

Phylogeny, species delimitation and revision of *Pleioluma* (Sapotaceae) in New Caledonia, a frequently gynodioecious genus

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Abstract. *Pleioluma* (Baill.) Baehni (Sapotaceae) circumscribes some 40 medium-sized trees and shrubs, many gynodioecious, in Australia, Malesia and New Caledonia. Systematics of the group is unclear and delimitations of species are notoriously difficult. We explore species boundaries in New Caledonia by multiple accessions of ‘species’, molecules and morphology in a Bayesian framework. The molecular phylogenetic signal is weak, but morphology provides enough information to support groups, species and recognition of one cryptic species. *Pleioluma* is then revised for New Caledonia, a genus distinguished by areolate higher leaf venation, sepals being pubescent on both surfaces, stamens inserted in or below the middle of the corolla tube, presence of staminodes, foliaceous cotyledons and endosperm. Seventeen endemic species are recognised with descriptions, recognition notes, distributions, etymologies and conservation assessments. Six species are described as new, of which four are assigned IUCN preliminary status as *Critically Endangered* and in urgent need of protection (*Pleioluma acutifolia* Swenson & Munzinger, *P. belepensis* Swenson & Munzinger, *P. butinii* Swenson & Munzinger and *P. tchingouensis* Swenson & Munzinger). The new species, *P. dioica* Swenson & Munzinger and *P. tenuipedicellata* Swenson & Munzinger are respectively assessed as *Data Deficient* and *Vulnerable*. The micro-endemic species *P. vieillardii* (Baill.) Swenson & Munzinger, confined to the Koniambo massif, is also critically endangered and needs urgent conservation management.

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Introduction

Pleioluma (Baill.) Baehni is a genus of Sapotaceae subfamily Chrysophylloideae Luerss. (Swenson and Anderberg 2005) and it circumscribes ~40 species of medium-sized trees and shrubs. The centre of diversity is in Australia, New Caledonia and New Guinea, but the genus extends through Malesia to South-east Asia. Historically, a limited number of highly variable floral features and the inability to identify consistent morphological characters have caused taxonomists to propose various classification systems of Sapotaceae during the past 50 years (Aubréville 1964a; Baehni 1965; Pennington 1991; Swenson and Anderberg 2005). Therefore, members of *Pleioluma* have been misplaced in several genera, especially *Pouteria* Aubl. (Baehni 1942; Pennington 1991; Govaerts *et al.* 2001; Vink 2002); however, phylogenetic analyses have demonstrated that *Pleioluma* forms a strongly supported group, sister to all other genera of the subfamily in Australasia (Bartish *et al.* 2005, 2011; Swenson *et al.* 2007a, 2008, 2013).

All members of the genus are easily distinguished by a character combination, including areolate higher leaf venation,

sepals having indument on the outer and inner surface, stamens inserted in the middle or near the base of the corolla tube, and presence of staminodes, which often are reduced in female flowers. Seeds have foliaceous cotyledons, an exerted radicle below the commissure and an endosperm. *Pleioluma* may be confused with the related genus *Pichonia* Pierre, with which it shares a similar areolate leaf venation and indument on both surfaces of the sepals (Swenson and Munzinger 2012).

Despite the fact that specimens can be readily placed in *Pleioluma*, species are frequently difficult to circumscribe. Wim Vink at the Leiden herbarium (L) has worked for decades to sort out problems in what he believed was *Pouteria sensu* Pennington (1991) in New Guinea (Vink 2002). In 2012, Vink showed me (US) several boxes of specimens he had set aside as especially problematic and tentatively calling it ‘the firma-group’ after *Pouteria firma* (Miq.) Baehni. He had unfortunately given up revising the group because he was unable to circumscribe the species. However, most, if not all, were easily identified as members of *Pleioluma*, a genus that was resurrected 1 year later (Swenson *et al.* 2013). Material from

New Guinea and elsewhere in Malesia is very different from species in New Caledonia, but their species boundaries may never be solved because many forests throughout this area have been logged and are now gone forever. Furthermore, much existing herbarium material has been treated with mercury and is not useful for molecular studies.

Aubréville (1967) recognised 11 *Pleioluma* species (placed in *Beccariella* Pierre at the time) in his flora of New Caledonia. Some of those were poorly known or believed to be merely ecological forms restricted to particular soil types. Through our own fieldwork in New Caledonia and herbarium studies in Paris, new entities have been recognised; however, taxon boundaries, just like in New Guinea, are frequently difficult. Possible reasons for poorly resolved phylogenies and unclear species limits are the low molecular variation in the group and rather recent, Upper Miocene and Pliocene, divergence dates (Swenson *et al.* 2013, 2014).

New Caledonia is an archipelago ~1500 km east of Queensland (Australia) in the south-western Pacific Ocean. The land area occupies some 19 060 km², with Grande Terre being the largest island covering some 16 595 km² (Neill and Trewick 2008). Grande Terre is a fragment of continental crust that was overlain by an ophiolite nappe of ultramafic substrates in the Eocene (Aitchison *et al.* 1995; Pelletier 2007; Maurizot and Vendé-Leclerc 2012). Today, a third of Grande Terre is covered by this nappe and the remainder consists of schist and other metamorphic rocks, with only smaller outcrops or islands of calcareous rocks. All this has formed a mosaic of soil types to which many species are restricted, usually to non-ultramafic or ultramafic substrates (Ibanez *et al.* 2014; Isnard *et al.* 2016). This is certainly true for Sapotaceae in this territory (Swenson and Munzinger 2016).

The main purpose of the present paper is to present a revision of New Caledonian *Pleioluma*. We begin with a historic review, followed by assessing phylogenetic relationships of the entire genus. Multiple accessions of some taxa are included if we consider them as problematic. Our primary goal is to circumscribe recognisable species, which has been proven difficult in this genus (Swenson *et al.* 2013, 2014). The phylogenetic results were useful for circumscribing the species. Seventeen species are accepted for New Caledonia, of which six are new to science. We include a diagnostic key, descriptions, distribution maps, and IUCN Red List assessments for each taxon.

Historic review

Pierre (1890) described the genus *Beccariella* Pierre in honour of Odoardo Beccari (1843–1920), an Italian biologist who devoted much of his life to studying plants in Malesia. One of the diagnostic characters Pierre used to distinguish his new genus was the fine higher-leaf venation, here called areolate, and he transferred 12 species of *Chrysophyllum* L. and *Sideroxylon* L. from New Caledonia and Malesia to *Beccariella*. Pierre was probably unaware that the name *Beccariella* Ces. had already been assigned to a fungal genus from Borneo, and, therefore, *Beccariella* Pierre must be considered an illegitimate later homonym (Swenson and Tehler 2009). Dubard (1912) transferred three of these species, together with another five of

Sideroxylon and one from *Sapota* Mill., to *Planchonella* Pierre, whereas the other remained in *Beccariella*. Baehni (1942) took a more simplistic approach and placed them all in *Pouteria*, a genus that at the time became very heterogenous and pantropical with 318 species. Van Royen (1957), opposed to Baehni's treatment, removed all of the present *Pleioluma* species and again placed them in *Planchonella*, which after that comprised a total of 99 species. Without justification, Herrmann-Erlee and van Royen (1957) retained several Australasian species in *Pouteria*, which at the time represented a highly heterogeneous group, the species of which are, today, distributed in *Pichonia*, *Planchonella*, *Pycnandra* Benth., *Sersalisia* R.Br. and *Van-royena* Aubrév. (Swenson *et al.* 2013).

In 1964, Aubréville proposed his classification of Sapotaceae and recognised the tribe Planchonelleae in which he distinguished *Planchonella* and *Beccariella*, the former with ~80 species and the latter with 14 species in Australasia (Aubréville 1964a, 1964b). He used the number of seeds in each fruit to distinguish between the two, one seed in *Beccariella* and usually two or more seeds in *Planchonella*, a character that is still rather useful for identification purposes in New Caledonia (but it is wise to open several fruit because of variability). Aubréville (1967) accepted 11 species in New Caledonia, of which *B. crebrifolia* (Baill.) Aubrév. was suspected to be an ecological form of *B. balansana* (Pierre ex Baill.) Aubrév.

In 1991, Pennington proposed a classification of Sapotaceae solely on the basis of morphology, and he reduced Aubréville's 122 genera to 53. Both *Planchonella* and *Beccariella* were united in *Pouteria* section *Oligothea* (A.DC.) Baehni, a section recognised by foliaceous cotyledons, a radicle extending below the cotyledon commissure, and endosperm (Seed type 1, *sensu* Faria *et al.* 2017). The seed characters that readily distinguish section *Oligothea* from the core members of *Pouteria*, viz. plano-convex cotyledons, an included radicle, and absence of endosperm (Seed type 2), were believed to be of little importance. In retrospect, section *Oligothea* became a blend of several evolutionary lineages including *Beccariella* (Seed type 1), *Planchonella* (Seed type 1), *Sersalisia* (Seed type 2) and *Van-royena* (Seed type 2), four genera resurrected by Swenson *et al.* (2007a). Another misconception of lineages was formed when Pennington (1991) described *Pouteria* section *Pierrisideroxylon* (Engl.) T.D.Penn. to include some 12 species that now are better placed in *Pichonia* (Seed type 2), *Planchonella* (Seed type 1) and *Sersalisia* (Seed type 2) (Swenson *et al.* 2013). Pennington had also overlooked two of the more useful key characters to distinguish between *Beccariella* and *Planchonella*, namely, the respective presence and absence of an areolate higher leaf venation (already noted by Pierre in 1890) as well as the presence or absence of indumentum on the inner sepal surface (albeit with some variation). *Pouteria* in this wide circumscription became pantropical in distribution and highly polyphyletic, a group with natural boundaries still hidden in obscurity (Faria *et al.* 2017).

In 2003, the first molecular study of Sapotaceae was published (Anderberg and Swenson 2003), followed by a new phylogenetic analysis and subfamilial classification (Swenson and Anderberg 2005). These cladistic studies clearly demonstrated that *Pouteria sens. lat.* is an unnatural assemblage of lineages, with one lineage plausibly being confined to Australasia.

Bartish *et al.* (2005), using ribosomal nucleotide sequence data, followed by Swenson *et al.* (2007a), who expanded the sample and included morphology, clearly showed that *Beccariella* and *Planchonella* are two independent lineages of Australasian Sapotaceae. Swenson *et al.* (2007a), therefore, transferred species to both genera, but overlooked that *Beccariella* Pierre was an illegitimate later homonym of *Beccariella* Ces. To avoid unnecessary nomenclatural changes, Swenson and Tehler (2009) suggested conserving the name *Beccariella* Pierre against *Beccariella* Ces., because the latter has not been in use for almost 60 years, a proposal on which the Nomenclatural Committee for Vascular Plants was unable to decide (Brummitt 2011). The Committee, therefore, held the name of this lineage in limbo, and it became necessary to investigate whether any published name was available or whether a new name might be required.

Pleioluma was originally described as a section of *Sersalisia* (Baillon 1891b) and later transferred to *Sideroxylon* at a sectional rank, comprising a single species, *S. crebrifolia* (Baill.) Engl. (Engler 1897). In a publication (Baehni 1965), which appeared after Baehni had died, *S. crebrifolia* was transferred to *Pouteria* (p. 59) simultaneously as *Pleioluma* was accepted as a distinct genus (p. 150), but without any formal transfer of the type species. *Pleioluma* had not been recognised in any subsequent classification until Swenson *et al.* (2013) applied the name to the lineage. *Pleioluma* today includes ~40 species, 17 being endemic to New Caledonia and revised here, seven occurring in Australia (yet to be revised), and ~14 species occurring in New Guinea and Malesia that still lack a modern systematic treatment.

Materials and methods

Species concept and sampling

We have used a traditional morphological species concept in combination with molecular data and phylogenetic inference in a series of revisions of Sapotaceae in New Caledonia (Munzinger and Swenson 2009, 2015; Swenson and Munzinger 2009, 2010a, 2010b, 2010c, 2012, 2016). This implies, for a species to be recognised, that at least two morphological characters should be correlated, and if molecular data from multiple accessions are available, phylogenetic analyses place species in monophyletic groups, provided there is a sufficiently strong phylogenetic signal.

The nomenclature follows that of Swenson *et al.* (2013). We used *Magodendron mennyae* Vink and *Van-royena castanosperma* (C.T.White) Aubrév. as outgroup taxa to orient the phylogenetic tree because they are two of the closest relatives of *Pleioluma* (Swenson *et al.* 2013). All New Caledonian and Australian species were included except for *P. xerocarpa* (F.Muell. ex Benth.) Swenson, because the accession used by Swenson *et al.* (2007a), although also included, has been redetermined to be *P. brownlessiana* (F.Muell.) Swenson & Munzinger. Included also is *Beccariella brevipedicellata* (P.Royen) Aubrév., a species not transferred to *Pleioluma* because it was suspected to be conspecific with an earlier described taxon (Swenson *et al.* 2013). Fourteen species are known from New Guinea and Malesia, but material of four of those species was not available for inclusion in the present study (*P. dies-reginae*

(P.Royen) Swenson, *P. krausei* (H.J.Lam) Swenson, *P. lanatifolia* (P.Royen) Swenson, and *P. rigidifolia* (K.Krause) Swenson). Five accessions from New Caledonia represent new species for science, here called *Pleioluma* sp. Munzinger 2581, *P. sp.* Munzinger 5759, *P. sp.* Munzinger 7295, *P. sp.* Swenson 722 and *P. sp.* Swenson 917. All voucher specimens, herbaria where specimens are deposited, and sequence accessions are listed in Appendix 1.

Multiple accessions of several taxa were included to test species monophyly. These include *P. balansana* (Pierre ex Baill.) Swenson & Munzinger (six accessions) and *P. longipetiolata* (Aubrév.) Swenson & Munzinger (five accessions), both of which vary in morphology and have frequently been misidentified. *Pleioluma lucens* (P.Royen) Swenson & Munzinger and *P. novocaledonica* (Dubard) Swenson & Munzinger are also two very similar species, impossible to separate with the keys provided by van Royen (1957) and Aubréville (1967). Ten accessions of these were available and also included.

Morphological data

Morphological features in Sapotaceae are known to be variable and difficult to code for phylogenetic analysis. Species are usually distinguished on a specific autapomorphy, which is uninformative in cladistic analysis. However, autapomorphies become synapomorphies and informative if multiple accessions of the same 'species' with the feature are included. We, therefore,

Table 1. Morphological characters and character states of *Pleioluma* (Sapotaceae) used in Bayesian inference

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| 1. Leaves obovate (0), oblanceolate (1), elliptic (2), lanceolate (3) |
| 2. Secondary venation on the lower leaf surface conspicuous (0), inconspicuous, slightly raised above the leaf blade (1), faint, not raised above the leaf blade surface (2) |
| 3. Indumentum on the lower leaf surface persistent (0), glabrescent apart from primary and secondary veins (1), whole leaf surface glabrescent (2), absent (3) |
| 4. Secondary venation on the upper leaf surface not impressed (0), clearly impressed (1) |
| 5. Tertiary venation on the lower leaf surface prominent, visible to the naked eye (0), faint, hardly visible to the naked eye (1), not distinguishable (2) |
| 6. Tertiary venation oblique (0), oblique and reticulate (1), reticulate (2), horizontal (3), not distinguishable from the areolate venation (4) |
| 7. Petiole length compared to the length of the blade short, <25% (0), long, >25% (1) |
| 8. Petiole villous (0), tomentose (1), tomentulose (2), glabrous (3) |
| 9. Pedicel villous (0), tomentose (1), tomentulose (2), glabrous (3) |
| 10. Flowers borne on normally thick pedicels (0), on slender, filiform pedicels (1), (sub)sessile (2) |
| 11. Sepals on the outer surface villous (0), tomentose (1), tomentulose (2), glabrous (3) |
| 12. Sepals with equally dense indumentum on all sepals (0), usually denser on the inner, overlapped sepals (1) |
| 13. Sepals on the inner surface with indumentum (0), glabrous (1) |
| 14. Ovary or fruit with indumentum throughout (0), indumentum around the base or the remnant style (1) |
| 15. Accession growing on ultramafic substrate (0), non-ultramafic substrate (1) |

coded the observed state on multiple collections regardless of whether the feature is variable or not in a 'species'. Fourteen morphological characters were scored (Table 1).

Most of the 14 characters are self-explanatory, but some characters need additional comment. All leaves have primary, secondary and, usually, tertiary leaf venation, but leaves can be smooth and flat, without any conspicuous venation (compare colour illustrations). Such venation is usually seen if the leaf is held against the light. In contrast, secondary veins can be impressed on the upper leaf surface and then be usually prominent on the lower leaf surface. These characters are readily seen in the field, but less so on herbarium specimens, which can be problematic if the character is used in determination keys. Both van Royen (1957) and Aubréville (1967) relied on vein characters, which we here have evaluated in Characters 2, 4 and 5.

Many organs of Sapotaceae are covered by indumentum formed by malpighiaceus trichomes, which have two branches of different lengths and are attached to the epidermis with a short stalk. Young leaves, for instance, are usually covered by indumentum, which usually drops as the leaves mature and secondarily become glabrous. The length of the trichome branches is important for indumentum appearance; long branches form a villous indumentum at one end of the range *v.* short branches that form an almost appressed tomentulose indumentum at the other end of the range (see *Indumentum* below). The term 'pubescent', following Harris and Harris (1997), is used when an organ bears some type of indumentum that cannot or need not be specified. Indumentum type and presence on leaves, petioles, pedicels and fruit are scored in Characters 3, 8, 9, 11, 12, 13 and 14.

Most species of Sapotaceae in New Caledonia are restricted to non-ultramafic or ultramafic substrates, but the situation for species of *Pleioluma* is unclear. Soil preference was, therefore, scored for each accession and used as an ecological indicator, but considered not appropriate to include in the phylogenetic analysis (Character 15).

Revision of the species relies on morphological data gathered from historical and recent collections primarily deposited at K, MO, MPU, NOU, P and S (abbreviations following Index Herbariorum, see <http://sweetgum.nybg.org/science/ih/>, accessed 21 January 2018). Flowers and fruit were temporarily removed from herbarium specimens and boiled in Copenhagen mixture (70 mL of ethanol, 29 mL of distilled water, 1 mL of glycerol) in a microwave oven until the parts were soft enough to permit examination under a stereo-microscope. Flower and seed characters were also studied in the field. Morphological terminology follows that of Harris and Harris (1997) and Beentje (2010), the latter providing a useful guide to colour terms. Illustrations were prepared using a combination of herbarium specimens and field images.

Molecular data

Plant material for DNA extraction was collected either as silica gel-dried leaf samples from living plants or fragments removed from herbarium specimens. Sequence information content of various molecular markers used for phylogenetic analysis of Sapotaceae was reviewed by Swenson *et al.* (2013), and, as far

as known, it is the nrDNA loci external transcribed spacer (ETS) and internal transcribed spacer (ITS) and the nuclear gene *RPB2* (Oxelman and Bremer 2000) that contain the richest source of phylogenetic information in the family. These three molecular markers combined, and a limited sample, have been insufficient to resolve relationships in *Pleioluma* (Swenson *et al.* 2013). We, therefore, searched for additional information and attempted to sequence the second intron FLO/LFY (*FLint2*) in the single-copy nuclear-encoded gene *Floricaula/Leafy* (Grob *et al.* 2004), an attempt which we had to abandon after several failures to amplify the intron. Sequences of ETS, ITS, and *RPB2* were obtained by following the protocols for primers, extraction, amplification and sequencing reported by Swenson *et al.* (2013). *RPB2* was not sequenced for all accessions because the sequences turned out to be almost identical. In total, 38 sequences each of ETS and ITS and 8 of *RPB2* were generated and added to a modified matrix used by Swenson *et al.* (2013). The sequences were aligned by hand and checked with AliView (Larsson 2014). Polymorphic nucleotide positions were IUPAC coded (see bioinformatics.org/sms/iupac, accessed 21 January 2018).

Bayesian inference

Phylogenetic relationships were estimated with Bayesian Markov-chain Monte Carlo (MCMC) methods (Rannala and Yang 1996; Yang and Rannala 1997) by using the program MrBayes (ver. 3.2.7, Ronquist *et al.* 2012, see <https://github.com/NBISweden/MrBayes>, accessed 21 January 2018). We performed both separate and combined analyses of nrDNA and morphological data. In addition, alignment gaps (insertions and deletions) were coded as absent or present characters and added to the data matrix (as 'datatype = restriction', hence assuming a binary model). The dataset was partitioned and treated by locus or gene (ETS, ITS, *RPB2*), morphology and gaps. Substitution model parameters were unlinked across partitions, and for the genes, a reversible-jump MCMC over the space of all GTR submodels was run for each of them by using the 'nst = mixed' command in MrBayes. For both the morphological and the gap data, we assumed that only variable character patterns had been sampled. Among-site rate variation within partitions was modelled using a discrete gamma distribution with four categories. We used partition-specific rate multipliers with a uniform Dirichlet distribution to allow the overall evolutionary rates to differ among partitions. For all analyses, four Metropolis-coupled chains (temperature constant set to 0.1), starting from random trees, were run, and sampling was performed every 500th generation. An automatic stopping rule was used for the MCMC, where an average standard deviation of split frequencies of <0.01, calculated for the last 75% of the sampled trees, would indicate convergence. The initial samples (25%) were discarded as burn-in (typically, >10 000 trees would be retained for inference). Calculations of credibility intervals, statistical analyses and graphical output were made using the R statistical programming language (R Foundation for Statistical Computing, Vienna, Austria, see <http://www.R-project.org/>, accessed 21 January 2018), utilising functions in the APE (Paradis *et al.* 2004) and phytools (Revell 2012) packages.

Nodes with a posterior probability of 0.7 and above are reported in the resulting consensus tree; the others are collapsed.

Conservation assessment

Risk of extinction assessments have become crucial in an archipelago such as New Caledonia, where the native vegetation and its component species are threatened by many anthropogenic activities including deliberately set fires, deforestation and mining (Jaffré *et al.* 1998; Pascal *et al.* 2008). Protected areas in New Caledonia are not yet adequate, but the number is increasing slowly; their names and locations can be found in Jaffré *et al.* (2010).

Beccariella brevipedicellata is currently the only member of *Pleioluma* (listed under the unpublished name '*Pouteria brevipedicellata* (P.Royen) ined.') treated by IUCN, where it is assessed as *Vulnerable* on the basis of information from Jaffré *et al.* (1998). Here, as well as in our previous revisions, we apply the IUCN Red List guidelines (IUCN 2001, 2008, 2012) to evaluate the conservation status of each species of *Pleioluma*. IUCN bases threat analysis on a variety of criteria and subcriteria involving population reduction (Criterion A), population geographic range, including fragmentation (Criterion B), decline or fragmentation of small to very small populations (Criteria C, D), and quantitative analyses of the probability of extinction (Criterion E). Geographic range is measured as *extent of occurrence* (EOO) and *area of occupancy* (AOO), where EOO is the minimum convex polygon containing all points of occurrence and AOO is the area estimated by superimposing a grid (2 × 2 km) onto occurrence points and calculating the cumulative area of the cells occupied by the species. For our assessments, we applied Criterion B by calculating EOO and AOO, by using the online 'GeoCAT' software (Bachman *et al.* 2011), but we followed the recommendation by Rivers *et al.* (2010) to calculate the number of subpopulations under ArcGIS 10.0 software (ESRI, Redlands, CA, USA) by using a 5.64-km circular buffer instead of a grid.

Results and discussion

Data

The complete data matrix contains 2395 characters, of which 2373 are from aligned nuclear sequences, 7 from coded gaps, 14 from morphology and one from soil preference. Soil preference was not included in the Bayesian inference, but was mapped on the tree. External transcribed spacer is represented by 372 nucleotides, of which 39 (10.5%) are parsimony informative, ITS of 840 nucleotides of which 61 (7.3%) are informative, and *RPB2* of 1161 nucleotides of which 23 (2.0%) are informative. *RPB2* sequences are mainly informative between taxa from New Guinea–Australia and New Caledonia, but not within the latter area.

Tree topology

The maximum credibility trees recovered from the analyses of molecular and combined data are similar and poorly resolved except near the base where five Australian species are recovered. Morphology provides an important phylogenetic signal and, if removed from the analysis, several subclades collapse, indicated with support values in italic (Fig. 1). The two strongly supported (posterior probability (PP) = 1) subclades recovered by Swenson *et al.* (2013, 2014), one with New Caledonian species (Fig. 1A), the other with New Guinean and New Caledonian species (Fig. 1B), are only partly recovered with this expanded taxon sampling. All except one species from New Guinea are recovered in two strongly supported clades (PP = 1), but it is unclear whether these form one monophyletic group. Five accessions of *Pleioluma firma* were included and these are not in a single group. Redetermination of one accession (*Bartish & Ford 28*) from *P. xerocarpa* to *P. brownlessiana* is not supported by molecular data, because it now forms a grade with *P. queenslandica* (P.Royen) Swenson. Revisionary work is required for *Pleioluma* in Australia, New Guinea and Malesia; however, this was beyond the scope of the present paper.

Accepted species in New Caledonia

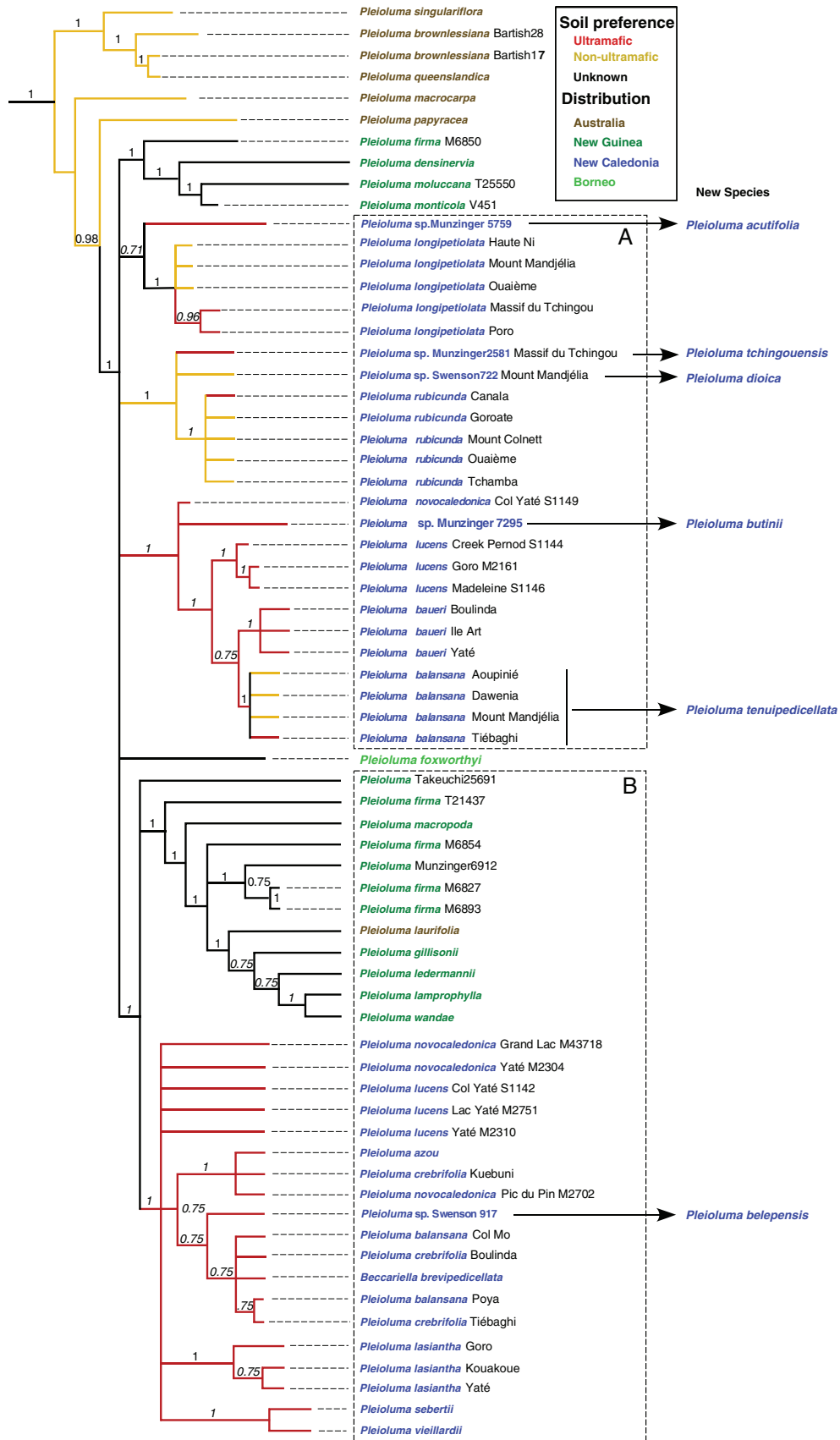
The primary purpose of our phylogenetic analyses was to gain additional guidance for species circumscription in *Pleioluma*. Most of the terminals have been determined to a specific name, but some have been labelled with only the collector and number, because they represent new species for science. Below we discuss the species in New Caledonia that we accept.

Pleioluma sp. Munzinger 5759 is confined to ultramafic substrate in the south of Grande Terre and is easily distinguished (see below). It grouped with *Pleioluma longipetiolata* with strong support in the previous study by Swenson *et al.* (2013), and here it occupies the same position, but with weak support. We accept this lineage as a new species and describe it below as *P. acutifolia* Swenson & Munzinger.

Pleioluma longipetiolata is very variable in leaf size and texture, varying from 5 to 20 cm long, the smaller leaves being more coriaceous than the larger ones. It primarily grows in humid forest on either schist or ultramafic soils (preferably serpentine). All five accessions group together on the basis of the molecular data alone and receive maximum support when combined data are used. The name *longipetiolata* was adopted to refer to the proportionally long petiole, a character that can be seen even in small-leaved individuals, i.e. the petiole length is consistently more or less than a third (30%) of the blade length.

Pleioluma sp. Munzinger 2581 and *P. sp.* Swenson 722 are two accessions that we believe to be related to *P. rubicunda* (Pierre ex Baill.) Swenson & Munzinger, here being included with five other accessions; however, we are uncertain whether the

Fig. 1. Maximum clade credibility tree of *Pleioluma* (Sapotaceae) obtained from two Bayesian analyses, one based on nrDNA data and the other based on nrDNA and morphology. Nodes with support of <0.7 posterior probability are collapsed. Clade support above branches is reported for molecular data (plain text) and combined data (italic), viz. nodes with node support in italic would collapse without morphological data. The accessions are derived from ultramafic substrates (red branches), non-ultramafic substrates (yellow branches) or unknown substrates (black branches). Colour of species names indicates the area of origin: Australia (dark brown), Borneo (light green), New Guinea (dark green) and New Caledonia (blue). Two dotted boxes (A and B) correspond more or less to the two clades recovered with maximum support by Swenson *et al.* (2013) and are retained for the simplicity of discussion. New species described herein are given to the right, outside the boxes. The outgroup taxa *Magodendron* and *Van-royena* have been pruned from the figure.



former should be treated as a species or subspecies, or merely as part of the variation within *P. rubicunda*. Phylogenetic analyses place all these accessions in a strongly supported monophyletic group, whereas morphology alone renders maximum support for *P. rubicunda* as a distinct species, separate from *P. sp. Munzinger 2581* and *P. sp. Swenson 722*. *Pleioluma rubicunda* differs from the two new taxa in the following five characters: conspicuous leaf venation on the lower leaf surface, oblique tertiaries, petiole with tomentose indumentum, and villous pedicel and sepals. The other two are molecularly identical, but differ from each other in ecology and distribution, the former being restricted to the Tchinguou massif where it grows on ultramafic substrate, whereas the latter is mainly found in the Panié massif growing on schist. They also differ in morphology, sepals of *P. sp. Munzinger 2581* having a denser indumentum on the inner sepals than on the outer sepals, whereas the indumentum is equally dense on all sepals of *P. sp. Swenson 722*. In addition, all flowers examined in *P. sp. Munzinger 2581* are hermaphroditic, in contrast to female in *P. sp. Swenson 722*, and we suspect the latter could be a dioecious species. Hence, we accept the following three species in this clade: *P. rubicunda*, and the other two as *P. tchingouensis* Swenson & Munzinger and *P. dioica* Swenson & Munzinger, both newly described.

Accessions of *P. sp. Munzinger 7295* have been previously determined as *Pichonia daenikeri* (Aubrév.) Swenson, Bartish & Munzinger, a species with stamens inserted in the tube orifice. Flowers of *P. sp. Munzinger 7295* have stamens inserted near the base of the corolla tube, suggesting that it is a member of *Pleioluma*. Comparing ETS and ITS sequence data of *P. sp. Munzinger 7295* and four accessions of *P. balansana* shows nearly identical sequences. However, *Pleioluma sp. Munzinger 7295* has several morphological features such as larger, elliptic leaves, which are rapidly glabrescent on the lower surface (except for the primary and secondary veins), and sessile flowers. We describe this species below as *P. butinii* Swenson & Munzinger.

Ten accessions of *Pleioluma lucens* and *P. novocaledonica* were included in the phylogenetic analyses and they are recovered in two different subclades supported by morphology, but not by molecules. If ETS and ITS sequences are compared, three nucleotides are in common for the accessions 'Goro M2161' and 'Madeleine S1146' and another of the two with 'Creek Pernod S1144' (Fig. 1A). In other words, the molecular signal is weak or almost absent, because there is not a single synapomorphy for all accessions for either species. The key characters used to distinguish these two species are whether the tertiary leaf venation is not visible *v.* impressed above (van Royen 1957, p. 259), or whether the secondaries are inconspicuous *v.* conspicuous below (Aubréville 1967). These characters vary across the material and are subjective to score, especially on herbarium specimens, but it is also likely that these authors confused tertiary with secondary veins. In addition, when van Royen described *P. lucens*, one pubescent and one glabrous fruit were illustrated, indicating that he possibly studied mixed material. The following question remains: should one or two taxa be recognised? Re-examination of the type material of *P. novocaledonica* shows that the indumentum is uniform on the sepals, and the fruit is glabrous, except around the remnant style and on the fruit

behind the sepals. In contrast, *P. lucens* has a glabrescent indumentum on the central part of the outer sepals and the fruit is initially pubescent, but partly loses trichomes as it grows. These characters are consistent, as far as known, with the sampled accessions as well as most other material identified to either of the two species, but coding these features provides no phylogenetic signal to group the accessions into two separate clades. Circumscribing them primarily on sepal and fruit indumentum, combined with leaf venation, is still a better solution than leaving all these collections in limbo. However, there are collections that do not fit in the circumscription of either species and we cannot exclude the possibility that future studies using larger samples and other molecular markers might bring better systematic order to this complex.

Beccariella brevipedicellata was not transferred by Swenson *et al.* (2013) to *Pleioluma* because it was suspected of being conspecific with *P. balansana*, a name which would have priority. Numerous collections labelled as *P. balansana* are intermediate between that species and *P. baueri* (Mountrouz.) Swenson & Munzinger, especially in respect to indumentum on leaves, pedicel and sepals, and we have speculated that these form a transition between the two species. Six accessions of *P. balansana* and three of *P. baueri* were therefore included. Phylogenetic analyses recovered these accessions in two subclades, four of which received molecular support and an indication of being sister to the accessions of *P. baueri* (Fig. 1A). The remaining accessions of *P. balansana* are grouped on the basis of morphology in a weakly supported clade with two accessions of *P. crebrifolia* and *B. brevipedicellata* (Fig. 1B). The nrDNA sequences of *P. balansana*–*P. baueri* are identical, except in one ITS nucleotide (bp 312), being 'A' in *P. balansana* and 'G' in *P. baueri* (apart from four autapomorphies in the accession from Ile Art), whereas the five sequences in the other subclade are identical. However, in comparing the two clades in which *P. balansana* is recovered, no less than 18 nucleotides differ. We interpret these results as indicating that some of the collections determined to *P. balansana* instead represent another case of a cryptic species of Sapotaceae in New Caledonia (Bickford *et al.* 2007; Swenson *et al.* 2015), and the challenge is to morphologically circumscribe the sister species to *P. baueri*, which we below describe as *P. tenuipedicellata* Swenson & Munzinger.

The next challenge is to delimit species in the subclade *Pleioluma balansana sens. str.*–*Beccariella brevipedicellata*–*P. crebrifolia*. The sequence data of these five accessions are uninformative. One useful morphological character, even if variable, is the distribution of indumentum on the lower leaf surface, being persistent in *B. brevipedicellata*, glabrescent apart from the venation in *P. balansana*, and glabrescent across the entire leaf surface in *P. crebrifolia* (which is not monophyletic). All accessions are from ultramafic substrate, except that *P. crebrifolia* occurs on serpentinite. Aubréville (1967) postulated a close relationship of this species with *P. balansana* and suggested that it might just be an ecological form occurring in maquis vegetation. Separating *B. brevipedicellata* from *P. balansana* is problematic, except that accessions from Ile de Pins usually have not as glabrescent leaves. On the basis of this evidence, we find that it is best to treat *B. brevipedicellata* in synonymy with *P. balansana*;

however, can *P. crebrifolia* be upheld? Accessions determined to this taxon occur on serpentinite and have small, 1.5–4.0-cm-long, obovate leaves, densely clustered at the tips of branches, in contrast to accessions of *P. balansana* that occurs on different types of ultramafic soils, have larger, 4.0–8.0-cm-long, obovate–oblanceolate or even elliptic leaves, not as densely clustered as in *P. crebrifolia*. These quantitative morphological features are difficult to capture in phylogenetic analyses. Furthermore, records of flower colour indicate that it is cream in *P. balansana* and white in *P. crebrifolia*. Hence, for the time being, two species are accepted and revised below as *P. balansana* and *P. crebrifolia*.

The new species, *Pleioluma* sp. Swenson 917, is indicated with weak support to be the sister taxon to *Pleioluma balansana* and *P. crebrifolia*. This taxon is very distinctive, easy to identify, confined to Ile Art, a small island north of Grande Terre, and is described below as *P. belepensis* Swenson & Munzinger.

Pleioluma azou (P.Royen) Swenson & Munzinger is a naturally rare and poorly known species of a doubtful status. It is similar in appearance to *P. lucens* with distinct secondary venation on the lower leaf blade and it groups (with support from morphology) with one accession of *P. crebrifolia* and one of *P. novocaledonica* (Fig. 1B). The overall morphology of these three accessions is not particularly similar. From examination of the type material and available collections, *P. azou* is characterised by oblanceolate–obovate, acute leaves, and 18–25 distinct secondary veins on the undersurface. We accept this taxon for the time being, and it appears to belong to the *P. lucens*–*P. novocaledonica* complex, which may need further attention.

Finally, at the lower end of the phylogeny (Fig. 1B) are three readily distinguished species, namely, *Pleioluma lasiantha* (Baill.) Swenson & Munzinger, *P. sebertii* (Pancher) Swenson & Munzinger and *P. vieillardii* (Baill.) Swenson & Munzinger. All three have conspicuous leaf venation on the lower surface, usually with ferruginous indumentum that contrasts with the greenish blade. All in all, we accept and treat 17 species of *Pleioluma* in New Caledonia.

General morphology of *Pleioluma*

Habitat and leaf venation

Species of Sapotaceae are characterised by white latex, having malpighiaceae trichomes on leaves, petioles and flowers (except in glabrous species), and stamens being inserted opposite the corolla lobes. Species of *Pleioluma* in New Caledonia form medium-sized trees, understory trees, treelets, and shrubs, and occur from low-altitude maquis (*P. lucens*, *P. novocaledonica*) to high-altitude moist forest on ultramafic substrates (*P. tchingouensis*) or schist (*P. dioica*, *P. rubicunda*). Some species have very beautiful foliage and are potentially ornamental trees (*P. belepensis*, *P. sebertii*, *P. vieillardii*). The leaves are simple, entire, stipulate, alternate and clustered at the tips of branches. Dried leaves usually turn brown, even if dried in silica gel, which makes it difficult to know whether the material is useful for DNA analysis. Patterns of secondary leaf venation vary, where some species have prominent, ferruginous pubescent secondaries on the lower leaf surface, and others have

impressed secondaries on the upper surface (*P. acutifolia*, *P. belepensis*, *P. lucens*). Other species have poorly developed leaf venation and the leaves need to be held against the light to allow observation of the venation (*P. baueri*, *P. crebrifolia*, *P. longipetiolata*, *P. tenuipedicellata*). The tertiary venation is oblique, reticulate, a combination of the two, or poorly developed and difficult to distinguish from the higher venation, which is *always areolate* and similar to that of *Pichonia*, which also occurs in New Caledonia (Swenson and Munzinger 2012). We often refer to faint and weak venation, meaning that it is hardly visible, or just visible respectively, especially in fresh material observed in the field.

Indumentum

Individuals of Sapotaceae are usually easily identified in the field on the basis of their foliage, which is frequently covered by ferruginous, brown, golden or grey (especially with age) indumentum. The indumentum is formed by malpighiaceae trichomes, which are epidermal structures with a short stalk and two arms, present on young branches, leaves, petioles, pedicels, sepals, ovaries and sometimes fruit. The length and curvature of the arms vary, rendering the trichomes T-shaped, Y-shaped or simple, resulting in a more or less tomentulose, tomentose or villous indumentum (see figures in Harris and Harris 1997; Swenson and Munzinger 2009, 2010b, 2012). Some trichomes are stalkless and form a pellicle. Differences in indumentum are difficult to observe for the unexperienced; however, these differences, especially in combinations, are important and specific. Tomentulose indumentum is formed by short trichomes matted over the surface (e.g. see leaf indumentum in *P. belepensis* and pedicel and sepals in *P. longipetiolata*). Tomentose indumentum is formed by longer trichomes, often in combination with short ones, and usually less matted over the surface (e.g. primary and secondary veins in *P. butinii*). Villous indumentum has even longer trichomes, often giving a woolly impression (e.g. the venation in *P. rubicunda* and the sepals in *P. vieillardii*).

In *Pleioluma*, the upper leaf surface is usually tomentose and rapidly glabrescent except for the midvein, or glabrous. Mature leaves are often coriaceous and green to dark green above. The majority of species lose the indumentum on the lower leaf surface, except on the primary and secondary veins, which contrast with the more or less green or greyish blade (*P. belepensis*, *P. butinii*, *P. rubicunda*, *P. sebertii*). For determination, the distribution of trichomes is more important on the lower than on the upper leaf surface. Species with glabrous leaves (*P. baueri*, *P. longipetiolata*, *P. tenuipedicellata*) are at sight less easy to identify as members of Sapotaceae; however, they always exude white latex from leaf and flower scars.

Flowers

The time that flowers are open in Sapotaceae is predicted to be short, possibly just a day or two (Terra-Araujo *et al.* 2012), and this is seemingly true for *Pleioluma*. The predominating sexual system in New Caledonian Sapotaceae is hermaphroditism, with bisexual flowers in *Pichonia*, *Planchonella* and *Pycnandra* (Swenson *et al.* 2007b; Swenson and Munzinger 2012, 2016). Gynomonoeicy with bisexual and female flowers on the *same*

individual is present in *Planchonella* (Méndez and Munzinger 2010). Aubréville (1967) reported flowers in *Pleioluma* (his *Beccariella*) being bisexual and female, but the distribution of flower types on individuals was not reported. In the studied material, bisexual and female flowers have been observed in 11 of 17 species, but never on the same individual. If this is correct, the majority of *Pleioluma* in New Caledonia would be gynodioecious, i.e. bisexual and female flowers occur on *different individuals*. Gynodioecy occurs in at least 50 angiosperms families, including Sapotaceae (Demyanova 1985), but it is a rare sexual system and occurs in less than 1% of the species (Rivkin *et al.* 2016). Moreover, gynodioecy is usually associated with herbaceous plants in temperate regions, not tropical tree species (Caruso *et al.* 2016). Below, when suggested by the data, gynodioecy is stated in the description, whereas the sexual system remains a hypothesis to be tested in future pollination studies. Dioecy is an uncommon sexual system in Sapotaceae, but verified in *Micropholis* (Griseb.) Pierre (Terra-Araujo *et al.* 2012). Here, we believe that we have found the first example of a dioecious species of Sapotaceae in New Caledonia, viz. *P. dioica*.

Flowers in *Pleioluma* are usually 5-merous (rarely 4-merous), borne in fascicles, often no more than three or four per fascicle, and the inflorescence never develops into a burl, a hard woody brachyblast from which flowers are set time after time. Fascicles are axillary, produced below the apical clusters of leaves. Flowers are never subtended by sepal-like bracts, like those observed in *Pycnandra* (see e.g. fig. 9, 13 and 17 in Swenson and Munzinger 2010b). The sepals are in one whorl, free, and *pubescent on both surfaces* (except for *P. baueri*). The corolla is cream, white or greenish, tubular or narrowly campanulate, always with erect corolla lobes that never flare out or spread as in *Pycnandra* and *Pichonia*. Stamens are inserted *near the base or in the middle* of

the corolla tube, never in the corolla tube orifice as in *Pichonia* or just below the tube orifice as in *Planchonella*. Stamines are always present, but frequently reduced or minute in female flowers, sometimes even in bisexual flowers (*P. rubicunda*, *P. sebertii*). The style is included within the corolla and never exposed to visiting pollinators.

Gynoecium and fruit

Species of *Pleioluma* have styles generally with five, round stigmatic areas, clearly seen with a hand lens, indistinguishable from those in *Planchonella*. The style and ovary, which is hispid pubescent, often form a flask-shaped gynoecium. The style persists in fruit, typically 1–3 mm long, and the indumentum is usually persistent around the base (behind the sepals). Species of *Pleioluma* in New Caledonia usually develop berries with one or up to four seeds (in *P. sebertii* and *P. vieillardii*). Fruit is still unknown in several species; however, as far as is known, all are ellipsoid or obovoid and turn dark purple or black when ripe, with little but excellent tasting pulp. The seed has foliaceous cotyledons, a radicle below the cotyledon commissure and an endosperm. The seed scar (hilum) is narrow or oblong, ~10% of the seed circumference, whereas the length varies among the species.

Taxonomic treatment

Pleioluma is one of four Chrysophylloideae genera present in New Caledonia, and a generic key was provided by Swenson *et al.* (2013). Below we revise 11 and describe six new species of *Pleioluma* in New Caledonia. Diagnoses of the new taxa are given in English, following Article 39.2 of the International Code of Nomenclature for algae, fungi and plants (ICN; Melbourne Code) (McNeill *et al.* 2012), which no longer

| Taxon | Substrate | Altitude | | Phenology | | | | | | | | | | | | | | |
|----------------------------|----------------|------------|----------|-----------|------|------|------|-----|------|------|------|------|------|------|------|--|---------------|------------------------|
| | | ASL | Red List | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | | | |
| <i>Pleioluma</i> | | | | | | | | | | | | | | | | | | |
| <i>P. acutifolia</i> | Ultramafic | ~250 m | CR | | | | | | | | | | | | | | Fruit unknown | |
| <i>P. azou</i> | Ultramafic | 100–200 m | EN | | | | | | | | | | | | | | | Fruit unknown |
| <i>P. balansana</i> | Ultramafic | 0–200 m | VU | | | | | | | | | | | | | | | |
| <i>P. baueri</i> | Ultramafic | 0–1000 m | LC | | | | | | | | | | | | | | | |
| <i>P. belepensis</i> | Ultramafic | 50–260 m | CR | | | | | | | | | | | | | | | Fruit unknown |
| <i>P. butinii</i> | Indifferent? | 350–650 m | CR | | | | | | | | | | | | | | | Fruit unknown |
| <i>P. crebrifolia</i> | Serpentinite | 0–650 m | LC | | | | | | | | | | | | | | | |
| <i>P. dioica</i> | Non-ultramafic | 600–750 m | DD | | | | | | | | | | | | | | | Phenology poorly known |
| <i>P. lasiantha</i> | Ultramafic | 150–1000 m | LC | | | | | | | | | | | | | | | |
| <i>P. longipetiolata</i> | Indifferent | 0–950 m | LC | | | | | | | | | | | | | | | |
| <i>P. lucens</i> | Ultramafic | 0–600 m | VU | | | | | | | | | | | | | | | |
| <i>P. novocaledonica</i> | Ultramafic | 0–600 m | VU | | | | | | | | | | | | | | | |
| <i>P. rubicunda</i> | Non-ultramafic | 600–1300 m | LC | | | | | | | | | | | | | | | |
| <i>P. sebertii</i> | Ultramafic | 0–600 m | VU | | | | | | | | | | | | | | | |
| <i>P. tchingouensis</i> | Ultramafic | 750–760 m | CR | | | | | | | | | | | | | | | |
| <i>P. tenuipedicellata</i> | Indifferent | 250–850 m | VU | | | | | | | | | | | | | | | |
| <i>P. vieillardii</i> | Ultramafic | 200–600 m? | CR | | | | | | | | | | | | | | | Phenology poorly known |

Fig. 2. Summarised data of substrate, altitudinal range, Red List assessment, and phenology for *Pleioluma* (Sapotaceae) in New Caledonia. Phenology: flowering (grey bars), fruiting (black bars) and extrapolation between flowering and fruiting periods (dotted bars). ASL, above sea level.

requires a Latin diagnosis for a validly published taxon name. The species follow an alphabetic order, each with a full description, note on recognition, distribution, etymology and conservation assessment. Phenology is generally poorly known in this group, but current knowledge, together with substrate preference, altitudinal range and Red List assessment, is summarised in Fig. 2. Constant generic characters are not reiterated in the descriptions. Known type localities are plotted on the distribution maps. Localities for some type collections are very imprecise, merely given as ‘Nouvelle-Calédonie’ in some cases, or as for the explorer Eugène Vieillard (1819–1896), referring to the regions of former military posts at localities such as Canala, Gatope, Balade and Wagap (Munzinger and Swenson 2016), and are therefore omitted from the maps.

Pleioluma (Baill.) Baehni, *Boissiera* 11: 150 (1965)

Sersalisia sect. *Pleioluma* Baill., *Hist. pl.* 11: 280 (Sep.–Oct. 1891); *Sideroxylon* sect. *Pleioluma* (Baill.) Engl., *Nat. Pflanzenfam. Nachtrag.* 277 (1897).

Type: *Pleioluma crebrifolia* (Baill.) Swenson & Munzinger (≡ *Lucuma crebrifolia* Baill.).

Beccariella Pierre, *Not. Bot. Sapot.* 1: 30 (1890), *nom. illeg., non Beccariella* Ces. (1879).

Type: *Beccariella sebertii* (Pancher) Pierre (≡ *Chrysophyllum sebertii* Pancher).

Description of *Pleioluma* in New Caledonia

Hermaphroditic, gynodioecious or dioecious trees, treelets or shrubs with white latex. *Leaves* simple, entire, alternate, usually clustered at branch tips, estipulate; blade glabrous or tomentose to tomentulose, quickly glabrescent above, more persistent below, indumentum often persistent on the venation; base cuneate; apex acute, subacute or rounded; trichomes usually brown or ferruginous, especially along primary and secondary veins on the lower blade surface, finally greyish; secondary venation variable, prominent, distinct to faint below, flat or sometimes impressed above; intersecondaries absent or present; tertiary venation horizontal, oblique or reticulate, distinct, faint or indistinguishable from the higher venation, which is always areolate. *Flowers* pedicellate, rarely sessile, bisexual, female or male (?), borne in axillary fascicles or below the clusters of leaves, inflorescences never developing into burls; pedicel usually pubescent, rarely subglabrous or glabrous, without sepal-like bracts. *Sepals* 5(–4) in a single whorl, free, quincuncial, more or less ovate, pubescent on both surfaces or, rarely, glabrous outside, persistent in fruit. *Corolla* tubular or narrowly campanulate, white or cream, rarely pinkish, glabrous; lobe margin glabrous or ciliate; tube and lobes of approximately equal length; lobes 5(–4), erect, usually quadrangular in shape. *Stamens* never exerted from the corolla (reduced in female flowers), opposite and equal in number to the corolla lobes, inserted in the middle or near the base of the corolla tube, glabrous; anthers usually ovate, basifixed, antrorse, 10–30% calcarate (spurred) of its length; anther appendage minute or absent. *Staminodes* inserted in the corolla sinus, oblong or lanceolate, glabrous, entire, rarely denticulate, often reduced in female flowers, sometimes even in bisexual flowers. *Gynoecium* flask- or cone-shaped with (4–)5

locules, hispid around the base; style pubescent to approximately half of its length, shorter than the corolla; style apex with 5 visible stigmatic areas. *Fruit* a black or dark purple berry with poorly developed pulp, ellipsoid, obovoid or rarely ovoid, usually pubescent behind the sepals and around the remnant style, sometimes throughout, 1(–4)-seeded; seeds usually laterally compressed, more or less of the same shape as the fruit; seed scar generally narrow, ~10% of the seed circumference, length variable; testa shiny, brown or chestnut brown; cotyledons foliaceous, white; radicle exerted below the cotyledon commissure, endosperm present.

Key to the species of *Pleioluma* in New Caledonia

Leaf indumentum characters are best observed on young leaves, because aging indumentum is usually caducous. It is also recommended that measurements are taken from several leaves, petioles, pedicels and flowers, as well as that the number of secondary veins are counted from a handful of leaves. Tertiary and areolate venation is best viewed on the lower leaf surface. *Pleioluma novocaledonica* is a difficult species to key out and appears twice in the key. Specimens that do not key out below are intermediate and represent still poorly understood taxa or possible hybrids.

1. Secondary veins on lower leaf surface clearly visible and raised above the blade surface 2
Secondary veins on lower leaf surface inconspicuous to more or less in level with blade surface 11
2. Flowers and fruit sessile or subsessile 3
Flowers and fruit borne on pedicels ≥ 3 mm long 5
3. Leaves elliptic, indumentum above brownish, soon glabrous, shining light green *P. butinii*
Leaves obovate–oblanceolate, indumentum above greyish, glabrescent, turning dark green 4
4. Tree or treelet usually more than 2 m tall; tertiary veins conspicuous; secondaries veins of 12–23 pairs *P. sebertii*
Shrub usually up to 2 m tall; tertiary veins faint, hidden by indumentum; secondary veins of 8–10 pair *P. vieillardii*
5. Secondary veins on upper leaf surface clearly impressed (cf. Fig. 4A, F, 10F) 6
Secondary veins on upper leaf surface leveled with blade (cf. Fig. 4C, 10E) *P. novocaledonica*
6. Indumentum on young leaves, petioles and flowers fawn; leaf margins revolute (cf. Fig. 4E, F) *P. belepensis*
Indumentum, if present, brown or ferruginous, never fawn in colour; leaf margins more or less flat 7
7. Leaves elliptic, usually acute; tertiary veins near midvein perpendicular (cf. Fig. 4A) *P. acutifolia*
Leaves obovate–oblanceolate; tertiary veins not perpendicular or indistinguishable 8
8. Leaf blades ≥ 10 cm long; fruit ≥ 18 mm long; mainly on non-ultramafic substrates *P. rubicunda*
Leaf blades ≤ 10 cm long; fruit ≤ 15 mm long; only on ultramafic substrates 9
9. Primary and secondary veins tomentose; pedicel and sepals persistent villous *P. lasiantha*
Primary and secondary veins glabrescent; pedicel and sepals tomentulose or tomentose, partly glabrescent 10
10. Secondary veins of 18–25 pairs; sepals evenly tomentulose; pedicel 3–6 mm long *P. azou*
Secondary veins of 10–15(–19) pairs; sepals tomentose, partly glabrescent; pedicel 5–10 mm long *P. lucens*

11. Leaves usually elliptic to oblong; length of petiole usually 1/3 of the blade..... *P. longipetiolata*
Leaves obovate-oblongate; length of petiole less than 1/3 of the blade..... 12
12. Tertiary veins weak, oblique, and somewhat reticulate..... 13
Tertiary veins not distinguishable from the areolate venation..... 15
13. Pedicel 4–10 mm long; corolla white; fruit \leq 12 mm long.....
..... *P. novocaledonica*
Pedicel \geq 10 mm long; corolla cream; fruit \geq 15 mm long..... 14
14. Sepals 3 mm long; flowers unisexual (only female known); corolla 3 mm long..... *P. dioica*
Sepals 3.0–4.5 mm long; flowers bisexual; corolla 5–6 mm long.....
..... *P. tchingouensis*
15. Young leaf blades (except the primary vein) glabrous beneath; pedicel filiform, \leq 0.5 mm thick..... 16
Young leaf blades tomentulose or with a golden pellicle beneath; pedicel not filiform, \geq 0.7 mm thick..... 17
16. Pedicel and at least outer sepals glabrous abaxially; primary vein glabrous..... *P. baueri*
Pedicel and all sepals tomentulose; primary vein usually with some indumentum..... *P. tenuipedicellata*
17. Leaf blades \geq 4 cm long; petiole usually \geq 4 mm long; corolla 2.5–3.5 mm long, cream..... *P. balansana*
Leaf blade \leq 4 cm long; petiole 3–4 mm long; corolla 3–4 mm long, white or greenish..... *P. crebrifolia*

Pleioluma acutifolia Swenson & Munzinger, sp. nov.

(Fig. 3, 4A, 5A.)

Diagnosis: *Pleioluma acutifolia* is diagnosed by its rather large, usually elliptic, 13–23-cm-long, glossy, dark green leaf blade, with impressed secondary venation on the upper surface and acute leaf tips; not possible to confuse with *P. lucens* or *P. novocaledonica* in which leaves are obovate-oblongate and shorter than 10 cm.

Type: Nouvelle-Calédonie, Province Sud, Pont des Japonais, 22°14'19"S, 166°46'24"E, 30 Aug. 2009, *J. Munzinger, U. Swenson, D. & I. Létocart 5759* (holo: P 06707694; iso: MO 6271729, NOU 051324, NOU 051325, S 16-57484, S 16-57846).

Hermaphroditic tree up to 10 m tall. *Leaf blades* elliptic, 13–23 \times 4.0–6.5 cm, dark green and glabrous above, green and tomentulose below, glabrescent except for some persistent trichomes along primary and secondary veins; apex usually acute (or somewhat rounded); venation craspedodromous; secondary veins of 14–22 pairs, impressed above, distinct below; intersecondary veins absent; tertiary veins perpendicular near midvein, oblique in the distal part, faint, hardly seen by naked eye; petiole 20–50 mm long, tomentulose. *Flowers* 5-merous, 2–7 per fascicle, borne on 4–6-mm-long, ferruginous tomentose to tomentulose pedicels. *Sepals* 4–5 mm long with the same indumentum as the pedicel. *Corolla* cream, 4–5 mm long with glabrous lobe margin. *Stamens* inserted in the middle of the corolla tube; anthers 0.8–1.0 mm long. *Staminodes* flat, linear or oblong, truncate, entire. *Gynoecium* forming a narrow cone, 3.0–3.5 mm long, hispid at base, only sparsely pubescent to half of its length. *Fruit* unknown.

Recognition

Pleioluma acutifolia should not be confused with any other congener and is distinguished by rather large, dark green

leaves with impressed secondary veins on the upper surface. Most leaves are acute, but some leaves on the same branch have more or less rounded apices. Some tertiary veins are perpendicular to and fuse with the primary vein (Fig. 3B), which is a character found only in this species of *Pleioluma* in New Caledonia.

Distribution

Pleioluma acutifolia is only known from a small area on the ultramafic formation in southern Grande Terre (Fig. 5A). It grows here in highly disturbed moist lowland forest at ~200-m elevation.

Etymology

This species is named *acutifolia* after the usually acute leaves.

Conservation status

Two known localities of *P. acutifolia* form an EOO of 0.8 km² and an AOO of 8 km². Neither locality is protected, but instead both localities are located in mining concessions under development. Therefore, this species faces a very high extinction risk from future mining activities. Anthropogenic fires are also an important threat in that area. *P. acutifolia* is, therefore, assigned an IUCN preliminary status of *Critically Endangered* (CR): B1ab(iii)+2ab(iii).

Specimens examined

PROVINCE SUD: haute vallée du Creek Pernod, Forêt Cachée, 250-m altitude, 20 Jul. 1973, *H.S. MacKee 26951* (NOU, P, S); piste du Pont des Japonais, 22°14'24"S, 166°46'35"E, 4 Feb. 2007, *J. Munzinger et al. 4118* (NOU, P, S).

Pleioluma azou (P.Royen) Swenson & Munzinger, *Taxon* 62: 763 (2013)

(Fig. 5A.)

Planchonella azou P.Royen, *Blumea* 8: 308, 428 (1957); *Beccariella azou* (P.Royen) Aubrév., *Adansonia, n.s.*, 2: 193 (1962).

Type: Nouvelle-Calédonie, Port Boisé, zone maritime, Oct. 1903, *L. Cribbs 1424* (holo: P 00282463; iso: L 0006346, NOU 009608).

Gynodioecious shrub or tree up to 6 m tall. *Leaf blades* oblanceolate to obovate, 6–10 \times 2.5–3.0 cm, greyish tomentulose, glabrescent, quickly so on the upper surface; apex acute or sometimes obtuse; venation brochidodromous with loops near the margin, often obscured if the margin is revolute; secondary veins of 18–25 pairs, faintly impressed above, distinct below, meeting the primary vein at an angle of 80–90°; intersecondary veins usually present; tertiary veins faint, difficult to distinguish from the areolate venation, or somewhat reticulate near the margin; petiole (6–)8–12(–14) mm long, tomentulose. *Flowers* 5-merous, 1–4 per fascicle, borne on 3–6-mm-long, ferruginous tomentulose pedicels. *Sepals* 3–4 mm long with the same indumentum as the pedicel. *Corolla* cream, 4 mm long with ciliate lobe margin. *Stamens* inserted in the middle of the corolla tube; anthers 0.7–1.0 mm long. *Staminodes* flat, oblong, entire, minute. *Gynoecium*

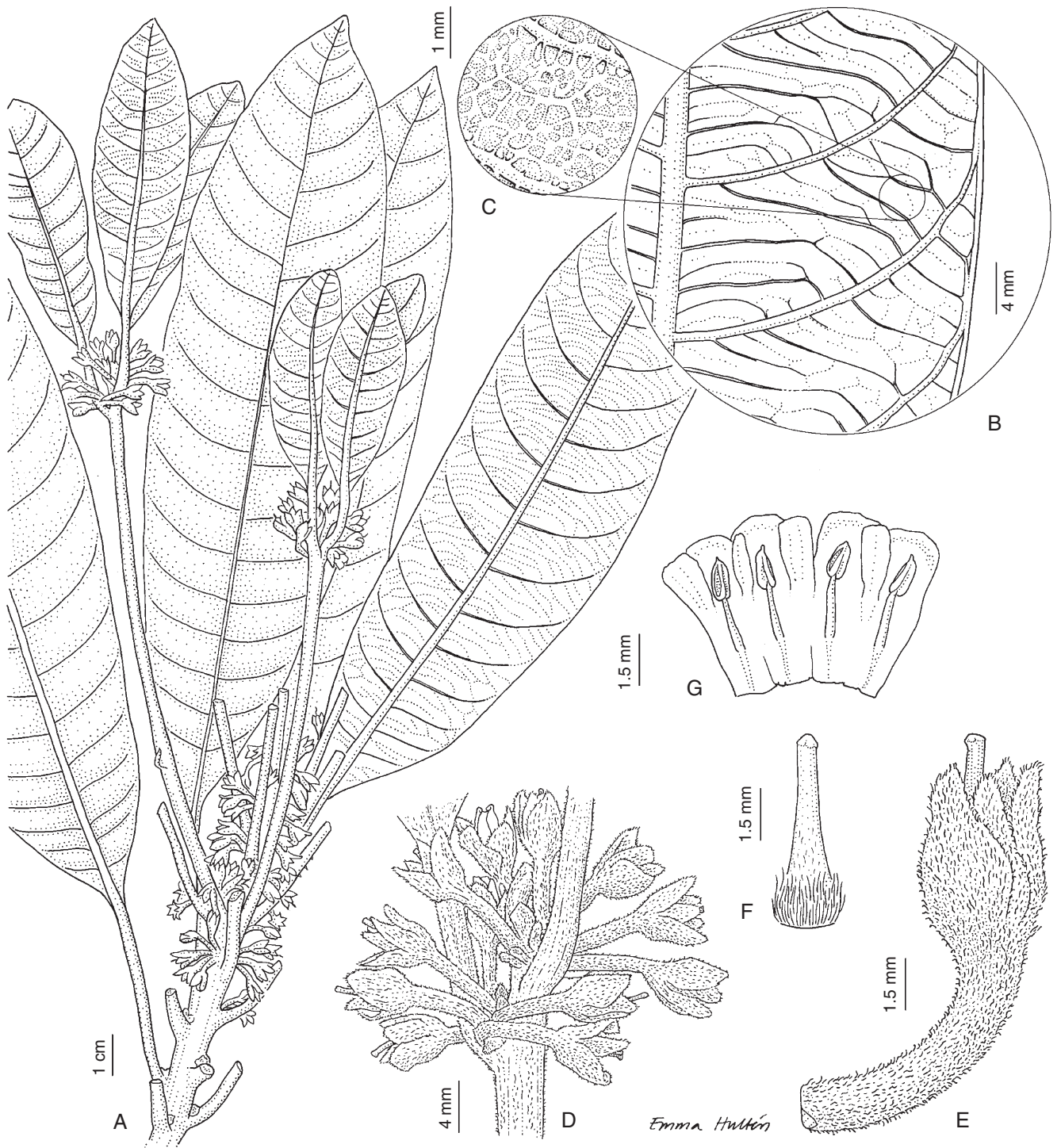


Fig. 3. *Pleioluma acutifolia*. A. Habit. B. Leaf venation (lower surface). C. Close-up of areolate venation (lower surface). D. Inflorescence. E. Flower after fall of corolla. F. Gynoecium with hispid base. G. Open corolla from the inside with stamens inserted in the middle of the corolla tube. Drawn from H.S. MacKee 26951.

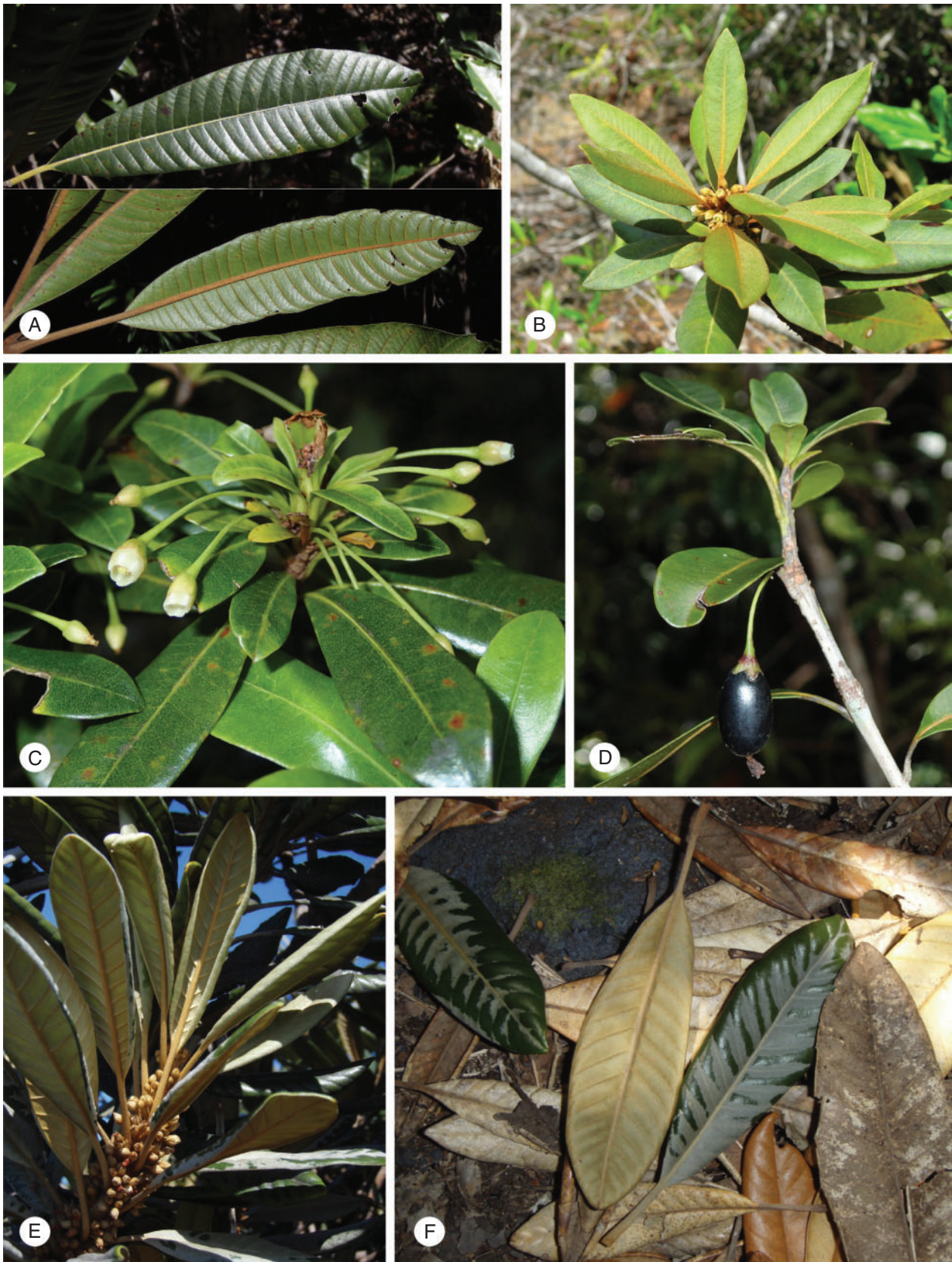


Fig. 4. Field images: A. *Pleioluma acutifolia*. B. *P. balansana*. C, D. *P. baueri*. E, F. *P. belepensis*. Photos: Ulf Swenson (A, C–F) and Vincent Dumontet (B).

forming a narrow cone, 3.0–4.0 mm long, hispid at base. *Fruit* unknown.

Recognition

Pleioluma azou seems to be naturally rare and is poorly known with doubtful systematic status. Fruit has never been collected, which could be an indication of a hybrid origin. No recent flowering material has been found and the description above relies on historical collections. The species should be recognised on two combined features, namely, acute leaves, similar to those of *P. acutifolia* but blades not longer than 10 cm, and secondaries that are almost perpendicular to the primary vein. The leaves are similar to those of *P. lucens*, but have 18–25 pairs of secondary veins, not 10–15 as in *P. lucens*.

Phenology

Flowers have been recorded from September to February.

Distribution

Pleioluma azou occurs in maquis vegetation on different types of ultramafic substrates in the very south of Grande Terre (Fig. 5A).

Etymology

The epithet *azou* is the vernacular name of the plant (van Royen 1957).

Conservation status

Pleioluma azou has an EOO of 193 km² and an AOO of 16 km². Four subpopulations are known, none being in a protected area, of which three are located inside mining concessions. The fourth locality (Col de Yaté) is in an area with a high risk of anthropogenic fire. We, therefore, propose that *P. azou* is assigned an IUCN preliminary status of *Endangered* (EN): B1ab(iii)+2ab(iii).

Specimens examined

PROVINCE SUD: Mont Dzumac, 21 Feb. 1910, *Mr & Mme Le Rat 1102* (P); Plaine des Lacs, 6 May 1964, *J.P. Blanchon 772* (NOU, P); plateau above Goro, 20 Nov. 1981, *G. McPherson 4409* (MO); Prony, Apr. 1914, *I. Franc 1711A* (BRI, G, K, L, P); Prony, 20 Dec. 1914, *I. Franc 1871* (BRI, G, K, P); route de la prise d'eau, Dumbéa, Sep. 1904, *Mr & Mme Le Rat 2253* (P); east slope of Col de Yaté, 22°09'47"S, 166°54'45"E, 220-m altitude, 9 Feb. 2013, *U. Swenson & J. Munzinger 1148* (S); slope above Goro, 100-m altitude, 19 Nov. 1981, *T.D. Pennington & G. McPherson 10339* (K, MO, NOU).

Pleioluma balansana (Pierre ex Baill.) Swenson & Munzinger, *Taxon* 62: 763 (2013)

(Fig. 4B, 5B.)

Sideroxylon balansanum Pierre ex Baill., *Bull. Mens. Soc. Linn. Paris* 2: 889 (1890); *Planchonella balansana* (Pierre ex Baill.) Dubard, *Ann. Mus. Colon. Marseille, sér. 2*, 10: 46 (1912); *Pouteria balansana* (Pierre ex Baill.) Baehni, *Candollea* 9: 317 (1942); *Beccariella balansana* (Pierre ex Baill.) Aubrév., *Adansonia, n.s.*, 2: 193 (1962).

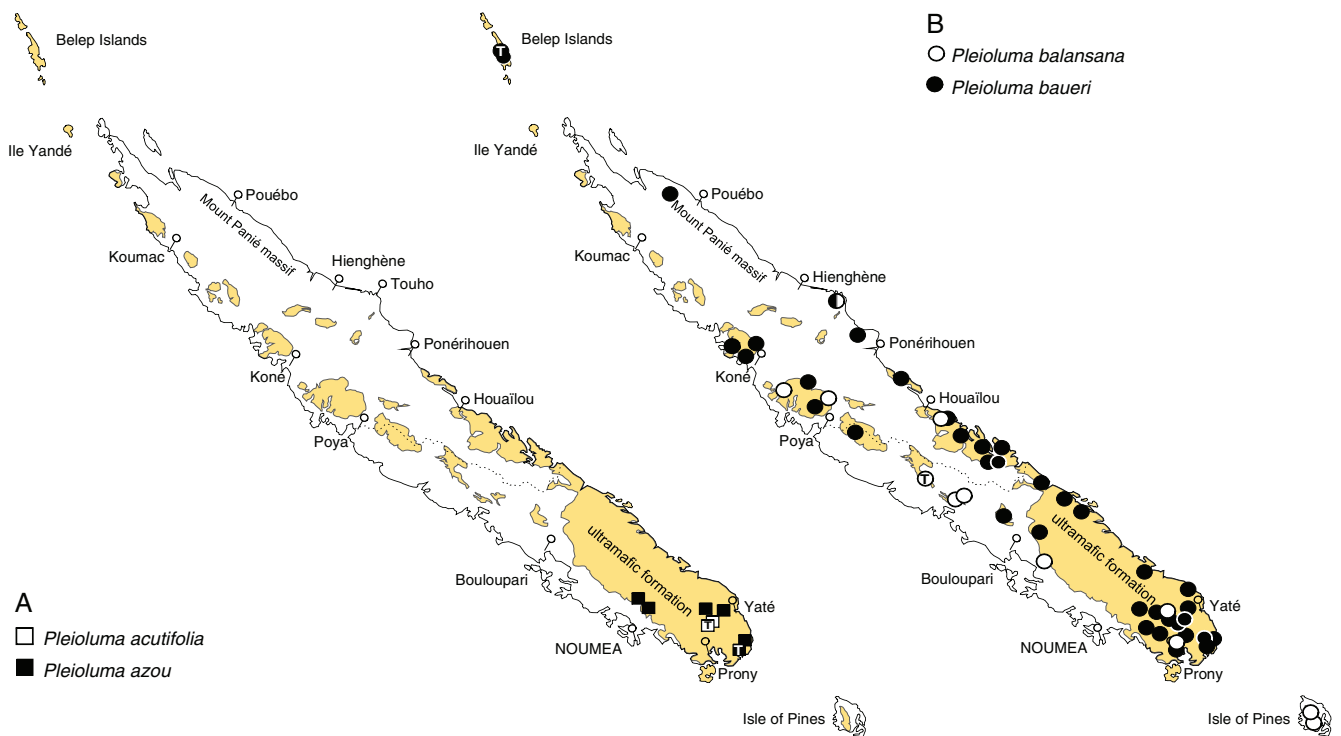


Fig. 5. A. Map of New Caledonia with distribution of *Pleioluma acutifolia* (open squares) and *P. azou* (closed squares). B. Map of New Caledonia with distribution of *P. balansana* (open circles) and *P. baueri* (closed circles). Sympatric species are indicated with half-closed and half-open symbols. T, type localities. Shaded areas are dominated by ultramafic substrates.

Type: Nouvelle-Calédonie, Mont Mi, 20 Feb. 1869, [B.] *Balansa 1327a* (lecto (designated by van Royen (1957, p. 419): P 00292392; iso: P 00292391).

Sideroxylon lecardii Baill., *Bull. Mens. Soc. Linn. Paris* 2: 904 (1891).

Type: Nouvelle-Calédonie, s. dat., *T. Lécard s.n.* (holo: P 00282455).

Planchonella baueri var. *brevipedicellata* P.Royen, *Blumea* 8: 418 (1957); *Beccariella brevipedicellata* (P.Royen) Aubrév., *Fl. Nouv.-Caléd.* 1: 118 (1967).

Type: Nouvelle-Calédonie, Ile des Pines, creek sur la pente SW du Pic N'Ga, 30 May 1951, *M.G. Baumann 13788* (holo: Z 28135; iso: P 00278064, US 113302).

Gynodioecious shrub or tree up to 20 m tall. *Leaf blades* obovate, oblanceolate or elliptic, 4–8 × 1.0–2.0(–2.5) cm, flat, golden or ferruginous tomentulose or tomentum pellicle-like, glabrescent, quickly so on the upper surface, some trichomes usually remain on the primary vein on the lower surface; apex rounded to acute; venation brochidodromous with poorly developed loops; secondary veins of 10–16 pairs, indistinct, not raised above the leaf blade surface on either side; intersecondary veins absent; tertiary veins indistinguishable from the areolate venation; petiole 3–7(–10) mm long, tomentulose. *Flowers* 5-merous, 1–5 per fascicle; pedicel 2–5 mm long, usually ≥0.7 mm wide, tomentulose. *Sepals* 1.0–2.0(–2.5) mm long with the same indument as the pedicel. *Corolla* cream, with white-edged corolla lobes, 2.5–3.5 mm long, sometimes with some minute cilia along the lobe margin. *Stamens* inserted in the middle of the corolla tube; anthers 0.5 mm long. *Staminodes* flat, oblong, entire or fringed. *Gynoecium* flask-shaped, hispid at base, pubescent half of its length. *Fruit* obovoid, 10–12 × 6–8 mm, 1-seeded, pubescent around the 1–2-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller; seed scar 40–45% of the seed length; testa brown, shiny, thin, ~0.2 mm thick.

Recognition

Pleioluma balansana is distinguished by rather small, obovate to oblanceolate leaves, on which only the primary vein is clearly visible. Leaf tomentum is pellicle-like and persists longest on the primary vein on the lower surface, which distinguishes it from the glabrous primary vein in *P. baueri*. Similar leaves with pubescent primary veins are also present in *P. tenuipedicellata*, a cryptic species here identified and distinguished from *P. balansana*. The former species has usually filiform pedicels (6–)8–14 mm long, ~3-mm-long sepals, 3–4-mm-long corolla, and 0.7–1.0-mm-long anthers, being distinctively larger than *P. balansana*, which has shorter pedicels (2–5 mm long), 1.0–2.0-mm-long sepals, 2.5–3.5-mm-long corolla and 0.5-mm-long anthers. *Pleioluma balansana* is restricted to ultramafic substrates, preferably serpentinite, whereas *P. tenuipedicellata* is indifferent but more frequent on schist.

Phenology

The flowering season begins at the end of February and continues until June, when fruit start to develop. Fruit has been recorded

from August to the end of December. The ratio of individuals with bisexual v. female flowers is ~1 : 1.

Distribution

Pleioluma balansana is the only species of *Pleioluma* occurring on Isle of Pines, with scattered records northward, almost reaching Hienghène (Fig. 5B). The species ecology is poorly documented, but it seems to occur in mesic to humid forest, always on ultramafic soils, preferably on serpentinite. One population found along Ponandou River, south of Touho on the eastern coast, occurs in a transition zone between ultramafic soil and schist (see map of Maurizot and Vendé-Leclerc 2012). This species is a member of lowland forests, so far unknown from an elevation above 200-m altitude.

Etymology

Pleioluma balansana was named in honour of Benedict Balansa (1825–1891), a French explorer who collected plants in New Caledonia between 1868 and 1872 (Morat 2010). Balansa is honoured by another three Sapotaceae species in New Caledonia, namely, *Pichonia balansae* (Baehni) Swenson & Munzinger, *Pichonia balansana* Pierre and *Pycnandra balansae* (Baill.) Swenson & Munzinger.

Conservation status

Pleioluma balansana has an EOO of 9147 km² and an AOO of 44 km² distributed in seven subpopulations. No population is located inside a protected area. The species usually occurs on serpentinites, a rock with minor value for mining companies because of the absence of nickel and cobalt; however, this habitat is often close to mined areas and, therefore, damaged by mining infrastructure. Five locations are included in different mining concessions. *Pleioluma balansana* is assigned an IUCN preliminary status of *Vulnerable* (VU): B1ab(i,ii,iii) 2ab(i,ii,iii).

Specimens examined

PROVINCE NORD: Pic Tiaoué [Mont Kopeto], 200-m altitude, 9 Oct. 2008, *J. Fambart-Tinel* (leg. *J.-P. Butin*) 180 (NOU); Poro, 30-m altitude, 6 Apr. 1966, *H.S. MacKee 14683* (L, NOU, P); Poya, Nétéa–Porin Néa, 21°15'06"S, 165°11'27"E, 3 Mar. 2007, *J. Munzinger & al.* 4196 (MO, NOU, NSW, P, S); Touho, Ponandou, 150-m altitude, 2 Jan. 1979, *H.S. MacKee 36354* (BRI, G, K, L, MO, MPU, NOU, NY, P, S). PROVINCE SUD: Col de Mo, 21°57'43"S, 166°10'48"E, 200-m altitude, 24 Nov. 2007, *J. Munzinger & al.* 4917 (K, NOU, P, S) and *J. Munzinger & al.* 4928 (NOU, P, S); Farino, *Lécart 47-44A* (P); Ile des Pins, la pente S du Pic Ngâ, 30 May 1951, *M.G. Baumann 13780* (P); Ile des Pins, slopes and summit of Pic Ngâ, 5 Aug. 1956, *H.S. MacKee 5039* (K, P); Ile des Pins, base ouest du Pic Ngâ, 30-m altitude, 18 Dec. 1965, *H.S. MacKee 14079* (NOU, P); Ile des Pins, versant ouest du Pic Ngâ, 100-m altitude, 9 Jun. 1966, *H.S. MacKee 15096* (K, NOU, P); Ile des Pins, plateau au SO de l'aéroport, 13 Jun. 1967, *M. Schmid 2162* (P, NOU); Ile des Pins, sentier du Pic Ngâ, 15-m altitude, 27 Mar. 2006, *V. Dumontet, C. Poullain & C. Zongo 658* (NOU, P, S); partie supérieur de Dotio, Dec. 1871, *Balansa 3462* (P); près de Bourail, 11 Apr. 1869, *Balansa 1327* (P); Prony, Mar. 1914, *I. Franc 1729A* (E, G, P); Sarraméa, 50-m altitude, 22 Feb. 1966, *H.S. MacKee 14405* (NOU, P), *loc. cit.* 20-m altitude, 20 Dec. 1966, *H.S. MacKee 16080* (P, S), and *loc. cit.* 50-m altitude, 4 Dec. 1991, *H.S. MacKee 45657* (BRI, G, MO, MPU, NOU, P, S).

Pleioluma baueri (Montrouze.) Swenson & Munzinger,
Taxon 62: 763 (2013)

(Fig. 4C, D, 5B.)

Sapota baueri Montrouze., *Mem. Acad. Roy. Sci. Lyon, Sect. Sci.* 10: 229 (1860); *Planchonella baueri* (Montrouze.) Dubard, *Ann. Mus. Colon. Marseille*, sér. 2, 10: 53 (1912); *Pouteria baueri* (Montrouze.) Baehni, *Candollea* 9: 329 (1942); *Beccariella baueri* (Montrouze.) Aubrév., *Adansonia, n.s.*, 2: 193 (1962).

Type: Nouvelle-Calédonie, Ile Art, s. dat., R.P. [X.] Montrouzier 133 (holo: P 00282388; iso: G).

Lucuma baladensis Baill., *Bull. Mens. Soc. Linn. Paris* 2: 896 (1890); *Sideroxylon baladense* (Baill.) Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam., Nachtr.* 1: 277 (1897).

Type: Nouvelle-Calédonie, versant des montagnes, Balade, s. dat., [E.] Vieillard 79 (lecto (here designated): P 00290178); isolecto: G 00434810, K, P 00290179, P 00282382, P 00282383, P 00282384).

Lucuma jacquiniifolia Baill., *Bull. Mens. Soc. Linn. Paris* 2: 897 (1891); *Sideroxylon jacquiniifolium* (Baill.) Engl. in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam., Nachtr.* 1: 277 (1897); *Planchonella jacquiniifolia* (Baill.) Dubard, *Ann. Mus. Colon. Marseille*, sér. 2, 10: 52 (1912); *Planchonella baueri* var. *jacquiniifolia* (Baill.) P.Royen, *Blumea* 8: 418 (1957).

Type: Nouvelle-Calédonie, forêt de la Baie de Prony, Sep. 1868, [B.] Balansa 452 (lecto (here designated): P 00282428); isolecto: P 00282429).

Gynodioecious shrub or treelet up to 4 m tall. *Leaf blades* obovate–oblanceolate, size variable, 2–12 × 1.0–5.0 cm, flat, glabrous; apex rounded, retuse or sometimes subacute; venation brochidodromous with poorly developed loops; secondary veins of 12–20 pairs, indistinct and very faint, not raised above the leaf blade surface on either side; intersecondary veins present; tertiary veins indistinguishable from the areolate venation; petiole 5–7(–15) mm long, glabrous. *Flowers* 5-merous, rarely 4-merous, 1 or 2 per fascicle; pedicel (8–) 18–25(–40) mm long, filiform, ~0.5 mm wide, glabrous. *Sepals* 2.0–3.0 mm long, the outer abaxially glabrous, the overlapped sometimes sparsely tomentulose on the abaxial surface, but trichomes from the inner surface often fringe the margin. *Corolla* 3.0–4.0 mm long, white to greenish, with white-edged corolla lobes, sometimes with some minute cilia along the margin. *Stamens* inserted near the corolla base; anthers 0.7–1.0 mm long. *Staminodes* flat, oblong, entire, often reduced in female flowers. *Gynoecium* conical, hispid at base. *Fruit* obovoid, 12–17 × 7–10 mm, often asymmetric at the top, 1 or rarely with 2 seeds, pubescent around the 3–5-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller; seed scar 40–45% of the seed length; testa brown, shiny, thin, 0.3–0.4 mm thick.

Recognition

Pleioluma baueri is readily distinguished and should not be confused with any other congener. It is the only species with glabrous leaves, petioles, pedicels and sepals, except that the overlapped sepals may have some scattered trichomes on the adaxial surface, and the flowers and fruit are borne on long, filiform, pendant pedicels. Populations with some indumentum

on the overlapped sepals occur in the massif of Boulinda, Koniambo and Oua Tilou. The only species it may resemble is *P. tenuipedicellata*, which differs in having indumentum on the petioles, pedicels, sepals and primary veins on the lower leaf surface. Leaves of *P. baueri* vary in size across its distribution. Plants from the type locality, Ile Art, have the largest leaves, often ~10 cm long, whereas individuals in the southern part of Grande Terre frequently have leaves only 2–4 cm long.

Phenology

The flowering season is long; flowers and fruit, often on the same individual, have been collected throughout the year. There seems to be a small pause in February; however, we predict that flowering is more a response to variation in weather than the seasons. Female plants seem to be predominant in *Pleioluma baueri*.

Distribution

Pleioluma baueri is the most common and widely distributed species of New Caledonian *Pleioluma*, ranging from Ile Art in the north to the southern tip of Grande Terre (Fig. 5B). It occurs in rather dry maquis vegetation to dense humid forests, always on ultramafic substrates, from sea level to ~1000 m in altitude. One locality west of Pouébo, on the trail to the hill Parari, is on a small isolated pocket of serpentine surrounded by schist.

Etymology

The plant is probably dedicated to Franz Andreas Bauer (1758–1840), botanist and illustrator, whom Montrouzier may have met in Montpellier.

Conservation status

Pleioluma baueri is usually very common where it grows and 16 subpopulations are known. We have calculated the EOO to 15 084 km² and the AOO to 248 km². It occurs in eight protected areas in Province Sud, including Barrage de Yaté, Chutes de la Madeleine, Haute Pourina, Montagne des Sources, Mont Do, Parc Provincial de la Rivière Bleue, Pic du Grand Kaori, and Saille; and it is, therefore, assigned an IUCN preliminary status of *Least Concern* (LC).

Nomenclatural note

Baillon (1890b) described *Lucuma baladensis* on the basis of *Vieillard 79* from Balade deposited in Vieillard's herbarium. Eugène Vieillard was a French naval surgeon and botanist who numbered his specimens according to perceived species rather than gatherings (Hopkins and Bradford 2009). Vieillard's number 79 represents at least two different gatherings, one from Balade and another from Wagap. In France, there are five specimens of *Vieillard 79* from Balade, and they were deposited in different herbaria, but are now gathered together in the Paris herbarium. We can find no evidence that Baillon used one particular specimen that can be considered the holotype *sensu* McNeill (2014) and it is therefore appropriate, following ICN Art. 9 (McNeill *et al.* 2012), to designate a lectotype. The specimen here selected is more complete than the others, having both flowers and fruit.

One month later, Baillon (1891a) described *Lucuma jacquiniifolia* using three different collections, viz. *Balansa*

452 and *Balansa 452a* from 'Baie de Prony' as well as *Balansa 1328* from 'Mont Mi', all of which are part of the original material and are syntypes, according to Article 9.5 of the ICN (McNeill et al. 2012). Baillon (1891a) described both hermaphroditic and female flowers, which is evident from notes on the sheet *Balansa 452* (P 00282428); however, this is not enough to consider *Balansa 452* as holotype because all three gatherings were cited (McNeill 2014). However, there is no doubt that the specimen *Balansa 452* was used by Baillon, and because it is the best-preserved specimen, it is therefore selected as lectotype.

Selected specimens

PROVINCE NORD: Povila, 230-m altitude, 10 Feb. 2005, *J. Munzinger* (leg. *J.-P. Butin*) 2779 (NOU); Povila, 235-m altitude, 165°17'44"E, 20°56'8"S, 4 Oct. 2009, *J. Munzinger & al.* 5903 (NOU); Belep Islands, Ile Art, 21 Jun. 1871, [*B.J. Balansa 3146*] (P); Ile Art, plateau nord, 150-m altitude, 8 Dec. 1975, *H.S. MacKee 30413* (G, MO, MPU, NOU, P, S); Ile Art, 25 Aug. 1978, *P. Morat 6185* (NOU, P) and *C. Tirel 1314* (MPU, P); Ile Art, north plateau, along the most eastern prospecting track, 19°42'10"S, 163°40'01"E, 256-m altitude, 24 Aug. 2009, *U. Swenson, J. Munzinger & L. Barrabé 912* (NOU, P, S) and *915* (MO, MPU, NOU, P, S); Ile Art, plateau sud, 24 Aug. 1978, *J.-M. Veillon 3701* (NOU, P, S). Boulinda, 900-m altitude, 9 Dec. 1970, *J.-M. Veillon 2238* (NOU, P); Boulinda, 21°17'00"S, 165°06'19"E, 23 Jan. 2008, *J. Munzinger, L. Barrabé & F. Rigault 4973* (NOU, P, S); crête au nord du Négropo, 400–500-m altitude, 6 Jan. 1966, *H.S. MacKee 14152* (P); base du Koniambo, Dec. 1973, *T. Jaffré 1266* (MPU, NOU, P); Koniambo, 900-m altitude, 6 Nov. 1990, *I.H. Müller 152* (P); Koniambo, S of Voh, 750-m altitude, 13 Oct. 1982, *G. McPherson 5030* (K, MO, NOU, P); Koniambo, 700-m altitude, 26 Oct. 2000, *T. Jaffré 3464* (NOU, P); Koniambo, Trazy, parcelle Ultrabio 1, 20°59'56"S, 164°49'40"E, 4 Apr. 2008, *J. Munzinger & M. Ducouso 5027* (NOU, S); Kouaoua, Dahi, 500-m altitude, 30 Mar. 1977, *H.S. MacKee 32983* (G, K, MO, MPU, NOU, P, S); Monéo, nord du massif – relevé Monéo 03, 21°08'24"S, 165°31'37"E, 90-m altitude, 26 Sep. 2007, *R. Barrière 155* (NOU, P, S); Mont Paéoua, 800–1100-m altitude, 14 Oct. 1967, *H.S. MacKee 17682* (G, NOU, P, S); Mont Paéoua, 21°09'43"S, 165°04'52"E, 717-m altitude, 26 Jan. 2010, *J. Munzinger & al.* 6027 (NOU, P, S); Nakety, Ouen Fémal, 300-m altitude, 29 Sep. 1989, *H.S. MacKee 44643* (NOU, P); Ponandou, Touho, 10–100-m altitude, 2 Jan. 1973, *H.S. MacKee 26150* (P); Poro, 5 km S, 600-m altitude, 1 May 1966, *H.S. MacKee 14850* (P); presque Ile de Bogota, 500-m altitude, 13 Sep. 1989, *H.S. MacKee 44611* (NOU, P); route du Col de Parari, 12 Feb. 1969, *M. Schmid 2732* (NOU, S); route Poro–Kouaoua, 500-m altitude, 10 Jan. 1991, *T. Jaffré 3103* (NOU, P). PROVINCE SUD: along banks of La Madeleine (Rivière de Lacs), S of Nouméa–Yaté road, 300-m altitude, 31 Aug. 1980, *G. McPherson 3007* (K, MO, NOU, P); along Noumea–Yaté road, E slope of Col de Yaté., 22°09'47"S, 166°54'45"E, 220-m altitude, 9 Feb. 2013, *U. Swenson & J. Munzinger 1141* (MPU, NOU, P, S); basse Rivière des Pirogues, 100-m altitude, 11 Oct. 1979, *H.S. MacKee 37431* (P); bassin de la Tontouta proximité mine SMMO 43, 280-m altitude, 6 Dec. 1988, *T. Jaffré & F. Rigault 2996* (NOU, P); Creek Pernod, 22°10'53"S, 166°50'28"E, 9 May 2004, *J. Munzinger & al.* 2030 (MO, NOU, P, S); crête au sud de la Baie de Ouinné, 21°59'49"S, 166°40'36"E, 300-m altitude, 5 Aug. 1973, *H.S. MacKee 27163* (K, MO, MPU, NOU, P, S); Forêt de Bon Secours, 12 Oct. 2006, *L. Barrabé* (leg. *F. Rigault & D. Kurpisz*) 379 (NOU, P); Forêt mois de Mai, Plaine des Lacs, 300-m altitude, 14 Aug. 1951, *M.G. Baumann-Bodenheim 15157* (G, MO, P); Goro, Ouendiana., 150-m altitude, 30 Oct. 1970, *H.S. MacKee 22829* (MPU, NOU, P, S); Goro, vallée de Tou, 100-m altitude, 13 Dec. 1990, *H.S. MacKee 45216* (NOU, P, S); Goro, 22°16'07"S, 166°56'30"E, 9 May 2004, *J. Munzinger & al.* 2034 (MO, NOU, P, S); haute Rivière Blanche, mois de Mai, 24 Jun. 1951, *M.G. Baumann-Bodenheim 14219*

(MO, P); hauteurs de Yaté, 250-m altitude, 13 Oct. 1985, *H.S. MacKee 42865* (BRI, G, L, MO, MPU, NY, P, S); Me Maoya, 300-m altitude, 30 Nov. 1992, *T. Jaffré 3218* (NOU, P, S); Mé Ouébo, 400-m altitude, 18 Dec. 1981, *J.-M. Veillon 4773* (NOU, P); Mont Mi, 25 Mar. 1896, *Balansa 1328* (P); Montagne des Sources, 700-m altitude, 14 Dec. 1979, *G. McPherson 2230* (MO, NOU, P); Mount Do, ~13 air-km NNW of Bouloupari, 800-m altitude, 3 Nov. 1979, *G. McPherson 1996* (K, NOU, P); Mamié, nord de Yaté, 400-m altitude, 8 Feb. 2005, *J. Munzinger, F. Rigault & G. Dagostini 2655* (NOU, P, S); Mois de Mai, 400-m altitude, 5 Jan. 1967, *J.-M. Veillon 1014* (NOU); Plaine des Lacs, Creek Pernod, 150-m altitude, *H.S. MacKee 14270* (K, NOU, P); Plaine des Lacs, route du Carenage près de la Capture, 250-m altitude, 10 Mar. 1966, *H.S. MacKee 14519* (P); Port Boisé, 75-m altitude, 19 Nov. 1981, *T.D. Pennington & G. McPherson 10336* (K, MO, NOU); Poro, Kaséoua, 17 Dec. 1992, *H.S. MacKee 46065* (P); Port Bouquet, Rivière Koum, 80-m altitude, 27 Nov. 2001, *J. Munzinger 1099* (MO, NOU, P); Prony, Sep. 1868, *Balansa 452a* (P); Prony, Mar. 1914, *I. Franc 1728* (A, E, K, P); Prony, tracé du 'Tuyau', 5 Apr. 2005, *J. Munzinger, G. Dagostini & F. Rigault 2764* (NOU, P, S); Réserve du Pic du Grand Kaori, 22°17'31"S, 166°53'37"E, 30 Aug. 2007, *J. Munzinger & al.* 4480 (NOU, P); Rivière Bleue Reserve, 150-m altitude, 17 Nov. 1981, *G. McPherson 4399* (MO); Rivière Bleue Reserve, trail to les Electriques, 1700-ft altitude, 17 Nov. 1981, *T.D. Pennington & G. McPherson 10322* (K, MO, NOU); Rivière des Lacs, 5 km en aval de la chute, 200-m altitude, 30 Nov. 1986, *H.S. MacKee 43369* (G, MO, NOU, P, S); Rivière des Pirogues, 6 Sep. 1981, *A. Gentry & G. McPherson 34473* (MO); route de Yaté, Rivière Bleue, 300-m altitude, 16 Jun. 1977, *H.S. MacKee 33318* (P, NOU, S); route de Yaté–Noumea, 3.5 km après le col de mouirange, intersection avec un creek en direction de Yaté, 19 Jan. 1999, *J. Munzinger 340* (NOU, P, S); trackside near the Madeleine Falls, 21 Nov. 2000, *J.H. Hemsley 7162* (K); valley of Rivière des Pirogues, 280-m altitude, 11 Sep. 1983, *G. McPherson 5779* (MO, NOU, P); Yaté, hauteurs à l'est du barrage, 22°09'21"S, 166°53'48"E, 350-m altitude, 9 Nov. 1970, *H.S. MacKee 22860* (BRI, G, MO, NOU, NY, P, S); Yaté, ancienne route à horaire, 22°10'S, 166°53'E, 8 Aug. 2004, *J. Munzinger 2306* (MO, NOU, P, S).

Pleioluma belepensis Swenson & Munzinger, sp. nov.

(Fig. 4E, F, 6, 7A.)

Diagnosis: *Pleioluma belepensis* is diagnosed by its brownish, glabrescent foliage with strongly revolute leaf margin, conspicuous secondary venation, and snowy-white flowers.

Type: New Caledonia, Province Nord, Ile Art, North Plateau, ~50 m east of the most eastern prospecting track, 19°41'44"S, 163°39'51"E, 256-m altitude, 26 Aug. 2009, *U. Swenson, J. Munzinger & L. Barrabé 917* (holo: P; iso: BRI, CHR, G, MO, NOU 051213, S 09-36489, S 09-39368, S 09-39369).

Hermaphroditic tree 3–4 m tall, with fawn indumentum on primary and secondary veins, petioles, pedicels and sepals. *Leaf blades* elliptic to obovate, 6.5–16.0 × 2.5–5.0 cm, coriaceous, light brown tomentulose on both surfaces, glabrescent above, revealing a dark green blade; apex usually acute to rounded; venation craspedodromous or brochidodromous with weak loops, difficult to observe behind the revolute leaf margin; secondary veins of (11–)15–20 pairs, impressed above, conspicuous below; intersecondary veins absent; tertiary veins indistinguishable from the areolate venation, but oblique, faint below if the tomentum is removed; petiole 18–35 mm long, tomentulose. *Flowers* 5-merous, 1–4 per fascicle, borne on 4–8 mm long, tomentulose pedicels. *Sepals* 4 mm long, rather acute, tomentulose. *Corolla* snowy-white, 4 mm long with

glabrous lobe margin. *Stamens* inserted in the mid-section of the corolla tube; anthers 0.8–1.0 mm long. *Staminodes* flat, linear or oblong, truncate, entire. *Gynoecium* forming a narrow cone, hispid at base, pubescent over basal half. *Fruit* unknown.

Recognition

Pleioluma belepensis is a handsome tree with beautiful foliage and has high potential as an ornamental tree, provided it can be cultivated and propagated. It is readily distinguished from all other congeners by its light brown, coriaceous leaves with strongly revolute margins, and fawn tomentum on the venation, petioles, pedicels and sepals that contrast to the lighter lower blade surface (Fig. 4E). The tree sets snowy-white flowers, each probably being short-lived.

Phenology

Flowers have been collected in August of 1978 and 2009; fruit has never been observed.

Distribution

Pleioluma belepensis is a micro-endemic species known only from the northern plateau on Ile Art where it grows in short, closed evergreen forest on ultramafic substrate formed by rocky iron crust (Fig. 7A). We were able to locate only a single old tree, but the species has been collected twice before, once by Cristiane Tirel and once by Jean-Marie Veillon, both collections being from 25 August 1978. Because these two collectors were on the same expedition to the Belep Islands, we suspect that both collections are from the same tree, whereas our type collection is probably from another individual because the records of Tirel and Veillon are from 50-m altitude and ours is from 264-m altitude.

Etymology

Pleioluma belepensis is named after the archipelago where it occurs, the Belep Islands (Îles Belep).

Conservation status

In August 2016, a huge, tragic anthropogenic fire destroyed 10.5 km² (20%) of the vegetation in Art Island. The only tree we saw in 2009 of *P. belepensis* (the type locality), judging from satellite images, did not succumb to the flames; however, the fate of the collection site from 1978 is unclear. The AOO of *P. belepensis* is calculated as 8 km² and includes the locality from 1978, with the hope that it is intact. The entire distribution area corresponds to a single subpopulation without protection, unfortunately within a mining concession. When we described *Pycnandra belepensis* Swenson & Munzinger, another micro-endemic for the island, we stressed that the northern plateau houses the last intact primary forest and suggested that it should be protected against further mismanagement and set aside as a nature reserve to protect this unique vegetation on Art Island (Swenson and Munzinger 2010a, p. 191). Without doubt, the risk that *P. belepensis* will go extinct is high and the species is here given a preliminary Red List assessment as *Critically Endangered* (CR): B2ab(iii), D1+2.

Specimens examined

PROVINCE NORD: Ile Art, N de Waala, 50-m altitude, 25 Aug. 1978, C. Tirel 1311 (P, S), and J.-M. Veillon 3719 (NOU, P, S).

Pleioluma butinii Swenson & Munzinger, sp. nov.

(Fig. 7A, 8.)

Diagnosis: *Pleioluma butinii* is similar in habit and foliage to *Pichonia daenikeri*, but differs in having oblique tertiary veins (not laxly reticulate), pubescent sepals on the entire inner surface (not only in the upper half), and stamens inserted near the base of the corolla tube (not in tube orifice).

Type: Nouvelle-Calédonie, Dôme de Tiébaghi, plateau central, 550-m altitude, 17 Jul. 1977, H.S. MacKee 33512 (holo: S 05-10657; iso: BRI, G, NOU 011122, P 00291142).

Hermaphroditic shrub up to 4 m tall. *Leaf blades* elliptic or somewhat obovate, 6–8(–11) × 3–4 cm, ferruginously tomentose on both sides, quickly glabrescent above except for the primary vein, exposing a shiny green surface, indumentum falling off in patches below, usually leaving trichomes along primary and secondary veins, ultimately glabrous; base cuneate, often asymmetric; apex usually rounded; venation craspedodromous; secondary veins of 10–13 pairs, slightly impressed above, distinct below; intersecondary veins absent; tertiary veins oblique, faint, hardly seen by naked eye; petiole 10–22 mm long, tomentulose. *Flowers* 5-merous, 2 or 3 per fascicle, sessile. *Sepals* 4 mm long, tomentulose. *Corolla* cream, 4.0–5.0 mm long with glabrous lobe margin. *Stamens* inserted near the corolla-tube base; anthers 1.0 mm long. *Staminodes* flat, oblong, entire. *Gynoecium* flask-shaped, 3.0–3.5 mm long, hispid to half of its length. *Fruit* unknown.

Recognition

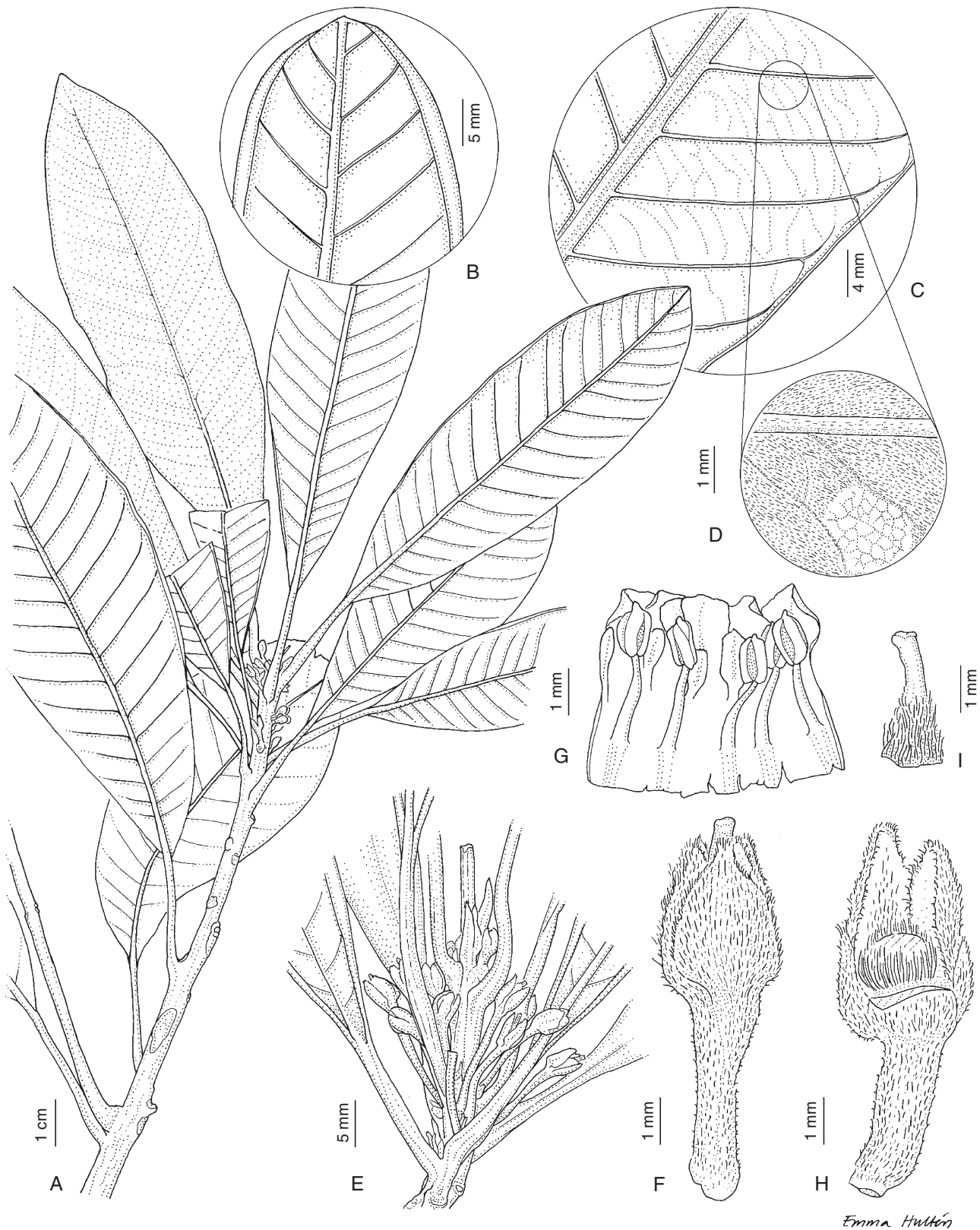
Pleioluma butinii, especially in its foliage and sessile flowers, resembles *Pichonia daenikeri* more than it does any of its congeners. *Pichonia daenikeri* is restricted to ultramafic substrates and the type locality is also on the Tiébaghi massif. Sterile material of these two can be difficult to separate, but the leaf venation of *Pleioluma butinii* is craspedodromous with faint oblique tertiaries, whereas it is brochidodromous with weak submarginal loops and a lax reticulate tertiary venation in *Pichonia daenikeri*. However, fertile material is readily separable because the stamens are inserted near the corolla base and the cotyledons better be foliaceous (even if yet being unknown) in *Pleioluma butinii*, v. stamens inserted in corolla-tube orifice and seeds with plano-convex cotyledons in *Pichonia daenikeri*.

Phenology

Seems to flower in May through July, possibly longer; fruit unknown.

Distribution

Pleioluma butinii is known from a handful of collections from the ultramafic-rich Dôme de Tiébaghi and a single collection near Roche Ouaième north-west of Hienghène (Fig. 7A). Roche Ouaième is part of Ton-Non, a massif composed of siliceous schist, partly with pH as low as 4 (Bradford and Jaffré 2004). The presence of this new species on Ton-Non is surprising and



Emma Hulthén

Fig. 6. *Pleioluma belepensis*. A. Habit. B. Leaf apex with revolute margin. C. Lower leaf surface with venation. D. Close-up of lower blade with indumentum removed to expose the areolate venation. E. Inflorescence. F. Flower. G. Open corolla. H. Flower with one sepal removed. I. Gynoecium. Drawn from U. Swenson *et al.* 917 (A–I).

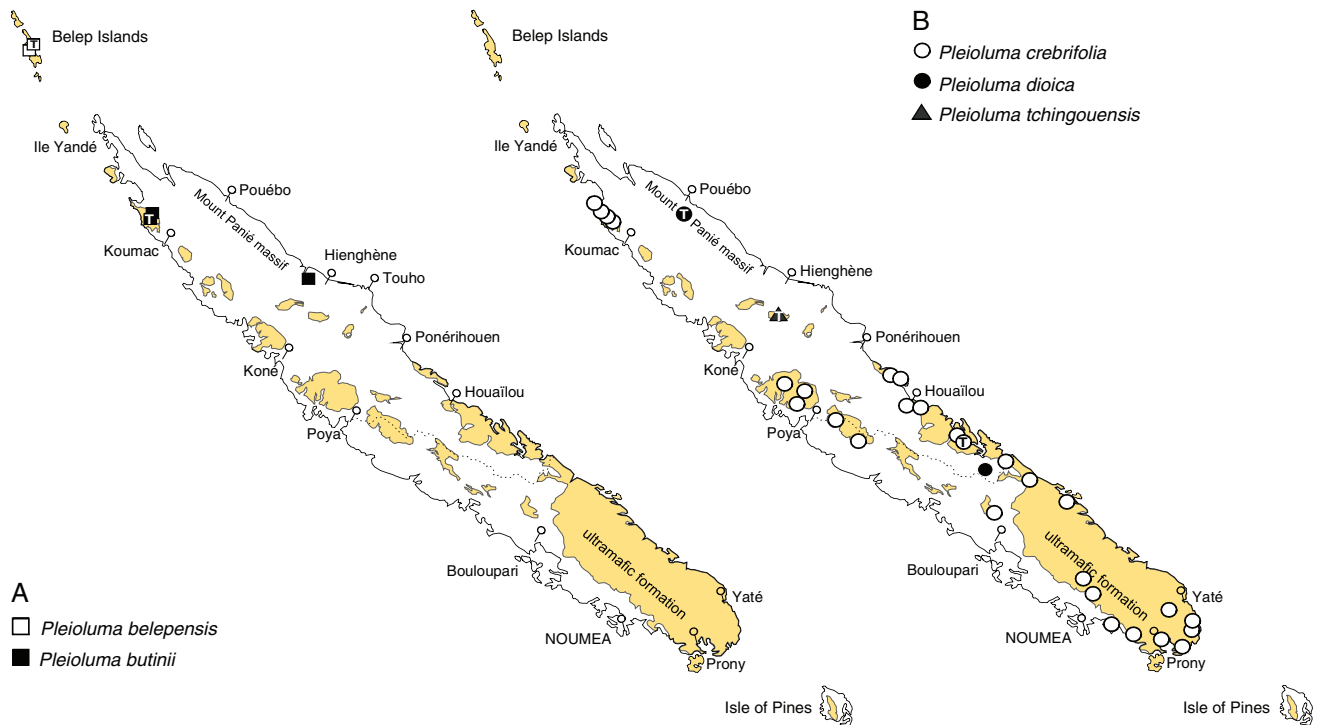


Fig. 7. A. Map of New Caledonia with distribution of *Pleioluma belepensis* (open squares) and *P. butinii* (closed squares). B. Map of New Caledonia with distribution of *P. crebrifolia* (open circles), *P. dioica* (closed circles), and *P. tchingouensis* (closed triangle). T, type localities. Shaded areas are dominated by ultramafic substrates.

efforts to relocate any population in an altitude of 350–650 m have failed. It is presumed to occur in undergrowth vegetation in tall maquis, but information on habitat is scarce.

Etymology

We dedicate this species to Jean-Pierre Butin (1953–present), a retired forest technician, passionate and autodidact botanist, for all his observations, collections, and crucial field assistance in New Caledonia (Fig. 9). Jean-Pierre has the ability to find rare and new plants in the green vegetation. His company and friendship on many field trips during nearly two decades are unforgettable. The species we dedicate to him is as discreet and rare as our friend.

Conservation status

The AOO of *P. butinii* is calculated as 8 km² (EOO cannot be calculated with only two localities), distributed on two subpopulations, one on Ouaième (*H.S. MacKee 14762*) and another on Dôme de Tiébaghi. The first mentioned has not been relocated and the second, Dôme de Tiébaghi, is currently under intensive mining activity, which has removed most of the soil surface and vegetation from the plateau (the type locality ‘plateau central’ is considered destroyed). The species was relocated in a place criss-crossed by trails that are usually cut before complete clearing of the vegetation. Without an active conservation plan by the mining company, we predict that *P. butinii* will shortly disappear from Tiébaghi. We assign it a preliminary IUCN status of *Critically Endangered* (CR): A2+3a,c,d, B2b(iii)c(i,ii,iii,iv).

Specimens examined

PROVINCE NORD: Dôme de Tiébaghi, 400-m altitude, 15 Oct. 1975, *T. Jaffré 1410* (NOU, P); Tiébaghi, 350-m altitude, 6 May 1978, *T. Jaffré 2465* (NOU, P, S); Tiébaghi, vers Fantoche, au nord-est du massif, 20°26'14"S, 164°11'55"E, 15 Apr. 2014, *J. Munzinger & al. 7295* (MO, MPU, NOU, P, S); piton dégagé sur la crête ouest de la Roche Ouaième, 650-m altitude, 19 Apr. 1966, *H.S. MacKee 14762* (MO, NOU, P, S).

Pleioluma crebrifolia (Baill.) Swenson & Munzinger,
Taxon 62: 763 (2013)

(Fig. 7B, 10A, B.)

Lucuma crebrifolia Baill., *Bull. Mens. Soc. Linn. Paris* 2: 897 (1891); *Sideroxylon crebrifolium* (Baill.) Engl. in H.G.A. Engler & K.A. E. Prantl, *Nat. Pflanzenfam., Nachtr.* 1: 277 (1897); *Planchonella crebrifolia* (Baill.) Dubard, *Ann. Mus. Colon. Marseille*, sér. 2, 10: 53 (1912); *Beccariella crebrifolia* (Baill.) Aubrév., *Adansonia, n.s.*, 2: 193 (1962); *Pouteria crebrifolia* (Baill.) Baehni, *Boissiera* 11: 59 (1965).

Type: Nouvelle-Calédonie, Collines éruptives entre Canala et Couaoua, Apr. 1871, [*B.*] *Balansa 3154* (lecto (designated by Swenson *et al.* (2013): P 00282377; isolecto: P 00282375, P 00282376, P 00282378).

Gynodioecious much-branched shrub or treelet 3–4 m tall. *Leaf blades* obovate–oblanceolate, 1.5–4.0 × 0.5–1.0 cm, flat, brownish tomentulose on both sides, quickly glabrescent except for the primary vein on the lower side, eventually glabrous; apex rounded to acute; venation brochidodromous, poorly developed, not raised above the leaf blade on either surface, secondaries and tertiaries usually impossible to distinguish

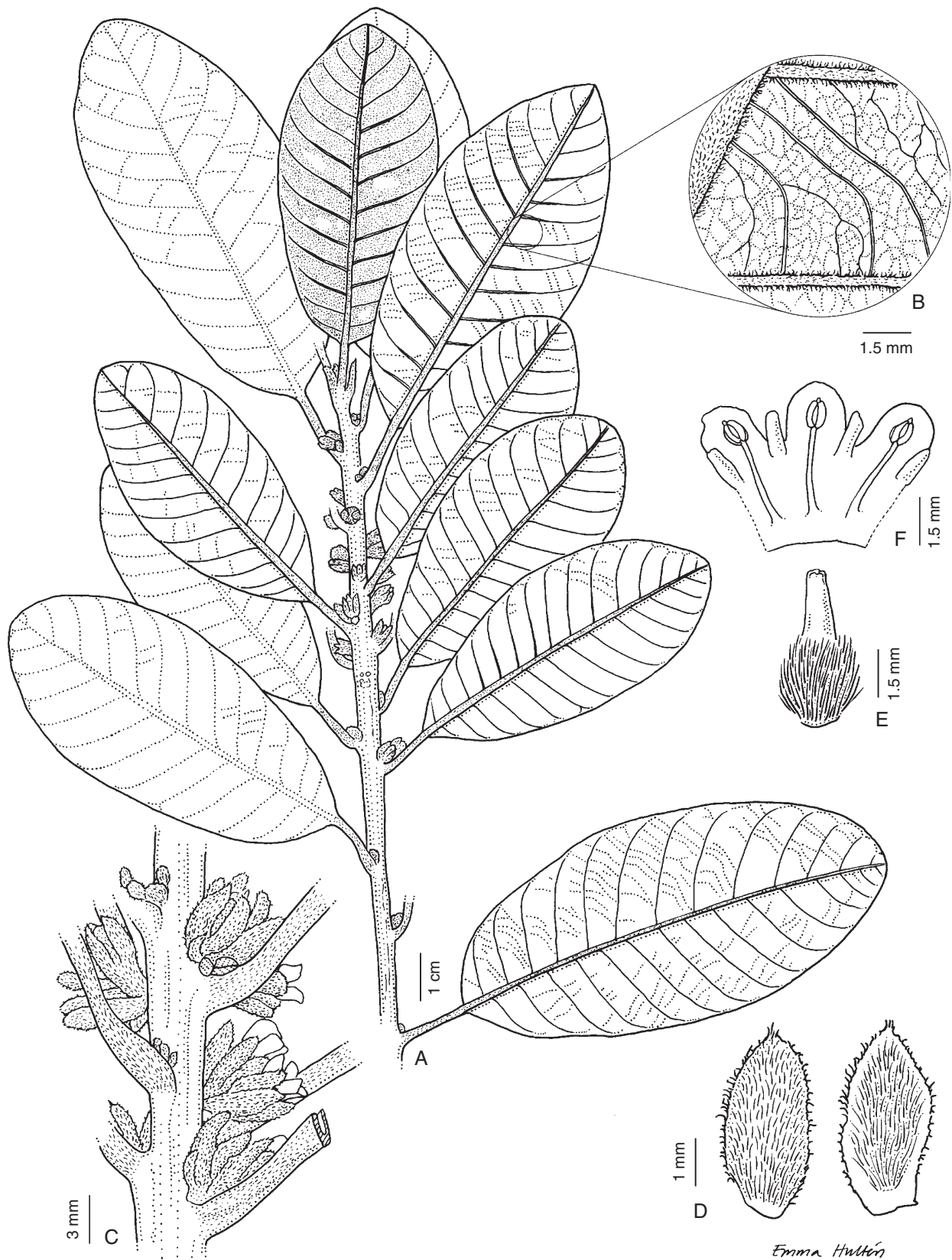


Fig. 8. *Pleioluma butinii*. A. Habit. B. Close-up of leaf venation (lower surface). C. Axillary and sessile flowers. D. Sepal from the outside (left) and inside (right). E. Gynoecium. F. Corolla with three corolla lobes (two removed). Drawn from *H.S. MacKee 33512* (A–F).



Fig. 9. Dressed for fieldwork in mining areas; Ulf Swenson (left) together with Jean-Pierre Butin (right) to whom we here dedicate the new species *Pleioluma butinii*, growing in the mining area on Dôme de Tiébaghi.

from the areolate venation; petiole 3–4 mm long, tomentulose. *Flowers* (4–)5-merous, usually 1 per fascicle; pedicel 4–8(–10) mm long, tomentulose. *Sepals* 2.5 mm long, with the same indumentum as the pedicel. *Corolla* white or tinged greenish, with white-edged corolla lobes, 3–4 mm long, with glabrous lobe margin. *Stamens* inserted in the middle of the corolla tube; anthers 0.5–0.6 mm long. *Staminodes* flat, oblong, entire, reduced in female flowers. *Gynoecium* conical to flask-shaped, hispid at base. *Fruit* obovoid, 6–12 × 5–6 mm, 1-seeded, pubescent around the 2–3-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller and compressed from the sides; seed scar 30–50% of the seed length; testa brown, shiny, thin, 0.3–0.4 mm thick.

Recognition

Pleioluma crebrifolia is usually readily distinguished from all congeners by rather long, slender branches that terminate with many, small (<4 cm long), closely clustered leaves. The secondary and tertiary leaf venation is usually indistinguishable from the areolate venation. Flowers are rather small, usually hidden between the leaves, white or somewhat greenish with white corolla lobe margin.

Phenology

Flowers and at least immature fruit seem to be produced throughout the year, with peak flowering in May and mature fruit in December and January. Individuals with female flowers are probably naturally rare.

Distribution

Pleioluma crebrifolia seems to be restricted to Grande Terre, occurring from Dôme de Tiébaghi in the north to Prony in the

south (Fig. 7B). It is a rather common species growing in maquis vegetation at low elevations, from sea level to 400-m altitude, occasionally higher, and it usually occurs on ultrabasic serpentinite. The species is not recorded from several ultramafic areas, but we predict it is present in additional areas where maquis vegetation occurs.

Etymology

The species epithet *crebrifolia* was probably adopted for the closely (*creber*) arranged leaves (*folia*), which is a useful diagnostic character.

Conservation status

Pleioluma crebrifolia is known from 19 subpopulations, which have an EOO of 12 614 km² and an AOO of 200 km². The species occurs in two protected area in Province Sud, Cap N'Dua and Parc de la Dumbéa. It is rather common in places, especially on serpentinites, a rock type not particularly targeted by mining interests; however, mining infrastructure does pose problems through habitat fragmentation. *Pleioluma crebrifolia* is here proposed an IUCN preliminary status of *Least Concern* (LC).

Selected specimens

PROVINCE NORD: Antenna Hill, N of Houaïlou, 100-m altitude, 6 Apr. 1981, *G. McPherson* 3738 (G, K, MO, NOU, P, S); basse Monéo (rive droite), 150-m altitude, 5 Dec. 1978, *H.S. MacKee* 36164 (NOU, P, S); Boulinda, base, 21°19'04"S, 165°06'00"E, 23 Jan. 2008, *J. Munzinger, L. Barrabé & F. Rigault* 4984 (NOU, P, S); Boulinda, piste de la mine St Louis, Forêt Française, 21°18'44"S, 165°06'00"E, 375-m altitude, 18 Jan. 2011, *J. Munzinger & al.* 6582 (NOU, P, S); Cape Bocage, sommet de crête, 50-m altitude, 29 Mar. 2006, *Y. Pillon & L. Barrabé* 333 (NOU,

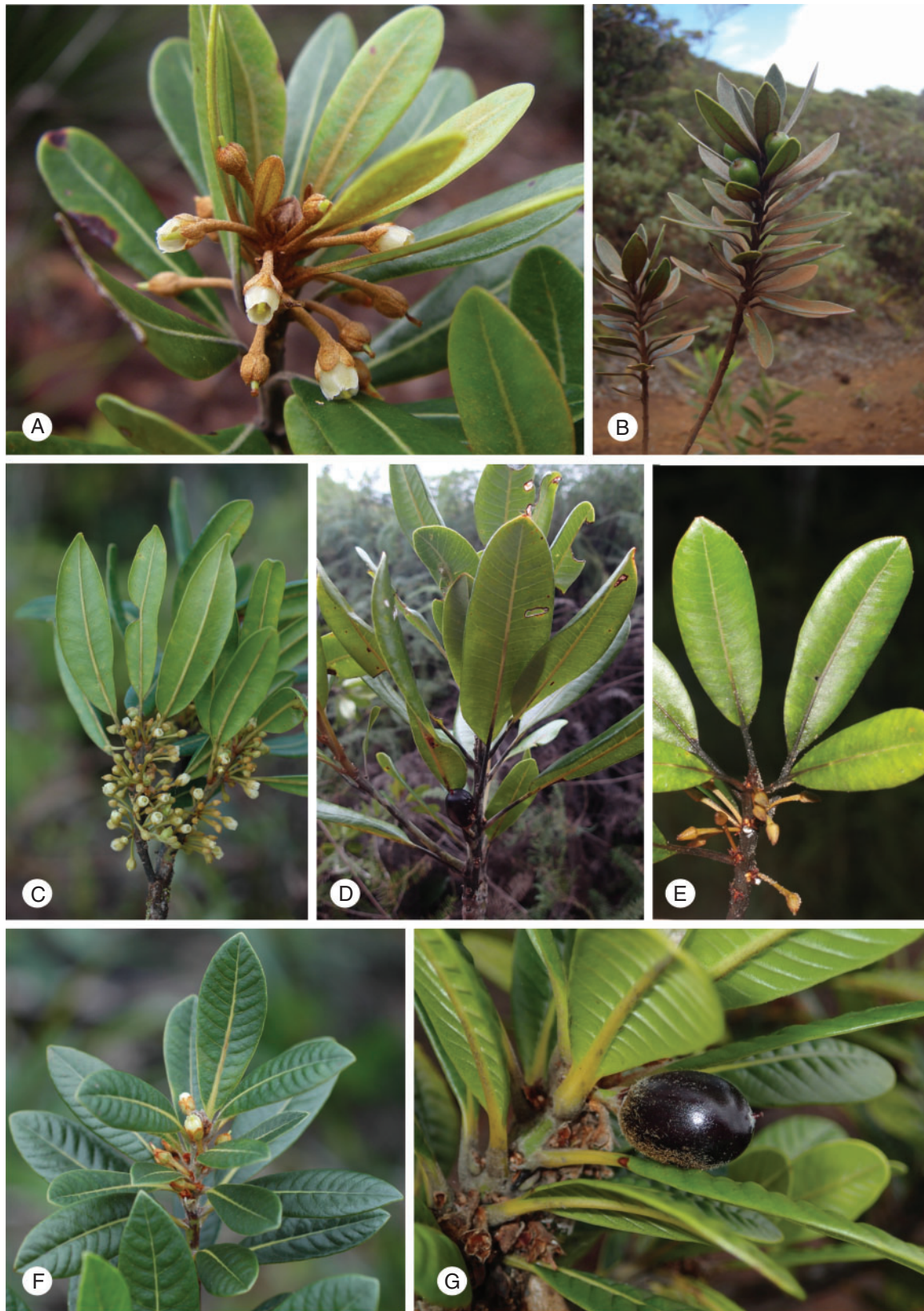


Fig. 10. Field images. A, B. *Pleioluma crebrifolia*. C–E. *P. longipetiolata*. F, G. *P. lucens*. Photos: Gildas Gâteblé (A), Ulf Swenson (B, D–G) and Jérôme Munzinger (C).

P, S); Dôme de Tiébaghi, 12 Feb. 1969, *M. Schmid 2731* (NOU, P); Dôme de Tiébaghi, pente sud-ouest, 300–500-m altitude, 9 May 1966, *H.S. MacKee 14937* (K, L, P) and 100–300-m altitude, 26 Dec. 1966, *H.S. MacKee 16186* (MO, MPU, NOU, P, S); Dôme de Tiébaghi, côté Chagrin, 15 Nov. 1975, *T. Jaffré 1688* (P, NOU); Dôme de Tiébaghi, 5 May 1978, *T. Jaffré 2458* (NOU, P); en direction du plateau Boakaine, 21°25'55"S, 165°50'26"E, 30 Apr. 2008, *R. Barrière & W. Nigote 185* (NOU, P); entre Thio et Houaïlou, 1910, *Fetscherin s.n.* (P); haute Népoui, Oua Péoué, contrefort sud du Kopeto, 600-m altitude, 25 Mar. 1969, *H.S. MacKee 20373* (NOU, P); Houaïlou, Cap Bocage., 150–300-m altitude, 1 May 1968, *H.S. MacKee 18758* (P, S); Houaïlou, Cap Bocage, 21°11'13"S, 165°36'26"E, 27 Jul. 2010, *L. Barrabé & F. Rigault 1019* (NOU, P, S); Houaïlou, presqu'île de Ba, 200-m altitude, 24 Sep. 1969, *H.S. MacKee 20861* (NOU, P, S); Koumac, Chagrin, 31 Jan. 1966, *H.S. MacKee 14324* (P); Koumac, Chagrin 300-m altitude, 10 Sep. 1982, *H.S. MacKee 40795* (MO, NOU, P, S); Koumac, Chagrin, 300-m altitude, 8 Jan. 1983, *H.S. MacKee 41163* (NOU, P, S); Koumac, Tangadiou, 8 Jan. 1971, *H.S. MacKee 23254* (BRI, G, MO, NOU, P, S); massif de Tiébaghi, W slope at Virage Grenaille, 20°27'33"S, 164°11'33"E, 354-m altitude, 28 Aug. 2009, *U. Swenson, J. Munzinger & L. Barrabé 923* (MO, NOU, P, S); Monéo, 250-m altitude, 23 Nov. 1977, *H.S. MacKee 34291* (NOU, P, S); Monéo, W side of RPN3, just N of village, ~100 m from seashore, 21°09'00"S, 165°29'03"E, 10 Oct. 2005, *U. Swenson & J. Munzinger 733* (MO, NOU, P, S); Mont Boulinda, pente au dessus de la Oua Nepoua, 750–850-m altitude, 26 Jul. 1967, *H.S. MacKee 17196* (NOU, P, S); Néhoué, Babouillat, 20°23'19"S, 164°07'42"E, 5-m altitude, 14 Apr. 1978, *H.S. MacKee 35006* (MO, MPU, NOU, P, S); Paagoumène, base du massif de Tiébaghi, creek à Paul, 21 May 2012, *H. Vandrot 545* (NOU, P); Poya, Ndokoa, 100-m altitude, 11 Jun. 1981, *H.S. MacKee 39215* (P). PROVINCE SUD: barrage de Dumbéa, 20°08'15"S, 166°31'30"E, 110-m altitude, 11 Nov. 2007, *J. Munzinger & al. 4655* (G, MO, NOU, P, S); Baie des Pirogues, extrémité ouest, 22°18'34"S, 166°40'31"E, 20-m altitude, 2 Dec. 1966, *H.S. MacKee 16052* (BRI, G, MO, MPU, NOU, P, S); basse vallée de Thio, 20 m, 25 Feb. 1966, *H.S. MacKee 14477* (K, L, NOU, P) and 21 Dec. 1966, *H.S. MacKee 16103* (G, MO, MPU, NOU, NY, P, S); Col de Plum, ascension du sommet du Wé Xi, 22°14'55"S, 166°37'17"E, 220–300-m altitude, 29 Jul. 2007, *L. Barrabé & F. Rigault 534* (NOU); Goro, 22 Mar. 1981, *G. McPherson 3632* (K, MO, NOU, P, S); Goro Mining, 22°19'56"S, 166°58'17"E, 26 May 2004, *J. Munzinger, G. Dagostini & McCoy 2105* (MO, NOU, P, S); Kuebini, 10-m altitude, 6 Feb. 1966, *H.S. MacKee 14495* (NOU, P) and 22°15'26"S, 167°00'21"E, 9 May 2004, *J. Munzinger & al. 2036* (K, MO, NOU, P, S); Mont Dzumac, 700-m altitude, 17 Jul. 1966, *J.-M. Veillon 793* (NOU); Mount Ongoné, near Port Boisé at S end of island, scrub 50-m altitude, 30 Oct. 1981, *G. McPherson 4270* (MO); Pic Ouitchambo, sur la pente est du pic à 100 m du sommet, 21°48'35"S, 166°01'31"E, 21 May 2006, *J. Fambart-Tinel* (leg. *G. Gâteblé*) 95 (NOU, S); Port Bouquet, Né Facia, 20-m altitude, 2 Dec. 1981, *H.S. MacKee 40020* (NOU, P); Prony, Mar. 1914, *I. Franc 1721* (G, K, P); Rivière Baraoua, ~11 miles NW of Bourail, 100-m altitude, 28 Jul. 1952, *C. McMillan 5174* (E, K, P); Rivière de Lacs (Rive droite), 6 km en aval de la chute., 220-m altitude, 28 Dec. 1986, *H.S. MacKee 43394* (G, MPU, NOU, P, S); S of Plum (S of Mount Dore), 50-m altitude, 6 Nov. 1981, *T.D. Pennington & G. McPherson 10286, 10287* (K, MO, NOU); vallée de la Dumbéa, basse altitude, 9 May 1965, *M. Schmid 176* (NOU, P).

Pleioluma dioica Swenson & Munzinger, sp. nov.

(Fig. 7B, 11.)

Diagnosis: *Pleioluma dioica* is similar in foliage and inflorescence to *P. tchingouensis* but differs in thicker pedicels, presence of unisexual, 3-mm-long flowers (v. 5–6 mm long,

bisexual flowers), vestigial staminodes (v. well developed), and growing only on schist (v. ultramafic substrates).

Type: New Caledonia, Province Nord, Pouébo: Mount Mandjélia, at campsite, just below the summit, along the track, 20°23'48"S, 164°31'56"E, 700-m altitude, 7 Oct. 2005, *U. Swenson & J. Munzinger 722* (holo: P 00612516; iso: MO 6039271, NOU 012234, S 05-10385).

Diocious trees up to 8 m tall. *Leaf blades* oblanceolate, 6–11(–13) × 1.5–2.2 cm, green, lower surface paler in shade, glabrous above except for the lower half of the primary vein, ultimately glabrous, exposing a slightly crested primary vein, tomentulose below, blade glabrescent but trichomes remain along the primary vein, ultimately glabrous; apex acute to acuminate; venation eucamptodromous or brochidodromous with weak loops near the apex; secondary veins of 14–20 pairs, flat above, inconspicuous below; intersecondary veins present, branching into a tertiary venation; tertiaries faint, reticulate and oblique, subdividing into the areolate venation; petiole (5–)8–10(–12) mm long, tomentulose, partly glabrescent. *Flowers* 5-merous, 1–3 per fascicle, borne on 10–20-mm-long, somewhat tomentose pedicels. *Sepals* 3 mm long, broadly ovate subacute or round, with the same indument as the pedicel on the outside; margin glabrous inside. *Corolla* cream, 3 mm long with glabrous lobe margin. *Stamens* and male (or bisexual) flowers unknown. *Staminodes* flat, vestigial. *Gynoecium* flask-shaped, hispid to half of its length, 4 mm long. *Fruit* obovoid or ellipsoid, ~20 × 10 mm, 1-seeded, pubescent around the 1–2-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller and compressed from the sides; seed scar 70–75% of the seed length; testa brown, shiny, thin, 0.2–0.3 mm thick.

Recognition

Pleioluma dioica is most similar to *P. tchingouensis* and *P. rubicunda*; with the latter of which it is sympatric on the non-ultramafic Mount Mandjélia. *Pleioluma rubicunda* is easy to separate from the other two species by its larger, dark green leaves, with secondary veins impressed above and conspicuous below, v. flat leaves above and inconspicuous secondaries below in the other two. *Pleioluma dioica* is best distinguished from *P. tchingouensis* by its smaller (~3 mm long), unisexual flowers, v. larger (5–6 mm long), bisexual flower in *P. tchingouensis*. They also have completely different substrate preferences, with *P. dioica* being restricted to humid forest on schist, whereas *P. tchingouensis* is only known from the ultramafic massif Tchingou, located in central-northern Grande Terre.

Phenology

Pleioluma dioica flowers in spring, from September to November, when it sets fruit. Male (or bisexual) individuals have not yet been observed.

Distribution

Pleioluma dioica is currently known only from two localities on Grande Terre, around the type locality on Mount Mandjélia and the western slope of Mount Canala (Fig. 7B). In both localities, it grows in humid forests between 600- and 750-m altitude on schist or volcano-sedimentary soils. This disjunct

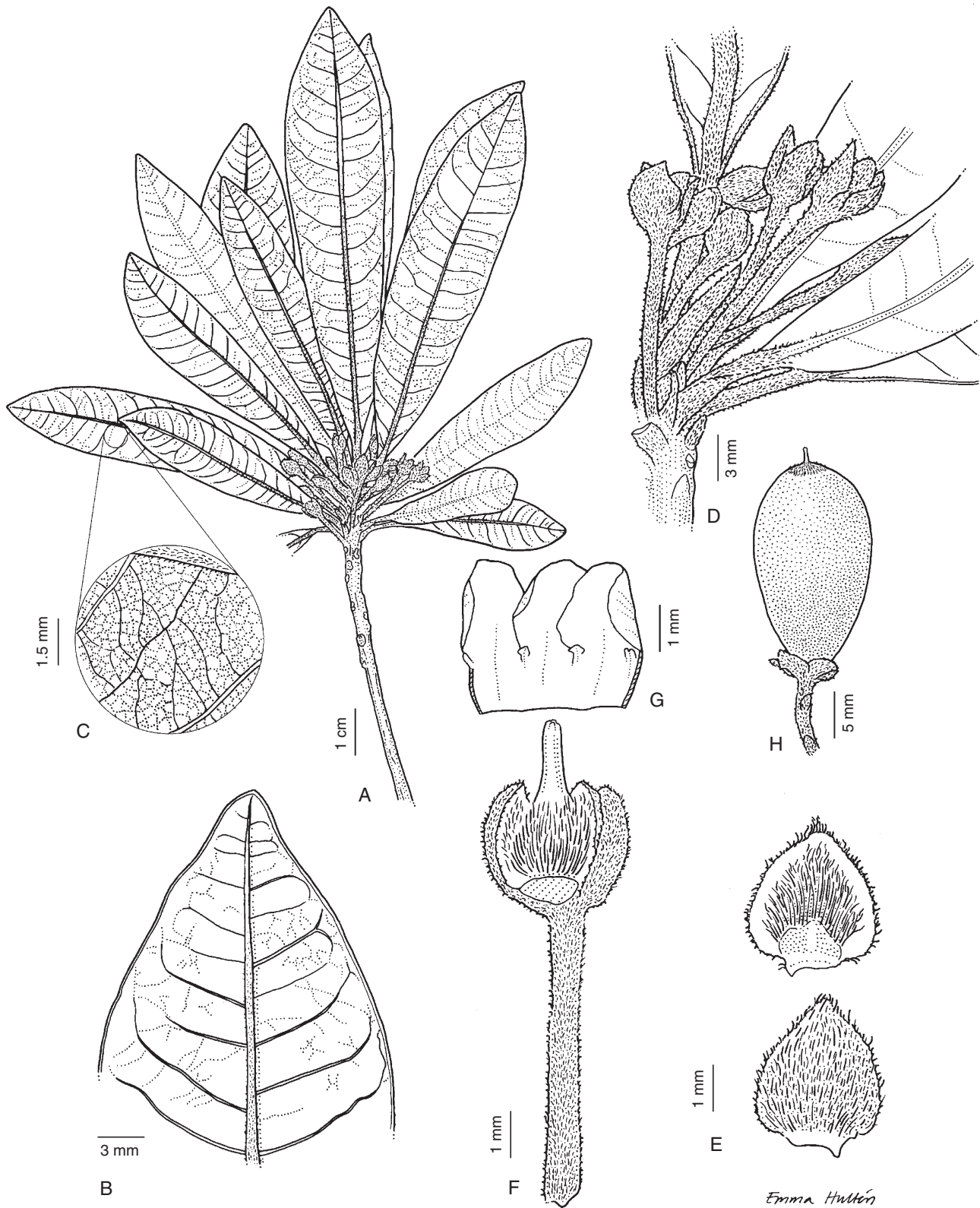


Fig. 11. *Pleioluma dioica*. A. Habit. B. Distal part of a leaf, with weak brochidodromous venation (lower surface). C. Close-up of areolate venation. D. Inflorescence. E. Sepal from the outside (bottom) and inside (top). F. Transection of a flower, showing a hispid gynoecium. G. Open corolla of female flower exposing vestigial staminodes (two corolla lobes removed). H. Fruit. Drawn from U. Swenson *et al.* 722 (A–D), T.D. Pennington & G. McPherson 10307 (E–G) and T.D. Pennington & G. McPherson 10309 (H).

distribution is peculiar because there are many apparently suitable humid forests at the right altitude between these two localities and we predict that the species will be discovered in additional sites.

Etymology

We have applied the species epithet *dioica* (Greek origin meaning 'two households') because we have found no evidence of bisexual flowers.

Conservation status

With only two localities, the EOO cannot be calculated for *P. dioica*. The AOO for this species is 8 km². Two subpopulations are known and both have been recently visited by the authors, but neither is currently protected. Threats to dense humid forests are less severe on shist than on ultramafic substrates, and we have not seen indications that the species is particularly vulnerable to deer herbivory. Because this new species has been confused with other similar species, we predict that future collections will add information to what is currently a poorly known taxon. For the time being, we think it is better to avoid suggesting any IUCN status and consider *P. dioica* as *Data Deficient* (DD).

Specimens examined

PROVINCE NORD: au alentours de la piste du captage de Mia, parcelle 3, 21°35'26"S, 165°57'49"E, 12 Sep. 2011, H. Vandrot, V. Hequet & C. Chambrey 467 (NOU); Mandjéla, above Pouébo, 650-m altitude, 12 Nov. 1981, T.D. Pennington & G. McPherson 10309 (K, MO, NOU, NY), 720-m altitude, 12 Nov. 1981, T.D. Pennington & G. McPherson 10307 (K, MO, NOU, NY), and forested slopes S of radio tower, 700-m altitude, 12 Nov. 1981, G. McPherson 4362 (MO, P).

Pleioluma lasiantha (Baill.) Swenson & Munzinger, *Taxon* 62: 764 (2013)
(Fig. 12, 13A.)

Sideroxylon lasianthum Baill., *Bull. Mens. Soc. Linn. Paris* 2: 887 (1890); *Planchonella lasiantha* (Baill.) Dubard, *Ann. Mus. Colon. Marseille, sér. 2*, 10: 58 (1912); *Pouteria lasiantha* (Baill.) Baehni, *Candollea* 9: 324 (1942); *Beccariella lasiantha* (Baill.) Aubrév., *Fl. Nouv.-Caléd.* 1: 114 (1967).

Type: Nouvelle-Calédonie, Mont Mi, 25 Mar. 1869, [B.] Balansa 1322 (lecto (here designated): P 00282336; isolecto: L 0006367, P 00282337, P 00282338).

Gynodioecious shrubs usually no more than 5 m tall but sometimes trees up to 15 m tall. *Leaf blades* obovate or somewhat oblanceolate, (5–)6–8(–10) × 2.0–3.5 cm, margins sometimes revolute, ferruginously tomentose on both sides, quickly glabrescent on both surfaces except for the primary and secondary veins on the lower surface, trichomes usually turning greyish with age; apex usually rounded; venation craspedodromous but secondaries often connected by weak loops; secondary veins of 9–13 pairs, impressed above, prominent below, in stark contrast to the blade because of their ferruginous indumentum; intersecondary veins sometimes present; tertiary veins oblique, sometimes branching, faint, hardly visible to the naked eye; petiole 5 mm long (rarely longer), villous, soon losing the longer trichomes. *Flowers*

5-merous, 1–4 per fascicle, borne on 8–9(–12)-mm-long, ferruginously villous pedicels. *Sepals* 3–4 mm long, with the same indumentum as the pedicel. *Corolla* cream, ~3 mm long, 5–6 mm wide, sometimes with minute cilia along the lobe margin. *Stamens* inserted near the corolla tube base; anthers 0.5 mm long. *Staminodes* flat, oblong, entire, somewhat reduced in female flowers. *Gynoecium* flask-shaped, 3.0–3.5 mm long, hispid to half of its length. *Fruit* obovoid or ellipsoid, 8–12 × 5–6 mm, 1-seeded, pubescent around the 1–2-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller and compressed from the sides; seed scar 50–65% of the seed length; testa brown, shiny, thin, 0.2–0.3 mm thick.

Recognition

Pleioluma lasiantha is readily distinguished from all congeners by its typically obovate leaves having brown or ferruginously villous indumentum on the well developed primary and secondary veins. Petioles and pedicels are surprisingly constant in length, 5 and 8–9 mm long respectively, and have the same indumentum as the venation. However, the indumentum usually turns greyish with age.

Phenology

Pleioluma lasiantha sets buds early in the year and starts to flower during March and April, with a peak flowering in May. Immature fruit is recorded from August, and ripe fruit has been collected from November until January.

Distribution

Pleioluma lasiantha is most frequently recorded from maquis between 150- and 1000-m altitude, with occasional records from humid forests. It has a south-eastern distribution across the large ultramafic formation, around Prony in the south to Houaïlou in the north (Fig. 13A). A few records are from isolated ultramafic areas such as the type locality in central Grande Terre.

Etymology

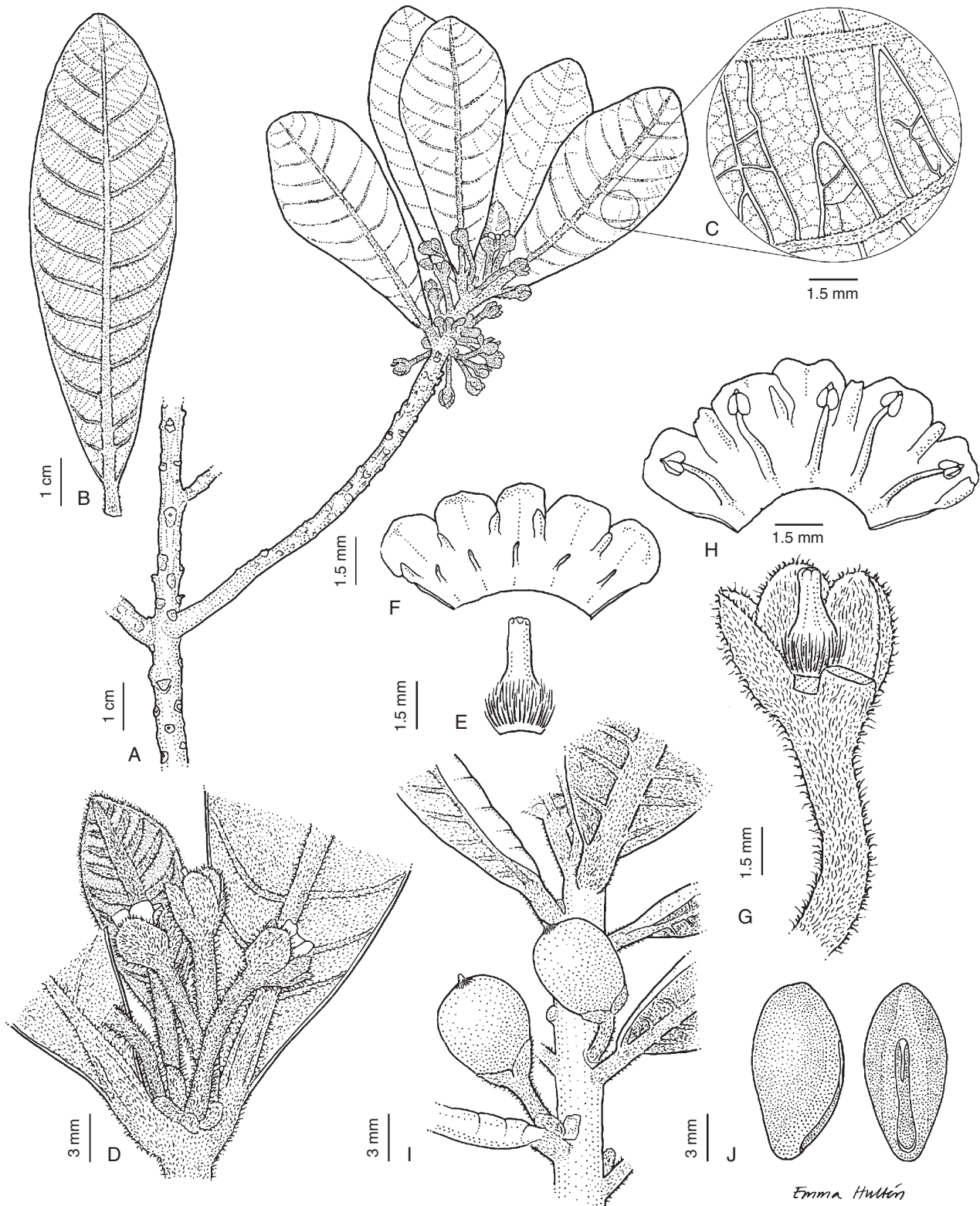
Baillon (1890a) applied the species epithet *lasianthum*, referring to the woolly or villous flowers (i.e. pedicel and sepals), which is a striking feature of the plant.

Conservation status

There are seven known subpopulations of *P. lasiantha* and it is known from the following five protected areas in Province Sud: Barrage de Yaté, Haute Yaté, Rivière Bleue, Kouakoué and Montagnes des Sources. The species has an EOO of 3554 km² and an AOO of 100 km². Because the species is quite abundant and has some protection, *P. lasiantha* is assigned a preliminary IUCN status of *Least Concern* (LC).

Nomenclatural note

Baillon (1890a) used the collection *Balansa 1322* from 'Mont Mi' to describe *Sideroxylon lasianthum* with 5-merous bisexual and female flowers. Baillon concluded that the species is dioecious or perhaps polygamous. Four specimens of this



Emma Hultén

Fig. 12. *Pleioluma lasiantha*. A. Habit. B. Leaf of another shape (lower surface). C. Close-up of tertiary and areolate venations. D. Inflorescence with typical indumentum. E. Gynoecium. F. Open corolla of female flower. G. Transection of flower, showing both sides of sepals and gynoecium. H. Open corolla of bisexual flower. I. Fruit. J. Seed, side view (left) and seed scar (right). Drawn from *J. Munzinger et al.* 2026 (A, C–F), *J. Munzinger et al.* 4053 (B, I), *J.-M. Veillon* 6782 (G–H) and *H.S. MacKee* 21215 (J).

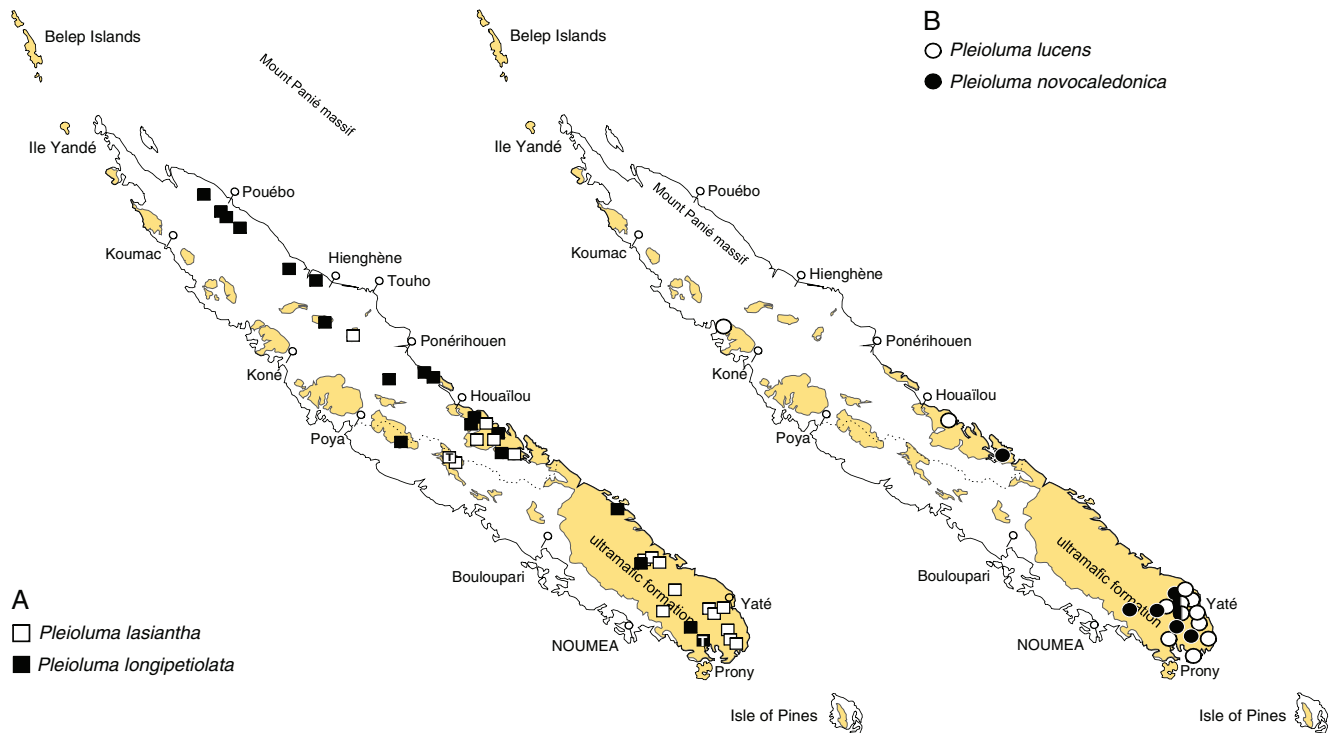


Fig. 13. A. Map of New Caledonia with distribution of *Pleioluma lasiantha* (open squares) and *P. longipetiolata* (closed squares) B. Map of New Caledonia with distribution of *P. lucens* (open circles), and *P. novocaledonica* (closed circles). Sympatric species are indicated with half-closed and half-open symbols. T, type localities. Shaded areas are dominated by ultramafic substrates.

gathering have been identified, three in the Paris herbarium (P 00282336, P 00282337, P 00282338) and one in Leiden (L 0006367). One of the P specimens, namely P 00282337, was once in J. B. L. Pierre's private herbarium, which was acquired by the Paris herbarium in 1906 (Staffleu and Cowan 1983; i.e. part of the original material but not available to Baillon). The other two specimens in Paris have different labels, one with annotations of flower morphology (P 00282338), the other clearly stating 'Mont Mi' (P 00282336), but both have a Paris Herbarium label with Baillon's initials (*H.Bn.*). Hence, both agree with the protologue and are thus syntypes. Both specimens are in a good condition, with plentiful of buds or young flowers, but the latter has more fertile material than the former and is here designated as lectotype.

Specimens examined

PROVINCE NORD: Canala, Plateau Boakaine, 21°29'27"S, 165°54'01"E, Dec. 2006, *J. Munzinger & al.* 4053 (NOU, P, S); Kouaoua, mine SLN, 14 Feb. 1978, *P. Cabalion* 395 (P); Kouaoua, Aréha, 500-m altitude, 30 Mar. 1982, *H.S. MacKee* (leg. *J.F. Cherrier*) 40297 (NOU, P); Kouaoua, Décharge Montmatre, 14 Feb. 1978, *J.-M. Veillon* 3494 (NOU, P); Mont Grandié, Haute Amoa, 800-m altitude, 14 May 1968, *H.S. MacKee* 18787 (G, MO, MPU, NOU, P, S); massif de Grandié, pente SE, 700-m altitude, 31 Mar. 1988, *J.-M. Veillon* 6782 (NOU, P); Ménazi ouest du massif, Ména 08, 21°27'05"S, 165°41'15"E, 800-m altitude, 8 Apr. 2008, *R. Barrière & W. Nigote* 177 (NOU, P, S); Poro, 5 km au sud, 600-m altitude, 1 May 1966, *H.S. MacKee* 14856 (L, NOU, P) and 14858 (NOU, P). PROVINCE SUD: 5 km from Grande Lac in direction de Goro, 15 Nov. 1955, *H.S. MacKee* 3387 (E, L, P); along banks of La Madeleine

(Rivière des Lacs), S of Noumea–Yaté road, 300-m altitude, 31 Aug. 1980, *G. McPherson* 3006 (K, MO, P) and 200-m altitude, 18 Feb. 1982, *G. McPherson* 4570 (K, MO, P); Goro-Nickel, 22°16'19"S, 166°57'48"E, 26 May 2004, *J. Munzinger & G. Dagostini* 2102 (MO, NOU, P, S) and *J. Munzinger & G. Dagostini* 2117 (MO, NOU, P, S); Goro, 4 Jan. 2005, *J. Munzinger & al.* 2614 (NOU, S); Goro-Nickel, 18 May 2002, *G. Dagostini & F. Rigault* 627 (NOU, P); haute vallée de La Ni, 21°59'35"S, 166°30'15"E, 750-m altitude, 29 Apr. 2004, *J. Munzinger, M. Pignal & P. Lowry* 2008 and 2009 (MO, NOU, P, S); Haute Yaté, Rivière Bleue, 200-m altitude, 16 Jun. 1977, *H.S. MacKee* 33313 (G, MPU, NOU, P, S); Kouakoué, 21°59'12"S, 166°30'38"E, 5 May 2004, *J. Munzinger, M. Pignal & P. Lowry* 2026 (MO, MPU, NOU, P, S); Les Electriques, 22°11'38"S, 166°39'55"E, 560-m altitude, 16 May 2004, *J. Munzinger & D. Létocart* 2055 (MO, NOU, P, S); massif du Kouakoué, par la Haute Ni, camp, 750-m altitude, 21 Oct. 2004, *J. Munzinger & G. McPherson* 2479 (MO, NOU, S); Mé Aui, 24 Apr. 1979, *P. Cabalion* 859 (MPU, P); Mé Ori, plateau sommet, 900–1000-m altitude, 3 Dec. 1969, *H.S. MacKee* 21215 (NOU, P, S); Plaine des Lacs, sources de la Kuebuni, 150-m altitude, Feb. 1965, *J.-M. Veillon* 65 (NOU, P); Yaté, ancienne route à horaire, 22°10'04"S, 166°53'42"E, 8 Aug. 2004, *J. Munzinger* 2308 (NOU, P, S); Yaté, barrage, 150-m altitude, 2 Mar. 1986, *H.S. MacKee* 43036 (NOU, P, S).

Pleioluma longipetiolata (Aubrév.) Swenson & Munzinger, *Taxon* 62: 764 (2013)

(Fig. 10C–E, 13A.)

Beccariella longipetiolata Aubrév., *Fl. Nouv.-Caléd.* 1: 121 (1967).

Type: Nouvelle-Calédonie, Prony, Nov. 1914, *I. Franc* 1885 (holo: P 00282310; iso: P 00282309).

Gynodioecious tree up to 10(–18) m tall. *Leafbaldes* oblong to elliptic, 4–14 × 1.5–4.0 cm, margins slightly revolute, glabrous except for the tomentulose (or glabrous) primary vein underneath; base cuneate or rounded; apex rounded to obtuse; venation brochidodromous with poorly developed loops; secondary veins of 20–35 pairs, weak, not raised above the leaf blade surface on either side; intersecondary veins sometimes present; tertiary veins indistinguishable from the areolate venation or somewhat reticulate in the distal part (high magnification); petiole 15–40(–50) mm long, length ~30% of the blade, tomentulose. *Flowers* 5-merous, 1–6 per fascicle, females rare; pedicel 7–12 mm long, brownish tomentulose. *Sepals* 3.0–4.0 mm long with the same indument as the pedicel. *Corolla* cream, lobes often white-edged, 3.0–6.0 mm long, bisexual flowers often larger than female flowers, usually with some minute cilia along the lobe margin. *Stamens* inserted in the middle of the corolla tube; anthers 0.8–0.9 mm long. *Staminodes* flat, oblong, entire or somewhat dentate. *Gynoecium* conical, hispid at base. *Fruit* obovoid, 15–20 × 8–10 mm, 1-seeded, pubescent around the 2–3-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller, not laterally compressed; seed scar 50% of the seed length; testa brown, shiny, thin, 0.2–0.3 mm thick.

Recognition

Pleioluma longipetiolata ought not to be confused with any congener and can be distinguished by its glabrous leaves, weak leaf venation, and the long petiole (up to 30% of the leaf-blade length). However, leaf size varies and individuals with 4–5- or 11–14-cm-long leaves respectively, may be equally common. Small-leaved individuals could be confused with *P. balansana*, a species with tomentulose indumentum on the lower leaf surface and sepals 1.0–2.0 mm long, *v.* glabrous leaves and sepals 3.0–4.0 mm long in *P. longipetiolata*.

Phenology

Flowering season of *P. longipetiolata* seems to peak between June and August when fruit start to develop; fruit mature in late November to December. Individuals with female flowers seem to be rare.

Distribution

Pleioluma longipetiolata is indifferent to substrate and occurs on the large ultramafic formation from Prony in the south (type locality), along the eastern coast, to the non-ultramafic Mount Panié massif in the north (Fig. 13A). The species has wide ecological amplitude, recorded from sea level to almost 1000-m altitude in the higher massif, usually in evergreen humid forest, but also in maquis.

Etymology

The epithet *longipetiolata* refers to the unusually long petiole, which is a distinguishing character.

Conservation status

Pleioluma longipetiolata is widely distributed in New Caledonia, known from 12 subpopulations and grows in the

following three protected areas: Mount Panié massif and Aoupinié (Province Nord) and la Nodela (Province Sud). The EOO and AOO are respectively calculated to be 7583 and 84 km². *Pleioluma longipetiolata* is usually naturally common in places where it occurs and is assigned a preliminary IUCN status of *Least Concern* (LC).

Specimens examined

PROVINCE NORD: Aoupinié, 31 Oct. 2008, *J. Fambart-Tinel* (leg. CNRS) 219 (NOU); Canala, Mé Aiu, 750-m altitude, 26 Jul. 1990, *H.S. MacKee* 45002 (BRI, G, MO, MPU, NOU, P, S); Haute Diahot, Paala, 600-m altitude, 15 Jul. 1977, *H.S. MacKee* 33460 (G, BRI, MO, MPU, NOU, P, S); Haute Diahot, Tendé, 700-m altitude, 12 Jul. 1979, *H.S. MacKee* 37118 (NOU, P, S); Houaïlou, Ho, 50-m altitude, 25 Mar. 1974, *H.S. MacKee* 28371 (P, S), 14 Jun. 1974, *H.S. MacKee* 28828 (G, L, MO, MPU, NOU, P, S), and 14 Sep. 1974, *H.S. MacKee* 29249 (P, S); inter Houaïlou et Poindimié, 21 Mar. 1965, *L. Bernardi* 9721 (G, L, P, S); Mandjélia, below radio tower, above Puebo, 700-m altitude, 18 Aug. 1981, *G. McPherson* 4093 (K, MO, NOU, P) and *G. McPherson* 4094 (G, K, L, MO, NOU, P, S); Mandjélia, above Puebo, 650-m altitude, 12 Nov. 1981, *T.D. Pennington* & *G. McPherson* 10310 (K, MO, NOU); Mandjélia, 700-m altitude, 12 Jun. 2005, *J. Munzinger* & *Y. Pillon* 2864 (NOU, P, S); Mandjélia, along trail towards Ignambi, 20°23'48"S, 164°31'56"E, 700-m altitude, 6 Oct. 2005, *U. Swenson* & *J. Munzinger* 721 (MO, NOU, P, S); Monéo, 250-m altitude, 23 Nov. 1977, *H.S. MacKee* 34265 (NOU, P, S); Mont Ignambi, pente nord est, 900-m altitude, 8 Nov. 1971, *H.S. MacKee* 24644 (MO, NOU, P, S); Mont Panié, above Haut Coulna, 20°37'22"S, 164°44'40"E, 700–720-m altitude, 26 Oct. 1999, *G. McPherson* & *H. van der Werff* 17742 (MO, NOU, P, S); Roche Ouaième, 950-m altitude, 14 Jun. 2005, *J. Munzinger*, *Y. Pillon* & *J.-P. Butin* 2911 (NOU, P, S); Roche Ouaième, along the trail to the summit, 20°38'21"S, 164°51'53"E, 720-m altitude, 3 Feb. 2013, *U. Swenson* & *J. Munzinger* 1132 (NOU, S); route de Houaïlou à Ponérihouen, 20 Jul. 1965, *M. Schmid* 445 (NOU, P); W side of Tchingou, along the old mining road, 20°53'57"S, 165°01'18"E, 860-m altitude, 1 Feb. 2013, *U. Swenson* & *J. Munzinger* 1127 (P, MO, NOU, S). PROVINCE SUD: Haute Ni, 750-m altitude, 24 Oct. 2004, *J. Munzinger* & *G. McPherson* 2496 (MO, NOU, P, S); Kouaoua plateau, 21°19'57"S, 165°43'31"E, 25 Jul. 2005, *J. Munzinger* 2954 (NOU, P, S); Port Bouquet, Rivière Koum, forêt de long de la rivière, berge ouest, 25-m altitude, 25 Nov. 2001, *J. Munzinger* 1048 (MO, NOU, P); Prony, Jan. 1914, *I. Franc* 1681A (A, G, L, P); route de Kouaoua-Poro, 21°21'16"S, 165°41'28"E, 16 Jul. 2004, *J. Munzinger* 2264 (NOU, P, S); valley of La Rivière des Pirogues, 280-m altitude, 11 Sep. 1983, *G. McPherson* 5780 (G, K, L, MO, NOU, P, S); vallée de la Nodela, sur la piste au niveau du plateau, 633-m altitude, 19 Oct. 2005, *V. Dumontet*, *C. Zongo* & *P. Maituku* 568 (NOU, S).

Pleioluma lucens (P.Royen) Swenson & Munzinger,

Taxon 62: 764 (2013)

(Fig. 10F, G, 13B.)

Planchonella lucens P.Royen, *Blumea* 8: 311, 429 (1957); *Beccariella lucens* (P.Royen) Aubrév., *Adansonia*, n.s., 2: 193 (1962); *Pouteria royenii* Baehni, *Boissiera* 11: 55 (1965).

Type: Nouvelle-Calédonie [without locality], 19 Oct. 1909, *M. [A.] & Mme [L.] Le Rat* 763 (holo: P 00282303; iso: K 000777982, L, P 00282301, P 00282302).

Gynodioecious shrubs usually no more than 2 m tall, occasionally taller. *Leaf blades* obovate or oblanceolate, (4–) 5–8 × 1.5–3.5 cm, margins somewhat revolute, glabrous on both sides except the primary vein being tomentulose near the

petiole, ultimately glabrous; apex rounded, subacute or acute; venation eucamptodromous or brochidodromous with weak loops; secondary veins of 10–15(–19) pairs, impressed above, distinct below, not in stark contrast to the blade; intersecondary veins sometimes present; tertiary veins oblique, sometimes branching, faint, hardly seen by naked eye; petiole 5–7(–10) mm long, first tomentose, losing the long trichomes, becoming tomentulose, ultimately glabrous. *Flowers* 5-merous, 1 or 2 per fascicle, borne on 5–10-mm-long, tomentose, partly glabrescent pedicels. *Sepals* 2.5–3.0 mm long, tomentose, the outer glabrescent, especially in the central part. *Corolla* greenish or cream, with white-edged corolla lobes, ~4 mm long, usually with cilia along the lobe margin. *Stamens* inserted in the middle of the corolla tube; anthers 1.0 mm long. *Staminodes* flat, oblong, entire, reduced in female flowers. *Gynoeceum* flask-shaped, 3.0–3.5 mm long, hispid. *Fruit* obovoid or ellipsoid, 10–14 × 5–9 mm, 1-seeded, pubescent throughout, partly glabrescent; remnant style 1–2-mm-long; seeds of the same form as the fruit, slightly smaller and compressed from the sides; seed scar 50% of the seed length; testa chestnut, shiny, thin, 0.2–0.3 mm thick.

Recognition

Pleioluma lucens and *P. novocaledonica* are two similar species that have been confused in the past, probably from the moment that *P. lucens* was described by van Royen (1957), and we foresee confusion in the future (see above). The foliage of the two species is rather similar and not a decisive character, but the upper surface of the blade is usually wrinkled by the impressed secondary veins in *P. lucens* (Fig. 10F), whereas the blade is usually flat in *P. novocaledonica*. Distribution of indumentum on sepals and especially young fruit are better diagnostic characters. In *P. lucens*, all five sepals and the entire fruit are initially tomentose, but the outer (non-overlapping) sepals are glabrescent, especially in the central part. In *P. novocaledonica*, all five sepals are evenly tomentulose (not glabrescent) and fruit is sparsely pubescent only around the remnant style and behind the sepals.

Phenology

Phenology is poorly known in *P. lucens*. The flowering season may start in July and seems to continue into February, whereas records of fruit are more sporadic from February, April, June and October. Individuals with female flowers and bisexual flowers seem to be equally common.

Distribution

Pleioluma lucens is mostly distributed on the large ultramafic formation in the south-eastern corner of Grande Terre, usually in maquis vegetation, from sea level to 300 m in altitude (Fig. 13B). There is one record further north, near Poro, at an altitude of 600 m, and another on the Katépaï massif near Voh at 550-m altitude. Two historical collections, cited by Aubréville (1967), are *Mr & Mme Le Rat 788* from Anse Vata and *Alleizette 34* from Balade. Label information here is scanty and these localities are respectively from sedimentary rock and mica schist, i.e. non-ultramafic. These two collections are, therefore,

excluded from the distribution map because we suspect one being cultivated and the other being mislabelled.

Etymology

The species epithet *lucens* was adopted for the ‘shiny leaves’ (van Royen 1957), which seems to be true for herbarium material, but not for fresh material and is not unique to *P. lucens*. Congeners with shiny leaves in New Caledonia are *P. acutifolia*, *P. baueri*, *P. butinii*, *P. crebrifolia* and *P. longipetiolata*.

Conservation status

Pleioluma lucens has an EOO of 3396 km² and an AOO of 48 km² and is known from three subpopulations. The species occurs in three protected areas in Province Sud, viz. Chutes de la Madeleine, Fausse Yaté and Barrage de Yaté, but eight localities are inside different mining concessions and face risk of destruction. *Pleioluma lucens* is quite naturally rare, even in the south-east, where only scattered individuals are known. Mining and anthropogenic fires are potential threats that lead us to propose an IUCN preliminary status of *Vulnerable* (VU): B2ab(iii).

Specimens examined

PROVINCE NORD: Poro, 5 km S, 600-m altitude, 1 May 1966, *H.S. MacKee 14854* (L, NOU, P); Voh, massif Katépaï, 20°55'30"S, 164°42'02"E, 550-m altitude, 31 Aug. 2016, *J. Munzinger* (leg. *R. Scopetra*) 7548 (MPU, S). PROVINCE SUD: ancienne route à l'heure de Yaté, 22°08'57"S, 166°54'27"E, 8 Aug. 2004, *J. Munzinger et al.* 2310 (NOU, P, S); E slope of Col de Yaté, 22°09'47"S, 166°54'45"E, 220-m altitude, 9 Feb. 2013, *U. Swenson & J. Munzinger* 1142 (NOU, S); Chutes de la Madeleine, NV corner, along the road, 22°13'48"S, 166°51'06"E, 250-m altitude, 9 Feb. 2013, *U. Swenson & J. Munzinger* 1146 (BRI, MO, MPU, NOU, P, S) and *U. Swenson & J. Munzinger* 1147 (MPU, NOU, P, S); Creek Pernod, 200-m altitude, 11 Jul. 1984, *H.S. MacKee 42025* (NOU, P, S); Creek Pernod, at the bridge of the old road, 22°10'52"S, 166°50'34"E, 130-m altitude, 9 Feb. 2013, *U. Swenson & J. Munzinger* 1144 (MPU, NOU, P, S); Creek Pernod, at the P-place of the old road, 22°10'52"S, 166°50'34"E, 130-m altitude, 9 Feb. 2013, *U. Swenson & J. Munzinger* 1145 (G, MO, MPU, NOU, P, S); Goro, 2 Jul. 2004, *J. Munzinger & G. Dagostini* 2161 (NOU, P, S); Lac de Yaté, 5 Apr. 2005, *J. Munzinger* 2751 (NOU); Mamié, N de Yaté, 400-m altitude, 8 Feb. 2005, *J. Munzinger, F. Rigault & G. Dagostini* 2664 (NOU, P, S); Port Boisé, 20–22 Jun. 2001, *V. Dumontet et al.* 37 (NOU, P); Prony, 1900–1910, *Mr & Mme Le Rat 1263* (P); Réserve botanique de la Fausse Yaté [22°12'26"S, 166°56'8"E], 300–500-m altitude, 8 Oct. 2007, *G. Dagostini et al.* 1420 (NOU, S); route de Yaté, entre La Rivière des Lacs et le Barrage, 200-m altitude, 25 Jul. 1967, *H.S. MacKee 18166* (NOU, P, S); route de Yaté, Rivière des Lacs, 200-m altitude, 21 Dec. 1986, *H.S. MacKee 43386* (NOU, P, S).

Pleioluma novocaledonica (Dubard) Swenson & Munzinger, *Taxon* 62: 765 (2013)

(Fig. 13B.)

Planchonella novocaledonica Dubard, *Notul. Syst. (Paris)* 2: 84 (1911); *Sideroxylon novocaledonicum* (Dubard) Baehni, *Candollea* 9: 428 (1942), *nom. illeg., non Engl.* (1897); *Beccariella novocaledonica* (Dubard) Aubrév., *Adansonia, n.s.*, 2: 193 (1962); *Pouteria egassia* Baehni, *Boissiera* 11: 60 (1965), *nom. nov.* [*non Pouteria novocaledonica* Baehni (1942)].

Type: Nouvelle-Calédonie [without locality], *s. dat.*, *Petit 130* (lecto (here designated): P 00282292; isolecto: G, L 0006376, P 00282293).

Gynodioecious shrub or treelet up to 5 m tall. *Leaf blades* obovate or oblanceolate, 5–9 × 1.5–3.0 cm, tomentulose on the lower surface, soon glabrous except for the primary vein in the lower half, ultimately glabrous; apex rounded, subacute or acute; venation eucamptodromous or brochidodromous with weak loops; secondary veins of 10–20 pairs, usually flat with blade on upper surface, weak to distinct below, not in stark contrast to the blade; intersecondary veins sometimes present; tertiary veins oblique, sometimes reticulate near the margin, weak to faint, hardly seen by naked eye; petiole 4–10 mm long, tomentulose, glabrescent. *Flowers* 5-merous, 1–3 per fascicle, borne on 4–10-mm-long, evenly tomentulose, pedicels. *Sepals* 3–4 mm long, tomentulose to tomentose, usually with persistent indumentum. *Corolla* possibly white, 3–4 mm long, probably without cilia along the lobe margin. *Stamens* inserted in the middle of the corolla tube; anthers 1.0 mm long. *Staminodes* flat, oblong, entire or somewhat dentate. *Gynoecium* flask-shaped, hispid. *Fruit* obovoid, 10–12 × 5–6 mm, 1-seeded, sparsely pubescent around the 1–2-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller and compressed from the sides; seed scar 50% of the seed length; testa brown, shiny, thin, 0.2–0.3 mm thick.

Recognition

Pleioluma novocaledonica is difficult to distinguish from *P. lucens* (see this species above).

Phenology

Flowers have been recorded from January to May, and fruit seem to mature in October to December.

Distribution

Pleioluma novocaledonica ecology is similar to that of *P. lucens*, viz. maquis vegetation on ultramafic substrate, from sea level to 300 m altitude (Fig. 13B). Both species occur partly in sympatry, but knowledge of them is insufficient to be definitive.

Etymology

The species epithet *novocaledonica* refers to the area of origin, New Caledonia.

Conservation status

Pleioluma novocaledonica is known from three subpopulations, the northernmost one inside a mining concession, which add up to an EOO of 1422 km² and an AOO of 40 km². The species occurs in two protected areas, namely Pic du Pin and Barrage de Yaté, both in Province Sud. *Pleioluma novocaledonica* is quite naturally rare across its entire distribution and known only from scattered individuals. Mining and anthropogenic fires are two severe threats to *P. novocaledonica*, which, therefore, is given a IUCN preliminary status of *Vulnerable* (VU): B2ab(iii).

Nomenclatural note

There are two sheets of the type material (*Petit 130*) in the Paris herbarium, one labelled ‘Herbier de L’Exposition Coloniale’ (P 00282293) and the other ‘Herb. L. Pierre’ (P 00282292), along with duplicates in G and L. Even though the former is in better condition and has been treated as the holotype, Dubard (1911) used and cited the material ‘in herb. Pierre’. This material is here designated as the lectotype.

Specimens examined

PROVINCE NORD: massif de Bogota: plateau – relevé Bogo 04, 21°29′44″S, 166°01′32″E, 4 Jun. 2008, R. Barrière & W. Nigote 208 (NOU, P). PROVINCE SUD: barrage de Yaté, 200-m altitude, 29 Oct. 1970, H.S. MacKee 22778 (BRI, G, L, MO, MPU, NOU, NY, P, S); entre la Rivière des Lacs et le barrage, 200-m altitude, 16 Apr. 1967, H.S. MacKee 16580 (P) and 31 Jan. 1969, H.S. MacKee 20222 (NOU, P, S); Grand Lac, nord-est, 250-m altitude, 27 Sep. 1987, H.S. MacKee 43718 (NOU, P, S); Montage des Sources, Forêt de la Superbe, 600–800-m altitude, 4 Dec. 2008, G. Dagostini, V. Apiazari & W. Nigote 1631 (NOU, P, S); près de la forêt du Pic du Pin, 27 Feb. 2005, J. Munzinger & al. 2702 (NOU, S) and Le Captage, base du Pic du Pin, 15 Aug. 2005, J. Munzinger & O. Chapelle 2969 (NOU, P, S); route de Yaté, 23 Apr. 1969, J.-M. Veillon 1930 (NOU, P, S) and along the road Yaté–Noumea, E slope of Col de Yaté, 22°09′47″S, 166°54′45″E, 220-m altitude, 9 Feb. 2013, U. Swenson & J. Munzinger 1149 (NOU, P, S); Yaté, ancienne route à horaire, 22°10′04″S, 166°53′42″E, 8 Aug. 2004, J. Munzinger 2304 (MO, NOU, S).

Pleioluma rubicunda (Pierre ex Baill.) Swenson
& Munzinger, *Taxon* 62: 765 (2013)

(Fig. 14A–C, 15A.)

Lucuma rubicunda Pierre ex Baill., *Bull. Mens. Soc. Linn. Paris* 2: 883 (1890); *Beccariella rubicunda* (Pierre ex Baill.) Pierre, *Not. Bot. Sapot.* 1: 30 (1890); *Planchonella rubicunda* (Pierre ex Baill.) Dubard, *Ann. Mus. Colon. Marseille, sér. 2*, 9: 287 (1911); *Pouteria rubicunda* (Pierre ex Baill.) Baehni, *Candollea* 9: 31 (1942).

Type: Nouvelle-Calédonie, forêts situées au sud de Canala, vers 900-m altitude, 20 Nov. 1869, [B.] Balansa 1825 (lecto (here designated): P 00282282; isolecto: P 00282281, P 00282283).

Gynodioecious trees, usually hermaphroditic and no more than 4–6 m tall, but attaining a height of 16 m in humid, tall forests. *Leaves* usually very tightly clustered at tips of thick branches, oblanceolate, 10–20 × 2–4(–5) cm, margins somewhat revolute, coriaceous, dark green above, paler below, tomentose on both sides, quickly glabrescent above and later also below except for the primary and secondary veins that remain ferruginously pubescent and contrast to the green blade, sometimes ultimately glabrous; apex usually acute; venation craspedodromous; secondary veins of 15–25 pairs, impressed above, prominent below, in stark contrast to the blade; intersecondary absent; tertiary veins oblique, sometimes branching, weak, hardly seen by naked eye; petiole 7–15(–20) mm long, tomentose, usually losing the longer trichomes. *Flowers* 5-merous, 2–4 per fascicle, borne on 8–18-mm-long, ferruginously villous pedicels. *Sepals* ~5 mm long, with the same indumentum as the pedicel. *Corolla* white or cream, 5–8 mm long, usually with some small cilia along the lobe margin. *Stamens* inserted in the middle of the corolla tube;

anthers 1.0–2.0 mm long. *Staminodes* flat, oblong or lanceolate, entire, sometimes reduced in bisexual flowers. *Gynoecium* conical, hispid to half of its length. *Fruit* ellipsoid to obovoid, 18–23 × 10–15 mm, 1-seeded, pubescent around the 2–3-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller and compressed from the sides; seed scar 90% of the seed length; testa chestnut, shiny, thin, 0.2–0.4 mm thick.

Recognition

Pleioluma rubicunda is one of the most distinctive species of the genus. It is readily distinguished by dense clusters of oblanceolate, 10–20-cm-long leaves with prominent, ferruginously pubescent primary and secondary venation, borne at apices of usually thick branches. Individuals with small or poorly developed leaves could possibly be confused with *P. dioica*, with which it is sympatric in the Mount Panié massif, but *P. dioica* has 6–11-cm-long leaves, inconspicuous secondary venation, and, as far as is known, only unisexual flowers.

Phenology

This species has probably one of the most regular flowering seasons among all congeners in New Caledonia. It starts to flower in October and stops in January. Mature fruit are recorded during the same season, but never together with flowers. Trees with bisexual flowers are regularly collected; female flowers are known only from a couple of collections, among them the type.

Distribution

Pleioluma rubicunda is one of the most widespread species of the genus occurring in humid forest on mica schist and greywacke in the higher mountain massifs between 600 and 1300 m in altitude, usually below the highest peaks (Fig. 15A). It has been collected in some forests on ultramafic substrates, such as, for example, in Haute Tiwaka (*H.S. MacKee 20126*) and Plateau de Boakaine near Canala (*J. Munzinger & al. 4046*), which are forests usually located at the base of slopes where rains may have washed the soils of heavy metals, making them habitable for species usually growing on non-ultramafic soil.

Etymology

The specific epithet *rubicunda* means red or reddish, and presumably refers to the ferruginous or reddish indument on petioles, venations, pedicels and sepals.

Conservation status

Pleioluma rubicunda is widespread and usually common on non-ultramafic substrates. Seedlings are frequently seen. There are at least 11 subpopulations of the species with a respective calculated EOO and AOO of 3757 and 132 km². This species occurs in four protected areas, namely, Mount Panié and Aoupinié in Province Nord and Parc des Grandes Fougères and Mont Do in Province Sud. *Pleioluma rubicunda* is assigned an IUCN preliminary status of *Least Concern* (LC).

Nomenclatural note

Baillon (1890a) described *Lucuma rubicunda* on the basis of a collection in the Paris herbarium made by Benedict Balansa (1825–1891). Baillon cited the specimen *Balansa 1835* and described it as a large 10-m-tall tree with anthers that seem to be sterile ('c'est un grand arbre (10 mètres), . . . que leurs petites anthers paraissent stériles'). '*Balansa 1835*' may be a misprint for *Balansa 1825* because the former specimen is *Vitex collina* (Montrouz.) Beauvis., whereas the latter agrees with the protologue and has been cited as the holotype by previous authors (van Royen 1957; Aubréville 1967; Swenson *et al.* 2013). There are three duplicates of *Balansa 1825* in the Paris herbarium (P 00282281, P 00282282, P 00282283), but it is unclear whether any of these can be established as the holotype. One specimen (P 00282281) is practically devoid of information except for the number 1825. The second specimen (P 00282282) is labelled '*1825 arbre de 10 mètres de hauteur. . .*', but lacks any information about flowers. The third specimen (P 00282283) is labelled with Pierre's herbarium label and has fragmentary information about flowers (*fl unisexuales femelle*), but with the annotation '*H. Baillon loc. cit. ale no 1835 de Balansa non 1825*', which we interpret as Baillon citing this specimen as '*1835*' and not '*1825*'. We find that Baillon based his description on the second specimen, but it cannot be determined whether or not he used the third specimen, which means that a holotype cannot be established (McNeill 2014). Following Art. 9 of the ICN (McNeill *et al.* 2012), we here designate the best-preserved specimen (P 00282282) as the lectotype of *L. rubicunda*.

Specimens examined

PROVINCE NORD: along an old lumber road S of the road leading from Cascade de Ciu to Koindé and La Foa, 650-m altitude, 10 Dec. 1983, *G. McPherson 6120* (MO, P, S); Col des Roussettes, 500-m altitude, 10 Nov. 1965, *H.S. MacKee 13916* (NOU, P); E slope of Plateau de Dogny, 29 Oct. 1959, *R.F. Thorne 28320* (P); Gohapin-Gôtea, 23 Aug. 2007, *V. Hequet* (leg. *D. Meandu Poveu*) 3704 (NOU); Haute Tchamba, 21°00'56"S, 165°15'05"E, 10 Nov. 2002, *J. Munzinger & al. 1427* (MO, NOU, P, S); Haute Tiwaka, contrefort est du Tchingou, 800-m altitude, 6 Jan. 1969, *H.S. MacKee 20126* (NOU, P, S); Houaïlou, 900-m altitude, 20 Oct. 1879, *T. Lécarré s.n.* (P); Mandjélia, along ridge, trail N from radio tower, 3 Oct. 1980, *G. McPherson 3158* (MO, NOU); Mandjélia, along lumber roads S of radio tower, 600-m altitude, 5 Oct. 1980, *G. McPherson 3209* (K, MO, NOU, P); Mandjélia, above Pueblo, 800-m altitude, 12 Nov. 1981, *T.D. Pennington & G. McPherson 10303, 10304 and 10306* (K, MO, NOU); Mandjélia, above Pueblo, 650-m altitude, 13 Nov. 1981, *T.D. Pennington & G. McPherson 10312* (K, MO, NOU); Mandjélia, 600-m altitude, 11 Sep. 1984, *J.-M. Veillon 5753* (NOU, P); Mandjélia, 20°23'52"S, 164°31'57"E, 15 Nov. 2002, *J. Munzinger, F. Tronchet & A. Oddi 1558* (MO, P); Mandjélia, summit, 20°23'48"S, 164°31'56"E, 790-m altitude, 6 Oct. 2005, *U. Swenson & J. Munzinger 716* (BRI, MO, NOU, P, S); Mandjélia, 11 Jan. 2007, *J. Munzinger* (leg. *M. Wanat*) 4120 (NOU); Mé Aiu, Canala, 650-m altitude, 23 Nov. 1990, *H.S. MacKee 45178* (MO, NOU, P, S); Mont Aoupinié, 900–1020-m altitude, 6 Nov. 1972, *H.S. MacKee 25761* (MPU, P); Mont Aoupinié, sommet, 900-m altitude, Oct-1978, *J.-M. Veillon 3874* (NOU, P); Mont Aoupinié, 900-m altitude, 10 Dec. 1980, *G. McPherson 3418* (K, MO, NOU, P); Mont Arago, 800-m altitude, 30 Nov. 1976, *H.S. MacKee* (leg. *J.F. Cherrier*) 32627 (P); Mount Colnett, at camp site at 1000-m altitude, 20°30'S, 164°43'E, 28 Oct. 2003, *U. Swenson, G. McPherson & A. Mouly 596* (MO, NOU, P, S); Mont Goroaté, 21°01'33"S, 165°10'01"E, 764-m altitude, 18 Nov. 2002,

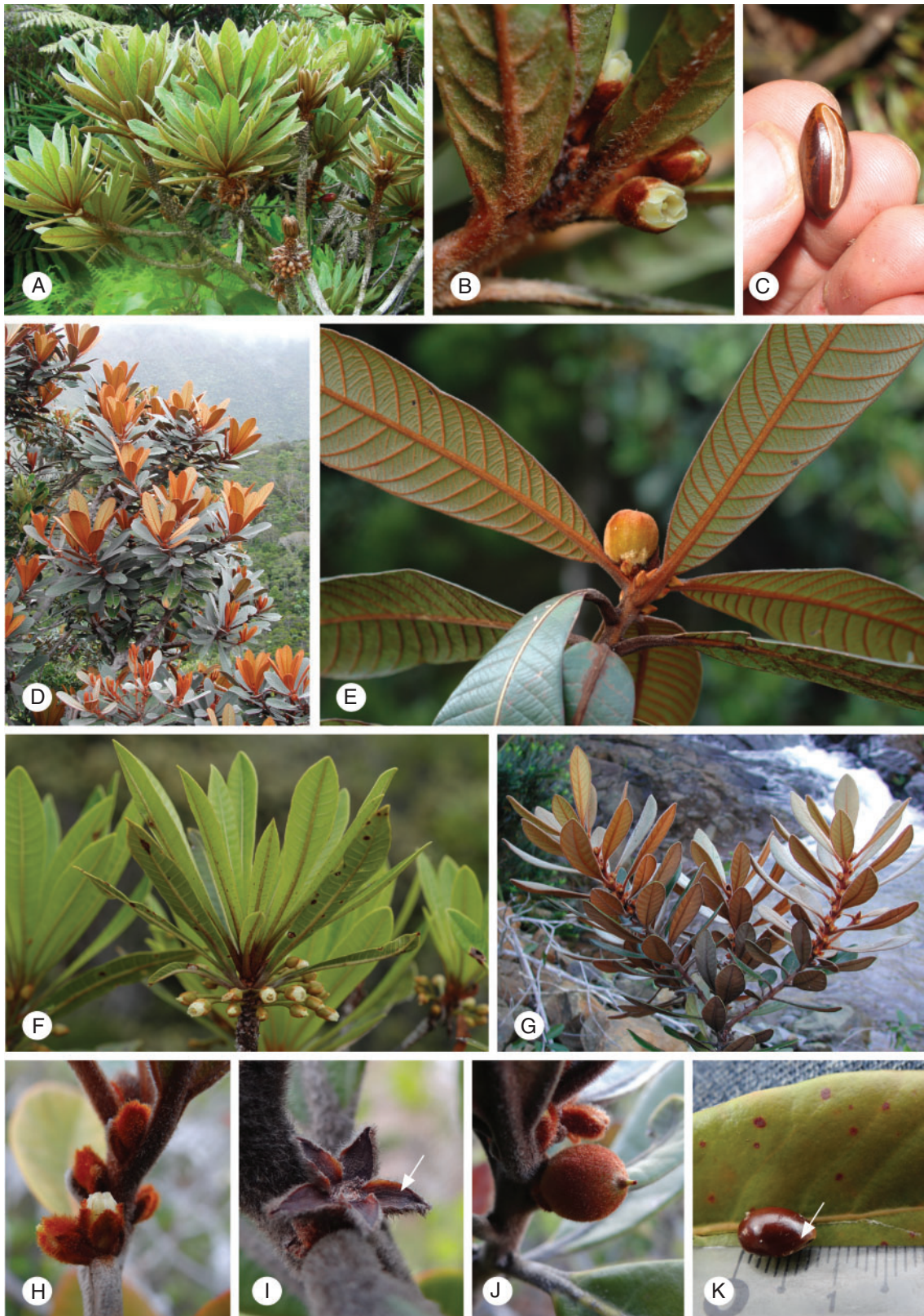


Fig. 14. Field images: A–C. *Pleioluma rubicunda*. D, E. *P. sebertii*. F. *P. tchingouensis*. G–K. *P. vieillardii*. Arrows point to the narrow band of trichomes (I) and the oblique seed scar (K) in *P. vieillardii*. Photos: Gildas Gâteblé (A, B), Ulf Swenson (C, E), Daniel Létocart (D), Jérôme Munzinger (F), Vincent Dumontet (G) and Rosa Scopetra (H–K).

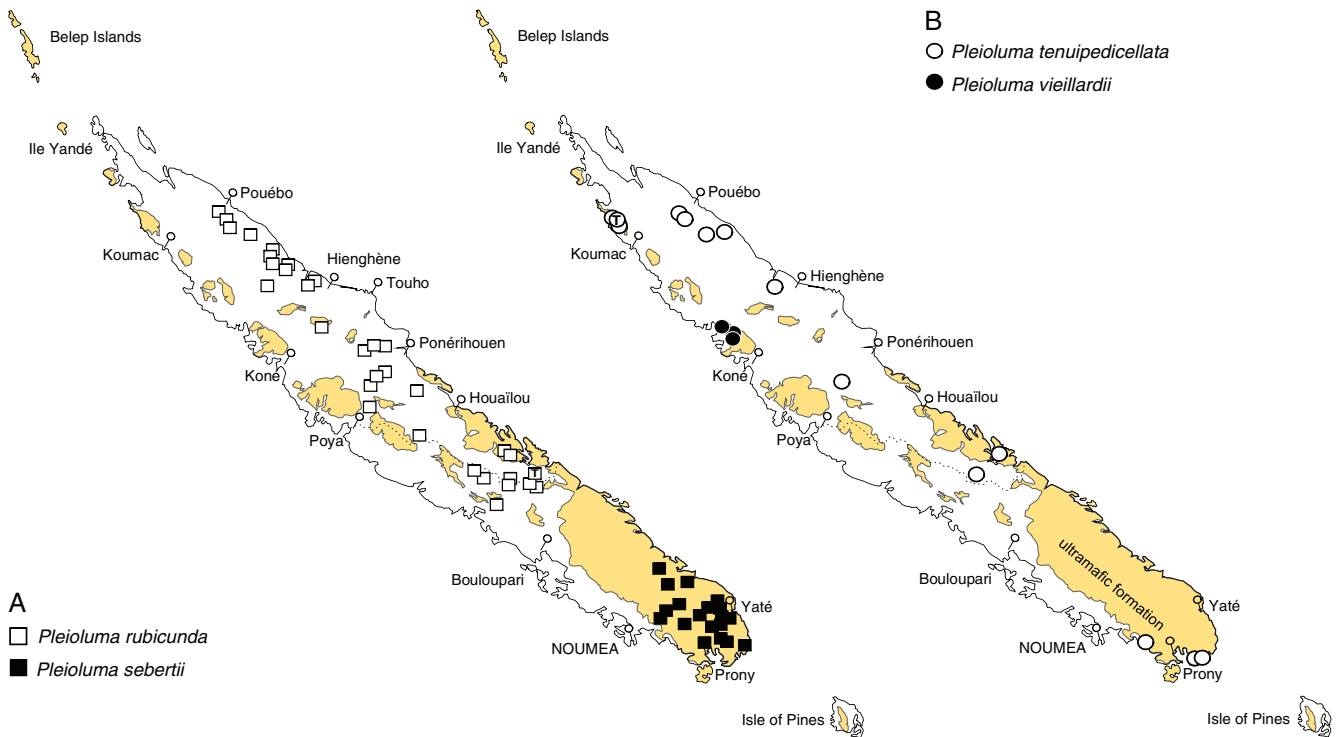


Fig. 15. A. Map of New Caledonia with distribution of *Pleioluma rubicunda* (open squares) and *P. sebertii* (closed squares). B. Map of New Caledonia with *P. tenuipedicellata* (open circles), and *P. vieillardii* (closed circles). T, type localities. Shaded areas are dominated by ultramafic substrates.

J. Munzinger & al. 1626 (MO, NOU, P, S); Mont Ignambi, slope above Oubatche, 800–900-m altitude, 12 Jun. 1956, *H.S. MacKee* 4789 (P); Mont Ignambi, W slope, 800–1000-m altitude, 1 Oct. 1956, *H.S. MacKee* 5372 (P); Mount Rembai, above Col d'Amieu, 600-m altitude, 7 Jun. 1983, *G. McPherson* 5732 (MO); Mont Ignambi, 1000-m altitude, 19 Aug. 1965, *J.-M. Veillon* 408 (NOU, P); Mont Panié, contrefort nord est, 600–800-m altitude, 11 Nov. 1965, *H.S. MacKee* 13849 (P); Mont Panié, 600–800-m altitude, 18 Sep. 1966, *M. Schmid* 1567 (NOU, P); Mont Panié, 550-m altitude, 7 Sep. 1978, *T. Sévenet & J. Puset* 1554 (MPU, NOU); Mont Panié, 1300-m altitude, 29 Nov. 1978, *H.S. MacKee* 36148 (P); Mount Panié, ~20 air-km NW of Hienghène, 950 m altitude, 6 Dec. 1979, *G. McPherson* 2193 (K, MO, NOU, P); Mont Panié, 750-m altitude, 17 Sep. 1981, *B. Suprin* 1419 (NOU, P); Mount Panié, SW above Haut Coulna, 20°36'82"S, 164°44'40"E, 550–700-m altitude, 25 Oct. 1999, *G. McPherson & H. van der Werff* 17732 (MO, NOU, P); piton dégagé sur crête ouest de la Roches Ouaième, 650-m altitude, 19 Apr. 1966, *H.S. MacKee* 14756 (P); plateau de Boakaine, Canala, 21°29'27"S, 165°54'01"E, 17 Dec. 2006, *J. Munzinger & al.* 4046 (NOU, P, S); Poami (Haute Temala), 700-m altitude, 6 Sep. 2010, *V. Hequet & J.-P. Butin* 3844 (NOU); Pouébo, Ouangati, 600-m altitude, 20 Oct. 1978, *H.S. MacKee* 35946 (P); Roches Ouaième, 850-m altitude, 22 Dec. 1977, *H.S. MacKee* (leg. *J.F. Cherrier*) 34464 (P); Roches Ouaième, 750-m altitude, 14 Jun. 2005, *J. Munzinger, Y. Pillon & J.-P. Butin* 2877 (NOU, P, S); Roches Ouaième, along the trail to the summit, 20°38'20"S, 164°52'08"E, 630-m altitude, 3 Feb. 2013, *U. Swenson & J. Munzinger* 1133 (MO, NOU, P, S); Tchamba, juste après de la cabane forestière, 30 Oct. 2005, *J. Munzinger & al.* 3184 (IND, NOU, P, S); Vallée Creek Tao (Oua Pandièrne), 20°34'15"S, 164°48'09"E, 9 Nov. 1965, *H.S. MacKee* 13811 (P). PROVINCE SUD: Col d'Amieu, 12–14 Jul. 1955, *A. Aubréville & H. Heine* 260 (P); Katrikoin (Haute Boghen), 500-m altitude, 4 Aug. 1965, *H.S. MacKee* 13266 (K, L, NOU, P); Mé Améri, 700-m altitude, 30 Nov. 1950, *A. Guillaumin & M.G. Baumann-Bodenheim* 9084 (G); Mont Me Ori, above Katrikoin, along old

lumber road to top, 950-m altitude, 8 Sep. 1980, *G. McPherson* 3070 (MO, NOU); Mont Nakada, pente sud, 18 Nov. 1979, *H.S. MacKee* 37610 (NOU, P).

Pleioluma sebertii (Pancher) Swenson & Munzinger,
Taxon 62: 765 (2013)
(Fig. 14D, E, 15A.)

Chrysophyllum sebertii Pancher in H. Sebert, *Not. Bois Nouv. Caléd.*: 194 (1874); *Beccariella sebertii* (Pancher) Pierre, *Not. Bot. Sapot.* 1: 30 (1890); *Planchonella sebertii* (Pancher) Dubard, *Ann. Mus. Colon. Marseille, sér. 2*, 10: 58 (1912); *Pouteria sebertii* (Pancher) Baehni, *Candollea* 9: 297 (1942); *Sideroxylon lasiocladon* Baill., *Bull. Mens. Soc. Linn. Paris* 2: 887 (1890) (as '*lasiocladum*').

Type: Nouvelle-Calédonie [without locality], *s. dat.*, [*H. Sebert & [E.] Fournier* 49 (lecto (designated by Aubréville (1967): P 00402856; isolecto: P00639319, P 00402857, P 00402858).

Gynodioecious shrub, treelet, or tree up to 9 m tall. *Leaf* blades obovate, 9–25 × 3–8 cm, coriaceous, young leaves ferruginously tomentose on both sides; indumentum on upper surface turning greyish, falling off, except for the primary vein; trichomes on the lower surface eventually greyish on the blade, persistent and ferruginous along primary, secondary and tertiary veins; veins on the lower surface prominent and in stark contrast to the blade; venation craspedodromous; secondary veins of 12–23 pairs, impressed above, prominent below; intersecondary veins sometimes present; tertiary veins oblique, prominent, visible to the naked eye; apex rounded, often mucronate; petiole 10–25 mm long, ferruginously villous,

turning greyish with time. *Flowers* 5-merous, 3–5 per fascicle, (sub)sessile. *Sepals* 5–6 mm long, with the same indument as the petiole, indument on the inside restricted to the upper-central part. *Corolla* cream or white, 4–6 mm long, sometimes with small cilia scattered along the lobe margin. *Stamens* inserted in the middle of the corolla tube; anthers 1.0–1.4 mm long. *Staminodes* flat, oblong or lanceolate, entire or denticulate, sometimes reduced in bisexual as well as female flowers. *Gynoecium* flask-shaped, hispid in the lower half. *Fruit* globose to obovoid, 12–25 × 12–18 mm, 1(–4)-seeded, villous, glabrous around the 2-mm-long remnant style; seeds 10–15 × 5–7 mm, slightly compressed from the sides; seed scar ~50% of the seed length; testa chestnut, shiny, thin, 0.3 mm thick.

Recognition

Pleioluma sebertii is a distinctive member of the genus and readily distinguished from all other congeners by its large, ferruginously tomentose foliage with prominent primary, secondary, and tertiary veins that are in sharp contrast to the blade on the lower side (Fig. 14E). Some specimens could possibly be confused with *P. lasiantha*, which is a species with smaller (usually less than 8 cm long) leaves, and pedicellate flowers, not sessile or subsessile as in *P. sebertii*. The globose, ferruginously villous fruit is also distinctive. *Pleioluma sebertii* has great potential as an ornamental tree due to its beautifully coloured foliage.

Phenology

Flowers have been observed from the end of May until August, peaking in July. Fruit is often observed on trees, from October until June, when a new flowering season starts.

Distribution

This decorative tree is naturally common in rather open forests of maquis vegetation on the large ultramafic formation in the south-eastern end of Grande Terre (Fig. 15A). It occurs here primarily on land with serpentine rocks but also iron crust, from almost sea level to 600 m in altitude.

Etymology

Jean Armand Isidore Pancher (1814–1877), gardener and botanist in the colony of Tahiti, attributed this species to Hippolyte Sebert (1839–1930), the collector of the type specimen, with the species epithet *sebertii*.

Conservation status

Pleioluma sebertii is restricted to the large ultramafic formation in the southern part of Grande Terre where it forms one main population with an EOO of 789 km² and an AOO of 104 km². It occurs in seven protected areas, namely Barrage de Yaté, Chutes de la Madeleine, Forêt Cachée, Massif du Kouakoué, Montagne des Sources, Pic du Pin and Rivière Bleue. Even if the species is rather common within its modest EOO, 14 of the known localities are inside mining concessions, some of them actively clearing vegetation. *Pleioluma sebertii* is, therefore, assigned an IUCN preliminary status of *Vulnerable* (VU): A3cd, B1ab(i,ii,iii) 2ab(i,ii,iii).

Nomenclatural note

Three years before he died, Pancher (in Sebert 1874) described *Chrysophyllum sebertii* on the basis of two collections, namely *Sebert & Fournier 49* and *Petit 49*. Four duplicates of the former (P 00402856, P 00402857, P 00402858, P 00639319) and one of the latter (P 00402859) have been located, previously distributed in three herbaria, viz. Paris herbarium, Herbier de l'Exposition Coloniale, and Pierre's private collection, all now being housed in the Paris herbarium. The specimen P 00639319 is a mixed collection of plant material (*Sebert & Fournier 49*) and two illustrations that originate from *Petit 49* (bisexual flower) and an unidentified collection with female flowers and fruit. All this material, except for the latter illustration, is part of the original material (cf. Art. 9.3 of the ICN; McNeill *et al.* 2012), but we cannot deduce which material Pancher used when he described *C. sebertii*.

Sixteen years later, Baillon (1890a) described *Sideroxylon lasiocladon*, although he suspected that Pancher and Sebert had described it in *Chrysophyllum*, quoting '*peut-être décrit comme Chrysophyllum par Pancher et Sébert*' (p. 887) and referred to a specimen by Pancher (*Mus. néo-caléd., no 253*). This annotation is found in the lower left corner on the specimen *Sebert & Fournier 49* (P 00639319). However, this specimen is not annotated '*S. lasiocladum* H.Bn', which is the case for two other specimens (P 00402856 and P 00402858), originally kept in the Paris herbarium and ought to have been in Baillon's possession. Hence, it is unclear which material Baillon used when he described *S. lasiocladon*.

Dubard (1912) realised that *Chrysophyllum sebertii* and *Sideroxylon lasiocladon* were based on the same original material and united them under *Planchonella*. Aubréville (1967) accepted this amalgamation, but put the species back in *Beccariella*, and stated that the holotype was housed in the Paris herbarium (P). In the Paris herbarium, the specimen P 00402856 is labelled as the holotype. However, following the reasoning by McNeill (2014), it is impossible to establish the holotype because different lines of evidence indicate that different or several specimens were used. Therefore, following Art. 9.9 of the ICN (McNeill *et al.* 2012), Aubréville's use of the term 'holotype' is here treated as an error, and corrected to lectotype.

Specimens examined

PROVINCE SUD: along Noumea–Yaté road, riverbank near bridge over La Madeleine, 2 Feb. 1980, *G. McPherson 2378* (MO, NOU, P); along Noumea–Yaté road, near descent towards Yaté, 400-m altitude, 8 Jul. 1981, *G. McPherson 3892* (K, MO, NOU, P); along Noumea–Yaté road, west of road near Col de Yaté, 22°10'07"S, 166°53'48"E, 330-m altitude, 9 Feb. 2013, *U. Swenson & J. Munzinger 1140* (MPU, NOU, P, S); basse vallée de la Petite Yaté, 5-m altitude, 31 Jul. 1966, *H.S. MacKee 15416* (P); Creek Pernod, 14 Jan. 1966, *J.-M. Veillon 601* (NOU, P, S); Creek Pernod, 22°10'53"S, 166°50'28"E, 9 May 2004, *J. Munzinger & al. 2028* (K, MO, NOU, P, S); Forêt Nord de Prony, 250-m altitude, Oct. 1903, *Cribs 1284* (P); Goro, 22°16'19"S, 166°57'48"E, 26 May 2004, *J. Munzinger & G. Dagostini 2100* (MO, NOU, P, S); Goro, 22°16'17"S, 166°57'37"E, 16 Apr. 2004, *J. Munzinger & al. 1975* (MO, NOU, P, S); Grande Lac, 5 km in direction of Goro, 15 Nov. 1955, *H.S. MacKee 3386* (E, P); haute vallée du Creek Pernod, 250-m altitude, 29 Jun. 1978, *H.S. MacKee 35318* (P); hills E of Plaine des Lacs, 250-m altitude, 27 Jun. 1982, *G. McPherson 4607* (K, MO, NOU, P); Mont Kouakoué, 600-m altitude, 1 Oct. 1981, *H.S. MacKee* (leg.

J.F. Cherrier 39704 (NOU, P); Montagnes des Sources, 500-m altitude, 11 Jan. 1969, *H.S. MacKee* 21406 (K, L, MO, NOU, P, S); road to Montagnes des Sources, 200-m altitude, 23 Jun. 1977, *M. Fallen, B. Suprin & J. Favier* 133 (MO, NOU, P); Montagnes des Sources Reserve, ~20 km NE of Noumea., 400-m altitude, 13 Jan. 1980, *G. McPherson* 2312 (MO, NOU, P); near the Madeleine Falls, Blue River district, 23 Nov. 2000, *J.H. Hemsley* 7160 (K); Noumea-Yaté, Rivière des Lacs, 1 Nov. 1981, *T.D. Pennington & G. McPherson* 10269 and 10270 (K, MO, NOU); Plain des Lacs, near campement 22, 5 Jul. 1949, *O.H. Selling* 104 (S); Plaine des Lacs, 14 Dec. 1949, *L.H. MacDaniels* 2514 (P); Plaine des Lacs, 22°14–16'S, 166°50–57'E, 200-m altitude, 3 Jul. 1965, *L. Bernardi* 9374 (G, K, L); Plaine des Lacs, Haute Rivière Blanche, Forêt Les Electriques, 200-m altitude, 27 Jul. 1966, *H.S. MacKee* 15369 (K, P) and *H.S. MacKee* 15368 (K, P, S); Plaine des Lacs au nord-est du Grand Lac, 250-m altitude, 9 Feb. 1971, *H.S. MacKee* 23294 (NOU, P); plaine de la Yaté, 155-m altitude, 2 Jul. 1958, *H. Hürlimann* 3069 (G, P); pont de la Rivière Madeleine (Noumea-Yaté), 22°10'S, 166°50'E, 150-m altitude, 20 Dec. 1977, *P. Bamps* 6016 (NOU, P); Prony, 250-m altitude, Oct. 1903, *Cribs* 1542 (P); Prony, Jun. 1912, *I. Franc* 1682A (G, L, P) and Jun. 1913, *I. Franc* 1523A (G, P); Rivière Bleue Reserve, 300-m altitude, 30 Jul. 1981, *G. McPherson* 4002 (K, MO, MPU, NOU, P); Rivière de Pirogues, 1909, *Mr & Mme Le Rat* 2618 (P); Rivière des Lacs, 29 Mar. 1987, *H.S. MacKee* 43480 (P); route de la Ugne, des Sources, 600-m altitude, 10 May 1956, *H.S. MacKee* 4511 (K, P); route de Yaté, Col de Ouénarou, 200-m altitude, 27 Mar. 1965, *H.S. MacKee* 12318 (P); S of Plum, overlooking Valley of Pirogues, 200 m, 6 Nov. 1981, *T.D. Pennington & G. McPherson* 10289 (K, MO, NOU); Tourmée des Lacs, 3 Jul. 1965, *Aubréville & Heiné*, 173 (P); Vallée des Lacs, 6 Oct. 1950, *A. Guillaumin & M.G. Baumann* 6724 (S); Vallée de la Ouinnée, *M. Schmid* 763 (NOU, P); Yaté, road between barrage and crossing of Rivière des Lacs, 26 Jun. 1955, *H.S. MacKee* 2648 (E, P).

***Pleioloma tchingouensis* Swenson & Munzinger, sp. nov.**

(Fig. 7B, 14F, 16.)

Diagnosis: *Pleioloma tchingouensis* is similar in foliage and inflorescence to *P. dioica*, but differs in having 5–6-mm-long bisexual flowers on slender pedicels (v. 3-mm-long unisexual flowers), well developed staminodes (v. vestigial), and occurring only on ultramafic substrate (v. schist).

Type: Nouvelle-Calédonie, Province Nord, massif du Tchingou, 20°54'47"S, 165°01'25"E, 750-m altitude, 17 Nov. 2004, *J. Munzinger, J.-N. Labat & J.-P. Butin* 2581 (holo: P 00708470; iso: P 00612470, NOU 007217, S 06-13034).

Much-branched hermaphroditic treelet up to 4 m tall. *Leaf blades* oblanceolate, (5–)7–12 × 1.2–2.2 cm, green in the same shade on both surfaces, glabrous above, sparsely tomentulose below, blade quickly glabrescent, primary vein also glabrescent, starting in the distal end, ultimately glabrous; apex acute to subacute; venation craspedodromous, somewhat brochidodromous, with weak loops near the apex; secondary veins of 17–22 pairs, flat above, inconspicuous below; intersecondary veins few, branching into a tertiary venation; tertiaries faint, reticulate and oblique, subdividing into the areolate venation; petiole (6–)10–15 mm long, tomentulose, partly glabrescent. *Flowers* 5-merous, 1 or 2 per fascicle, borne on slender, ≤0.7 mm wide, 12–20 mm long, somewhat tomentose pedicels. *Sepals* 3.0–4.5 mm long, broadly ovate, subacute or round; indumentum on sepals differentiated, sparse on the outer, dense on the inner, overlapped sepals. *Corolla* cream, 5–6 mm long with glabrous

lobe margin. *Stamens* inserted in the base of the corolla tube; anthers 1.0 mm long. *Staminodes* flat, oblong, entire, bifid or trifid. *Gynoecium* flask-shaped, hispid to half of its length, 5–6 mm long. *Fruit* obovoid or ellipsoid, ~15 × 8 mm, 1-seeded, pubescent around the 2-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller and compressed from the sides; seed scar 50% of the seed length; testa chestnut, shiny.

Recognition

Pleioloma tchingouensis is similar to *P. dioica*; both species have a similar habit and oblanceolate leaves with inconspicuous or weak secondary venation; however, detailed studies of foliage and flowers will show differences. Leaves of *P. tchingouensis* are green in the same shade on both blade surfaces, whereas the lower surface is paler than the upper in *P. dioica*. *Pleioloma tchingouensis* sets larger, 5–6-mm-long, bisexual flowers with well developed staminodes, in contrast to *P. dioica*, which has 3-mm-long, unisexual flowers, and vestigial staminodes. The ecology differs too, the former being restricted to ultramafic substrate, the latter to non-ultramafic soils.

Phenology

Flowers are produced from mid-November to mid-December; ripe fruit in October.

Distribution

Pleioloma tchingouensis is, as far as is known, endemic to the Tchingou massif, located in central Grande Terre, some 25 km south of Hienghène (Fig. 7B). It grows in evergreen humid forest at an altitude of 750–860 m on ultramafic substrates. Fieldwork in this massif is difficult and we hope that future exploration will locate additional individuals of this otherwise naturally rare species.

Etymology

The specific epithet refers to the Tchingou massif, located in central New Caledonia, to which the species appears to be restricted.

Conservation status

Pleioloma tchingouensis is known from a single population that forms an EOO of 0.6 km² and an AOO of 8 km². It occurs inside a mining concession (owned by a single company), which is currently inactive. However, *P. tchingouensis* faces a high risk of extinction if exploitation of the massif becomes active in the future. Anthropogenic fires are another important threat in that area. We, therefore, assign *P. tchingouensis* an IUCN preliminary status of *Critically Endangered* (CR): D1+2.

Specimens examined

PROVINCE NORD: massif du Tchingou: Pente sud-est, 850-m altitude, 11 Dec. 1986, *J.-M. Veillon* 6148 (NOU, P); Tchingou, face est par l'ancienne piste minière, 20°53'57"S, 165°01'18"E, 8 Oct. 2013, *J. Munzinger* (leg. *J.-P. Butin*) 7304 (MPU, NOU); W slope of Tchingou, along the old mining road, 20°53'57"S, 165°01'18"E, 860-m altitude, 1 Feb. 2013, *U. Swenson & J. Munzinger* 1129 (MO, NOU, P, S).

Pleioluma tenuipedicellata Swenson & Munzinger, sp. nov.
(Fig. 15B, 17.)

Diagnosis: *Pleioluma tenuipedicellata* is similar in foliage and inflorescence to *P. balansana* and *P. baueri*, but differs from *P. balansana* in having glabrous lower leaf blades, filiform pedicels, and larger, ~3 mm long, sepals (not tomentulose leaf blades, short and stout pedicels, and 1.0–2.0 mm long sepals); and from *P. baueri* in having tomentulose indumentum on the petioles, pedicels, sepals, and primary veins of the lower leaf surface, structures that are glabrous in *P. baueri*.

Type: Nouvelle-Calédonie, Plateau du Dôme de Tiébaghi, 20°27'37"S, 164°12'07"E, 500-m altitude, 17 Oct. 1969, *H.S. MacKee 21015* (holo: S 14-34468; iso: BRI, K, L, MO 6565545, MPU, NOU, NY, P 02089447, P 02089448).

Gynodioecious treelet or tree up to 10 m tall. **Leaf blades** obovate to oblanceolate, (2.5–)4–8 × (0.8–)1.0–2.0 cm, flat, glabrous apart from the primary vein that eventually becomes glabrous; apex rounded or somewhat subacute; venation brochidromous, weak, with poorly developed loops; secondary veins of 10–14 pairs, indistinct, faint, not easy to count, not raised above the leaf blade surface on either side; intersecondary veins few, branching into the areolate venation; tertiary veins indistinguishable from the areolate venation; petiole 5–15(–20) mm long, tomentulose. **Flowers** 5-merous, 1–3 per fascicle; pedicel (6–)8–14 mm long, filiform, ~0.5 mm wide, usually sparsely tomentulose. **Sepals** ~3.0 mm long, tomentulose. **Corolla** 3.0–4.0 mm long, cream, usually with some minute cilia along the lobe margin. **Stamens** inserted in the base of the corolla tube; anthers 0.7–1.0 mm long. **Staminodes** flat, oblong, entire or shallowly bifid, reduced in female flowers. **Gynoecium** flask-shaped, hispid at base. **Fruit** obovoid, 10–15 × 6–10 mm, 1-seeded, pubescent around the 2–3-mm-long remnant style and behind the persistent sepals; seeds of the same form as the fruit, slightly smaller and compressed from the sides; seed scar 40–45% of the seed length; testa cinnamon to chestnut, shiny, thin, 0.2–0.4 mm thick.

Recognition

Pleioluma tenuipedicellata is a cryptic species, previously confused with *P. balansana* (see Fig. 1A). It belongs to a group of four species with rather small, flat leaves with weak leaf venation, where the tertiaries cannot be separated from the areolate venation. Specimens of *P. tenuipedicellata* give an impression of possibly being hybrids between *P. balansana* and *P. baueri*; however, our analyses showed that it is molecularly similar to the latter, with only a single nucleotide difference. Morphology of *P. tenuipedicellata* resembles that of *P. baueri*, especially with flowers borne on long and slender pedicels, but *P. tenuipedicellata* has indumentum on the petiole, pedicel, sepals and primary vein of the undersurface of the leaf, at least in the lower half (becoming glabrous), and the leaf size is less variable than in *P. baueri*, a species glabrous in all parts except for some trichomes on the innermost and overlapped sepals in a few populations. *Pleioluma tenuipedicellata* is further distinguished from *P. balansana* by its glabrous leaves, and particularly in larger flowers with sepals ~3 mm long, corolla 3–4 mm long, and anthers ~1 mm long, compared with sepals

1–2 mm long, corolla 2.5–3.5 mm long, and anthers ~0.5 mm long in *P. balansana*. These size differences may seem minor, but they are consistent and decisive.

Phenology

Flowering occurs from October to January. Immature fruit are known from November, maturing occurs during April and May.

Distribution

Pleioluma tenuipedicellata occurs mostly in the northern part of Grande Terre, with occasional collections from the southern tip of the island (Fig. 15B). The species is indifferent to substrate and occurs in maquis vegetation on ultramafic soils as well as in humid forest on non-ultramafic soils, usually between 400- and 850-m altitude. There are several old records from low altitudes in the vicinity of Prony, but the species has not been re-located in recent times.

Etymology

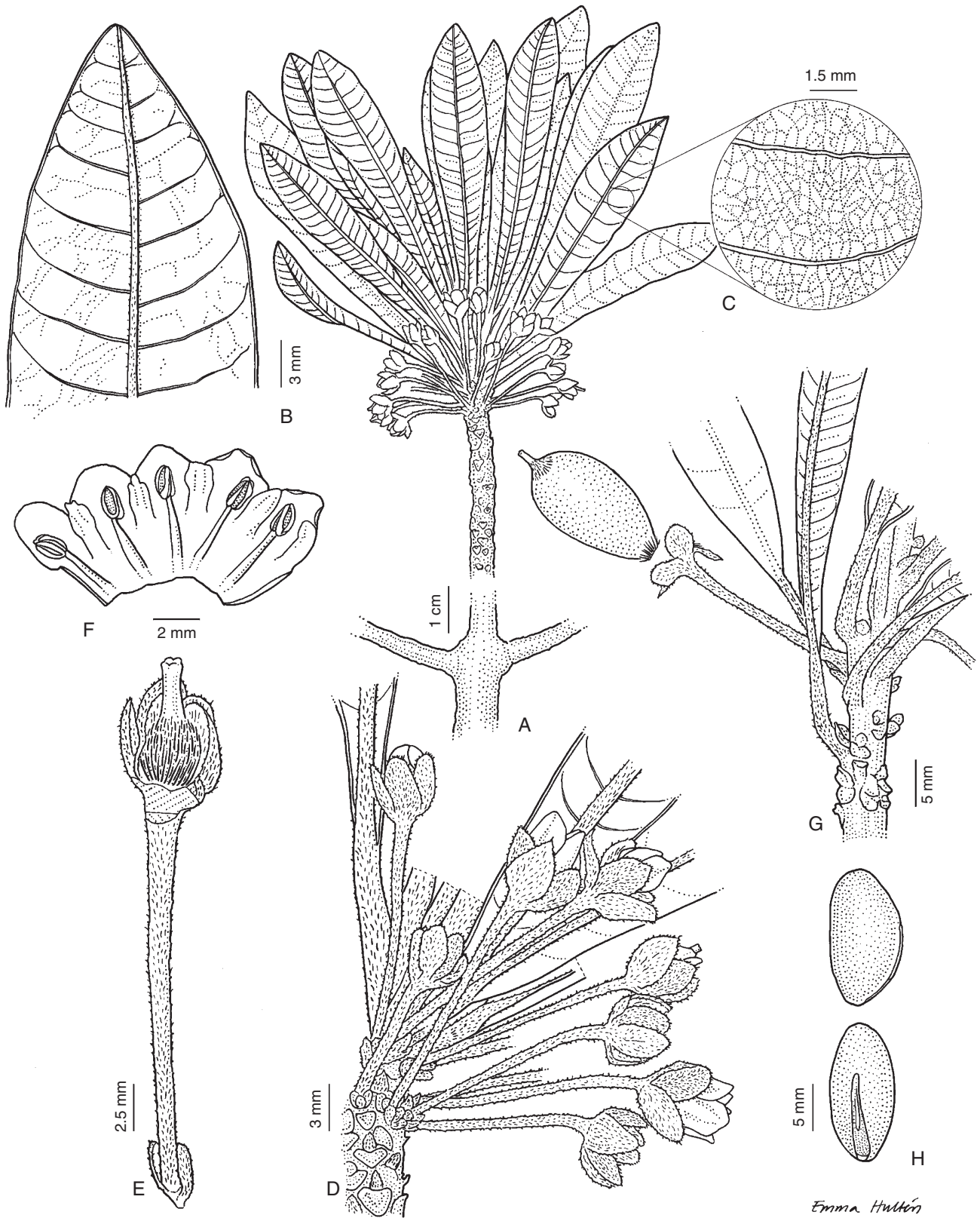
The specific name *tenuipedicellata* is adopted because of the long, thin (*tenui*) or slender pedicels, on which the flowers are borne.

Conservation status

Pleioluma tenuipedicellata has an EOO of 5131 km² and an AOO of 32 km², and is known from seven subpopulations. These calculations exclude the collections by Le Rat and Alleizette from the southern tip of Grande Terre (Fig. 15B) because the species has not been collected in that area for more than a century. One occurrence in Aoupinié (Province Nord) is protected, but two populations, namely those on Dôme de Tiébaghi and Bogota, are inside two mining concessions. On Tiébaghi, the species was encountered (collection *U. Swenson & J. Munzinger 1118*) in the mining society's 'Botanical Reserve', which is an informal reserve without protection. This is an important point because most of the massif is under active vegetation clearing and exploitation. On the basis of these facts, *P. tenuipedicellata* is assigned an IUCN preliminary status of *Vulnerable* (VU): A3cd, B1ab(i,ii,iii)2ab(i,ii,iii).

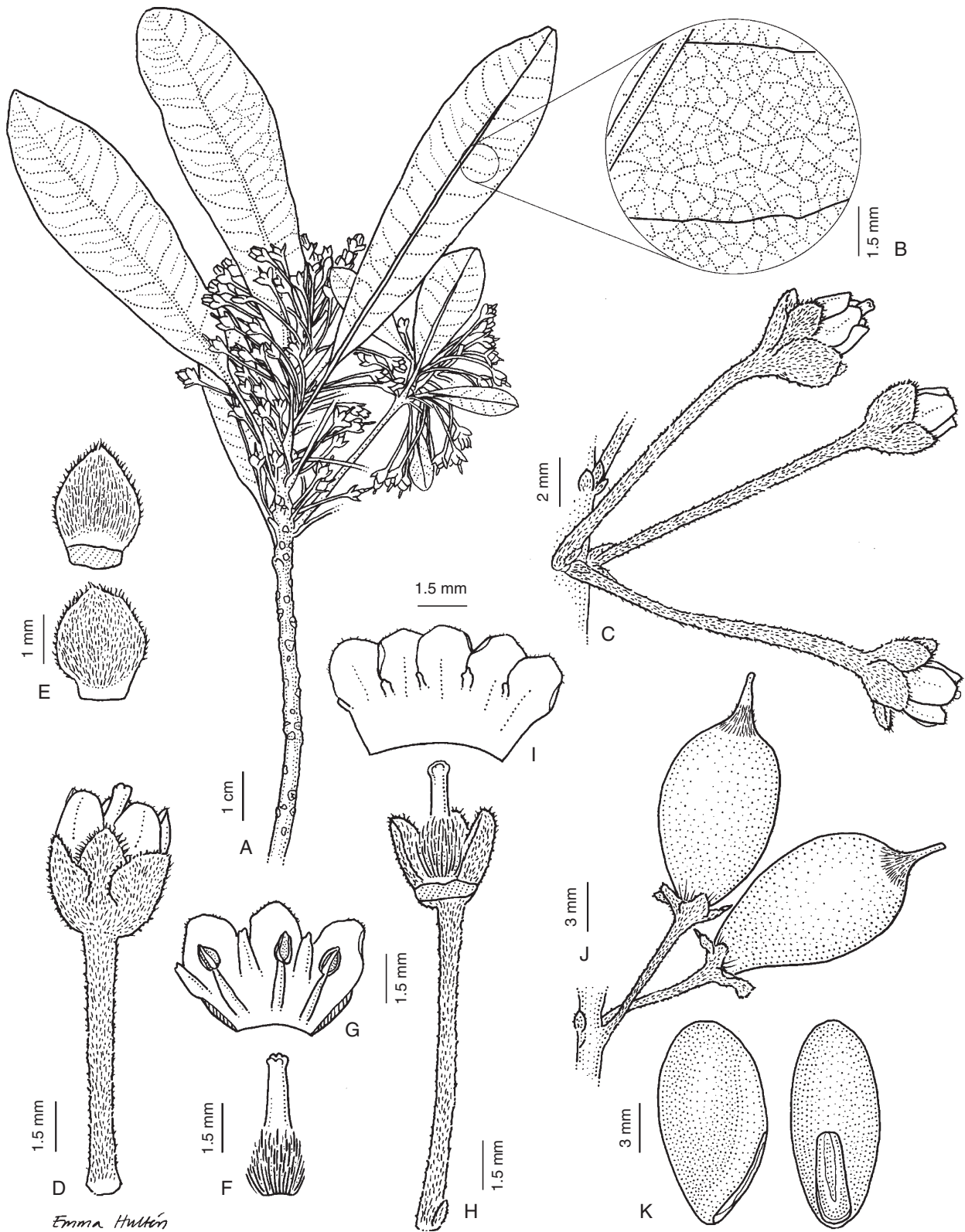
Specimens examined

PROVINCE NORD: Aoupinié, près de l'ancienne scierie, 550-m altitude, 3 Nov. 2005, *J. Munzinger 3236* (NOU, P, S); Crête Boisée, entre les vallées de la Tanghène et de la Ouaième (contrefort ouest de la Roche Ouaième, massif de Ton Non), 500–600-m altitude, 19 Apr. 1966, *H.S. MacKee 14745* (P); Dawenia [W slope of Mount Colnett]: crête de recolonisation à *Codia incrassata*, 20°32'00"S, 164°40'47"E, 679-m altitude, 15 Nov. 2010, *J. Munzinger & al. 6336* (G, MO, NOU, P, S); Dôme de Tiébaghi, 400-m altitude, 15 Oct. 1975, *T. Jaffré 1409* (NOU, P); Dôme de Tiébaghi, 550-m altitude, 22 Dec. 1981, *H.S. MacKee 40146* (NOU, P); Dôme de Tiébaghi, piste vers le nord, 549-m altitude, 6 Dec. 2007, *C. Poullain & A. Cardineau 176* (NOU, S); Galarino, 50–100-m altitude, 12 Sep. 1966, *H.S. MacKee 15626* (K, L, NOU, P); Mandjélia, 600–750-m altitude, 4 Jan. 1971, *H.S. MacKee 24575* (BRI, G, MO, NOU, P, S); Mandjélia, above Pouébo, 700-m altitude, 3 Dec. 1982, *G. McPherson 5254* (K, MO, NOU, P); Mandjélia, 2 Dec. 2006, *J. Munzinger & al. 4005* (NOU, P, S); Mandjélia juste sous l'antenne, 20°23'46"S, 164°31'53"E, 846-m altitude, 1 Oct. 2009, *J. Munzinger & al. 5844* (NOU, P, S); massif de Bogota, plateau – relevé Bogo 04,



Emma Hulkin

Fig. 16. *Pleioluma tchingouensis*. A. Habit. B. Distal part of leaf with weak brochidodromous venation. C. Close-up of areolate venation (lower surface). D. Inflorescence. E. Flower with sepals removed to expose the gynoecium. F. Open corolla of a bisexual flower. G. Fruit. H. Seed, side view (top) and seed scar (bottom). Drawn from *J. Munzinger et al.* 2581 (A–F) and *J. Munzinger* (leg. *J.-P. Butin*) 7304 (G, H).



Emma Hullón

Fig. 17. *Pleioluma tenuipedicellata*. A. Habit. B. Close-up of areolate venation (lower surface). C. Inflorescence. D. Bisexual flower. E. Sepals from the inside (top) and outside (bottom). F. Gynoecium. G. Corolla with three lobes of a bisexual flower (two lobes removed). H. Flower with two removed sepals exposing the gynoecium. I. Open corolla of female flower. J. Part of branch with two fruit. K. Seed, side view (left) and seed scar (right). Drawn from H.S. MacKee 21015 (A–G), J. Munzinger *et al.* 4005 (H, I), and H.S. MacKee 24575 (J, K).

21°29'44"S, 166°01'32"E, 4 Jun. 2008, *R. Barrière & W. Nigote 207* (NOU, P); on top of massif de Tiébaghi, 21 Oct. 1959, *Thorne 28107* (MO, P); massif de Tiébaghi, 450-m altitude, 17 Oct. 1970, *M. Schmid 3468* (NOU, P); massif de Tiébaghi, creek-side forest remnant, W slope, 450-m altitude, 10 Nov. 1980, *G. McPherson 3350* (K, MO, NOU, P); massif de Tiébaghi, 11 Jan. 2004, *J. Munzinger 1912* (NOU); massif de Tiébaghi, Central Botanical Reserve, 20°28'02"S, 164°12'29"E, 480-m altitude, 31 Jan. 2013, *U. Swenson & J. Munzinger 1118* (NOU, S); Mont Pembai, 400-m altitude, 7 May 1981, *H.S. MacKee 39034* (P); PROVINCE SUD: Cap Ndoua, *M & Mme Le Rat 72* (P); Cap Ndoua, 50–100-m altitude, Jul-1910, *C.A. Alleizette 111* (P); Baie des Pirogues, *Le Rat 314* (P); Port Boisé, Sep. 1903, *L. Cribbs 1730* (P).

Pleioluma vieillardii (Baill.) Swenson & Munzinger,
Taxon 62: 765 (2013)
 (Fig. 14G–K, 15B.)

Sideroxylon vieillardii Baill., *Bull. Mens. Soc. Linn. Paris* 2: 886 (1890); *Planchonella vieillardii* (Baill.) Dubard, *Ann. Mus. Colon. Marseille, sér. 2*, 10: 58 (1912); *Pouteria vieillardii* (Baill.) Baehni, *Candollea* 9: 414 (1942); *Beccariella vieillardii* (Baill.) Swenson, *Bartish & Munzinger, Cladistics* 23: 221 (2007a).

Type: Nouvelle-Calédonie, Gatope, 1861–1867, [*E.*] *Vieillard 2889* (lecto (here designated): P00291280); isolecto: K 000777979).

Gynodioecious shrub usually no more than 2 m tall. *Leaf blades* obovate to broadly oblanceolate, 4–8 × 2–4 cm, coriaceous with revolute margins; young leaves brownish, soon dark green above, greyish by indumentum on both sides, except for primary and secondary veins on young leaves that have a ferruginous colour; trichomes on upper surface soon falling off, except for the primary vein and along the leaf margin, eventually glabrous, indumentum usually persistent below; venation craspedodromous; secondary veins of 8–10 pairs, not impressed above, prominent below; intersecondary veins absent; tertiary veins hidden by the indumentum, faint, oblique near the margin, branching into the areolate venation; apex rounded to subacute; petiole 7–15 mm long, ferruginously villous, turning greyish with time. *Flowers* 5-merous, 1–3 per fascicle, (sub)sessile. *Sepals* 4–5 mm long, with the same indumentum as the petiole, almost glabrous on the inside except for a central band. *Corolla* cream, 4–6 mm long, without cilia along the lobe margin. *Stamens* inserted in the middle of the corolla tube; anthers 0.6–1.0 mm long. *Staminodes* flat, oblong, entire. *Gynoecium* conical, hispid at base. *Fruit* poorly known, obovoid, 10–15 × 7–10 mm, 1–3-seeded, villous, remnant style 2-mm-long; seeds slightly smaller than the fruit, compressed from the sides; seed scar 40–50% of the seed length, oblique; testa chestnut, shiny, thin, 0.2–0.3 mm thick.

Recognition

Pleioluma vieillardii is one of three species of *Pleioluma* in New Caledonia with sessile flowers and can possibly be confused with *P. sebertii*. These two species, together with *P. lucens*, are, as far as is known, the only species in the territory with pubescent fruit, but the latter has pedicellate flowers and tomentulose, glabrescent fruit (Fig. 10F, G), compared with sessile, villous fruit in the two former (Fig. 14E, J). *Pleioluma vieillardii* is distinguished from

P. sebertii by rather small, 4–8 cm long, greyish villous leaves that soon lose the indumentum on the upper side and expose a dark, glossy green, flat surface, and underneath only the primary and the secondary leaf venation are readily observable; tertiaries are faint, covered by indumentum and are not visible to the naked eye. In contrast, *P. sebertii* has larger (9–25 cm long) leaves with impressed secondaries on the upper surface, whereas, on the lower surface, even the tertiary veins are in sharp contrast to the blade. *Pleioluma vieillardii* is further distinctive by its sepals that are glabrous on the inner surface apart from a narrow, central band of trichomes (Fig. 14I) and an oblique seed scar (Fig. 14K).

Phenology

This is overall a poorly known species. Flowers are known from June–July, and fruit from December.

Distribution

Pleioluma vieillardii is a micro-endemic species, known only from the north-western corner of massif Koniambo, where it grows in maquis vegetation on serpentine at 500–600-m altitude, or possibly lower (Fig. 15B). The type collection is from the obscure and imprecise locality ‘Gatope’, which is also true for *Pycnandra longiflora* (Benth.) Munzinger & Swenson (Munzinger and Swenson 2016). The latter species was recently declared extinct (Munzinger & Swenson 2015), but has been rediscovered near a mining site at Onajiele, just north of the distribution area of *P. vieillardii*. It is, therefore, possible that the type collection of *P. vieillardii* was made in the same area.

Etymology

Species named in honour of Eugène Vieillard (1819–1896), a French naval surgeon and botanist who collected plants in New Caledonia 1857–1859 and 1861–1869 (Swenson and Munzinger 2010a).

Conservation status

Pleioluma vieillardii has an EOO of 17.7 km² and an AOO of 12 km², provided a buffer zone of 5.64 km is included around the single known population. Approximately 50 years ago, H. S. MacKee (his numbers 16856 & 23016) remarked ‘Several individuals seen but looks localised’. All four known collections are inside a mining concession of one mining company, which is actively clearing huge areas of vegetation (Koniambo mining project). Conservation measurements are, therefore, urgent and *P. vieillardii* is assigned an IUCN preliminary status of *Critically Endangered* (CR): A3cd.

Nomenclatural note

Baillon (1890a) described *Sideroxylon vieillardii* on the basis of the collection *Vieillard 2889* and wrote, ‘Je n’ai sous les yeux qu’un fragment d’une espèce probablement très voisine, le *S. Vieillardii*, que M. Vieillard (no 2889) a trouvée près de Gatope en 1861–67’ and ended the paragraph with ‘...et le fruit noué est encore trop jeune pour être décrit’ (p. 886). This text clearly indicates that Baillon had access only to a fragment and that the fruit was too young to be described. Five specimens of *Vieillard 2889* have been located, four in

the Paris herbarium (P 00291280, P 00291281, P 00291282, P 00639320) and one in the Kew herbarium (K 000777979). As pointed out above, Vieillard numbered his specimens according to how he perceived species rather than as gatherings and used very imprecise localities (Hopkins and Bradford 2009; Munzinger and Swenson 2016). In other words, a species could have been collected several times at the same or different localities. Two of the specimens have very young fruit (P 00291280, K 000777979), two have better developed fruit (P 00291281, P 00639320), and the fifth specimen (P 00291282), which was once housed in J. B. L. Pierre's private herbarium, has two leaves and two simple illustrations of a fruit. We deduce that all five specimens are syntypes, probably originating from at least two collections, and that the specimens with fruit were not studied by Baillon, because the fruit would not have escaped his eyes. The specimen in Pierre's herbarium was likely not available, because his private herbarium was acquired by the Paris herbarium in 1906 (Stafleu and Cowan 1983). Hence, following Art. 9.11 of the ICN (McNeill *et al.* 2012) and recommendations made by McNeill (2014), we herein designate the specimen P 00291280 as lectotype, material used by Baillon (1890a).

Specimens examined

PROVINCE NORD: Koniambo, 700 m, 30 Jul. 2004, *J. Munzinger 2282* (NOU, P, S); Rivière Coco, base du Koniambo, Dec. 2006, *J. Munzinger 3985* (MO, NOU, P, S); Voh, crête sommitale du Mont Katépahié, 600-m altitude, 7 Jun. 1967, *H.S. MacKee 16856* (BRI, G, L, MO, MPU, NOU, P, S); Voh, Katépahié, 550-m altitude, 10 Dec. 1970, *H.S. MacKee 23016* (NOU, P).

Conflicts of interest

The authors declare that they have no conflicts of interest.

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Handling editor: Leon Perrie

Appendix 1. Sampled accessions and voucher information of *Pleioluma* (Sapotaceae) in the following order

Taxon name with authority, area of origin, collector(s), collector number (herbarium abbreviation), European Nucleotide Archive and GenBank accessions, and character codings of morphology. The sequences published here have the prefix MF

| Taxon | Voucher (origin: collector, number (herbaria)) | ENA and GenBank accession number | | | Morphology |
|---|--|----------------------------------|----------|----------|-----------------|
| | | ETS | ITS | RPB2 | |
| <i>Beccariella brevipedicellata</i> (P.Royen) Aubrév. | New Caledonia: Dumontet, Poullain & Zongo 658 (NOU, P, S) | HE860130 | HE860068 | HE995707 | ?20024022020010 |
| <i>Magodendron menyae</i> Vink | New Guinea: Takeuchi, Ama & Siga 16570 (S) | HE860155 | AY552114 | HE995685 | 21301203202112? |
| <i>Pleioluma azou</i> (P.Royen) Swenson & Munzinger | New Caledonia, Col Yaté: Swenson & Munzinger 1148 (S) | MF572830 | MF572868 | – | 1120240220200?0 |
| <i>Pleioluma balansana</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Aoupinié: Munzinger 3236 (NOU, P, S) | MF572831 | MF572869 | – | 022024022120011 |
| <i>Pleioluma balansana</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Col de Mo: Munzinger 4917 (NOU, P, S) | MF572832 | MF572870 | – | 021024022020010 |
| <i>Pleioluma balansana</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Dawenia: Munzinger & al. 6336 (NOU, P, S) | MF572833 | MF572871 | – | 022024022120011 |
| <i>Pleioluma balansana</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Mandjéla: Munzinger & al. 4005 (NOU, P, S) | MF572834 | MF572872 | – | 022024022120011 |
| <i>Pleioluma balansana</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Poya: Munzinger & al. 4196 (MO, NOU, P, S) | HE860127 | HE860066 | HE995704 | 121024022020010 |
| <i>Pleioluma balansana</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Tiébaghi: Swenson & Munzinger 1118 (NOU, S) | MF572835 | MF572873 | – | 022024122020010 |
| <i>Pleioluma baueri</i> (Montrouz.) Swenson & Munzinger | New Caledonia, Boulinda: Munzinger & al. 4973 (NOU, P, S) | MF572836 | MF572874 | – | 023024033131010 |
| <i>Pleioluma baueri</i> (Montrouz.) Swenson & Munzinger | New Caledonia, Ile Art: Swenson & al. 915 (MO, NOU, P, S) | MF572837 | MF572875 | – | 023024033131010 |
| <i>Pleioluma baueri</i> (Montrouz.) Swenson & Munzinger | New Caledonia, Yaté: Munzinger 340 (NOU, P, S) | HE860128 | AY552113 | HE995705 | 0230240331310?0 |
| <i>Pleioluma crebrifolia</i> (Baill.) Swenson & Munzinger | New Caledonia, Boulinda: Munzinger & al. 4984 (NOU, P, S) | MF572838 | MF572876 | – | 022024022020010 |
| <i>Pleioluma crebrifolia</i> (Baill.) Swenson & Munzinger | New Caledonia, Kuebuni: Munzinger & al. 2036 (NOU, P, S) | HE860132 | DQ154042 | HE995597 | 022024022020010 |
| <i>Pleioluma crebrifolia</i> (Baill.) Swenson & Munzinger | New Caledonia, Tiébaghi: Swenson & al. 923 (MO, NOU, P, S) | MF572839 | MF572877 | – | 121024022020010 |
| <i>Pleioluma brownlessiana</i> (F. Muell.) Swenson & Munzinger | Australia: Bartish & Ford 17 (BRI, MO, NOU, P, S) | HE860131 | DQ154063 | HE995708 | 210023022120011 |
| <i>Pleioluma brownlessiana</i> (F. Muell.) Swenson & Munzinger | Australia: Bartish & Ford 28 (BRI, MO, NOU, P, S) | HE860149 | DQ154048 | HE995683 | 210023022120011 |
| <i>Pleioluma densinervia</i> (K.Krause) Swenson | Iran Jaya: Polak 1372 (L) | MF572840 | MF572878 | MF572906 | 21201003202001? |
| <i>Pleioluma firma</i> (Miq.) Swenson | Papua New Guinea: Takeuchi, Ama & Jisaka 21437 (LAE, S) | HE860188 | HE860091 | HE995615 | 21302402202001? |
| <i>Pleioluma firma</i> (Miq.) Swenson | Papua New Guinea: Munzinger & al. 6827 (S) | MF572841 | MF572879 | MF572907 | 21002102??????? |
| <i>Pleioluma firma</i> (Miq.) Swenson | Papua New Guinea: Munzinger & al. 6850 (S) | MF572842 | MF572880 | MF572908 | 21002102??????? |
| <i>Pleioluma firma</i> (Miq.) Swenson | Papua New Guinea: Munzinger & al. 6854 (S) | MF572843 | MF572881 | MF572909 | 21302102??????? |
| <i>Pleioluma firma</i> (Miq.) Swenson | Papua New Guinea: Munzinger & al. 6893 (S) | MF572844 | MF572882 | MF572910 | 21002102??????? |
| <i>Pleioluma foxworthyi</i> (Elmer) Swenson | Borneo, Kalimantan: Laman & al. 1345 (L) | MF572845 | MF572883 | NS | 20101002202001? |
| <i>Pleioluma gillisonii</i> (Vink) Swenson | Papua New Guinea: Takeuchi & Ama 19050B (LAE, S) | HE860237 | HE860116 | HE995748 | 21101000000001? |
| <i>Pleioluma lamprophylla</i> (K.Krause) Swenson | Papua New Guinea: Takeuchi, Ama & Gambia 25573 (LAE, S) | HE860200 | HE860098 | HE995619 | 21101000101001? |
| <i>Pleioluma lasiantha</i> (Baill.) Swenson & Munzinger | New Caledonia, Goro: Munzinger & al. 2614 (NOU, S) | MF572846 | MF572884 | – | 001110000000010 |
| <i>Pleioluma lasiantha</i> (Baill.) Swenson & Munzinger | New Caledonia, Kouakoué: Munzinger & al. 2026 (NOU, P, S) | MF572847 | MF572885 | – | 001110000000010 |

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Appendix 1. (continued)

| Taxon | Voucher (origin: collector, number (herbaria)) | ENA and GenBank accession number | | | Morphology |
|--|--|----------------------------------|----------|----------|-----------------|
| | | ETS | ITS | RPB2 | |
| <i>Pleioluma lasiantha</i> (Baill.) Swenson & Munzinger | New Caledonia, Yaté: <i>Munzinger</i> 2308 (NOU, P, S) | HE860133 | DQ154044 | HE995598 | 00111000000010 |
| <i>Pleioluma laurifolia</i> (A.Rich.) Swenson | Australia: <i>Dixon & Leach</i> 1032 (BRI, DNA, S) | HE860134 | HE860069 | HE995749 | 213013033130011 |
| <i>Pleioluma ledermannii</i> (K.Krause) Swenson | Papua New Guinea: <i>Takeuchi & al.</i> 17700 (LAE, S) | HE860202 | HE860099 | HE995732 | 01101000000000? |
| <i>Pleioluma longipetiolata</i> (Aubrév.) Swenson & Munzinger | New Caledonia, Haute Ni: <i>Munzinger</i> & <i>McPherson</i> 2496 (P, S) | MF572848 | MF572886 | – | 223024122020010 |
| <i>Pleioluma longipetiolata</i> (Aubrév.) Swenson & Munzinger | New Caledonia, Mandjélie: <i>Munzinger & Pillon</i> 2864 (NOU, P, S) | MF572849 | MF572887 | – | 2230241220200?1 |
| <i>Pleioluma longipetiolata</i> (Aubrév.) Swenson & Munzinger | New Caledonia, Ouaième: <i>Munzinger</i> & <i>al.</i> 2911 (NOU, P, S) | HE860136 | HE860070 | HE995710 | 223024122020011 |
| <i>Pleioluma longipetiolata</i> (Aubrév.) Swenson & Munzinger | New Caledonia, Poro: <i>Munzinger &</i> <i>Létocart</i> 2264 (NOU, P, S) | HE860135 | DQ154045 | HE995709 | 223024122020010 |
| <i>Pleioluma longipetiolata</i> (Aubrév.) Swenson & Munzinger | New Caledonia, Tchingou: <i>Swenson &</i> <i>Munzinger</i> 1127 (P, S) | MF572850 | MF572888 | – | 223024122020010 |
| <i>Pleioluma lucens</i> (P.Royen) Swenson & Munzinger | New Caledonia, Col de Yaté: <i>Swenson</i> & <i>Munzinger</i> 1142 (S) | MF572851 | MF572889 | – | 113011022011000 |
| <i>Pleioluma lucens</i> (P.Royen) Swenson & Munzinger | New Caledonia, Creek Pernod: <i>Swenson & Munzinger</i> 1144 (P, S) | MF572852 | MF572890 | – | 003111021011000 |
| <i>Pleioluma lucens</i> (P.Royen) Swenson & Munzinger | New Caledonia, Goro: <i>Munzinger &</i> <i>Dagostini</i> 2161 (NOU, P, S) | MF572853 | MF572891 | – | 103111011011000 |
| <i>Pleioluma lucens</i> (P.Royen) Swenson & Munzinger | New Caledonia, Lac de Yaté: <i>Munzinger</i> 2751 (NOU) | MF572854 | MF572892 | – | 003111022011000 |
| <i>Pleioluma lucens</i> (P.Royen) Swenson & Munzinger | New Caledonia, Madeleine: <i>Swenson</i> & <i>Munzinger</i> 1146 (P, S) | MF572855 | MF572893 | – | 003111011011000 |
| <i>Pleioluma lucens</i> (P.Royen) Swenson & Munzinger | New Caledonia, Yaté: <i>Munzinger &</i> <i>Létocart</i> 2310 (NOU, P, S) | HE860137 | HE860071 | HE995711 | 103111011011000 |
| <i>Pleioluma macrocarpa</i> (P.Royen) Swenson | Australia: <i>Bartish & Ford</i> 24 (S) | HE860138 | DQ154073 | HE995712 | 213011122020011 |
| <i>Pleioluma macropoda</i> (H.J.Lam) Swenson | Papua New Guinea: <i>Munzinger & al.</i> 6862 (LAE, MPU, S) | MF572856 | MF572894 | MF572911 | 21101103??????? |
| <i>Pleioluma moluccana</i> (Burck) Swenson | Papua New Guinea: <i>Takeuchi, Ama &</i> <i>Gambia</i> 25550 (S) | HE860139 | HE860072 | HE995671 | 21201103202000? |
| <i>Pleioluma monticola</i> (K.Krause) Swenson | Papua New Guinea: <i>van Valkenburg</i> 451 (L) | MF572857 | MF572895 | MF572912 | 2100210220200?? |
| <i>Pleioluma novocaledonica</i> (Dubard) Swenson & Munzinger | New Caledonia, Col de Yaté: <i>Swenson</i> & <i>Munzinger</i> 1149 (P, S) | MF572860 | MF572898 | – | 1120110220200?0 |
| <i>Pleioluma novocaledonica</i> (Dubard) Swenson & Munzinger | New Caledonia, Grand Lac: <i>MacKee</i> 43718 (P, S) | MF572861 | MF572899 | – | 013021022020010 |
| <i>Pleioluma novocaledonica</i> (Dubard) Swenson & Munzinger | New Caledonia, Pic du Pin: <i>Munzinger</i> & <i>al.</i> 2702 (NOU, S) | MF572862 | MF572900 | – | 1120110220200?0 |
| <i>Pleioluma novocaledonica</i> (Dubard) Swenson & Munzinger | New Caledonia, Yaté: <i>Munzinger</i> 2304 (MO, NOU, S) | HE860141 | HE860074 | HE995714 | 01201102201?010 |
| <i>Pleioluma papyracea</i> (P.Royen) Swenson | Australia: <i>Bartish & Ford</i> 20 (S) | HE860142 | DQ154046 | HE995715 | 012011010020011 |
| <i>Pleioluma queenslandica</i> (P.Royen) Swenson | Australia: <i>Bartish & Jessup</i> 8 (S) | HE860143 | DQ154043 | HE995659 | 223024032121011 |
| <i>Pleioluma rubicunda</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Canala: <i>Munzinger &</i> <i>al.</i> 4046 (NOU, P, S) | MF572863 | MF572901 | – | 101010010000010 |

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Appendix 1. (continued)

| Taxon | Voucher (origin: collector, number (herbaria)) | ENA and GenBank accession number | | | Morphology |
|---|--|----------------------------------|----------|----------|-----------------|
| | | ETS | ITS | RPB2 | |
| <i>Pleioluma rubicunda</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Mount Colnett: Swenson & al. 596 (NOU, P, S) | HE860144 | AY552160 | HE995716 | 101010010000011 |
| <i>Pleioluma rubicunda</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Mount Goroaté: Munzinger & al. 1626 (NOU, P, S) | MF572864 | MF572902 | – | 101010010000011 |
| <i>Pleioluma rubicunda</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Ouaième: Swenson & Munzinger 1133 (NOU, P, S) | MF572865 | MF572903 | – | 101010010000011 |
| <i>Pleioluma rubicunda</i> (Pierre ex Baill.) Swenson & Munzinger | New Caledonia, Tchamba: Munzinger & al. 1427 (MO, P, S) | MF572866 | MF572904 | – | 101010010000011 |
| <i>Pleioluma sebertii</i> (Pancher) Swenson & Munzinger | New Caledonia: Munzinger & al. 1975 (MO, NOU, P, S) | HE860145 | DQ154047 | HE995717 | 000100000200000 |
| <i>Pleioluma singuliflora</i> (C.T.White & W.D.Francis) Swenson | Australia: Ford & Metcalfe 4547 (QRS, S) | HE860146 | DQ246699 | HE995718 | 223024022121011 |
| <i>Pleioluma vieillardii</i> (Baill.) Swenson & Munzinger | New Caledonia: Munzinger 2282 (NOU, P, S) | HE860148 | DQ154087 | HE995719 | 000024000200000 |
| <i>Pleioluma wandae</i> (Vink) Swenson | Papua New Guinea: Armstrong 305 (E, S) | HE860242 | HE860122 | NS | 21301302202001? |
| <i>Pleioluma</i> sp. Munzinger 2581 | New Caledonia: Munzinger, Labat & Butin 2581 (NOU, P, S) | HE860140 | HE860073 | HE995713 | 112011021111010 |
| <i>Pleioluma</i> sp. Munzinger 5759 | New Caledonia: Munzinger & al. 5759 (NOU, P, S) | HE860126 | HE860065 | HE995703 | 211111022021010 |
| <i>Pleioluma</i> sp. Munzinger 6912 | Papua New Guinea: Munzinger & al. 6912 (LAE, MPU, S) | MF572858 | MF572896 | MF572913 | 11101000??????? |
| <i>Pleioluma</i> sp. Munzinger 7295 | New Caledonia: Munzinger 7295 (S) | MF572859 | MF572897 | – | 21101002?2200?0 |
| <i>Pleioluma</i> sp. Swenson 722 | New Caledonia, Mandjélie: Swenson & Munzinger 722 (NOU, P, S) | MF572867 | MF572905 | – | 111011021120011 |
| <i>Pleioluma</i> sp. Swenson 917 | New Caledonia: Swenson & al. 917 (MO, NOU, P, S) | HE860129 | HE860067 | HE995706 | 200120022020010 |
| <i>Pleioluma</i> sp. Takeuchi 25691 | Papua New Guinea: Takeuchi & al. 25691 (LAE, S) | HE860147 | HE860075 | HE995599 | 32002401??????? |
| <i>Van-royena castanosperma</i> (C.T.White) Aubrév. | Australia: Bartish & Ford 26 (BRI, MO, NOU, P, S) | HE860248 | DQ154096 | HE995658 | 22301203212102? |