

## New Records of Rhodomelaceae (Rhodophyta) from the Canary Islands

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**Abstract**

Six species of Rhodomelaceae are reported from the Canary Islands for the first time: *Aphanocladia stichidiosa* (Funk) Ardré, *Polysiphonia funebris* De Notaris, *Polysiphonia ceramiaeformis* P. L. Crouan *et al.* H. M. Crouan, *Polysiphonia denudata* (Dillwyn) Greville *ex Harvey in* W. J. Hooker, *Polysiphonia harveyi* Bailey and *Polysiphonia caretia* Hollenberg. Data concerning morphology, phenology, habitat and geographical distribution of the species are presented.

**Introduction**

Recent investigations on the seaweed flora of the Canary Islands by Sansón *et al.* (1991), Afonso-Carrillo *et al.* (1992), Gil-Rodríguez and Haroun (1992), Ballesteros *et al.* (1992) and Reyes *et al.* (in press) have increased the floristic information of the studies of Børgesen (1925–1930), Gil-Rodríguez and Afonso-Carrillo (1980) and Afonso-Carrillo and Sansón (1989). The present account adds six species of Rhodomelaceae to the seaweed flora of the Canary Islands.

**Material and Methods**

Specimens were collected between 1991 and 1992 at several localities on Tenerife and El Hierro (Canary Islands) and were deposited at TFC (Departamento de Biología Vegetal, Botánica, Universidad de La Laguna, Canary Islands). Permanent slides for anatomical studies were prepared from specimens preserved in 4% formalin in sea water. Camera lucida drawings were obtained using a Zeiss microscope.

**Results***Aphanocladia stichidiosa* (Funk) Ardré (Fig. 1)

*Aphanocladia stichidiosa* has been reported from the western Mediterranean Sea (Funk 1955, Boudouresque

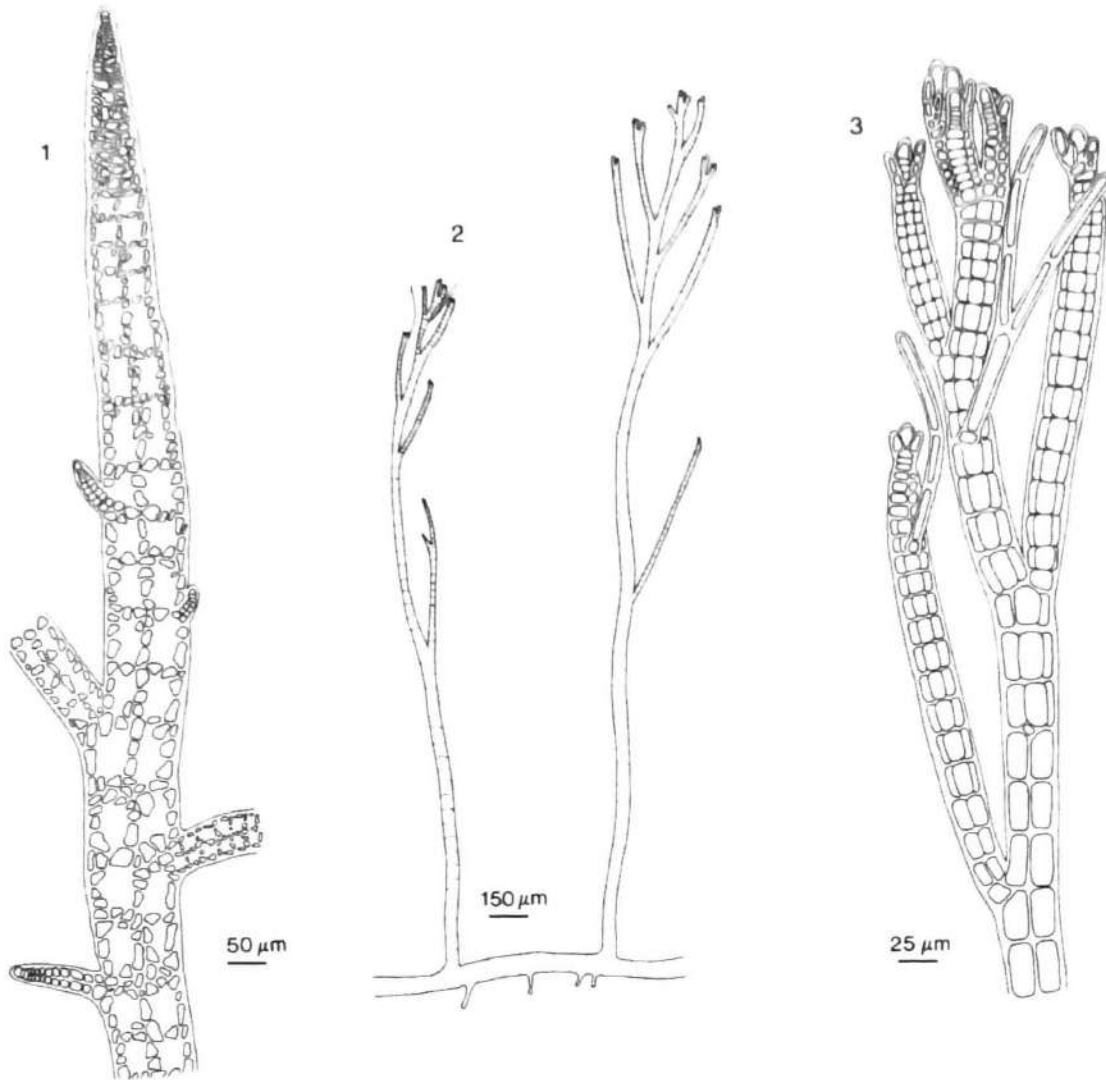
1970, Cormaci *et al.* 1976, Ballesteros 1990) and the Atlantic coasts of Portugal and Spain (Ginsburg-Ardre 1963, as *Polysiphonia stichidiosa* Funk, Ardré 1970 a, 1970 b, Cremades and Bárbara 1990). Price *et al.* (1986) on the basis of a personal communication of Prud'homme van Reine have reported *Aphanocladia cf stichidiosa* from the Canaries.

*Aphanocladia stichidiosa* was collected in February and April at Puerto de la Cruz (Tenerife) growing epilithically in tide pools, mixed with other caespitose algae such as *Herposiphonia secunda* (C. Agardh) Falkenberg and *Centroceras clavulatum* (C. Agardh) Montagne (TFC Phyc. 7880, 7881).

Sterile plants were collected in the Canary Islands and are in good agreement with previous descriptions of the species (Ardré 1970 a, Cormaci *et al.* 1976, Cremades and Bárbara 1990). Plants were up to 10 mm tall, with extensive prostrate axes attached to the substratum by unicellular rhizoids cut off from the distal end of pericentral cells, and erect irregularly arranged axes with four pericentral cells covered by a discontinuous cortical layer (Fig. 1).

*Polysiphonia funebris* De Notaris (Figs 2–3)

*Polysiphonia funebris* is a poorly known species only previously reported from the Mediterranean Sea (De



Figs 1–3.

Fig. 1 *Aphanocladia stichidiosa* (Funk) Ardré. Erect axis showing the irregular development of branches and the discontinuous cortication. Figs 2–3 *Polysiphonia funebris* De Notaris. Fig. 2. Habit. Fig. 3. Apex of an erect axis showing alternate and distichous way of branching.

Notaris 1846, Pignatti and Giaccone 1967, as *Polysiphonia funebris* Kützinger, Perret-Boudouresque and Seridi 1989) and from Portugal (Kützinger 1864, Ginsburg-Ardre 1966, Ardré 1970 b, Gallardo *et al.* 1985, South and Tittley 1986). Fertile plants are not known.

*Polysiphonia funebris* was collected in November at Las Teresitas, a sheltered locality in E. Tenerife, growing at 1–3 m depth, on an anchor rope over a sandy bottom, mixed with other Rhodomelaceae such as *Herposiphonia secunda* (C. Agardh) Falkenberg, *Lophosiphonia cristata* Falkenberg, *Polysiphonia sphaerocarpa* Borgesen, *Polysiphonia ferulacea* Suhr *ex* J. Agardh and *Polysiphonia denudata* (Dillwyn) Greville (TFC Phyc. 7882).

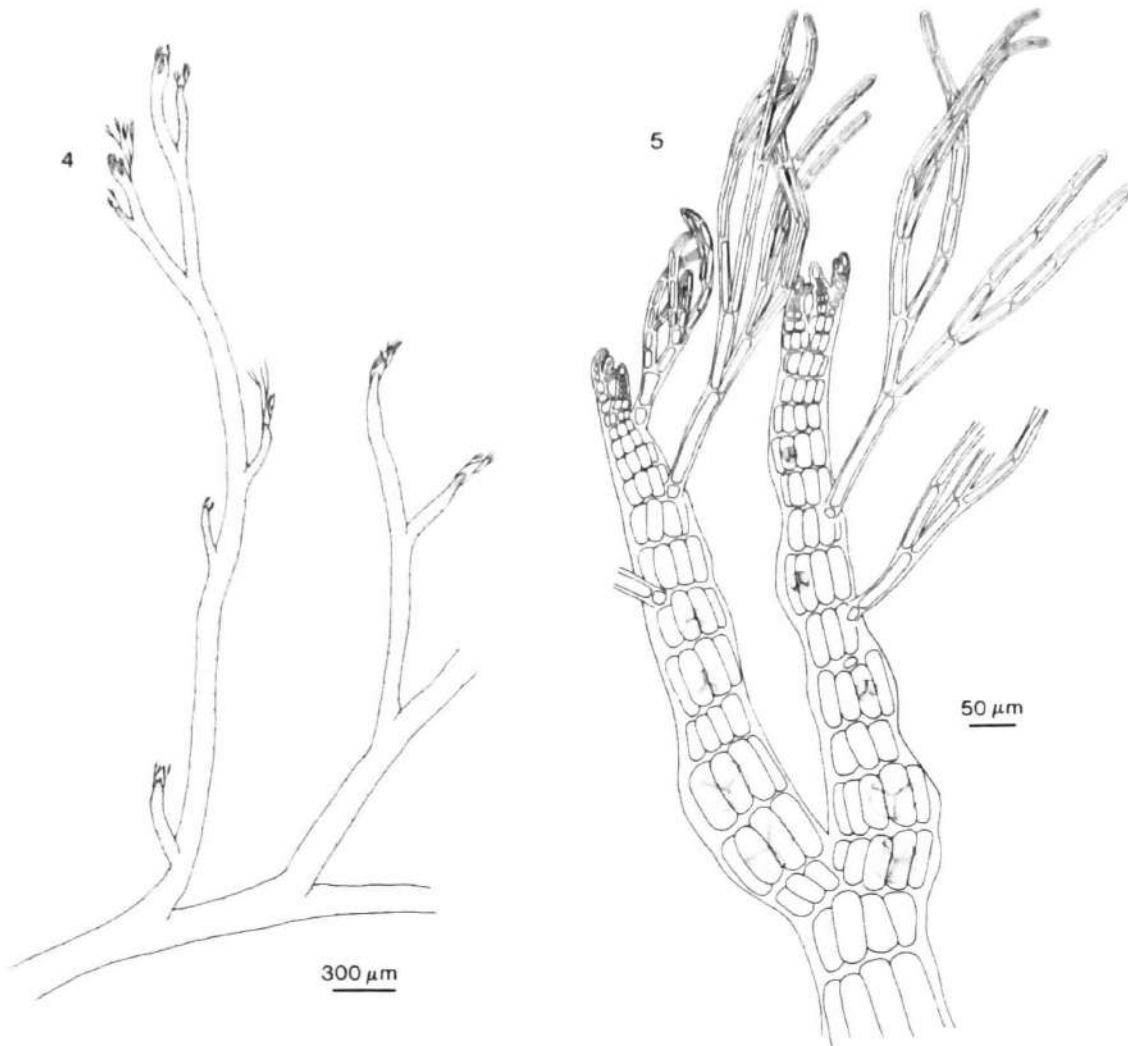
Sterile plants examined agreed with the description given by Ardré (1970 b). Plants were minute, up to 5 mm tall, dark red in colour, with extensive prostrate axes (Fig. 2). Axes were uncorticated with four pericen-

tral cells and rhizoids in open connection with pericentral cells. Branches replaced trichoblasts and branching was alternate and distichous (Figs 2–3).

*Polysiphonia ceramiaeformis* P. L. Crouan *et* H. M. Crouan (Figs 4–5)

*Polysiphonia ceramiaeformis* was described by Crouan and Crouan (1867) from Finistère (Atlantic coast of France) and later considered to be a form of *Polysiphonia furcellata* (C. Agardh) Harvey. Lauret (1970), studying plants from the Western Mediterranean, found fairly good differences and considered *Polysiphonia ceramiaeformis* as a distinct species. *Polysiphonia ceramiaeformis* has been recently reported from the British Isles (Maggs and Hommersand 1993)

According to Lauret (1970), *Polysiphonia furcellata* (C. Agardh) Harvey, a very common species in the Canary



Figs 4–5. *Polysiphonia ceramiaeformis* H. L. Crouan *et* P. M. Crouan.  
Fig. 4 Habit. Fig. 5 Tetrasporangial branches.

Islands, differs from *Polysiphonia ceramiaeformis* mainly by:

- (1) its erect axes pseudodichotomously branched;
- (2) the segments 2–4 diameters long;
- (3) its 8 pericentral cells; and
- (4) the scarcity of short branchlets.

*Polysiphonia ceramiaeformis* was collected at Puerto de la Cruz, N. Tenerife, growing in tide pools. Tetrasporangia were observed in January, February and May (TFC Phyc. 7883, 7884, 7885).

Plants examined were reddish brown in colour and up to 20 mm tall and in good agreement with the description given by Lauret (1970). Prostrate axes were attached to the substratum by rhizoids cut off from the pericentral cells and ended in a discoid holdfast. The erect uncorticated axes were irregularly alternately branched (Fig. 4), and consisted of segments one diameter long and with 11–13 pericentral cells. Both branches replacing trichoblasts in development and short

lateral branches were present. Tetrasporangia were placed in series in ultimate branches, swelling each segment (Fig. 5). Sexual plants were not found.

*Polysiphonia denudata* (Dillwyn) Greville *ex* Harvey *in* W. J. Hooker (Fig. 6)

*Polysiphonia denudata* is a widespread species in temperate and tropical waters throughout the world: Western Atlantic (Taylor 1957, 1960, Edwards 1970, Kapraun 1977, 1979, 1980, Wynne 1986, Kapraun and Norris 1982), Atlantic Europe, Morocco, and the Mediterranean Sea (Veldkamp 1950, Ardré 1970 b, Maggs and Hommersand 1993) and West Africa (Lawson and John 1977).

*Polysiphonia denudata* was collected in sheltered localities growing on floating docks, hulls, buoys and anchor ropes, at Puerto de los Gigantes and Las Teresitas (Tenerife) and La Restinga (El Hierro). Spermatangia, cystocarps and tetrasporangia were observed in March,

April, June and November (TFC Phyc. 7886, 7887, 7888, 7889).

Plants examined agreed with previous accounts of the species. Erect plants were up to 40 mm tall, occasionally with erect axes from decumbent branches and arose from a discoidal base, attached to the substratum by rhizoids cut off from the proximal end of pericentral cells. Branches were formed at the axils of trichoblasts and arranged in a subdichotomous and divergent way. Axes with 6–7 pericentral cells occasionally show a slight basal cortication in older parts. Spermatangial branches were long, conical, with 1–3 sterile tip cells. Cystocarps were spherical and flattened, opening by a narrow ostiole. Tetrasporangia were arranged in long series in upper branches (Fig. 6).

*Polysiphonia harveyi* Bailey

(Fig. 7)

This species has been reported from the Northeastern coast of North America (Taylor 1957, Kapraun 1977, 1980) and recently from the British Isles (Maggs and Hommersand 1993).

*Polysiphonia harveyi* was collected at La Restinga (El Hierro), growing on buoys, hulls and anchor ropes over a sandy bottom. Spermatangia, cystocarps and tetrasporangia were observed in March, June and November (TFC Phyc. 7890, 7891, 7892).

The Canarian specimens agreed with Kapraun's description (1977, 1980). Erect plants were brown in colour, up to 30 mm tall, arising from a discoidal base. Axes with four pericentral cells were slightly corticated in the older parts. Spermatangial branches were cylindrical, with an sterile apical cell. Cystocarps were spherical to urceolate, opened by a wide ostiole (Fig. 7). Tetrasporangia were arranged in series in upper branches.

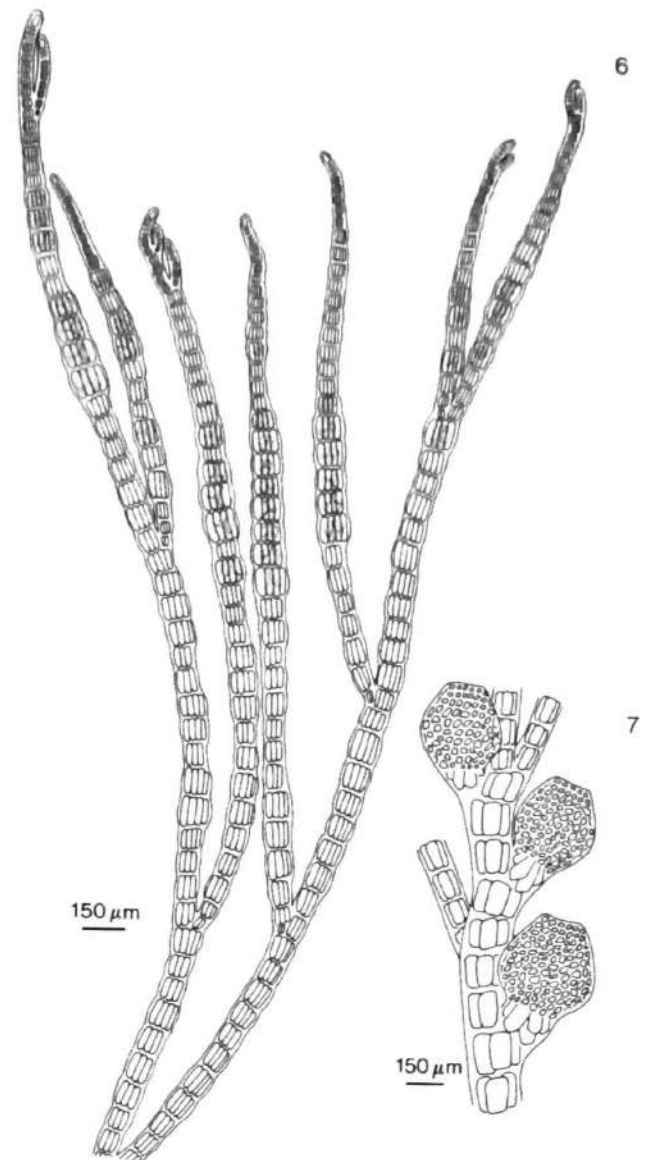
*Polysiphonia caretta* Hollenberg

(Figs 8–14)

*Polysiphonia caretta* was described by Hollenberg (1971) from plants growing on the caparace of the sea turtle *Caretta caretta* Linné from Santa Catalina Island, California. Hollenberg found only tetrasporic plants and according to Abbott and Hollenberg (1976) this species is only known from the type collection.

*Polysiphonia caretta* was collected at Poris de Abona and Güimar (Tenerife) growing on the posterior half of the sea turtle *Caretta caretta*. Tetrasporangia were observed in June and cystocarps and spermatangia in October (TFC Phyc. 7893, 7894).

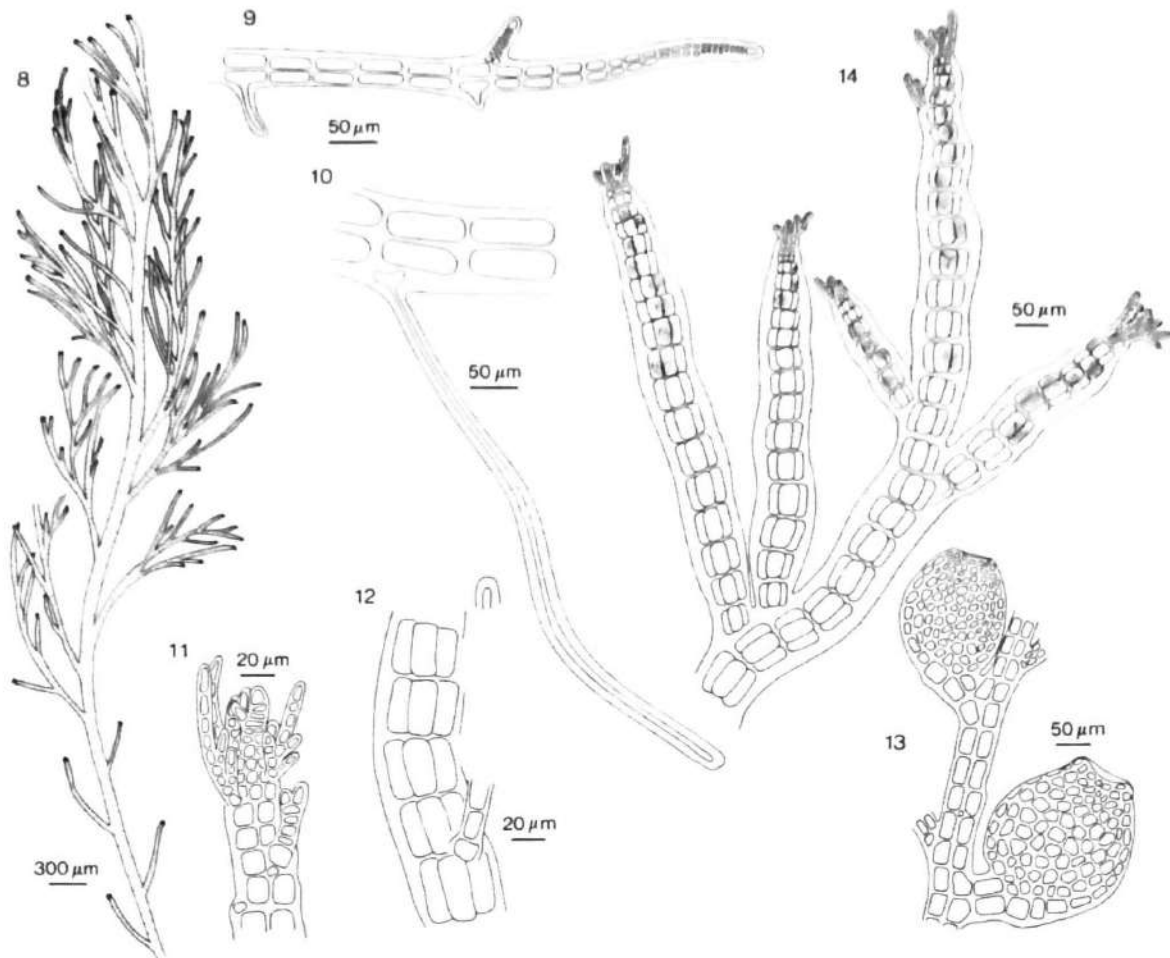
Plants collected in the Canary Islands were in good agreement with the description given by Hollenberg (1971). In addition we have also examined sexual plants.



Figs 6–7.

Fig. 6. *Polysiphonia denudata* (Dillwyn) Greville ex Harvey in W. J. Hooker. Tetrasporangial branches. Fig. 7. *Polysiphonia harveyi* Bailey. Branch with cystocarps.

Plants were soft and delicate, forming dense tufts, light brown in colour, up to 15 mm tall (Fig. 8). Creeping axes were 35–75 µm diameter, attached by unicellular rhizoids which a first were in open connection with pericentral cells but later were cut off by a cross wall (Figs 9–10). Erect axes in lowermost parts were unbranched or scarcely branched, but abundantly branched above. Lateral branches arose at irregular intervals replacing trichoblasts in development (Fig. 11). Axes with four pericentral cells were uncorticated. Segments were usually 2–3 diameters long and up to 40 µm diameter, but only 1–2 diameters long and up to 15 µm diameter. Slender trichoblasts were formed at irregular intervals of 1–2 segments in a short spiral sequence (Fig. 11), leaving scar cells when they hung down. Spermatangial branches were elongated, ovoid to cylindrical, up to 130 µm long and up to 40 µm broad, stalked on 2–3 basal



Figs 8–14. *Polysiphonia caretta* Hollenberg.

Fig. 8 Habit. Figs 9–10 Prostrate axes with rhizoids. Fig. 11 Apex. Fig. 12. Spermatangial branch. Fig. 13. Branch with cystocarps. Fig. 14. Tetrasporangial branches.

cells, and with a conspicuous sterile apical cell (Fig. 12). Cystocarps were ovoid, usually becoming urceolate, up to 275  $\mu\text{m}$  long and up to 250  $\mu\text{m}$  broad, stalked on large basal cells and opening by a narrow ostiole (Fig. 13). Tetrasporangia, 25–35  $\mu\text{m}$  diameter, formed spiral series in upper branches (Fig. 14).

According to Hollenberg (1971), the species shows unicellular rhizoids which are not cut off by a cross wall from the pericentral cell, while in the Canary specimens rhizoids, when developed, were cut off by a cross wall. A revision of the type material of *Polysiphonia caretta* is needed to evaluate the variability of the rhizoid connections.

### Conclusions

These newly reported species from the Canary Islands are the result of investigations on the genus *Polysiphonia*, poorly known in this region, and the study of collections from habitats generally poorly investigated (floating docks, hulls, buoys and anchor ropes in sheltered localities; or the carapace of sea turtles).

*Polysiphonia caretta* was previously only known from California. The record of this taxon in the Atlantic Ocean, growing on the same species of turtle, suggests a widespread distribution for this poorly known species. *Polysiphonia harveyi* was previously reported only from the Northwestern Atlantic, and recently from the British Isles. Three species (*Aphanocladia stichidiosa*, *Polysiphonia funebris* and *Polysiphonia ceramiaeformis*) were previously known from the Mediterranean Sea and the Northeastern Atlantic, the Canary Islands now constitute the southernmost known limit of their distribution. Finally, *Polysiphonia denudata* is a widespread species in temperate and tropical waters and its presence in the Canary Islands was not unexpected.

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## References

- Abbott, I. A. and G. J. Hollenberg 1976 *Marine Algae from California*. Stanford University Press, California. 827 pp.
- Afonso-Carrillo, J. and M. Sansón 1989 *Clave ilustrada para la determinación de los macrofitos marinos bentónicos de las Islas Canarias*. Dept. Biología Vegetal Univ. La Laguna. 55 pp.
- Afonso-Carrillo, J., S. Pinedo and Y. Elejabeitia 1992. Notes on the benthic marine algae of the Canary Islands. *Cryptogamie Algol* 13: 281–290.
- Ardre, F. 1970a. Observation sur le genre *Aphanocladia* Falkenberg (Rhodomelaceae) et sur ses affinités. *Rev Algol* 10: 37–55.
- Ardre, F. 1970b. Contribution à l'étude des algues marines du Portugal 1 – La Flore. *Portugaliae Acta Biol B* 10: 1–423, pl. 1–56.
- Ballesteros, E. 1990. Checklist of benthic marine algae from Catalonia (North Western Mediterranean). *Treballs de l'Institut Botanic de Barcelona* 13: 1–52.
- Ballesteros, E., M. Sansón, J. Reyes, J. Afonso-Carrillo and M. C. Gil-Rodríguez 1992. New records of benthic marine algae from the Canary Islands. *Bot. Mar.* 35: 513–522.
- Børgesen, F. 1925–30. The marine algae of Canary Islands, specially from Tenerife and Gran Canaria. I – Chlorophyceae, II – Phaeophyceae, III – Rhodophyceae, part 1, 2, 3. *K. Danske Vidensk. Selsk. Biol. Medd.* 5 (5): 1–123 (1925); 6 (2): 1–112 (1926); 6 (6): 1–97 (1927); 8 (1): 1–97 (1929); 9 (1): 1–159 (1930).
- Boudouresque, C. F. 1970. Recherches de bionomie analytique, structurale et expérimentale sur les peuplements benthiques scrapiques de Méditerranée Occidentale (Fraction algale). Thèse Sci. nat., Univ. Aix-Marseille II. 624 pp.
- Cormaci, M., Furnari, G. and B. Scammacca. 1976. Su alcune specie interessanti della flora algale della Sicilia orientale. *Boll. Pesca Piscic. Idrobiol.* 31: 177–186.
- Cremades, J. and I. Bárbara 1990. *Audouinella corymbifera* (Thuret) Dixon y *Aphanocladia stichidiosa* (Funk) Ardre, dos nuevos rodófitos para el NO peninsular. *Anal. J. Bot. de Madrid* 47: 494–496.
- Crouan, P. L. and H. M. Crouan 1867. *Florule du Finistère*. Brest.
- De Notaris, G. 1846. Prospetta della flora linguistica e dei zoofiti del mare linguistico. In *Descrizione di Genova e del Genovesato. Vol. 1. Tipografia Ferrando*. Genova. 80 pp.
- Edwards, P. 1970. Field and cultural observations on the growth and the reproduction of *Polysiphonia denudata* from Texas. *Br. Phycol. J.* 5: 145–153.
- Funk, G. 1955. Beiträge zur Kenntnis der Meeresalgen von Neapel. *Pubbl. Staz. Zool. Napoli* 25 (suppl.): 1–178, pl. 1–30.
- Gallardo, T., A. Gómez Garreta, M. A. Ribera, M. Alvarez and F. Conde 1985. *A Preliminary Checklist of Iberian Benthic Marine Algae*. Real Jardín Botánico, Madrid. 83 pp.
- Gil-Rodríguez, M. C. and J. Afonso-Carrillo 1980. *Catálogo de las algas marinas bentónicas (Cyanophyta, Chlorophyta, Phaeophyta y Rhodophyta) para el Archipiélago Canario*. Aula de Cultura de Tenerife, Tenerife. 47 pp.
- Gil-Rodríguez, M. C. and R. Haroun 1992. *Laurencia viridis* sp. nov. (Ceramiaceae, Rhodomelaceae) from the Macaronesian Archipelagos. *Bot. Mar.* 35: 227–237.
- Ginsburg-Ardre, F. 1966. Algues du Portugal. Liste préliminaire. III. *Rev. Gen. Bot.* 73: 353–359.
- Hollenberg, G. J. 1971. Phycological notes. V. New species of marine algae from California. *Phycologia* 10: 11–16.
- Kapraun, D. F. 1977. The genus *Polysiphonia* in North Carolina. *U.S.A. Bot. Mar.* 20: 313–331.
- Kapraun, D. F. 1979. The genus *Polysiphonia* (Ceramiaceae, Rhodophyta) in the vicinity of Port Aransas, Texas. *Contr. Mar. Sci.* 22: 105–120.
- Kapraun, D. F. 1980. *An Illustrated Guide to the Benthic Marine Algae of Coastal North Carolina I. Rhodophyta*. The University of North Carolina Press, Chapel Hill. 206 pp.
- Kapraun, D. F. and J. N. Norris 1982. The red alga *Polysiphonia* Greville (Rhodomelaceae) from Carrie Bow Cay and Vicinity, Belize. In (K. Ruetler and I. G. MacIntyre, eds) *Atlantic Barrier Reef Ecosystem at Carrie Bow Cay, Belize. I. Structure and Communities*. *Smithsonian Contr. Mar. Sci.* 12: 225–238.
- Kützing, F. T. 1864. *Tabulae Phycologicae*. XIV. Nordhausen.
- Lauret, M. 1970. Morphologie, phénologie, repartition des *Polysiphonia* marins du littoral languedocien. II. section *Polysiphonia Naturalia monspeliensis*, sér. Bot. 21: 121–163.
- Lawson, G. W. and D. M. John 1977. The marine flora of the Cap Blanc peninsula: its distribution and affinities. *J. Linn. Soc. (Bot.)* 75: 99–118.
- Maggs, C. A. and M. H. Hommersand 1993. *Seaweeds of the British Isles Volume 1. Rhodophyta Part 3A. Ceramiaceae*. The Natural History Museum, London. 444 pp.
- Perret-Boudouresque, M. and H. Seridi 1989. *Inventaire des algues marines benthiques d'Algérie*. GIS Posidonie publ., Marseille. 117 pp.
- Pignatti, S. and G. Giaccone 1967. Flora sommersa del Golfo di Trieste. *Nova Thalassia* 3 (1): 1–17.
- Price, J. H., D. M. John and G. W. Lawson 1986. Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. IV. Rhodophyta (Florideae). 1. Genera A–F. *Bull. Br. Mus. nat. Hist. (Bot.)* 15 (1): 1–122.
- Reyes, J., M. Sansón and J. Afonso-Carrillo 1994. Notes on some interesting marine algae new from the Canary Islands. *Crypt. Bot. (in press)*.
- Sansón, M., J. Reyes and J. Afonso-Carrillo 1991. Contribution to the seaweed flora of the Canary Islands: new records of Florideophyceae. *Bot. Mar.* 34: 527–536.
- South, G. R. and I. Tittley 1986. *A Checklist and Distributional Index of the Benthic Marine Algae of the North Atlantic Ocean*. Huntsman Marine Laboratory and British Museum (Natural History). St. Andrews and London. 76 pp.
- Taylor, W. R. 1957. *Marine Algae of the Northeastern Coast of North America*. 2nd ed. Univ. Michigan Press, Ann Arbor. 509 pp.
- Taylor, W. R. 1960. *Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas*. Univ. Michigan Press, Ann Arbor. 860 pp.
- Veldkamp, H. 1950. The genus *Polysiphonia* in the Netherlands. *Blumea* 6: 517–527.
- Wynne, M. J. 1986. A checklist of benthic marine algae of the tropical and subtropical western Atlantic. *Can. J. Bot.* 64: 2239–2281.