

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/236962163>

# Frankincense on Soqatra Island (Boswellia, Burseraceae; Yemen)

Article in *Cactus and Succulent Journal* · January 2000

---

CITATIONS  
10

READS  
460

4 authors, including:



**Bruno Mies**

University of Duisburg-Essen

40 PUBLICATIONS 166 CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:



biogeography of the Cape Verde Islands [View project](#)

FRANKINCENSE ON SOQOTRA ISLAND  
(*BOSWELLIA*, BURSERACEAE; YEMEN)

BRUNO A. MIES, JOHN J. LAVRANOS AND GARY J. JAMES

Reprinted from CACTUS AND SUCCULENT JOURNAL  
Vol. 72, No. 5, SEPTEMBER–OCTOBER, 2000  
*Made in United States of America*

## FRANKINCENSE ON SOQOTRA ISLAND (*BOSWELLIA*, BURSERACEAE; YEMEN)

BRUNO A. MIES<sup>1</sup>, JOHN J. LAVRANOS<sup>2</sup> & GARY J. JAMES<sup>3</sup>

<sup>1</sup>Linnicher Strasse 60, D-50933 Köln, Germany

<sup>2</sup>Apartado 243, P-8100 Loulé, Portugal

<sup>3</sup>481 Magnolia St., Costa Mesa, CA 92627-2301, U.S.A.

The island of Soqatra—off the Horn of Africa (Fig. 1)—holds an unusual wealth of endemic frankincense trees. Thulin & Gifri (1998) studied the genus *Boswellia* in 1994 during a field trip of three weeks; they mention four species of *Boswellia* as having been described previously from the island and recognise two further taxa as new to science. Although they made a thorough study of the Soqotran members of the genus in the field and proposed to deal with them formally in a world-wide monograph of *Boswellia* (Thulin, in prep.), these authors, surprisingly, chose to subsume *Boswellia nana* under *B. popoviana*, which led us to the supposition that they did not have at hand sufficient material of *B. nana*.

The genus being of particular interest to us, we decided to pay special attention to frankincense during our survey on the island in February 1999. In our view there are at least seven species present there, as the dwarf *B. nana* appears indeed to be a distinct species that should not be included under *B. popoviana*. A proposal for a provisional revised field-key is provided and five of the species are illustrated by photographs taken during three expeditions by the second author since 1967 (Lavrano, 1994) and six by the first (BM) since 1993.

The Soqotran islands form an archipelago consisting of Soqatra, Samhah and Darsa ("The Brothers"), and Abdalkuri (3549 km<sup>2</sup> area in total). All are composed of crystalline cores of granites and gneisses and bear more or less extensive caps of Cretaceous to early Oligocene limestones. Soqatra itself lies 240 km east of Cape Guardafui, off the African mainland (12°19' to 12°42' N, 53°18' to 54°32' E). It measures 110 km from east to west but does not exceed 30 km from north to south (Fig. 1). It had probably become isolated as an island at some time between the end of the Cretaceous, some 70 mio. BP, and the early Oligocene, at about 37 mio. BP, surrounded by a shallow epicontinental sea (Mies, 1995, 1998). The geological fractures of the Gulf of Aden and the Abdalkuri-Somalian rift occurred in Miocene times and the strata of the islands are identical to those of the Horn of Africa and the southern Arabian mainland.

The Soqotran flora is renowned among botanists since the works of Balfour (1888) and

Forbes (1903) and the island has been regarded as a world-wide centre of plant diversity (Miller, 1994). Popov (1957), Mies et al. (1995) and Mies & Beyhl (1998) described the peculiar vegetation of the island, with dense forests in the mountains and interior valleys in which frankincense trees are characteristic and often the dominant woody species (Fig. 2). Soqatra has been mentioned since early historical times as producing frankincense and other gums and was known even to the Egyptians as an island "behind the land of Punt", a classical name for Somaliland, and to the Greeks as the Island of Dioscorides (Doe, 1994; Beyhl, 1998). There, frankincense, dragon's blood and *Aloe* sap were said to be produced and shipped to harbours on the southern shores of Arabia (Qana, e.g.). During many centuries these products—coming from such ancient kingdoms as Saba'a—were transported by camel caravans along the historical "Frankincense Road" to the Mediterranean. On Soqatra the vernacular name of the tall-growing trees *Boswellia ameero*, *B. elongata* and *B. popoviana* is "am'eiro" in the Soqotri language and "luban" in Arabic (Beyhl & Mies, 1998). In their paper, Thulin & Gifri (l.c.) mention the names "semanu" for *B. popoviana*, "*B. bullata*" and "*B. dioscoridis*" and "haliof" or "telieh" for *B. socotrana*.

### Systematics and Biogeography

The xerophytic genus *Boswellia* has its principal centre of endemism in northeastern Africa, southern Arabia and Soqatra (Engler, 1915); thus *B. pirottae* and *B. papyrifera* occur in Ethiopia, the latter also in the Sudan; three species (*B. chariensis*, *B. daltzei*, *B. occidentalis*) occupy a belt stretching from northern Nigeria and Cameroun to the southwestern Sudan; one species aggregate is found in the Sind region (Engler, 1913, 1915); one species (*B. sacra* sensu Thulin & Warfa, 1987) on the limestone plateaux and the Indian Ocean forelands of southern Arabia; eight species (*B. bbaudajiana*, *B. boranensis*, *B. sacra* sensu Thulin [= *B. carteri*], *B. freereana*, *B. multifoliolata*, *B. neglecta*, *B. rivae*, *B. ruspoliana*) have been reported from the Horn of Africa, although some of these have now been placed into synonymy (Thulin & Warfa, 1987). And there are of course the ones from the island of







**Fig. 2.** The frankincense gardens with *Boswellia* "dioscoridis" in the island's interior in Wadi Di-Ishal, east of the Hajhir Mountains.

Soqatra. Gillett (1991) mentions 19 to 20 species of *Boswellia* in all, from the Ivory Coast to India and south to northeast Tanzania and northern Madagascar. The species are not easy to find in the field when bearing neither flowers nor foliage. Some of them have a flaking bark and can be distinguished by it even during the long annual drought. The most reliable indication in the field is the presence of a typical orange-like smell when freshly cut, although this also occurs in some species of *Commiphora*. One may enquire of the local people about frankincense, or "luban" in Arabic; they still collect the aromatic resin and use this name for it. Certain species have local vernacular names, and certain of them are not used for incense.

The flowers are often very tiny and there is a certain lack of diagnostic features. Balfour, for instance, treated *Boswellia socotrana* from Soqatra twice. Besides describing this species, he used a poor herbarium specimen of the same taxon for his new *Odina asplenifolia*, which he placed in the Anacardiaceae (see Thulin & Gifri, 1998). Even Engler, who first monographed the African Burseraceae, had placed this *Odina* in the genus *Lannea* A. Rich., which also belongs in the Anacardiaceae, and failed to realise that it belonged, in fact, to *Boswellia*. The epithet "*socotrana*" had taxonomic priority. Recent collections have established beyond

doubt that this taxon clearly belongs to the Burseraceae and that it is a somewhat variable species.

The radial, insect-pollinated flowers of *Boswellia* normally develop capsules with three seeds, and the genus is separated from the myrrhs (*Commiphora* Jacq.) by the fleshy drupes characteristic of the latter, in which, in most cases, only one seed of two becomes viable (Engler, 1915). *Boswellia* produces dry fruits which, as stated, usually contain three, and in the case of some Soqotran species, up to five seeds. There are ten anthers and five greenish, creamy or white to reddish petals and five minute, 1-3-mm-long sepals. The systematics of both genera remain a problem still to be resolved (Thulin & Warfa, 1987; Gillett, 1991) and therefore an insight into the genus as it occurs on Soqatra contributes to its taxonomy as a whole.

The myrrhs or commiphoras, the sister genus of frankincense, have a wider distribution. It is a close relative of the American genus *Bursera* Jacq. ex L. and some taxonomists advocate merging these two genera. The name *Commiphora* has taxonomic priority over the well-known synonym *Balsamodendron*. These trees and shrubs are characteristic of the *Acacia-Commiphora* shrubland and other formations throughout semi-arid and arid Africa and the Arabian peninsula, their range extending to

←

**Fig. 1.** Map of Soqatra (a), overview of the region (b), and geology (c).





**Fig. 3.** *Boswellia ameero* with leaves and new flowers in the Hajhir Mountains.



**Fig. 4.** Branch of the inflorescence and bright red flowers of *Boswellia ameero*.

western India and Madagascar. Although there are several species of *Commiphora* on Soqatra, only frankincense species are generally characteristic of certain vegetation types (Mies & Beyhl, 1998).

The flowers of *Boswellia* open widely and are rich in nectar, attracting birds, butterflies as well as hymenoptera, which act as pollinators (Fig. 4). A pinkish to reddish colour especially attracts the Soqotran sunbird (*Nectarinia balfouri*), which feeds on the flowers during the flowering season between February and April (for birds see Al Sagheir & Porter, 1998).

An artificial field-key to the Soqotran *Boswellia* species based on easy-to-recognise morphological features (after the authors' data and from cited references):

- 1 Leaves entire (sometimes deeply lobed or only with a basal pair of minute pinnae) . . . . . 2
- 1\* Leaves compound, consisting of 7-31 leaflets (in the Soqotran species) . . . . . 3
- 2 Leaves simple, mostly 10-15 cm long, although sometimes deeply serrate to nearly pinnate; sometimes only 4-5 cm when very young and then resembling those of *B. nana*; if so, leaf-

- stalk > 3 cm. Bark flaking, yellowish to reddish. Flowers usually in many-flowered, rebranching panicles or racemes; petals pink or reddish, outer side glabrous. Erect woody shrub or tree to 8 m. Occasional on coastal rocky hillsides of the north coast and on north-facing cliffs. Higher up on the limestone mountains west of Hadibu. . . . . *B. popoviana*
- 2\* Leaves simple, less than 4 cm long, margin finely serrate but never pinnate, leaf-stalk shorter than 3 cm. A prostrate or almost creeping subshrub with flaking yellowish to reddish bark, often growing in rock crevices and covered with white crustose lichens. If heavily grazed over a long period, a stout, short, wooden corpus evolves. Flowers single in terminal unbranched fascicles; petals (as observed by us) pink or reddish, glabrous outside. Rare, only observed on the Hamaderoh plateau in the northeast of Soqatra, mostly on gentle or precipitous south-facing limestone slopes. . . . . *B. nana*
- 3 Leaf rachis winged, like a small fern frond. The western population has leaves with fewer leaflets that are more winged than in the eastern ones. Bark grey to brownish and rather smooth. Flowers creamy (eastern) to yellowish (western) in many-flowered loose racemes. Common in undisturbed *Croton-Jatropha* bushland. A tree to 8 m in height with a dense flat crown of ascending branches. . . . . *B. socotrana*
- 3\* Rhachis unwinged, leaflets more than 1 cm long. Bark yellowish to reddish, flaking. . . . . 4
- 4 Leaves glabrous, similar to those of *B. elongata* (q. v.). Flowers cream to slightly pinkish; petals glabrous on outer side; produced in loose glabrous panicles or racemes. In the eastern Hajhir foothills. A tree to 10 m tall with widely spreading, wavy, thick main branches, the leaves clustered in rosettes at the apex of secondary branchlets. . . . . *B. "dioscoridis"*
- 4\* Leaves hairy, particularly beneath or on the veins . . . . . 5
- 5 Leaflets usually wider than 2 cm; underside light or darker green, tomentose with spreading hairs. Flowers bright pink in dense inflores-



cences, which are finely tomentose to glabrous; stigma pink; petals glabrous and 4-8 mm long. Common in the central Hajhir Mts. A spreading tree to over 10 m tall with thick, ascending primary branches, the large leaves densely clustered at the apices of the stout secondary branches. The flowers appear while the foliage is becoming red or has dropped. . . . . *B. ameero*

- 5\* Leaflets usually less than 2 cm wide; under surface whitish and densely covered with short, crisped hairs. Flowers cream or reddish, stigma green, produced together with the foliage. . . . . 6
- 6 Leaflets finely pubescent on major veins of upper surface only. Petals glabrous on outer side, 6.5-7 mm long. Common in the lower mountain ranges. A tree to 8 m with horizontally spreading, conspicuously wavy branches, the leaves clustered at the tips of the stout secondary branches. . . . . *B. elongata*
- 6\* Leaflets more or less densely hirsute on entire upper surface, crinkly. Petals pubescent on outer side, 3.5-4 mm long. According to Thulin & Gifri (1998), it is restricted to the west on limestone screes around Qalansiyah (cream flowers) and in the central north (red flowers) of the island. A smaller tree to 4 m (?), the leaves rather smaller than in *B. elongata* but otherwise similar. (We have no further information regarding habit, size, branching.) . . . . . *B. "bullata"*

**The Species**

***Boswellia ameero* Balf.f.** Balfour, I. B. 1882. Proc. Roy. Soc. Edinburgh 11: 505.

*Boswellia ameero* is a common tree of the Hajhir mountain ranges above 400 m (Fig. 3) and ecologically the altitudinal vicariant of *B. elongata*, the latter occurring on the lower hillsides. It forms scattered populations and is locally dominant in the central granitic Hajhir Mountains. The local people lop branches off the trees for fodder in times of drought or let the livestock, particularly camels, browse on them (Fig. 8).

This is a large tree with a yellowish-brown to -grey flaking bark. The leaves are large with (9-)11-17(-25) leaflets, which are (15-)25-90 x (10-) 20-60 mm, tomentose to sparsely pubescent (not white-felted underneath). There is a great variability in the leaf margins, which can be shallowly to distinctly crenate to serrate-crenate. The fruits are 10(-15) x 8 mm and thus comparatively large. The primitive number of five seeds (seldom four) in the capsule indicates the basic position of that Soqotran species within the genus and moreover in the family. The trees have bright pink flowers in beautiful, dense, very short-stemmed racemes; the stigma is also pink (Fig. 4). The inflorescences often appear while the plant is still in the leafless state. At the beginning of the dry season, in late February, the foliage turns red from developing anthocyanins, giving the landscape an unforgettable appearance.



**Fig. 5.** The inflorescence of *Boswellia "dioscoridis"*.



**Fig. 6.** Cream flowers of *Boswellia "dioscoridis"*.



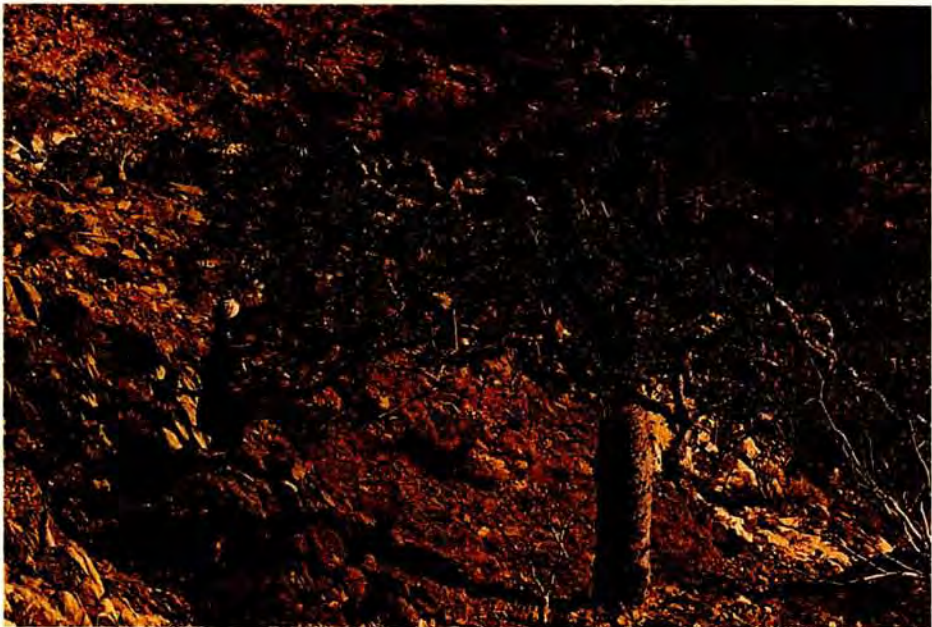


**Fig. 7.** *Boswellia elongata* in the interior valley of Wadi Ayhaft.

***Boswellia "bullata"*** Thulin & Gifri, l.c.: 111. Nom. prov.

As we were not able to collect this species in western Soqatra, we follow the description given by the authors. They argue that one can separate this species from *B. elongata* because *B. "bullata"* is a rather small tree with considerably smaller, (9-)11-19-foliolate leaves. The leaflets are 10-40 (-55) × 5-13 (-18) mm, white-felted underneath. The main difference

from *B. elongata* lies in the densely hirsute hair-cover of the upper leaf surface. The leaflets are described as characteristically crinkly with irregularly serrate-crenate margins. The flowers appear in tomentose, many-flowered panicles and have cream or red petals 3.5-4 mm long, pubescent on the outer side. The fruits are 4-5-celled and 6-8 × 4.5-6 mm. We were not able, for lack of time, to study this plant in its habitat and we base this note on the information sup-



**Fig. 8.** Single tree of *Boswellia ameero* lopped by a shepherd for fodder.





**Fig. 9.** The leaves of the widespread *Boswellia elongata*.

plied by Thulin & Gifri (l. c.). The local name is "semanu" as for both *B. "dioscoridis"* and *B. popoviana*, according to those authors.

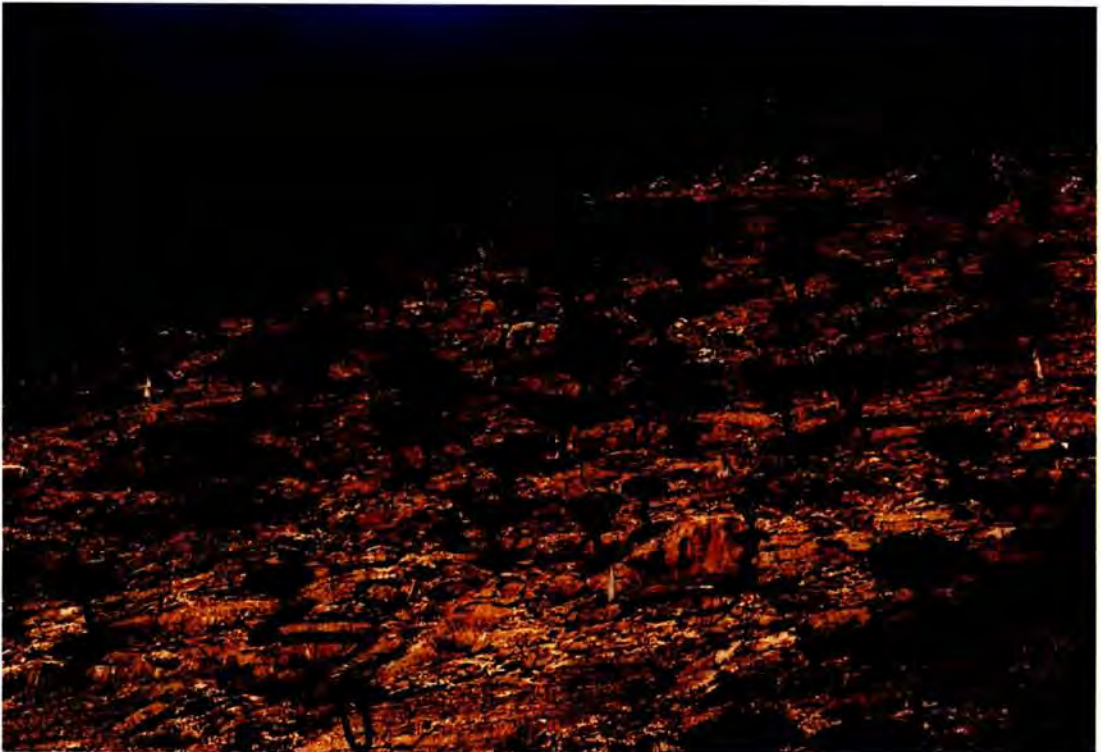
***Boswellia "dioscoridis"*** Thulin & Gifri, l. c.: 111. Nom. prov.

The species is common in the eastern

foothills of the Hajhir Mountains, where it is intensively used for incense collecting (soqotri, "semanu"). To this day, when finding oneself in a grove of these trees, one has the strong impression of what an incense forest must have been like in former times, as this species appears almost as if it had been cultivated (Fig. 2). Simple stone-walls may have represented terraces for water collection or to mark the limit of private ownership.

The description of the species in Thulin & Gifri (l. c.) reminds one strongly of the following species, differing only where vegetative characters are concerned. The main difference of *B. "dioscoridis"* from *B. elongata* lies in the glabrous nature of the leaves of the latter. *B. "dioscoridis"* has other features in common with that species in being a large tree with leaves bearing 11-17 folioles with crenate-serate margins (for dimensions see under *B. elongata*). The flowers too are produced at the same time as the foliage in "glabrous many-flowered panicles or racemes (that) have white or cream, sometimes pinkish-flushed petals, glabrous outside" (Figs. 5, 6). The fruits are three- or five-celled and slightly larger than the 7-11 × 5-9 mm mentioned in the description. The relationships of this taxon remain to be further investigated.

***Boswellia elongata* Balf.f.** Balfour, I. B. 1882. Proc. Roy. Soc. Edinburgh 11: 505.



**Fig. 10.** The Hamaderoh plateau in northwestern Soqotra, with dominant dragon trees.



**Fig. 11.** A mature, unbrowsed specimen of *Boswellia nana* hanging down a steep cliff-face.

This tree is a common species on Soqatra because, at least until recently, it was obviously protected from felling or injury and possibly also established in frankincense plantations (Fig. 7). The greater part of the resin was produced and is still obtained in smaller quantities from this species all over the island. It appears to be the lower-altitude vicariant of the montane *B. ameero*. The locals also use it for fodder as in the latter species (Fig. 8).

*B. elongata* differs from *B. ameero* by the pale cream colour of its flowers, the longer inflorescences and in the size of the 11-21 oval leaflets of  $30-95 \times 7-30$  mm (Fig. 9). The capsule of *B. elongata* is about  $10-13 \times 7-11$  mm and contains five seeds or rarely four, indicating as in the case of *B. ameero* its basic position within the genus, as well as the relationship with the latter, which however is quite distinct. The leaves of *B. elongata* are pubes-



**Fig. 12.** An overgrazed dwarf individual of *Boswellia nana* in leaf.





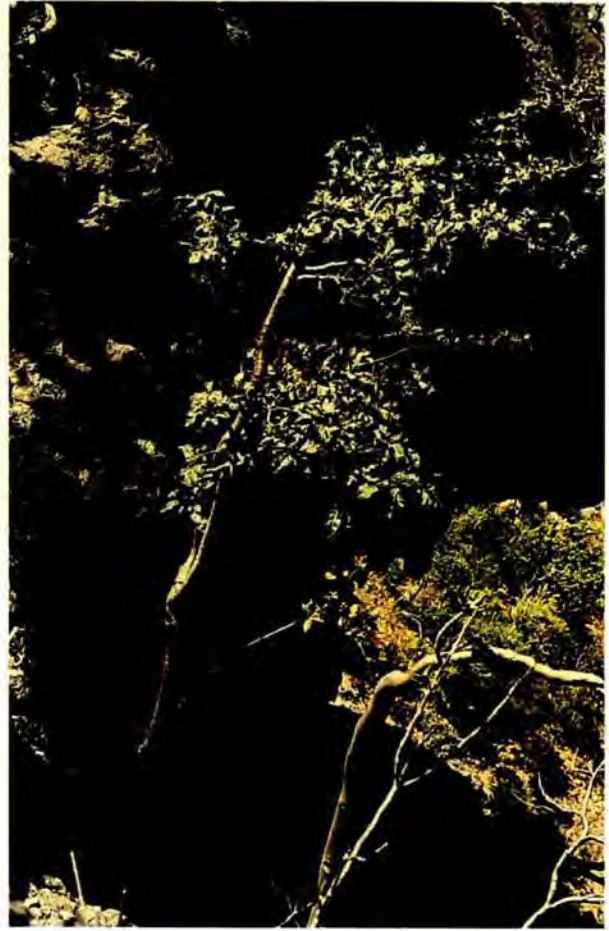
**Fig. 13.** The inflorescence of *Boswellia nana*.

cent underneath and, at least on the major veins, on the upper surface. Thulin and al-Gifri's *B. "bullata"* seems to be related, though distinct from *B. elongata* by its smaller leaflets, which have "rather deeply and irregularly serrate-crenate margins" and a characteristic crinkly texture. The colour of the petals in *B. elongata* is described by Thulin and al-Gifri as cream to pale-greenish pink and glabrous outside. This also applies to the flowers of *B. "dioscoridis"*. Nevertheless, all these characters are variable according to our observations in the field.

***Boswellia nana* Hepper.** Hepper, E.N. 1971. Hooker's Ic. Pl., (37), 5. ser., 7, 4, t. 3676 p. 1

The small shrub *Boswellia nana* is, in our view, a good species that occurs at the type locality, on the Hamaderoh plateau in the northeast of Soqatra at altitudes from 400 to 600 m (Fig. 10). It grows to 60 cm in height and can reach a diameter of 150 cm or more in protected positions, on inaccessible cliff faces (Fig. 11). On these steep rock faces, the natural morphology can be observed, but the plants from the gently south-sloping plateau beyond are heavily overgrazed. On the plateau the tree is often only present in rock-fissures and able to re-grow from a small wooden corpus with short, stout shoots. The Hamaderoh plateau is intensively used as a pasture for goats and the specimens that one finds can be as old as the ones from the cliff's faces but stand only 5 cm high above ground level. They could well be a couple of hundred years old (Fig. 12). This species is not used for resin collecting.

*B. nana* has simple, serrate to crenate, obovoid leaves of 15-30 × 8-14 mm. These in



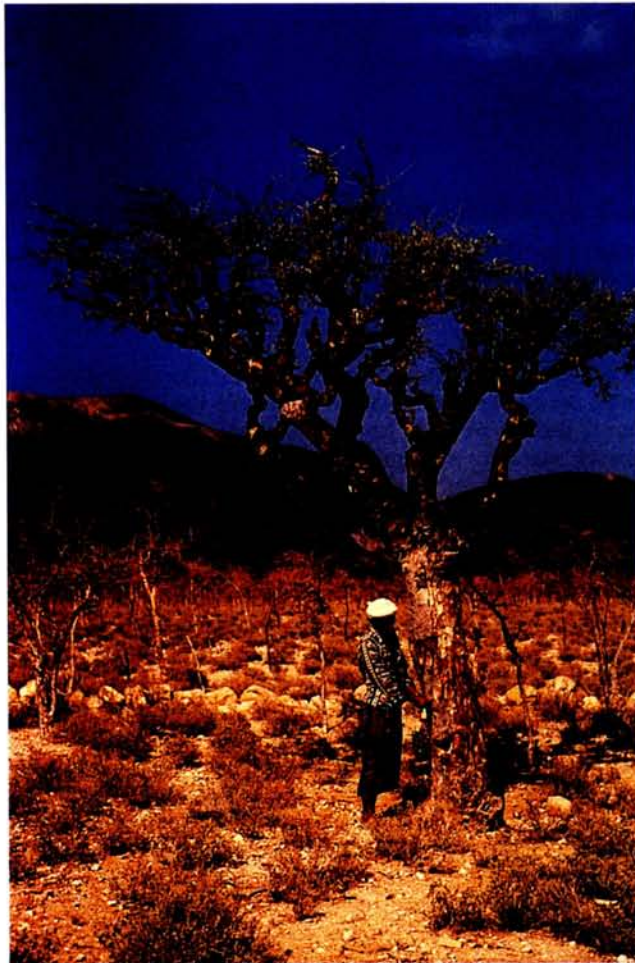
**Fig. 14.** The typical habitats of *Boswellia popoviana* are limestone boulders and steep rock-faces of coastal promontories (Ras).

effect bear two minute caducous leaflets (2-3 mm) on either side below the base of the lamina. It differs from *B. popoviana* mainly by its dwarf stature, the much smaller size of its leaves, as also in the length of the leaf stalk, which is characteristically shorter. Moreover, the inflorescence is a terminal fascicle and not a panicle, with only a few light pink to reddish flowers (Fig. 13), while the inflorescences of *B. popoviana* are paniculate, branching from a long, central peduncle. *B. nana* produces bright pink flowers that are usually borne, two to five together in a fascicle, on a very short peduncle. The style is bright green. The gynoeceum usually consists of three carpels yielding three seeds in a purplish fruit. The number of carpels was observed only once by dissecting flowers of the type collections and—due to severe overgrazing—could not again be verified. Unfortunately no one has ever detected ripe fruits of this species. Hepper has already stated that the carpels may number from three to five as in other Soqotran *Boswellia* species. Hence as well, no seeds have been collected yet; it

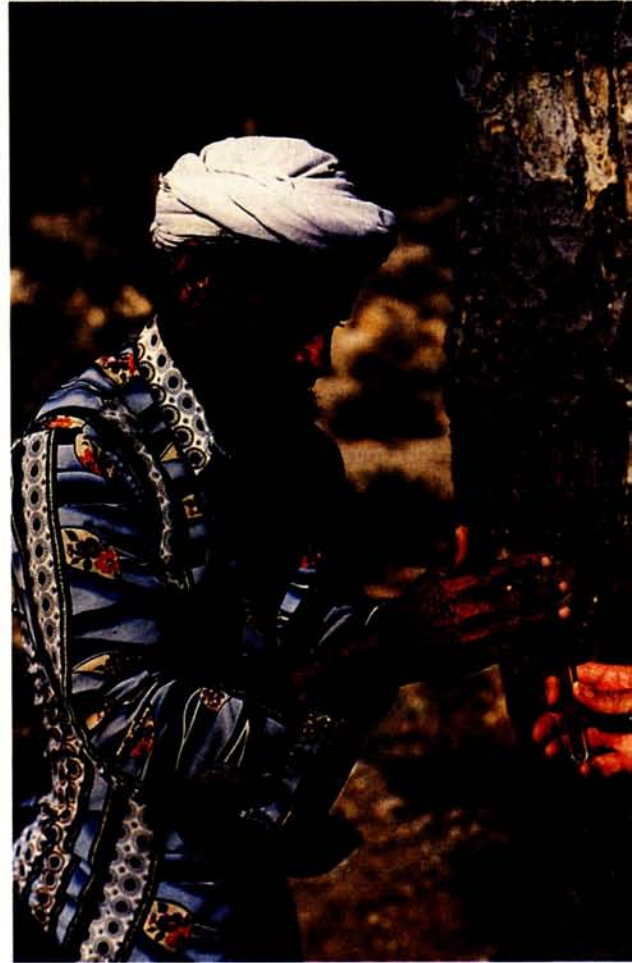




**Fig. 15.** Typically incised but entire 4-to-15-cm-long leaves of *Boswellia popoviana*.



**Fig. 16.** An individual of *Boswellia socotrana* in *Croton socotrana-jatropha uncostata* bushland.



**Fig. 17.** A local farmer explains the aseptic qualities of frankincense used as a chewing gum for mouth hygiene.





**Fig. 18.** Typical leaves of *Boswellia socotrana* from the western population in Qalansiyah valley, with many oval leaflets on short shoots and a narrowly winged rhachis.

would be interesting to obtain some from our living material, which is growing well, to establish what they look like.

***Boswellia popoviana* Hepper.** Hepper, F.N. 1971. Hooker's Ic. Pl., (37), 5. ser., 7, 4, t. 3677 p. 1

This species is a tree of up to 5 m (Fig. 14), although dwarf specimens exist, especially in crevices and holes of the steep limestone cliff faces where it occurs together with a succulent of the Moraceae, *Dorstenia gigas* Balf.f (see Mies, 1999, Fig. 11). The resin seems to be considered by the locals as of inferior quality. They use "semanu" to differentiate the gum from the others, which they call "amero" or "luban" (Thulin & Gifri, l. c.).

The leaves are simple,  $3-16 \times 1.5-9$  cm, but show a certain variability, and often the deep embayments of their margins remind one of compound leaves (Fig. 15). The hairy underside is similar to that of the compound leaves of *B. elongata*. The inflorescence is bright pink to reddish, although it is more diffuse than in the equally pink *B. ameero*. The flowers appear in many-flowered, compound, long-stalked panicles after the end of the foliage period. The number of carpels appears to vary from four to five, but sufficient fruit and seed material is still very much needed. Thulin & Gifri (l.c.) indicate the capsules as  $9-14 \times 4-7$  mm. *B. popoviana* seems to be related morphologically to *B. ameero* or *B. elongata* and related taxa and not to *B. nana*.

***Boswellia socotrana* Balf.f.** Balfour, I.B. 1882. Proc. Roy. Soc. Edinburgh 11: 505.

This frankincense species typically occurs in natural bushland of *Croton socotranus* and *Jatropha uncostata* (Fig. 16). The size of the tree varies from 7 to 8 meters down to dwarf specimens of shrub height, particularly where grazing is heavy. Aside from *B. elongata*, it is the most common frankincense species on Soqatra and is used intensively for the collection



**Fig. 19.** Foliage and inflorescence of *Boswellia socotrana* from the western population in Qalansiyah valley.





**Fig. 20.** Stand of some 620 individuals of tall-growing *Boswellia socotrana* in the valley of Qalansiyah in 1999. This population is highly endangered due to the need for lumber.

of its resin, although probably less so than *B. ameero*, *B. elongata* and *B. "dioscoridis"* (Fig. 17).

The rather smooth stem differs from that of other Soqotran frankincenses as the bark does not flake and is grey or brownish, as in certain *Commiphora* species. The winged leaf-rhachis is the characteristic feature of *B. socotrana* by which one can separate it in the field from similar-shaped leaves of myrrh (Fig. 18). The leaves, resembling a fern-frond, are 3–10 (–15) × 0.5–1 (–2) cm, with 7–31 leaflets measuring 1.5–10 × 1.5–7 mm. The flowers do not appear every year but, when they do, they appear together with the leaves in glabrous racemes (Fig. 19). The petals are glabrous on both surfaces. The capsules are three-celled, 6–8 × 4.5–6 mm and broadly ovoid or subglobose.

*B. socotrana* occurs from the western tip of the island to the easternmost plains and hills around Hamaderoh. We could not verify Thulin and al-Gifri's statement that it is restricted to limestone plains. We have found it on soils of mixed calcareous and granitic origin from near sea-level to 600 m. In 1994, we counted a population of 640 tall individuals in the valley of Qalansiyah. Thulin & Gifri (l. c.) state that these plants from the west of the island have glabrous leaves and fewer and more lobed leaflets than the eastern populations (Figs. 17, 19, 20). A specimen from that western population was described under the synonym *Odina asplentifolia* Balf.f (Syn. *Lansea asplentifolia* (Balf.f) Engl.).

### The Future

A rather depressing feature is the accelerated development of the island in latter years. An offshore survey for gas and oil potentials in the Arabian Sea on the Somali shelf was followed in 1996 by a project aimed at the conservation of biodiversity. Nevertheless, the ongoing efforts to improve the basic infrastructure by construction of roads, a proper airport and harbour facilities has attracted not only workers from the overpopulated mainland but also their families and merchants as well, who have settled in the main villages on the north coast of Soqatra. During the past years, the number of households has increased fourfold, e.g., on the Hadibu plain, resulting in a rise in population there by some 5000 souls (Mies et al., in prep.). As the needs of the people on the island depend almost entirely on local resources, there is an increasing demand for building material and fuel. The large *Boswellia* species are among the only available tall-growing trees with durable wood and hence are severely endangered (Fig. 21). Furthermore, the need for firewood, as well as meat and dairy products from goats and sheep, leads to increased destruction of the natural forests and scrub in which frankincense seedlings face heavy ecological pressures. One of the principal aims for the future should be to conserve the genetic wealth of this key genus on the island itself but also away from it in nurseries abroad, so that it might survive the inexorably increasing future risks of progressive desertification.





**Fig. 21.** Surviving specimens of *Boswellia elongata* in Wadi Ayhaft where firewood and building material have recently been cut.

### Acknowledgements

Thanks for co-operation and help in many ways are due to H. Al-Hamdani, M. Al-Juneid and M. Al-Khawlani (all EPC, Sana'a), E. Zandri and the staff of the UNDP-GEF project on Soqatra, P. Raven (Missouri Botanical Garden), W. Barthlott (Bonn Univ.), P. Morat (Mus. d'Hist. Nat. Paris), H. Thiele, K.H. Strauss and M. Kiesler (all of the German Embassy), Maj. M. Bahlooly (Min. of Defense), Mr. Benoît Tadié and M. Lebois (French Embassy), A.N. Al-Gifri, F. Beyhl, G. Beyer, G.-B. Feige, S.A. Gabali, P. Hein, M. Karer, A. Karim Nasher, N. Kilian, R. Lösch, C. Printzen, M. Schultz, M. Siméone-Sénelle, J. Thiede, E. Wolff-Straub, H. & H. Zimmer, and to the Rector of the University of Aden, Magn. Prof. Dr. S.A. Basurra. The authors are further indebted for generous support to the Cactus & Succulent Society of America (BM, JL), the International Organisation for Succulent Plant Study (BM), the Deutsche Kakteen-Gesellschaft (BM) and the Heinrich and Erna Walter Foundation (BM).

### References

- Al Sagheir, O., & R. Porter. 1998. The bird biodiversity of Soqatra. Proc. First Int. Symp. Soqatra Island: Present and Future. Aden, March 1996. Vol. 1. (H. J. Dumont, ed.): 199-212, United Nations Publ., New York.
- Balfour, I. B. 1888. Botany of Socotra. Transact. Roy. Soc. Edinburgh 31: 1-446, 100 pl.
- Beyhl, F. E. 1998. Anmerkungen zum Drachenblut und zu den Namen der Insel Soqatra. (Notes on the dragon's blood and on the names of the Island of Soqatra.) Z. Deut. Morgenl. Ges. 148: 35-82. Franz Steiner Verlag, Stuttgart.
- Beyhl, F. E., & B. A. Mies. 1998. The plants of Soqatra Island and their vernacular names. Contribution to Soqatran ethnobotany. [With German and English title and summary.] Acta Biol. Benrod. 9: 77-109. Düsseldorf
- Doe, B. 1994. Socotra. Island of tranquility. London.
- Engler, A. 1913. Burseraceae. Bot. Jahrb. 48: 447. Berlin.
- Engler, A. 1915. Die Pflanzenwelt Afrikas insbesondere seiner tropischen Gebiete. III. Bd., 1. Heft. In: Die Vegetation der Erde. (A. Engler and O. Drude, eds.): 779-797. Verlag W. Engelmann, Leipzig.
- Forbes, H. O., ed. 1903. A natural history of the islands of Socotra and Abd El Kuri. Being the report upon the results of the conjoint expedition to these islands in 1898-9, by Mr. W. R. Ogilvie-Grant, of the British Museum, and Dr. H. O. Forbes, of the Liverpool Museums, together with information from other available sources forming a monograph of the islands. Botany of Sokotra and Abd-el-Kuri. Liverpool Mus. Rep. Sokotra Exped.: 443-582. Henry Young, London.
- Gillett, J. B. 1991. Burseraceae. In: Flora of Tropical East Africa. (R. M. Polhill, ed.): 94pp. Balkema Publ., Rotterdam.
- Lavranos, J. J. 1994. Impressions from Socotra & Abd Al-Kuri. Euph. J. 9: 190-209.
- Mies, B. A. 1995. On the comparison of the flora and vegetation of the island groups of Socotra and Macaronesia. Bol. Mus. Munic. Funchal, Supl. 4: 455-471. Funchal.
- . 1998. The phytogeography of Soqatra. Evidence for disjunctive taxa, especially with Macaronesia. Proc. First Int. Symp. Soqatra Island: Present and Future. Aden, March 1996. Vol. 1. (H. J. Dumont, ed.): 83-105. United Nations Publ., New York.



- . 1999. Bottle-trees and heat on Socotra (Yemen): a big-foot story. A temperature study of *Adenium socotranum* (Apocynaceae) and *Dendrosciyos socotrana* (Cucurbitaceae). *Cact. Succ. J. (U.S.)* 71: 60–73.
- Mies, B.A., F.E. Beyhl & C. Printzen. 1995. Die Waldformationen der Insel Sokotra (Indischer Ozean). [The forest belts of the island of Socotra (Indian Ocean). (In German.)] *Nat. Mus.* 125: 122–132. Frankfurt.
- Mies, B.A., & F.E. Beyhl. 1998. The vegetation ecology of Soqotra. *Proc. First Int. Symp. Soqotra Island: Present and Future, Aden, March 1996, Vol. 1.* (H. J. Dumont, ed.): 35–81. United Nations Publ., New York.
- Miller, A. G. 1994. Somali-Masai Regional Centre of Endemism: CPD Site SWA4. Socotra, Yemen. In: Centres of plant diversity. A guide and strategy for their conservation. Vol. 1, Europe, Africa, South West Asia and the Middle East. (S. D. Davis, V. H. Heywood, and A. C. Hamilton, eds.): 312–316. World Wildlife Fund for Nature, Information Press, Oxford.
- Popov, G. 1957. The vegetation of Socotra. *J. Linn. Soc. London* 55: 706–720.
- Thulin, M., & A. N. al-Gifri. 1998. The frankincense trees (*Boswellia* spp.) of Soqotra. *Proc. First Int. Symp. Soqotra Island: Present and Future, Aden, March 1996, Vol. 1.* (H. J. Dumont, ed.): 107–113. United Nations Publ., New York.
- Thulin, M., & A. M. Warfa. 1987. The frankincense trees (*Boswellia* spp., Burseraceae) of northern Somalia and southern Arabia. *Kew Bull.* 42: 487–500. Richmond (U. K.).

## FIELDNOTES—MORE ABOUT *MAMMILLARIA MACHUCAE*

W.A. & BETTY FITZ MAURICE

Hermanos Infante 225

78250 San Luis Potosí, S.L.P., Mexico

In this Journal (Vol. 72, No. 2, March–April, 2000) we described *Mammillaria machucaae* as a new species in Series Stylothelae. In a subsequent posting to CACTI\_ETC, Dave Ferguson noted that the plant we had described was remarkably similar to the Series Polyacanthae plants, *M. spinosissima* and *M. nunezii*. Although Ferguson's remarks raised questions, we felt that the geographic separation of those two species from *M. machucaae* made it unlikely that we had erred. Following our CACTI\_ETC posting in response to Ferguson, Michel Lacoste pointed out that Reppenhagen had described two Polyacanthae plants, *M. supraflumen* and *M. silvatica*, in the same general area where *M. machucaae* is found. In response to our query, Jonas Lüthy (in litt.) noted that Polyacanthae and his Bombycinae (David Hunt's western Stylothelae) are very similar and that the two taxa must be quite closely related. He recommended that we examine the *M. machucaae* hypodermis cellular structure, since Polyacanthae species are unique in this regard. We made the slides and examined the epidermis and hypodermis with our light microscope at 400×. The unique I-shaped cells of Polyacanthae were clearly present, as shown in the illustration. These are osteosclereids per Lüthy, and account for the tubercular rigidity found in Polyacanthae plants. Lüthy also noted the distinctly irregular pits in the seed testa of Polyacanthae plants, but *M. machucaae* does not appear to have this characteristic.

Our description of *M. machucaae* is then erroneous in the sense that it is from Series Polyacanthae rather than Hunt's Series Stylothelae. It also appears that *M. machucaae* is a redescription of Reppenhagen's *M. silvatica* and/or *M. supraflumen*. Hunt placed *M. silvatica* and *M. supraflumen* in synonymy with *M. nunezii* in the *CITES Cactaceae Checklist*, Second Edition, 2000. It is of interest to note that if Hunt's placement is accepted, *M. nunezii* will join *M. zephyranthoides*, *M. discolor* and *M. uncinata* as the mammillaria species unique in growing on both sides of the Trans-Mexican Volcanic Belt.

We will investigate this matter further with fieldwork in the area south of Laguna Chapala in the state of Jalisco.



**Fig. 1.** Microscope view (400x) of the cross-section of the cuticle, epidermis and hypodermis of a tubercle of WAF 2408, described as *M. machucaae*. To the right of the black pointer, one epidermis cell and one hypodermis cell have been outlined for clarity.