers June–Sept. Map 377.

W.A.: Type locality, *A.S.George 17417* (BRI, MEL, NSW, PERTH).

Discovered in 1998 by Abe van de Sande, a field officer with the Western Australian Department of Conservation and Land Management. Closely related to *D. rufistylis*, differing in the bushy rather than columnar habit, the wider, erect leaves and especially in the larger elliptic follicle. The seed has an annular wing, in contrast to the terminal wing of *D. rufistylis*. in flower colour and habit resembles *D. platycarpa* which has pinnatipartite leaves usually with more teeth, generally smaller flowers and a much wider follicle.

Ser. 22. Pectinatae

Dryandra ser. **Pectinatae** (Meisn.) A.S.George, *Nuytsia* 10: 391 (1996)

Dryandra § *Pectinatae* Meisn., in A.L.P.P. de Candolle, *Prodr*. 14: 475 (1856). T: *D. nana* Meisn.

Dwarf shrubs, with small lignotuber. Leaves petiolate; lamina pinnatipartite; margins revolute. Inflorescence terminal; involucral bracts much shorter than flowers; receptacle flat. Perianth straight but limb reflexing before anthesis, flared widely at apex of tube. Pistil crook-shaped, much longer than perianth; pollen presenter swollen, not ribbed. Flowers persistent. Follicles broadly obovate, sparsely hairy, loosely attached, usually remaining closed until burnt. Seed wing shortly notched.

A monotypic series, occurring in the Badgingarra area, south-western W.A. Characterised by the very long pistil and swollen pollen presenter. The inflorescence has fewer flowers than any other species.

82. Dryandra nana Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 121 (1855)

Josephia nana (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: south-western W.A., 1850–51, *J.Drummond 6: 210*; holo: NY; iso: B, BM, CGE, K, MEL, PERTH.

Illustrations: A.S.George, *Introd. Proteaceae W. Australia* 45, t. 62 (1984); R.M.Sainsbury, *Field Guide Dryandra* 61 (1985); J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 169 (1989).

Shrub with short underground stems, with small lignotuber. Stems tomentose. Leaves: petiole to 10 cm long, ±glabrous; lamina pinnatipartite, 4–19 cm long, 10–24 mm wide, acute, pungent; margins revolute; lobes 10–35 each side, linear, pungent. Inflorescence terminal; involucral bracts ovate to lanceolate, to 10 mm long, acute, pubescent; flowers 12–17 per head. Perianth ±straight with limb reflexed before anthesis, 33–34 mm long, pale green with yellow limb, appressed-pubescent outside, shortly pubescent inside; limb broadly elliptic, 4.5–5 mm long, glabrous. Pistil crook-shaped, 6.8–7.9 cm long, dull red, loosely spreading-hirsute; pollen presenter ovoid, 2 mm long, green. Follicles broadly obovate, 13–14 mm long, sparsely hirsute. Fig. 58A–C.

Locally common in the Badgingarra district, south-western W.A. Grows in low kwongan on lateritic hills. Flowers Oct. Map 378.

W.A.: N side, Badgingarra Natl Park, *A.S.George 16278 & P.Nikulinsky* (K, MEL, NSW, PERTH); near Dandaragan, Sept. 1968, *A.Popplewell* (PERTH); Badgingarra Research Stn, *R.D.Royce 7696* (PERTH).

Distinctive among the prostrate species, easily recognised by the long style with swollen pollen presenter. The tepals flare widely at the apex of the tube.

Ser. 23. Acuminatae

Dryandra ser. **Acuminatae** A.S.George, *Nuytsia* 10: 391 (1996)

Type: *D. preissii* Meisn.

Prostrate shrubs, with lignotuber. Leaves petiolate; lamina pinnatipartite, some lobes again pinnatipartite; margins revolute. Inflorescence terminal; involucral bracts many, lanceolate, long-acuminate; receptacle prominently conical; flowers at anthesis forming a circle leaving a central hollow. Perianth straight, sparsely hirsute with spreading sticky hairs; limb inflexed before anthesis. Pistil incurved, longer than perianth; pollen presenter slightly swollen at base, ribbed. Old flowers persistent. Follicles several, obliquely obovate, firmly attached, opening when burnt. Seed wing notched.

A monotypic series, occurring between Woodanilling and Cranbrook, south-western W.A., characterised by the bipinnatipartite leaves, many acuminate involucral bracts and sticky perianth hairs. Flowers arranged in the head as in ser. *Niveae*.

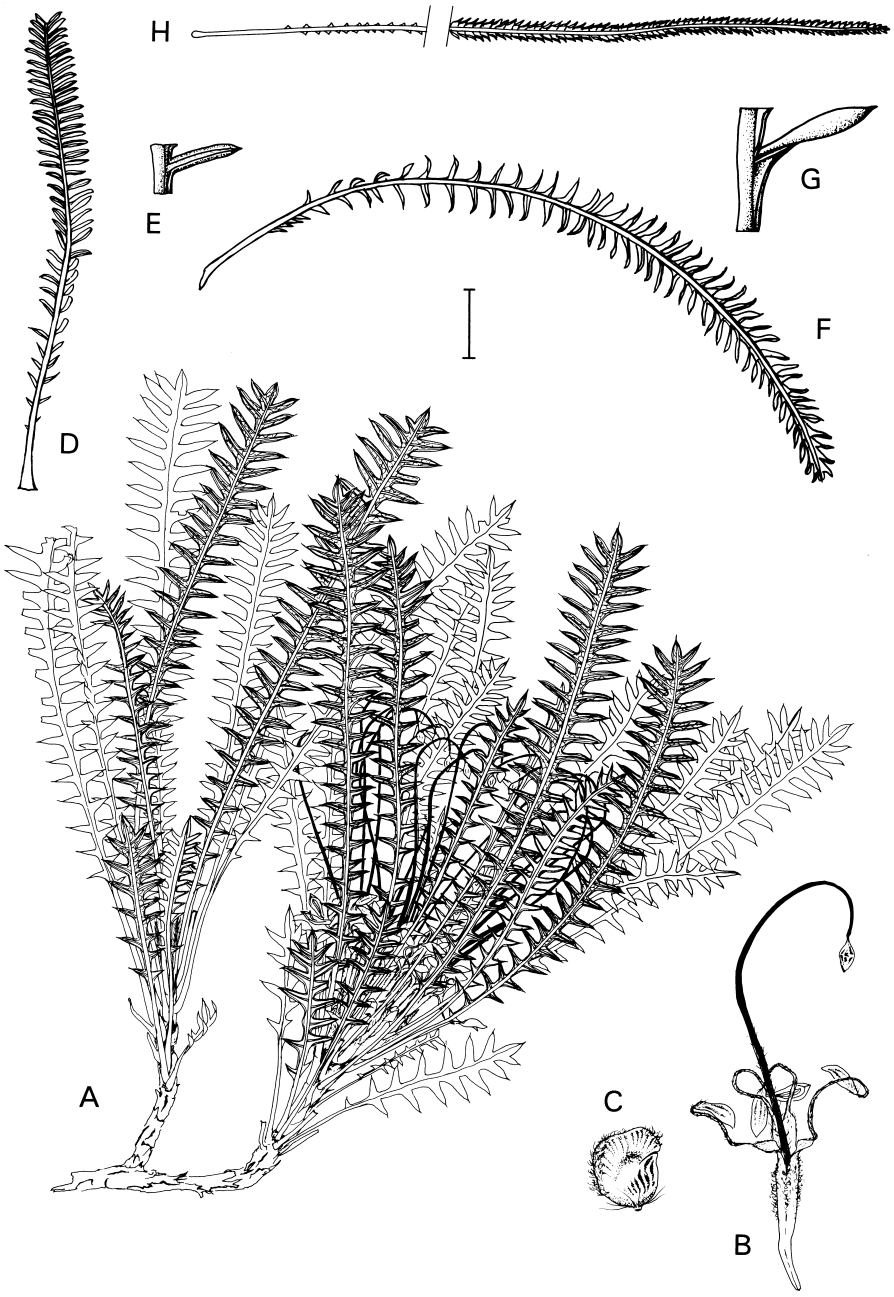


Figure 58. *Dryandra*. **A–C**, *D. nana*. **A**, flowering branch; **B**, flower; **C**, follicle (**A–C**, A.George 16278, PERTH). **D–E**, *D. arctotidis*. **D**, leaf; **E**, detail of lower surface of leaf (**D–E**, A.George 16672, PERTH). **F–G**, *D. tortifolia*. **F**, leaf; **G**, detail of lower surface of leaf (**F–G**, A.George 16865, PERTH). **H**, *D. stenoprion*, leaf (A.George 2603, PERTH). Scale bar: **A–C** = 1.3 cm; **D, F, H** = 2 cm; **E, G** = 7 mm. Drawn by: **A–C**, P.Nikulinsky; **D–G**, D.Boyer; **H**, P.Dundas.

83. Dryandra preissii Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 599 (1845)

Josephia preissii (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: near Gordon R., W.A., 7 Nov. 1840, *L.Preiss 528*; syn: B, G, MEL.

Shrub to 1 m across with prostrate stems, with lignotuber. Stems tomentose, with scattered linear to narrowly triangular glabrescent prophylls. Leaves: petiole 2–6 mm long; lamina deeply pinnatipartite, with uppermost lobes usually also pinnatipartite, 7–15 cm long, 3–8 cm wide; margins revolute; lobes linear, acute, loosely hirsute and shortly pubescent but glabrescent above, tomentose below. Inflorescence terminal, sometimes several clustered, subtended by leaves; involucral bracts lanceolate, long-acuminate, pale to dark-rusty hirsute to pubescent-tomentose, glabrous towards apex; innermost bracts 20–30 mm long; flowers 50–70 per head. Perianth 24–25 mm long (outer) to 21 mm long (inner), pale pink at base, mauve above, sparsely hirsute above base with sticky hairs at 90°; claw very slender; limb 2–3 mm long, grey-brown or gold, hirsute. Pistil incurved, 29–40 mm long, cream or pink, sparsely hairy in lower half; pollen presenter slightly swollen at base, 0.7–1 mm long, green. Follicles broadly and obliquely obovate with narrowed base, 10–11 mm long, sparsely hairy.

Occurs between Woodanilling and Cranbrook, W.A. Grows in gravelly sandy loam in eucalypt low woodland, and in sandy loam in kwongan. Flowers Sept.–Oct. Map 379.

W.A.: c. 25 km W of Woodanilling, *A.S.George 14930* (PERTH); Paterson Rd, S of Dumbleyung L., *A.S.George 16638* (PERTH); near Tunney, 31 Oct. 1962, *A.J.Gray* (PERTH); NW of Cranbrook, *K.Newbey 915* (PERTH).

A distinctive species somewhat resembling *D. bipinnatifida* but with less divided leaves and very different flowers and fruit. Northern populations tend to have longer leaves and longer tips to the involucral bracts. Flowers strongly scented. New growth red. A hybrid with *D. ferruginea* subsp. *ferruginea* has been collected near Woodanilling (*R.Garstone*, PERTH).

Ser. 24. Niveae

Dryandra ser. **Niveae** Benth., *Fl. Austral.* 5: 564, 574 (1870)

Type: *D. nivea* (Labill.) R.Br.

Shrubs with prostrate or shortly erect, divaricately branched stems, with or without lignotuber. Leaves petiolate; lamina linear, pinnatifid, pinnatipartite or pinnatisect; margins recurved to revolute. Inflorescence terminal, sometimes subtended by new branchlets; involucral bracts shorter than flowers, flat; receptacle markedly convex; flowers at anthesis forming a circle leaving a central hole; floral bracts linear, obtuse, variously hairy and with apical papillae or curled hairs. Perianth straight but with limb inflexed before anthesis. Pistil of outer flowers longer than inner, longer than perianth, strongly incurved; pollen presenter scarcely enlarged. Flowers persistent. Follicles obovate, sometimes markedly narrowed towards base, loosely attached, opening when burnt. Seed wing not notched.

A closely knit series of seven species widespread in southern W.A. between Geraldton, Cape Leeuwin and Israelite Bay and inland to Corrigin. One of the most difficult series taxonomically, with remarkably uniform floral and fruit morphology, species being separated largely on the basis of habit and leaf morphology.

84. Dryandra arctotidis R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 39 (1830)

Josephia arctotidis (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891), as *arctotides*. T: King George Sound, [W.A.], 1829, *W.Baxter*; ?holo: BM; iso: K, MEL, PERTH.

Shrub to 70 cm across, with short underground fire-tolerant stems. Leaves: petiole 1–3 cm long; lamina pinnatipartite, 8–15 cm long, 5–8 mm wide, V-shaped in cross section; margins revolute; lobes 25–45 each side, linear, pungent; sinuses 2–5 mm across. Inflorescence subtended by filiform hirsute 'bracts'; involucral bracts ovate (outer) or oblong (inner), 20–25 mm long, obtuse, glabrous or pubescent, with densely ciliate margins; flowers 75–100 per head. Perianth 26–31 mm long, cream, glabrous at base, hirsute above including limb;

limb 2.5–2.8 mm long, broader in upper half. Pistil 39–45 mm long, yellow, glabrous except long-hirsute ovary; pollen presenter cylindrical to narrowly ovoid, slightly swollen at base, 0.7–1 mm long, green. Follicles obovate, narrowed at base, sometimes curved or one side ±straight, 10–14 mm long, sparsely hirsute across top, otherwise glabrous. Fig. 58D, E.

Occurs from Kojonup to Ongerup and south through the Stirling Range Natl Park towards Albany, W.A. Grows in sandy loam or sandy loam over gravel in thick kwongan or mallee-kwongan. Flowers Sept. Map 380.

W.A.: West R. road, c. 15 km from Hassell Hwy, *K.Alcock 489* (MEL); below N side of Bluff Knoll, Stirling Range Natl Park, *R.Filson 8980* (MEL); 4.2 km S on Nightwell South Rd from Nightwell Rd, SW of Ongerup, *A.S.George 16684* (PERTH).

Sometimes sympatric with D. brownii. Leaf lobes narrow, as in D. tortifolia, but not twisted.

85. Dryandra tortifolia Kippist ex Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 121 (1855)

Dryandra arctotidis var. *tortifolia* (Kippist ex Meisn.) Benth., *Fl. Austral.* 5: 575 (1870). T: south-western W.A., 1850–51, *J.Drummond 6: 211*; syn: BM, K, MEL, PERTH.

Shrub, with short underground fire-tolerant stems. Leaves: petiole 1–3 cm long; lamina pinnatipartite, 10–17 cm long, 7–13 mm wide, broadly channelled along midrib on upper surface; margins tightly revolute; lobes 40–85 each side, linear, pungent, twisted so that upper half of lobe is horizontal. Inflorescence subtended by a few filiform hirsute 'bracts'; involucral bracts to 20 mm long, obtuse to shortly acute, appressed-pubescent to hirsute with densely ciliate margins; flowers 70–90 per head. Perianth 27–34 mm long, long-hirsute, cream and pink with greenish cream limb; limb 3–3.5 mm long, usually evenly elliptic. Pistil 38–54 mm long, pale yellow, glabrous except ovary; pollen presenter 1–1.1 mm long. Follicles obovate, 12–14 mm long, glabrous apart from long hairs across apex. Plate 62; Fig. 58F, G.

Occurs between Eneabba and Cataby, W.A. Grows in deep sand in tall kwongan and in sand over laterite in low kwongan. Flowers Oct. Map 381.

W.A.: 8 km S of Eneabba, Brand Hwy, *K.Alcock 224* (MEL); 2 km E of Brand Hwy on Tootbardi Rd, *A.S.George 16818* (PERTH); 15 km N of Cataby Roadhouse, Brand Hwy, *A.S.George 16873* (PERTH).

Follicles similar to those of *D. stenoprion* (*q.v.*), not so narrowed at base as are those of *D. arctotidis* and *D. brownii*. Young leaves are long-hirsute along midrib on both surfaces.

86. Dryandra stenoprion Meisn., *Hooker's J. Bot. Kew Gard. Misc.* 7: 122 (1855)

T: south-western W.A., 1850–51, *J.Drummond 6: 212*; syn: BM, CGE, K, MEL, NY (fragments).

Shrub, with short underground fire-tolerant stems. Leaves: petiole 1–3 cm long; lamina pinnatisect, 12–20 cm long, 3–9 mm wide, V-shaped in cross section; lower surface usually woolly only in pits; lobes 40–85 each side, narrowly triangular to ±elliptic, acute, with lower margin revolute, slightly overlapping the slightly recurved upper margin of lobe below. Inflorescence with no or very few subtending filiform 'bracts'; involucral bracts to 20–25 mm long, obtuse, rusty-pubescent; flowers 60–90 per head. Perianth 28–35 mm long, straw-coloured, golden, pale mauve or purple, shortly hirsute above base; claw pubescent to hirsute; limb 3 mm long, ±evenly elliptic, hirsute. Pistil 38–41 mm long, cream to pale yellow, glabrous; pollen presenter slightly swollen at base and apex, 1–1.2 mm long. Follicles broadly obovate, 12–15 mm long, ±glabrous. Fig. 58H.

Occurs from Cockleshell Gully to Badgingarra, W.A. Grows in sand or lateritic soil in kwongan. Flowers June–Aug. Map 382.

W.A.: N of Badgingarra, *A.S.George 2603* (PERTH); NW corner of Badgingarra Natl Park, *E.A.Griffin 3448* (PERTH).

Typically has smaller leaf lobes than *D. lindleyana*. Follicles similar to those of *D. tortifolia*, with which it is sometimes sympatric. An uncommon species.

87. Dryandra cypholoba A.S.George, *Nuytsia* 10: 392 (1996)

T: junction of Coorow–Greenhead Rd and Tootbardi Rd, W.A., 5 Aug. 1986, *A.S.George 16777*; holo: PERTH; iso: CANB, K, NSW.

Shrub, with short underground fire-tolerant stems. Leaves: petiole 1–4 cm long, pubescent, glabrescent; lamina pinnatipartite, 12–20 cm long, 8–20 mm wide; lobes 25–40 each side, broadly triangular, usually markedly convex, obtuse to acute, with upper margin usually incurved to apex. Inflorescence often subtended by hirsute dwarf leaf-bracts; involucral bracts narrowly ovate-lanceolate, acute, passing to broadly linear and obtuse, 20–28 mm long, green and orange-brown, rusty-pubescent; flowers 50–60 per head. Perianth 27–37 mm long, pale pinkish brown, shortly appressed-hirsute above base, passing to appressed-pubescent claws; limb 3–4 mm long, hirsute with shaggy apex. Pistil 41–47 mm long, lemon-yellow, glabrous; pollen presenter narrow, 1.3–1.5 mm long. Follicles obovate, 13–16 mm long, glabrous except apical and marginal hairs. Fig. 59 C–E.

Occurs from west of Arrino south to Alexander Morrison Natl Park, W.A. Grows in sand and gravelly loam, in kwongan with scattered *Eucalyptus todtiana* or in thick scrub. Flowers Aug. Map 383.

W.A.: corner of Beekeeper Rd and First North Rd, *A.S.George 16796* (PERTH); 14 km W of Arrino on Richardson Rd, *A.S.George 17010* (PERTH); 8 km W of Willis Rd on Eneabba–Carnamah Rd, *E.A.Griffin 3494* (PERTH).

Differs from *D. lindleyana* especially in the leaves having large, coarse lobes that are usually recurved towards the apex giving the leaf a rolled appearance. The collection *A.C.Beauglehole 12135* from c. 33 km W of Winchester (PERTH) has broad sinuses and fewer leaf lobes.

88. Dryandra lindleyana Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 598 (1845)

T: near 'Pointwater' (probably Point Walter), Swan R., Perth, W.A., 17 July 1839, *L.Preiss 511*; holo: NY; iso: BM, FI, G, L, MEL, P.

[*Dryandra nivea auct. non* (Labill.) R.Br.: G.Bentham, *Fl. Austral.* 5: 574 (1870), *p.p.*; B.L.Rye, in N.G.Marchant *et al.*, *Fl. Perth Region* 324, 326 (1987)]

Shrub, with fire-tolerant underground stems and short aerial stems. Leaves: petiole 1–12 cm long, tomentose, glabrescent; lamina pinnatipartite or pinnatisect, 6–20 cm long, 2–20 mm wide, hirsute but glabrescent above, white-tomentose below; margins ±equally recurved to revolute; lobes 10–80 each side, obliquely triangular to oblong, obtuse. Inflorescence sometimes (subsp. *agricola*) subtended by dwarf leaf-like hirsute 'bracts'; involucral bracts lanceolate (outer) to broadly linear and obtuse (inner), appressed-pubescent to glabrous except for ciliate margins, with hairs often rusty; innermost bracts to 15–25 mm long; flowers 30–70 per head. Perianth 20–35 mm long, cream, golden or pink, shortly hirsute near base, appressed-pubescent above; limb 2.8–3 mm long, hirsute. Pistil 30–40 mm long, cream at base, cream, pink or maroon above; pollen presenter not or slightly thickened, 0.8–1 mm long, green. Follicles obovate, narrowed or rounded at base, 7–13 mm long, glabrous apart from marginal hairs.

Widespread between Geraldton and Albany, W.A. A highly variable species with five subspecies but needing further study. This species includes taxa that for many years have been included within a broadly circumscribed *D. nivea*. The type of the latter is from near Esperance Bay and is non-lignotuberous. Apart from the other taxa here recognised at specific rank, all forms with underground, fire-tolerant stems and small, ±triangular leaf lobes are here included in *D. lindleyana*, a name published in 1845 but until recently placed in synonymy under *D. nivea*. *Dryandra lindleyana* differs from *D. cypholoba* especially in the smaller, finer leaf lobes.

1 Leaf lobes obliquely oblong or narrowly triangular (common in central and southern forests) **88e.** subsp. **sylvestris**

1: Leaf lobes essentially broadly triangular

2 Leaves divided almost or quite to midrib

3 Leaf lobes ±regularly triangular, although upper margin usually shorter than lower; leaves 2–8 mm wide

4 Leaves 3–8 mm wide; lobes 30–60 each side of leaf (widespread from Mt Adams to Cape Naturaliste including Darling Plateau) **88a.** subsp. **lindleyana**

4: Leaves 2–3 mm wide; lobes 60–80 each side of leaf (Watheroo National Park to Moora) **88b.** subsp. **pollosta**

3: Leaf lobes with lower (basal) margin shallowly S-shaped or concave, the distal half more strongly recurved giving a twisted aspect; leaves 7–10 mm wide (Eneabba to Badgingarra) **88c.** subsp. **media**

2: Leaves divided ½ to ¾ to midrib (central wheatbelt) **88d.** subsp. **agricola**

88a. Dryandra lindleyana Meisn. subsp. lindleyana

Leaves: petiole 1–3 cm long; lamina 10–20 cm long, 3–8 mm wide; margins recurved to revolute; lobes 30–60 each side, triangular with the upper side shorter, often curved upwards, obtuse; sinuses V-shaped, 2–5 mm across. Involucral bracts to 15–23 mm long, glabrous to densely pubescent, densely ciliate; flowers 50–70 per head. Perianth 22–30 mm long. Pistil 24–40 mm long; pollen presenter scarcely thickened at base, 1–1.3 mm long.

A variable subspecies with two varieties recognised here.

Plant with most stems procumbent, the aerial part less than 10 cm long (Geraldton to Cape Naturaliste) **88a[1].** var. **lindleyana**

Plant with aerial stems to 45 cm tall (Darling Plateau to Cape Naturaliste) **88a[2].** var. **mellicula**

88a[1]. Dryandra lindleyana Meisn. subsp. lindleyana var. lindleyana

Dryandra nivea var. *subevenia* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 472 (1856). T: locality not cited, south-western W.A., date not cited, *L.Preiss 508*; lecto: NY, *fide* A.S.George, *Nuytsia* 10: 394 (1996); south-western W.A., 1840s, *J.Drummond 1: 640*; syn: BM, K, MEL.

[*Dryandra nivea auct. non* (Labill.) R.Br.: E.M.Bennett, *Bushland Pls Kings Park W. Australia* 63 (1988)]

Illustration: E.M.Bennett, *Bushland Pls Kings Park W. Australia* 63 (1988), as *D. nivea*.

Stems procumbent, mainly underground. Leaf lamina 10–20 cm long, 3–8 mm wide. Fig. 59G.

Occurs between Geraldton and Cape Naturaliste, W.A. Grows in sand, often over limestone, sometimes over laterite in kwongan and low woodland, and on the Darling Scarp and Plateau in lateritic or granitic soil in shrubland and open forest. Flowers July–Aug. Map 384.

W.A.: c. 21 km W of Watheroo, *J.C.Anway 190* (PERTH); Burma Rd, SE of Walkaway, *A.C.Burns 16* (PERTH); Tunnell Rd, Saddleback State Forest, *D.Halford 808142* (PERTH); Ruabon Nature reserve, E of Busselton, *G.J.Keighery 13368* (PERTH); Churchman Brook Rd, Kelmscott, *A.Travers 10* (PERTH).

Variable in leaf length and width and in the size of the lobes. A collection 'between Moora and Jurien', *T.G.Hartley 13924* (PERTH), has a large inflorescence (involucral bracts to 30 mm long, perianth 35 mm, pistil 53 mm). Of the two other syntypes of *D. nivea* var. *subevenia* cited by Meisner, south-western W.A., 1840s, *J.Drummond 4: 313*; syn: BM, K, MEL, is *D. nivea* subsp. *nivea*; and south-western W.A., 1840s, *J.Drummond 5: 419*; syn: BM, K, MEL is *D. brownii*.

88a[2]. Dryandra lindleyana subsp. lindleyana var. mellicula A.S.George, *Nuytsia* 10: 394 (1996)

T: Chittering valley, W.A., 3 Sept. 1994, *A.S.George 17210*; holo: PERTH; iso: CANB, K, NSW, PERTH.

[*Dryandra nivea auct. non* (Labill.) R.Br.: A.S.George, *Introd. Proteaceae W. Australia* 44, t. 61 (1984)]

Illustration: A.S.George, *Introd. Proteaceae W. Australia* 44, t. 61 (1984), as *D. nivea*.

Stems prostrate to erect, to 45 cm tall. Leaf lamina 10–15 cm long, 5–10 mm wide.

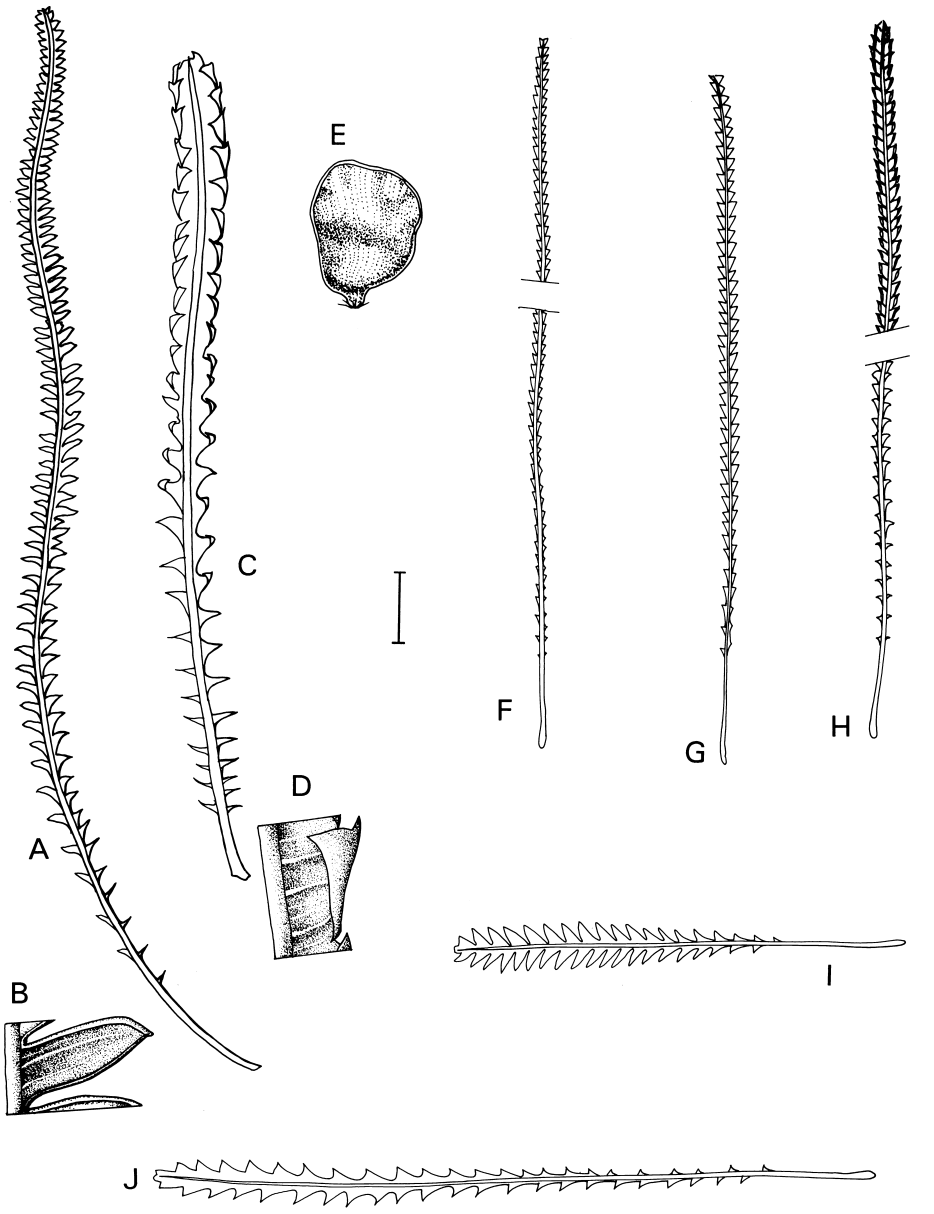


Figure 59. *Dryandra.* **A–B**, *D. brownii*. **A**, leaf; **B**, detail of lower surface of leaf (**A–B**, J.Powell 3316, PERTH). **C–E**, *D. cypholoba*. **C**, leaf; **D**, detail of lower surface of leaf; **E**, follicle (**C–E**, A.George 16777, PERTH). **F**, *D. lindleyana* subsp. *pollosta*, leaf (K.Kenneally 4391, PERTH). **G**, *D. lindleyana* subsp. *lindleyana* var. *lindleyana*, leaf (May 1897, R.Helms, PERTH). **H**, *D. lindleyana* subsp. *media*, leaf (E.Griffin 854, PERTH). **I**, *D. lindleyana* subsp. *sylvestris*, leaf (A.Gundry 653, PERTH). **J**, *D. lindleyana* subsp. *agricola*, leaf (A.George 14363, PERTH). Scale bar: **A, C, F–J** = 2 cm; **B**, **D–E** = 7 mm. Drawn by: **A–D**, D.Boyer; **E–J**, P.Dundas.

Common on the Darling Plateau and along the Darling Scarp east of Perth, extending south to Cape Naturaliste, W.A. Grows in lateritic gravel in Jarrah-Marri forest, occasionally in sand in woodland. Flowers July–Sept. Map 385.

W.A.: Barrington Quarry, [Darling Scarp], *H.Demarz 7487* (PERTH); locality unknown, *J.Drummond 9* (MEL); Kalamunda, *R. & M.Hamilton 105* (PERTH); 27 km NE of Perth on Toodyay Rd, *M.E.Phillips 68/810* (CANB, PERTH).

Differs from var. *lindleyana* mainly in the erect stems and more coarsely lobed leaves, and the flowers tending to be smaller; sometimes occurs close to var. *lindleyana* but flowers earlier.

88b. Dryandra lindleyana subsp. **pollosta** A.S.George, *Nuytsia* 10: 396 (1996)

T: just W of cemetery, Moora, W.A., 9 Aug. 1993, *A.S.George 17002*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Leaves: petiole 1–4 cm long, tomentose, glabrescent; lamina pinnatipartite, 13–20 cm long, 2–3 mm wide, ±flat except margins; lobes 60–80 each side, obliquely triangular, obtuse, white-tomentose below; sinuses oblique, V- to U-shaped, 1–3 mm across. Involucral bracts lanceolate (outer) to broadly linear and obtuse (inner), appressed-pubescent to glabrous except for ciliate margins; innermost bracts to 15–22 mm long; flowers 35–45 per head. Perianth 25–30 mm long, shortly hirsute above base, appressed-pubescent above; limb 2.8–3 mm long, hirsute. Pistil 32–37 mm long, pale maroon; pollen presenter slightly thickened, 1 mm long. Fig. 59F.

Recorded from a few localities between Lancelin, Watheroo and Moora, and west of Wongan Hills. Grows in sand, in *Banksia* woodland and open shrubland. Flowers Aug. Map 386.

W.A.: W of Moore R. on Old Bennies Rd, 5 Sept. 1978, *J.Dodd* (PERTH); locality unknown, *J.Drummond 10* (MEL); Prices Rd, S of Namban West Rd, *A.S.George 17005* (PERTH); Mortlock Flora Reserve, *K.F.Kenneally 5371* (PERTH).

Distinguished from other subspecies by the very fine leaves but grades into subsp. *lindleyana*.

88c. Dryandra lindleyana subsp. **media** A.S.George, *Nuytsia* 10: 395 (1996)

T: 5.6 km S of Eneabba on Brand Hwy, W.A., 6 Aug. 1993, *A.S.George 16808*; holo: PERTH; iso: CANB, K, PERTH.

Leaves: petiole 1–3 cm long; lamina broadly linear, pinnatipartite, 15–20 cm long, 7–10 mm wide; lobes 25–40 each side, broadly triangular, obtuse, with lower margin usually shallowly S-shaped and the distal half more strongly recurved giving a twisted aspect; sinuses 3–10 mm across. Involucral bracts to 20–25 mm long, rusty; flowers 50–65 per head. Perianth 26–30 mm long, cream-pink. Pistil 35–40 mm long, cream at base, pink above; pollen presenter swollen at base, 1.3 mm long, green. Fig. 59H.

Occurs between Eneabba, Badgingarra and Mt Lesueur, in deep sand or sandstone-gravel in kwongan. Flowers Aug. Map 387.

W.A.: 21.4 km W of Brand Hwy on Jurien Rd, *A.S.George 17048* (PERTH); Beekeeper Rd, off Brand Hwy, N of Eneabba, *E.A.Griffin 3496* (PERTH).

Leaves usually broader and more coarsely lobed than other subspecies. Somewhat intermediate between *D. lindleyana* and *D. cypholoba*.

88d. Dryandra lindleyana subsp. **agricola** A.S.George, *Nuytsia* 10: 397 (1996)

T: near Jubuk, 60 km E of Brookton, W.A., 8 Oct. 1994, *A.S.George 17219*; holo: PERTH; iso: CANB, K, MEL, NSW, PERTH.

Leaves: petiole 2–4 cm long; lamina broadly linear, pinnatipartite, 10–17 cm long, 8–13 mm wide, glaucous above, white below, densely hirsute when young; margins ±equally recurved to revolute; lobes 15–30 each side, ±triangular, ±flat; sinuses obliquely curved-V-shaped, 3–8 mm across. Inflorescence with subtending dwarf hirsute leaf-bracts; involucral bracts oblong to broadly linear, appressed-pubescent and densely ciliate, 18–20 mm long; flowers 50–60 per head. Perianth c. 20 mm long, pale yellow, hirsute above base, passing to

pubescent claws and limb. Pistil 33–35 mm long, pale yellow; pollen presenter not enlarged, 0.8 mm long. Fig. 59J.

Occurs between Corrigin and Traysurin in the central wheatbelt, in sandy loam in kwongan. Flowers Sept. Map 388.

W.A.: SE of Corrigin, W.A., *A.S.George 14363* (CANB, PERTH); 6 km W of Corrigin, *A.S.George 16752* (PERTH); c. 1.5 km NE of Traysurin, *K.Newbey 2487* (PERTH).

The broad leaves divided c. half-way to midrib, and always-yellow flowers are distinctive. The few follicles seen are smaller than in the other subspecies (7–10 mm long) but this may not be consistent.

88e. Dryandra lindleyana subsp. **sylvestris** A.S.George, *Nuytsia* 10: 396 (1996)

T: E of Mayanup, SE of Boyup Brook, W.A., 22 Sept. 1972, *A.S.George 11621*; holo: PERTH; iso: CANB.

Leaves: petiole 5–12 mm long; lamina broadly linear, almost pinnatisect, 6–16 cm long, 10–20 mm wide; margins convex towards lobe apices, almost flat; lobes 10–35 each side, obliquely oblong to narrowly triangular, acute, pungent; sinuses obliquely V-shaped to narrowly U-shaped. Involucral bracts to 20–24 mm long; flowers 30–40 per head. Perianth 22–25 mm long, golden, hirsute. Pistil 30–37 mm long, glabrous; pollen presenter slightly swollen at base, 1 mm long. Fig. 59 I.

Widespread in the Jarrah-Marri forest of the lower south-west of W.A., in lateritic soil. Flowers Sept.–Oct. Map 389.

W.A.: 20 km NE of Manjimup, *A.C.Beauglehole 12604* (PERTH); Wandering, 1 Sept. 1957, *F.Lullfitz* (PERTH); North Bannister, *K.Newbey 2465* (PERTH).

Differs from the other subspecies mainly in the short leaves with fewer, longer, ±oblong lobes, and from *D. brownii* in the fire-tolerant habit and short leaves. Some collections have larger flowers, e.g. N Dinninup Reserve, *E.M.Bennett 2037*, and near Bannister, *K.Newbey 2465* (both at PERTH), with the perianth 35 mm long and pistil 43 mm.

89. Dryandra brownii Meisn., in J.G.C.Lehmann, *Pl. Preiss.* 1: 595 (1845)

T: Mt Wuljenup [Mt Willyung], W.A., 20 Oct. 1840, *L.Preiss 509*; holo: NY; iso: FI, G, MEL, NY, P.

[*Dryandra arctotidis auct. non* R.Br.: R.M.Sainsbury, *Field Guide Dryandra* 5 (1985)]

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 5 (1985), as *D. arctotidis*.

Shrub to 70 cm, much-branched and bushy, without lignotuber. Leaves dark green; petiole 1.5–3 cm long, often hirsute; lamina pinnatisect or almost so, 15–35 cm long, 10–16 mm wide; margins shortly recurved; lobes 40–75 each side, ±oblong, acute to obtuse, with upper margin strongly curved in to apex, white-tomentose below; sinuses V-shaped, 3–8 mm across. Inflorescence subtended by filiform hirsute 'bracts'; involucral bracts oblong, to 22–25 mm long, obtuse, pubescent to ±glabrous; flowers 55–70 per head. Perianth 28–39 mm long, pink, hirsute in lower half with dense, curled hairs along midrib, appressed-hirsute in upper half; limb 2 mm long, coarsely hirsute, grey-brown. Pistil 41–54 mm long, deep red; pollen presenter thickened at base, 0.6–0.8 mm long. Follicles obovate, narrowed at base, 12–14 mm long, glabrous except a few long apical hairs. Fig. 59A, B.

Occurs from Albany to the Stirling Ra. and east to Fitzgerald River Natl Park, W.A. Grows in gravelly loam, gravelly sand or sandy loam, in tall kwongan and open mallee-kwongan. Flowers Aug. Map 390.

W.A.: 5.5 km along Bluff Knoll Rd from Chester Pass Rd, *A.S.George 16688* (PERTH); c. 2 km W of Bremer Bay, *K.Newbey 272* (PERTH); 5 km N of Ellen Peak, *K.Newbey 323* (PERTH); E of Hamersley R., *E.Wittwer 424* (PERTH).

Sometimes sympatric with *D. arctotidis*. Some collections tend towards *D. nivea* in having shorter, ±triangular leaf lobes. The filiform, hirsute 'bracts' subtending the oblong involucral bracts are lacking in *D. nivea*. Further research is needed to assess the differences between *D. nivea* and *D. brownii*.

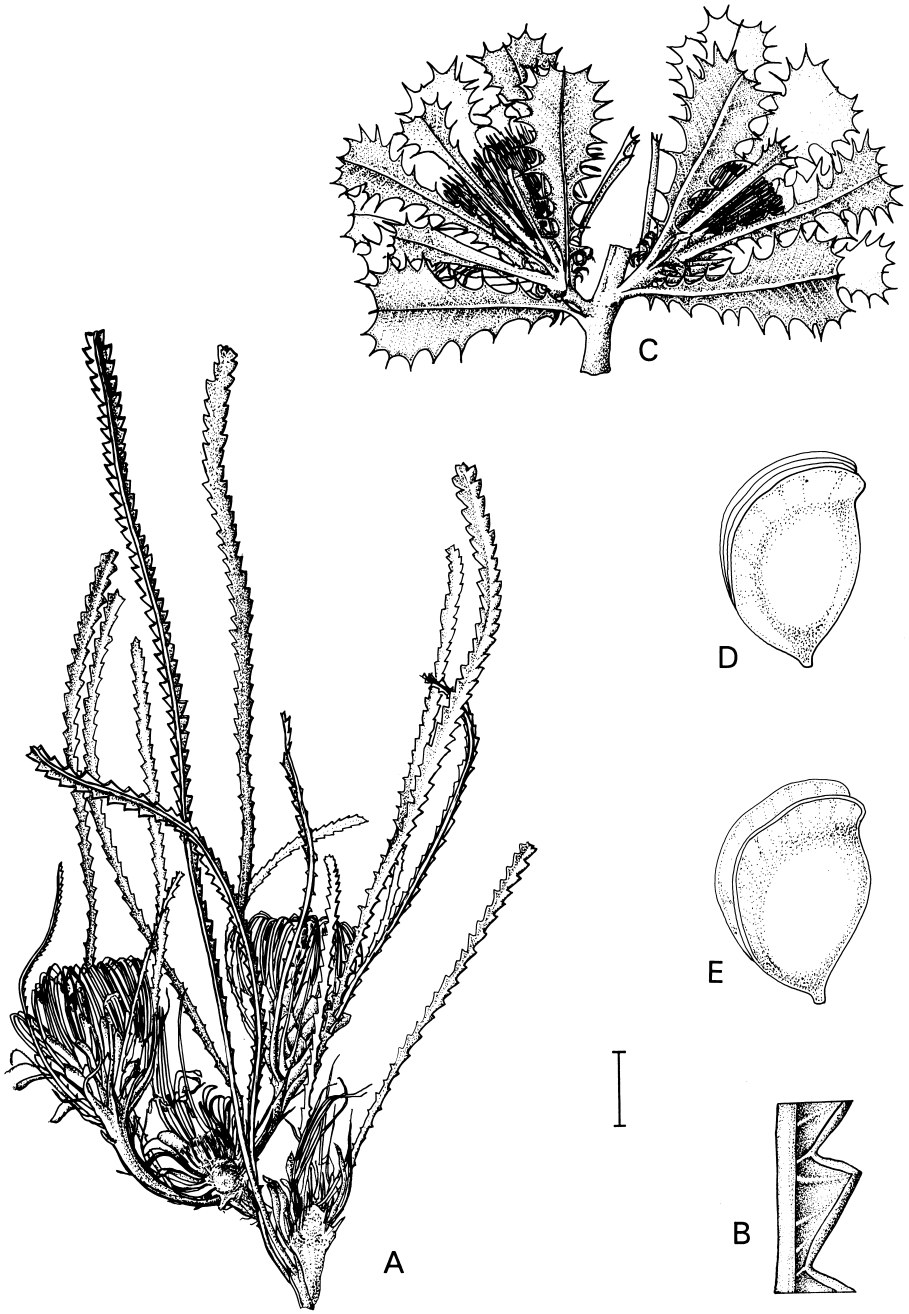


Figure 60. *Dryandra.* **A–B**, *D. nivea* subsp. *nivea*. **A**, flowering branch; **B**, detail of lower surface of leaf (**A–B**, A.George 16693, PERTH). **C**, *D. glauca*, flowering branch (A.George 16773, PERTH). **D–E**, *D. bipinnatifida* subsp. *bipinnatifida*. **D**, seeds and intervening plates united at base; **E**, open follicle (**D–E**, A.George 16616, PERTH). Scale bar: **A, C** = 2 cm; **B** = 2.5 mm; **D–E** = 7 mm. Drawn by: **A–C**, D.Boyer; **D–E**, P.Dundas.

90. Dryandra nivea (Labill.) R.Br., *Trans. Linn. Soc. London* 10: 214 (1810)

Banksia nivea Labill., *Voy. Rech. Pérouse* 411, t. 24 (1800); *Josephia rachidifolia* Knight, *Cult. Prot.* 111 (1809), *nom. illeg.*; *Dryandra nivea* var. *adscendens* Endl., *Gen. Pl.* 4 (2): 89 (1848), *nom illeg.*; *Dryandra nivea* var. *venosa* Meisn., in A.L.P.P. de Candolle, *Prodr.* 14: 472 (1856), *nom. illeg.*; *Josephia nivea* (Labill.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: le Grand Bay [Esperance Bay, W.A.], 1791, *J.J.H. de Labillardière*; lecto: FI, *fide* A.S.George, *Nuytsia* 10: 398 (1996).

Rounded shrub to 1.3 m high and wide, dichotomously much-branched, without lignotuber. Leaves: petiole 1–6 cm long; lamina linear, pinnatipartite, 20–45 cm long, 3–10 mm wide, silky-tomentose above but glabrescent, white-tomentose below; margins shortly revolute; lobes 45–85 each side, ±triangular, rounded-obtuse. Inflorescence terminal but usually subtended by new branches; involucral bracts ovate to oblong, to 18–22 mm long, obtuse, appressed-hirsute or almost glabrous except ciliate margins; flowers c. 70–90 per head. Perianth 25–38 mm long, cream with brown limb, hirsute in lower half, appressed-pubescent distally; limb 2–3 mm long, hirsute. Pistil 32–45 mm long, cream or red, glabrous; pollen presenter not or slightly thickened at base, 0.7–1.1 mm long. Follicles obovate, ±acute at base, 9–13 mm long, almost glabrous.

Widespread through south-western W.A. from Lake Indoon to Ongerup and east almost to Israelite Bay. Distinguished from most species of ser. *Niveae* in the non-lignotuberous, much-branched habit, and from the non-lignotuberous *D. brownii* by the narrower leaves with triangular lobes. The leaves are typically longer than those of related species. There are two subspecies.

Pistil 32–40 mm long; leaf lamina to 35 cm long, 3–8 mm wide (widespread Eneabba to Cape Arid, in dry soil) **90a.** subsp. **nivea**

Pistil 41–45 mm long; leaf lamina to 45 cm long, 7–10 mm wide (winter-wet flats near Busselton and the Scott R.) **90b.** subsp. **uliginosa**

90a. Dryandra nivea (Labill.) R.Br. subsp. **nivea**

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 156 (1989), as *Dryandra* sp. (Boyagin Rock).

Shrub less than 1 m tall. Leaves: petiole 1.5–6 cm long; lamina usually 20–35 cm long, 3–8 mm wide; lobes 45–85 each side, obliquely triangular, obtuse. Involucral bracts ovate to oblong, to 18–22 mm long; flowers c. 70–90 per head. Perianth 25–38 mm long. Pistil 32–40 mm long; pollen presenter 0.7–1.1 mm long. Plate 63; Fig. 60A, B.

Widespread from Lake Indoon to Ongerup and east almost to Israelite Bay. Grows in lateritic gravel or sandy-loam, in woodland and kwongan. Flowers usually Aug.–Sept. Map 391.

W.A.: Dryandra State Forest, *A.S.George 16615* (PERTH); N of Tieline Rd on Albany–Lake Grace road, *A.S.George 16692* (PERTH); Cape Arid Natl Park, *R.Hnatiuk 761047* (PERTH); 1 km E of L. Indoon, *R.Hnatiuk 761420* (PERTH); Dongolocking Nature Reserve, *B.G.Muir 27 (4.12)* (PERTH).

Highly variable in the number and shape of the leaf lobes. *M.Pieroni 94/2* from Morangup Nature Reserve (PERTH) has almost glabrous involucral bracts, c. 55 flowers per head, red styles, and is unusual in flowering in April.

90b. Dryandra nivea subsp. **uliginosa** A.S.George, *Nuytsia* 10: 399 (1996)

T: Governor Broome Rd, Scott River plain, W.A., 21 Oct. 1993, *A.S.George 17117*; holo: PERTH; iso: CANB, K, NSW.

Shrub to 1.3 m tall. Leaves: petiole 1–3 cm long; lamina 20–45 cm long, 7–10 mm wide; lobes 60–80 each side, obliquely triangular, obtuse. Involucral bracts ovate to oblong, to 20 mm long; flowers c. 70 per head. Perianth 29–38 mm long. Pistil 41–45 mm long, glabrous; pollen presenter 0.7–0.9 mm long.

Occurs to the east of Busselton and on the Scott River plain, W.A. Grows on winter-wet flats, in clay over laterite in thick scrub. Listed as 'Endangered' in the ANZECC Threatened Flora List 1997. Flowers Sept. Map 392.

W.A.: c. 20 km SE of Busselton, *G.J.Keighery 6622* (PERTH); Tutunup, *R.D.Royce 5751* (PERTH).

Generally a larger plant with more coarsely lobed leaves, and occurring in a winter-wet habitat.

Subg. 2. Hemiclidia

Dryandra subg. **Hemiclidia** (R.Br.) A.S.George, *Nuytsia* 10: 400 (1996)

Hemiclidia R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 40 (1830). T: *H. baxteri* R.Br.

Erect shrubs, without lignotuber. Leaves petiolate; lamina cuneate, serrate to pinnatipartite; margins flat to gently recurved. Inflorescence terminal or on short lateral branchlet, conspicuous; involucral bracts shorter than flowers; receptacle flat. Perianth straight. Pistil incurved to almost straight, longer than perianth; pollen presenter narrow, smooth. Flowers persistent. Follicles cartilaginous, ovoid, hairy, loosely attached, usually remaining closed until burnt. Separator present. Seed elliptic, pale, not winged.

A subgenus of two species, one in the kwongan north of Perth, the other in southern districts from the Stirling Ra. to Israelite Bay. The very small, relatively soft fruit is distinctive.

91. Dryandra falcata R.Br., *Trans. Linn. Soc. London* 10: 213 (1810)

Josephia falcata (R.Br.) Poir., *Dict. Sci. Nat.* 24: 246 (1822); *Hemiclidia baxteri* R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 40 (1830). T: Lucky Bay [W.A.], Jan. 1802, *R.Brown Iter Austral. 3427*; holo: BM; iso: K.

Dryandra dorrienii Domin, *Věstn. Král. Ceské Společn. Nauk. Tř. Mat. Přír.* 1921–22, 2: 17 (1923). T: between Cranbrook and Warrungup, W.A., 1909–10, *A.A.Dorrien-Smith*; syn: K.

Illustration: M.Morcombe, *Australia's Wildfl.* 105 (1970).

Shrub to 2.3 m, without lignotuber. Stems spreading-pubescent to loosely hirsute. Leaves: petiole 5–12 mm long, tomentose, glabrescent; lamina cuneate, undulate, serrate to pinnatipartite, 3.5–8 cm long, 15–30 mm wide, truncate to acute, mucronate, openly hirsute above and on veins below, glabrescent except in pits; margins flat or gently recurved; teeth 7–13 each side, pungently acute. Inflorescence on short lateral branchlet or terminal; involucral bracts linear to narrowly lanceolate, acute, tomentose, with apex silky-villous; innermost bracts to 15–20 mm long, rusty; flowers 110–150 per head. Perianth 30–39 mm long, bright yellow, villous above base; claw silky; limb 3–4.5 mm long, yellow (often orange in late bud), keeled, glabrous or sparsely hairy. Pistil 32–45 mm long, yellow, glabrous; pollen presenter slightly thickened, 1–1.5 mm long, smooth. Follicles ovoid, 6–7 mm long, hirsute, soft.

Occurs from the Stirling Ra. to Esperance, W.A. Grows in sand over laterite or quartzite or in sand over shale, in kwongan. Flowers at any season but chiefly winter and spring. Map 393.

W.A.: N of Dillon Bay, *T.E.H.Aplin 2742a* (PERTH); West Mt Barren, *D.B.Foreman 1375* (CANB, MEL, PERTH); N of Red Gum Pass, *A.S.George 17154* (AD, K, MEL, NSW, PERTH); Chillinup Rd, 6 km NW of South Stirling, *A.Strid 21597* (PERTH).

Although the type is from Lucky Bay, there is no collection this century from east of Thumb Peak. The collection from Thumb Peak (*S.Barrett*, PERTH) has unusually large leaves (lamina 6–11 cm long, to 33 mm wide) but appears to be from a sheltered habitat. The type of *D. dorrienii* represents a form with large heads.

92. Dryandra glauca A.S.George, *Nuytsia* 10: 400 (1996)

T: Watheroo Rd, Watheroo Natl Park, W.A., 5 Aug. 1986, *A.S.George 16773*; holo: PERTH; iso: CANB, K.

Illustration: J.W.Wrigley & M.Fagg, *Banksias, Waratahs & Grevilleas* 156 (1989), as *Dryandra* sp. C.

Shrub to 1.5 m, without lignotuber. Stems tomentose and hirsute. Leaves: petiole 5–10 mm long, flat, tomentose; lamina cuneate, 4.5–7.5 cm long, 2–3.5 cm wide, truncate, shortly

mucronate, ±glaucous, rusty-hirsute, glabrescent except in pits in lower surface; margins deeply serrate, thickened but flat to gently recurved; lobes 6–13 each side, narrowly triangular with subulate pungent tips, with apical lobes directed upwards. Inflorescence on short leafy branchlet; involucral bracts broadly linear, tapering, acute, silky; outermost bracts recurved and ±glabrescent, pale rusty; inner bracts 12–18 mm long; flowers c. 80–110 per head. Perianth 28–34 mm long, pale yellow, hirsute; limb 2.5–3.2 mm long, keeled, glabrous. Pistil 30–35 mm long, cream, glabrous; pollen presenter slightly thickened, 1.2–1.7 mm long, smooth, cream. Follicles ovoid, 7 mm long, shortly pubescent, with margins densely long-hirsute. Plate 64; Fig. 60C.

Occurs from north-east of Eneabba and Tathra Natl Park south to Badgingarra, W.A. Grows on lateritic rises in kwongan. Flowers July–Oct. Map 394.

W.A.: First North Rd, c. 5 km N of Three Springs–Eneabba road, *A.S.George 16802* (PERTH); S of Badgingarra, *E.A.Griffin 3445* (PERTH); W of Clarke Rd on Eneabba–Carnamah road, *E.A.Griffin 3489* (PERTH); Coomallo Ck, *R.J.Hnatiuk 761399* (PERTH); 8 km S of Eneabba, *R.J.Hnatiuk 771286* (PERTH).

Closely related to *D. falcata* but differs in the usually glaucous leaves (bright green in *D. falcata*), paler flowers and slightly larger follicles. The two are quite disjunct geographically.

Subg. 3. Diplophragma

Dryandra subg. **Diplophragma** (R.Br.) A.S.George, *Nuytsia* 10: 401 (1996)

Dryandra sect. *Diplophragma* R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 37 (1830). T: *D. bipinnatifida* R.Br.

Dwarf shrubs, with lignotuber. Leaves petiolate; lamina linear, bipinnatipartite; margins revolute. Inflorescence terminal, commonly well beyond leaves and 'erupting' from soil, large; involucral bracts as long as or exceeding flowers; receptacle flat. Perianth straight to gently curved. Pistil straight, shorter than perianth; pollen presenter narrow, ribbed. Flowers falling. Follicles woody, large, ±obovate, loosely attached, glabrous, usually opening when mature. Separator absent. Seed brown, elliptic with annular wing, with a large supplementary wing each side attached at the base.

A monotypic subgenus. The seed is very unusual and the floral bracts enlarge more than in any other species, but the flowers are very similar to those of *Dryandra* ser. *Gymnocephalae*. Bipinnatipartite leaves also occur in *D. preissii*.

93. Dryandra bipinnatifida R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 39 (1830)

Josephia bipinnatifida (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 578 (1891). T: Swan River, [W.A.], Mar. 1827, *C.Fraser*; holo: BM.

Shrub, with lignotuber. Stems underground, to 15 cm long, covered with prophylls. Leaves few; petiole 1.5–4 cm long, tomentose-hirsute; lamina bipinnatipartite, 7–33 cm long, 3–7 cm wide; margins revolute; segments linear, acute, loosely hairy above, tomentose below; primary segments to 5 cm long; secondary segments to 1.7 cm. Inflorescence terminal, with or without subtending leaves; involucral bracts ovate to oblong, obtuse; innermost bracts 4.5–8 cm long, tomentose outside, glabrous inside; flowers 30–45 per head. Perianth 40–57 mm long, pink with cream to pale yellow limb, hirsute except mid-line in lower half, glabrous distally, with or without a few long apical hairs; limb 17–21 mm long. Pistil 43–60 mm long, cream, glabrous; pollen presenter 13–14 mm long, ribbed. Follicles ±obovate, 17–23 mm long, 13–17 mm wide, glabrous.

Ranges from Eneabba and Mt Lesueur south to Busselton and Manjimup and inland to Chidlow and Dryandra, W.A. A distinctive species in its foliage, large flowers and fruit. Perianth almost succulent at base, the tepals broadened above, then very narrow, with very long limb. The floral bracts enlarge greatly in fruiting heads. The only other species with bipinnatipartite leaves is *D. preissii*, which has very different flowers and fruit. There are two subspecies based mainly on flower size and leaf form.

Perianth 48–57 mm long, with a few long apical hairs; involucral bracts 6–8 cm long; leaf lobes 1.2–3 mm wide (Perth southwards) **93a.** subsp. **bipinnatifida**

Perianth 40–45 mm long, the apex glabrous or rarely with 1 or 2 long hairs; involucral bracts 4.5–6 cm long; leaf lobes usually 0.6–0.8 mm wide (Eneabba to Muchea) **93b.** subsp. **multifida**

93a. Dryandra bipinnatifida R.Br. subsp. **bipinnatifida**

Illustration: R.M.Sainsbury, *Field Guide Dryandra* 13 (1985).

Leaf lamina usually 25–33 cm long; lobes 1.2–3 mm wide. Involucral bracts 6–8 cm long. Perianth 48–57 mm long; limb with a few long, apical hairs. Floral bracts elongating to 28–35 mm in fruit. Fig. 60D, E.

Occurs from the Darling Plateau east of Perth south to Manjimup. Grows in lateritic soil in Jarrah forest and woodland. Flowers Oct.–Nov. Map 395.

W.A.: Darlington, Nov. 1902, *C.Andrews* (PERTH); Chidlow, June 1939, *C.A.Gardner s.n.* (PERTH); Palgarup, *M.Koch 2671* (PERTH); Dryandra State Forest, *D.M.Rose 452* (PERTH).

93b. Dryandra bipinnatifida subsp. **multifida** A.S.George, *Nuytsia* 10: 402 (1996)

T: 5 km S of Cataby, Brand Hwy, W.A., 11 Oct. 1983, *A.S.George 16276 & P.Nikulinsky*; holo: PERTH; iso: CANB, K, NSW.

Leaf lamina usually 15–20 cm long; lobes usually 0.6–0.8 mm wide. Involucral bracts 4.5–6 cm long. Perianth 40–45 mm long; limb glabrous or with 1 or 2 long, apical hairs. Floral bracts elongating to 20–23 mm in fruit.

Occurs between Eneabba and Muchea. Grows in sand over laterite in kwongan. Flowers Oct.–Nov. Map 396.

W.A.: Eneabba–Three Springs road, just SW of intersection with Kangaroo and Turkey Flat Rds, *K.Alcock 500* (MEL); E of Muchea, *A.S.George 11155* (PERTH); N of Mt Benia, *E.A.Griffin 2415* (PERTH).

Leaves more finely divided and with narrower lobes than subsp. *bipinnatifida*. in *A.S.George 11155* the leaf lobes are c. 1 mm wide, intermediate between the two varieties, but the perianth and involucral bracts place it with subsp. *multifida*. *D.Whibley 4990*, from 70 km S of Moora (PERTH), has long but finely lobed leaves.

Excluded names and names of uncertain application

Dryandra baxteri Courtois, *Magasin d'Horticulture* 1: 322 (1833), *nom. illeg. non* R.Br. (1830)

T: not given (presumably cultivated in Belgium).

Description insufficient. Apparently the foliage resembled that of *D. mucronulata*.

Dryandra cordata Thunb., *Nov. Gen. Pl.* 60 (1781)

This belongs in the Euphorbiaceae.

Dryandra floribunda J.Drumm., *J. Bot. (Hooker)* 4: 308 (1842), *nom. illeg. non* R.Br. (1810)

T: none cited.

Description insufficient.

Dryandra oleifera Lam., *Encycl.* 2: 329 (1786)

This belongs in the Euphorbiaceae.

Dryandra petrophiloides C.A.Gardner, *J. Roy. Soc. W. Australia* 19: 82 (1934)

T: near Newdegate, W.A., Nov. 1931, *W.E.Blackall s.n.*; holo: PERTH.

This is *Isopogon gardneri* Foreman, *Fl. Australia* 16: 207, 479 (1995).

Dryandra spiralis J.Drumm., *J. Bot. (Hooker)* 4: 81 (1842)

T: none cited.

Description insufficient.

Dryandra teretifolia Morrison, *J. Bot. British & Foreign* 50: 279 (1912)

T: Kellerberrin, W.A., Sept., *R.B.Leake*; *n.v.*

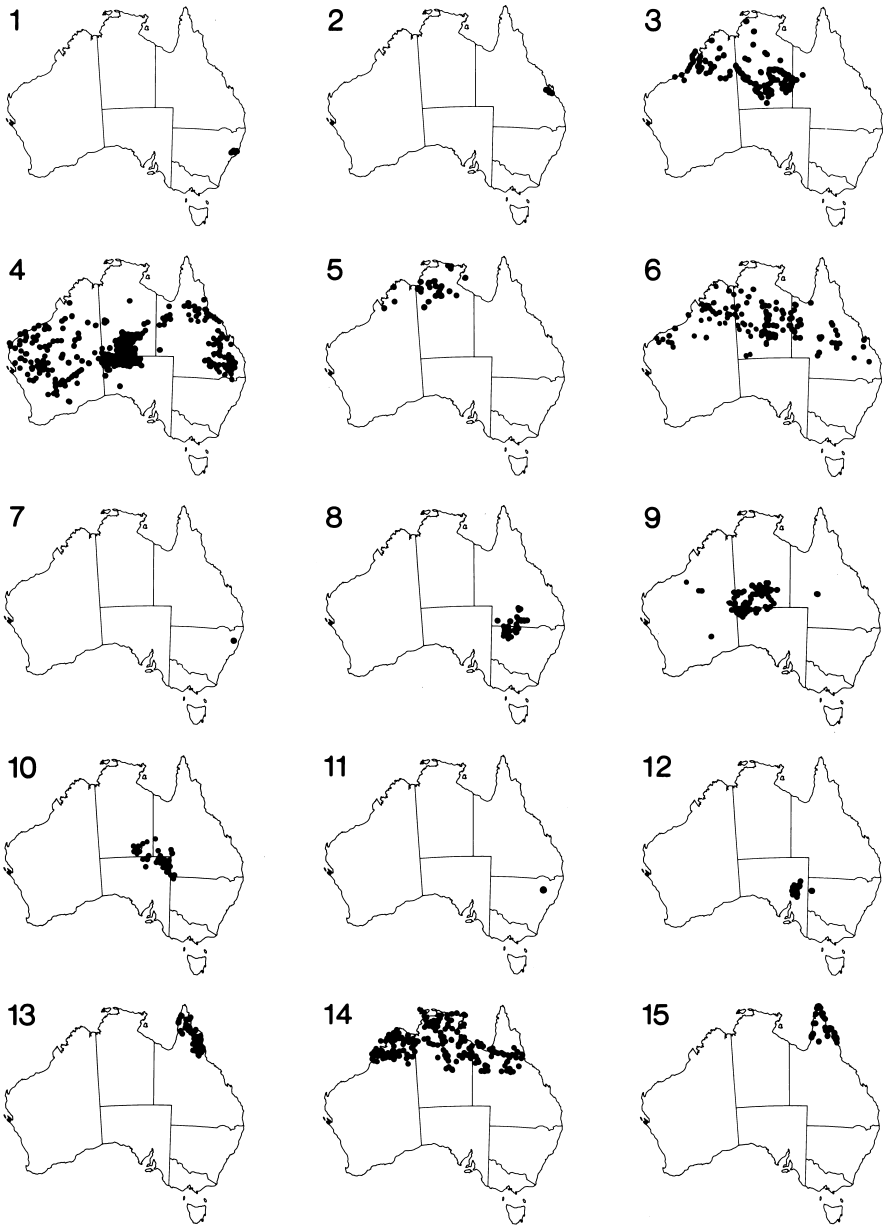
This is a species of *Isopogon*.

Dryandra vernicia Corrêa, *Ann. Mus. Natl Hist. Nat.* 8: 69 (1822)

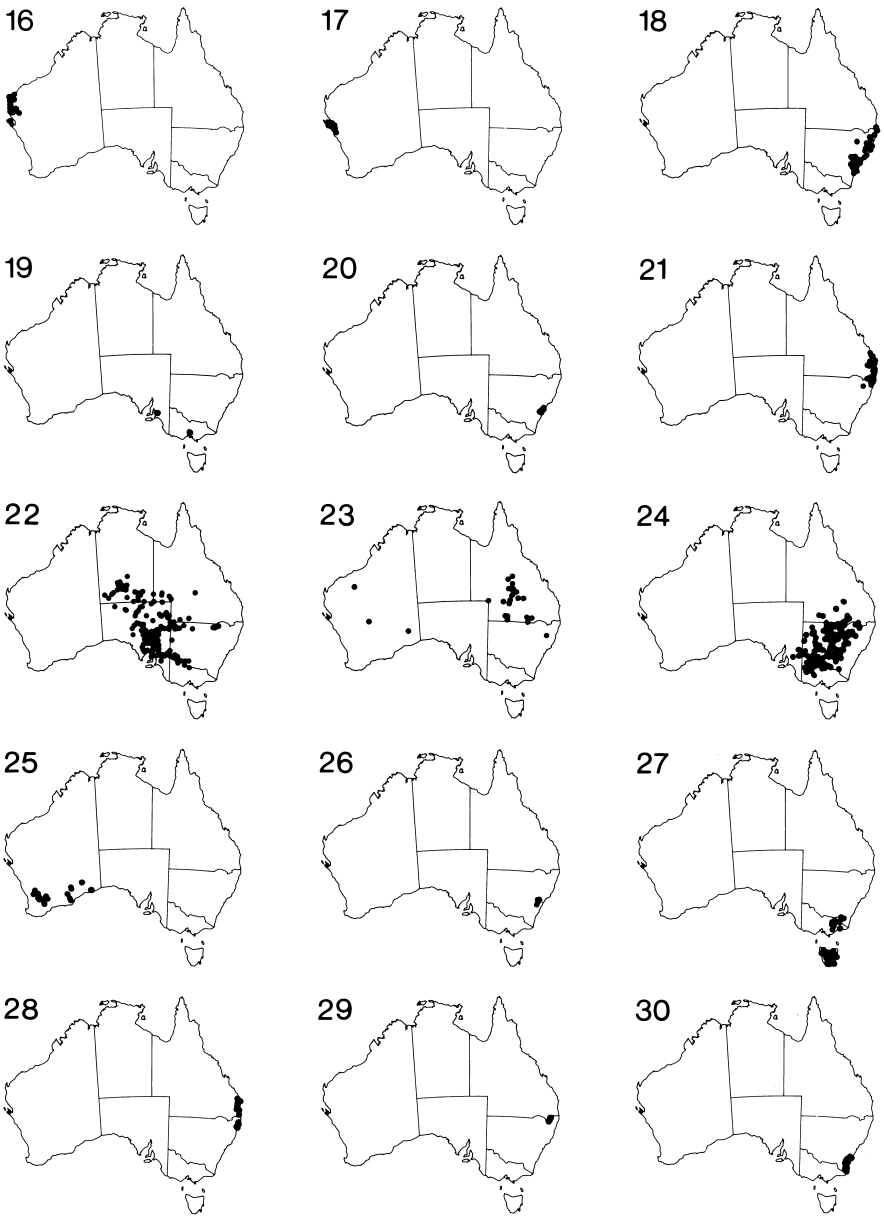
This belongs in the Euphorbiaceae.

MAPS

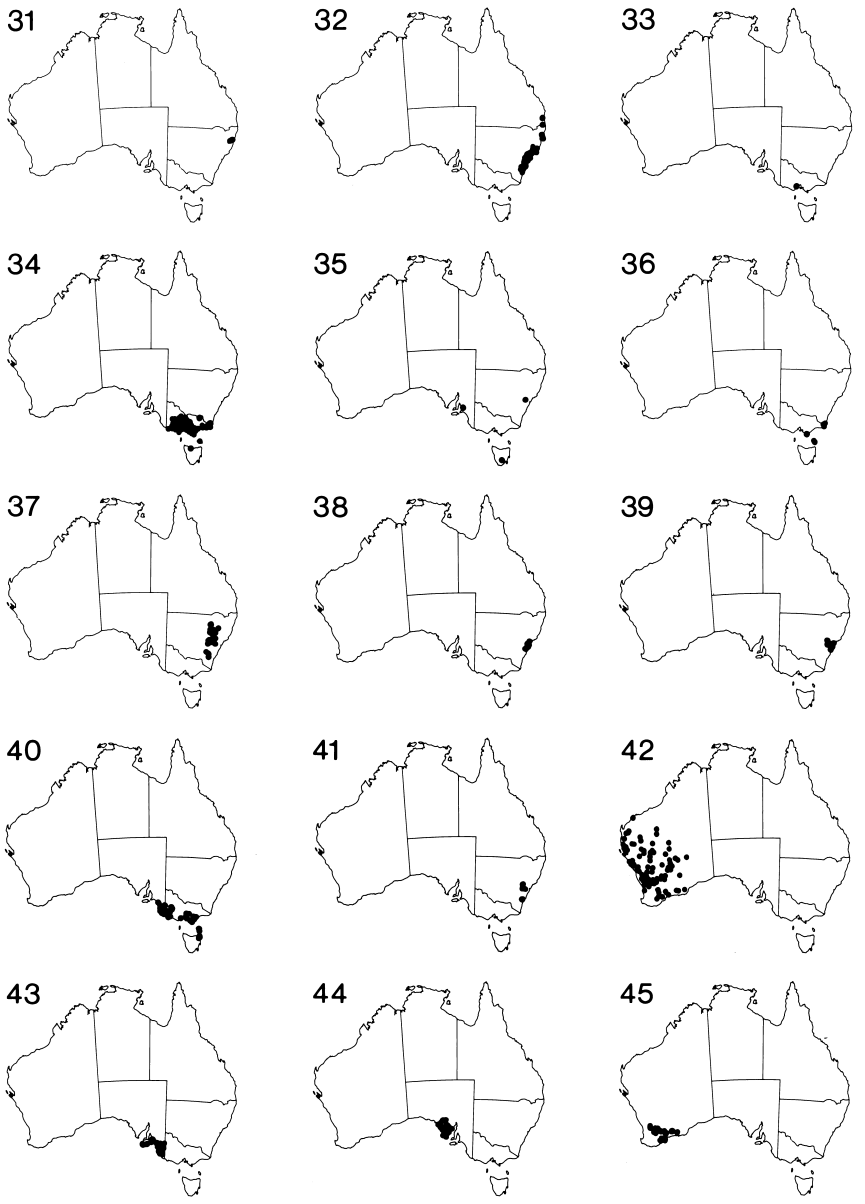
Number in brackets refers to the page on which the taxon is described.



1. Hakea archaeoides (35)
2. Hakea trineura (36)
3. Hakea macrocarpa (38)
4. Hakea lorea subsp. lorea (40)
5. Hakea lorea subsp. borealis (40)
6. Hakea chordophylla (41)
7. Hakea fraseri (41)
8. Hakea ivoryi (42)
9. Hakea divaricata (43)
10. Hakea eyreana (43)
11. Hakea pulvinifera (44)
12. Hakea ednieana (44)
13. Hakea persiehana (46)
14. Hakea arborescens (46)
15. Hakea pedunculata (48)



16. Hakea stenophylla subsp. stenophylla (49)
17. Hakea stenophylla subsp. notialis (49)
18. Hakea salicifolia subsp. salicifolia (50)
19. Hakea salicifolia subsp. salicifolia, naturalised (50)
20. Hakea salicifolia subsp. angustifolia (52)
21. Hakea florulenta (52)
22. Hakea leucoptera subsp. leucoptera (55)
23. Hakea leucoptera subsp. sericipes (55)
24. Hakea tephrosperma (55)
25. Hakea kippistiana (56)
26. Hakea constablei (56)
27. Hakea lissosperma (57)
28. Hakea actites (59)
29. Hakea macrorrhyncha (59)
30. Hakea macraeana (60)



31. Hakea ochroptera (60)

32. Hakea sericea (61)

33. Hakea sericea, naturalised (61)

34. Hakea decurrens subsp. physocarpa (63)

35. Hakea decurrens subsp. physocarpa, naturalised (63)

36. Hakea decurrens subsp. platytaenia (64)

37. Hakea decurrens subsp. decurrens (64)

38. Hakea gibbosa (64)

39. Hakea propinqua (66)

40. Hakea nodosa (66)

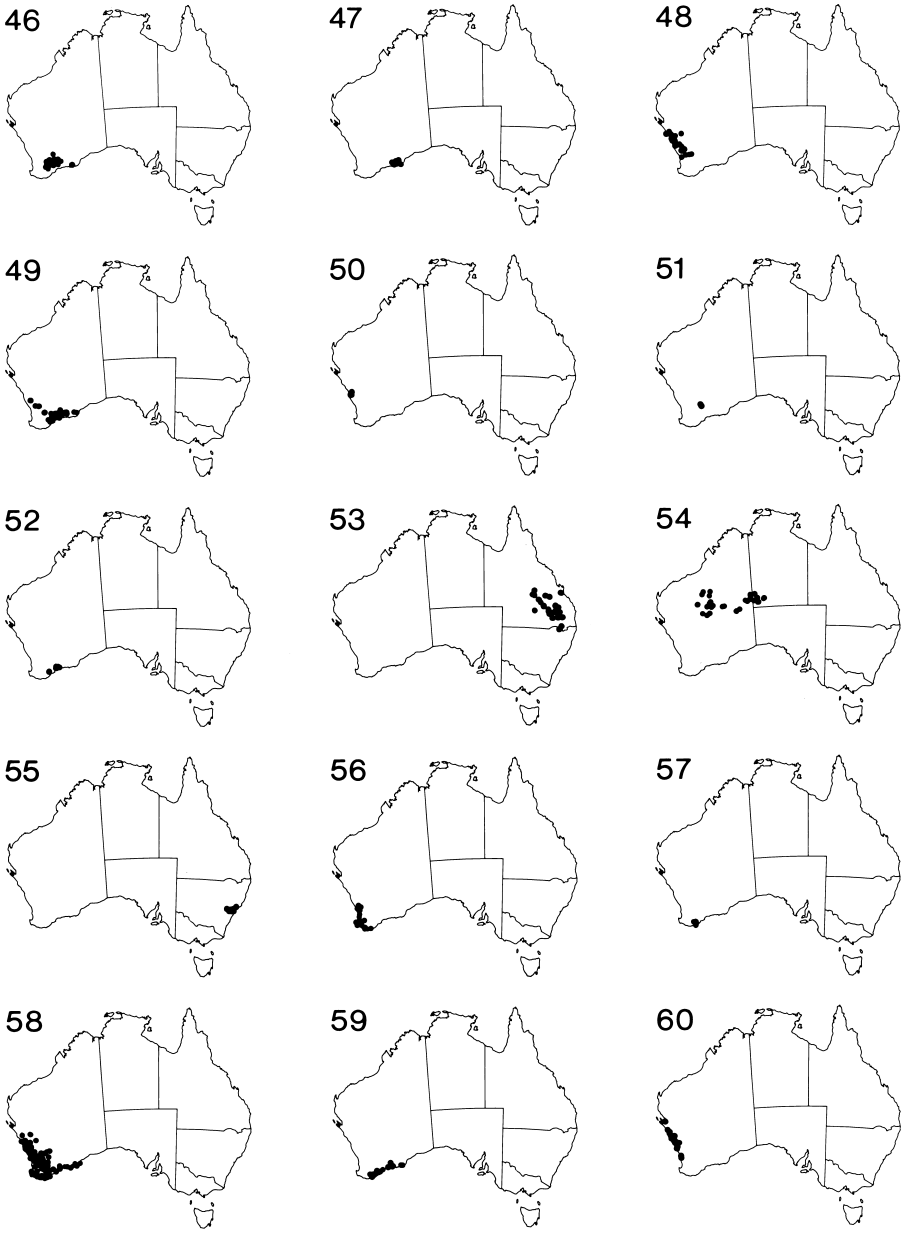
41. Hakea pachyphylla (67)

42. Hakea preissii (69)

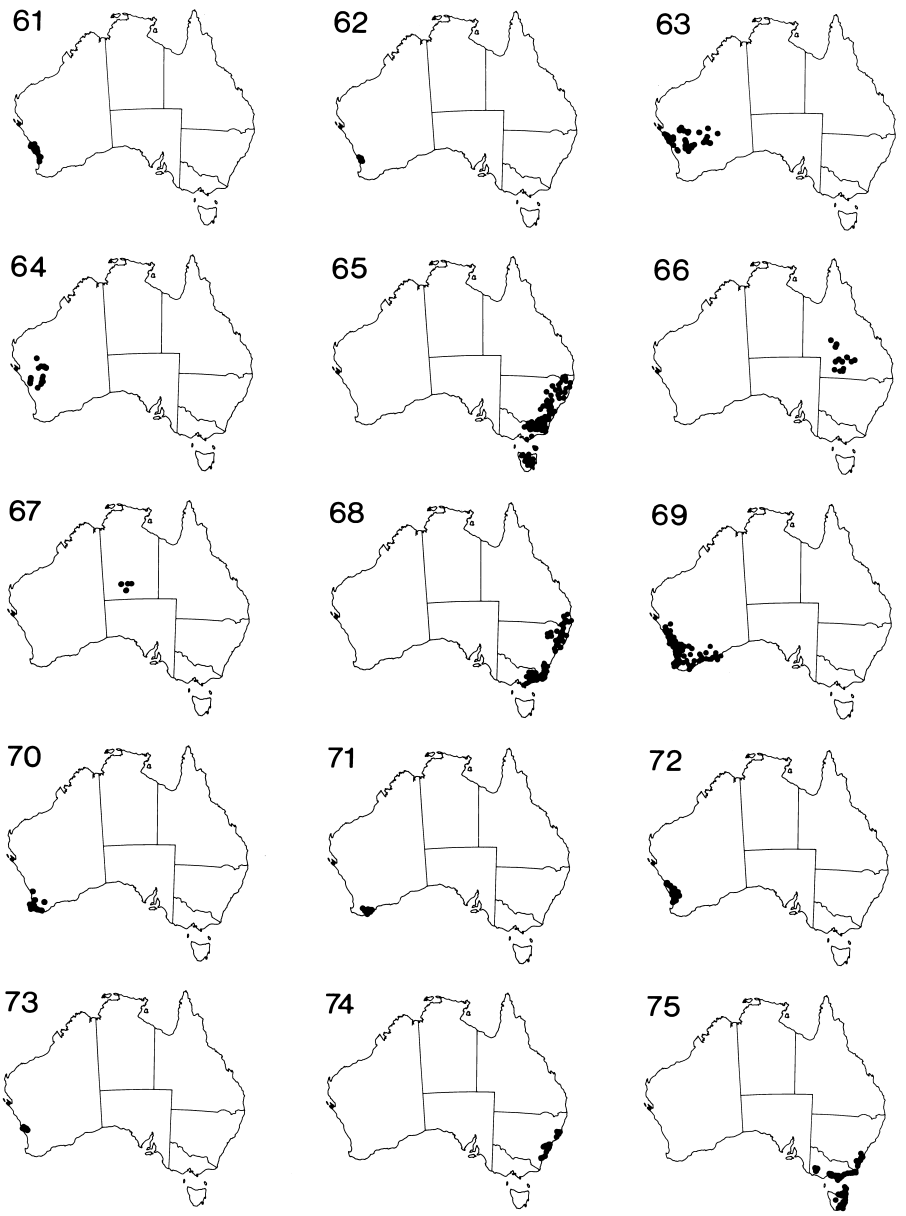
43. Hakea vittata (69)

44. Hakea cycloptera (70)

45. Hakea strumosa (70)



46. Hakea newbeyana (70)
47. Hakea bicornata (71)
48. Hakea circumalata (71)
49. Hakea commutata (73)
50. Hakea megalosperma (73)
51. Hakea pendens (75)
52. Hakea verrucosa (75)
53. Hakea purpurea (76)
54. Hakea rhombales (78)
55. Hakea bakeriana (78)
56. Hakea amplexicaulis (79)
57. Hakea pritzelii (80)
58. Hakea prostrata (80)
59. Hakea denticulata (82)
60. Hakea auriculata (82)



61. Hakea spathulata (83)

62. Hakea cristata (84)

63. Hakea recurva subsp. recurva (85)

64. Hakea recurva subsp. arida (87)

65. Hakea microcarpa (87)

66. Hakea collina (88)

67. Hakea standleyensis (88)

68. Hakea eriantha (89)

69. Hakea trifurcata (90)

70. Hakea lasianthoides (91)

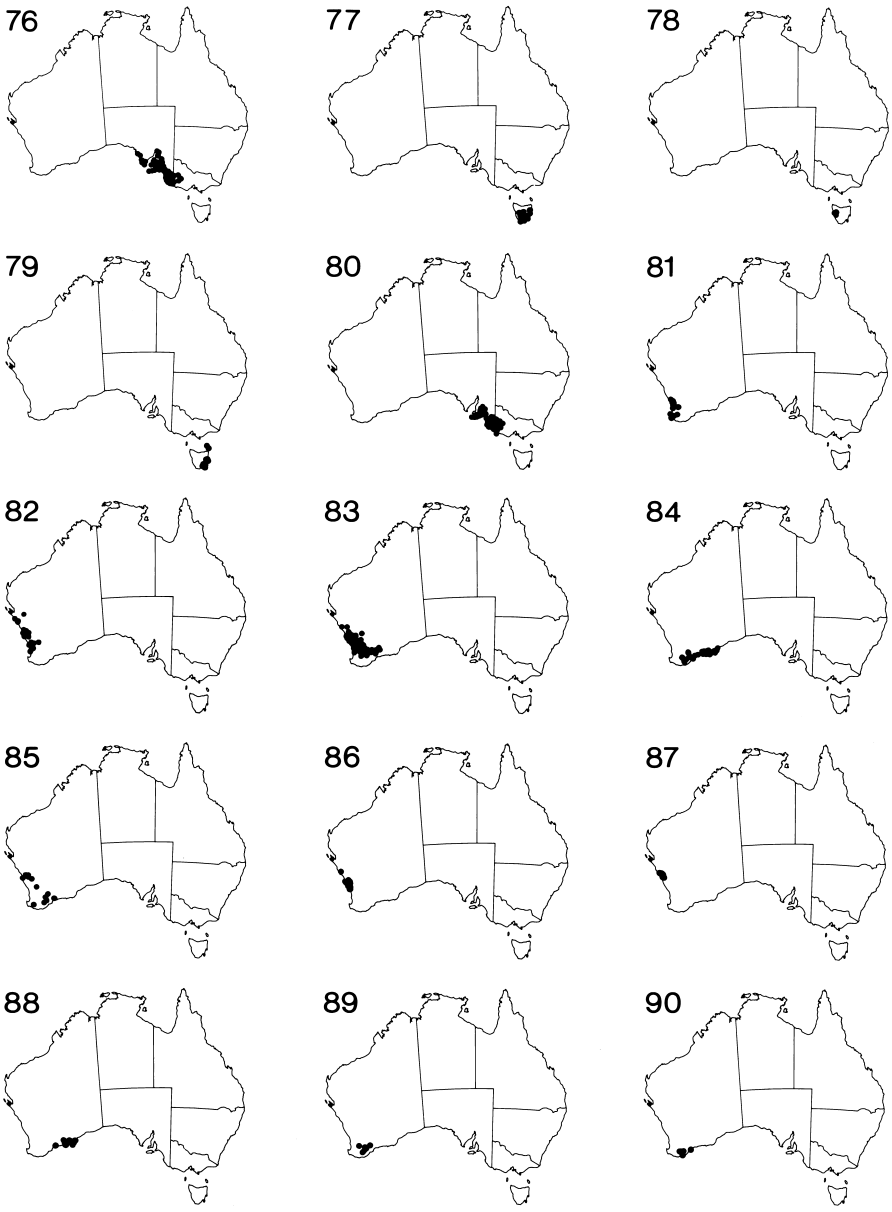
71. Hakea lasiantha (92)

72. Hakea erinacea (92)

73. Hakea longiflora (94)

74. Hakea teretifolia subsp. teretifolia (95)

75. Hakea teretifolia subsp. hirsuta (95)



76. Hakea rugosa (96)

77. Hakea epiglottis subsp. epiglottis (97)

78. Hakea epiglottis subsp. milliganii (97)

79. Hakea megadenia (98)

80. Hakea rostrata (98)

81. Hakea cyclocarpa (99)

82. Hakea candolleana (100)

83. Hakea incrassata (100)

84. Hakea obliqua subsp. obliqua (102)

85. Hakea obliqua subsp. parviflora (102)

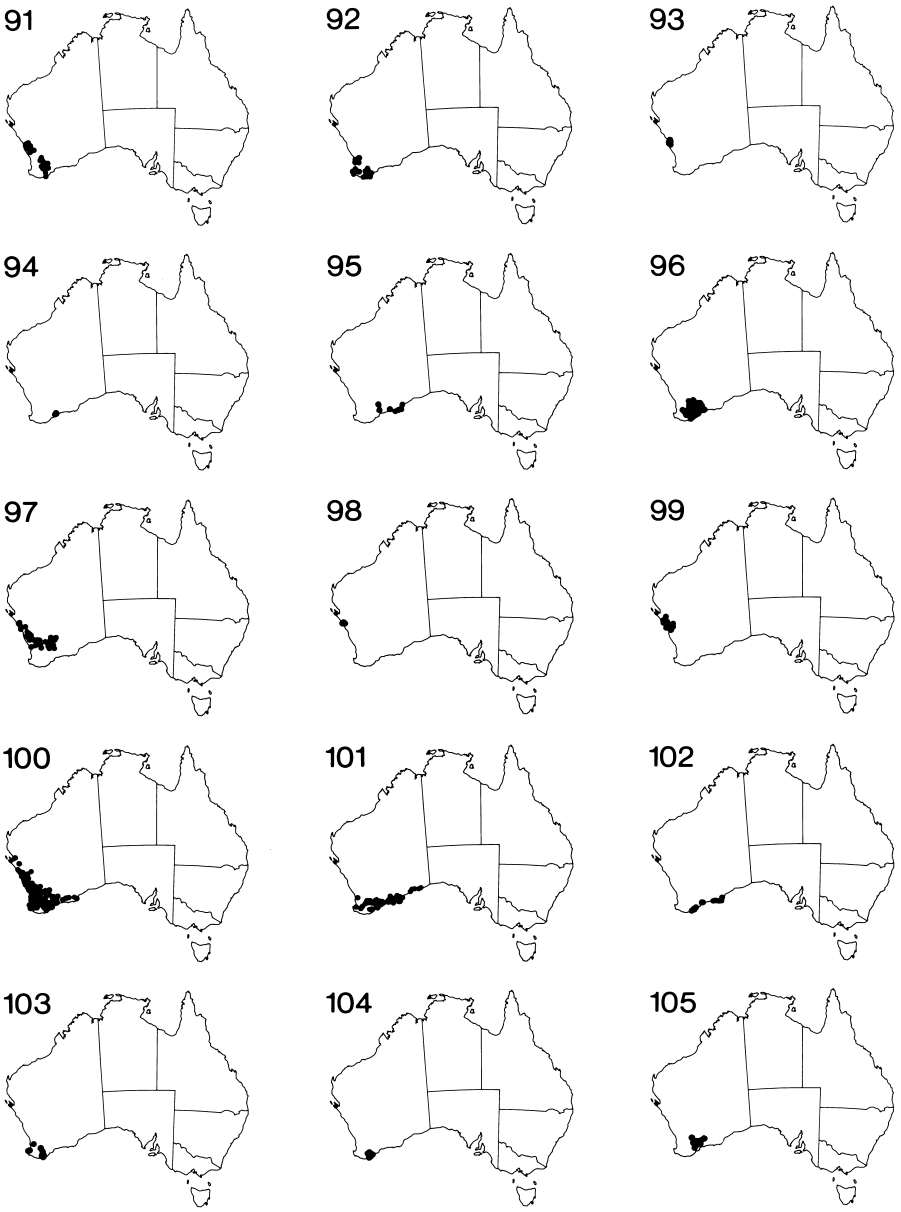
86. Hakea psilorrhyncha (102)

87. Hakea polyanthema (103)

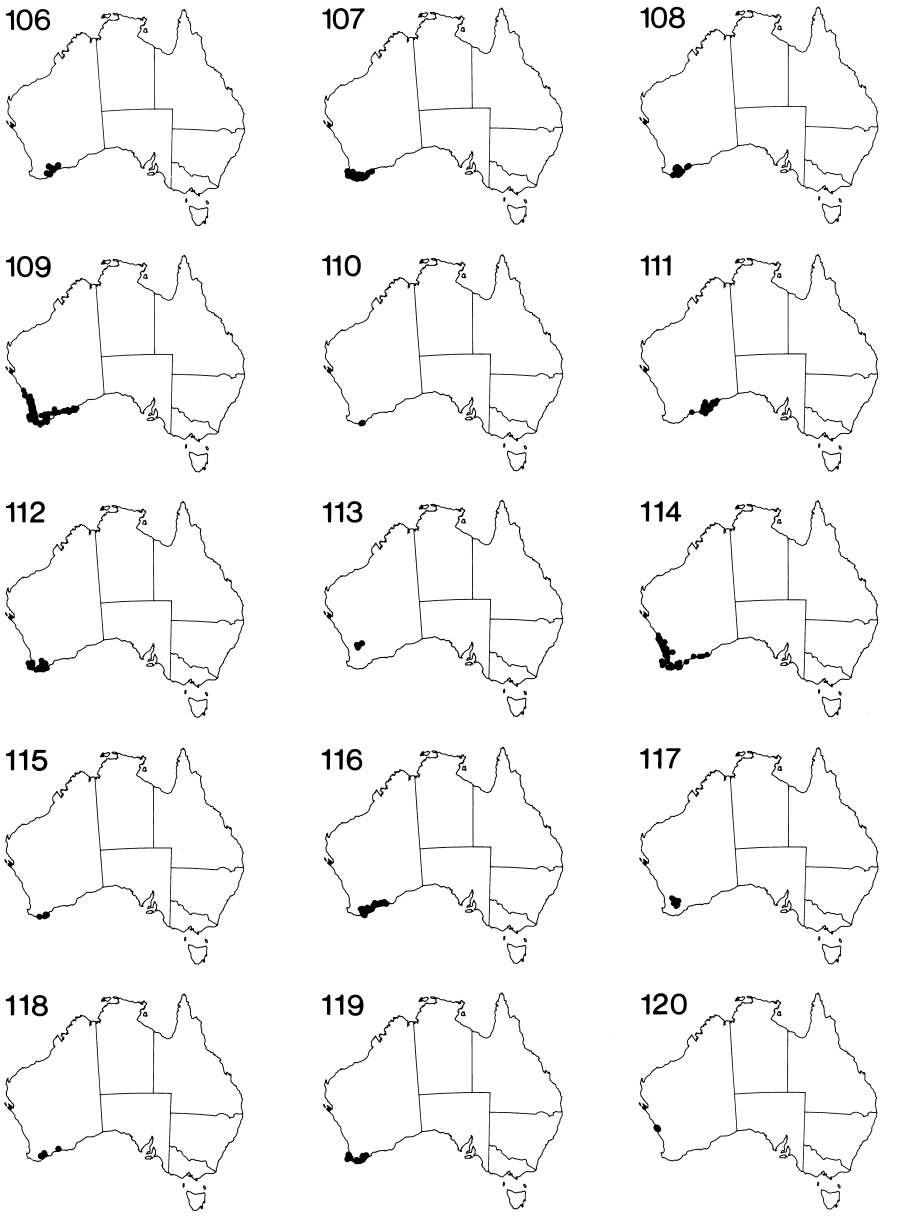
88. Hakea adnata (103)

89. Hakea brachyptera (104)

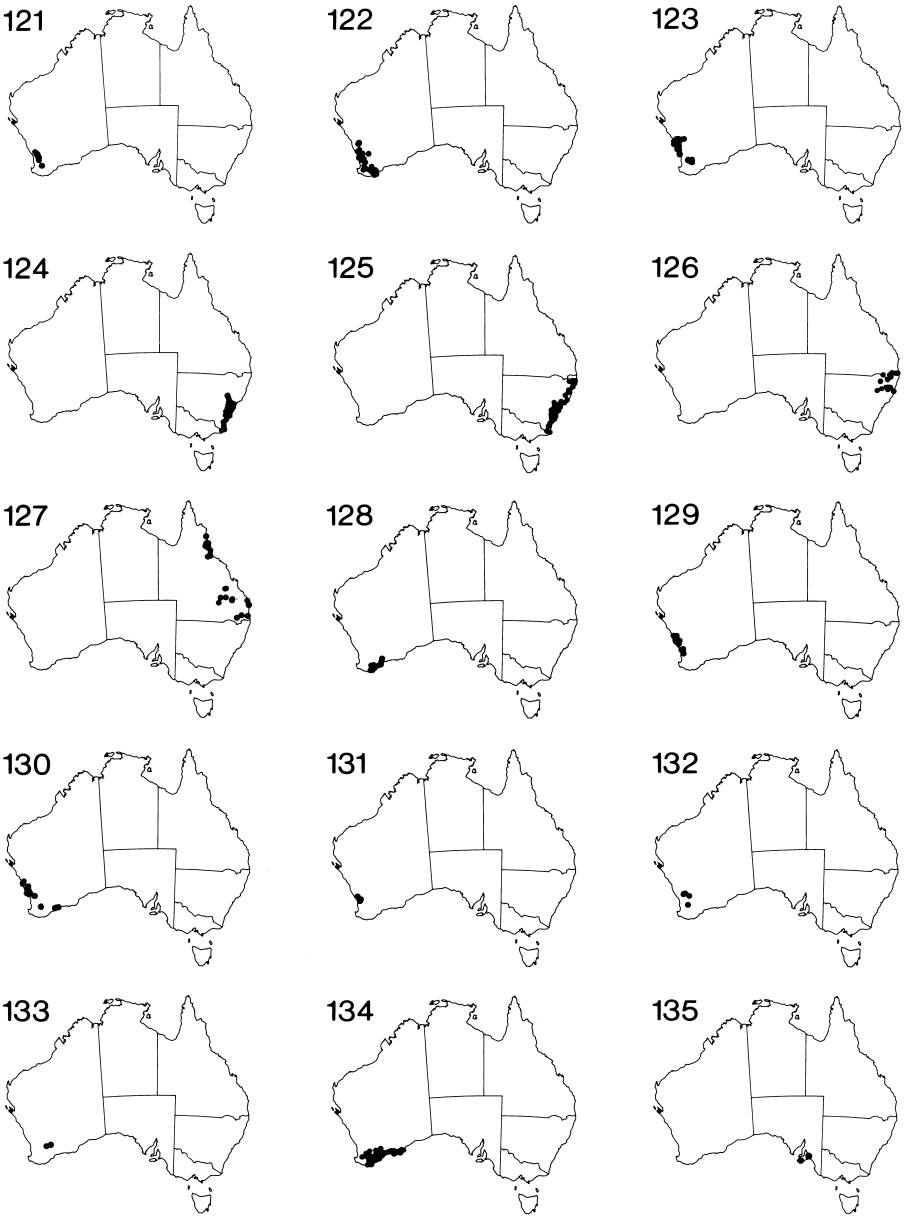
90. Hakea baxteri (105)



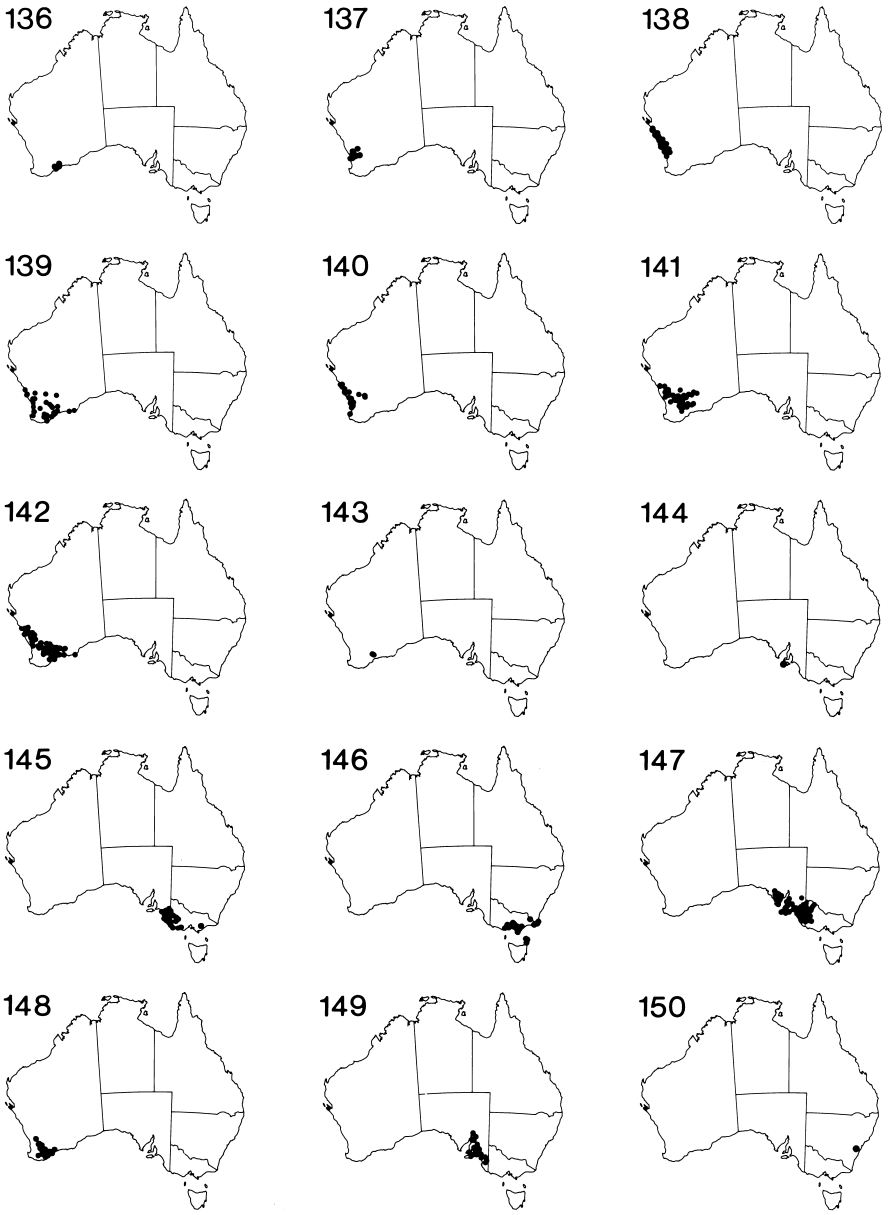
91. Hakea brownii (105)
92. Hakea ceratophylla (107)
93. Hakea flabellifolia (108)
94. Hakea hookeriana (108)
95. Hakea pandanicarpa subsp. pandanicarpa (110)
96. Hakea pandanicarpa subsp. crassifolia (110)
97. Hakea platysperma (111)
98. Hakea orthorrhyncha var. orthorrhyncha (112)
99. Hakea orthorrhyncha var. filiformis (112)
100. Hakea lissocarpha (113)
101. Hakea nitida (115)
102. Hakea drupacea (115)
103. Hakea oldfieldii (116)
104. Hakea lasiocarpha (117)
105. Hakea horrida (118)



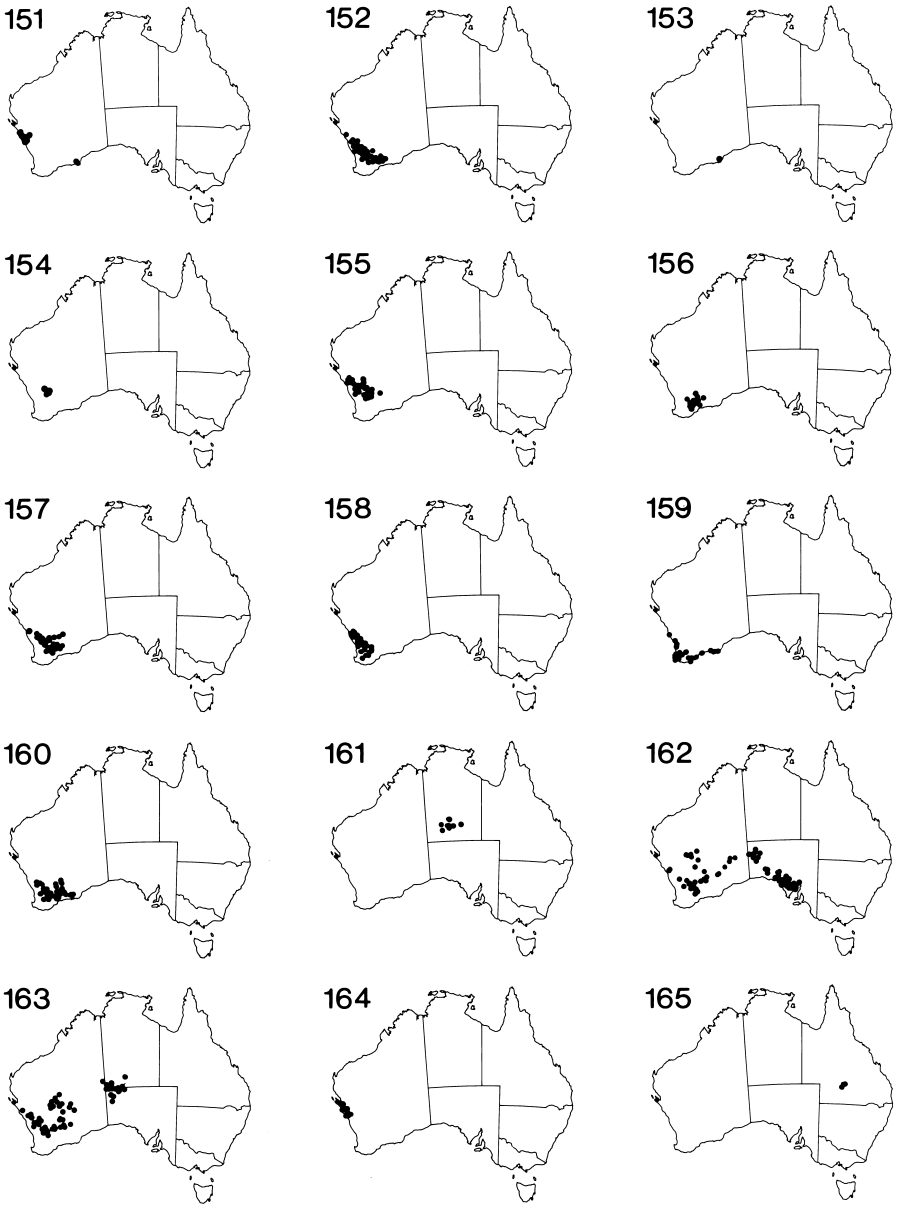
106. Hakea ilicifolia (118)
107. Hakea oleifolia (119)
108. Hakea florida (121)
109. Hakea varia (121)
110. Hakea tuberculata (122)
111. Hakea clavata (122)
112. Hakea linearis (123)
113. Hakea aculeata (124)
114. Hakea ruscifolia (124)
115. Hakea elliptica (127)
116. Hakea ferruginea (127)
117. Hakea hastata (127)
118. Hakea ambigua (128)
119. Hakea falcata (128)
120. Hakea neurophylla (130)



121. Hakea loranthifolia (130)
122. Hakea undulata (131)
123. Hakea anadenia (131)
124. Hakea dactyloides (133)
125. Hakea laevipes subsp. laevipes (134)
126. Hakea laevipes subsp. graniticola (134)
127. Hakea plurinervia (135)
128. Hakea cucullata (136)
129. Hakea conchifolia (136)
130. Hakea smilacifolia (138)
131. Hakea petiolaris subsp. petiolaris (140)
132. Hakea petiolaris subsp. trichophylla (140)
133. Hakea petiolaris subsp. angusta (140)
134. Hakea laurina (140)
135. Hakea laurina, naturalised (140)



136. Hakea obtusa (141)
137. Hakea myrtoides (145)
138. Hakea costata (145)
139. Hakea marginata (147)
140. Hakea stenocarpa (147)
141. Hakea erecta (148)
142. Hakea cygna subsp. cygna (149)
143. Hakea cygna subsp. needlei (149)
144. Hakea aenigma (149)
145. Hakea repullulans (150)
146. Hakea ulicina (150)
147. Hakea mitchellii (151)
148. Hakea lehmanniana (151)
149. Hakea carinata (152)
150. Hakea dohertyi (154)



151. Hakea pycnoneura (154)

152. Hakea scoparia subsp. scoparia (155)

153. Hakea scoparia subsp. trycherica (155)

154. Hakea rigida (155)

155. Hakea invaginata (156)

156. Hakea subsulcata (157)

157. Hakea meisneriana (157)

158. Hakea gilbertii (158)

159. Hakea sulcata (158)

160. Hakea multilineata (160)

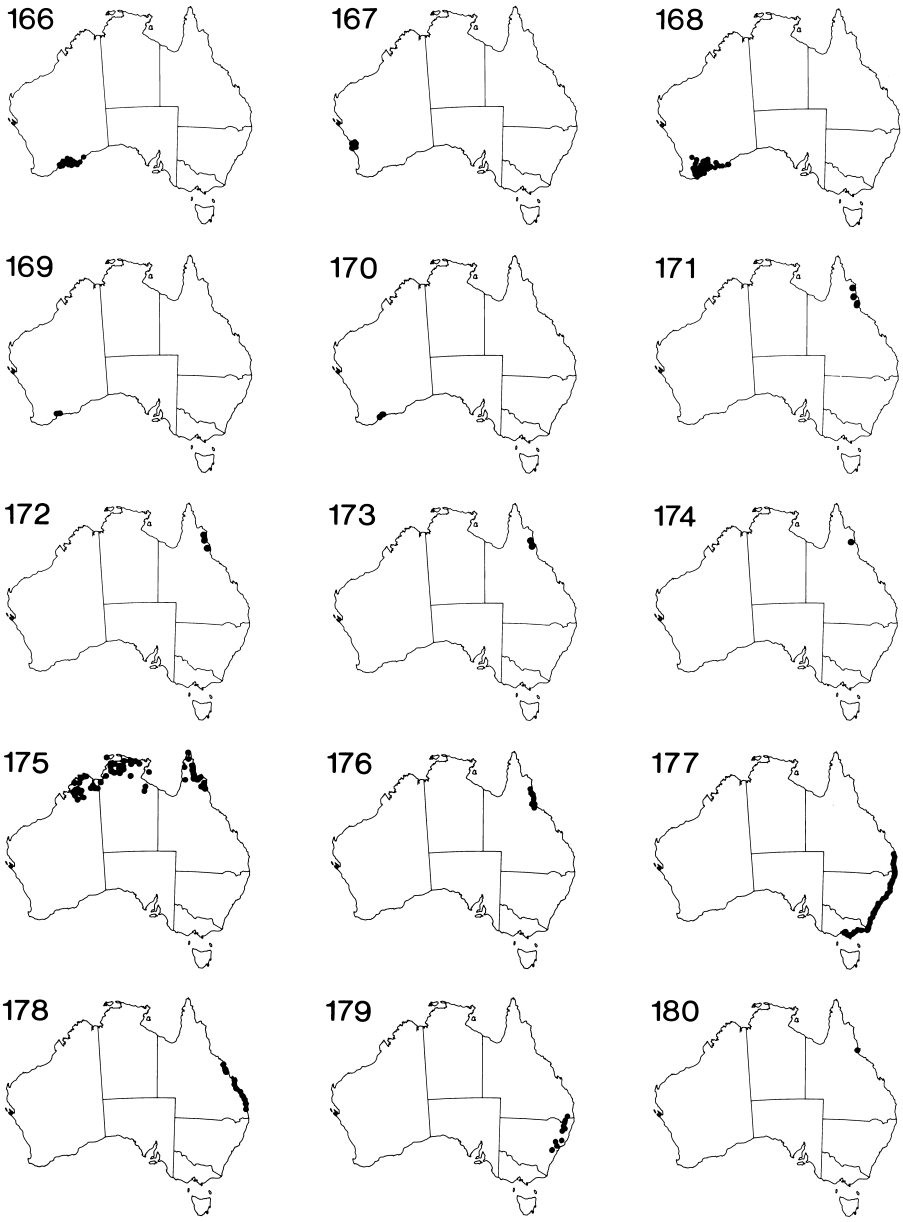
161. Hakea grammatophylla (160)

162. Hakea francisiana (162)

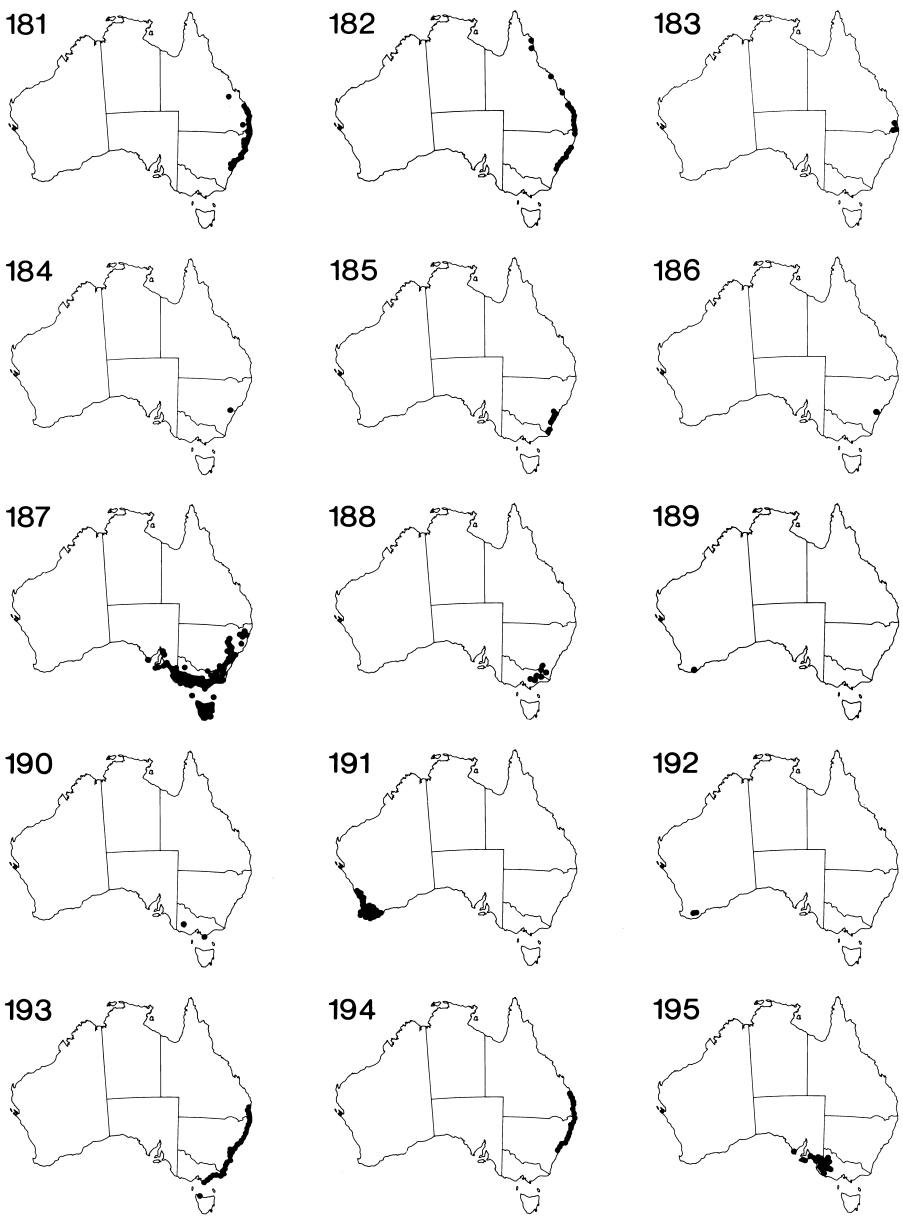
163. Hakea minyma (164)

164. Hakea bucculenta (164)

165. Hakea maconochieana (165)



166. Hakea cinerea (166)
167. Hakea eneabba (166)
168. Hakea corymbosa (167)
169. Hakea acuminata (167)
170. Hakea victoria (168)
171. Musgravea heterophylla (172)
172. Musgravea stenostachya (172)
173. Austromuellera trinervia (173)
174. Austromuellera valida (173)
175. Banksia dentata (185)
176. Banksia aquilonia (185)
177. Banksia integrifolia subsp. integrifolia (188)
178. Banksia integrifolia subsp. compar (188)
179. Banksia integrifolia subsp. monticola (188)
180. Banksia plagiocarpa (189)



181. Banksia oblongifolia (189)

182. Banksia robur (190)

183. Banksia conferta subsp. conferta (191)

184. Banksia conferta subsp. penicillata (191)

185. Banksia paludosa subsp. paludosa (192)

186. Banksia paludosa subsp. astrolux (193)

187. Banksia marginata (193)

188. Banksia canei (194)

189. Banksia canei, naturalised (194)

190. Banksia saxicola (195)

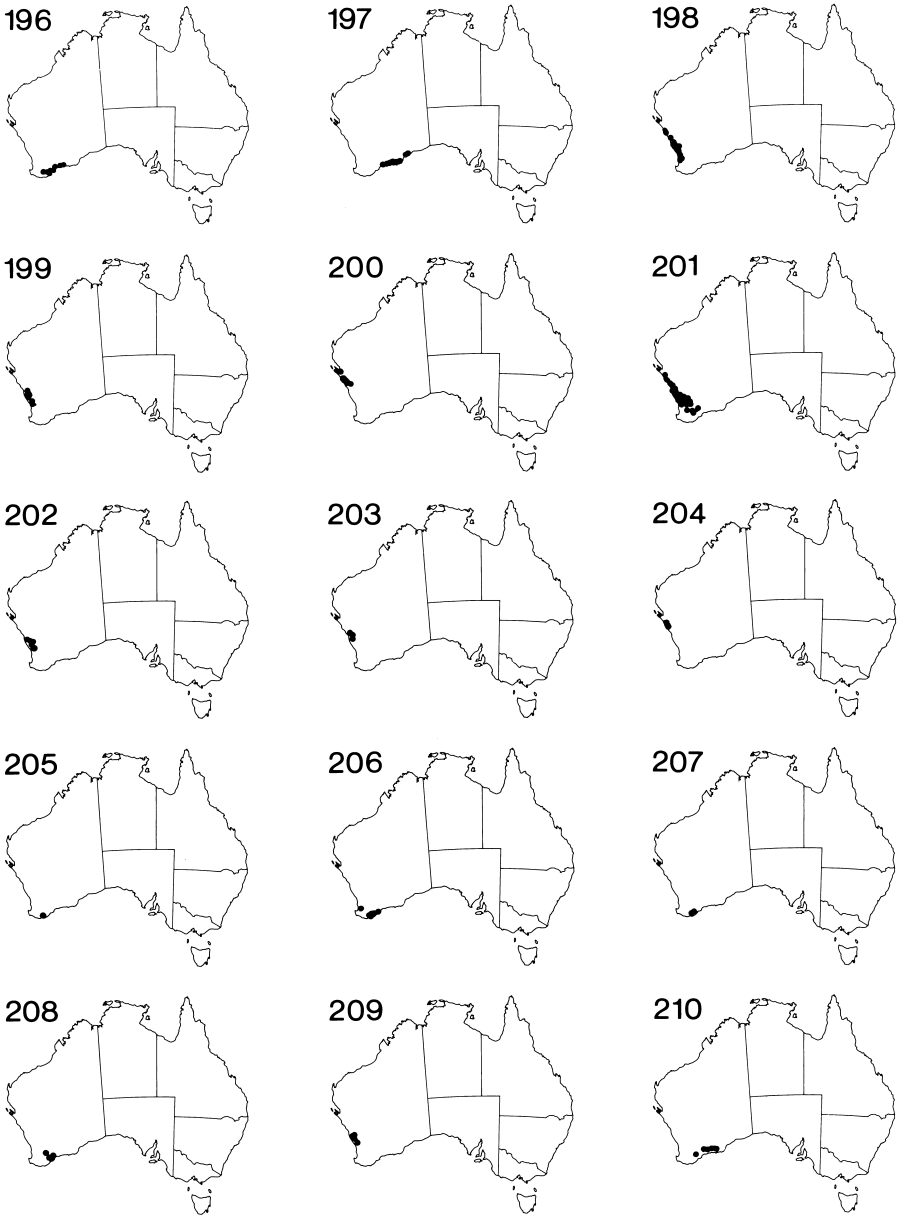
191. Banksia grandis (195)

192. Banksia solandri (196)

193. Banksia serrata (197)

194. Banksia aemula (199)

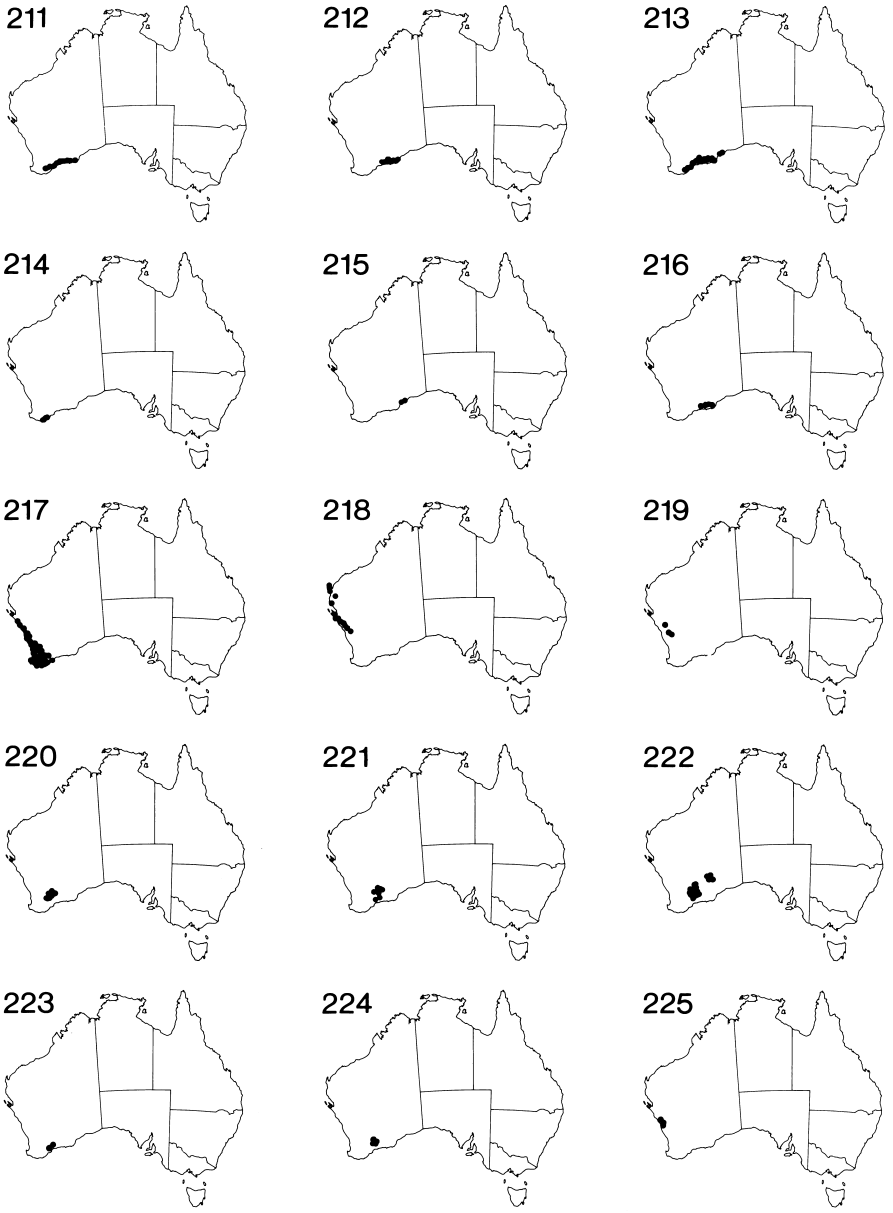
195. Banksia ornata (199)



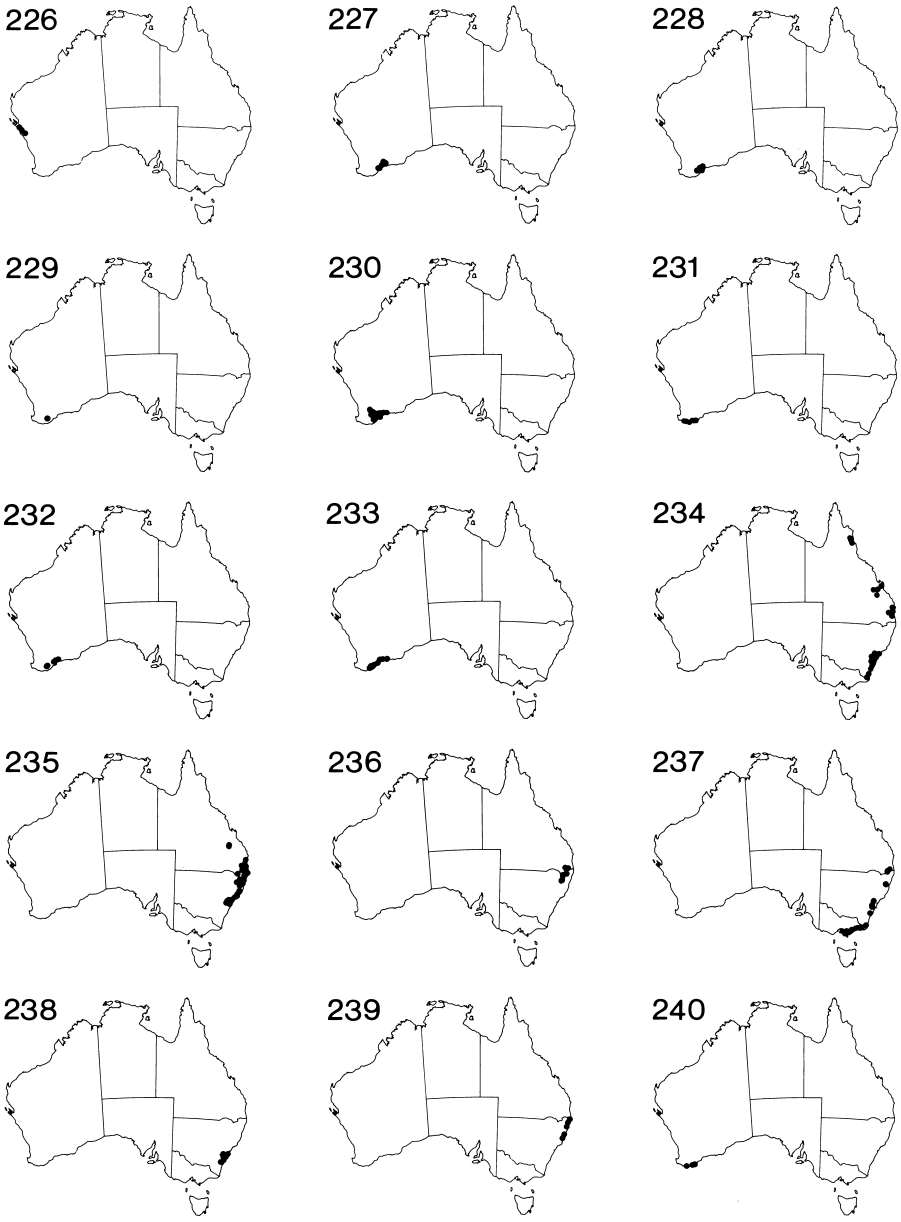
196. Banksia baxteri (200)
199. Banksia candolleana (201)
202. Banksia burdettii (204)
205. Banksia goodii (207)
208. Banksia gardneri var. hiemalis (209)

197. Banksia speciosa (200)
200. Banksia sceptrum (203)
203. Banksia hookeriana (206)
206. Banksia gardneri var. gardneri (209)
209. Banksia chamaephyton (211)

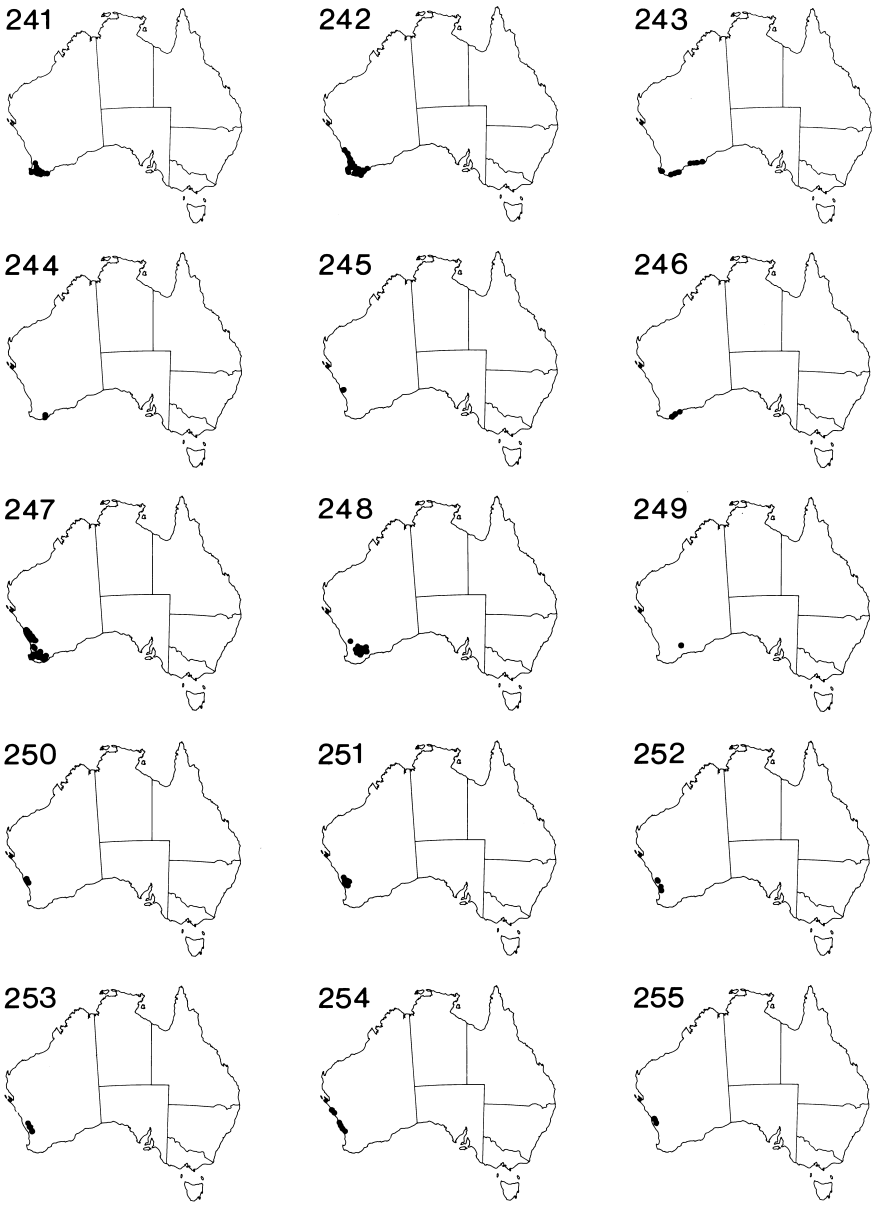
198. Banksia menziesii (201)
201. Banksia prionotes (204)
204. Banksia victoriae (206)
207. Banksia gardneri var. brevidentata (209)
210. Banksia blechnifolia (211)



211. Banksia repens (213)
212. Banksia petiolaris (213)
213. Banksia media (214)
214. Banksia praemorsa (215)
215. Banksia epica (215)
216. Banksia pilostylis (216)
217. Banksia attenuata (216)
218. Banksia ashbyi (217)
219. Banksia benthamiana (217)
220. Banksia audax (218)
221. Banksia lullfitzii (218)
222. Banksia elderiana (218)
223. Banksia laevigata subsp. laevigata (219)
224. Banksia laevigata subsp. fuscolutea (221)
225. Banksia elegans (221)



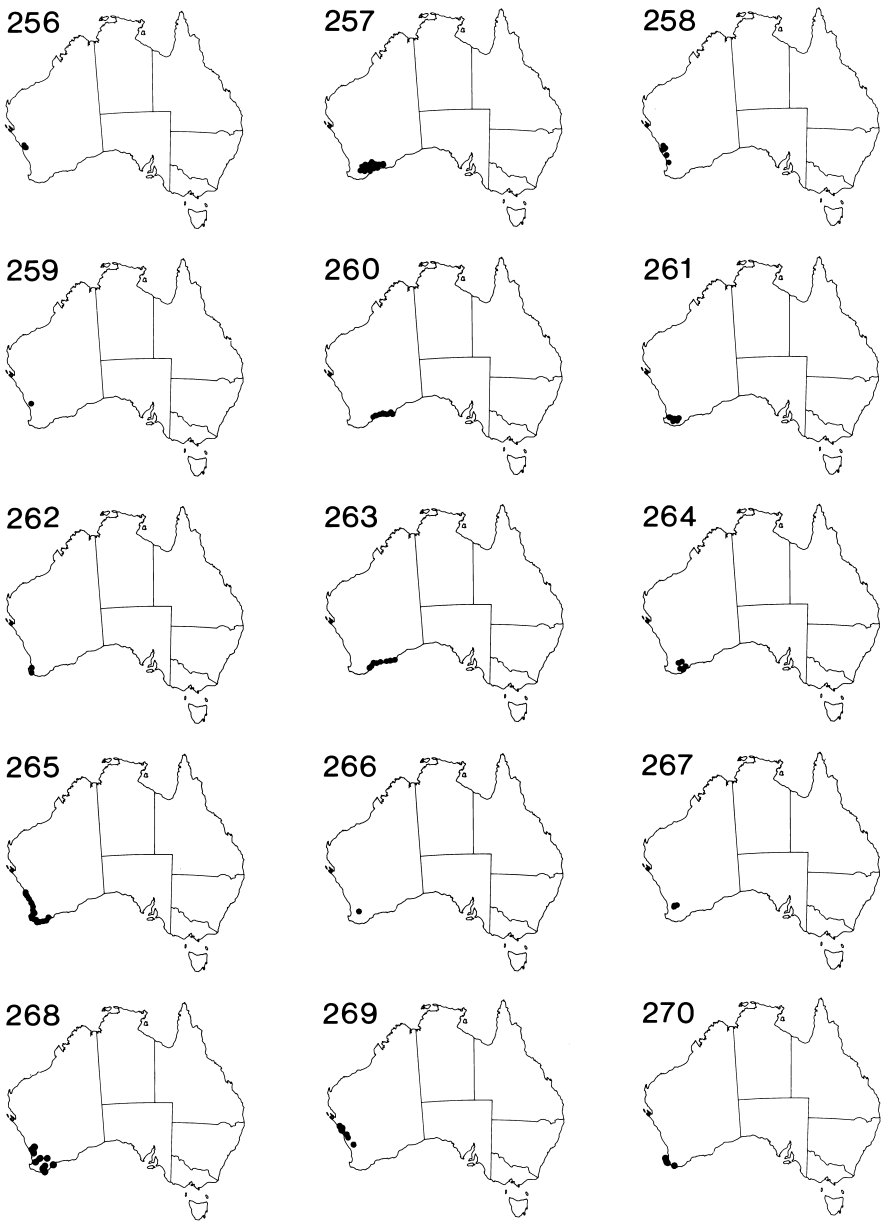
226. Banksia lindleyana (221)
227. Banksia lemanniana (222)
228. Banksia caleyi (223)
229. Banksia aculeata (223)
230. Banksia baueri (225)
231. Banksia quercifolia (226)
232. Banksia oreophila (226)
233. Banksia coccinea (227)
234. Banksia spinulosa var. spinulosa (230)
235. Banksia spinulosa var. collina (230)
236. Banksia spinulosa var. neoanglica (231)
237. Banksia spinulosa var. cunninghamii (231)
238. Banksia ericifolia subsp. ericifolia (232)
239. Banksia ericifolia subsp. macrantha (232)
240. Banksia verticillata (233)



241. Banksia seminuda (233)
244. Banksia brownii (235)
247. Banksia sphaerocarpa var. sphaerocarpa (239)
250. Banksia micrantha (240)
253. Banksia leptophylla var. leptophylla (241)

242. Banksia littoralis (234)
245. Banksia tricuspis (237)
248. Banksia sphaerocarpa var. caesia (239)
251. Banksia grossa (240)
254. Banksia leptophylla var. melletica (242)

243. Banksia occidentalis (234)
246. Banksia dryandroides (237)
249. Banksia sphaerocarpa var. dolichostyla (239)
252. Banksia telmatiaea (240)
255. Banksia lanata (242)



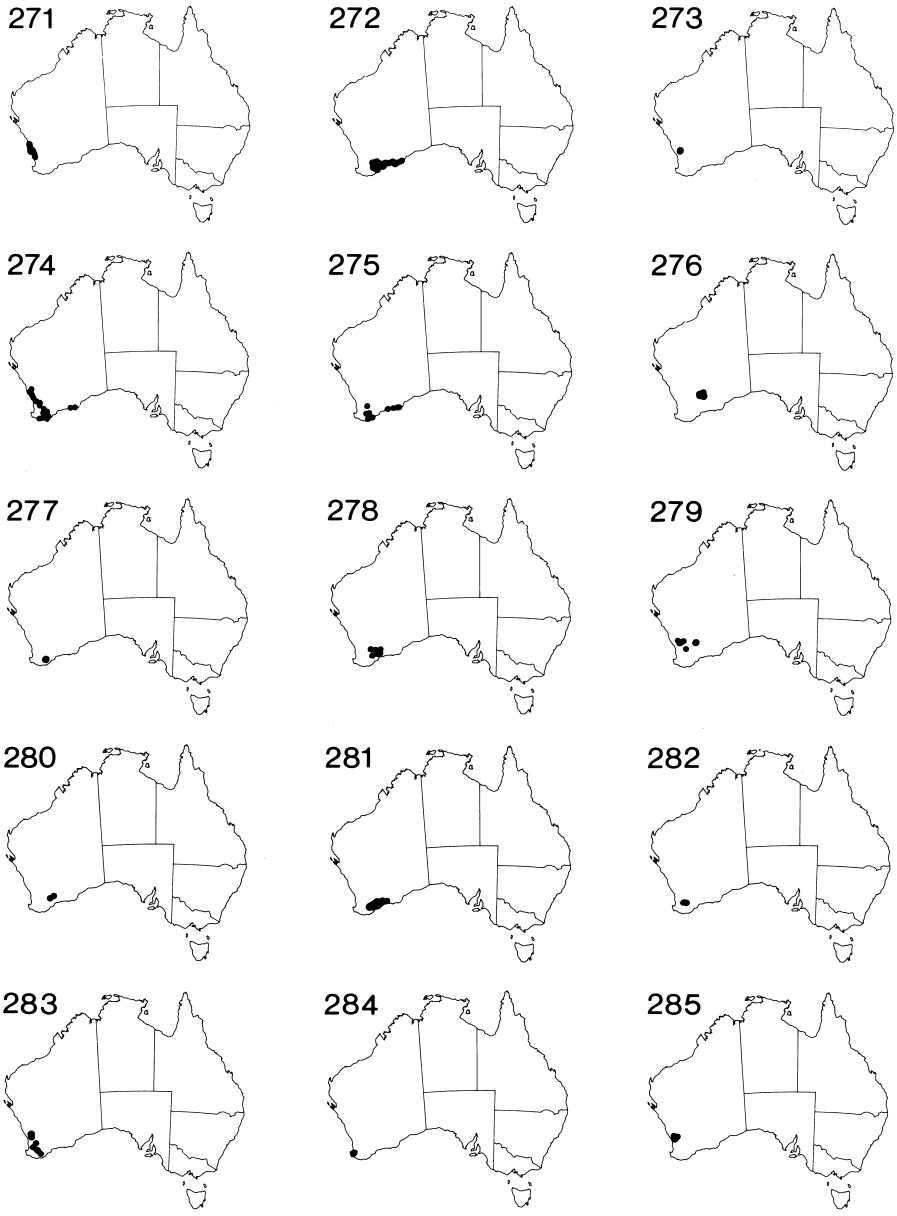
256. Banksia scabrella (242)
259. Banksia laricina (245)

262. Banksia meisneri subsp. ascendens (246)
265. Banksia ilicifolia (248)
268. Dryandra sessilis var. sessilis (264)

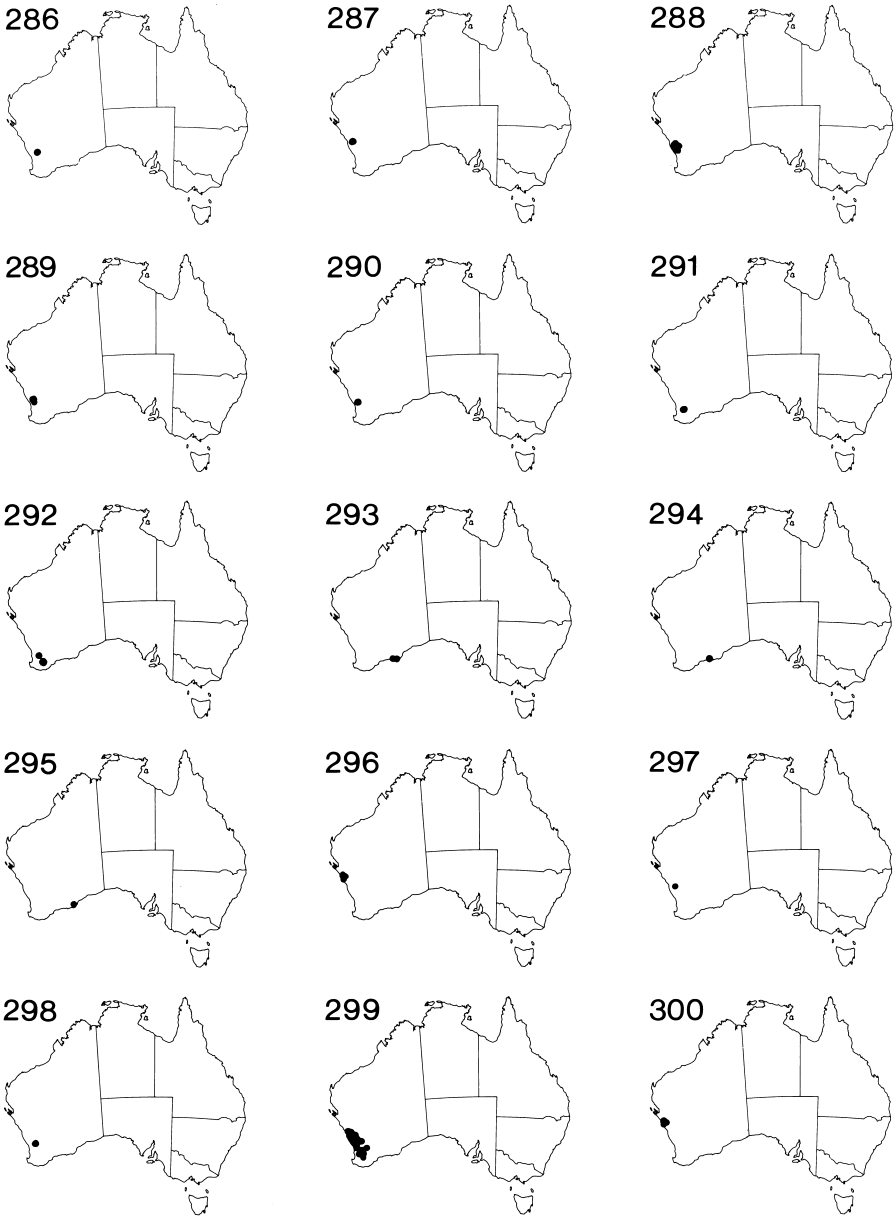
257. Banksia violacea (243)
260. Banksia pulchella (245)

263. Banksia nutans var. nutans (247)
266. Banksia oligantha (248)
269. Dryandra sessilis var. flabellifolia (266)

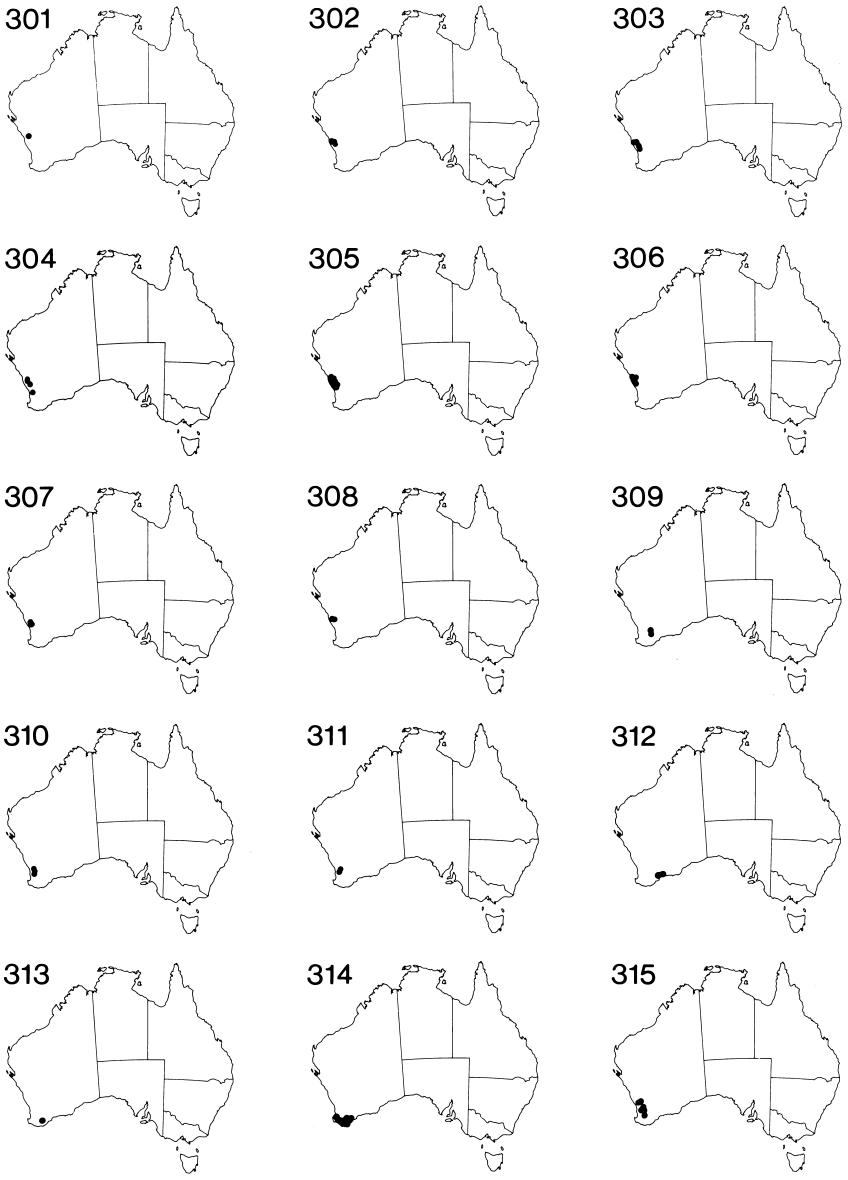
258. Banksia incana (243)
261. Banksia meisneri subsp. meisneri (246)
264. Banksia nutans var. cernuella (247)
267. Banksia cuneata (249)
270. Dryandra sessilis var. cordata (266)



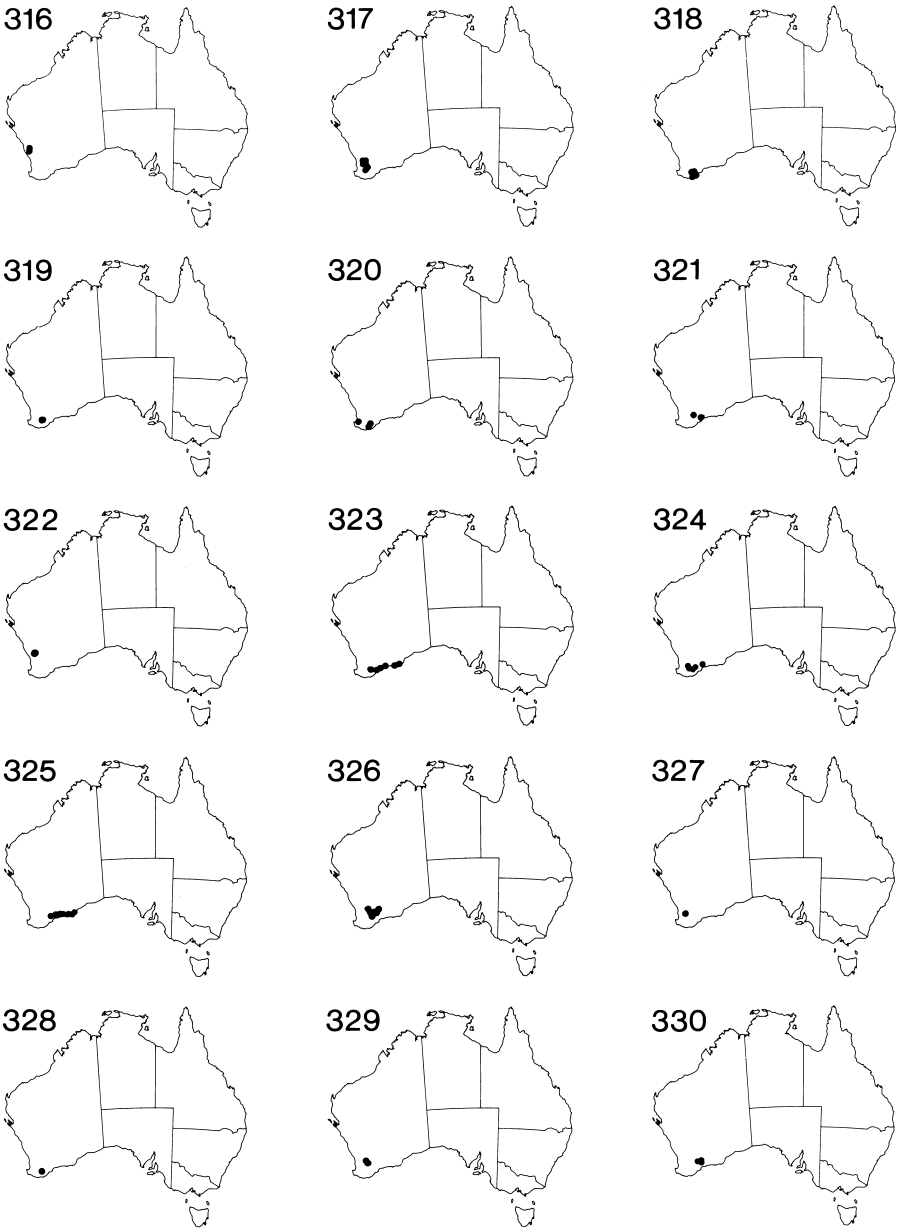
271. Dryandra sessilis var. cygnorum (266)
272. Dryandra cuneata (267)
273. Dryandra fuscobractea (268)
274. Dryandra armata var. armata (269)
275. Dryandra armata var. ignicida (269)
276. Dryandra arborea (269)
277. Dryandra hirsuta (270)
278. Dryandra pallida (270)
279. Dryandra purdieana (271)
280. Dryandra xylothemelia (271)
281. Dryandra cirsioides (271)
282. Dryandra acanthopoda (272)
283. Dryandra squarrosa subsp. squarrosa (274)
284. Dryandra squarrosa subsp. argillacea (274)
285. Dryandra hewardiana (274)



286. Dryandra wonganensis (275)
287. Dryandra trifontinalis (275)
288. Dryandra stricta (277)
289. Dryandra echinata (277)
290. Dryandra polycephala (278)
291. Dryandra subpinnatifida var. subpinnatifida (280)
292. Dryandra subpinnatifida var. imberbis (280)
293. Dryandra longifolia subsp. longifolia (281)
294. Dryandra longifolia subsp. calcicola (281)
295. Dryandra longifolia subsp. archeos (281)
296. Dryandra borealis subsp. borealis (283)
297. Dryandra borealis subsp. elatior (283)
298. Dryandra pulchella (284)
299. Dryandra fraseri var. fraseri (285)
300. Dryandra fraseri var. ashbyi (285)



301. Dryandra fraseri var. oxycedra (286)
302. Dryandra sclerophylla (286)
303. Dryandra kippistiana var. kippistiana (288)
304. Dryandra kippistiana var. paenepeccata (288)
305. Dryandra carlinoides (288)
306. Dryandra tridentata (289)
307. Dryandra serratuloides subsp. serratuloides (290)
308. Dryandra serratuloides subsp. perissa (290)
309. Dryandra meganotia (291)
310. Dryandra praemorsa var. praemorsa (292)
311. Dryandra praemorsa var. splendens (292)
312. Dryandra quercifolia (292)
313. Dryandra anatona (293)
314. Dryandra formosa (293)
315. Dryandra nobilis subsp. nobilis (294)



316. Dryandra nobilis subsp. fragrans (296)

317. Dryandra stuposa (296)

318. Dryandra mucronulata subsp. mucronulata (297)

319. Dryandra mucronulata subsp. retrorsa (297)

320. Dryandra baxteri (299)

321. Dryandra foliosissima (299)

322. Dryandra comosa (300)

323. Dryandra tenuifolia var. tenuifolia (301)

324. Dryandra tenuifolia var. reptans (301)

325. Dryandra obtusa (301)

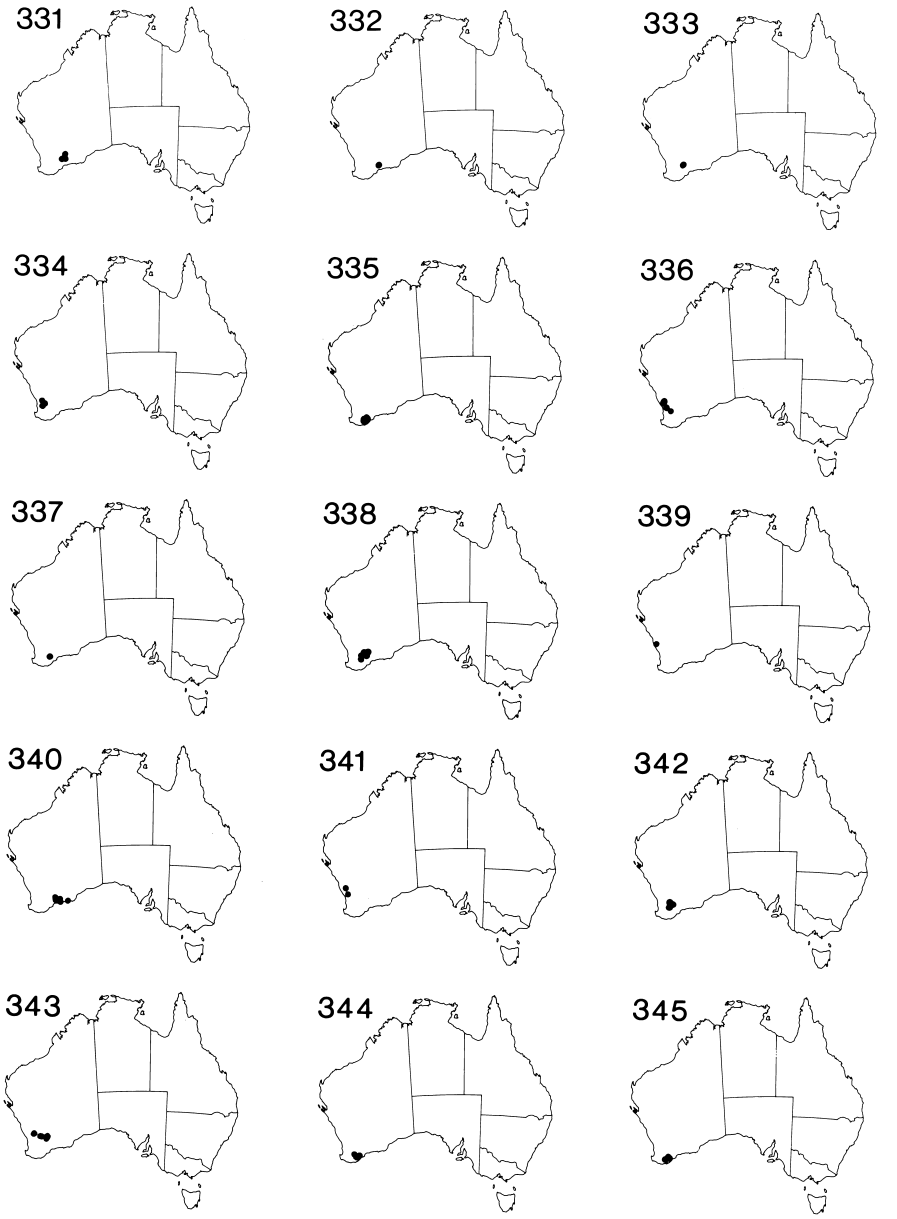
326. Dryandra ferruginea subsp. ferruginea (304)

327. Dryandra ferruginea subsp. tutanningensis (304)

328. Dryandra ferruginea subsp. pumila (305)

329. Dryandra ferruginea subsp. obliquiloba (305)

330. Dryandra ferruginea subsp. chelomacarpa (305)



331. Dryandra ferruginea subsp. flavescens (306)

332. Dryandra corvijuga (306)

333. Dryandra epimicta (306)

334. Dryandra proteoides (307)

335. Dryandra drummondii subsp. drummondii (308)

336. Dryandra drummondii subsp. hiemalis (308)

337. Dryandra drummondii subsp. macrorufa (308)

338. Dryandra octotriginta (310)

339. Dryandra catoglypta (310)

340. Dryandra pteridifolia subsp. pteridifolia (311)

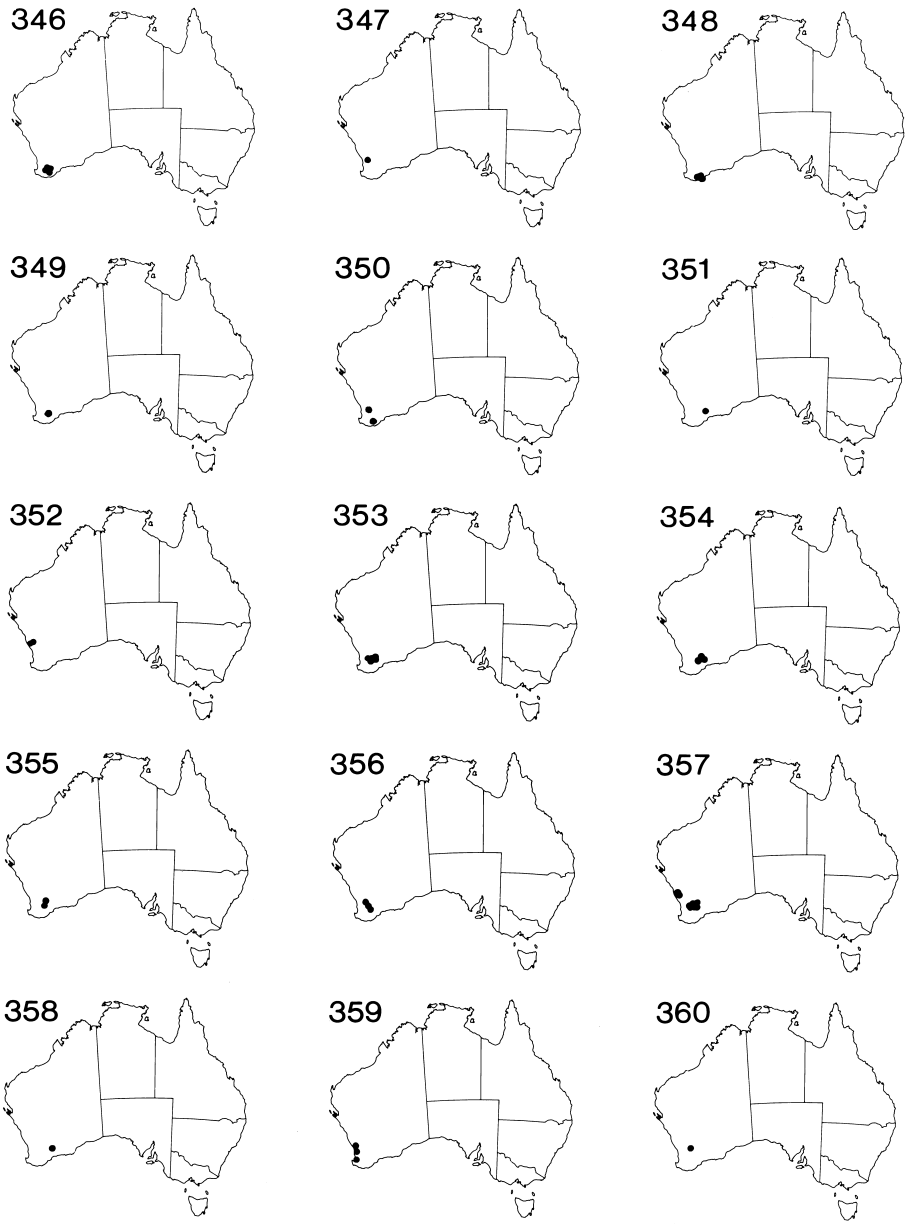
341. Dryandra pteridifolia subsp. vernalis (311)

342. Dryandra fililoba (312)

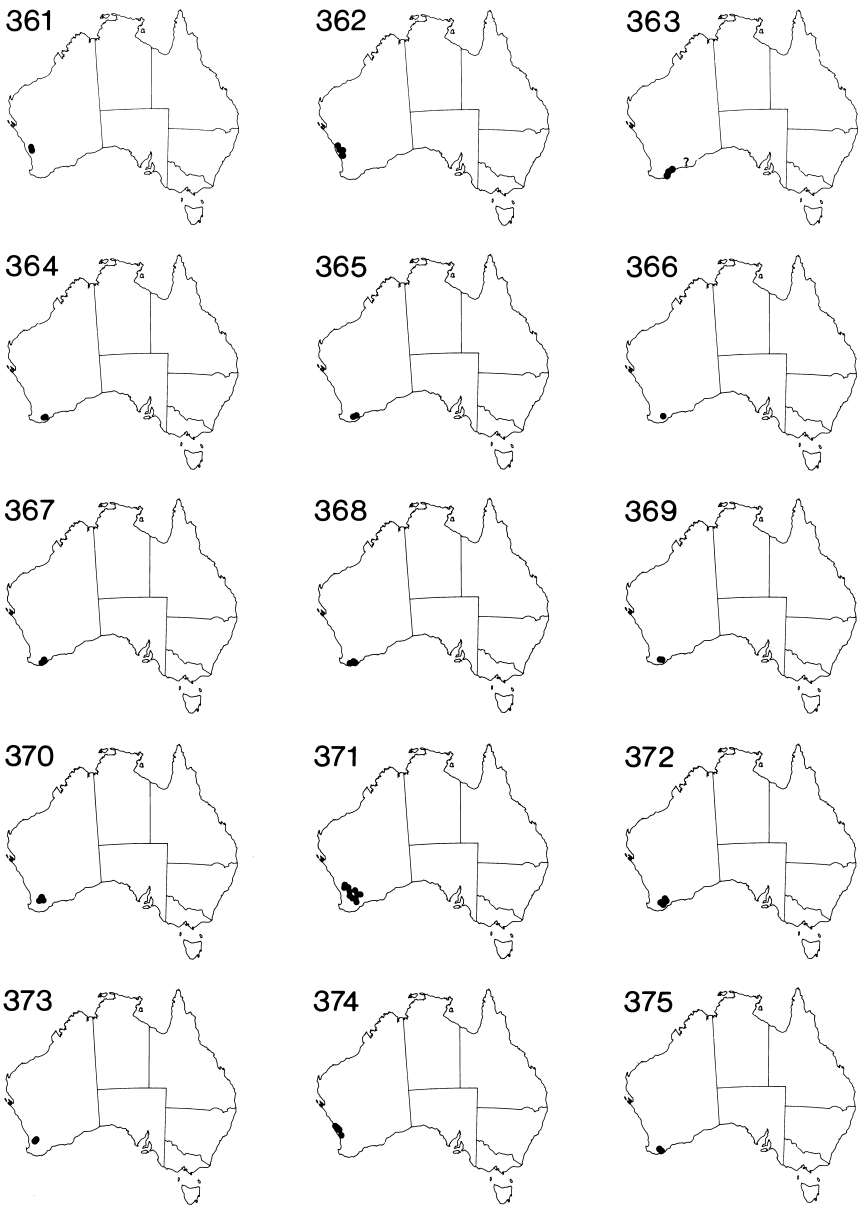
343. Dryandra shanklandiorum (312)

344. Dryandra nervosa (312)

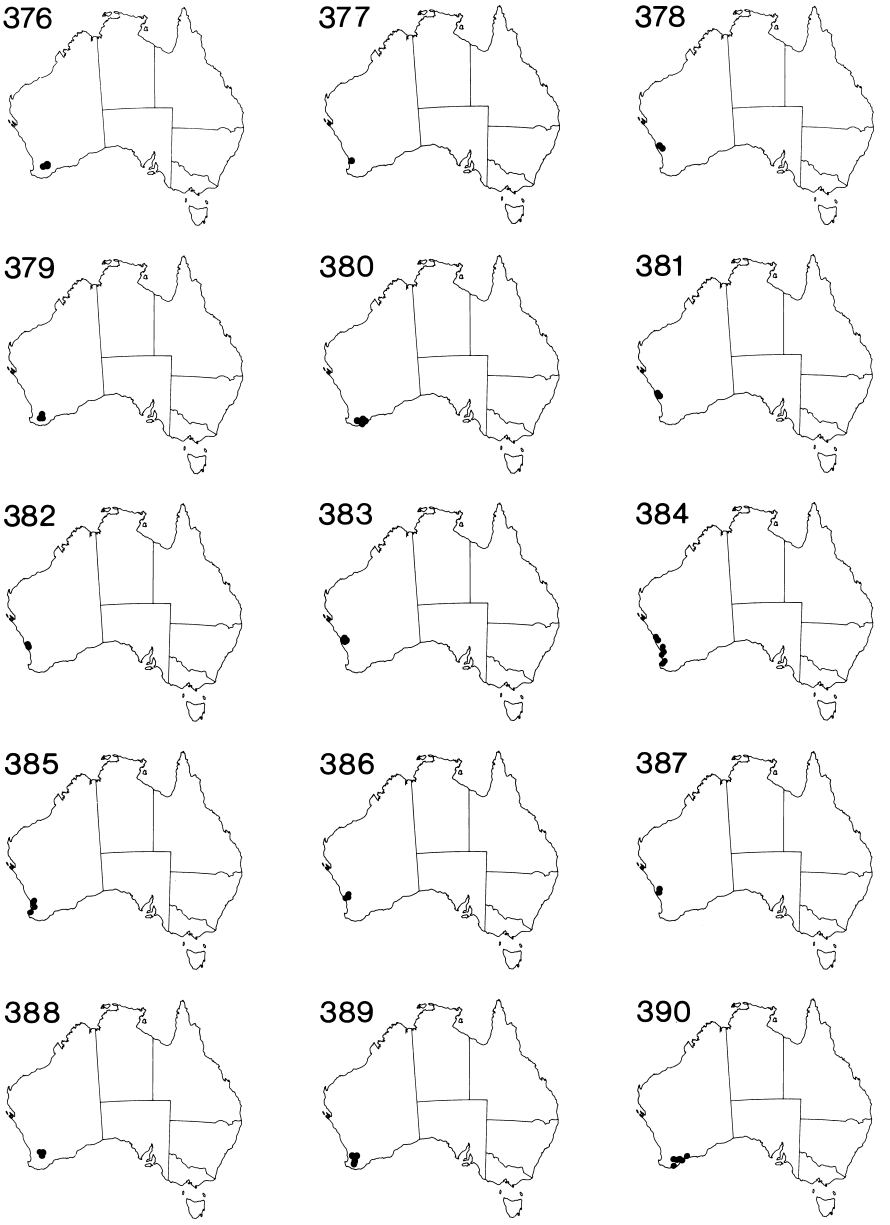
345. Dryandra blechnifolia (314)



346. Dryandra porrecta (314)
347. Dryandra aurantia (315)
348. Dryandra calophylla (315)
349. Dryandra lepidorhiza (316)
350. Dryandra ionthocarpa (316)
351. Dryandra idiogenes (318)
352. Dryandra subulata (328)
353. Dryandra cynaroides (330)
354. Dryandra erythrocephala var. erythrocephala (330)
355. Dryandra erythrocephala var. inopinata (332)
356. Dryandra horrida (332)
357. Dryandra vestita (332)
358. Dryandra viscida (335)
359. Dryandra mimica (335)
360. Dryandra speciosa subsp. speciosa (337)



361. Dryandra speciosa subsp. macrocarpa (337)
362. Dryandra shuttleworthiana (337)
363. Dryandra plumosa subsp. plumosa (339)
364. Dryandra plumosa subsp. denticulata (340)
365. Dryandra pseudoplumosa (340)
366. Dryandra montana (340)
367. Dryandra concinna (341)
368. Dryandra serra (343)
369. Dryandra foliolata (343)
370. Dryandra fasciculata (344)
371. Dryandra conferta var. conferta (346)
372. Dryandra conferta var. parva (346)
373. Dryandra columnaris (346)
374. Dryandra platycarpa (347)
375. Dryandra seneciifolia (347)



376. Dryandra rufistylis (348)

377. Dryandra insulanemorecincta (348)

378. Dryandra nana (349)

379. Dryandra preissii (351)

380. Dryandra arctotidis (351)

381. Dryandra tortifolia (352)

382. Dryandra stenoprion (352)

383. Dryandra cypholoba (353)

384. Dryandra lindleyana subsp. lindleyana var. lindleyana (354)

385. Dryandra lindleyana subsp. lindleyana var. mellicula (354)

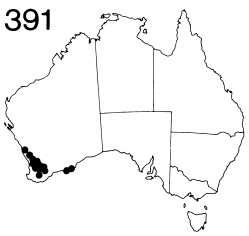
386. Dryandra lindleyana subsp. pollosta (356)

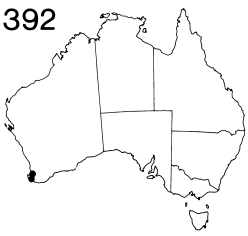
387. Dryandra lindleyana subsp. media (356)

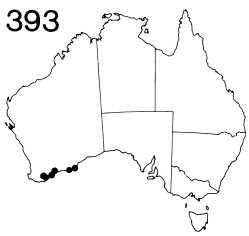
388. Dryandra lindleyana subsp. agricola (356)

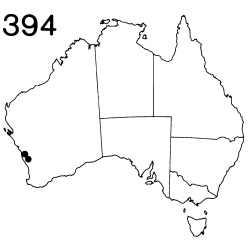
389. Dryandra lindleyana subsp. sylvestris (357)

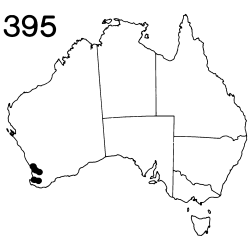
390. Dryandra brownii (357)

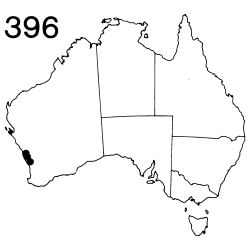












391. Dryandra nivea subsp. nivea (359)

392. Dryandra nivea subsp. uliginosa (359)

393. Dryandra falcata (360)

394. Dryandra glauca (360)

395. Dryandra bipinnatifida subsp. bipinnatifida (362)

396. Dryandra bipinnatifida subsp. multifida (362)

APPENDIX

New taxa, combinations and lectotypifications

New taxa, combinations and lectotypifications occurring in this volume of the *Flora of Australia* are formally published here. Taxa are arranged in the order they appear in the text. For economy the entries are brief; the treatment in the main text is more comprehensive. Accepted names are in **bold**, basionyms and synonyms in *italic*. The date of publication of this Volume will be given in Volume 11.

HAKEA

L.Haegi[1], *W.R.Barker*[1], *& R.M.Barker*[1]

Hakea archaeoides W.R.Barker, *sp. nov*.

Prope *H. trineura* (F.Muell.) F.Muell. foliis planis in superficiebus ambabus et secus margines venibus longitudinalibus conspicuis, racemibus longis, praebitore pollinis obliquo, fructibusque cornibus carentibus, sed rachidi pubescenti densius, tepalis viridibus, stylo rubro, et fructibus seminibusque parvioribus differt.

T: 3 km E along Big Nellie Rd towards Burrawang Rd, near Coopernook, Lansdowne S[tate] F[orest], N.S.W., 4 Dec. 1986, *P.Hind 4662*; holo: NSW; iso: AD, BRI.

The epithet is derived from *archae-* original or beginning, and the substantive suffix *-oides* resembling, alluding to the near basal position of the *Trineura* group in cladograms generated with *Grevillea* as the outgroup.

Hakea lorea subsp. **borealis** W.R.Barker, *subsp. nov*.

Subspeciebus *lorea* differt fructu maiore, valvis zonisque ligni latioribus et perianthio longiore plerumque, et etiam plantis ex Australia centrali indumento in ramulis inflorescentiisque appresse pubescenti.

T: 77 miles [123 km] N Wilton River-Bulmen Crossing, NT35791, 15 June 1972, *J.R.Maconochie 1463*; holo: NT; iso: K *n.v.*, NSW, PERTH *n.v.*

The epithet is derived from the adjective *borealis*, alluding to the isolated northern Australian distribution of the taxon, disjunct from ssp. *lorea* to the south and east.

Hakea salicifolia subsp. **angustifolia** (A.A.Ham.) W.R.Barker, *comb. et stat. nov.*

Hakea saligna var. *angustifolia* A.A.Ham., *Proc. Linn. Soc. New South Wales* 45: 261 (1920). T: Woronora R., Heathcote, Oct. 1915, *A.A.Hamilton s.n.*; holo: NSW.

Hakea verrucosa F.Muell., *Fragm.* 5: 25 (1865) *p.p.*

T: Western Australia, *s.d., Anon. s.n.*; lecto (here designated): MEL 675664; ?isolecto: B *p.p.* (herb. Bernhardi, excluding fruit), BR (2 sheets, excluding fruit on one sheet), CANB (ex herb. Lawson, L, MEL 675673, NY (Torrey herb.), NY. possible remaining syn: Ex horto MEL, *s.d.*, ?*F.Mueller s.n.*; syn: BR, L, MEL 1537947, MEL 675665, NY (Torrey herb.); Western Australia (cultivated), *s.d., Anon. [F.Mueller] s.n.*; syn: MEL.

Excluded syntypes (flowering specimens of *H. propinqua* labelled as *H. verrucosa* F.Muell.): Western Australia, *s.d., Anon. s.n.*; syn: BM (herb. Hance 19556), BR (herb. F.Mueller), DBN, E, G-DC, L (ex herb. F.Mueller), P (ex herb. van Heurck).

[1] State Herbarium of South Australia, Botanic Gardens, North Terrace, Adelaide, South Australia 5000.

Excluded syntypes (fruiting specimens of *H. propinqua* labelled as *H. verrucosa* F.Muell.): Western Australia, *s.d.*, *Anon. s.n.*; syn: B *p.p.* (herb. Bernhardi, fruit only), BR *p.p.* (fruit only).

There is no doubt that Mueller initially thought that the fruits of *H. propinqua* belonged with the flowers of *H. verrucosa*. Specimens in B (herb. Bernhadi) and BR consist of a number of *H. verrucosa* branches with the addition of a single fruit of *H. propinqua*. Based on specimens grown at the Melbourne Botanic Gardens and preserved on the sheets in MEL (MEL675669) and K, Mueller observed in a later publication (*Fragm.* 6: 218 (1868)) that he had found that the fruits of *H. verrucosa* were smooth with a bicornate apex. Thus the choice of the MEL specimen (MEL675664) as lectotype preserves Mueller's concept and current usage of *H. verrucosa* even though the epithet refers to the fruits of a different species. As there are no dates on any of the specimens cited it is impossible to be certain whether they were available to Mueller at the time of publication. Those specimens from the Botanic Gardens, Melbourne, which were widely distributed by Mueller to overseas institutions, are of unknown status with respect to the protologue as they also are undated.

Hakea recurva subsp. **arida** (Diels) W.R.& R.M.Barker, *comb. et stat. nov*.

Hakea arida Diels, *Bot. Jahrb. Syst.* 35: 162 (1904). T: Yalgarn and Murchison goldfields, July 1901, *E. Pritzel 437*; syn: B, BM, BR, E, G (Herb. DC.), G (herb. Delessert), L, MEL, MO, NSW, PERTH *p.p.*; Murchison goldfields west of Cue, July 1901, *L.Diels 3284*; syn: B; In distr. Irwin pr. Mingenew in acacietis lutosis flor. m. Sept., *L.Diels 6022* (not located).

These two subspecies, subsp. *arida* and subsp. *recurva*, are very distinctive when their extremes are encountered, but there are numerous specimens intermediate in the characters used to distinguish them and so they have been reduced to subspecies.

Hakea epiglottis subsp. **milliganii** (Meisn.) R.M.Barker, *comb. et stat. nov*.

Hakea milliganii Meisn. in A.DC., *Prodr.* 14: 395 (1856). T: In Ins. Diemen, occidentali, circa Macquarie harbour, 10 Oct. 1846, *J.Milligan 737*; lecto (here designated): NY; isolecto: BM, HO (labelled as *Gunn 737*), K, W.

The status of *H. milliganii* Meisn. was discussed in an earlier paper (R.M.Barker, *in* M.R.Banks *et al.* (eds), *Aspects of Tasmanian Botany: a tribute to Winifred Curtis*, pp. 79–84 (1991)). In the absence of any recent collections, specimens in which the claw and the limb had differently coloured hairs were treated as part of the variation of *H. epiglottis* Labill. Since then there have been further collections from the Macquarie Harbour area which also exhibit this contrasting colour of hairs on the perianth (e.g. C*ollier 4373*) and so it has been decided to recognise this taxon at an infraspecific level.

The Milligan specimen in Meisner's herbarium has been chosen as the lectotype since it is clearly labelled by Meisner as 'H. milliganii Nob'.

Hakea hastata Haegi *sp. nov*.

Ab *H. ferruginea* Sweet affini distincta: floribus minoribus (pistillo 4.5–6.0 mm longo c.f. 6.5–10.5 mm), pedicellis comparate longioribus (longitudine pedicelli 0.6–0.8 plo longitudine pistilli, c.f. 0.3–0.5 plo), fructis minoribus minus manifeste rostratis 1.6–2.0 cm longis c.f. 2.0–3.1 cm), et area geographica magis septentrionali.

T: Tuttanning Nature Reserve, Avon District, W.A., 5 Nov. 1971, *Hj.Eichler 20971*; holo: AD; iso: K, PERTH.

The epithet, the adjectival form of the Latin *hasta*, a spear, refers to the usual spearhead shape of the leaves of this species.

Hakea anadenia Haegi *sp. nov*.

Ad *H. undulatam* R.Br. affinis, a qua floribus majoribus (pistillo 4–6 mm longo), pedicellis brevioribus quam pistillis (ratio 0.5–0.8, c.f. 1.0–1.7), et foliis angustioribus (3.4–6.7 plo longioribus quam latis c.f. 2.0–3.1) differt.

T: 28 km E of Jurien on road to Brand Hwy at 30º14'S, 115º18'E, W.A., 15 Nov. 1983, *L.Haegi 2673 & P.S.Short*; holo: PERTH; AD, MEL.

The epithet is a substantive, from the Greek prefix *an-* (without) and *aden, -os* (a gland), in reference to the flowers of this species commonly lacking glands. It also refers indirectly to the generic name *Anadenia* Lindley a synonym of *Hakea*, based on the closely related *H. undulata* R.Br.

Hakea laevipes subsp. **graniticola** Haegi *subsp. nov*.

A subsp. *laevipes* statim distinguitur pedicellis glabris, area geographica et substrato granitico in quo reperta etiam distincta est.

T: 68 km E of Armidale on Grafton road, N.S.W., 20 Oct. 1989, *W.Molyneux s.n.*; holo: AD; iso: NSW.

The epithet, from the Latin *graniticus* granite and *-cola*, -dweller, refers to the usual occurrence of this subspecies in association with granite outcrops.

Hakea petiolaris subsp. **trichophylla** Haegi *subsp. nov*.

Ab subsp. *petiolare* foliis majoribus 8–11.2 cm × 3.2–6 cm, fructibus parvioribus ellipticis ad ovatis-ellipticis 2.2–2.5 cm longis (c.f. 3.1–3.6 cm) et ab subspeciebus duobus pubescentia appressa persistentia, foliis ita nitore griseo sub anthesi instructis distinguenda.

T: Dingo Rock Reserve, 7 miles [11.2 km] W of Manmanning, W.A., 12 June 1985, *B.H.Smith 582*; holo: AD; iso: CANB, HO, NSW, PERTH).

The epithet from the Greek *trichos*, a hair and *phyllon*, a leaf, refers to the characteristically persistent appressed pubescence of the leaves, giving them a grey sheen at flowering time.

Hakea petiolaris subsp. **angusta** Haegi *subsp. nov*.

Ab subspeciebus ceteris foliis proportione angustis, basi folii similis petioli tantum brevi, apice longo-acuminato distincta et ab subsp. *petiolare* fructibus parvioribus ellipticis 2.3–2.5 cm longis (c.f. 3.1–3.6 cm) praeterea differt.

T: 38 miles [60.8 km] E of Pingaring, W.A., 29 May 1969, *A.S.George 9341*; holo: PERTH; iso: CANB, K, NSW, MEL, BRI.

The epithet, from the Latin *angustus*, narrow, refers to the distinctive relatively narrow leaves of this subspecies when compared with the other two.

Hakea dohertyi Haegi *sp. nov*.

Ab *H. ulicina* R.Br. cognata foliis longis tenuibus (20–40 cm longis et 1.8–2.2 m latis), et inflorescentiis non nisi floribus 4–6 sine glande distinguenda.

T: Blue Mountains, N.S.W., 17 Nov. 1984, *M.Doherty NSW 167553*; holo: NSW; iso: AD.

This species is named after its discoverer: ecologist and bushwalker Michael Doherty of the New South Wales National Parks and Wildlife Service.

Hakea scoparia subsp. **trycherica** Haegi *subsp. nov*.

Ab subsp. *scoparia* foliis canaliculis inter acies (venis) radosis, foliis interdum compressis et fructibus majoribus 2.2–2.5 cm longis, 12–17 mm latisque distincta.

T: S end of Mt Ragged, W.A., *A.S.George 14309*; holo: PERTH; iso: AD.

The epithet, from the Greek *trycheros*, ragged, refers to Mount Ragged to which this subspecies is restricted in occurrence.

Hakea rigida C.A.Gardner ex Haegi *sp. nov*.

Ad H. erectam Lamont affinis, a qua foliis rigidoribus in sectio transverso pentagonis vel compressio-pentagonis et seminis etiam nigris differt.

T: Campion, W.A., 28 Sept. 1931, *C.A.Gardner 2761*; holo: PERTH; iso: PERTH.

The epithet, used by C.A.Gardner as a manuscript name on specimens in the Western Australian Herbarium, is understood to be from the Latin *rigidus*, rigid, referring to the leaves.

Hakea maconochieana Haegi *sp. nov*.

Inter species ad *H. multilineata* affinia foliis crassis tenuibus 7–13.5 cm longis, 1.5–2.7 mm latis et 0.4–0.8 mm crassis, pedicellis florum sparsim ad moderate pubescentibus, et fructibus haud lignosis mox dehiscentibus ample distincta.

T: Ambathala Range, 50 km E of Adavale, Qld, 5 Apr. 1981, *C.Sandercoe 507*; holo: BRI; iso: AD.

The epithet commemorates the late John Maconochie, a botanist who contributed to the knowledge of *Hakea* and in particular the group to which this species belongs (J.R.Maconochie, *Trans. & Proc. Roy. Soc. S. Australia* 97: 127–133 (1973)).

Hakea eneabba Haegi *sp. nov*.

H. corymbosae R.Br. affinis sed caudicis repullulanti, bracteis involucri magis dense ciliatis ciliis longioribusque, et floribus vivide flavis differt.

T: 2.8 km E of Brand Hwy on Tootbardi Rd, W.A., *A.S.George 16817*; holo: PERTH; iso: AD, CANB.

The epithet, which has a Latin form, is based on the use as a substantive of the Aboriginal place name Eneabba, a modern locality on which the distribution of this species is centered.

Hakea acuminata Haegi *sp. nov*.

Ad *H. victoriam* J. Drumm. affinis sed differt: ramificatione denso, foliis subverticillatis anguste obovatis ad ellipticis, integris vel minute denticulatis, 3–10 cm longis, 9–38 mm latis, gradatim acuminatis, inflorescentiis floribus 16–24.

T: north slope of One Tree Hill, S of Ravensthorpe, W.A., 14 July 1979, *Pearce s.n.*; holo: PERTH; iso: AD.

The epithet refers to the characteristically and pronounced acuminate shape of the leaf apex.

AUSTROMUELLERA

B.P.M.Hyland[1]

Austromuellera valida B.Hyland *sp. nov*.

A. trinerviam simulans, sed foliis simplicibus, interdum trifoliolatis vel pinnatis paribus foliolatis c. 2–3; inflorescentiis 17–30 cm longis; tepalis 14–17 mm longis, differt.

T: 1 mile [1.6 km] past E/P18, North Mary Logging Area, Qld, 7 Feb. 1974, *K.Sanderson 549*; holo: QRS.

The name *valida* alludes to the fact that the branches are strong, and are difficult to break to collect botanical specimens.

[1] Tropical Forest Research Centre, Australian National Herbarium, CSIRO, PO Box 780, Atherton, Queensland 4883.

APPENDIX

BANKSIA

A.S.George[1]

Banksia sect. **Oncostylis** Benth., *Fl. Austral.* 5: 542, 544 (1870)

Lecto (here designated): *B. sphaerocarpa* R.Br.

Bentham's diagnosis is readily applicable to most of the 13 species that he included. In the description of the leaves, however, he gave more weight to the linear state ('linear or rarely lanceolate'), so selection of a lectotype may be restricted to those taxa with linear leaves. Further, he described the stigmatic end (i.e. pollen presenter) as 'very small', hence the two species with enlarged pollen presenters (*B. pulchella* and *B. meisneri*) may also be excluded from consideration. There is no other guidance in the protologue. I have therefore selected the first-described species with the leaf character states given first in the protologue—linear, entire leaves with revolute margins, i.e. *B. sphaerocarpa* R.Br.

Banksia ser. **Tricuspidae** A.S.George *ser. nov.*

Arbores parvae erectae. Folia conferta, margine utroque cum dente brevi obtuso infra apicem; margines revoluti. Inflorescentia in ramulo brevi laterali inserta, cylindrica; ordinatio regularis gemmarum ante anthesin amissa. Perianthium sub anthesin dorsaliter rumpens, pubescens; limbus perianthii ante anthesin deorsum verticaliter descendens; tepala mutica. Folliculi mesocarpium spongiosum. Seminae ala non incisa.

Type: *B. tricuspis* Meisn.

For discussion, see main text.

DRYANDRA

A.S.George[1]

Dryandra insulanemorecincta A.S.George, *sp. nov.*

Dryandra rufistylis A.S.George affinis, a qua habitu non-columnari, foliis oblanceolatis latioribus (10–24 mm latis), folliculo elliptico, et seminis ala annulari, differt.

T: off Brookton Hwy, Darling Plateau, W.A., c. 32°17'S, 116°25'E, 22 June 1998, *A.S.George 17419*; holo: PERTH; iso: AD, CANB, K, MEL, NSW.

Known from several populations on the Darling Plateau W of Brookton (precise details withheld for conservation reasons). Grows in lateritic or granitic soil in areas of low heath surrounded by Jarrah forest.

The epithet is derived from the Latin *insula* (an island), *nemus* (a wood or forest), and *cinctus* (from *cingo*, to girdle), in reference to the unusual habitat—'islands' of heath in the midst of forest. To be pronounced 'in-soo-la-ne-mor-ay-sink-ta'.

[1] 'Four Gables', 18 Barclay Road, Kardinya, Western Australia 6163.

SUPPLEMENTARY GLOSSARY

pusticule: diminutive of pustule.

root suckering: vegetative (re)growth from roots.

serotiny: in relation to fruiting stages of plants, retention on the parent plant for longer than the period for normal dispersal. In the Proteaceae, it pertains to the hard woody fruits which remain closed until damage by fire or death of the supporting branch. adj. **serotinous**.

sprouting/resprouting: vegetative (re)growth from stems or roots.

Abbreviations and Contractions

Literature

Author abbreviations follow R.K.Brummitt & C.E.Powell, *Authors of Plant Names* (Royal Botanic Gardens, Kew, 1992).

Journal titles are abbreviated in accordance with G.H.M.Lawrence *et al.*, *Botanico-Periodicum-Huntianum* (Hunt Botanical Library, Pittsburgh, 1968) and G.D.R.Bridson & E.R.Smith, *Botanico-Periodicum-Huntianum/Supplementum* (Hunt Institute for Botanical Documentation, Pittsburgh, 1991).

Other literature is abbreviated in accordance with F.A.Stafleu & R.S.Cowan, *Taxonomic Literature*, 2nd edn (Bohn, Scheltema & Holkema, Utrecht, 1976–1987), except that upper case initial letters are used for proper names and significant words. The *Flora of Australia* is abbreviated to *Fl. Australia*.

Herbaria

Abbreviations of herbaria are in accordance with P.K.Holmgren, N.H.Holmgren & L.C.Barnett, *Index Herbariorum* Part I, 8th edn (New York Botanical Garden, 1990). Those most commonly cited in the *Flora* are:

AD	State Herbarium of South Australia, Adelaide
BM	The Natural History Museum, London
BRI	Queensland Herbarium, Brisbane
CANB	Australian National Herbarium, Canberra
CBG	Australian National Botanic Gardens Herbarium, Canberra
DNA	Northern Territory Herbarium, Darwin
HO	Tasmanian Herbarium, Hobart
K	Royal Botanic Gardens, Kew
MEL	National Herbarium of Victoria, Melbourne
NSW	National Herbarium of New South Wales, Sydney
PERTH	Western Australian Herbarium, Perth
QRS	Australian National Herbarium, Atherton

States, Territories

Abbreviations of Australian States and Territories as used in statements of distribution and citation of collections are:

A.C.T.	Australian Capital Territory
N.S.W.	New South Wales
N.T.	Northern Territory
Qld	Queensland
S.A.	South Australia
Tas.	Tasmania
Vic.	Victoria
W.A.	Western Australia

General abbreviations

add.	addendum
alt.	altitude
app.	appendix
auct.	*auctoris/auctorum* (of an author or authors)
auct. mult.	*auctorum multorum* (of many authors)
auct. non	*auctorum non* (of authors [but] not....), used for misapplied names
c.	*circa* (about)
Ck	Creek
cm	centimetre
coll.	collector
colln	collection
comb.	*combinatio*/combination
cons.	*conservandus*
cult.	cultivated
cv.	cultivar
d.b.h.	diameter at breast height
Dept	Department
descr.	*descriptio*
diam.	diameter
E	east
ed./eds	editor/editors
edn	edition
eds	editors
e.g.	*exempli gratia* (for example)
et al.	*et alii*/*et aliorum*; and others/and of others
f.	*forma*/form
fam.	*familia*/family
fig./figs	figure/figures (in other works)
Fig.	Figure (referring to a Figure in this volume of the *Flora*)
gen.	*genus*/genus
gen. nov.	*genus novus* (new genus)
Gt	Great
holo	holotype
hort.	*hortus* (garden) or *hortensis* (of a garden)
HS	Homestead
Hwy	Highway
i.e.	*id est* (that is)
ined.	*ineditus* (unpublished)
in litt.	*in litteris* (in correspondence)
in obs.	*in observatio* (in observation)
Is.	Island/s
iso	isotype
isolecto	isolectotype
km	kilometre
L.	Lake
L.A.	Logging Area
lat.	latitude
lecto	lectotype
loc. cit.	*loco citato* (in bibliographic citations: in the same work and page as just cited)
loc. id.	*loco idem* (in specimen citations: in the same place as just cited)
long.	longitude
L.H.S.	left hand side

L.S.	longitudinal section
l:w	length to width ratio
m	metre
mm	millimetre
Mt/Mts	Mount/Mounts
Mtn/Mtns	Mountain/Mountains
N	north
n	haploid chromosome number
2n	diploid chromosome number
Natl	National
n.d.	no date
NE	north-east (ern)
nom. cons.	*nomen conservandum* (conserved name)
nom. cons. prop.	*nomen conservandum propositus* (proposed conserved name)
nom. illeg.	*nomen illegitimum* (illegitimate name)
nom. inval.	*nomen invalidum* (name not validly published)
nom. nov.	*nomina nova* (new name)
nom. nud.	*nomen nudum* (name published without a description or reference to a published description)
nom. prov.	*nomen provisorium* (provisional name)
nom. rej.	*nomen rejiciendum* (rejected name)
nom. superfl.	*nomen superfluum* (superfluous name)
nov.	*novus*/new
n. ser.	new series
n.v.	*non vidi* (not seen)
NW	north-west (ern)
op. cit.	*opere citato* (in the work cited above)
opp.	opposite
orth.	orthography, orthographic
p./pp.	page/pages
penin.	peninsula
pers. comm.	by personal communication
pl./pls	plate/plates
p.p.	*pro parte* (in part)
p.p. max	*pro parte maxima*, the larger part
p.p. min	*pro parte minore*, the smaller part
pro syn.	*pro synonymo*, as a synonym
q.v.	*quod vide* (which see)
R.	River
Ra.	Range
Rd	Road
rly	railway
S	south
SE	south-east (ern)
sect.	*sectio*/section
SEM	Scanning Electron Micrograph
ser.	series
S.F.R.	State Forest Reserve
s.d.	*sine dies* (without date)
s. lat.	*sensu lato* (in a wide sense)
s. loc.	*sine loco* (without locality)
s.n.	*sine numero* (without number)
sp./spp.	species (singular/plural)
sp. aff.	*species affinis* (species related to)

sp. nov.	*species nova* (new species)
s. str.	*sensu stricto* (in a narrow sense)
St	Saint/Street
stat.	*status*/status
Stn	(pastoral) Station
subg.	subgenus
subsp./subspp.	subspecies (singular/plural)
subsp. nov.	*subspecies nova* (new subspecies)
suppl.	supplement
SW	south-west (ern)
syn	syntype
synon.	synonym
T	Type (collection)
t./tt.	*tabula/tabulae* (plate/plates)
T.R.	Timber Reserve
trib.	*tribus*/tribe
trig.	trigonometric station
T.S.	transverse section
typ. cons.	*typus conservandus* (conserved type)
var.	*varietas*/variety
viz.	*videlicet* (namely)
vs	versus
UV	ultraviolet
W	west
x	basic chromosome number

Symbols

†	taxon included in key but not treated further in text
*	naturalised taxon, not originally native
#	native taxon now naturalised in Australia beyond its natural range
[ ]	misapplied name or *nomen invalidum*; also, in localities, denotes a place name later than that originally cited or on the herbarium sheet
±	*in species descriptions*, more or less
±	*in lichen chemistry*, with or without
<	less than
≤	less than or equal to
>	more than
≥	more than or equal to
µm	micrometre
(♀)	female
(♂)	male

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Volume 1	2 March 1999 (2nd edn)
Volume 3	24 April 1989
Volume 4	12 November 1984
Volume 8	9 December 1982
Volume 12	4 May 1998
Volume 16	30 November 1995
Volume 18	8 June 1990
Volume 19	27 June 1988
Volume 22	17 May 1984
Volume 25	25 December 1985
Volume 28	28 June 1996
Volume 29	27 July 1982
Volume 35	6 August 1992
Volume 45	15 May 1987
Volume 46	2 May 1986
Volume 48	27 October 1998
Volume 49	3 May 1994
Volume 50	29 July 1993
Volume 54	4 September 1992
Volume 55	21 December 1994

For the publication date of Volume 17B, see Volume 11.

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