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David M. JOHNSON &
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Novitates neocaledonicae XIV: A third species of *Goniothalamus* (Blume) Hook.f. & Thomson from New Caledonia and lectotypification of *G. obtusatus* (Baill.) R.M.K. Saunders

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ABSTRACT

A new species is described from New Caledonia in the genus *Goniothalamus*, which now includes three endemic species from the archipelago. The new species was first collected over 150 years ago, but had not been subsequently studied until now. Material of the New Caledonian taxa was included in a recent molecular phylogeny, which shows that they are related and belong to the same clade, but they are easily distinguished from one another by morphology. *Goniothalamus hmoope* sp. nov. differs from *G. obtusatus* by its smaller leaves and its monocarps that are terete and 3–8 seeded (vs narrowly ellipsoid, ellipsoid, subglobose to obovoid, 1–3-seeded), and from *G. dumontetii* by its flat leaves with plane secondary veins (versus slightly bullate with impressed venation), and its monocarps that are terete (vs flattened elongate with lateral triangular projections). The new species, which is restricted to the North Province and can be abundant in the Mt. Panié range, was assessed by the New Caledonian Red List Authority as Vulnerable (VU) based on the IUCN Red List criteria.

KEY WORDS

Annonaceae,
Oxymitra,
Richella,
endemic,
IUCN status,
lectotypification,
new species.

RÉSUMÉ

Novitates neocaledonicae XIV: Une troisième espèce de Goniothalamus (Blume) Hook.f. & Thomson de Nouvelle-Calédonie et lectotypification de G. obtusatus (Baill.) R.M.K. Saunders.

Une espèce nouvelle est décrite de Nouvelle-Calédonie dans le genre *Goniothalamus*, qui comprend maintenant trois espèces endémiques de l'archipel. La plante a été collectée pour la première fois il y a plus de 150 ans, mais n'avait pas été étudiée par la suite. Elle a récemment été incluse dans une phylogénie moléculaire, qui montre que les trois espèces calédoniennes sont apparentées et appartiennent au même clade, mais se distinguent facilement par leur morphologie. *Goniothalamus hmoope* sp. nov. diffère de *G. obtusatus* par ses feuilles plus petites, et ses monocarpes térétes à 3–8 graines (vs ellipsoïdes, à 1–3 graines), et de *G. dumontetii* par ses feuilles plates avec des nervures secondaires planes (contre légèrement bullées avec une nervation imprimée), et ses monocarpes térétes (vs allongés aplatis avec des projections triangulaires latérales). La plante qui est limitée à la Province Nord et peut être abondante dans la chaîne du Mont Panié, a été évaluée par l'Autorité de la Liste Rouge de la Nouvelle-Calédonie comme Vulnérable (VU) selon les critères de la liste Rouge de l'UICN.

MOTS CLÉS

Annonaceae,
Oxymitra,
Richella,
endémique,
statut UICN,
lectotypification,
espèce nouvelle.

INTRODUCTION

Goniothalamus (Blume) Hook.f. & Thomson is the largest genus of Annonaceae in the Asia-Pacific region, with 136 species distributed from India and Sri Lanka east to southern China and Fiji (Turner 2018; Leeratiwong *et al.* 2021). The genus comprises treelets to medium-sized trees found in lowland and submontane wet forests. Flowers in the genus have inner petals that are generally much shorter than the outer petals and are connivent to form a mitriform dome over the stamens and carpels, a floral morphology shared by a number of unrelated Asian Annonaceae genera. The apocarpous fruits may be single- or multi-seeded, and are adapted for dispersal by a range of vertebrate species (Tang *et al.* 2015a). An unusual feature of the seeds in a number of species is the presence of dense mucilaginous trichomes on the seed coat.

Relationships within the genus were examined by Nakkuntod *et al.* (2009) and Tang *et al.* (2015a) using molecular data. Among the accessions included by Nakkuntod *et al.* (2009) was *Suprin 1216* from New Caledonia, identified in that publication as *Goniothalamus* sp. nov. This plant appeared in the Bayesian phylogenetic tree in a strongly supported subclade along with the two other New Caledonian species but the relationships within this subclade were not further resolved.

Recent collecting and more thorough review of museum material have revealed that the species represented by the *Suprin* voucher collection is distinct from other New Caledonian *Goniothalamus* species and that it appears to be common in the region around Mt. Panié in the northern part of the island, but it also occurs on Plateau de Tango, towards Mont Grandié, further to the south. It was collected as early as the 1860s by Vieillard, confirming that herbaria remain a main source for species discovery (Bebber *et al.* 2010). In this paper we provide a formal description and illustration of the new species, and a key distinguishing it from the two other New Caledonian members of the genus.

MATERIAL AND METHODS

We used field observations and all specimens (146) deposited at GH, HKU, MO, MPU, NOU (Bruy *et al.* 2021), P (Le Bras *et al.* 2017) and RSA (abbreviations follow Thiers 2022); the scanned images of specimens at Z were consulted online at <http://www.herbarien.uzh.ch/en.html>, and specimens in K at <http://apps.kew.org/herbcat/gotoHomePage.do>. Plant terminology follows Harris & Harris (2001). When coordinates or elevation were not given on original labels of herbarium specimens, they were added post-facto using the georep website (<https://georep.nc/>) and are placed between brackets in the material cited. Coordinates in hundredths of a degree have been converted to seconds (*McPherson & van der Werff 17741*). We calculated EOO and AOO (2 × 2 km² grid) using the online “geocat” software (<http://geocat.kew.org>; Bachman *et al.* 2011), applied IUCN criteria (IUCN Standards and Petitions Subcommittee 2019), and requested an evaluation from the New Caledonian Red List Authority.

SYSTEMATICS

Family ANNONACEAE Juss.

Genus *Goniothalamus* (Blume) Hook.f. & Thomson

Goniothalamus hmoope

Munzinger & D.M. Johnson, sp. nov.

(Figs 1; 2)

Goniothalamus species distinguished from congeners by the combination of a truncate apex of the anther connective, narrowly cylindrical and slightly bifid funnel-shaped stigma, narrowly oblong (dactyliform), torulose monocarps with up to eight seeds, and mucilaginous trichomes on the testa.

TYPUS. — **New Caledonia.** Province Nord, Mandjéla, above Puébo [Pouébo], forested slopes, c. 700 m, [20°23'58.2"S, 164°31'40.188"E], 3.XII.1982, bud, fr., *G. McPherson 5249* (holo-, P[P01987649]!; iso-, GH!, K, L [L.1761617]!, MO!, NOU! [NOU012381]!, RSA!).

PHENOLOGY. — Flowers in March–June, November, and December, fruits in April, May, and October–December.

HABITAT. — *Goniothalamus hmoope* sp. nov. grows in dense humid forest at low and medium elevation, sensu Jaffré *et al.* (2012) at elevations of 300–720 m. The species can be locally abundant; it was observed as the second most numerous species among trees larger than 5 cm DBH in a 400 m² plot located at Dawenia (Munzinger 2013).

DISTRIBUTION. — The plant appears to be endemic to the Northern Province of New Caledonia. All the collections come from the Mont Panié (the northernmost population is Mandjéla) and Ton-Non (Roches de la Ouaième) massifs, except for one from the Plateau de Tango, towards Mont Grandié, which is a little off-centre in the south (Fig. 3).

CONSERVATION STATUS. — The species is known from the “Réserve de nature sauvage du mont Panié” protected area. The calculated EOO is 205 km² and the AOO is 40 km². Some subpopulations may be threatened by introduced browsers, and those at lower altitudes may also be threatened by fire. *Goniothalamus hmoope* sp. nov. was assigned a risk of extinction status of Vulnerable by the New Caledonian Red List Authority on 28 Sept. 2022 (Endemia & RLA Flore NC 2022).

VERNACULAR NAME. — Hmoope (Nemi language) (Munzinger 2013).

ETYMOLOGY. — The specific epithet refers to the vernacular name.

PARATYPI. — **New Caledonia.** Mt. Panié, above Haut Coulna, on SW forested slopes, 700–720 m, [20°36'49"S, 164°44'24"E], 26.X.1999, fr., *McPherson & van der Werff 17741* (MO, NOU[NOU012355], P[P00507387]); Mandjéla, above Puébo, forested slopes, 600–700 m, [20°23'58.2"S, 164°31'40.188"E], 15.IV.1984, fl., young fr., *McPherson 6466* (P[P01987634], MO[MO 3224998]); Vallée du Ruisseau Faiya (affluent de la Ouaième) au-dessous du Col de Kouiri, 300 m, [20°39'21"S, 164°49'21"E], 18.IV.1966, fl., *MacKee 14721* (P[P01987624]); Haut Diahot, Tendé, 500–600 m, exploitation forestière Frouin, [20°24'37"S, 164°31'19"E], 12.XII.1968, (bud, fl., fr.), *MacKee 19978* (P[P01987630, P01987631]); *ibid.*, 500 m, [20°24'26"S, 164°31'31"E], 31.III.1969, fl., *MacKee 20461* (NOU[NOU012462], P[P01987629]); *ibid.*, 600 m, [20°24'37"S, 164°31'19"E], 16.V.1981, fl., fr., *MacKee 39054* (NOU[NOU012461], P[P01989352]); *ibid.*, 600 m, [20°24'37"S, 164°31'19"E], 30.VI.1982, bt., fl., *MacKee 40573* (P[P02034823]); Wewec, parcelle 1, 640 m, [20°35'0.594"S, 164°43'38.3"E], 7.XI.2010, fl., fr. *Munzinger 6192* (NOU[NOU063369], P[P00871530, P06901166]); Wewec, [20°35'56"S, 164°43'50"E], c. 300 m, 7.XI.2010 (fl., fr.) *Munzinger (leg. Folger) 6199* (NOU[NOU063376]); Parcelle Dawenia 1, 608 m, [20°32'26.4"S, 164°40'40.8"E], 12.XI.2010, fr., *Munzinger*

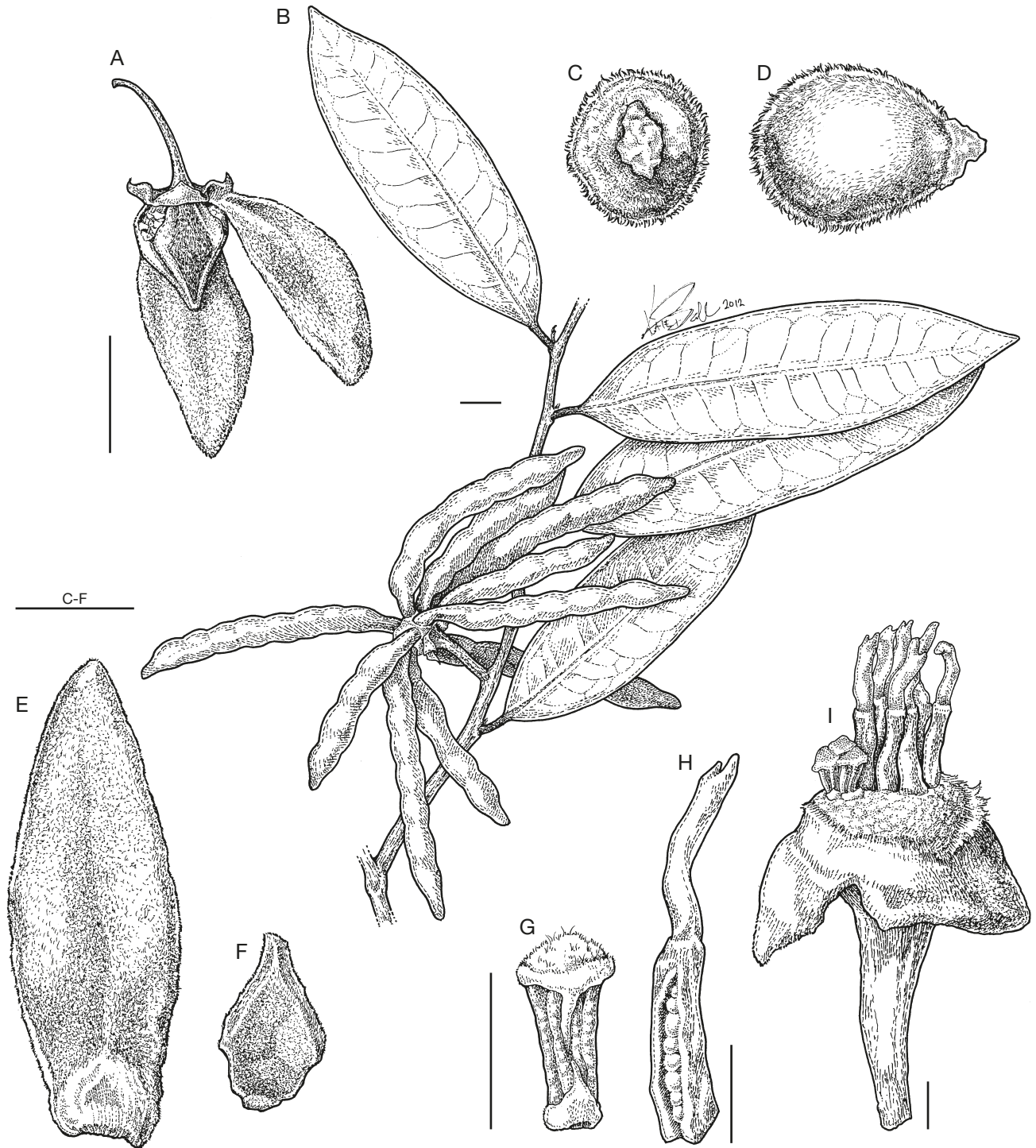


FIG. 1. — *Goniothalamus hmoope* Munzinger & D.M. Johnson, sp. nov.: **A**, flower, side view with one outer petal removed; **B**, habit; **C**, seed, view from micropylar end; **D**, seed, side view; **E**, outer petal, adaxial view; **F**, inner petal, adaxial view; **G**, stamen, abaxial view; **H**, carpel, ovary dissected to show row of ovules; **I**, Flower with petals and most of stamens removed, showing sepals, three stamens, six carpels, and torus. **A**, **E**-**I**, based on *McPherson 6466* (MO3224998); **B**-**D**, based on *McPherson 5249* (MO3208807). Drawing by Kate Stenger. Scale bars: A, B, 1 cm; C-F, 5 mm; G-I, 1 mm.

et al. 6262 (NOU[NOU063441]); Parcelle Dawenia 2, 619 m, 20°32'17.7"S, 164°40'57.9"E, 13.XI.2010, fl., *Munzinger et al.* 6273 (NOU[NOU063452]); La Guen, cascade (Panié), 637 m, 20°37'29"S, 164°46'40"E, 22.XI.2010, fl., *Munzinger 6464* (NOU[NOU063644], P[P06901165]); La Guen, [20°37'28"S, 164°46'57"E], [580 m], 23.XI.2010, fl., *Munzinger 6475* (NOU[NOU063655], P[P04021461]); Massif du Mandjélia, exploitation forestière Frouin, [20°23'47.76"S,

164°31'41.48"E], [c. 700 m], 16.IV.1981, fl., young fr., *Suprin 1216* (NOU[NOU012382, NOU012383]); Mandjelia, piste de la tour radio, 20°24'0.45"S, 164°31'33.3"E, [c. 700 m], 16.III.2010, fl., *Vandrot 296* (NOU[NOU053914]); Plateau de Tango, en direction du Mont Grandié, 24.I.2013, 20°58'48"S, 165°6'0"E, [c. 400 m], fl., *Vandrot 671* (NOU[NOU083129]); Wagap, 1861-1867, fr., *Vieillard 2283* (P[P01987561, P01987563]).

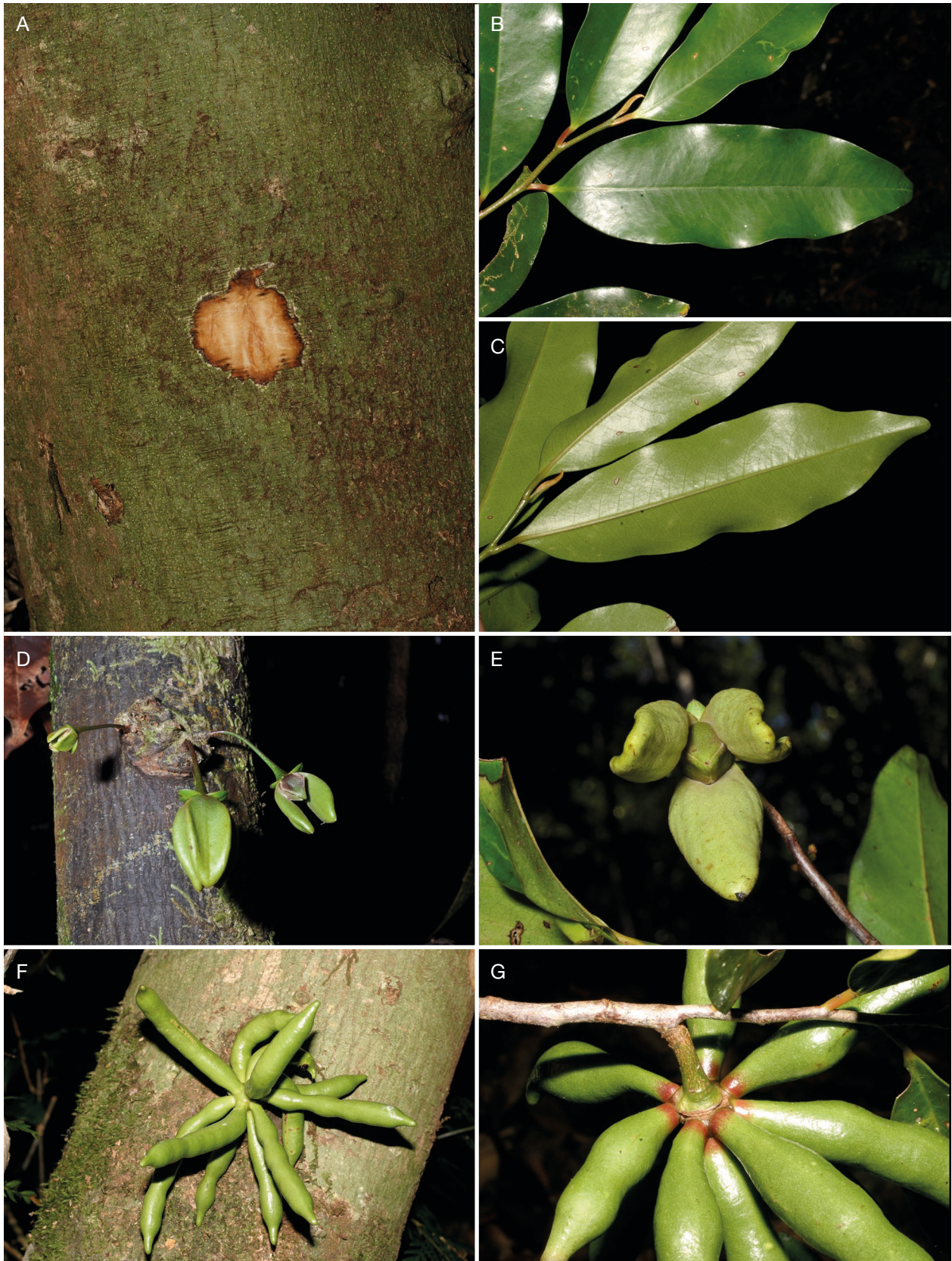


FIG. 2. — Field photos of *Goniothalamus hmoope* Munzinger & D.M. Johnson, sp. nov.: **A**, trunk with slash; **B**, adaxial face of leaves; **C**, abaxial face of leaves; **D**, inflorescence borne on trunk (cauliflory); **E**, flower from below; **F**, cauliflorous fruit; **G**, ramiflorous fruit seen from above. (Photos: A-C, F, G, © Ph. Birnbaum; D, E, © P. Lowry).

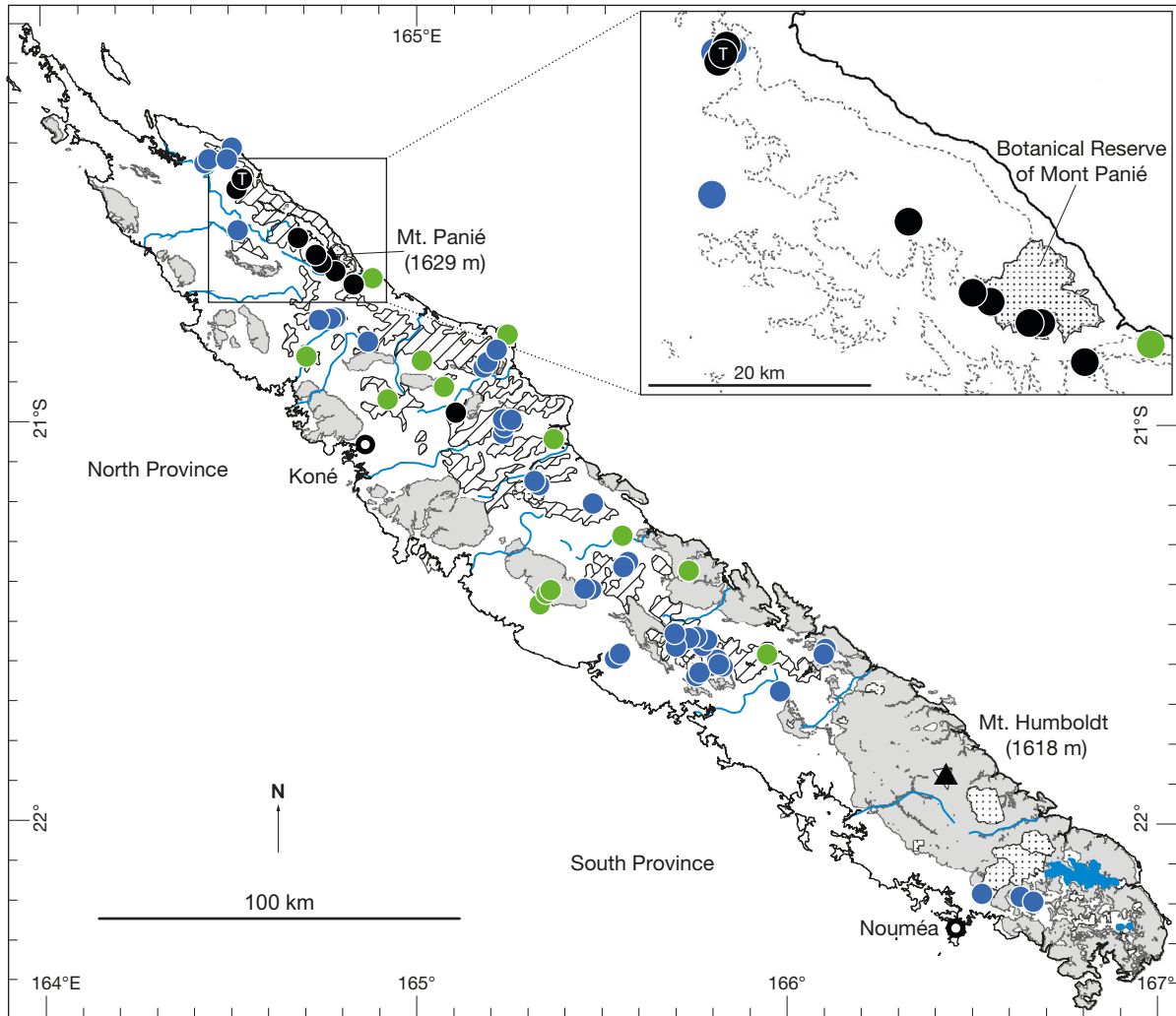


FIG. 3. — Distribution of *Goniothalamus* spp. in New Caledonia. *G. hmoope* Munzinger & D.M. Johnson, sp. nov. (●), *G. dumontetii* (●), *G. obtusatus* (●). Abbreviation: T, type specimen. Gray represents ultramafic substrates; slanting lines represent low elevation dense humid forest (Jaffré *et al.* 2012); dotted area in zoom is the “Réserve de nature sauvage du mont Panié” protected area; dotted lines indicate 500 m elevational intervals. A dynamic distribution map is available: <http://u.osmf.fr/m/936288/>

DESCRIPTION

Shrub or small tree 4-10 m tall, DBH up to 23 cm. Buds initially rusty-pubescent, twigs soon glabrate, gray-green to greenish brown, soon gray, longitudinally wrinkled. Lamina of larger leaves 6.3-12.0 cm long, 2.4-3.7 cm wide, (sub)coriaceous or rarely chartaceous, paler beneath, narrowly elliptic to oblong-ob lanceolate, base cuneate and short-decurrent, apex obtuse to acute, margins slightly revolute, glabrous above, very sparsely short-pubescent to glabrate and punctate below; midrib plane to slightly impressed above, raised below; secondary veins 10-16 per side, at midpoint of leaf diverging at 45-80° from the midrib, weakly brochidodromous, indistinct to slightly raised above, slightly raised below; higher-order veins indistinct to slightly raised above, slightly raised below. Petiole 4-8 mm long, (0.7-)-0.8-1.2(-1.5) mm wide, shallowly canaliculate in cross-section, sparsely pubescent to glabrate. Inflorescences of 1 or 2 flowers, arising from leaf axils or from short tubercles on leafless older twigs

or directly on trunk (cauliflory); pedicels (12-)-15-27 mm long, 0.6-0.7 mm thick at midpoint, thicker at apex, sparsely pubescent to glabrate, bearing 3 or 4 basal bracts, the uppermost attached 2.5-3.3 mm above the pedicel base, 1-1.5 mm long, triangular, acute, slightly concave, sparsely to densely pubescent. Sepals free, 3-4.2 mm long, 3.6-4.2 mm wide, triangular, acute, sparsely pubescent. Petals green with purplish base *in vivo*; outer petals 19-23 mm long, 7-8 mm wide, fleshy, lanceolate, apex acute, margins recurved, fine-pubescent on both surfaces; inner petals 8-9.5 mm long, 5-6 mm wide, fleshy, connivent over the stamens and carpels, rhombic to ovate-acuminate, trigonous in apical 1/3, appressed-pubescent externally, the pubescence shorter and finer along the margins, pubescent on connivent margins internally, glabrous and somewhat corrugated on the inner concavity. Stamens ca. 100, 1-1.4 mm long, oblong-clavate to quadrate, anthers 6-8-locellate, anther connective apex truncate, pubescent in center, papillate on periphery; filament rudimentary.

Carpels 10-12; ovaries 1.8-1.9 mm long, oblong, glabrous; ovules 6-8 in a single row; stigma articulated at the apex of the ovary, 1.7-1.9 mm long, narrowly cylindrical and slightly bifid funnel-shaped. Torus of flower 3.1-3.7 mm in diameter, 1.2-1.5 mm high, glabrous, ovary bases slightly sunken in center. Fruit of 7-12 monocarps borne on a pedicel 16-25 mm long, 1.8-3 mm thick, longitudinally wrinkled, glabrate; torus of fruit 10-13 mm in diam., 6-7 mm high, depressed-globose; monocarps green (immature?) *in vivo*, 4.5-6.6 cm long, 0.7-1.1 cm wide, narrowly oblong (dactyliform), torulose, basally tapered gradually into a hollow stipe 4-10 mm long, apex contracted into a distinct beak 3-12 mm long; pericarp 0.5-0.6 mm thick. Seeds up to 8 per monocarp, usually 5-7, lying parallel or slightly oblique to the long axis, in a single row, 8.7-10.1 mm long, 6-7.1 mm wide, 5.4-6.8 mm thick, brown, ellipsoid, covered by a thin shiny fragile layer than upon wetting becomes pubescent and mucilaginous; micropyle obscured by pubescent ariloid mass.

NOTES

Revisionary work on Asian-Pacific Annonaceae in recent years led to the recognition that the Asian genus *Goniothalamus* is represented on New Caledonia. Van Heusden (1996) proposed that *Richella* A. Gray, represented in New Caledonia by *R. obtusata* (Baill.) R. E. Fr. (Fries 1959; van Steenis 1964), was not distinct from *Goniothalamus*, and their resemblance had previously been noted by Jessup (1988). This was subsequently supported by the molecular phylogenetic study of Nakkuntod *et al.* (2009), leading to the nomenclatural transfer of *R. obtusata* to *Goniothalamus* made by Saunders & Wang (2011) after the generic name *Goniothalamus* (Blume) Hook.f. & Thomson (Hooker & Thompson 1855) had been conserved (Saunders 2009) against *Richella* A. Gray (1852). In the meantime, a new species from New Caledonia was described as *G. dumontetii* R.M.K.Saunders & Munzinger (Saunders & Munzinger 2007).

In the phylogenetic study of *Goniothalamus* by Nakkuntod *et al.* (2009) the New Caledonian species *G. dumontetii* and *G. obtusatus* (Baill.) R.M.K.Saunders were retrieved

in the same subclade as the new species described here. The analysis of Tang *et al.* (2015a) did not include material of *G. hmoope* sp. nov., but the other two species again fell in the same strongly supported subclade, which also included *G. australis* Jessup from Australia, not included in the earlier study. The New Caledonian species did not group with sampled taxa from New Guinea or Fiji in either study, as might have been expected, but instead were part of a clade comprising species from mainland Southeast Asia and nearby areas. The only synapomorphy identified for members of this Austro-Caledonian subclade by Tang *et al.* (2015a) was the pubescent testa, which also occurs in *G. hmoope* sp. nov. (not included in the analysis). While all three species are endemic to the main island “Grande-Terre” of New Caledonia, only *G. obtusatus* is widespread, while *G. dumontetii* is restricted to the centre, and *G. hmoope* sp. nov. has the smallest distribution, restricted to the north-east (Fig. 3).

Goniothalamus hmoope sp. nov. resembles *G. australis* Jessup (Jessup 1986) in its narrow elliptic leaves and relatively small inner petals compared to outer petals, but has a much narrower fruit. On the basis of its morphology, the new species would be classified in *G.* subgen. *Truncatella* Bân (Bân 1974); the analysis of Tang *et al.* (2015b) showed, however, that recognition of this subgenus was not consistent with their phylogenetic results.

In some localities *Goniothalamus hmoope* sp. nov. is sympatric with *Xylopia vieillardii* Baill., which it superficially resembles in habit, leaf shape, and leaf size. In the presence of flowers and/or fruits, the two species are readily distinguishable; when sterile, *X. vieillardii* may be distinguished from *G. hmoope* sp. nov. by its architecture type (main axis with spiral branching, see Johnson [2003], versus distichous in *G. hmoope* sp. nov.), conspicuous white lenticels on the twigs, the more prominent tertiary vein reticulum on the lower leaf surface (absent in *G. hmoope* sp. nov.), and the occasional presence of two branches from the same leaf axil (always absent in *G. hmoope* sp. nov.) (Johnson *et al.* 2013).

Goniothalamus hmoope sp. nov. can be distinguished from its New Caledonian congeners using the following key and Fig. 4:

KEY FOR *GONIOTHALAMUS* (BLUME) HOOK.F. & THOMSON SPECIES IN NEW CALEDONIA

1. Leaves with secondary veins obviously impressed, lamina consequently slightly bullate (not flat); petals red-brown; monocarps flattened elongate with lateral triangular projections as a result of constrictions between seeds; flowers borne mostly at the base of the trunk (plants cauliflorous) *G. dumontetii* R.M.K.Saunders & Munzinger
- Leaves with secondary veins plane, not or weakly impressed, lamina mostly flat; petals pale green to cream-colored; monocarps elongate, terete or ellipsoid; flowers borne on leafy branches and sometimes on the trunk (plants cauliflorous) 2

2. Leaves 6.3-12 cm long, petiole 4-8 mm long, 0.7-1.5 mm in diameter, monocarps elongate, terete, 4.5-6.6 cm long, 0.7-1.1 cm in diameter, apex beaked, slightly to strongly torulose, seeds 3-8 *G. hmoope* Munzinger & D.M. Johnson, sp. nov.
- Leaves 17.5-30 cm long, petiole 10-21 mm long, 2.1-3.8 mm in diameter, monocarps narrowly ellipsoid, ellipsoid, subglobose to obovoid, 2.9-5.45 cm long, 1.1-3.05 cm in diameter, obtuse, apex rounded to acute, smooth, not torulose, seeds usually (1-)2(-3) *G. obtusatus* (Baill.) R.M.K. Saunders

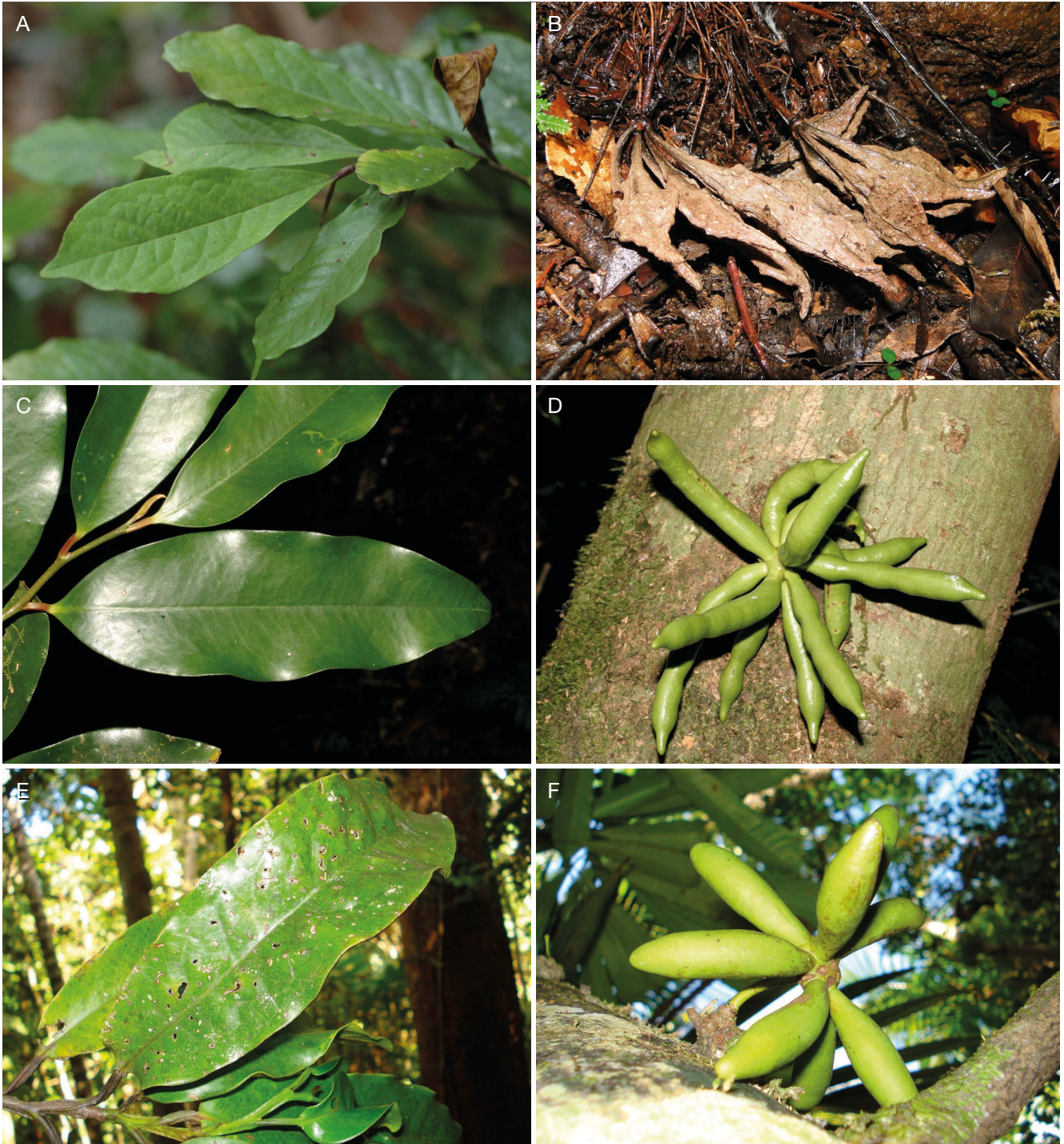


FIG. 4. — Field photos of the three species of *Goniothalamus* (Blume) Hook.f. & Thomson in New Caledonia: **A, B**, *G. dumontetii* R.M.K.Saunders & Munzinger: **A**, leaves; **B**, fruits; **C, D**, *G. hmoope* Munzinger & D.M. Johnson, sp. nov.: **C**, leaves; **D**, fruit; **E, F**, *G. obtusatus* (Baill.) R.M.K.Saunders; **E**, leaves; **F**, fruit. Photos: **A**, © J. Munzinger; **B**, Ch. Davidson; **C, D**, © Ph. Birnbaum; **E, F**, V. Hequet.

Goniothalamus obtusatus (Baill.) R.M.K.Saunders

Oxymitra obtusata Baill., *Adansonia; recueil d'observations botaniques* 8: 178 (Baillon 1868). — Lectotype: New Caledonia. *sin. loc.*, 186[?], *Vieillard 641* (P[P01982592], here designated).

LECTOTYPIFICATION

Baillon (1868: 178) described *Oxymitra obtusata* Baill., the basionym of *Goniothalamus obtusatus*, based on specimens indicated as being “dans les collections de M. Vieillard”, and following the diagnosis, he stated “*Oritur in Novae-Caledoniae montibus, ubi*

legit cl. Vieillard^p, which indicates that the type material comprises Vieillard's collections (plural). Saunders & Wang (2011) interpreted this as *Vieillard s.n.* and cite the "holotype" as being at P. But the Paris herbarium has no fewer than eight herbarium specimens made by Vieillard, all of which thus represent potential syntypes. Moreover, the system used by Vieillard to number his material is well known to be "special and irrational" (Morat 2010) because he assigned a given number to what he thought was a species rather than a single gathering, a situation that was further complicated by the fact that label exchanges are also suspected (Guillaumin 1942). Thus when a species is typified by two or more Vieillard specimens, it is prudent to consider them as probable syntypes or isosyntypes (Gâteblé *et al.* 2021). Of the eight sheets of *Oxymitra obtusata* deposited in Paris, three (P01749441, P01982589, P01982591) were previously in the herbarium in Caen (CN transferred to Paris in the 1970s) and were probably not seen by Baillon. Among the five remaining specimens, three have labels with locality information, Balade (P01982590) or Wagap (P01982594, P01982595), which is not indicated in the protologue. The two remaining specimens (P01982592, P01982593) are the only ones with the name *Oxymitra obtusata* Baill. in Baillon's hand; P01982592 is in better condition and includes dissected fruits with isolated seeds in a packet, and since it was on the basis of the characteristics of the seed that Baillon used the epithet "obtusata", this sheet (P01982592) is chosen as the lectotype.

Some variations can be observed in *Goniothalamus obtusatus* (Baill.) R.M.K.Saunders, notably in monocarp shape, with some being globose, wide and with a rounded apex in one, and others narrower with a more acute apex. We were not able to relate this variation to other morphological characters nor to ecological or edaphic differences.

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