



Taxonomic review of *Hydrolithon samoëense* (Corallinaceae, Corallinales, Rhodophyta) and other taxa found to be conspecific

G.W. MANEVELDT*, E. VAN DER MERWE & D.W. KEATS

* Corresponding author: gmaneveldt@uwc.ac.za

Department of Biodiversity & Conservation Biology, University of the Western Cape, P. Bag X17, Bellville 7535, South Africa.

Abstract

Based on new studies of the type and of specimens from various localities in the Indian and Pacific oceans, *Hydrolithon samoëense* was reaffirmed as a distinct species. The following taxa were found to be heterotypic synonyms thereof: *Neogonolithon caribaeum*, *N. erosum* and *N. rugulosum*. Based on morphological and anatomical data *H. samoëense* not only occurs extensively throughout the Indo-Pacific and northern, southern and subtropical eastern Atlantic oceans, but as a result of the present study, is now known to occur throughout the tropical and subtropical regions of the western Atlantic Ocean.

Key words: Hydrolithoideae; non-geniculate coralline red algae; taxonomy

Introduction

The genus *Hydrolithon*, and the taxa ascribed to it, has undergone many taxonomic revisions (see Penrose & Woelkerling 1988, 1992, Bittner *et al.* 2011, Kato *et al.* 2011). Within the recently erected subfamily Hydrolithoideae A.Kato & M.Baba (Kato *et al.* 2011: 669) (Corallinaceae), algae belonging to this genus are characterised by: 1) having thalli that are unsegmented (i.e. non-geniculate); 2) lacking secondary pit connections, but bearing lateral cell fusions between contiguous filaments; 3) lacking a basal layer of palisade cells; 4) lacking trichocytes in large, tightly packed horizontal fields; 5) having their tetra/bisporangial conceptacles formed by filaments peripheral to the fertile area and interspersed among the tetra/bisporangial initials; and 6) possessing spermatangia that develop only on the floor of the male conceptacle chamber. Additionally, within tetrasporangial conceptacles the pore canals are lined by a ring of conspicuous, enlarged cells that arise from filaments interspersed among the tetra/bisporangial initials. These pore canal cells do not protrude into the pore canal but are orientated more-or-less perpendicularly (vertically orientated) to the roof surface. *Hydrolithon* differs from the closely related genus *Porolithon* only by its trichocyte arrangement, with large, tightly packed horizontal fields (that lack vegetative filaments between the individual trichocytes) occurring in the latter genus (Kato *et al.* 2011: 669).

While many taxa have been ascribed to the genus *Hydrolithon* (see Guiry & Guiry 2014 for a detailed list), some have notably received more attention than others, largely because of their reported widespread occurrences. One such species is *H. samoëense* (Foslie) Keats & Y.M.Chamberlain. In our continued efforts to better understand the taxonomy of the non-geniculate coralline algae, we have found a number of taxa to conform to the current understanding of *H. samoëense*. Here we report on these findings and demonstrate that the species is more widespread than previously reported.

Material and Methods

Type specimens and prepared micro-slides were obtained from TRH and USNC respectively. Fragments of type material were first fixed in 1 part liquid detergent: 4 parts commercial formalin in distilled water (4 % formaldehyde) for at least 48 hours prior to examination. This method was found useful for rehydrating the material (see also Maneveldt & Keats 2014). For representative material, thalli were examined as far as possible when fresh; otherwise they were air-dried

type material for advancing taxonomic knowledge (see also Maneveldt & Keats 2014). Having said this, we are not discounting the importance of molecular analyses. On the contrary, we accept that such analyses are critical to fully understanding the distributions of all biological entities.

In summary, the conspecificity of a number of taxa ascribed to the genus *Hydrolithon*, based here on morphological and anatomical data, will clearly have both biogeographic and biodiversity implications (see also Maneveldt & Keats 2014). While this study has increased the geographic range of *H. samoëense*, it has also resulted in a reduction of the number of real taxa. This is perhaps not surprising seeing that Chamberlain (1991) had already concluded that after thorough study of types and modern material, a considerable reduction in the number of real species would occur. Increasingly this is becoming true for a number of other coralline floras (e.g. Woelkerling 1997, Aguirre & Braga 1998, Bassi *et al.* 2005, Maneveldt *et al.* 2008, Iryu *et al.* 2012, Maneveldt & Keats 2014).

Acknowledgements

We thank the Department of Biodiversity & Conservation Biology at the University of the Western Cape for providing funding and research equipment, and the South African National Research Foundation (NRF) for research grants to GWM and DWK. We are most grateful to the following for provided invaluable discussion and input: Walter H. Adey, Yvonne M. Chamberlain, Paul C. Silva and William J. Woelkerling. Sigurd M. Sæstad and Tommy Prestø (TRH), and Walter H. Adey (USNC) greatly facilitated the loan of herbarium specimens. Special thanks to Stein Fredrikson (University of Oslo, Norway) for translating Foslie's notes. Two anonymous reviewers are thanked for their valuable comments.

References

- Adey, W.H. (1970) A revision of the Foslie crustose coralline herbarium. *Det Kongelige Norske Videnskabers Selskabs Skrifter* 1: 1–46.
- Adey, W.H. & Adey, P.J. (1973) Studies on the biosystematics and ecology of the epilithic crustose Corallinaceae of the British Isles. *British Phycological Journal* 8: 343–407.
- Adey, W.H. & Lebednik, P.A. (1967) *Catalog of the Foslie Herbarium*. Det Kongelige Norske Videnskabers Selskab Museet, Trondheim, 92 pp.
- Adey, W.H., Townsend, R.A. & Boykins, W.T. (1982) The crustose coralline algae (Rhodophyta: Corallinaceae) of the Hawaiian Islands. *Smithsonian Contributions to Marine Science* 15: 1–74.
- Afonso-Carrillo, J. (1984) Estudios en las algas Corallinaceae (Rhodophyta) de las Islas Canarias. II. Notas taxonomicas. *Vieraea* 13: 127–144.
- Afonso-Carrillo, J. (1988) Structure and reproduction of *Spongites wildpretii* sp. nov. (Corallinaceae, Rhodophyta) from the Canary Islands, with observations and comments on *Spongites abisimile* comb. nov. *British Phycological Journal* 23: 89–102.
- Aguirre, J. & Braga, J.C. (1998) Redescription of Lemoine's (1939) types of coralline algal species from Algeria. *Palaeontology* 41: 489–507.
- Bassi, D., Braga, J.C., Zakrevskaya, E. & Radionova, E.P. (2005) Re-assessment of the type collections of coralline genera (Corallinales, Rhodophyta) described by Maslov (1935–1962). *Palaeontology* 48: 1–17.
- Braga, J.C. & Aguirre, J. (1995) Taxonomy of fossil coralline algal species: Neogene Lithophylloideae (Rhodophyta, Corallinaceae) from southern Spain. *Review of Palaeobotany and Palynology* 86: 265–285.
- Bittner, L., Payri, C.E., Maneveldt, G.W., Couloux, A., Cruaud, C., de Reviers, B. & Le Gall, L. (2011) Evolutionary history of the Corallinales (Corallinophycidae, Rhodophyta) inferred from nuclear, plastidial and mitochondrial genomes. *Molecular Phylogenetics and Evolution* 61: 697–713.
- Chamberlain, Y.M. (1990) The genus *Leptophytum* (Rhodophyta, Corallinaceae) in the British Isles with descriptions of *Leptophytum bornetii*, *L. elatum* sp. nov. and *L. laeve*. *British Phycological Journal* 25: 179–199.
- Chamberlain, Y.M. (1991) Historical and taxonomic studies in the genus *Titanoderma* (Rhodophyta, Corallinales) in the British Isles. *Bulletin of the British Museum (Natural History), Botany* 21: 1–80.
- Chamberlain, Y.M. (1993) Observations on the crustose coralline red alga *Spongites yendoii* (Foslie) comb. nov. in South Africa and its relationship to *S. decipiens* (Foslie) comb. nov. and *Lithophyllum natalense* Foslie. *Phycologia* 32: 100–115.
- Chamberlain, Y.M. (1994). *Pneophyllum coronatum* (Rosanoff) D. Penrose comb. nov., *P. keatsii* sp. nov., *Spongites discoideus* D. Penrose

- et Woelkerling and *S. impar* (Foslie) Chamberlain comb. nov. (Rhodophyta, Corallinaceae) from South Africa. *Phycologia* 33: 141–157.
- Dawson, E.Y. (1960) Marine red algae of Pacific Mexico. Part 3. Cryptonemiales, Corallinaceae subf. Melobesioideae. *Pacific Naturalist* 2: 3–125.
- Foslie, M. (1906) Algologiske notiser. II. *Det Kongelige Norske Videnskabers Selskabs Skrifter* 1906 (2): 1–28.
- Foslie, M. (1907) Algologiske notiser. III. *Det Kongelige Norske Videnskabers Selskabs Skrifter* 1906 (8): 1–34.
- Foslie, M. (1909) Algologiske notiser. VI. *Det Kongelige Norske Videnskabers Selskabs Skrifter* 1909 (2): 1–63.
- Guiry, M.D. & Guiry, G.M. (2014) *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. Available from: <http://www.algaebase.org> (accessed 24 October 2014).
- Iryu, Y., Bassi, D. & Woelkerling, Wm.J. (2012) Typification and reassessment of seventeen species of coralline red algae (Corallinales and Sporolithales, Rhodophyta) described by W. Ishijima during 1954–1978. *Journal of Systematic Palaeontology* 10: 171–209.
- Kato, A., Baba, M. & Suda, S. (2011) Revision of the Mastophoroideae (Corallinales, Rhodophyta) and polyphyly in nongeniculate species widely distributed on Pacific coral reefs. *Journal of Phycology* 47: 662–672.
- Keats, D.W. & Chamberlain, Y.M. (1994) Three species of *Hydrolithon* (Rhodophyta, Corallinaceae): *Hydrolithon onkodes* (Heydrich) Penrose and Woelkerling, *Hydrolithon superficiale* sp. nov., and *H. samoense* (Foslie) comb. nov. from South Africa. *South African Journal of Botany* 60: 8–21.
- Lemoine, Mme.P. (1929) Melobesieae. *Det Kongelige Danske Videnskabernes Selskab Biologiske Meddelelser* 8: 19–68.
- Littler, D.S. & Littler, M.M. (2003) *South Pacific Reef Plants*. OffShore Graphics, Washington, 331 pp.
- Maneveldt, G.W. & Keats, D.W. (2014) Taxonomic review based on new data of the reef-building alga *Porolithon onkodes* (Corallinaceae, Corallinales, Rhodophyta) along with other taxa found to be conspecific. *Phytotaxa* 190 (1): 216–249.
- Maneveldt, G.W. & van der Merwe, E. (2012) *Heydrichia cerasina* sp. nov. (Sporolithales, Corallinophycidae, Rhodophyta) from the southern-most tip of Africa. *Phycologia* 51: 11–21.
- Maneveldt, G.W., Chamberlain, Y.M. & Keats, D.W. (2008) A catalogue with keys to the non-geniculate coralline algae (Corallinales, Rhodophyta) of South Africa. *South African Journal of Botany* 74: 555–566.
- Masaki, T. (1968) Studies on the Melobesioideae of Japan. *Memoirs of the Faculty of Fisheries, Hokkaido University* 16: 1–80.
- Mason, L.R. (1953) The crustaceous coralline algae of the Pacific Coast of the United States, Canada and Alaska. *University of California Publications in Botany* 26: 313–390.
- Penrose, D. & Chamberlain, Y.M. (1993) *Hydrolithon farinosum* (Lamouroux) comb. nov.: implications for generic concepts in the Mastophoroideae (Corallinaceae, Rhodophyta). *Phycologia* 32: 295–303.
- Penrose, D. & Woelkerling, Wm.J. (1988) A taxonomic reassessment of *Hydrolithon* Foslie, *Porolithon* Foslie and *Pseudolithophyllum* Lemoine emend. Adey (Corallinaceae, Rhodophyta) and their relationships to *Spongites* Kützing. *Phycologia* 26: 159–176.
- Penrose, D. & Woelkerling, Wm.J. (1992) A reappraisal of *Hydrolithon* and its relationship to *Spongites* (Corallinaceae, Rhodophyta). *Phycologia* 31: 81–88.
- Printz, H. (1929) *M. Foslie - 'Contributions to a Monograph of the Lithothamnia'*. Det Kongelige Norske Videnskabers Selskab Museet, Trondhjem. 60 pp. + 75 pls.
- Segonzac, G. (1984) Algues calcaires actuelles (Rhodophycées, Chlorophycées) récoltées dans l’océan Indien Occidental. *Tethys* 11: 93–104.
- South, G.R. & Skelton, P.A. (2003) Catalogue of the marine benthic macroalgae of the Fiji Islands, South Pacific. *Australian Systematic Botany* 16: 699–758.
- Stearn, W.T. (1973) *Botanical Latin*. David & Charles, Newton Abbot, 566 pp.
- Taylor, W.R. (1960) *Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas*. University of Michigan Press, Ann Arbor, Michigan, 860 pp.
- Thiers, B. (2014) *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden’s Virtual Herbarium. Available from: <http://sweetgum.nybg.org/ih/>.
- Woelkerling, Wm.J. (1985) A taxonomic reassessment of *Spongites* (Corallinaceae, Rhodophyta) based on studies of Kützing’s original collections. *British Phycological Journal* 20: 123–153.
- Woelkerling, Wm.J. (1993) Type collections of Corallinales (Rhodophyta) in the Foslie Herbarium (TRH). *Gunneria* 67: 1–289.
- Woelkerling, Wm.J. (1997) The biodiversity of Corallinales (Rhodophyta) in southern Australia: 1976 vs 1996 with implications for generating a world biodiversity database. *Cryptogamie Algologie* 18: 225–261.
- Woelkerling, Wm.J. & Campbell, S.J. (1992) An account of southern Australian species of *Lithophyllum* (Corallinaceae, Rhodophyta). *Bulletin of the British Museum (Natural History) Botany* 22: 1–107.
- Woelkerling, Wm.J. & Irvine, L.M. (1986) The neotypification and status of *Mesophyllum* (Corallinaceae, Rhodophyta). *Phycologia* 25: 379–396.
- Woelkerling, Wm.J. & Lamy, D. (1998) *Non-geniculate Coralline Red Algae and the Paris Museum: Systematics and Scientific History*.

Publications Scientifiques du Muséum /ADAC, Paris, 767 pp.

- Woelkerling, Wm.J., Irvine, L.M. & Harvey, A.S. (1993) Growth-forms in Non-geniculate Coralline Red Algae (Corallinales, Rhodophyta). *Australian Systematic Botany* 6: 277–293.
- Wynne, M.J. (2011) A checklist of benthic marine algae of the tropical and subtropical western Atlantic: third revision. *Nova Hedwigia Beihefte* 140: 7–166.