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Pytinicarpa (Asteraceae, Astereae) in New Caledonia

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Abstract

The genus *Pytinicarpa* G.L.Nesom is taxonomically revised in New Caledonia with four species recognised. The circumscription of one previously published species, *P. sarasinii* (Däniker) G.L.Nesom, is discussed and updated, and *P. neocaledonica* (Guillaumin) G.L.Nesom is placed in its synonymy. The name *P. comptonii* Gâteblé, Lannuzel & M.Pignal, *nom. nov.* is proposed to accommodate the former *Lagenophora neocaledonica* S.Moore in *Pytinicarpa*, and its lectotype is designated. Two new narrowly endemic species are also described. The first is from the top of Mount Kaala massif with the name *P. kaalaensis* Lannuzel, Gâteblé & M.Pignal, *sp. nov.* The second, *P. tonitrui* Lannuzel, Gateblé & M.Pignal, *sp. nov.* is from the Babouillat peninsula, and is supposedly extinct, as extensive field research did not allow to find it. The four species are fully described, illustrated, and keyed. The distribution, ecological affinities, and threats for the four species are discussed to support the assessments of conservation status for two of them as Endangered (EN), one as Critically Endangered (CR) and one as Extinct (EX), following the IUCN Red List guidelines and criteria.

Keywords: Asteroideae, Lagenophorinae, flora, new species, threatened species

Introduction

After the revision of *Lagenophora* Cassini (1816: 199) in New Caledonia (Lannuzel *et al*. 2021a), another group of daisies, the closely allied *Pytinicarpa* Nesom (1994a: 136) also required a formal and updated treatment. *Pytinicarpa* belongs to the subfamily Asteroideae (Cassini 1819: 195) Lindley (1829: 1074), tribe Astereae Cassini (1819: 195), subtribe Lagenophorinae Nesom (1994b: 207) (Nesom & Robinson 2007). It is endemic to New Caledonia and Fiji and currently comprises two species in New Caledonia and one in Fiji (Nesom 2001).

Since its description, *Pytinicarpa* has been considered as closely related to *Lagenophora*. However, unlike in other genera, no *Pytinicarpa* species has ever been included in a molecular phylogeny study, so its relationships within Lagenophorinae are not known. Morphologically, Nesom (1994a, 2001) considered the following characters as specific to *Pytinicarpa*: conical-convex receptacles, ray florets in a single series, and multinerved, subcylindric cypselae. Lannuzel *et al*. (2021a), on the other hand, considered the absence of glands and a beak at the top of the cypsela to be the only character diagnostic between *Pytinicarpa* and *Lagenophora*. We believe that only a molecular study with a large sampling would be able to clarify this point. It is however beyond the scope of this study, which mainly focused on revising the genus in New Caledonia on a morphological basis.

At the species level, the genus was established by Nesom (1994a) to accommodate two New Caledonian endemic species formerly recognised in *Brachyscome* Cassini (1816: 199), viz. *Pytinicarpa neocaledonica* (Guillaumin 1937: 61) Nesom (1994a: 138) and *P. sarasinii* (Däniker 1933: 479) Nesom (1994a: 138), the former being designated as the type of the genus. Later, Nesom (2001) also transferred a species of *Keysseria* Lauterbach (1914: 241) that is endemic to Fiji to *Pytinicarpa* as *P. pickeringii* (Gray 1861: 121) Nesom (2001: 516). In his revision of *Lagenophora*, Cabrera

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(1966) has excluded *L. neocaledonica* Moore (1921: 345) from that genus but considered this species closely related to *Brachyscome neocaledonica* Guillaumin (1937: 61) and termed it as "*Lagenophora neocaledonica* S.Moore = *Brachycome* aff. *neocaledonica* Guillaumin". Nesom (1994a) did not mention the name *Lagenophora neocaledonica* S.Moore but he later (Nesom 2001) considered it as a synonym of *P. sarasinii* without giving any argument. In the same paper, Nesom (2001) also recognised that the name *L. neocaledonica* (Moore 1921) predates the name *Brachyscome sarasinii* Däniker (1933: 479), but argued that it cannot be transferred to *Pytinicarpa* because of the already existing combination *P. neocaledonica* (Guillaumin) G.L.Nesom.

The existing literature only poorly addresses the morphological characters diagnostic at specific level. Indeed, leaf shape, size and presence or absence of trichomes, along with the disc's size were first considered as diagnostic characters (Däniker 1933, Nesom 1994a). Later, Nesom (2001) added the cypsela surface as a character to distinguish the Fiji species. Guillaumin (1937) also dealt with a species here considered as *Pytinicarpa*, but he actually made the distinction between *Lagenophora* and *Pytinicarpa* based on the cypsela shape, which was later considered as characteristic of the genus (Nesom 1994a) against *Lagenophora*. As none of the previous authors discussed the validity of these characters, we made numerous observations and propose a series of diagnostic characters to be used in this genus in New Caledonia. In addition, we are addressing the nomenclatural issues and we propose to describe two new narrowly endemic species, one severely threatened by nickel mining at the top of the Kaala massif and another most probably extinct on the Babouillat peninsula.

Materials and methods

This revision is based on the morphological examination of *Pytinicarpa* material at NOU (Bruy *et al*. 2021) and P, and images of specimens kept at AA, BM, GH, NOU, P and Z (acronyms following Thiers 2020 onwards). An exclamation mark "!" is used for the specimens physically seen, while "image!" is used for specimens seen only by means of digital images. The few specimens that were destroyed along with those of *Lagenophora* at the Australian border (see Lannuzel *et al*. 2021a) are noted with †. Morphological descriptions and terminology follow Harris & Harris (2001) and the species concept used here is based on morphology. In addition to dried specimens, live specimens were collected by two of the authors and Dominique Fleurot and, subsequently, cultivated at the nursery of the Institut Agronomique néo-Calédonien in Païta, Port-Laguerre, to make finer measurements and facilitate observations. As many as possible localities, recorded for older specimens, were visited to collect additional plants and to assess the ecology where they were found. To clarify the morphological differences between *P. sarasinii* and *P. tonitrui*, we dissected material from fourteen herbarium sheets and six cultivated plants from two localities of *P. sarasinii*, and all available herbarium material for *P. tonitrui* (see Lannuzel *et al*. 2022). Overall, dissections were made by MP at P from 30 sheets representing 92 plants. Measurements, based on living cultivated material, were made using an Olympus SZ2-ILST binocular equipped with a camera, while the measurements from herbarium specimens were made with a Hirox RH 2000 microscope (MIRCoV programme) and RECOLNAT-ANNOTATE tool, version 1.9.5, accessible at https://www.recolnat.org/fr/annotate. Specimen locations were mapped with QGIS 3.16 (QGIS Development team 2021) to generate the distribution maps and to help with IUCN (2019) evaluation assessments.

Taxonomic treatment

Key to the New Caledonian species of *Pytinicarpa*

1. Leaves obovate to spatulate (3.5–5.5 times longer than wide), always regularly lobate or dentate, lamina glabrous or with scattered short trichomes (0.05 mm). Corolla tube of ray and disc florets glabrous ..... *P. comptonii*
- Leaves linear to narrowly oblong or narrowly spatulate (5–27 times longer than wide), entire or with 1–4 subapical teeth, glabrous to densely hairy with long trichomes (1–2 mm). Corolla tube of ray florets glabrous or with trichomes 0.5–1.5 mm long. Corolla tube of disc florets glabrous or with scattered long trichomes (0.5–1 mm long) 2
2. Plant with a stem developed above ground, leaves 2–5 cm long. Corolla tube of ray florets densely hairy with trichomes ca. 1 mm long, corolla tube of disc florets with scattered trichomes 1 mm long at base ..... *P. kaalaensis*
- Plant with a rosulate habit (stem absent above ground), leaves 4–16 cm long. Corolla tube of ray florets glabrous or with scattered trichomes ca. 0.5 mm long, corolla tube of disc florets glabrous 3
3. Plant glabrous in most parts, except the leaf basis. Corolla tube of ray and disc florets glabrous. Ovary of all disc florets sterile ..... *P. tonitrui*
- Plant hairy in most parts, especially young leaves. Corolla tube of ray florets with scattered trichomes ca. 0.5 mm long. Ovary of the outer row of disc florets sometimes fertile, other rows with sterile ovary ..... *P. sarasinii*

Taxonomic synopsis

Pytinicarpa G.L.Nesom (1994a: 136).

Type:—*Pytinicarpa neocaledonica* (Guillaumin) G.L.Nesom.

Pytinicarpa comptonii Gâteblé, Lannuzel & M.Pignal, ***nom. nov.*** (Figs. 1, 2, 3). *Lagenophora neocaledonica* S.Moore (1921: 345). Type:—NEW CALEDONIA. North Prov., Taom, 2500 feet [762 m], 2 December 1914, *R.H. Compton 2305* (Lectotype: BM barcode BM000629629image!, designated here; Fig. 1).

FIGURE 1. *Compton 2305* (BM000629629). Designated lectotype of *Lagenophora neocaledonica* S.Moore.

Perennial rhizomatous herbs; roots fibrous; stem usually absent or very short (leaves in basal rosette). *Leaves* 5–20, obovate to spatulate, 1.5–8 cm long × 0.4–1.5 cm wide (3.5–5.5× longer than wide), lamina gradually attenuated to the base, petiole-like base 0.1–3 cm long; lamina apex obtuse to acute with a terminal tooth or lobe; margins lobate or dentate, usually with 3–8 lobes or teeth per side, lobe depth varying from 0 to 3 (–5) mm; upper lamina surface greyish-green; glabrous or with scattered appressed trichomes, ca. 0.05 mm long; lower lamina surface pale green, glabrous; leaf margins ciliate with trichomes, ca. 0.3 mm; secondary veins obscure on both sides on fresh material, sometimes visible on dry material. *Scapes* generally 1–3 per tuft, (6–) 10–17 (–22) cm long, 1–1.4 mm diameter; bracts 2–7, 2–5 × 0.5 mm with trichomes 0.2–0.5 mm long; 15–20 trichomes (0.5 mm long) per mm^2 at mid-point of scape, 40–60 appressed trichomes (0.5 mm long) per mm^2 towards apex. *Capitula* 4–6 mm long, 4–5.5 mm diameter; phyllaries ca. 25 in 2–3 rows, lanceolate, apex acute to rounded, glabrous or with trichomes ca. 0.3 mm occasionally along mid-rib on outer surface, with fringed margins in distal half, outer phyllaries 2–2.9 × 1 mm, inner phyllaries 2.7–3.7 × 1–3 mm. *Receptacle* conical at anthesis, 2–3 mm diameter and 1–2 mm high. *Ray florets* female, 11–20 in 1 row; tube 0.9–1.1 mm long, ca. 0.3 mm wide, glabrous, greenish; ligules 3.1–6.3 × 1.2–2.4 mm, with longitudinal veins obscure, glabrous, white or very occasionally pink, apex obtuse, retuse or bidentate; style branches ca. 1 mm long; ovary 1.6–2.2 × 0.5–0.6 mm. *Disc florets* male, 25–50, tubular, 1.7–3.2 mm long, glabrous; corolla lobes (4–) 5, deltate, 0.4–0.6 × 0.3–0.4 mm; stamens 4–5, anthers ca. 1.2 mm long; style branches ca.1.2 mm long; sterile ovary 0.8–1.2 mm long; corolla greenish, pappus scales absent. *Cypselae* oval in cross section, lacking beak, oblanceolate, 2.6–3 × 0.9–1 mm, uniformly brown at maturity; surfaces with 1–3 longitudinal ribs on each side.

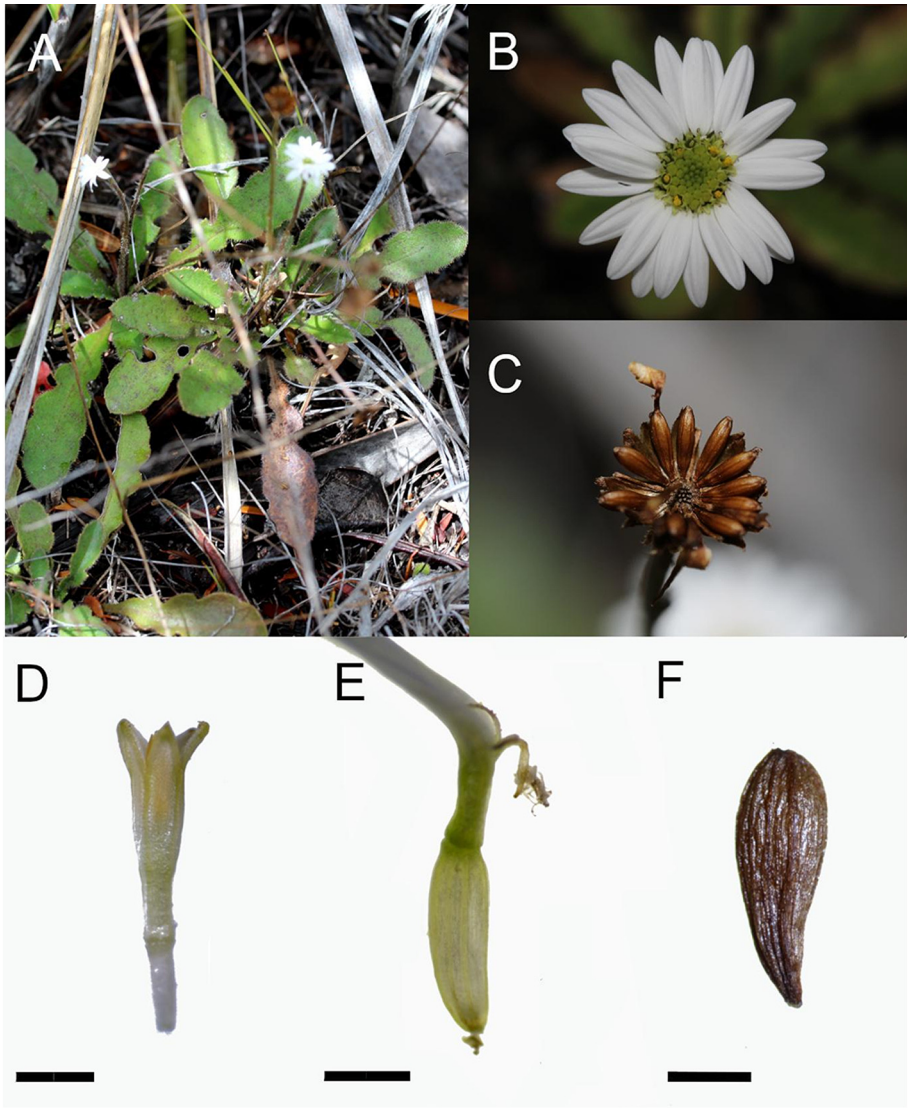

FIGURE 2. *Pytinicarpa comptonii* Gâteblé, Lannuzel &M.Pignal, *nom. nov.* **A.** Habit; **B.** Capitulum; **C.** Capitulum with mature cypselae; **D.** Disc floret; **E.** Ray floret; **F.** Cypsela. **A–C**, **E–F** from *Gâteblé 1064*, **D** from *Lannuzel 171*. Photos **A–C** from G. Gâteblé, **D–F** from G. Lannuzel. Scale bars: 1 mm.

Distribution and habitat:—Restricted to the massifs of Ouazangou and Taom areas from low (50 m) to high (1000 m) elevations in the northwest of Grande Terre (Fig. 3). It grows in open scrubland (maquis minier) on ultramafic substrates, on serpentines and even serpentinic alluvium at the base of the massifs and on peridotitic derived soil at higher elevations.

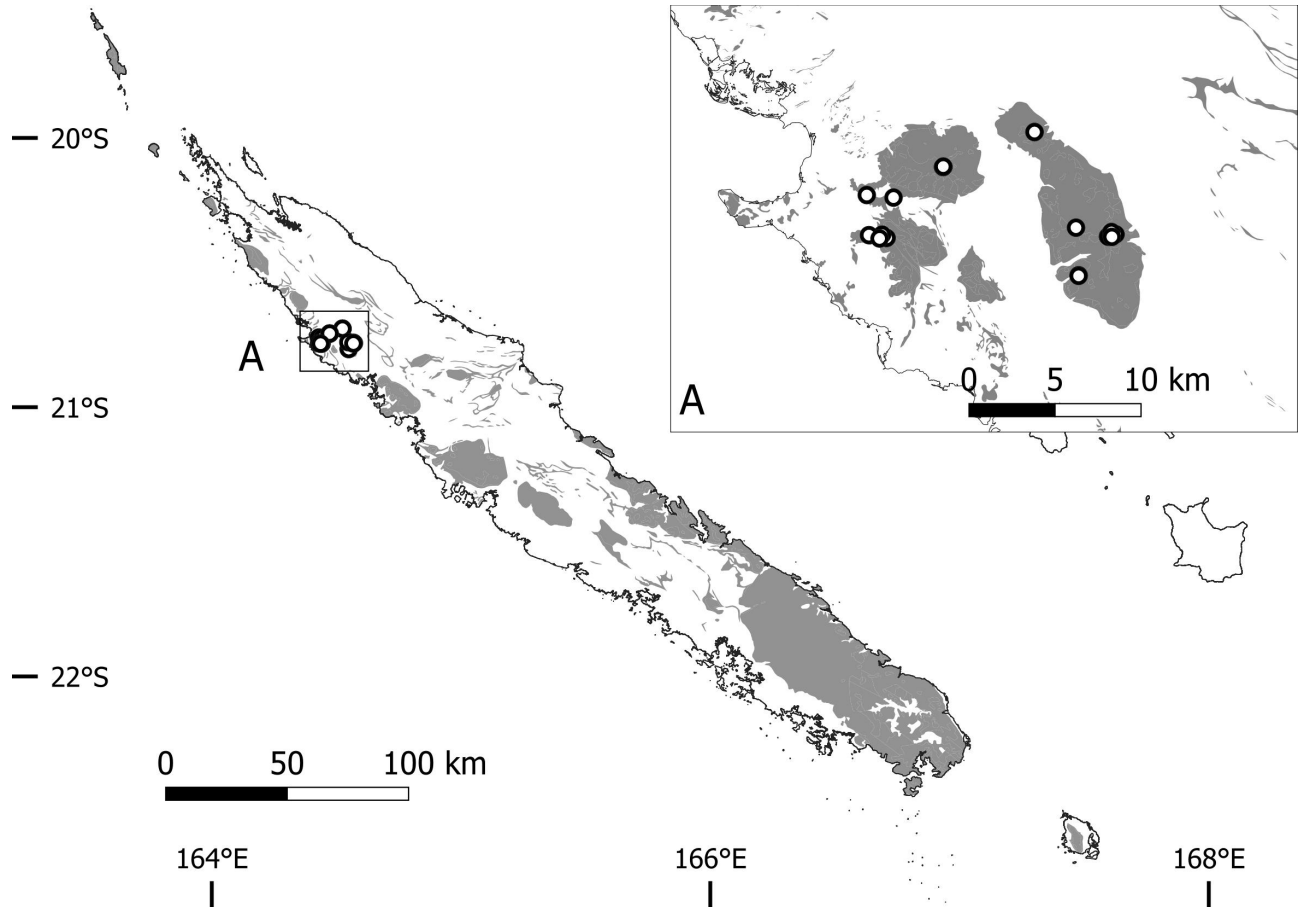

FIGURE 3. Distribution of *Pytinicarpa comptonii* Gâteblé, Lannuzel & M.Pignal, nom nov. Inset (A) shows the Ouazangou–Taom massif. Grey shaded areas represent ultramafic outcrops.

Phenology:—Herbarium specimens indicate flowering from February to May, July and September through to November. The species might therefore be able to flower all year round.

Etymology:—The proposed new name is to acknowledge the extensive collections made by Robert Harold Compton (1886–1979) in New Caledonia during the years 1914–1915.

Conservation status:—*Pytinicarpa comptonii* is limited to the two nearby ultramafic massifs of Ouazangou and Taom, usually united as the Ouazangou–Taom massif. The threats to this species are different between populations present at the base or at the top of the mountains. The low elevation maquis of Tinip is subject to anthropogenic fire threats and to civil engineering structures (mining roads, roads, housing, electrification pylons, settling ponds/decanters...). The high-elevation maquis populations are threatened by open nickel mining activities, especially on the Ouazangou mountain (Itititaty *et al*. 2020) and, to a lesser extent, on that of Taom. The northern part of the Taom massif (Homédéboa) has been subjected to nickel mining in the past, but that activity has ceased. The species can be considered as very threatened in the Tinip, Ouazangou and Taom localities and less threatened in that of Homédéboa. With four localities, an EOO of 72 km² and an AOO of 32 km², the species is proposed as Endangered (EN) under criterion B,i.e. B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v), using IUCN (2019) guidelines.

Notes:—Main diagnostic characters are the rosulate habit (rarely with a developed stem underground as a plant on P03276840), spatulate lamina glabrous or with short trichomes, along with glabrous ray and disc florets. All specimens are similar in flower shape and pubescence, leaf shape and pubescence. The main difference is in the leaf size. Specimens from Tinip (low elevation) have slightly smaller leaves, which are more serrate than sinuate, similar to the specimens from Taom (1000 m), while specimens from Ouazangou (800 m) have larger lobate leaves. The cypsela shape can be variable between populations, but an X-ray analysis (data not shown) showed that it might be

due to comparison between viable versus non-viable cypselae. Taken together, the glabrous ray floret and the absence of long trichomes on leaves are a clear distinction between this species and *P. sarasinii* and *P. kaalaensis*. The only other species to have glabrous ray floret tubes, *P. tonitrui*, differs by its long, sometimes linear leaves. In addition, the trichomes, when present, are much longer in *P. tonitrui*. It is also similar to the two New Caledonian *Lagenophora* species, regarding the leaf shape, and the venation pattern, not typical of *Pytinicarpa,* as defined by Nesom (1994a). The absence of glandular beak on cypsela is however a character of *Pytinicarpa*. In the absence of further molecular studies, we here chose to follow Nesom (1994a) and keep this species in the genus *Pytinicarpa*.

The combination of Moore's epithet *neocaledonica* in *Pytinicarpa* is not possible because this would be a later homonym of *Pytinicarpa neocaledonica* (Guillaumin) G.L.Nesom (which is based on *Brachyscome neocaledonica* Guillaumin), so we propose a replacement name for this species.

There is only one sheet of *Compton 2305* in BM, and no other specimen could be found in other herbaria. There are four plants on the sheet (Fig. 1). All plants are on the right side of the sheet and are separated by a hand-drawn line. This suggests that other plants might have previously been on the sheet. Furthermore, there is no sign of Moore's handwriting on this sheet and no mention of BM in the protologue. However, BM's Asteraceae curator (Ranee Prakash), when asked about this, considered it usual practice at that time to draw a pencil line when there was more than one plant on a sheet and to keep space for eventual future plants to be mounted on the same sheet. Considering these facts, the specimen is best considered as a lectotype, rather than a holotype.

The specimen *MacKee 37169* (NOU019509), held at NOU, bears an error on the wrapper. MacKee's field notebook (held at NOU Herbarium) shows that n°37169 is a *Helichrysum* specimen and n°37170 a *Brachyscome*. Consequently, the correct collecting number is 37170 and both specimens NOU019509 and P03276836 represent the same collection.

Specimens examined:—NEW CALEDONIA. North Prov.: Taom, 12 September 2006, *Barrière & Rigault 25* (NOU014338!); Tinip, en contrebas du Pic Biki, 25 February 2004, *Dagostini, Rigault & Fambart-Tinel 827* (NOU003007!); Tinip, 80 m, 20°46'46.77"S, 164°27'32.35"E, 24 Apr 2017, *Gâteblé 856* (NOU105132!); Tinip, 70 m, 1 October 2018, *Gâteblé & Lannuzel 1064* (NOU108019!); Mont Ouazangou, proche du sommet, 850 m, 20°44'33"S, 164°29'43"E, 3 July 2018, *Lannuzel & Loslier 171* (NOU090305!); Tinip (Ouaco to Gomen), 19 October 1956, *MacKee 5467* (L.1815300image!, P03292519!); Mont Ouazangou, base ouest, 20 m, 11 September 1967, *MacKee 17527* (NOU054763!); Taom, Mont Homédéboa, 800–900 m, 16 May 1968, *MacKee 18825* (P04427670image†!); Taom, Mt. Homédéboa, 800–900 m, 16 October 1969, *MacKee 20970* (P04234037!); Taom, Mt. Homédéboa, 800–900 m, 3 November 1971, *MacKee 24567* (P04427678image†!); Taom, Ouéou, 350 m, 4 July 1978, *MacKee 35349* (NOU019511!, NSW 939387, P03276838!); Mont Taom, crête Est, 1000 m, July 1979, *MacKee 37169* [*37170*– see notes] (NOU019509!); Mont Taom, crête Est, 1000 m, 13 July 1979, *MacKee 37170* (P03276836!); Mont Taom, contrefort NO, 900 m, 8 February 1980, *MacKee 37837* (NOU054765!, P03276840!); Plateau sommital Mont Ouazangou, 800 m, 26 March 1980, *MacKee 37952* (CANB 284963.1, NOU019510!, P03276834!); Vers le sommet de Taom, 1000 m, 24 March 1982, *Suprin 1735* (NOU019513!); Plateau du massif de Taom, vers 1000 m, 24 March 1982, *Veillon 4838* (NOU054764!).

Pytinicarpa kaalaensis Lannuzel, Gâteblé & M.Pignal, ***sp. nov.*** (Figs. 4, 5)

Diagnosis:—*Pytinicarpa kaalaensis affinis P. sarasinii anguste oblongis foliis et corollae ligulatae piloso tubo, sed foliis brevioribus et corollae tubo densiore piloso atque Lagenophorinarum neocaledonicarum aliis omnibus caule (vs. rosulam) praecipue differt.*

Type:—NEW CALEDONIA. North Prov.: Mont Kaala (Sommet Nord), 1080 m, 17 April 1977, *H.S.MacKee 33040* (Holotype: P barcode P03276835!; isotypes: B, BISH barcode BPBM751901, CHR, G, K, MO, NOU barcode NOU071919!, NSW, US barcode US2592926 image!).

Perennial rhizomatous herbs; roots fleshy; young plants with one erect stem, older ones with 1 to 5 stems, procumbent then erect in the leafy portion. Stems up to 25 cm, lanate; leaves inserted along the stem, older at the base, often withered. *Leaves* 10–30, narrowly oblong, 2–5 cm long × 0.4–0.8 cm wide (5–6.5 × longer than wide), sessile; lamina apex rounded, sometimes with a terminal tooth; margins entire or with 1–2 teeth per side, each tooth ca. 1 mm long; upper leaf surface green, lanate at base with trichomes ca. 1.5 mm long, densely hairy towards apex; lower leaf surface pale green lanate at base with trichomes ca. 1.5 mm long, densely hairy towards apex; leaf margins densely hairy, with trichomes ca. 1 mm long; veins usually obscure on dried material on both surfaces. *Scapes* 1–3 per stem, subterminal or sometimes at leaf axil, 2.7–25 cm long, 1–1.5 mm diameter; bracts 2–4, ca. 2–4 × ca. 0.8 mm with trichomes 0.6–0.9 mm long, 15–20 trichomes (1 mm long) per mm² at mid-point of scape, 15–20 trichomes (0.5 mm long) per mm² towards apex. *Capitula* 3.7–4.5 mm long, 3.8–5.7 mm diameter; phyllaries ca. 26 in 3 rows, lanceolate, oblong or

obovate, apex obtuse to acute, glabrous or hairy, margin laciniate on distal half, outer phyllaries 1.6–2.3 × 0.9–1 mm, inner phyllaries 2.1–3.9 × 0.8–1 mm. *Receptacle* convex, 2–3 mm diameter and 0.8–1 mm high. *Ray florets* female, 30–40 in 1–2 rows; tube, ca. 0.6 mm long, ca. 0.5 mm wide, greenish, densely covered with trichomes, each ca. 1 mm; ligules ca. 4.5 mm × ca. 0.9 mm, glabrous, with longitudinal veins obscure, white, creamy or purple with age, apex acute to obtuse or bidentate; style branches ca. 0.4 mm long, ovary 1.8 × 0.5 mm. *Disc florets* male ca. 45, tubular, 3–3.3 mm long, outer surface with sparse trichomes ca. 1 mm long at base; corolla lobes 5, deltate, 0.2–0.3 × 0.8–1 mm; stamens 5, anthers ca. 1 mm long; style branches ca. 1.2 mm long; sterile ovary 1.3–1.8 mm long; corolla light yellow, pappus scales absent. *Cypselae* oval in cross section, lacking beak, oblanceolate, 2.6–3 × 0.6–1 mm, uniformly brown at maturity; surfaces with 1–2 longitudinal ribs on each side.

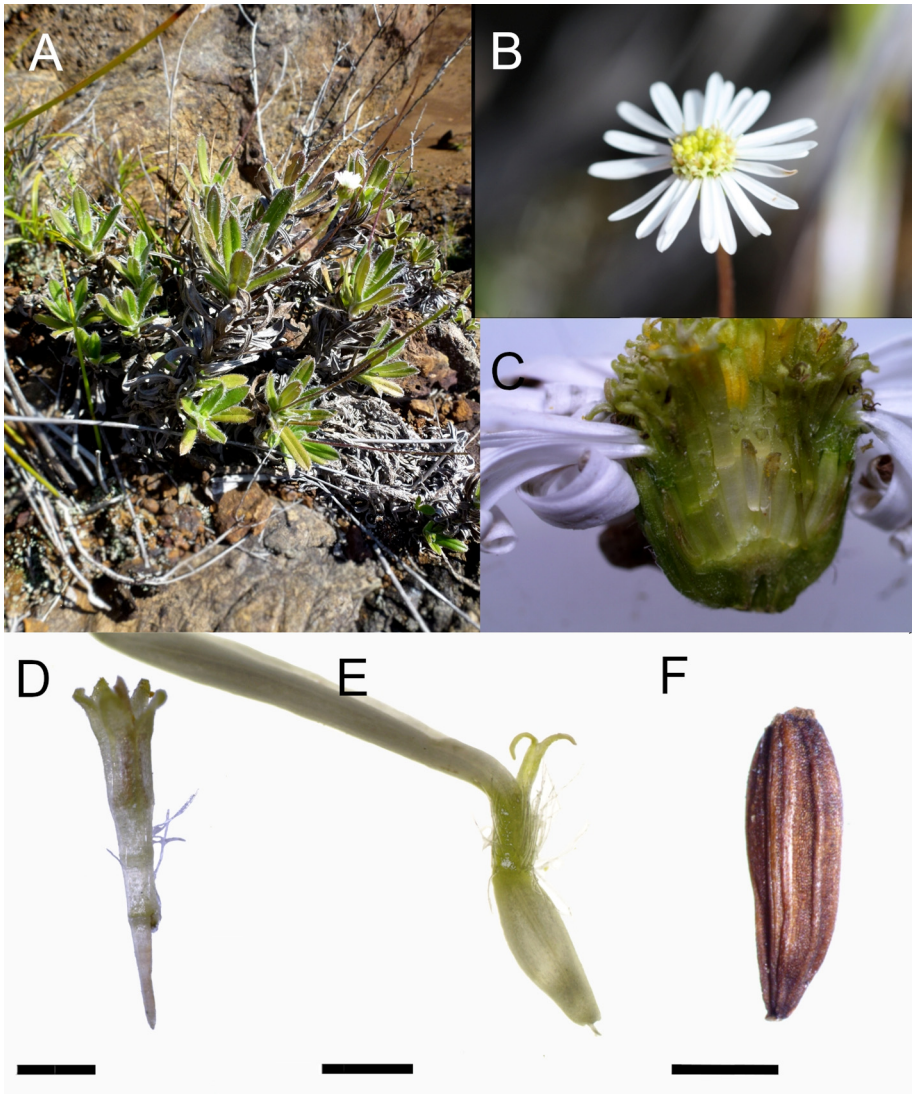

FIGURE 4. *Pytinicarpa kaalaensis* Lannuzel, Gâteblé & M.Pignal, *sp. nov.* **A.** Habit; **B.** Capitulum; **C.** Capitulum in longitudinal section; **D.** Disc floret; **E.** Ray floret; **F.** Cypsela. **A–F** from *Lannuzel 134*. Photos from G. Lannuzel. Scale bars: 1 mm.

Distribution and habitat:—Restricted to Mount Kaala ultramafic massif, at relatively high elevation, from 600 m to the summit at 1080 m. It grows in open "maquis minier" within blocks of peridotites (Fig. 4A). Its habitat and putative distribution within the massif have recently been modelled by Lannuzel *et al*. (2021b) using refined SDMs (species distribution models) methods.

Phenology:—Based on ad hoc surveys (Lannuzel *et al*., unpublished) and herbarium specimens, the species appears to flower almost throughout the year with a gap in February and March. In cultivation, it seems to be able to flower throughout the year as well, but too few specimens were surveyed to make any definite conclusion.

Etymology:—The specific epithet refers to Mount Kaala, the only known location of the species.

Conservation status:—On the Kaala massif, this new species is highly threatened by open nickel mining activities that have already impacted some populations and are likely to destroy the others. As it has a very narrow endemic

distribution with an EOO of 6 km² and an AOO of 16 km², the species meets the Critically Endangered category under criterion B as CR B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v), following IUCN (2019) guidelines.

Notes:—*Pytinicarpa kaalaensis* differs from all other Lagenophorinae species of New Caledonia by its caulescent habit. It resembles *P. sarasinii* (Däniker) G.L.Nesom with leaves narrowly oblong and hairy ray florets corolla tube, but has shorter leaves and more densely hairy corolla tube. One specimen of this taxon (*Green 1817*) was identified by Nesom (1994a) as *P. sarasinii*, but subsequent material supports the distinction of a new species restricted to Mt. Kaala.

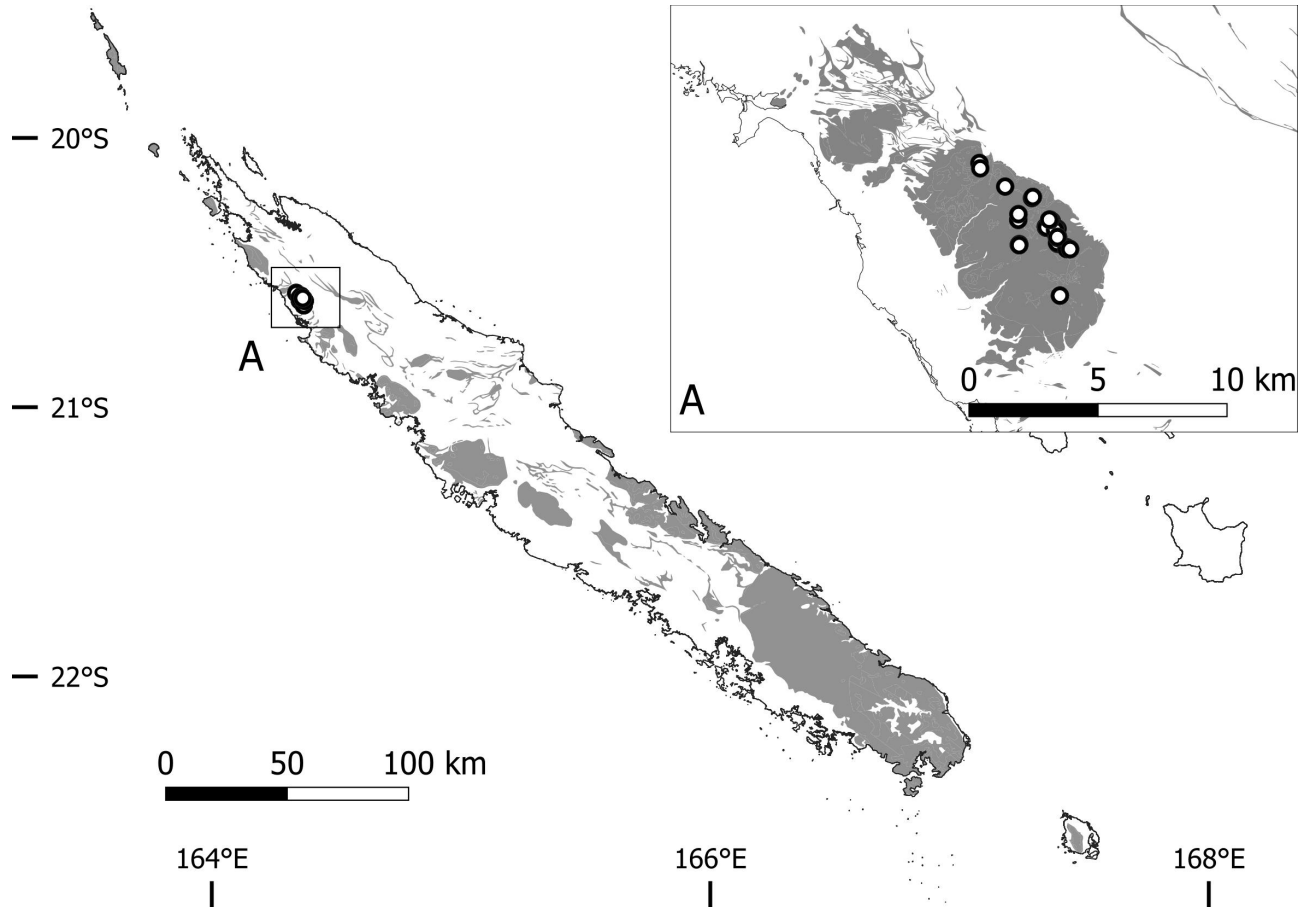

FIGURE 5. Distribution of *Pytinicarpa kaalaensis* Lannuzel, Gâteblé & M.Pignal, *sp. nov.* with a focus on Mount Kaala massif (A). Grey shaded areas represent ultramafic outcrops.

The label of the isotype specimen in NOU (NOU071919) incorrectly mentions that the plant comes from the garden of ORSTOM (now IRD). Instead, this specimen was collected, like the others, on the north summit of Mount Kaala, 1080 m elev., on 17 April 1977 as written in MacKee's gazetteer held at NOU. The error comes from a handwritten note in this gazetteer stating "planté dans le jardin du centre". This manuscript note from Jean-Marie Veillon (confirmed by J.-M. Veillon himself in May 2021) was added to the gazetteer to add the information that living plants of this MacKee collection have also been planted in the garden, a common practice at ORSTOM during this period (Gâteblé 2015: 27). The staff in NOU who made the label then mixed the original note from MacKee with the one from Veillon. Despite this error on the label, the NOU specimen should be considered as an isotype. Other isotypes are cited according to the duplicates listed on the holotype's label at P (P03276835), but most of them were not retrieved in herbaria online databases.

Specimens examined:—NEW CALEDONIA. North Prov.: Mont Kaala, 600 m, 29 June 2010, *Barrabé, Nigote, Merlot & Broucke 995* (NOU053782!); Sommet du Kaala, 1050 m, 20°36'45.45"S, 164°23'22.32"E, 27 April 2016, *Gâteblé 763* (NOU105458!); Top of Mont Kaala (about 15 km SE of Koumac), 1000 m, 9 December 1963, *Green 1817* (A00283448); Mont Kaala, Pic de Pandop, 800 m, 6 July 1992, *Jaffré 3163* (NOU071921!); Mont Kaala, sommet proche de l'antenne, 1065 m, 20°36'44"S, 164°23'22"E, 10 January 2018, *Lannuzel & Balmot 134-1* (NOU088999!); Mont Kaala, sommet proche de l'antenne, 1065 m, 20°36'44"S, 164°23'22"E, 10 January 2018, *Lannuzel & Balmot 134-2* (NOU089000!); Mont Kaala, sommet proche de l'antenne, 1065 m, 20°36'44"S, 164°23'22"E, 10 January 2018, *Lannuzel & Balmot 134-3* (NOU089001!); Mont Kaala, pente nord, 800 m, 17 May 1981, *MacKee 39081*

(NOU071920!, P03276837!); Mont Kaala, sommet nord, 1050 m, 17 May 1981, *MacKee 39088* (P03276831!); Sommet du Mont Kaala, 21 June 1966, *Nothis 192* (NOU054756!); Mt Kaala, 1000 m, 16 June 1982, *Suprin 1990* (NOU054755!, P04234040!, P04234041!).

Pytinicarpa sarasinii (Däniker) G.L.Nesom (1994a: 138). *Brachyscome sarasinii* Däniker (1933:479). Type:—NEW CALEDONIA. Am obern Abhang des Mt. Koniambo ob Koné bei der Mine Boume I [Koné, Mt Koniambo, mine Boum I], 14 January 1925, *A.U. Däniker 880* (Holotype: Z barcode Z000003139image!; isotypes: Z barcodes Z000003140image!, Z000003141image!, Z000003142image!). (Figs. 6, 7).

= *Pytinicarpa neocaledonica* (Guillaumin) G.L.Nesom (1994a: 138). *Brachyscome neocaledonica* Guillaumin (1937: 61).Type:—NEW CALEDONIA. Gatope, 1861–1867, *Vieillard 2823* (Lectotype: P barcode P00537796!, designated by Wang *et al*. (2022: 80); isolectotypes: A barcode A00097920image!, GH barcode GH00097921image!, P barcodes P00537797!, P00537798!), ***syn. nov.***

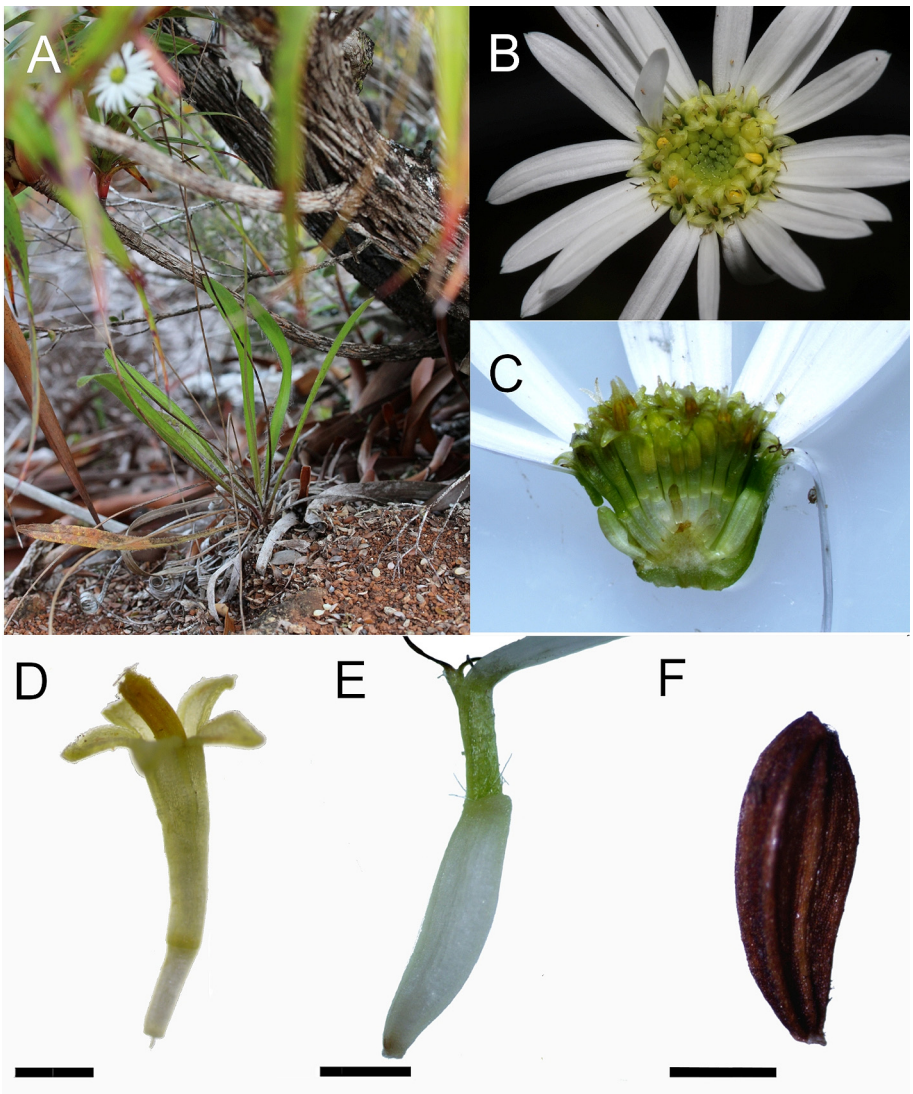

FIGURE 6. *Pytinicarpa sarasinii* (Däniker) G.L.Nesom. **A.** Habit; **B.** Capitulum; **C.** Capitulum in longitudinal section; **D.** Disc floret; **E.** Ray floret; **F.** Cypsela. **A–D**, **F** from *Lannuzel 189*, **E** from *Lannuzel 168*. Photos from G. Lannuzel. Scale bars: 1 mm.

Perennial rhizomatous herbs; roots and rhizomes fibrous; above ground stem absent (leaves in basal rosette). *Leaves* 5–15, narrowly spatulate, 6–11 cm long × 0.8–1.1 cm wide (7.5–10× longer than wide), lamina attenuate to the base, petiole indistinct; lamina apex obtuse with a terminal tooth; margins entire or dentate, with 2–4 teeth per side, each tooth ca. 0.5 mm when present; upper leaf surface greyish-green; lower leaf surface pale green, both surfaces lanate when young, then with scattered trichomes (1–2 mm long); leaf margins glabrous to densely hairy with trichomes ca. 1.5 mm; secondary veins obscure. *Scapes* generally 1 per tuft, 10–24 cm long, 1–1.5 mm diameter; bracts 2–6, 1.8–6.4 × 0.2–0.5 mm with trichomes 0.4–0.8 mm long; 0–1 trichomes per mm^2 at mid-point of scape, glabrous towards apex.

Capitula 4.2–6.4 mm long, 4.2–5.6 mm diameter; phyllaries ca. 30 in 2–3 rows, ovate, apex acute, glabrous, with margins glabrous to ciliate in distal half, outer phyllaries 1.5–3.2 × 0.4–0.9 mm, inner phyllaries 3.3–4.7 × 1.3 mm. *Receptacle* sharply conical at anthesis, 2.5–3 mm diameter and 1.5–2 mm high. *Ray florets* female, 18–22 in 1 row; tube 1–1.3 mm long, 0.4–0.5 mm wide, with scattered trichomes ca. 0.5 mm long, greenish; ligules 6.4–8.2 × 1.3–1.7 mm, with longitudinal veins obscure, glabrous, white or very occasionally pink, apex obtuse and bidentate; style branches ca. 2 mm long, ovary 2–2.5 × 0.6 mm. *Disc florets* male, sometimes hermaphrodite in the outer row, 54–60, tubular, ca. 2.5 mm long, outer surface glabrous; corolla lobes 5, deltate, 0.6–0.8 × 0.7–0.8 mm; stamens 4–5, anthers ca. 1–1.5 mm long; style branches ca. 2 mm long; sterile ovary ca. 1.6 mm long, fertile ovary ca. 2.8 mm when present; corolla greenish, pappus scales absent. *Cypselae* oval in cross section, lacking beak, oblanceolate, 2.6–3 × 0.9–1 mm, uniformly brown at maturity; surfaces with 2–3 longitudinal ribs on each side.

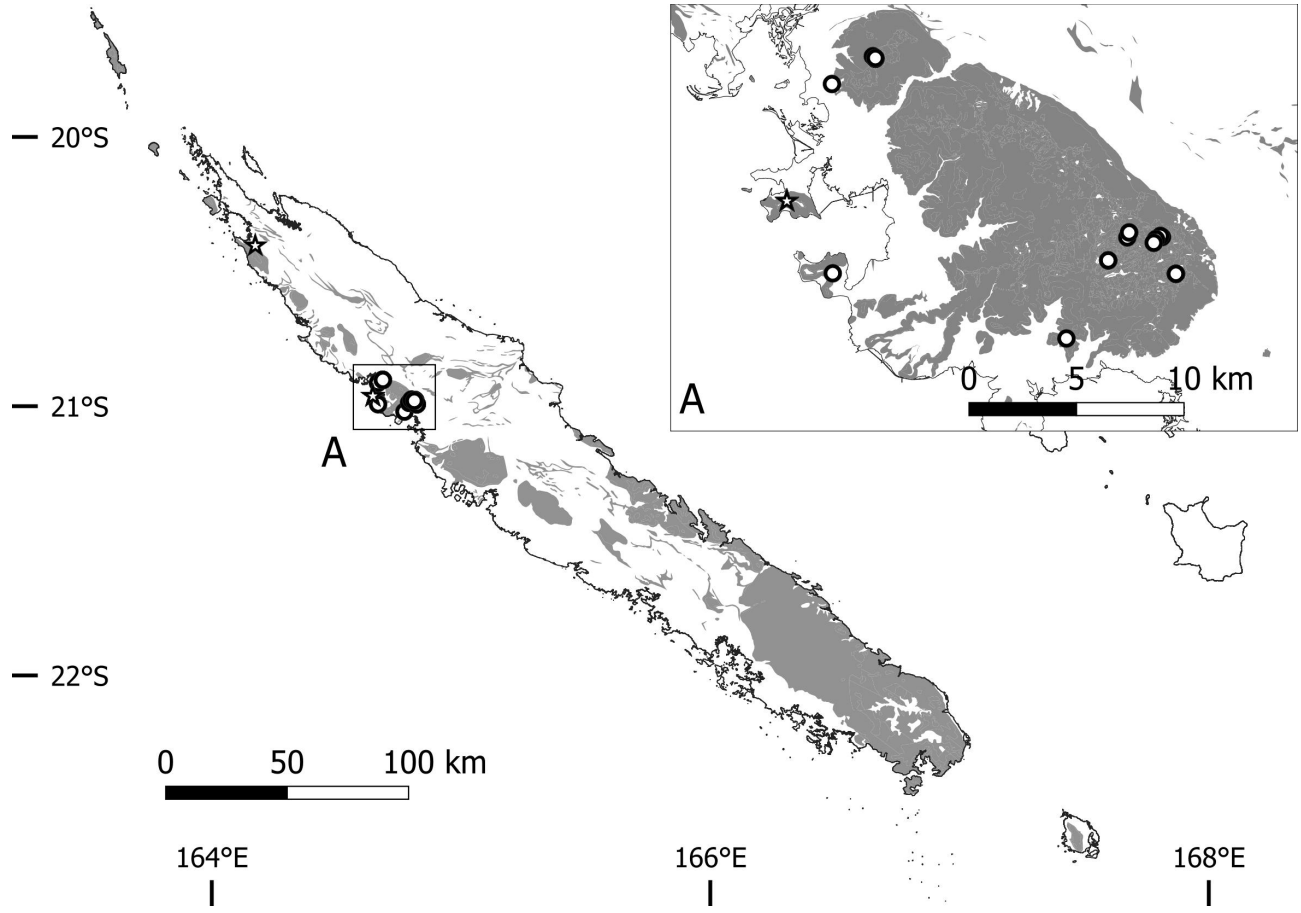

FIGURE 7. Distribution of *Pytinicarpa sarasinii* (Däniker) G.L.Nesom. Inset (A) shows the Katepahie / Koniambo massifs. Dots represent reliable localities, stars doubtful ones, grey shaded areas represent ultramafic outcrops.

Distribution and habitat:—As presently understood, *P. sarasinii* is restricted to Koniambo and Katepahie ultramafic massifs where the species has been seen growing on the slopes and summits from 50 to 925 m elevation. It has also been recently collected on the Vavouto Peninsula. The species grows in "maquis minier", on serpentines at low elevations and on peridotitic-derived soil at higher elevations.

Phenology:—From information on herbarium specimens, the species appears to flower from December to February, April–July and October. In cultivation, specimens are flowering almost all year long.

Conservation status:—The old Gatope locality *sensu* Vieillard, if correct, corresponds to the Koniambo / Katepahie area. The Koniambo massif is under intensive open nickel mining so that the populations at the top of the massif are severely threatened. The Katepahie location is not presently under pressure from nickel mining, but under anthropogenic fire threats. With an EOO of 121 km² and an AOO of 28 km², the species is proposed as Endangered (EN) under criterion B with four localities as EN B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v), using IUCN (2019) guidelines.

Notes:—The species is readily distinguishable from the two other *Pytinicarpa* species, *P. comptonii* and *P. kaalaensis* and from *Lagenophora* by its long and almost linear leaves. The closest morphologically species is *P. tonitrui* which does not bear trichomes on the corolla tube of both ray and disc florets. Full explanations of the differences

between both taxa are provided in the dedicated section of *P. tonitrui* (Table 1). It is also the only *Pytinicarpa* species in New Caledonia having hermaphrodite disc florets; however, these are not on every individual. At first glance, we were also about to include two specimens from the Tchingou Massif in *P. sarasinii*. However, a closer examination of these specimens at P (*Bernardi 10414*, P03276808! and *Hürlimann 121*, P04234043!) shows that the top of the disc floret's ovary is covered by glands. Further collections are needed to fully describe this taxon, but this character being distinctive of *Lagenophora* (Lannuzel *et al.* 2021a), it is not treated in the present work.

Brachyscome neocaledonica was recently lectotypified by Wang *et al*. (2022) who accepted *Vieillard 2823* (P00537796) as the lectotype, based only on herbarium scans available online. However, they have not discussed the identity of both species, *P. neocaledonica* and *P. sarasinii*. Our careful examination of syntypes of *B. neocaledonica* (*Vieillard 2823*, *Deplanche 425* and *Pancher 94*) at P revealed two different species among the plants on these specimens—see notes under *P. tonitrui* section below for a full explanation. It was customary for Deplanche, Pancher, and Vieillard specimens to pass through CN where plants were often rearranged (and mixed) by R. Lenormand and colleagues. The same collection number thus cannot be considered as one gathering, neither can several plants on one sheet be considered coming from the same population. All plants from this ancient material must then be examined individually. *Vieillard 2823* (P00537796, designated by Wang *et al*. 2022 as *P. neocaledonica* lectotype), presents all characters of *P. sarasinii* as circumscribed above. The name *P. neocaledonica* thus becomes a synonym of *P. sarasinii*. *Deplanche 425* (P00537801!) was examined by MP, but we could not confirm the identity of each plant. However, from some flower fragments, at least some *P. sarasinii* were present. The specimen *Deplanche 425* (P00537799!) also went through CN. On this specimen, the two plants on the right belong to *P. sarasinii*, while the two on the left belong to *P. tonitrui*.

The name *Brachyscome sarasinii* does not require lectotypification because Däniker (1933) cited his specimen *Däniker 880* (Z-000003139) as the type in the protologue. The other specimens (*Heim 50* and *Sarasin 86*), cited by Däniker (1933), could not be retrieved in the Z database, neither in G or B. In his discussion, Däniker (1933) compared his new species against *B. neocaledonica* Guillaumin that was published four years later. Däniker and Guillaumin may have discussed these together at that time as we cannot find any mention of the name *B. neocaledonica* in previous literature. Surprisingly, however, Guillaumin (1937) did not cite *B. sarasinii* described four years earlier in his revision of New Caledonian Asteraceae, but later established a key between the two species, based on leaf pubescence (Guillaumin 1948). It is unclear to which point both authors were aware of each other work. However, they clearly considered that both species were different. If the synonymy here presented seems to be in contradiction with the previous works of Guillaumin and Däniker, it is only because we believe that Wang *et al*. (2022) didn't choose the right lectotype for *P. neocaledonica* (see Lannuzel *et al*. 2022 for full explanation).

Specimens examined:—NEW CALEDONIA. North Prov. Koniambo, 820 m, 11 October 2006, *Dagostini & Barrière 1256* (NOU019061!); Nene [Neue], *Deplanche 425* (P00537801! – pro parte see notes); Nene [Neue], *Deplanche 425* (P00537799! – pro parte see notes); Massif du Koniambo, 900 m, 1 June 1972, *Jaffré 780* (NOU054760!, P04431194!); Koniambo, 650 m, 13 February 2002, *Jaffré 3483* (NOU071917!, NOU071918!, P03276806!, P03276807!); Massif du Koniambo, 875 m, 20°59'45"S, 164°49'49"E, 20 December 2017, *Lannuzel & Loslier (leg. Gensous) 151* (NOU089026!); Mont Koniambo, 925 m, 20°59'45"S, 164°49'50"E, 24 May 2018, *Lannuzel (leg. Gensous) 168-1* (NOU088996!); Mont Koniambo, 925 m, 20°59'45"S, 164°49'50"E, 24 May 2018, *Lannuzel (leg. Gensous) 168-2* (NOU088997!); Mont Koniambo, 925 m, 20°59'45"S, 164°49'50"E, 24 May 2018, *Lannuzel (leg. Gensous) 168-3* (NOU088987!); Mt. Katepahie, 600 m, 20°55'10"S, 164°42'11"E, 26 July 2018, *Lannuzel & Karnadi 189-1* (NOU090307!); Mt. Katepahie, 600 m, 20°55'10"S, 164°42'11"E, 26 July 2018, *Lannuzel & Karnadi 189-2* (NOU090308!); Voh, Mt Katépahie, vers 600 m, 20 January 1963, *MacKee 10087* (CANB 145979.1, P04234042!, P04234045!); Voh, base sud-ouest du Mt Katepahie, 7 June 1967, *MacKee 16835* (NOU054757!, P04234046!); Voh, crête sommitale du Mt Katepahie, 600 m, 5 April 1968, *MacKee 18635* (NOU054757!, P04234044!); Mont Koniambo (base S.O.), 100 m., 24 April 1974, *MacKee 28534* (NOU054758!); Mont Koniambo, plateau sud, 800 m, 7 May 1974, *MacKee 28634* (P03276804!); Mt Koniambo, 800 m, 11 October 1982, *McPherson 4990* (CHR 440389Aimage!, CHR 440389Bimage!, NOU054759!, MO 784036); Koniambo, 854 m, 20°59'55"S, 164°49'40"E, 4 April 2008, *Munzinger & Ducousso 5034* (NOU049652!); Vavouto, 9 September 2004, *Munzinger, Jaffré & Roumagnac 2368* (NOU006848!); Massif du Koniambo tronçon 28, 20°59'39"S, 164°49'2"E, 6 January 2003, *Tronchet & Roumagnac 652* (NOU004864!, P00354671!); Gatope, 1861–1867, *Vieillard 2823* (A00097920image!, A00097921image!, P00537796!, P00537797!, P00537798!); Massif de Koniambo, 850 m, 13 December 1973, *Webster & Jaffré 19301* (P03276830!).

The other specimens (*Heim 50* and *Sarasin 86*), cited by Däniker, could not be retrieved in the Z database, neither in G or B.

Pytinicarpa tonitrui Lannuzel, Gâteblé & M.Pignal, ***sp. nov.*** (Figs. 8, 9)

Diagnosis:—*Pytinicarpae sarasinii* (Däniker) G.L.Nesom *similis, magnitudine formaque, sed tubo corolla florum ligulatorum omnino glabro et tubulosis bisexualibus floribus carentibus, praecipue differt. Similis Pytinicarpae kaalaensi* Lannuzel, Gâteblé & M.Pignal, *sed habitu rosulanti multo longioribus folisque (2–5 vs 6–11 cm) praecipue differt.*

Type:—NEW CALEDONIA. North Prov.: Néhoué, Babouillat, 04 February 1968, *H.S. MacKee 18336* (Holotype: P barcode P03276809!).

FIGURE 8. *Pytinicarpa tonitrui* Lannuzel, Gâteblé & M.Pignal, *sp. nov. MacKee 18336* (P03276809) herbarium sheet. **A.** Habit, **B.** Ray floret; **C.** Ray floret corolla tube; **D.** Disc floret, **E.** Cypsela; **A**–**D** from *MacKee 18336* (P03276809, details from specimen on right), **E** from *Mus. Néocal. [Pancher] 94 [Vieillard 2823]* (P00537795).

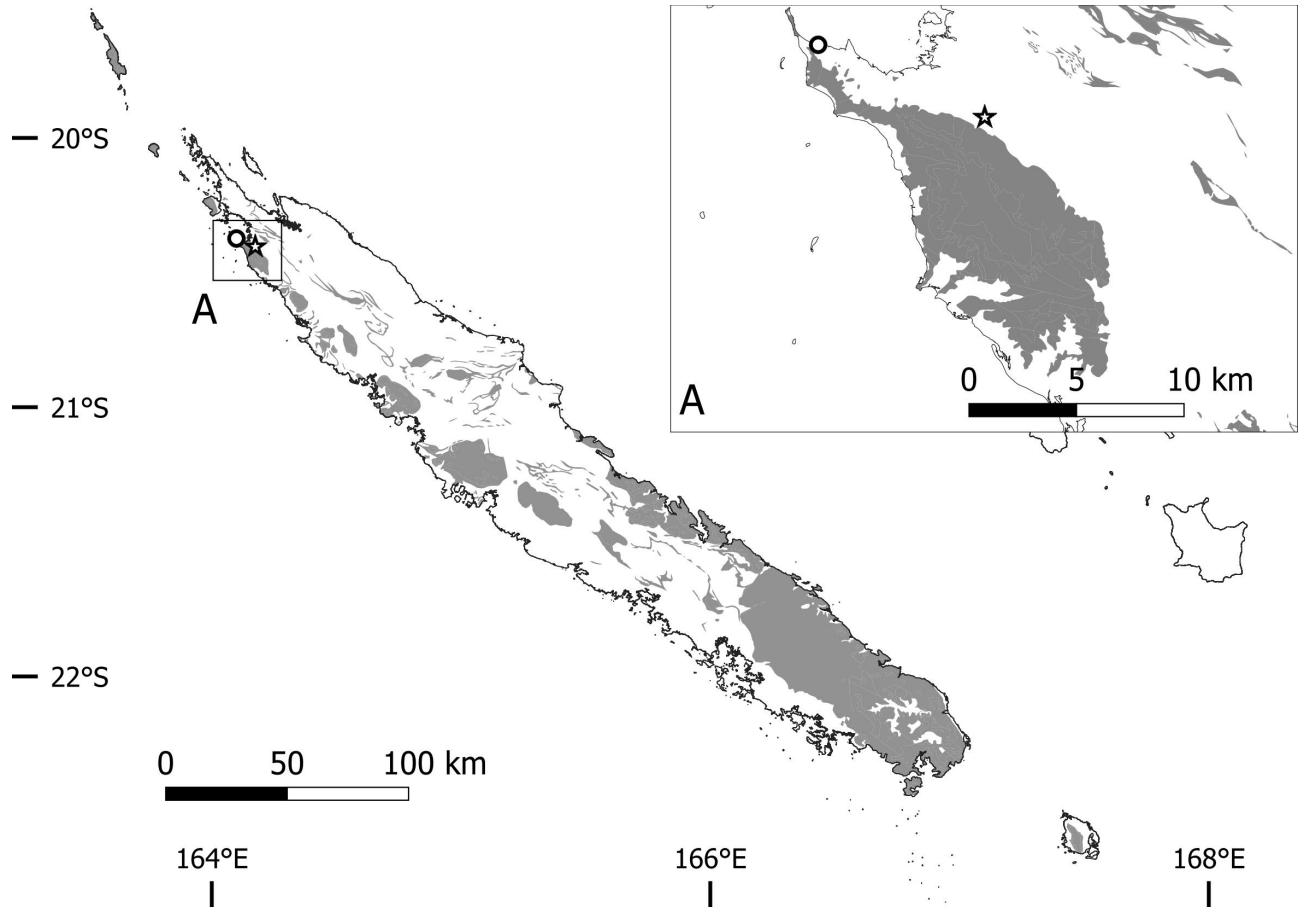

FIGURE 9. Distribution of *Pytinicarpa tonitrui* Lannuzel, Gâteblé & M.Pignal, *sp. nov*. Inset shows the Néhoué and Babouillat area (A). Dots represent reliable localities, stars doubtful ones, grey shaded areas represent ultramafic outcrops.

Perennial rhizomatous herbs; roots fibrous; above ground stem absent (leaves in basal rosette). *Leaves* 5–15, linear to narrowly oblong, (44–) 79–130 (–162) mm long × (2–)3–5(–6) mm wide (22–27× longer than wide), lamina attenuate to the base, petiole indistinct; leaf apex obtuse with a terminal tooth; margins entire or dentate, with 1–3 teeth per side, each tooth ca. 0.5 mm long when present; upper leaf surface dark greyish-green on dry material; lower leaf surface pale greyish-green on dry material, both surfaces glabrous, but trichomes (1–2 mm) sometimes present at leaf base; leaf margins and surfaces glabrous to hairy with trichomes 1–1.5 mm; secondary veins brochidodromous, obscure, sometimes visible on abaxial surface on dry material. *Scapes* generally 1–3 per tuft, 8–23 cm long, (0.3–) 0.5–0.9 (–1.4) mm diameter; bracts 2–3, 1.8–6.4 × 0.2–0.5 mm with trichomes 0.4–0.8 mm long; 0–1 trichomes per mm² at mid-point of scape, glabrous towards apex; *Capitula* ca. 3 mm long, (3.4–) 4.8–7.2 (–9) mm diameter; phyllaries ca. 30 in 2–3 rows, ovate to ovate-lanceolate, apex obtuse to acute, glabrous, margins glabrous to ciliate on distal half, outer phyllaries 3 × 1 mm. *Receptacle* sharply conical at anthesis, 2.5–3 mm diameter and 1.5–2 mm high. *Ray florets* female 18–22 in 1 row; tube 0.5–1 mm long, ca. 0.2 mm wide, glabrous; style branches ca. 1 mm long; ligules 5–8.2 × 0.7–1.7 mm, with longitudinal veins obscure, glabrous, apex obtuse, ovary 1.1–2.4 × ca. 0.4 mm. *Disc florets* male tubular, ca.1.3 mm long, outer surface glabrous; corolla lobes 5, deltate, 0.6–0.8 × 0.7–0.8 mm; stamens, 5, anthers yellow, linear, ca. 0.8 mm; style branches ca. 2 mm long; sterile ovary ca. 1.2 mm long, pappus scales absent. *Cypselae* oval in cross section, lacking beak, obfusiform, 3.2 × 0.8 mm uniformly brown at maturity; surfaces with 2–3 longitudinal ribs on each side.

Distribution and habitat:—The species is only known from Néhoué–Babouillat (Neué) on the north base of the ultramafic Tiebaghi massif or Cap Tonnerre. Despite several days of fieldwork at different periods of the years in search of this rare species, we were unable to find it. From *MacKee 18336* and specimens collected immediately before and after, the ecology of the Babouillat population could be inferred as an open scrubland (maquis minier) at low elevation, most probably on serpentinic alluvium.

Phenology:—From the most recent herbarium specimen with only one mentioning a precise date, the species flowers at least in early February.

Etymology:—This species is named after Cap Tonnerre ("Thunder Cape" in English), a locally accepted name for the peninsula where the locality Néhoué-Babouillat is located, and where every known specimen were most probably collected.

Conservation status:—The Néhoué–Babouillat locality and population where the type of *Pytinicarpa tonitrui* was collected could be considered as extinct. MacKee label, in 1968, mentions that "the species seems to be rare". Since the 1860s (Pancher and Deplanche) and even more recently, the habitat in the Babouillat area has been severely impacted by anthropogenic fires and invasive Rusa deer (*Rusa timorensis*), so this might explain its rarity or extinction, such as is the case for the Critically Endangered and possibly extinct *Brunoniella neocaledonica* (Heine 1976: 34) Moylan (2000: 480) (Tanguy *et al*. 2020). Since we (GG and GL), Dominique Fleurot and David Bruy have spent several days searching unsuccessfully for the species in the field, we can consider it as Extinct (EX), following IUCN (2019) guidelines. If the local Red List unit (Meyer *et al*. 2022) confirms this assessment, it will be the second New Caledonian endemic species after *Pycnandra micrantha* (Beauvisage 1901: 88) Munzinger & Swenson (2015: 102) to fall into this category.

Notes:—The material of *Pytinicarpa tonitrui* contains some specimens (*Deplanche 425*, *Mus. Néocal. 94* [*Pancher 94* / *Vieillard 2823*]) originally cited by Guillaumin (1937) as syntypes of *Brachyscome neocaledonica*, a name here put in the synonymy of *P. sarasinii.* Unfortunately, Wang *et al*. (2022) based the lectotypification of *B. neocaledonica* only on online scans, and failed to observe that two actually different species were mixed within syntypes of *B. neocaledonica*. Our careful examination of the original material revealed several distinctive characters (Table 1). For instance, the main distinctive character is the pubescence of the ray florets corolla tube which is glabrous in *P. tonitrui*, and systematically hairy in *P. sarasinii*. Florets are also much shorter in *P. tonitrui* than in *P. sarasinii*, respectively 0.5–1 mm vs. 1–1.3 mm long for the ray florets, and ca 1.3 mm vs. ca. 2.5 mm long for the disc florets. As far as observed, *P. sarasinii* remains the only *Pytinicarpa* in New Caledonia to have hermaphrodite disc floret, all disc florets observed for *P. tonitrui* being functionally male. Further, sterile material can be differentiated between both species, as *P. sarasinii* are always hairy plants, while *P. tonitrui* tends to be almost glabrous, with the pubescence limited to the leaf base. Yet the distinction on sterile material remains tricky and needs to be confirmed on fertile material, the pubescence of the ray floret corolla tube being the final distinctive character. Consequently, within some sheets of *Deplanche 425*, a gathering originally cited as syntype of *B. neocaledonica*, some individual plants belong to *P. tonitrui*. P00537800 and K000890083 plants all belong to *P. tonitrui*. P00537799 is a mixed specimen, with the two plants on the left belonging to *P. tonitrui,* while the two on the right belong to *P. sarasinii.* P00537801 (said to be from Neue, not an original label) is clearly a mixed specimen with plants probably collected in different places and at different times. Some plants belong to *P. sarasinii,* which were most likely collected in the Koniambo area (Gatope *s.l.*), but it was impossible to definitively identify each plant.

From all the specimens known, only one *Mus. Néocal.94* (P00537795), was retrieved and belongs to *P. tonitrui*, as confirmed by Guillaumin's drawings showing the glabrous ray floret corolla tube.

Specimens examined:—NEW CALEDONIA. North Prov.Nené [Neué], 1861–1867, *Deplanche 425* (K000890083image!, P00537799p.p.! see notes, P00537800!); Néué, 1870, *Mus. Néocal. [J.A.I. Pancher] 94 [E. Vieillard 2823]* (P00537795).

Acknowledgements

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are also acknowledged for their review of a previous version of this work. This original research was first submitted to PhytoKeys in December 2021 but unethical behaviour and scientific misconduct occurred during the process, so we have preferred to resubmit the manuscript to Phytotaxa. Full explanation is given in Lannuzel *et al*. (2022).

TABLE 1. Comparison of vegetative characters between *Pytinicarpa tonitrui* and *P. sarasinii,* based on 822 measurements (minimum value, **first quartile, third quartile,** maximum value).

Character	*P. tonitrui*	*P. sarasinii*	Comment
Leaf length	(44–) **79–128** (–162) mm	(42–) **80–144** (–251) mm	equivalent
Leaf width	(2–) **3–5** (–6) mm	(1–) **4–7** (–11) mm	narrower leaves in *P. neocaledonica*
Leaf apex angle	(15–) **49–74** (–93)°	(26.8–) **31–47** (–54.6)°	angle more obtuse in *P. neocaledonica*
Capitula width	(3.4–) **4.8–7.2** (–9) mm	(3.5–) **6.1–8.5** (–14.7) mm	equivalent
Scape length	(82–) 113–160 (–220) mm	(96–) **202–296** (–405) mm	scape shorter in *P. neocaledonica*
Scape width	(0.3–) **0.5–0.9** (–1.4) mm	(0.6–) **0.9–1.1** (–2.3) mm	scape narrower in *P. neocaledonica*
Tooth length	(0.3–) **0.5–1** (–1.4) mm	(0.4–) 0**.9–1.9** (–3.3) mm	equivalent

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