

The Bangiophyte Species of the Faroe Islands

Reyðtarar av bólkinum Bangiophycidae í føroyskum øki.

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Úrtak

Víðfevnandi innsavningar av algum í Føroyum hava avdúkað hesi sløg av reyðalgum, sum hoyra til flokkin Bangiophycidae: *Bangia atropurpurea*, *Erythrocladia irregularis*, *Erythrotrichia bertholdii*, *E. carnea*, *Porphyropsis coccinea*, *Sahlingia subintegra*, *Porphyra amplissima*, *P. dioica*, *P. leucosticta*, *P. linearis*, *P. miniata*, *P. purpurea*, *P. umbilicalis* og minst trí sløg, sum helst ikki enn hava fingið navn. Skilnaður millum slektirnar *Porphyra* og *Bangia* sæst best á blaðskapi, liti á turkaðum herbarieintøkum og bygnaði av nøringsgögnum. Hini sløgini kunnu bert navngreinst við kanning í sjóneyku. Úrslitini av hesari kanning verða samanborin við úrslitini frá øðrum nýligum kanningum av hesum *Porphyra* algum í Bretsku Oyggjunum, har tey somu sløgini finnast uttan *P. miniata*.

Abstract

A study of the bangiophyte species (i.e. those belonging to the subclass of red algae the Bangiophycidae), based on extensive collections from the Faroe Islands, has revealed the following species: *Bangia atropurpurea*, *Erythrocladia irregularis*, *Erythrotrichia bertholdii*, *E. carnea*, *Porphyropsis coccinea*, *Sahlingia subintegra*, *Porphyra amplissima*, *P. dioica*, *P. leucosticta*, *P. linearis*, *P. miniata*, *P. purpurea*, *P. umbilicalis* and at least three possibly undescribed species. *Porphyra* and *Bangia* species can be distinguished on the basis of shape of frond, colour of dried herbarium specimens and

the nature of the reproductive structures. The other species require microscopic examination to be identified. The *Porphyra* data are discussed in relation to the recently studied British Isles bangiophyte flora which is similar but lacks *P. miniata*.

Introduction

Between 1994 and 1997 extensive collections were made of the marine algae and fauna in shallow water around the Faroe Islands as part of the BIOFAR project, the aim of which was to produce an inventory of all the plant and animal species present. This paper deals specifically with species of red algae collected that are currently assigned to the subclass Bangiophycidae (bangiophytes). These are dealt with separately from other red algae, the Florideophycidae. Two genera of bangiophytes, *Bangia* and *Porphyra*, have species that are notoriously difficult to identify because of the lack of obvious morphological characters.

The basic life history was originally elucidated by Drew (1949; 1954), who showed it to be heteromorphic, and consisting of

the conspicuous blade phase and the inconspicuous microscopic shell boring conchocelis phase. The conchocelis was originally described as a separate species, *Conchoceles rosea* Batters (Batters, 1892). In sexual reproduction, male gametangia and female gametes develop either on the same blade or on separate blades. After fertilisation, zygotosporangia release zygotospores that germinate into the diploid filamentous conchocelis phase. This phase develops conchosporangial branches with sporangia from which conchospores are released. These develop into the haploid blade phase. Asexual reproduction has also been reported and different species have the capacity to develop a variety of different spore types (for terminology see Nelson *et al.*, 1999). It has also been proposed that some spores from the blade phase can produce haploid conchocelis filaments (Kornmann, 1994) and there is some evidence of this from chromosome counts in *Porphyra dioica* (Holmes, pers. comm.). Recently, the use of molecular techniques has made it possible to obtain a much better understanding of the taxonomy of *Porphyra* at the species level (e.g. Brodie *et al.*, 1996; 1998). Molecular data also indicate that *Bangia atropurpurea* from Denmark and the British Isles are closely related to *Porphyra* (Brodie *et al.*, 1998; see also Müller *et al.*, 1998).

This paper presents a list of bangiophyte species known for the Faroe Islands, supplemented with annotations to characterise the species and help with identification. For more detailed descriptions of most species see Brodie and Irvine (2002).

Material and methods

Algae were collected selectively by hand at 265 stations from the littoral to 25 m depth. Sublittoral collections were by Scuba diving. Collections were made at all seasons, but less in the winter months. The localities visited were on most of the larger islands and included places at the open coasts with different exposure to waves and more or less sheltered places in the fjords. Information about the localities with details of collection dates, depth and geographical coordinates for each station are available in Sørensen *et al.* (2001), while a map showing the locations of the stations is available in Nielsen and Gunnarsson (2001). The material was examined fresh when possible, and for some collections after preservation in 2% formalin and stored in a deep freezer for one to several months. Specimens in shells and other calcified material were decalcified over night in a 5% acetic acid/water solution. Permanent slide preparations were mounted in KARO® (corn syrup). Voucher specimens are kept in the Botanical Museum, Copenhagen (C) with duplicate collections in the Faroese Museum of Natural History, Tórshavn and the Marine Research Institute, Reykjavik, Iceland. Molecular analyses were applied to confirm some of the identifications. The procedure was the same as used by Brodie *et al.* (1996; 1998). Names not in current use but applied by Simmons (1897), Børgeesen (1902) and Irvine (1982) are given. Author names are abbreviated according to Brummit and Powell (1992).

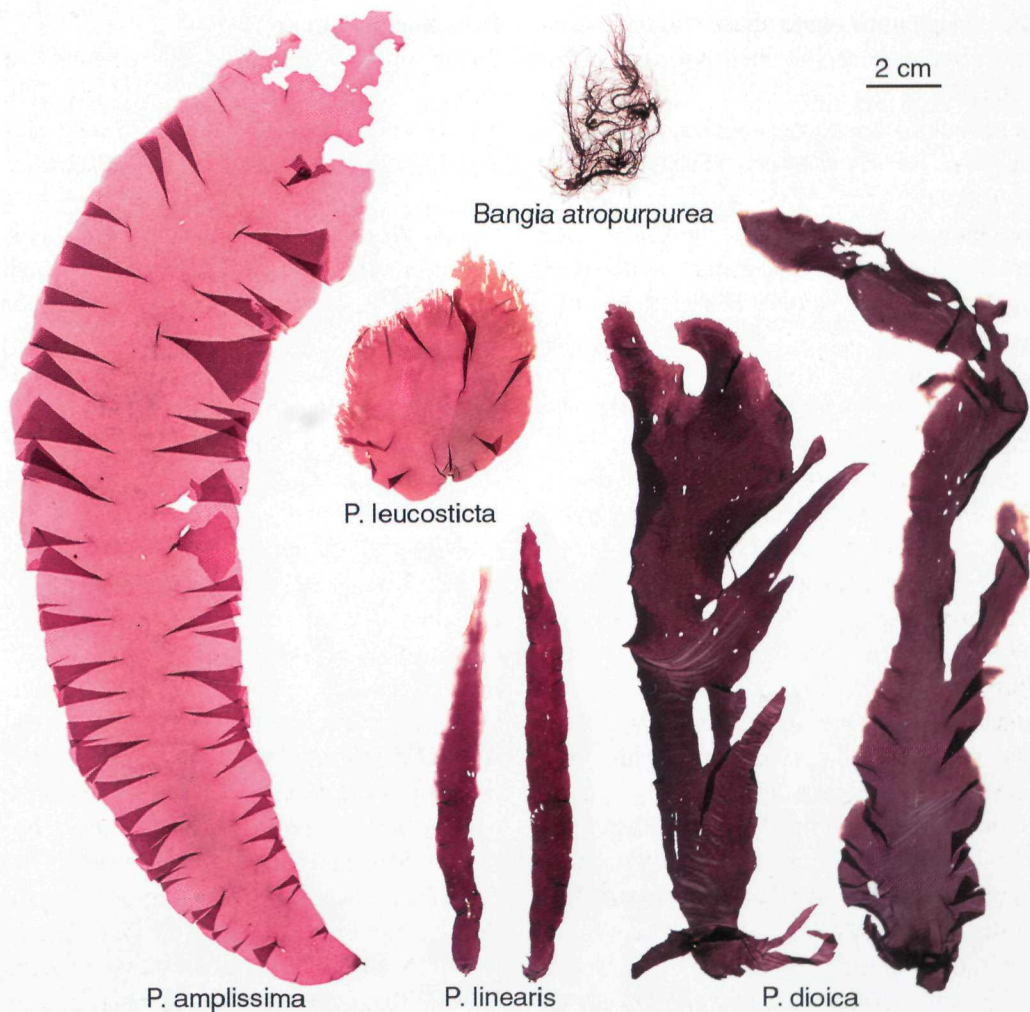


Fig. 1. Herbarium specimens of *Porphyra* species and *Bangia atropurpurea*.

Results

Herbarium specimens showed a more distinct colour than fresh material, but after formalin treatment the colours changed markedly and often became duller.

The list of species includes the following symbols:

*: new or previously unpublished records for the Faroe Islands.

() : collection from a wide depth range.

Terminology for reproductive structures follows Nelson *et al.* (1999).

Bangia atropurpurea (Roth) C. Agardh (Fig. 1)*Bangia fuscopurpurea* (Dillwyn) Lyngb.

Reference: Kornmann and Sahling (1977).

Stations: 1016, 1024, 1049, 1110, 1347, 1349, 1352, 1353, 1354, 1358, 1362, 1363, 1364, 1371, 1376, 1380, 1700, 1719, 1720, 1721, 1722, 1732, 1738, 1759, 1760, 1762, 1763, 1768, 1769, 1774, 1775, 1779, 1780, 1911, 1913.

Littoral.

Remarks: collected in April-August and October. Male gametangia and zygotosporangia in May. On rocks and occasionally on barnacles.

Morphology: thallus unbranched, filamentous (unimultiseriate).

Herbarium specimens: purplish-red to almost black, resembling fine hair, adhering well to paper.

Conchocelis phase

Stations: 1004, 1006, 1009, 1012, 1013, 1015, 1018, 1020, 1021, 1026, 1027, 1028, 1032, 1033, 1034, 1036, 1037, 1040, 1041, 1043, 1049, 1117, 1118, 1119, 1121, 1123, 1127, 1128, 1132, 1134, 1273, 1274, 1276, 1278, 1279, 1283, 1285, 1291, 1294, 1298, 1299, 1300, 1301, 1305, 1347, 1349, 1351, 1353, 1354, 1359, 1360, 1363, 1364, 1365, 1372, 1378, 1682, 1684, 1688, 1689, 1691, 1692, 1693, 1695, 1697, 1701, 1702, 1703, 1710, 1715, 1716, 1720, 1726, 1727, 1732, 1736, 1738, 1768, 1769, 1773, 1776, 1783, 1850, 1852, 1853, 1903, 1912, 1913.

Littoral to 25 m depth.

Remarks: collected in February, April-October. Frequent in shells of barnacles, molluscs and tubes of serpulid polychaetes. The identification of conchocelis to species level was not attempted. In cul-

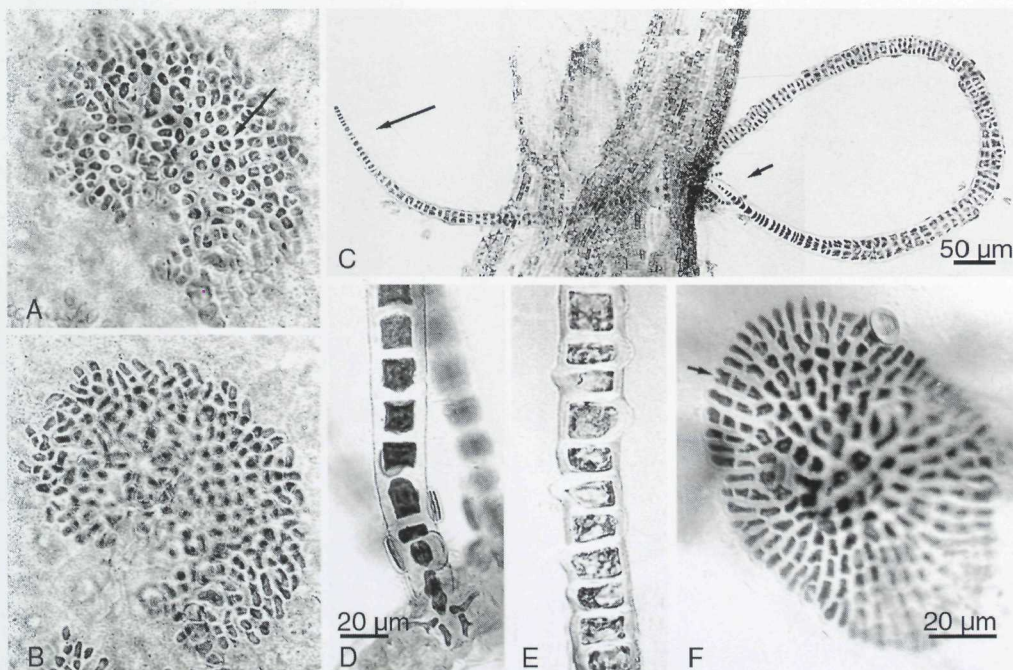


Fig. 2. A, B. *Erythrocladia irregularis* epiphytic on *Osmunda pinnatifida*. A. Central part with spores (arrow). B. Free filaments at margin. C. *Erythrotrichia bertholdii* epiphytic on *Desmarestia viridis*, uniseriate tip (long arrow) and base (short arrow). D. Basal cells of *E. bertholdii*. E. *Erythrotrichia carnea* uniseriate filament, and characteristic wall bulges; stellate plastid visible in some cells. F. *Sahlingia subintegra* showing bifurcate marginal cell (arrow). A, B and F same magnification. D and E same magnification.

ture this phase is morphologically distinct between species (Brodie and Irvine, 2002).

Morphology: rose-red spots in calcified material, consisting of uniseriate filaments with alternate or opposite branches. Cells cylindrical or irregularly swollen to globular.

* **Erythrocladia irregularis** Rosenv. (Fig. 2A, B)

Reference: Kornmann and Sahling (1985).

Stations: 1283, 1903.

Sublittoral, 5-10 m depth.

Remarks: collected in August-September: monosporangia present. Epiphytic on *Palmaria palmata* (L.) Kuntze and *Desmarestia viridis* (O.F.Müll.) J.V.Lamour.

Morphology: thallus microscopic, bright red, prostrate filaments forming irregular patches on host.

* **Erythrotrichia bertholdii** Batters (Fig. 2C, D)

Reference: Brodie and Irvine (2002).

Stations: 1003, 1005, 1008, 1017, 1117, 1118, 1140, 1305.

Sublittoral, 0-20 m depth.

Remarks: collected in June-July and September. Epiphytic on *Polysiphonia stricta* (Dillwyn) Grev., *Pterosiphonia parasitica* (Huds.) Falkenberg, *Pilota gunneri* P.C.Silva, Maggs & L.M.Irvine, *Desmarestia aculeata* (L.) J.V.Lamour., *Ectocarpus siliculosus* (Dillwyn) Lyngb., *Cladophora rupestris* (L.) Kütz. and epizoic on a hydroid.

Morphology: thallus microscopic, purple-red, erect, unbranched filaments, uniseriate below, becoming multiseriate and cylindrical above. Attached by 2-3 elongated basal cells.

Erythrotrichia carnea (Dillwyn) J.Agardh (Fig. 2E)

Erythrotrichia ceramicola (Lyngb.) Aresch.

Reference: Kornmann and Sahling (1985), Rosenvinge (1909).

Stations: 1041, 1042, 1043, 1116, 1119, 1127, 1272, 1275, 1349, 1682, 1686.

Littoral to 15 m depth.

Remarks: collected in April, June-July and September. Epiphytic on *Ceramium rubrum* (Huds.) C.Agardh,

Cystoclonium purpureum (Huds.) Batters, *Polysiphonia fucoides* (Huds.) Grev., *Desmarestia viridis*, *Laminaria faeroensis* Børgesen, *Dityosiphon ekmanii* Aresch., *D. foeniculaceus* (Huds.) Grev., *Cladophora flexuosa* (O.F.Müll.) Kütz. and *C. rupestris*.

Morphology: thallus microscopic, rose-red, erect, unbranched, uniseriate filaments. Attached by a single expanded cell.

Porphyra amplissima (Kjellm.) Setch. & Hus (Fig. 1)

Porphyra miniata (C.Agardh) C.Agardh f. *amplissima* (Kjellm.) Rosenv.

References: Bird and McLachlan (1992), Brodie and Irvine (2002).

Stations: 1046, 1111, 1116, 1119, 1126, 1127, 1137, 1274, 1359, 1360, 1776.

Sublittoral, 0-15 (-20) m depth.

Remarks: collected in May-July and September.

Morphology: blade can be one or two cells thick, obovate. Margins usually with ruffles (folds in the frond). These become very apparent in herbarium specimens extending from near middle of blade. Stipe often conspicuous, up to about 1 mm. Male gametangial and zygotosporangial sori marginal, intermixed on the same blade. Older specimens with paler yellowish margins where male gametangia and spores have been released.

Herbarium specimens: pink to pink-magenta, adhering well and integrating with the paper, making it hard to distinguish the edge of pressed specimens by feel, whereas it is possible with the other sublittoral species *P. miniata*.

Porphyra dioica Brodie & L.M.Irvine (Fig. 1)
Porphyra umbilicalis (L.) J.Agardh f. *laciniata* (C.Agardh) LeJol.

References: Brodie *et al.* (1996), Brodie and Irvine (1997).

Stations: 1043, 1137, 1174, 1183, 1272, 1282, 1288, 1289, 1297, 1347, 1348, 1349, 1351, 1352, 1353, 1355, 1357, 1358, 1362, 1364, 1696, 1697, 1709, 1732, 1738, 1768, 1771, 1773, 1774, 1775, 1779, 1780, 1781.

Littoral, including rockpools.

Remarks: collected in February and April-October.

Morphology: blade one cell thick mostly broadly oval in shape, often elongate; one to several blades from

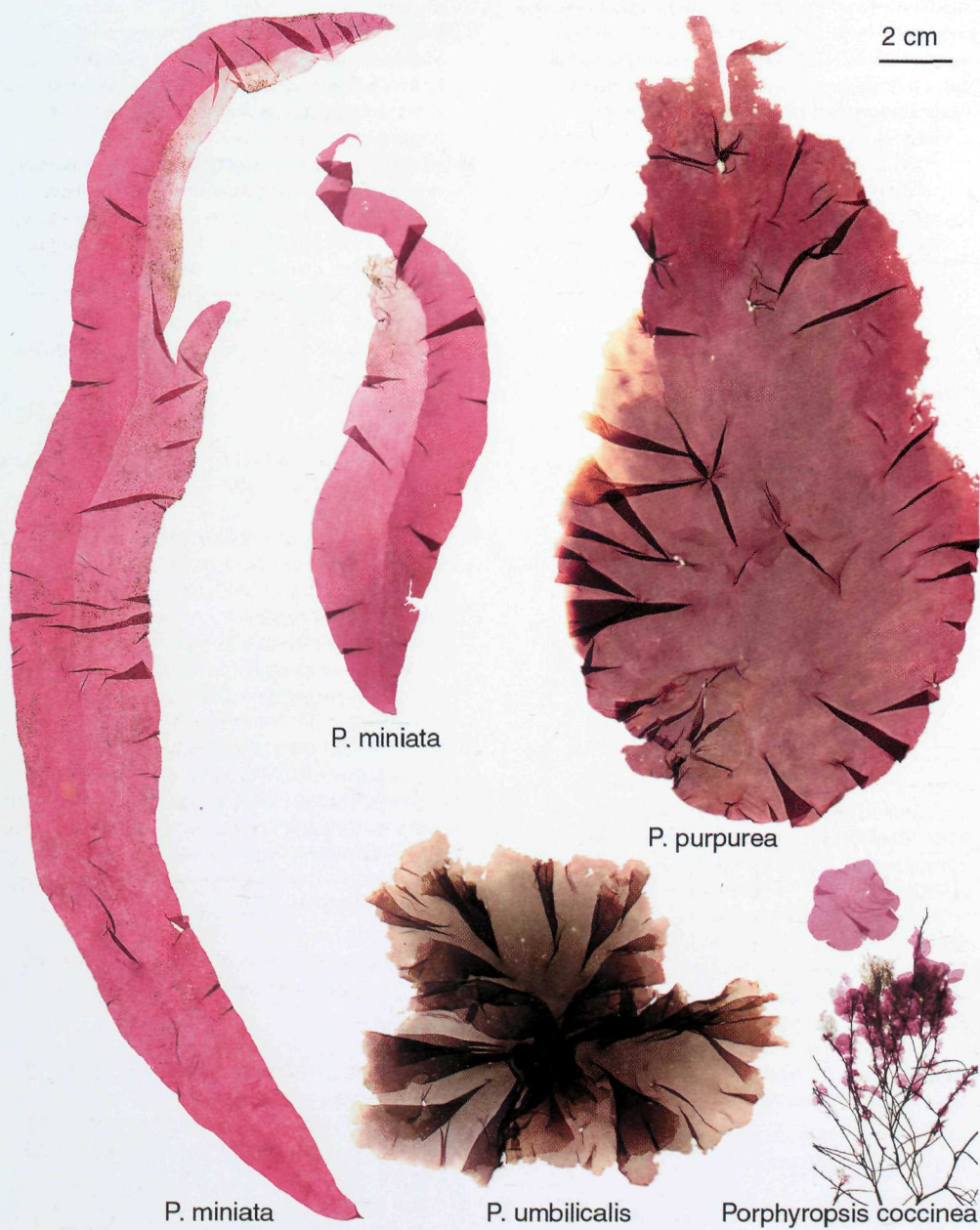


Fig. 3. Herbarium specimens of *Porphyra* species and *Porphyropsis coccinea* epiphytic on *Desmarestia aculeata*. Upper specimen of *P. coccinea* removed from *D. aculeata*.

holdfast, often lacinate (appearing as if the blade is cut into ribbons). Margins ruffled. Stipe microscopic. Male gametangial and zygotosporangial sori marginal, usually on separate individuals. Male gametangial sori yellowish-white. Zygotosporangial sori bright red, continuous or interrupted. Male gametangial blade often narrower than zygotosporangial blade. If male gametangial and zygotosporangial sori are present on the same individual, then they are separated by a sharp line that extends to the holdfast.

Herbarium specimens: brownish purple to dark purple, sometimes with a dark green tinge.

Porphyra leucosticta Thur. in LeJol. (Fig. 1)

Reference: Bird and McLachlan (1992), Brodie and Irvine (2002)

Stations: 1033, 1034, 1035, 1045, 1046, 1047, 1049, 1124, 1126, 1142, 1174, 1183, 1187, 1272, 1281, 1288, 1305, 1347, 1349, 1352, 1353, 1354, 1358, 1363, 1364, 1371, 1380, 1688, 1720, 1722, 1723, 1738, 1768, 1769, 1771, 1773, 1774, 1775, 1776, 1777, 1850, 1911, 1912.

Littoral, including rockpools to shallow subtidal.

Remarks: collected in April-October. On rocks and epiphytic on other algae, commonly on *Mastocarpus stellatus* (Stackh. in With.) Guiry in Guiry *et al.*, and *Fucus* spp., occasionally on *Himanthalia elongata* (L.) Gray.

Morphology: blade one cell thick, ovate, oblong, orbicular, irregular or umbilicate, often with a cordate base. Margins usually with some ruffles. Male gametangial and zygotosporangial sori on the same blade; intermixed in separate sori, scattered along the margins and extending towards the centre of the blade. Male gametangial sori distinct pale yellowish-white, oblong / lozenge / diamond / irregular shaped patches; sometimes merging to give a pale margin in older individuals. Zygotosporangial sori inconspicuous in slightly darker patches.

Herbarium specimens: purple-mauve / pinkish-mauve. Mostly adhering well to paper.

Porphyra linearis Grev. (Fig. 1)

Porphyra umbilicalis (L.) J.Agardh f. *linearis* (Grev.) LeJol.

Reference: Bird and McLachlan (1992).

Stations: 1046, 1347, 1352, 1356, 1357, 1358, 1380, 1709.

Upper littoral.

Remarks: collected in January-February and April-May. Commonly intermixed with *Calothrix scopulorum* (F.Weber & D.Mohr) C.Agardh ex Bornet & Flahault and other blue-green algae. In May becoming sparse and reduced in size.

Morphology: blade one cell thick, initially ovate, becoming linear. Margins not or slightly ruffled. Stipe usually distinct, up to 1 mm long. Blades up to 22 cm long and 2 cm wide. Male gametangial and zygotosporangial sori marginal, usually on separate individuals. Male gametangial sori pale yellow, zygotosporangial sori dark red.

Herbarium specimens: purple; specimens collected in May were pale.

Porphyra miniata (C.Agardh) C.Agardh (Fig. 3)

Porphyra miniata (C.Agardh) C.Agardh f. *typica* Rosenv.

Reference: Bird and McLachlan (1992).

Stations: 1018, 1019, 1020, 1032, 1034, 1036, 1037, 1353, 1358, 1362, 1726, 1729.

Sublittoral, 0-25 m depth.

Remarks: collected in May and July.

Morphology: blade 2 cells thick, linear to broadly ovate. Margins usually with some ruffles. Stipe inconspicuous. Blade divided into two sectors, one with male gametangial and the other with zygotosporangial sori. Male gametangial sector pale yellow towards the tip of the blade. Zygotosporangial sector becoming pinkish-red toward the tip of the blade. Male gametangial sector maturing before zygotosporangial, eroding away, sometimes leaving only the zygotosporangial sector, when the blade may appear falcate.

Herbarium specimens: vivid dark-pink / magenta to brownish pink, adhering well to paper.

Porphyra purpurea (Roth) C.Agardh (Fig. 3)

Reference: Brodie and Irvine (1997).

Stations: 1043, 1045, 1046, 1121, 1126, 1183, 1272, 1275, 1279, 1289, 1297, 1305, 1347, 1364, 1723, 1771, 1777.

Littoral to 1 m depth.

Remarks: collected in April-July and September.

Morphology: blade one cell thick, ovate, sometimes falcate, occasionally appearing umbilicate (as with a naval). Margins ruffled. Stipe inconspicuous.

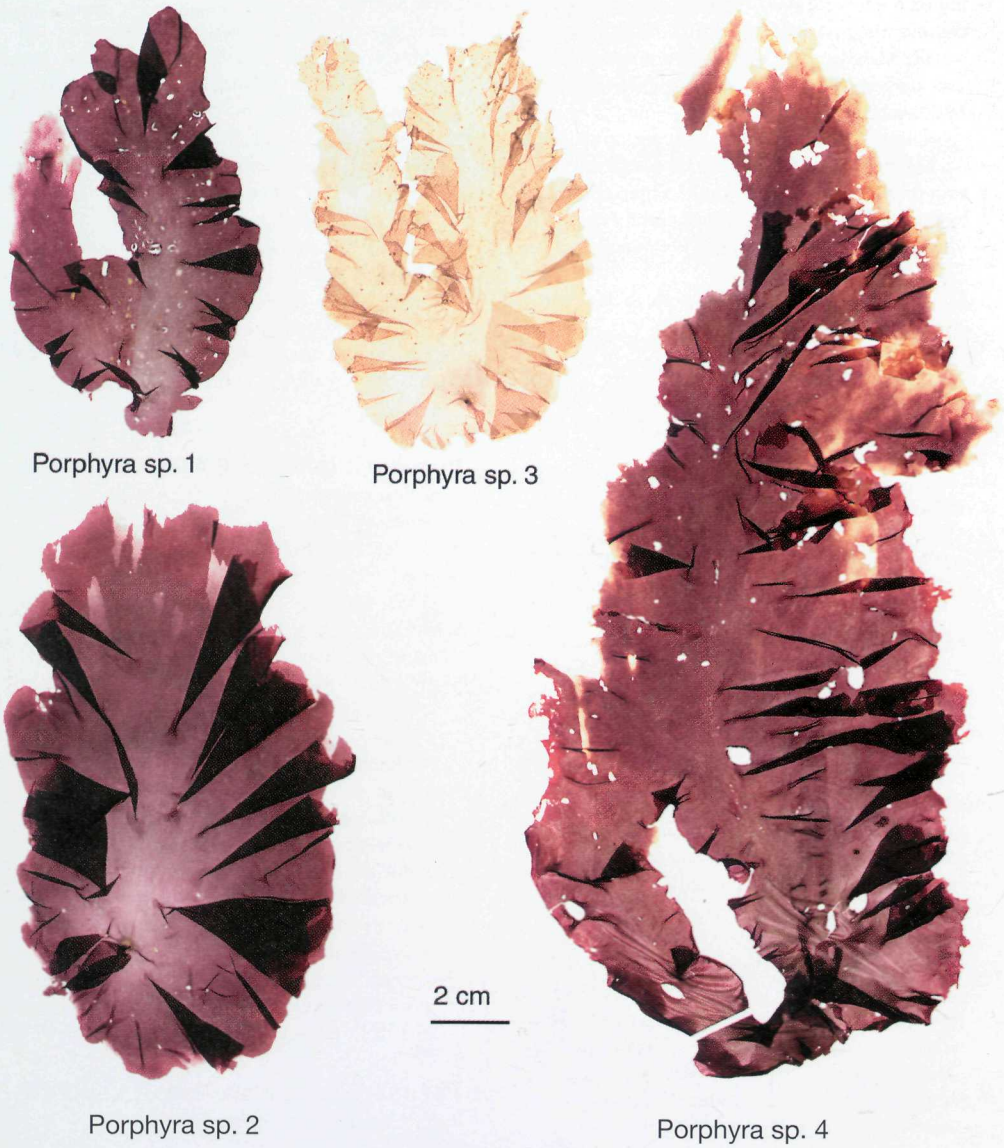


Fig. 4. Herbarium specimens of unidentified *Porphyra* species. The pink colour of *Porphyra* species 3 lost due to preservation in formalin.

Blade with a separate unequal male gametangial and zygotosporangial sector divided by a partial line from the margin to part way into the frond, but not reaching the holdfast. Male gametangial sori yellowish-white; zygotosporangial sori red; marginal.

Herbarium specimens: purple-brown, light purple, adhering well to paper.

Porphyra umbilicalis (L.) Kütz. (Fig. 3)

Reference: Bird and McLachlan (1992), Brodie and Irvine (2002).

Stations: 1033, 1035, 1043, 1137, 1183, 1187, 1280, 1349, 1351, 1352, 1353, 1354, 1358, 1363, 1700, 1720, 1721, 1732, 1770, 1774, 1775, 1780, 1781, 1783, 1784, 1785, 1850, 1851, 1911, 1913.

Littoral.

Remarks: collected in April-October.

Morphology: blade one cell thick, appearing umbilicate (as with a naval), often with several to many lobes from holdfast to give a rosette appearance. Margins ruffled. Stipe inconspicuous. Male gametangial and zygotosporangial sori marginal on separate individuals. Male gametangial sori yellowish-white; zygotosporangial sori red.

Herbarium specimens: light olive-green, pale brown, reddish brown, not adhering well to paper.

***Porphyra* sp. 1** (Fig. 4)

Stations: 1279, 1280, 1289.

Remarks: collected in September.

Littoral.

Morphology: blade one cell thick, ovate. Margins slightly ruffled. Stipe inconspicuous. In one specimen, male gametangial and zygotosporangial each on a separate lobe of the thallus, and divided from margin to holdfast. Other details of reproduction are unknown. Male gametangial sori yellowish-white. Zygotosporangial sori red.

Herbarium specimens: brown purple, adhering well to paper.

***Porphyra* sp. 2** (Fig. 4)

Station: 1781.

Remarks: collected in August.

Littoral.

Morphology: blade one cell thick, ovate. Margins with some ruffles. Stipe inconspicuous. Male gametan-

gial and zygotosporangial sori as in *P. leucosticta*, but male gametangial patches larger and more elongate.

Herbarium specimens: purple brown, adhering well to paper.

***Porphyra* sp. 3** (Fig. 4)

Station: 1126.

Remarks: collected in June.

Littoral.

Morphology: blade one cell thick, ovate but dividing into 2 lobes. Margins ruffled. Stipe inconspicuous. Male gametangial sori as in *P. leucosticta*, but patches very pale and tending to blend with the rest of thallus.

Herbarium specimens: very pale brown (straw), adhering well to paper.

***Porphyra* sp. 4** (Fig. 4)

Reference: Brodie and Irvine (2002), Kornmann and Sahling (1991, as *P. insolita*. Kornmann & Sahling)

Stations: 1046, 1174, 1184, 1280, 1281, 1297, 1305, 1346, 1347, 1348, 1352, 1353, 1354, 1358, 1362, 1363, 1683, 1684, 1685, 1686, 1687, 1688, 1689, 1690, 1691, 1692, 1693, 1695, 1696, 1697, 1701, 1702, 1703, 1721, 1738, 1768, 1770, 1773, 1775, 1779, 1780, 1781, 1911, 1913.

Littoral to 1 m depth.

Remarks: collected in January and April-October.

Morphology: blade one cell thick, broadly ovate to umbilicate (as with a naval). Margins ruffled. Stipe inconspicuous. Male gametangial and zygotosporangial sori in broad marginal band, appearing on separate or on the same individual. When on the same individual, then separated by a line from the margin to the holdfast. Male gametangial sori pale yellow; zygotosporangial sori bright red.

Herbarium specimens: dark purple, adhering quite well to paper.

Porphyropsis coccinea (J.Agardh ex Aresch.)

Rosenv. (Fig. 3)

Porphyra coccinea J.Agardh ex Aresch.

Reference: Kornmann and Sahling (1977).

Stations: 1003, 1008, 1009, 1011, 1012, 1013, 1026, 1027, 1032, 1036, 1037, 1038, 1111, 1114, 1117, 1118, 1229, 1366, 1373, 1381, 1382, 1496, 1724,

1725, 1726, 1730, 1731, 1737.

Sublittoral, 5-25 m depth.

Remarks: collected in May-August. Epiphytic on *Callophyllis laciniata* (Huds.) Kütz., *Dilsea carnosa* (Schmidle) Kuntze, *Odonthalia dentata* (L.) Lyngb., *Desmarestia aculeata*, blade of *Laminaria hyperborea* (Gunnerus) Foslie, and on *Modiolus modiolus* L.

Morphology: blade one cell thick, ovate, arising from a cushion of cells. Blade sometimes microscopic.

Herbarium specimens: pink-mauve, translucent.

Porphyrostromium boryanum (Mont.) Trevis.

Erythrotrichia boryana (Mont.) Berthold.

Reference: Kornmann (1984) as *Erythrotrichopeltis boryana* (Trevis.) Kornmann.

Remarks: recorded by Irvine (1982) but has not been confirmed nor collected since.

Stylonema alsidii (Zanardini) K.M.Drew

Goniotrichum alsidii (Zanardini) M.Howe.

Reference: Bird and McLachlan (1992).

Observed in Børgesen's permanent preparations of *Callithamnion scopulorum* (no. 839, Vaagö, 4.IV.1896). Otherwise only recorded by Holt (unpubl. report, 1975, as *G. elegans* (Chauv.) LeJol.); cited by Irvine (1982).

* **Sahlingia subintegra** (Rosenv.) Kornmann

(Fig. 2F)

Reference: Kornmann (1989).

Stations: 1008, 1015, 1688.

Littoral to 20 m depth.

Remarks: collected in July and October. Epiphytic on *Lomentaria articulata* (Huds.) Lyngb., *Polysiphonia fibrillosa* (Dillwyn) Spreng. and epizoic on hydroids.

Morphology: thallus microscopic, monostromatic, filamentous, disc-shaped with some bifurcate marginal cells.

Discussion

Six species of non-*Porphyra*/*Bangia* bangiophytes have been recorded from the

Faroe Islands, although the records for *Porphyrostromium boryanum* and *Stylonema alsidii* could not be confirmed (Irvine, 1982). This may be an underestimate of the diversity of these species as most can only be detected and identified with the aid of a microscope. Culture work coupled with molecular studies are necessary to get a better understanding of the taxonomy of these species (Brodie, pers. obs.).

At least 11 species of *Porphyra* have been recognised, including four which may represent undescribed taxa. In the context of the northeast Atlantic (see Brodie *et al.*, 1998) *Porphyra* is a well-represented genus in the Faroe Islands. In comparison with the British Isles, whose *Porphyra* flora has recently been studied (Brodie and Irvine, 2002), most species are common to both areas (Table 1). *P. dioica*, *P. leucosticta*, *P. linearis*, *P. purpurea* and *P. umbilicalis* are widespread throughout both areas. *P. miniata* and *P. amplissima* are northern elements of the flora, with the former not recorded from the British Isles and the latter only extending south to the Isle of Man. *P. drachii* J. Feldmann was not reported from the Faroe Islands in this study. It was not recognised in the British Isles until 1994 (Brodie *et al.*, 1998) and the full extent of its distribution is unknown. The same is also true for *P. yezoensis* sensu Kornmann (1986) and there has only been one record from the British Isles (Brodie and Irvine, 2002). The four possibly undescribed species from the Faroe Islands may also be more widespread but have hitherto gone unrecognised. *Porphyra* sp. 1 has an identical *rbcL-rbcS* intergenic spacer to

Table 1. Occurrence of species of *Bangia* and *Porphyra* from around the British Isles and the Faroe Islands.

Species	British Isles	Faroe Islands
<i>B. atropurpurea</i>	+	+
<i>P. amplissima</i>	+	+
<i>P. dioica</i>	+	+
<i>P. drachii</i>	+	-
<i>P. leucosticta</i>	+	+
<i>P. linearis</i>	+	+
<i>P. miniata</i>	-	+
<i>P. purpurea</i>	+	+
<i>P. umbilicalis</i>	+	+
<i>P. sp. 1</i> (Faroes, Norway)	-	+
<i>P. sp. 2</i> (' <i>leucosticta</i> ')	-	+
<i>P. sp. 3</i> (pale golden)	-	+
<i>P. yezoensis</i> sensu Kornmann	+	-

that of a specimen from Norway (Brodie, pers. obs.) and might represent a more northerly element of the flora.

The possibility that some specimens currently placed as *Porphyra* sp. 4 may represent a separate species, possibly *P. insolita* needs to be determined. *P. insolita* was only recently described as a new species (Kornmann and Sahling 1991) and it is apparent that it has been confused with *P. umbilicalis* and *P. purpurea* in the northeast Atlantic. However, in the absence of a type specimen for *P. insolita* and conflicting molecular data (Brodie, pers. obs.), further studies are required to determine whether this is a distinct taxon.

A number of other specimens remain unidentified in the collection and it is possible that there are other undescribed species present, but this requires further molecular studies to determine the exact identity of such individuals.

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