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Source: Willdenowia, 34(1) : 159-182

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.34.34114

doi:10.3372/wi34.34114 (available via http://dx.doi.org

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Further notes on the flora of the southern coastal mountains of Yemen

Abstract

Kilian, N., Hein, P. & Hubaishan, M. A. (ed.): Further notes on the flora of the southern coastal mountains of Yemen. – Willdenowia 34: 159-182. – ISSN 0511-9618; © 2004 BGBM Berlin-Dahlem.

Two refugia of mesic palaeo-African genoelements in the southern coastal mountains of Yemen, viz. the Maderan area in the Urays range, Abyan, and the Jabal Gedu range, Shabwa, earlier not explored botanically, are briefly described. First records of vascular plants of phytogeographical significance for the southern mountains are given, including *Juniperus procera* and *Mimusops laurifolia*. Based on our own collections made in the southern governorates of the Republic of Yemen between 1999 and 2003 new and noteworthy records of vascular plants from other areas are also added. Eight species, *Adiantum balfourii, Brachiaria arida, Maerua macrantha, Ophioglossum gomezianum, Portulaca commutata, P. constricta, Psiadia incana* and *Ruellia lineari-bracteolata,* are reported as new for the Arabian Peninsula, the presence of *Filago abyssinica* is confirmed, and ten species, *Campanula erinus, Capillipedium parviflorum, Hermannia testacea, Laportea interrupta, Lindenbergia muraria, Loudetia flavida, Oplismenus burmannii, Portulaca dhofarica, Sorghum versicolor* and *Wahlenbergia flexuosa,* are reported as new for mainland Yemen. Thirty six species are reported to extend their previously known distribution range to or in the southern governorates of Yemen. Brief comments are given on the phytogeography of the taxa, distribution maps are provided for eight species; *Maerua macrantha* and *Ophioglossum gomezianum* are illustrated.

1. Introduction

This paper supplements two recent contributions (Thulin & al. 2001, Kilian & al. 2002), which provided numerous new and noteworthy records of vascular plants for the insufficiently explored Yemeni part of the southern mountain range of the Arabian Peninsula.

The southern mountains of the Arabian Peninsula stretch along the southern coast as far as eastern Dhofar in Oman, where they end in the dramatic escarpment of Jabal Samhan. Over vast areas the southern mountains form an inhospitable limestone plateau at altitudes between 1000 and 1500 m. In Hadhramout they culminate on the seaward side at elevations between 2000 and 2100 m, farther inland they decline gradually, dissected by a labyrinth of gorge-like wadis, towards the desert of the Rub al Khali. In coast-near promontories, however, climatically favoured sea facing escarpments form fog oases (Troll 1935 ["Nebeloasen"], Miller 1994) and shelter a mesic tropical flora of, in particular, palaeo-African genoelements (sensu Zohary 1973), which

have been our main interest of research. Brief information on the background and scope of this research as well as on the field work and the collector teams have been provided by Kilian & al. (2002), including a map of the administrative divisions of Yemen and the location of the principal investigated refugia.

The first two parts of the present contribution deal with two refugia so far not known to science, and phytogeographically significant vascular plant records gathered therein. The third part adds some more records from other regions of the southern mountains, most of them from the *Anogeissus dhofarica* association (Kürschner & al. 2004) in the easternmost governorate of Al-Mahra. These records also supplement a recent checklist for the Hawf area by Hussein (2003).

The present paper includes, besides those by the editors themselves, contributions by John Burrows, Simone Kipka, Abdullah Mukram, Mohamed Hassan Omar and Katharina Rabe, all indicated as such (see also 'Addresses of the editors and contributors').

New or confirming reports for the Arabian Peninsula are marked with double asterisks, ** or (**) respectively, new reports for mainland Yemen with a single asterisk *, unmarked reports give phytogeographically significant extensions of the known range of species. The abbreviation "YP" preceding the collection numbers indicate the collection of the BIOTA Yemen Project, "NK" and "PH" earlier collections of the first and second author respectively.

Voucher specimens are (or will be) deposited in the herbarium of the Botanic Garden and Botanical Museum Berlin-Dahlem (B), Germany, and in the herbaria of the Head Office of the Agricultural Research and Extension Authority (AREA) in Dhamar and of the AREA research station in El Kod, Abyan, Yemen; further duplicates will be distributed to other herbaria.

Terminology of phytochoria largely follows Wickens (1976). The distribution maps, based on the global digital elevation model GOTOPO30 (EROS Data Center 1996), were generated with the Geographic Information System (GIS) software DIVA-GIS (Hijmans & al. 2003), in which the distances between populations were also calculated.

2. The Gedu mountain range, Shabwa

The Gedu mountain range is a limestone promontory of the southern chain, situated between c. 46°50' and 47°45'E, and belonging administratively to the Rodoum district of the governorate of Shabwa. The promontory is delimited to the east by the wide north-south corridor of Wadi Mayfah and to the west by the plains dividing it from the coastal volcano massif in Abyan. The wadi Al-Himae [Al-Himmah], running from c. 14°06'N, 47°17'E to 13°48'N, 47°34'E, divides it in a western and an eastern part. Jabal Gedu (an indigenous name not found in current gazetteers and maps) is situated in the eastern part. It culminates in a peak of 1996 m altitude at 14°06' 30"N, 47°27'20"E and has a plateau, named Jabal Qawa'il (National Geospatial-Intelligence Agency 2004), at c. 1300 m altitude, centred at c. 14°05'N, 47°30'E.

To our knowledge, the Gedu mountain range has never been explored botanically. We visited the area in March 2002 and March/April 2003.

2.1. On the lower altitudes of the sea facing escarpment of Jabal Gedu along ravines and wadis, in and close to the wadi beds and on the adjacent slopes, a sparse but comparatively species-rich *Acacia-Commiphora* woodland is present. It includes, in particular, the trees *Acacia harala* Thulin & Gifri, *A. tortilis* Hayne, *Balanites aegyptiacus* (L.) Del.[1], *Boscia arabica* Pestalozzi, *Commiphora* cf. *foliacea* Sprague, *Delonix elata* (L.) Gamble, *Moringa peregrina* (Forssk.) Fiori, *Salvadora persica* L., *Sterculia africana* (Lour.) Fiori, *Ziziphus spina-christi* (L.) Desf., the shrubs *Adenium obesum* (Forssk.) Roem. & Schult., *Anisotes trisulcus* (Forssk.) Vahl, *Cadaba longifolia* DC., *Caesalpinia erianthera* Chiov., *Cryptolepis yemenensis* Venter & R. L. Verh., *Ephedra foliata* Boiss. ex C. A. Mey., *Euphorbia cuneata* Vahl, *Gossypium incanum* (O.

[1] In contrast to the prevailing use (see, e.g., Sands 2001), the gender of *Balanites* is masculine according to Art. 62.4 (see also App. III) of the International Code of Botanical Nomenclature.

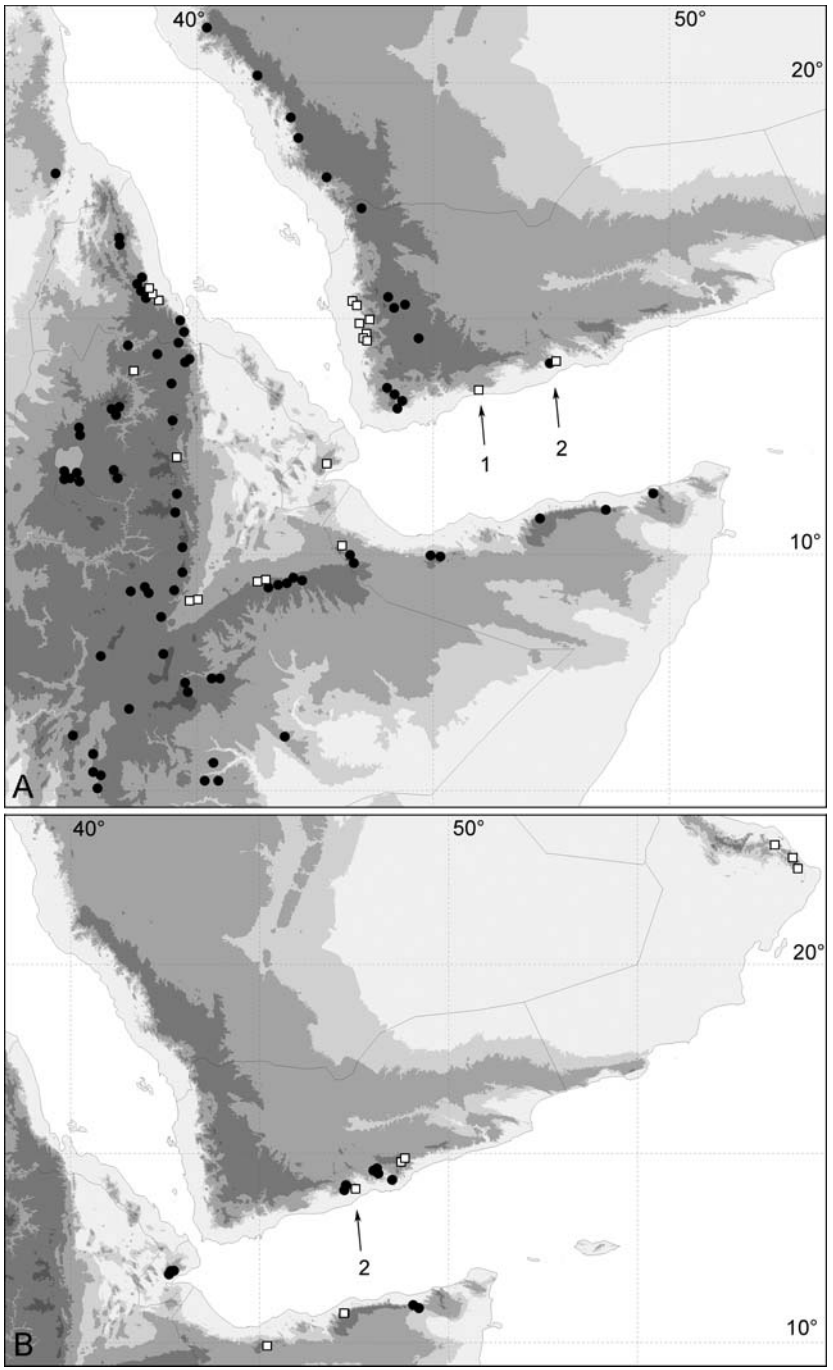

Fig. 1. A: Distribution of *Mimusops laurifolia* (□, entire range) and *Juniperus procera* (●, partial range in the Horn of Africa and the Arabian Peninsula). – B: Distribution (entire range) of *Livistona carinensis* (●) and *Ceratonia oreothauma* (□). – Based on own records and the literature cited in the text; the new records are indicated by arrows, 1 = Maderan and 2 = Jabal Gedu.

Schwartz) Hillcoat, *Maerua macrantha* Gilg, *Megalochlamys linifolia* (Lindau) Lindau, *Ochradenus spartioides* (O. Schwartz) Abdallah, *Tephrosia dura* Baker, *Turraea parvifolia* Deflers and the climbers *Cocculus pendulus* (J. Forster) Diels and *Ochradenus baccatus* Del.

In Wadi Al-Himae, *Anogeissus bentii* Baker, a tree of 10-15 m endemic to Hadhramout and Shabwa and here at its westernmost limit, adds to the gallery woodland; it is highly regarded by the local people for its leaves, which are fed to livestock. In upper Wadi Al-Himae, palms play a conspicuous role in the vegetation. Besides *Phoenix caespitosa* Chiov. and a *Hyphaene* species of yet uncertain status, named *H. nodularia* Becc. by Burret (1943) or *H. reptans* Becc. when without erect trunk (but according to our observations in the field probably representing one and the same species) and more recently but perhaps incorrectly identified as *H. thebaica* Mart. (Bazara'a & al. 1990), *Livistona carinensis* (see below) is also found here.

The occurrence of the following species deserves particular mention:

Rhigozum somalense Hallier f. *(Bignoniaceae)*
This shrub to 2-3 m is a regional endemic, with a disjunct distribution present in the foothills of N Somalia and Djibouti, in the southern Tihama and adjacent foothills of NW Yemen (Wood 1997: 277, Khulaidi 2000: 51). It is reported for the first time for the southern mountains, from the foothills of the Gedu Mt range.
Shabwa: Mountains NW of Rodoum, 14°07'55.1"N, 47°40'59.5"E, 300 m, small wadi and tributaries, on sand and gravel, 7.3.2002, *YP1335.*

Adenia venenata Forssk. *(Passifloraceae)*
Vigorous individuals of this small bottle tree have in its easternmost known population on the Arabian Peninsula trunks of up to 2.5 m height and 1 m in diameter. The species is distributed in the northeastern part of the Sudano-Zambesian Floristic Region (Wickens 1976: 96, map 50) and has been reported for the Arabian Peninsula from the western mountains (W Yemen: Wood 1997: 113, Khulaidi 2000: 146; SW Saudi Arabia: Collenette 1999: 599) and from the westernmost part of the southern mountains (W Abyan: Schwartz 1939: 171). Our records show that its distribution extends farther east into the southern mountains.
Abyan: Jabal Urays, Wadi Asurie, southwest facing slope, 13°28'22.9"N, 45°55'02.6"E, 700-820 m, 13.3.2002, *YP 1542.*
Shabwa: Jabal Gedu range, Habarun, Wadi Tawila, between 14°02'52.1"N, 57°33'14.4"E, 340 m, and An Namaser, 14°04'12.4"N, 47°31'55.1"E, 770 m, limestone, 1.4.2003, *YP 4554.*

Scadoxus multiflorus (Martyn) Raf. *(Amaryllidaceae)*
Widespread in tropical Africa, the species has been reported for the Arabian Peninsula so far only from the western mountains (SW Saudi Arabia: Collenette 1999: 40; W Yemen: Wood 1997: 405, Khulaidi 2000: 24). We report it here also for the western half of the southern mountains as far as central Hadhramout.
Abyan: Jabal Urays, Wadi Asurie, southwest facing slope, 13°28'22.9"N, 45°55'02.6"E, 700-820 m, 13.3.2002, *YP 1550;* Jabal Urays range, Maderan, gorge-like wadi, 13°31'01.8"N, 45°57'57.9"E, 1250 m, 27.3.2003, *YP 4370.*
Shabwa: Track from Rodoum into Wadi Al-Himae, coastal plains W of Rodoum, small wadi beds, 13°52'16.0"N, 47°35'00.2"E, c. 50 m, 25.3.2003, *YP 4228.*
Hadhramout: Jol plateau, some km NW of Ghail-bin-Yemen towards As-Saah (S of Ghayl Omar), 15°31'38.1"N, 48°57'20.0"E, 850-930 m, 18.9.2001, *YP 194.*

Livistona carinensis (Chiov.) J. Dransf. & N.W. Uhl *(Palmae)*
The largest indigenous palm tree on the Arabian Peninsula, an Indo-Malayan genoelement, is found only in Yemen, Djibouti (Lebrun & al. 1989) and N Somalia (Thulin 1995). It is classified in the IUCN Red List as "Endangered" (Johnson 1997). At least 90 % of its less than 2000 individuals grow in Yemen. The species was thought to be present only in Wadi Hajar in the Hadhramout (Bazara'a & al. 1990, El-Mashjary & al. 2001), where it was discovered and photographed in 1929 by Meulen & Wissmann (1932: 222; see also Burret 1943). In the upper wadi

Fig. 2. *Livistona carinensis* – a stand around a freshwater spring at the upper end of Wadi Al-Himae, above the village Al-Maharaq. – Photograph by N. Kilian, on 25.3.2003; vouchers: *YP 4339*.

Al-Himae scattered individuals grow close to the gravelly wadi bed among the more common *Hyphaene* species at altitudes of 400-500 m (Fig. 1B). A stand of c. 80 mature individuals populate a shallow gully with a freshwater spring on the S-SW slopes terminating the wadi (Fig. 2).
SHABWA: Middle Wadi Al-Himae, 14°04'30.6"N, 47°17'52.4"E, 470 m, edge of a small tributary wadi, on gravel, 25.3.2003, *YP 4334*; upper end of Wadi Al-Himae, above small village called Al-Maharaq, 14°06'26.9"N, 47°19'00.8"E, S-SW facing slope, 770 m, 25.3.2003, *YP 4339*.

2.2. The relics of (semi-)evergreen Afromontane woodland of *Olea europaea* subsp. *cuspidata* and *Juniperus procera,* which grow above an altitude of only c. 750-800 m on the sea-facing escarpment of Jabal Gedu, are spectacular. The Afromontane *Olea-Juniperus* forest (Wissmann 1972, White 1983, Friis 1992) was apparently present in prehistoric times on the Arabian Peninsula as a more or less continuous belt on the high altitude western mountains, spanning from the area of Taif in the N Asir in Saudi Arabia (König 1987) to Jabal Eraf, governorate Lahj, in Yemen (Kilian & al. 2002, Kürschner 2003). In Yemen today most of the stands are heavily degraded or even destroyed (Wood 1997, Herzog 1998). In the southern mountains (semi-)evergreen Afromontane woodland relics are much more scattered, and for Shabwa this is the first record. The relics on Jabal Gedu contain many species found in other refugia in the southern mountains. These include the trees *Acacia etbaica* subsp. *uncinata* Brenan, *Olea europaea* subsp. *cuspidata* (Wall. ex G. Don) Cif., *Rhus flexicaulis* Baker, the shrubs *Cometes abyssinica* (R.Br.) Wallich, *Dodonaea angustifolia* L.f., *Gaillonia jolana* Thulin, *Gnidia somalensis* (Franch.) Gilg, *Grewia trichocarpa* Hochst. ex A. Rich., *G. tembensis* Fresen., *Haplophyllum amoenum* (O. Schwartz) C. C. Townsend, *Justicia areysiana* Deflers, *Kleinia squarrosa* Cufod., *Maytenus senegalensis* (Lam.) Exell, *Micromeria imbricata* (Forssk.) C. Chr., *Otostegia fruticosa* subsp. *schimperi* (Benth.) Sebald, *Periploca visciformis* (Vatke) Schumann, *Psiadia punctulata* Vatke, *Tarchonanthus camphoratus* L., *Tarenna graveolens* subsp. *arabica* (Cuf.) Bridson, *Trichodesma trichodesmoides* (Bunge) Gürke, and herbs such as *Leucas inflata* Benth., *Kalanchoe bentii* C. H. Wright, *Atractylis kentrophylloides* (Baker) F. G. Davies, *Gladiolus* cf. *dalenii* Van Geel, *Albuca abyssinica* Dryand., *Dorstenia foetida* (Forssk.) Schweinf., *Launaea massauensis* (Fresen.) Kuntze and *Digitaria velutina* (Forssk.) P. Beauv.

Particularly noteworthy are, however, the following species:

Juniperus procera Hochst. ex Endl. *(Cupressaceae)*
The African juniper forms high montane forest communities in the E African mountains as far south as Zimbabwe and in the southwestern part of the Arabian Peninsula (Farjon 1992, Wissmann 1972). In contrast to its wide distribution in the western mountains (Miller & Cope 1996: map 64), the southern coastal mountains of the Arabian Peninsula seemed to lack a *Juniperus procera* belt, or a (semi-)evergreen woodland with *Juniperus,* respectively, although its occurrence across the Gulf of Aden in the N Somali mountains (Hemming 1966, Friis 1992) made a former presence rather likely. The discovery of an isolated occurrence of African juniper on Jabal Gedu, 350 km E of the southernmost populations in the western mountains (Fig. 1A), is thus striking but not unexpected. A former (prehistoric?) occurrence of juniper on the higher, coast-near elevations of the Jol in Hadhramout, such as Kor Seiban, can now also be assumed. As elsewhere in its distribution area, the African juniper is highly regarded for its fragrant wood and cut by the local people. Another occurrence, on the eastern side of the central plateau in the governorate Al-Bayda, not given in the consulted literature (Wood 1997: 63, Herzog 1998) and worth to be mentioned on this occasion, is on the volcano Jabal Isbil (14°34'N, 44°42'E), where a few stunted individuals were found at 2800-2850 m on 10.4.1997 *(PH 3964)*.
SHABWA: Jabal Gedu, slopes and wadis of the S-SE flank of the mountain, uppermost Wadi Tawila, close to the pass, 14°04'18.1"N, 47°31'18.4"E, 1100 m, 1.4.2003, *YP 4620.*

Ceratonia oreothauma Hillcoat & al. *(Caesalpiniaceae)*
This very rare and endangered tree has hitherto only been known on the Arabian Peninsula from the western Hajar (Jabal Aswad) in N Oman (Hillcoat & al. 1980, Ghazanfar 1994) and the summit area of the Kor Seiban in the governorate of Hadhramout (Thulin 2001, Kilian & al. 2002).

Jabal Gedu, where a few individuals occur, is another locality on the Arabian Peninsula. Outside the Arabian Peninsula it occurs only in a few localities in the mountains of N Somalia (Fig. 1B).
SHABWA: Jabal Gedu, slopes and wadis of the S-SE flank of the mountain, uppermost Wadi Tawila, close to the pass, 14°04'18.1"N, 47°31'18.4"E, 1100 m, 1.4.2003, *YP 4619.*

Cordia monoica Roxb. [Syn.: *C. ovalis* DC. & A. DC.] *(Cordiaceae)*
Widespread from tropical Africa to the Indian Subcontinent and Sri Lanka (Verdcourt 1991: 17), this small tree has been reported for the Arabian Peninsula from the southwestern mountains (NW Yemen, SW Saudi Arabia), from an isolated occurrence in the western part of the southern mountains on the upper escarpments of Jabal Urays, and, from much farther east, from Dhofar, Oman (Kilian & al. 2002). Our record from Jabal Gedu, 200 km east of Jabal Urays, is another indication for its former continuous distribution across southern Arabia.
SHABWA: Jabal Gedu, slopes and wadis of the S-SE flank of the mountain, uppermost Wadi Tawila, close to the pass, 14°04'18.1"N, 47°31'18.4"E, 1100 m, 1.4.2003, *YP 4597.*

Plectranthus hyemalis J.R.I. Wood *(Labiatae)*
This endemic of Yemen is rather distinctive for its shrubby habit with a height of 1.5 m, its branches with terminally clustered obovate leaves and the throat of its fruiting calyces being almost closed by white hairs (as in the widespread, woody perennial *P. barbatus* Andr.). It was described by Wood (1984: 133, fig, 7) from the border region of the former two Yemeni states, which has been the only occurrence of this montane species reported so far (Wood 1997: 250, Khulaidi 2000: 122). Disjunct populations of the species exist, however, 200 km and 350 km further east, in the higher mountains of Shabwa and Hadhramout (Fig. 3B), in sites climatically favoured by mist precipitation, as is the Gedu refugium.
SHABWA: Jabal Gedu, slopes and wadis of the S-SE flank of the mountain, uppermost Wadi Tawila, close to the pass, 14°04'18.1"N, 47°31'18.4"E, 1100 m, 1.4.2003, *YP 4589*.
HADHRAMOUT: Kor Seiban, Maula Matar gorge, S part of the gorge near the mullah's grave, 14°47'38.8"N, 48°46'47.2"E, 1800 m, SE facing slope with scattered shrubs and trees (e.g. *Tarchonanthus camphoratus*), 21.9.2001, *YP 276;* Kor Seiban, wadi (running S to N) parallel to the vertical escarpment into Wadi Howeirah, 14°48'54"N, 48°49'07"E, 1950-2000 m, rocky slopes, 15.10.2001, *YP 1237.*

Helinus integrifolius (Lam.) Kuntze *(Rhamnaceae)*
This climbing shrub has been known on the Arabian Peninsula only from the Taiz area, before it was discovered also on the Kor Seiban (Kilian & al. 2002). Jabal Gedu is thus its third locality on the Arabian Peninsula.
SHABWA: Jabal Gedu, slopes and wadis of the S-SE flank of the mountain, uppermost Wadi Tawila, close to the pass, 14°04'18.1"N, 47°31'18.4"E, 1100 m, 1.4.2003, *YP 4585.*

Pappea capensis Eckl. & Zeyh. *(Sapindaceae)*
An evergreen tree widely distributed in E and S Africa and very rare on the Arabian Peninsula. It was reported the first time for Yemen from Kor Seiban in Hadhramout by Thulin & al. (2001) and Kilian & al. (2002) and before only known from Dhofar in Oman.
SHABWA: Jabal Gedu, slopes and wadis of the S-SE flank of the mountain, uppermost Wadi Tawila, close to the pass, 14°04'18.1"N, 47°31'18.4"E, 1100 m, 1.4.2003, *YP 4615.*

2.3. Afrotropical riverine woodlands, which are still extant in the northwestern governorates of Yemen in several places though strongly endangered (Wood 1997), were not known to extend into the southern coastal mountains. The upper Wadi Tawila and its tributaries on the sea facing escarpment of Jabal Gedu, however, shelter a species-poor relic, in which two remarkable species occur along with *Ficus sycomorus* L. and *F. vasta* L.:

Combretum molle R. Br. ex D. Don *(Combretaceae)*
This malacophyllous tree to c. 10 m with a beautiful, spreading crown, widespread in the Sudano-Zambesian Floristic Region, has been known on the Arabian Peninsula so far from the north-

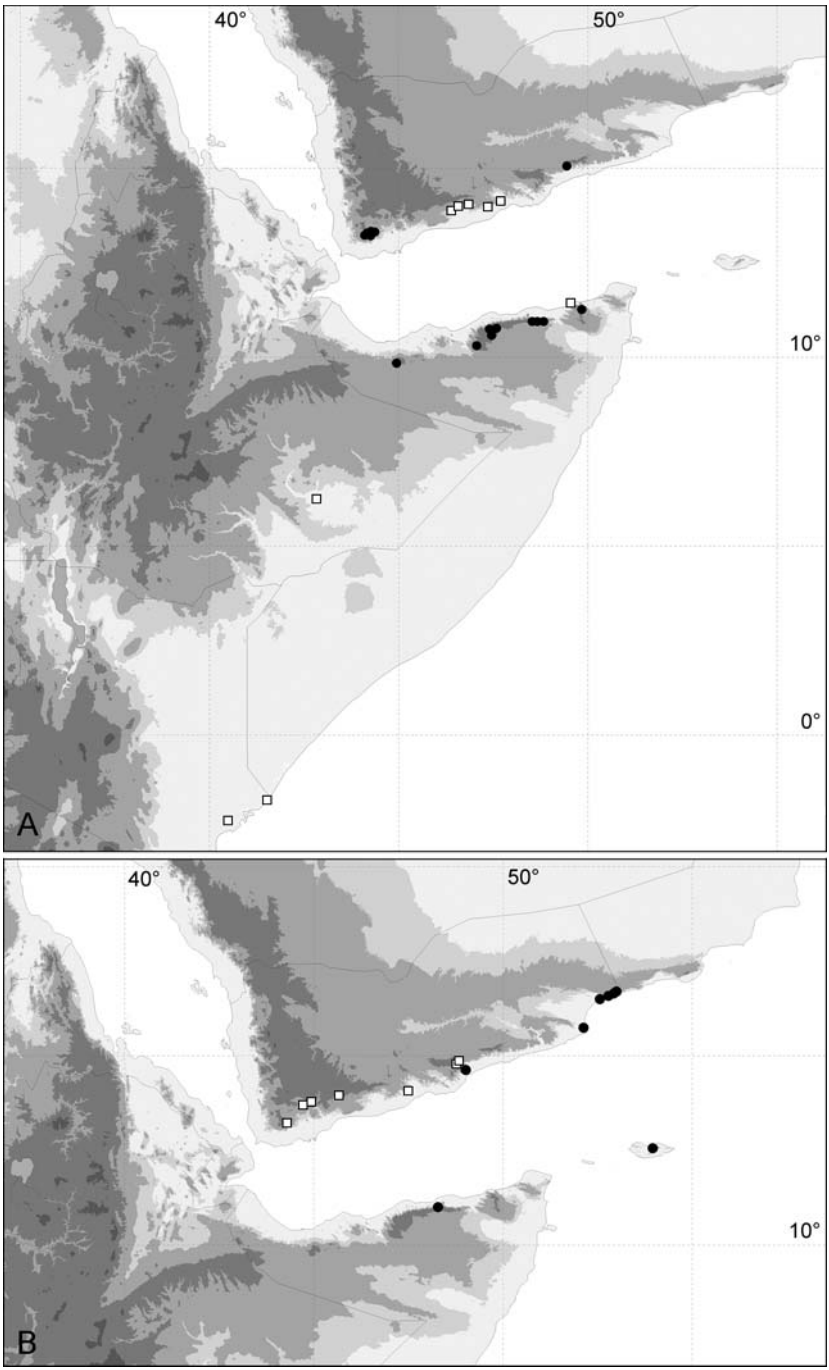

Fig. 3. A: Distribution (entire range) of *Maerua macrantha* (□) and *Wendlandia arabica* (●). – B: Distribution (entire range) of *Plectranthus hyemalis* (□) and *Brachiaria arida* (●). – Based on herbarium material and the literature cited in the text.

western governorates and SE Saudi Arabia. Its occurrence in Wadi Tawila, some hundred kilometres further east, is the only known in all the southern mountains. In Wadi Tawila it is the dominant tree species, with dozens of fruiting individuals.
SHABWA: Jabal Gedu range, Habarun, Wadi Tawila, between An Namaser, 14°04'12.4"N, 47°31'55.1"E, 770 m, and 14°04'18.4"N, 47°31'35.4"E, 940 m, limestone, 1.4.2003, *YP 4578.*

Mimusops laurifolia (Forssk.) Friis *(Sapotaceae)*
With a height of up to 40 m, it is the tallest and most attractive indigenous tree in Yemen. It is native only to Yemen, Saudi Arabia, Ethiopia and Somalia (Friis 1981, 1992; Fig. 1A). It has been thought so far to occur in Yemen only in a few wadis of the northwestern governorates (Wood 1997, Khulaidi 2000). The occurrence of 12 old trees in the upper Wadi Tawila in the Jabal Gedu area (nom. indig. 'Leboch', thus the same as reported from N Yemen, see Friis 1981), being the easternmost stand of this species, is therefore a surprise. A second locality in the southern mountains, with a single individual seen (and a second one said to occur), we discovered further west in the Maderan area, in Abyan (see below). Young growth is, however, missing in Wadi Tawila, and attempts to multiply the slow growing tree by the local people have so far failed.
ABYAN: Jabal Urays range, Maderan, between 13°30'23.4"N, 45°58'17.1"E, 1200 m, and 13°29'56.9"N, 45°58'31.4"E, 1060 m, close to the escarpment, 28.3.2003, *YP 4435.*
SHABWA: Jabal Gedu range, Habarun, Wadi Tawila, between An Namaser, 14°04'12.4"N, 47°31'55.1"E, 770 m, and 14°04'18.4"N, 47°31'35.4"E, 940 m, limestone, 1.4.2003, *YP 4577.*

3. The Maderan fog oasis in the Jabal Urays range, Abyan – by Norbert Kilian, Peter Hein, Abdullah Mukram & Mohamed Hassan Omar

To the east of the small town Shuqra, the coastal plain becomes very narrow. Between c. 45°45' and 46°25'E, thus for about 65 km, the black volcanic massif of the Urays range rises between the coast and the limestone plateau further inland. The western part is closest to the coast and has a maximum elevation of 1732 m, the eastern part is lower and more distant from the coast, but except for the central south coast of the Arabian Peninsula, there is no other mountain massif with a comparable elevation situated so close to the coast. Eastwards of the volcanic massif a wide coastal plain opens again, making the massif an isolated promontory. It is named after its highest peak, the Jabal al-Urays [variants: al-Arays, al-Urus], situated at 13°30'46"N, 45°55'01"E (National Geospatial-Intelligence Agency 2004). Its character as an outstanding refugium and its phytogeographical significance, which is emphasised by a number of local endemics, is known since its first exploration by the French botanist Albert Deflers in 1893 (Deflers 1895). Since the 1970s it has been revisited by several botanists, starting with John Lavranos, but all focused their investigation on the Wadi Asurie, whose upper end is a spectacular semicircular caldera, and the dry higher elevations of the summit area above it.

Only about 5 km as the crow flies eastwards, the relief of the higher elevations changes, giving space, over a length of some kilometres to the east, for a c. 2-3 km wide, gently declining plateau-like area at an altitude of c. 1200-1350 m, stretching between the foot of the 1500-1600 m high E-W ridge and the steep escarpment to the coastal plain. The plateau itself is drained by some small, first shallow and then gorge-like wadis, which finally heavily dissect the plateau closer to and at the escarpment itself. Several of the wadis suddenly end in breathtaking, vertical falls over several hundred to almost a thousand metres. These relief features in immediate proximity to the coast make the area an outstanding fog oasis. During most of the year, the humid air from the sea, which is uplifted at the sea facing flank, condenses to a cloud bank and starts covering the upper escarpment and lower plateau area in the afternoon hours. Fog precipitation and occasional drizzling rain provide the area with a humidity that is, judged from the vegetation, along the entire south coast seconded only by the Dhofar-Al-Mahra fog oasis. Nevertheless, the Maderan fog oasis has never before been studied botanically, except for a short visit made by the last author in 1996. During the Yemeni-German BIOTA Project the flora and vegetation of the area was studied in March 2002 and March 2003.

Fig. 4. Maderan, with *Olea-Tarchonanthus* woodland on upper escarpment and largely cleared on the lower plateau areas, view from 13°30'23.4"N, 45°58'17.1"E, 1200 m, southwestwards. – Photograph by N. Kilian on 28.3.2003.

The natural vegetation of the upper escarpment and lowermost plateau at c. 800-1200 m altitude, which is most frequently and intensively affected by the cloud bank, is a semi-evergreen Afromontane *Olea europaea* subsp. *cuspidata* - *Tarchonanthus camphoratus* woodland. It includes the trees *Acokanthera schimperi* (A. DC.) Benth., *Cordia monoica* Roxb., *Euclea schimperi* (A. DC.) Dandy (very rare), *Rhus flexicaulis*, *R. glutinosa* subsp. *abyssinica* (Oliver) M. Gilbert, the shrubs *Adenia venenata, Dodonaea angustifolia*, *Dyschoriste longicalyx* (Deflers) O. Schwartz, *Euphorbia cuneata*, *Forsskaolea griersonii* A. G. Mill., *Grewia tembensis* Fresen., *G. trichocarpa* Hochst. ex A. Rich., *Hildebrandtia africana* subsp. *arabica* Sebsebe, *Jatropha spinosa* (Forssk.) Vahl, *Lantana viburnoides* (Forssk.) Vahl, *Maytenus senegalensis, Pavonia somalensis* Franch., *Rhamnus staddo* var. *deflersii* (Schweinf.) Chiov., *Ruellia grandiflora* (Forssk.) Blatter, *R. patula* Jacq., *Ruttya fruticosa* Lindau, *Sageretia thea* (Osbeck) M. C. Johnst., *Tarenna graveolens* subsp. *arabica* Sebsebe, the climbers *Coccinia grandis* (L.) Voigt, *Jasminum grandiflorum* subsp. *floribundum* (Fresen.) P. S. Green and the herbs *Asphodelus tenuifolius* Cav., *Crossandra johanninae* Fiori, *Geranium trilophum* Boiss., *G. ocellatum* Camb., *Iphigenia olivieri* Engl., *Justicia flava* (Vahl) Vahl, *Launaea massauensis, Scadoxus multiflorus, Silene schweinfurthii* Rohrb., *Viola cinerea* var. *stocksii* (Boiss.) Becker, *Volutaria albicaulis* (Deflers) J. R. I. Wood.

The gorges close to and in the escarpment provide the most humid sites and shelter the most luxuriant stands of *Olea-Tarchonanthus* woodland, in which also elements of Afrotropical riverine woodland are mixed. Confined to these sites are such species as the trees *Clerodendrum myricoides* (Hochst.) Vatke, *Ficus ingens* (Miq.) Miq., *Mimusops laurifolia, Nuxia oppositifolia* (Hochst.) Benth., the climbers *Clematis hirsuta* Guillemin & Perr., *Dregea schimperi* (Decne.) Bullock, *Ipomoea ficifolia* Lindl. and *Rhoiocissus revoilii* Planch.; further species are listed below.

The plateau areas further away from the escarpment edge are reached less regularly by the cloud bank, and this is apparent in a rapid change of the vegetation within a distance of only two kilometres. Whereas *Olea-Tarchonanthus* woodland follows the wadi beds further up, it is replaced on the open plateau very soon by *Acacia etbaica* woodland, which still higher up and further inland fades out into sparse *Euphorbia balsamifera* shrubland. The usual woodland zonation in the escarpments of the Horn of Africa and of the western Arabian Peninsula, in which the montane sclerophyllous *Olea* woodland is found above the montane *Acacia* woodland (König 1987, Friis 1992), is inverted here because of the decreasing fog precipitation with increasing distance from the escarpment edge.

Still today the size of the montane woodland area in the Maderan fog oasis is outstanding in the southern mountains. However, probably most of the *Acacia* woodland of the plateau area has been cleared by the local population, and also the *Olea-Tarchonanthus* woodland is to a considerable extent degraded or even cleared on the lowermost plateau (Fig. 4). Judging from the destruction of the woodland vegetation within the last seven years, as seen by the H. M. Omar, a conservation management plan is urgently needed.

A few floristic findings deserve particular mention:

***Adiantum balfourii* Baker *(Adiantaceae)*
This conspicuous species with suborbicular to fan-shaped pinnae is a regional endemic, hitherto known from the Socotra archipelago and the Horn of Africa region (Thulin 1993: 12). Our single record from the Maderan area is the first from the Arabian Peninsula (Miller & Cope 1996: 53).
ABYAN: Jabal Urays range, Maderan, wadi at Rukob Fa'aia, 13°30'37.9"N, 45°58'38.1"E, 1170 m, falling 800-1000 m into Wadi Nachl, shady rock face in gorge, 29.3.2003, *YP 4495.*

Dregea schimperi (Decne.) Bullock *(Apocynaceae-Asclepioideae)*
This climber of montane tropical African woodlands is rare on the Arabian Peninsula and so far only known from the western mountains (Wood 1997: 218, Collenette 1999: 672, Khulaidi 2000: 33).
ABYAN: Jabal Urays range, Maderan, between 13°30'23.4"N, 45°58'17.1"E, 1200 m, and 13°29'56.9"N, 45°58'31.4"E, 1060 m, lower plateaus and wadis, 28.3.2003, *YP 4438.*

Cynoglossum bottae Deflers [Syn.: *Paracynoglossum bottae* (Deflers) R. Mill & A.G. Mill.] *(Boraginaceae)*
The four species of *Cynoglossum* on the Arabian Peninsula have been thought so far to be restricted to the western mountains in Saudi Arabia and NW Yemen (Schwartz 1939: 212, Mill & Miller 1984, Wood 1997: 241, Collenette 1999: 86, Khulaidi 2000: 53). Our records of the Arabian endemic *C. bottae* from Maderan, where the species occurs in moist, shady gorges, are the first from the southern mountains.
ABYAN: Jabal Urays range, Maderan, volcanic plateau with gorge-like wadis, 13°31'01.8"N, 45°57'57.9"E, 1250 m, 27.3.2003, *YP 4352;* ibid., wadi at Rukob Fa'aia, 13°30'37.9"N, 45°58'38.1"E, 1170 m, falling 800-1000 m into Wadi Nachl, 29.3.2003, *YP 4477.*

**Campanula erinus* L. *(Campanulaceae)*
So far this widespread and chiefly Mediterranean-W Irano-Turanian dwarf annual (Heller & Heyn 1993: 3) has been known only to touch the Arabian Peninsula in the extreme SE (mountainous N Oman and UAE: Ghazanfar 1992: 31, Jongbloed & al. 2002: 38), where it apparently entered from Iran, and in the extreme NW (mountainous border region of Saudi Arabia with Jordan: Collenette 1999: 103, Chaudhary 2000: 42). The Maderan population is situated 2000 km south and 1600 km west of these other occurrences and it therefore appears more likely that it reached the area from East Africa, where it is present in Sudan, Eritrea and Ethiopia.
ABYAN: Jabal Urays range, Maderan, between 13°30'23.4"N, 45°58'17.1"E, 1200 m, and 13°29'56.9"N, 45°58'31.4"E, 1060 m, lower plateaus and wadis, 28.3.2003, *YP 4394.*

Arenaria leptoclados (Rchb.) Guss. [Syn.: *A. foliacea* Turrill] *(Caryophyllaceae)*
The *Arenaria serpyllifolia* aggr. has been reported on the Arabian Peninsula from N Saudi Arabia, from the western mountains, the Hajar range in N Oman and, by Schwartz (1939: 56, based

on collections by Deflers) from the southwestern Yemeni governorates of Lahj and Abyan. According to Chamberlain (in Miller & Cope 1996: 206-207, map 255) most likely all records are referable to *A. foliacea,* which is alternatively considered conspecific with *A. leptoclados* (see, e.g., Gilbert in Thulin 1993). Our material confirms the occurrence of this species in the southwestern governorates, from where Chamberlain had not seen material.
Lahaj: Jebel Eraf, between 13°06'44.1"N, 44°14'57.4"E, 1330 m and 13°06'32.4"N, 44°15'14.5"E, 1430 m, 10.3.2002, *YP1427c, 1433.*
Abyan: Jabal Urays range, Maderan, between 13°30'23.4"N, 45°58'17.1"E, 1200 m, and 13°29'56.9"N, 45°58'31.4"E, 1060 m, lower plateaus and wadis, 28.3.2003, *YP 4402*; Jabal Urays, Wadi Asurie, southwest facing slope, 13°28'22.9"N, 45°55'02.6"E, 700-820 m, 13.3.2002, *YP 1558.*

(**)*Filago abyssinica* Sch. Bip. ex A. Rich. *(Compositae)* – determination confirmed by G. Wagenitz 3.2004
The species is distributed in the highlands of the Horn of Africa, where it has been reported from Ethiopia and Eritrea (Wagenitz 1969: 407). From the Arabian Peninsula a single collection has been reported from the summit ridge of Jabal Ta'kar (13°52'N, 44°07'E) at 3100 m in N Yemen with the restriction that "the names used here are tentative and may need revision" (Wood 1997: 292; see also Khulaidi 2000: 40). Our material from Maderan, where the species has been found only at one spot, confirms its presence on the Arabian Peninsula.
Abyan: Jabal Urays range, Maderan, wadi at Rukob Fa'aia, 13°30'37.9"N, 45°58'38.1"E, 1170 m, falling 800-1000 m into Wadi Nachl, on wadi embankment, between shrubs, on volcanic rock, 29.3.2003, *YP 4463.*

Pulicaria nivea O. Schwartz *(Compositae)*
This dwarf (sub)shrub has been considered so far a local endemic of the limestone Jol escarpment and plateau of Hadhramout, from where some gatherings are known (Schwartz 1939: 285, Gamal-Eldin 1981: 226, Khulaidi 2000: 47). Its occurrence in the open *Acacia etbaica* woodland of the volcanic Jabal Urays massif is 340 km further west.
Abyan: Jabal Urays range, Maderan, volcanic plateau with scattered *Acacia etbaica,* 13°31'01.8"N, 45°57'57.9"E, 1250 m, 28.3.2003, *YP 4374.*

Linum strictum L. *(Linaceae)*
This Mediterranean-Irano-Turanian annual has rare occurrences in tropical E Africa (NE Ethiopia, NE Sudan and on Jabal Marra in NW Sudan, see Wickens 1976: 93, map 45, Lebrun & Storck 2003: 776) and on the Arabian Peninsula, where it is known only from higher altitudes (2400-3200 m) of a few mountains in the highest rainfall area of the northern governorates of Yemen (Wood 1997: 194, Khulaidi 2000: 126). Its presence in the Maderan fog oasis is a parallel to *Campanula erinus*.
Abyan: Jabal Urays range, Maderan, uppermost Wadi Maderan, from 13°30'18.1"N, 45°57'23.9",1290 m, down to c. 1000 m, 18.3.2002, *YP 1932.*

Rumex vesicarius L. *(Polygonaceae)*
The chiefly Saharo-Arabian annual is widespread in the Arabian Peninsula (Miller & Cope 1996: 136, map 152) but has not been known from the southern governorates of Yemen. The only records known from the southern coastal mountains are from Dhofar, Oman.
Lahaj: Jebel Eraf, between 13°06'44.1"N, 44°14'57.4"E, 1330 m and 13°06'32.4"N, 44°15'14.5"E, 1430 m, *Juniperus procera* woodland, 10.3.2002, *YP 1397.*
Abyan: Jabal Urays range, Maderan, volcanic plateau with gorge-like wadis, 13°31'01.8"N, 45°57'57.9"E, 1250 m, 27.3.2003, *YP 4355;* Jabal Urays, middle Wadi Lobob, W facing slope, into the wadi, S of 13°27'29.5"N, 45°45'57.3"E, 300-500 m, 19.3.2002, *YP 2009.*

Nuxia oppositifolia (Hochst.) Benth. *(Stilbaceae)*
This tall tree, present in Afrotropical riverine forest of E Africa, has been reported on the Arabian Peninsula so far from the mountains of SW Saudi Arabia and NW Yemen (Friis 1992: 233, map 131, Wood 1997: 210, Collenette 1999: 542, Khulaidi 2000: 127).

ABYAN: Jabal Urays range, Maderan, volcanic plateau with gorge-like wadis, 13°31'01.8"N, 45°57'57.9"E, 1250 m, bottom of gorge, 27.3.2003, *YP 4371;* ibid., gorge-like wadi between Jabal Sadid, 13°30'22.4"N, 45°57'46.6"E, 1280 m, and eastern tributary falling into Wadi Massqa, 13°29'55.9"N, 45°57'59.4"E, 1080 m, 30.3.2003, *YP 4524.*

Parietaria umbricola A. G. Mill. *(Urticaceae)*
The annual or short-living perennial is a recently described endemic of the western Arabian mountains, so far only known from the northernmost governorates of Yemen and of SW Saudi Arabia (Miller & Cope 1996: 112, map 115). Our record from a gorge in the escarpment of the Maderan area is the first from the southern mountains.
ABYAN: Jabal Urays range, Maderan, wadi between Jabal Sadid, 13°30'22.4"N, 45°57'46.6"E, 1280 m, and eastern tributary falling into Wadi Massqa, 13°29'55.9"N, 45°57'59.4"E, 1080 m, 30.3.2003, *YP 4529.*

4. Further noteworthy records from the southern Arabian mountains

***Ophioglossum gomezianum* Welw. ex A. Braun *(Ophioglossaceae)* – by John Burrows & Norbert Kilian
The tiny perennial (Fig. 5A) with thin horizontal rhizome, whose aerial parts are ephemeral, only to be seen during the monsoon season, is the second species of *Ophioglossum,* besides *O. polyphyllum* A. Braun, known to occur on the Arabian Peninsula. *O. gomezianum* is widespread in (sub)tropical Africa, from Senegal to the Horn of Africa and from there southwards extending to southern Africa and eastwards to India (Burrows in Burrows & Johns 2001: 8). The Arabian material somewhat differs from typical African plants. The spores (Fig. 5B-E) are more jagged than usual for *O. gomezianum,* but may nevertheless fall within an acceptable range of variation for the species. More serious is the lack of any persistent old leaf bases, which is normally an easy clue for the species, but the same appears to be true for plants from India. *O. gomezianum* generally grows in xerotropical woodland and savannah, and has been found in Yemen on limestone, at the edge of tiny patches of semi-evergreen *Anogeissus dhofarica* woodland (Kürschner & al. 2004) with *Olea europaea* subsp. *cuspidata, Acokanthera schimperi, Euclea schimperi, Jasminum grandiflorum,* in small lawn-like population of dozens of individuals on less than 0.5 m^2. Apart from the above restrictions, the species is morphologically very constant over its entire distribution range.
AL-MAHRA: N Fartak Mts, Jabal Karmoum, southwestern flank, 15°50'16.1"N, 51°59' 56.7"E, c. 850 m, 31.8.2002, *YP 3234.*

Barleria hochstetteri Nees *(Acanthaceae)*
The subshrub distributed from the Horn of Africa region and S Sudan to S Pakistan has been known on the Arabian Peninsula as a rare species of low altitudes in the western mountains (SW Saudi Arabia and W Yemen) and from two further, disjunct occurrences in Dhofar, S Oman, and, as a common species on dry hill slopes, in N Oman (Schwartz 1939: 253, Ghazanfar 1992: 14, Wood 1997: 272, Collenette 1999: 3, Khulaidi 2000: 11). Our records show its presence also in SE Yemen.
AL-MAHRA: Northern Fartak Mts, dissected table-land W below J. Karmoum, 15°49'39.2"N, 51°58'14.4"E, 600-650 m, 30.8.2002, *YP 3185;* Hawf Mts, Uteq, S facing slope with big boulders, 16°38'57.5"N, 52°57'39.2"E, 800 m, 29.9.2001, *YP 474a.*

Justicia anisotoides J.R.I. Wood *(Acanthaceae)*
This rare regional endemic (N Yemen and N Somalia) of striking superficial resemblance to *Anisotes trisulcus* (Wood 1984: 126, fig. 3; 1997: 274) is reported here from a disjunct occurrence in Al-Mahra. It seems to occur in low numbers only.
AL-MAHRA: S Fartak Mts, narrow wadi W of and parallel to the mountain ridge along the E coast (vertical cliffs), 15°38'45.7"N, 52°12'30.8"E, 500-550 m, close to wadi bed, 10.10.200, *YP 1187;* ibid., narrow rocky wadi, running SE to NW, 15°38'36.0"N, 52°11'48.9"E, 550 m, 3.9.2002, *YP 3294.*

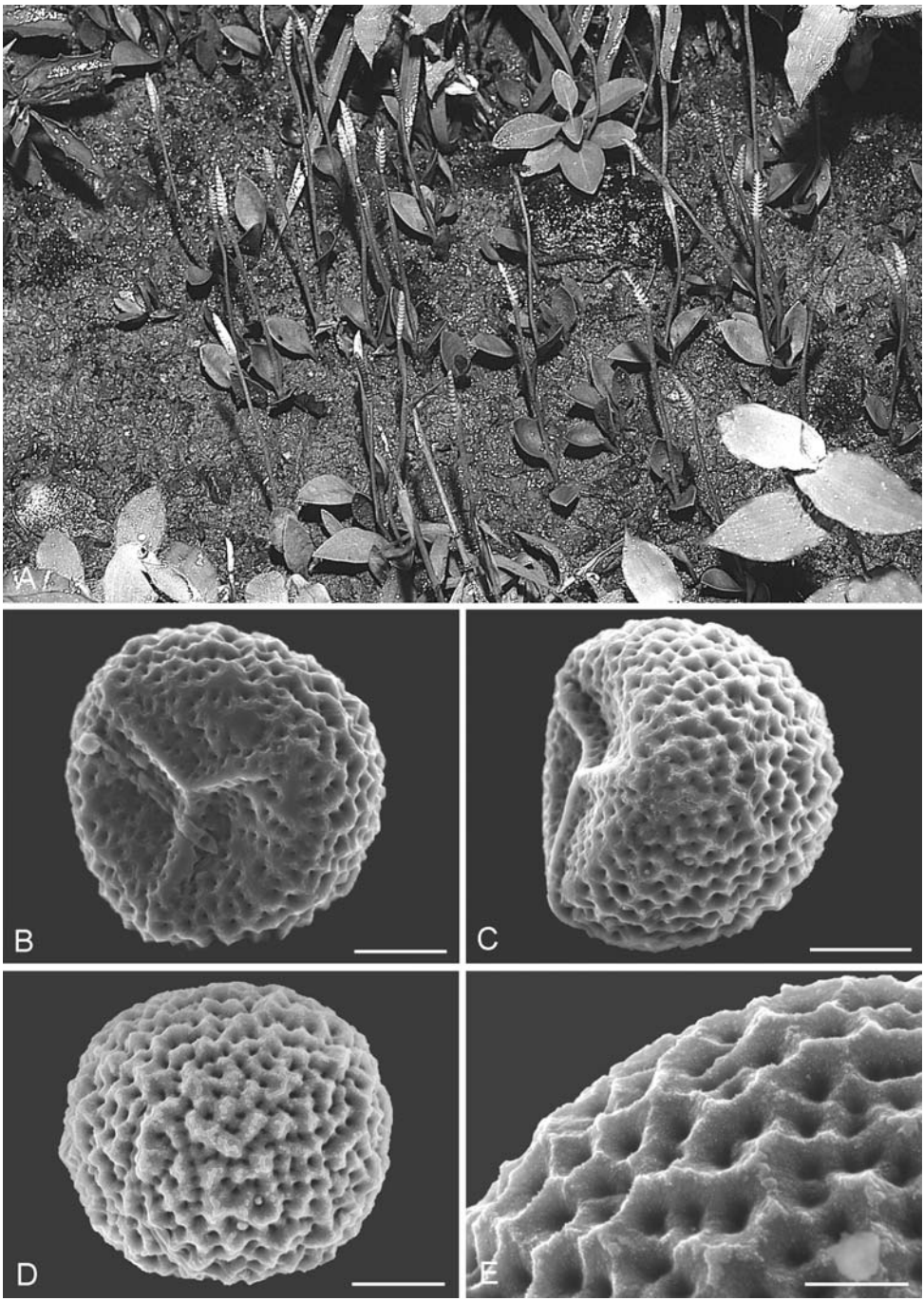

Fig. 5. *Ophioglossum gomezianum* in the Fartak Mts – A: habit, photograph by N. Kilian on 31.8.2002; B-E: SEM photographs of spores. – Scale: B-D = 10 µm, E = 4 µm; all from the collection *YP 3234*.

****Ruellia lineari-bracteolata** Lindau *(Acanthaceae)*
This dwarf shrub of dry areas with conspicuous linear leaves and bracts described from S Somalia and reported to occur in the central and northern part as well (Kuchar 1988: 248) is also present in the Arabian Peninsula. The Arabian material matches perfectly material from S Somalia in B determined so by K. Vollesen.
HADHRAMOUT: Upper (& western) Wadi Charid, N above the settlement Charid (or Shíthéme), 650 m, 15°08'N, 49°46'E, E facing rocky slopes above the wadi bed, open low scrub, 22.11.2000, *NK 6991*.
AL-MAHRA: N Fartak Mts, W facing slopes of the summit plateau with the radio tower, c. 15°50'N, 52°00'E, 550-950 m, 26.11.1999, *NK 6395*.

Adansonia digitata L. *(Bombacaceae)*
The three stunted trees of about 10 m height at the edge of a date palm grove of the village Ad Diz in the coastal plains of E Hadhramout are certainly planted. This must have been, however, so long ago that even the elder people remember them to have been of the same size in their youth and no one knows when they were planted and by whom. The people regard the trees for their leaves, the young twigs are regularly cut and fed to their livestock. Considering the strong historical connections by trade and migration between Hadhramout and E Africa, the existence of planted baobab in Hadhramout is no surprise. The case is, however, of interest in the light of the discussion whether the other four S Arabian occurrences of baobab (two of a single individual each in NW Yemen near Samsarah and Jabal Raymah, Wood 1997: 104, and two in Dhofar, one a reproducing population of a few dozens individuals above Wadi Hinna near Taqah on Jabal Qara, and the other a single individual near Dhalkut on Jabal Qamar, Miller & Morris 1988: 68, Ghazanfar 2003: 100) are indigenous or introduced.
HADHRAMOUT: At the village Ad Diz, c. 20 km E of Shehr, irrigated date palm grove and fields, 21.3.2002, *YP 2023*.

***Wahlenbergia flexuosa* (Hook. f. & Thomson) Thulin *(Campanulaceae)*
The annual species is widely distributed from tropical Africa to S Asia (Thulin 1976), but was known on the Arabian Peninsula so far only from Dhofar, Oman (Miller & Morris 1988, Ghazanfar 1992: 31). Much similar to *Lindenbergia muraria* (see below) it is a herbaceous element of the *Anogeissus dhofarica* association and as such also present in the Yemeni *Anogeissus* forest in the Hawf mountains.
AL-MAHRA: Hawf Mts, environment of Shah'rut, 16°33'55.4"N, 52°46'27.1"E, 650-700 m, 3.10.2001, *YP 793;* Hawf Mts, Uteq, S facing slopes with big boulders, below the vertical rock face of the summit escarpment, 16°38'57"N, 52°57'39"E, 1000-1100 m, 29.9.2001, *YP 493;* Hawf Mts, NE of Hawf, 650 m, c. 16°39'N, 53°03'E, at spring near junction of tracks to Con and the border with Oman, 11.11.2000, *NK 6740*.

****Maerua macrantha** Gilg *(Capparaceae)* – by Katharina Rabe
The habitually variable, stout to scandent or straggling shrub of 3 m height is here reported for the first time from the Arabian Peninsula (compare Chamberlain & Lamond in Miller & Cope 1996) by collections from the southwestern governorates Abyan and Shabwa, where it grows in open *Acacia-Commiphora* woodland, often on rocky outcrops. It is particularly frequent in the limestone hills between Lawdar and Shahilah (E Abyan and W Shabwa) and through its glaucous, persisting leaves also a conspicuous element in the deciduous *Acacia-Commiphora* woodland. *Maerua macrantha* is a seldom collected and poorly known species and was hitherto thought to be confined to NE tropical Africa (Kenya, Ethiopia and Somalia, see Fig. 3A; Thulin & Kers in Thulin 1993: 43, Kers 2000: 112). Gilg (1904: 226) already pointed out that *M. macrantha* resembles *M. oblongifolia* (Forssk.) A. Rich. in respect of its toroulose fruits (Fig. 6C). In addition, the seeds of both species are often arranged in several (2-4) rows, the inner margin of the cylindrical receptacle is prolonged into a disc with a free, very short and entire rim (Fig. 6A) and their flowers possess oblanceolate to elliptic petals 3-11 mm long. Furthermore, both species are glabrous or show a dense, stiff and hyalin indumentum of twigs, petioles and leaves (Fig.

6B). Elffers & al. (1964: 37) described *M. oblongifolia* as an extremely variable species and suspected that *M. macrantha* may perhaps be inseparable from *M. oblongifolia*. However, *M. macrantha* can be distinguished from *M. oblongifolia* by the following features: (1) the thick, fleshy to leathery, broadly elliptic leaf blade, 20-65 × 14-43(-70) mm (orbicular in *YP 4331*: 65 × 70 mm), never oblong as often in *M. oblongifolia*); (2) leaf venation with two basal pairs of secondary veins raised, arcuate and running ± parallel to the margin up to the top of the blade, whereas in *M. oblongifolia* secondary veins are often rather equally raised, ± straight, ± parallel to each other and running towards the margin; (3) sepals 12-24 mm (instead of 7-12 mm) long, anthers 3-4.5 mm (instead of 1-2.5 mm) long and the ovary 4-5 mm (instead of 2-4 mm) long. The Arabian collections of *M. macrantha* are in bud or sterile. All material is rather similar to the specimens from Ethiopia and Somalia (*Riva 965* holotype, B!; *C. L. Collenette 44*, B!; *Thulin & Warfa 5591*, UPS!). The flowers in bud with developing sepals of 13 mm, petals of 4 mm, ovaries of 5 mm and anthers of 3 mm perfectly match the typical flower structure.
Abyan: Some km W of Mahwit, calcareous slopes with sparse *Acacia* woodland, 14°02'44.7"N, 46°50'38.9"E, 600 m, 31.3.2003, *YP 4549*.
Shabwa: Lower Wadi Al-Himae, between 13°55'08.5"N, 47°24'21.3"E, 200 m, and 13°59' 42.4"N, 47°22'00.0"E, 330 m, at Al Modero, dry, stony-rocky hill slope, 25.3.2003, *YP 4331;* mountains W of Wadi Mayfah, track from Rodoum, 14°07'55.1"N, 47°40'59.5"E, 300 m, rocky slope, with *Acacia* sp. and *Balanites aegyptiacus,* 7.3.2002, *YP 1334.*

***Psiadia incana* Oliver & Hiern *(Compositae)*
Psiadia is a palaeotropical genus of c. 60 species with the highest diversity on Madagascar and the Mascarene Islands. From the Arabian Peninsula, so far only *P. punctulata,* a shrub distributed in the western and southern mountains and widespread from S Africa across all E Africa, has been known. *P. incana* we know only from a single locality on the sea facing escarpment in Hadhramout. It is a shrub to c. 2 m high and is otherwise distributed on the African mainland from N Kenya to Ethiopia and N Somalia (Beentje 2002: 516).
Hadhramout: S facing rocky slope above Wadi Shahora, ascent to the Jol plateau, 14°43' 28.1"N, 48°53'23.1"E, 1400 m, limestone, 12.9.2002, *YP 3482.*

Corallocarpus schimperi (Naud.) Hook.f. [Syn.: *C. erostris* (Schweinf.) Hook.] *(Cucurbitaceae)*
The species, distributed rather widely in tropical E Africa and in Asia from Iran to India, has been known so far on the Arabian Peninsula only from the southwestern mountains southeastwards as far as Aden (Schwarz 1939: 265, Wood 1997: 117, Collenette 1999: 269, Khulaidi 2000: 83). Our records from Al-Mahra reveal a second, disjunct distribution area in the eastern part of the southern mountains, where the species occurs in the *Anogeissus* association.
Al-Mahra: Hawf Mts, plateau and slopes around the village Con, 650-800 m, 16°39'N, 53°02'E, 14.11.2000, *PH 8192;* Hawf Mts, Uteq, S facing slope with big boulders, 16°38'57.5"N, 52°57' 39.2"E, 800 m, 29.9.2001, *YP 459.*

Ehretia obtusifolia A. DC. *(Ehretiaceae)*
On the Arabian Peninsula this shrub or small tree, with a distribution extending from southern Africa across E tropical Africa, the Horn of Africa including Socotra, as far as Pakistan and NW India (Verdcourt 1991: 35), is known from the western mountains in SW Saudi Arabia and Yemen (Schwartz 1939: 204, Wood 1997: 237, Collenette 1999: 88, Khulaidi 2000: 54), from Dhofar and from Jabal Akdhar in Oman (Ghazanfar 1992: 26). Our report from Jabal Urays, where only a few individuals have been met, is the first from the southern Yemeni mountains.
Abyan: Jabal Urays, southwest slopes, below the rock faced closing Wadi Asurie, 13°28'N, 45° 55'E, 820-900 m, 13.3.2002, *YP 1593;* ibid., W facing slope of Wadi Asurie, at the base of the rock face, south of 13°28'31.7"N, 45°55'23.4"E, 750-850 m, 17.3.2002, *YP 1861.*

Desmodium ospriostreblum Steud. ex Chiov. *(Leguminosae)*
An annual species fairly widespread in tropical Africa (Thulin in Hedberg & Edwards 1989: 151). On the Arabian Peninsula known from two disjunct occurrences, one in the southwestern

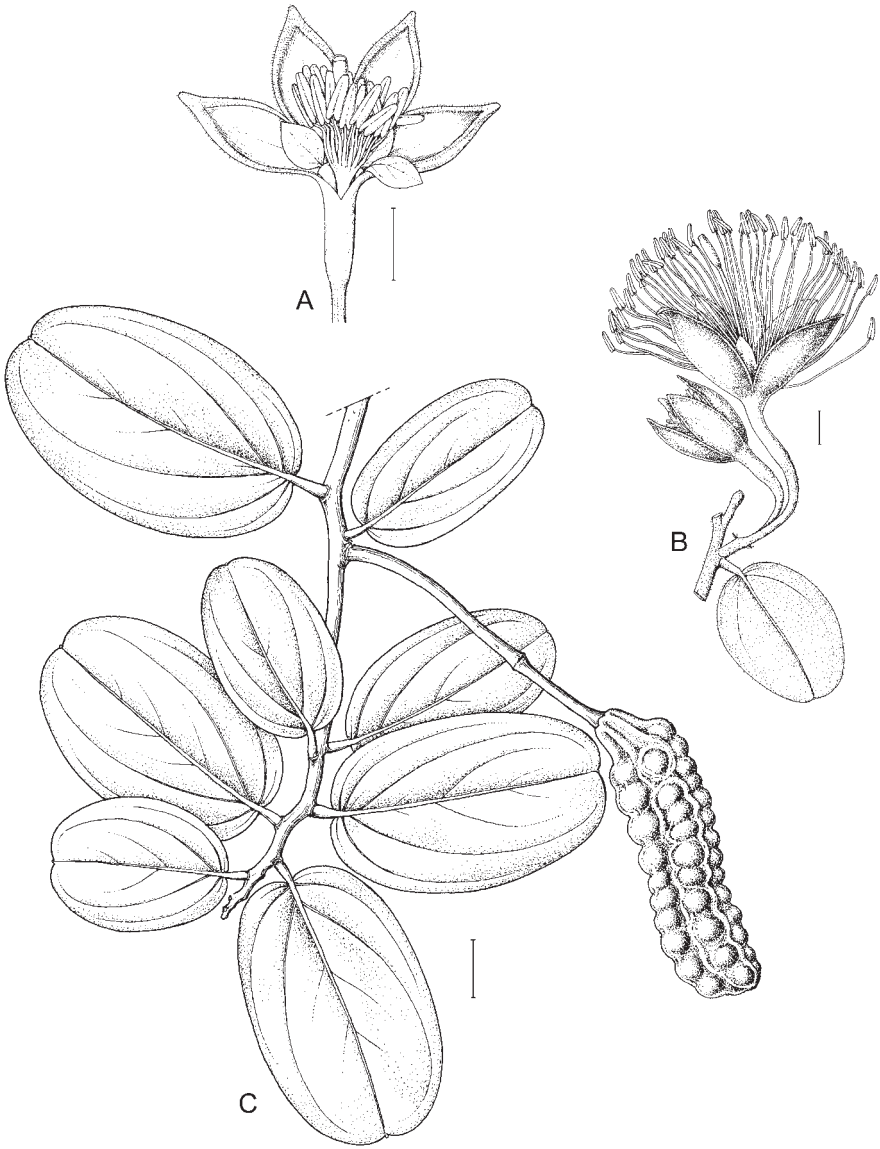

Fig. 6. *Maerua macrantha* – A: opened bud showing the androgynophor and the entire disc with petals, B: flowering twig with dense, stiff indumentum; C: fruiting twig with a mature, toroulose fruit having the seeds in 4 rows. – Drawn by Ingo Haas; A and C from *Thulin & Warfa 5591* (glabrous specimen); B: from *C. L. Collenette 44* (hairy specimen).

mountains of N Yemen (Wood 1997: 154, Khulaidi 2000: 104), the other in Dhofar (Ghazanfar 1992: 67), which is extended with our first record from southeastern Yemen.

The same extension of the known range provides a record *(PH 8010)* of the palaeotropical perennial *D. gangeticum* (L.) DC., which has the same distribution pattern on the Arabian Peninsula.

Al-Mahra: Hawf Mts, at Shah'rut, 16°34'12.1"N, 52°46'29.9"E, 680 m, 4.10.2001, *YP 854.*

Indigastrum costatum subsp. *goniodes* (Hochst. ex Baker) Schrire [Syn.: *Indigofera costata* subsp. *gonoidies* (Hochst. ex Baker) Gillett, *I. goniodes* Hochst. ex Baker, *Indigastrum macrostachyum* Jaub. & Spach] *(Leguminosae)*
An annual of tropical E Africa including S Somalia and Ethiopia (Thulin1993: 418), which has been reported also from the Arabian Peninsula as a weed and species of disturbed places in the Yemeni part of the western mountains south of 15°05'N (Wood 1997: 148, Khulaidi 2000: 105). We report an extension into the southern mountains and a second, disjunct occurrence in the *Anogeissus dhofarica* association of the fog oasis of the central south coast. Both occurrences are suspected to be anthropogenous.
Abyan: Jabal Urays range, Maderan, wadis between Jabal Sadid, 13°30'22.4"N, 45°57'46.6"E, 1280 m, and eastern tributary falling into Wadi Massqa, 13°29'55.9"N, 45°57'59.4"E, 1080 m, 30.3.2003, *YP 4518.*
Al-Mahra: Hawf Mts, Shah'rut [i.e.16°33'55.4"N, 52°46'27.1"E], 650-700 m, 2.10.2001, *YP 720;* Hawf Mts, above 'Uteq' towards 16°39'14.3"N, 52°57'27.2"E, 950-1220 m, steep rocky, humid gorge with open semi-evergreen woodland, scree and open soil near a path, 30.9.2001, *YP 585a.*

Teramnus repens subsp. *gracilis* (Chiov.) Verdc. *(Leguminosae)*
The perennial prostrate herb is distributed in tropical E Africa (Thulin 1993: 430), on Socotra, the southwestern mountains of the Arabian Peninsula (Collenette 1999: 530, Wood 1997: 157, Khulaidi 2000: 112) and has a disjunct occurrence in the eastern part of the southern mountains. There it has been known already from Dhofar (Ghazanfar 1992: 74) and is now also reported for Al-Mahra, Yemen.
Al-Mahra: Hawf Mts, environment of Shah'rut,16°33'55.4"N, 52°46'27.1"E, 650-700 m, 2.10.2001, *YP 748;* ibid., 2.10.2001, *YP 803.*

Telephium sphaerospermum Boiss. *(Molluginaceae)*
The prostrate annual is widespread in the western mountains, northwards extending to the Sinai, and has been recorded in Oman from mountains in Dhofar and Jabal Akhdar, but there has been hardly any record from the mountains in southern Yemen (Miller & Cope 1996: 169, map 204, Khulaidi 2000: 18). We add a first record from Abyan and confirm its presence in Hadhramout.
Abyan: Jabal Urays range, Maderan, plateau between 13°31'01.8"N, 45°57'57.9"E, 1250 m and Rukob Fa'aia, 13°30'37.9"N, 45°58'38.1"E, 1170 m, 29.3.2003, *YP 4459.*
Hadhramout: Jol plateau, on pipeline rd., 4.5 km SE of 15°06'N, 49°24'E, 1300 m, 17.9.2001, *YP 105;* Jol plateau, on the pipeline rd. from Wadi Araf to Tawila fields, immediately S of the highest point and watershed, 15°09'53.8"N, 49°22'37.1"E, 1620 m, 18.9.2001, *YP 223.*

***Portulaca commutata* M. G. Gilbert *(Portulacaceae)* – by Simone Kipka
The E African annual to pauciennial herb has long been confused with the widespread *Portulaca quadrifida* L. as well as with *P. wightiana* Wall. ex Wight & Arn. and has been recognized as a separate species only ten years ago (Gilbert & Phillips 2000). *P. commutata* can be distinguished from these latter species by its papillose stems and the narrower scales at the nodes of young stems always having hair-like tips; in contrast to *P. quadrifida* it has an ascending-erect growth; its seeds are dull grey as also usually in *P. quadrifida,* but are greyish brown with a metal gleam in *P. wightiana.* It has not been reported so far from the Arabian Peninsula but actually seems to be rather widespread in the south of Yemen and was also found in Dhofar, Oman. Attention should be paid to its possible occurrence in the northern governorates of Yemen and SW Saudi Arabia.
Yemen: Lahaj: Escarpment SE of the village At Turbah, 13°12'N, 44°07'E, 1650-1800 m, 1.4. 1997, *PH 3777.*
Hadhramout: Kor Seiban, summit plateau, main wadi S of the highest point, 14°49'15"N, 48°49' 03"E, 1900-2000 m, *YP 3570.*
Al-Mahra: N Fartak Mts, summit area of J. Karmoum, wadi NW below the disused radio tower, 15°50'19"N, 52°00'25"E, 850-900 m, 7.10.2001, *YP 995b;* Wadi Mougaib, between 16°35' 57.3"N, 52°53'26.7"E and the track Damqaut to Hawf, 100-180 m, 28.8.2002, *YP 3123;* W of Jadib,16°38'N,

52°55'E, 150-250 m, 26.9.1998, *PH 5029;* Hawf Mts, steep gorge almost parallel to the S-SE facing summit escarpment, between c. 52°39'E and 16°39'14.3"N, 52°57'27"E, 1150-1250 m, 28.9.2001, *YP 449.*
OMAN: DHOFAR: Jabal Samhan, 17°10'10"N, 54°52'20"E, 690-1130 m, 30.9.2002, *Meister & Oberprieler CHO 10247.*

***Portulaca constricta* M. G. Gilbert – by Simone Kipka**
The annual to pauciennial herb is a regional endemic, hitherto known from SE Ethiopia, N Somalia and Socotra (Gilbert & Phillips 2000), with a conspicuously constricted capsule lid. The single collected cited is the first record from the Arabian Peninsula.
HADHRAMOUT: Al Mukalla - Sayun road, wide flat wadi close to the foothills of the Jol, S of the village Abdallah Karib, 14°50'N, 49°11'E, 180 m, gravel and, partly, sand or silt, 10.11.1999, *NK 5916.*

Portulaca dhofarica* M. G. Gilbert – by Simone Kipka
This tiny woody perennial has been described only recently from Dhofar, Oman (Gilbert in Gilbert & Phillips 2000). Our records extend its known distribution range to the eastern half of the southern coastal mountains of the Arabian Peninsula.
HADHRAMOUT: Wadi Al-Muhammedin, 14°31'N, 48°47'E, 320-500 m, wadi bed, 14.11.1999, *PH 6316;* between Maula Matar gorge and the village Hesi, 14°46'29.4"N, 48°47'20.3"E, 1700 m, rocky slope, 19.9.2002, *YP 3484.*
AL-MAHRA: Jabal Sharwayn 10 km W of Qishn, 15°24'N, 51°35'E, 180 m, 24.9.1998, *PH 4878a;* N Fartak Mts, 15°49'N, 51°57'E, 620 m, rocky slopes, 24.9.1998, *NK 5114, PH 4905;* ibid., 15°49'N, 51°57'E, 600-800 m, 19.11.1999, *PH 6540;* ibid., 15°50'19.1"N, 52°00'25.1"E, 650-980 m, 6.10.2001, *YP 917;* ibid., c. 15°25'16.7"N, c. 51°59'57.1"E, 450-600 m, 6.10.2001, *YP 966;* ibid., 15°49'39.2"N, 51°58'14.4"E, 600-650 m, 30.8.2002, *YP 3146;* ibid., NE flank of the Fartak Mts SW of Nishtun, 200-450 m, 15°47'N, 52°10'E, 20.11.1999, *PH6598b;* ibid., 15°46'N, 52°09'E, 20.11.1999, *PH 6609;* S Fartak Mts, 15°38'11.8"N, 52°11'40.8"E, 520 m, 4.9. 2002, *YP 3297;* Hawf Mts, 16°33'N, 52°48'E, 100-150 m, bare rocky coastal slopes, 4.10. 2001, *YP 824.*

Wendlandia arabica Deflers *(Rubiaceae)*
This is the first record of this rare regional endemic from the southern mountains. The riverine woodland shrub is the only African-Arabian representative of a chiefly Indo-Malayan genus. Hitherto it has been reported for the Arabian Peninsula only from the Hudjariyah, in the southern Taiz governorate (Schwarz 1939: 262, Wood 1997: 279). Its total distribution is restricted to N Somalia (Friis 1992: 254, map 148) and the SW Arabian Peninsula. The new finding is situated 590 km further E from the other populations in Yemen, but on almost the same longitude as the easternmost population in N Somalia (Fig. 3A).
HADHRAMOUT: Northern tributary of Wadi Araf, near village Haglay, close to the steep end of the wadi, 15°02'53.9"N, 49°26'49.3"E, c. 550 m, shady rocky gorge with permanent streamlet, large shrub hanging from rocks, 16.9.2001, *YP 95.*

Aptosimum pumilum (Hochst.) Benth. *(Scrophulariaceae)*
This annual of a chiefly southern African genus has a restricted distribution ranging from the Tibesti Mts (Scholz 1966: 196) across the Darfur and Kordofan regions of N Sudan to the Asir Mts of SW Saudi Arabia (Collenette 1999: 673) and the N Yemeni highlands (Schwartz 1939: 241, Wood 1997: 259), and has also been reported from N Somalia (Kuchar 1988: 233) and Socotra (Khulaidi 2000: 181). Our report from the edge of Rub al Khali in E Hadhramout is the first from the entire southern Yemen.
HADHRAMOUT: Road from Tarim to Thamud, 16°38'08.0"N, 49°29'11.2"E, 1000 m, 19.8.2002, *YP 2832.*

**Lindenbergia muraria* (Roxb.) Brühl *(Scrophulariaceae)*
The annual species is distributed from Ethiopia to India, Nepal and SE Asia and has been reported from the Arabian Peninsula only from Dhofar, Oman (Hjertson 1996: 299, fig. 11 map,

Ghazanfar 1992: 106). As a herbaceous element of the *Anogeissus dhofarica* association the species is also frequent in moister Yemeni *Anogeissus* forest.
Al-Mahra: Hawf Mts, slopes ENE of the village Con, 700-860 m, 16°40'N, 53°02'E, 14.11.2000, *NK 6832;* Hawf Mts, Uteq, S facing rocky slopes, 16°38'57"N, 52°57'39"E, 900-1000 m, 29.9. 2001, *YP 515;* Hawf Mts, Al Ain Ayn, wadi bed at and above the permanent spring, 16°38' 14.2"N, 52°56'36.1"E, c. 480 m, 1.10.2001, *YP 649.*

**Hermannia testacea* Vollesen *(Sterculiaceae)*
This annual of the Horn of Africa region (Somalia, Ethiopia; Thulin 1999: 35) has been reported from the Arabian Peninsula so far only from Dhofar, Oman (Miller & Morris 1988: 340, Ghazanfar 2002: 98). Like *Wahlenbergia flexuosa* and *Lindenbergia muraria* it is an ephemeral element of the *Anogeissus* forests, perishing with the end of the monsoon, and like them it is also present in the Yemeni *Anogeissus* forests in the Hawf mountains.
Al-Mahra: Hawf Mts, environment of Shah'rut, 16°33'55.4"N, 52°46'27.1"E, 650-700 m, 3.10. 2001, *YP 785;* ibid., 23.8.2002, *YP 2956.*

Grewia trichocarpa Hochst. ex A. Rich. [Syn.: *G. mollis* var. *trichocarpa* (Hochst.) Burret] *(Tiliaceae)*
The species is widespread in tropical Africa in the Sudano-Zambesian Floristic Region and occurs on the Arabian Peninsula both in the western mountains (Wood 1997: 100, Collenette 1999: 717) and in the western part of the southern mountains (e.g. Jabal Urays, Schwartz 1939: 156; Maderan area, *YP 1954*), and then again in the eastern part of the southern mountains. From the latter region it has been recorded before from Dhofar (Ghazanfar 1992: 113). We add first records from Al-Mahra.
Al-Mahra: S Fartak Mts, 15°39'37.6"N, 52°11'50.9"E, 830 m, 6.9.2002, *YP3397;* Hawf Mts, below Shah'rut, wadi running from 16°34'24.6"N, 52°48'33.9"E (350 m) southwestwards to 16°34' 16.2"N, 52°48'21.0"E (270 m), S facing slope, 24.8.2002, *YP 3029;* Hawf Mts, Uteq, 16°38' 57.5"N, 52°57'39.2"E, 800-850 m, 30.9.2001, *YP 596.*

**Laportea interrupta* (L.) Chew *(Urticaceae)*
This palaeotropical annual has been known hitherto on the Arabian Peninsula only from the *Anogeissus* forest in Dhofar (Miller & Cope 1996: 106, map 105, Ghazanfar 2003: 26). It is here reported also for the *Anogeissus* forest in the Hawf Mts of Yemen.
Al-Mahra: Hawf Mts, Shah'rut, 16°34'21.9"N, 52°47'12.9"E, 540-550 m, 23.8.2002, *YP 2966b.*

***Brachiaria arida* (Mez) Stapf *(Gramineae)* – det. H. Scholz
This little known regional endemic, described from Socotra and N Somalia (syntypes: Socotra, Granithöhlen, Wadi Dilal, 200 m, 23.4.1881, *Schweinfurth 509* (B!); Somalia, Ahl Mts, 1300 m [= c. 11°N, 48°15'E, see Beentje 1998: 854], 4.1875, *Hildebrandt 1483* (B!)) and hitherto only known from there (Cope 1985: 45, Cope in Thulin 1995: 227, Khulaidi 2000: 150), has been collected by us repeatedly in the southern coastal mountains of Yemen, where it is an eastern element (Fig. 3B) and grows on slopes favoured by mist precipitation; selected records are cited.
Hadhramout: Track from Al Mukalla to Bayn al Jibal, rocky slopes c. 20 km N of Al Mukalla, 14°37'N, 49°01'E, 750-800 m, 17.11.1999, *PH 6443.*
Al-Mahra: N Fartak Mts, northeastern flank SW of Nishtun, 15°46'N, 52°09'E, 450-500 m, mist-affected rocky slopes and hilltops, 20.11.1999, *PH 6617;* 20 km E of Al Faydami, 16°30'N, 52°35'E, 50-250 m, mountain ridge, sea-exposed rocky slopes and cliffs, 26.9.1998, *PH 4986;* Hawf Mts, Shah'rut, 16°33'55.4"N, 52°46'27.1"E, 650-700 m, 30.10.2001, *YP 777;* Hawf Mts, c. 10-15 km W of Jadib, 150-250 m, 16°38'N, 52°55'E, rocky slopes, 26.9.1998, *PH 5058;* Hawf Mts, above 'Uteq' towards 16°39'14.3"N, 52°57'27.2"E, 950-1220 m, dry gorge at 1200 m in the wind shade of huge rock faces, 30.9.2001, *YP 591.*

Brachiaria eruciformis (Sm.) Griseb. *(Gramineae)* – det. H. Scholz
A weedy species widespread from the Mediterranean across the Arabian Peninsula to India, which has not been reported so far from the southern governorates of Yemen (Cope 1985: 45,

Khulaidi 2000: 151). It was collected in rather dense *Anogeissus dhofarica* forest and forest patches, respectively.
Al-Mahra: N Fartak Mts, W flank of J. Karmoum, 15°50'04.2"N, 51°59'43.3"E, 780 m, 6.10. 2001, *YP 944;* Hawf Mts, Uteq, 16°38'57.5"N, 52°57'39.2"E, 800-850 m, 30.9.2001, *YP 613.*

**Capillipedium parviflorum* (R. Br.) Stapf *(Gramineae)* – det. H. Scholz
The widespread palaeotropical perennial has been reported so far for the Arabian Peninsula only from Dhofar, Oman (Cope 1985: 55, Ghazanfar 1992: 131).
Al-Mahra: N Fartak Mts, W flank of J. Karmoum, 15°50'16.7"N, 51°59'57.1"E, 900 m, semi-evergreen *Anogeissus* forest patch, 6.10.2001, *YP 963.*

**Dichanthium micranthum* Cope *(Gramineae)* – det. H. Scholz
The distribution range of this species, so far considered as endemic to Dhofar, Oman (Cope 1985: 55, Ghazanfar 1992: 133), actually extends into Al-Mahra, Yemen.
Al-Mahra: 5-10 km W of Hawf, c. 16°38'N, 52°57'E, disturbed woodland, 100-200 m, 26.9. 1998, *NK 5226.*

Hackelochloa granularis (L.) Kuntze [Syn.: *Mnesithea granularis* (L.) Koning & Sosef] *(Gramineae)* – det. H. Scholz
The widespread tropical annual is known on the Arabian Peninsula only from the two maximum precipitation areas, viz. near Ibb in N Yemen and from Dhofar, Oman, in the fog oasis of the central south coast (Cope 1985: 60, Wood 1997: 395, Ghazanfar 1992: 135); in the latter its distribution extends to Al-Mahra.
Al-Mahra: Hawf Mts, environment of Shah'rut,16°33'55.4"N, 52°46'27.1"E, 650-700 m, 2.10. 2001, *YP 751a;* ibid., 16°34'17.9"N, 52°47'19.3"E, 580 m, 23.8.2002, *YP 2953.*

**Loudetia flavida* (Stapf) C. E. Hubb. *(Gramineae)* – det. H. Scholz
So far this southern and tropical African tufted perennial has been reported from the Arabian Peninsula exclusively from Dhofar (Cope 1985: 39, Ghazanfar 1992: 136), but its distribution extends westwards to Hadhramout.
Hadhramout: Jol plateau, c. 15°06'N, 49°24'E, on the plateau of a table mountain and on its slopes, 1350-1450 m, 17.9.2001, *YP 119a*
Al-Mahra: 15 km W of Al Fatk, southern flank of Jabal Faydami, 16°30'N, 52°35'E, 350-450 m, 8.11.2000, *PH 7979*.

**Oplismenus burmannii* (Retz.) P. Beauv. *(Gramineae)* – det. H. Scholz
The widespread tropical annual has been reported from Socotra, and on the Arabian Peninsula from Dhofar, Oman, only (Cope 1985: 45, Ghazanfar 1992: 136, Khulaidi 2000: 159). Our Yemeni records are from moist *Anogeissus* woodland.
Al-Mahra: Hawf Mts, Uteq, S facing slope with big boulders, 16°38'57.5"N, 52°57'39.2"E, 800 m, 29.9.2001, *YP 477;* Wadi Mougaib, between Ka'ab and Damqaut, 16°35'57.3"N, 52°53' 26.7"E, 180 m, 28.8.2002, *YP 3102.*

**Sorghum versicolor* Andersson *(Gramineae)* – det. H. Scholz
Distributed from southern Africa all across E Africa to Ethiopia and N Somalia, the pauciennial species has been known on the Arabian Peninsula from Dhofar, Oman, only (Cope 1985: 54, Ghazanfar 1992: 139). We report it here also from the Yemeni part of monsoon woodland.
Al-Mahra: Hawf Mts, Shah'rut,16°33'55.4"N, 52°46'27.1"E, 650-700 m, *Anogeissus-Commiphora* woodland, 2.10.2001, *YP 758*.

Tripogon leptophyllus (A. Rich.) Cuf. *(Gramineae)* – det. H. Scholz
This perennial is a regional endemic, known so far only from Sudan (Jabal Marra), NE Ethiopia, Eritrea and, as a rare species, from the central escarpment in N Yemen (Wickens 1976: map 206, Cope 1985: 25, Wood 1997: 366, Khulaidi 2000: 165). Our record from the Fartak Mts, some 900 km E from the central escarpment occurrences, constitutes a surprising range extension.
Al-Mahra: N Fartak Mts, W flank of J. Karmoum, 15°50'N, 52°00'42"E, 920 m, *Anogeissus* woodland patch below a rock ledge, 7.10.2001, *YP 980a.*

Acknowledgements

The research was mainly conducted in the framework of the Yemeni German BIOTA [Biodiversity Monitoring Transect Analysis] Project funded by the German Federal Ministry of Research and Education (BMBF) from 2001-2004. We also gratefully acknowledge the support by the Head Office of the Agricultural Research and Extension Authority (AREA) in Dhamar and its Chairman Ismail A. Muharram, and of the Director General of the AREA research station El-Kod, Abyan, Dr Ahmed Saeed Al-Zarri. We are thankful to Sheik Shaiya Salim Al-Dahouri, Urays range, to Mohamed Salim, Head of the Shuqra district, and to the police department of Abyan for their support of our field work in the Urays range, and to the kabila Al-Athemi in the Rodoum district, Shabwa, for their permission to enter Jabal Gedu, for their kind hospitality and guidance. Special thanks are due to Hildemar Scholz, Berlin, for his determination of the *Gramineae,* to Gerhard Wagenitz, Göttingen, for expert advice on *Filago,* to Jeannette Ueckert, Berlin, for assistance with the scanning electron microscopy, and to Ingo Haas, Berlin for preparing the drawings of *Maerua macrantha.* We thank the referees Shahina Ghazanfar (Kew) and Mats Thulin (Uppsala) for their valuable comments on an earlier version of this paper.

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