

APOCYNACEAE

SPECIES DELIMITATION IN *CARVALHOA CAMPANULATA* (RAUVOLFIOIDEAE)

INTRODUCTION

The genus *Carvalhoa*, typified by *C. campanulata* K.Schum., was established in 1897 by Karl Schumann based on a collection made by Manuel Rodrigues P. de Carvalho in 1884–1885 on the small island of Cabaceira Pequena (15°0'40" S, 40°45'5"E), about 11 km ESE of Mossuril, a seaside settlement in Nampula Province of northern Mozambique. Despite Leeuwenberg's assertion

that all material within the genus belongs to a single species (Leeuwenberg 1985a), it is clear that there are two distinct taxa represented over its range: one a species of moist evergreen forest, and the other of dry coastal vegetation at low altitudes. In this contribution the morphology and ecology of the two taxa are examined and the younger name, *C. macrophylla* K.Schum., for the taxon that is widespread in the montane forests, is reinstated. The name *C. campanulata* is retained for the typical

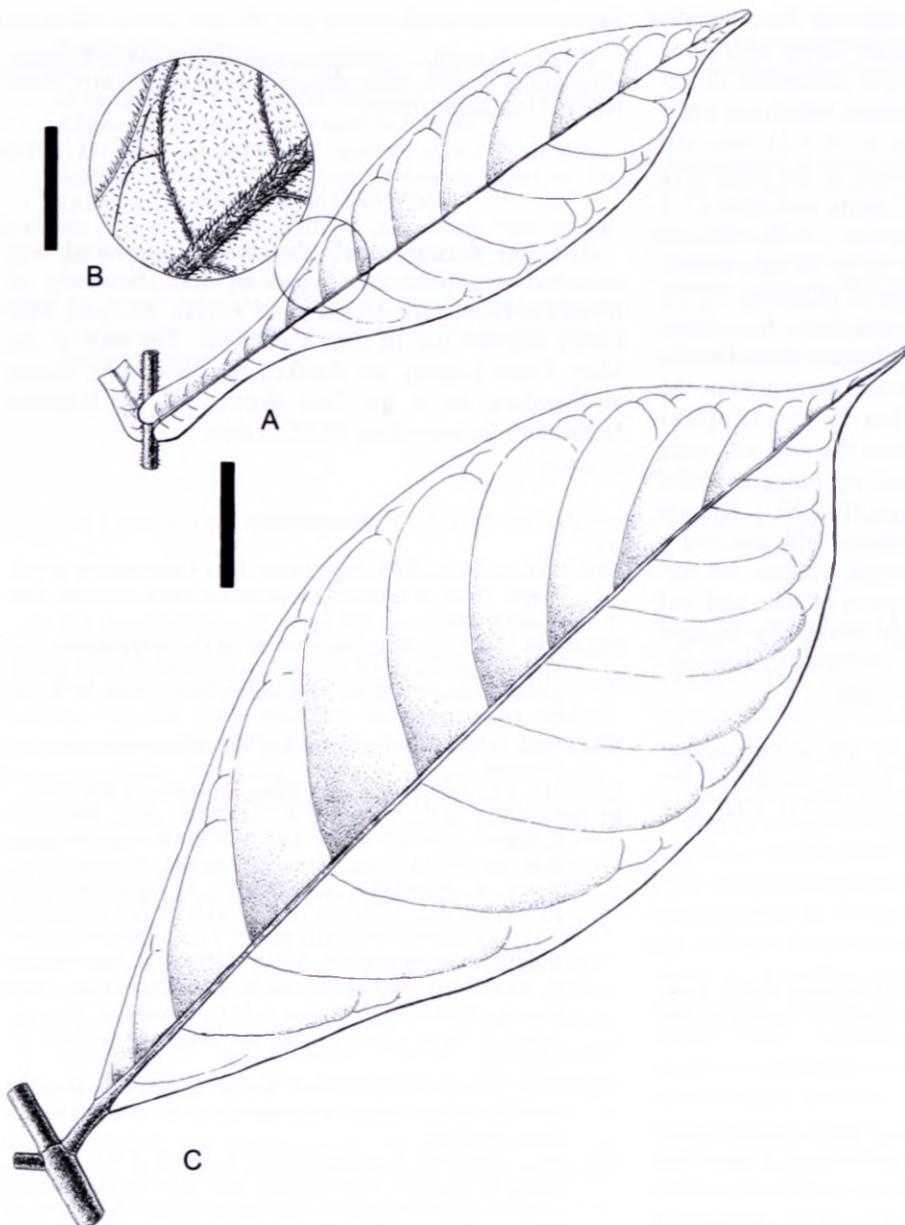


FIGURE 5.—*Carvalhoa campanulata*, Burrows & Burrows 9735 (BNRH): A, leaf; B, indumentum. *C. macrophylla*, Golding, Timberlake & Clarke 41 (BNRH, K, PRE): C, leaf. Scale bars: A, C, 20 mm; B, 5 mm. Artist: Sandra Burrows.

material which is confined to the coastal regions of northern Mozambique.

Until the Buffelskloof Herbarium, Lydenburg, is awarded an international acronym, the temporary acronym BNRH is used here.

DISCUSSION

Morphology: if *Carvalhoa* is regarded as a monotypic genus (Leeuwenberg 1985a, b; Omino 2002), the morphological variation in leaf size, leaf shape, leaf indumentum and petiole length over its range is, in the opinion of the author, unacceptably great. However, if the genus is divided into two species, the most striking and consistent differences between the two taxa are the shape and size of the leaf. In *C. campanulata sensu stricto* the leaves are narrowly elliptic to oblanceolate or narrowly obovate, with the base attenuating to a narrowly auriculate or truncate base (Figure 5A). Leaf size is 34–120 × 14–34 mm, with a width-to-length ratio of 1:(2.2–)2.8–4.0(–4.5). In *C. macrophylla*, the leaves measure 80–280

× 30–120 mm, with a width-to-length ratio of 1:1.9–2.5. The leaf base is always variously cuneate (Figure 5C).

In addition, the lateral venation of *Carvalhoa campanulata* is rather obscure, whereas those of *C. macrophylla* are always distinct, both in fresh and dried material. The leaves of *C. macrophylla* are almost always glabrous, although a single specimen from Namuli Mountain in Mozambique displayed a few sparse hairs. In contrast, the leaves of *C. campanulata* are always set on both surfaces with a very sparse indumentum of minute pale hairs, slightly more densely so along the margins, the midrib and the lateral veins (Figure 5B).

The author has been unable to detect any significant floral or fruit characters on which to differentiate the species, although it would appear that the paired carpels of *Carvalhoa campanulata* are smaller than those of *C. macrophylla* and are held at 180° to one another when ripe, whereas those of *C. macrophylla* are seldom spread as wide apart as 180°.

Ecology: the author has visited the type locality of *Carvalhoa campanulata* on two occasions: once in

October 2005 and once in December 2006. The area around Mossuril comprises a mosaic of open to closed woodland on coastal sands, interspersed with dense patches of coastal thicket, that are sometimes extensive and are dominated by emergent specimens of *Terminalia zambesiaca* (Combretaceae). In October, the area was extremely dry and the vegetation, with the exception of only a handful of species (notably *Ludia mauritiana*, Flacourtiaceae), was totally leafless and grey. Although not detected then, the *Carvalhoa* were almost certainly leafless at that time of year. In contrast, in mid-December the vegetation in the same area was fully in leaf, despite having had little, and late, rain. At this time *C. campanulata* was collected in flower and with immature fruit. This collection therefore represents topotypic material, close to where Carvalho originally collected the type specimen. Data from other collections of the same taxon indicate that the species occurs in coastal *Brachystegia/Julbernardia* ('miombo') woodland as well as on granite inselbergs where the plants are exposed to extreme heat and aridity during the dry season. Typical *C. campanulata* is therefore a species of seasonally arid deciduous woodland and deciduous thicket on coastal sands, or on rocky outcrops. Altitude ranges from sea level to 550 m.

In direct contrast, White *et al.* (2001) state that in Malawi, *Carvalhoa campanulata sensu lato* occurs 'in understorey of mid-altitude and montane rain forest', between altitudes of 750–2 000 m. Leeuwenberg (1985b) records that in the *Flora zambesiaca* region, *C. campanulata s.l.* occurs in 'montane rain forest and secondary forest; (300)800–1 900 m', whereas Omino (2002) states that in East Africa it grows in 'moist forest, riverine forest; 300–2 300 m.' The author has seen this taxon growing in moist undergrowth of evergreen lowland forest in the Great Ruo Gorge of Mt Mulanje, Malawi. While the altitudinal range of the montane taxon is commonly between 750 and 2 000 m, it does sometimes extend to altitudes of as low as 288 m in the moist lowland forests of coastal Kenya and Tanzania.

In his original description of the genus, Schumann (1897) mentions that *Carvalhoa campanulata* stretches from the inland highlands to the Mozambique coast, a view he was to change a few years later when he raised two predominantly montane species, *C. macrophylla* in 1902 and *C. petiolata* in 1904. However, it is puzzling that, although Leeuwenberg lists in his *Flora zambesiaca* treatment, numerous collections from coastal Mozambique, including the specimen *Gomes e Sousa 4559* which was collected near the sea at Pemba, and Carvalho's type collection gathered on an island, he does not recognize or indicate that it grows at or near sea level (Leeuwenberg 1985b). This gives the contemporary, but erroneous impression that *C. campanulata s.l.* is only a montane species.

Because of the foregoing, I propose the reinstatement of Schumann's *Carvalhoa macrophylla* which is a montane evergreen species with leaves cuneate at the base and almost entirely glabrous. In contrast, *C. campanulata* is a deciduous coastal species with smaller, sparsely pubescent leaves with a narrowly auriculate base. *C. petiolata*, while differing in some minor aspects (e.g. number of lateral veins), is regarded as synonymous with *C. macrophylla*.

Key to species of *Carvalhoa*

- 1a Plants deciduous; leaves narrowly elliptic to oblanceolate or narrowly obovate, attenuated into a very narrowly auriculate or truncate base; in deciduous coastal woodland and thicket; 0–550 m 1. *C. campanulata*
 1b Plants evergreen; leaves elliptic, subsessile or petiolate up to 7 mm long, base cuneate; in evergreen lowland or montane forests; (290–)750–2 000(–2 300) m 2. *C. macrophylla*

1. ***Carvalhoa campanulata* K.Schum.** in Engler & Prantl, *Die Natürlichen Pflanzenfamilien*, edn 1, 4,2: 189 (1897); Leeuwenberg: 50 (1985a), pro parte excl. *C. macrophylla* K.Schum. (1902) and *C. petiolata* K.Schum. (1904). Type: Mozambique, Nampula Province, Mossuril, Cabaceira Pequena, 1884–1885, *M.R.P. de Carvalho s.n.* (B, holo.†; COI, lecto.; K!, P, Z, isolecto.).

Ecology: occurring in seasonally arid deciduous or semi-deciduous coastal forest, thicket or coastal miombo woodland, on sands and 'basaltic sands'. On the *Gomes e Sousa 4559* voucher, he states 'very common in Querimba Islands, where it forms dense communities'. It also grows on rocky granite outcrops with species of *Xerophyta*, *Myrothamnus*, *Aloe* and *Asparagus* on Monte Ancuabe. Altitude range from 0–550 m.

Distribution: endemic to the provinces of Cabo Delgado and Nampula in northern Mozambique; possibly yet to be discovered in the extreme southeast of Tanzania. Its entire distribution falls within White's (1983) Zanzibar-Inhambane undifferentiated forest of his Zanzibar-Inhambane regional mosaic (mapping unit 16a).

Conservation status: a status of Not Threatened, Least Concern is recommended. The species appears to be widespread within its area of occurrence and is, in places, still frequent.

Specimens examined

MOZAMBIQUE.—1139: Cabo Delgado Province, Mueda to Negamano road, Nambiti village, fl. & fr. 2 April 1960, *Gomes e Sousa 4561* (COI, K!, PRE!, SRGH). 1239: Ancuabe District, Monte Ancuabe, 550 m, *de Koning & Groenendijk 9525* (K!, LMU). 1240: S of Porto Amelia (Pemba), road to Maringanha lighthouse, 2 April 1960, *Gomes e Sousa 4559* (COI, K!, PRE!). 1440: Nampula Province, Memba District, Memba, fl. & fr. 18 March 1961, *M.F. de Carvalho 468* (K!, LMU); Monapo District, Monapo, Monte Ndjidji, 250 m, 12 February 1984, *Groenendijk, de Koning & Dungo 9598* (K!, LMU); Monapo District, Monapo, forest reserve of Sr Wolf, fr. 10 February 1984, *Groenendijk, de Koning & Dungo 976* (K!, LMU); *ibid.*, *Groenendijk, de Koning & Dungo 994* (K!, LMU); *ibid.*, 11 February 1984, *de Koning, Groenendijk & Dungo 9344* (K!, LMU); Mossuril District, on road from Mossuril to Matibane, 60 m, fr. & fl. 22 December 2006, *J.E. & S.M. Burrows 9735* (BNRH).

2. ***Carvalhoa macrophylla* K.Schum.** in Engler, *Botanische Jahrbücher* 30: 381 (1902); Beentje: 479 (1994); White *et al.*: 138 (2001), both as *C. campanulata*. Type: Tanzania, Rungwe District, Poroto Mts, Gurumbi (Ngurumbi) Mtn, 1 700 m, October 1899, *Goetze 1343* (B, holo.†; BR, lecto.; E, K!, Z, isolecto.).

C. petiolata K.Schum.: 317, 318 (1904). Type: Tanzania, Usambara Mtns, Derema, 800 m, 14 February 1900, *Scheffler 219* (B, holo.†; PRE, lecto.!).

Note: Leeuwenberg (1985a: 50) states that Schumann erroneously cites Goetze's collecting number as 1143. This is confirmed here; Goetze's correct number is 1343.

Ecology: an evergreen shrub in the understory of moist evergreen montane or lowland forest, sometimes locally frequent, mostly at altitudes of 750–2 000 m but extending to much lower altitudes along the East African coast: 390 m (Shimba Hills, Kenya); 350 m (Lushoto, Tanzania); 400 m (Udzungwa Mountains, Tanzania); 288 m (Namatimbili Forest, Lindi District, Tanzania); 500 m (Mueda Plateau, Mozambique). At the upper limit of its range, *Carvalhoa macrophylla* is recorded growing at 2 300 m in 'bush often under *Hagenia*' (specimen data).

Distribution: coastal Kenya, Tanzania, Malawi, north-western Mozambique (as in Leeuwenberg 1985a, excluding specimens from coastal Mozambique).

Conservation status: a status of Not Threatened, Least Concern is recommended. This taxon is widespread in the moist evergreen forests of southeastern Africa and much of this habitat is legally protected.

Selected specimens examined

KENYA.—0439: Kwale District, Shimba Hills, Longomagandi, 390 m, 17 March 1991, *Luke & Robertson 2727* (EA, K!); *ibid.*, Mwele Mdogo Forest, 400 m, 28 May 1987, *Roberston 4673* (EA, K!, MO).

TANZANIA.—0637: Morogoro District, Uluguru Mts, 1 250 m, 16 January 1933, *Schlieben 3253* (B, BM!, G, K!, LISC, M, MO, Z). 0933: Mbeya District, Rungwe, 'Station Kyimbila', 1 450 m, 29 November 1910, *Stoltz 375* (BM!, BR, G, GH, HBG, K!, L, MO, S, US, W, WAG, Z).

MALAWI.—1133: Vipya Plateau, in Pamphala rainforest, 11 February 1956, *J.D. Chapman 285* (BM!, FHO, K!). 1334: Nchisi Mtn, 1 450 m, 19 February 1959, *Robson 1657* (BM!, K!, LISC, PRE!, SRGH).

MOZAMBIQUE.—1237: Niassa Province, Niassa Game Reserve, Simba Camp to Serra Mecula Peak, 1 000 m, 11 June 2003, *Golding, Timberlake & Clarke 41* (BNRH!, K!, PRE!). 1636: Zambezia Province, Lugela District, Tacuane, *Faulkner 124* (K!, S).

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