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Contribution to the bryophyte flora of New Caledonia. II: Taxonomic notes, new taxa and localities

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Résumé – Le sporophyte d'*Hymenodon tenellus* est décrit pour la première fois. L'examen de types et d'autres spécimens anciens et nouveaux permet de préciser l'identité en Nouvelle-Calédonie de *Bryum daenikeri* et de *Macromitrium serpens* assimilés respectivement à *B. pancheri* et *M. tongense*. Quatre hépatiques sont nouvelles pour le Territoire : *Andrewsianthus chimbuensis*, *Lejeunea stenodentata*, *Plagiochila integrilobula* et *Radula lingulata* et de nouvelles stations pour *Mitthyridium flavum* et *Trichosteleum stigmosum* sont rapportées.

Bryophyta / Marchantiophyta / Nouvelle Calédonie / mousses / hépatiques / nouvelles espèces / région Pacifique

Abstract – The sporophyte of *Hymenodon tenellus* is newly described. Comparison of types and further specimens allows to clarify the identity in New Caledonia of *Bryum daenikeri* and *Macromitrium serpens* and assign them respectively to *B. pancheri* and *M. tongense*. Four new species of liverworts: *Andrewsianthus chimbuensis*, *Lejeunea stenodentata*, *Plagiochila integrilobula* and *Radula lingulata* and new localities of *Mitthyridium flavum* and *Trichosteleum stigmosum* are reported.

Bryophyta / Marchantiophyta / New Caledonia / mosses / liverworts / new records / Pacifique region

INTRODUCTION

New Caledonia bryophyte flora is known from extensive works since the mid 19th century. The results are compiled in two checklists (Thouvenot & Bardat, 2010; Thouvenot *et al.*, 2011) completed by several following publications (Müller, 2011, 2012, 2013; Zhu & Müller, 2012; Thouvenot & Bardat, 2013; Müller & Tan, 2013; Thouvenot & Reeb 2014). Given the more recent taxonomic and floristic works including the present, New Caledonia has a wealth of a thousand bryophyte species or infraspecific taxa including 540 mosses and 485 liverworts and hornworts. The observation of specimens gathered by the author during two field trips (2008, 2012) in the main island of this French Territory together with the review of herbarium specimens and types (PC, REN) provides evidence for new synonymies and amendments. Synonymies have been inferred by morphological comparison following the procedures indicated below for each concerned species. Furthermore four liverworts are recognized as new for the local flora and we mention new localities for two recently discovered mosses. Specimens are kept in the private herbarium of the author, unless otherwise specified.

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TAXONOMIC NOTES AND AMENDMENTS WITH A DESCRIPTION OF *HYMENODON TENELLUS* SPOROPHYTE

Hymenodon tenellus Broth. *et* Paris

Two species of *Hymenodon* were hitherto recorded in New Caledonia: *H. tenellus* Broth. *et* Paris and *H. sphaerothecius* Besch. During the field trip in September 2012, we had the opportunity to collect a sample of fertile *Hymenodon* in Mont Ningua, Province Sud. It was growing on tree fern stipe with *Spiridens camusii* Thér., at 1050 m asl, in a mesophilous *Metrosideros* forest. Brotherus (1911) described *Hymenodon tenellus* from sterile collection of Louise Le Rat, 1909, and, up to now, no fertile collection was reported (Karttunen & Bäck, 1988; Tessler, 2012). As asserted by Brotherus, *H. tenellus* is very similar to the Javanese species *H. sericeus* (Dozy *et* Molk.) Müll.Hal. from which it differs only by its smaller size. Karttunen & Bäck (1988) assigned both plants to subspecific status under *H. pilifer* Hook.f. *et* Wilson in the section *Hymenodon,* but tentatively for *H. tenellus* since the peristome features would be decisive when they are found (Shaw & Anderson, 1986). The other New Caledonian species, *H. sphaerothecius*, is a member of the section *Polystichella* Müll.Hal. *emend.* Kartt. *et* Bäck of the genus, which differs from the section *Hymenodon* by a strong costa and a multicellular hair point. Later, the new species *H. chenianus* Pócs was described from Fiji (Pócs, 2007; Müller, 2012b). Finally, Tessler (2012) provided morphological and molecular evidences to restore the specific status of *H. tenellus* and *H. sericeus*.

The sporophyte of the new specimen will be described after its gametophytic characteristics are compared with two isotypes of *H. tenellus* kept in PC and with the descriptions of *H. sericeus, H. tenellus* and *H. pilifer* in Tessler (2012) in order to verify if this fertile specimen may be refered to *H. tenellus* or another of these very similar species.

Table 1. Vegetative features of *Hymenodon pilifer*, *H. tenellus* and *H. sericeus* in Tessler (2012) compared to measures of two *H. tenellus* isotypes and a new specimen from New Caledonia

	H. tenellus (from Tessler, 2012)	*H. tenellus (from isotypes)*	*Mt Ningua specimen*	*H. sericeus (from Tessler, 2012)*	*H. pilifer (from Tessler, 2012)*
Stem length	4-8 mm	10 mm	10-17 mm	8-22 mm	8-14 mm
Leave shape	elliptic to oblong	elliptic	elliptic	oblong-elliptic	broadly elliptic
Leave length (without hair point)	0.6-1.1 mm	(0.45-) 0.63 (-0.95) mm	(0.7-) 0.84 (-0.95) mm	0.66-1.28 mm	0.55-1.05 mm
Leave width	0.19-0.29 mm	(0.16-) 0.20 (-0.22) mm	(0.26-) 0.29 (-0.35) mm	0.24-0.34 mm	0.22-0.37 mm
Half lamina width in number of cells	10-14	(8-) 11 (-15)	(13-) 18 (-24)	12-18	12-21
Hair point length	0.19-0.4 mm	0.14-0.28 mm	0.10-0.27 mm	0.30-0.40 mm	0.19-0.50 mm
Cell length	5-12.5 µm	9.8 -13.5 µm	9-12 µm	7.5-15 µm	4-11 µm
Costa	usually percurrent	percurrent in most leaves	subpercurrent to percurrent	percurrent at least in some leaves	subpercurrent (rarely percurrent: New Zealand)
Axillary hair	2-4 cells, 45-60 µm	3 cells, 50 µm long	3 cells, 60 µm long	2-4 cells, 60-95 µm long	2-3 cells, 40-85 µm long
Costa in perichaetial leaves	not seen	not seen	percurrent	subpercurrent to excurrent	Ω of leaf length, rarely excurrent

Gametophyte: Table 1 shows the characters measured on the specimen from Mt Ningua and two isotypes of *Hymenodon tenellus*, compared to data in Tessler (2012). We omitted to show differences with *H. chenianus* which are conspicuous, mainly in the much shorter stem and caducous hair points.

Some usually discriminant morphological characters including costa length, stem length, leaf width (in number of cells), are often inconstant, as argued by Karttunen & Bäck (1988) for subspecific status in their *H. pilifer* group. However, following Tessler opinion on key features regarding the differences between species of *Hymenodon*, the specimen from Mt Ningua is not *H. pilifer* because of its frequently percurrent costa, in vegetative as well as perichaetial leaves. It is more hardly distinguishable from *H. sericeus*. Although, in average, it displays shorter stems, smaller leaves and smaller cells. But the upper values intergrade the *H. sericeus* ones. On the contrary, hair points and axillary hairs are always shorter. The Mt Ningua specimen shape and sizes are more consistent with the examined type of *H. tenellus*, although the later have smaller leaves and the nerve more often excurrent. The description in Tessler (2012) includes Fiji and Vanuatu specimens which differ from the type in several features as caducuous hair point. The new specimen and the type, both from New Caledonia have firm points. Also, Tessler notes that small forms of *H. sericeus* can be found in exposed situation, but specimen from Mt Ningua was gathered in a very shaded place. Thus, our fertile specimen exhibits sporophytes which can be related to *H. tenellus* of which no fertile specimen was known to date and the protologue of *H. tenellus* can be added by the following sporophytic characters:

Sporophyte (Figs 1-4): Perichaetium basal on the stem, dark brown, with leaves 0.6-0.9 mm long, 0.22-0.27 mm wide, ovate lanceolate, acuminate in short or medium point, with percurrent to shortly excurrent costa, cells large, irregular, thin-walled, smaller and with thicker walls in the apex, margin entire; seta 10-15 mm long; capsule 1.1 mm long, 0.4 mm wide, short oblong, with a short neck, exothecial cells collenchymatous, isodiametric to short oblong, 10-25 µm wide, 15-30 µm long, stomata phaneroporous; peristome haplolepideous, basal membrane 50-70 µm high, 16 narrow exostome teeth 350-400 µm high, 37 µm wide, split in the upper 1/4-1/3, both surfaces with longitudinal thickenings; lid obliquely rostrate.

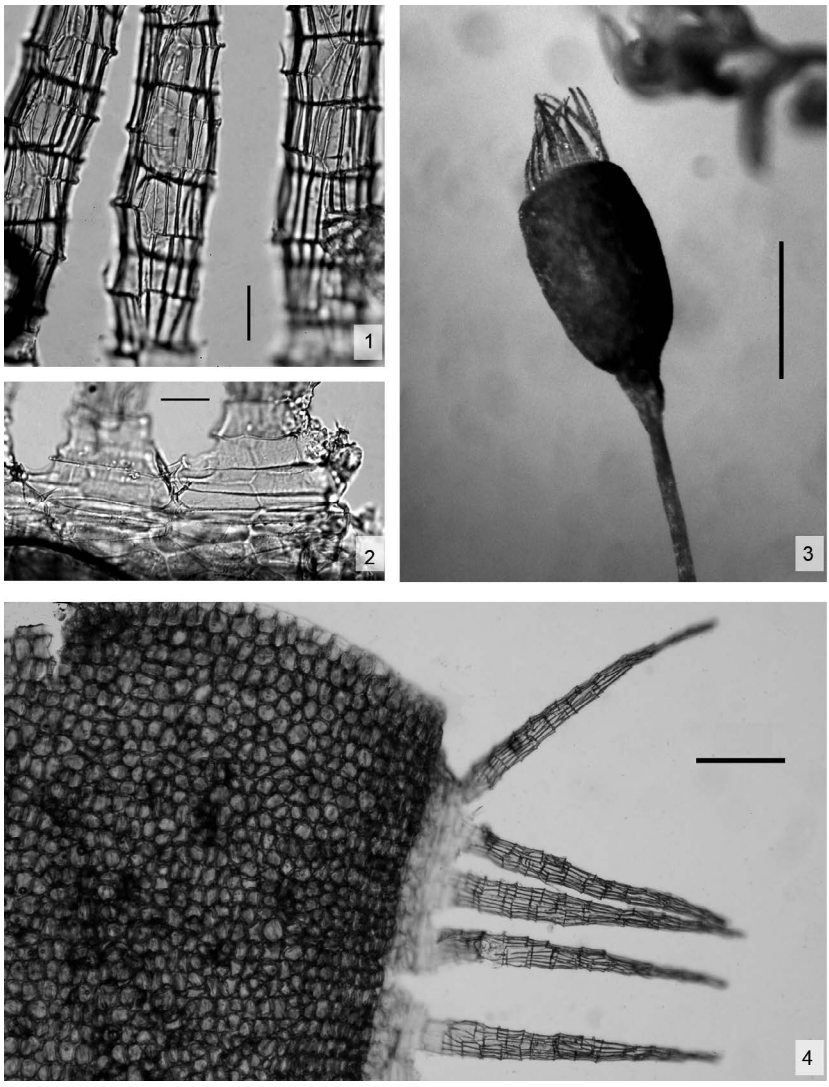
The peristome of the specimen is very similar to these of *H. sericeus* (Shaw & Anderson, 1986) and *H. pilifer* (Karttunen & Bäck, 1988), with longitudinally striate teeth of exostome. Furthermore, size and shape of capsule, teeth, seta, and lid are identical. On the contrary, the peristome of *H. chenianus* differs by its well developped endostome and a vestigial exostome (Müller, 2012b).

Selected specimens examined: *Hymenodon tenellus*, "Nov. Caledonia, in summo Dent de St Vincent (1475 m)", July 1909, *L. Le Rat*, *s.n.* (isotypes, PC0697689, PC0697691); Nouvelle-Calédonie, South Province, Thio, Mt Ningua, 1050 m, on fern stipe, UTM 58K 0619476-7594867, 29/09/2012, *L. Thouvenot NC 820* (PC0167205)

Bryum pancheri Jaeger

= *Bryum daenikeri* Thér. *Vierteljahrsschr. Naturf. Ges. Zürich* 74: 75. 1929 ***syn. nov.*** Type: Nouvelle-Calédonie, Koniambo, auf feuchtem Tonboden, 19/1/1925, *Däniker s.n.* (PC0097567!).

Bescherelle (1873) described *Bryum crassinervium* Besch., a new species from New Caledonia, but because of an illegal homonymy, Jaeger (1875) gave it the name *Bryum pancheri*. Later, Thériot (1929) described *Bryum daenikeri* as a



Figs 1-4. *Hymenodon tenellus* sporophyte. **1.** Exostome teeth (scale bar: 20 µm). **2.** Basal membrane (scale bar: 20 µm). **3.** Capsule (scale bar: 0.5 mm). **4.** Exothecial cells and peristome (scale bar: 100 µm), (all from *L. Thouvenot NC820*).

new species. After examination of the types of *B. crassinervium* and of *B. daenikeri*, together with several specimens collected between 1902 and the present and named either *B. pancheri* or *B. daenikeri*, we have found evidence that there is no difference between them.

The plants of this species are characterized by: 1) red brown colour, stem elongate or more often bud-like, 3-15 mm high, frequently branched by sub-perichaetial innovations, matted with red brown tomentum, leaves appressed to slightly contorted along stem, the upper ones more concave and crowded in a bud-like top and frequently in successive comal tufts along the stem;

2) leaves 1-2.2 mm long, 0.4-0.85 mm wide, dark red to shining green in young shoots, oblong, lingulate to spathulate with rounded apices, stout red nerve excurrent in a mucro, margins unbordered or with 1-2 rows of linear cells, recurved from base to apex, hardly denticulate; 3) unequal areolation usually reddish throughout with upper and median cells rhomboide, incrassate, in conspicuous divergent files, lower and basal cells wider, short rectangular to quadrate; 4) – nerve abaxially strongly protruding, in transverse section rounded with epidermal cells on both sides, one layer of guide cells and one single rounded dorsal stereid group and 5) – nodding or pendent claviform capsules, 3-4 mm long, attenuated in a long neck, more or less as large as the urn, with a well developed double peristome.

Among the examined specimens, those from Col d'Amieu (herbarium of E.G. Paris) are the most robust: stem up to 15 mm high with several successive comal tufts in which leaves reach 2.2 mm long and 0.85 mm wide, when the other features are usual for the species. Col d'Amieu is situated in a volcano-sedimentary basin whereas all other specimens come from laterite soil in ultramafic massifs. The different habitat features could determine the difference in the habit.

According to these morphological characteristics, this species may be a member of the genus *Gemmabryum* J.R.Spence *et* H.P.Ramsay (2005), but without more evidence in the phylogeny of the Bryaceae (Pedersen *et al.*, 2003), it is best to wait before changing the generic name.

Selected specimens examined: *Bryum crassinervium*: "Mus. Neocal n° 573", "sol ferrugineux, Sud de la Calédonie" and "Île des Pins (Kouala)", isosyntype PC0135985; *Bryum pancheri*: "Mus. Neocal n° 573 (*Bryum crassinervium*)", "Sol ferrugineux nu, Île des Pins (*Pancher legit*)" (and) "Bryum Pancheri Jgr. Terrains nus, 300 m, Calédonie, Mont d'Or", isosyntype PC0097559; "Île des Pins, donné par M. Pancher, 1870, mars", isosyntype PC0135986; Col d'Amieu, *Marc Buso s.n.*, REN-EGP *s.n.*; Nouvelle-Calédonie, *Franc s.n.*, PC0097566; *Bryum daenikeri*: Yaté road, 200 m, 21/06/1965, *Schmid 28bis*, PC0097566; Dumbéa river, 100-200 m, 5/6/1955, *Mac Kee 2585*, PC0738558; Mont Koghi, 500 m, 20/2/1955, *Mac Kee 2140*, PC0738559; North Province, Koumac, Tiébaghi, coordinate UTM 58K 0415604-7737571, 28/9/2008, *L. Thouvenot NC279*; South Province, Yaté, Creek Pernod, coordinate UTM 58K 0686658-7543222, 10/10/2013, *C. Flouhr NC992*.

Macromitrium tongense Sull.

In a previous paper, Thouvenot & Bardat (2013) have recorded *Macromitrium serpens* (Bruch *ex* Hook. *et* Grev.) Brid. as a new species for New Caledonia. They underlined that the quoted New Caledonia specimen differed from *M. serpens* in habit when dry as the latter has erect twisted leaves with a circinate apex. The examination of many types and other specimens of *Macromitrium* with pluristratose leaves, short oblong obtuse, collected in the Territory has provided evidence that all of them appear to share the same erect appressed leaves, usually spirally arranged with apices straight or oblique, never circinate. As this habit seems constant in New Caledonia specimens, it clearly differs from *M. serpens* and corresponds to *M. tongense*. In New Caledonia, we consider conservatively a complex getting *M. tongense* together with *M. villosum (*Besch.) Broth. *var. pl., M. densifolium* Thér., *M. ludovicae* Broth. *et* Paris, until finalisation of the ongoing revision of the genus in New Caledonia. *M. tongense* is the older name among them and will probably be the only recognized.

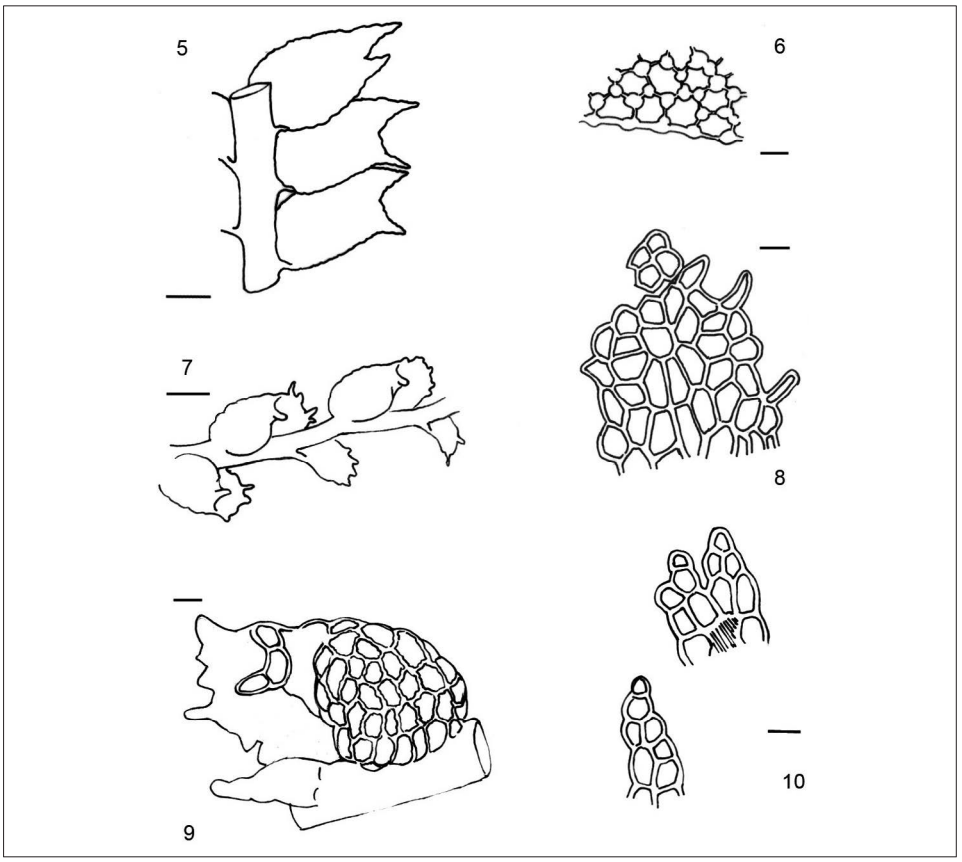
As a result, *M. serpens* must be removed from the list of New Caledonian mosses.

NEW LIVERWORTS REPORTED FROM NEW CALEDONIA

Andrewsianthus chimbuensis R.M.Schust.

Andrewsianthus chimbuensis differs from the previously reported *A. puniceus* (Nees) R.M.Schust. *ex* Grolle which has leaves round to broadly ovate, retuse to shallowly lobed with rounded lobes. On the opposite, *A. chimbuensis* has oblong to narrowly ovate leaves, 0.4 -0.5 µm long, 0.18-0.2 µm wide, usually 1/4 bifid with rectangular to acute sinus and acute lobe apices ending in one to three uniseriate cells. In addition, succubous leaves are canaliculate, and leaf margins nodulose because of thick marginal cell corners (Figs 5-6). The specimen is sterile.

A. chimbuensis was only known from Papua New Guinea (1100-4200 m asl) and Malaysia (North Borneo) (Váňa & Piippo, 1989). The presence in one of the highest mountains of New Caledonia (at 1 400 m asl) could be linked to long



Figs 5-10. **5-6.** *Andrewsianthus chimbuensis*. **5.** Shoot fragment (scale bar: 100 µm). **6.** Leaf margin cells (scale bar: 20 µm), (from *L. Thouvenot NC1134*). **7-10.** *Lejeunea stenodentata*. **7.** Shoot fragment, ventral view, underleaves not shown (scale bar: 100 µm). **8.** Bract apex (scale bar: 20 µm). **9.** Leaf and reduced underleaf, ventral view (scale bar: 20 µm). **10.** Two kinds of underleaves (scale bar: 20 µm), (from *L. Thouvenot NC1135*).

distance dispersal and indo-malesian character of the bryophyte flora of New Caledonia (Thouvenot *et al*., 2011).

Specimen examined: New Caledonia, South Province, Mont Humboldt, 1 400 m, corticolous in mountain shrubland on peridotite, coordinates UTM58K: 0646455-7579629, 01/10/2008, *L. Thouvenot NC 1134.*

Lejeunea stenodentata M.A.M.Renner *et* Pócs.

On the same piece of bark, we found a Lejeuneaceae with a shape looking like *Lejeunea exilis* (Reinw., Blume *et* Nees) Grolle: small size, dimorphic underleaves, bifid or undivided lanceolate (Fig. 10), and leaves erect along the stem with very large lobules. But the lobe margins and the bracts are strongly serrate with some elongated teeth and few celled fragments breaking away (Figs 7-9). The specimen has some gynoecia but undeveloped perianth. Professor Rui-Liang Zhu identified it as *Lejeunea stenodentata* M.A.M. Renner *et* Pócs, a species which was initially described as *Drepanolejeunea dentata* Steph., then integrated in *Stenolejeunea* (Pócs *et al*., 1995). It was known only from Borneo, Philippines, Moluccas, Western Melanesia and Australia with the nearest localities in Solomon Islands and Queensland (Renner *et al.*, 2013). Mizutani (1970) reported this species for Kinabalu, Malaysia, but Lee (2013) omitted it in her monograph of *Lejeunea* in Malaysia. This new collection in New Caledonia is the most southern.

Specimen examined: New Caledonia, South Province, Mont Humboldt, 1400 m, corticolous in mountain shrubland on peridotite, coordinates UTM58K: 0646455-7579629, 01/10/2008, *L. Thouvenot NC1135.*

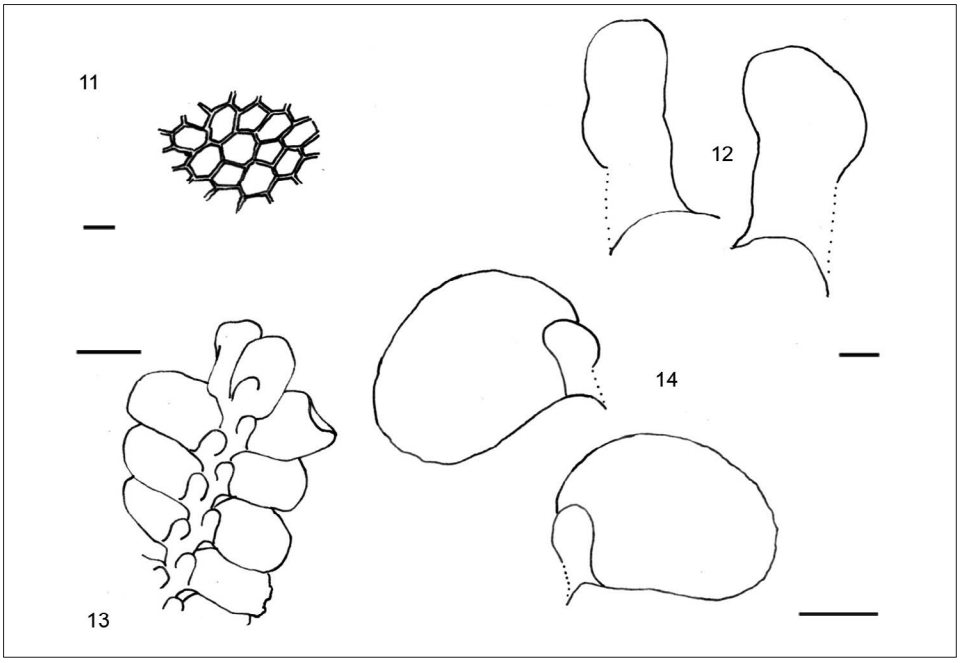
Plagiochila integrilobula Schiffn.

Two species of subgenus *Metaplagiochila* Inoue were hitherto reported from New Caledonia: *P. vitiensis* Mitt. and *P. bantamensis* (Reinw., Blume *et* Nees) Mont. The newly recorded *P. integrilobula* has leaf ventral margins with saccate lobules which are ovate-oblong instead of linear like in the former and entire instead of ciliate like in the latter. Some sterile shoots were collected in Massif des Lèvres (near Touho, North Province), so far unexplored by bryologists. This species was known from Southeast Asia: Java, Ceylon, Philippines, Taiwan (Inoue, 1984), Thailand (Lai *et al.*, 2008) and Vietnam (Pócs & Ninh, 2005).

Specimen examined: New Caledonia, North Province, Touho, Massif des Lèvres, corticolous, at base of a tree in lowland wet forest, 315 m a.s.l. in Tipiléi upper valley, 12/10/2012, *L. Thouvenot NC1192.*

Radula lingulata Gottsche.

Radula lingulata, a species of the subgenus *Radula* section *Longilobae (*Steph.) Castle, is characterized by a small size, a brown colour, leaves with oblong lobes, spreading at 90˚ with the stem, widely rounded lobe apices, ventral margins of lobes straight, keels short and incurved, without sinus, lobules long-lingulate, parallel with the stem, the apex widely rounded. In addition, the cells are regularly thin walled, without trigone (Figs 11-14). No species reported from New Caledonia exhibits those features together. The specimen has been collected in Massif des Lèvres. The sterile plants were growing mixed with *Plagiochila* sp., the shoots gathered up were 9-15 mm long, 3 mm wide including leaves, with stems 0.2 mm thick, lobes 0.9-1 mm long, 1.2-1.45 mm wide, lobules 0.45-0.55 mm long, 0.25-0.3 mm wide, median cells 15-20 µm.



Figs 11-14. *Radula lingulata*. **11.** Median cells of lobes (scale bar: 20 µm). **12.** Lobules (scale bar: 100 µm). **13.** Branch, ventral view (scale bar: 1 mm). **14.** Leaves (scale bar: 0.5 mm), (all from *L. Thouvenot NC1183*).

The known range of *R. lingulata* was hitherto restricted to Java and New Guinea (Yamada, 1979).

Specimen examined: New Caledonia, North Province, Touho, Massif des Lèvres, on rocks in the splashing zone of a waterfall, 315 m a.s.l. in Tipiléi upper valley, 12/10/2012, *L. Thouvenot NC1183.*

NEW LOCALITIES

Mitthyridium flavum (Müll.Hal.) Rob.

This species has been first recorded in New Caledonia by Müller (2012a). A second locality is registered about 6 km west of the previous, in the Provincial Natural Park of Grandes Fougères. *M. flavum* is so far known only in the central range of New Caledonia.

Specimen examined: New Caledonia, South Province, Moindou, near Rivalin Camp, 430 m, on palm tree stipe in mesophilous forest, coordinate UTM58K: 0577685-7610349, 24/9/2008, *L. Thouvenot NC332.*

Trichosteleum stigmosum Mitt.

This species, first recorded in New Caledonia by Müller & Tan (2013), was collected in two new localities: one in the same natural region, in the South of the island, the other in Province Nord, in the Massif des Lèvres.

Specimens examined: Nouvelle-Calédonie, South Province, Mont Dore, Kaoris River in Prony Bay, 24/8/2013, *L. Courmont NC1073*; North Province, Touho, Massif des Lèvres, top of Tipilei Valley, on fern stipe in lowland rain forest, 300-400 m, 12/10/2012, *L. Thouvenot NC965*.

CONCLUSION

In New Caledonia, unexplored parts of Grande-Terre and other islands, Île des Pins and Îles Loyauté, have still many new interesting records to offer. Furthermore, an extensive revision of early records is necessary, allowed by the important collections held in herbarium linked to New Caledonia History: PC, REN-EG, NOU, G, H-BR, B, etc.

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