

The Liagoraceae (Rhodophyta) of New Caledonia collected by Vieillard, including *Ganonema filicoides* (Kützing) comb. nov.

John M. HUISMAN^{a*} & Alan J. K. MILLAR^b

^aSchool of Biological Sciences and Biotechnology, Murdoch University,
Murdoch, W.A. 6150, and Western Australian Herbarium,
Department of Environment and Conservation, Locked Bag 104,
Bentley Delivery Centre, W.A. 6983, Australia

^bRoyal Botanic Gardens Sydney, Mrs Macquaries Rd, Sydney,
N.S.W. 2000 Australia

(Received 30 October 2006, accepted 20 December 2006)

Abstract – Historical specimens of Liagoraceae (Rhodophyta) collected by Eugène Vieillard from New Caledonia in the 1850s and housed in the Leiden herbarium have been examined and their identities clarified. Included are: *Liagora ceranoides*, *L. maderensis* (a new record for New Caledonia), *Ganonema farinosum*, *Ganonema filicoides* (Kützing) comb. nov., and *Yamadaella caenomyce*. Type material of two species, *Liagora tomentosa* Kützing and *Nemalion filicoides* Kützing, is present. The former is shown to be a heterotypic synonym of *Ganonema farinosum* (Lamouroux) Fan et Wang. The latter is incorrectly placed in *Nemalion* and displays the cortical structure and reproductive development of *Ganonema*. Thus, the combination *Ganomema filicoides* (Kützing) Huisman et Millar is proposed. *Ganonema filicoides* is similar, if not identical, to the later named *Ganonema samaense* (Tseng) Huisman.

Liagora ceranoides / *Liagora tomentosa* / *Nemalion filicoides* / *Yamadaella caenomyce* /
Liagora maderensis / *Nemaliales* / red algae

Résumé – Les Liagoraceae (Rhodophyta) collectées par Vieillard en Nouvelle Calédonie, incluant *Ganonema filicoides* (Kützing) comb. nov. Les spécimens historiques de Liagoraceae (Rhodophyta) récoltés par Eugène Vieillard en Nouvelle Calédonie dans les années 1850 et conservés dans l'herbier de Leyde ont été examinés et leurs identités clarifiées. Ils comprennent : *Liagora ceranoides*, *L. maderensis* (nouveau pour la Nouvelle Calédonie), *Ganonema farinosum*, *Ganonema filicoides* (Kützing) comb. nov., et *Yamadaella caenomyce*. Le matériel type de *Liagora tomentosa* Kützing et de *Nemalion filicoides* Kützing est présent. Le premier est un synonyme hétérotypique de *Ganonema farinosum* (Lamouroux) Fan et Wang. Le deuxième, incorrectement placé dans le genre *Nemalion*, présente une structure corticale et un développement de la reproduction de *Ganonema*, conduisant à proposer la combinaison *Ganomema filicoides* (Kützing) Huisman et Millar. *Ganonema filicoides* est semblable, sinon identique, au nom postérieur *Ganonema samaense* (Tseng) Huisman.

* Correspondence and reprints: J.Huisman@murdoch.edu.au
Communicating editor: Frederik Leliaert

INTRODUCTION

The collections of marine algae from New Caledonia made by Eugène Vieillard (1819-1896) and described by Friedrich Kützing during the mid 1800s (1863a, 1863b-1869) include many of historical importance. Until recently, most of the Kützing names had not re-appeared in the literature since their description, nor have they been critically re-examined taking into account updated taxonomy and nomenclature. Millar & Prud'homme van Reine (2005) have recently clarified the identities of many of these species. Arising from that study was the need for a detailed examination of the Vieillard collection of Liagoraceae, the results of which are presented here. All specimens collected from New Caledonia by Vieillard and housed in the Rijksherbarium at Leiden (L) were examined. Type specimens of two species (*Nemalion filicoides* Kützing and *Liagora tomentosa* Kützing) were examined, plus several specimens that possibly formed the basis of later records. The identities of several other Liagoraceae listed in the catalogue of New Caledonian algae by Garrigue & Tsuda (1988) are also considered, but unfortunately no specimens are available to support those records.

MATERIALS AND METHODS

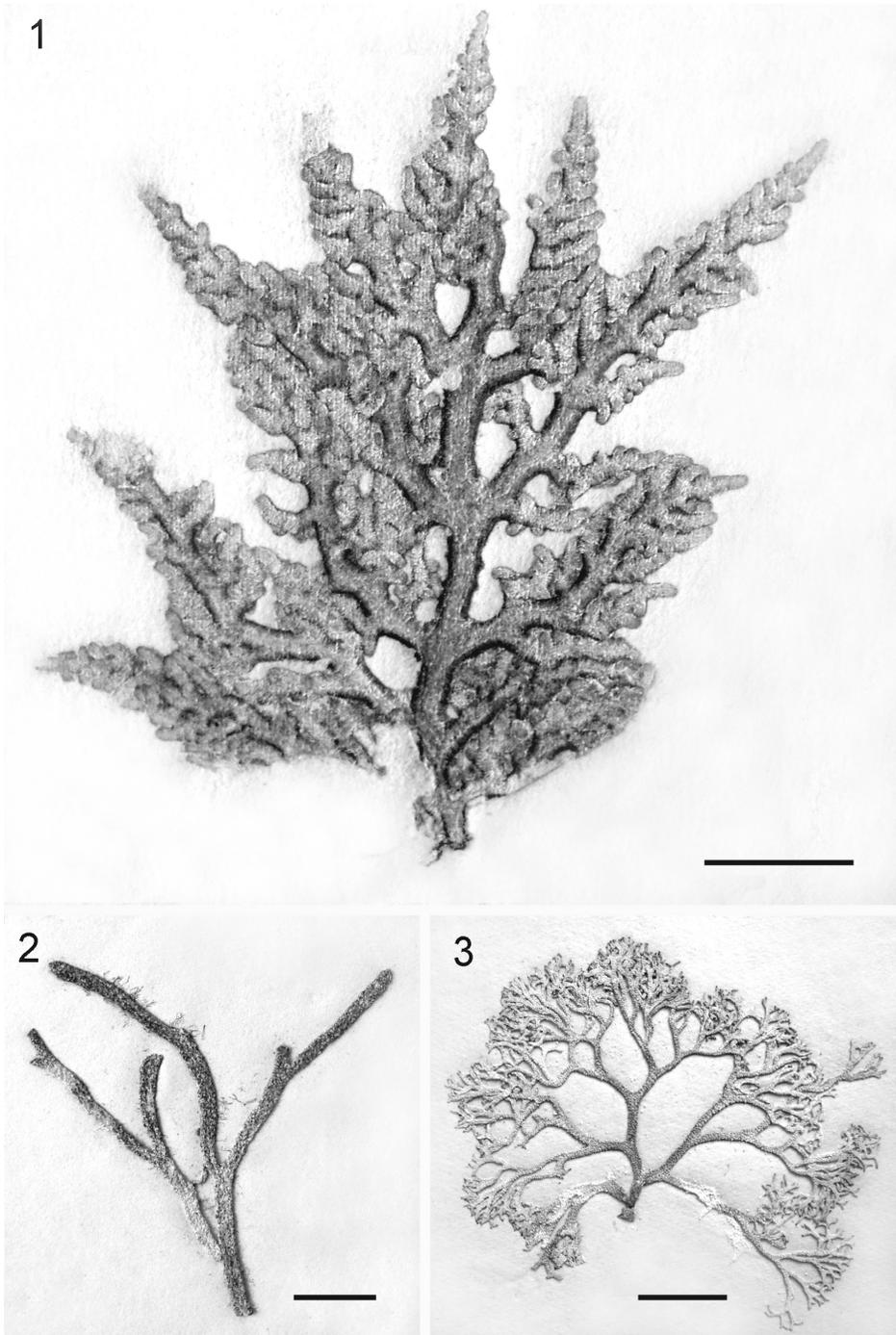
Specimens were loaned from Leiden and examined at Murdoch University. Small portions of plants were rehydrated for several minutes, decalcified with dilute HCl, stained with aniline blue, and then mounted on slides in a solution of 50% Karo (ACH Food Companies, Inc.) and water. The coverslips were pressed lightly to spread the filaments. Photographs of dried plants were taken with a Nikon Coolpix 4200 digital camera and arranged for publication in Adobe Photoshop v. 7.

RESULTS

***Ganonema filicoides* (Kützing) Huisman et Millar, comb. nov. (Fig. 1)**

Basionym: *Nemalion filicoides* Kützing, *Tabulae Phycologicae* XVI: 23, tab. 65a, b (1866). Holotype: L 941,181-267 (barcode L 0056029) from Wagap, New Caledonia, 1863, Vieillard #2094b.

The sole specimen is 53 mm in height, lightly calcified, and light pink in colour. Branching is probably radial, but appears pinnate in the pressed specimen, with each order of branching progressively shorter. From the general aspect of the pressed specimen and its adherence to paper, it would also appear that the plant might have been mucilaginous when living. Cortical fascicles are 350-450 µm long, dichotomously divided except near the tips, where the terminal branches are often 4-5 cells long. Distal cells of cortical filaments are ellipsoid to barrel-shaped and 15-18 µm in diameter. Medullary filaments are 15-25 µm in diameter. Carpogonial branches are 4 celled, the cells 15 µm in diameter. Other reproductive structures were not observed.



Figs 1-3. Liagoraceae collected by Vieillard from New Caledonia. **1.** Type specimen of *Nemalion filicoides* (= *Ganonema filicoides*) (L 941,181-267). **2.** Isotype specimen of *Liagora tomentosa* (= *Ganonema farinosum*) (L 940,284-299). **3.** *Liagora ceranoides* (L 941,149-218). Scales = 1 cm.

Remarks: The morphology and observed reproductive structures of *N. filicoides* are incompatible with *Nemalion*, a genus with elongate carpogonial branches with the carpogonium terminating an elongate branch comparable to a vegetative filament (Womersley, 1994; Huisman & Womersley, 2006). The shorter, 4-celled carpogonial branches of *N. filicoides* are similar to those found in the genus *Ganonema* Fan *et* Wang (Huisman *et al.*, 2004). In fact, the holotype of *N. filicoides* (Fig. 1) is very similar in habit to the more recently described *Ganonema samaense* (Tseng) Huisman (2002: 829) (Basionym: *Liagora samaensis* Tseng 1941: 276), particularly a specimen from the Hawaiian Islands depicted by Huisman *et al.* (2004, fig. 35). Unfortunately the type specimen of *N. filicoides* did not rehydrate well, but vegetative dimensions are comparable to those described by Huisman *et al.* (2004). We also observed 4-celled carpogonial branches that are relatively straight and have large cells. They are borne from the mid to proximal end of the bearing cell. Other details are unclear and further study on more recently collected specimens is needed to ascertain the conspecificity of *G. filicoides* and *G. samaense*. If this can be demonstrated, the species should be known as *G. filicoides*, the name based on the earlier of the two basionyms.

Ganonema farinosum (Lamouroux) Fan *et* Wang, 1974: 492. **(Fig. 2)**

Liagora tomentosa Kützing, 1863a: 13. Type is L 941,149-236 (barcode L 0056005) from New Caledonia by *Viellard*. Isotype on sheet L 940,284-299 (barcode L 0055801) with the holotype of *Gongroceras subtile* Kützing (= *Ceramium flaccidum*).

Remarks: The holotype of *Liagora tomentosa* is presently mislaid, but an image of the specimen exists on the NHN website database. However, an isotype (which also happens to have the epiphytic holotype of *Gongroceras subtile* Kützing) has the distinctive cylindrical cortical filaments and carpogonial branches of *Ganonema farinosum*. The specimen also has mature cystocarps. *Liagora tomentosa* is therefore placed in the synonymy of *Ganonema farinosum*.

Liagora ceranoides Lamouroux, 1816: 239. **(Fig. 3)**

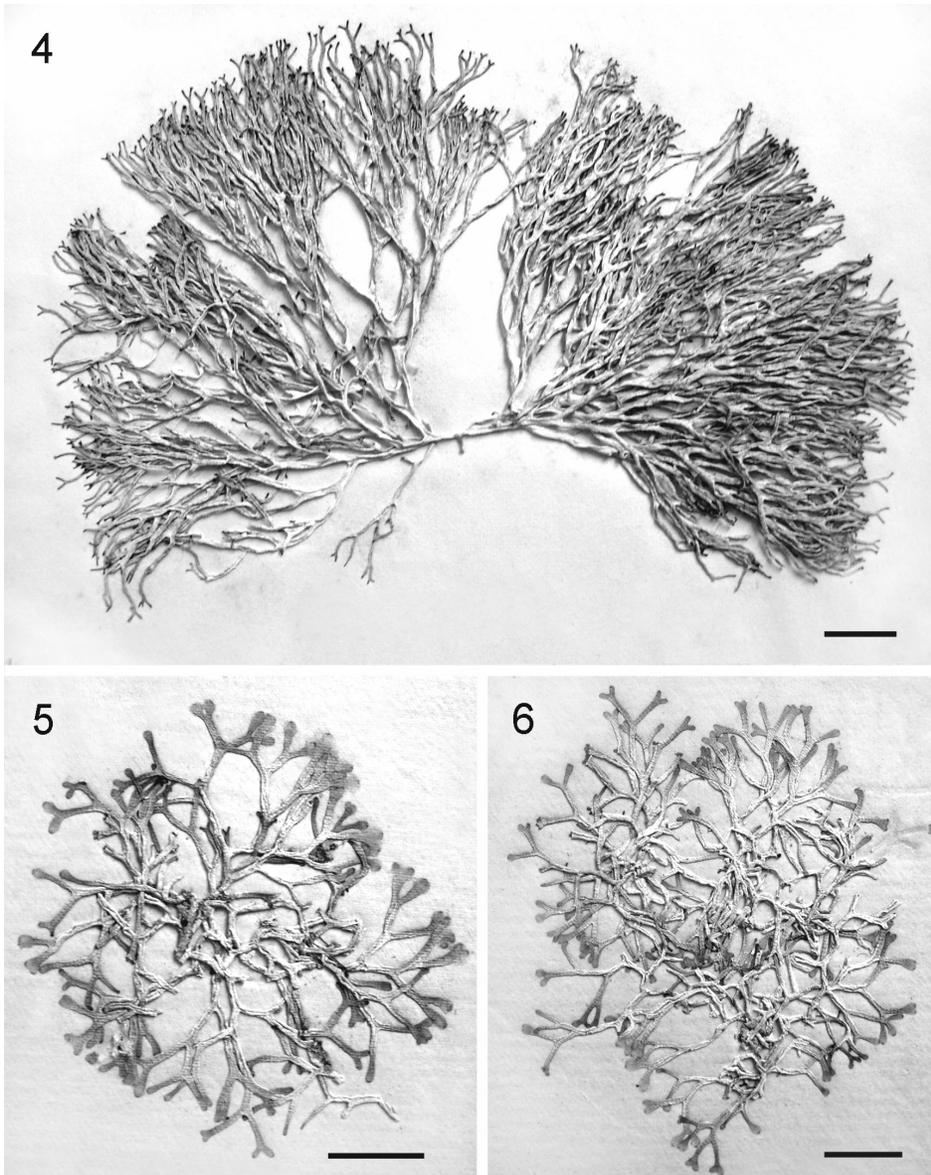
Specimen: Wagap, New Caledonia, 1863, *Viellard* 2092 (L 941,149-218; barcode 0193975).

Remarks: This small size and vegetative structure of this specimen are entirely compatible with *L. ceranoides*, a species with a wide distribution in tropical seas (Huisman, 2002).

Liagora maderensis Kützing, 1858: 43, tab. 91, figs 1a-e. **(Fig. 4)**

Specimen: Noirmontiers, New Caledonia (L 941,149-234; barcode 0193977).

Remarks: This specimen is filed under *Liagora versicolor* Lamouroux, a superfluous name for *L. distenta* (Mertens) Lamouroux (Abbott 1990a: 114). *Liagora distenta* does not apparently occur in the Pacific Ocean (Abbott 1990a: 116) and this specimen is clearly misidentified. The thallus is moderately calcified, dichotomously divided without proliferous branches, and structurally has much-divided cortical filaments, strongly curved, four-celled carpogonial branches, compact gonimoblasts, no fusion cell, and branched involucrel filaments with cylindrical cells. These features indicate conspecificity with *Liagora maderensis* Kützing, as described by Kvaternik & Afonso-Carillo (1995), who examined the type specimen. Similar specimens from Australia were also attributed to this species by Huisman (2002).



Figs 4-6. Liagoraceae collected by Vieillard from New Caledonia. **4.** *Liagora maderensis* (L 941,149-234). **5, 6.** *Yamadaella caenomyce* (L 941,149-230). Scales = 1 cm.

Yamadaella caenomyce (Decaisne) I.A.Abbott, 1970: 117.

(Figs 5, 6)

As *Liagora rugosa* var. *vieillardii* Grunow (Garrigue & Tsuda, 1988: 66).

Specimens: Wagap, New Caledonia, 1863, *Vieillard 1909* (L 941.149.230; barcode 0193973 and 0193974). Bibouarama, New Caledonia, 1863, *Vieillard 2091* (L 941,149-215; barcode 0193976).

Remarks: These specimens are filed in Leiden as *Liagora valida* and are also annotated as *L. rugosa*, a synonym of *Yamadaella caenomyce* (Abbott, 1970). They have the distinctive inflated outer cortical cells of *Y. caenomyce* (see Abbott, 1970; Yoshizaki, 1979; Wynne & Huisman, 1998; Huisman, 2006) and are clearly that species. Some specimens also have the large, three-celled carpogonial branches of this species. Another specimen (L 941,149-215) of this species is filed in Leiden as *Liagora viscida*. It is a male specimen, with spermatangia arising at the apices of stalk cells borne on cells subtending the inflated outer cortical cells, again typical of this species.

DISCUSSION

The specimens examined here represent the majority of Liagoraceae thus far recorded from New Caledonia. In addition to the species mentioned above, Garrigue & Tsuda (1988) also recorded *Liagora annulata* and *L. boergesenii*, but the whereabouts of specimens to support these records is unknown. *Liagora annulata* is regarded as a synonym of *Titanophycus validus* (Harvey) Huisman, G.W. Saunders et A.R. Sherwood (Huisman *et al.*, 2006) by Abbott (1990b, as *Liagora valida* Harvey), but it is not known what taxon the specimens from New Caledonia actually represent. Some of the specimens in Leiden are misidentified as *L. valida*, but are in fact *Yamadaella caenomyce*. However, *Titanophycus validus* is common in tropical seas generally, and it is entirely possible that it occurs at New Caledonia. Specimens of *L. boergesenii* were not seen, but again this species is easily misidentified. Neither *Titanophycus validus* or *Liagora boergesenii* were present in the Leiden collection.

Acknowledgements. We thank Willem Prud'homme van Reine, who arranged the loan from Leiden and whose detective work allowed us to see type material of *Liagora tomentosa*. JMH acknowledges the financial support of the "Australian Biological Resources Study". The French Embassy in Canberra, Australia generously funded AJKM (in collaboration with Prof. Claude Payri) through a Cooperative Research Program between the French and Australian Governments.

REFERENCES

- ABBOTT I.A., 1970 — *Yamadaella*, a new genus in the Nemaliales (Rhodophyta). *Phycologia* 9: 115-123.
- ABBOTT I.A., 1990a — A taxonomic and nomenclatural assessment of the species of *Liagora* (Nemaliales, Rhodophyta) in the herbarium of Lamouroux. *Cryptogamie, Algologie* 11: 111-136.
- ABBOTT I.A., 1990b — A taxonomic assessment of the species of *Liagora* (Nemaliales, Rhodophyta) recognized by J. Agardh, based upon studies of type specimens. *Cryptogamic botany*: 308-322.
- FAN K.-C. & WANG Y.-C., 1974 — Studies on the marine algae of Hsisha Islands, China I. *Ganonema* gen. nov. *Acta phytotaxonomica Sinica* 12: 489-495.
- GARRIGUE C. & TSUDA R.T., 1988 — Catalog of the marine benthic algae from New Caledonia. *Micronesica* 21: 53-70.
- HUISMAN J.M., 2002. — The type and Australian species of the red algal genera *Liagora* and *Ganonema* (Liagoraceae, Nemaliales). *Australian systematic botany* 15: 773-838.
- HUISMAN J.M., 2006 — *Algae of Australia: Nemaliales*. Canberra, ABRS; Melbourne, CSIRO Publishing, viii + 153 p.

- HUISMAN J.M., ABBOTT I.A. & SHERWOOD A.R., 2004 — The Liagoraceae (Nemaliales, Rhodophyta) of the Hawaiian Islands III: The genus *Ganonema*, with a description of *Ganonema yoshizakii* sp. nov. *Phycologia* 43: 296-310.
- HUISMAN J.M. & WOMERSLEY H.B.S., 2006 — *Nemalion*. In: Huisman J.M. *Algae of Australia: Nemaliales*. Canberra, ABRIS; Melbourne, CSIRO Publishing, pp. 77-78.
- HUISMAN J.M., SAUNDERS G.W. & SHERWOOD A.R., 2006 — Recognition of *Titanophycus*, a new genus based on *Liagora valida* Harv. (Liagoraceae, Nemaliales). In: Huisman J.M. *Algae of Australia: Nemaliales*. Canberra, ABRIS; Melbourne, CSIRO Publishing, pp. 116-119.
- KÜTZING F.T., 1858 — *Tabulae Phycologicae*. Vol. 8. Nordhausen, 48 p., 100 pls.
- KÜTZING F.T., 1863a — Diagnosen und Bemerkungen zu drei und siebenzig neuen Algenspecies. In: *Zur der öffentlichen Prüfung sämtlicher Klassen der Realschule zu Nordhausen, welche Freitag den 27. März und Sonnabend den 28. März veranstaltet werden soll*, pp. 1-19. Nordhausen.
- KÜTZING F.T., 1863b — *Tabulae Phycologicae*. Vol. 13. Nordhausen, 31 p., 100 pls.
- KÜTZING F.T., 1865 — *Tabulae Phycologicae*. Vol. 15. Nordhausen, 36 p., 100 pls.
- KÜTZING F.T., 1866 — *Tabulae Phycologicae*. Vol. 16. Nordhausen, 35 p., 100 pls.
- KÜTZING F.T., 1867 — *Tabulae Phycologicae*. Vol. 17. Nordhausen, 30 p., 100 pls.
- KÜTZING F.T., 1868 — *Tabulae Phycologicae*. Vol. 18. Nordhausen, 35 p., 100 pls.
- KÜTZING F.T., 1869 — *Tabulae Phycologicae*. Vol. 19. Nordhausen, 36 p., 100 pls.
- KVATERNIK D. & AFONSO-CARRILLO J., 1995 — The red algal genus *Liagora* (Liagoraceae, Rhodophyta) from the Canary Islands. *Phycologia* 34: 449-471.
- LAMOUREUX J.V.F., 1816 — *Histoire des polypiers coralligènes flexibles, vulgairement nommés Zoophytes*. Caen, F. Poisson, lxxxiv + 560 p.
- MILLAR A.J.K. & PRUD'HOMME VAN REINE W.F., 2005 — Marine benthic macroalgae collected by Vieillard from New Caledonia and described as new species by Kützing. *Phycologia* 44: 536-549.
- TSENG C.K., 1941 — Studies on the Chinese species of *Liagora*. *Bulletin of the Fan Memorial institute of biology, Botany* 10: 265-282.
- WOMERSLEY H.B.S., 1994 — *The Marine Benthic Flora of Southern Australia. Rhodophyta*. Part. IIIA. Canberra, Australian Biological Resources Study, 508 p.
- WYNNE M.J. & HUISMAN J.M., 1998. — First report of *Yamadaella caenomyce* (Liagoraceae, Rhodophyta) from the Atlantic Ocean, with descriptive notes and comments on nomenclature. *Caribbean journal of science* 34: 280-285.
- YOSHIZAKI M., 1979 — Morphology and taxonomy of the Japanese representative of Nemaliales (4) Thallus structure and reproductive organs of *Yamadaella caenomyce*. *Journal of Japanese botany* 54: 225-233.