Vegetation and flora of Kings Plains National Park

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Vegetation and Floristics of

Kings Plains National Park

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A Report to the New South Wales

National Parks and Wildlife Service

Summary

The vegetation of Kings Plains National Park is described and mapped (scale 1:25 000). Seven communities are defined based on PATN analysis and one specialised community is as circumscribed by previous surveys. Eight communities are mapped based on ground truthing, air photo interpretation and altitude. Most communities are of a Woodland structure, however Forests exist along with Shrublands. The distribution of communities is related to past disturbances, soil depth, soil type, physiography, aspect, slope, altitude, and protection from the south west. Many of the communities show considerable variation and intergrade along common boundaries. A number of specialised communities are thought to be endangered.

A total of 441 taxa were found from 79 families and 238 genera. At present 10% of the flora is exotic in origin. Very few of these exotic species are considered to pose any major threat at present. Seventeen ROTAP taxa of which six are TSC Act listed and one newly discovered species that should be considered for listing, were found during the survey. Many other species were thought to be significant in a regional perspective and an additional eight rare species may potentially occur with further investigation.

Most management issues are related to weed invasion and revegetation of some areas is needed. Appropriate fire regimes will need to be researched and implemented. It is suggested that a variable and adaptive fire regime is adopted. Monitoring of a subset of the survey plots in subsequent years will enable a review of management practices to allow modification as new information is forthcoming. Introduced plants, pigs and stray cattle are sources of disturbance and will need to be eradicated.

Kings Plains conserves some of the major and widespread communities found along the western escarpment of the tablelands and the vegetation associated with acid volcanic soils. Many of these communities are within the centre of their known distribution some though are highly significant with one listed as an endangered community and another that warrants endangered listing. A large number of rare species are found within the reserve and this area represents a high concentration of rare species associated with rhyolitic outcrops and also a few species associated with

basaltic soils. Targeted searches will be needed for rare and threatened plant taxa that are known from or are likely to occur in the National Park. New additions to the reserve should target basalt and laterite soils even if these are degraded in nature. While the park is of great significance, at present it under-represents many of the communities found within the region.

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Introduction

1.1 Objectives

This survey of the vegetation of the Kings Plains National Park was prepared by John T. Hunter at the request of the Glen Innes District of the New South Wales National Parks and Wildlife Service. The Glen Innes District required that existing information from previous floristic surveys be collated and that 50 stratified sites be surveyed in order to complete a comprehensive survey of the vegetation and flora of Kings Plains National Park. This report represents the findings of this survey. The collated information is to be used as a guide for management purposes.

The requirements of the investigation were:

1. Collate existing information from previous vegetation surveys conducted within the Kings Plains National Park. Data sources recovered included 21 full floristic sites:
    - Site descriptions conducted for a vegetation survey of granitic areas of the Northern Tablelands (Roberts 1983).
    - 19 sites conducted for the floristic inventory of the granitic outcrop vegetation of the New England Batholith (Hunter 1999).
    - 3 sites placed within close proximity to Kings Plains National Park during the survey of the proposed EASTLINK route (1996).
    - 6 sites placed within Kings Plains National Park for a survey of *Astrotricha roddii* (Nadolny *et al.* 1998).
2. Site placement to be based on selected environmental variables and be distributed based on the area they occupy.
3. Identify weed species and their occurrence.
4. Identify ROTAP and TSC Act species and their occurrence.
5. Identify regionally significant species.
6. Provide known fire ecology information on species and communities.
7. Construction of a vegetation map based on communities as defined by PATN analysis.

8. Provide management recommendations.
9. Collection of voucher specimens for reference.

1.2 Study area

Kings Plains National Park occurs approximately 50 km north west of Glen Innes (Figure 1). The full extent of the reserve is within the Inverell Shire, the County of Arrawatta and the Parish of Kings Plains. The land currently under control of the Service includes portions 49, 53, 56, 57, 60, 61, 63, 64, 68, 70 and 71. The reserve occurs along the western escarpment of the Main Range (Figures 1 & 2) and straddles the Northern Tablelands and the North Western Slopes Botanical Districts (the boundary of which is usually defined at around 800-900 m altitude). At present the park includes 6816 ha with new additions that have yet to be gazetted incorporating 1703 ha (namely portions 56, 57, 61 and 70). The survey area is covered by two 1:25 000 topographic maps, namely; Hurricane Hill and Sapphire.

The National Park is completely surrounded by private land (12 holdings in total). Part of the north western boundary follows Kings Plains Creek for approximately 1.5 km and parts of the southern boundary are delineated by Weean Creek. The northern and western boundaries have adjacent lands with relatively intact remnants within private holdings. Other boundaries have predominantly highly modified landscapes adjacent the reserve boundary.

Figure 1: Location of study region within north eastern New South Wales. See Figure 2 for more detail of local region and nearby townships.

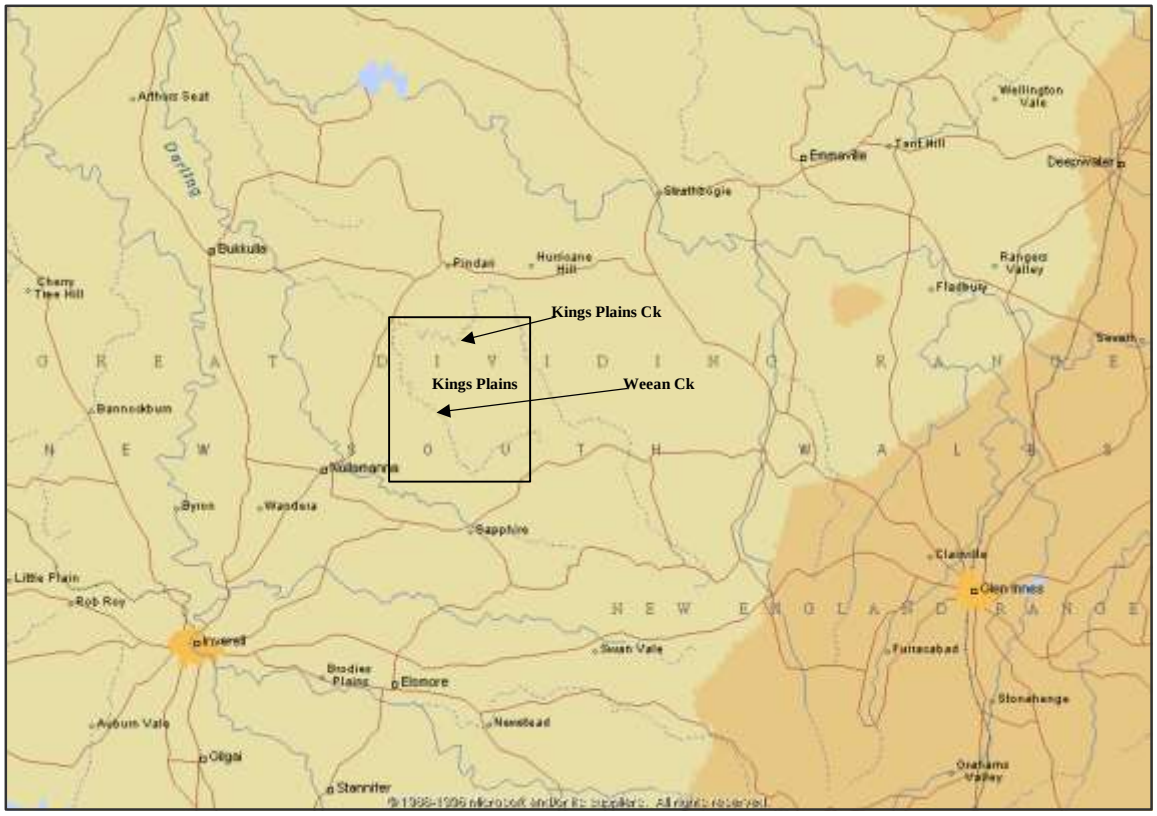

Figure 2: Location of Kings Plains National Park within the study area.

Figure 3: Eastern boundary of Kings Plains National Park and grazed neighboring private holdings.

1.3 Conservation gains and gazettal of reserve

The original proposal for Kings Plains National Park was referred to the New South Wales National Parks and Wildlife Service in February 1969 and included an application over portion 71 of the County of Arrawatta. Service personnel carried out an investigation in 1971 and in 1974. A subsequent proposal and investigation occurred in 1976 and 1977 over lands incorporating 8900 ha. An area of 6816 ha was formally gazetted as Kings Plains National Park in 1988. In 1996/7 an additional 1703 ha was purchased by the service on the southern and eastern boundaries however some of this land is yet to be gazetted.

Nearby reserved lands include Severn River Nature Reserve gazetted as far back as 1968. The Severn River Nature Reserve occurs 7 km to the north. Severn River originally incorporated 1946 ha but it also has had some substantial additions within recent years (1426 ha in 1998; 3372 ha in total). The Torrington State Recreation Area occurs about 30 km to the north east of Kings Plains National Park, incorporates approximately 30000 ha, and was gazetted in 1996.

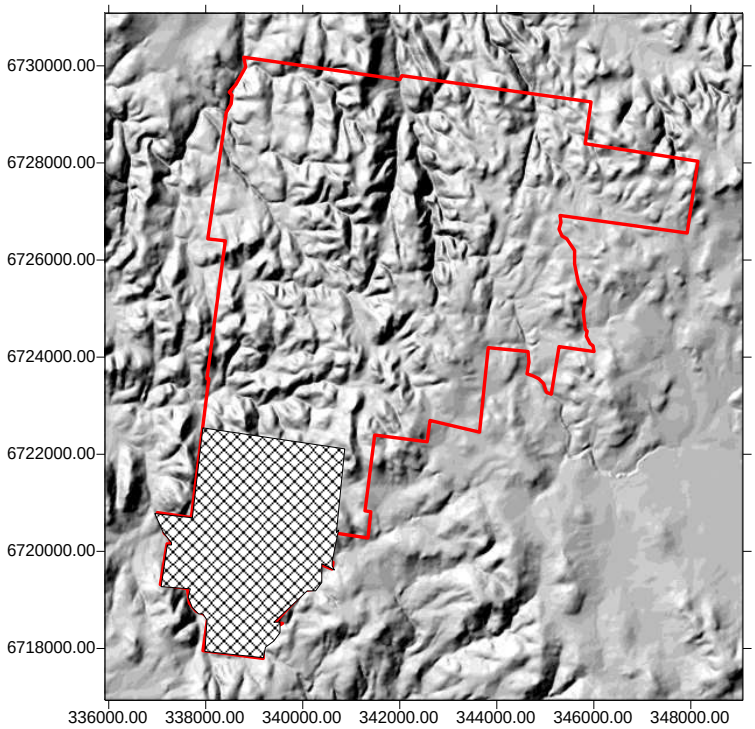

Figure 4: The current boundaries of land controlled by the Service. Clear areas are the current Kings Plains National Park, the hatched areas are new recent additions yet to be gazetted.

1.4 Climate

Rainfall ranges from around 750 mm to 840 mm with a predominantly summer maximum but often-reliable rainfall in the winter months. Great variability occurs in rainfall and one in every five years on average is drought declared (Division of National Mapping 1986). Temperatures range from warm to hot during summer with a mean maximum around 31°C and a mean minimum of 13°C. Winters are mild to cold with a mean minimum of around –0.5°C and a mean maximum of 17°C. Frosts are common and occur from April to late October. Dry south west to westerly winds predominate in the winter months.

The dissected nature of the terrain with a deep gorge and slopes leading to high plateau areas dominated by Acid Volcanic outcrops results in a range of microclimates. Varying inclination and aspect around Kings Plains Ck gorge, the outcrop country and its attendant gully systems affects the microclimate with some very steep and protected sites supporting lower than average evaporation rates and often double or higher moisture due to shedding of runoff from the impermeable outcrops.

1.5 Landform

Kings Plains National Park occurs on the western slopes of the New England Region and is on the northwestern edge of a low plateau, which dominates the landscapes to the south. The south eastern section of the reserve is undulating to hilly and forms part of the plateau (Figure 7 & 8) with the remainder of the park being heavily dissected with numerous steep ridges that fall away to the west (Roberts 1977). Altitude is lowest along the western margin at Weean and Kings Plains Creeks where it is 690 m and is highest in the north east of the reserve at 1009 m. Much of park is between the 700 and 900 m altitude range.

The soils through much of the reserve are thin to skeletal with the parent rock exposed in numerous places, particularly along the escarpment and along the edge of the plateau. Soil depth increases away from these areas and in particular in the upper

plateau regions. The drainage is necessarily dendritic, with the major drainage lines being Kings Plains Creek and some of its larger tributaries such as Three Waterholes Creek. Kings plains Creek enters the central eastern portion of the reserve from the upper plateau and passes through the upper escarpment in a north west direction whereby it drops 65 m (Figure 5) into gorge country at Kings Plains Falls (Roberts 1977). The creek then heads more or less westerly before it turns to the north and exits the park. The creek then heads turns and returns to the south where it forms the boundary of the park at its upper north western boundary. Above the falls the creek is shallowly entrenched with several large waterholes and thick alluvial banks (Figure 6). Below the falls the creek is deeply entrenched and lies in a gorge 120 m deep (Roberts 1977). The gorge bottom is rocky and often composed of rock pavements with waterholes primarily only in the lower reaches and usually have poor alluvial bank development. Weean Creek, which, more or less, defines the southern boundary of the new and yet to be gazetted additions is the only other major permanent water source. This creek has a bouldery basement and has a small but broader valley of deeper soils associated with its margins. Many other creeks exist within the reserve with most of the northern ones flowing to the north and all the western ones flowing to the west. None however have the permanency of the Kings Plains or Weean Creeks.

Figure 5: The lower section of Kings Plains Falls, which separates the plateau and gorge areas of Kings Plains Creek.

Figure 6: Kings Plains Creek. Top shows the exposed parent rock that is associated with the upper escarpment just prior to Kings Plains Falls. Below shows a typical scene from the shallowly entrenched sections of Kings Plains Creek within the upper plateau areas of the reserve.

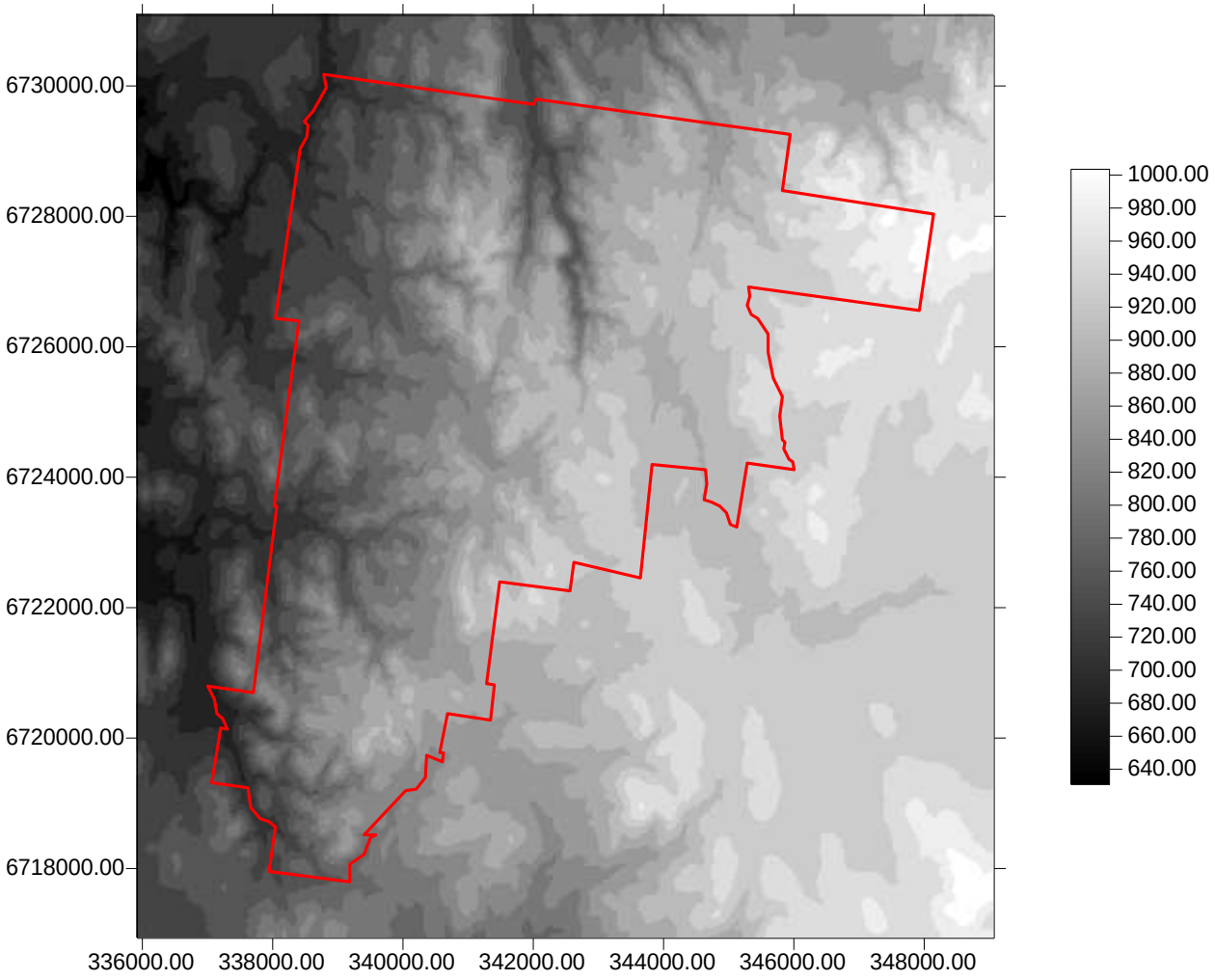

Figure 7: Topographic patterns in the area containing Kings Plains National Park. Drainage patterns run north and west. Axes are in AMG Co-ordinates. Note the high plateau area to the east and the dissected escarpment that incorporates the bulk of the current reserve.

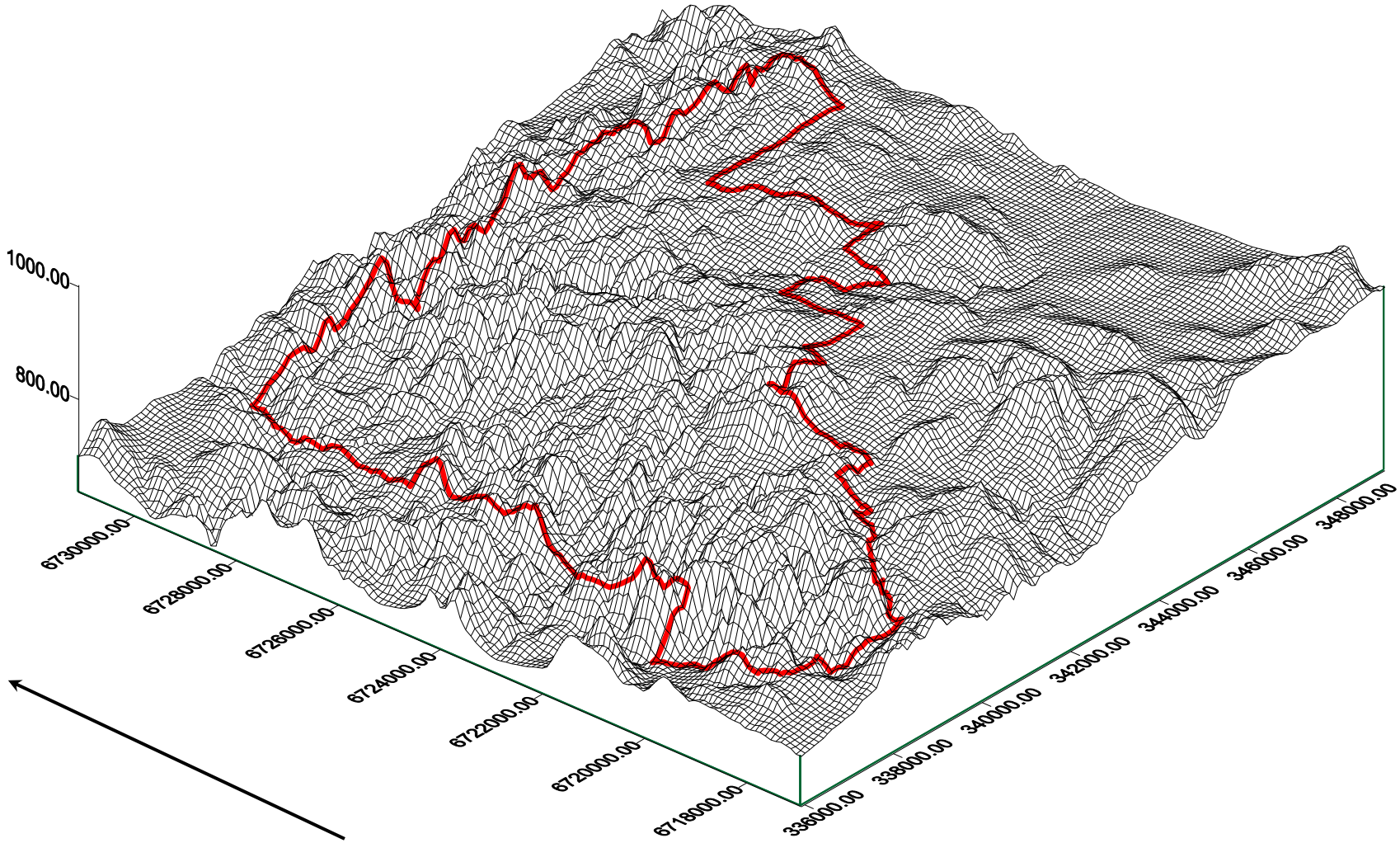

Figure 8: 3-D surface plot of landforms and altitudinal changes and associated drainage patterns at Kings Plains National Park. Not the hilly and dissected nature of the terrain within the reserve and the high plateau area to the east. Axes are AMG co-ordinates and altitude.

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1.6 Geology and geological setting

Kings Plains is located in the southern New England Orogen (or New England Fold Belt) in an area that has undergone substantial volcanic igneous activity during the Permian and later during the Tertiary. Little detailed geological mapping has been undertaken within the boundary of the National Park, and available maps of the region were compiled using rapid field checking. There is purported to be a granitoid in the center of the National park, however this has not been confirmed by recent field mapping. Apart from this, based on the 1:250 000 geological map (Stroud & Brown 1998), the area consists entirely of outcrops of volcanic rocks and Cenozoic alluvial and placer deposits plus, as observed during this study, 'tongues' of pisolitic laterite. Underlying the Permian volcanics are Palaeozoic basement sedimentary rocks and Permian conglomerate (McQueen 1975), and outcrops of these occur outside the Park (e.g. to the south east). The area is significant for its sapphires and other placer deposits which are related to periods of volcanism during the Tertiary.

Permian Volcanics

According to the map compilation of the Geological Survey of New South Wales (Stroud & Brown 1998), the bulk of the volcanic rocks in the National Park belong to the Emmaville Volcanics (Pwev) which are related to the Wandsworth Volcanic Group. Specifically, as determined from petrological examination from this study and previous work by McQueen (1975), they are rhyolitic ash fall tuffs. These are of Permian age and are thought to pre-date the granitoid mentioned above (refer Stroud & Brown 1998). It is apparent from hand specimen and petrological examination of a rock sample collected in the southeast of the Park that it is a devitrified pyroclastic volcanic rock of rhyolititc composition with a fine ground mass; and therefore related to the Permian and not the Tertiary volcanics. This rock is dark green black, has a rich red weathering surface and has a finer groundmass than other specimens collected from within the Permian volcanics in the National Park. It is located near the mapped Tb unit (refer to map Figure 9 – sample 1) and occurs within the area described as having 'rolling hills'. This section of the Park contrasts distinctly in landform to the other areas of the Park. Such landforms of rolling hills are typical of those produced from basalt elsewhere in the New England area. Field examination and ground

mapping would establish more clearly the rock types in this area which form these 'rolling hills'.

Tertiary Volcanics

Some investigation of rocks from the southeastern area has previously been undertaken, and from this the area has been generally mapped on the 1:250 000 geological map (Stroud & Brown 1998) as basalt and undifferentiated basaltic flows (Tb). However, Brown & Stroud (1997) also state that a broad range of volcanic rock types have been mapped as Tb and include an epiclastic facies in which there is abundant volcaniclastic material, and a tuffaceous lahar (a very brick red facies) within which there is a distinctive breccia (present locally) – both contain appreciable amounts of sub-economic sapphire. Furthermore, petrological examination of a rock in the Tb unit within the National Park by McQueen (1975) shows it to be a trachyandesite – an alkaline volcanic rock of intermediate composition. Other rock types within this Tb unit, as determined by McQueen (1975), include hawaiite, alkali olivine basalt, trachybasalt and limburgite but these have not been reported to be within the Park boundary. These volcanic facies have subsequently undergone intense clay alteration and ferruginization (Oakes *et al.* 1996).

Tertiary and Quaternary Weathering Products

'Tongues' of pisolitic laterite, an ironstone formed in the near-surface environment as part of the weathering environment, are present within the Park. Such rock is relatively common in the New England area, lying on top of old land surfaces. It is commonly associated spatially with Tertiary basalt (*pers. comm.* P.M. Ashley 1999).

Regionally, the alluvium and alluvial flood plains have been worked for sapphire but placer deposits also include corundum, zircon, tin, and smoky quartz. The tertiary volcanic sequence is the main source of the sapphire deposit. It is thought that sapphires in the region were brought to the surface during initial stages of what was an explosive period of volcanism in the Tertiary – the laharic tuff facies and epiclastic facies from these events contain appreciable quantities of sub-economic sapphire (Oakes *et al.* 1996; Brown & Stroud 1997). The two placer deposits closest to the

National Park are deposit no. 234 Weean Creek alluvials, derived from Cainozoic sediments and volcanics, and deposit no. 241 Kings Plains Creek alluvials, comprised of Tertiary/Quaternary alluvial sediment. Weean Creek alluvial sediment. Weean Creek alluvials contain sapphire as the primary ore mineral but corundum and zircon are also present. The Kings Plains Creek alluvial deposit also is a sapphire placer deposit in which sapphire occurs with zircon, corundum, minor tin and smoky quartz crystal (Brown & Stroud 1997).

Structures

Numerous faults cross the region (Stroud, *unpublished*). A rock sample taken from the north west area of the Park lies adjacent to a major NW trending lineament and shows upon petrological examination evidence of fault-related features such as fracturing of quartz and feldspar and recrystallisation of quartz in particular. Some secondary chlorite also shows deformation.

Qa	Cenozoic	Quaternary & Tertiary	Placer alluvial deposits, including sapphires.
Tpl			Pisolitic laterite.
Tb	Mesozoic	Tertiary	Basalt and undifferentiated basalt flows.
Pwev		Permian	Emmaville Volcanics (Wandsworth Volcanic Group) – flat lying ignimbrite flows rhyolitic to rhyodacitic crystal lithic and vitric tuff; minor dacite and andesite compositions; rhyodacitic lava and interbedded sediment.
Pxg		?Permian	? unnamed quartz-feldspar-biotite granitiod

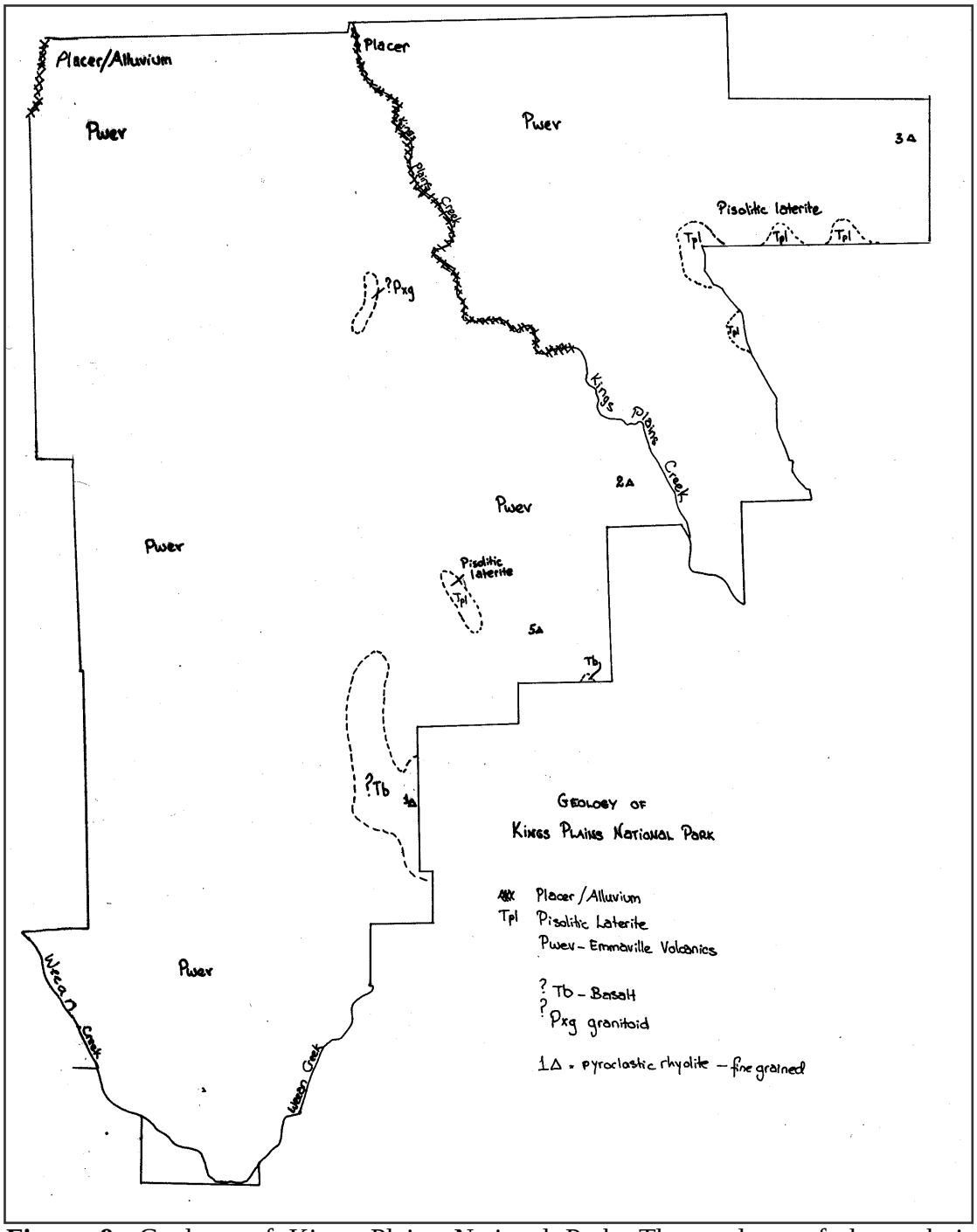

Figure 9: Geology of Kings Plains National Park. The geology of the park is primarily rhyolite of the Emmaville Volcanics with small incursions of laterite and potentially basalt and granite. Information compiled from Stroud & Brown 1998 (1:250 000), unpublished (1:25 000) maps from geological survey of New South Wales and recent observations from this study.

1.7 Aboriginal Landuse

The chronology of Aboriginal pre-history in the district is poorly known. Occupation of the tablelands probably occurred around the mid-Holocene (State Forests of New South Wales 1995). Local occupants probably included the Anaiwan and Ngarbul.

1.8 European history and Landuse

The initial settlement of this region of New South Wales occurred in the 1830's and squatters' shacks and cattle were known in the Inverell district as far back as 1827 (McMinn 1970). Settlement of the nearby tablelands areas probably occurred around the 1840's. Permanent townships were established by the 1860's. It wasn't until the 1860's that extensive clearing began after the introduction of the Robertson Selection Acts (Pearson 1992; RACAC 1996b). By the 1890's about 10% of the Northern Tablelands had been ring-baked or cleared (Benson & Ashby 1996). Pasture improvement with a range of exotic species commenced in the 1920's and by the 1970's 19% of the tablelands was sown to improved pastures (Benson & Ashby 1996).

Logging began in the 1860's when sawmills were set up on the tablelands. Logging took place on the slopes later, but where in operation by the turn of the century. The Forestry Commission was established in 1917 (Pearson 1992). Mining has occurred throughout the region from as far back as about the 1870's.

Within the reserve commercial logging operations have not occurred however thinning has occurred to supply fencing material to adjacent properties (Roberts 1977). Rough grazing has probably occurred over the entire proposal since last century. Grazing appears to have been most concentrated within the southern and southern central parts of the reserve. Overall clearing appears to have been minimal and has been concentrated in a few key areas. Near the entrance of the reserve along Kings Plains Creek clearing has occurred in the recent past and has been associated with rough grazing and mining activities. Along the south eastern boundary within the new additions to the reserve clearing for grazing has occurred earlier this century and

has regenerated considerably since this time. Remnants of huts and fences along with a small *Pinus radiata* plantation occur within section 56 and 61. Extensive clearing has occurred within portion 70 and in the southern parts of portion 71. These areas appear to have been completely cleared in the past along valleys and has subsequently been invaded by dense and uninterrupted Tea-tree. The extent of this past clearing and subsequent habitat modification appears to have been missed by the two previous investigations of these lots for inclusion within the proposal (Roberts 1977). Mining within the reserve has occurred along the alluvials of Kings Plains Creek and also at the intersection of rock types, particularly along the eastern margins of the reserve where the upper plateau (basalt) merges with the escarpment (rhyolite). Sapphires in particular have been mined along Kings Plains Creek and mining leases and applications exist along the entire length of the creek. Worked open cut areas occur adjacent to Kings Plains Creek and are intrusions within the reserve which as yet have not been revegetated.

1.9 Botanical exploration

Alan Cunningham was a botanist and explorer who first opened up this region of the state in 1827 in a search for an inland route to Morton Bay from Sydney. Some of the earliest publications on the vegetation and flora of the north east of New South Wales are those of Turner (1903; 1906). No specific collectors appear to have worked within the Kings Plains area however in the region in general many botanists both professional and amateur collected; some of these include Maiden, Betche, Boorman, Blake, Rupp, Blakely, McKie and Youman.

It wasn't until the late 1950's and early 1960's that any concerted effort was made to survey the vegetation and flora of the New England. Unfortunately due to arguments amongst those carrying out the surveys, all site data was destroyed and the only record remaining of this work is the annotated checklist published by Gray (1961). Williams (1963) described the major changes in vegetation across the eastern scarp to the western slopes.

Roberts (1977) provides the first general descriptive account of the flora and major vegetation changes within the reserve that is based on 5 days inspection in November

of 1976. A very brief and poorly descriptive vegetation report on the communities around the Pindari Dam 7 km to the north was provided by the Department of Water Resources (1991) for an EIS on the dams' expansion. Bowlay (1992) broadly described the vegetation communities within the nearby Severn River Nature Reserve for a Batchelor of Natural Resources thesis submitted to the University of New England. Much of the vegetation of the Severn River is closely allied with that of Kings Plains National Park. Nadolny *et al.* (1998) conducted a survey for *Astrotricha roddii* across the species known distribution and subsequently six survey sites and one permanent plot were placed within Kings Plains National Park.

Systematic vegetation surveys in the Kings Plains area have begun to occur within the last decade. The first of these was conducted across the Ashford 1:100 000 Map Sheet by the Royal Botanic Gardens of Sydney (Le Brocque & Benson 1995). Although Kings Plains does not occur on this map sheet, the sheet is adjacent to those that include Kings Plains and this survey placed sites within similar communities along the Severn River as are known to occur within the reserve. Hunter (1999) systematically surveyed the rock outcrop vegetation and some of the adjacent woodlands in a comprehensive survey of such systems on the New England. This survey included an analysis of 19 sites that were placed within Kings Plains National Park and the results have been formally published by Hunter & Clarke (1998). Clarke *et al.* (1996) surveyed the proposed route for EASTLINK, which passed alongside the eastern boundary of Kings Plains, and six sites were placed just outside the boundaries of the reserve. Within the same regional biome but further afield Clarke *et al.* (1998) systematically surveyed the Torrington State Recreation Area by the placement of 204 plots. Hunter (1998) surveyed the vegetation of Kwiambal west of Ashford. A number of other systematic surveys have occurred within the Northern Tablelands and the North Western Slopes over the last five years, however most of these have less direct relevance to Kings Plains National Park. Clarke and Falloon (1999) conducted fire trials within Torrington State Recreation Area, some of the results of which may be of relevance to species occurring within Kings Plains National Park.

Methodology

2.1 Survey design

The survey was carried out in a stratified random way in order to sample and replicate the major environmental changes. Fifty new sites were surveyed and information from an additional 25 sites were compiled, thus providing a base of 75 sites for use in subsequent analysis and mapping which was far in excess of the minimum 50 sites required by the tender documents. The survey quadrats were divided proportionately between combinations of three major environmental variables. Specialised communities are often missed in stratified sampling strategies. Often this is due to the their small area of occurrence or that they were not known from the area under investigation. Additional sites were placed in specialised communities that were not included in the *a priori* sampling strategy or to stratified classes that were not replicated in the sampling design.

As only 75 quadrats were available for distribution only a small number of variables could be chosen as with the addition of each variable there is a marked reduction in replication. Altitude was also chosen as an environmental variable. Two altitudinal bands were chosen above 800 m (800-1009 m) and below 800 m (690-800 m). This altitude was selected as it corresponds to the rough cut off point of the Northern Tablelands and North Western Slopes Botanical Districts. Soil type was chosen as second environmental variable. The third environmental variable was physiography (Table 1).

The area in hectares was then used to proportionately distribute the quadrats across the environmental classes. The number of plots allocated to each class was directly proportional to the area it supposedly occupied. The square root of the number of hectares was used so that proportionately less effort was given to larger areas. This enables a more equitable distribution of sites.

Where a variable was adequately sampled sites were placed to take into account other environmental considerations such as aspect. The basic stratification was modified in the field when the information used was found to be inaccurate.

Table 1: Environmental attributes and the classes within them used for stratifying sample sites. 15 environmental sub-classes were sampled.

Environmental Attribute	Class	Number of Samples
Altitude	690-800 m	30
	900-1250 m	20
Total		50
Landform	Plateau	10
	Hill Slopes	19
	Lower Slopes	15
	Creek Lines	6
	Rock Outcrops	NA this instance
Total		50
Soil Type	Rhyolite	45
	Laterite	3
	Basalt	2
Total		50

2.2 Site and species information

Topological information was also collected along with measurements of altitude, slope, aspect and horizontal elevation. Altitude was taken directly from topographic maps. Slope and horizontal elevation were measured using a 'SUUNTO Optical Reading Clinometer'. Horizontal elevation was measured at eight compass bearings. Aspect was measured using a compass with reference to magnetic north. Information on soil, fires and other disturbances was also collected in a form amenable to the site survey data sheets supplied by the Glen Innes District of the National Parks and Wildlife Service (Appendix A). Site location was derived from a Magellan Trailblazer XL GPS with reference to topographic maps.

Vegetation structure was derived using the system developed by Walker and Hopkins (1990). This method uses growth form, height and crown cover of the dominant taxa in each of the strata layers that are identifiable. Individual taxon data for each quadrat was recorded using the species data forms supplied by the Glen Innes District of the National Parks and Wildlife Service (Appendix A). Species were scored in

accordance with a modified Braun-Blanquet (1982) cover abundance six ranking scale. Cover codes are as follows:

Cover Code	Projected Canopy Cover
1	<5% few individuals
2	<5% any number of individuals
3	6-25%
4	26-50%
5	51-75%
6	>75%

These methods will enable cross comparison of species records with other major vegetation surveys carried out by the New South Wales National Parks and Wildlife Service.

2.3 Vouchering

The importance of vouchering is discussed by Hosking *et al.* (1996) who conclude that without vouchers one may as well not publish results. As Hosking *et al.* (1996) state, current taxonomic knowledge is continually changing, and what was once one species may be split into ten or vise-versa. Vouchers can be checked with up to date descriptions and nomenclature changes as they are published.

It is unreasonable and impossible to collect all taxa from all sites. During this survey where possible at least one sample of each taxon was collected. All taxa that could not be identified accurately without doubt in the field were sampled from each site and labled according to the site they were taken. Opportunistic sitings of taxa were also collected if they were not found in any of the previous survey sites.

A single complete as practical set of taxa were prepared on field cards and retained by the Glen Innes District of the New South Wales National Parks and Wildlife Service. Additional good quality material of many taxa were also retained as vouchers and sent to the Coffs Harbour Botanic Gardens Regional Herbarium (CFSHB) then to the National Herbarium of New South Wales (NSW) as a second choice and further

duplicates were sent to NCW Beadle Herbarium (NE) and other recognised herbaria if available.

2.4 Data management

'Paradox 7 for Windows' (1995) a relational database, was used for data management, validation, storage and retrieval. 'Parent' tables were created with verified information that was used for data entry in 'Child' tables allowing consistency in data entry (for example the spelling of species names (Campbell 1984; McKenzie 1991; McKenzie *et al.* 1991)). Three 'parent' tables were created to store information with six 'child' tables used for referential integrity, validation and data entry. The three primary tables stored information relating to the taxa found the quadrats placed. The region number and site number were the relational fields used to link the three main tables. These three record values are unique and duplicate values were not accepted by the database. The system was designed to minimise the number of keystrokes, and allow for subsequent specimen determinations and results of analyses to be incorporated later without disruption. Field data collected during a single field trip were added either at night in the field on a 'note book' computer or immediately on the days after returning from the field on the main computer. Thus, discrepancies could be sorted out while the relevant survey sites were fresh in the mind.

Sorted data was exported to EXCEL spreadsheets prior to analysis. All site and species attributes are presented in EXCEL spreadsheets and included in the electronic form of this document that is held with the Glen Innes District of the New South Wales National Parks and Wildlife Service.

2.5 Multivariate Analysis

Initial exploratory analysis of sites was conducted using classification and ordination techniques available in PATN: Pattern Analysis Package (Belbin 1995ab). PATN was developed for manipulation, analysis and display of patterns in multivariate biological data (Belbin 1995a). Both classification and ordination were performed on data as each technique is complimentary and the use of both highlights anomalies produced by the other (Gauch 1982). Ordination will detect natural clusters if they are present

and highlight overall trends clarifying relationships alluded to with classification (Belbin 1991; Belbin 1995a). However, strong discontinuities in survey data can affect the way ordination techniques display continuous variation (Faith 1991). Classification techniques will impose groups on continuous data even if they are not present (Belbin 1991; Faith 1991; Belbin 1995a). In such situations 'chaining' may occur whereby samples grow by accretion one by one rather than by fusion with other clusters (Goodall 1980). Even in such situations utility can be found in imposed divisions (Gauch 1982). Classification is useful in detecting outliers that may affect ordination procedures (strong discontinuity). This technique also aids in the detection of smaller groupings or trends within the data that may be difficult to see from an ordination where groupings may be less obvious (Faith 1991).

Site classification was achieved using the Kulczynski association measure that has proven to be a superior measure of association with ecological data (Faith et al. 1987; Belbin 1995b). Agglomerative hierarchical clustering using flexible UPGMA (Unweighted Pair Group arithMetic Averaging) was used for group joining, this optimises the hierarchy and not the groups. UPGMA gives equal weight to objects not groups in the fusion process thereby groups are weighted proportionally to the number of objects contained (Belbin 1995b). This method has been widely tested and is the most frequently used classification technique (Gauch 1982; Belbin 1995b) and it provides the best fit between the association measure and the distances implied from the dendrogram (Belbin 1991). Flexible UPGMA enables the value of β, which ranges from –0.1 to 1.0 to be changed, this controls the amount of space dilation during the fusion process (Belbin 1991; Belbin 1995b). A β value of –0.1 was used to enable slight dilation to occur; this has been shown to better recover known partitions (Belbin 1995b).

Semi- Strong- Hybrid Multidimensional Scaling (SSH) was used as the ordination technique. Multidimensional scaling (MDS) moves objects around in a space defined by the number of dimensions chosen and the dissimilarities among sites in terms of their composition (Faith 1991; Belbin 1991). SSH calculates the level of stress, which is the miss-match between distances between points and the best estimate of the same values (Belbin 1995b). Subsequently all points in the initial ordination are moved

slightly to reduce stress, this process is iterated a specified number of times or until a minimum stress is achieved (Orl✱ci 1978; Belbin 1995b). MDS has been shown to be a robust method (Minchin 1987; Faith 1991). SSH has the advantage of being designed to cope with unimodal responses of taxa replacing the assumption of linearity used by many other ordination procedures (see e.g. Noy-Meir & Whittaker 1978; Orl✱ci 1978; ter Braak & Prentice 1988; Faith 1991; Belbin 1995a).

The number of groups to be recognised can be based on a number of a priori methods. The point at which a leveling of a scree plot of dissimilarity and number of fusion points occurs can be an indication of the optimal cut off point. At such a point, many clusters are formed at essentially the same linkage distance. Binns (1995b) described understorey communities using the same analyses procedures within the same area at a dissimilarity of 0.8.

'Canonical Correspondence Analysis' (CCA) via CANOCO (ter Braak 1987-1992) was used for exploration of site attributes and their affects on site ordination. CCA is a multivariate direct gradient analysis technique for the analysis of patterns of variation in community composition that can be explained by environmental variables. The technique is based on the reciprocal averaging algorithm of Correspondence Analysis (CA). In CCA the axis of the ordination is constrained to be linear combinations of the environmental variables (i.e. direct gradient analysis), which enables the analysis to handle complex environmental gradients. A major advantage of this type of analysis is it assumes a unimodal Gaussian response of taxa which is more ecologically realistic (see e.g. Gauch 1982, ter Braak 1986; Sparrow 1990; Austin 1991; Faith 1991), but it is also robust to significant departures from this (Gauch 1982; ter Braak 1986; Palmer 1993).

Forward selection of variables was used for data reduction, ranking of variable importance and significance testing (ter Braak & Verdonschot 1995). This was achieved by using the forward selection module on CANOCO. Here the variation explained by each variable is partitioned and a model of significant variables is constructed, i.e. all environmental variables are ranked based on the fit of each variable separately. The significance of the effect of each variable is tested by a Monte Carlo permutation test (in this case 999 iterations). A variable was added if its

significance was at the 5% level or less. As each variable is selected, the remaining variables are reassessed based on the fit that each variable gives in conjunction with the variables already selected (ter Braak & Verdonschot 1995). Forward selection ceases when the significance based on the Monte Carlo tests is greater than 5%. The overall significance of the CCA ordinations was tested by Monte Carlo permutation (99 iterations) of residuals of the taxa after fitting co-variables and environmental variables (ter Braak 1992).

A total of 21 environmental variables collected at each site were chosen for analysis. These variables included: Slope, Easting, Northing, Fire, Clearing, Pollution, Grazing, Horizontal Elevation N, NE, E, SE, S, SW, W, NW, Altitude, Aspect, Geology, Soil Depth, Drainage, and Physiography. Aspect was coded into four 90° groups for use in analyses thereby avoiding the problem that north is both 0° and 360°. 1 = NNW to NNE; 2 = W to NNW, E to NNE; 3 = W to SSW, E to SSE; 4 = SSE to SSW. This assumes that the greatest differences are between North and South (S✶derstr✶m 1981).

2.6 Significant vascular plant taxa within the reserve

Three main sources of information were used initially to assess the significance, in terms of rarity, of any taxa found within the reserve. The national list of rare or threatened Australian plants (ROTAP) (Briggs & Leigh 1996) along with the New South Wales Threatened Species Conservation Act 1995 (TSC Act) was used as a primary indicator of national and state significance. The regional significance of taxa was assessed with reference to other flora survey publications, local botanical knowledge as expressed in unpublished survey reports and the personal experience of the author and other botanists was used as a final source of information.

2.7 Analysis of regional diversity

Regional diversity is calculated by assuming that an exponential species-area curve relationship exists. The regional diversity index is calculated by D=S/logA, where S is the number of taxa in a region of A hectares.

Results

3.1 Site stratification

The basic stratification as outlined in the methods was completed. Some modification was necessary as some environmental classes were not as suggested by the information on the E-RMS. Furthermore, certain combinations did not exist. In total, the 43 stratified sites were sampled over a period of 6 field days (Figure 10). This represents the completion of part one of the survey.

3.2 Floristics

A total of 436 vascular plant taxa were recorded during the collation of existing site data and subsequent extra sampling (Appendix B). Approximately 10% (42) of all taxa recorded were introduced. From the 50 new survey sites 368 taxa were recorded from survey plots. A further 19 taxa were recorded opportunistically. The remaining 48 taxa were recorded from previous surveys within the boundaries of the present reserve and were not found during this investigation. This represents 9% of the total New South Wales Flora. The total number of taxa found within the reserve is of significance (Table 2) as Le Brocque and Benson (1995) in their survey of 105 sites across the entire Ashford Map Sheet found 290 taxa in total, with an additional 213 species being collated from all previous surveys. Hunter (1998) found only 266 taxa from 42 sites at Kwiambal. Site species richness is particularly high and on a 0.1 ha basis would equal or better the site richness at Torrington State Recreation Area and is nearly have as rich again as most other quadrat based surveys conducted within the same bioregion (Table 2). However based on the regional diversity index the richness of Kings Plains National Park is intermediate (Table 2). This measure of regional diversity may be an underestimate as many of the areas that have a higher regional diversity have been surveyed many times over a number of seasons and years and thus may have elevated richnesses. Furthermore many areas with a higher regional diversity have a substantially higher introduced species count (i.e. 30+% compared to 7%). In comparison to other surveys conducted on a ‘one off’ basis using quadrat based data Kings Plains is one of the more regionally rich areas yet surveyed.

The 441 taxa occurred in 79 families and 238 genera. The families with the greatest number of taxa are Poaceae (61), Asteraceae (49), Fabaceae (44), Myrtaceae (31), Cyperaceae (14), Proteaceae (13), Epacridaceae (13), Rutaceae (11), Rubiaceae (9), Apiaceae (8), Euphorbiaceae (8). The richest genera are *Eucalyptus* (15), *Acacia* (16), *Austrodanthonia* (8), *Leptospermum* (8), *Olearia* (7), *Eragrostis* (6), *Leucopogon* (7), *Olearia* (6), *Persoonia* (6), *Dichelachne* (5), *Galium* (5), and *Zieria* (5).

Table 2. Comparison of species richness for other recently surveyed areas in the North Western Slopes of New South Wales.

Number of Taxa	Introduced Species	Number of Sties	Mean Richness	Regional Diversity Index	Area Covered by Survey
752	5%	201	60/0.1 ha	168	Torrington State Recreation Area (Clarke *et al.* 1998). 0.1 ha sites. 600 spp. found in survey plots 152 species from previous records.
507	31%	None	NA	143	Warrabah National Park (Hosking & James 1998). Random meanders over a number of seasons and years.
503	10%	105	37/0.04 ha	53	1:100 000 Map Sheet (Le Brocque & Benson 1995). 20 x 20 m sites (290 taxa) and all additional records (213 extra taxa).
467	47%	None	NA	172	Oxley Park, Tamworth (Hosking & James 1998). Random meanders over a number of seasons and years.
441	**10%**	**75**	**51/0.04 ha**	**112**	***Ibid.***
410	35%	None	NA	140	Attunga State Forest (Hosking & James 1998). Random meanders over a number of seasons and years.
407	17%	101	40/0.04 ha	116	Kwiambal National Park (Hunter 1998). 20 x 20 sites.
330	11%	50	?	80	Coolah Tops [truly Northern Tablelands but western influenced] (Binns 1997). 50 x 20 m plots.
304	4%	20	56/0.1 ha	105	Bornhardtia, Ironbark near Barraba (Hunter, *unpublished data*). 32 x 32 m sites.
251	5%	50	32/0.04 ha	61	Southern Portion Mt Kaputar National Park (Porteners 1998). 20 x 20 m sites
198	5%	30	31/0.04 ha	71	Sub-alpine communities in Mt Kaputar National Park (Porteners 1997). 20 x 20 m sites
90	2%	7	?	25	Derra Derra Ridge, Bingara (Benson *et al.* 1996). 20 x 20 m sites.

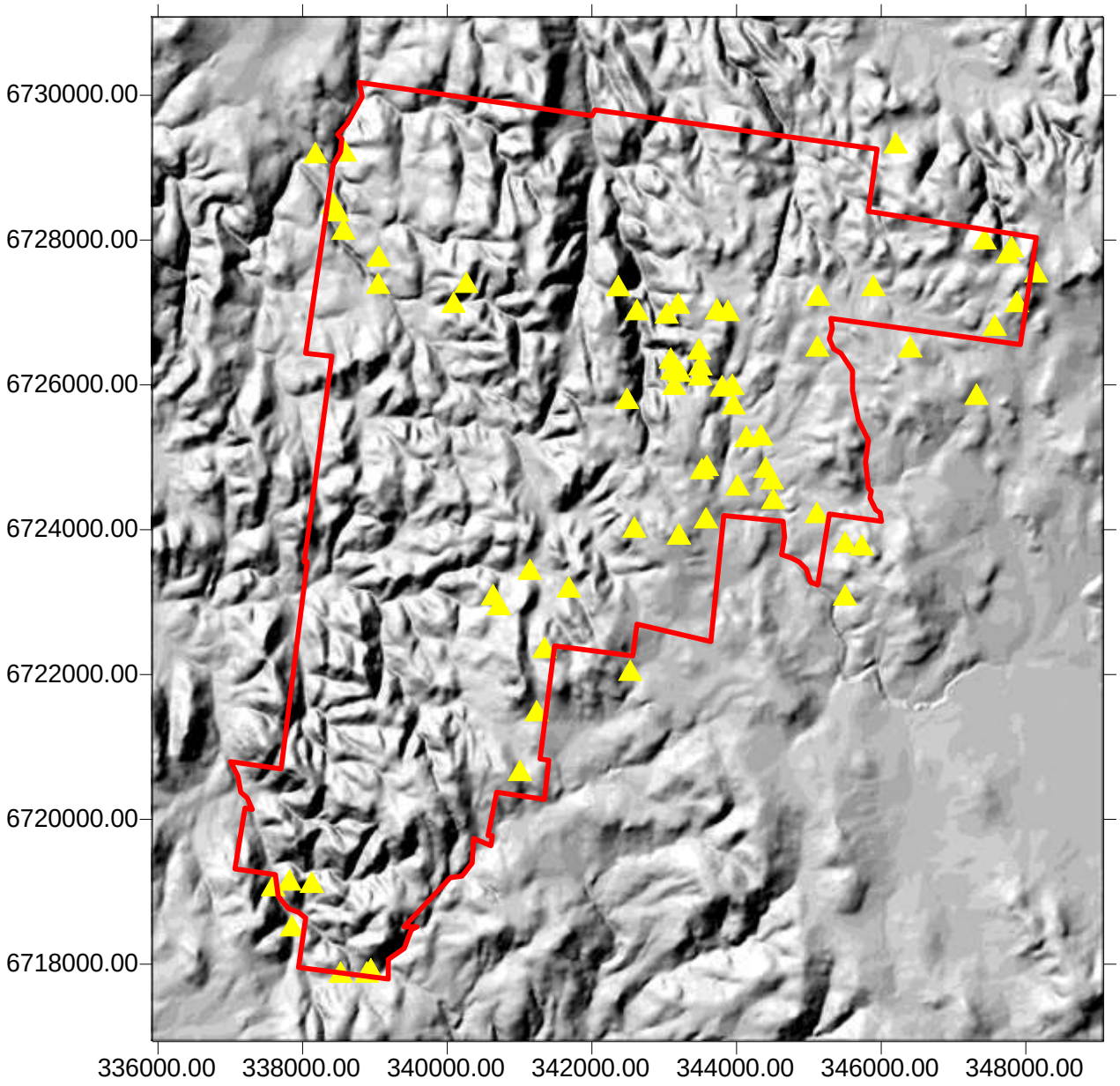

Figure 10: Distribution of the 75 full floristic survey sites at Kings Plains National Park.

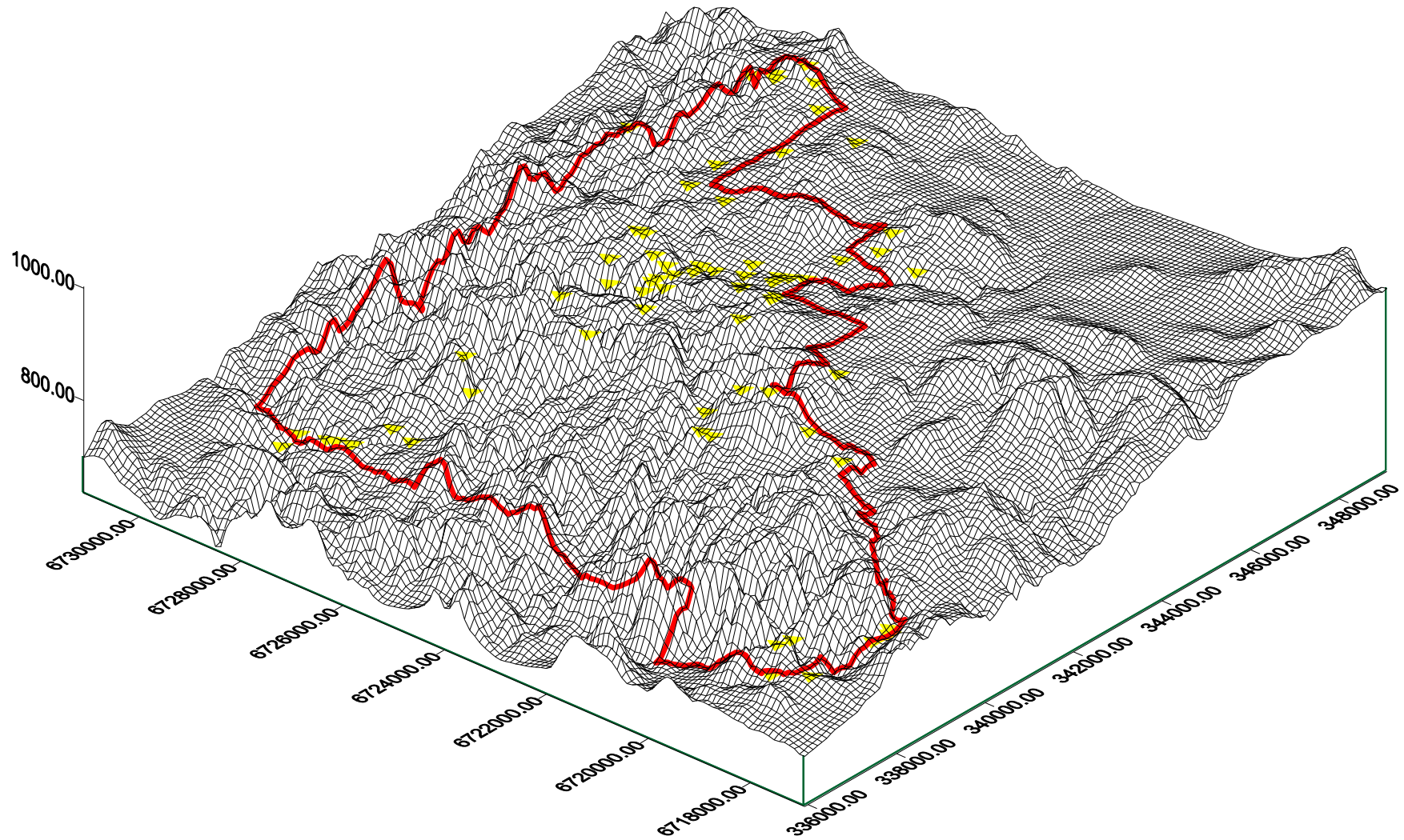

Figure 11: Topographic placement of all full floristic sites placed at Kings Plains National Park.

3.3 Community definition

The scree plot analysis indicates that the point of inflection lies near the 0.8 dissimilarity level thereby 7 groups of species assemblages are recognized (Figure 12). This level of inference for community definition is the same used by other investigators in the same bioregion after similar scaled investigations (Hunter 1998). The seven new communities recognized are displayed in a summary dendrogram (Figure 13) that highlights three major larger groupings or floristic elements. These major distinctions in the dendrogram appear to be related to soil characteristics in terms of soil type and depth which may be related to water retention properties and or nutrient availability. The communities are distinctive also in the ordination plot in which a gradient of soil characteristics may be inferred.

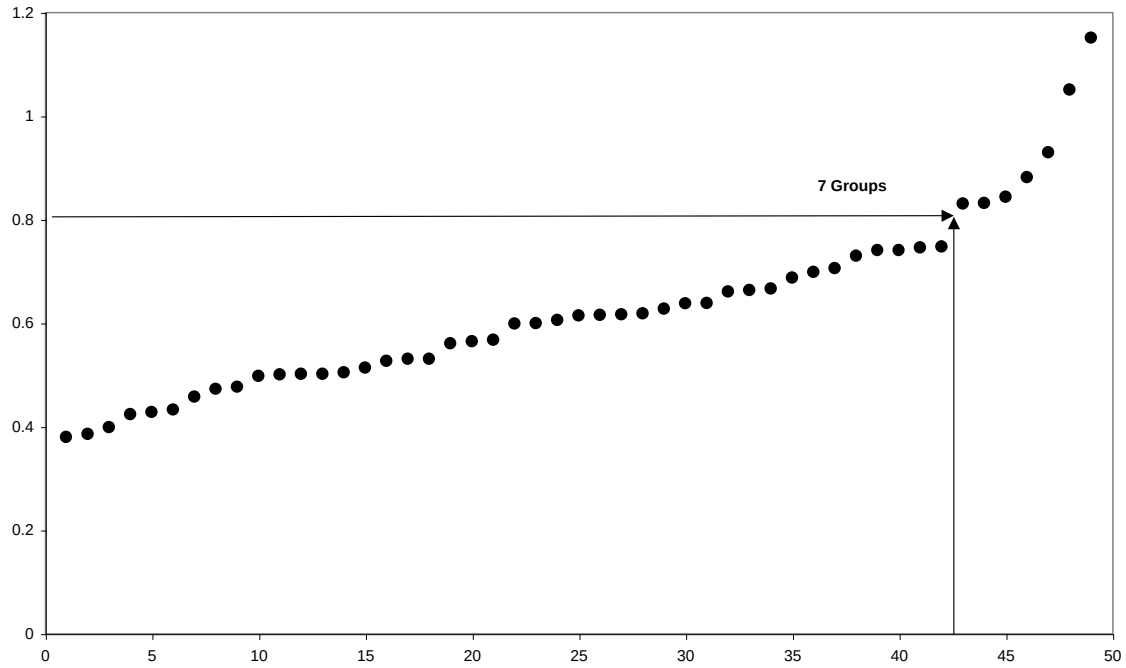

Figure 12: Scree plot of Kulczynski association measure and flexible UPGMA fusion strategy results. The line of demarcation represents the cut off point for recognition of floristic groups (*c.* 0.8 dissimilarity, 7 communities). Note that groups are recognized near the point of inflection of the curve and that the scree plot is based on analysis of the 50 new sites only.

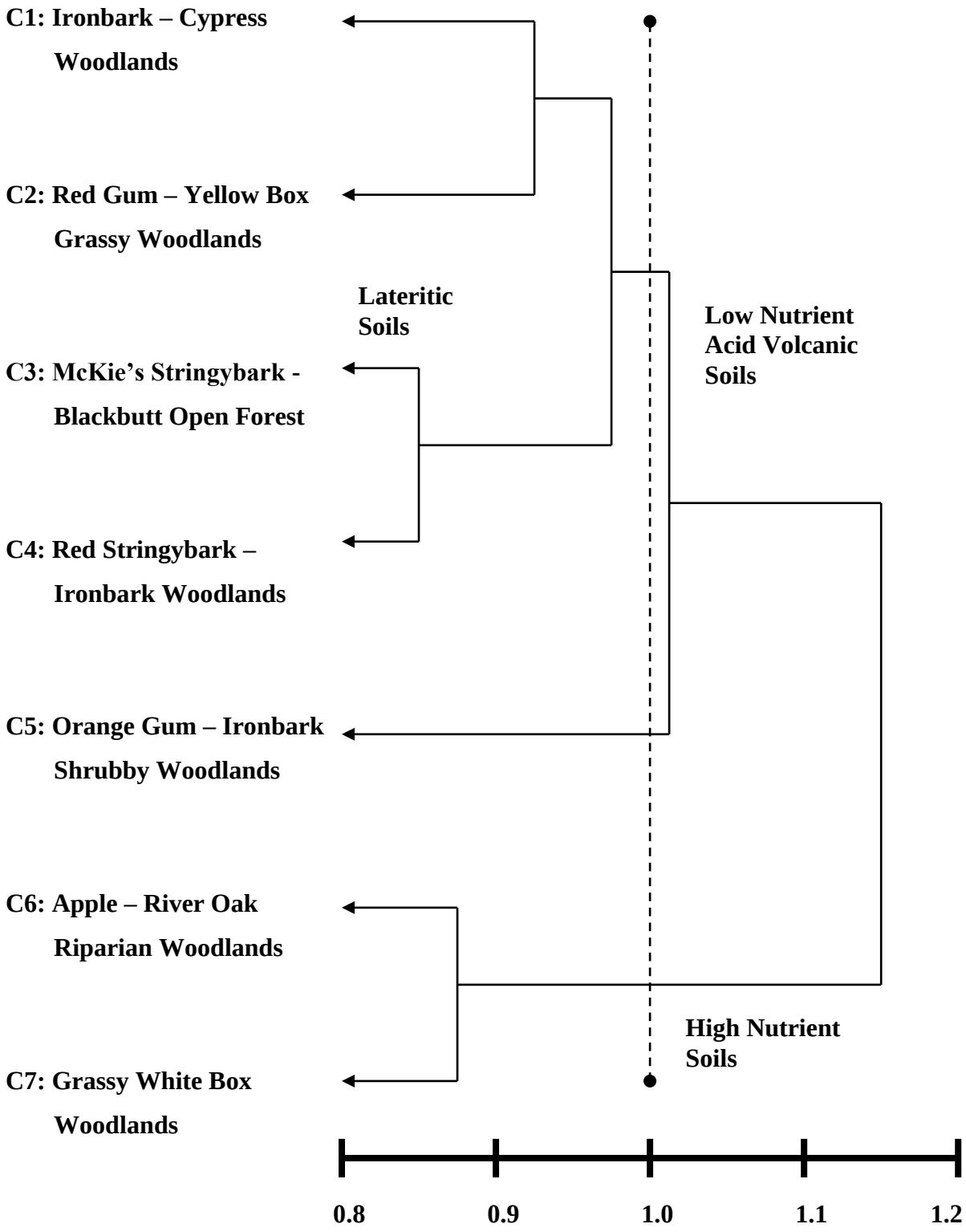

Figure 13: Summary dendrogram of full dataset of sites surveyed during this investigation (50 in total) using Kulczynski association and flexible UPGMA fusion strategy and a β value of –0.1. Communities have been defined at a dissimilarity level of *c.* 0.8. An eighth community (Severn Rock Outcrop Shrublands) has been defined from previous investigations and is not incorporated on this dendrogram.

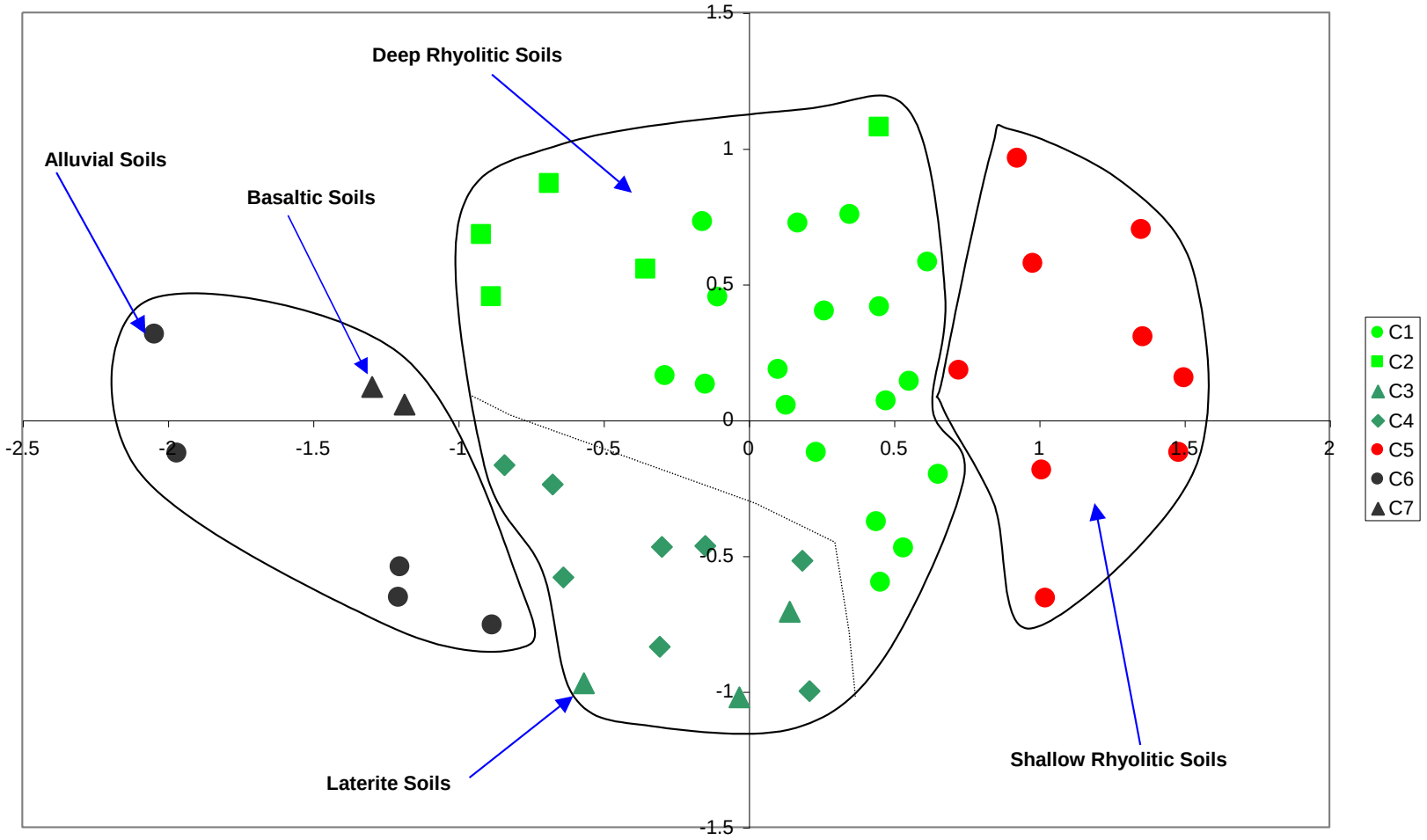

Figure 14: Two dimensional ordination scattergram of all sites sampled during this investigation (50 in total) based on full floristics and analysis by flexible UPGMA association measure and Semi-Strong-Hybrid Multi-Dimensional Scaling. Seven communities have been defined by classification (Figure 12).

3.4 Canonical correspondence analysis

A CCA plot of the significant environmental variables on the distribution of sites is shown in Figure 10. The axes shown account for 94% of the variance (axis one = 53%) of the constrained ordination. Monte Carlo permutations on the first constrained axis and the overall model are significant at 0.001%. Simple rules are associated with the interpretation of CCA biplots and these include:

- Sites with similar distributions will be close and those with divergent distributions will be distant.
- Arrows point in the direction of maximal change in that variable.
- The longer the arrow the more important the variable.
- The order of perpendicular projected points on the variable arrows gives an inferred ranking.
- Points and arrows on the same side are positively correlated.
- Those on the opposite side are negatively correlated.
- Those that are perpendicular are not correlated at all.

The environmental variables imply the following gradients:

- Physiography in this analysis implies an increase in physical protection from crests to low open depressions.
- Soil type implies an inferred gradient from Rhyolite, Laterite, Alluvial to Basalt.
- Aspect implies a gradient increasing from north to south.
- SW implies a gradient of increasing protection from the south west.

Eight of the 21 tested variables were found to be significant at the 5% level or less (Figure 15). These environmental variables were correlated to the distribution of the three major vegetation associations highlighted in the dendrogram and scattergram ordination (Figures 13 & 14). The strongest and most highly significant variable effecting the constrained distribution of sites was past mining, the next most significant variable was Soil Depth followed by Soil Type, Physiography, protection

from the SW, Easting, Altitude and finally Aspect. The statistical significance of these correlations varied with only Mining, Soil Depth, Soil Type, Easting and Altitude being highly significant.

No sites are associated with the centroid of the ordination which indicates that all samples are affected by the correlations displayed. Communities 6 and 7 are associated with 'richer' soils (+ve Soil Type), either alluvial or basaltic on areas of flatter topography (+ve Physiography) protected from the south west (+ve SW) and areas disturbed by mining (+ve Mining; in particular Community 6). Although individual sites associated with Community 6 are affected by soil depth the community as a whole will occur on shallow and deep soils. Community 7 however is significantly associated with deep soils.

Although a single site occurs on deeper soils Community 5 is strongly correlated with increasingly shallow soils. Most sites from these communities are weakly associated with more exposed positions (-ve Physiography, -ve SW), a 'poor' soil type (-ve Soil Type), lower altitudes (-ve Altitude) and the associated western distribution (-ve Easting). Disturbance from Mining in general is uncorrelated with this community.

In most cases intermediate soil depths are strongly correlated with Community 4, weaker correlations also occur with lower altitudes (-ve Altitude), a western distribution (-ve Easting), 'poorer' soils (-ve Soil Type) and an exposed position (-ve Physiography). Community 3 was strongly correlated with deep soils and an eastern high altitude position (+ve Easting and Altitude) but appears to be weakly or not correlated to most other measured environmental variables. Community 2 is correlated to deeper soils (-ve Soil Depth), at higher altitudes along the east of the reserve with more southerly aspects (+ve Aspect, Altitude, Easting) but are less responsive to the other ordinated variables. Community 1 is overall ambivalent to soil depth although deeper soils may be preferred. This community is more commonly correlated to eastern, high altitude sites on protected aspects (+ve Altitude, Easting, Aspect) but in areas associated with rhyolitic soils (-ve Soil Type) on crests and slopes (-ve Physiography), which haven't been disturbed by mining (-ve Mining).

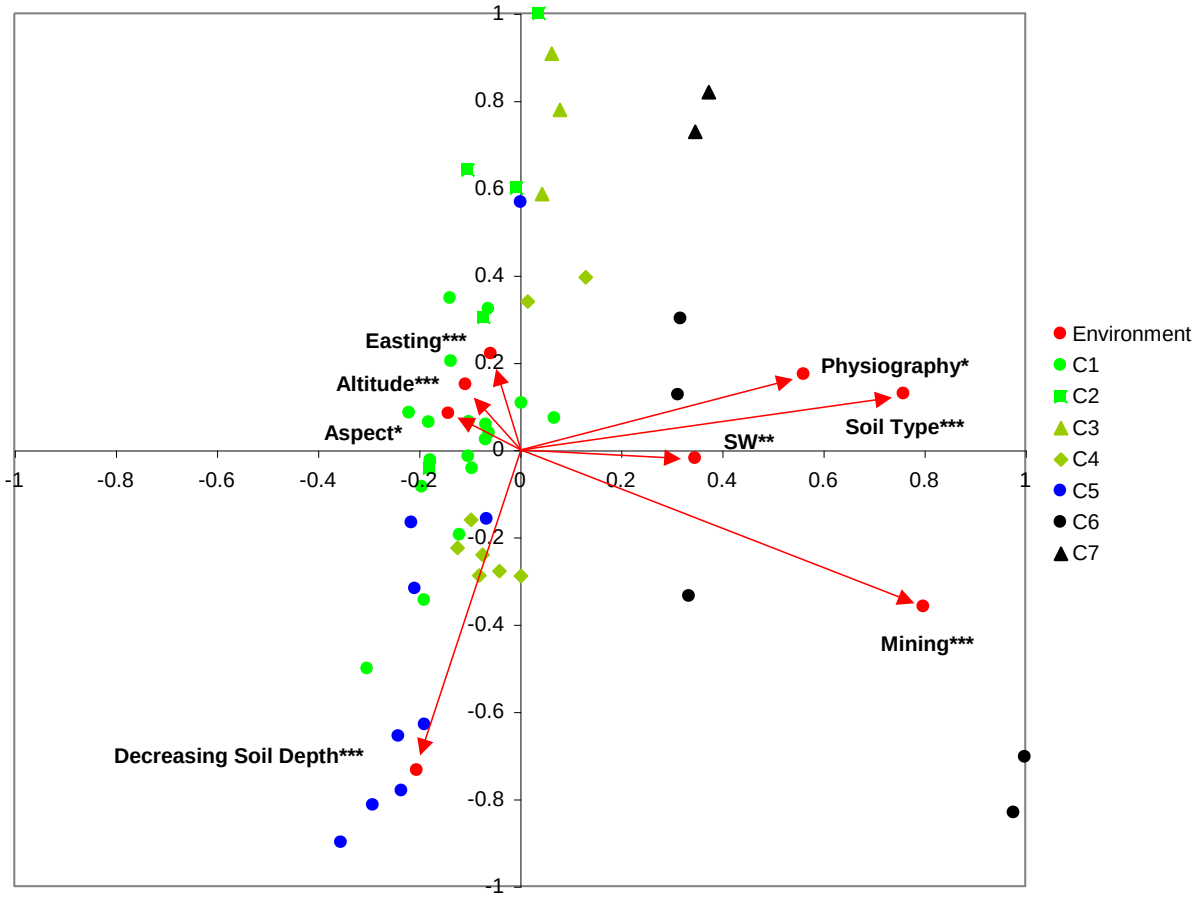

Figure 15: Biplot of canonical correspondence analysis. Red arrows = environmental and disturbance variables. The statistical significance of constrained correlations are given as thus: *** = P < 0.001; ** = P < 0.01; * = P < 0.05. C1 = Ironbark/Cypress Woodlands; C2 = Red Gum/Yellow Box Grassy Woodlands; C3 = McKie's Stringybark/Blackbutt Open Forest; C4 = Red Stringybark/Ironbark Woodland; C5 = Ironbark/Orange Gum Shrubby Woodland; C6 = Apple Box/River Oak Riparian Woodlands; C7 = Grassy White Box Woodlands.

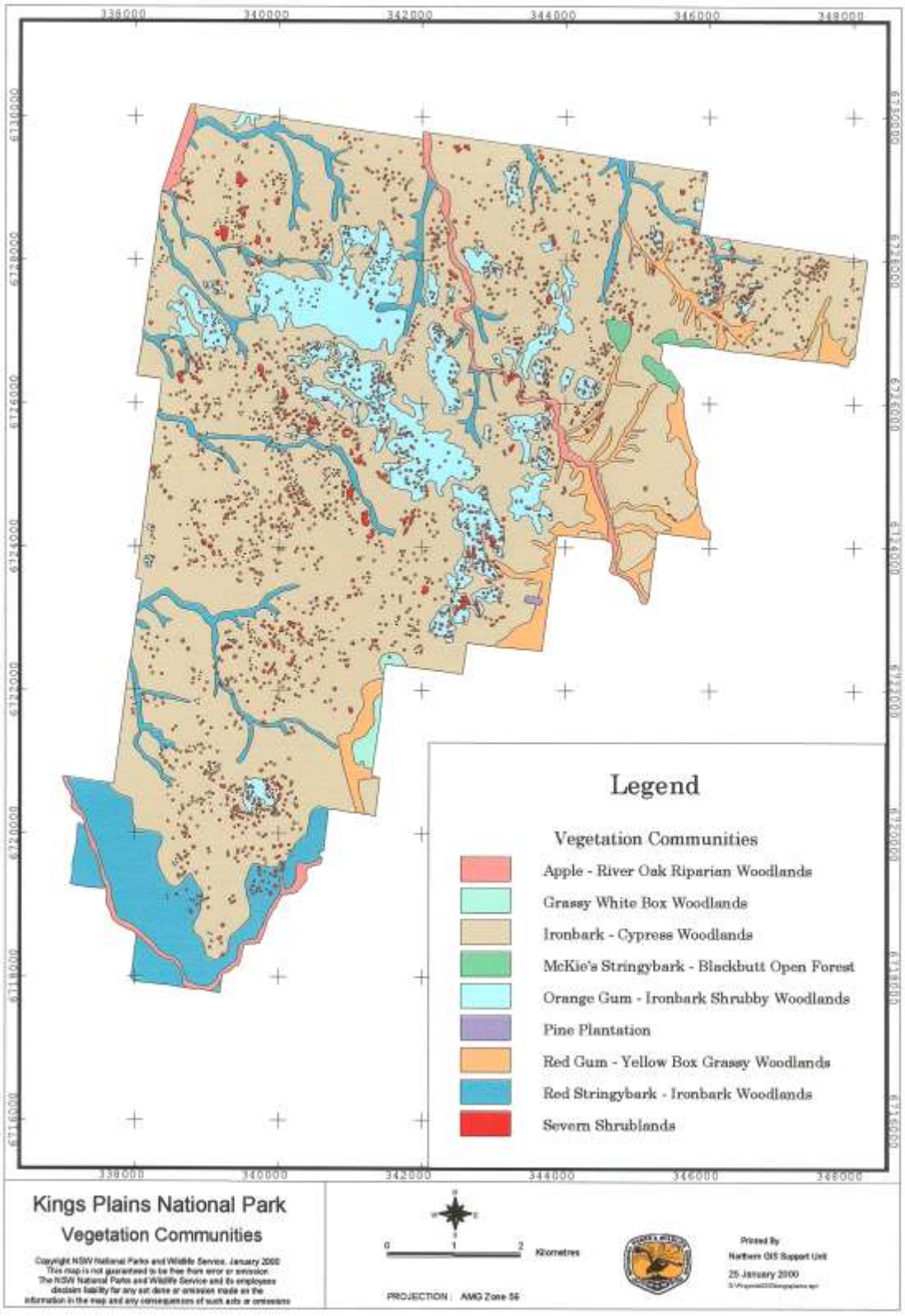

Figure 16: Mapped distribution of communities.

3.5 Description of plant communities

Most of the vegetation communities within Kings Plains National Park are Woodlands with either a predominantly shrubby or grassy understorey. Shrublands and herbfields do occur but are of restricted distribution primarily on shallow skeletal soils. Grasslands were not found. Sedgelands were also missing, apart from minor occurrences directly associated with creek banks. It is likely that sedgeland assemblages are beyond the climatic limit of their development. Forests are also found but these are infrequent and usually associated with the periphery of the reserve adjacent cleared agricultural land. A white box community is also found however it has a minimal occurrence adjacent to improved pastures. The most prominent trees in terms of frequency and abundance are *Callitris endlicheri* (Black Cypress Pine), *Eucalyptus prava* (Orange Gum) and *Eucalyptus caleyi* subsp. *caleyi* (Caley's Ironbark). These three species are found to dominate a number of communities listed below. However the fidelity of associated understorey species changes considerably allowing the recognition of communities despite overstorey similarities. Overall communities within Kings Plains National Park are Cypress Pine and Ironbark dominant with minor occurrences of Stringybark and Box on better deeper soils. Eight communities in total were defined and these are mapped and described below.

3.5.1 Community 1: Ironbark – Cypress Woodlands

Caley's Ironbark (*Eucalyptus caleyi* subsp. *caleyi*) – Black Cypress Pine (*Callitris endlicheri*) – Orange Gum (*Eucalyptus prava*).

Sample sites (18): 1, 3, 4, 5, 7, 13, 20, 24, 25, 26, 27, 29, 30, 31, 32, 33, 46, 49.
Number of hectares: 4970 **Proportion of reserves:** 71.3%.
Landform: Crests and hillslopes.
Distribution: Found restricted within the reserve to the rhyolitic soils that surround rock outcrops that are not influenced by alluvial input or are to shallow. Probably the most common community across the entire reserve and particularly prevalent on deeper rhyolitic soils.

Structure: Upper (10-) 15-20 (-25) m tall; cover 30-40%. Mid shrub 3-8 m; 10-40% not always present. Low shrub 1-2 m tall; 20-70% cover, not always present. Ground to 1 m tall; 30-100% cover.

No. of taxa: 208 **No. of taxa per plot:** 53 av. (33-66).

Common natives: Listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Eucalyptus caleyi* subsp. *caleyi, Callitris endlicheri, Eucalyptus prava, Eucalyptus dealbata, Eucalyptus crebra, Eucalyptus machrorhyncha, Eucalyptus banksii, Eucalyptus andrewsii, Allocasuarina inophloia, Eucalyptus stannicola.*

Shrubs: *Leucopogon muticus, Lissanthe strigosa, Leptospermum brevipes, Melichrus urceolatus, Kunzea obovata, Persoonia cornifolia, Dillwynia sieberi, Pultenaea* sp. C, *Leptospermum novae-angliae, Jacksonia scoparia, Styphelia triflora, Xanthorrhoea johnsonii, Acacia pruinosa, Acacia neriifolia, Calytrix tetragona, Acacia penninervis, Acacia buxifolia, Grevillea triternata, Brachyloma daphnoides* subsp. *glabrum, Solanum cinereum, Monotoca scoparia, Hibbertia acicularis, Acacia leptoclada, Leucopogon virgatus, Hibbertia obtusifolia, Dodonaea viscosa.*

Climbers & trailers: *Hardenbergia violacea, Cassytha filiformis, Parsonsia eucalyptophylla.*

Ground cover: *Echinopogon caespitosus* subsp. *caespitosus, Goodenia bellidifolia* subsp. *argentea, Cheilanthes sieberi* subsp. *sieberi, Cymbopogon refractus, Hypericum gramineum, Pomax umbellata, Opercularia aspera, Lomandra multiflora, Goodenia hederacea* subsp. *hederacea, Schoenus apogon, Dianella caerulea* subsp. *caerulea, Austrodanthonia eriantha, Wahlenbergia luteola, Trachymene incisa, Haloragis heterophylla, Brachyscome nova-anglica, Aristida vagans, Hydrocotyle peduncularis, Euchiton sphaericus, Aristida jerichoensis, Lomandra filiformis, Gonocarpus tetragynus, Entolasia stricta, Aristida ramosa, Vittadinia cuneata, Panicum simile, Lagenifera stipitata, Digitaria breviglumis, Oxalis chnoodes, Chrysocephalum apiculatum.*

Introduced taxa: *Hypochaeris radicata, Conyza albida, Taraxacum officinale, Centaurium erythraea, Sonchus olearceus, Sigesbeckia orientalis* subsp. *orientalis, Cirsium vulgare, Panicum antidotale, Conyza bonariensis, Aira cupaniana, Silybum marianum, Hyparrhenia hirta, Ciclospermum leptophyllum, Anagallis arvensis.*

Percent of species introduced: 7%.

Variability: The assemblage can be further divided into two or three subgroups, however these are based solely on geographic distribution and are a reflection of altitudinal changes with some understorey species being replaced by others.

Condition: Very good condition overall. Mining has affected small portions and clearing and rough grazing have been more prevalent in the past along the eastern boundaries. In the southern portion of the lands controlled by the service particularly within portion 70 and 71 large portions of this community have been affected by wholesale clearing and regeneration of thick *Leptospermum brevipes*.

Taxa of conservation importance: *Callistemon pungens, Isotoma anethifolia, Pultenaea stuartiana, Allocasuarina brachystachya, Eucalyptus mckieana, Actinotus gibbonsii*. Potentially *Eucalyptus caleyi* subsp. *ovendenii*.

Notes: Broadly synonymous communities are described by Heil (1996) and Young and McDonald (1989) for the granite belt in Queensland occurring on adamellite and adjacent elevated traprock and rhyolite around 700-800 m altitude. Clarke *et al*. (1998) describe a similar community being confined to rugged and low relief areas to the west of Torrington. Although not formally described similar communities are known to occur as far south as Warrabah National Park and are known from Ironbark Nature Reserve, the Basin Nature Reserve, Moredun Dams and at Howell near Copeton Dam. Specht *et al*. project the distribution of this assemblage in the broader sense as occurring a far south as Wollemi National Park. Measures to control the dominance of *Leptospermum brevipes* may need to be sorted out the areas where it has regenerated densely. This species is forming mono-dominant stands that exclude most other species natural to these habitats. These areas are severely degraded habitats that are also prone to erosion if the Tea-tree is just removed. Fire is unlikely to be appropriate as a management tool as the species resprouts readily. In general the other areas containing this community are in good condition and the only management problems may be the continued eradication of goats and removal of stray cattle.

Conservation status: Communities similar to this are widespread across the North Western Slopes, the western parts of the Northern Tablelands and the western Darling Downs Region and as a unit are probably reasonably represented within conservation reserves across their range. However, directly synonymous communities are probably of much more restricted distribution and may only occur from rhyolitic soils associated with the Kings Plains and Severn River areas and potentially the Moredun

Dams area near Tingha. All of these areas thus far have conservation reserves and therefore based on this information this community may be considered adequately reserved.

Management considerations: Some collections of *Eucalyptus caleyi* subsp. *caleyi* were true to the usual morphological features of this subspecies but somewhat intermediate between subsp. *caleyi* and subsp. *ovendenii*. There is potential that subsp. *ovendenii* may also occur within the reserve and that such intermediate morphological features are signs of a hybrid swarm associated with nearby true populations of subsp. *ovendenii* or ghost hybridization between the subspecies. As such there may be the potential of finding populations of true subsp. *ovendenii* within the reserve and a targeted search may be warranted.

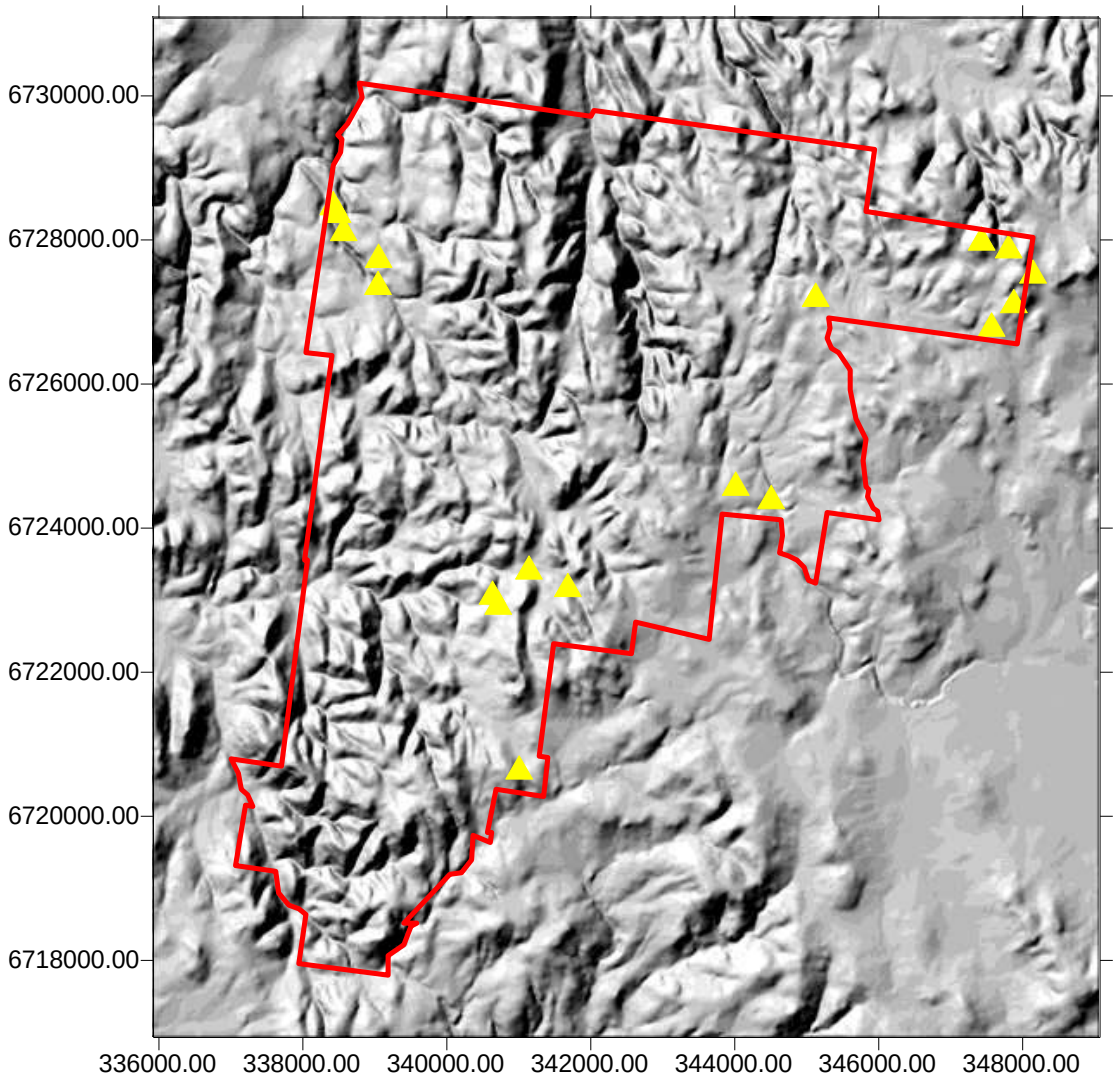

Figure 17: Placement of sites within Community 1.

Figure 18: Photographs of Community 1. Above Site 1; below Site 32.

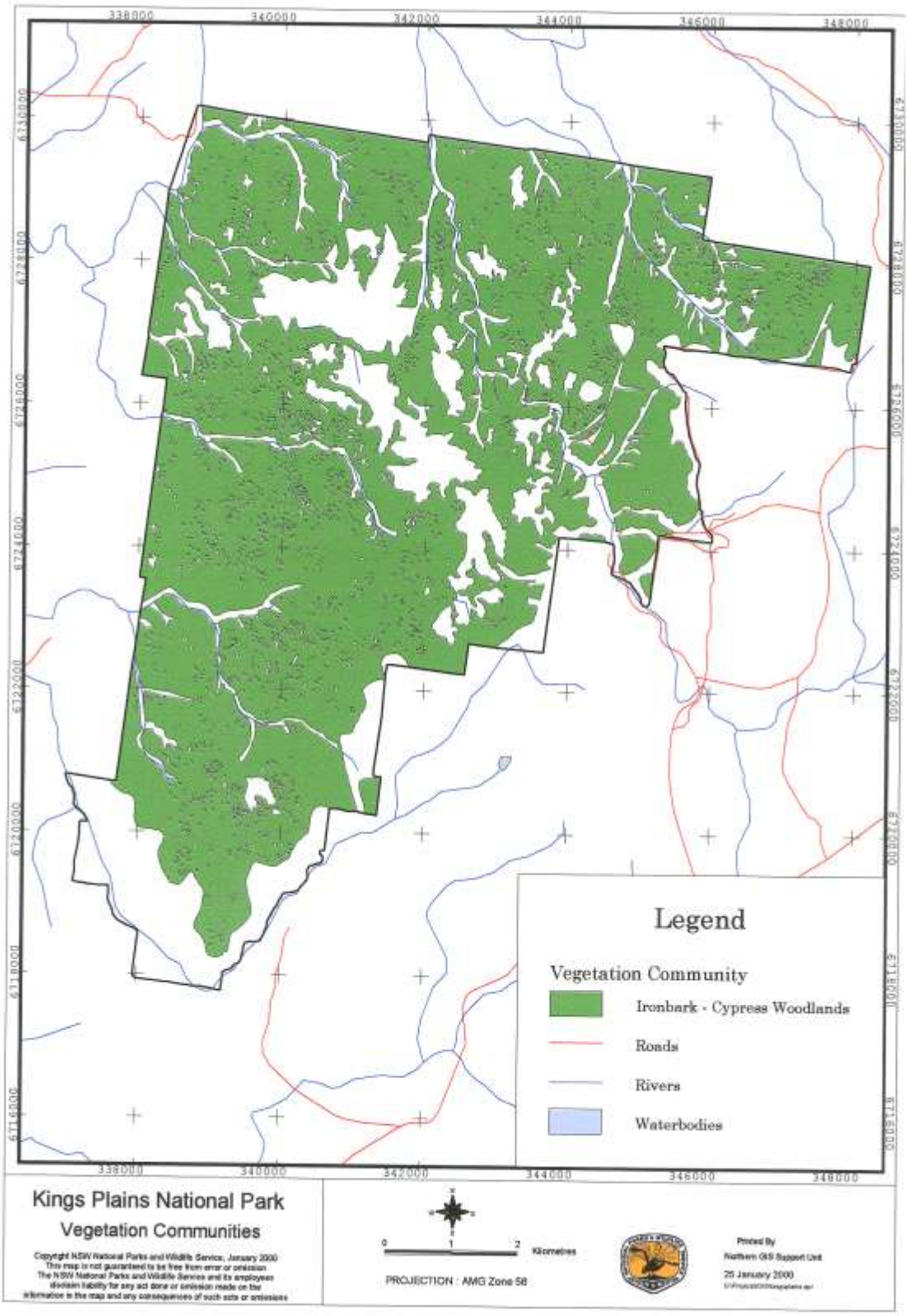

Figure 19: Distribution of Community 1.

3.5.2 Community 2: Red Gum - Yellow Box Grassy Woodlands

Blakely's Red Gum (*Eucalyptus blakelyi*) – Black Cypress Pine (*Callitris endlicheri*) Yellow Box (*Eucalyptus melliodora*).

Sample sites (5): 2, 6, 8, 11, 21.

Number of hectares: 268 **Proportion of reserves:** 3.8%.

Landform: Low country open depressions.

Distribution: Restricted to the low-lying flat terrain at higher altitudes on the eastern margin of the reserve on soils that are associated with creeks and are occasionally waterlogged or at least with poor drainage.

Structure: Upper (15-) 20-25 m tall; 20-45% cover. Mid shrub not always present 2.5-10 m tall; 10-30% cover. Ground layer to 1 m tall; 80-100% cover.

No. of taxa: 114 **No. of taxa per plot:** 42 av. (32-53).

Common natives: Listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Eucalyptus blakelyi, Callitris endlicheri, Eucalyptus prava, Eucalyptus melliodora, Eucalyptus mckieana, Eucalyptus caleyi* subsp. *caleyi, Eucalyptus banksii, Angophora floribunda.*

Shrubs: *Leptospermum novae-angliae, Acacia filicifolia, Kunzea obovata, Acacia fimbriata, Leptospermum brachyandrum, Acacia leiocalyx, Leptospermum minutifolium, Dillwynia sieberi, Leptospermum polygalifolium* subsp. *transmontanum, Aotus subglauca* var. *filiformis.*

Climbers & trailers: *Desmodium varians, Hardenbergia violacea, Glycine clandestina.*

Ground cover: *Schoenus apogon, Haloragis heterophylla, Goodenia bellidifolia* subsp. *argentea, Echinopogon caespitosus* subsp. *caespitosus, Juncus remotiflorus, Hypericum gramineum, Brachyscome stuartii, Goodenia gracilis, Austrodanthonia eriantha, Themeda triandra, Gonocarpus micranthus* subsp. *ramosissimus, Arundinella nepalensis, Viola betonicifolia, Lomandra multiflora, Fimbristylis dichotoma, Dianella caerulea* subsp. *caerulea, Wahlenbergia luteola, Panicum simile, Murdannia graminea, Luzula flaccida, Juncus fockei, Gonocarpus tetragynus Lomandra longifolia, Euchiton sphaericus, Dichondra repens, Chrysocephalum apiculatum, Calotis cuneifolia, Aristida jerichoensis Senecio quadridentatus,*

Opercularia aspera, Lepidosperma laterale, Lagenifera stipitata, Juncus pauciflorus, Hydrocotyle peduncularis, Eragrostis lacunaria, Cymbopogon refractus, Cymbonotus lawsonianus, Brachyscome nova-anglica.

Introduced taxa: *Hypochaeris radicata, Conyza albida, Taraxacum officinale, Centaurium erythraea, Aira cupaniana, Conyza bonariensis, Cirsium vulgare, Ciclospermum, leptophyllum, Verbena brasiliensis, Sonchus olearceus, Rubus chloocladus, Centaurea solstitialis, Bromus madritensis, Briza minor.*

Percent of species introduced: 12%.

Variability: Little internal variability was noted within this community. However it does occur as, more or less small and linear patches within a matrix of much more widespread communities. As such there may be much overlap between this community and those that surround it such as Community 1, 3 or 4. Some patches are influenced by soil from nearby Lateritic areas which may influence some of the understorey species present.

Condition: Generally good. Many areas with this community have been either partially cleared in the past or have been grazed up to the point of acquisition by the service. There is a fairly high level of introduced species which may be related to the past use of these areas or their proximity to the cleared agricultural lands nearby.

Taxa of conservation importance: *Eucalyptus mckieana, Echinopogon mckiei.*

Notes: This community is restricted to the higher altitude eastern parts of the reserve. Specht *et al.* (1995) map similar communities as occurring from south-central Queensland along the western slopes and western parts of the tablelands south to the Victorian Border.

Conservation status: In the broad sense this community is widespread in New South Wales and has been extensively modified across its entire occurrence. Simpson (1969) states that early settlers used *Eucalyptus melliodora* as an indicator species for choosing productive agricultural land. These assemblages are intensively grazed and pasture improved (Beadle 1981; Semple 1997). Bowlay (1992) and Le Brocque and Benson (1995) note that this community type is highly disturbed throughout the Ashford sheet. Benson (1991) considers plant associations of inland watercourses as poorly conserved, however this assemblage appears to be reserved in a number of areas across the state (Specht *et al.* 1995). This community type is indeed generally widespread however the understorey-associated species vary widely across its range. Of particular note is the actual original extent of these assemblages. Generally

although representation of these communities are found in a number of reserves it is usually only as very small remnants that have previously been modified. Therefore the representation of this assemblage within reserves is inadequate considering their modified nature and the percentage of reserved area compared to its original extent.

Management considerations: Weed control is an important issue in regards to this community. Also this community is found nearby surrounding private holdings and hence fences will need to be maintained to keep stray cattle from entering. Fire trails should avoid these systems where possible and placement of camping grounds and other facilities should be kept to a minimum within these areas.

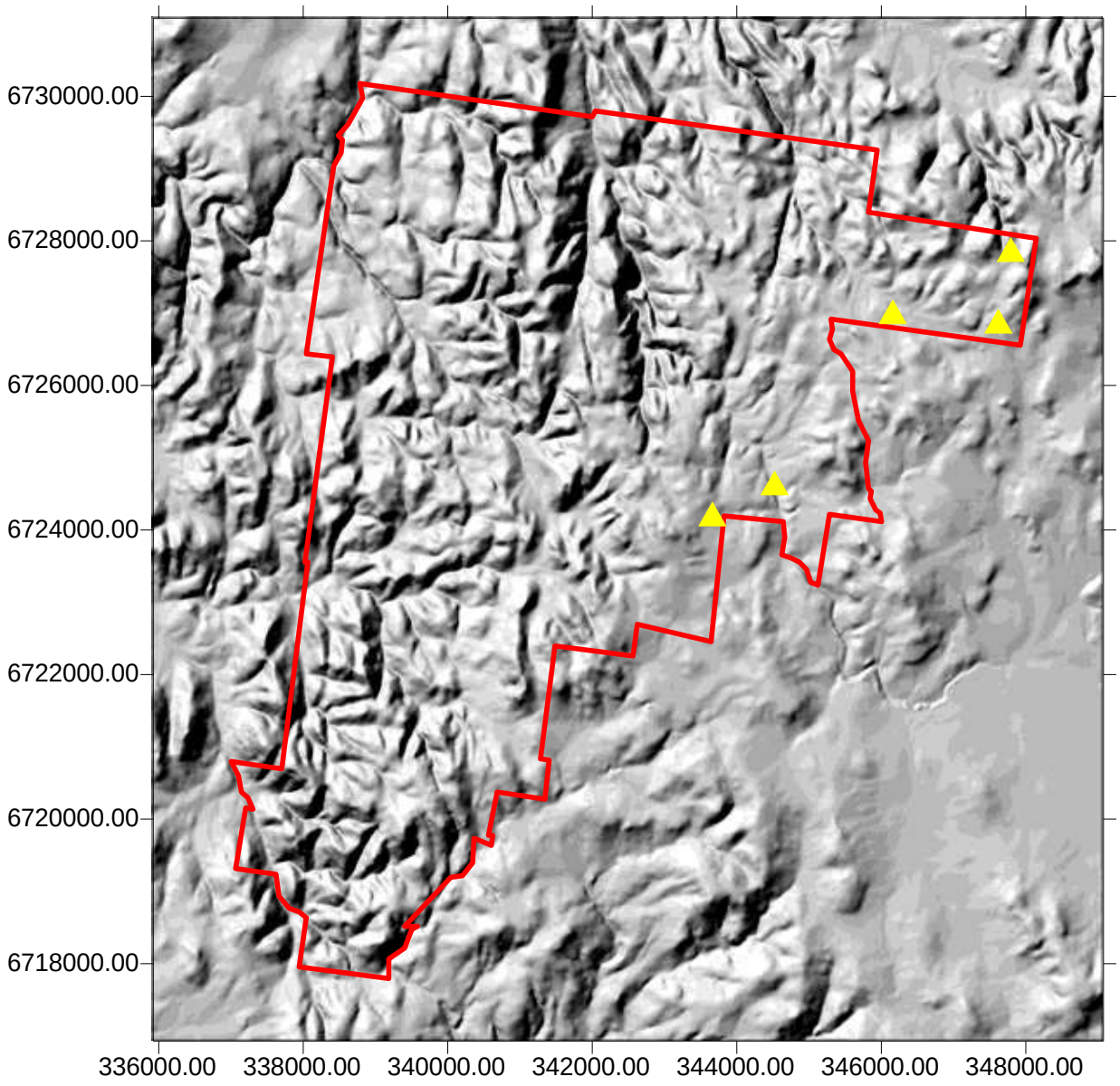

Figure 20: Placement of sites within Community 2.

Figure 21: Photographs of Community 2: Above Site 11; below Site 21.

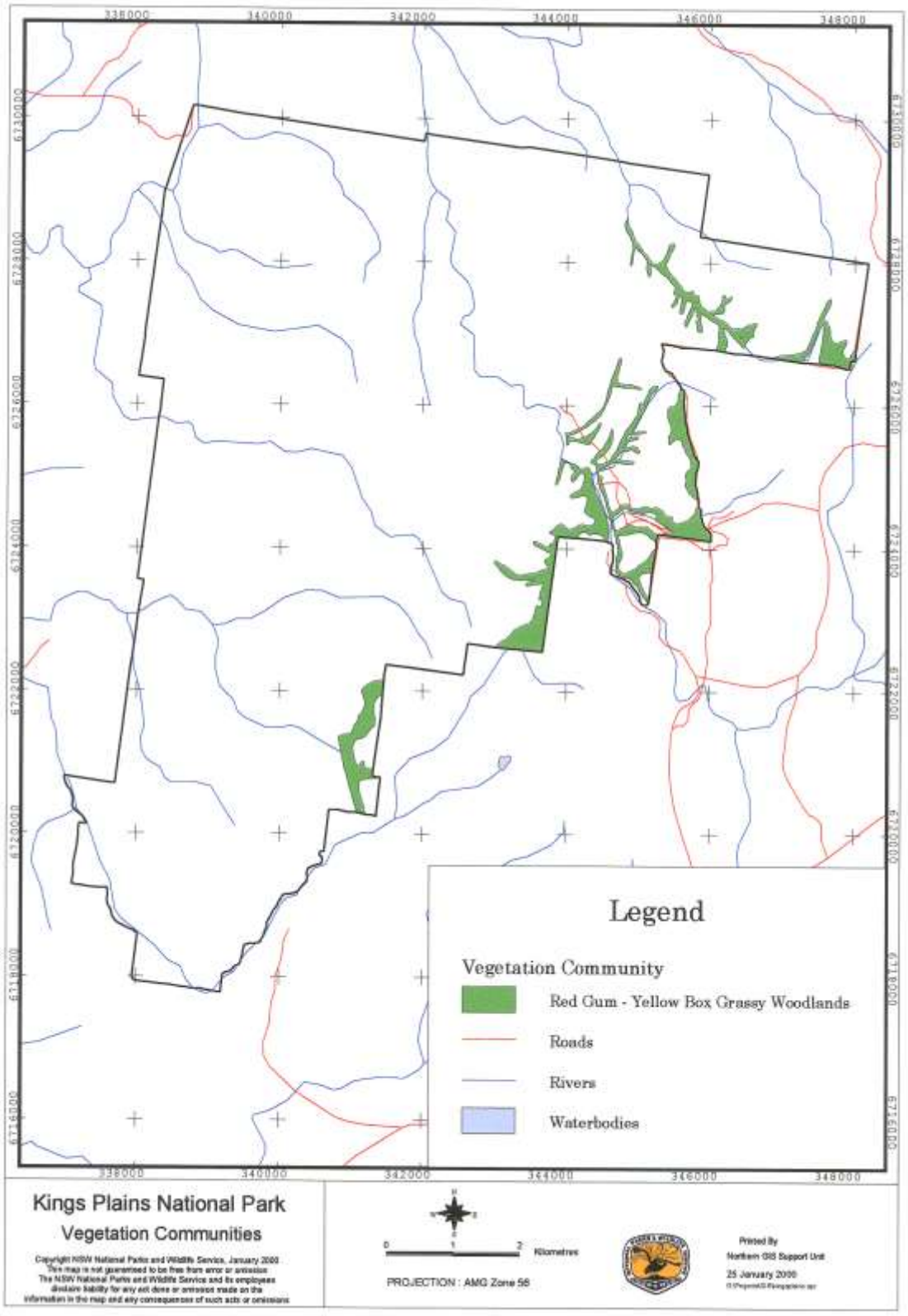

Figure 22: Distribution of Community 2.

3.5.3 Community 3: McKie's Stringybark - Blackbutt Open Forest

McKie's Stringybark (*Eucalyptus mckieana*) – Western New England Blackbutt (*Eucalyptus andrewsii*) – Black Cypress Pine (*Callitris endlicheri*).

Sample sites (3): 9, 10, 50.

Number of hectares: 31 **Proportion of reserves:** 0.4%.

Landform: Low lying areas on hill slopes and open depressions.

Distribution: Found entirely restricted to Lateritic soils on the eastern boundary fence of the reserve.

Structure: Upper 25-30 m tall; 40% cover. Middle shrub 5-15 m tall; 20-30% cover. Lower shrub 1-5 m tall; 30-40% cover. Ground to 1 m tall; 60-90% cover.

No. of taxa: 88 **No. of taxa per plot:** 48 av. (39-60).

Common natives: Listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Eucalyptus mckieana, Eucalyptus andrewsii, Callitris endlicheri, Eucalyptus melliodora, Eucalyptus stannicola, Eucalyptus crebra, Eucalyptus banksii, Angophora floribunda.*

Shrubs: *Acacia filicifolia, Leucopogon biflorus, Hibbertia obtusifolia, Leucopogon muticus, Myoporum montanum, Melichrus urceolatus, Leptospermum brevipes, Brachyloma daphnoides* subsp. *glabrum, Acacia neriifolia, Styphelia triflora, Pomaderris angustifolia, Monotoca scoparia, Indigofera australis, Hibbertia acicularis, Cassinia uncata, Acacia buxifolia, Persoonia cornifolia, Olearia elliptica, Lissanthe strigosa, Leucopogon lanceolatus.*

Climbers & trailers: *Glycine clandestina, Clematis glycinoides, Hardenbergia violacea, Desmodium varians.*

Ground cover: *Goodenia* sp. nov?*, Lepidosperma laterale, Viola betonicifolia, Microlaena stipoides, Imperata cylindrica, Gahnia aspera, Echinopogon caespitosus* subsp. *caespitosus, Vernonia cinerea, Lagenifera stipitata, Dichondra repens, Cheilanthes sieberi* subsp. *sieberi, Veronica calycina, Poranthera microphylla, Pomax umbellata, Hypericum gramineum, Galium gaudichaudii, Echinopogon ovatus, Digitaria breviglumis, Dianella revoluta, Calotis cuneifolia, Austrostipa rudis* subsp. *rudis, Austrodanthonia eriantha, Pteridium esculentum, Opercularia aspera, Hybanthus monopetalus, Euchiton sphaericus.*

Introduced taxa: *Cirsium vulgare, Viola odorata, Conyza bonariensis, Sonchus olearceus, Centaurium erythraea, Hypochaeris radicata, Taraxacum officinale, Conyza albida.*

Percent of species introduced: 9%.

Variability: Only a few hectares of this community are found within the reserve and as such little variation was noted. However, one area that had incursions of a number of frequent fires from neighboring properties had lost its shrubby understorey which was replaced by *Imperata cylindrica* (Blady Grass).

Condition: Poor. Only such a small amount of this community was found and this was associated with the boundary fence and a fire trail and as such the community is prone to gradual attrition and weed invasion.

Taxa of conservation importance: *Eucalyptus mckieana, Goodenia* sp. nov?, *Pomaderris angustifolia.*

Notes: This community is of limited extent and no comparable described assemblages could be found. A number of common species found in this community showed unusual morphological variation that in themselves do not warrant taxonomic recognition at this stage, however may be worthy of investigation. A number of species found further east or higher on the tablelands that were infrequent within the reserve were found in this community, for example *Pteridium esculentum, Leucopogon biflorus* and *Daviesia latifolium* etc.

Conservation status: As circumscribed here this community is unlike any others described for the region. This type of community is also known to occur south of Gilgai also on Lateritic soils and also on Clayton Chase on the southern Boundary of Severn River Nature Reserve. The community is of limited extent unreserved and many areas cleared completely in the Gilgai area and occurrences within Clayton Chase near Severn River NR have recently been impacted upon by selective logging. This assemblage is highly restricted and disjunct in its occurrence and extends only from Gilgai to the Severn River. It appears that only these few hectares within Kings Plains are the only place of reservation and this should be considered inadequate. This community should be considered for listing as an endangered community under the TSC Act and should be a priority for further acquisitions.

Management considerations: Listing of this community on the TSC Act should be considered. Incorporation of similar lands should be of a high priority. Weeds are at a reasonable high level within the this community and will need to be reduced. Fire

trails should avoid these very small remnants were possible. A targeted search for further areas containing this community within the reserve should be undertaken.

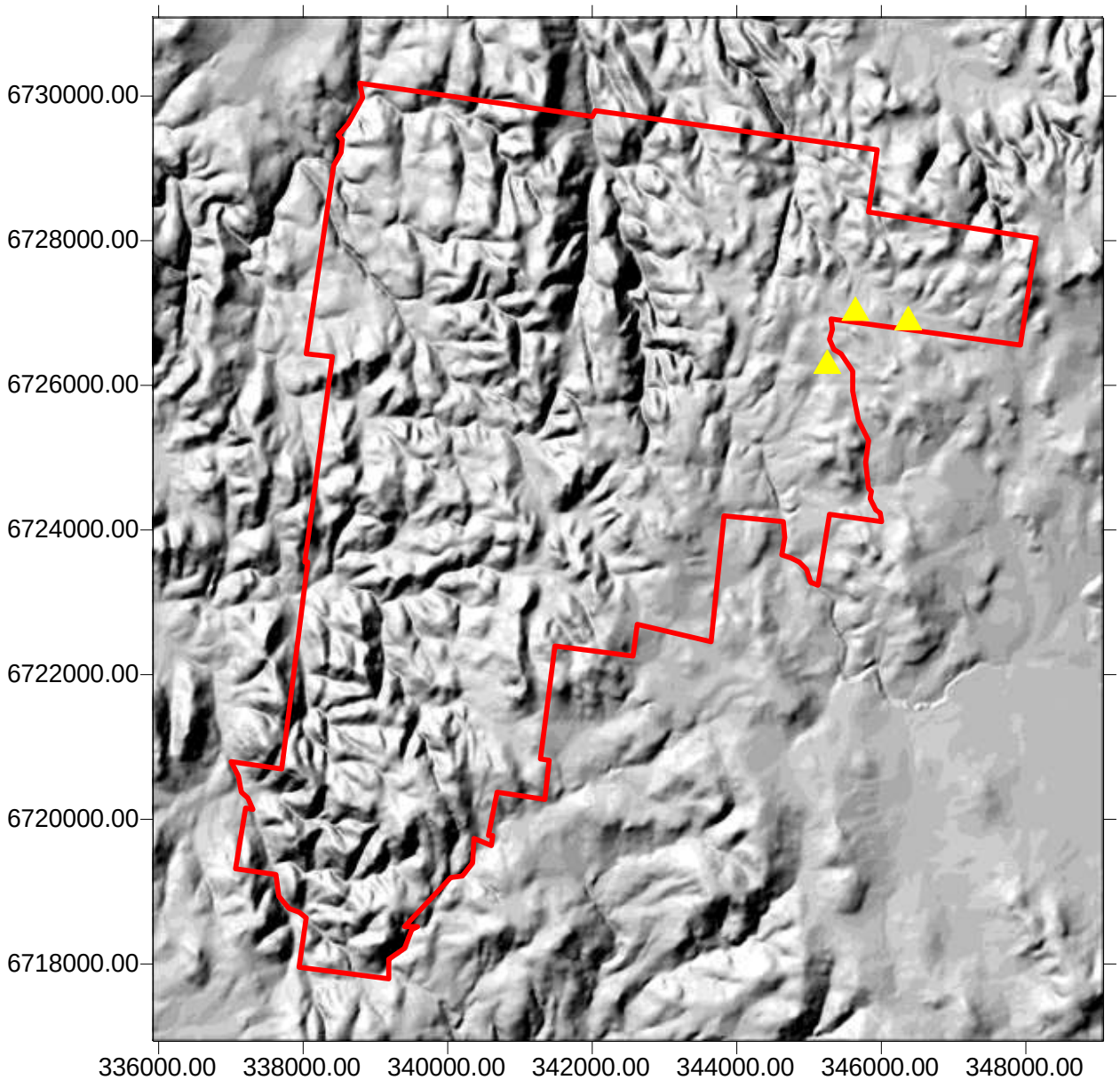

Figure 23: Placement of sites within Community 3.

Figure 24: Photographs of Community 3. Above Site 10; below Site 50.

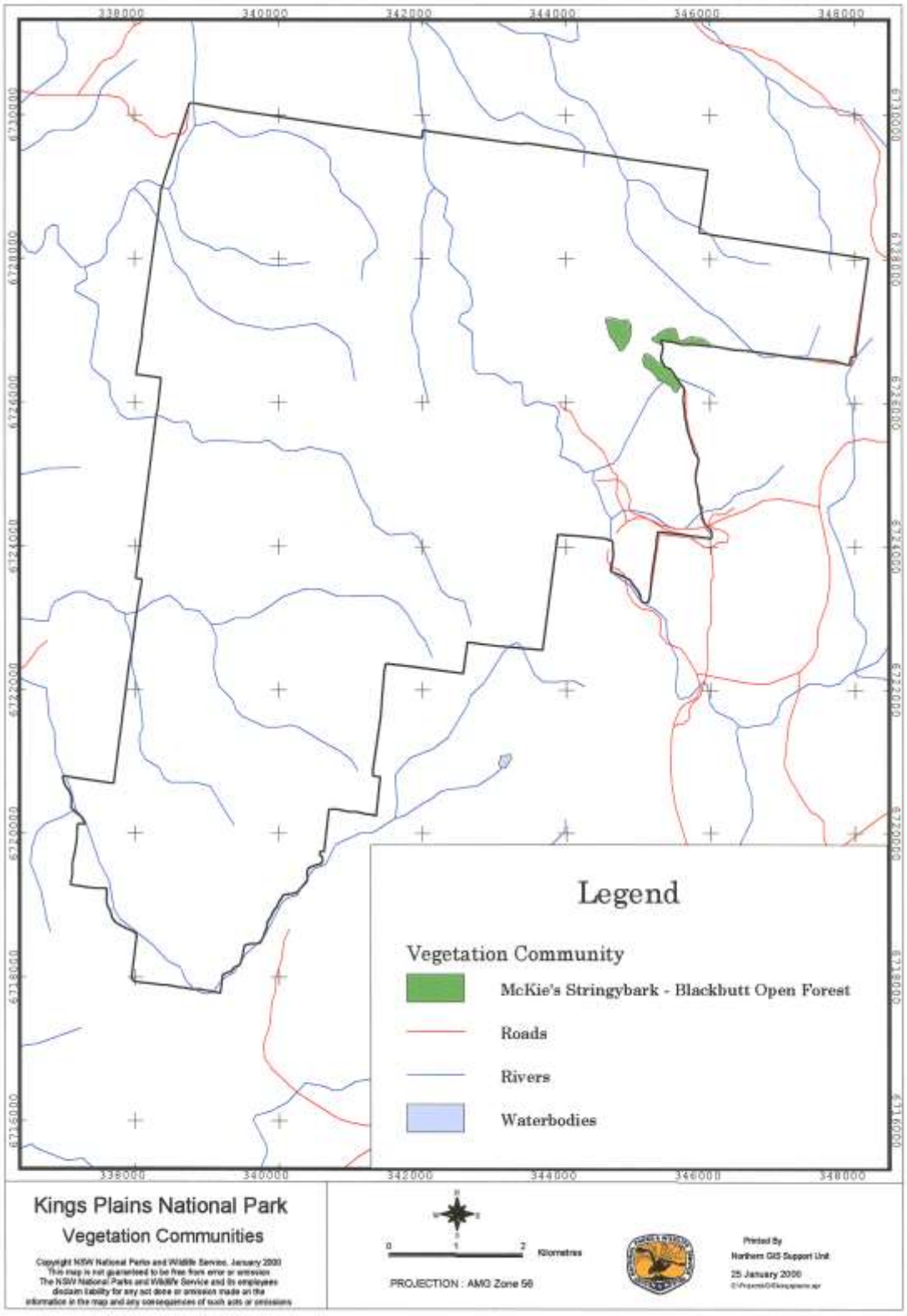

Figure 25: Distribution of Community 3.

3.5.4 Community 4: Red Stringybark – Ironbark Woodland

Red Stringybark (*Eucalyptus machrorhyncha*) – Narrow-leaved Ironbark (*Eucalyptus crebra*) – Tumbledown Gum (*Eucalyptus dealbata*).

Sample sites (8): 36, 37, 38, 39, 40, 41, 42, 43.

Number of hectares: 638 **Proportion of reserves:** 9.2%.

Landform: Hill slopes and open depressions at low altitudes (< 800 m).

Distribution: Found in the warmer low altitude areas commonly associated with deeper soils.

Structure: Upper 15-25 m tall; 20-40% cover. Upper middle 5-15 m tall; 10-60% cover, not always present. Lower middle 1-4 m tall; 10-70% cover, not always present. Ground to 1 m tall; 50-100% cover.

No. of taxa: 178 **No. of taxa per plot:** 57 av. (44-69).

Common natives: Listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Eucalyptus machrorhyncha, Callitris endlicheri, Eucalyptus crebra, Eucalyptus dealbata, Angophora floribunda, Eucalyptus caleyi* subsp. *caleyi, Eucalyptus melliodora, Casuarina cunninghamiana.*

Shrubs: *Olearia elliptica, Acacia neriifolia, Leucopogon muticus, Hibbertia obtusifolia, Bursaria spinosa* subsp. *obovata, Notelaea microcarpa, Leptospermum brevipes, Melichrus urceolatus, Xanthorrhoea johnsonii, Desmodium brachypodum, Cassinia uncata, Monotoca scoparia, Brachyloma daphnoides* subsp. *glabrum, Pomaderris angustifolia, Leptospermum brachyandrum, Grevillea triternata, Beyeria viscosa, Swainsona galegifolia, Callistemon sieberi.*

Climbers & trailers: *Desmodium varians, Glycine clandestina, Jasminum lineare. Parsonsia eucalyptophylla, Hardenbergia violacea.*

Ground cover: *Dichondra repens, Cheilanthes sieberi* subsp. *sieberi, Aristida ramosa, Echinopogon caespitosus* subsp. *caespitosus, Pomax umbellata, Austrostipa rudis* subsp. *rudis, Wahlenbergia luteola, Euchiton sphaericus, Austrodanthonia eriantha, Oxalis chnoodes, Veronica calycina, Hypericum gramineum, Vittadinia sulcata, Scutellaria humilis, Digitaria breviglumis, Plantago varia, Microlaena stipoides, Glossogyne tannensis, Arundinella nepalensis, Poranthera microphylla, Panicum simile, Geranium solanderi* subsp. *solanderi, Galium migrans, Fimbristylis*

dichotoma, Eragrostis elongata, Brachyscome nova-anglica, Sporobolus creber, Scleria mackaviensis, Daucus glochidiatus, Aristida vagans, Ajuga australis, Stackhousia viminea, Senecio diaschides, Rumex brownii, Poa sieberiana, Cymbonotus lawsonianus.

Introduced taxa: *Petrorhagia nanteuilii, Conyza albida, Centaurium erythraea, Hypochaeris radicata, Anagallis arvensis, Taraxacum officinale, Ciclospermum leptophyllum, Verbena rigida, Cirsium vulgare, Opuntia stricta, Gnaphalium coarctatum, Briza minor, Sonchus olearceus, Setaria gracilis, Medicago lupulina, Sigesbeckia orientalis, Senna occidentalis, Rosa rubiginosa, Plantago lanceolata, Pavonia hastata, Lepidium bonariense, Cerastium fontanum, Centaurea solstitialis, Aira cupaniana.*

Percent of species introduced: 14%.

Variability:

Condition: Mostly poor. This community in the majority within the reserve is associated within many of the lower altitude areas that have been either extensively cleared or selectively logged and certainly grazed heavily over a number of years. The number of weeds within this community is high and many of them are some of the worst weeds. Regeneration will need to occur within this area and *Leptospermum brevipes* may need to be controlled in some areas despite it being a native species. Much will need to be done particularly on the southern boundary of the reserve around the banks of Weean Creek.

Taxa of conservation importance: *Pomaderris angustifolia, Thesium australe, Solanum laciniatum, Phyllanthus subcrenulatus.*

Notes: Within this community was the only locality in which two *Eucalyptus moluccana* trees were found on a boundary fence associated with the incursion of a different soil type. Incorporation of more of these lands should be considered as a high priority despite their degraded nature. *Eucalyptus machrorhyncha* and *Eucalyptus crebra* are both very widespread species within eastern Australia. This assemblage as circumscribed here probably fits closest to published community descriptions in which *E. crebra* is the diagnostic species despite it being a subordinate in here. The *Eucalyptus crebra* alliance of Beadle (1981) occurs from north Queensland to southern New South Wales. Despite the widespread nature all the dominant species this association is likely to be restricted to the western parts of the tablelands and the north western slopes from Stanthorpe in Queensland south to

Watsons Creek Nature Reserve north of Bendemeer and west possibly as far as the Pilliga region. Other *E. crebra* associations are described for the general vicinity however these are clearly distinct and occur on 'better' quality soils and are often associated with *E. albens* or *E. moluccana*.

Conservation status: This community is likely to be a variant of much more widespread alliances that cross over at these intermediate elevations on the west of the tablelands. The most likely synonymous community described by Specht *et al.* (1995) would be the *E. crebra*, *E. dealbata* and *Callitris glaucophylla* communities that are thought to occur in a number of reserves including Mt Kaputar NP, Girraween NP, Sundown NP, Warrabah NP, Severn River NR, Watsons Ck NR, Ironbark NR and the Basin NR. It is likely that although many areas containing this assemblage have been extensively modified or selectively logged many substantial areas are represented in reserves across the communities natural range and thus this community could be considered as adequately reserved.

Management considerations: Significant areas around Weean Creek will need active regeneration and continual weed control. The dominance of *Leptospermum brevipes* in regeneration areas will need to be closely watched. Erosion is occurring on some areas on the banks of Weean Creek and control measures will need to be put into place to prevent further erosion occurring. A search of this southern region of the new acquisitions may need to occur to judge the full extent of past clearing and the effects of subsequent regeneration.

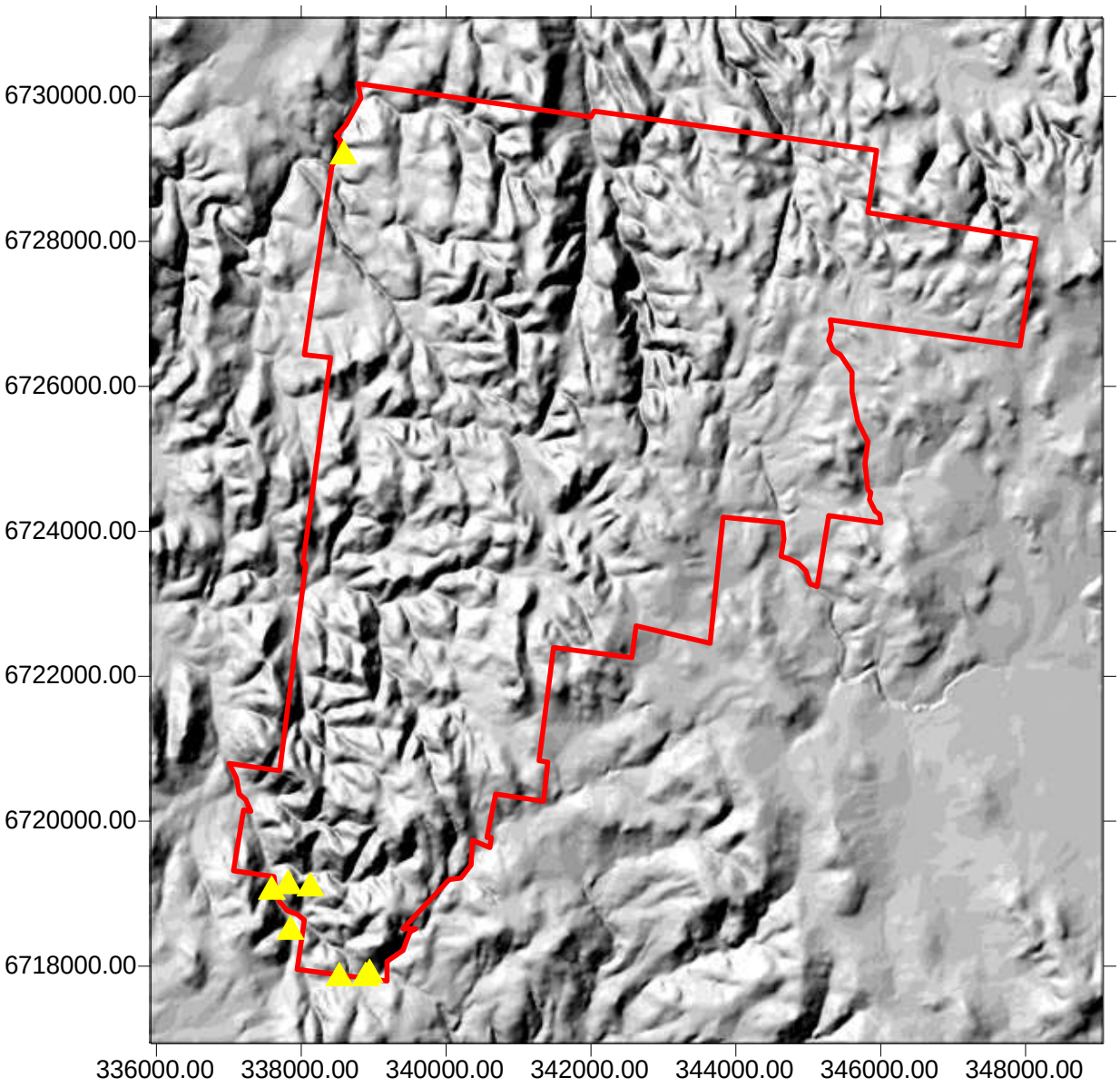

Figure 26: Placement of sites within Community 4.

Figure 27: Photographs of Community 4. Above Site 42; below Site 43.

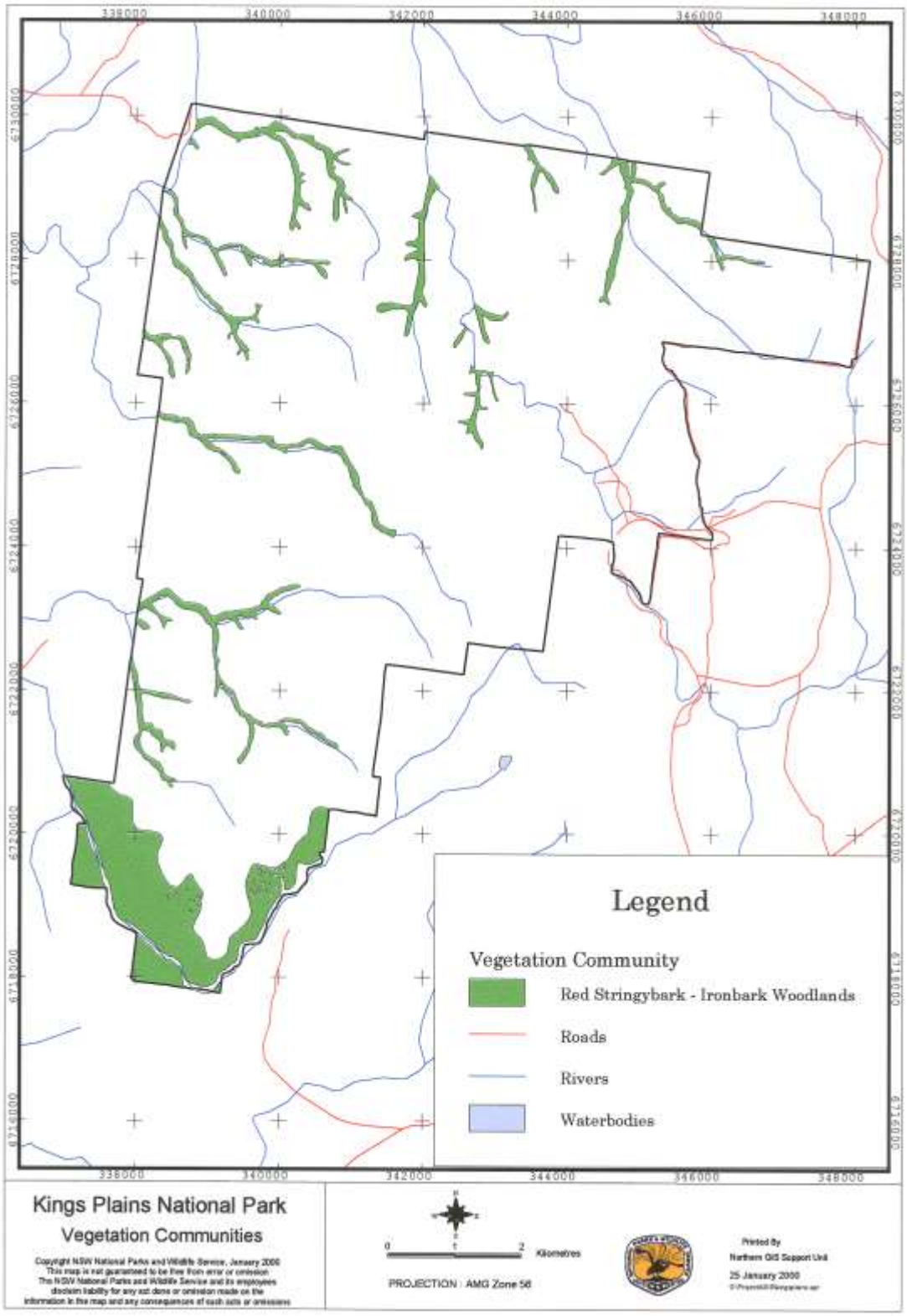

Figure 28: Distribution of Community 4.

3.5.5 Community 5: Orange Gum – Ironbark Shrubby Open Woodlands

Orange Gum (*Eucalyptus prava*) – Caley's Ironbark (*Eucalyptus caleyi* subsp. *caleyi*) –Red Stringybark (*Eucalyptus machrorhyncha*).

Sample sites (9): 12, 14, 15, 16, 17, 22, 23, 34, 35.

Number of hectares: 672 **Proportion of reserves:** 9.6%.

Landform: Restricted to exposed crest and hill slopes on shallow soils associated with the margins of rock outcrops or fugitive outcrops.

Distribution: Common throughout most of the reserve.

Structure: Highly variable. Upper 5-15 (-25) m tall; 5-10 (-30)% cover. Upper middle 2-5 m tall; 10-60% cover, not always present. Lower middle 1-2 m tall; 10-90% cover. Ground to 1 m tall; 20-80% cover.

No. of taxa: 147 **No. of taxa per plot:** 46 av. (37-67).

Common natives: Listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Eucalyptus prava, Eucalyptus caleyi* subsp. *caleyi, Eucalyptus machrorhyncha, Allocasuarina inophloia, Callitris endlicheri, Eucalyptus andrewsii, Eucalyptus dealbata, Eucalyptus banksii.*

Shrubs: *Leptospermum novae-angliae, Allocasuarina brachystachya, Persoonia cornifolia, Xanthorrhoea johnsonii, Calytrix tetragona, Melichrus urceolatus, Dampiera lanceolata, Monotoca scoparia, Hibbertia riparia, Hakea dactyloides, Acacia penninervis, Grevillea triternata, Styphelia triflora, Lissanthe strigosa, Kunzea obovata, Isopogon petiolaris, Acacia ulicifolia, Pultenaea stuartiana, Prostanthera saxicola, Phyllanthus occidentalis, Mirbelia speciosa* var. *speciosa, Leucopogon virgatus, Leucopogon muticus, Callistemon pungens, Boronia rubiginosa, Babingtonia densifolia, Cryptandra amara* var. *amara, Brachyloma daphnoides* subsp. *glabrum, Acacia neriifolia, Acacia buxifolia, Olax stricta, Leionema rotundifolium, Hibbertia acicularis.*

Climbers & trailers: *Cassytha filiformis, Hardenbergia violacea.*

Ground cover: *Entolasia stricta, Goodenia bellidifolia* subsp. *argentea, Dianella caerulea* subsp. *caerulea, Platysace ericoides, Trachymene incisa, Pomax umbellata, Aristida acuta, Lepidosperma laterale, Austrodanthonia eriantha, Laxmannia compacta, Schoenus apogon, Goodenia hederacea* subsp. *hederacea, Rhytidosporum*

procumbens, Lomandra filiformis, Microlaena stipoides, Lomandra multiflora, Lepidosperma viscidum, Gonocarpus tetragynus, Wahlenbergia luteola, Tripogon loliiformis, Themeda triandra, Aristida vagans.

Introduced taxa: *Hypochaeris radicata.*

Percent of species introduced: 0.1%.

Variability: This community is widespread throughout the reserve. The community is internally quite variable depending on the depth soil and the protection of the sites. Small changes in either of these conditions can change which species are dominant both in the over and understoreys. This community grades into both Community 8 and also Community 1.

Condition: Very good. Virtually no weeds are seen in this assemblage and past management practices within the region have impacted little on this community. Goats do graze within this community but this does not appear to have significant impact within the reserve.

Taxa of conservation importance: *Allocasuarina brachystachya, Aristida acuta, Callistemon pungens, Lepidosperma viscidum, Leionema rotundifolium, Olearia gravis, Astrotricha roddii, Actinotus gibbonsii, Acacia torringtonensis, Allocasuarina gracilis, Homoranthus biflorus, Leptospermum divaricatum, Cryptandra scortichenii, Boronia granitica, Olearia rosmarinifolia, Cheiranthera cyanea* subsp. *borealis.*

Notes: The distinction between this community and Community 8 may be hard to define in many situations. Similar assemblages are known to occur as far south as Watsons Creek and north to Sundown National Park and west to Mt Kaputar National Park. However in the strictest sense this community is probably restricted to rhyolitic shallow soils from Tingha to Severn River.

Conservation status: This community both in broad and narrow circumscription should be considered well reserved. This community occurs prominently on country that is rough and of little use for most other purposes and as such has been set aside within reserves. Apart from Community 8 this community has the highest concentration of rare species within the reserve. This and somewhat synonymous assemblages are reserved on rhyolitic rock types within Severn River Nature Reserve and Sundown National Park and in the broader sense on granite within Torrington SRA, Ironbark NR, the Basin NR, Watsons Ck NR, Warrabah NP, Girraween NP and Mt Kaputar NP. As such this community should be considered as well reserved across its range.

Management considerations: This community is little disturbed and widespread throughout the reserve including many parts of the parks interior. Many rare species are known to occur within this community and as such fire regimes will need to be carefully implemented. Goats will need to be controlled within the park.

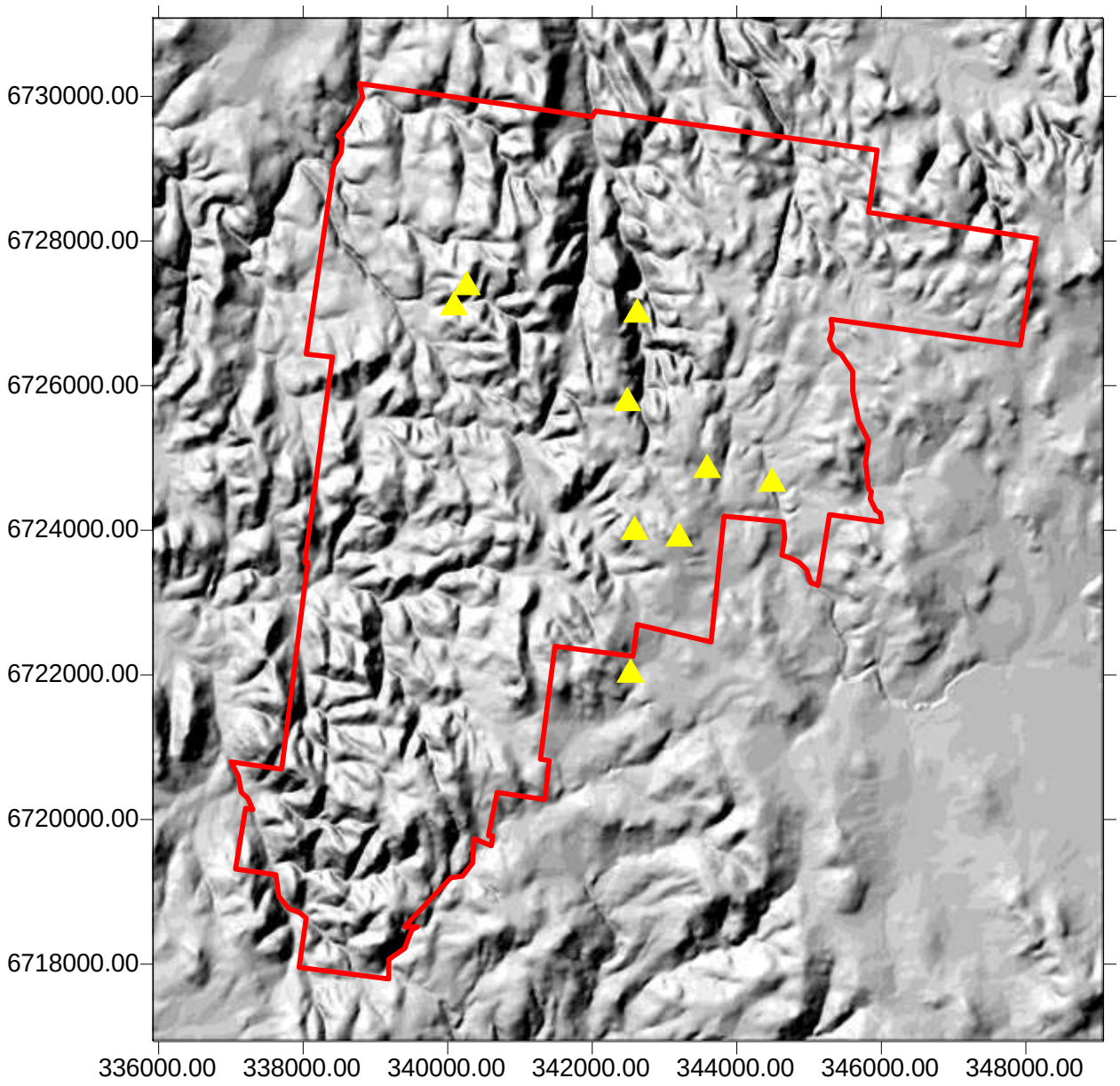

Figure 29: Placement of sites within Community 5.

Figure 30: Photographs of Community 5. Above Site 14; below Site 34.

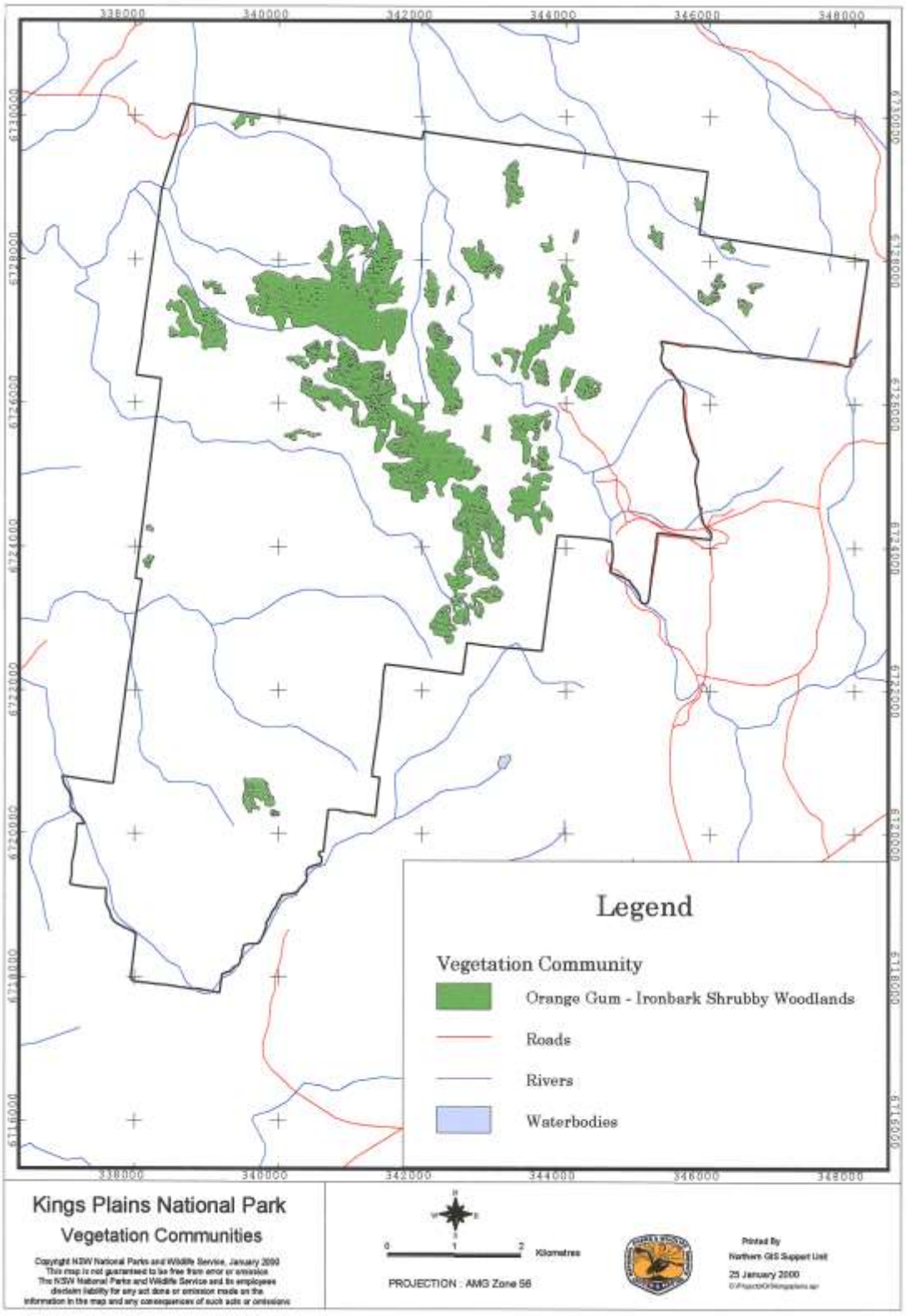

Figure 31: Distribution of Community 5.

3.5.6 Community 6: Apple – River Oak Riparian Open Woodlands

Rough-barked Apple (*Angophora floribunda*) – Tenterfield Woolly-butt (*Eucalyptus banksii*) – River Oak (*Casuarina cunninghamiana*).

Sample sites (5): 18, 19, 28, 47, 48.

Number of hectares: 120 **Proportion of reserves:** 1.7%.

Landform: Open depressions along creek banks.

Distribution: Restricted to the margins of major creek banks on alluvial soils.

Structure: Upper 15-20 m tall; 10-30% cover. Middle 1-4 m tall; 10-20% cover. Ground to 1 m tall; 10-60% cover..

No. of taxa: 154 **No. of taxa per plot:** 55 av. (49-69).

Common natives: Listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Angophora floribunda, Callitris endlicheri, Eucalyptus banksii, Casuarina cunninghamiana, Eucalyptus blakelyi, Eucalyptus dealbata, Brachychiton populneus.*

Shrubs: *Notelaea microcarpa, Indigofera adesmiifolia, Lespedeza juncea* subsp. *sericea, Geranium solanderi* subsp. *solanderi, Callistemon viminalis, Xanthorrhoea johnsonii, Bursaria spinosa* subsp. *obovata, Westringia longifolia, Pomaderris angustifolia, Leptospermum brachyandrum, Desmodium brachypodum, Callistemon sieberi, Beyeria viscosa, Acacia viscidula, Acacia neriifolia.*

Climbers & trailers: *Desmodium varians, Rubus parvifolius, Glycine clandestina, Pandorea pandorana, Kennedia rubicunda, Jasminum lineare.*

Ground cover: *Lomandra longifolia, Imperata cylindrica, Arundinella nepalensis, Geranium solanderi* subsp. *solanderi, Acaena nova-zelandiae, Cymbopogon refractus, Juncus remotiflorus, Bothriochloa decipiens, Wahlenbergia luteola, Hydrocotyle tripartita, Eleocharis sphacelata, Cyperus bifax, Asperula conferta, Ajuga australis, Themeda triandra, Poa sieberiana, Picris hieracioides, Paspalum distichum, Lythrum salicaria, Hydrocotyle laxiflora, Cyperus flavidus, Vittadinia sulcata, Vittadinia cuneata, Viola betonicifolia, Senecio quadridentatus, Senecio diaschides, Persicaria decipiens, Mentha satureioides, Euchiton sphaericus, Dichondra repens, Dichelachne inaequiglumis, Craspedia variabilis, Alternanthera denticulata.*

Introduced taxa: *Verbena rigida, Conyza albida, Ciclospermum leptophyllum, Setaria gracilis, Plantago lanceolata, Medicago lupulina, Gladiolus carneus, Conyza bonariensis, Petrorhagia nanteuilii, Hypochaeris radicata, Cirsium vulgare, Centaurium erythraea, Centaurea solstitialis, Vulpia bromoides, Trifolium repens, Rumex crispus, Rosa rubiginosa, Verbena hispida, Taraxacum officinale, Gratiola peruviana, Axinopus affinis, Anagallis arvensis, Xanthium spinosum, Sonchus olearceus, Senna occidentalis, Rubus chloocladus, Hyparrhenia hirta, Gomphocarpus fruticosus, Aira cupaniana.*

Percent of species introduced: 19%.

Variability: .

Condition: Generally poor. This community has been disturbed greatly in many areas of the park. In particular alluvial sapphire mining of Kings Plains Creek has severely modified this community. There is a very high incidence of weeds, many of which are very invasive and or noxious. Some clearing has also occurred within this community in the past along with grazing.

Taxa of conservation importance: *Thesium australe, Pomaderris angustifolia, Cheiranthera cyanea* subsp. *borealis, Phyllanthus subcrenulatus, Kennedia rubicunda, Callistemon pungens.*

Notes: *Angophora floribunda* and *Casuarina cunninghamiana* riparian communities are widespread throughout New South Wales. Beadle (1981) states that *Casuarina cunninghamiana* communities fringing creeks and rivers are common from southern New South Wales to Cape Yorke and even to Arnhem Land. However, there are no regular associated species. It appears that although riverine communities similar to Community 13 occur throughout the north-east at least they have been rarely sampled or described. As the riparian community is described here there appears to be no synonymous entities in the literature. *Eucalyptus banksii* fringing riparian communities such as is seen at Kings Plains occurs in a narrow band along the western margin of the Tablelands from around Howell near Copeton Dam to as far north as Girraween National Park. Further to the south or higher on the tablelands *E. banksii* is replaced by *E. bridgesiana* and or *E. nova-anglica*. This community intergrades with Community 2.

Conservation status: This community probably occurs throughout the western side of the Tablelands from at least Howell to the Queensland border. It is greatly disturbed across its range. What is known within reserves is a very small percentage

of the communities coverage and usually highly disturbed also. This community should be considered as poorly conserved across its range and much that is reserved as of poor quality. These systems should be a priority for further inclusion into the reserve network.

Management considerations: Weed eradication in this community is of a high priority. In addition some areas may warrant some re-vegetation and creek bank stabilization particularly on the eastern boundary of the reserve. The community is linear with a large edge to area ratio. Most of the campsites along Kings Plains Ck are within this restricted and highly disturbed community.

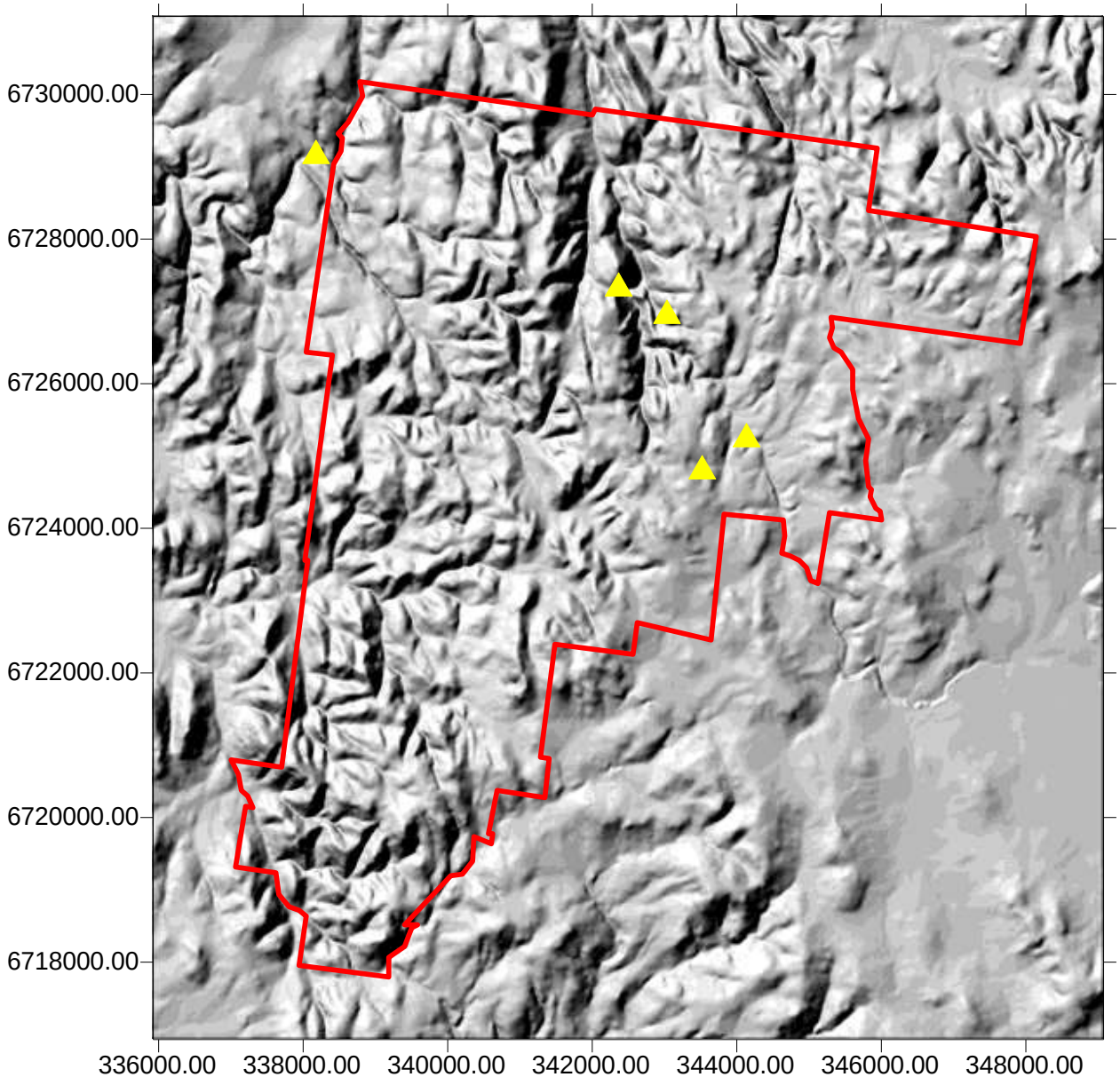

Figure 32: Placement of sites within Community 6.

Figure 33: Photographs of Community 5. Above Site 28; below Site 47.

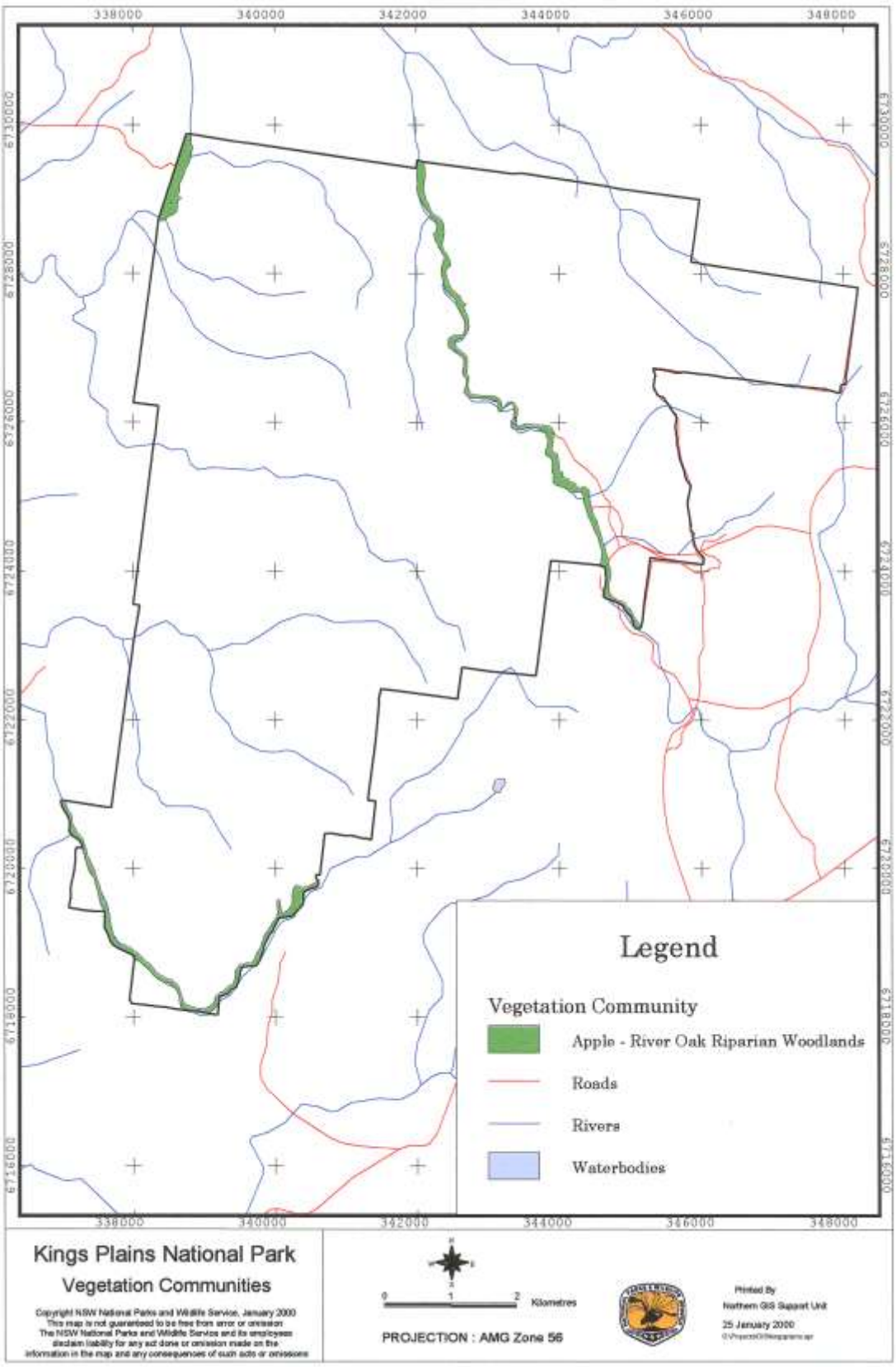

Figure 34: Distribution of Community 6.

3.5.7 Community 7: Grassy White Box Woodlands

White Box (*Eucalyptus albens*)

Sample sites (2): 44, 45.

Number of hectares: 24 **Proportion of reserves:** 0.3%.

Landform: Hill slopes with basalt soils.

Distribution: Restricted to a very small patch of basalt inclusion on the eastern boundary of the reserve.

Structure: Upper 15-25 m tall; 30-40% cover. Middle 3-8 m tall; 10% cover. Ground to 1 m tall; 60-80% cover.

No. of taxa: 63 **No. of taxa per plot:** 43 av. (36-49).

Common natives: Listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Eucalyptus albens, Callitris endlicheri, Eucalyptus viminalis, Angophora floribunda, Eucalyptus melliodora.*

Shrubs: *Acacia leiocalyx, Lespedeza juncea, Pultenaea* sp. C, *Dillwynia sieberi, Olearia viscidula, Olearia elliptica, Notelaea microcarpa, Acacia penninervis.*

Climbers & trailers: *Desmodium varians, Glycine clandestina.*

Ground cover: *Poa sieberiana, Chamaesyce dallachyana, Wahlenbergia stricta* subsp. *stricta, Plantago varia, Dichondra repens, Dichelachne inaequiglumis, Daucus glochidiatus, Bothriochloa biloba, Asperula conferta, Veronica calycina, Senecio quadridentatus, Schoenus apogon, Phyllanthus virgatus, Dianella caerulea* subsp. *caerulea, Cymbonotus lawsonianus, Austrodanthonia eriantha, Ajuga australis, Vittadinia cuneata, Viola betonicifolia, Sorghum leiocladum, Senecio diaschides, Picris hieracioides, Lomandra multiflora, Lagenifera stipitata, Echinopogon caespitosus* subsp. *caespitosus.*

Introduced taxa: *Taraxacum officinale, Rosa rubiginosa, Cirsium vulgare, Verbena hispida, Sonchus olearceus, Centaurium erythraea, Petrorhagia nanteuilii, Medicago lupulina, Gomphocarpus fruticosus, Conyza albida, Bidens pilosa.*

Percent of species introduced: 18%.

Variability: Very little variability is noticeable as only such a small amount of this community occurs within the reserve.

Condition: Reasonable, however the number of weeds is exceptionally high compared to all but Community 6 within the reserve. Furthermore much of the area has suffered from partial clearing and subsequent recent regrowth. The condition of this remnant would be much improved if weeds were controlled and more of this Community was incorporated within the reserve.

Taxa of conservation importance: *Eucalyptus albens, Bothriochloa biloba, Emilia sonchifolia.*

Notes: The association as it exists at Kings Plains is probably restricted to the upper Peel and Gwydir Valleys (Prober 1996). Le Brocque and Benson (1995) did not record *E. albens* in their survey of the Ashford sheet but did record the often associated *E. moluccana*. Beadle (1981) describes *E. albens* as being particularly common on soils with a high base status particularly in calcium and generally of high fertility. This community was not recognised as occurring within the proposed reserve in Roberts (1977) initial survey.

Conservation status: Box woodlands are one of the most poorly conserved ecosystems in Australia (Benson 1991; Sivertsen 1993; Prober 1996; LWRRDC 1997) and are highly vulnerable or endangered in agricultural lands. Benson (1991) highlights Box woodlands on the western slopes as a priority for reservation. The current reserve network within Box woodlands is not representative of natural variation (Prober 1996). Prober & Theile (1993) and Prober (1996) state that remnants of much less quality than this (i.e. traveling stock reserves) are in need of urgent protection and reservation. This type of Box community is likely to be unreserved (see Specht *et al.* 1995 for known reserved areas of other Box combinations in NSW). Grassy White Box Woodlands have recently been listed on the TSC Act as an Endangered Ecological Community and hence the occurrence of this community no matter how small is of particular conservation significance.

Management considerations: Only a very small amount of this community (?20 ha) was found within the reserve. This community abuts sharply a very cleared neighboring property and as such this is a very small and isolated remnant. This community is not only endangered on a state basis but is the most restricted community defined within the reserve. The boundary fence in this section must be maintained to a high standard and stray cattle removed. Further incorporation of similar remnants would probably be of the highest imperative considering the status of the other communities within the reserve. Care must be taken with any works that

are to occur nearby this remnant and in particular upgrading of fences should not impinge or cause further gradual attrition of this very small community. There is a very high level of introduced species within this community and active management to control these weeds is needed. Much of the problem in terms of weeds is likely to be due to the very large edge to area ratio with the neighboring cleared lands that abut this community.

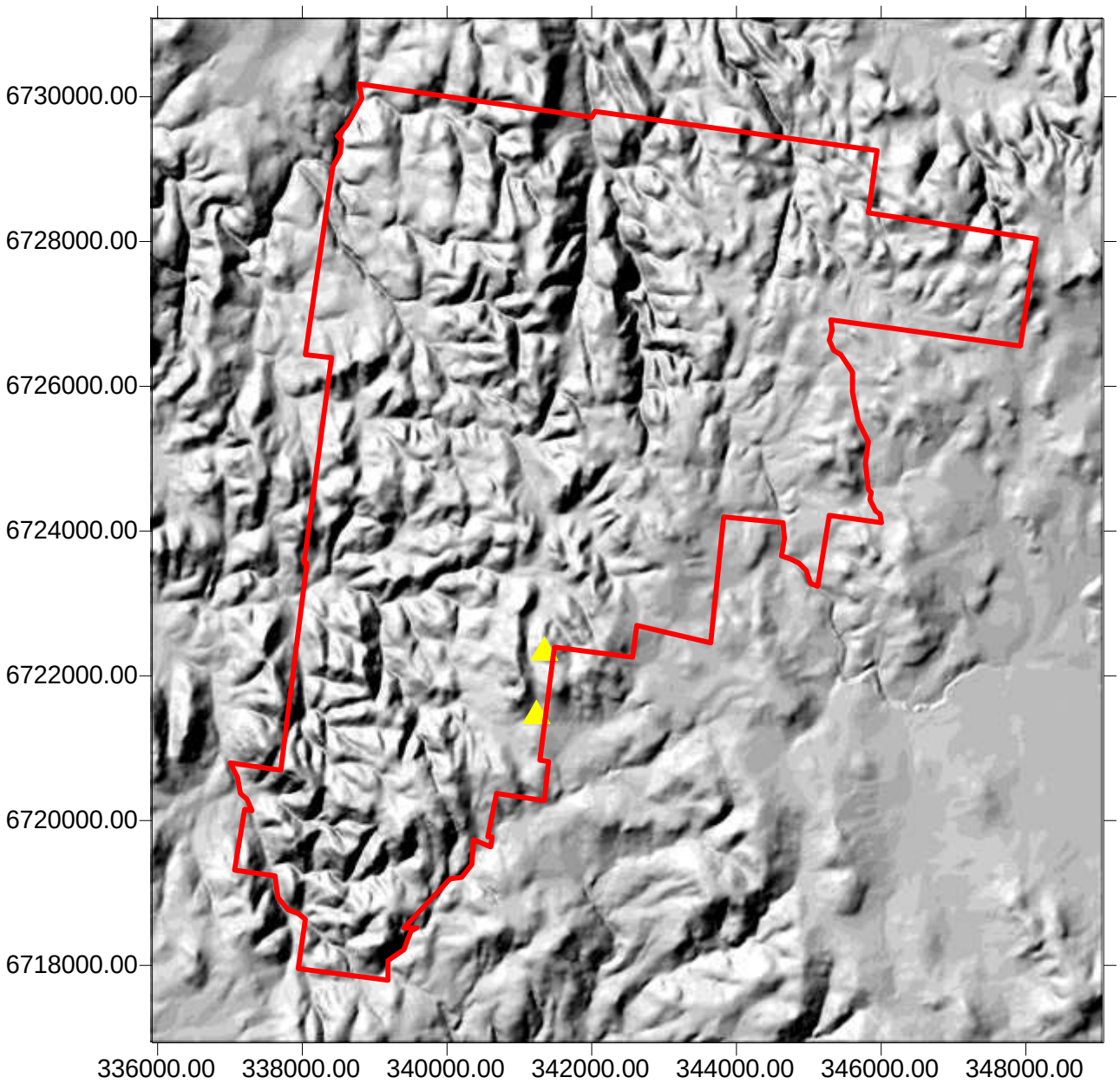

Figure 35: Placement of sites within Community 7.

Figure 36: Photograph of Community 7. Site 44.

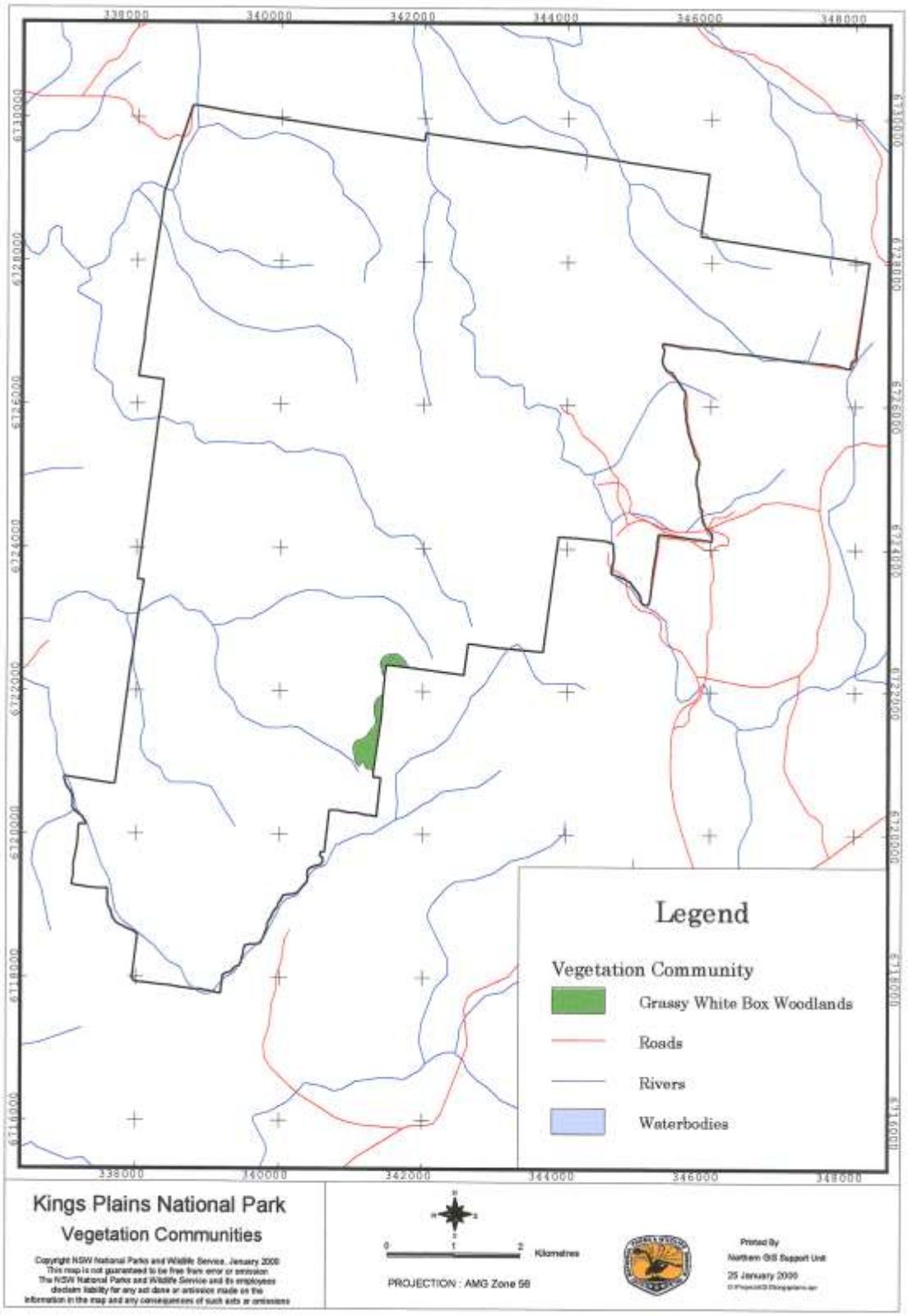

Figure 37: Distribution of Community 7.

3.5.8 Community 8: Severn Shrublands

Fringe Myrtle (*Calytrix tetragona*) – New England Tea-tree (*Leptospermum novae-angliae*).

Sample sites (12): Formally published by Hunter & Clarke (1998).

Number of hectares: 250 **Proportion of reserves:** 3.6%.

Landform: Exposed rock outcrops with skeletal soils.

Distribution: Throughout the entire reserve in small and very disjunct occurrences.

Structure: Upper 5-15 m tall; 0-10% cover. Ground 0.5-2.5 m tall; 20-90% cover.

No. of taxa: 109 **No. of taxa per plot:** 44 av. (33-47).

Common natives: Listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Eucalyptus prava, Callitris endlicheri, Eucalyptus caleyi* subsp. *caleyi, Eucalyptus mckieana.*

Shrubs: *Leucopogon neo-anglicus, Calytrix tetragona, Leptospermum nova-angliae, Melichrus urceolatus, Cryptandra amara* subsp. *floribunda, Allocasuarina brachystachya, Homoranthus biflorus, Xanthorrhoea johnsonii Leucopogon attenuatus, Hibbertia riparia, Prostanthera saxicola, Persoonia cornifolia, Kunzea parvifolia, Mirbelia speciosa* var. *speciosa, Acacia williamsiana, Grevillea triternata, Boronia granitica, Acacia torringtonensis, Leionema rotundifolium, Allocasuarina gymnanthera, Dampiera lanceolata, Leptospermum brevipes, Isopogon petiolaris, Babingtonia densifolia, Astrotricha roddii, Prostanthera nivea, Hakea dactyloides.*

Climbers & trailers: *Cassytha globella.*

Ground cover: *Tripogon loliiformis, Aristida jerichoensis* subsp. *subspinulifera, Lepidosperma laterale, Laxmannia compacta, Cheilanthes sieberi* subsp. *sieberi, Entolasia stricta, Trachymene incisa, Digitaria breviglumis, Austrodanthonia bipartite, Fimbristylis dichotoma, Wahlenbergia luteola, Goodenia bellidifolia* subsp. *argentea, Lobelia gracilis, Paspalidium constrictum, Cyperus fulvus, Isotoma axillaris, Hybanthus monopetalus, Gonocarpus teucrioides, Cymbopogon refractus, Dianella revoluta, Lomandra multlfora, Pomax umbellata, Platysace ericoides, Hypericum gramineum, Brachyscome stuartii..*

Introduced taxa: *Hypochaeris radicata.*

Percent of species introduced: 1%.

Variability: Highly stochastic. The small population sizes and the harsh environment afforded by this rock outcrop habitat necessarily means that even adjacent occurrences are likely to contain very different species assemblages (Hunter 1999). Although a few species may be dominant in most situations they may inexplicably be missing from nearby sites.

Condition: Very good. This community is very intact with very minimal weed invasion. Goats are not in high numbers and visitor activity at present is relatively low. If kept at the present condition this community is secure and should not degrade.

Taxa of conservation importance: *Allocasuarina brachystachya, Homoranthus biflorus, Acacia williamsiana, Boronia granitica, Leionema rotundifolium, Acacia torringtonensis, Allocasuarina gymnanthera, Astrotricha roddii, Hibbertia* sp. B, *Callistemon pungens, Eucalyptus mckieana, Olearia gravis.*

Notes: Roberts (1977) in his original survey of the proposed park included this community under Open Heaths. The community has been circumscribed based on a region wide analysis of outcrop communities in the New England. This analysis has shown that in the broadest sense this community has affinities with rock outcrops at Bolivia Hill, Torrington and the Mt McKenzie (Eagle Creek) area west of Tenterfield. However in the strict sense this community is known only from the rhyolitic areas west of Glen Innes that are presently incorporated in Kings Plains NP, Severn River NR and the areas in between.

Conservation status: This community is very restricted in its distribution and is of small isolated and disjunct patches. It is also the richest in rare and threatened species and includes 4 TSC Act species. Despite the small overall coverage of this community, it is clearly well reserved both in terms of broad and narrow circumscription across its known range. In *sensu lato* terms all major areas of the community are reserved in Bolivia Hill NR, Torrington SRA and in the *sensu stricto* sense within Kings Plains NP and Severn River NR. Despite this Hunter (1999) has shown that due to the very stochastic nature of species occurrences within this community any addition to the reserve network is likely to incorporate significant new records. In summary this community is now well reserved but new additions may still be fruitful.

Management considerations: Community 8 is a fragile environment that may be severely impacted upon by walking traffic. Plants are known to die due to soil compaction and an increase in nutrients due to organic rubbish. Trials should avoid

this community where possible or skirt around them in necessary. Appropriate fire regimes for this community is likely to be of high importance as most of the species are obligate seeders that are potentially frequent fire avoiders. Hence research into the dynamics of this community in terms of fire and general recruitment is necessary. Some 'fire ephemeral' species were noted to occur within this community after small lighning strike fires such as *Actinotus gibbonsii*. Throughout the north east of New South Wales deaths appear to have occurred across the range of outcrop communities both in places like Kings Plains and also down on the New South Wales coast. Such changes in community dynamics have been attributed to the end of the El Nino and subsequent higher than average rainfalls in 1997-8 by Andrew Benwell (*pers. comm.*). It is likely that this may indeed be the case and that these communities may have long-term climate driven processes that aid in the reshuffling of dominant species. Casual monitoring of such changes and written record may give insight in years to come of such processes and their implications.

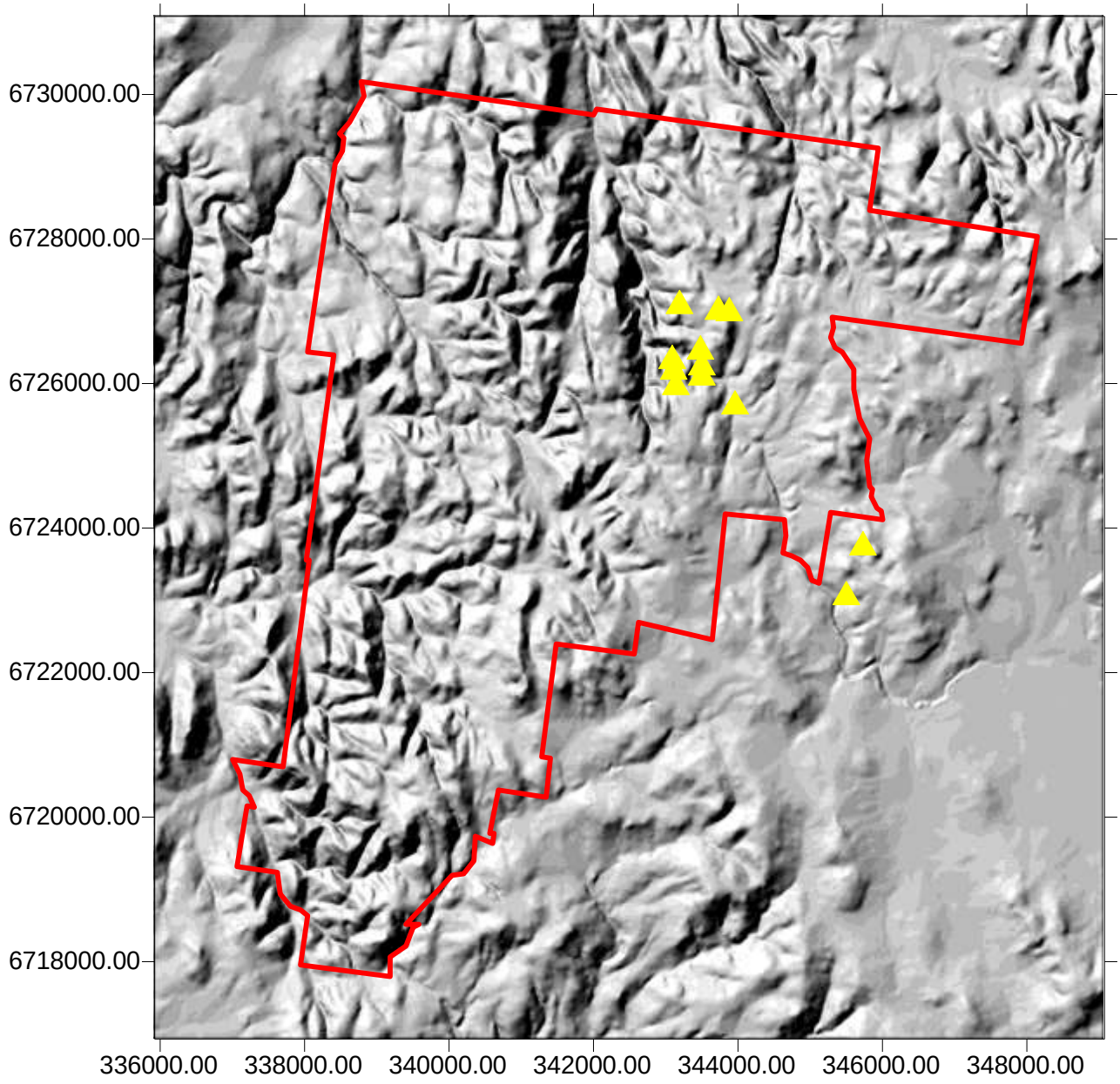

Figure 38: Placement of sites within Community 8.

Figure 39: Photographs of Community 8.

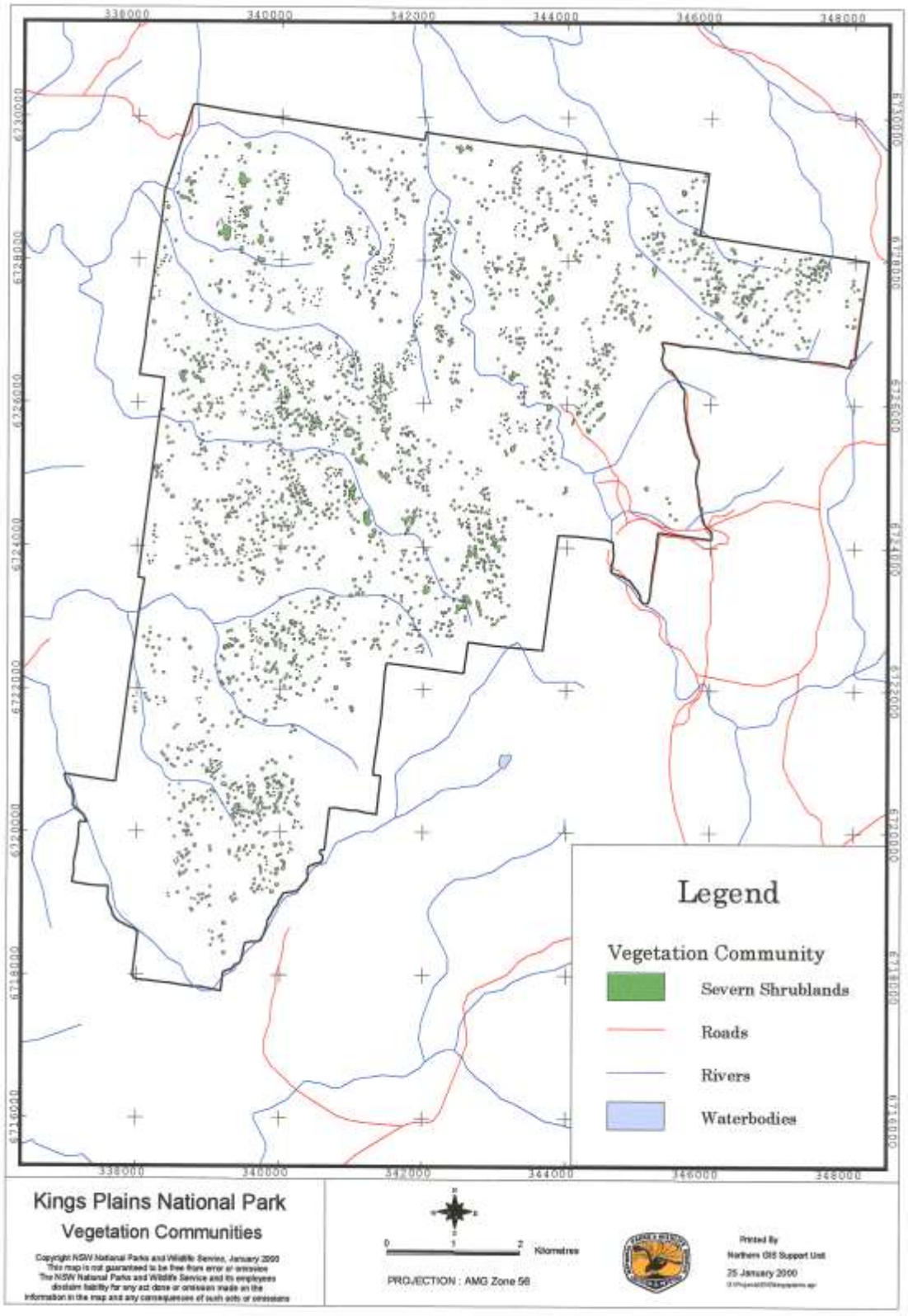

Figure 40: Distribution of Community 8.

3.6 Reservation status of communities and comparison with other studies

Table 3: Comparative table of Kings Plains National Park PATN defined communities with other communities defined in the north east of New South Wales and their reservation status.

Kings Plains Floristic Community	Other Floristic Classifications	Specht *et al.*	Reservation Status
1. *Eucalyptus caleyi – Callitris endlicheri – E. prava*	≈ 5a *Eucalyptus dealbata – E. caleyi – Callitris endlicheri* (Clarke *et al.* 1998). ≈ W10a *Eucalyptus dealbata* (Heil 1996). = 10b *Eucalyptus dealbata – E. caleyi – Callitris endlicheri* (Clarke *et al.* 1995). = 8. *Eucalyptus caleyi – Allocasuarina inophloia* association (Le Brocque & Benson 1995). ≈ 10a *Eucalyptus dealbata, E. youmanii* (Young & McDonald 1989).	T365c *Eucalyptus caleyi – Acacia doratoxylon.*	This community is reserved within Kings Plains NP and Severn River Nature Reserve. Broadly similar assemblages are reserved within Torrington SRA, Bolivia Hill NR, Sundown NP, Ironbark NR, the Basin NR and potentially also in the broadest circumscription within Girraween NP and Wollemi NP. This community should be considered as well reserved across its range of occurrence.
2. *Eucalyptus blakelyi – Callitris endlicheri – Eucalyptus melliodora*	≈ *Eucalyptus floribunda – E. blakelyi* (Clarke *et al.* 1998). ≈ *Eucalyptus melliodora – Eucalyptus blakelyi – Callitris glaucophylla* Alluvial Woodlands (Hunter 1998) = *Eucalyptus blakelyi* association (Le Brocque & Benson 1995)	T338b *Eucalyptus melliodora – E. blakelyi* Open Forest/Woodland.	Considered poorly reserved across their range by Benson (1991). Reservation considered reasonable by Specht *et. al.* (1995). Widely reserved in the broad sense and locally. However, compared to its original extent only small portions are found within reserves, which are usually modified to some extent, and thus representation within reserves should be considered as Poor.
3. *Eucalyptus mckieana E. andrewsii – Callitris endlicheri*	No comparable communities described as the assemblage is described here. Broader associations would include many *E. andrewsii* assemblages.	No comparable assemblages.	Not known to be reserved anywhere else but is known to occur at Clayton Chase on the southern boundary of Severn River NR. Should be considered as an endangered assemblage that is highly inadequately reserved. Warrants listing on the TSC Act as an endangered community.
4. *Eucalyptus machrorhyncha – E.*	≈ 5a *Eucalyptus dealbata – E. caleyi – Callitris endlicheri* (Clarke *et al.* 1998).	T36ad *Eucalyptus crebra – E. dealbata – Callitris*	Considered as adequately reserved by Specht *et al.* (1995). Reserved within

crebra – E. dealbata	≈ 9. *Eucalyptus crebra – Callitris glaucophylla – Acacia cheelii* (Porteners 1998). ≈T.10 *Eucalyptus crebra* (Heil 1996). ≈7d *Eucalyptus crebra – Callitris glaucophylla – E. dealbata* (Clarke *et al.* 1995). ≈ 2. *Eucalyptus crebra – Angophora leiocarpa* (Le Brocque & Benson 1995). 10a *Eucalyptus dealbata – E. youmanii* (Young & McDonald 1989). 2.2.3 *Eucalyptus crebra* Sub alliance (Beadle 1981).	*glaucophylla*	Kings Plains NP, Severn River NR, Sundown NP, Warrabah NP, Ironbark NR, Watson's Ck NR, and potentially MT Kaputar NP, Girraween NP and the Pilliga NR.
5. *Eucalyptus prava – Eucalyptus caleyi – Eucalyptus machrorhyncha*	≈ 7a *Eucalyptus prava – Callitris endlicheri* (Clarke *et al.* 1998). ≈ W30 *Eucalyptus andrewsii* subsp. *andrewsii* (Heil 1996). = 10a *Eucalyptus prava* (Clarke *et al*. 1995). = *Eucalyptus caleyi – Allocasuarina inophloia* (Le Brocque & Benson 1995).	No comparable combinations.	Known to be reserved within Kings Plains NP, Severn River NR, Torrington SRA, Ironbark NR, Watson's Ck NR, the Basin NR, Mt Kaputar NR, Sundown NP, Mt Kaputar NP and Girraween NP
6. *Angophora floribunda – Eucalyptus banksii – Casuarina cunninghamiana*	No synonymous communities apparent except in the broadest sense.	None directly comparable except in the broadest sense	Reserved within Kings Plains NP, Severn River Nature Reserve and potentially within the Basin NR, Sundown NP and Girraween NP. Should be considered as inadequately reserved across its range and in particular since the stands within reserves is small and usually highly modified.
7. *Eucalyptus albens*	See Prober (1996) for a bioregional approach. 3. *Callitris glaucophylla – Eucalyptus melanophloia – E. albens* (Hunter 1998). 8. *Eucalyptus albens – Callitris endlicheri – Callitris glaucophylla* (Porteners 1998). 5a. *Eucalyptus albens* (Clarke *et al.* 1995). 2.7. *Eucalyptus albens* Alliance (Beadle 1981).	T338c *Eucalyptus albens*	Recently listed as an Endangered Community on the TSC Act.
8. *Calytrix tetragona – Leptospermum novae-angliae*	5. *Kunzea* sp. D – *Leptospermum brevipes – Calytrix tetragona* (Porteners 1997). 10a. *Eucalyptus prava* (Clarke *et al.* 1998). 30. Rock pavements with low shrubland (Young & McDonald 1989).	No comparable communities described.	In the strict sense reserved within Kings Plains NP and Severn River NR. In the broad sense reserved within Torrington SRA, Bolivia Hill NR, Mt Kaputar NP and Sundown NP. Adequately reserved across its range.

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3.7 Description of taxa of conservation significance

3.7.1 *Acacia williamsiana* J.T.Hunter (2RCa)

Taxonomy

Type: New South Wales: North Western Slopes: on the banks of Kings Plains Ck, in Kings Plains National Park, north-west of Glen Innes, *J.T. Hunter 4112 & P.J. Clarke*, 1 November 1996 (*holo*: NSW; *iso*: AD, BRI, HO, MEL, NE, PERTH).

Family: *Fabaceae.*

Affinities: Unclear at this stage, however it is possible that they are near *A. bulgaensis* Tind. & Stuart J. Davies and *A. diphylla* Tind.

Synonymy: Often mislabeled as *Acacia cheelii*, or *Acacia* sp. aff. *cheelii*.

Derivation of name: Named in honour of John B. Williams.

Common name: Severn Wattle.

Published conservation status: 2RCa (Hunter 1997).

Life history

Growth form: Often spreading widely when young but usually become fruticose and then erect, 2 to 15 m tall. Phyllode form is variable with juvenile foliage much wider and shorter than the adult (Hunter 1997).

Vegetative spread: No.

Longevity: Unknown however plants on the western side of the Macintyre River suggest that this species may have a relatively long life compared to many other *Acacia* species. Possibly greater than 40 years.

Primary juvenile period: c. 3 years.

Flowers: September to December.

Fruit/seed: September to December.

Dispersal, establishment & growth: Dispersal is via the seed, ants may be involved but this needs corroboration. Populations are usually from single cohorts and plants do not seem to regenerate without soil disturbance or fire. Plants have been seen growing on disturbed road verges. The seeds are likely to have a high longevity.

Fire response: Germinates readily and in high numbers after fire.

Interactions with other organisms: Pollinated by insects.

Distribution

Botanical sub-regions: North Western Slopes.

General distribution: This distribution is disjunct with small populations known from the south-western portions of the Torrington SRA, within Kings Plains NP, Kwiambal NP and at the Severn River NR and nearby Pindari Dam area.

Distribution within Kings Plains: Common on rocky soils and exposed ridges, rock dominated riparian areas, usually around rock outcrops. Primarily from the falls westwards.

Habitat

Habitat: Restricted to granite and rhyolitic outcrops. Within Kings Plains this species is mostly restricted to rhyolitic outcrops but will also occur off outcrops when in exposed situations such as disturbed sites particularly on the western boundary of the reserve.

Altitude: 280-1100.

Annual Rainfall: 660-760.

Abundance: This species often occurs in mono-specific stands where it does occur.

Kings Plains community: Usually within Community 8 but also common in Community 5.

Substrate: Restricted to shallow to exposed granite and rhyolite.

Exposure: Fully exposed sites.

Management

Population size: Although restricted in distribution this species will often form mono-dominant stands. Within Kings Plains the population size would be several thousand, more accurate estimation will need to occur.

Reserved: Kings Plains NP, Severn River NR, Kwiambal NP and Torrington SRA.

Threats: Inappropriate fire regimes.

Management considerations: This species is killed outright by fire and requires at least three years before flowering occurs. It is unknown whether the seeds require a dormancy period which can be associated with rock outcrop plants (Hunter *et al.* 1997; Hunter 1998). Fires with a high frequency will be detrimental to the survival of this species.

Figure 41: Photograph of *Acacia williamsiana*.

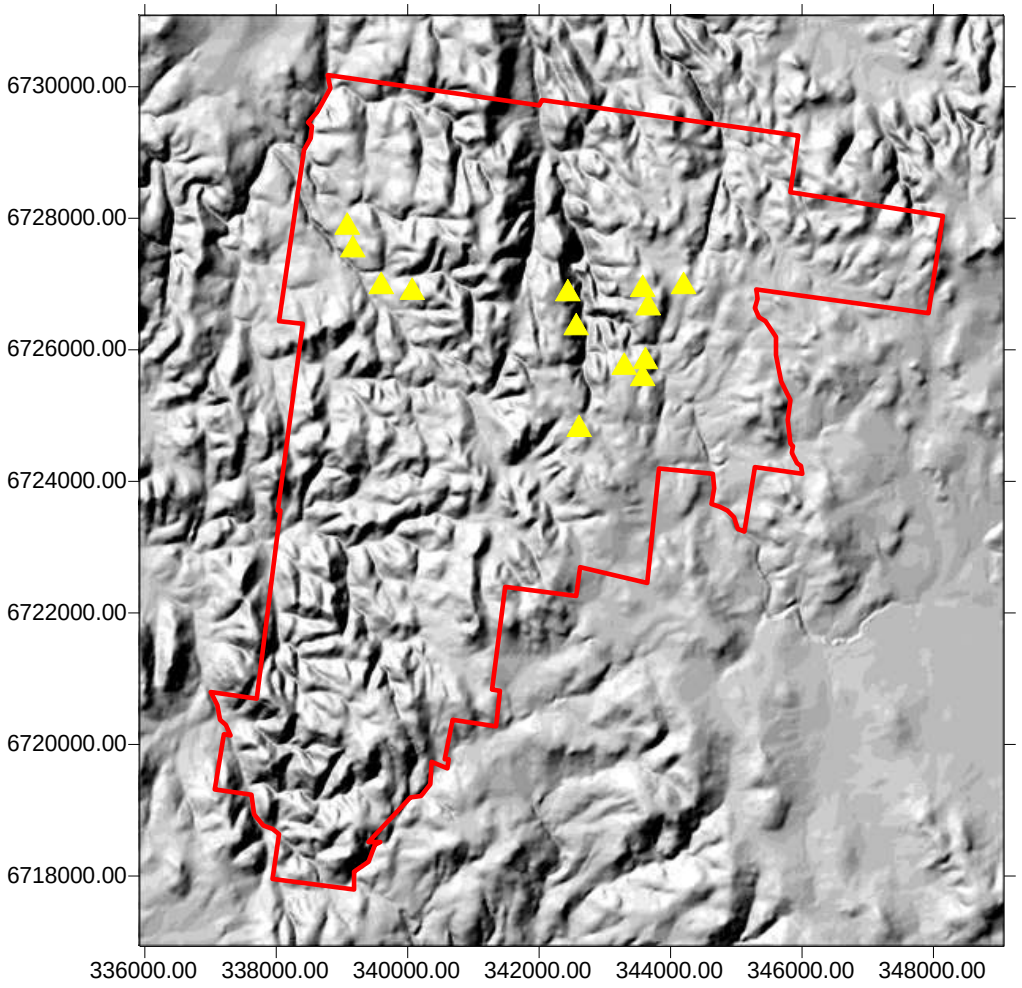


Figure 42: Surveyed localities of *Acacia williamsiana*.

3.7.2 *Allocasuarina brachystachya* L.A.S.Johnson (2RCa)

Taxonomy

Type: 19.5 km SE of Tingha on Tenterden-Moredun Dams road, N.S.W., 9 Oct. 1980, *K.L. Wilson 3191* (*holo*: NSW, with cones; *iso*: BRI, CANB, K, MO).

Reference: *Flora of Australia* 3: 193 (1989).

Family: Casuarinaceae.

Affinities: Affinities to *A. paludosa* but with smaller parts.

Synonymy: None.

Derivation of name: *Brachy* meaning short and *stachy* meaning spike; Short spike.

Common name: None.

Published conservation status: Originally believed to be restricted to the Moredun Dams area and given a suggested code of 2V- but reduced to 2RCa by Quinn *et al.* (1995).

Life history

Growth form: Shrub to 3 m tall.

Vegetative spread: None.

Longevity: Unknown but probably relatively long lived, i.e. many decades.

Primary juvenile period: Unknown.

Flowers: Spring to Summer.

Fruit/seed: Summer to Autumn.

Dispersal, establishment & growth: Via samara.

Fire response: Unknown but potentially and obligate seeder.

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: Restricted to the Northern Tablelands and North Western Slopes.

General distribution: Emmaville south to Guyra and the Moredun Dams area.

Distribution within Kings Plains: Common throughout much of the park although of restricted distribution in the lower altitude areas of the western boundary.

Habitat

Habitat: Restricted to shallow soils associated with rhyolitic outcrops and their margins.

Altitude: 700-1000 m.

Annual Rainfall: 600-800 mm.

Abundance: Extremely abundant in many areas for almost monodominant stands both within Kings Plains and at Severn River.

Kings Plains community: Community 1, 5 and 8.

Substrate: Shallow rhylotic soils.

Exposure: Fully exposed sites.

Management

Population size: Potentially tens of thousands in both Kings Plains and Severn River.

Reserved: Kings Plains National Park and Severn River Nature Reserve.

Threats: Inappropriate fire regimes. The extremely dense stands do not appear to effected greatly by many factors at all.

Management considerations: Basic research regarding the species biology, particularly in terms of recruitment and primary juvenile period and responses to fire are needed to properly form management criteria for this species.

Figure 43: Photograph of a stand of *Allocasuarina brachystachya*.

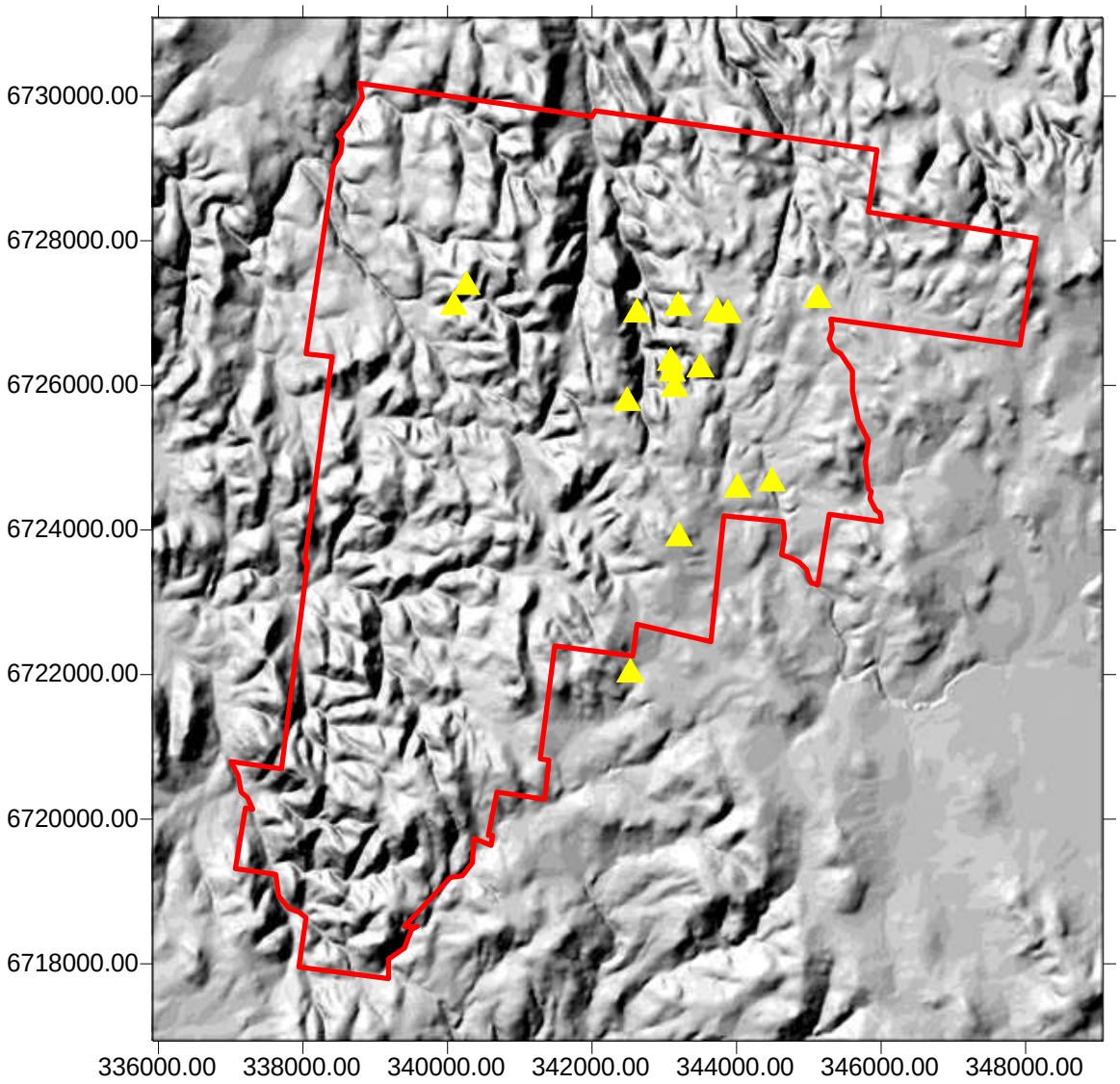


Figure 44: Surveyed localities of *Allocasuarina brachystachya*.

3.7.3 *Allocasuarina gracilis* m.s. (J.T.Hunter) ?2ECt

Taxonomy

Type: Not formally described.

Reference: None.

Family: Casuarinaceae.

Affinities: *Allocasuarina brachystachya*.

Synonymy: None.

Derivation of name: Graceful habit.

Common name: None.

Suggested conservation status: A new species discovered during this survey. This species was only found in a single population of a few hundred individuals and will probably warrant TSC Act listed as Endangered despite its current reservation status.

Life history

Growth form: Shrub to 2 m tall.

Vegetative spread: None.

Longevity: Unknown.

Primary juvenile period: Unknown.

Flowers: Spring to Summer.

Fruit/seed: Summer to Autumn.

Dispersal, establishment & growth: Samara.

Fire response: Unknown but restricted to creekline and may potentially be an obligate seeder.

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: North Western Slopes.

General distribution: Only known from a small creek line within the interior of Kings Plains National Park for a few hundred metres.

Distribution within Kings Plains: Restricted to the upper reaches of Branch Creek.

Habitat

Habitat: Densely heathy creek line.

Altitude: 800-900 m.

Annual Rainfall: 700-800 mm.

Abundance: Only a few hundred individuals were noted.

Kings Plains community: Only found within Community 5.

Substrate: Rhyolitic soils on creek margins.

Exposure: Partially sheltered.

Management

Population size: Possibly only a few hundred individuals at present count.

Reserved: Kings Plains National Park.

Threats: Small populations size and inappropriate fire regimes.

Management considerations: Targeted searches need to be conducted for this species along with basic information regarding the species life history.

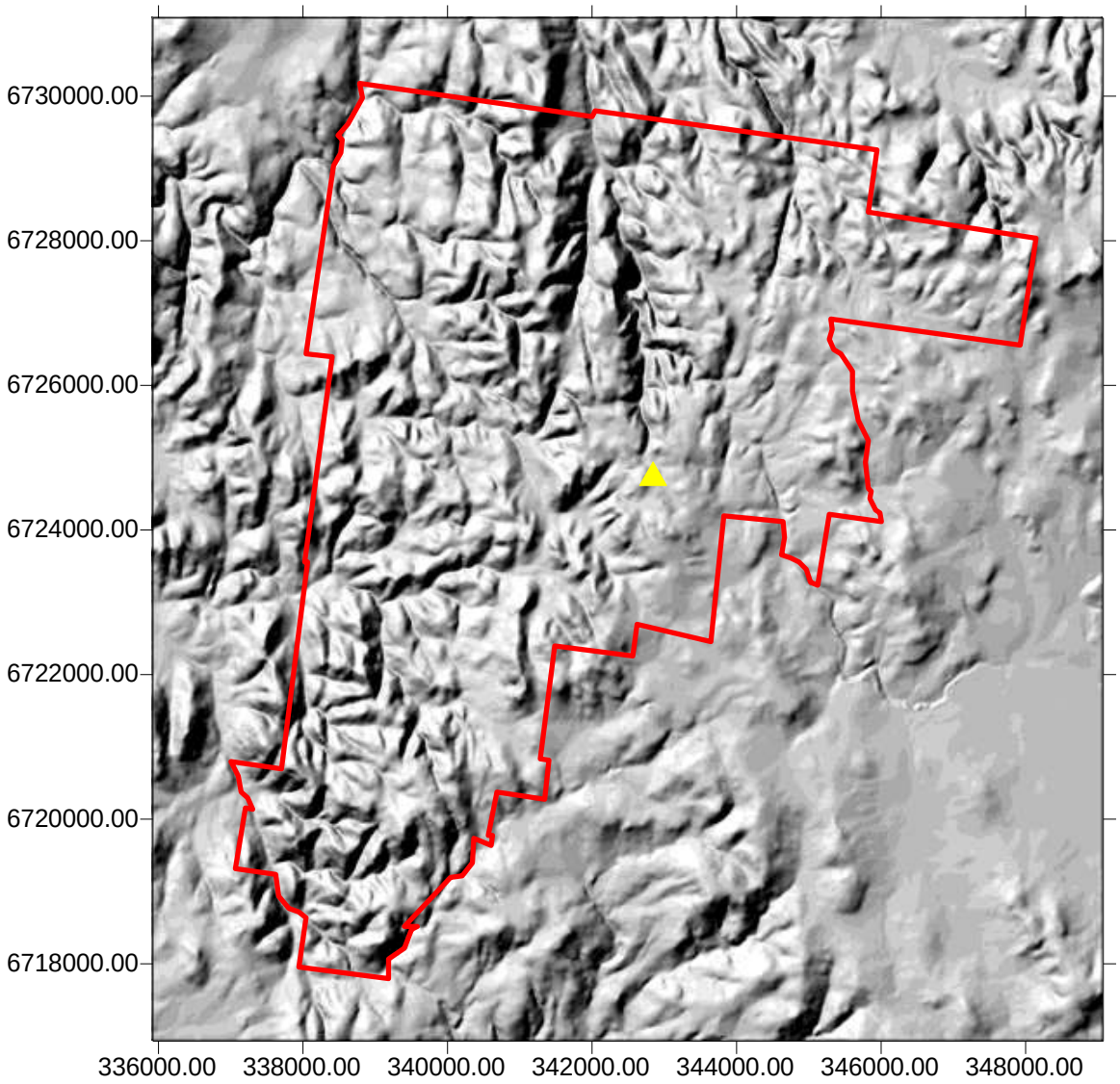


Figure 45: Surveyed locality of *Allocasuarina gracilis*.

3.6.4 *Astrotricha roddii* Makinson (3VCa; TSC Schedule 1)

Taxonomy

Type: Holotype: New South Wales: North Western Slopes: Macintyre Falls, 3 km S of Junction of the Macintyre and Severn Rivers, *A.N.Rodd 4096*, 23 Nov 1984 (NSW 198521; ISO: BRI, MEL).

Family: Araliaceae.

Affinities: Makinson (1991) considered the cogeneric affinities of this species as unclear but superficial resemblance occurred with *A. floccosa* (cream flowers), *A. longifolia* (cream flowers and smaller leaves) and *A. bidduphiana* (less hairy, smaller leaves and flowers). Bean (1997) however placed *A. roddii* within the subgenus

Hexocenia with *A. pterocarpa*. Though *A. roddii* does not possess the winged fruits that are associated with *Hexocenia*, Bean (1997) believes that the unbranched slender habit and three-locular mericarps supports its placement.

Synonymy: None apparent.

Derivation of name: In honor of A.N. Rodd and T. Rodd.

Common name: Rod's Star Hair.

Published conservation status: 2EC or 2RC (Makinson 1991); 3VCi (Nadolny *et al.*1997); 3VCa (Briggs & Leigh 1996).

Life history

Growth form: *Astrotricha roddii* (Rod's Star-hair) is an erect, sparsely branching shrub, usually 1-3 m tall, with narrow - elliptic leaves, 10-20 cm long. The leaves are glaucous with a purple blush. The three-chambered mericarp is a unique feature associated with this species and its purple inflorescence separates this species from many others. In early summer larger plants usually have a dense purple inflorescence.

Vegetative spread: No, but the species does posses a prominent tap root.

Longevity: *Astrotricha roddii* is a perennial shrub and individual plants appear capable of surviving for many years. Most other species in the genus are perennial, but some are monocarpic - lasting just a few years (Tony Bean, *pers. comm.*). *Astrotricha roddii* has a prominent taproot, which probably helps its establishment in an extreme, rocky environment. At Kings Plains National Park all *A. roddii* plants in a plot of approximately 100 m^2 were tagged and measured in December 1993 and measured again in December 1994 and March 1998. The year was particularly dry, with the district being drought declared for most of the period. Of 38 plants tagged in the initial census, 10 (26%) were apparently dead after one year and, at the final census, only 3 (8%) were still alive. Those that had remained alive until 1998, however, were at the apparent maximum height for this species and were not healthy. One of the last remaining original plants had flowered not long before the final census. This reveals that *A. roddii* will survive and reproduce for at least 5 years. At the time of the final census in 1998, an additional 13 new plants were found. These new plants were healthy, despite an apparent very dry period indicated by many other species in the area obviously drought affected and dying. Most of the new plants which were under 50 cm tall (44 cm average), with the tallest being 90 cm. This

contrasted with the height of many of the dead stems which were often almost 3 m tall.

Primary juvenile period: 18 months (Makinson 1991).

Flowers: November-February.

Fruit/seed: December-March.

Dispersal, establishment & growth: Establishment is likely to be strongly affected by the density of the surrounding vegetation, i.e. canopy shading (Makinson 1991). Seedlings will establish in the absence of fire (Makinson 1991; Hunter *pers obs.*). The seed is the dispersal unit. Fire and other soil disturbances are known to aid recruitment of cogeners.

Fire response: Cogeners are known to resprout from taproots after fire.

Interactions with other organisms: Beatles and wasps have been seen around the flowers (Nadolny *et al.* 1997).

Distribution

Botanical sub-regions: North Western Slopes in New South Wales and the Darling Downs in Queensland.

General distribution: *Astrotricha roddii* is a rare plant endemic to 12 known localities on the North Western Slopes of New South Wales, and has recently been recorded from a site in southern Queensland. Twelve small populations of the species have been located (Map 1), spanning a distance of about 110 km. The populations within NSW include localities within Kings Plains and the proposed Kwiambal National Park, Severn River Nature Reserve a few localities on private and public land nearby these reserves.

Distribution within Kings Plains: Very scattered but widespread throughout granite outcrop and rocky ridge areas of the park.

Habitat

Habitat: *Astrotricha roddii* has specific habitat requirements. All known areas of occurrence, it is restricted to the margins and crevices of rocky outcrops primarily in shrubland. This habitat is of limited extent but occurs commonly along the banks of and hills adjacent to the Severn River. The shrublands are often dominated by the ROTAP listed species *Allocasuarina brachystachya* and other rare, endangered or disjunct species (see section 5). At the proposed Kwiambal National Park such areas are outside the appropriate climatic envelope for the development of these shrublands.

Altitude: 350-980.

Annual Rainfall: 660-770 mm.

Abundance: *A. roddii* is genuinely rare, and while it is probable new populations will be found, it is likely that those populations will be small and localised. It is estimated that the population in known localities would range between 2250 and 6565 plants. At present the largest accurately known population is at Kings Plains National Park. The conservative estimate should be the one used for listing purposes, until more information becomes available to confirm the population size and distribution of the species.

Kings Plains community: Generally restricted to Community 8, this species occasionally turns up in Community 5.

Substrate: Restricted to granite and rhyolite.

Exposure: Well exposed sites with plenty of light.

Management

Population size: *Astrotricha roddii* was discovered at Kings Plains National Park in October 1993 by R.G. Coveny. In December 1993, about 600 plants were found in a circuit covering about 4 km near the upper portion of the creek. In December 1994 an additional 48 plants were found on a ridge extending about 1 km north of the creek. At the same time, no plants were found in a search of the north eastern corner of the Park, which chiefly contained regrowth forest, but 13 dead and two live plants were found in the north western corner of the park on ridges near Kings Plains Creek, about 4 km from the center of the main population. This western portion of the Park appeared drier than the eastern part of the Park at that time (December 1994). An unsuccessful search for the plant was also conducted on Lyndon and Doris Palmer's property, 'Deenyi', to the south-west of the Park in similar country. The observed distribution is consistent with the notion that the plant is discontinuously distributed along many of the more rocky ridges throughout parts of the Park, and possibly adjacent areas, that have not previously been developed for agriculture. Most of the Park is geologically similar, consisting of late Permian undifferentiated ignimbrites and lavas, which give rise to very infertile soils. The population at Kings Plains National Park is currently the largest known population of this species. Closer investigations of the populations at Severn River Nature Reserve and Severn State Forest may find that these populations are as large. Estimating the total population of

plants in the Park is difficult. Even if the species is almost entirely restricted to the known localities in the Park, there are certainly at least 800 plants, as it was difficult to find every plant in the rugged bushland (Nadolny *et al*. 1996). However, less than 20% of the country suitable for *A. roddii* was searched, so if plant densities are similar in searched and unsearched areas, about 4000 plants could be expected to occur in the Park and adjacent areas.

Reserved: Kwiambal NP, Kings Plains NP and Severn River NR.

Threats: It is possible that some apparently dead plants may sprout from the base, but in most cases, the entire plant including the root appeared dead. Many living plants had also been browsed, and only one third of the plants gained height during the period. Of these plants, the mean height increment was 9 cm. In contrast, Bob Makinson (*pers. comm.*) reported that some plants had grown by about 1 m in the 1988/89 season, which was relatively wet. Makinson (1991) estimated the life-span of the shrub to be between 5 and 8 years, which is reasonable according to the results obtained. A large proportion of dead plants were recorded throughout the study. Dead plants were particularly prominent in survey work conducted in late 1994. The most likely explanation for the high mortality rates was that plants had died from a combination of drought and browsing pressure. A further possibility is that the drought was accompanied by unusually severe frosts. Severe frosts were recorded elsewhere in the region. Bob Makinson (*pers. comm.*) reported Rosellas breaking the stems of the plant at the base of the inflorescence - a type of damage that was commonly observed throughout the study. However, at the last census a very large number of dead stems were discovered (over 100) in the plot. The number of dead stems may also be due to the comparatively short lifespan and the persistence of the dead stems for many years afterwards. *Astrotricha roddii*'s response to fire is unknown, however, fire and other soil disturbances are known to aid the recruitment of cogeners (Makinson 1991).

Management considerations: The number of plants overall is limited and populations are scattered, small and habitat specific. The species is therefore vulnerable to sporadic fluctuations in climate or browsing pressure. Walking tracks may need to be placed to avoid populations. Education of visitors in the form of a fact sheet at the car park may help visitors recognise and avoid this species. The populations close to areas of high visitation will need to be regularly monitored. Staff should become familiar with this species and easily accessed populations in order to

check on recruitment. This may involve simple visual estimates taken on days when other work is occurring within the proposed park.

Figure 46: Photograph of *Astrotricha roddii* that has been browsed by goats.

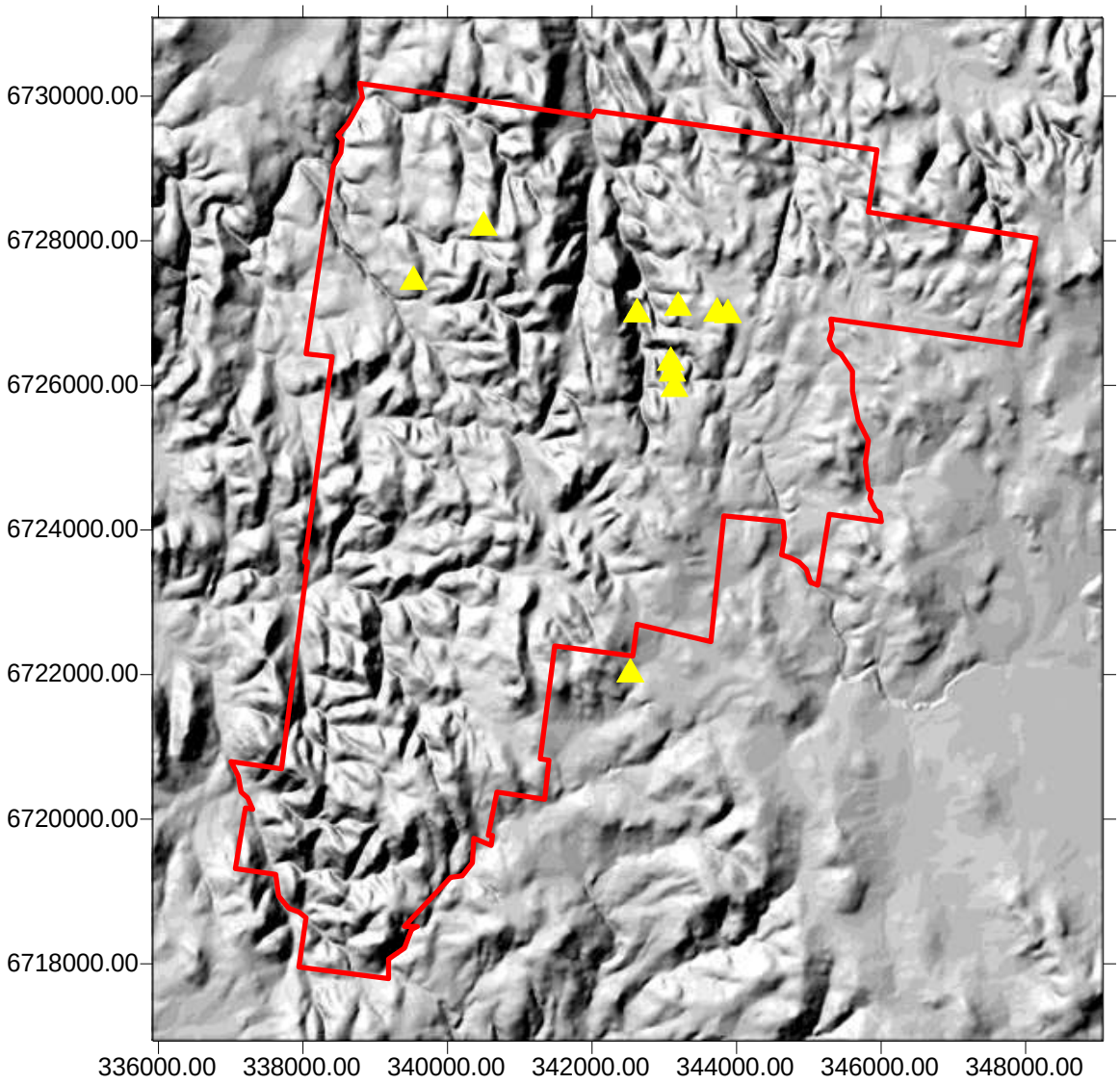


Figure 47: Surveyed localities of *Astrotricha roddii*.

3.7.5 *Boronia granitica* Maiden & Betche (3VC-; TSC Endangered)

Taxonomy

Type: Howell, N.S.W., *J.H.Maiden & J.L.Boorman* Aug '05 (*holo*: NSW).

Reference: *Proceedings of the Linnean Society of New South Wales* 30: 357 (1905).

Family: Rutaceae.

Affinities: *Boronia repanda, Boronia warrumbunglensis* and *Boronia boliviensis*.

Synonymy: None.

Derivation of name: In reference to the substrate of common occurrence.

Common name: Granite Boronia.

Published conservation status: 3VC- (Briggs & Leigh 1996), unchanged since. The species was listed as Schedule One of the TSC Act as an endangered species. The species is truly rare but probably only warrants a 3RCa coding or a 3VCa at best.

Life history

Growth form: Small shrub to 1.5 m tall.

Vegetative spread: None.

Longevity: Unknown.

Primary juvenile period: .

Flowers: Spring to summer.

Fruit/seed: Via seed locally dispersed.

Dispersal, establishment & growth: May recruit well in post fire environment.

Fire response: Obligate seeder (Clarke & Fulloon 1999).

Interactions with other organisms: Ants are known to disperse the seeds.

Distribution

Botanical sub-regions: Northern Tablelands, North Western Slopes and the Darling Downs.

General distribution: From west of Armidale (Parlour Mountains) north to Stanthorpe.

Distribution within Kings Plains: Common particularly along the gorge rim and associated rock outcrops of the upper parts of Kings Plains Creek.

Habitat

Habitat: Restricted to skeletal soils associated with rock outcrops and their margins.

Altitude: 800-1100 m.

Annual Rainfall: 700-1000 mm.

Abundance: Often very common in its preferred habitat.

Kings Plains community: Community 5 and 8.

Substrate: Restricted to shallow soils associated with granite and rhyolitic outcrops.

Exposure: Fully exposed sites.

Management

Population size: Within Kings Plains National Park the population may be in the order of 2000 individuals.

Reserved: Girraween NP, Torrington SRA, Severn River NR, Kings Plains NP and Goonoowigal FR.

Threats: Grazing has occurred by stock and goats. Inappropriate fire regimes.

Management considerations: This species has a restricted distribution within the park but is fairly common where it does occur. Goats are the major threat to the populations within the park along with inappropriate fire regimes.

Figure 48: Photograph of *Boronia granitica*.

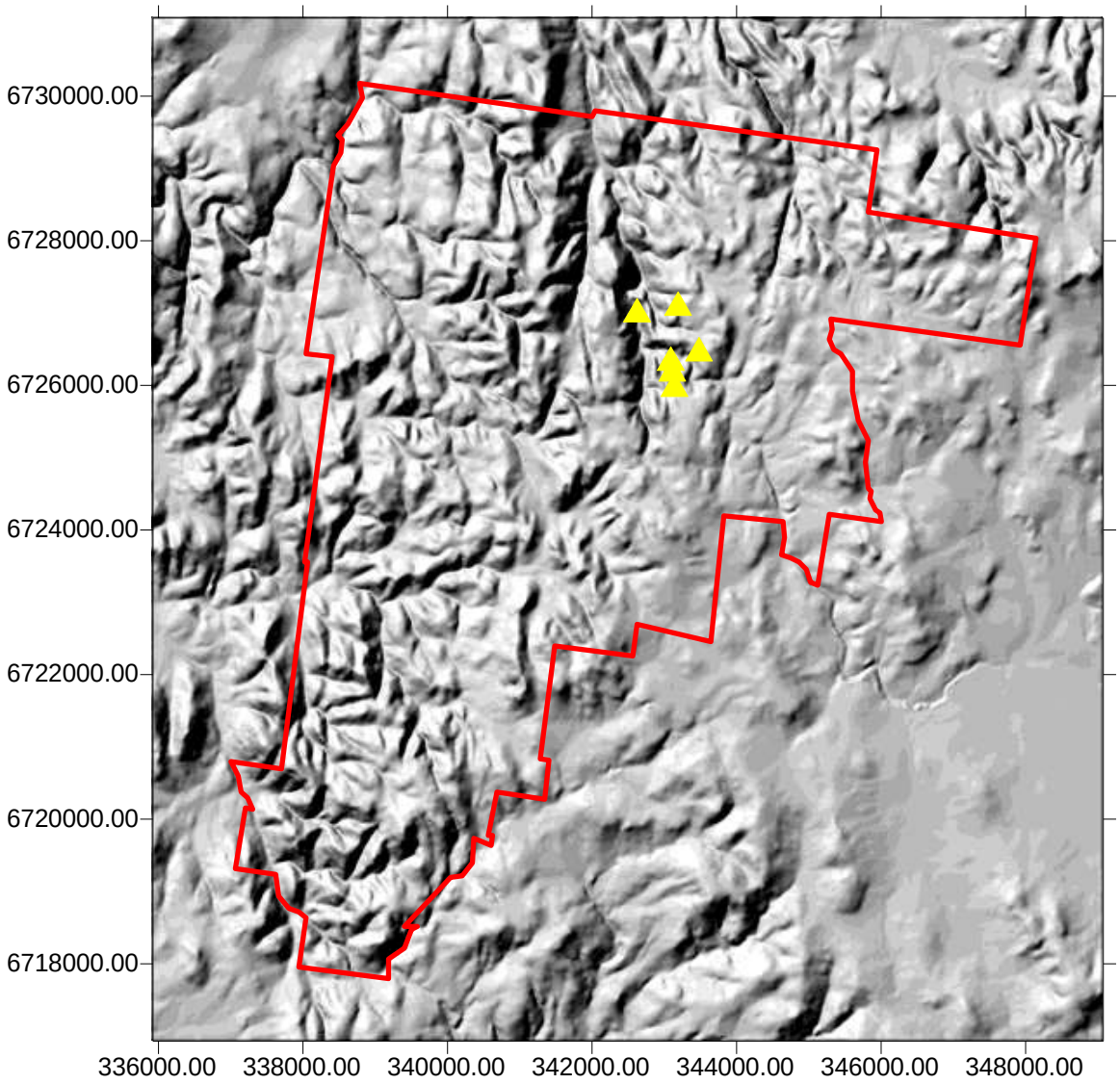


Figure 49: Surveyed localities of *Boronia granitica*.

3.7.6 *Bothriochloa biloba* S.T.Blake

Taxonomy

Type: Warialda, May 1908, *Hadley* (*holo*: BRI; *iso*: NSW).

Reference: *University of Queensland Papers, Department of Biology* 2: 27 (1944).

Family: Poaceae.

Affinities: Uncertain.

Synonymy: None.

Derivation of name: Meaning two parted.

Common name: None.

Published conservation status: 3V (Briggs & Leigh 1996). Listed on Schedule 2 as Vulnerable on the TSC Act.

Life history

Growth form: A tufted grass to 1 m tall.

Vegetative spread: None.

Longevity: Unknown.

Primary juvenile period: Seasonal, 1 year.

Flowers: In Summer to early Autumn from January to March.

Fruit/seed: Seed.

Dispersal, establishment & growth: Achene.

Fire response: Unknown but probably resprouts.

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: North Coast, Northern Tablelands, North Western Slopes, Central Western Slopes, North Western Plains and Darling Downs.

General distribution: From Cobar to Armidale.

Distribution within Kings Plains: Only found in one locality on the far eastern boundary of the reserve within 100 m of the boundary fence.

Habitat

Habitat: Found in a variety of woodlands and grasslands on basaltic hills and in drainage slopes and also on rich black or red soils.

Altitude: 200-1200 m.

Annual Rainfall: 500-1200 mm.

Abundance: Sparse and uncommon and potentially decreasing in size.

Kings Plains community: Restricted to Community 7.

Substrate: Basalt within the reserve but also on black and red soils elsewhere.

Exposure: Partially protected.

Management

Population size: Only a handful of plants were found probably less than 20 noted.

Reserved: Not formally known from any reserves.

Threats: Clearing and grazing across the range of its occurrence.

Management considerations: A targeted search for further populations is warranted. The basalt tongue that extends into the reserve is of very limited occurrence further

purchases of similar land would be beneficial. As potentially the only site of reservation this population warrants special attention. No works should be carried out in this locality.

Figure 50: Photograph of *Bothriochloa biloba*.

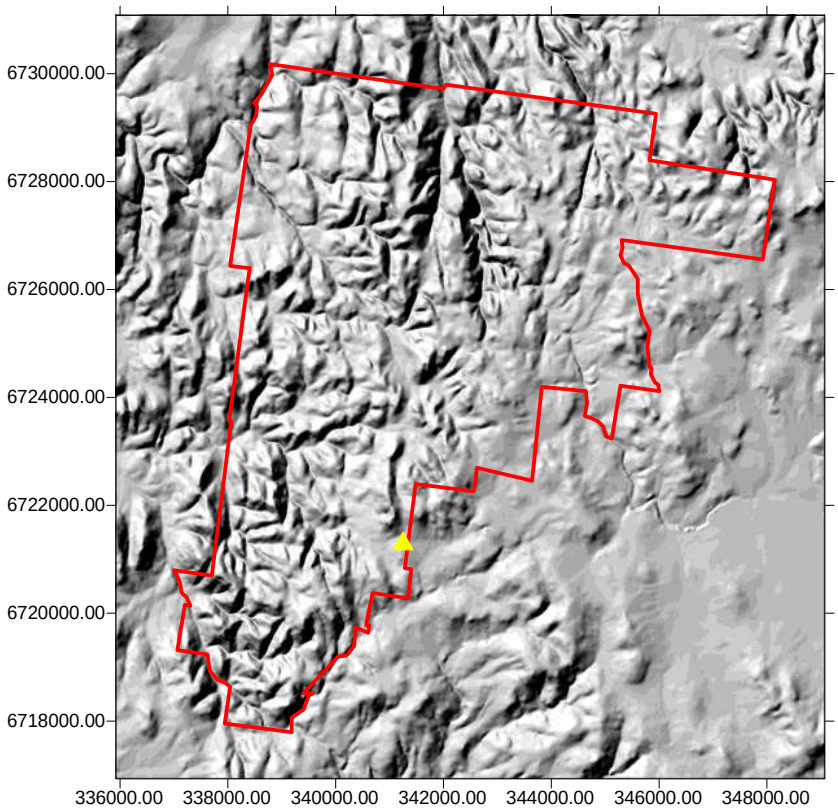


Figure 51: Surveyed locality of *Bothriochloa biloba*.

3.7.7 *Callistemon pungens* Lumley & Spencer (3RCa)

Taxonomy

Type: New South Wales, Northern Tablelands, *c.* 3 km along road to Armidale from junction with road from Armidale/Dorrigo Road to Hillgrove, (*c.* 4 km from Highway), 30°33'S, 151°54'E, 21.xi.1983, *P.F.Lumley 1150* (*holo*: MEL; *iso*: NSW).

Reference: *Muelleria* 7: 253 (1991).

Family: Myrtaceae.

Affinities: Close to *Callistemon citrinus* but characterized by purple stamens and pungent leaf tips.

Synonymy: Known in cultivation for a number of years as *C. 'Lana'* and *C. 'gilesii'*.

Derivation of name: In reference to the pungent leaves.

Common name: None.

Published conservation status: Lumley and Spencer (1991) considered the species was vulnerable. Given a 3R by Briggs & Leigh (1996). Copeland and Hunter (2000) have given this species a 3RCa coding.

Life history

Growth form: Shrub or small tree to 5 m tall with rigid branches.

Vegetative spread: None.

Longevity: Unknown but apparently long lived.

Primary juvenile period: .

Flowers: Spring to summer.

Fruit/seed: Autumn.

Dispersal, establishment & growth: Seed.

Fire response: Potentially a resprouter (Clarke & Fulloon 1999).

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: Northern Tablelands, North Western Slopes and the Darling Downs.

General distribution: From Armidale to Stanthorpe.

Distribution within Kings Plains: Found throughout many of the upper creek lines.

Habitat

Habitat: Restricted to shallow soils associated with creeks and rivers on granite or rhylotic soils.

Altitude: 500-11000 m.

Annual Rainfall: 700-1000 mm.

Abundance: Common and abundant along creek lines throughout the western margin of the tablelands.

Kings Plains community: Community 1, 5, 6 and 8.

Substrate: Found on granite or rhyolite.

Exposure: Fully exposed to partially protected.

Management

Population size: Very abundant within the reserve and likely to be many thousands of individuals.

Reserved: Ironbark NR, Kings Plains NP, Severn River NR, Mann River NR, Oxley Wild Rivers NP, Torrington SRA, Arakoola NP, Warrabah NP and Sundown NP. Informally reserved at Goonoowiggal FR.

Threats: None readily apparent apart form possible inappropriate fire regimes.

Management considerations: Basic biological information required particularly in regards to fire response.

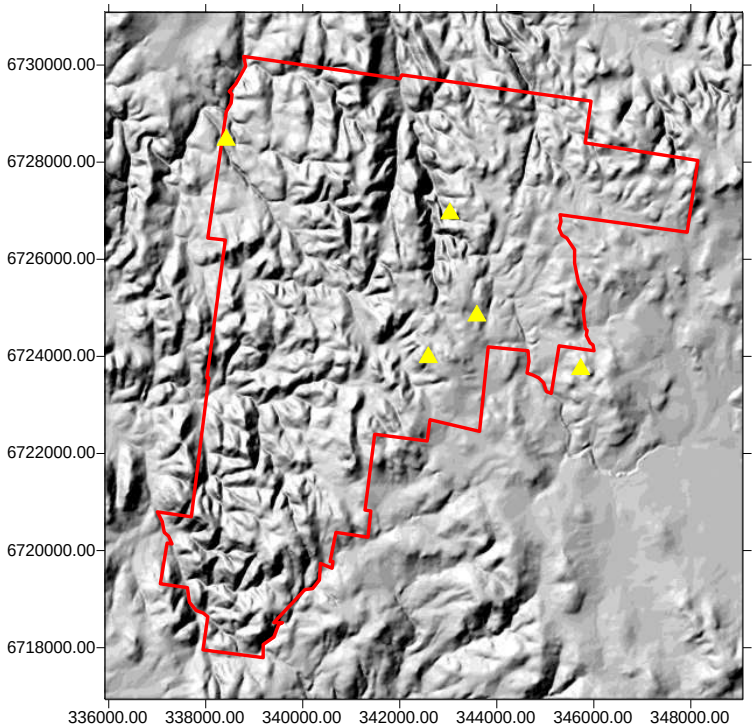


Figure 52: Surveyed localities for *Callistemon pungens*.

3.7.8 *Derwentia arenaria* (A.Cunn. ex Benth.) B.G.Briggs & Ehrend.

Taxonomy

Type: arid sandy flat on the plain of Daby, Cugeegong River … 50 miles north from Bathurst, *A. Cunningham*, Apr. 1823 (*holo*: K; *iso*: BM, MEL, NSW).

Reference: *Telopea* 5: 264 (1992).

Family: Scrophulariaceae.

Affinities: Uncertain.

Synonymy: *Veronica arenaria* A.Cunn. ex Benth.

Derivation of name: *Arenaria* meaning sandy, referring to the substrate on which the species is found.

Common name: None.

Published conservation status: 3RC- (Briggs & Leigh 1996). 3RCa proposed by Copeland and Hunter (2000).

Life history

Growth form: Herb with a sometimes woody base to 1 m tall.

Vegetative spread: None.

Longevity: Unknown but seasonally resprouts from base and above ground shoots die over winter.

Primary juvenile period: Unknown but likely to be only 1 yr.

Flowers: Spring to Summer.

Fruit/seed: Summer.

Dispersal, establishment & growth: Via seed.

Fire response: Unkown but probably resprouts readily in post fire environment.

Interactions with other organisms: Unknown.

Distribution

Botanical sub-regions: Northern Tablelands, North Western Slopes, Central Western Slopes and the Darling Downs.

General distribution: From Bathurst to Stanthorpe.

Distribution within Kings Plains: Found only rarely on the eastern margin of the reserve in open woodlands.

Habitat

Habitat: Found along side creeks and rivers and rocky slopes.

Altitude: 500-1000 m.

Annual Rainfall: 600-900 mm.

Abundance: Infrequent but likely to be missed as the species is both inconspicuous and annual at least in terms of above ground biomass.

Kings Plains community: Found opportunistically in a previous survey.

Substrate: Granite and rhyolite.

Exposure: Fully exposed to partially shaded sites.

Management

Population size: Unknown.

Reserved: Kings Plains NP, Warrabah NP, Ironbark NR and Torrington SRA.

Threats: Unknown but likely frequent grazing by cattle and goats will reduce numbers. Frequent fires may also be detrimental.

Management considerations: Targeted searches in appropriate seasons are needed to establish where this species occurs and what the potential size of the populations are. Basic biological knowledge is also needed before management guidelines can be written for this species.

Figure 53: Photograph of *Derwentia arenaria*.

3.7.9 *Dodonaea hirsuta* (Maiden & Betche) Maiden & Betche (3RC-).

Taxonomy

Type: Jennings N.S.W., *J.L. Boorman,* October 1901 (holo: NSW).

Reference: *Proceedings of the Linnean Society of New South Wales* 38: 245.

Family: Sapindaceae.

Affinities: Not apparent.

Synonymy: *Dodonaea peduncularis* var. *hirsuta*.

Derivation of name: In reference to the hairy leaves.

Common name: Hairy Hop Bush.

Published conservation status: .3RC- (Briggs & Leigh 1996), unchanged since.

Life history

Growth form: Shrub to 1.5 m tall.

Vegetative spread: None.

Longevity: Not known.

Primary juvenile period: Unknown but probably 3-5 yrs.

Flowers: Within spring to summer.

Fruit/seed: Summer.

Dispersal, establishment & growth: Via fruit, wind dispersed.

Fire response: Obligate seeder. Apparently recruits readily post fire.

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: Darling Downs, North Coast, Northern Tablelands and North Western Slopes.

General distribution: From Kings Plains to Wallangara and to Grafton.

Distribution within Kings Plains: Found during a previous survey on a rhyolitic outcrop.

Habitat

Habitat: Shrubby forests and heathlands on outcrops.

Altitude: 800-1200 m.

Annual Rainfall: 700-1400 m.

Abundance: Often found abundantly but with a disjunct distribution.

Kings Plains community: Community 8.

Substrate: Sandstone and granite.

Exposure: Usually partially shaded to fully exposed sites.

Management

Population size: Probably only in the tens within the reserve. None were found during this investigation.

Reserved: Banyabba Nature Reserve, Girraween National Park, Fortis Creek National Park, Boonoo Boonoo National Park, Torrington State Recreation Area.

Threats: Inappropriate fire regimes.

Management considerations: Targeted searches for this species are warranted to confirm the if populations are still extant and their potential size. Further work into the fire responses of this species is warranted.

3.7.10 *Eucalyptus mckieana* Blakely (2V; TSC Act Vulnerable)

Taxonomy

Type: At Moredun Creek, on the upper part of the Gwydir watershed, this new species is found growing on the quartz-porphyry formation on the edge of the Tingha tin-granite, at an elevation of 3,000 feet or more above sea-level (*holo*: NSW).

Reference: *Proceedings of the Linnean Society of New South Wales* 55: 594 (1930).

Family: Myrtaceae.

Affinities: Not apparent.

Synonymy: None.

Derivation of name: Named after the collector and amateur bontanist Reverend McKie of Backwater.

Common name: McKie's Stringybark.

Published conservation status: 2V (Briggs & Leigh 1996). Listed on Schedule 2 of the TSC Act as Vulnerable. The population size of this species within the Tingha district is very large and the species often forms monodominant stands of many thousands of individuals. The plant is also recorded to germinate well after disturbance and will reinvade cleared country in high numbers (Quinn *et al*. 1996; Hunter, *unpublished data*).

Life history

Growth form: Tree to 30 m tall.

Vegetative spread: None.

Longevity: Unknown.

Primary juvenile period: Unknown, but probably within 15 yrs.

Flowers: March to May.

Fruit/seed: Seeds released slowly year round from capsules.

Dispersal, establishment & growth: Recorded to germinate readily after disturbance.

Fire response: Not certain but likely to respond well by resprouting of epicormic buds.

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: Northern Tablelands and North Western Slopes.

General distribution: From North of Bundarra to Torrington.

Distribution within Kings Plains: Found in a number of communities on the eastern margin of the reserve.

Habitat

Habitat: Prefers deeper soils usually on low lying terrain but sometimes on low hills or less rarely around the base of rock outcrops.

Altitude: 700-1000 m.

Annual Rainfall: 700-900 mm.

Abundance: Usually forms pure stands of many tens thousands particularly from south of Inverell to Bundarra.

Kings Plains community: Community 1, 2, 3 and 8.

Substrate: Soils derived from granite, rhyolite and laterite.

Exposure: Exposed to partial shade.

Management

Population size: Within the reserve the species appears to be of limited distribution and is restricted to the eastern margin, potentially less than a 1000 individuals may occur.

Reserved: Kings Plains NP, Severn River NR and Torrington SRA.

Threats: The most significant threat is gradual attrition from clearing and possible attrition of juveniles by grazing.

Management considerations: A targeted search to establish the boundaries of the current population distribution and size within the reserve is warranted. Basic information on the species biology is needed.

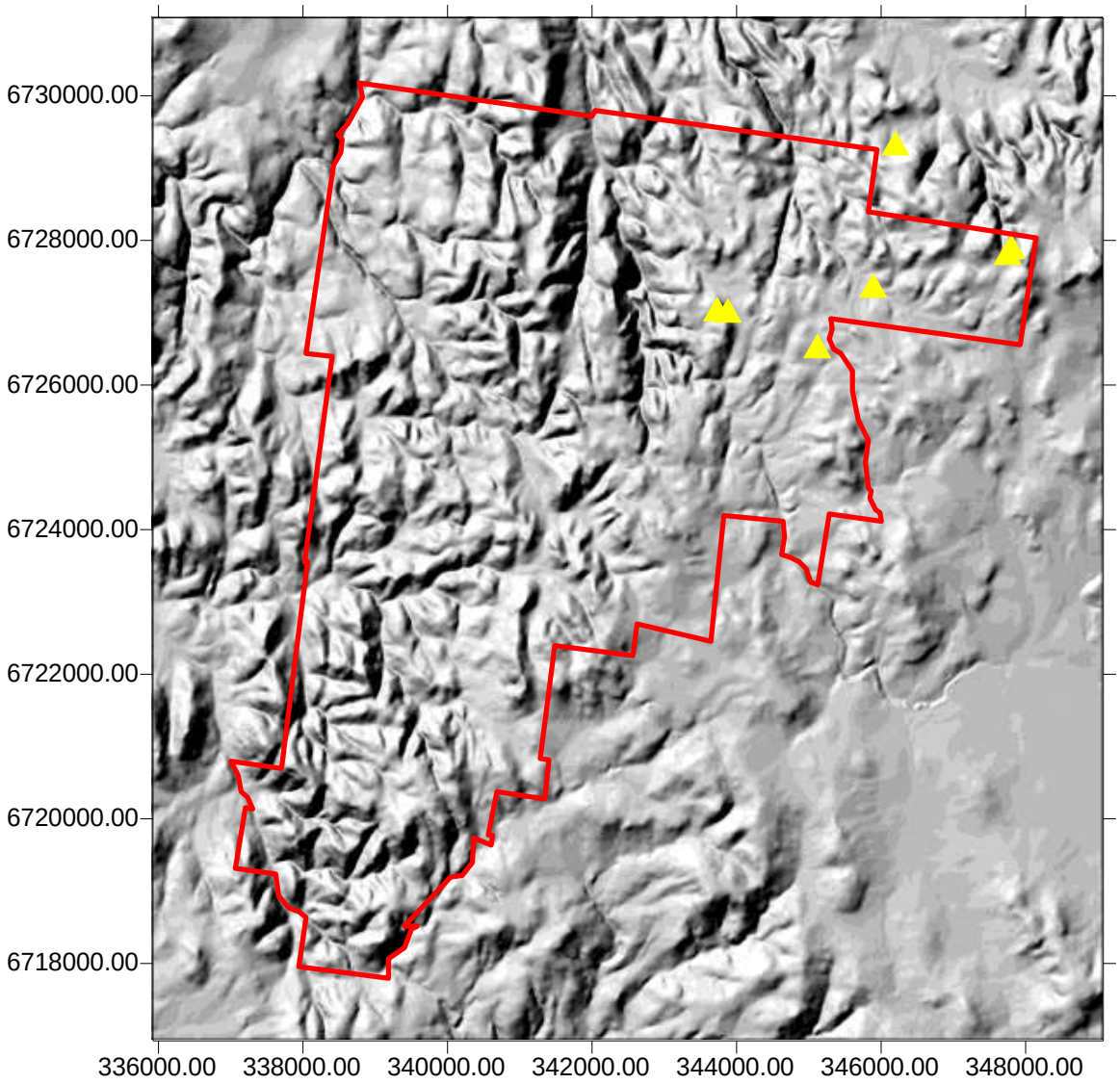


Figure 54: Surveyed localities of *Eucalyptus mckieana*.

3.7.11 *Hibbertia* sp. B (2KC-).

Taxonomy

Type: Not yet formally described.

Reference: NA.

Family: Dilleniaceae.

Affinities: *Hibbertia obtusifolia* complex.

Synonymy: *Hibbertia obtusifolia*.

Derivation of name: NA.

Common name: Guinea Flower.

Published conservation status: 2K (Briggs & Leigh 1996), unchanged since. Clarke and Fulloon (1999) state that the taxon requires TSC Act vulnerable listing. However the size of populations within Torrington SRA, Severn River NP, Kings Plains NP and Bald Rock National Park would probably preclude this and the species probably warrants a 3RCa classification.

Life history

Growth form: Erect shrub to 80 cm tall.

Vegetative spread: None.

Longevity: Unknown.

Primary juvenile period: Unknown but probably 2-3 years.

Flowers: Summer.

Fruit/seed: Late summer to autumn.

Dispersal, establishment & growth: Via seed, ant dispersed.

Fire response: Killed by fire, obligate seeder. Post fire seedlings noted by germination experiments by Clarke and Fulloon (1999) failed to germinate seeds. Probably has specialised dormancy cues and a long lived seed bank.

Interactions with other organisms: Secondary dispersal by ants.

Distribution

Botanical sub-regions: Northern Tablelands and the North Western Slopes.

General distribution: From the Severn River to southern Bald Rock National Park.

Distribution within the Kings Plains: Restricted to the rhyolitic rock outcrops or margins of outcrops associated with the gorge rim of upper Kings Plains Creek.

Habitat

Habitat: Found only on granite and rhyolitic outcrops or within the surrounding boulder fields.

Altitude: 700-1100 m.

Annual Rainfall: 700-1000 mm.

Abundance: Found commonly on and around granite and rhyolitic outcrops in the Severn River and Torrington areas.

Kings Plains community: Community 8.

Substrate: Granite and rhyolite.

Exposure: Fully exposed sites.

Management

Population size: Within the reserve only a handful of plants were seen, the total population may only be in the lower hundreds.

Reserved: Severn River Nature Reserve, Kings Plains National Park, Torrington State Recreation Area and Bald Rock National Park.

Threats: Inappropriate fire regimes and cattle and goat grazing.

Management considerations: A survey of the total population size and distribution would be beneficial.

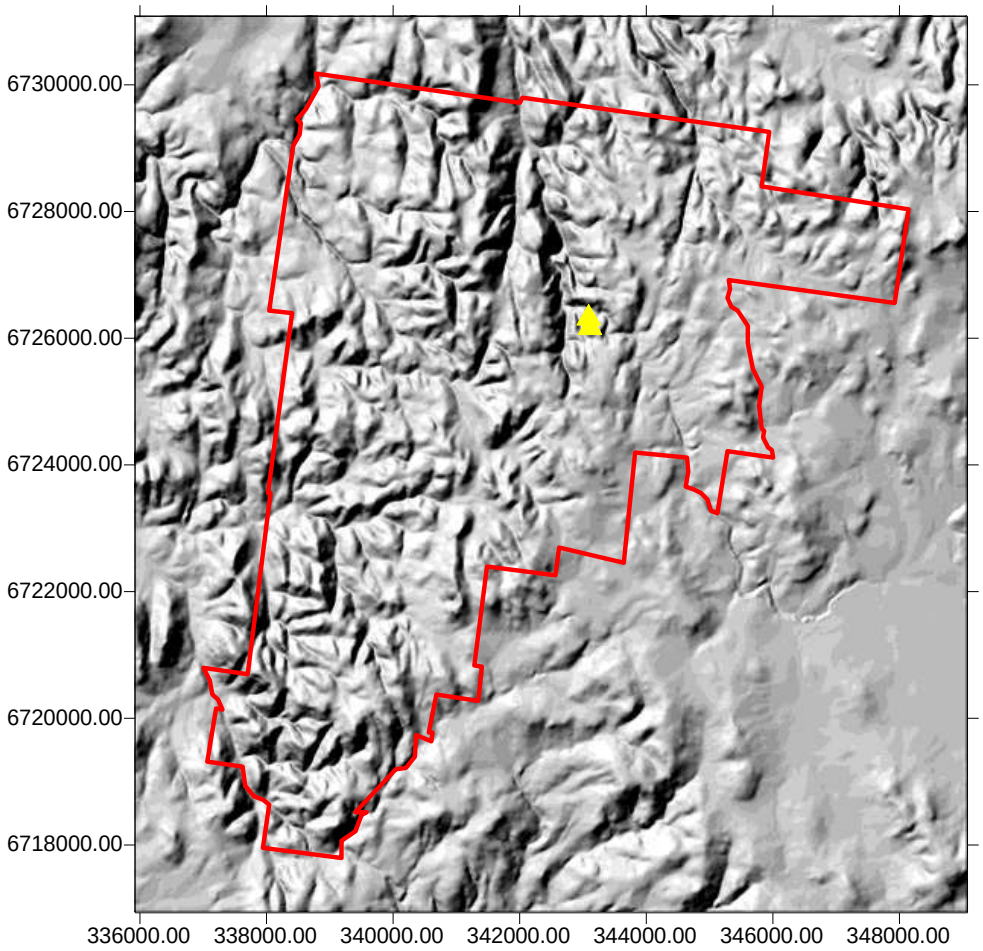


Figure 55: Surveyed localities of *Hibbertia* sp. B.

3.7.12 *Homoranthus biflorus* Craven & S.R.Jones (2VC-; TSC Vulnerable).

Taxonomy

Type: Kings Plains National Park, *Jones* (*holo*: CANB).

Reference: *Australian Systematic Botany* 6: 26 (1991).

Family: Myrtaceae.

Affinities: *Homoranthus croftianus* and *Homoranthus montanus*.

Synonymy: None.

Derivation of name: Meaning two flowered.

Common name: None.

Published conservation status: 2VC- (Briggs & Leigh 1996), unchanged since. Listed on Schedule 2 of the TSC Act as a Vulnerable species.

Life history

Growth form: Shrub to 1.5 m tall.

Vegetative spread: None.

Longevity: Unknown.

Primary juvenile period: Unknown.

Flowers: Spring to Summer.

Fruit/seed: Summer.

Dispersal, establishment & growth: Via fruit.

Fire response: Unknown but likely to be an obligate seeder.

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: Northern Tablelands and the North Western Slopes.

General distribution: From Kings Plains to Pindari Dam.

Distribution within the Kings Plains: Found throughout the reserve.

Habitat

Habitat: Rock outcrops and shallow soils on the margins of outcrops.

Altitude: 600-900 m.

Annual Rainfall: 600-800 mm.

Abundance: Found in dense stands where it occurs, probably has a limited dispersal.

Kings Plains community: Community 5 an d 8.

Substrate: Rhyolite.

Exposure: Fully exposed sites.

Management

Population size: Not certain but probably between 2000 and 5000 individuals.

Reserved: Severn River Nature Reserve and Kings Plains National Park.

Threats: Inappropriate fire regimes.

Management considerations: Basic information on the biology of this species and fire responses is needed.

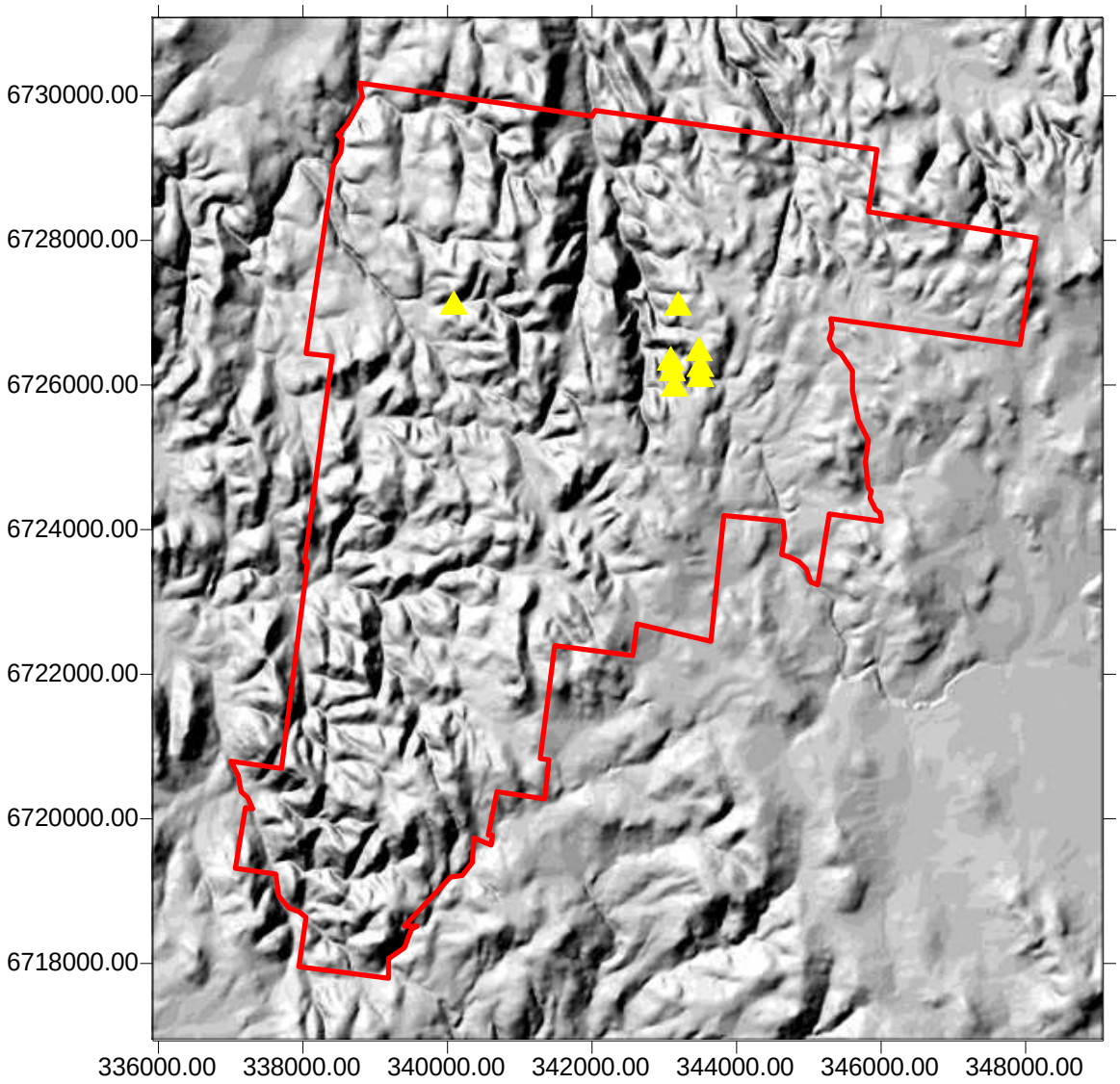


Figure 56: Surveyed localities of *Homoranthus biflorus*.

3.7.13 *Leionema rotundifolium* (Endl.) Paul G. Wilson (3RCa)

Taxonomy

Type: Mount Dangar, Hunters River, New South Wales, *A. Cunningham 55* (*iso*: K, MEL). A number of Cunningham's collections from Mt Hunter are thought to be erroneous and probably collected elsewhere on the Northern Tablelands of New South Wales.

Reference: *Nuytsia* 12: 276 (1998).

Family: Rutaceae.

Affinities: Not apparent.

Synonymy: *Eriostemon rotundifolius* Endl.; *Phebalium rotundifolium* (Endl.) Benth.

Derivation of name: In reference to the round leaves.

Common name: Round-leafed Leionema (*nee Phebalium*).

Published conservation status: 3RC- (Briggs & Leigh 1996). Due to the size of populations within the Girraween NP, Torrington SRA, Severn River NR and Kings Plains NP the species should be considered as adequately reserved.

Life history

Growth form: Shrub to 2 m tall.

Vegetative spread: None.

Longevity: Unknown.

Primary juvenile period: Unknown but likely to be within 5 yrs.

Flowers: Spring.

Fruit/seed: Summer.

Dispersal, establishment & growth: Via seed.

Fire response: Dormant seeds are stimulated by smoke and heat but is an obligate seeder (Clarke & Fulloon 1999). The species has been found to germinate in dense stands in a post fire environment (Hunter, *pers. obs.*).

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: Northern Tablelands, North Western Slopes and the Darling Downs.

General distribution: Found along the western margin of the tablelands from Howell north to Stanthorpe in Queensland.

Distribution within Kings Plains: Found commonly on rock outcrops and their margins throughout the entirety of the reserve but more abundant on the gorge rim and nearby outcrops of the upper parts of Kings Plains Creek.

Habitat

Habitat: Restricted to rock outcrops and shallow soils.

Altitude: 700-1150 m.

Annual Rainfall: 650-1000 mm.

Abundance: Very common on rock outcrops from Howell to the border but necessarily in disjunct small populations.

Kings Plains community: Community 5 and 8.

Substrate: Rhyolite and granite outcrops, but also known off outcrops on Lateritic soils at Severn River NR.

Exposure: Fully exposed to partially shady sites.

Management

Population size: Potentially between 2000-5000 individuals within the reserve.

Reserved: Kings Plains NP, Severn River NR, Goonoowigal FR, Torrington SRA and Girraween NP.

Threats: Known to be browsed by goats (*pers. obs.*). Inappropriate fire regimes.

Management considerations: A targeted search and population size assessment is warranted along with basic information of the species biology.

Figure 57: Photograph of *Leionema rotundifolium*.

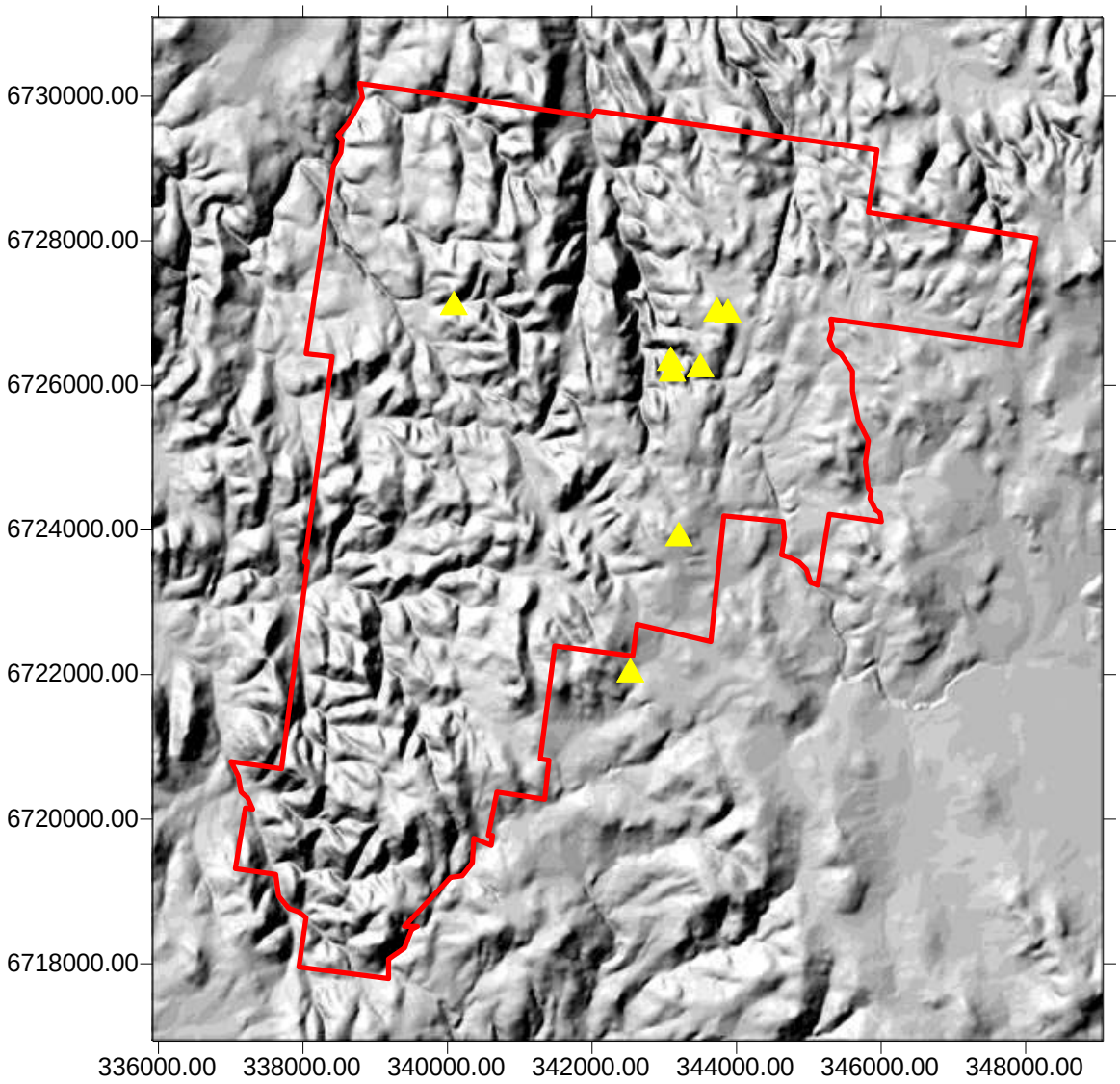


Figure 58: Surveyed localities of *Leionema rotundifolium*.

3.7.14 *Olearia gravis* (F.Muell.) F.Muell. ex Benth. (3KC-).

Taxonomy

Type: Near Tenterfield, New England, *C. Stuart s.n.* (?MEL).

Family: Asteraceae.

Affinities: Uncertain possibly *O. stellutlata*.

Synonymy: *Aster gravis* F.Muell., *Olearia gravis* S.T.Blake.

Derivation of name: Meaning heavy.

Common name: Daisy Bush.

Published conservation status: 3RC (Thomas & McDonald 1989; McDonald *et al.* 1995); 3KC- (Briggs & Leigh 1996).

Life history

Growth form: Densely hairy shrub to 1.6 m tall.

Vegetative spread: No.

Longevity: Not known, but at least 5 years.

Primary juvenile period: Known to flower in the second year.

Flowers: October to December.

Fruit/seed: November to January.

Dispersal, establishment & growth: Dispersed by seed via wind. The species is known to germinate after soil disturbance such as on the side of roads or after road grading (Hunter, *pers. obs.*).

Fire response: Known to germinate after fire, known to resprout.

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: Northern Tablelands and the North Western Slopes of New South Wales. Darling Downs and Burnett in Queensland.

General distribution: A disjunct and sporadic distribution occurs from Murgon to Girraween National Park in Queensland to Torrington and Kwiambal and also at Gibraltar Range National Park.

Distribution within Kings Plains: Found primarily on the gorge rim above Kings Plains Creek and the surrounding shallow skeletal soil areas associated with rock outcrops.

Habitat

Habitat: Usually restricted to granite and rhyolitic outcrops or rocky ridges.

Altitude: 300-1100.

Annual Rainfall: 650-1200 mm.

Abundance: This species often has a clumped distribution with many plants growing in close proximity.

Kings Plains community: Community 5 and 8.

Substrate: Granite and Rhyolite.

Exposure: Fully exposed positions.

Management

Population size: Sparse but common along the gorge rim associated with the upper reaches of Kings Plains Creek, probably 500+ individuals at minimum.

Reserved: Torrington State Recreation Area, Kwiambal National Park, Boonoo Boonoo National Park, Kings Plains National Park and Gibraltar Range National Park in New South Wales. The western portion of Girraween National Park and also Sundown National Park in Queensland.

Threats: Goats have been known to browse this species.

Management considerations: Basic information on the biology and population size of this species is needed. Accurate estimations of the population size of this species within the park are needed.

Figure 59: Photograph of *Olearia gravis*.

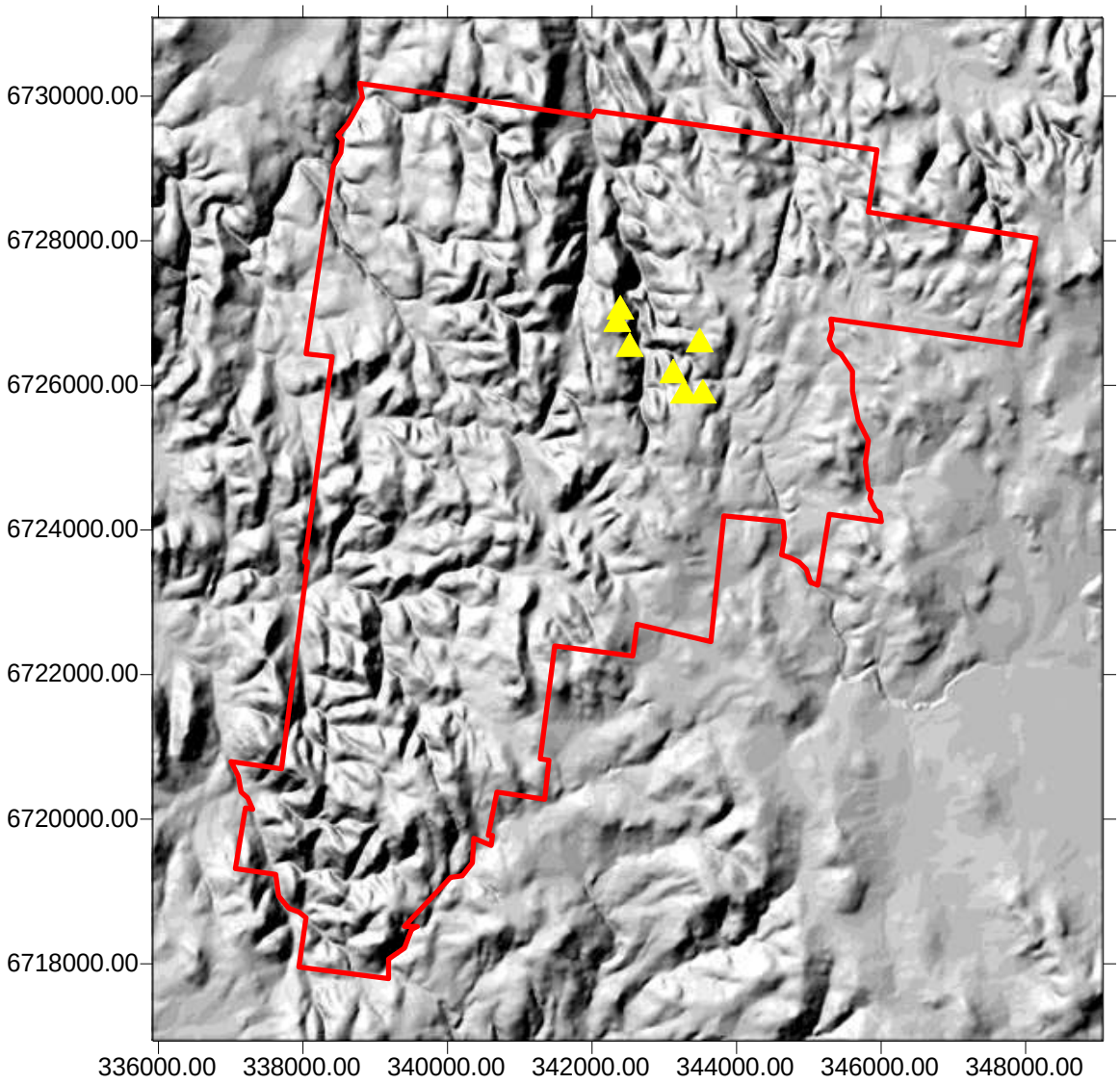


Figure 60: Surveyed distribution of *Olearia gravis*.

3.7.15 *Persoonia terminalis* subsp. *recurva*

Taxonomy

Type: Warialda, *H.M.R. Rupp*, Jan 1907 (*holo*: NSW).

Reference: *Telopea* 4: 282 (1991).

Family: Proteaceae.

Affinities: *Persoonia terminalis* subsp. *terminalis*.

Synonymy: None.

Derivation of name: In reference to the curved back leaf.

Common name: None apparent.

Published conservation status: 3R (Briggs & Leigh 1996), unchanged since.

Life history

Growth form: Shrub to 1 m tall.

Vegetative spread: None.

Longevity: Unknown.

Primary juvenile period: Unknown but probably within 3 yrs based on observations of subsp. *terminalis*.

Flowers: December to January but as late as July.

Fruit/seed: Winter to Spring.

Dispersal, establishment & growth: Fruit.

Fire response: Unknown but subsp. *terminalis i*s an obligate seeder with a long lived seed bank within an unknown recruitment cue.

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: North Western Slopes and Darling Downs.

General distribution: A disjunct distribution in the Cecil Plains and Inglewood area of south east Queensland and Warialda and Severn area of New South Wales.

Distribution within Kings Plains: Not found during the current survey and its occurrence needs to be verified. However the species is likely to occur as it is known from Severn River NR.

Habitat

Habitat: Found on shallow soils associated with the margins of rock outcrops to the east and also from sandstone derived soils.

Altitude: 400-800 m.

Annual Rainfall: 600-800 mm.

Abundance: Found disjunctly in small populations.

Kings Plains community: Unknown.

Substrate: Sandstone, rhyolite and laterite.

Exposure: Fully exposed to partial shade.

Management

Population size: None found during this survey may need verification.

Reserved: ?Kings Plains NP, Severn River NR.

Threats: Inappropriate fire regimes.

Management considerations: The presence of this species within the reserve needs verification and a targeted search should be conducted. Basic information on the species biology and recruitment is needed.

Figure 61: Photograph of *Persoonia terminalis* subsp. *recurva*.

3.6.16 *Thesium australe* R.Br. (3VCi; TSC Schedule 2)

Taxonomy

Type: New South Wales: Central Coast: Cow pasture plains (Camden), near Port Jackson, N.S.W., *R. Brown s.n.*, 19 October 1803 (ISO: MEL).

Family: Santalaceae.

Affinities: The genus has c. 245 species in Europe, Africa, Asia and South America however this is the only representative within Australia.

Synonymy: *Linosyris australe* (R.Br.) Kuntze.

Derivation of name:

Common name: Toadflax.

Published conservation status: 3ECi (Briggs & Leigh 1988); 3VCi (Briggs & Leigh 1996).

Life history

Growth form: Perennial pale green or yellow green parasitic herb to 40 cm tall.

Vegetative spread: No.

Longevity: Unknown.

Primary juvenile period: Unknown.

Flowers: September to March.

Fruit/seed: September to March.

Dispersal, establishment & growth: Dispersal by a dry nut like drupe.

Fire response: Known to resprout after fire. Prolific germination associated with fire or other disturbances (Steve Griffith and Paul Sheringham, *pers. obs.*, *pers. comm.*).

Interactions with other organisms: Parasitic on the roots of grasses. Despite records to the contrary since 1980 the species is still often recorded as being obligately parasitic on *Themeda triandra* (Cohn 1999), however a large number of records are from communities which do not contain *Themeda* but do include a number of other grass species including areas dominated solely by introduced grasses have been noted from as early as 1980.

Distribution

Botanical sub-regions: North Coast, Central Coast, Northern Tablelands, Southern Tablelands, North Western Slopes and Central Western Slopes in New South Wales. Known from Moreton, Darling Downs and Leichhardt in Queensland. In Victoria from D, N, R, S, V, V and from North-eastern in Tasmania.

General distribution: This species has a widespread distribution from south-east Queensland to Gippsland in Victoria and the Bass Strait Islands with a historical record from Tasmania.

Distribution within Kings Plains: Found primarily associated with the margins of Kings Plains and Weean Creeks, usually in areas disturbed by mining.

Habitat

Habitat: Generally restricted to grasslands and woodlands usually on basalts although known from metamorphic sedimentary rocks associated with headlands on the coast and granitic and acid volcanic soils.

Altitude: 100-1800 m.

Annual Rainfall: 400-1200 mm.

Abundance: Known from very sporadic and disjunct populations. Often many plants will occur in a single population.

Kings Plains community: Restricted to Community 5 and 6.

Substrate: Rhyolite.

Exposure: Protected to exposed sites.

Management

Population size: Not definite but probably over 500 individuals throughout the reserve.

Reserved: Known to be reserved in Bullen Range NR, Crowdy Bay NP, Hat Head NP, Kattang NR, Kwiambal NP, Bolivia Hill NR, Kings Plains NP, Arakoola NP, Severn River NR, Kosciusko NP, Llangotholin Lagoon NR, Moonee Beach NR, Mount Greville NP, and Namadgi NP.

Threats: Domestic grazing is a threat to this species however mining does not seem to have affected populations.

Management considerations: Populations are near a major access road and quick monitoring program should be set up to take up minimal time so it may be fitted in with other work be carried out by staff within the proposed park. A more systematic search should occur along Kings Plains and Weean Creeks.

Figure 62: Photograph of *Thesium australe*.

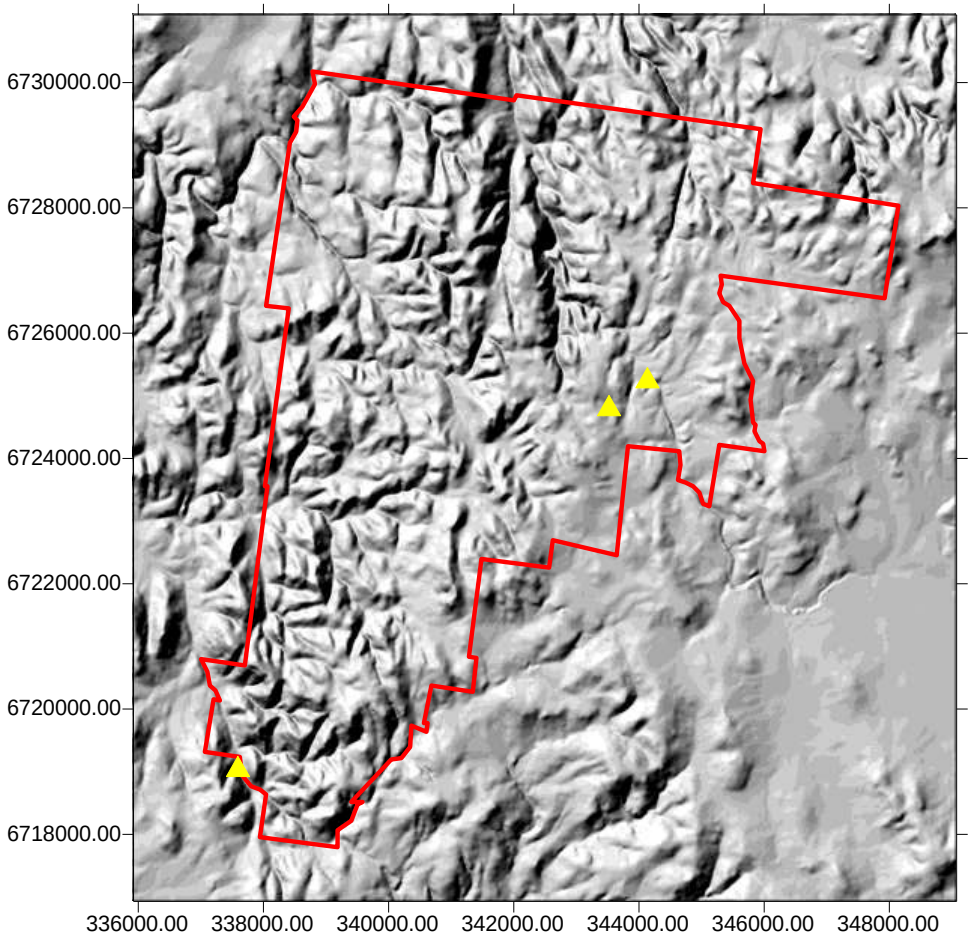


Figure 63: Surveyed distributions of *Thesium australe*.

3.7.17 *Zieria odorifera* m.s. (3RCi)

Taxonomy

Type: Not formally described.

Reference: No formal reference but refer to *Flora of New South Wales* Vol. 2.

Family: Rutaceae.

Affinities: *Zieria aspalathoides*.

Synonymy: None.

Derivation of name: In reference to the strong smell of the leaves when crushed.

Common name: None apparent.

Published conservation status: 3RCi (Briggs & Leigh 1996), unchanged since.

Life history

Growth form: Low shrub to 50 cm tall.

Vegetative spread: None.

Longevity: Unknown.

Primary juvenile period: Unknown but probably within 3 yrs.

Flowers: Spring to Summer.

Fruit/seed: Summer to Autumn.

Dispersal, establishment & growth: Via seed.

Fire response: Unknown.

Interactions with other organisms: None apparent.

Distribution

Botanical sub-regions: North Western Slopes and Northern Tablelands.

General distribution: From Warrumbungles to Howell and north to the Severn River.

Distribution within Kings Plains: Found opportunistically at the north eastern boundary of the reserve and also outside the reserve under the EASTLINK power line easement.

Habitat

Habitat: Shallow soils associated with rock outcrops and their margins.

Altitude: 600-1100 m.

Annual Rainfall: 600-900 mm.

Abundance: Disjunctly distributed and in low numbers.

Kings Plains community: Not formally known.

Substrate: Rhyolite and granite.

Exposure: Fully exposed to partial shade.

Management

Population size: Unknown on one opportunistic recording.

Reserved: Warrumbungle NP and Kings Plains NP.

Threats: Known to be browsed by goats. Inappropriate fire regimes.

Management considerations: A targeted search for this species is warranted. Basic information on the basic biology of this species including responses to fire are required.

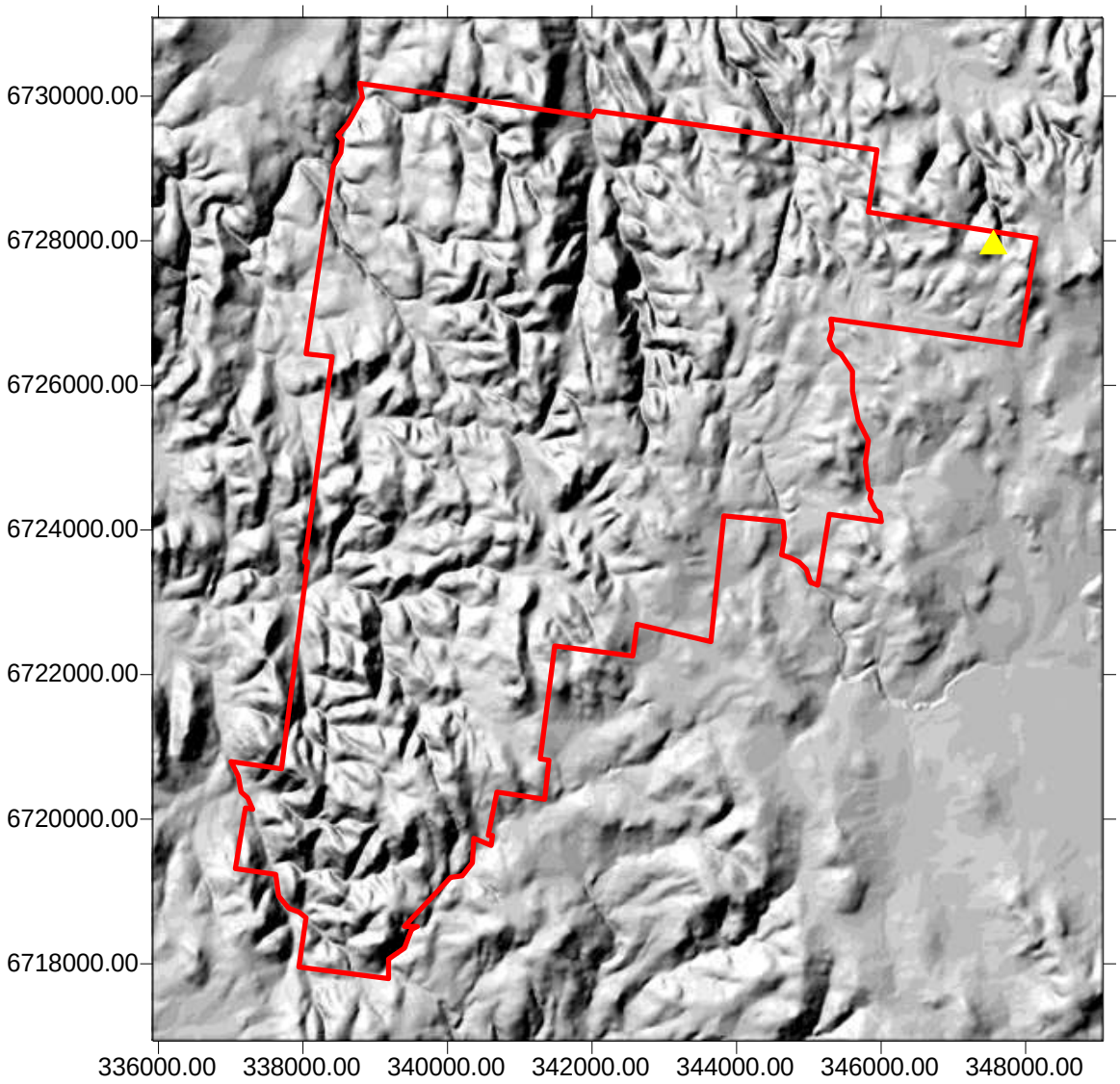


Figure 64: Surveyed distribution of *Zieria odorifera*.

3.7.18 Distribution of rare and threatened species

The biplot of rare plant distribution and significant environmental variables (Figure 65) highlights that a number of these species are associated with shallow soils in exposed positions on rhyolitic soils (-ve Physiography and Soil Type). However, *Eucalyptus mckieana* is restricted to the high altitude eastern margin of the reserve and may be at its climatic limits within the reserve. *Thesium australe* and *Bothriochloa biloba* are correlated with sites of lower topography on 'better soils'. *Thesium australe* is also associated with sites of previous alluvial mining. *Callistemon pungens* is restricted to deeper and 'better' soils on lower topographies also.

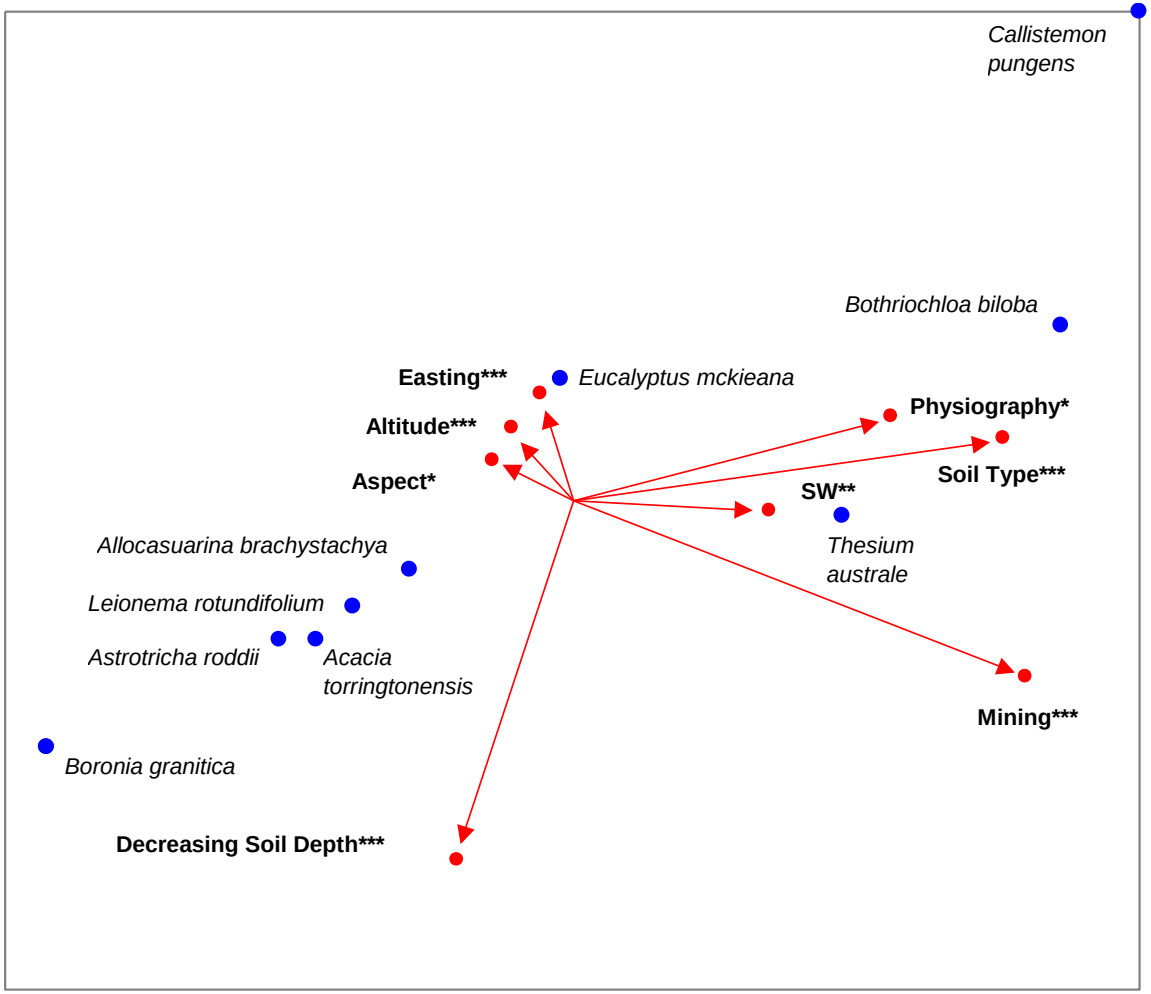


Figure 65: Biplot ordination of the nine rare and threatened species that were sampled in plots during this survey and significant environmental variables.

3.7.19 Other taxa of conservation significance

Actinotus gibbonsii is a prostrate and spreading herb that is considered to be regionally uncommon in the north-east of New South Wales but common elsewhere in the state. The species has been found sporadically throughout mainly higher parts of the north-east. The species is probably more common than collections indicate. This species is often found on rock outcrops particularly after recent fires. Hunter (1999) has found this species to become almost dominant on many granitic and other outcrops after fire and that population numbers decline gradually as time since fire increases. Many of these areas had not had fires in recent years and the seed bank of this species is probably long lived. The ephemeral nature of this species and its restricted habitat requirements have probably led to the infrequent number of collections made. This species was noted a handful of times mainly in areas of small but recent lightning strike fires on exposed skeletal soils.

Allocasuarina gymnanthera is a regionally rare shrub not found during this survey. The species occurs primarily within the Pilliga area. The presence of this species in the reserve requires confirmation and is based on a record from a previous survey. It may be that this record is based on the misidentification of *Allocasuarina brachystachya* or the placement of *Allocasuarina gracilis* under *A. gymnanthera.*

Aristida acuta is a small grass that is considered to be uncommon and at its distribution limit within the north-east of New South Wales. The species is only known from the North Western Slopes and Northern Tablelands on New South Wales.

Cheiranthera cyanea var. *borealis* is a small herb and this variety of the species has until now never been found in New South Wales. The subspecies is common within Queensland. The occurrence of this subspecies is of significance as it is the only confirmed locality within the state, a disjunct distribution and the southern limit of the taxons distribution.

Emilia sonchifolia is a small herb that is regionally rare and the occurrence within Kings Plains is of regional significance.

Eucalyptus moluccanus is a widespread tree species but one that prefers better quality soils and as such is poorly reserved across its range. Only two trees were found in the most southern boundary of the reserve.

Isotoma axillaris is a disjunctly distributed regionally rare herb. It is found often on rock outcrops on the Northern Tablelands and North Western Slopes of New South Wales.

Lepidosperma viscidum is a sedge that has not been found within the North Western Slopes before. This confirmed occurrence is a new disjunct record of this species at its new northern limit of distribution and is thus of regional conservation significance.

Leptospermum divaricatum is a shrub usually found on further west and the occurrence of this species within Kings Plains should be considered significant as the species is at its eastern limits of distribution and is very disjunct. The nearest record is from Coonabarrabran.

Leptospermum parvifolium is a regionally rare shrub that is poorly reserved in northern New South Wales. An old record exists from 1911 around Emmaville and the species has more recently been recorded from the Torrington SRA. Its occurrence within Kings Plains is of regional significance.

Lobelia gibbosa is a regionally scattered herb and its occurrence within Kings Plains could be considered as significant.

Melaleuca erubescens is a regionally rare species near the eastern limit of its distribution. The occurrence of this species within the reserve is of significance.

Melichrus erubescens is a low shrub that is regionally rare and near the limit of the species distribution. The species is more common near Dubbo and Mendooran. The species is only known from a handful of plants within the Torrington SRA and was found in Kings Plains in a previous survey. Verification of the species occurrence within the reserve needs to occur and the size of populations established.

Olearia rosmarinifolia is regionally rare bush and also rare within the reserve (see section 3.7.20). The occurrence of this species within the reserve is of significance.

Phyllanthus subcrenulatus is a regionally disjunct and rare low shrub. It occurs on rock outcrops along the North Western Slopes and western parts of the Northern Tablelands. The species also occurs commonly in Queensland where it is a tall shrub with much larger leaves and is associated with rainforests. It is likely that the New South Wales specimens are a separate species from the Queensland counterparts.

Pomaderris angustifolia is a regionally rare species that has a disjunct northern distribution and has not until now been found this far north. The previous most northern distribution for this species was Warrabah National Park. These new localities within the reserve represent the distributional limit of the species which is also very disjunct in its northern localities.

Solanum laciniatum is a shrub that is considered to be uncommon across its range and regionally rare. The occurrence within the reserve is of regional significance.

3.7.20 Taxa infrequent within Kings Plains National Park

Lists of rare and threatened plants are generally dominated by species that have restricted ranges and/or habitats but other forms of rarity may related to species that are widespread but sparsely distributed (McIntyre 1992). This type of distribution is sometimes called ‘diffuse’. Some of these species may not necessarily have a ‘diffuse’ distribution but may be either seasonally abundant or at the natural climatic limits and thus abundances are low. Of the 436 taxa found within Kings Plains National Park 140 (32%) had summed cover scores from the 75 sample sites of less than 5. Of these 47 (11% of total flora) had summed cover scores of only 1. Diffusive rarity is suggested to be involved in the rarity of 27 of these taxa (Table 4). Some of the results presented may be due to coarse sampling and only further targeted survey can truly assess the rarity within the reserved of the species listed in Table 4.

Table 4: Species found to have summed cover scores of only 1 from 75 plots. Reasons are suggested for the infrequency of sightings.

Name	Diffusive Rarity	Seasonality	Limit of Tolerances	Other
Acacia stricta	?		X	
Agrostis aemula	?	X		
Amyema bifurcatum	X			
Amyema miquelii	X			
Asplenium flavellifolium			X	
Boerhavia dominii	X			May be fire related
Boronia anethifolia			X	
Bracteantha viscosa	?	X		
Calotis dentex	X			
Centipeda minima	X		?	
Centrolepis strigosa	X			
Crassula sieberiana	X			
Cullen tenax	X			
Cynodon dactylon		X		?Sampling intensity
Daviesia genistifolia	X			
Derwentia derwentiana	X	X		
Dipodium variagatum		X		
Dodonaea hirsuta	X			Also ROTAP
Emilia sonchifolia	X		?	
Eragrostis trachycarpa		X		
Evolvulus alsinoides			X	
Galium binifolium			X	
Glycine tabacina	X			?Sampling intensity
Haemodorum planifolium	X			May be fire related
Helichrysum scorpioides	X		?	
Hovea linearis			X	
Kennedia rubicunda			X	
Leucopogon lanceolatus			X	
Mirbelia pungens	X		X	
Notelaea linearis	X			
Olearia microphylla	X			
Olearia ramulosa	X			
Olearia rosmarinifolia	X			
Ozothamnus diosmifolius			X	
Pandorea pandorana	X			
Panicum effusum		X		
Pelargonium inodorum	X			May be fire related
Plantago debilis		X		?Sampling intensity
Podolepis jacioides		X		
Scleranthus biflorus	X			
Stellaria angustifolia	X			
Thelymitra pauciflora		X		
Tricoryna elatior		X		
Urtica incisa	X			?Sampling intensity
Zieria cytisoides	X			
Zieria laevigata	X			

3.7.21 Significant species recorded within close proximity to Kings Plains National Park

Acacia macnuttiana is a vulnerable shrub that has previously been found within the Severn River Nature Reserve and Torrington State Recreation Area on the North Western Slopes. The species did have its largest known single population at Pindari Dam only 7 km away. There is a high likelihood that this species may yet be found within Kings Plains National Park.

Acacia pubifolia is a vulnerable shrub that until recently was thought to be restricted to the Torrington area within New South Wales but has subsequently been found near Warrabah National Park. This species is restricted to rock outcrops and this species may potentially be found within Kings Plains National Park.

Cryptandra lanosiflora is a rare species known from the Torrington State Recreation Area on the North Western Slopes of New South Wales and may yet be found within this reserve.

Eucalyptus caleyi subsp. *ovendenii* is a vulnerable tree that has according to Clarke *et al*. (1998) has been found in both Severn River Nature Reserve and Kings Plains National Park. There are no collections to support these claims. The material photography of this taxon within Clarke and Fulloon (1999) appears to be an intermediate form similar to that found here and as such these observations may be observer error. There is a high likelihood that this species will be found at Kings Plains National Park and the Severn River Nature Reserve however, confirmation is yet to occur. This species at present may only be reserved within the Torrington State Recreation Area.

Micromyrtus grandis is an endangered shrub thus far only known from one locality within Severn River Nature Reserve. However as the Kings Plains National Park has the same rock type and very similar communities this species may potentially occur within the park.

Monotaxus microphylla is a small short-lived fire ephemeral that is listed as endangered within New South Wales. This species has previously been found after fires in the Torrington State Recreation Area and also at Copeton Dam. There is potential for this species to be found in rocky sites after the passage of fire within Kings Plains National Park.

Phebalium glandulosum subsp. *eglandulosum* is an endangered shrub known to occur within the Torrington State Recreation Area and the Severn River Nature Reserve. It is very likely that this species may be found within Kings Plains National Park.

Thelionema grande is a rare species known to occur on rocky substrates across the North Western Slopes and Northern Tablelands of New South Wales. It has previously been found in the nearby Torrington State Recreation Area and other nearby areas within the same bioregion such as Copeton Dam and the Ironbark Nature Reserve. This species may potentially occur in the reserve but also may not occur due to the area being rhyolitic rather than granitic.

3.8 Introduced taxa

A total of 42 species (10%) found during this survey of Kings Plains National Park were introduced. Some of these species are new records of escape for the region including *Verbena brasiliensis* and *Gladiolus carneus*, which are both prevalent along creek lines within the reserve. This number of weeds is relatively low and somewhat intermediate between the more eastern Tablelands surveys (usually *c.* 5-8%) and surveys of areas further west (up to 20% or more). The distribution of weeds is highly skewed to a few communities. In particular Communities 6 and 7 had a very large number of weeds (18-19%) but very low in communities on poor shallow soils such as Community 8 (0.01%). The biplot of weed distributions and significant environmental variables highlights this trend (Figure 66). Most weed species are positively correlated with 'better' soils (+ve Soil Type) on a lower topography (+ve Physiography) and in sites disturbed by mining. On the other had only a couple of species are primarily associated with shallow soils on rhyolite (e.g. *Panicum antidotale*). However, a handful of species at the centroid are not, or weakly, associated with any of the variables displayed for example *Rosa rubiginosa*.

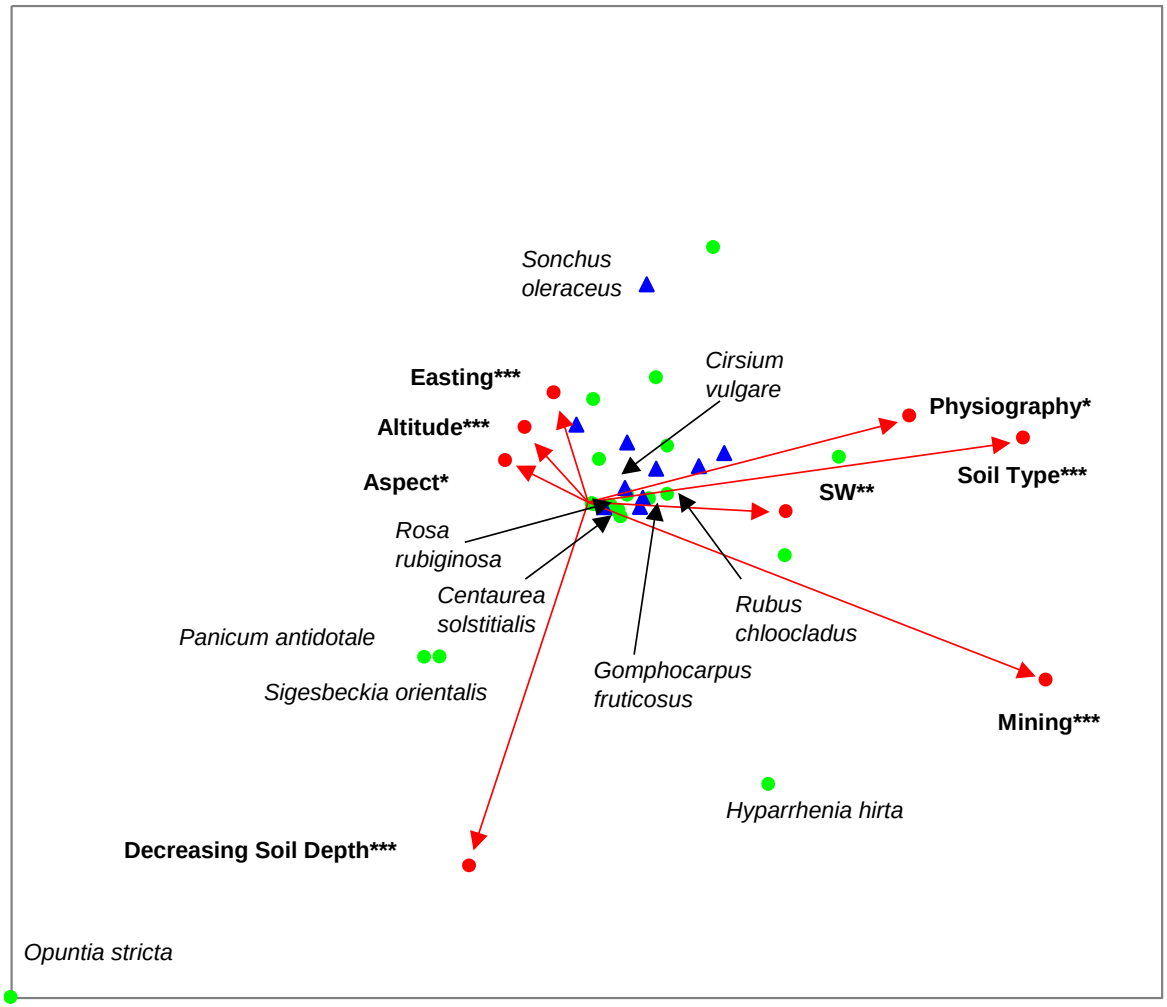


Figure 66: Biplot ordination of introduced species and significant environmental correlations. Blue triangles are the ten most common weeds as indicated by summed frequency and cover. Some of the more notable weeds (including those that are noxious) are labeled.

3.9 Fire responses of individual taxa

The following represents a review of the current literature on the fire responses of individual taxa.

Table 5: Known fire responses and traits of taxa found in Kings Plains National Park. NPFR refers to National Fire Register. Fire responses are based on published information, some of which is contradictory. Possible reasons for these contradictions are discussed in section 4.3.

Name	**Comments**	**References**
Acacia fimbriata	Unheated seed 15% germination, heated 70°C for 10-200 min 80% germination.	Floyd (1976)
Acacia floribunda	Obligate seeder.	Benson (1981)
Acacia ulicifolia	Obligate seeder and facultative resprouter. Variable response to fire. No germination at 60°C. Variable with some populations needing longer duration of heating between 90°-100°C to begin germination. All seeds killed at 120°C for more than 1 min.	Fox & Fox (1986); Auld & O'Connell (1991); Auld (1996); Benwell (1998)
Acaena novae-zelandiae	First recorded 3 –4 months after fire in wet and grassy forest after fire. Regeneration greater 16-24 months after fire than 0-16 months.	Dickinson & Kirkpatrick (1987)
Actinotus gibbonsii	Obligate seeder. This species has been noted to germinate in large numbers of rocky outcrops within a few months of fire and can dominated many burnt patches for 1-2 yrs after fire. The population numbers decrease steadily in the inter-fire period and its presence and abundance may be a rough indicator of time since fire.	*pers. obs.* (JTH)
Actinotus helianthi	Obligate seeder. 100% scorch kills. Initial seed viability 83% but only 65% after 1 yr as soil stored. Usually only 1.5 yrs to set seed but 3-4 yrs for 50% of population to flower. Dies within 5 yrs. Early successional species. Germination is significantly increased in both fresh and soil stored seed up to 2 yrs if smoked.	Siddiqi *et al* (1976); Clemens & Franklin (1990); Benson (1985); Fox & Fox (1986); Conroy (1996); Bradstock *et al.* (1997)

Agrostis avenacea	Facultative resprouter. Annual. Regeneration from seed after intense autumn fire and flowered within 9 months.	Lunt (1990)
**Aira cupaniana*	Obligate seeder. Will flower within 9 months of fire. Numbers increased with fire.	Purdie (1977); Lunt (1990)
Ajuga australis	Sort lived 2-3 yrs, often prominent in disturbed areas such as roadsides and within 1 yr of fire.	Benson & McDougall (1997); *pers. obs.* (JTH).
Alphitonia excelsa	Facultative resprouter. Survives 100% scorch from basal sprouts	NPFR
Alternanthera denticulata	Obligate seeder.	Benson & McDougall (1993); NPFR
Amyema pendulum	Killed by canopy fire.	Benson & McDougall (1997); Reid (1997).
Angophora floribunda	Resprouts from epicormic buds	Benson & McDougall (1998)
Aristida jerichoensis	Fire may increase population numbers.	Gill (1984)
Aristida ramosa	Facultative root resprouter. Fire resistant decreaser. Secondary juvenile period 1 yr.	Purdie & Slatyer (1976)
Arthropodium milleflorum	Recorded 1 month after fire in grassy and wet forest. Cover similar in areas burnt by low and high intensity fires.	Dickinson & Kirkpatrick (1987)
Asperula conferta	Secondary juvenile period < 9 months after intense autumn fire.	Lunt (1990)
Austrodanthonia spp.	Obligate seeder and facultative resprouter. Survive 100% scorch by basal sprouts. Secondary juvenile period < 9 months after intense autumn fire. Significantly more abundant in burnt areas	Lunt (1990); NPFR
Austrostipa rudis	Facultative resprouter. Secondary juvenile period < 9 m after intense autumn fire.	Lunt (1990)
Billardiera scandens	Obligate seeder and facultative resprouter. Variable response. Survive 100% scorch from basal regeneration. Fire resistant decreaser. Seedlings 1 yr after fire.	Purdie (1977); Hamilton *et al.* (1991)
Bracteantha bracteata	Probably killed by fire. Seedling recruitment fire and disturbance related.	Benson & McDougall (1994)
Breynia cernua	Resprouts from base. Mature fruit within 1 yr of high intensity fire.	Benson & McDougall (1995)

Bulbostylis barbata	100% scorch kills. Obligate seeder.	NPFR
Bursaria spinosa	Facultative resprouter. Germination is significantly reduced if smoke treated. Smoke inhibits germination.	Roche *et al*. (1997)
Callistemon sieberi	Resprouter from base. Survives 100% scorch.	NPFR
Calotis cuneifolia	Probably killed by fire.	Benson & McDougall (1994)
Calotis hispidula	Obligate seeder.	NPFR
Carex inversa	Resprouter. Secondary juvenile period < 9 months after intense autumn fire.	Lunt (1990)
Casuarina cunninghamiana	Killed by fire.	Benson & McDougall (1995)
Cheilanthes distans	Facultative resprouter.	Benson & McDougall (1993); NPFR
Cheilanthes sieberi	Facultative resprouter.	Benson & McDougall (1993); NPFR
Chrysocephalum apiculatum	Obligate seeder with some minor regeneration. 100% scorch kills. Secondary juvenile period < 9 months after intense autumn fire Flower production not significantly different 6 months or 2 yrs after spring burns.	Lunt (1990); Lunt (1994)
Chrysocephalum semipapposum	Facultative resprouter. Variable response 100% scorch can kill or may survive from root suckers and basal sprouts. Fire resistant increaser.	Purdie & Slatyer (1976); Purdie (1977)
**Cirsium vulgare*	Obligate seeder. Post burn seed colonizer. Weed promoted by fire. Regeneration slower 16-24 months after fire than 0-16 months. Recorded 1 month after fire in grassy and wet forests.	Floyd (1966); Purdie (1976); Gill (1988); Dickinson & Kirkpatrick (1987); Chesterfield *et al*. (1991)
Commelina cyanea	Obligate seeder and basal resprouter. Survives 100% leaf scorch.	NPFR
**Conyza bonariensis*	Obligate seeder. 100% scorch kills.	NPFR
Correa reflexa	Obligate seeder and facultative resprouter. 100% scorch kills. Increase in number of individuals after low	Hamilton *et al.* (1991)

	intensity autumn fire but none recorded in burnt area immediately after fire.	
Craspedia variabilis	Maximum recruitment may take place if burning occurs very frequently such as every 1-2 yrs.	Lunt (1994)
Crassula sieberiana	Obligate seeder. Seedlings in burnt and unburnt sites 1 yr after fire. Flowers within 7 months of high intensity fire.	Purdie (1977); Benson & McDougall (1995)
Cryptandra amara	Obligate seeder. 100% scorch kills.	Gill (1975)
Daucus glochidiatus	Obligate seeder. Primary juvenile period <1 yr.	Purdie & Slatyer (1976); Purdie (1977)
Desmodium varians	Facultative resprouter. Secondary juvenile period < 9 months after intense autumn fire.	Lunt (1990)
Dianella caerulea	Facultative resprouter. Survives 100% scorch. Resprouted within 1 month of burn. Significant increase one year after fire.	Hamilton *et al.* (991)
Dianella longifolia	Facultative resprouter.	NPFR
Dianella revoluta	Obligate seeder and facultative resprouter. Survives 100% scorch. Fire resistant increaser. Viability 96% initially only 36% after 1 yr of soil storage. Secondary juvenile period < 9 months after intense autumn fire.	Purdie & Slatyer (1976); Purdie (1977); Lunt (1990); Roche *et al.* (1997)
Dichelachne crinita	Facultative resprouter. Secondary juvenile period < 9 months after intense autumn fire.	Lunt (1990)
Dichelachne micrantha	Facultative resprouter.	NPFR
Dichelachne rara	Facultative resprouter.	NPFR
Dichondra repens	Obligate seeder and Resprouter. Did not flower within 9 months after intense autumn fire.	Lunt (1990)
Dodonaea viscosa	Facultative resprouter. Fire sensitive. Germination widespread without fire but recruitment promoted by fire if soil temperature < 70-80°C.	Hodgkinson & Oxley (1990); Hodgkinson (1991); *pers. obs.*
Drosera binata	Facultative resprouter. Flowers abundantly only after fire (pyrogenic flowering).	Keith (1996)
Drosera spatulata	Facultative resprouter. 100% scorch kills.	NPFR
Echinopogon ovatus	Facultative resprouter. Survives 100% scorch	NPFR

Entolasia stricta	Facultative resprouter. Survives 100% scorch from root suckers. Clonal increaser. Lower mortality after spring fires than autumn. Time of year burnt and temperature are predictors of occurrence.	Clark (1988); Bradstock *et al.* (1997); Benwell (1998)
Epilobium billardierianum subsp. *cinereum*	Obligate seeder.	NPFR
Eucalyptus andrewsii	Resprouter from lignotuber and coppice.	Gill (1981)
Eucalyptus melliodora	Resprouter. Seedlings remarkable tolerance to being burnt.	Leigh & Holgate (1979); Gill (1997)
Euchiton involucratus	Obligate seeder. Primary juvenile period 1 yr.	Purdie & Slatyer (1976); Purdie (1977)
Euchiton sphaericus	Obligate seeder.	NPFR
Exocarpus cupressiformis	Facultative resprouter. Root suckers and basal sprouts. Survive 100% scorch. Fire resistant increaser. Seedlings recorded 1 yr after fire.	NPFR
Fimbristylis dichotoma	Resprouter.	Benwell (1998)
Galium binifolium	Obligate seeder.	NPFR
Galium propinquum	Facultative resprouter.	NPFR
Geranium solanderi	Obligate seeder. Reduced in areas frequently burnt.	Hamilton *et al.* (1991); NPFR
Glycine clandestina	Variable, obligate seeder and Facultative resprouter. Has persistent rootstock and deep taproot. Increasing germination with increased duration of exposure to 80°C.	Jarrett & Petrie (1929); Floyd (1966); Auld & O'Connell (1991)
Gonocarpus micranthus	Variable, obligate seeder and facultative resprouter. Killed by fire. Clonal reproduction after seedling establishment. Rapidly thinning survivorship. Primary juvenile period 6-12 months. Probably killed after high intensity fire. Resprouted and killed by fire at Bald Rock National Park, germination within 3 months of fire.	Keith (1992); Keith (1996); Benson & McDougall (1997); Benwell (1998); *pers. obs.*

		(JTH)
Gonocarpus tetragynus	Variable, obligate seeder and facultative resprouter. Regrowth from suckers. Survives and is killed by 100% scorch. Seedlings 1 yr after fire. Secondary juvenile period 2 yrs. Within 2 months of fire at Bald Rock National Park.	Benson & McDougall (1997); *pers. obs.* (JTH)
Gonocarpus teucrioides	Variable, obligate seeder and resprouter. 100% scorch kills. Seedlings within 10 weeks of high intensity fire. Episodic recruitment after fire.	Benson (1985); Keith (1996); Benson & McDougall (1997)
Goodenia bellidifolia	Variable, obligate seeder and facultative resprouter. Survive 100% scorch. Primary juvenile period between 2-4 yrs. Secondary juvenile period 2 yrs. Absent or rare in heath unburnt for 10 yrs. Survival dependent on fire intensity.	Clemens & Franklin (1980); Benson (1985); Benson & McDougall (1997); Bradstock *et al.* (1997)
Goodenia hederacea	Facultative resprouter. Survives 100% scorch. Fire resistant increaser. Seedlings of greater density in unburnt areas. Seeds destroyed by fire. Secondary juvenile period 1-2 yrs. Burning may retard its vegetative spread. Poor post fire survival but strong recruitment 1 yr after fire.	Purdie & Slatyer (1976); Purdie (1977a); Purdie (1977b); Clark (1988); Benson & McDougall (1997)
Gratiola peruviana	Obligate seeder.	NPFR
Haemodorum planifolium	Resprouter. Survives 100% scorch. Seed set in 1.5 yr old heath. Absent or rare in 10 yr old heath.	Clemens & Franklin (1980)
Hakea dactyloides	Facultative resprouter. Survives and is killed by 100% scorch. Vegetative regeneration and flowering at 9 months after spring fire.	Clancy (1981); NPFR
Haloragis heterophylla	Resprouter. Secondary juvenile period < 9 m after intense autumn fire. Multiplied vegetatively after autumn fire.	Lunt (1990); Benson & McDougall (1997)
Hardenbergia violacea	Variable, obligate seeder and facultative resprouter. Survive 100% scorch. Fire resistant decreaser. Seedlings 1 yr after fire. Rare in unheated soil. Highest germination if soil reaches 90°C, less if 100°C or higher. Secondary juvenile period 1 yr after fire. Survives 2 successive fires in 2 years at Bald Rock National Park.	Floyd (1966); Purdie (1977a); Auld & O'Connell (1991)

Helichrysum rutidolepis	Facultative resprouter. Secondary juvenile period < 9 months after intense autumn fire. Multiplied vegetatively after autumn fire.	Lunt (1990)
Hibbertia acicularis	Facultative resprouter. 100% scorch kills. Non-clonal decreaser.	Benwell (1998)
Hibbertia obtusifolia	Variable (probably consists of many taxa). Fire resistant increaser. Survives 100% scorch. Killed after hot fire. Germination within 1 yr after fire.	Purdie & Slatyer (1976); Siddiqi *et al.* (1976); Purdie (1977a); Fox & Fox (1986); Benson & McDougall (1995); Benwell (1998)
Hovea linearis	Facultative resprouter. Survives and is killed by 100% scorch. Decreaser. Better autumn than spring recruitment.	Clark (1988)
Hybanthus monopetalus	100% scorch kills.	NPFR
Hydrocotyle laxiflora	Obligate seeder	NPFR
Hypericum gramineum	Variable, obligate seeder and facultative resprouter. Fire resistant decreaser. Secondary juvenile period < 9 months after intense autumn fire. First recorded 1 month after fire in wet and grassy forest. Recruitment mainly after fire.	Purdie & Slatyer (1976); Dickinson & Kirkpatrick (1987); Lunt (1990); Benson & McDougall (1995)
**Hypochaeris radicata*	Variable, obligate seeder and facultative and obligate seeder. Post burn seed colonizer. Fire resistant decreaser. Survives 100% scorch. Primary juvenile period 1 yr. Secondary juvenile period < 9 months after intense autumn fire. First recorded 1 month after fire.	Purdie & Slatyer (1976); Purdie (1977a); Dickinson & Kirkpatrick (1987); Lunt (1990); Hamilton *et al.* (1991)
Imperata cylindrica	Facultative resprouter. Survives 100% scorch. Common in areas burnt extensively. Absent from infrequently burnt sites. Burning encourages spread.	Benson (1985); Nieuwenhuis (1987)
Indigofera australis	Variable, obligate seeder and facultative resprouter. Fire resistant increaser. Survives 100% scorch. Primary	Floyd (1976); Purdie &

	juvenile period 2-3 yrs. Secondary period 2 yrs. Flowers greatest after low intensity burn and decreases with increasing intensity.	Slatyer (1976); Purdie (1977a); Leigh & Holgate (1979)
Isotoma axillaris	Resprouter.	Benson & McDougall (1997)
Jacksonia scoparia.	Size of stem may influence survival after low intensity burn. Seedlings present within 1 yr after fire. Resprouts from root suckers.	Auld (1996); Benson & McDougall (1997); *pers. obs.* (JTH)
Juncus pauciflorus	Obligate resprouter.	NPFR
Kennedia rubicunda	Variable, obligate seeder and facultative resprouter. Increasing germination with increasing exposure to 80°C, germination also high at 100°C although long duration's decreased germination. Hot fire favors this species. Could be used as an indicator of high intensity fires.	Floyd (1976); Auld & O'Connell (1991)
Lagenifera stipitata	Variable, obligate seeder and facultative resprouter. Flower within a month of high intensity fire.	Benson & McDougall (1994); NPFR
Lepidosperma laterale	Facultative and obligate resprouter. First recorded 1 month after fire.	Dickinson & Kirkpatrick (1987); Hamilton *et al.* (1991)
Leptospermum arachnoides	Facultative resprouter. Survives 100% scorch.	NPFR
Leptospermum novae-angliae	Obligate seeder. Killed by 100% scorch at Bald Rock National Park.	*pers. obs.* (JTH)
Leptospermum polygalifolium	Facultative resprouter. Non-clonal decreaser. Survives 100% scorch.	Benwell (1998); NPFR
Leucopogon lanceolatus	Facultative resprouter. Survives 100% scorch. Survives 2 fires in 2 yrs at Bald Rock National Park.	Fox & Fox (1986); *pers. obs.* (JTH)

Leucopogon virgatus	Facultative resprouter. Survives 100% scorch. Non-clonal decreaser. No seedlings within 1 yr after fire. Primary juvenile period 2 yrs.	Gill (1975); Fox & Fox (1986); Purdie & Slatyer (1976); Purdie (1977a); Benwell (1998)
Lobelia gibbosa	Variable, obligate seeder and obligate resprouter. Flowering within 12 months of fire.	Benson & McDougall (1997)
Logania albiflora	Resprouter. Resprouts from base after high intensity fire. Secondary juvenile period after high intensity fire between 1 and 3+ yrs.	Benson & McDougall (1997)
Lomandra filiformis	Variable, obligate seeder and facultative and obligate resprouter. Survives 100% scorch. Fire resistant increaser. No seedlings recorded in 1st year after fire although plants present in all pre-burn sites. Secondary juvenile period 1 yr.	Fox & Fox (1986); Purdie & Slatyer (1976); Purdie (1977a); Bradstock *et al.* (1997)
Lomandra longifolia	Variable, obligate seeder and facultative and obligate resprouter. Clonal decreaser. Fire resistant increaser. No seedlings within 1st yr after fire although plants present pre fire. Cover remained the same pre and post fire. Survived 2 burns in 2 yrs at Bald Rock National Park.	Purdie (1977a); Fox *et al.* (1979); Leigh & Holgate (1979); Dickinson & Kirkpatrick (1987); Hamilton *et al.* (1991); Benwell (1998); *pers. obs.* (JTH)
Lomandra multiflora	Facultative and obligate resprouter. Fire resistant increaser. No seedlings within 1st yr after fire although plants present pre burn. Smoke increases germination. Secondary juvenile period 2 yrs. Absent from infrequently burnt sites.	Purdie & Slatyer (1976); Purdie (1977a); Nieuwenhuis (1987); Roche *et al.* (1997)
Mentha satureioides	Probably resprouts from rhizome.	Benson & McDougall (1997)
Microlaena stipoides	Facultative resprouter. Fire resistant increaser. Survives 100% scorch. Secondary juvenile period 2 yrs. Regeneration greater 16-24 months after fire than 0-16 months. First recorded 1 month after fire. High rate of	Purdie & Slatyer (1976); Purdie (1977a); Dickinson &

	survival and recruitment.	Kirkpatrick (1987); Clark (1988)
Monotoca scoparia	Variable, obligate seeder and facultative and obligate resprouter. Non-clonal decreaser. Fire resistant decreaser. Negligible mortality after fire.	Purdie & Slatyer (1976); Purdie (1977a); Leigh & Holgate (1979); Fox & Fox (1986); Benson & McDougall (1995); Benwell (1998)
Muellerina eucalyptoides	Resprouter.	Benson & McDougall (1997)
Opercularia aspera	Obligate seeder. Present in 1.5 yr old heath but absent or rare in 10 yr old heath.	Clemens & Franklin (1980); Fox & Fox (1986)
Opercularia hispida	Resprouter. Survives 100% scorch.	NPFR
Pandorea pandorana	Facultative resprouter. 100% scorch kills. Resprouts after high intensity fire.	Benson & McDougall (1994); NPFR
Patersonia sericea	Facultative resprouter. Good post fire recruitment.	Clark (1988); Bradstock *et al.* (1997); Benwell (1998)
Persoonia tenuifolia	Facultative resprouter.	NPFR
Petrophile canescens	Facultative resprouter. Non-clonal decreaser.	Benwell (1998)
Phyllanthus occidentalis	Facultative resprouter. Clonal increaser.	Hunter *pers. obs.*; NPFR
Pimelea linifolia	Variable response, obligate seeder and obligate and facultative resprouter. Resprouts and is killed by 100% scorch. Fire sensitive decreaser. Seedlings within 1 yr after fire in all burnt sites. Soil stored seed probably lives up to 20 yrs. Primary juvenile period 2-4 yrs. Lifespan probably 10-12 yrs. Disappears from communities 10-12 years after fire.	Purdie & Slatyer (1976); ; Purdie (1977a); Clemens & Franklin (1980); Benson (1985); Clark (1988); Bradstock *et al.* (1997);

		Benwell (1998)
**Plantago lanceolata*	Obligate resprouter.	Lunt (1990)
Plantago varia	Facultative resprouter. Recorded 1 month after fire in grassy forest.	Dickinson & Kirkpatrick (1987)
Platysace ericoides	Variable response, obligate seeder and facultative resprouter. Clonal increaser. Killed and survives 100% scorch. Poor survival but excellent recruitment.	Clark (1988); Benson & McDougall (1993); Benwell (1998)
Plectranthus parviflorus	Killed after high intensity fire. Germination < 4 months after high intensity fire. Primary juvenile period < 1 yr. Longevity 2-5 yrs.	Benson & McDougall (1997)
Poa sieberiana	Facultative resprouter. Secondary juvenile period < 9 months after intense autumn fire. No mortality when grazed and burnt. Successive spring fires 3 years apart will increase density.	Leigh & Holgate (1979); Lunt (1990); Keith (1996)
Pomax umbellata	Obligate seeder. 100% scorch killed.	Benwell (1998)
Poranthera microphylla	Obligate seeder. 100% scorch kills. Germinate within 1 yr after fire. Primary juvenile period 1 yr. Flowers profusely the year after fire. Not recorded in woodland unburnt for 20 yrs.	Purdie & Slatyer (1976); Purdie (1977a); Bradfield (1981); Benson & McDougall (1995)
Pratia purpurascens	Resprouter, after high intensity fire. Some resprouters flowered 9 wks after high intensity fire.	Benson & McDougall (1997)
Pteridium esculentum	Facultative resprouter, rhizomes. Survives 100% scorch. Numbers increase after fire. Recruitment decreases with time since fire. Will persist for more than 30 yrs in open places. Can dominate the understorey up to 18 months after fire. Significant negative correlation between bracken density and species diversity. Cover reaches a peak 5-10 yrs after fire. Will peak initially 1 yr after fire and 5 yrs after fire.	Cremer & Mount (1965); Fox *et al.* (1979); Benson (1985); Dickinson & Kirkpatrick (1987); Fox (1988); Barker (1990); Hamilton *et al.* (1991); Benson & McDougall

		(1993); Keith (1996)
Schoenus apogon	Variable, obligates seeder and facultative and obligate seeder. Secondary juvenile period < 9 m after intense autumn fire. First recorded 3 months after fire in wet forest and 1 month after fire in grassy forest. Favoured areas of low intensity burn in wet and grassy forests.	Dickinson & Kirkpatrick (1987); Lunt (1990)
Senecio diaschides	Obligate seeder. Seedlings grow vigorously after fire.	Benson & McDougall (1994); NPFR
Senecio quadridentatus	Obligate seeder. Primary juvenile period 1 yr. Longevity 2-3 yrs.	Purdie & Slatyer (1976); Purdie (1977a); Benson & McDougall (1994)
**Sigesbeckia orientalis*	100% scorch kills. Regular fire increases population numbers. Germinates vigorously and immediately after fire. Can flower within 4 months of fire.	Benson & McDougall (1994); NPFR; *pers. obs.* (JTH)
**Sonchus asper*	Obligate seeder. Primary juvenile period 1 yr. Successful post burn seed colonizer.	Purdie & Slatyer (1976); Purdie (1977a); Dickinson & Kirkpatrick (1987)
Stackhousia viminea	Obligate seeder. Seed bank half life in several decades.	Keith (1996)
Stellaria flaccida	Obligate seeder. Large numbers germinate in many burnt habitats. Probably killed by fire	Jarrett & Petrie (1929); Melick & Ashton (1991); Benson & McDougall (1995)
Stylidium graminifolium	Variable, obligate seeder and obligate and facultative resprouter. Fire resistant decreaser. Seedlings substantially higher in burnt areas. Seedlings recorded within 1 yr after fire. 100% scorch kills. Secondary juvenile period 1 yr.	Leigh & Holgate (1979); Purdie & Slatyer (1976); Purdie (1977a); Purdie (1977b); Kirkpatrick (1984); Benwell (1998)

Stypandra glauca	Facultative resprouter. Survives 100% scorch.	Roche *et al*. (1997). NPFR
Themeda triandra	Facultative resprouter. Non-clonal decreaser. Survive 100% scorch. Secondary juvenile period < 9 months flowered after intense autumn fire. May dominate in frequently burned sites. Shooting 2 weeks after fire. Seedlings did not flower within 9 months of autumn fire and were significantly higher in the burnt areas.	Rowley & Brooker (1987); Lunt (1990); Benson & Howell (1994)
Thysanotus tuberosus	Variable, obligates seeder and facultative and obligate resprouter. Secondary juvenile period 4 months after fire. Common in areas burnt by severe fires 2 yrs previous.	Fox (1974); Bradfield (1981); Benwell (1998)
Trachymene incisa	100% scorch kills.	NPFR
Tricoryne elatior	Facultative resprouter. Killed and survives 100% scorch. Secondary juvenile period < 9 months after intense autumn fire. Absent 9 months after spring/summer fires in clay heath	Clancy (1981); Lunt (1990); Roche *et al*. (1997); Benwell (1998)
Urtica incisa	Prolific after fire.	Gill (1981); Melick & Aston (1991)
Viola hederacea	Variable, obligates seeder and facultative resprouter. 100% scorch kills. % cover the same before, immediately after and 1 yr after low intensity autumn burn. Common in areas burnt by severe fire 2 yrs previous.	Jarrett & Petrie (1929); Bradfield (1981); Hamilton *et al.* (1991)
Wahlenbergia communis	Obligate seeder. 100% scorch kills. Killed by fire. Flowers within 16 weeks of fire. .	Benson & McDougall (1995); NPFR
Wahlenbergia gracilis	Facultative resprouter. Probably killed by high intensity fire. Flowering within 4 months of fire.	NPFR
Wahlenbergia stricta	Obligate seeder. 100% scorch kills.	NPFR
Xanthorrhoea johnsonii	Does not require fire for flowering but fire stimulates flowering. Fires in summer will increase flowering and seed set. Often found in more fire prone communities.	Gill & Ingwersen (1975)

Discussion

4.1 Floristic and environmental relations

A total of 441 taxa were found within Kings Plains National Park. This is of high richness for a region on the western parts of the tablelands with minimal rock type differentiation. Most areas that have greater richness within the same bioregion have been surveyed over a number of seasons and years. It is likely that after subsequent sampling the richness of the park will be between 500 and 600 species. The regional diversity is also very high and shows a similar pattern. Site richness was comparatively high with most sites considered species rich. Most 0.04 ha plots had a richness of between 45-55 species, which is much higher than most surveys within the same bioregion except for the survey conducted at Torrington (Clarke *et al.* 1998).

The significant correlations highlight many of the general trends that have been found throughout other similar scaled surveys in the north east of New South Wales. Surprisingly though Mining as a qualitatively scored variable was shown to be the most significant correlation in terms of canonical distribution of sites and species. Soil Depth, Soil Type and Physiography were the next most significant correlations. These factors accounted for most of the variance in site ordination. All of these factors may be defacto variables for water retention a factor shown to be highly significant in other studies of community analysis (Hunter 1998; Hunter 1999ab; Hunter & Alexander 1999). Many species and communities found within the reserve seemed to be at the limit of their climatic tolerances within Kings Plains and were restricted to the plateau area of the park that was restricted along the eastern boundary. This is reflected in Altitude and Easting being somewhat collinear and both being of high significance but generally of little explanatory power overall. Protection from the SW has been noted in a number of studies also and it appears that in particular across the western and higher parts of the New England the dry south westerly winds are a significant factor in community and species occurrences (Hunter 1998b; Hunter 1999).

4.2 Comparison with previous surveys

Very few floristic surveys and predictive analyses have been performed for communities within the western parts of the Northern Tablelands and the North Western Slopes of New South Wales (Figure 67). Biogeographically Kings Plains National Park is best described as being part of the Nandewar (NAN) Bioregion although it is currently placed within the New England Tablelands (NET) Bioregion. The park truly represents a crossover from the NET and the NAN but with greatest overall affinities for the latter. Morgan and Terrey (1999) have further divided the currently circumscribed NET bioregion into 18 provinces. Of these Kings Plains National Park and Severn River Nature Reserve are placed within Province 10 Severn Volcanics.

The most extensive surveys to have been conducted within some proximity to Kings Plains National Park are those from Torrington SRA (Clarke *et al.* 1998), the Ashford Map Sheet (Le Brocque & Benson 1995) and Hunter (1999). These however are only of broad relevance to the major communities found within the National Park. Although some overlap occurs between communities found within Torrington and the Ashford Map Sheet these areas are quite different due to their topography and the rock types on which the vegetation occurs. The work of Hunter (1999) is also of limited comparative use as it only concentrates on one of the eight communities recognised by this survey. The most synonymous regions with relevance to Kings Plains National Park are the Severn River Nature Reserve, the laterite country south of Gilgai, the Moredun Dams area west of Guyra and Sundown National Park in Queensland. It is not until some systematic vegetation work is carried out in these places that a comprehensive understanding of the communities found within Kings Plains and their distribution will be truly understood. However based on current knowledge it can be surmised that overall the flora and vegetation of Kings Plains National Park is most closely linked to Severn River Nature Reserve then to Moredun Dams and Sundown National Park and then to places such as Howell, Torrington, Girraween National Park and areas as far south as Warrabah National Park and west to Mt Kaputar National Park.

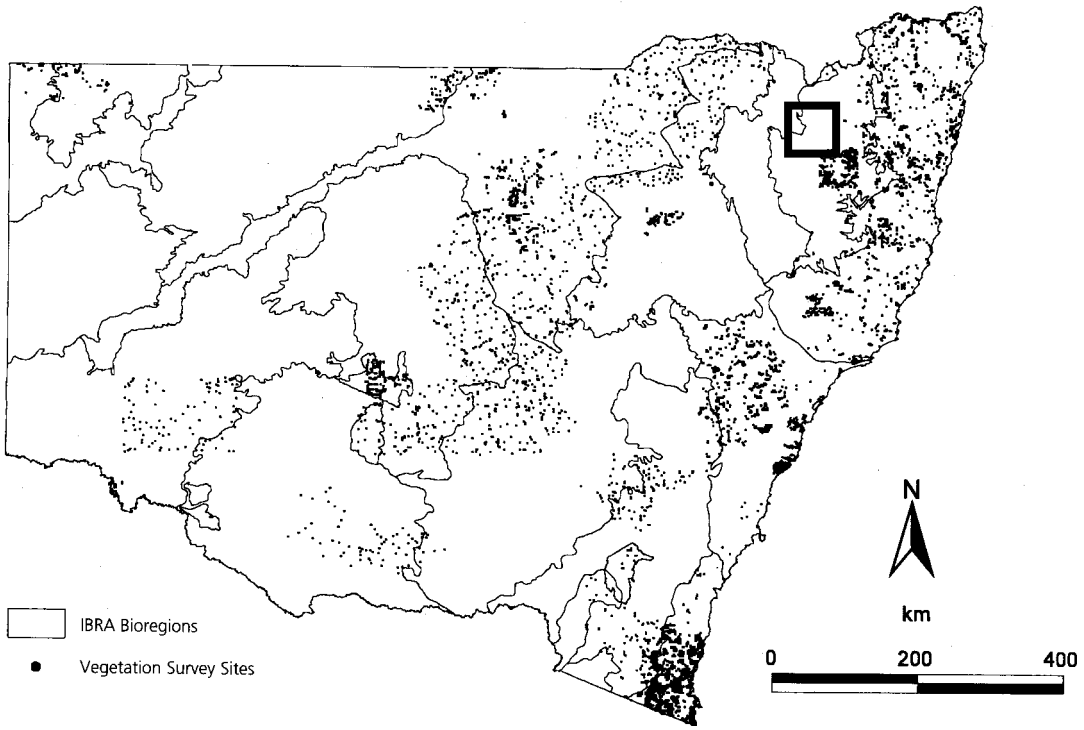


Figure 67: Taken from Benson (1999) this map shows the locations of vegetation sample survey plots in New South Wales based on over 20 000 databased plots. The general location of Kings Plains National Park is given by the placement of the square. Note the few to no plots placed on the western slopes of the state.

4.3 Fire

Fire is a natural component of many communities within Australia, particularly for the south east. A lot of research has been conducted over recent years into the effects of fire regimes (in terms of frequency, intensity and seasonality) on individual species and communities as a whole. Most of this research has centred on temperate communities such as coastal forests and heaths, tablelands and alpine areas. This research is often habitat and site specific and the usefulness of the findings to other areas, even somewhat synonymous ones, is debatable. Table 5 shows the responses of some of the Kings Plains species to the effects of fire. Several of these observations may be based on mis-classification of functional type, the taxa in question being a complex of yet undefined entities or as some recent research suggests; plant age (Hansen *et al.* 1991), seed age and dormancy requirements (Roche *et al*. 1997); Hunter *et al.* 1998) and local population differences (Benwell 1998; Hunter 1999). Such differences may exist in nearby or the same sites. The application of fire regimes

at the community level based on the culmination of the responses of individual taxa, is of debatable use. However, from the literature and the responses of individual taxa broad general statements can be formulated for many communities. These suggestions should then be modified to suite the local variation in responses, as data that is more specific becomes available. This can only be achieved by research and constant monitoring.

4.2.1 *Callitris* dominated woodlands

The affects of fire and its various aspects on the natural communities at Kings Plains can only be guessed at based on the scanty information that exists for some of major species. Most communities within Kings Plains are dominated by *Callitris endlicheri* and various Ironbarks and Gums. *Callitris* spp. are very sensitive to fire, being killed outright if crown scorch occurs (Bowman *et al.* 1988; Bowman & Latz 1993; Latz 1995). Furthermore, high intensity fires can have a longer lasting affect beyond simply removing the adult trees. The long-term management of *Callitris* spp. requires a reduced fire intensity (Bowman & Latz 1993) as seed production has been shown to decline after severe fires (Hawkins 1966). Seedlings of *Callitris* spp. are easily killed by browsing animals such as rabbits, sheep and goats (Johnson 1967) when regenerating.

Callitris endlicheri however, is an aggressive coloniser of new sites in the absence of severe wildfires or grazing (Forestry Commission of New South Wales 1988; Young & McDonald 1989). Although *Callitris* seeds have no longevity the species are prolific seeder and will regenerate thickly, but the species lacks a self-thinning strategy (Forestry Commission of New South Wales 1988). In the absence of fire *Callitris glaucophylla* can become mono-dominant and exclude most other species. For example, at Howell the region has gone from eucalypt dominated woodlands where *Callitris* was rare, to one that is almost mono-dominant with *Callitris* due to the lack of fire (Hunter 1998). Thinning will only occur through low intensity fires and its subsequent removal of individual trees rather than a whole population (Forestry Commission of New South Wales 1988).

Gill (1981) describes a replacement series in *Callitris* – *Eucalyptus* woodlands. The simplest scenario describes *Eucalyptus* species as being resprouters that will regenerate from seed only after fire. *Callitris* is killed by fire yet the canopy- stored seed will be released and can germinate any time in the inter-fire period. *Callitris* seedlings however take ten years to become reproductively mature. Without fire *Callitris* will dominate, as it will continue to recruit while the *Eucalyptus* species will eventually die out (c. 100 years). Fire intervals of less than ten years will promote *Eucalyptus* as the only survivor. For a mixed stand to develop, according to this basic model, fires need to be greater than ten years and less than 100 years. As more species are considered however the model becomes more complex.

4.2.2 Fire and rhyolitic outcrops

Observations suggest that fires are much less frequent on rock outcrops and that even within fire prone environments they are likely to have fire intervals many times greater than the surrounding forests or woodlands. Outcrops are unlikely to evolve a fire promoted flora and work by Clarke and Fulloon (1999) and Hunter (1999) has explicitly shown that obligate seeders dominate the flora of rock outcrops.

Outcrop communities are generally collectively lumped with other shrubland or heath communities although this allocation is often inappropriate from a management perspective. Outcrop shrublands do not respond in the same way as other structurally similar communities. Even when the same species are shared with other communities their responses may be different.

Most of the rare and threatened species found during this survey were restricted to, or predominantly found on rock outcrops. It is therefore important that fire strategies designed for these systems are properly formulated or there is the risk that many of these species will decline. Fires are certainly likely to be needed on rock outcrops however it is suggested that the intervals between fires be greater than that of the surrounding communities.

4.2.3 Fire and areas of impeded drainage

Fire management within creek and riparian areas is a complex issue. Such areas are not uniform in terms of associated species. Certainly areas with *Casuarina cunninghamiana* probably should not have fires at all and rock dominated creek banks which are extensive at the upper reaches of Kings Plains Creek probably should have long fire intervals the same or similar to those proposed for rock outcrops. However some of the associated communities that may be dominated by *Angophora floribunda* and *Eucalyptus banksii* on deeper alluvial soils are likely to require more frequent but lower intensity fires. Overall targets for riparian communities within the reserve cannot be suggested and will need to be considered on a site by site basis.

4.2.4 Fire and the eastern boundary

Unfortunately most of the most vulnerable and threatened communities found within the reserve are of very limited extent and occur against the eastern boundary fence. Fire, while not being a widespread management tool in the surrounding private holdings, appears to have affected some parts of the eastern boundary with a regularity that is probably higher than is needed for the region. This was seen to be the case in Community 4 that was restricted to the laterite along the north eastern boundary. Fire frequencies within this community may need to be checked and fires from the neighboring properties may need to be excluded from this community in the short term.

4.2.4 General comments

Fire research has often emphasized species richness as a management goal. In most situations, overall richness is achieved by maintaining communities at an intermediate stage of development by constant and moderate disturbance. However, as Gill (1977) comments, managers should consider recommending protection of older stands of vegetation from fire so that chronosequences remain. Variability and adaptability in fire regimes is the goal suggested by recent research (Bradstock *et al.* 1995; Conroy 1996). It is suggested that rigorously imposed fire regimes based on blocks in the landscape is unachievable. Single wildfire events can severely disrupt imposed fire

regimes. It is suggested that overall, the results of wildfires should be incorporated in an adaptive a regime that creates a variability in chronosequences (Bradstock *et al.* 1995) and that some mature systems be maintained even though richness will decline. This will require that the extent and affects of fire both natural and human induced are constantly monitored and updated. This approach should be modified in communities that are highly restricted or have known frequency thresholds, in such communities management of fire regimes will need to be more direct. The extremes of the frequency scale of fires should be based on the population extinction risk of taxa of importance rather than richness and density (i.e. diversity) (Bradstock *et al.* 1995).

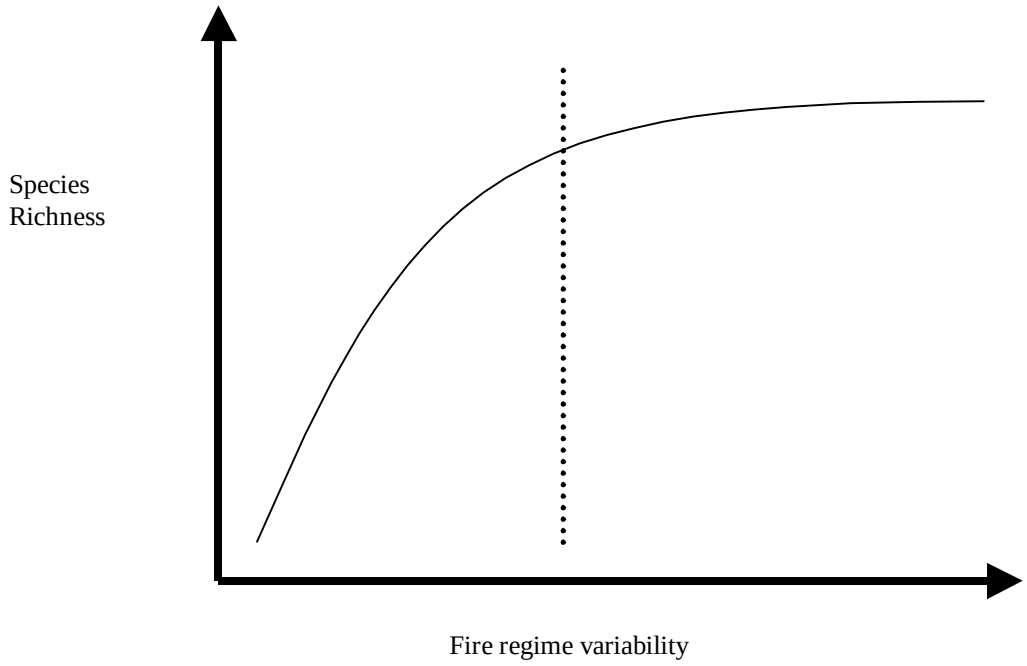


Figure 68: Taken from Bradstock *et al.* 1995). A variability of fire regime beyond a certain threshold is likely to maintain richness at an optimum.

Table 6: Suggested fire regimes for each of the eight defined communities. The suggestions made here are only broadly applicable and much variability should occur within them but they should ultimately be constrained by the ability of the flora within each to recover between fires i.e. primary and secondary juvenile periods and not be longer than the lifespan of the species with the lifespan of the seed bank. Research needs to be conducted within these communities to ascertain if these suggestions are valid.

Community	Suggested Fire Regimes
Community 1 Ironbark – Cypress Woodlands	No two fires within a 15 yr period. Fires to be of greater intervals following high intensity fires i.e. not within a 25 yr period after a high intensity fire. Small low intensity fires may occur of higher frequency but only in small patches. Generally a 30 to 100 yr fire intervals to maintain the mixed nature of the dominants.
Community 2 Red Gum – Yellow Box Woodlands	No two fires within a 10 year period. Fires generally within a 10 to 30 yr period and a maximum of 50 yrs.
Community 3 McKies Stringybark – Blackbutt Open Forest	No two fires within a 10 year period. Fires generally within a 20-50 yr period with a maximum of 100 yrs. Fires to be of greater intervals following high intensity fires i.e. not within a 25 yr period after a high intensity fire.
Community 4 Red Stringybark – Ironbark Woodland	No two fires within a 10 year period. Fires generally within a 20-50 yr period with a maximum of 100 yrs. Fires to be of greater intervals following high intensity fires i.e. not within a 25 yr period after a high intensity fire.
Community 5 Orange Gum – Ironbark Woodlands	No two fires within a 10 yr period. Fires to be of greater intervals following high intensity fires i.e. not within a 25 yr period after a high intensity fire. Small low intensity fires may occur of higher frequency but only in small patches. Generally a 30 to 100 yr fire intervals to maintain the mixed nature of the dominants.
Community 6 Apple Box – River Oak Riparian Woodlands	Highly variable fire regime on a site by site basis. Exclude fires from *Casuarina cunninghamiana* sites; of intervals between 50 + years where rock outcrops dominate banks and within 10 to 30 and up to 50 yrs in grassy Apple and Box sections.
Community 7 Grassy White Box	No two fires within a 10 yr period and fires generally within a 20 to 50 yr cycle.
Community 8 Severn Shrublands	Fire intervals of larger intervals probably preferred. No two fires within a 20 yr period and fires generally 50 yrs + to indefinite.

4.4. Conservation status of taxa and communities

4.4.1 Communities

Specht *et al.* (1995) discusses the reservation status of communities within New South Wales. This work is a starting point for investigations into the conservation status of Australian vegetation communities. It does, however, have a number of limitations. The analysis is based on survey sites existing at the time of compilation and as is shown in Figure 67 this is extremely limiting on the western slopes of New South Wales. The analyses incorporated in this work were necessarily of a large scale and therefore many unique assemblages are lumped together with larger more widespread associations. Furthermore, the reservation status is based on the area reserved and the number of reserves that have a vegetation type. These criteria do not take into account representativeness across the range of the community or the quality of stands. Benson (1999) states that only 7.5% of the Northern Tablelands Bioregion is represented in conservation reserves. One of the major features of the district is that it forms a major east west corridor and forms a hub from which major regional corridors extend from the tablelands to the western slopes.

In their assessment of 18 provinces within the New England Tablelands Bioregion Morgan and Terrey (1999) concluded that reservation within province 10 (Severn River Volcanics) was inadequate and skewed towards rough western areas only. This summarises the findings of this study in terms of the communities found within Kings Plains National Park. In general the western communities from rough areas are well represented within the park and adequately reserved across their range but communities associated with higher plateau areas and on 'better' soils is very poor.

Kings Plains National Park contains one community that is currently listed as an Endangered community on the TSC Act (Community 7; Grassy White Box Woodlands) and a second that should be considered for listing as an endangered community (Community 3; McKie's Stringybark forests on laterite). Both of these communities only occur as very small remnants within the reserve and both are found abutting the boundary fence with extensively cleared agricultural lands. Both communities are threatened within the reserve by gradual attrition due to their small

size and also weed invasions which form a significant component of the standing flora at present.

Community 6 while not an endangered community should be considered as inadequately reserved across its range. The extent of this community within Kings Plains is also very limited and has been impacted upon by past activities such as mining and grazing. This community will need to be regenerated in a number of areas and at present has a high number of invasive weeds associated within it including a number that previously have not been recorded as weeds in the district.

All of these above communities (3, 6 and 7) are found restricted to the eastern margin of the reserve and are associated with other soil types that are usually not represented within conservation reserves. The other communities found within the reserve are associated with rugged country and 'poor' soils (rhyolite) and are considered to be adequately reserved across their range and also adequately represented within Kings Plains National Park itself. Subsequent additions to the reserve should target the rare and endangered communities associated with 'better' soils even most of these may have been highly modified.

4.4.2 Species

There are at least 17 ROTAP or TSC Act listed species within Kings Plains National Park. This number may yet increase if subsequent surveys or opportunistic records are made in subsequent seasons and other remote areas of the park are searched. In comparison only 16 rare or threatened species were found within the Washpool Additions (Hunter 1998), only eight within Guy Fawkes River National Park (Hunter & Alexander 1999) and only five from Kwiambal National Park (Hunter 1998). In contrast, however, Clarke *et al.* (1998) found up to 42 rare and threatened species from the Torrington SRA. Most of the rare taxa found within the reserve are correlated with skeletal soils and rock outcrops (Figure 65). Some species however are associated with 'better' quality soils. This trend however probably reflects the restricted and harsh nature of rock outcrop environments and the large areas of this type of community within the reserve. *Thesium australe* however is interesting in that it was positively correlated with mining activities. As with the reservation of

communities the species associated with the rugged 'poor' quality sites are mostly well represented within the reserve network but those associated with 'better' quality sites and soils are inadequately reserved across their geographic range.

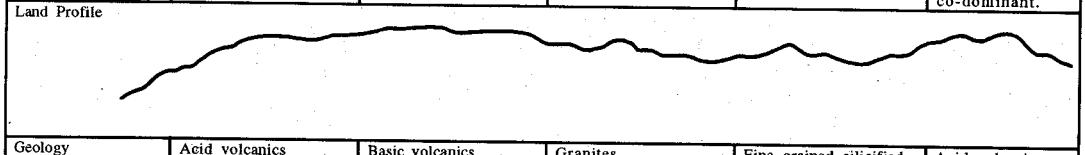
Distribution	Western areas; 600-900m above sea level; co-dominant.	Western areas; 600-900m above sea level; minor.	North-west; 600-800m above sea level; minor.	North-west; 600-800m above sea level; minor.	Eastern; 900-1200m above seal level; co-dominant.
Land Profile					
Geology	Acid volcanics	Basic volcanics	Granites	Fine grained silicified sediments.	Acid volcanics
Landform and Soils	Low hilly to rugged; podzolics, lithosols and rock outcrop dominant, solodics on lower slopes.	Undulating to low hilly; euchrozems, with chocolate soils on steeper slopes.	Hilly; podzolics and siliceous sands.	Hilly; solodics and podzolics.	Hilly to rugged; lithosols and podzolics dominant, solodics in valley bottoms.
Natural vegetation	Complex vegetation: Woodland or heath on shallow soils, including *E. prava, E. caleyi, E. dealbata,* and *C. endlicheri;* Open forest on deeper soils, including *E. andrewsii, E. macrorhyncha* and *E. crebra;* on undulating tops, Woodland of *E. crebra, E. albens, E. melliodora, A. floribunda* and *E. blakelyi.*	Woodland of *E. albens* with *E. melliodora, A. floribunda* and *E. blakelyi.* Open forest of *E. caliginosa, E. melliodora* and *E. blakelyi* on Tertiary residual soils.	Probably open forest of *E. andrewsii, E. youmanii, E. macrorhyncha, E. dealbata* and *E. prava.*	Probably woodland including *E. melanophloia, E. albens, E. blakelyi* and *E. melliodora*	Open forest of *E. caliginosa, E. banksii, E. melliodora* and *E. crebra,* with *E. bridgesiana* and *E. blakelyi* in run-on areas and *E. prava* on rockier areas.
Condition	Extensive natural areas remain on more rugged areas. Most valleys and lower slope areas developed. Slight or no dieback.	Dieback limited but *A. floribunda* severely affected.	Not surveyed	Not surveyed	Undeveloped except for lower slopes and valley bottoms. Some rural subdivision. Dieback severe in more developed areas.
Representation in Conservation Reserves	Large areas in Severn River Nature Reserve and Kings Plains National Park	None	None	None	None
Comments	Largely within Multiple Use Zone.		Small area in Multiple Use Zone.		Multiple Use Zone

Figure 69: Conservation and management considerations for the Province 10 (Severn River Volcanics) that includes Kings Plains National Park. Taken from Morgan and Terry (1999).

4.4.3 Management considerations

Due to the large number of rare or threatened species a number of management options may need to be considered and these may include:

- Targeted searches to establish the population sizes of rare species.

- Targeted searches for species not yet found, but which are likely to occur.
- Targeted searches for Community 3.
- Research into appropriate fire regimes.
- Reduced access to outcrop communities.
- Regeneration of the upper reaches of Kings Plains Creek damaged by past mining.
- Control of weeds.

4.5 Introduced taxa

In most instances, introduced plants require some form of disturbance or modification of the environment, such as an increase in nutrients, to become established. Within the reserve 10% of the flora was found to be introduced in origin. This is intermediate between surveys conducted on the tablelands and those of the western slopes. At Torrington State Recreation Area 5% of the flora was introduced, the Washpool Western Additions had 5% (Hunter 1998b) as did Guy Fawkes River (Hunter & Alexander 1999) and Bald Rock and Boonoo Boonoo (Hunter 1999) but 17% was found at Kwiambal National Park (Hunter 1998a). Many of the exotic species were associated with tracks, disturbed creek margins, areas of associated with mining, old stock yards and areas frequented by goats. Most exotic species were correlated with 'better' soils and low lying topography including all of the most prominent weeds within the reserve (Figure 65). Only a few species were found to be correlated within shallow 'poor' soils in undisturbed habitats (e.g. *Panicum antidotale*, *Sigesbeckia orientalis* and *Opuntia stricta*). Exotic taxa can be segregated into; those that are a serous problem and are invasive (e.g. *Rubus chloocladus* and *Hyparrhenia hirta*), those that are confined to disturbed areas (e.g. *Cirsium*) and those that are ubiquitous and therefore would be a problem to remove in the long term (e.g. *Hypochaeris radicata* and *Sigesbeckia orientalis*).

4.5.1 Riparian zones

The greatest number of introduced taxa occur along the more accessible parts of the larger creeks probably due to a combination of mining, grazing and flood damage.

Increased nutrients from fertilizer application on neighboring land and the naturally richer soils and soil moisture can also favour exotic species. Some of the most troublesome weeds along the creek banks are *Gomphocarpus fruticosus, Bidens, Xanthium, Myriophyllum, Juncus* and *Rubus chloocladus*.

It should be noted however that invasions from upstream outside the boundaries of the reserve are difficult or impossible to manage from the perspective of the park managers. In the short term many species can be rapidly replaced due to seeds from upstream, these weed invasions should be controlled to reduce the incidence and subsequent build up of seed banks.

4.5.2 Fire trails

Exotic taxa occur along boundaries and tracks but they will usually be restricted to a short distance from the disturbed area. The movement of vehicles along tracks encourages the spread of weeds. This is particularly true if vehicles have to move through heavily infested areas prior to reaching the desired trails. This is the case in most situations as the main trails pass through private grazing land before entering the reserve. There are a number of boundary tracks within the reserve of which many are important for fire management purposes. Fire trails along the north eastern boundary impact on the few small incidences of Community 3 which has a high incidence of weeds. This fire trail should be avoided in wet conditions when the transportation of weeds is greatly increased.

4.5.3 Management priorities

Priorities will need to be established in order to develop an effective weed management system. In particular major source areas should be reduced and those weeds likely to spread should be given highest priority. Although the incidence of weeds in the reserve is considered only to be minor, broad priorities may include:

- Finding major weed infestations and reducing these source populations, particularly along major creek lines that are disturbed by traffic.

- Weed invasions into areas of vegetation of regional significance or restricted distribution in the reserve, for example the wet heath, outcrop communities and the small sedgeland.
- Invasive or noxious weeds should be eradicated as soon as possible. Some of these include Blackberry (*Rubus chloocladus*).
- Keeping well used trails in good condition particularly on creek crossings
- Revegetation of old mine sites.
- Co-ordination of weed programs with local authorities.
- Removal of feral goats, pigs and wild cattle.

The control of exotic plants within a national park is a complex issue. Application of herbicides can be inappropriate as native vegetation or animals in streams may be affected. The affects on native vegetation need to be minimised. Many weeds while a problem due to their widespread occurrence in natural areas may be left as a low priority for management. Some examples include *Hypochaeris radicata* and *Stellaria* spp., which are in general ubiquitous to most communities in the north east and would be impossible to eradicate.

4.6 General conclusions

Kings Plains National Park is a significant conservation reserve as it represents a comparatively little disturbed habitat. The Park conserves some of the major and widespread communities found along the western escarpment of the tablelands and the vegetation associated with acid volcanic soils. Many of these communities are within the centre of their known distribution some though are highly significant with one listed as an endangered community and another that warrants endangered listing. A large number of rare species can be found within the reserve and this area represents a high concentration of rare species associated with rhyolitic outcrops and also a few species associated with basaltic soils. Some of these species may need targeted searches and searches for rare species that are likely to occur may be fruitful. New additions to the reserve should target basalt and laterite soils. While the park is of great significance, at present it under-represents many of the communities found within the region.

Much of the stability of the vegetation communities and the rare species found within the reserve will depend on the management of appropriate fire regimes and potentially of what may be increasing numbers of visitors. A high variability of fire regimes should occur as this will maximize richness at the landscape scale. Monitoring of selected sample sites within each community should be made on a continuing basis and manipulated fire experiments would be an asset.

Weeds are overall not a major problem within most of the reserve, however a number of weeds are noxious and invasive and strongly associated with some of the more restricted and conservationally more significant communities on better soils. Such areas will need weed eradication programs and constant monitoring. Much of some of the recent acquisitions of land are severely degraded by past clearing and subsequent reinvasion of *Leptospermum brevipes.* Measures to control this species in these regeneration areas may need to be sought and areas around Weean Creek and along the upper reaches of Kings Plains Creek may need revegetation.

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Appendix A: Site survey forms.

NPWS Glen Innes District Vegetation Survey Form

Date: _____ **Recorder:** _____ **Site No:** _____

Film No: _____ **Photo No:** _____

General Location: _____

Quadrat Size (if not 20 x 20 m): _____

Map Name: _____ **Scale:** _____
AMG Ref: _____ E _____ N
Lat: _____ 'S **Long:** _____ 'E

Landform Pattern: _____
Physiography: (circle)
Crest Upper Slope Mid-slope Lower Slope Flat Open Depression

Altitude: _____ metres
Slope: _____ degrees
Aspect: _____ degrees (magnetic)
Horizontal Elevation: N____ NE____ E____ SE____ S____ SW____ W____ NW____
Map Geology: _____ **Lithology:** _____

Soil: (circle)
Drainage: Waterlogged Damp Moist Well drained
Texture: _____
Colour: _____
Depth: Deep (>1m) Shallow (0.3-1m) Skeletal (<0.3m)

Fire History (how determined)_____

Other Disturbance: (circle) clearing logging grazing erosion feral animals
other (state):_____

Vegetation Structure: (Walker & Hopkins, 1983)

Stratum	Height (m)	% Cover	Dominant Species

Structural Formation Class: _____
Comments: _____

Appendix A: Site survey forms.

Floristic Composition:

Site No:

No.	Species	C/A	Data	No.	Species	C/A	Data
1				31			
2				32			
3				33			
4				34			
5				35			
6				36			
7				37			
8				38			
9				39			
10				40			
11				41			
12				42			
13				43			
14				44			
15				45			
16				46			
17				47			
18				48			
19				49			
20				50			
21				51			
22				52			
23				53			
24				54			
25				55			
26				56			
27				57			
28				58			
29				59			
30				60			

C/A: Cover Abundance Scale -Modified Braun Blanquet
Data: to be marked when entered into computer database

Cover Abundance Scale (Modified Braun Blanquet)
1 = cover less than 5% of site and uncommon
2 = cover less than 5% of site and common
3 = cover of 6-20% of site
4 = cover of 21-50% of site
5 = cover of 51-75% of site
6 = cover of 76-100% of site

Appendix B: Taxon list with recognized authorities and common names.

Flora of Kings Plains National Park

(John T. Hunter)

Pteridophytes

Aspleniaceae
Asplenium flabellifolium Cav. .....Necklace Fern
Pleurosorus subglandulosus (Hook. & Grev.) Tindale .....Blanket Fern

Dennstaediaceae
Pteridium esculentum (G.Forst.) Cockayne.....Bracken Fern

Marsileaceae
Marsilea drummondii A.Braun.....Common Nardoo

Sinopteridaceae
Cheilanthes distans (R.Br.) Mett. .....Hairy Rock Fern
Cheilanthes sieberi Kunze.....Narrow Rock Fern
Pellaea falcata
var. *nana* Hook. .....Pellaea

Conifers

Cupressaceae
Callitris endlicheri (Parl.) F.M.Bailey .....Black Cypress Pine

Monocotyledons

Anthericaceae
Arthropodium milleflorum (DC.) J.F.Macbr.....Vanilla Lily
Laxmannia compacta Conran & P.I.Forst. .....Compact Wire Lily
Thysanotus tuberosus R.Br.....Fringe Lily
Tricoryne elatior R.Br. .....Yellow Lily

Asphodelaceae
Bulbine bulbosa (R.Br.) Haw. .....Golden Lily

Centrolepidaceae
Centrolepis strigosa (R.Br.) Roem. & Schult.
subsp. *strigosa*.....Centrolepis

Commelinaceae
Commelina cyanea R.Br.....Scurvey Weed
Murdannia graminea (R.Br.) G.A.Bruckn. .....Lily

Cyperaceae
Carex inversa R.Br. .....Knob Sedge
Cyperus bifax C.B.Clarke.....Sedge
**Cyperus congestus* Vahl. .....Sedge
Cyperus flavidus Retz. .....Sedge
Cyperus fulvus R.Br.....Sticky Sedge
Cyperus gracilis R.Br. .....Sedge
Eleocharis plana S.T.Blake.....Sedge
Eleocharis sphacelata R.Br. .....Sedge
Fimbristylis dichotoma (L.) Vahl. .....Common Fringe Rush

Gahnia aspera (R.Br.) Spreng. ..... Sedge
Lepidosperma gunnii Boeck. ..... Saw Sedge
Lepidosperma laterale R.Br. ..... Variable Saw Sedge
Lepidosperma lineare R.Br. ..... Slender Razor Sedge
Lepidosperma viscidum R.Br. ..... Sticky Saw Sedge
Schoenus apogon Roem & Schult. ..... Sedge
Scleria mackaviensis Boeck. ..... Sedge
Scirpus polystachyus F.Muell. ..... Tall Club Rush

Haemodoraceae
Haemodorum planifolium R.Br. ..... Blood Root

Hydrocharitaceae
Villisneria gigantea Graeb. ..... Ribbon Weed

Hypoxidaceae
Hypoxis exilis R.J.F.Hend. ..... Yellow Lily

Iridaceae
**Gladiolus carneus* D.Delaroche ..... Gladiola
Patersonia sericea R.Br. ex Ker ..... Blue Flag

Juncaceae
Juncus firmus L.A.S.Johnson ..... Rush
Juncus fockei Buchenau ..... Rush
Juncus remotiflorus L.A.S.Johnson ..... Rush
Juncus vaginatus R.Br. ..... Rush
Luzula flaccida (Buchenau) Edgar ..... Grass Rush

Lomandraceae
Lomandra filiformis (Thunb.) Britten ..... Narrow-leaved Mattrush
Lomandra longifolia Labill. ..... Long-leaved Mattrush
Lomandra multiflora (R.Br.) Britten ..... Hard Mattrush

Orchidaceae
Dipodium variegatum D.L.Jones & M.A.Clem. ..... Hyacinth Orchid
Microtus unifolia (G.Forst.) Rchb.f. ..... Common Onion Orchid
Orthoceras strictum R.Br. ..... Horned Orchid
Pterostylis coccina Fitzg. ..... Greenhood
Pterostylis daintreana Benth. ..... Greenhood
Thelymitra pauciflora R.Br. ..... Slender Sun Orchid

Phormiaceae
Dianella caerulea
subsp. *caerulea* ..... Blue Flax Lily
Dianella revoluta R.Br. ..... Blue Flax Lily
Stypandra glauca R.Br. ..... Blue Lily

Poaceae
Agrostis aemula R.Br. ..... Blowngrass
Amphipogon caricinus F.Muell.
var. *caricinus* ..... Long Greybeard Grass
Agrostis sp. A ..... Agrostis
Aristida acuta S.T.Blake ..... Wire Grass
Aristida jerichoensis
var. *subspinulifera* Henrard ..... Jericho Wire Grass
Aristida ramosa
var. *speciosa* Henrard ..... Three-awned Grass
Arundinella nepalensis Trin. ..... Reedgrass
Austrodanthonia eriantha (Lindl.) H.P.Linder ..... Wallaby Grass

Austrodanthonia fulva (Vickery) H.P.Linder .....Wallaby Grass
Austrodanthonia laevis (Vickery) H.P.Linder .....Wallaby Grass
Austrodanthonia linkii (Kunth.) H.P.Linder .....Wallaby Grass
Austrodanthonia monticola (Vickery) H.P.Linder .....Wallaby Grass
Austrodanthonia penicillata (Labill.) H.P.Linder .....Slender Wallaby Grass
Austrodanthonia richardsonii (Cashmore) H.P.Linder .....Wallaby Grass
Austrodanthonia sp. aff. *laevis* .....Wallaby Grass
Austrostipa pubescens (R.Br.) S.W.L.Jacobs & J.Everett .....Corkscrew Grass
Austrostipa rudis (Spreng.) S.W.L.Jacobs & J.Everett
subsp. *rudis* .....Spear Grass
Austrostipa setacea (R.Br.) S.W.L.Jacobs & J.Everett .....Corkscrew Grass
**Axinopus affinis* Chase .....Millet Swamp Grass
Bothriochloa biloba S.T.Blake .....Grass
Bothriochloa decipiens (Hack) C.E.Hubb. .....Redleg Grass
Briza minor L. .....Small Shivery Grass
**Bromus madritensis* L. .....Madrid Broome
Chrysopogon fallax S.T.Blake .....Chrysopogon
Cleistochloa rigida (S.T.Blake) R.D.Webster .....Grass
Cymbopogon obtectus S.T.Blake .....Silky Heads
Cymbopogon refractus (R.Br.) A.Camus .....Barbed Wire Grass
Cynodon dactylon (L.) Pers. .....Couch
Dichelachne crinita (L.) Hook.f. .....Long-hair Plumegrass
Dichelachne inaequiglumis (Hackel ex Cheeseman) Edgar & Connor .....Plumegrass
Dichelachne micrantha (Cav.) Domin .....Plumegrass
Dichelachne rara (R.Br.) Vickery .....Plumegrass
Dichelachne sieberiana Trin. & Rupr. .....Plumegrass
Digitaria breviglumis (Domin) Henrard .....Umbrella Grass
Digitaria diffusa Vickery .....Umbrella Grass
Digitaria ramularis (Trin.) Henrard .....Umbrella Grass
Echinopogon caespitosus C.E.Hubb.
var. *caespitosus* .....Hedgehog Grass
Echinopogon mckiei C.E.Hubb. .....Hedgehog Grass
Echinopogon ovatus C.E.Hubb. .....Forest Hedgehog Grass
Enneapogon gracilis (R.Br.) P.Beauv. .....Slender Nineawn
Entolasia stricta (R.Br.) Hughes .....Rice Flowered Grass
Eragrostis brownii (Kunth.) Nees .....Browns' Lovegrass
Eragrostis elongata Jacq. .....Clustered Lovegrass
Eragrostis lacunaria F.Muell. .....Purple Lovegrass
Eragrostis laniflora Benth. .....Woollybutt
Eragrostis leptostachya Steud. .....Paddock Lovegrass
Eragrostis trachycarpa (Benth.) Domin .....Lovegrass
**Hyparrhenia hirta* (L.) Stapf. .....Coolatai Grass
Imperata cylindrica P.Beauv. .....Blady Grass
Microlaena stipoides (Labill.) R.Br. .....Meadow Rice Grass
Panicum effusum R.Br. .....Hairy Panic
Panicum simile Domin .....Two Coloured Panic
Paspalidium constrictum (Domin) C.E.Hubb. .....Box Grass
Paspalum distichum L. .....Water Couch
Pennisetum alopecuroides (L.) Spreng. .....Swamp Foxtail
Poa queenslandica C.E.Hubb. .....Grass
Poa sieberiana Labill. .....Snow Grass
**Setaria gracilis* Kunth. .....Slender Pigeon Grass
Sorghum leiocladum (Hack.) C.E.Hubb. .....Native Sorghum
Sporobolus creber De Nardi .....Rats Tail Crass
Sporobolus elongates R.Br. .....Slender Rats Tail Grass
Themeda triandra Forssk. .....Kangaroo Grass
Tripogon loliiformis (F.Muell.) C.E.Hubb. .....Five Minute Grass

Xanthorrhoeaceae
Xanthorrhoea johnsonii A.T.Lee .....Grasstree

Dicotyledons

Acanthaceae
Rostellularia adscendens (R.Br.) R.M.Barker
subsp. *adscendens* var. *adscendens* ..... Rostellularia

Amaranthaceae
Alternanthera denticulata R.Br. ..... Lesser Joyweed

Apiaceae
Actinotus gibbonsii F.Muell. ..... Gibbons Flannel Flower
Actinotus helianthi Labill. ..... Flannel Flower
**Ciclospermum leptophyllum* (Pers.) Sprague ..... Slender Celery
Hydrocotyle laxiflora DC. ..... Stinking Pennywort
Hydrocotyle peduncularis R.Br. ex A.Rich. ..... Pennywort
Hydrocotyle tripartita R.Br. ex A.Rich. ..... Pennywort
Daucus glochidiatus (Labill.) Fisch., C.A.Mey. & Ave-Lall. ..... Daucus
Platysace ericoides (Sieber ex Spreng.) C.Norman ..... Small Platysace
Trachymene incisa Rudge ..... Native Parsnip

Apocynaceae
Parsonsia eucalyptophylla F.Muell. ..... Vine

Araliaceae
Astrotricha longifolia Benth. ..... Star-hair Bush
Astrotricha roddii Makinson ..... Rod's Star-hair Bush

Asclepiadaceae
**Gomphocarpus fruticosus* (L.) R.Br. ex Spreng. ..... Balloon Fruit

Asteraceae
Bidens pilosa L. ..... Cobblers Tacks
Brachyscome microcarpa F.Muell. ..... Brachyscome
Brachyscome nova-anglica G.L.R.Davis ..... New England Brachyscome
Brachyscome stuartii Benth. ..... Granite Brachyscome
Bracteantha bracteata (Vent.) Anderberg & Haegi ..... Yellow Everlasting
Bracteantha viscosa (DC.) Anderberg & Haegi ..... Sticky Everlasting
Calotis cuneifolia R.Br. ..... Blue-bottle Daisy
Cassinia quinquefaria R.Br. ..... Common Cassinia
Cassinia uncata A.Cunn. ex DC. ..... Sneezebush
**Centaurea solstitialis* L. ..... St Barnaby's Thistle
Centipeda cunninghamii (DC.) A.Braun. & Asch. ..... Common Sneezeweed
Chrysocephalum apiculatum (Labill.) Steetz ..... Yellow Buttons
Chrysocephalum semipapposum (Labill.) Steetz ..... Yellow Buttons
**Cirsium vulgare* L. ..... Thistle
**Conyza albida* Willd. ex Spreng. ..... Tall Fleabane
**Conyza bonariensis* (L.) Cronq. ..... Flaxleaf Fleabane
Craspedia variabilis Everett & Doust. ..... Billy Buttons
Cymbanotus lawsonianus Gaudich. ..... Bears Ears
Emilia sonchifolia (L.) DC. ..... Daisy
Euchiton gymnocephalus (DC.) Holub ..... Creeping Cudweed
Euchiton involucratus (G.Forst.) Holub ..... Cudweed
Euchiton sphaericus Holub. ..... Cudweed
Glossogyne tannensis (Spreng.) Garn.-Jones ..... Cobblers Tacks
**Gnaphalium coarctatum* Willd ..... Cudweed
Helichrysum collinum DC. ..... Everlasting
Helichrysum scorpioides Labill. ..... Button Everlasting
Hypochaeris radicata L. ..... Catsear
Lagenifera stipitata (Labill.) Druce ..... Blue Bottle-daisy

Olearia elliptica DC. ..... Sticky Daisy Bush
Olearia gravis F.Muell. ..... Grey Daisy Bush
Olearia microphylla (Vent.) Maiden & Betche ..... Small-leaved Daisy Bush
Olearia ramosissima (DC.) Benth. ..... Blue Daisy Bush
Olearia ramulosa (Labill.) Benth. ..... Daisy Bush
Olearia rosmarinifolia (DC.) Benth. ..... Daisy Bush
Olearia viscidula (F.Muell.) Benth. ..... Sticky Daisy Bush
Ozothamnus diosmifolius (Vent.) DC. ..... White Dogwood
Ozothamnus obcordatus DC. ..... Granite Daisy Bush
Picris heirarchioides L. ..... Hookweed
Podolepis jacioides (Sims) Voss ..... Copper-wire Daisy
Rhodanthe diffusa
subsp. *leucactina* (F.Muell.) Paul G. Wilson ..... Daisy
Senecio diaschides Drury ..... Fireweed
Senecio hispidulus A.Rich.
var. *hispidulus* ..... Hill Fireweed
Senecio quadridentatus Labill. ..... Fireweed
**Sigesbeckia orientalis* L.
subsp. *orientalis* ..... Sigesbeckia
**Silybum marianum* (L.) Gaertn. ..... Variegated Tistle
**Sonchus oleraceus* L. ..... Thistle
Triptilodiscus pygmaeus Turcz. ..... Daisy
Vittadinia cuneata
var. *cuneata* forma *minor* N.T.Burb. ..... Fuzzweed
Vittadinia muelleri N.T.Burb. ..... Fuzzweed
Vittadinia sulcata N.T.Burb. ..... Fuzzweed
Vernonia cinerea (L.) Less.
var. *cinerea* ..... Vernonia

Bignoniaceae
Pandorea pandorana (Andrews) Steenis ..... Wonga Vine

Boraginaceae
Cynoglossum australe R.Br. ..... Austral Hounds Tongue

Brassicaceae
**Lepidium bonariense* L. ..... Peppercress

Cactaceae
**Opuntia stricta* (Haw.) Haw. ..... Prickly Pear

Campanulaceae
Wahlenbergia gracilis (Forst.f.) Schrad. ..... Bluebell.
Wahlenbergia littoricola P.J.Sm. ..... Bluebell
Wahlenbergia luteola P.J.Sm. ..... Bluebell
Wahlenbergia stricta (R.Br.) Sweet
subsp. *stricta* ..... Tall Bluebell

Caryophyllaceae
**Anagallis arvensis* L. ..... Anagallis
**Cerastium fontanum*
subsp. *vulgare* (Hartn.) Greuter & Burdet. ..... Mouse-ear Joyweed
**Petrorhagia nanteuilii* (Burnat) B.W.Ball & Haywood ..... Proliferous Pink
Scleranthus biflorus (G.Forst. & Forst.f.) Hook.f. ..... Knawel
Stellaria angustifolia Hook. ..... Chickweed

Casuarinaceae
Allocasuarina brachystachya L.A.S.Johnson ..... Small Shrub She-oak
Allocasuarina gracilis m.s. (J.T.Hunter) ..... Kings She-oak
Allocasuarina gymnanthera L.A.S.Johnson ..... Western Shrub She-oak

Allocasuarina inophloia (F.Muell. & Bailey) L.A.S.Johnson .....Stringybark She-oak
Casuarina cunninghamiana Miq. .....River Oak

Celastraceae
Maytenus cunninghamii (Hook.) Loes. .....Western Orange Bark

Chenopodiaceae
Chenopodium melanocarpa (J.M.Black) J.M.Black .....Black-seed Saltbush

Clusiaceae
Hypericum gramineum Forst.f. .....Small St. Johns Wort
Hypericum japincum Thunb. .....St. Johns Wort

Crassulaceae
Crassula sieberiana (Schultes & Schultes f.) Druce .....Stonecrop

Convulvulaceae
Dichondra sp. A .....Kidney Weed
Dichondra repens G.Forst. & Forst.f. .....Kidney Weed
Evolvulus alsinoides (L.) L. .....Bindweed

Dilleniaceae
Hibbertia acicularis (Labill.) F.Muell. .....Prickly Guinea Flower
Hibbertia obtusifolia DC. .....Guinea Flower
Hibbertia riparia (R.Br. ex DC.) Hoogl. .....Common Guinea Flower
Hibbertia sp. B .....Grey Guinea Flower
Hibbertia vestita A.Cunn. ex Benth. .....Guinea Flower

Epacridaceae
Brachyloma daphnoides
subsp. *glabrum* (Blakely) J.T.Hunter .....Red-flowered Daphne Heath
Leucopogon attenuatus A.Cunn. .....Sharp Beard Heath
Leucopogon biflorus R.Br. .....Nodding Beard Heath
Leucopogon lanceolatus (Sm.) R.Br. .....Lance-leaf Beard Heath
Leucopogon melaleucoides A.Cunn. ex Benth. .....Beard Heath
Leucopogon muticus R.Br. .....Beard Heath
Leucopogon neo-anglicus F.Muell. ex Benth. .....Prickly Beard Heath
Leucopogon virgatus (Labill.) R.Br. .....Beard Heath
Lissanthe strigosa (Sm.) R.Br. .....Peach Heath
Melichrus erubescens A.Cunn. ex DC. .....Ruby Urn Heath
Melichrus urceolatus R.Br. .....Urn Heath
Monotoca scoparia (Sm.) R.Br. .....Broom Heath
Styphelia triflora Sm. .....Green Five-corners

Euphorbiaceae
Bertya gummifera Planch. (?*neglecta* Drummer) .....Bertya
Beyeria viscosa (Labill.) Miq. .....Sticky Beyeria
Breynia cernua Poir. .....Appleberry
Chamaesyce dallachyana (Baill.) Hassall .....Caustic Weed
Chamaesyce drummondii (Boiss.) Hassall .....Caustic Weed
Phyllanthus occidentalis J.T.Hunter & J.J.Bruhl. .....Western Spurge
Phyllanthus subcrenulatus F.Muell. .....Spurge
Phyllanthus virgatus Forst.f. .....Spurge
Poranthera microphylla Brongn .....Small Poranthera

Fabaceae
Acacia brownei (Poir.) Steuc. ex. DC. .....Wattle
Acacia buxifolia A.Cunn. .....Box-leaved Wattle
Acacia falciformis DC. .....Broad-leaved Hickory
Acacia filicifolia Cheel & M.B.Welch ex M.B.Welch, Coombs & McGlynn. Fern-leaved Wattle

Acacia fimbriata A.Cunn. ex G.Don ..... Fringed Wattle
Acacia leptoclada Tindale ..... Tingha Wattle
Acacia leucocalyx (Domin) Pedley ..... Wattle
Acacia montana Benth. ..... Sticky Wattle
Acacia neriifolia A.Cunn. ex Benth. ..... Oleander Wattle
Acacia penninervis Sieber ex DC. ..... Mountain Hickory
Acacia pruinosa A.Cunn. ex Benth. ..... Frosted Wattle
Acacia torringtonensis Tindale ..... Torrington Wattle
Acacia ulicifolia (Salisb.) Court ..... Prickly Moses
Acacia venulosa Benth. ..... Veiny Wattle
Acacia viscidula Benth. ..... Sticky Wattle
Acacia williamsiana J.T.Hunter ..... Severn Wattle
Aotus subglauca
var. *filiformis* Blakely & McKie ..... Northern Aotus
Bossiaea neo-anglica F.Muell. ..... New England Bossiaea
Bossiaea scortichenii ..... Bossiaea
Cullen tenax ..... Emu-foot
Daviesia genistifolia A.Cunn. ex Benth. ..... Broom Bitter Pea
Daviesia latifolia R.Br. ..... Bitter Pea
Desmodium brachypodum A.Gray ..... Tick Trefoil
Desmodium varians (Labill.) Endl. ..... Slender Tick Trefoil
Dillwynia phylicoides A.Cunn. ..... Bristly Parrot Pea
Dillwynia sericea A.Cunn. ..... Silky Parrot Pea
Dillwynia sieberi Steud. ..... Prickly Parrot Pea
Glycine clandestina Wendl. ..... Twining Glycine
Glycine tabacina (Labill.) Benth. ..... Variable Glycine
Hardenbergia violacea (Schneev.) Stearn ..... False Sarsaparilla
Hovea lanceolata Sims ..... Grey-leaved Hovea
Hovea linearis (Sm.) R.Br. ..... Hovea
Indigofera australis Willd. ..... Indigo
Indigofera adesmiifolia A.Gray ..... Indigo
Jacksonia scoparia R.Br. ..... Dogwood
Lespedeza juncea
subsp. *sericea* (Thunb.) Steenis ..... Lespedeza
**Medicago lupulina* L. ..... Black Medic
Mirbelia pungens A.Cunn. ex G.Don ..... Prickly Mirbelia
Mirbelia speciosa Sieber ex DC. ..... Blue Mirbelia
Pultenaea foliolosa A.Cunn. ex Benth. ..... Small-leaved Bush-pea
Pultenaea sp. C. ..... Shiny-leaved Bush-pea
Pultenaea stuartiana Benth. ..... Bush-pea
**Senna occidentalis* (L.) Link. ..... Senna
Swainsona galegifolia (Andrews) R.Br. ..... Smooth Darling Pea
**Trifolium repens* ..... Clover
**Vicia sativa*
subsp. *angustifolia* (L.) Gaudich. ..... Narrow-leaved Vetch
Zornia dyctiocarpa
var. *dyctiocarpa* ..... Zornia

Gentianaceae
Centaurium erythraea Rafn. ..... Common Centuary

Geraniaceae
Geranium solanderi Carolin ..... Native Geranium
Pelargonium inodorum Willd. ..... Rock Pelargonium

Goodeniaceae
Dampiera lanceolata A.Cunn. ex DC. ..... Grey Dampiera
Dampiera stricta (Sm.) R.Br. ..... Common Dampiera
Goodenia bellidifolia
subsp. *argentea* Carolin ..... Goodenia

Goodenia gracilis R.Br. .....Delicate Goodenia
Goodenia hederacea Sm.
subsp. *hederacea* .....Trailing Goodenia
subsp. ?nova .....Trailing Goodenia

Haloragaceae
Gonocarpus micranthus
subsp. *ramosissimus* Orchard .....Swamp Raspwort
Gonocarpus teucrioides DC. .....Raspwort
Gonocarpus tetragynus Labill. .....Raspwort
Haloragis heterophylla Brongn. .....Variable Raspwort
Myriophyllum striatum .....Myriophyllum
Myriophyllum verrucosum .....Myriophyllum

Lamiaceae
Ajuga australis R.Br. .....Austral Bugal
Mentha satureioides R.Br. .....Mintbush
Plectranthus parviflorus Willd .....Mintbush
Prostanthera nivea A.Cunn. ex Benth.
var. *nivea* .....Mintbush
Prostanthera saxicola
var. *bracteolata* J.H.Willis .....Mintbush
Scutellaria humilis R.Br. .....Dwarf Skullcap
Westringia longifolia R.Br. .....Westringea

Lauraceae
Cassytha filiformis L. .....Devil's Twine
Cassytha glabella R.Br. .....Devil's Twine

Lobeliaceae
Isotoma anethifolia Summerh. .....Isotome
Isotoma axillaris Lindsey .....Showy Isotome
Lobelia gibbosa Labill. .....Tall Lobelia
Lobelia gracilis Andrews .....Trailing Lobelia
Pratia concolor (R.Br.) Druce .....Pratia
Pratia purpurascens (R.Br.) E.Wimm. .....Purple Pratia

Loganiaceae
Logania sp. B .....Logania

Loranthaceae
Amyema bifurcatum (Benth.) Tieghem
var. *bifurcatum* .....Rusty Mistletoe
Amyema miquelii (Lehmn. ex Miq.) Tieghem .....Drooping Mistletoe

Lythraceae
Lythrum salicorn L. .....Purple Loosestrife

Malvaceae
**Hibiscus trionum* L.
var. *trionum* .....Bladder Ketmia
**Pavonia hastata* Cav.

Moraceae
Ficus rubiginosa Desf. ex Vent. .....Fig

Myrtaceae
Angophora floribunda (Sm.) Sweet .....Rough-barked Apple
Babingtonia densifolia (Sm.) F.Muell. .....Baeckea
Callistemon linearis (Schrader & Wendl.) Sweet .....Narrow-leaved Bottlebrush

Callistemon pungens Lumley & Spencer .....Prickly Bottlebrush
Callistemon sieberi DC. .....River Bottlebrush
Callistemon viminalis (Sol. ex Gaertn.) G.Don ex Loudon .....Weeping Bottlebrush
Calytrix tetragona Labill. .....Fringe Myrtle
Eucalyptus albens Benth. .....White Box
Eucalyptus andrewsii Maiden .....Western New England Blackbutt
Eucalyptus banksii Maiden .....Tenterfield Woollybutt
Eucalyptus blakelyi Maiden .....Blakely's Red Gum
Eucalyptus bridgesiana R.T.Baker .....Apple Box
Eucalyptus caleyi Maiden
subsp. *caleyi* .....Caley's Ironbark
Eucalyptus crebra F.Muell. .....Narrow-leaved Ironbark
Eucalyptus dealbata A.Cunn. ex Schauer .....Tumbledown Gum
Eucalyptus mckieana Blakely .....McKie's Stringybark
Eucalyptus melliodora A.Cunn. ex Schauer .....Yellow Box
Eucalyptus moluccana Roxb. .....Grey Box
Eucalyptus prava L.A.S.Johnson & K.D.Hill .....Orange Gum
Eucalyptus stannicola L.A.S.Johnson & K.D.Hill .....Stringybark
Eucalyptus subtillior L.A.S.Johnson & K.D.Hill .....White Stringybark
Eucalyptus viminalis Labill. .....Manna Gum
Homoranthus biflorus Craven & S.R.Jones .....Kings Plains Homoranthus
Kunzea obovata Byrnes .....Northern Pink Kunzea
Kunzea parvifolia Schauer .....Hairy Pink Kunzea
Leptospermum arachnoides Gaertn. .....Prickly Tea-tree
Leptospermum brevipes F.Muell. .....Grey Tea-tree
*Leptospermum brachyandru*m (F.Muell.) Druce .....Tea-tree
Leptospermum divaricatum Schauer. .....Tea-tree
Leptospermum minutifolium C.T.White .....Tiny-leaved Tea-tree
Leptospermum novae-angliae Joy Thomps. .....New England Tea-tree
Leptospermum parvifolium Sm. .....Small-leaved Tea-tree
Leptospermum polygalifolium
subsp. *transmontanum* Joy Thomps. .....Creek Tea-tree
Melaleuca erubescens Otto .....Bottlebrush

Myoporaceae
Myoporum montanum R.Br. .....Myoporum

Nyctaginaceae
Boerhavia dominii Meikle & Hewson .....Tar-vine

Olacaceae
Olax sticta R.Br. .....Olax

Oleaceae
Jasminum lineare R.Br. .....Narrow-leaved Jasmin
Notelaea linearis Benth. .....Narrow-leaved Mock Olive
Notelaea microcarpa R.Br.
var. *microcarpa* .....Western Mock Olive

Oxalidaceae
Oxalis chnoodes Lourteig .....Wood Sorrel
Oxalis perennans Haw .....Wood Sorrel

Pittosporaceae
Billardiera scandens Sm. .....Appleberry
Bursaria spinosa
var. *obovata* E.Bennett .....Prickly Bursaria
Cheiranthera cyanea
var. *borealis* E.Bennett .....Finger Flower
Rhytidosporum diosmoides (Putt.) L.Cayzer, Crisp & I.Telford .....Rhytidosporum

Plantaginaceae
Plantago debilis R.Br. ..... Shade Plantain
**Plantago lanceolata* L. ..... Plantain
Plantago varia R.Br. ..... Variable Plantain

Polygonaceae
Persicaria decipiens (R.Br.) K.L.Wilson ..... Persicaria
Rumex brownii Campd ..... Swamp Dock
Rumex crispus L. ..... Dock

Proteaceae
Grevillea arenaria R.Br. ..... Grevillea
Grevillea floribunda R.Br. ..... Rusty Grevillea
Grevillea triternata R.Br. ..... Prickly Grevillea
Hakea dactyloides (Gaertn.) Cav. ..... Finger Hakea
Hakea microcarpa R.Br. ..... Swamp Hakea
Isopogon petiolaris A.Cunn. ..... Drumstick
Persoonia cornifolia A.Cunn. ex R.Br. ..... Broad-leaved Geebung
Persoonia fastigata R.Br. ..... Narrow-leaved Geebung
Persoonia sericea A.Cunn. ex R.Br. ..... Silky Grevillea
Persoonia tenuifolia R.Br. ..... Dwarf Narrow-leaved Geebung
Persoonia terminalis
subsp. *recurva* L.A.S.Johnson & P.H.Weston ..... Geebung
Petrophile canescens A.Cunn. ex R.Br. ..... Grey Conesticks

Ranunculaceae
Clematis glycinoides DC. ..... Forest Clematis
Clematis microphylla DC. ..... Small-leaved Clematis
Ranunculus lappaceus Sm. ..... Buttercup

Rhamnaceae
Alphitona excelsa (Fenzl.) Benth. ..... Red Berry
Cryptandra amara Sm.
var. *amara* ..... Common Cryptandra
var. *floribunda* Maiden & Betche ..... Red Cryptandra
Cryptandra scortechinii F.Muell. ..... Clustered Cryptandra
Pomaderris angustifolia Wakef. ..... Pomaderris

Rubiaceae
Asperula conferta Hook.f. ..... Asperula
Galium binifolium Wakef. ..... Bedstraw
**Galium divaricatum* Lam. ..... Slender Bedstraw
Galium gaudichaudii DC. ..... Rough Bedstraw
Galium migrans Ehrend & McGillivray ..... Bedstraw
Galium propinquum A.Cunn. ..... Bedstraw
Opercularia aspera Gaertn. ..... Stinkweed
Opercularia hispida Spreng. ..... Hairy Stinkweed
Pomax umbellata (Gaertn.) Soland. ex A.Rich. ..... Pomax

Rosaceae
Acaena echinata Nees ..... Acaena
Acaena novae-zelandiae Kirk ..... Bidgee Widgee
**Rosa rubiginosa* L. ..... Rose Hip
**Rubus chloocladus* W.C.R.Watson ..... Blackberry
Rubus parvifolius L. ..... Small-leaved Bramble

Rutaceae
Boronia anethifolia A.Cunn. ..... White & Red Boronia
Boronia granitica Maiden & Betche ..... Granite Boronia

Boronia ledifolia (Vent.) DC. ..... Ledum Boronia
Correa reflexa (Labill.) Vent.
var. *reflexa* ..... Green Correa
Leionema rotundifolium (Endl.) Paul G. Wilson ..... Round-leaved Leionema
Philotheca myoporoides
subsp. *conduplicatus* (Paul G. Wilson) Bayly ..... Folded-leaf Wax Flower
Zieria aspalathoides A.Cunn. ex Benth. ..... Zieria
Zieria cytisoides Sm. ..... Downy Zieria
Zieria fraseri Hook. ..... Fraser's Zieria
Zieria laevigata Bonpl ..... White Zieria
Zieria odorifera m.s. (Armstrong) ..... Small-leaved Pink Zieria

Santalaceae
Exocarpus strictus R.Br. ..... Twiggy Ballart
Thesium australe R.Br. ..... Austral Toadflax

Sapindaceae
Dodonaea falcata J.G.West ..... Narrow-leaved Hop Bush
Dodonaea hirsuta (Maiden & Betche) Maiden & Betche ..... Hairy Hop Bush
Dodonaea viscosa (L.) Jacq ..... Hop Bush

Scrophulariaceae
Derwentia arenaria (A.Cunn. ex Benth.) B.G.Briggs & Ehrend ..... Fine-leaved Speedwell
Derwentia arcuata B.G.Briggs & Ehrend ..... New England Speedwell
**Verbascum thapsus* L. ..... Aaron's Rod
Veronica calycina R.Br. ..... Hairy Speedwell

Solanaceae
Solanum cinereum R.Br. ..... Narrawa Burr
Solanum laciniatum Aiton ..... Large-flowered Kangaroo Apple
Solanum opacum A.Braun & Bouche ..... Nighshade

Stackhousiaceae
Stackhousia viminea Sm. ..... Yellow Stackhousia

Sterculiaceae
Brachychiton populneus (Schott. & Endl.) R.BR. ..... Kurrajong

Stylidiaceae
Stylidium graminifolium Sw. ex Willd. ..... Grass Triggerplant

Thymeliaceae
Pimelea linifolia Sm. ..... Common Rice Flower

Urticaceae
Urtica incisa Poiret ..... Stinging Nettle

Verbenaceae
**Verbena brasiliensis* Vell. ..... Verbena
**Verbena rigida* Spreng. ..... Veined Verbena

Viscaceae

Muellerina bidwillii (Benth.) Barlow ..... Pine Mistletoe

Violaceae

Hybanthus monopetalus (Roem. & Schult.) Domin ..... Slender Violet Bush

Viola betonicifolia Sm. ..... Viola

Viola hederacea Labill. .....Viola

**Viola odorata* L. .....Sweet Violet

Appendix C: Introduced taxa: their life history, control and distribution. A priority scale of invasiveness is suggested with 1 being of highest priority for eradication due to high invasiveness of natural habitats and 5 either ubiquitous or non-invasive.

Anagallis arvensis

Family: Primulaceae.

Synonymy:

Common name: Scarlet Pimpernel, Blue Pimpernel.

Habit: Small perennial or annual herb to 30 cm tall.

Life cycle:

Origin & distribution: Native of Europe, Asia, North Africa; NC, CC, SC, NT, CT, ST, NWS, CWS, NWP, SWP, NFWP; Qld; Vic.; Tas.; SA; WA.

Dispersal:

Priority: 3.

Habitat: Usually in damp places in gardens, wasteland, roadsides, creek banks and irrigated and natural grasslands.

Properties: Has poisoned horses, sheep, cattle, birds and tested to be toxic to dogs and rabbits.

Control & management: MCPA or 2,4-D are partially effective on seedlings; Ioxynil will kill the plant, hand weeding.

Axonopus affinis

Family: Poaceae.

Synonymy:

Common name: Narrow-leaved Carpet Grass, Mat Grass.

Priority: 4.

Habit: Glabrous rhizomatous and stoloniferous perennial to 0.5 m tall often forming dense mats.

Life cycle: Flowers during warmer months.

Origin & distribution: Native of America. NC, CC, SC, NT, ST and SWP in NSW. Qld.

Dispersal: Via caryopsis.

Habitat: Lawns, naturalized in run down pastures on alluvial soils. A serious weed of wetter regions.

Properties:

Control & management: Difficult to eradicate once established. Spot spraying with kerosene or diesel distillate. Glyphosate.

Bidens pilosa

Family: Asteraceae.

Synonymy:

Common name: Cobbler's Pegs, Stick-tights, Pitch-forks.

Habit: Erect annual forb 60 cm to 1 m with angular branches.

Life cycle: Germinates spring & summer after rain, flowers throughout year but mainly late summer-autumn.

Origin & distribution: Native of tropical South America; now spread throughout warm regions of world; widespread north of Milton NSW and ACT; coastal Qld, LHI, Vic, NT, SA, WA.

Priority: 2.

Dispersal: Seeds which readily attach to fur/clothing by the 2 barbed spines.

Habitat: Gardens, cultivated land, waste areas, roadsides; usually on loam or clay loam soils (Western NSW).

Properties: One report indicates it may taint milk.

Control & management: Spray with 2,4–D or MCPA.

Briza minor

Family: Poaceae

Synonymy:

Common name: Shivery Grass.

Priority: 3.

Habit: Annual to 0.6 m.

Life cycle: Flowers spring.

Origin & distribution: Native to Europe. NC, CC, SC, NT, CT, ST, NWS, CWS, SWS, NWP, SWP. All states except NT.

Dispersal: Via caryopsis. Sometimes found in pasture seed.

Habitat: Weed of disturbed areas, cultivation and waste ground.

Properties: -.

Control & management: -.

Bromus driandrus
Family: Poaceae.

Synonymy: *Bromus gussonii*

Common name: Great Brome, Jabbers.

Priority: 3.

Habit: Loosely tufted, annual grass to 0.3 m tall.

Life cycle: Prefers a wet winter or spring.

Origin & distribution: Introduced from Europe. Grows in all divisions of New South Wales and also south-eastern Queensland.

Dispersal: Seed.

Habitat: Usually damp areas and by creeks in disturbed areas.

Properties: Not aggressive and does not persist. The mature seeds can cause death to browsing animals.

Control & management: Regeneration of denuded areas should control the species, which is not a seriously invasive weed.

Cirsium vulgare

Family: Asteraceae.

Synonymy: *Carduus lanceolatus*, *Carduus vulgaris*, *Cnicus lanceolatus*.

Common name: Spear thistle, Bull thistle, Scotch thistle (NZ), swamp thistle.

Habit: Erect biennial to 1.5 m high.

Life cycle: Seeds germinate mostly after autumn rains; winter development of root system; rosette grows through summer to next spring of the second year when it flowers August - April; plant dies end of summer-early autumn; grows after spring and summer rains.

Origin & distribution: Native to Europe, western Asia and North Africa. In all Australian states except NT; in all divisions NSW; common throughout central and southern Qld, particularly on the Darling Downs; naturalised in Vic in 1850s, Tas, SA, WA;

Dispersal: Seed – wind, water, mud, vehicles, and in feed.

Habitat: Weed of old cultivated land, run-down pastures and newly cleared Brigalow country in Qld.

Properties: Noxious weed (all Vic; Tas, parts NSW and WA); smothers pastures; stock avoid grazing amongst plants; seeds short dormancy; low wind dispersal potential; rarely eaten by stock but infections are transmitted to animal by the spines of spear thistle; positive response to increased fertility.

Control & management: Spray with 2,4-D or MCPA (but old plants are fairly resistant) in the rosette to early flowering stages, or cut annual plant at base just as flower buds are opening and remove root; in cleared Brigalow it often disappears after 2 years being replaced by other plants.

Conyza albida

Family: Asteraceae.

Synonymy:

Common name: Tall Fleabane.

Habit: Robust erect spreading annual herb to 2 m high.

Life cycle: Flowers summer to autumn (mainly December – ?August)

Origin & distribution: native of North America; NC CC SC NT CT ST NWS CWS SWS SWP, LHI; Qld, Vic, SA, WA.

Dispersal: Achenes.

Priority: 3.

Habitat: Cultivated areas, pastures, wasteland.

Properties:

Control & management: Spraying with 2,4-D o MCPA plus dicamba.

Conyza bonariensis

Family: Asteraceae.

Synonymy: *Erigeron bonariensis*

Common name: Flax-leaf Fleabane.

Habit: Annual herb up to 1-2 m high.

Life cycle: Active growth starts spring-early autumn; seed production over long period; flowers throughout year.

Origin & distribution: Native of South America; widespread all divisions NSW, all states.

Dispersal: Seed by wind.

Priority: 3.

Habitat: Most soil types and plant communities particularly in disturbed soil eg roadsides, cultivation and lawns.

Properties: Suspected of poisoning stock; may irritate skin.

Control & management: Spraying with 2,4-D o MCPA plus dicamba. Pulling by hand probably an easy way for removing individuals.

Hyparrhenia hirta

Family: Poaceae.

Synonymy:

Common name: Coolatai Grass.

Habit: Densely tufted perennial to 1.2 m tall.

Priority: 1

Life cycle:

Origin & distribution: Native to the Mediterranean. Common from the coast to the western plains. Also known from all mainland states except Victoria.

Dispersal: Seed.

Habitat: Common on roadsides.

Properties: Very invasive, even in pristine areas.

Control & management: This species is a serious weed and poses a great threat to Kings Plains. No methods are listed for eradication of this species. Monitoring of this species is required and immediate action should be taken to control this species. Tracks leading through non-infested areas should be traveled on less frequently.

Hypochaeris radicata

Family: Asteraceae.

Synonymy:

Common name: Catsear, Flatweed, False Dandelion.

Habit: Perennial rosette herb 30-60 cm high with taproot; may act as an annual (western NSW).

Life cycle: Flowers spring-autumn but mainly spring & summer.

Origin & distribution: Native of Europe; widespread - in all divisions NSW except NWP; all states.

Dispersal: seed

Priority: 5.

Habitat: Common weed in almost all situations, gravelly waste to pastures & lawns, roadsides, disturbed habitats.

Properties:

Control & management: Killed by spraying with 2,4-D (0.1-0.2%) or MCPA; hand weeding below crown in early spring.

Opuntia stricta

Family: Cactaceae.

Synonymy:

Common name: Common Prickly Pear, Pest Pear, Erect Prickly Pear, Gayndah Pear.

Habit: Bush, clumped plant, distinct trunks absent, usually <1.5 m tall.

Life cycle: New plants arise from seed or from detached segments, plants are long lived and seeds are viable for at least 20 years.

Origin & distribution: Native of southern North America; all divisions and mainland states.

Priority: 3.

Dispersal: Segments spreading by animals, floods and vehicles.

Habitat: Semi arid savannas in warm temperate, subtropical and tropical regions.

Properties: Noxious weed; drought resistant; irritating spines.

Control & management: Biological control using *Cactoblastis cactorum* and *Dactylopius opuntiae* then disposal of remaining plants by spraying with arsenical preparations, or grubbing, heaping and burning.

Panicum antidotale

Family: Poaceae.

Synonymy:

Common name: Giant Panic Grass, Blue Panic.

Habit: Robust tufted, rhizomatous perennial to 1.5 m tall.

Life cycle: Flowers in summer. Requires prolonged rainfall for establishment.

Origin & distribution: Native of India and Asia. Known from the coast to the western plains of New South Wales. Also within Queensland, the Northern Territory and Western Australia.

Dispersal: Seed.

Priority: 2

Habitat: A cultivated species, usually in pastures.

Properties: Seeds prolifically.

Control & management: Regeneration of disturbed areas should help control the numbers of this species.

Paspalum dilatatum
Family: Poaceae.

Synonymy:

Common name: Paspalum, Dallas Grass, Water Couch, Golden Crown Grass.

Habit: Tufted perennial to 2 m tall.

Life cycle: Flowers summer and autumn.

Origin & distribution: Native of South America. Throughout New South Wales. All states except the Northern Territory.

Priority: 3.

Dispersal: Seed.

Habitat: A pasture species also found in lawns and disturbed areas. Usually in drainage lines and creek banks.

Properties: Has an underground rootstock. Ergot infested seeds are poisonous and can cause dermatitis on humans.

Control & management: Can be controlled by diesel or kerosene. May be cut below the crown. This species is widespread and fairly ubiquitous, management would probably be ineffectual particularly on riversides.

Pavonia hastata

Family: Malvaceae.

Synonymy:

Common name:

Habit: Spreading shrub to 1.5 m tall.

Life cycle: Flowers in summer.

Origin & distribution: Native of South America; NC, CC, NT, NWS, CWS, SWS, SWP; Qld.

Dispersal:

Priority: 3.

Habitat: Waste areas and hillsides.

Properties:

Control & management:

Plantago lanceolata
Family: Plantaginaceae.

Synonymy:

Common name: Lamb's Tongues, Common Plantain, Ribwort, Ribgrass, Buckhorn Plantain.

Habit: Annual or biennial herb with a well developed and persistent tap root.

Life cycle: Flowers mainly September to April.

Origin & distribution: Native to Europe and north and central Asia. NC, CC, SC, NT, CT, ST, NWS, CWS, SWS, SWP in NSW. All states except NT.

Dispersal: Capsule.

Habitat: Grows in disturbed sites such as roadsides and waste places.

Properties: Important cause of hay fever and a host for some plant diseases.

Control & management: Chipping and hand pulling, Spot spraying.

Petrorhagia nanteuilii

Family: Caryophyllaceae.

Synonymy: *Petrorhagia prolifer.*

Common name: Proliferous Pink.

Habit: Erect annual herb to 60 cm tall.

Life cycle: Winter to spring annual.

Origin & distribution: Native to Europe; CC, SC, NT, CT, ST, NWS, CWS, SWS, NWP, SWP; Qld; Vic; Tas; SA; WA.

Dispersal: Seed.

Priority: 2.

Habitat: Pastures, roadsides and damp disturbed sites.

Properties: Plentiful in years of high cool-season rainfall.

Control & management:

Rosa rubiginosa

Family: Rosaceae.

Synonymy: *Rosa eglanteria*.

Common name: Sweet Briar.

Habit: Erect or scrambling deciduous perennial shrub to 3m high.

Life cycle: Abundant seed, few seedlings survive, seeds germinate all year round, suckers from crown, flowers at 3 years old.

Origin & distribution: Native of Europe and Western Asia to northern India; CC, SC, NT, CT, ST, NWS, SWS, NWP, SWP; all states.

Dispersal: Seed dispersed by birds and mammals eating the fruit and possibly by water.

Priority: 2.

Habitat:

Properties: Spread increased by reduced grazing pressure and reduced competition, dense stands can harbour rabbits.

Control & management: Removal of established plants by hand or with Briarmatic unit when soil is moist, spraying base of canes with ester 2,4,5-T in flowering or early fruiting. Tordon at full leaf to ripe fruit stage. Misting with picloram; hexazinone applied to crowns with spot gun.

Rubus chloocladus
Family: Rosaceae.

Synonymy: *Rubus procerus*.

Common name: Blackberry.

Priority: 1.

Habit: Scrambling semi-deciduous shrub to 2 m, with primo-canes erect and arching rooting at the apex.

Life cycle: As above.

Origin & distribution: Native to Europe. NC, CC, SC, CT, ST, NWS in NSW. Vic., SA, WA.

Dispersal: Spread by birds when fruit is succulent. Arching canes can root and the thickets can be spread vegetatively.

Habitat: Mainly in areas with fertile soils, common on roadsides, stream banks and can be invasive in native bush.

Properties: May overcrowd and eliminate native species.

Control & management: Bulldoze large plants then rip to bring large roots out to surface dry, spray or pull emerging seedlings. Imazapyr or triclopyr during the early flowering period can be effective but the plants need to be thoroughly wetted. Dead canes should be left for 6 months and then burnt.

Setaria gracilis
Family: Poaceae.

Synonymy: *Setaria geniculata* var. *pauciseta*.

Common name: Slender Pigeon Grass.

Priority: 3.

Habit: Tufted perennial to 1.2 m high.

Life cycle: Flowers summer.

Origin & distribution: Native of America. NC, CC, SC, NT, CT, ST, NWS, CWS, SWS, SWP in NSW. All mainland states except NT.

Dispersal: Via caryopsis.

Habitat: Roadsides and often disturbed areas.

Properties:

Control & management: Chipping and removal of plant material.

Sigesbeckia orientalis subsp. *orientalis*
Family: Asteraceae.

Synonymy: *Sigesbeckia microcephala*.

Common name: Indian Weed.

Priority: 5.

Habit: Erect annual herb to 80 cm tall or sometimes to 2 m.

Life cycle: Flowers summer to autumn. Growth commences in cooler months and may continue through summer especially in shaded and sheltered sites.

Origin & distribution: Native of east Asia and Africa. NC, CC, SC, NT, CT, ST, NWP, SWP in NSW. All mainland states.

Dispersal: Achene.

Habitat: Grows in stony soils and riverbanks. Prefers wet situations or more fertile soils and is often abundant after fires.

Properties: Used medicinally for skin problems.

Control & management: Pulling and chipping. A high fire frequency is likely to increase population numbers.

Sonchus asper subsp. *glaucescens*

Family: Asteraceae.

Synonymy:

Common name: Rough Sow thistle, Prickly Sow thistle, Spiny Sow thistle, Rough Milk Thistle.

Habit: Erect annual or over wintering herb 20-150 cm high, with woody taproot.

Life cycle: Grows in cooler seasons and die after flowering October-December if favourable conditions do not persist; otherwise they grow throughout the year and flower at any time.

Origin & distribution: Native of Europe; all divisions except NWS NWP; all states.

Dispersal: Achene - readily dispersed.

Priority: 3.

Habitat: Weed of most habitats, particularly roadsides, cultivation, gardens, wasteland.

Properties: May causing photosensitization in cattle.

Control & management: Cultivation followed by hand weeding or hoeing of scattered plants; mow waste places before seeds form.

Sonchus oleraceus

Family: Asteraceae.

Synonymy:

Common name: Common Sow thistle, Milk thistle.

Habit: Erect succulent annual or over wintering herb 1-1.5 m high, taproot, with milky sap.

Life cycle: grow in cooler seasons and die after flowering if favourable conditions do not persist; otherwise they may grow throughout the year and flower at any time.

Origin & distribution: Native of Europe & central Asia (Eurasia); all divisions, all states.

Dispersal: Achene - readily dispersed.

Priority: 3.

Habitat: widespread weed of cultivation, pastures & disturbed areas; most soil types most communities.

Properties: Suspected of causing photosensitization in cattle

Control & management: Readily controlled by spraying with 2,4-D (1.1 kg/ha) or MCPA; normally can be controlled by cultivation and pulling isolated plants before seed set.

Stellaria media

Family: Caryophyllaceae.

Synonymy:

Common name: Common Chickweed.

Habit: Annual or biennial with weak stems rooting at nodes.

Life cycle: Winter-spring annual.

Origin & distribution: Native of Europe; all divisions except NFWP; Qld; Vic.; Tas.; SA; WA.

Dispersal: Seed.

Priority: 4.

Habitat: Weed of cultivation; sometimes river flats; shaded crevices and valleys on rocky hillsides.

Properties:

Control & management: Hand weeding, mecoprop and various herbicides.

Taraxacum officinale

Family: Asteraceae.

Synonymy:

Common name: Dandelion, Common Dandelion.

Habit: Prostrate perennial herb 15-30 cm and basal rosette of leaves, scapes 5-40 cm high.

Life cycle: Flowers most of year, in spring in western NSW; reproduces by seeds and new shoots from roots.

Origin & distribution: Native of Europe; NC, CC, SC, NT, CT, ST, NWS, SWS, NWP, SWP; all states except NT.

Dispersal: Achene

Habitat: Widespread weed of lawns, roadsides, wasteland, cultivated land and pastures; found where there is adequate moisture available throughout year; favours cool climates.

Priority: 4.

Properties: Not known to be poisonous; medicinal properties

Control & management: Spot spraying with selective herbicides and rotary hoe in arable land or cut crown below soil surface when hand pulling; very difficult to eradicate once established.

Verbascum thapsus

Family: Scrophulariaceae.

Synonymy:

Common name: Great Mullein, Blanket Weed, Aaron's Rod, Flannel Leaf, Velvet Mullein.

Habit: Erect, densely hairy biennial herb to 2.5 m tall.

Life cycle: Seeds germinate in autumn and spring; flowers January to March; die in autumn; seeds mostly viable and long lived.

Origin & distribution: Native of Eurasia; CC, SC, NT, CT, ST, NWS, CWS, SWP, NFWP; Qld; Vic.; Tas; SA.

Dispersal: Only be seeds.

Habitat: Temperate regions of moderate summer temperatures and more than 500 mm annual rainfall, on dry well drained soils, sites of lower fertility and high pH; disturbed land, woodlands an pastures.

Properties: Doesn't persist when soil fertility raised.

Priority: 3.

Control & management: Removal of individual plants with as much taproot as possible, glyphosate can be applied at rosette stage.

Verbena rigida

Family: Verbenaceae.

Synonymy:

Common name: Veined Verbena, Wild Verbena.

Habit: Perennial herb to 60 cm tall.

Life cycle: Flowers throughout the year.

Origin & distribution: Native of South America; NC, CC, SC, NT, NWS, SWS, Qld.

Dispersal:

Priority: 2.

Habitat: Widespread weed of waste ground, roadsides, creek banks and run down pastures.

Properties:

Control & management: Spraying with 2,4-D/2,4,5-T mixtures or sodium chlorate.

Vulpia bromoides

Family: Poaceae.

Synonymy:

Common name: Squirrel Tail Fescue, Silvery Grass, Brome Fescue, Rat's Tail Fescue.

Habit: Tufted annual to 40 cm tall.

Life cycle: Flowers in spring.

Origin & distribution: Native of the Mediterranean. Known from most areas in New South Wales and in all states except the Northern Territory.

Priority: 2.

Dispersal: Seed.

Habitat: Usually in disturbed areas.

Properties: Prefers high winter rainfall when in can become prolific.

Control & management: Regeneration of cultivated areas should help control populations.

Xanthium spinosum

Family: Asteraceae.

Synonymy:

Common name: Bathurst Burr, Spiny Cocklebur.

Habit: Robust much branched annual usually 60-90 cm but up to 1 m high.

Life cycle: Several germinations after summer rain or irrigation; plants grow quickly producing flowers January - June. Oldest plants produce burrs in February and

continue bearing fruit for several months; late summer emergents produce seed when only a few weeks old; most die early winter.

Origin & distribution: Native of South America; Mediterranean climates worldwide; all divisions except SWS; widespread in Qld; irrigated lands in Vic; floodplains SA; NT; WA.

Dispersal: Seeds - (dispersed by animals & water) some remain dormant for at least 3 years.

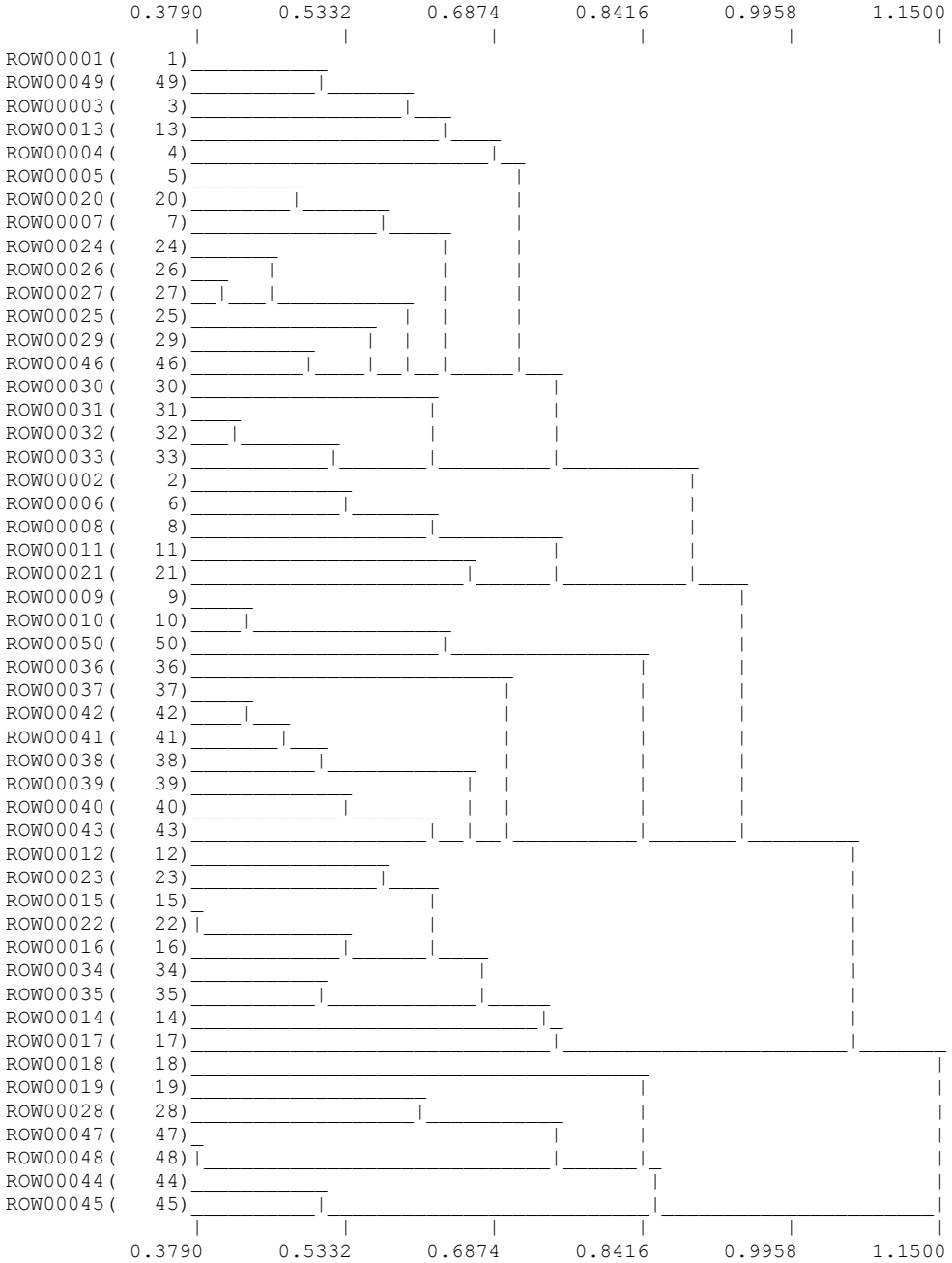
Habitat: Exposed, moderately warm situations in temperate regions on high fertility soils; growing on roadsides, old cultivated paddocks, run-down pastures and sheep camps; invading irrigation areas, watercourses, flood plains.

Priority: 1.

Properties: Noxious weed; young plants are poisonous to stock; host to fungal diseases in horticultural plants; seedlings are poisonous to cattle, goats, poultry, sheep, and particularly horses and pigs producing nausea, vomiting, gastroenteritis, depression, weakened muscle movement, dermatitis in humans, loss of egg production and early moult in poultry, and death may occur in a few hours or days; poisonous constituent is hydroquinone.

Control & management: Destroy by spraying with MCPA or 2,4-D at 1.1kg/ha; and by cultivation so mow and slash before burrs form and monitor area for 3 years; destroy plants with burrs by burning.

Appendix D: Original dendrogram from Kulczynski association and flexible UPGMA.



Appendix E: Two-way table showing species occurrences within each of the eight communities defined by analysis in this investigation.

Name	**Community**								
	kp1	kp2	kp3	kp4	kp5	kp6	kp7	kp8	Total
Acacia buxifolia	1	1	1		1				4
Acacia falciformis								1	1
Acacia filicifolia	1	1	1						3
Acacia fimbriata	1	1							2
Acacia leiocalyx	1	1		1			1		4
Acacia leptoclada	1				1				2
Acacia neriifolia	1		1	1	1	1		1	6
Acacia penninervis	1				1	1	1		4
Acacia pruinosa	1			1	1	1		1	5
Acacia stricta						1			1
Acacia torringtonensis					1			1	2
Acacia ulicifolia	1			1	1			1	4
Acacia venulosa	1				1			1	3
Acacia viscidula	1			1		1			3
Acacia williamsiana								1	1
Acaena novae-zelandiae						1	1		2
Actinotus gibbonsii	1				1				2
Actinotus helianthi					1				1
Agrostis aemula		1							1
Agrostis sp. A	1	1							2
Aira cupaniana	1	1		1		1			4
Ajuga australis	1		1	1		1	1		5
Allocasuarina brachystachya	1				1			1	3
Allocasuarina gracilis					1				1
Allocasuarina gymnanthera								1	1
Allocasuarina inophloia	1				1				2
Alternanthera denticulata						1			1
Amphipogon caricinus					1	1			2
Amyema bifurcatum				1					1
Amyema miquelii		1							1
Amyema pendulum	1						1		2
Anagallis arvensis	1			1		1			3
Angophora floribunda	1	1	1	1		1	1		6
Aotus subglauca	1	1			1			1	4
Aristida acuta				1	1				2
Aristida jerichoensis	1	1		1				1	4
Aristida ramosa	1			1	1		1		4
Aristida vagans	1	1		1	1	1			5
Arthropodium milleflorum	1			1	1	1			4
Arundinella nepalensis	1	1		1	1	1			5
Asperula conferta				1		1	1		3
Asplenium flavellifolium								1	1
Astrotricha longifolia					1			1	2
Astrotricha roddii					1			1	2
Austrodanthonia bipartita								1	1
Austrodanthonia eriantha	1	1	1	1	1		1		6
Austrodanthonia monticola	1	1			1				3

Austrodanthonia penicellata				1					1
Austrodanthonia richardsonii	1								1
Austrostipa rudis	1	1	1	1	1				5
Austrostipa setacea	1	1							2
Axonopus affinis						1			1
Babingtonia densifolia					1			1	2
Bertya gummifera						1			1
Beyeria viscosa				1		1			2
Bidens pilosa							1		1
Billardiera scandens	1				1				2
Boerhavia dominii				1					1
Boronia anethifolia								1	1
Boronia granitica					1			1	2
Boronia ledifolia					1				1
Bossiaea neo-anglica					1				1
Bossiaea scortechinii			1						1
Bothriochloa biloba							1		1
Bothriochloa decipiens	1			1		1	1		4
Brachychiton populneus	1					1			2
Brachyloma daphnoides	1		1	1	1			1	5
Brachyscome microcarpa	1								1
Brachyscome nova-anglica	1	1	1	1	1				5
Brachyscome stuartii	1	1							2
Bracteantha viscosa	1								1
Briza minor		1		1					2
Bromus madritensis		1							1
Bulbine bulbosa	1	1				1			3
Bursaria spinosa				1		1			2
Callistemon linearis	1				1				2
Callistemon pungens	1				1	1			3
Callistemon sieberi				1		1			2
Callistemon viminalis						1			1
Callitris endlicheri	1	1	1	1	1	1	1	1	8
Calotis cuneata	1								1
Calotis cuneifolia	1	1	1						3
Calotis dentex			1						1
Calytrix tetragona	1				1			1	3
Cassinia uncata	1	1	1	1		1			5
Cassytha filiformis	1				1	1			3
Cassytha globella								1	1
Casuarina cunninghamiana				1		1			2
Centaurea solstitialis		1		1		1			3
Centaurium erythraea	1	1	1	1		1	1		6
Centipeda minima				1					1
Centrolepis strigosa					1				1
Cerastium fontanum				1					1
Chamaesyce drummondii				1		1			2
Chamaesyce sp. A							1		1
Cheilanthes distans	1			1		1			3
Cheilanthes sieberi	1	1	1	1	1	1		1	7
Cheiranthera cyanea	1				1	1			3
Chrysocephalum apiculatum	1	1		1	1				4

Chrysopogon fallax						1			1
Ciclospermum leptophyllum	1	1		1		1			4
Cirsium vulgare	1	1	1	1		1	1		6
Cleistochloa rigida					1			1	2
Clematis glycinoides			1						1
Commelina cyanea				1		1		1	3
Conyza albida	1	1	1	1		1	1		6
Conyza bonariensis	1	1	1			1			4
Correa reflexa				1		1			2
Craspedia variabilis						1			1
Crassula sieberiana						1			1
Cryptandra amara					1	1		1	3
Cryptandra scortechinii	1				1				2
Cullen tenax						1			1
Cymbonotus lawsonianus	1	1		1		1	1		5
Cymbopogon obtectus	1				1				2
Cymbopogon refractus	1	1	1	1	1	1	1	1	8
Cynodon dactylon						1			1
Cynoglossum australe			1	1					2
Cyperus bifax				1		1			2
Cyperus flavidus		1				1			2
Cyperus fulvus								1	1
Cyperus gracilis					1				1
Dampiera lanceolata					1			1	2
Daucus glochidiatus	1			1		1	1		4
Daviesia genistifolia	1								1
Desmodium brachypodum	1			1		1			3
Desmodium varians	1	1	1	1		1	1		6
Dianella caerulea	1	1	1	1	1	1	1		7
Dianella revoluta			1					1	2
Dichelachne crinita	1					1			2
Dichelachne inaequiglumis	1	1		1	1	1	1		6
Dichelachne micrantha	1			1		1			3
Dichelachne rara	1	1			1				3
Dichelachne sieberiana	1	1		1					3
Dichondra repens	1	1	1	1		1	1		6
Digitaria breviglumis	1	1	1	1	1			1	6
Digitaria parviflora	1								1
Digitaria ramularis				1	1				2
Dillwynia phylicoides					1				1
Dillwynia sieberi	1	1		1			1	1	5
Dipodium variegatum				1					1
Dodonaea hirsuta								1	1
Dodonaea viscosa	1	1		1	1	1		1	6
Echinopogon caespitosus	1	1	1	1	1		1		6
Echinopogon mckiei		1							1
Echinopogon ovatus	1		1						2
Eleocharis plana						1			1
Eleocharis sphacelata						1			1
Emilia sonchifolia							1		1
Enneapogon gracilis				1	1	1			3
Entolasia stricta	1			1	1	1		1	5

Epilobium billardierianum		1							1
Eragrostis brownii				1					1
Eragrostis elongata	1			1					2
Eragrostis lacunaria	1	1							2
Eragrostis leptostachya	1			1		1			3
Eragrostis trachycarpa	1								1
Eucalyptus albens							1		1
Eucalyptus andrewsii	1		1		1				3
Eucalyptus banksii	1	1	1		1	1			5
Eucalyptus blakelyi	1	1				1			3
Eucalyptus caleyi	1	1		1	1			1	5
Eucalyptus crebra	1		1	1				1	4
Eucalyptus dealbata	1			1	1	1		1	5
Eucalyptus macrorhyncha	1			1	1				3
Eucalyptus mckieana	1	1	1					1	4
Eucalyptus melliodora	1	1	1	1			1		5
Eucalyptus prava	1	1			1			1	4
Eucalyptus stannicola	1		1						2
Eucalyptus viminalis							1		1
Euchiton gymnocephalus	1						1		2
Euchiton involucratus	1					1			2
Euchiton sphaericus	1	1	1	1		1	1		6
Exocarpus cupressiformis				1		1			2
Fimbristylis dichotoma	1	1		1	1	1		1	6
Gahnia aspera	1	1	1		1				4
Galium binifolium				1					1
Galium gaudichaudii		1	1						2
Galium migrans	1		1	1					3
Galium propinquum	1			1					2
Geranium solanderi	1	1		1		1	1		5
Gladiolus carneus						1			1
Glossogyne tannensis	1			1					2
Glycine clandestina	1	1	1	1		1	1		6
Glycine tabacina				1					1
Gnaphalium coarctatum				1					1
Gomphocarpus fruticosus						1	1		2
Gonocarpus micranthus	1	1			1				3
Gonocarpus tetragynus	1	1	1		1			1	5
Gonocarpus teucrioides								1	1
Goodenia bellidifolia	1	1	1	1	1			1	6
Goodenia gracilis		1			1				2
Goodenia hederacea	1			1	1				3
Goodenia rotundifolia			1						1
Gratiola peruviana						1			1
Grevillea arenaria	1				1				2
Grevillea floribunda	1							1	2
Grevillea triternata	1			1	1			1	4
Haemodorum planifolium				1					1
Hakea dactyloides	1				1			1	3
Hakea microcarpa						1			1
Haloragis heterophylla	1	1		1	1				4
Hardenbergia violacea	1	1	1	1	1	1			6

Helichrysum scorpioides		1							1
Hibbertia acicularis	1		1	1	1				4
Hibbertia obtusifolia	1		1	1		1		1	5
Hibbertia riparia		1			1			1	3
Hibbertia sp. B								1	1
Hibbertia vestita					1				1
Homoranthus biflorus					1			1	2
Hovea lanceolata				1	1			1	3
Hovea linearis	1								1
Hybanthus monopetalus			1					1	2
Hydrocotyle laxiflora						1	1		2
Hydrocotyle peduncularis	1	1	1	1					4
Hydrocotyle tripartita		1		1		1			3
Hyparrhenia hirta	1					1			2
Hypericum gramineum	1	1	1	1				1	5
Hypochaeris radicata	1	1	1	1	1	1		1	7
Hypoxis exilis		1							1
Imperata cylindrica			1			1			2
Indigofera adesmiifolia						1			1
Indigofera australis	1		1	1	1				4
Isolepis hookeriana						1			1
Isopogon petiolaris					1			1	2
Isotoma anethifolia	1								1
Isotoma axillaris								1	1
Jacksonia scoparia	1			1					2
Jasminum lineare				1		1			2
Juncus firmis				1					1
Juncus fockei		1							1
Juncus pauciflorus	1	1							2
Juncus remotiflorus	1	1		1		1			4
Juncus vaginatus				1					1
Kennedia rubicunda						1			1
Kunzea obovata								1	1
Kunzea parvifolia	1	1			1				3
Lagenifera stipitata	1	1	1	1			1		5
Laxmannia compacta	1				1			1	3
Leionema rotundifolium					1			1	2
Lepidium bonariense				1					1
Lepidosperma gunnii	1				1				2
Lepidosperma laterale	1	1	1	1	1			1	6
Lepidosperma viscidum					1				1
Leptospermum arachnoides	1								1
Leptospermum brachyandrum	1	1		1		1			4
Leptospermum brevipes	1		1	1	1			1	5
Leptospermum divaricatum					1				1
Leptospermum minutifolium		1							1
Leptospermum novae-angliae	1	1			1			1	4
Leptospermum polygalifolium		1							1
Lespedeza juncea		1		1		1	1		4
Leucopogon attenuatus								1	1
Leucopogon biflorus	1		1						2
Leucopogon lanceolatus			1						1

Leucopogon melaleucoides	1							1	2
Leucopogon muticus	1		1	1	1	1		1	6
Leucopogon neoanglicus					1			1	2
Leucopogon virgatus	1				1				2
Lissanthe strigosa	1	1	1	1	1				5
Lobelia gibbosa	1				1				2
Lobelia gracilis	1				1			1	3
Logania albiflora					1				1
Lomandra confertifolia	1	1							2
Lomandra filiformis	1			1	1				3
Lomandra longifolia	1	1		1	1	1	1	1	7
Lomandra multiflora	1	1	1	1	1		1	1	7
Luzula flaccida	1	1							2
Lythrum salicaria						1			1
Marsilea drummondii				1					1
Medicago lupulina				1		1	1		3
Melichrus urceolatus	1		1	1	1			1	5
Mentha satureioides	1			1		1			3
Microlaena stipoides	1		1	1	1				4
Microtus unifolia	1	1		1	1				4
Mirbelia pungens					1				1
Mirbelia speciosa					1			1	2
Monotoca scoparia	1		1	1	1			1	5
Murdannia graminea	1	1							2
Myoporum montanum			1						1
Myriophyllum striatum						1			1
Myriophyllum verrucosum						1			1
Notelaea linearis						1			1
Notelaea microcarpa	1			1		1	1		4
Olax stricta					1			1	2
Olearia elliptica	1		1	1			1		4
Olearia gravis					1				1
Olearia ramulosa	1								1
Olearia rosmarinifolia					1				1
Olearia viscidula							1		1
Opercularia aspera	1	1	1	1	1				5
Opercularia hispida			1		1				2
Opuntia stricta				1					1
Orthoceras strictum	1			1					2
Oxalis chnoodes	1		1	1		1			4
Oxalis perennans	1		1			1			3
Ozothamnus diosmifolius	1								1
Ozothamnus obcordatus								1	1
Pandorea pandorana						1			1
Panicum antidotale	1								1
Panicum simile	1	1	1	1	1				5
Parsonsia eucalyptophylla	1			1					2
Paspalidium constrictum								1	1
Paspalum distichum						1			1
Patersonia sericea	1		1		1				3
Pavonia hastata				1					1
Pelargonium inodorum						1			1

Pennisetum alopecuroides					1					1
Persicaria decipiens							1			1
Persoonia cornifolia	1	1	1		1				1	5
Persoonia sericea	1									1
Persoonia tenuifolia						1				1
Petrophile canescens						1				1
Petrorhagia nanteuilii					1		1	1		3
Philotheca myoporoides									1	1
Phyllanthus occidentalis	1					1				2
Phyllanthus subcrenulatus					1		1			2
Phyllanthus virgatus					1		1	1		3
Picris hieracioides		1	1				1	1		4
Pimelea linifolia	1				1	1	1		1	5
Plantago lanceolata					1		1			2
Plantago varia	1	1			1		1	1		5
Platysace ericoides	1					1			1	3
Plectranthus parviflorus					1					1
Poa sieberiana		1			1		1	1		4
Podolepis jaceoides	1									1
Pomaderris andromedifolia							1			1
Pomaderris angustifolia				1	1					2
Pomax umbellata	1			1	1	1			1	5
Poranthera microphylla	1			1	1					3
Pratia concolor							1			1
Prostanthera nivea	1					1			1	3
Prostanthera saxicola	1					1			1	3
Pteridium esculentum				1						1
Pterostylis coccinea									1	1
Pterostylis daintreana	1								1	2
Pultenaea foliolosa									1	1
Pultenaea sp. C	1					1		1		3
Pultenaea stuartiana	1					1				2
Ranunculus lappaceus							1			1
Rhodanthe diffusa						1				1
Rhytidosporum procumbens						1				1
Rosa rubiginosa					1		1	1		3
Rostellularia adscendens					1					1
Rubus chloocladus		1					1			2
Rubus fruticosus	1						1			2
Rubus parvifolius							1			1
Rumex brownii					1		1			2
Rumex crispus							1			1
Schoenus apogon	1	1			1	1	1	1	1	7
Scleria mackaviensis					1					1
Scutellaria humilis					1					1
Senecio diaschides	1	1			1	1	1	1		6
Senecio hispidulus	1				1					2
Senecio quadridentatus	1	1					1	1		4
Senna occidentalis					1		1			2
Setaria gracilis					1		1			2
Sigesbeckia orientalis	1				1					2
Silybum marianum	1									1

Solanum cinereum	1			1	1				3
Solanum laciniatum				1					1
Sonchus oleraceus	1	1	1	1		1	1		6
Sorghum leiocladum	1			1		1	1		4
Sporobolus creber	1			1	1		1		4
Sporobolus elongatus		1		1		1			3
Stackhousia viminea	1			1					2
Stellaria angustifolia						1			1
Stylidium graminifolium				1	1				2
Stypandra glauca					1			1	2
Styphelia triflora	1		1		1			1	4
Styphelia viridis	1				1				2
Swainsona galegifolia				1		1			2
Taraxacum officinale	1	1	1	1		1	1		6
Thelymitra pauciflora				1					1
Themeda triandra	1	1		1	1	1			5
Thesium australe				1		1			2
Thysanotus tuberosus	1		1						2
Trachymene incisa	1	1		1	1	1		1	6
Tricoryne elatior					1				1
Trifolium repens						1			1
Tripogon loliiformis	1				1	1		1	4
Triptilodiscus pygmaeus				1		1			2
Verbena brasiliensis		1							1
Verbena hispida						1	1		2
Verbena rigida				1		1			2
Vernonia cinerea	1	1	1	1					4
Veronica calycina	1		1	1		1	1		5
Viola betonicifolia	1	1	1	1		1	1		6
Viola hederacea	1					1			2
Viola odorata			1						1
Vittadinia cuneata	1	1	1	1		1	1		6
Vittadinia muelleri			1	1					2
Vittadinia sulcata	1	1		1		1			4
Vulpia bromoides						1			1
Wahlenbergia luteola	1	1	1	1	1	1		1	7
Wahlenbergia stricta	1	1		1	1		1		5
Westringia longifolia						1			1
Xanthium spinosum						1			1
Xanthorrhoea johnsonii	1			1	1	1		1	5
Zieria aspalathoides					1				1
Zieria cytisoides					1				1
Zieria fraseri								1	1
Zieria laevigata					1				1
Zornia dyctiocarpa	1			1					2

Appendix f: Locality and site information for all sites surveyed during this project. Details of sites conducted by Hunter (1999) are also included after site 50.

Site No.	Date	Aspect	Slope	Map	Easting	Northing	Notes	N	NE	E	SE	S	SW	W	NW	Altitude	Rock Type
1	31/01/99	190	3	Hurricane Hill 9138-I-N	348,143.00	6,727,562.00	> 10 yrs since fire. Near NE boundary of park.	2	3	2	0	2	0	2	3	1,000	Acid Volcanic
2	31/01/99	270	1	Hurricane Hill 9138-I-N	347,747.00	6,727,828.00	Gully floor NE corner of the park	3	2	1	1	0	1	2	1	965	Acid Volcanic
3	31/01/99	300	2	Hurricane Hill 9138-I-N	347,805.00	6,727,912.00	10 yrs since fire? Pig rooting. Saddle north east corner of park.	1	2	3	3	2	2	2	0	960	Acid Volcanic
4	31/01/99	220	3	Hurricane Hill 9138-I-N	347,429.00	6,728,020.00	10 yrs since fire. Hilltop - NE corner of park.	3	2	0	0	0	0	2	3	990	Acid Volcanic
5	31/01/99	150	2	Hurricane Hill 9138-I-N	347,877.00	6,727,152.00	10 yrs since fire. Eastern fence line.	2	1	1	1	0	1	2	3	975	Acid Volcanic
6	31/01/99	150	1	Hurricane Hill 9138-I-N	347,317.00	6,725,872.00	10 yrs + since fire. Near boundary of NE corner.	1	0	1	1	0	1	2	1	920	Acid Volcanic
7	31/01/99	270	2	Hurricane Hill 9138-I-N	347,569.00	6,726,826.00	10 yrs + since fire. Southern side of eastern projection.	2	2	1	1	1	0	0	2	950	Acid Volcanic
8	31/01/99	290	10	Hurricane Hill 9138-I-N	346,400.00	6,726,526.00	15 yrs + since fire. Southern side of eastern projection	1	1	1	1	1	1	1	1	940	Acid Volcanic
9	31/01/99	330	2	Hurricane Hill 9138-I-N	345,891.00	6,727,374.00	15 yrs + since fire. Some clearing for fence line. Red soil area bottom of eastern projection.	0	1	1	1	1	1	0	0	965	Acid Volcanic
10	31/01/99	310	1	Hurricane Hill 9138-I-N	346,201.00	6,729,343.00	20 yrs + fire. Pig rooting. Red soil corner.	1	2	2	1	0	0	0	0	930	Acid Volcanic
11	1/02/99	0	1	Hurricane Hill 9138-I-N	344,401.00	6,724,863.00	10-20 yrs since fire. Opposite mine site on ridge.	0	1	1	1	1	1	1	0	900	Acid Volcanic
12	1/02/99	70	3	Hurricane Hill 9138-I-N	344,489.00	6,724,703.00	10-20 yrs since fire. 500 m west of mining area.	0	0	0	1	1	1	1	1	910	Acid Volcanic
13	1/02/99	260	2	Hurricane Hill 9138-I-N	344,014.00	6,724,618.00	10-20 yrs since fire. Pig rooting. 600 m west of mine area.	0	1	3	3	0	0	0	0	910	Acid Volcanic
14	1/02/99	155	1	Hurricane Hill 9138-I-N	343,590.00	6,724,890.00	15-20 yrs since fire. Pig rutting. 1 km west of mine site.	1	2	1	1	3	1	0	1	900	Acid Volcanic
15	1/02/99	220	4	Hurricane Hill 9138-I-N	342,531.00	6,722,060.00	15-20 yrs since fire. North trending ridge parallel to and west of Kings Plains Creek.	2	2	1	0	0	0	1	1	900	Acid Volcanic
16	1/02/99	60	3	Hurricane Hill 9138-I-N	342,485.00	6,725,815.00	15-20 yrs since fire. Ridge west of Kings Plains Creek.	0	0	1	1	3	1	1	1	890	Acid Volcanic
17	1/02/99	60	6	Hurricane Hill 9138-I-N	342,623.00	6,727,040.00	10 yrs since fire. Western side of Creek below falls.	0	0	1	0	1	1	1	1	860	Acid Volcanic
18	1/02/99	30	2	Hurricane Hill 9138-I-N	342,366.00	6,727,371.00	No evidence of fire. Creek gorge of Kings Plains Ck below falls. Riparian	5	8	4	8	14	10	7	3	740	Acid Volcanic

19	1/02/99	360	1	Hurricane Hill 9138-I-N	343,034.00	6,726,994.00	15-20 yrs since fire. Gorge floor, base of Falls.	6	8	6	10	4	6	6	2	820	Acid Volcanic
20	2/02/99	350	1	Hurricane Hill 9138-I-N	344,506.00	6,724,432.00	10 yrs since fire. Hill 300 m west of southern mining area.	1	1	1	1	1	1	1	1	900	Acid Volcanic
21	2/02/99	60	1	Hurricane Hill 9138-I-N	343,577.00	6,724,166.00	10 yrs since fire. Pig rooting extensive. Creek line near corner of fence line 400 m west of southern mining area.	1	1	1	1	0	1	1	1	900	Acid Volcanic
22	2/02/99	50	2	Hurricane Hill 9138-I-N	343,202.00	6,723,942.00	10 yrs since fire. Outcrop 2 km west of mine site.	0	0	0	0	0	0	0	0	930	Acid Volcanic
23	2/02/99	260	3	Hurricane Hill 9138-I-N	342,587.00	6,724,035.00	10 + yrs since fire. Creek line 3 km south west of abandoned mines.	2	4	3	3	3	3	2	1	870	Acid Volcanic
24	2/02/99	300	1	Hurricane Hill 9138-I-N	341,682.00	6,723,211.00	20 yrs since fire. Creek flat, Pig Crk ca. 3 km west of abandoned mine.	1	2	2	2	1	1	1	1	850	Acid Volcanic
25	2/02/99	320	9	Hurricane Hill 9138-I-N	341,141.00	6,723,455.00	20 yrs since fire. 300 m south of Pig Crk, west of old boundary fence.	0	1	4	7	4	1	0	0	870	Acid Volcanic
26	2/02/99	280	1	Hurricane Hill 9138-I-N	340,635.00	6,723,105.00	20 yrs since fire. Old ring barking in area. Flat area of scrub below Pig Crk.	0	3	5	4	0	0	1	0	870	Acid Volcanic
27	2/02/99	230	5	Hurricane Hill 9138-I-N	340,714.00	6,722,967.00	20 yrs + since fire, no real evidence. Old ring barking. Hillside 300 m south of Pig Creek, 600 m off shire boundary line.	5	4	3	2	0	0	3	5	810	Acid Volcanic
28	3/02/99	215	3	Hurricane Hill 9138-I-N	338,178.00	6,729,207.00	No evidence of fire. Creek bed northern extremity of Kings Plains Cr in park.	2	4	3	2	2	1	4	4	700	Acid Volcanic
29	3/02/99	230	2	Hurricane Hill 9138-I-N	338,482.00	6,728,405.00	20 yrs since fire. Ridge 400 m south of abandoned mining area north boundary of Parish.	1	1	1	1	1	1	1	1	700	Acid Volcanic
30	3/02/99	300	1	Hurricane Hill 9138-I-N	338,422.00	6,728,512.00	No obvious evidence of past fire. Creek line off Kings Plains Ck, northern boundary of Park.	4	7	8	3	3	3	2	1	705	Acid Volcanic
31	3/02/99	90	1	Hurricane Hill 9138-I-N	338,567.00	6,728,152.00	20 yrs since fire. Ridge north western boundary of park.	0	0	0	1	0	0	0	0	710	Acid Volcanic
32	3/02/99	250	1	Hurricane Hill 9138-I-N	339,053.00	6,727,781.00	20 yrs + since fire. Ridge north west corner of reserve.	1	1	1	1	0	0	0	1	740	Acid Volcanic
33	3/02/99	260	1	Hurricane Hill 9138-I-N	339,044.00	6,727,404.00	Burnt within 10 yrs. Hill NW corner of park.	1	1	1	0	0	0	0	1	740	Acid Volcanic
34	3/02/99	190	8	Hurricane Hill 9138-I-N	340,087.00	6,727,141.00	No signs of fire 20 + yrs? Hill NW corner of Park.	5	2	2	1	1	0	0	2	820	Acid Volcanic
35	3/02/99	210	8	Hurricane Hill 9138-I-N	340,265.00	6,727,418.00	No sign of fires, 20 yrs since fire? Hillside NW of 836 high pint, NW corner of Park.	5	5	3	2	0	0	0	2	810	Acid Volcanic

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36	3/02/99	280	6	Hurricane Hill 9138-I-N	338,584.00	6,729,231.00	No obvious signs 20 yrs + fire? Creek line north western corner of park, near abandoned mining area.	1	3	5	4	3	2	3	2	700	Acid Volcanic
37	4/02/99	180	4	Sapphire 1:25 000	337,820.00	6,719,163.00	5 yrs ago, according to local landholder.	3	6	4	3	2	2	4	2	740	Acid Volcanic
38	4/02/99	160	4	Sapphire 1:25 000	338,943.00	6,717,938.00	Burnt 50 yrs previous, local landholder. Hill slope southern part of park below Cattari Peak.	6	3	1	1	1	0	1	4	780	Acid Volcanic
39	4/02/99	180	3	Sapphire 1:25 000	338,889.00	6,717,893.00	Burnt 50 yrs ago, local landholder. Hillslope below Catari Peak, near Weean Creek, southern boundary.	5	3	1	2	1	1	1	3	775	Acid Volcanic
40	4/02/99	250	2	Sapphire 1:25 000	338,526.00	6,717,891.00	50 yrs since fire, local landholder. Hill cleared area, Scheecks Block, southern boundary.	1	2	1	1	1	0	1	0	770	Acid Volcanic
41	4/02/99	340	4	Sapphire 1:25 000	337,851.00	6,718,532.00	50 yrs since fire, local landholder. Valley, hillside, Black Bull Gully, southern boundary of park.	1	3	3	4	5	2	2	2	740	Acid Volcanic
42	4/02/99	220	3	Sapphire 1:25 000	338,128.00	6,719,132.00	50 yrs since fire, local landholder. Hillside 500 m from Weean Ck, southern boundary of park.	2	5	6	3	1	1	4	3	750	Acid Volcanic
43	4/02/99	360	1	Sapphire 1:25 000	337,593.00	6,719,085.00	50 yrs since fire, local landholder. On Weean Ck, southern boundary of park.	1	4	3	5	2	4	5	2	700	Acid Volcanic
44	27/02/99	210	2	Sapphire 1:25 000	341,236.00	6,721,500.00	> 20 yrs fire, some ring barking and selective tree removal. Hillside, Weean Creek adjacent to Ken Fizzels.	2	3	2	1	0	0	1	2	890	Basalt
45	27/02/99	210	3	Sapphire 1:25 000	341,344.00	6,722,376.00	> 20 yrs since fire. Hillside, Weean Ck, S-E corner of Park near Frizzel.	1	3	3	1	0	0	1	2	910	Basalt
46	27/02/99	246	1	Sapphire 1:25 000	341,005.00	6,720,678.00	> 20 yrs since fire. Some selective logging, old rabbit burrows. Flat, SE corner of Park, portion 56, Weean Ck.	2	2	2	2	1	1	0	1	860	Acid Volcanic
47	27/02/99	270	1	Hurricane Hill 9138-I-N	343,522.00	6,724,845.00	> 20 yrs since fire, pig droppings, some mining. Creek Flat, Kings Plains Creek, near 1st picnic area	1	2	2	1	2	2	2	2	890	Acid Volcanic
48	27/02/99	280	1	Hurricane Hill 9138-I-N	344,135.00	6,725,289.00	> 20 yrs since fire. Rehabilitated creek banks after mining. Creek flat, Kings Plains Ck between 2 camping areas.	2	2	2	1	1	2	2	1	885	Acid Volcanic
49	27/02/99	220	3	Hurricane Hill 9138-I-N	345,125.00	6,727,240.00	5-10 yrs since fire. Hillside, north east corner of park in from red soil corner.	2	1	1	1	2	2	1	2	885	Acid Volcanic

50	27/02/99	200	1	Hurricane Hill 9138-I-N	345,117.00	6,726,538.00	5 yrs since fire. Larger fire about 10 yrs previous. Hill, red soil site, 500 m from red corner.	1	2	1	1	1	1	1	2	930	Acid Volcanic
1F	7/03/95	210	1	Hurricane Hill 9138-I-N	345,500.00	6,723,830.00		1	3	1	0	0	0	0	0	915	Acid Volcanic
1F	7/03/95	304	2	Hurricane Hill 9138-I-N	344,340.00	6,725,310.00	once grazed and old fence with some removal of trees	0	1	1	1	1	0	0	0	890	Acid Volcanic
1F	7/03/95	270	1	Hurricane Hill 9138-I-N	345,110.00	6,724,240.00	some past grazing and minor clearing beside creek	1	1	1	2	1	0	1	2	905	Acid Volcanic
1F	9/03/95	50	2	Hurricane Hill 9138-I-N	343,210.00	6,726,190.00	small forest between outcrops with much rocky soil	1	2	1	1	3	4	2	0	885	Acid Volcanic
1F	9/03/95	46	0	Hurricane Hill 9138-I-N	343,800.00	6,725,990.00	riverine on low side of river	2	3	2	1	3	2	1	1	875	Acid Volcanic
1F	9/03/95	280	4	Hurricane Hill 9138-I-N	343,940.00	6,726,010.00		2	2	2	1	1	2	1	1	880	Acid Volcanic
1O	7/03/95	280	1	Hurricane Hill 9138-I-N	345,730.00	6,723,790.00		3	1	1	0	0	0	0	1	935	Acid Volcanic
2O	7/03/95	260	6	Hurricane Hill 9138-I-N	345,500.00	6,723,100.00		1	2	1	0	0	0	0	0	920	Acid Volcanic
3O	7/03/95	310	2	Hurricane Hill 9138-I-N	343,960.00	6,725,740.00		1	1	1	0	1	1	0	1	870	Acid Volcanic
4O	8/03/95	57	2	Hurricane Hill 9138-I-N	343,880.00	6,727,030.00		0	0	0	1	0	0	0	0	900	Acid Volcanic
4O	8/03/95	290	2	Hurricane Hill 9138-I-N	343,730.00	6,727,050.00		0	1	1	0	0	0	0	0	915	Acid Volcanic
5O	8/03/95	248	1	Hurricane Hill 9138-I-N	343,190.00	6,727,130.00		1	2	1	1	1	0	0	1	985	Acid Volcanic
5O	8/03/95	297	4	Hurricane Hill 9138-I-N	343,140.00	6,726,010.00		1	2	3	1	0	0	0	0	980	Acid Volcanic
6O	8/03/95	268	3	Hurricane Hill 9138-I-N	343,090.00	6,726,370.00		0	1	1	1	1	1	0	0	870	Acid Volcanic
6O	8/03/95	280	4	Hurricane Hill 9138-I-N	343,110.00	6,726,220.00		0	1	2	1	1	1	0	0	880	Acid Volcanic
7O	9/03/95	240	4	Hurricane Hill 9138-I-N	343,480.00	6,726,500.00		4	5	4	2	1	1	0	2	905	Acid Volcanic
8O	9/03/95	210	4	Hurricane Hill 9138-I-N	343,500.00	6,726,280.00		3	3	2	1	1	0	0	1	895	Acid Volcanic
9O	9/03/95	287	3	Hurricane Hill 9138-I-N	343,500.00	6,726,140.00		2	3	3	2	2	1	1	1	880	Acid Volcanic

Appendix G: Nomenclature.

Recent Nomenclature Changes

Linder, H.P. (1996)
Austrodanthonia eriantha = Danthonia eriantha
Austrodanthonia fulva = Danthonia fulva
Austrodanthonia laevis = Danthonia laevis
Austrodanthonia linkii = Danthonia linkii
Austrodanthonia monticola = Danthonia monticola
Austrodanthonia peniceillata = Danthonia penicillata
Austrodanthonia richardsonii = Danthonia richardsonii

Jacobs, S.W.L. & Everett, J. (1997)
Austrostipa pubescens = Stipa pubescens
Austrostipa rudis = Stipa rudis

Bean, A.R. (1997)
Babingtonia densifolia = Baeckea densifolia

Hunter, J.T. & Williams, J.B. (1995)
Brachyloma daphnoides subsp. *glabrum = Brachyloma daphnoides* var. *glabrum*

Bruhl, J.J. (*in prep.*) *Breynia. Flora of Australia* Vol. 26.
Breynia cernua = Breynia oblongifolia

Reinstatement of original names
Euchiton involucratus = Gnaphalium involucratum
Euchiton gymnocephalus = Gnaphalium gymnocephalum
Euchiton sphaericus = Gnaphalium sphaericum

Wilson, P.G. (1998)
Leionema rotundifolium = Phebalium rotundifolium

Hunter, J.T. & Bruhl, J.J. (1997)

Phyllanthus occidentalis = Phyllanthus hirtellus subsp. B

Reinstatement of original name

Themeda triandra = Themeda australis