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A revision of *Ventilago* (*Rhamnaceae*) in New Caledonia and Vanuatu with notes on dyeing properties

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Abstract: The climbing genus *Ventilago* Gaertn. (*Rhamnaceae*) is revised in New Caledonia and Vanuatu. The description of *V. pseudocalyculata* Guillaumin was based on four gatherings (syntypes). The name is lectotypified with a specimen from Lifou, and the species is now considered to be restricted to the Loyalty Islands, while the specimens from Grande Terre (the main island of New Caledonia) are treated as a new species, *V. tinctoria* Cahen, Toussiroit & Pillon. A total of four endemic species are therefore recognized in New Caledonia: *V. buxoides* Baill., *V. neocaledonica* Schltr. and *V. tinctoria* from Grande Terre and *V. pseudocalyculata* from the Loyalty Islands. The plants from Vanuatu, often identified as *V. neocaledonica*, are treated here as a new species, *V. vanuatuana* Cahen, Toussiroit & Pillon, endemic to that archipelago.

Key words: dye, island, lectotype, Melanesia, New Caledonia, new species, *Rhamnaceae*, taxonomy, tinctorial plants, tropical climbers, ultramafic, Vanuatu, *Ventilagineae*, *Ventilago*

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Introduction

Rhamnaceae are represented by about ten species in seven genera in New Caledonia (Morat & al. 2012; Munzinger & al. 2012+). The most complete overview for New Caledonia is a short summary of the family with identification keys and description of new species by Guillaumin (1926). A short description of the family and a key to species was also included in *Flore analytique et synoptique de la Nouvelle-Calédonie* (Guillaumin 1948a). Recent work has included the lectotypification

of *Emmenosperma pantherianum* Baill., a species once thought to be endemic to New Caledonia and discovered in 2005 in Queensland (Bean 2013). A molecular phylogenetic study (Hopkins & al. 2015) has indicated that *Alphitonia erubescens* Baill. and *A. xerocarpa* Baill. were misplaced in the genus *Alphitonia* Reissek ex Engl. and were accommodated in a newly described genus *Jaffrea* H. C. Hopkins & Pillon, endemic to New Caledonia. This study also included the lectotypification of these two species names, along with *A. neocaledonica* Schltr. A phylogenetic and biogeographic

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analysis of *Alphitonia* and of related *Emmenosperma* F. Muell., *Granitites* Rye and *Jaffrea* supports the currently applied taxonomy in these genera (Hauenschild & al. 2018). The genera *Colubrina* Rich. ex Brongn. (Johnston 1971) and *Rhamnella* Miq. (= *Dallachya* F. Muell.; Smith 1943) are each represented by a single non-endemic species: *Colubrina asiatica* (L.) Brongn. and *Rhamnella vitiensis* (Benth.) A. C. Sm.

No taxonomic treatment of *Ventilago* Gaertn. or *Gouania* Jacq. in New Caledonia has been published since Guillaumin (1926, 1948a). However, recent work on *Ventilago* in neighbouring regions was published (Cahen & Utteridge 2017), and the closely related genus *Smythea* Seem., which occurs in Vanuatu, was revised (Cahen & Utteridge 2018). *Ventilago* and *Smythea* are the only members of tribe *Ventilagineae* Hook. f., unique in *Rhamnaceae* in its members' fruits having a pronounced apical appendage. Generic delimitation between *Ventilago* and *Smythea* is based on the shape of the seed chamber of the fruit: conspicuously globose and clearly differentiated from the wing in *Ventilago*, compressed and gradually flattened into the wing (when present) in *Smythea* (Cahen & Utteridge 2018). *Ventilago* is a genus of about 30 species of tropical climbing shrubs, lianas and, rarely, small trees, absent from the Neotropics, easily recognized by their fruits having the combination of an oblong wing-like apical appendage and a conspicuously globose seed chamber (Suessenguth 1953; Medan & Schirarend 2004; Cahen & Utteridge 2018). The traditional use of *Ventilago* plants as a source of dyes in New Caledonia and Vanuatu and potential further uses were documented in Blanc (2008), Cardon (2007) and Cardon & al. (2010). Three species of *Ventilago* were considered to be native to New Caledonia (Morat & al. 2012; Munzinger & al. 2012+): *V. buxoides* Baill., *V. neocaledonica* Schltr. and *V. pseudocalyculata* Guillaumin. An additional species, *V. tinctoria* Cahen, Toussiot & Pillon is recognized here. The abundance of ultramafic soils in New Caledonia, which cover one-third of the surface of Grande Terre (the main island) acts as an ecological filter affecting species composition, with plants having to face high Mg:Ca ratios, high metal concentrations, poor fertility and often limited water availability (Pillon & al 2010). Despite this, species of *Ventilago* appear to grow indiscriminately on both ultramafic and non-ultramafic substrates in New Caledonia.

The genus is also present in Vanuatu, where the material has often been determined as *Ventilago neocaledonica* (e.g. Guillaumin 1948b), but is identified here as belonging to a distinct endemic species: *V. vanuatuana* Cahen, Toussiot & Pillon (see Remarks for *V. vanuatuana* and Notes on dyeing properties). Other *Rhamnaceae* genera reported to occur in Vanuatu are *Colubrina*, *Gouania*, *Rhamnella* and *Smythea* (Wheatley 1992). While some species in these genera were enumerated or described by Guillaumin (1931), Wheatley (1992) and Ramon & Sam (2015), no comprehensive taxonomic treatment of *Rhamnaceae* has been published for Vanuatu. The archipelago is located very near New Caledonia, with Aneityum just

over 200 km northeast of the Loyalty Islands and 350 km from Grande Terre, and in some cases phytogeographic relationships between the two archipelagos are strong (Lowry 1989), despite most plants possibly coming to Vanuatu from the northwest from Malesia via New Guinea and the Solomons, and from Fiji (Ramon & Sam 2015). Given their geographic proximity and because of previous misidentifications of Vanuatu material as *V. neocaledonica*, the genus is advantageously studied for both areas together and its taxonomy is revised here for both New Caledonia and Vanuatu.

Material and methods

Herbarium specimens from CANB, K, L, MPU, NOU, P and Z were studied; an exclamation mark (!) is used to show that a specimen has been seen, whereas "image!" is used to show that an image of the specimen has been seen. Hair density terms are defined as follows: *sparse* when hairs are scattered enough not to touch when pressed toward each other, *abundant* when hairs are close enough to touch if pressed toward each other, *dense* when hairs are so close to each other that they hide the surface of the organ they grow on. Leaf anatomy terms used are from Hickey (1979) and other morphology terms follow Beentje (2010). GeoCat (Bachman & al. 2011) was used to calculate Extent of Occurrence (EOO). All examined specimens appear in the Appendix (see Supplemental content online), sorted alphabetically first by species and then by collector's name.

Results and Discussion

Notes on dyeing properties

Natural dyes are an integral component of cultural heritage worldwide, and the use of plant-derived dyes in the Pacific Ocean is the subject of ongoing research (e.g. Cardon 2007; Cardon & al. 2010; Toussiot & al. 2012, 2014). The phytochemical study of *Ventilago* species shows that the colours obtained from them are often due to a rich mixture of quinones (Cardon & al. 2010). Three anthraquinones in particular, emodin, physcion and chrysophanol, are found in the bark and roots (Blanc 2008; Toussiot 2014).

Studies conducted with the University of New Caledonia examined the dyeing and biological properties of the *Ventilago* species present in New Caledonia and Vanuatu (Blanc 2008; Cardon & al. 2010; Toussiot 2014). A climber from Vanuatu, named *laba* (Apma language, central Pentecost) is of great cultural significance in some islands of north-central Vanuatu, where the bark of its root is used to prepare the red dye of ceremonial mats. Bourdy & Walter (1986) described its use in Pentecost and had already noted the need for an in-depth taxonomic as well as ethnological study of this plant. The *laba* climber was at

the time identified as *V. neocaledonica*. However, significant colour differences were observed following dyeing tests carried out with different species (including among the species from New Caledonia, Fig. 8). The experimental protocols of these tests, including the mordanting methods and types of fibres used, as well as colorimetric and colour absorption measurements, are documented by Blanc (2008). Furthermore, subsequent analyses of the chemical profile of the specimens revealed qualitative and quantitative differences in their anthraquinone composition (Blanc 2008). The differences in colour and in quinone composition suggested that *laba* and *V. neocaledonica* could be different species of *Ventilago*, and at this stage it was hypothesized that *laba* was *V. vitiensis* A. Gray rather than *V. neocaledonica* (Blanc 2008; Cardon & al. 2010). The taxonomic work presented here shows that *laba* is actually morphologically different from both *V. neocaledonica* and *V. vitiensis* and represents a distinct, hitherto undescribed species: *V. vanuatuana*.

This shows the potential benefits of interdisciplinary scientific research allowing analyses to complement one another. In this case, the study of the traditional use of dyes eventually led to the hypothesis of an undescribed species, which was confirmed here by study of herbarium specimens. Alternatively, improved taxonomic knowledge could refine studies of the traditional uses of these plants, for example by determining whether separate species previously believed to be the same have slightly different properties and therefore uses.

Key morphological characters

All species of *Ventilago* in New Caledonia and Vanuatu are woody climbers, sometimes growing as scandent shrubs, and are easily recognized when in fruit, as the fruits have a distinct wing-like apical appendage and a conspicuous, globose basal portion enclosing the seed chamber (Fig. 4A, K; Fig. 6A, K). These characters help distinguish *Ventilago* species from all other *Rhamnaceae* genera occurring in the region: species of *Alphitonia* in New Caledonia and Vanuatu are all trees or shrubs with unwinged capsular fruits; *Emmenosperma pancherianum* is a shrub with capsular fruits and red seeds persisting on the pedicel after the pericarp has fallen; species of *Jaffrea* are trees and shrubs with conical flowers and late-dehiscent beaked fruits; *Rhamnella vitiensis* is a shrub with flowers in umbel-like cymes, and drupaceous fruits. Among the climbing genera, *Colubrina asiatica* (occasionally scandent) is distinct in the 3-seeded capsules with the outer pericarp irregularly breaking away and leaves with only 2 or 3 secondary veins (vs 4–8 in *Ventilago*); *Gouania* is distinct in the presence of tendrils and fruits that are 3-winged schizocarps; *Smythea lanceata* is distinct in the crustaceous inflated wingless fruits (see Remarks for *V. vanuatuana* for further distinguishing characters). Morphological differences between *Alphitonia*, *Emmenosperma* and *Jaffrea* are discussed

in Hopkins & al (2015) and genus-level morphological descriptions in *Rhamnaceae* are available in Medan & Schirarend (2004).

Leaves

In all *Ventilago* species of New Caledonia and Vanuatu, leaves are simple, alternate, \pm symmetric, usually subcoriaceous, glabrous to subglabrous, and have a single medial primary vein serving as the origin for 4–8 up-turned secondary veins gradually diminishing apically inside the margin (“camptodromous venation” sensu Hickey 1979) (Fig. 4A; Fig. 6A). *Ventilago buxoides* differs from all other species in the small ($0.5\text{--}3.5 \times 0.3\text{--}2$ cm vs $2.2\text{--}13 \times 1.2\text{--}8.5$ cm) often apically notched leaves (vs unnotched). Leaf margin and lamina shape characters are useful to distinguish the remaining species: margin crenate to serrate in *V. vanuatuana* (Fig. 6B, F); entire to weakly serrate in *V. neocaledonica*; entire, obscurely repand in both *V. pseudocalyculata* and *V. tinctoria*, but lamina broadly ovate to (broadly) elliptic in *V. pseudocalyculata* vs (narrowly) elliptic in *V. tinctoria* (Fig. 4A, E).

Inflorescences and flowers

In New Caledonia and Vanuatu, *Ventilago* flowers are arranged in cymes congested into fascicles (Fig. 4G; Fig. 6H). In *V. buxoides*, leaves subtending fascicles of open flowers are usually persistent. In all other species, subtending leaves are mostly fugaceous so that the fascicles of open flowers are arranged in racemiform thyrses (Fig. 4F; Fig. 6G), and often enough leaves are fugaceous for the thyrses to be arranged in a panicle. Flowers in *Ventilago* species of the area are remarkably homogenous: all are bisexual, c. 3 mm wide when open, with 5 triangular adaxially keeled sepals (Fig. 4J; Fig. 6J), 5 clawed apically notched petals each enclosing a stamen, a 2-locular ovary partially immersed in a smooth glabrous subpentagonal disk, and a bifid style (Fig. 4J; Fig. 6J). *Ventilago neocaledonica* can be distinguished from *V. pseudocalyculata*, *V. tinctoria* and *V. vanuatuana* in the inflorescence rachis, pedicels and abaxial surface of the calyx being glabrous to densely hairy (the hairs may be close enough to touch each other but are usually not so close as to hide the surface they grow on) vs almost always densely hairy (the hairs are so close to each other that they hide the surface they grow on). *Ventilago vanuatuana* differs from *V. pseudocalyculata* and *V. tinctoria* in the indumentum of mostly spreading hairs on most parts of the plant, including the inflorescence rachis, pedicels and abaxial surface of the calyx (Fig. 6H) vs indumentum mostly appressed antrorse (Fig. 4G, H).

Fruit

All *Ventilago* species of New Caledonia and Vanuatu have fruits with a distinct wing-like apical appendage

and a conspicuous globose basal portion enclosing the seed chamber (see Introduction) (Fig. 4A, K; Fig. 6A, K). The dimensions of the wing are quite homogenous among species of the area (from c. 3×0.7 cm in *V. buxoides* to c. 3.5×0.8 cm in *V. neocaledonica* and *V. pseudocalyculata*). The only species with glabrous fruits are *V. buxoides* and *V. neocaledonica*, which are distinguished from each other in leaf and inflorescence characters (see above). All other species have densely hairy fruits, and *V. vanuatuana* is recognized in the hairs being mostly spreading (vs mostly appressed antrorse in *V. pseudocalyculata* and *V. tinctoria*). The fruit wing of *V. pseudocalyculata* is usually slightly curved and often \pm trullate, distinctly narrower at the base, vs oblong in all other *Ventilago* species in the area. The species is further distinguished from *V. tinctoria* in the pedicel being usually swollen in fruit, gradually widening into the calyx, vs remaining slender in fruit, suddenly expanding into the calyx (Fig. 4K).

The species of *Ventilago* in New Caledonia and Vanuatu

1. Leaf lamina small, to c. 3.5 cm long, apex rounded, often notched; inflorescences with usually 1 flower left per fascicle at anthesis; leaves subtending fascicles of open flowers and fruits usually persistent **1. *V. buxoides***
- Leaf lamina longer, apex rounded to attenuate, not notched; inflorescences with usually several flowers left per fascicle at anthesis; leaves subtending fascicles of open flowers and fruits usually fugaceous so that fascicles are arranged in racemiform thyrses, thyrses often arranged in a panicle **2**
2. Fruit glabrous; inflorescence rachis, pedicels and abaxial surface of calyx glabrous to densely hairy, hairs may be close enough to touch each other but are usually not so close as to hide surface they grow on **2. *V. neocaledonica***
- Fruit hairy; inflorescence rachis, pedicels and abaxial surface of calyx usually densely hairy, hairs are so close to each other that they hide surface they grow on **3**
3. Leaf lamina margin crenate to serrate; hairs of branchlets, petioles, inflorescence and fruit mostly spreading **5. *V. vanuatuana***
- Leaf lamina margin (sub)entire; hairs of branchlets, petioles, inflorescence and fruit mostly appressed antrorse **4**
4. Leaf lamina broadly ovate, base symmetric, rounded; petiole 0.5–1 cm long; fruit wing usually slightly curved, often distinctly tapering at base; pedicel usually swollen in fruit, gradually widening into calyx **3. *V. pseudocalyculata***
- Leaf lamina elliptic, base slightly asymmetric, cuneate; petiole 0.3–1.5 cm long; fruit wing oblong; pedicel remaining slender in fruit, suddenly expanding into calyx **4. *V. tinctoria***

- 1. *Ventilago buxoides*** Baill. in Adansonia 11: 268. 1874.
– Type citation in protologue: “[...] in Austro-Caledonia, ubi cl. *Deplanche* (exs. n. 272) in insula *Taule* in ramis iisdem floriferam fructigeramque legit (Herb. Mus. par. et alior.)”. – **Lectotype (designated here)**: New Caledonia, North Province, Île Tanlé, 1861–1867, *Deplanche* 272 (P! [P06886610]; isolectotypes: K! [K001342513], P! [P06886607, P06886609]).
- *Ventilago* ‘*buxifolia*’, orthographical variant in Guillaumin (1926).

Description — Woody climber, to at least 4 m long. *Indumentum* sparse at base of branchlets, dense at distal end of branchlets and inflorescence rachis, hairs mostly whitish to sometimes fulvous, straight to slightly curved, mostly spreading. *Branches* slender, terete, smooth; branchlets often deeply ridged. *Stipules* fugaceous, though often persisting past flowering at distal end of branchlets, c. 1 mm long, narrowly deltoid to subulate. *Leaves*: petiole 1–2 mm long, densely hairy; lamina dark green, shiny adaxially, broadly to narrowly ovate, $0.5\text{--}3.5 \times 0.3\text{--}2$ cm, subcoriaceous, subglabrous, sparsely hairy abaxially along primary vein, base usually slightly asymmetric, rounded to cordate, margin entire or broadly crenate to serrate, obscurely near base, serrations topped by callosities, apex rounded, often notched; secondary veins 4–8, often not readily discernible from tertiary veins, remaining separate near margin or joining each other and forming loops near margin; tertiary venation not conspicuously scalariform. *Inflorescence* of cymes congested in fascicles in axils of leaves, fascicles sometimes arranged in racemiform thyrses when leaves subtending fascicles are fugaceous, flowers up to 6 per fascicle when in bud, usually only 1 left per fascicle by anthesis, racemiform thyrses usually less than 2 cm long. *Flowers* bisexual, c. 3 mm wide; pedicel c. 2 mm long when fully developed, pedicel and abaxial side of hypanthium sparsely hairy, with hairs spreading to appressed, white, straight to slightly curved, c. 0.1 mm long; sepal lobes 5, triangular, c. 1.2 mm long, adaxially keeled with an apical protuberance; petals 5, obcordate, c. 0.9 mm long, glabrous, base clawed, apex notched; stamens 5, each opposite and enclosed by a petal, filaments c. 0.7 mm long, anthers dorsifixed; disk subpentagonal, filling hypanthium, fleshy, smooth, glabrous; ovary immersed in to sometimes more than $\frac{1}{2}$ exerted from disk, slightly hairy at level of exertion from disk, glabrous distally, locules 2; style 2-fid. *Fruit* glabrous, with a conspicuous globose basal portion enclosing seed chamber and a distinct wing-like apical appendage, oblong, reaching c. 3×0.7 cm at maturity; apex rounded with style remains forming a distinct mucro; persistent calyx annular at base of fruit to slightly cupular and enclosing less than $\frac{1}{4}$ of globose part of fruit.

Distribution and ecology — This species is found in scrubland (maquis) and possibly forest at low elevation

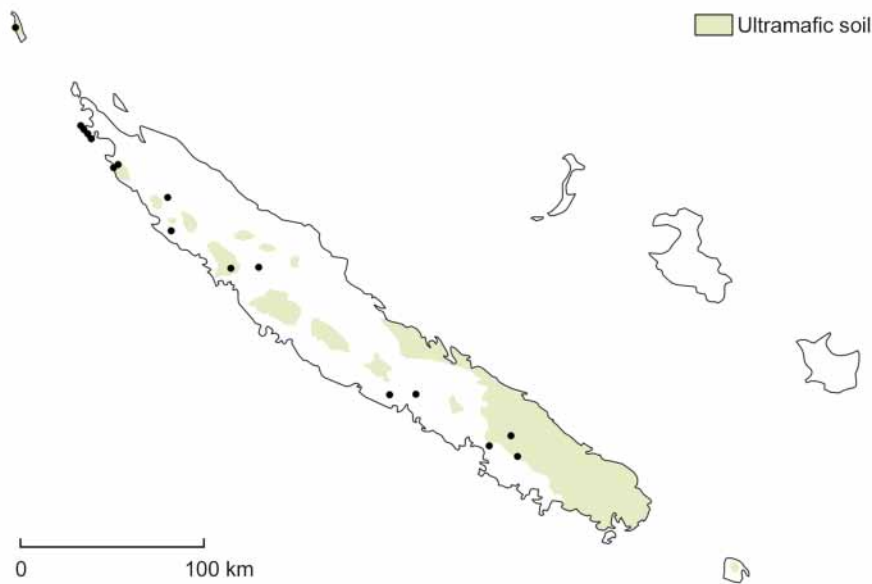


Fig. 1. Distribution of *Ventilago buxoides* (●) in New Caledonia.

on the western side of New Caledonia, from Mt Mou and the Tontouta valley to Île Art. It has been collected on ultramafic substrate, probably on serpentine in most cases. Fig. 1.

Conservation status — This relatively widespread species (Extent of Occurrence: 8350 km²) has been evaluated as Least Concern (LC) according to the IUCN criteria (2012, 2017) during the workshop of the New Caledonia Plant Red List Authority of 24 Oct 2019.

Remarks — *Ventilago buxoides* is recognized by its small and often apically notched leaves. It also dif-

fers from *V. neocaledonica* and *V. tinctoria* in the inflorescences with usually one flower left per fascicle at anthesis and leaves subtending fascicles of open flowers and fruits usually persistent; the flowers are more rarely in a racemiform thyrse when the distal leaves fall off. The venation pattern is distinctive, with the tertiary venation not conspicuously scalariform, and the secondary veins often not readily discernible from the tertiary veins and sometimes forming loops near the leaf margin.

In the protologue, Baillon (1874) cited a single gathering, *Deplanche 272*.

Baillon worked in Paris and there are three specimens of *Deplanche 272* in P, but only one of them bears the handwritten “*Ventilago buxoides* H. Bn.”, presumably in Baillon’s hand, and is therefore chosen as the lectotype.

Selected specimens — NEW CALEDONIA: Mt Koniambo, 21 Dec 1950, *Guillaumin & Baumann-Bodenheim 9541* (P! [P06888200], Z image! [Z-000058892]); Pente sud-ouest du dôme de Tiébaghi, 100 m, 9 May 1966, *MacKee 14906* (MPU image! [MPU312097], P! [P06900529]); Pouembout: base nord du plateau de Tia, 100 m, 16 Sep 1968, *MacKee 19530* (MPU image! [MPU312096], P! [P06888876]); Poya: Avangui, 200 m, 29 Oct 1973, *MacKee 27622* (P! [P06765294]); Île Art: plateau Nord, 200 m, 10 Dec 1975, *MacKee 30494* (P! [P06765312]); Poya: Ndokoa, 50 m, 14 Aug 1977, *MacKee 33621* (P! [P06765322]); Montagne de Poum, west of village, 29 Nov 1983, 60 m, *McPherson 6078* (P! [06765292]); Tontouta, 21 Nov 2004, *Munzinger & Labat 2606* (P! [P01068511, P06765326]); Col de Mo, 22 Aug 2004, *Munzinger & Letocart 2325* (P! [P06765167]); Basse vallée de la Tontouta, 22 Oct 1968, *Veillon 1852* (P! [P06765324]).

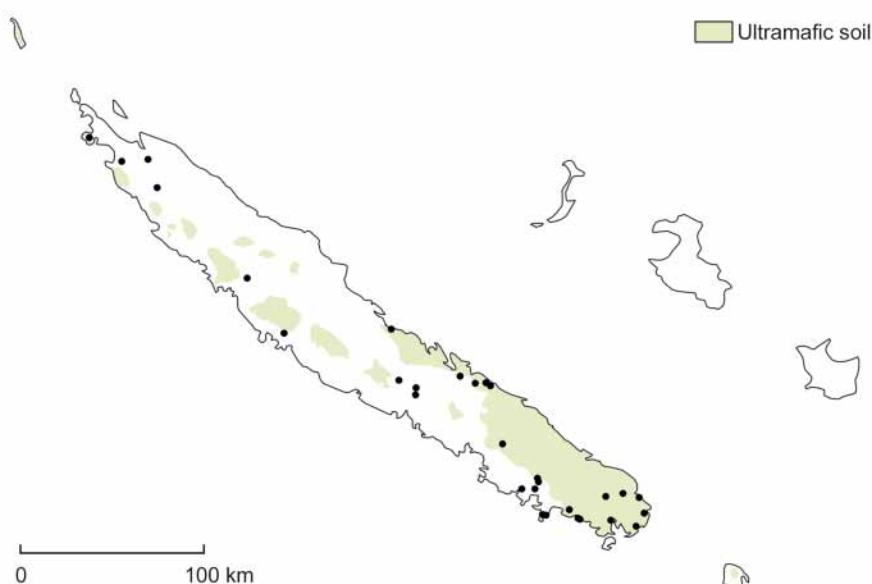


Fig. 2. Distribution of *Ventilago neocaledonica* (●) in New Caledonia.

2. *Ventilago neocaledonica* Schltr. in Bot. Jahrb. Syst. 39: 178. 1906 [*'neo-caledonica'*]. – Type citation in protologue: “Süd-Bezirk: längs der Bäche auf den Hügeln bei Paita, ca. 50 m ü. M. — n. 14905, blühend im Oktober 1902.” – **Lectotype (designated here)**: New Caledonia, South Province, auf den Hügeln bei Paita, 50 m, 4 Oct 1902, *Schlechter 14905* (K! [K000681978]; isolectotypes: BR image! [5238804], HBG image! [510061], M image! [0211801], P! [P06886583], S image! [S-G6301], Z image! [Z-000020556]).

– *Ventilago maderaspatana* sensu Guillaumin (1911), non Gaertn.

Description — Woody climber, to at least 3 m long. *Indumentum* very sparse to sometimes dense at distal end of branchlets, inflorescence rachis and calyx, hairs mostly whitish to sometimes fulvous, slightly curved, mostly appressed antrorse, hairs usually denser on calyx. *Branches* slender, terete, smooth; branchlets often deeply ridged. *Stipules* fugaceous, usually gone by anthesis, c. 1.2 mm long, subulate. *Leaves*: petiole 0.5–1.5 cm long, glabrous to sparsely hairy; lamina dark green and shiny adaxially, paler green and shiny abaxially, broadly to narrowly ovate-elliptic, 2.2–7.2 × 1.2–5 cm, chartaceous to subcoriaceous, glabrous, base often asymmetric, broadly cuneate, margin entire, obscurely repand to weakly serrate with sometimes a minute black callosity on undulation lobes or serrations, apex rounded to attenuate; secondary veins 5 or 6, clearly discernible, remaining separate, gradually curving upward and diminishing near margin; tertiary venation conspicuously scalariform. *Inflorescence* of cymes congested in fascicles with subtending leaves mostly fugaceous so that fascicles are arranged in racemiform thyrses, flowers up to 7 per fascicle at anthesis, racemiform thyrses to 3.5 cm long. *Flowers* scented, bisexual, c. 3.5 mm wide; pedicel c. 3 mm long when fully developed, pedicel and abaxial side of hypanthium glabrous; sepal lobes 5, triangular, c. 1.5 mm long, adaxially keeled with an apical protuberance; petals 5, obcordate, c. 1 mm long, glabrous, base clawed, apex notched; stamens 5, each opposite and enclosed by a petal, filaments c. 0.7 mm long, anthers dorsifixed; disk subpentagonal, filling hypanthium, fleshy, smooth, glabrous; ovary less than ½ exserted from disk, glabrous, locules 2; style 2-fid. *Fruit* glabrous, with a conspicuous globose basal portion enclosing seed chamber and a distinct wing-like apical appendage, oblong, c. 3.5 × 0.8 cm at maturity; apex rounded with style remains forming a distinct mucro; persistent calyx annular at base of fruit to cupular and enclosing basal c. ⅓ of globose part of fruit.

Distribution and ecology — This species is widespread across the main island of New Caledonia, collected on both ultramafic and non-ultramafic substrate, in maquis, dry forest and rainforest. Fig. 2.

Conservation status — This relatively widespread spe-

cies (Extent of Occurrence: 14950 km²) has been evaluated as Least Concern (LC) according to the IUCN criteria (2012, 2017) during the workshop of the New Caledonia Plant Red List Authority of 24 Oct 2019.

Remarks — *Ventilago neocaledonica* is recognized by its glabrous fruits. It most resembles *V. tinctoria* in the flower fascicles in racemiform thyrses, often arranged in panicles, and ovate leaf shape, but differs in the glabrous fruits, the sparser indumentum throughout, smaller leaves with a sometimes serrated margin and calyx usually enclosing more of the globose part of the fruit. *Ventilago buxoides* also has glabrous fruits, but has smaller leaves with a notched apex and open flowers and fruits most often inserted singly in the axils of persistent leaves.

In the protologue, Schlechter (1906) cited a single gathering, *Schlechter 14905*. The specimen in B was presumably destroyed in World War II (no specimen of *Schlechter 14905* is currently in B, Robert Vogt, pers. comm.), but several duplicates of this gathering have been found with the indication “*Ventilago neocaledonica* Schltr. n. sp.”, probably in Schlechter’s hand, and the better-preserved specimen in K is chosen as a lectotype.

Selected specimens — NEW CALEDONIA: Tina, 20 m, 20 Dec 2015, *Bruy 114* (P! [P00982902]); Houailou, 30 Oct 1965, *MacKee 13765* (P! [P06888191]); Col d’Amieu, 350 m, 22 Feb 1966, *MacKee 14437* (P! [P06888194]); Sarramea, 20 m, 20 Dec 1966, *MacKee 16089* (K!, P! [P06888205]); Noumea: Montravail, 50–100 m, 20 Mar 1969, *MacKee 20301* (P! [P06765164]); Koumac, 1 Dec 1972, *MacKee 25991* (P! [P06888193]); Vallée de la Koelagogaumba, 100 m, 9 Dec 1977, *MacKee 34045* (K!, P! [P06765310]); Ouegoa: Mérétrice, 10 m, 7 Jan 1983, *MacKee 41140* (P! [P06765297]); Dumbea, 50 m, 5 Jan 1984, *MacKee 41742* (P! [P06765305]); Valley of Riviere des Pirogues, 22°11'S, 166°45'E, 200 m, 12 Nov 1999, *McPherson & van der Werff 17885* (P! [P06888202]).

3. *Ventilago pseudocalyculata* Guillaumin in Bull. Soc. Bot. France 73: 105. 1926 [*'pseudo-calyculata'*]. – Type citation in protologue: “Nouvelle-Calédonie : Port Saint-Vincent (*Pancher*), bord de la Rivière des Français (*Balansa 528*), bords du Kouétou-Kouéta (*Balansa 1036*), Lifou (*Deplanche 62*).” – **Lectotype (designated here)**: New Caledonia, Lifou, s.d., *Deplanche 62* (P! [P06886566]; isolectotype: P! [P06886565]). – Excluded syntypes (all these are taxonomically *Ventilago tinctoria*): Baie du Port saint Vincent, s.d., *Pancher 5746* (P! [P06886569]); Bords de la rivière des Français, près de Nouméa, Oct 1868, *Balansa 528* (P! [P06886560, P06886561, P06886562]); Bords du ruisseau de Kouétou-Kouéta, 26 Dec 1868, *Balansa 1036* (P! [P06886559, P06886564]).

Description — Woody climber, to at least 3 m long. *Indumentum* dense, at least at distal end of branchlets and inflorescence rachis; hairs whitish to fulvous slightly

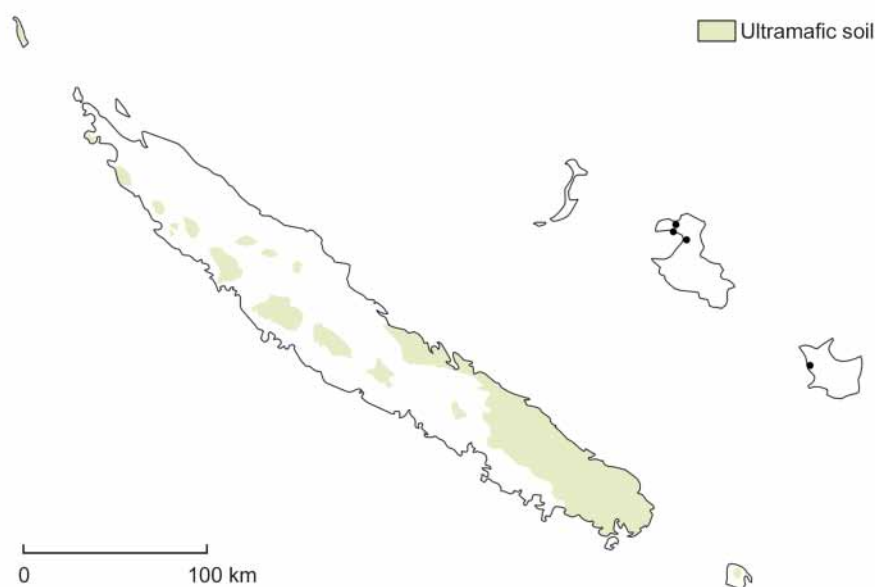


Fig. 3. Distribution of *Ventilago pseudocalyculata* (●) in the Loyalty Islands.

curved, mostly appressed antrorse. *Branches* slender, terete, smooth; branchlets often deeply ridged. *Stipules* fugaceous, often persisting by fruiting stage, c. 0.8 mm long, deltoid. *Leaves*: petiole 0.5–1 cm long, subglabrous; lamina green and shiny on both surfaces, broadly ovate to (broadly) elliptic, 5–13 × 2.5–8.5 cm, chartaceous to subcoriaceous, glabrous, base ± symmetric, rounded to broadly cuneate, ± perpendicular to petiole, margin entire, obscurely repand with sometimes a minute black callosity on undulation lobes, apex rounded to attenuate; secondary veins 5 or 6, clearly discernible, remaining separate, gradually curving upward and diminishing near margin; tertiary venation conspicuously scalariform. *Inflorescence* of cymes congested in fascicles with subtending leaves mostly fugaceous so that fascicles are arranged in racemiform thyrses, thyrses often arranged in a panicle, flowers up to 7 per fascicle at anthesis, racemiform thyrses to 8 cm long. *Flowers* bisexual, c. 2–2.5 mm wide; pedicel 2–3 mm long when fully developed, pedicel and abaxial side of hypanthium densely hairy with hairs subappressed, whitish to fulvous, slightly curved, c. 0.1 mm long; sepal lobes 5, triangular, c. 1 mm long, adaxially keeled with an apical protuberance; petals 5, obcordate, c. 0.6 mm long, glabrous, base clawed, apex notched; stamens 5, each opposite a petal, filaments c. 0.5 mm long, anthers dorsifixed, slightly exserted above enclosing petal apex; disk subpentagonal, filling hypanthium, fleshy, smooth, glabrous; ovary c. ½ immersed in disk, densely hairy, locules 2; style 2-fid. *Fruit* very densely appressed hairy, with a conspicuous globose basal portion enclosing seed chamber and a distinct wing-like apical appendage, usually slightly curved, often ± trullate, distinctly narrower at base, sometimes oblong with edges parallel, to at least 3.5 × 0.8 cm; apex rounded with style remains forming a distinct mucro; pedicel swollen in fruit, gradu-

ally widening into calyx; persistent calyx cupular, enclosing basal c. ⅓ of globose part of fruit.

Distribution and ecology — This species has been collected only in the Loyalty Islands, on Lifou and Maré, in forest or forest edge on limestone. It may be present on other Loyalty Islands (Ouvéa and Tiga). Fig. 3.

Conservation status — This species has been evaluated as Near Threatened (NT) according to the IUCN criteria (2012, 2017) during the workshop of the New Caledonia Plant Red List Authority of 24 Oct 2019.

Remarks — *Ventilago pseudocalyculata* resembles *V. tinctoria* from Grande Terre in the usually dense and mostly appressed antrorse hairs of branchlets, petioles, inflorescence and fruit and in the (sub-)entire leaf margin. It differs in the usually slightly curved fruit wing, often distinctly narrower at the base (vs oblong in *V. tinctoria*), the usually larger and more broadly ovate leaves, with a symmetric and rounded base (vs slightly asymmetric and cuneate base), and the pedicel usually swollen in fruit, gradually widening into the calyx (vs suddenly expanding into the calyx).

In the protologue, Guillaumin (1926) cited four gatherings but no herbarium locations: *Pancher s.n.* (Port Saint-Vincent), *Balansa 528* (bord de la Rivière des Français), *Balansa 1036* (bords du Kouétou-Kouéta) and *Deplanche 62* (Lifou). In P, where Guillaumin worked, one specimen of *Balansa 1036*, one of *Balansa 528*, two of *Deplanche 62* and one of *Pancher 5746* (Port Saint Vincent) bear the name “*Ventilago pseudocalyculata* Guillaum” and Guillaumin’s signature, one of *Deplanche 62* also bears the handwritten “type” in Guillaumin’s hand and is therefore chosen as the lectotype. *Deplanche 62* is the only one of Guillaumin’s syntypes that taxonomically belongs to *V. pseudocalyculata*. *Pancher s.n.*, *Balansa 528* and *Balansa 1036* are all specimens of *V. tinctoria*.

Selected specimens — NEW CALEDONIA: Lifou: Xépénéhé, 25 Oct 1925, *Däniker 2304* (P! [P06886563], Z image! [Z-000058887]); Lifou: Mutchaweng, 30 m, 18 Feb 1974, *MacKee 28189* (K!, P! [P04458673]); Lifou: secteur de Chépénéhé, 20 May 1966, *Schmid 1321* (P! [P06765329]); Lifou: au sud de Chila, 24 May 1966, *Schmid 1321* (P! [P06765330]); Lifou: plateau secteur de Xépénéhé, 15 Aug 1966, *Schmid 1321* (P! [P06888192]).

4. *Ventilago tinctoria* Cahen, Toussiroit & Pillon, **sp. nov.** – Fig. 4.

Holotype: New Caledonia, South Province, Upper reaches of valley Rivière des Pirogues, 200 m, 12 Dec 1981, *McPherson 4447* (P! [P06765327]; isotypes: K! [K001342514], L images! [L.2336455, L.2336456], MO, NOU! [017688], NSW [505283]).

– *Ventilago pseudocalyculata* sensu Guillaumin (1926, 1948a), Blanc (2008), Cardon & al (2010) et Munzinger & al. (2012+), omnia pro parte, excluso lectotypo.

Diagnosis — *Ventilago tinctoria* is most similar to *V. pseudocalyculata* in the hairy fruits, in the usually dense and mostly appressed antrorse hairs of the branchlets, petioles, inflorescence and fruit, and in the (sub)entire leaf margin, but it differs in the oblong fruit wing (vs usually slightly curved and tapering at base in *V. pseudocalyculata*), usually smaller and more narrowly elliptic leaves (3–11.5 × 1.5–5.5 cm in *V. tinctoria* vs 5–13 × 2.5–8.5 cm in *V. pseudocalyculata*), usually slightly asymmetric and cuneate at the base (vs symmetric and rounded in *V. pseudocalyculata*), and in the pedicels remaining slender in fruit and suddenly expanding into the calyx (vs gradually widening into the calyx in *V. pseudocalyculata*).

Description — Woody climber, to at least 10 m long. *Indumentum* dense, at least at distal end of branchlets and inflorescence rachis; hairs yellowish-white to fulvous, slightly curved, mostly appressed antrorse. *Branches* slender, terete, smooth; branchlets often deeply ridged. *Stipules* fugaceous, rarely persisting by fruiting stage, c. 1 mm long, subulate. *Leaves*: petiole 0.3–1.5 cm long, subglabrous; lamina green and shiny on both surfaces, (narrowly) elliptic, 3–11.5 × 1.5–5.5 cm, chartaceous to subcoriaceous, glabrous, base usually asymmetric, (narrowly) cuneate, margin entire, obscurely repand with sometimes a minute black callosity on undulation lobes, apex rounded to attenuate; secondary veins 4–6 (or 7), clearly discernible, remaining separate, gradually curving upward and diminishing near margin; tertiary venation conspicuously scalariform. *Inflorescence* of cymes congested in fascicles with subtending leaves mostly fugaceous so that fascicles are in racemiform thyrses, thyrses often arranged in a panicle, flowers up to 7 per fascicle at anthesis, racemiform thyrses to 6 cm long. *Flowers* fragrant, bisexual, c. 2.5 mm wide; pedicel c. 4 mm long when fully developed, pedicel and abaxial side of hypanthium densely hairy with hairs subappressed, whitish to fulvous, slightly curved, c. 0.1 mm long; sepal lobes 5, triangular, c. 1 mm long, adaxially keeled with an apical protuberance; petals 5, obcordate, c. 0.6 mm long, glabrous, base clawed, apex notched; stamens 5, each opposite a petal, filaments c. 0.7 mm long, anthers dorsifixed, slightly exerted above enclosing petal apex; disk subpentagonal, filling hypanthium, fleshy, smooth, glabrous; ovary c. ½ immersed in disk, densely hairy, locules 2; style 2-fid. *Fruit* very densely appressed hairy, with a

conspicuous globose basal portion enclosing seed chamber and a distinct wing-like apical appendage, straight, oblong with parallel edges, c. 3 × 0.8 cm at maturity; apex rounded with style remains forming a distinct mucro; pedicel remaining slender in fruit, suddenly widening into calyx; persistent calyx annular, enclosing at most basal ½ of globose part of fruit at maturity.

Distribution and ecology — This species has been collected in scrubland (maquis) and forest on ultramafic substrate in New Caledonia in the south and the eastern side of Grande Terre and on Île des Pins. Fig. 5.

Etymology — The specific epithet refers to the dyeing properties of this species (Blanc 2008; Cardon & al. 2010, cited as *Ventilago pseudocalyculata*).

Conservation status — Because its ecology and distribution are still imperfectly understood, this species has been evaluated as Data Deficient (DD) according to the IUCN criteria (2012, 2017) during the workshop of the New Caledonia Plant Red List Authority of 24 Oct 2019.

Remarks — *Ventilago tinctoria* differs from all other Grande Terre *Ventilago* species (*V. buxoides* and *V. neocaledonica*) in its hairy fruit. It resembles *V. pseudocalyculata* of the Loyalty Islands, but differs in having an oblong fruit wing (Fig. 4A, K), usually smaller and narrower leaves that are slightly asymmetric and cuneate at the base (Fig. 4A, B), and slender pedicels that suddenly expand into the calyx (Fig. 4K).

Three of the four gatherings that Guillaumin cited in the protologue of *Ventilago pseudocalyculata* were collected in Grande Terre and are now recognized as *V. tinctoria*. The fourth gathering, *Deplanche 62*, from Lifou, is designated here as the lectotype of *V. pseudocalyculata* (see *Remarks* for *V. pseudocalyculata*). Most herbarium material of *V. tinctoria* had previously been identified as *V. pseudocalyculata*, following Guillaumin (1926), but the Grande Terre specimens are morphologically distinct from those of Lifou, and *V. pseudocalyculata* as recognized here seems to be restricted to the Loyalty Islands.

Selected specimens — NEW CALEDONIA: Bords de la rivière des Français, près de Nouméa, Oct 1868, *Balansa 528* (P! [P06886560, P06886561, P06886562]); Bords du ruisseau de Kouétou-Kouéta, 26 Dec 1868, *Balansa 1036* (K!, P! [P06886559, P06886564]); Houailou-Ponerihouen, 21°10'S, 165°30'E, 150 m, 29 Nov 1977, *Bamps 5864* (NOU image! [17685], P! [P06751515]); Ouroué, 10–150 m, 20 Oct 1965, *MacKee 13645* (NOU image! [017684], P! [P06784016]); Col de Tonghoue, 100 m, 22 Oct 1970, *MacKee 22770* (P! [P06765318]); Île des Pins, plateau central, 100 m, 7 Sep 1977, *MacKee 33783* (NOU image! [017682], P! [P06765317]); Monéo, 10 m, 25 Nov 1977, *MacKee 34324* (P! [P06765320]); Road to Yaté from Nouméa, 30 Oct 1980, *McPherson 3293* (NOU! [017687],



Fig. 4. *Ventilago tinctoria* – A: habit; B: leaf node with base of inflorescence; C: stem indumentum; D: leaf venation, abaxial view; E: leaf margin, adaxial view; F: flower fascicles (hairs omitted); G: flower buds; H: flower, side view; J: flower, face view; K: fruit apex and base detail; L: fruit wing edge indumentum. – A, K, L from MacKee 34324 (P); B–E, G–J from McPherson 3293 (P); F from MacKee 13645 (P). – Drawn by Andrew Brown.

P! [P06765331]); Port Boisé, 10 m, 20 Nov 1981, *McPherson 4405* (NOU! [017692], P! [P06765328]); Baie du Port saint Vincent, s.d., *Pancher 5746* (P! [P06886569]); 2.1 km SE of col de Mouirange, 21 Aug 1978, *Phillips & Schmid 3317* (P! [P04458712]).

5. *Ventilago vanuatuana*
Cahen, Toussiroit & Pillon,
sp. nov. – Fig. 6.

Holotype: Vanuatu, Santo, Penaorou, parcelle 600-C, 14°58'0.22"S, 166°38'41.5"E, 600 m, 27 Oct 2006, *Munzinger 3609* (P! [P06765295]; isotypes: CANB image! [CANB 00726521]), K! [K001342515], MO, NOU, P! [P06765293], PVNH).

- *Ventilago neocaledonica* sensu Bourdy & Walter (1986), Cardon (2007) et Ramon & Sam (2015), non Schltr.
- *Ventilago vitiensis* sensu Cardon & al (2010), non A. Gray.

Diagnosis — *Ventilago vanuatuana* most closely resembles *V. tinctoria* in the hairy fruits with an oblong wing and in the flower fascicles being in racemiform thyrses, often arranged in panicles, but it differs in its narrower leaves with a crenate to serrate margin (vs margin entire, obscurely repand in *V. tinctoria*) and hairs of branchlets, petioles, inflorescence and fruit mostly spreading (vs hairs mostly appressed antrorse in *V. tinctoria*).

Description — *Woody climber. Indumentum* sparse to usually dense at distal end of branchlets and inflorescence rachis; hairs mostly yellowish-white to fulvous, slightly curved, mostly spreading. *Branches* slender, terete, smooth; branchlets often deeply ridged. *Stipules* fugaceous, rarely persisting by fruiting stage, c. 1 mm long, subulate. *Leaves*: petiole 3–6 mm long, with dense subappressed to mostly spreading hairs; lamina broadly to narrowly ovate, 3–10 × 1.5–4.7 cm, chartaceous to subcoriaceous, glabrous, sometimes hairy abaxially along primary and secondary veins, base ± symmetric, rounded to weakly cordate, margin crenate to serrate, serrations topped by callosities, apex rounded to attenuate; secondary veins 5 or 6, clearly discernible, remaining separate, gradually curving upward and diminishing near margin; tertiary venation conspicuously scalariform. *Inflorescence* of cymes congested in fascicles, with subtending leaves mostly fugaceous so that fascicles are arranged in racemiform thyrses, thyrses often arranged in a panicle, flowers up to at least 5

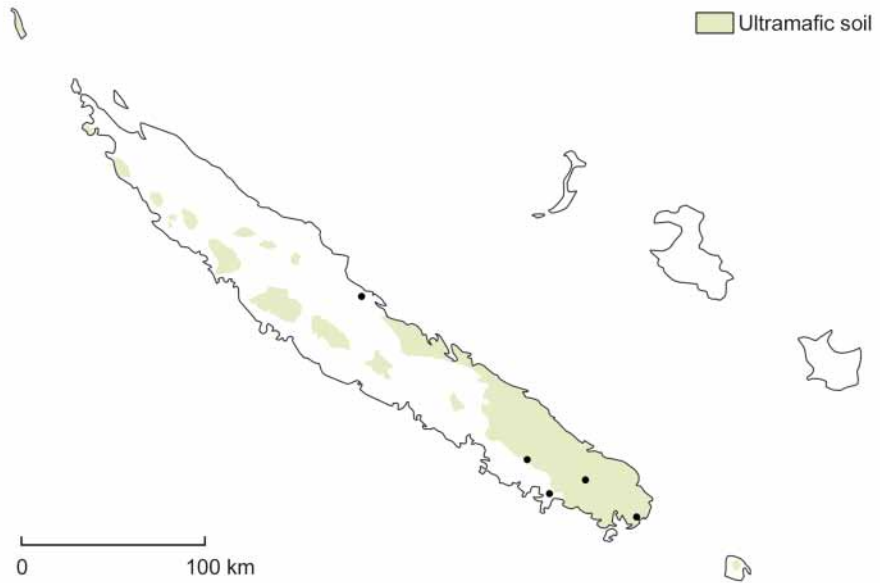


Fig. 5. Distribution of *Ventilago tinctoria* (●) in New Caledonia.

per fascicle at anthesis, racemiform thyrses to 9 cm long. *Flowers* bisexual, c. 3 mm wide; pedicel c. 2 mm long when fully developed, pedicel and abaxial side of hypanthium densely hairy with hairs subappressed to spreading, whitish to fulvous, slightly curved, c. 0.1 mm long; sepal lobes 5, triangular, c. 1 mm long, adaxially keeled with an apical protuberance; petals 5, obcordate, c. 0.9 mm long, sparsely hairy abaxially, base clawed, apex notched; stamens 5, each opposite and enclosed by a petal, filaments c. 0.8 mm long, anthers dorsifixed; disk subpentagonal, filling hypanthium, fleshy, smooth, glabrous; ovary c. ½ immersed in disk, densely hairy, locules 2; style 2-fid. *Fruit* very densely mostly spreading hairy, with a conspicuous globose basal portion enclosing seed chamber and a distinct wing-like apical appendage, oblong, to at least 3 × 0.8 cm at maturity, wing straight; apex rounded with style remains forming a distinct mucro; persistent calyx cupular, enclosing basal c. 1/5 of globose part of fruit.

Distribution and ecology — This plant has been collected in forests in Vanuatu, on the islands of Santo, Malekula, Pentecost, Éfaté and Anatom. It probably occurs on other islands of the archipelago. Fig. 7.

Etymology — The plant is named after the country in which it is endemic, Vanuatu.

Vernacular name — Called (*butsu laba*) in the Apma language (Pentecost), according to field notes on *Aubert de la Rue s.n.* and Bourdy & Walter (1986).

Conservation status — The distribution of this species is incompletely known because there are still few botanical collections from Vanuatu. The ecology is not well known, and it is not known if there are important threats. The spe-

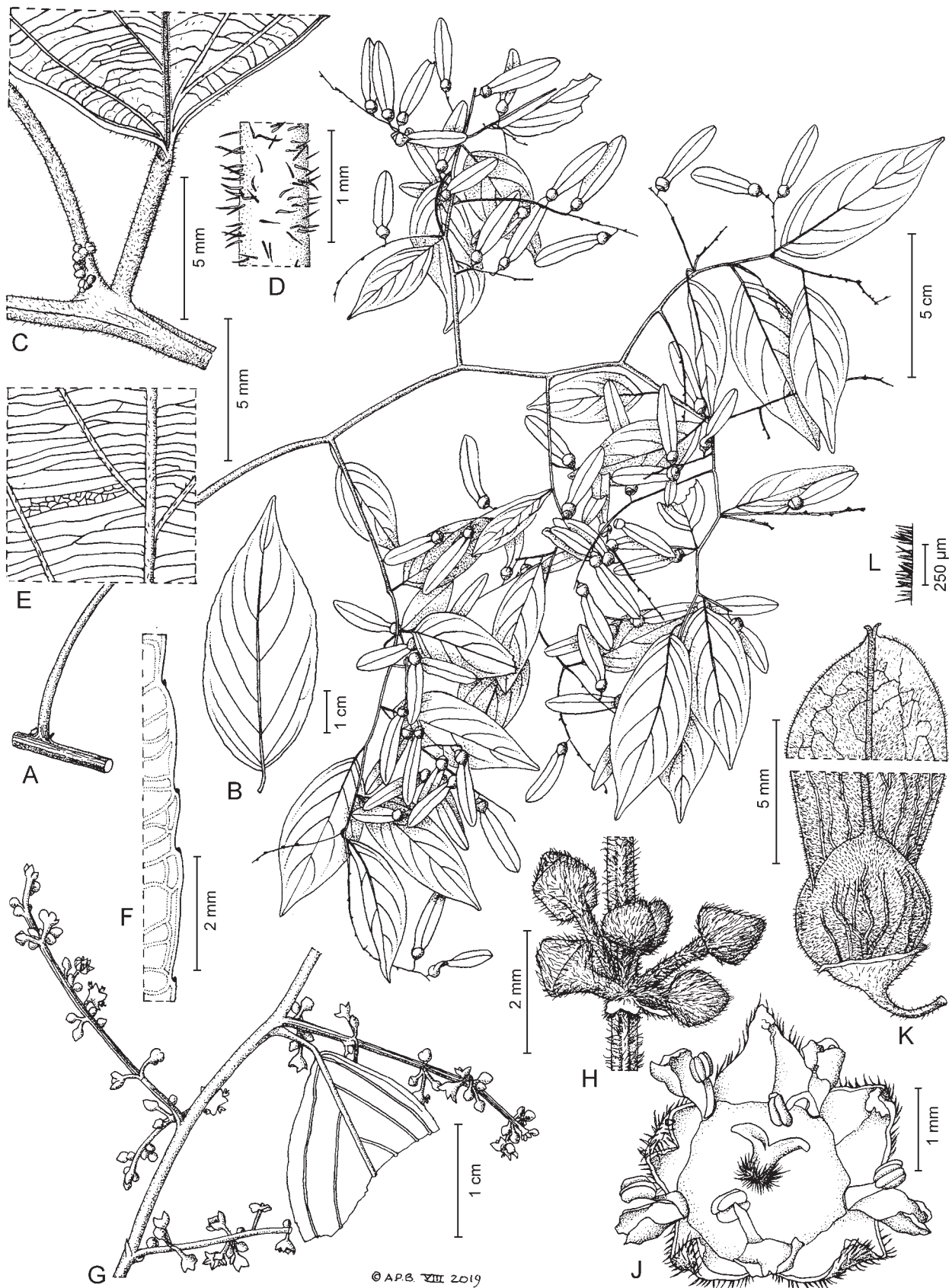


Fig. 6. *Ventilago vanuatuana* – A: habit; B: leaf, adaxial view; C: leaf node with base of inflorescence; D: petiole indumentum; E: leaf venation, abaxial view; F: leaf margin, adaxial view; G: flower fascicles; H: flower buds; J: flower, face view; K: fruit apex and base detail; L: fruit wing edge indumentum. – A–F from Munzinger 3609 (P); G–J from Ramon 237 (P); K, L from Munzinger 3609 (K). – Drawn by Andrew Brown.

cies is therefore assessed here as Data Deficient (DD). It is not clear if the use of the roots as a dye is sustainable or may represent a threat to the populations.

Remarks — *Ventilago vanuatuana* is the only known species of *Ventilago* to occur in Vanuatu. It was previously identified as *V. neocaledonica* on various herbarium sheets, but *V. neocaledonica* has glabrous fruits. It has also been suggested that material from this species could belong to *V. vitiensis* A. Gray, originally described from Fiji (Cardon & al. 2010), but *V. vanuatuana* has hairy fruits and a crenate to serrate leaf margin (vs glabrous fruits and an entire leaf margin in *V. vitiensis*). It differs from the other New Caledonian species *V. pseudocalyculata* and *V. tinctoria* in the narrower crenate to serrate leaves (Fig. 6A, B, F) and indumentum of mostly spreading hairs (Fig. 6C, D, H). It also differs from the Solomon Island *Ventilago* specimens, which seem to belong to *V. papuana* Merr. & L. M. Perry and which have wider leaves with an entire margin and flowers with densely hairy nectary disks.

Smythea lanceata (Tul.) Summerh., a mostly coastal species with a wide distribution, in a genus closely related to *Ventilago* (Cahen & Utteridge 2018), was recently observed and collected in Vanuatu (Éfaté-Mosso-Sounaï, 0 m, 28 Sep 2014, *Ramon 167* (P image! [P02434008])). When the crustaceous inflated wingless fruits are available it is easily distinguished from *V. vanuatuana*. The flowers are arranged in fascicles in the axils of persistent leaves (vs leaves fugaceous in *V. vanuatuana* so that the fascicles are in racemiform thyrses, the thyrses often arranged in a panicle). When sterile, it can be recognized by the leaves having 3–5 pairs of secondary veins (vs 5 or 6 in *V. vanuatuana*), well spaced along the primary vein, and in the conspicuous domatia, pockets often combined with tufts of hairs in the axils of the secondary veins (vs domatia absent in *V. vanuatuana*).

Selected specimens —

VANUATU: Pentecost, Vanmul, côte 50, 31 Dec 1935, *Aubert de la Rüe s.n.* (P! [P06886649] [sterile]); Pentecost, route Melsisi, Hou-bikou, 350–400 m, 4 Oct 1980, *Cabalion 1196* (NOU! [080584], P! [P06886651]); Santo, Penaorou, 14°58'00"S, 166°38'15"E, 300 m, 16 Nov 2006, *McPherson & al. 19426* (NOU! [062758]); Pentecost: Namaran, Dec 1976, *Morat 5248* (NOU! [080585] [sterile]); Éfaté, Mangaliliu, 50 m, 14 Aug 2015, *Ramon 237* (P!

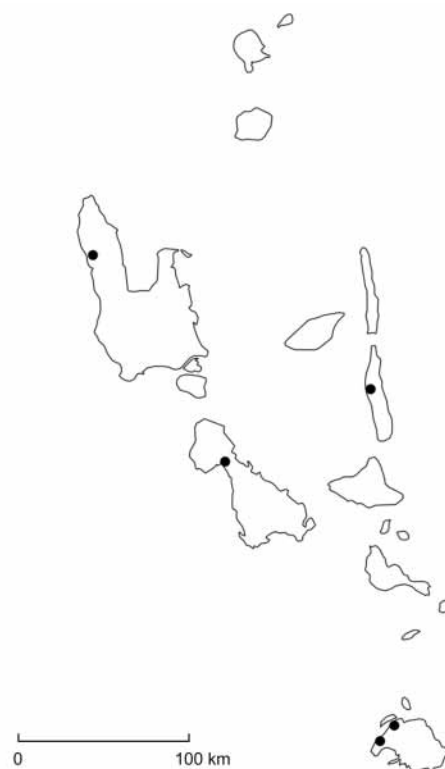


Fig. 7. Distribution of *Ventilago vanuatuana* (●) in Vanuatu.

[P02434415], NY, PVNH); Malekula: Walla: endroit appelé Nimev, 20 m, 9 Nov 1980, *Sam 35* (NOU! [080586] [sterile]); Vaté [Éfaté], Tututuk, 15 Nov 1974, *Sam 5124* (NOU! [080587]); Anatom, SE, 20 Jul 1971, *Schmid 3987* (NOU! [080588] [sterile]).



Fig. 8. Dyes on different fibres obtained with the three species of *Ventilago* from New Caledonia. Dyes from left to right: *V. buxoides*; *V. tinctoria*; *V. neocaledonica*. — Photo: M. Toussiroit. — Dyes: B. Blanc, D. Cardon and M. Boulanger-Penduff.

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