
Is the transfer of *Chondria glandulifera* (Rhodomelaceae, Rhodophyta) to the genus *Chondrophycus* (as *Chondrophycus glandulifer*) taxonomically correct?

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When Kützing (1849: 855) transferred all members of what he had called *Chondria* in 1845 to *Laurencia*, he also transferred *Chondria glandulifera* Kützing (1845: 329, type locality: Trieste) to the genus *Laurencia* as *L. glandulifera* (Kützing) Kützing and later illustrated that species in *Tab. Phyc.* Vol. 15, pl. 59 c, d. (Kützing, 1865). The species is recorded worldwide (see Guiry & Guiry, 2016). Both Ardissonne (1883: 328-329) and De Toni (1903: 788) considered *L. glandulifera* and *L. patentiramea* Montagne to be synonyms of *L. paniculata* (C. Agardh) J. Agardh *nom. illeg.* [= *Palisada thuyoides* (Kützing) Cassano, Senties, Gil-Rodríguez & M.T.Fujii], overlooking the fact that *L. glandulifera* is the earliest available name at the specific level. Ardissonne's taxonomic opinion was partly followed by Hauck (1885: 207), who listed *L. glandulifera* as a synonym of his *L. paniculata* f. *patentiramea* (Montagne) Hauck, in our opinion a taxon of uncertain taxonomic position.

The first author to recognise the specific distinction between *L. paniculata* and *L. glandulifera* was Yamada (1931: 192-193), who examined specimens of Kützing's species held at B (Botanischer Garten und Botanisches Museum Berlin-Dalhem, Germany; herbarium abbreviations follow Thiers, 2016) and in L [Naturalis Biodiversity Center (ex Rijksherbarium), Leiden, The Netherlands, collection Anna Weber-van Bosse, then still in her private laboratory at Eerbeek]. Yamada pointed out that *L. glandulifera* is a terete species showing cortical cells neither elongated radially nor arranged like palisade cells in cross section of branchlets (in contrast to *L. paniculata*, with cortical cells elongated radially and arranged like palisade cells in cross section of branchlets, as observed by him in C. Agardh's material of *Chondria obtusa* var. *paniculata* C. Agardh held at LD, Herbarium of the Botanical Museum of Lund University, Sweden).

Yamada's taxonomic opinion was subsequently confirmed by Saito (1985: 167-171, figs 1 c,d, 2, 3A-D, 4A-C), who studied Kützing's herbarium specimens then held by Weber-van Bosse, now in L. In fig. 2 of his paper, Saito showed the specimen he considered as "Holotype" (but see the comments below on this interpretation). He also stated that records of *L. glandulifera* from Japan and adjacent areas should be referred to *L. japonica* Yamada.

Cecere *et al.* (1996, figs 6-9) described specimens of *L. glandulifera* from the Cheradi Islands (Gulf of Taranto, Italy) and based on Saito's (1985) taxonomic study, confirmed the specific distinction between *L. paniculata* and *L. glandulifera*, adding for *L. glandulifera* the following diacritical characters: occurrence of secondary pit-connections between epidermal cells; four pericentral cells per axial segment; and tetrasporangia with a parallel arrangement. In the same year, Rindi *et al.* (1996, figs 9-13) described specimens of *L. glandulifera* from Leghorn (Livorno, Tuscany, Italy) as showing the same characters of those from the Cheradi Islands.

However, some authors, such as Basson *et al.* (1989), Silva *et al.* (1996¹) (who offered no

¹ It should be noted that nine years earlier Silva *et al.* (1987) listed *L. glandulifera* as a distinct species of *L. paniculata* (the latter reported as a synonym of *L. patentiramea*).

taxonomic opinions), and Abbott (1999) [who provided both a description and illustrations (fig. 112 E-F)], ignoring the above taxonomic studies, followed Ardissonne in considering *L. paniculata* (and/or *L. patentiramea*) as a synonym of *L. glandulifera*. More recently, Nam (1999) treated *L. paniculata* as a synonym of *L. patentiramea*, which he transferred to the genus *Chondrophyucus* as *C. patentirameus* (Montagne) K.W.Nam [now *Palisada patentiramea* (Montagne) Cassano, Senties, Gil-Rodríguez & M.T.Fujii]. Boisset *et al.* (2000) then demonstrated the specific distinction between *L. paniculata* and *L. patentiramea*, based on a study of the respective type materials. In that paper *L. paniculata* was transferred to the genus *Chondrophyucus* as *Chondrophyucus paniculatus* (C.Agardh) G.Furnari *nom. illeg.* (see Furnari *et al.*, 2001) [= *Palisada thuyoides* (Kützing) Cassano, Senties, Gil-Rodríguez & M.T. Fujii] and the distinction at the specific level of *L. glandulifera* was reaffirmed (for the main characters distinguishing *L. glandulifera* from *P. patentiramea* and *P. thuyoides*, see Table 1).

Unfortunately, the paper by Boisset *et al.* (2000) was largely ignored so that various authors continued to consider *L. paniculata* as a synonym of *L. glandulifera* (e.g. Neto *et al.*, 2001; N'Yeurt, 2001, figs 226, 306, 307, 313, 315, 321; Lobban & Tsuda, 2003; Tsuda, 2003). While no comments can be made on records of *L. glandulifera* reported in papers in which no taxonomic details are given (e.g., Basson *et al.* (1989), Silva *et al.* (1996), Neto *et al.*, 2001, etc.), some remarks can be made on papers reporting description and illustrations of *L. glandulifera*. In particular, in our opinion, Hawaiian specimens described and illustrated by Abbott (1999) cannot be ascribed to *L. glandulifera* in showing “outer cortical cells radially elongate” and “tetrasporangia of right-angle type”. Similarly, specimens from the Fiji Islands described and illustrated by N'Yeurt (2001) belong to *L. glandulifera* in having “paniculately branched axes”, cortical cells “arranged in a distinct palisade layer” and “secondary pit connections absent”.

Lipkin & Silva (2002: 35) transferred *Chondria glandulifera* Kützing to the genus *Chondrophyucus* as *Chondrophyucus glandulifer* (“*glanduliferus*”) (Kützing) Lipkin & P.C.Silva, treating it as a distinct species with no heterotypic synonyms. Such a choice is very surprising particularly as they gave no taxonomic reasons for their proposal. Two years later, ignoring Lipkin & Silva's (2002) paper, but following nomenclatural comments by Silva, Basson & Moe (1996), Prud'homme & John in John *et al.* (2004: 71) proposed the new combination *Chondrophyucus glandulifer* (“*glanduliferus*”) (Kützing) Prud'homme & D.M.John *nom. illeg.*

More recently, N'Yeurt & Payri (2010) reported *Laurencia glandulifera* from French Polynesia. But from the description and illustrations given in that paper, the French Polynesian specimens cannot be referred, in our opinion, to *L. glandulifera* in having “axes compressed to flattened” and “cortical cells radially elongate”. *Chondrophyucus glandulifer* (“*glanduliferus*”) was reported by Norris (2014) from the Gulf of California based on reports by Mendoza-González & Mateo-Cid (1986, as “*L. paniculata*”) and Mateo-Cid *et al.* (2006, as “*L. glandulifera*”), papers in which there are no taxonomic observations but which are simple floristic lists. Moreover, because Norris did not see any specimens of that species, he reported a description based on Abbott (1999), a description that, as stated above, cannot be referred to as *L. glandulifera*. Finally, *Chondrophyucus glandulifer* was also recorded, with no taxonomic comments, by Afonso Carrillo (2014) and Ang *et al.* (2014) from the Canary Islands and the Philippines, respectively.

While records of *Laurencia glandulifera* in Mediterranean check-lists (Gómez-Garreta *et al.*, 2001; Rindi *et al.*, 2002; Furnari *et al.*, 2003, 2010) refer mainly to Cecere *et al.* (1996) and Rindi *et al.* (1996) papers that consider this species to be distinct from *L. paniculata*, this is not the case for most non-Mediterranean records in which *L. paniculata* is treated as a synonym of *L. glandulifera*. Taking into account also that in papers with illustrations, specimens attributed to *L. glandulifera* should be considered as misidentifications for other species (see above), the distribution area of

Laurencia glandulifera outside the Mediterranean Sea should be re-considered and specimens attributed to that species require re-examination.

In order further to ascertain the taxonomic status of this species, we examined the type material of *Chondria/Laurencia glandulifera* held at L (*Herb. Lugd. Bat.* 941.99-243 = L.4058494 in the barcoding system). This sheet, labelled "23 *Laurencia glandulifera*, 5 ex, Triest, Tab. ph. XV.59" (Fig. 1), contains an envelope including three smaller envelopes (A, B, C) and three photocopies (glued to the main sheet) made by Saito reporting his personal comments. In the small envelope A there are two unmounted specimens (Fig. 2) and five mounted specimens (Fig. 3). In the photocopy of the above specimens Saito wrote: "*Upper right: type of Laurencia glandulifera Kützing. It is an independent species in the Adriatic Sea. It is not a synonym of Laurencia paniculata or close species. Once, Japanese species with a big frond (Laurencia nipponica Yamada) was identified (partly) to this species. But it is not correct. Three other specimens are referable to the above species (L. glandulifera). Three specimens of lower law [sic!, possibly "row" is meant?] are not clear to be the same to the above four. However, seem to be a young form of the above. Noted by Dr. Yuzuro Saito*".

In the small envelope B there are three mounted specimens (Fig. 4) and an unmounted specimen (Fig. 5). Saito wrote on the photocopy of one of the above specimens: "*Longitudinal secondary pits are clear between epidermal cortical cells. Clear to be a member of Subgenus Laurencia. Also close to Laurencia glandulifera Kützing. Noted by Dr. Yuzuro Saito*". In the small envelope C there are four unmounted fragments, the smallest of which not here illustrated (Fig. 6). In the photocopy of the above specimens Saito wrote: "*Palisade-like cortical cells are not clear in transection. Secondary pit-connection could not be clearly found. Cutting-off tetrasporangial initial seemed to be abaxial. Its arrangement seemed to be right-angles to the axis. Can be a member of Chondrophyucus. Closest to Laurencia paniculata however could not be because of its lack of palisade-like cortical cell arrangement. Noted by Dr. Yuzuro Saito*".

Therefore, taking into account that Kützing did not indicate or consider "types" and that the "original material" belong to more than one taxon (specimens inside the small envelope C are distinct from those of the small envelopes A and B), the term "Holotype" used by Saito (1985, fig. 2) is incorrect. According to Art. 9.9 of ICN (McNeill *et al.*, 2012), however, it can be treated as an error and corrected to "Lectotype, designated here". This Lectotype (the upper right specimen of our Fig. 3), is that used by Kützing to illustrate the species in his *Tabulae Phycologicae* XV, pl. 59c, d.

We made transverse sections of a branchlet of the Lectotype and of the unmounted specimen of small envelope B (Fig. 5). In both sections we observed secondary pit-connections between epidermal cells and cortical cells neither elongated radially nor arranged like palisade (Tab. 1), thus confirming what was previously observed by Yamada in Kützing's specimens held at B (destroyed during World War II; Regine Jahn, personal communication) and by Saito in Kützing's Herbarium specimens held at L. Unfortunately, we were not able to observe the number of pericentral cells in the Lectotype. However, four pericentral cells per axial segment and tetrasporangia with a parallel arrangement characters were observed in specimens from the Cheradi Islands (Ionian Sea) and Leghorn (Livorno, Tyrrhenian Sea) by Cecere *et al.* (1996) and Rindi *et al.* (1996), respectively, strongly similar to the Lectotype of *Laurencia glandulifera*. Therefore, we do not think it is justified to transfer *Chondria glandulifera* to the genus *Chondrophyucus* and we support its retention in the genus *Laurencia*.

Table 1. Morphological comparison of species considered in this study. Data from Furnari *et al.* (2001: *Palisada patentiramea* and *P. thuyoides* as *Chondrophyucus patentirameus* and *C. thuyoides*, respectively). * indicates characters observed also in the Lectotype (this study).

| Characters | <i>Laurencia glandulifera</i> | <i>Palisada patentiramea</i> | <i>Palisada thuyoides</i> |
|---|---|-------------------------------|---------------------------|
| No of pericentral cells | 4 | 2 | 2 |
| Attachment | Discoid holdfast (sometimes forming stolon-like branches) | Disc and stolon-like branches | Discoid holdfast |
| Secondary pit connections between epidermal cells | Present* | Absent | Absent |
| Epidermal cells arrangement in TS | Not palisade-like* | Not palisade-like | Palisade-like |
| Tetrasporangia arrangement | Parallel | Right angle | Right angle |

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Fig. 1. *Laurencia glandulifera*. L (Herb. Lugd. Bat. 941.99-243 = L.4058494). x 0.50.



Fig. 2. *Laurencia glandulifera*. L (Herb. Lugd. Bat. 941.99-243 = L.4058494). Unmounted specimens in the small envelope A. x 0.80.



Fig. 3. *Laurencia glandulifera*. L (Herb. Lugd. Bat. 941.99-243 = L.4058494). Mounted specimens in the small envelope A. x 0.80.



Fig. 4. *Laurencia glandulifera*. L (Herb. Lugd. Bat. 941.99-243 = L.4058494). Mounted specimens in the small envelope B. x 0.80.



Fig. 5. *Laurencia glandulifera*. L (Herb. Lugd. Bat. 941.99-243 = L.4058494). Unmounted specimen in the small envelope B. x 0.80.



Fig. 6. *Laurencia glandulifera*. L (Herb. Lugd. Bat. 941.99-243 = L.4058494). Unmounted specimens in the small envelope C. x 0.80.