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RESEARCH NOTE

# Evidence for the treatment of *Talarodictyon tilesii* as an older taxonomic synonym of *Hydroclathrus stephanosorus* (Scytosiphonaceae, Phaeophyceae)

**Wilfred John E. Santiañez**[1*,†] **and Michael J. Wynne**[2]

[1]Department of Natural History Sciences, Graduate School of Science, Hokkaido University, Sapporo, Japan and

[2]Department of Ecology and Evolutionary Biology, University of Michigan Herbarium, Ann Arbor, Michigan, USA

## SUMMARY

Morphological and anatomical evidence is presented to support the taxonomic judgment that *Talarodictyon tilesii* Endlicher is conspecific with *Hydroclathrus stephanosorus* Kraft in Kraft & Abbott. Because the former name has nomenclatural priority over the latter name, *Hydroclathrus tilesii* (Endlicher) comb. nov. is proposed.

Key words: *Hydroclathrus*, *Hydroclathrus tilesii* comb. nov., phaeophyceae, taxonomy.

## INTRODUCTION

*Talarodictyon tilesii* Endlicher, the type and only species of the genus *Talarodictyon* Endlicher, was described in 1843 based on a drift, net-like alga collected by W.G. Tilesius in Nagasaki Harbor, southern Japan in April 1805 (Endlicher 1843). The species was traditionally considered as a green alga (Phylum Chlorophyta): Kützing (1849) assigned it to Anadyomeneae (=Anadyomenaceae), while Wille (1890) placed it under Valoniaceae, and De Toni (1889) listed it in the Cladophoraceae. This enigmatic and obscure taxon has never been recollected nor reported elsewhere since it was first described. *Talarodictyon tilesii* remained poorly understood until Sinkora and Wynne (1990) discovered protologue material of *Talarodictyon tilesii* including the actual specimen and an unpublished plate with notes in the Sonder Herbarium of the National Herbarium of Victoria (MEL). An examination of the specimen revealed the presence of plurilocular sporangia, evidence that *T. tilesii* was a brown alga, not a green alga. Both the specimen and the accompanying hand-colored etching showed a sheet perforated by a dense arrangement of holes, ranging from small to large, very similar to *Hydroclathrus clathratus* (C. Agardh) M. Howe. Consequently, they concluded that *T. tilesii* is a junior taxonomic synonym of *H. clathratus.*

The genus *Hydroclathrus* remains a relatively small genus of tropical and warm temperate brown algae (Scytosiphonaceae), with six species currently recognized (Guiry & Guiry 2018). The generitype, *H. clathratus*, has a pantropical distribution. *Hydroclathrus tenuis* C.K. Tseng & Lu Baoren with a type locality of Xisha Island, Guandong Province, China, was the second species to be described (Tseng & Lu 1983). It was subsequently recorded from elsewhere in China (Tseng 1983), Japan (Yoshida 1998), the east coast of Africa (Coppejans *et al*. 2000), the Philippines (Trono Jr. 1997), Vietnam (Nguyen *et al*. 2013), Indonesia (Verheij & Prud'homme van Reine 1993), New Caledonia (Payri 2007), India (Jagtap & Untawale 1996), Rodrigues Island (Coppejans *et al*. 2004), Hawaii, and Mexico (Santiañez *et al*. 2017). Later, Kraft and Abbott (2003) assigned two additional species to the genus. *Hydroclathrus tumulis* Kraft & I.A. Abbott was described from Necker Island in the northwestern Hawaiian Islands, and *H. stephanosorus* Kraft was described from Lord Howe Island, New South Wales, Australia. N'Yeurt and Payri (2007) later reported *H. tumulis* from French Polynesia. Meanwhile, *H. stephanosorus* was recently found throughout the northern Pacific (Japan, Korea, Taiwan, Hawaii, and Panama) as well as in the eastern Atlantic (Azores, Portugal) (Santiañez *et al*. 2017). *Hydroclathrus minutus* Santiañez & Kogame in Santiañez *et al*. (2017) was described from Senaga, Naha, Okinawa, Japan. Its recognized distribution extended to Vietnam. *Hydroclathrus rapanuii* Santiañez, Macaya & Kogame in Santiañez *et al*. (2018) was recently described from Easter Island, its only known locality.

We recognized that an old name that had been thought to be a later taxonomic synonym of *Hydroclathrus clathratus*, when the genus had only two species assigned to it, needed to be reconsidered. Now that additional species have been placed in *Hydroclathrus*, we decided that it was prudent to reconsider the placement of *Talarodictyon tilesii.*

## MATERIALS AND METHODS

Scans of the actual specimen and the hand-colored soft-ground etching of *Talarodictyon tilesii* (MEL501457) together with associated notes were provided to the authors through the courtesy of MEL. Slides of cross-sections of the *T. tilesii* specimen

*To whom correspondence should be addressed.
Email: wjesantianez@gmail.com
†Present Address: The Marine Science Institute, College of Science, University of the Philippines, Diliman, Quezon City 1101, Philippines
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previously prepared by D. Sinkora was also loaned and sent by MEL to WJES for further morpho-anatomical observations.

## RESULTS

The thallus of *Talarodictyon tilesii* was torn, somewhat membranous, and perforated with numerous subcircular to elliptical holes that often have thickened margins (Fig. 1a,b). It also showed indications of having saccate portions, particularly at the periphery (Fig. 1a; arrowhead). The original specimen has 6–8 (–9) × 6–12 μm surface cells that were squarish to pentagonal (Fig. 1c). In cross-section, the cortical layer was composed of one to sometimes two layers of pigmented, broadly rounded to ovoid cells (Fig. 1d), 4–5 × 5–8 (–9) μm in size. The medullary layer has two to four layers of clear cells that were progressively larger towards the hollow basal portion of the membrane (Fig. 1d). Hair primordia were in groups, bead-like, and were rarely extended into hairs.

## DISCUSSION

The habit and morpho-anatomical features of *Talarodictyon tilesii* closely resemble those of *Hydroclathrus stephanosorus* rather than *H. clathratus.* Although the latter two species are often confused with each other, vegetative thalli of *H. stephanosorus* can be consistently distinguished from *H. clathratus* through its habit and several morpho-anatomical characteristics (Table 1). We see the similarities of the habit of the *T. tilesii* holotype (Fig. 1a) with those of the holotype of *H. stephanosorus* (Kraft & Abbott 2003: fig. 17), including the thickened margins of thallus perforations. The latter is also apparent in the hand-etched illustration of *T. tilesii* (Fig. 1b). Additionally, the cortical cell shape and number of medullary cell layers of *T. tilesii* were also comparable to the original and subsequent descriptions of *H. stephanosorus* populations from Australia (Kraft & Abbott 2003; Kraft 2009). Both *H. tumulis* and *H. rapanuii* have membranous and saccate thalli similar to *H. stephanosorus.* However, *H. tumulis* has broader membranes, and its cortical cells were distinctly subacutely papillate (Kraft & Abbott 2003). The putative Easter Island endemic *H. rapanuii* was also different in having narrowly to broadly oblong cortical cells and three to seven medullary cell layers (Santiañez *et al*. 2018). Rather than being membranous, the net-like thalli of other *Hydroclathrus* species (i.e., *H. clathratus*, *H. minutus*, and *H. tenuis*) had low membrane-to-hole ratios and were strap-shaped. Thus, we believe that *T. tilesii* is conspecific with

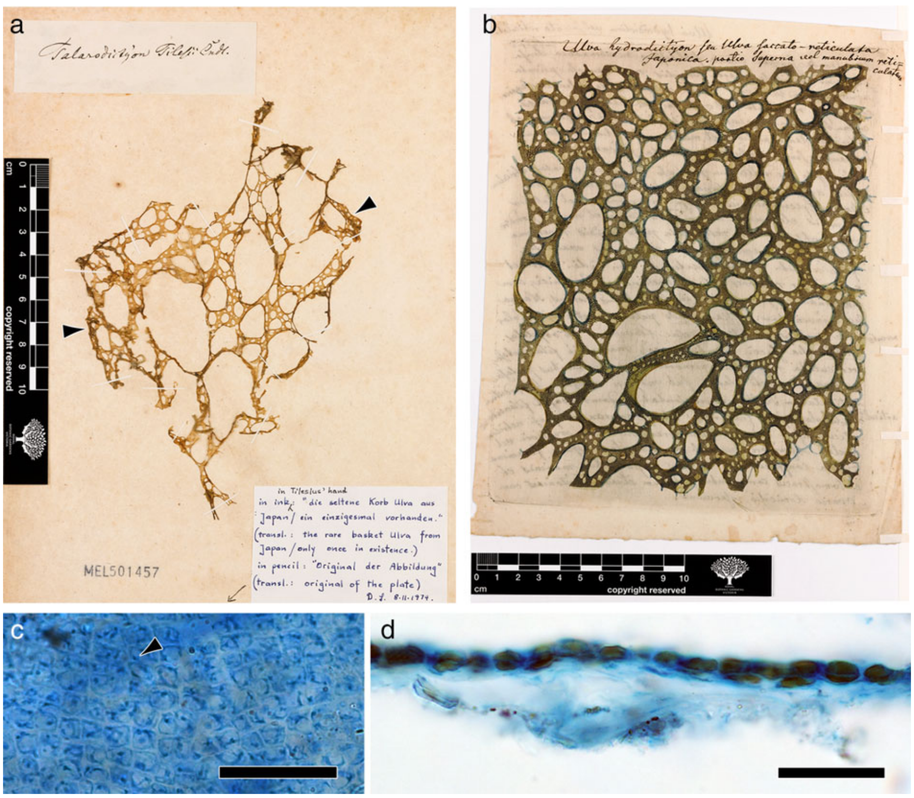


**Fig. 1.** *Hydroclathrus tilesii* (Endlicher) Santiañez & M.J.Wynne comb. nov. (a) Scanned image of the holotype specimen of *Talarodictyon tilesii* Endlicher (MEL501457) showing various sizes of subcircular to elliptical holes. Indications of having sac-like portions apparent at the periphery of the thalli (arrowheads). (b) Hand-colored etching of '*T. tilesii*' presenting thickened margins of relatively larger perforations. (c) Surface cortical cells of '*T. tilesii*' (MEL501457) showing a conspicuous pyrenoid (arrowhead) per cell. Scale bar = 50 μm. (d) Cross-section of '*T. tilesii*' membrane showing one to two layers of pigmented, broadly rounded cortical cells and two to four layers of colorless, large medullary cells. Scale bar = 10 μm. Images were reproduced with permission from the Royal Botanic Gardens, Victoria (MEL). [Color figure can be viewed at wileyonlinelibrary.com]

**Table 1.** Morpho-anatomical comparison between *Hydroclathrus tilesii* comb. nov. and some common *Hydroclathrus* species[†]

| Characters | ***Hydroclathrus tilesii*** (Endlicher) Santiañez & M.J. Wynne | ***Hydroclathrus stephanosorus*** Kraft | ***Hydroclathrus clathratus*** (C. Agardh) M. Howe | ***Hydroclathrus tenuis*** C.K. Tseng & Lu Baoren |
|---|---|---|---|---|
| **Thallus form** | Some parts somewhat saccate and membranous, holes subcircular | Saccate, sheet-like; membranous; holes subcircular | Strap-shaped to net-like, convoluted; irregularly perforated | Net-like, convoluted; perforated membranes thin to fibrous |
| **Membrane thickness (μm)** | — | 60–520 | 100–650 | 40–590 |
| **Cortical cells** | | | | |
| No. cell layers | 1–2 | 1–2 | 1–2 (3) | 1–2 |
| Shape (surface) | Square to rectilinear to pentagonal | Oblong to rectilinear to pentagonal | Oblong to rectilinear to pentagonal/hexagonal | Square to rectilinear |
| Size (surface; width × length, μm) | 6–8 (–9) × 6–12 | 4–7 (–8) × (5–) 6–12 | (3–) 4–9 (–11) × 5–11 (–14) | 4–8 × 6–9 (–11) |
| Shape (cross section) | Broadly rounded to periclinally elongate, apices domed | Broadly rounded to ovoid, apices domed to obtuse | Ovate to broadly ovate to papillate | Ovate to broadly ovate, domed to papillate |
| Size (cross section; width × length, μm) | 4–5 × 5–8 (–9) | (4–) 5–11 (–13) × (5–) 6–10 (–15) | (4.5–) 5–11 (–12) × (5–) 6–14 (–16) | 5–9 (–10) × 7–11 (–12) |
| **Medullary cells** | 2–4 (–5?) layers; thin-walled | (2–) 3–6 layers; thin-walled | 5–9 layers; thin-walled | (3–) 5–6 (–8) layers; thin-walled |
| Size (width, μm) | 60–130[‡] | Up to 220 | Up to 260 | up to 250 |
| **Hair primordia** | | | | |
| Nature and arrangement | In groups, rarely extended into hyaline hairs | In groups of more than five in shallow depressions, pits; some extended into hyaline hairs | In groups of ≤25 in depressions, pits, and channels; usually extended into hyaline hairs | In groups of more than five; often with long hyaline hair extensions |
| **Plurangia** | | | | |
| Sori shape and nature | — | Sori nearly circular in outline, surround hair tufts | Sori diffused with angular margins, sometimes confluent; surround hair tufts | Sori irregularly shaped with margins angular; confluent and may occur extensively on surface |
| Arrangement | — | Laterally biseriate, each column divided into four locules | Laterally biseriate, each column divided into four locules | Laterally biseriate, each column divided into four locules |
| Length (cross section, μm) | — | (12–) 18–28 | 10–30 | 22–25 |

[†]Modified from Santiañez *et al*. (2018).
[‡]Based on Sinkora and Wynne (1990).

*H. stephanosorus* due to the aforementioned similarities. Because the name *Talarodictyon tilesii* Endlicher (1843) has priority over the recently described *Hydroclathrus stephanosorus* Kraft (2003), we herein propose the new combination:

*Hydroclathrus tilesii* (Endlicher) Santiañez & M.J. Wynne comb. nov.

*Basionym: Talarodictyon tilesii* Endlicher, Gen. Pl. Suppl. III: 14 (1843).

*Heterotypic synonym: Hydroclathrus stephanosorus* Kraft in Kraft and Abbott (2003).

*Holotype:* MEL501457, April 1805, collected by W.G. Tilesius, deposited in MEL (Sinkora & Wynne 1990).

*Type locality:* Nagasaki Harbor, Japan (Endlicher 1843).

*Distribution:* Australia (New South Wales and Western Australia), Japan, Korea, Taiwan, Hawaii, Panama, Portugal (Azores) (Santiañez *et al*. 2017).

In assessing the taxonomies and distributions of *Hydroclathrus* species using both morphological and molecular phylogenetic information, Santiañez *et al*. (2017) reported on the wide distribution range of *H. tilesii* (as *H. stephanosorus*). The species is common along the shallow intertidal of the Japan archipelago: in Niigata and Fukuoka in the western seaboard; in Hiroshima, Hyogo, Kanagawa, and Chiba along the eastern seaboard; and, Okinawa in the south (Santiañez *et al*. 2017). Nagasaki Harbor, Nagasaki in south-western Japan, the type locality of *H. tilesii*, falls within the distribution range of the species.

Ideally, DNA fingerprinting should be made on the type specimen of "*T. tilesii*" to confirm its conspecificity with "*H. stephanosorus*". However, we did not attempt to conduct molecular analysis on the type specimen as DNA of old brown algal herbarium specimens (in this case, more than 200 years old) are already likely degraded. Nonetheless, Santiañez *et al*. (2017) suggested that vegetative specimens of "*H. stephanosorus*" can be distinguished from *H. clathratus* "*based on the shape and nature of hair primordia, cortical cell shape and size as well as medullary cell size and layers.*" As we have noted earlier, the morpho-anatomical features of "*T. tilesii*" agree well with those of "*H. stephanosorus*". Moreover, our morphological assessment of the *Hydroclathrus* collections from around Japan deposited at the Herbarium of the Faculty of Science, Hokkaido University, Sapporo, Japan

(SAP) also indicated that several specimens should be assigned to *H. tilesii.* The same is also true with the "*H. clathratus*" from the Atlantic Ocean (i.e., Bermuda, Florida, Belize, Venezuela) deposited at the University of Michigan Herbarium (MICH), Ann Arbor, Michigan, USA. Thus, these suggest the need to re-assess the identity of *Hydroclathrus* collections deposited in various algal herbaria.

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