Nova Hedwigia **75** 3—4 333—356 Stuttgart, November 2002

# A description of *Plocamium fimbriatum* sp. nov. (Plocamiales, Rhodophyta) from the Sultanate of Oman, with a census of currently recognized species in the genus

by

Michael J. Wynne

Herbarium and Department of Ecology and Evolutionary Biology
University of Michigan, Ann Arbor, Michigan 48109, U.S.A.

With 18 figures

Wynne, M.J. (2002): A description of *Plocamium fimbriatum* sp. nov. (Plocamiales, Rhodophyta) from the Sultanate of Oman, with a census of currently recognized species in the genus. - Nova Hedwigia 75: 333-356.

**Abstract**: A new species of red algae, *Plocamium fimbriatum*, is described from the Sultanate of Oman. It is distinguished by the following suite of characteristics: robust main axes (to 25 cm in length by 4-6 mm in width) with marginal branches produced in series of alternating pairs; production of abundant marginal proliferations resulting in a densely fringed appearance, and tetrasporangial stichidia arising along axillary margins and in the proliferations. The species joins the growing number of new taxa that have been described recently from the benthic marine algal flora of the northern Arabian Sea, a region impacted by the summertime monsoon of nutrient-rich, relatively cold-water conditions. A census of the 35 other species now recognized as belonging to the genus *Plocamium* is provided. The combination *Plocamium cartilagineum* (Linnaeus) P. Dixon var. *uncinatum* (C. Agardh) M.J. Wynne comb. nov. is effected.

## Introduction

*Plocamium* Lamouroux (1813) is a widespread genus of red algae currently thought to contain approximately 35 species (see census in Appendix) which are widely distributed in tropical and warm- and cold-temperate seas. A total of 16 species was reported by Silva et al. (1996) for the Indian Ocean exclusive of the Red Sea. Some of these have distributions more or less restricted to South Africa, whereas several others are known only from western Australia. Only two species are reported from the northern Arabian Sea (i.e., from the coasts of Yemen, Oman, the Makran coast of Iran, Pakistan and western India), the widely occurring generitype, *P. cartilagineum*

DOI: 10.1127/0029-5035/2002/0075-0333 0029-5035/02/0075-0333 $ 6.00

(Linnaeus) P. Dixon, and *P. telfairiae* (W. Hooker & Harvey) Harvey ex Kützing. The former is the only species of *Plocamium* previously reported from Oman (Wynne & Jupp 1998).

Robust, non-reproductive specimens of an apparently undescribed species of *Plocamium* have been collected from the coast of the Sultanate of Oman since 1983 (Barratt & Hiscock 1986). Barratt & Hiscock (1986) reported it as "*Plocamium* sp.", indicating that it was probably an opportunistic and "uncommon feature of understorey" in the *Ecklonia* community. Recent abundant collections have included a few tetrasporangial specimens, allowing a more definitive conclusion that the Omani material represents an undescribed species. The delineation of that species is the focus of this paper.

## Materials and methods

Most of the collections reported in this paper were made in Sept. 2000 and Sept. 2001 in Dhofar, Oman, as part of the Algal Biodiversity Project of Oman (1999-2002) funded by the British Government's Darwin Initiative grant for the Survival of Species. Two other collections from 1983 were kindly supplied by the Tropical Marine Research Unit, University of York. Specimens were gathered both in the attached state by SCUBA and also from the drift. Material was usually processed as herbarium mounts soon after collecting. Some specimens were preserved in 5% Formalin/sea-water. Small portions of pressed specimens were rehydrated, gently cut away and mounted on glass slides for observation with a standard Zeiss research microscope. Portions of main axes were hand-sectioned using a single-edged razor blade. Line-drawings were made with a camera lucida attached to the microscope. Photomicrographs, using Kodak T-MAX 100 film, were made with a camera-back attached to the same microscope. Habit photographs were taken with a standard 35 mm camera. Coordinates were obtained in the field by using several GPS devices. The primary one used was a model made by Garmin Etrex Summit. Herbarium abbreviations are according to Holmgren et al. (1990).

## Results

**Plocamium fimbriatum** M.J. Wynne sp. nov.

DIAGNOSIS: thalli erecti, 10-25 cm in altitudine, clare rubri, per hapteron conspicuum affixi; axes principales lati, 4-6 mm, descrescentes distale, 2 mm, non-costati, membranacei tenuiter, 825-910 μm in crassitudine; omnes rami marginibus axium evoluti; ramuli laterales plerumque in series duo (interdum tres); ramulus infirmus seriei duo basaliter latus, distale attenuatus, et in abaxali pagina dentatus; ramuli dense proliferi e marginibus formati, praecipue in axillis ramulo infirmo laterali seriei duo; stichidia cylindrica vel ramosa, secus margines vel inter ramos proliferationum dispersorum formata. Thalli sexuales ignoti.

Thalli erect, 10-25 cm in height, bright red, attached by a conspicuous holdfast; main axes broad, 4-6 mm wide, narrowing to 2 mm distally, non-costate, thinly membranous, 825-910 μm thick; all branches developing from margins of the axes; lateral branchlets usually in series of two (occasionally three), the lower member of a pair basally broad, narrowing to a tip and strongly dentate on the abaxial surface; densely proliferous branchlets are formed mainly in the lowermost member of a pair of lateral branches; tetrasporangial stichidia cylindrical or branched, are formed along the margins or scattered among the branches of the proliferations. Sexual thalli unknown.

Etymology: Lat. *fimbriatum*, fringed; referring to the densely fringing marginal proliferations.

TYPE LOCALITY: Raaha (= Alto) Bay (16.95116°N, 54.81650°E), east of Wadi Zead and east of Mirbat, Dhofar, Sultanate of Oman.

HOLOTYPE: leg. M. Wynne 11092000-04-32, 11.ix.2000; in drift; deposited in MICH (Fig. 1).

ISOTYPES: deposited in BM, GENT, MELU, ON, PC, SAP, US. Some tetrasporangial specimens were present in the type collections.

ADDITIONAL RECORDS: Sultanate of Oman: Raaha (= Alto) Bay: 6.ix.2001, leg. M. Wynne 6092001-01-01, in drift (BM, MICH, ON, PC, UC, US); 7.ix.2001, leg. M. Wynne 7092001-02-05, tetrasporangial, in drift (BM, FI, MICH, ON); 12.ix.2001, leg. M. Wynne 12092001-07-39, in drift (MICH, ON). Hatom Cove (16.96091°N, 54.82795°E), east of Mirbat, Dhofar: 8.ix.2001, leg. M. Wynne 8092001-03-16, in drift (BM, MICH, ON). Western side of Wadi Zeid (= Hoon's Bay) (16.94497°N, 54.80402°E), east of Mirbat, Dhofar: 21.x.1983, 17 m., leg. TMRU (MICH); 12.ix.2000, leg. G. Minton 12092000-05-03, tetrasporangial, 7 m. depth (BM, MICH, ON); 21.ix.2000, leg. G. Richards 2192000-14-13 (MICH); 9.ix.2001, leg. G. Richards 9092001-04-06, attached (BM, MICH, ON). Cove adjacent to Abalone Research Lab (16.96888°N, 54.70151°E), Mirbat, Dhofar: 10.ix.2001, leg. M. Wynne 10092001-05-29, in drift (BM, MICH, ON). First cove east of Sadh (17.05755°N, 55.08544°E), Dhofar: 19.ix.2000, leg. G. Minton 19092000-13-06, in drift (BM, MICH, ON); leg. T. Collins 19092000-13-27, attached (MICH, ON). Wadi Haart reef (17.07666°N, 55.11166°E), Sadh, Dhofar: 30.ix.1983, leg. TMRU, 6-10 m. depth (MICH, ON). Masirah Island: viii.1995, leg. John Bryan (MICH, slide only).

Distribution: known only from the Sultanate of Oman, the northern Arabian Sea. All the collections known so far are from Dhofar (southern Oman) except for a single collection made from Masirah Island (eastern Oman).

Description of vegetative organization:

Thalli are erect, 10-25 cm in height and bright red in color. Main axes are non-costate, thinly membranous (825-910 μm thick), 4-6 mm wide, gradually narrowing to 2 mm distally (Figs 1 & 2). Attachment is by a conspicuous holdfast, 1.0-2.0 cm in diameter, and made up of much branched, narrow, flattened haptera along with aggregated coarse sand and shellgrit. In older thalli major axes become somewhat thickened and more eroded in aspect but also bear localized clusters of adventitious proliferations (Fig. 3). All branches are borne from the margins of the axes. Ramuli occur in alternating pairs (Figs 4, 11 & 12); the lower ramulus of a pair is usually determinate in growth, broad, pointed distally, strongly toothed or serrate on the abaxial side, and slightly to moderately serrate on the adaxial side. The upper ramulus of a pair is usually well developed and has the potential to continue indefinite growth. The lower ramulus in a pair, although essentially determinate (and representing the previous apex of a sympodially growing axis), may have new branches proliferating from its adaxial margin (Figs 5, 13 & 14).


Fig. 1. *Plocamium fimbriatum.* Holotype specimen (in MICH). Scale bar = 3 cm.

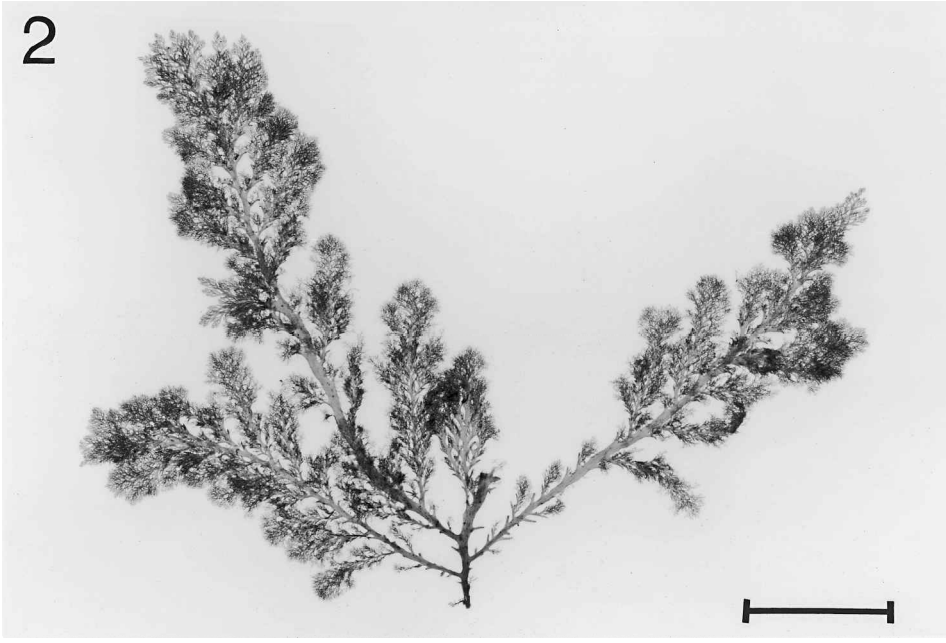



Fig. 2. *Plocamium fimbriatum.* Isotype specimen (in BM). Scale bar = 3 cm.

Tetrasporangial reproduction:

Stichidia most often arise in axillary locations, that is, from the adaxial margin of a determinate branch and the adjacent margin of the parent axis (Figs 6, 7, 15 & 16) or they may be located in isolated positions in the proliferous branches (Fig. 18), usually in proximal positions. Often stichidia are produced alongside vegetative proliferations (Figs 15 & 16). Stichidia are never borne in dense clusters nor do they arise from a special pad of tissue. Tetrasporangial stichidia can be variously branched (Fig. 15), usually at a wide angle near the base or distally (Figs 8 & 9) or can be a simple cylindrical structure (Figs 10 & 17). Tetrasporangia are 44-46 μm long by 24-32 μm in diameter and are zonately divided.

## Discussion

In recent years much interest has been directed toward *Plocamium* as a rich source of secondary compounds, such as halogenated monoterpenes that deter the settlement of barnacle larvae (Konig et al. 1999a) or that exhibit antimicrobial (Rovirosa et al. 1990), cytotoxic (Konig et al. 1999b), or insecticidal activities (Watanabe et al. 1989). The search for pharmaceutically useful marine natural products is driving much of this interest in *Plocamium* (Konig & Wright 1996). Although the order

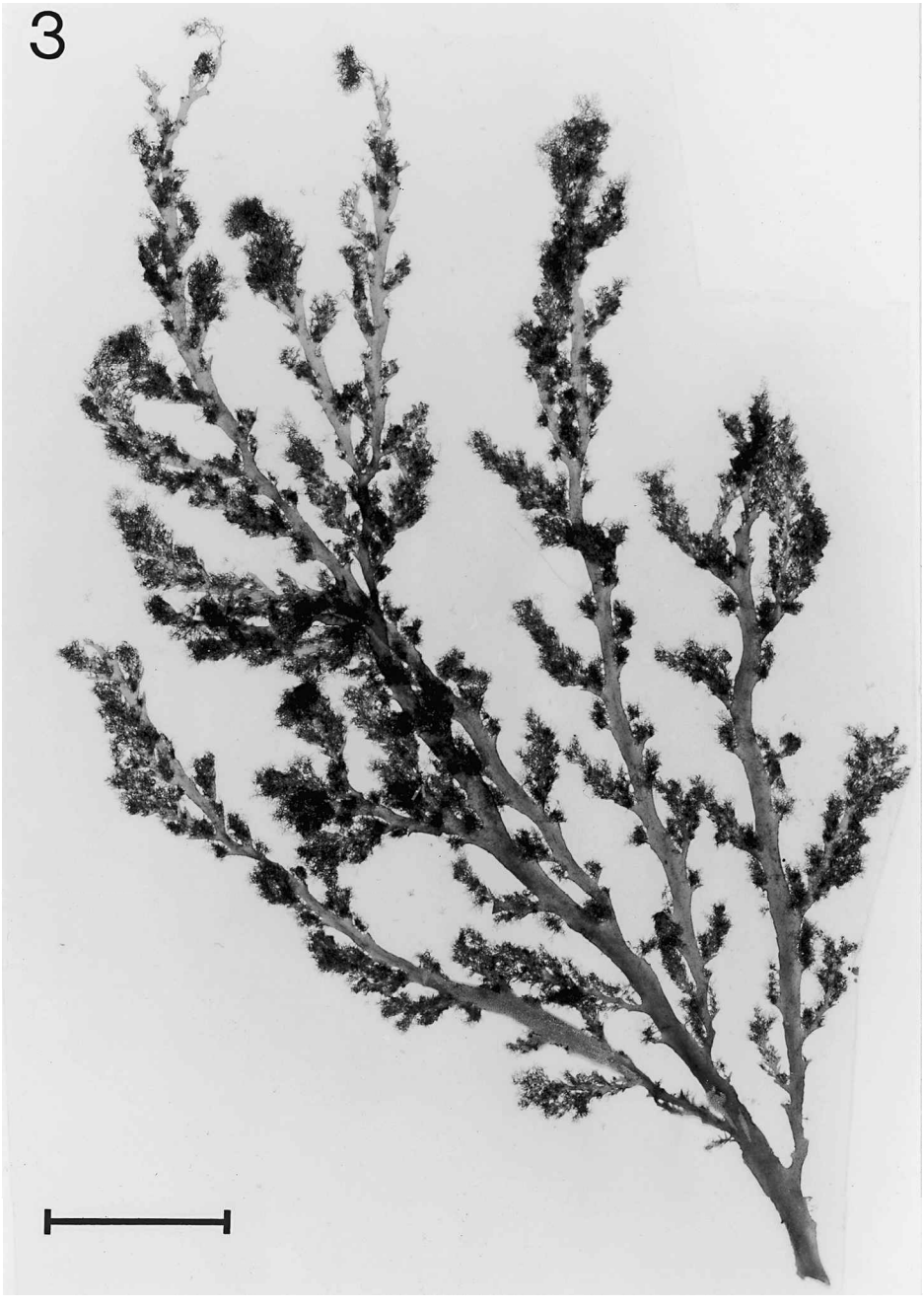
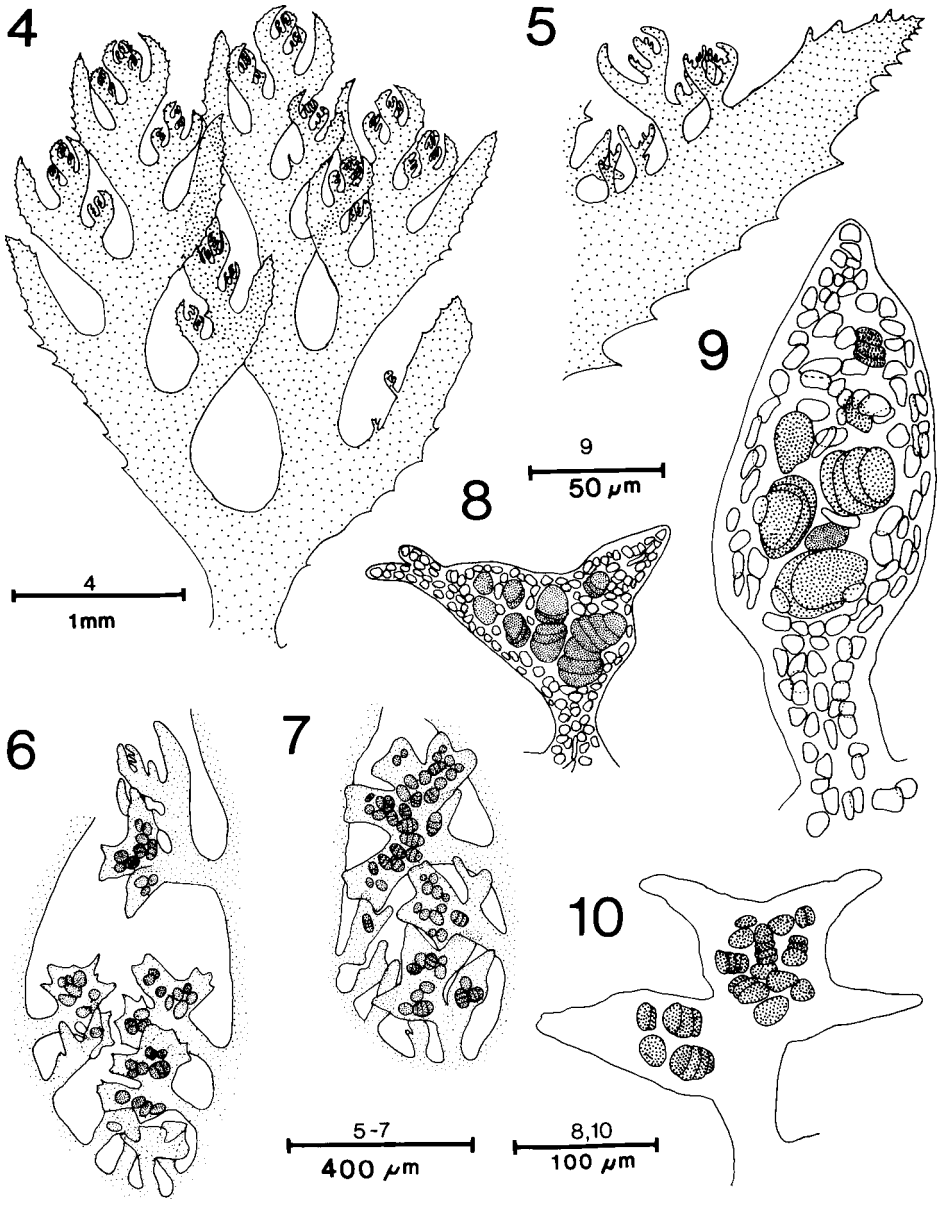
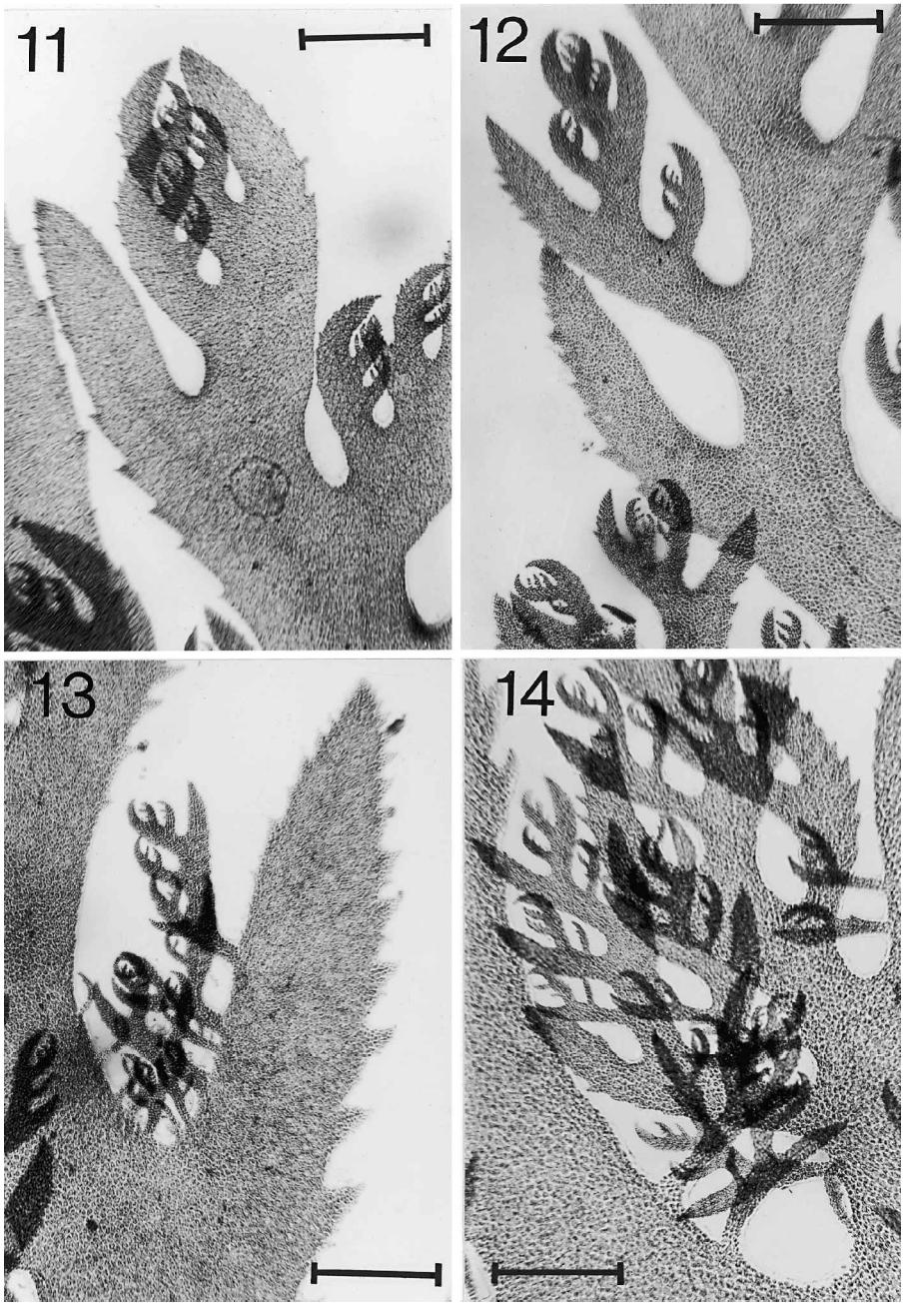


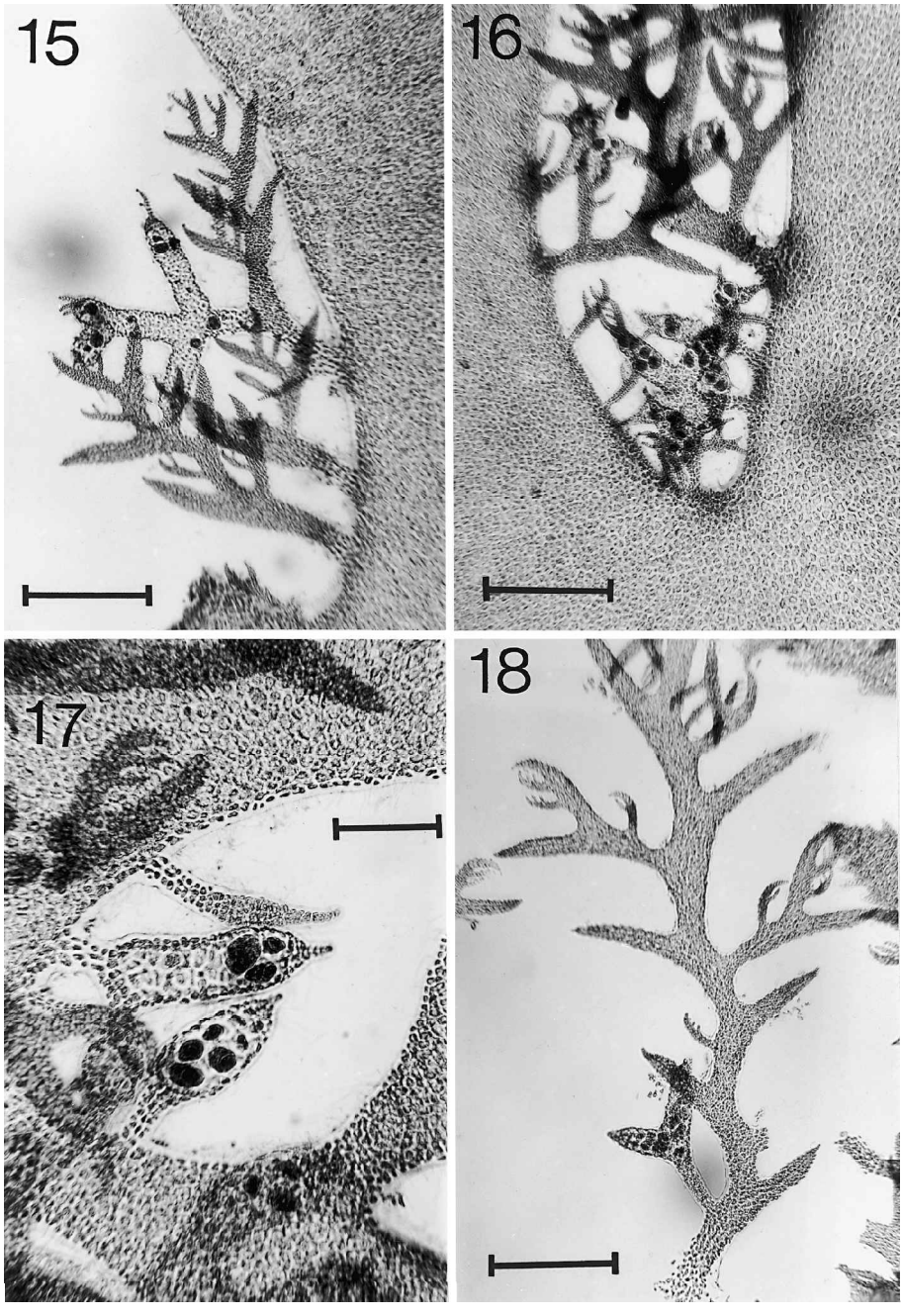

Fig. 3. *Plocamium fimbriatum.* Older specimen with fringing branches arising in dense tufts from margins (Western side of Wadi Zead, 21.x.1983, in MICH). Scale bar = 3 cm.




Figs 4-10. *Plocamium fimbriatum.* Fig. 4. Distal portion of thallus. Fig. 5. Production of fringing branches from the adaxial surface of a determinate ramulus. Figs 6 & 7. Production of stichidia from margins of axillary regions. Figs 8-10. Variously shaped stichidia.




Figs 11-14. *Plocamium fimbriatum.* Figs 11 & 12. Distal portions of thallus showing marginal branches arising in pairs. Figs 13 & 14. Production of adventitious proliferations from adaxial margin of determinate ramulus. Scale bars =150 µm for figs 11-14.




Figs 15-18. *Plocamium fimbriatum.* Figs 15 & 16. Production of tetrasporangial stichidia and vegetative proliferations from axillary regions. Fig. 17. Stichidia arising from axillary region. Fig. 18. Stichidia arising near base of an adventitious proliferation. Scale bars= 150 µm for figs 15, 16 & 18; 50 µm for fig. 17.

Plocamiales was recently established by Saunders & Kraft (1994) for *Plocamium* and its adelphoparasite *Plocamiocolax*, there have been no recent attempts to treat the species of *Plocamium* in a broad, monographic context, except for regional floras.

In most keys to species of *Plocamium* the first dichotomy concerns whether the ramuli are in alternating pairs or in alternating series of 3-4 (or more) (Simons 1964; South & Adams 1979; Womersley 1971, 1994; Yoshida 1998). The new species falls into the former category, which includes the majority of species in the genus. The narrow width of the axes in several species (*P. angustum*, *P. cirrhosum*, *P. cornutum*, *P. rigidum*, *P. sandvicense*, *P. suhrii*, and *P. telfairiae*) and other features of shape of determinate laterals or stichidial pattern preclude them from further consideration.

Several *Plocamium* species with laterals in alternating pairs have main axes with relatively broad widths comparable with *P. fimbriatum*. The new species is similar to the South African *Plocamium corallorhiza* in its robustness and height (to 30 cm tall), its extensive prostrate system, and the broad primary axes (5 mm, rarely up to 10 mm in width), but the stichidia of the latter species are produced in dense axillary clusters (Simons 1977), not marginally and scattered as in the new species. The main axes in *P. mertensii* may be up to 5 mm broad and are thin and delicate in younger parts, but its stichdia arise in a dense cluster from a pad of tissue in the axil of laterals (Womersley 1994). The erect axes of *P. dilatatum* may be 3.5 mm broad, and the lower ramulus of a pair has its abaxial side bearing serrations, but this species bears its stichidia in massive axillary clusters (Womersley 1994), thus unlike the new species. In *P. patagiatum* axes are 3-4 mm broad, but the upper member of each pair of ramuli is typically arrested in its development, and the lower member has entire margins. Furthermore, the stichidia in this species are borne in dense globular clusters (Womersley 1994).

In the Japanese *Plocamium serratulum* Okamura (1932), ramuli also occur in alternating pairs, the lower member being simple and with a markedly serrate ab-axial side (Okamura 1923, pl. 198, figs. 1-4, as *Plocamium costatum*), somewhat like the new species, but the main axes are barely 1 mm. broad. In *P. recurvatum* the lower member of each pair of ramuli is simple and strongly recurved, easily distinguishing this species from *P. fimbriatum*.

There is a resemblance of the new species to the Australian *Plocamium leptophyllum* in bearing some stichidia on the branches and in producing short adventitious ramuli that occur on the axis opposite to the series of normal ramuli as well as between the members of the series (Womersley 1994). The main axes of *P. leptophyllum*, however, are only about 0.5 mm broad with ramuli in alternating series of 4 or 5 (rarely 3) unlike the paired arrangement in *P. fimbriatum*, and that species also has strongly hooked branchlets.

Finally, the shape and the manner of production of the tetrasporangial stichidia in *Plocamium fimbriatum* bears some resemblance to these features in *P. cartilagineum* (Kornmann & Sahling 1977; Womersley 1994). In the latter species, however, the marginal ramuli are usually in series of 3, 4 or more, main axes reach to only 1.5 mm in width.

**Acknowledgements**

I am grateful to the British Government's Darwin Initiative grant for the Survival of Species. The Darwin Initiative is part of the British Government's Department of Environment Transport and the Regions (DETR). The project was managed by HTS Development Ltd., U.K., working with the Natural History Museum of Muscat, Oman, and supported by the Natural History Museum of London and the University of Michigan. I am very grateful to the following persons who made some of the algal collections: Mr. Glenn Richards, Mrs. Gianna Minton, Mr. Tim Collins, and Dr. Henry Ford. Mr. Richards was the only permanent member of the HTS staff; the others were volunteers on the 2000 or 2001 Expedition. In addition, I thank Dr. Lynne Barrett for making available two collections made in 1983 by unnamed personnel of the Tropical Marine Research Unit (= TMRU) of the University of York, U.K. Mr. David Bay, Universiy of Michigan, kindly assisted in the preparation of the artwork.

**Literature cited**

ABBOTT, I.A. (1999): Marine Red Algae of the Hawaiian Islands. - Bishop Museum Press, Honolulu, Hawai'i. xv + 477 pp.

ADAMS, N.M. (1994): Seaweeds of New Zealand. An Illustrated Guide. - Canterbury University Press, Christchurch. 360 pp.

AGARDH, C.A. (1822-1823): Species algarum. Vol. 1, Pt. 2. Lundae. Pp. 169-398 (1822), 399-531 (1823).

AGARDH, J.G. (1841): In historiam algarum symbolae. - Linnaea **15**: 1-50, 443-457.

AGARDH, J.G. (1842): Algae maris Mediterranei et Adriatici. Fortin, Masson et Cie, Paris. x + 164 pp.

AGARDH, J.G. (1852): Species, genera et ordines algarum. Vol. 2, Part 2. Pp. 337-720. Lund.

AGARDH, J.G. (1876): Species, genera et ordines algarum. Vol. 3, Part 1. vii +724 pp. Lund.

AGARDH, J.G. (1892): Analecta algologica. - Acta Univ. Lund. **28**(6): 1-182, 3 pls.

AGARDH, J.G. (1894): Analecta algologica. Cont. I. - Acta Univ. Lund. **29**(9): 1-144, 2 pls.

ARESCHOUG, J.E. (1854): Phyceae novae et minus cognitae in maribus extraeuropaeis collectae... - Nova Acta Regiae Soc. Sci. Upsal., ser. 3, **1**: 329-372.

ASKENASY, E. (1897): Enumération des algues des îles du Cap Vert. - Bol. Soc. Brot. **13**: 150-175.

BAARDSETH, E. (1941): The marine algae of Tristan da Cunha. - Results of the Norwegian Scientific Expedition to Tristan da Cunha 1937-1938, No. 9. 173 + [1] pp. Oslo.

BARRATT, L. & S. HISCOCK (1986): Notes on a collection of algae from Dhofar taken in 1985. - Unpublished msc. deposited at the Natural History Museum in Muscat. 11 pp.

BØRGESEN, F. (1902): The marine algae of the Faeröes. Botany of the Faeröes, Part II, pp. 339-532, 1 pl. - H. H. Thiele, Copenhagen.

BORY DE SAINT-VINCENT, J.B. (1826-1829): Cryptogamie. In: L.J. Duperrey, Voyage autour *d*u Monde...sur...La Coquille, pendant les années 1822, 1823, 1824, et 1825... Botanique. 301 pp. + Atlas. Paris. [atlas: 1826; pp. 1-96: 1827; pp. 97-200: 1828; pp. 201-300: 1829].

BORY DE SAINT-VINCENT, J.B. (1834): Hydrophytes, Hydrophytae. In: C. Belanger, Voyage aux Indies-Orientales...pendant 1825, 1826, 1827, 1828 et 1829. Vol. 3. Botanique. IIptie. Cryptogamie. Pp. 159-178, pls. XV, XVI. Paris.

CHAPMAN, V.J. (1971): The marine algae of Fiji. - Rev. Algol., N. S., **10**: 164-171, pl. 17.

CHAPMAN, V.J. (1979): The marine algae of New Zealand. Part III: Rhodophyceae. Issue 4: Gigartinales. - Pp. 279-510. V. Cramer, Vaduz.

COLLINS, F.S. (1915): Some algae from the Chincha Islands. - Rhodora **17**: 89-96**.**

CONDE, F., A. FLORES-MOYA, A., J. SOTO, M. ALTAMIRANO & A. SÁNCHEZ (1996): Check-list of Andalusia (S. Spain) seaweeds. III. Rhodophyceae. - Acta Botanica Malacitana **21**: 7-33.

CORDEIRO-MARINO, M. (1978): Rodofíceas bentônicas marinhas do Estado de Santa Catarina. - Rickia **7**: 1-243.

CORDERO, P. (1977): Studies on Philippine marine red algae. - Special Publ. Seto Mar. Biol. Lab. **4**. 258 pp., 28 pls.

CORMACI, M., G. FURNARI & D. SERIO (1999): First record of the austral species *Plocamium secundatum* (Gigartinales, Rhodophyta) from the Mediterranean Sea. - Cryptogamie, Algol. **12**: 235-244.

CRIBB, A. B. (1983): Marine Algae of the Southern Great Barrier Reef – Rhodophyta. - Australian Coral Reef Society, Handbook No. 2, 173 pp., 71 pls., + Index. Brisbane.

CUNNINGHAM, A. (1839): Florae insularum Novae Zelandiae precursor; or a specimen of the botany of the islands of New Zealand. - Companion Bot. Mag. **2**: 222-233; 327-336; 358-378, pls. XXXI-XXXII.

DANGEARD, P. (1949): Les algues marines de la côte occidentale du Maroc. - Botaniste **34**: 89-189.

DAWSON, E. Y. (1961): Marine red algae of Pacific Mexico. Part 4. Gigartinales. - Pacific Naturalist **2**: 191-343.

DELF, E.M. & M.R. MICHELL (1921): The Tyson collection of marine algae. - Ann. Bolus Herb. **3**: 89-119.

DE TONI, G.B. (1900): Sylloge algarum. Vol. IV. Florideae. - Patavii [Padua]. Pp. 387-774 + 775-776 [Index].

DICKIE, G. (1874): Enumeration of algae collected at the Cape-Verde Islands by H. N. Moseley, M.A., Naturalist to H.M.S. 'Challenger'. - J. Linn. Soc., Bot. **14**: 344-349.

DIXON, P.S. (1967): The typification of *Fucus cartilagineus* L. and *F. corneus* Huds. - Blumea **15**: 55-62.

DIXON, P.S. & L.M. IRVINE (1977): Seaweeds of the British Isles. Vol. 1 Rhodophyta. Part 1 Introduction, Nemaliales, Gigartinales. - Br. Mus. (Nat. Hist.), London. xi +251 pp.

DONZE, M. (1968): The algal vegetation of the Ria de Arosa (NW. Spain). - Blumea **16**: 159-192.

DOTY, M.S. (1947): The marine algae of Oregon Part II. Rhodophyta. - Farlowia **3**: 159-215.

FARLOW, W.G. (1877): On some algae new to the United States. - Proc. Amer. Acad. Arts, n.s., **4**: 235-245.

FUHRER, B. (1981): Seaweeds of Australia. - Reed Pty Ltd., Sydney. 112 pp.

GABRIELSON, P.W. & R.F. SCAGEL (1989): The marine algae of British Columbia, northern Washington, and southeast Alaska: division Rhodophyta (red algae), class Rhodophyceae, order Gigartinales, families Caulacanthaceae and Plocamiaceae. - Canad. J. Bot. **67**: 1221-1234.

GAYRAL, P. (1958): Algues de la côte atlantique Marocaine. - La Nature au Maroc, Rabat. 523 pp.

GMELIN, S.G. (1768): Historia fucorum. - Petropoli. [12] + 239 + [6] pp., 35 pls.

GREUTER, W., J. McNEILL, F.R. BARRIE, H.M. BURDET, V. DEMOULIN, T.S. FILGUEIRAS, D.H. NICOLSON, P.C. SILVA, J.E. SKOG, P. TREHANE, N.J. TURLAND & D.L. HAWKSWORTH (eds.) (2000): International Code of Botanical Nomenclature (Saint Louis Code) adopted by the Sixteenth International Botanical Congress, St. Louis, Missouri, July-August 1999. - Regnum Veg. **138**. xviii + 474 pp.

GREVILLE, R.K. (1830): Algae britannicae... - Edinburgh. lxxxxviii + 218 pp., 19 pls.

GREVILLE, R.K. (1833): Algae. Vol. 2: 423, 424, 436, 447-450. In: Voyage dans le district des diamans et sur le littoral du Brésil, vol. 2 by A. de Saint-Hilaire. Paris.

GRUNOW, A. (1867): Algae. In E. Fenzl (ed.), Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859... Botanischer Theil. Erster Band. Sporenpflanzen. Wien. 104 pp., 12 pls.

HARVEY, W.H. (1834): Notice of a collection of algae, communicated to Dr. Hooker by the late Mrs. Charles Telfair, from "Cap Malheureux", in the Mauritius; with descriptions of some new and little known species. - J. Bot. (Hooker) **1**: 147-157, 2 pls.

HARVEY, W.H. (1846-1851): Phycologia Britannica... 4 vols. - Reeve & Benham, London.

HARVEY, W.H. (1847, 1849): Nereis australis. - London. viii + 124 pp., 50 [pls. [1847: viii + 64 pp., pls. 1-25; 1849: pp. 65-124, pls. 26-50]

HARVEY, W.H. (1855): Algae. In: J. D. Hooker, The Botany of the Antarctic Voyage. Part II. Flora Novae-Zelandiae. Pp. 211-266, pls. 107-121. - Reeve, London.

HARVEY, W.H. (1859): Phycologia Australica. Vol. 2, 61-120. - Reeve, London.

HARVEY, W.H. (1862): Phycologia Australica. Vol. 4, pls. 181-240. - Reeve, London.

HARVEY, W.H. (1863): Phycologia Australica. Vol. 5, pls. 241-300, synopsis, pp. i-lxxiii. Reeve, London.

HAWKES, M.W., C.E. TANNER & P. A. LEBEDNIK (1978): The benthic marine algae of northern British Columbia. - Syesis 11: 81-115.

HAY, C.H., N.M. ADAMS & M.J. PARSONS (1985): Marine algae of the subantarctic islands of New Zealand. - Misc. Ser. Natl. Mus. New Zealand **11**. 70 pp.

HOFFMANN, A. & B. SANTELICES (1997): Flora Marina de Chile Central. Marine Flora of Central Chile. - Ediciones Universidad Catolica de Chile. Santiago. 434 pp.

HOLMGREN, P.K., N.H. HOLMGREN & L. C. BARNETT (1990): Index Herbariorum. Part I: the Herbaria of the World. - 8th edn. New York, New York Botanical Garden [Regnum Vegetabile vol. **120**].

HOOKER, J.D. & W.H. HARVEY (1845a): Algae Antarcticae... - London J. Bot. **4**: 249-276, 293-298.

HOOKER, J.D. & W. H. HARVEY (1845b): Algae Novae Zelandiae... - London J. Bot. **4**: 521-551.

HOOKER, J.D. & W. H. HARVEY (1847): Algae Tasmanicae... - London J. Bot. **6**: 397-417.

HOWE, M.A. & W.R. TAYLOR (1931): Notes on new or little-known marine algae from Brazil. - Brittonia **1**: 7-33, 2 pls.

HUDSON, W. (1778): Flora anglica... Editio altera. Vol. II. xxxviii + 690 pp. - London.

HUISMAN, J.M. (2000): Marine plants of Australia. - University of Western Australia Press, Nedlands, Western Australia. ix + 300 pp.

IRVINE, D.E.G. (1982): Seaweeds of the Faroes: 1. The flora. - Bull. Brit. Mus. (Nat. Hist.), Bot. **10**: 109-131.

JOLY, A.B. (1965): Flora marinha do litoral norte do Estado de Sâo Paulo e regiies circunvizinhas. - Bolm. Fac. Fil., Ciênc. Letras Univ. Sâo Paulo no. **294** (Botânica 21. 393 pp.

KONIG, G. M. & A. D. WRIGHT (1996): Marine natural products research: current directions and future potential. - Planta Medica **62**: 193-211.

KONIG, G.M., A.D. WRIGHT & R. DE NYS (1999a): Halogenated monoterpenes from *Plocamium costatum* and their biological activity. - J. Natural Products **62**: 383-385.

KONIG, G.M., A.D. WRIGHT & A. LINDEN (1999b): *Plocamium hamatum* and its monoterpenes: chemical and biological investigations of the tropical marine red alga.- Phytochemistry **52**: 1047-1053.

KORNMANN, P. & P.-H. SAHLING (1977): Meeresalgen von Helgoland. Bentische Grün-, Braun- und Rotalgen. Helgoländer wissensch. Meeresunters. **29**: 1-289.

KÜTZING, F.T. (1843): Phycologia generalis. - Leipzig. xxxii + 458 pp., 80pls.

KÜTZING, F.T. (1849): Species algarum. - Lipsiae. vi + 922 pp.

KÜTZING, F.T. (1866): Tabulae Phycologicae... Vol. 16. [iii] + 35 pp., 100 pls. - Nordhausen.

KYLIN, H. (1925): The marine red algae in the vicinity of the biological station at Friday Harbor, Wash. - Acta Univ. Lund., N. F., Avd. 2, **21**(9). 87 pp.

KYLIN, H. (1938): Verzeichnis einiger Rhodophyceen von Südafrika. - Acta Univ. Lund., N. F., **34**(8). 25 pp., 8 pls.

LAMOUROUX, J.V.F. (1813): Essai sur les genres de la famille des thalassiophytesnon articulées. - Ann. Mus. Natl.Hist. Nat. **20**: 21-47, 115-139, 267-293, pls. 7-13.

LAWSON, G.W. & D.M. JOHN (1977): The marine flora of the Cap Blanc Peninsula: its distribution and affinities. - Bot. J. Linn. Soc. **75**: 99-118.

LAWSON, G.W., W.J. WOELKERLING, J.H. PRICE, W.F. PRUD'HOMME VAN REINE & D.M. JOHN (1995): Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. IV. Rhodophyta (Florideae) 5. Genera P. - Bull. Nat. Hist. Mus. Lond., Bot. **25**(2): 99-122.

LEVRING, T. (1944): Meeresalgen von den Crozet-Inseln und Kerguelen. - Ark. Bot. **31**A(8). 31 pp.

LEWIS, J.E. & J.N. NORRIS (1987): A history and annotated account of the benthic marine algae of Taiwan. - Smithsonian Contr. Mar. Sci. **29**. 38 pp.

LINNAEUS, C. (1753): Species plantarum 2. - Stockholm.

LYNGBYE, H.C. (1819): Tentamen hydrophytologiæ danicae... - Hafniae. xxxii + 248 pp., 70 pls.

MAGRUDER, W.H. & J.W. HUNT (1979): Seaweeds of Hawaii. - Oriental Publishing Co., Honolulu. 116 pp.

MARTENS, G. VON 1868. ["1866"] Die Tange. In: Die Preussische Expedition nach Ost-Asien. Botanischer Theil. - Berlin. 152 pp., 8 pls.

MAZZA, A. (1908): Saggio di algologia oceanica. - Nuova Notarisia **19**: 1-24.

MENEGHINI, G. (1844): Algarum species novae vel minus notae. - Giorn. Bot. Ital. **1**(1): 296-306.

MILLAR, A.J.K. (1990): Marine red algae of the Coffs Harbour region, northern New South Wales. - Austral. Syst. Bot. **3**: 293-593.

MILLAR, A.J.K. (1999): Marine benthic algae of Norfolk Island, South Pacific. - Austral. Syst. Bot. **12**: 479-547.

MILLAR, A.J.K. & G.T. KRAFT (1993): Catalogue of marine and freshwater red algae (Rhodophyta) of New South Wales, including Lord Howe Island, South-western Pacific. - Austral. Syst. Bot. **6**: 1-90.

NELSON, W.A. & N.M. ADAMS (1984): Marine algae of the Kermadec Islands. - Misc. Ser. Natl. Mus. New Zealand **10**. 29 pp.

N'YEURT, A.D.R., G.R. SOUTH & D.W. KEATS (1996): A revised checklist of the benthic marine algae of the Fiji Islands, South Pacific (including the Island of Rotuma). - Micronesica **29**: 49-98.

O'CLAIR, R.M. & S.C. LINDSTROM (2001): North Pacific seaweeds. - Plant Press, Auke Bay, Alaska. xi + 162 pp.

OKADA, Y. (1956): Natural Colored Icones of Japanese Seaweeds. Revised Edition. - Kazama Shobo, Kanda, Tokyo. 178 + 42 pp.

OKAMURA, K. (1896): Contributions to knowledge of marine algae of Japan. 2. - Bot. Mag. (Tokyo) **10**: 33-40, pl. 3.

OKAMURA, K. (1913): Icones of Japanese algae. Vol. III(1). Pls. 101-105. Tokyo.

OKAMURA, K. (1923): Icones of Japanese algae. Vol. IV(10). Pls. 196-200. Tokyo.

OKAMURA, K. (1932): Icones of Japanese algae. Vol. VI(10). Pls. 296-300. Tokyo.

OKAMURA, K. (1936): Nippon Kaiso-shi. Tokyo. Frontispiece + 9 + 6 + 964 + 11 pp. [In Japanese.]

OKAMURA, K. (1942): Icones of Japanese algae. Vol. VII(10). Tokyo.

PAPENFUSS, G.F. (1964): Catalogue and bibliography of Antarctic and Sub-Antarctic benthic marine algae. - Antarc. Res. Ser. **1**: 1-76. American Geophysical Union.

PAPENFUSS, G.F. (1968): Notes on South African marine algae: V. - J.S. African Bot. **39**: 267-287.

POIRET, J.L.M. (1808): Varec. *Fucus*. In: Lamarck, Encyclopedie methodique. Botanique. **8**: 340-409. H. Agasse, Paris.

PREDA, A. (1909): Bibliografia algologica. Introduzione alle alghe. - Flora Italica Cryptogama **1**(1): 1-45 + i-lvi + 1-462 + [1 = errata].

RAMÍREZ, M.E. & B. SANTELICES (1991): Catálogo de las algas marinas bentónicas de la costa temperada del Pacífico de Sudamérica. - Monografías Biológicas no. 5, Facultad de Ciencias Biológicas Pontificia Universidad Católica de Chile. 437 pp.

RAPHÉLIS, A. (1929): Algues du Maroc récoltées par M.J. Gattefossé. - Bull. Soc. Bot. France **76**: 719-730.

RICKER, R.W. (1987): Taxonomy and Biogeography of Macquarie Island Seaweeds. - British Museum (Nat. Hist.), London. vi +[2] + 344 pp.

ROVIROSA, J., I. SANCHEZ, Y. PALACISO, J. DARIAS, & A. SAN MARTIN (1990): Anti-microbial activity of a new monoterpene from *Plocamium cartilagineum* from Antarctic Peninsula. - Boletin Soc. Chilena Quimica **35**: 131-135.

SAUNDERS, G.W. & G.T. KRAFT (1994): Small-subunit rRNA gene sequences from representatives of selected families of the Gigartinales and Rhodymeniales (Rhodophyta). 1. Evidence for the Plocamiales ord. nov. - Canad. J. Bot. **72**: 1250-1263.

SCAGEL, R.F., P.W. GABRIELSON, D.J. GARBARY, L. GOLDEN, M.W. HAWKES, S.C. LINDSTROM, J.C. OLIVEIRA & T.B. WIDDOWSON (1989): A synopsis of the benthic marine algae of British Columbia, Southeast Alaska, Washington and Oregon. - Phycol. Contr. No. **3**, Dept. of Botany, University of British Columbia, Vancouver, British Columbia. vi + 532 pp.

SCHNEIDER, C.W. & R.B. SEARLES (1991): Seaweeds of the Southern United States. Cape Hatteras to Cape Canaveral. - Duke University Press, Durham and London. xiv + 553 pp.

SEAGRIEF, S.C. (1980): Seaweeds of Maputaland. In: Studies on the Ecology of Maputaland (M.N. Bruton & K.H. Cooper, eds.) Pp. 18-41. - Rhodes University and The Natal Branch of The Wildlife Society of Southern Africa, Grahamstown.

SEAGRIEF, S.C. (1988): Marine algae. In: A Field Guide to the Eastern Cape Coast. (R.A. Lubke, F.W. Gess, & M.N. Bruton, eds.). Pp. 35-72. - Wildlife Society of Southern Africa, Grahamstown.

SEOANE-CAMBA, J. (1965): Estudios sobre las algas bentónicas en la costa sur la Península Ibérica (litoral de Cádiz). - Inv. Pesq. **29**: 3-216.

SHAMEEL, M. (1987): A preliminary survey of seaweeds from the coast of Lasbela, Pakistan. - Bot. Mar. **30**: 511-515.

SILVA, P.C., P.W. BASSON & R.L. MOE (1996): Catalogue of the benthic marine algae of the Indian Ocean. - Univ. Calif. Publ. Bot. **79**. xiv + 1,259 pp.

SILVA, P.C., E.G. MEÑEZ & R.L. MOE (1987): Catalog of the benthic marine algae of the Philippines. - Smithsonian Cont. Mar. Sci. **27**. iv + 179 pp.

SIMONS, R.H. (1964): Species of *Plocamium* on the South African coast. - Bothalia **8**: 183-193.

SIMONS, R.H. (1977, "1976"): Seaweeds of southern Africa: guide-lines for their study and identification. - Republic of South Africa, Department of Industries, Sea Fisheries Branch, Fish. Bull. **7**. 113 pp.

SMITH, G.M. (1944): Marine Algae of the Monterey Peninsula, California. - Stanford University Press, Stanford, California. ix + 622 pp.

SONDER, O.W. (1845): Nova algarum genera et species, quas in itinere ad oras occidentales Nova Hollandiae, collegit L. Preiss, Ph.Dr. - Bot. Zeit. **3**: 49-57.

SONDER, O.W. (1853): Plantae Mullerianae, Algae. - Linnaea **25**: 657-703.

SOUTH, G.R. & N.M. ADAMS (1979): A revision of the genus *Plocamium* Lamouroux (Rhodophyta, Gigartinales) in New Zealand. - Phycologia **18**: 120-132.

STEGENGA, H., J.J. BOLTON & R.J. ANDERSON (1997): Seaweeds of the South African West Coast. - Contr. Bolus Herb., Number **18**. University of Cape Town. 655 pp.

SUHR, J.N. VON (1834): Uebersicht der Algen, welche von Hrn. Ecklon an der südafrikanischen Küste gefunden worden sind. - Flora, Jena **17**: 721-735, 737-743, pls. I, II.

SUHR, J.N. VON (1840): Beiträge zur Algenkunde. - Flora, Jena **23**: 257-265, 273-282, 289-298.

TANAKA, T. & H. ITONO (1972): The marine algae from the Island of Yonaguni-II. - Mem. Fac. Fish. Kagoshima Univ. **21**: 1-14.

TURNER, D. (1807-1808): Fuci... Vol. I. Pls. 1-71. - John and Arthur Arch, London.

TURNER, D. (1808-1809): Fuci... Vol. II. Pls. 72-134. - John and Arthur Arch, London.

TURNER, D. (1811-1819): Fuci... Vol. IV. Pls. 197-258. - John and Arthur Arch, London.

WATANABE, K., M. MIYAKADO, N. OHNO, A. OKADA, K. YANAGI & K. MORIGUCHI (1989): A polyhalogenated insecticidal monoterpene from the red alga *Plocamium telfairiae*. - Phytochemistry 28: 77-78.

WOMERSLEY, H.B.S. (1971): The genus *Plocamium* (Rhodophyta) in southern Australia. - Trans. Roy. Soc. South Australia **95**: 9-27.

WOMERSLEY, H.B.S. (1994): The marine benthic flora of southern Australia Part IIIA. - Flora of Australia Supplementary Series Number 1 Richmond, S. Australia. 508 pp.

WYNNE, M.J. (1986): Report on a collection of benthic marine algae from the Namibian coast (southwestern Africa). - Nova Hedw. **43**: 311-355.

WYNNE, M.J. (2002): *Plocamium cirrhosum* comb. nov. (Plocamiales, Rhodophyta) to replace *P. costatum*. - New Zealand J. Bot. **40**: 137-142.

WYNNE, M.J. & B. P. JUPP (1998): The benthic marine algal flora of the Sultanate of Oman: new records. - Bot. Mar. **41**: 7-14.

XIA, B. (editor) & J. ZHANG (sub-editor) (1999): Ahnfeltiales, Gigartinales, Rhodymeniales. In: Flora Algarum Marinarum Sinicarum. Tomus II Rhodophyta. No. V. - Consilio Florarum Cryptogamarum Sinicarum, Academiae Sinicae Edita, Science Press. vi + 201 pp., 11 pls.

YENDO, K. (1915): Notes on algae new to Japan. III. - Bot. Mag. (Tokyo) **29**: 99-117.

YOSHIDA, T. (1991): Catalogue of the type specimens of algae preserved in the Herbarium, Department of Botany, The University Museum, The University of Tokyo. - The University Museum, The University of Tokyo Materials Reports No. **24**. 17 pp., 67 pls. Tokyo.

YOSHIDA, T. (1998): Marine algae of Japan. - Uchida Rokakuho Publ. Co., Ltd., Tokyo. 1,222 pp.

YOSHIDA, T., Y. NAKAJIMA & Y. NAKATA (1990): Check-list of marine algae of Japan (revised in 1990). - Jap. J. Phycol. **38**: 269-320.

## Appendix: Currrently recognized species of *Plocamium*

1) **P. affine** Kützing, 1849, p. 884.
Type locality: Port Natal [Durban], Natal Prov., South Africa.
Distribution: South Africa.

2) **P. angustum** (J. Agardh) Hooker f. & Harvey, 1847, p. 404.
Basionym: *Thamnophora angusta* J. Agardh, 1841, p. 10.
Type locality: "ad oras Novae Hollandiae" [Australia].
Distribution: New Zealand (including subantarctic islands) and southern Australia, including Tasmania and into New South Wales; Fiji.
References: Kützing (1866, pl. 48, figs a & b); South & Adams (1979); Chapman (1979); Fuhrer (1981); Hay et al. (1985); Millar & Kraft (1993); Adams (1994); Womersley (1994); N'Yeurt et al. (1996).
Tax. syn.: *P. abnorme* Hooker f. & Harvey (1845b) (fide South & Adams 1979); tax. syn.: *P. angustatum* Kützing (1866); tax. syn.: *P. dispermum* Harvey in Hooker (1855) (fide South & Adams 1979); tax. syn.: *P. botryoides* Kützing, 1866, p. 18, pl. 50a-c (Type locality: New Caledonia) (*fide* Chapman 1971); tax. syn.: *P. gracile* J. Agardh (1876) (fide South & Adams 1979).

3) **P. beckeri** Schmitz ex Simons, 1964, p. 185, fig. 3.
Type locality: Port Edward, Natal, South Africa.
Distribution: eastern South Africa and Mozambique.
References: Simons (1977); Seagrief (1980, 1988); Stegenga et al. (1997)
= *P. glomeratum* sensu Kylin (1938), pl. 3, fig. 7, non J. Agardh (1852) (fide Simons 1964).

4) **P. brasiliense** (Greville) Howe & Taylor, 1931, p. 14.
Basionym: *Thamnophora brasiliensis* Greville, 1833, p. 448, figs. 7 & 8.
Type locality: Brazil.
Distribution: Brazil, Venezuela, Netherland Antilles, North Carolina, South Carolina.
References: Joly (1965); Cordeiro-Marino (1978); Schneider & Searles (1991).

5) **P. cartilagineum** (Linnaeus) P. Dixon, 1967, p. 58.
Basionym: *Fucus cartilagineus* Linnaeus, 1753, p. 1161.
Type locality: "in Oceano australiore" [more likely from northern Europe fide Dixon, 1967].

Distribution: widely reported in temperate seas around the world, including eastern North Atlantic, Chile, eastern and western North Pacific, the northern Arabian Sea, Australia and New Zealand.
References: Harvey (1846-1851, pl. xliv); Kützing (1866); Børgesen (1902); Okamura (1913, pl. 103, figs 6 & 7, as *Plocamium leptophyllum* var. *flexuosum*); Papenfuss (1964); Dixon & Irvine (1977); Kornmann & Sahling (1977); Chapman (1979); Fuhrer (1981); Shameel (1987); Gabrielson & Scagel (1989); Millar & Kraft (1993); Lawson et al. (1995); Hoffmann & Santelices (1997); Huisman (2000); O'Clair & Lindstrom (2000).
Tax. syn.: *P. coccineum* (Hudson) Lyngbye, 1819, p. 39, pl. 9b.
Basionym: *Fucus coccineus* Hudson, 1778, p. 586; tax. syn.: *P. coccineum* f. *compactum* Collins (1915) (fide Ramírez & Santelices 1991); tax. syn.: *P. coccineum* var. *confervaceum* (Bory de Saint-Vincent) Kützing (1849); basionym: *P. confervaceum* Bory de Saint-Vincent in Duperrey (1828) [Type locality: Conçepcion, Chile] (fide Ramírez & Santelices, 1991); tax. syn.: *P. vulgare* Lamouroux, 1813, p. 50; basionym: *Fucus plocamium* S.G. Gmelin, 1768, p. 153; pl. 16, fig. 1; *Delesseria plocamium* (S. Gmelin) C. Agardh 1822, p. 180; tax. syn.: *P. binderianum* Kützing 1843, p. 450 "In mari germanico" [= Helgoland, North Sea]; tax. syn.: *Plocamium pusillum* Sonder, 1845, p. 54 (fide Womersley, 1971); *P. coccineum* var. *pusillum* (Sonder) Kützing (1849); *P. angustum* [var.] *pusillum* (Sonder) Harvey, 1863, synop.: xxxix; tax. syn.: *P. coccineum* var. *subtile* Lyngbye (1819) [type locality: Faeroes, North Atlantic] [A single species, *P. cartilagineum*, was recognized as commonly present in the Faeröes by Irvine (1982).] ; tax. syn.: *P. lyngbyanum* Kützing, 1843, p. 450 [type locality: Helgoland, Germany]; tax. syn.: *P. brachiocarpum* Kützing, 1849, p. 885 [type locality: New Zealand] (fide South & Adams 1979); tax. syn.: *P. cruciferum* Harvey in Hooker (1855) p. p. (fide South & Adams 1979); tax. syn.: *P. pacificum* Kylin (1925) [type locality: south False Bay, San Juan Island, Washington, USA]; *P. coccineum* var. *pacificum* (Kylin) Dawson (1961) (fide Hawkes et al. 1978).

**Plocamium cartilagineum** (Linnaeus) P. Dixon var. **uncinatum** (C. Agardh) M.J. Wynne **comb. nov.**
Basionym: *Delesseria Plocamium* var. *uncinata* C. Agardh, 1822, p. 181. [type locality: "ad litora Armoricae" = northwestern coast of France, Atlantic] Typus: No. 27915 in Agardh Herbarium, Lund.
*Plocamium coccineum* [var.] *uncinatum* (C. Agardh) Kützing nom. illeg., 1849, p. 884. J. Agardh (1842) had used this same name, *P. coccineum* var. *uncinatum*, earlier, but without citing his father's basionym. *Plocamium uncinatum* (C. Agardh) Kützing (1866); Tax. syn.: *P. coccineum* var. *mediterraneum* (Meneghini) Kützing (1849); basionym: *P. mediterraneum* Meneghini, 1844, p. 300 [syntype localities: Liburnia (Adriatic Sea) and Genoa (Ligurian Sea); (fide DeToni 1900, and Preda, 1909); Kützing, 1866, p. 16, pl. 44a-c; tax. syn: *P. subtile* Kützing, 1866, p. 15, pl. 42a,b; basionym: *Plocamium coccineum* [var.] *subtile* Kützing, 1843, p. 449 [type locality: Helgoland, Germany] nom. illegit. (non *P. coccineum* [var.] *subtile* Lyngbye, 1819); tax. syn.: *P. coccineum*

var. *fenestratum* (Kützing) Kützing (1849); basionym: *P. fenestratum* Kützing, 1843, p. 450 [syntype localities: Split and Trieste, Adriatic Sea] (fide DeToni, 1900); tax. syn.: *P. irregulare* Meneghini (1844, p. 300) [type locality: Dalmatia, Adriatic Sea); (fide DeToni 1900, and Preda 1909).
References: Kützing (1866, p. 16, pls. 43c, d, and 44d, e).

6) **P. cirrhosum** (Turner) M.J. Wynne, 2002
Basionym: *Fucus cirrhosus* Turner, 1807-1808, p. 142, pl. 63.
Type locality: "Dusky Bay, on the coast of New Zealand".] This is now known as Dusky Sound and is in the Fiordland region of the South Island. The entrance to Dusky Sound is ca. 45°49'S, 166°19'E.
Distribution: Australia, New Zealand, including Chatham Islands and sub-antarctic islands; the Philippines.
References: Kützing (1866, pl. 53a-c); Cordero (1977); South & Adams (1979); Chapman (1979); Hay et al. (1985); Millar & Kraft (1993); Adams (1994); Womersley (1994).
Tax. syn.: *P. cunninghamii* (Greville in Cunningham) Hooker & Harvey, 1845b, p. 543; basionym: *Thamnophora cunninghamii* Greville in Cunningham (1839) [Type locality: Bay of Islands, New Zealand].
Tax. syn.: *P. costatum* (C. Agardh) Hooker f. & Harvey, 1847, p. 404; basionym: *Delesseria plocamium* var. *costata* C. Agardh, 1822, p. 181; *Thamnophora costata* (C. Agardh) J. Agardh, 1841, p. 10 [type locality: "ad oras Novae Hollandiae" = Australia].
Although this species has been known as *Plocamium costatum* in the literature, at the species level, *Thamnophora cunninghamii* Greville in Cunningham (1839) predates *T. costata* (C. Agardh) J. Agardh (1841) by two years and in light of the proposal made by Wynne (2002), the correct name is *Plocamium cirrhosum* (Turner) M.J. Wynne, based on *Fucus cirrhosus* Turner (1807-1808). Starting with C. Agardh (1822), *Fucus cirrhosus* has been long treated as conspecific with *Plocamium corallorhiza*, but Wynne (2002) presented evidence that *F. cirrhosus* is taxonomically identical to *P. costata*. Also, an apparent problem with the basionym of *P. costata* is that C. Agardh (1822) listed *Fucus maxillosus* Poiret as a syn. of his [var.] *costata*.

7) **P. concinnum** Areschoug, 1854, p. 353.
Type locality: São Vicente, Cape Verde Islands.
Distribution: endemic to Cape Verde Islands.
References: Lawson et al. (1995).
Tax. syn.: *P. biserratum* Dickie (1874) (fide Askenasy, 1897).

8) **P. corallorhiza** (Turner) Harvey in Hooker & Harvey, 1845b, p. 542.
Basionym: *Fucus corallorhiza* Turner, 1808-1809, p. 70, pl. 96; *Thamnophora corallorhiza* (Turner) C. Agardh, 1822, p. 225.
Type locality: Cape of Good Hope, South Africa.
Distribution: South Africa, Mozambique, Madagascar, St. Paul Island, Île Amsterdam (Silva et al. 1996).

References: Kützing (1866, pl. 56f-k); Simons (1964, 1977); Seagrief (1980, 1988); Stegenga et al. (1997).
Tax. syn.: *P. robertiae* Schmitz ex Mazza, 1908, p. 19.

9) **P. cornutum** (Turner) Harvey, 1849, p. 123.
Basionym: *Fucus cornutus* Turner, 1811-1819, p. 152, pl. 258; *Sphaerococcus cornutus* (Turner) C. Agardh, 1822, p. 293; *Thamnophora cornuta* (Turner) Greville, 1830, p. xlvix; *Thamnocarpus cornutus* (Turner) Kützing, 1843, p. 450, pl. 59, III.
Type locality: Cape of Good Hope, South Africa.
Distribution: South Africa, Namibia, Chile.
References: Kützing (1843, pl. 59, III, as *Thamnocarpus cornutus*; 1866, pl. 55a-c); Simons (1964, 1976); Wynne (1986); Seagrief (1988); Ramírez & Santelices (1991); Stegenga et al. (1997).

10) **P. delicatulum** Baardseth, 1941, p. 71, figs 36C, 37.
Syntype localities: Tristan da Cunha, Nightingale, and Stoltenhoff islands, South Atlantic.
Distribution: as above.
References: Baardseth (1941).

11) **P. dilatatum** J. Agardh, 1876, p. 347.
Syntype localities: "ad oras Novae Zelandiae et Tasmaniae"; lectotype locality: Tasmania (Womersley, 1971).
Distribution: West Island (S. Australia) to Port Phillip Bay (Vic.) and around Tasmania.
References: Womersley (1971, 1994); Fuhrer (1981).

12) **P. froelichianum** Kützing, 1843, p. 450.
Type locality: "tropical Atlantic Ocean" "In oris Senegambiae" [= region of the Senegal and Gambia rivers, West Africa].
Distribution: West Africa.
References: Lawson et al. (1995).

13) **P. fuscorubrum** Baardseth, 1941, p. 69, figs 35, 36D-E.
Syntype localities: Tristan da Cunha, Nightingale, Stoltenhoff and Inaccessible islands, South Atlantic.
Reference: Baardseth (1941).

14) **P. glomeratum** J. Agardh, 1852, p. 397.
Type locality: Cape of Good Hope, South Africa.
Distribution: South Africa, Namibia.
References: Simons (1964); Wynne (1986); Seagrief (1988); Stegenga et al. (1997).
Tax. syn.: *P. subfastigiatum* Kützing (1866) (fide Simons 1964); *P. membranceum* f. *subfastigiatum* (Kützing) DeToni (1900).

15) **P. hamatum** J. Agardh, 1876, p. 338.
Type locality: Norfolk Island, South Pacific.
Distribution: Norfolk I.; northeastern Australia; Lord Howe I.; New Zealand, including Kermadec Islands.
References: Chapman (1979); Cribb (1983); Nelson & Adams (1984); Millar & Kraft (1993); Adams (1994); Millar (1999).

16) **P. hookeri** Harvey in Hooker & Harvey, 1845a, p. 257.
Type locality: "Christmas Harbour, Kerguelen's Land [= Îles Kerguelen].
Distribution: subantarctic islands (Heard I., Îles Kerguelen, Macquarie I., South Georgia, South Orkney Is.).
References: Harvey (1849, pl. 42); Kützing (1866, pl. 52a-c); Ricker (1987).

17) **P. leptophyllum** Kützing, 1849, p. 885.
Type locality: Tasmania, Australia.
Distribution: Tasmania, S. Australia to New South Wales, and New Zealand, including subantarctic islands.
References: Kützing (1866, pl. 45a-c); Hay et al. (1985); Millar & Kraft (1993); Adams (1994).
Tax. syn.: *P. flexuosum* (Hooker & Harvey) Sonder, 1853, p. 682; basionym: *P. coccineum* var. *flexuosum* Hooker & Harvey (1847).
Tax. syn.: *P. leptophyllum* Kützing var. *flexuosum* J. Agardh (Hooker & Harvey) J. Agardh (1876).
Tax. syn.: *P. cartilagineum* (Linn.) P.S. Dixon var. *leptophyllum* (Kützing) V.J. Chapman (1979). Womersley (1971) and South & Adams (1979) recognized *P. leptophyllum* as a separate species.

**P. leptophyllum** var. **recurvatum** J. Agardh, 1876, p. 339.
Syntype localities: Tasmania and New Zealand.
Womersley (1971) called for a re-investigation of the type material of this taxon.

**P. leptophyllum** var. **strictum** J. Agardh, 1876, p. 338.
Type locality: Not specified other than "*Pl. coccineum auct. austral.*"
Womersley (1971) suggested that this is "probably a form of *P. cartilagineum*".

18) **P. maxillosum** (Poiret) Lamouroux, 1813, p. 50.
Basionym**:** *Fucus maxillosus* Poiret, 1808, p. 389.
Type locality: Cape of Good Hope, South Africa.
Distribution: South Africa.
References: Papenfuss (1968); Stegenga et al. (1997).
Tax. syn.: *P. membranceum* Suhr, 1840, p. 261 (fide Papenfuss 1968).

19) **P. mertensii** (Greville) Harvey, 1849, p. 122.
Basionym: *Thamnophora mertensii* Greville, 1830, p. xlix.
Type locality: "ad Novam Hollandiam" [Australia].
Distribution: western to southern Australia (Victoria), and northern Tasmania, Australia.

References: Harvey (1862, pl. 223); Kützing (1866, pl. 54a-d, pl. 55d-h); Womersley (1971, 1984); Fuhrer (1981); Huisman (2000).
Tax. syn.: *P. procerum* (C. Agardh) Suhr, 1834, as to name but not as to record from South Africa. Basionym: *Delesseria plocamium* var. *procerum* C. Agardh, 1823, p. 181 [syntype localities: Western Australia and Cape of Good Hope, South Africa]; non *P. procerum* (C. Agardh) Hooker & Harvey nom. illegit., 1845b, p. 542. Cf. Womersley (1971, p. 18); *Thamnophora procera* (C. Agardh) J. Agardh, 1841, p. 10; *Plocamium nidificum* Harvey ex J. Agardh, 1876, p. 346.

20) **P. microcladioides** South & Adams, 1979, p. 128.
Type locality: Jackson Bay, South Westland, New Zealand.
Distribution: New Zealand (southern North I., South I., Stewart I., Chatham Is., Auckland Is., subantarctic islands).
References: Hay et al. (1985); Millar (1990); Millar & Kraft (1993); Adams (1994).

21) **P. minutum** Levring, 1944, p. 11, figs 5 & 6.
Type locality: Crozet Islands.
Distribution: Crozet Islands.
References: Levring (1944); Papenfuss (1964).

22) **P. oregonum** Doty, 1947, p. 177, pl. 14, fig. B.
Type locality: Harris State Park, Brookings, Curry County, Oregon, USA.
Distribution: southern British Columbia (Canada) to Sonoma County, California (USA).
References: Gabrielson & Scagel (1989); Scagel et al. (1989).

23) **P. ovicorne** Okamura, 1896, p. 23 ("P. ovicornis"), pl. 3, figs 3 & 4.
Type locality: Kanagawa, Prov. Sagami, Enoshima, Japan.
Distribution: Japan.
References: Okamura (1913, pl. 103, as *P. oviforme*); Okada (1956, as *P. oviforme*); Yoshida (1991, pl. 67, as *P. ovicornis*; 1998).
Tax. syn.: *P. oviforme* Okamura ex DeToni (1900).

24) **P. patagiatum** J. Agardh, 1894, p. 133.
Syntype localities: Encounter Bay and mouth of the Hopkins River, southern Australia.
Distribution: Nuyts Reef, S. Aust. to Cape Woolamai, Vic. and around Tasmania, Australia (Womersley, 1994).
References: Womersley (1971, 1994).

25) **P. patens** G. Martens, 1868, p. 32.
Type locality: Zamboanga, Mindanao, Philippines.
Distribution: Philippines.
There have been no new collections reported since Martens' description of this species (Silva et al., 1987).

26) **P. preissianum** Sonder, 1845, p. 54.
Type locality: southwestern Australia.
Distribution: western Australia, southern Australia to Wilsons Promontory, Victoria.
References: Harvey (1849, pl. 63; 1859, pl. 63); Kützing (1866, pl. 53d-f, as *P. Preisii*); Womersley (1971, 1984); Huisman (2000).

27) **P. raphelisianum** Dangeard, 1949, p. 163, figs. 14B, C.
Syntype localities: Salé, Fedhala, Casablanca, Mogador (Morocco).
Distribution: Rabat to Mihrleft, Morocco, south to Cap Vert (Sénégal) Cf. Lawson & John (1977); southern and northwestern Spain.
References: Raphélis (1929, as *Plocamium latifrons* J. Agardh nom. ined.); Gayral (1958); Seoane-Camba (1965); Donze (1968); Lawson et al. (1995); Conde et al. (1996).

28) **P. recurvatum** Okamura, 1913, p. 7, pl. 102, figs. 3 & 4.
Syntype localities: Hirakata in Prov. Hitachi and Kobama in Prov. Kadzusa, Japan
Distribution: Japan.
References: Yoshida (1998).

29) **P. rigidum** Bory de Saint-Vincent in Belanger, 1834, p. 164.
Type locality: Cape of Good Hope, South Africa.
Distribution: Namibia, South Africa.
References: Simons (1964, 1976); Papenfuss (1968); Wynne (1986); Seagrief (1988); Stegenga et al. (1997).
Tax. syn.: *P. condensatum* Kützing (1866) (fide Delf & Mitchell, 1921); tax. syn.: *P. latiusculum* Kützing (1866, pl. 47d-e) (fide Papenfuss 1968); tax. syn.: *P. coccineum* var. *latiusculum* Kützing (1849); tax. syn.: *P. robustum* Kützing (1866, pl. 49a-b).

**P. rigidum** var. **tenuius** Grunow, 1867, p. 74.
Type locality: Algoa Bay, Cape Prov., South Africa.

30) **P. sandvicense** J. Agardh, 1892, p. 95.
Type locality: Honolulu, Hawaii (USA).
Distribution: Hawaiian Islands.
References: Magruder & Hunt (1979); Abbott (1999).

31) **P. secundatum** (Kützing) Kützing, 1866, p. 15, pl. 42c, d.
Basionym: *P. coccineum* var. *secundatum* Kützing, 1849, p. 883.
Type locality: N. W. Bay, Hermite Island, Cape Horn, Tierra del Fuego.
Tax. syn.: *P. coccineum* [var.] *australe* J. Agardh (1852).
Distribution: Falkland Is., Fuegia, Îles Kerguelen, Macquarie I., South Georgia, South Orkney Is. cf. Ricker (1987); Chile; Mediterranean Sea.
References: J. Agardh (1876); Kützing (1866); Ricker (1987); Cormaci et al. (1991); Ramírez & Santelices (1991).

32) **P. serratulum Okamura**, 1932, p. 101.
Type locality: Kôtôshô, east of the south tip of Taiwan.
Distribution: Japan, Taiwan.
References: Okamura (1923, pl. 198, figs 1-4, as *P. costatum*); Tanaka & Itono (1972); Lewis & Norris (1987).
There has been confusion about the spelling of this epithet because Okamura (1932) twice used "*serrulatum*" in his English account but twice used "*serratulum*" in his Japanese account. Although Okamura (1942) twice used "*P. serrulatum*" in the index in the final part of his "Icones", he had earlier used "*P. serratulum*" (Okamura 1936). This first choice by the author should be followed according to Art. 61.3 of the ICBN (Greuter et al. 2000).

**P. serratulum** var. **pectinatum** Cordero, 1977, p. 140. figs 128 & 129.
Type locality: Batanes, Basco, Tajojora, Philippines.

33) **P. suhrii** Kützing, 1849, p. 886.
Type locality: Cape of Good Hope.
Distribution: South Africa.
References: Kützing (1866, pl. 54e-f); Simons (1964, 1976); Seagrief (1980, 1988); Stegenga et al. (1997).
Tax. syn.: *P. procerum* sensu Suhr, 1834, p. 726, pl. 2, fig. 20w, x, y; *P. nobile* J. Agardh, 1852, p. 397; tax. syn.: *P. fullerae* Schmitz ex Mazza, 1908, p. 19; *P. membranceum* sensu Kylin (1938) pl. 3, fig. 9, non Suhr (1840) (fide Papenfuss 1968).

34) **P. telfairiae** (W. Hooker & Harvey) Harvey in Kützing, 1849, p. 885.
Basionym: *Thamnophora telfairiae* W. Hooker & Harvey in Harvey, 1834, p. 147, pl. 125; *P. coccineum* var. *tenue* Kützing (1866).
Type locality: Mauritius.
Distribution: Indian Ocean, Japan, Korea, China, Philippines, South Africa (widespread in many temperate and tropical seas).
References: Okamura (1913, pl. 101, as *P. abnorme*); Yendo (1915); Lawson et al. (1995); Xia & Zhang (1999).
Tax. syn.: *Plocamium telfairiae* f. *uncinatum* (Okamura) Okamura (1942, p. 103); basionym: *P. abnorme* Hooker f. & Harvey f. *uncinatum* Okamura (1913, p. 2, pl. 102, figs. 1 & 2) (fide Yoshida et al. 1990).

35) **P. violaceum** Farlow, 1877, p. 240.
Lectotype locality: Santa Cruz, California (USA) (Dawson, 1961).
Distribution: northern southeast Alaska to Mexico; Chile.
References: Smith (1944); Gabrielson & Scagel (1989); Scagel et al. (1989); Ramírez & Santelices (1991).
Tax. syn.: *P. tenue* Kylin (1925) [lectotype locality: south of False Bay, San Juan Island, Washington (USA); see Gabrielson & Scagel (1989)].

Received 23 July 2001, accepted in revised form 23 January 2002.