A FIELD KEY TO THE BRITISH BROWN SEAWEEDS (PHAEOPHYTA)

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INTRODUCTION

The larger, or macroscopic marine ALGAE (seaweeds) are mainly found in three of the algal classes:

CHLOROPHYTA—Green algae, usually rather delicate plants, grass-green in colour.

PHAEOPHYTA—Brown algae (the group covered by this key) which are either olive-green in colour or any shade of brown between golden to very dark.

RHODOPHYTA—Red algae which exhibit a wide range of colours from red or pink to a dark purplish-brown, almost black. They often bleach to a light brown or yellow in bright sunlight and may then become difficult to separate from brown algae. The base, shaded by the rest of the plant, often remains dark and plants with light upper parts and dark bases are probably red algae.

Fig. 1
Some littoral species of red algae that are commonly confused with brown algae.

Microscopic individuals of blue-green algae (CYANOPHYTA) are often present in large numbers and may appear as small black blobs or coloured slimes on seashores.

The main parts of a brown seaweed are illustrated in Fig. 2. The shape (or absence) of the holdfast is important for the identification of some species. In others it is the shape and size of the receptacles (reproductive structures) and/or air bladders that must be noted. Air bladders are sometimes confused with receptacles, but bladders are generally smooth outside, hollow inside, and have no other visible structures. The bladders of Halidrys are divided into compartments by internal cross-walls that are easily seen when the bladder is cut open lengthwise. Receptacles are usually rough or lumpy on the outside with the conceptacles (tiny cavities...
containing the reproductive structures) visible as minute spots, especially when held up to the light. Receptacles are not usually hollow but filled with jelly. Fig. 3 illustrates the differences between bladders and receptacles in three of the commoner species. Reference should also be made to Figures 8-22.

**ECOLOGY**

The dominant brown *seaweeds* of rocky sea shores grow in more or less distinct horizontal bands, or zones, across the rock surface. Each species occupies a characteristic level in response to prevailing environmental conditions, the major factor being the length of time that the plants are covered and uncovered by the tide. Upper shore species must withstand more extensive periods of desiccation, particularly in the summer, than plants growing lower down. Species intolerant of drying conditions are either absent from the shore (although perhaps abundant below low water mark) or are confined to rock pools, runnels or overhangs in shady places. However all these habitats, particularly on the upper shore, experience sudden changes in salinity which some species cannot tolerate. Estuarine habitats also experience large changes in salinity and few species penetrate the upper reaches.
Other factors, such as the intensity of wave action, tidal range, water turbidity and scour, the slope and aspect of the substrate, competition from other species and the grazing activities of herbivores are also important in determining the extent of zones and the presence (or absence) of particular species.

Zonation continues below low water mark of spring tides but, here in the sublittoral, it is light penetration that becomes the major factor determining the extent and depth of the various zones. In turbid waters seaweeds hardly extend below low water mark, but in clear water they may reach depths in excess of 40 m. Red seaweeds generally penetrate slightly deeper than the deepest Browns.

Different species characterise, both on the shore and sublittorally, areas exposed to and sheltered from strong wave action (Figs 4 and 5).

The vertical zonation of some species of brown seaweed at a typical exposed rocky site. The kite diagrams show the abundance of different species at vertical intervals. The wider the kite, the greater the abundance of a particular species.
Most brown seaweed species normally grow on bedrock or on large stable boulders although in some extremely sheltered areas they can be found unattached on the shore or, sublittorally, lying on the bottom. *Ascophyllum nodosum* var. *mackaii* appears not to develop a holdfast at all. Most of the other unattached forms have probably broken away from normal plants.

Unstable pebble beaches are devoid of attached algae in exposed areas, but seaweeds will colonist: pebbles if the wave action is insufficient to dislodge them. On
A Field Key to the British Brown Seaweeds (Phaeophyta)

The vertical zonation of some species of brown seaweed at a typical site of unstable substrate (e.g., shingle and gravel).

the shore (Fig. 6) the species are similar to those found on bedrock in sheltered sites (Fig. 5) but below the tidemarks the large kelps (Laminaria hyperborea and ochroleuca) are absent or confined to large boulders and other species may become dominant. In some areas pebbles may be stable throughout the summer but moved about during winter storms. Here the larger perennial plants do not survive beyond a juvenile stage, being removed by scour during winter storms. Summer annuals may then thrive in the lack of competition for space and light. This is particularly true sublittorally.
NOTES ON *FUCUS* SPECIES

1. There are three main reasons for difficulty in the identification of *Fucus*. Firstly, the species adapt to a wide range of environmental conditions by adopting an equally wide range of frond form. For example, *F. vesiculosus* grows with bladders on sheltered shores, but without on exposed shores; the ecological advantages should be obvious. Other variations in form with habitat are outlined below. Secondly, some species apparently hybridise freely with others. The resulting hybrid plants may exhibit characteristics of both parents and are common on some shores. Thirdly, mature receptacles are sometimes necessary to confirm identifications, particularly for *F. distichus* subsp. *edentatus* and *F. spiralis*. As receptacles are absent for part of the year, sterile plants may have to be lumped together. This applies particularly to *F. vesiculosus* var. *linearis* and *F. spiralis* on semi-exposed shores.

2. *Fucus spiralis* (Fig. 13)
   The main diagnostic features of this species in the field are spiral frond form and receptacles usually with a sterile rim. Young plants with no receptacles may be impossible to separate from *F. vesiculosus* var. *linearis* on semi-exposed shores. Generally *F. spiralis* occupies the highest *Fucus* zone on the shore, below *Pelvetia canaliculata* and above *F. vesiculosus*, but this rule is by no means rigid. A dwarf form, *F. spiralis* var. *nanus* also exists on some extremely exposed shores.

3. *Fucus vesiculosus* (Fig. 13)
   The most variable of the fucoid species. Plants may reach 1 m in length on sheltered shores, with many pairs of bladders. At the other extreme, *F. vesiculosus* var. *linearis* seldom exceeds 20 cm and has no bladders. On some shores plants with and without bladders are occasionally found growing next to each other, i.e. in identical conditions.
   It is worth mentioning that under certain weather conditions fucoid species other than *F. vesiculosus* form pockets of gas in the central tissue layers of the frond, distending parts of the frond into cushions which could be mistaken for true bladders. These are probably only temporary structures.

4. *Fucus distichus* (Fig. 12)
   It is not likely that *F. distichus* will be found on the shore by many people in view of its limited known distribution in the British Isles — remoter parts of northern
Scotland and Ireland. The continued growth of the frond beyond the receptacle often occurs in this species, but not in any other *Fucus* species. There are three subspecies with very different form and habitat (see key p. 15): subsp. *distichus*, subsp. *anceps* and subsp. *edentatus*. All three are described in Powell (1957).

5. Saltmarsh forms
Fucoids can live unattached in saltmarshes and other places of extreme shelter from wave action either free-floating or entangled amongst other plants. Unusual forms may develop in such situations and also in areas of freshwater runoff. Spiral frond form is common in other species as well as *F. spiralis*. A very small species *F. muscoides* (Fig. 12) grows as a turf (less than 4 cm high) in saltmarshes or at the top of extremely sheltered shores, and has a rounded or flattened thallus. Although *F. muscoides* has been listed as a separate species in Parke and Dixon (1976) many authorities (D. E. G. Irvine, Polytechnic of North London and H. Powell, Scottish Marine Biological Association—personal communications) consider that several species may take this form, including *Fucus vesiculosus*, *F. spiralis*, *F. ceranoides*, *Ascophyllum nodosum* and *Pelvetia canalculus*. Whether one species or several, *Fucus muscoides* is usually a distinct entity and should key out easily.
NOTES ON THE KEY

1. The key is partly based on Jones (1962:64) 'A key to the genera of British Seaweeds'.
2. The key is a 'field' key, using macroscopical characteristics. A ×10 hand lens may be necessary at times.
3. Nearly all British macroscopical (larger than 1 cm) brown seaweeds can be identified to a group if not to species level. Entities which are sufficiently distinct have been identified to species, subspecies or varieties. Others are taken as far as possible without use of a microscope. Littoral, sublittoral and rare species are included.
4. Identifications should be checked using the attached Figs. 8-22, Newton (1193) or other textbooks, and herbarium specimens. Nomenclature changes are given on page 40. References to works for further identification are given on pp. 41-42.
5. If your plant does not key out satisfactorily, check that it is not in fact a red alga (see introduction).
6. Technical terms used in the key have been kept to a minimum, but the use of some unfamiliar words is unavoidable. A glossary is provided at the end of the key.
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KEY

READ DESCRIPTIONS A TO E BEFORE PROCEEDING. Choose the nearest description to your plant and go to the page indicated. Then start at number 1 and choose one of the alternative descriptions (there are two unless otherwise stated) and follow the numbers.

GROUP A  All or some parts of plant flattened or compressed; may be rolled up to appear channelled. (Look at separate parts of plant—some whole plants may appear flattened because of their growth habit, but examination of parts will show them to be cylindrical in cross-section and they will key out under B-E below). Not hollow except for air bladders in some species. Plants a few cm to several m long.

GROUP B  Plant with main axis filiform (thicker than cotton thread, 0.25 mm to 5 mm wide) without markedly flattened parts. Not hollow except for air bladders in some species. Plants a few cm to several m long.

GROUP C  Plant with main axis and branches filamentous (made up of individual fine hairs, finer than cotton thread, less than 0.25 mm thick). Filaments may be long or short, stiff or floppy, separated or tangled together into woolly cords. Usually less than 15 cm long, but up to 30 cm.

GROUP D  Plant entirely or largely hollow — look at cut section of main axis or widest part of plant (but not through an air bladder or reproductive structure). Usually less than 40 cm long.

GROUP E  Forming easily seen crusts, cushions or membranes on rocks or other seaweeds.

GROUP A

1. Plants with midrib (may be indistinct, look carefully)

   Plants without midrib

2. Some lateral branches may be flattened, but main axis usually cylindrical, often with short spines arranged all around axis giving a 'prickly' or 'heathy' appearance. Plants often much branched, bushy. May be pinnate in younger parts. To 90 cm. Mainly S and SW coasts. Cystoseira spp.

GROUP B (26) p. 20

   Plant not as Cystoseira above

3. Air bladders present

   Air bladders absent
4. Plant with air bladders set in frond, usually in pairs either side of the midrib. (Beware ‘false’ air bladders—see fucoid note 3 p. 6.)
   To 1 m
   Air bladders stalked

   **Fucus vesiculosus** (Fig. 13)

5. Plant with pod-shaped air bladders divided internally by cross-walls.
   (Look carefully for small pods in young plants and cut lengthwise section.) Branching basically dichotomous but appearing alternate, as most branches are of limited growth, ending in air bladders or receptacles. Often with ‘zig-zag’ appearance to main axis

   **Halidrys siliquosa** (Fig. 17)

   Plant with many small (less than 6 mm), spherical, stalked air bladders. To 3-4 m. S coast and spreading

   **Sargassum muticum** (Fig. 15)

6. Plant unbranched (except perhaps for a cluster of strap-shaped sporophylls near the base)
   Plant variously branched

7. Plant with opposite side veins from narrow midrib, membranous.
   May have marginal outgrowths. Rare, deep sublittoral only.
   To 30 cm

   **Desmarestia dresnayi** (Fig. 11)

   No side veins

8. Plant with claw holdfast, cylindrical stipe, and flattened leathery midrib with wavy, membranous, often torn lamina either side.
   May have cluster of scrap-shaped sporophylls near the base.
   Lower shore, usually on exposed coasts. To 5 m

   **Alaria esculenta** (Fig. 11)

   Plant without claw holdfast, less than 10 cm long

9. Plant leathery, flattened lamina either side of midrib. Littoral
   young **Fucus** spp (Fig. 12)

   Plant with narrow midrib and thin, membranous lamina either side.
   May have leaflets growing from the midrib. Sublittoral, S and W coasts
   young **Dictyopteris membranacea** (Fig. 14)

10. Branches opposite, flattened, narrowing at each end. Midrib may be indistinct.
    Clothed with hairs in summer and in young plants. Quickly turns green out of water; the cell sap is very acid and will quickly rot other seaweeds collected with it. To 180 cm

    **Desmarestia ligulata** (Fig. 19)

    Branching dichotomous, may appear irregular
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11. Plants small, less than 4 cm, forming a turf at the top of very sheltered shores and saltmarshes. Branching dichotomous or irregular, frond rounded, channelled or flattened, midrib may be visible on widest fronds. Fruiting bodies ovoid. See fucoid note 5, p. 7

   **Fucus muscoides** (Fig. 12)

   Plants more than 4 cm; not as *Fucus muscoides* above  

12. Plant sublittoral, thin and membranous or *cartilaginous* and brittle  

   Plant littoral, tough and leathery, often abundant. *Fucus* spp.  

13. Frond to 15 mm wide, thin and membranous, often split to narrow midrib. Superficially resembling *Fucus* species but much more delicate and normally sublittoral. May have small leaflets growing from midrib. May turn green or yellow in drift. To 30 cm. S and W

   **Dictyopteris membranacea** (Fig. 14)

   Frond less than 2 mm wide, midrib may be indistinct. Plant brittle, tips of fronds with tufts of hairs or a mitre-shaped receptacle. Sublittoral only; S coast and Lundy. To 25 cm

   **Carpomitra costata** (Fig. 18)

14. Frond rolled up longitudinally to form a channel down the middle. Growing in tufts on the upper shore, on rock. To 15 cm (occasionally occurs as a small form in saltmarshes—see fucoid note 5, p. 7)

   **Pelvetia canaliculata** (Fig. 14)

   Frond not channelled (wherefrond broad, distal margin may be inrolled)  

15. Plants small, less than 4 cm, forming a turf at the top of very sheltered shores and saltmarshes. Branching dichotomous or irregular, frond rounded, or flattened, midrib may be visible on widest fronds. Fruiting bodies ovoid (see fucoid note 5, p. 7)

   **Fucus muscoides** (Fig. 12)

   Plants not as *Fucus muscoides*  

16. Holdfast a large warty bulb attached by rhizoids. Stipe markedly flattened with narrow wavy lamina each side, expanding into a broad leathery lamina divided into fingers. Lower shore and sublittoral. To 2 m

   **Saccorhiza polyschides** (Fig. 10)

   Holdfast not a warty bulb. Plant not as *Saccorhiza polyschides*  

17. Plant consisting of a stout, undivided, cylindrical stipe, expanding into a lanceolate or digitate lamina. Attached by a claw-shaped holdfast. Adult plants large, 50 cm to 4 m or more long

   Plant without stout cylindrical stipe and claw holdfast  

   **Carpomitra costata** (Fig. 18)
18. Lamina lanceolate, not divided into fingers
   Lamina digitate (divided into fingers)
19. Lamina crinkly, wavy edged. To 4 m
   Lamina smooth
   \textit{Laminaria saccharina} (Fig. 11)
20. Stipe with small swelling, which later becomes a large bulb
   young \textit{Saccorhiza polyschides} (Fig. 11)
   Stipe without swelling
   young \textit{Laminaria} spp. (Fig. 11)
21. Stipe flexible, will not stand up by itself, crushes when bent, smooth and without epiphytes. Stipe expands gradually into a broad digitate lamina. Lower shore. To 2 m or more
   \textit{Laminaria digitata} (Fig. 10)
   Stipe stiff, stands up by itself, snaps when bent.
   Extreme lower shore and sublittoral
22. Stipe rough, usually with many re\$ algal epiphytes.
   Stipe expands abruptly into a broad digitate lamina which is shed annually. Lower shore and sublittoral. (Commonest sublittoral kelp.) To 3 m
   \textit{Laminaria hyperborea} (Fig. 10)
   Stipe smooth, without epiphytes; otherwise as \textit{L. hyperborea} (above). Sand.
   SW coasts, sublittoral. To 3 m
23. Frond undivided or divided only from base
   Frond variously divided, lobed or branched
24. Frond with chalky deposit, distal margins inrolled.
   Frond banded. S coast
   Frond without chalky deposit
25. Frond membranous and cone-shaped when young; flat, leathery, lobed and split when older. Fringe of hairs at the margin may wear off in older parts and in winter. Sublittoral only, S and SW coasts.
   To 20 cm across
   \textit{Zanardinia prototypus} (Fig. 8)
   Frond elongated, rounded or ribbon-shaped
26. Strap-shaped frond arising from a stalked button or 'mushroom'
   \textit{Himanthalia elongata} (Fig. 17)
   Plant riot arising from a stalked button
27. Frond membranous, thin but tough. Simple undivided ribbons narrowing to a short stipe at the base. Frond width varies with species. To 30 cm
   Petalonia (3 spp.) (Fig. 9)
Frond membranous, delicate, easily torn. Ribbon-like or rounded, gelatinous to the touch. Often spotted with spore patches. Frond width varies with species. To 40 cm
   Punctaria (4 spp.) (Fig. 9) and Desmotrichium undulatum

28. Frond strap-like with single large (1-5 cm) ovoid bladders at intervals. Stalked receptacles, if present, in marginal notches. Sheltered shores.
   To 150 cm. (Dark red tufts of Polysiphonia, a red alga, are often found growing on this seaweed)
   Ascophyllum nodosum (Fig. 15)
Plant not as above

29. Plant living unattached in sheltered seal-lochs in Scotland and Ireland. Frond cartilaginous, much branched, regularly dichotomous. Frond tips squared. Air bladders, if present, small and ovoid. To 40 cm
   Ascophyllum nodosum var. mackaii (Fig. 15)
Plant normally attached (although some live unattached in loose-lying masses sublittorally at sheltered sites). Not as Ascophyllum nodosum var. mackaii above

30. Branching opposite
   Branching various, not opposite

31. Frond to 1 cm wide, narrowing at each end. May have indistinct midrib. Delicate hairs along margins in summer and in young parts. To 180 cm
   Desmarestia ligulata (Fig. 19)
Frond less than 2 mm wide, with branches gradually shorter towards the distal end. Delicate hairs along margins in summer. To 40 cm
   Desmarestia viridis (Fig. 18)
   (All Desmarestia species have a very acid cell sap and will spoil other seaweeds if collected in the same bag.)

32. Branching alternate. Frond narrow, less than 2 mm, and much branched. Smallest branchlets short and spine-like in older specimens, giving a serrated appearance to the margins. Alternate tufts of delicate hairs along margins in summer and on young plants. To 180 cm
   Desmarestia aculeata (Fig. 19)
Plant not fitting above description

33. Branching basically dichotomous, may appear alternate
   Irregularly branched, lobed or split frond
34. Plant with pod-shaped air bladders divided internally by cross-walls (look carefully for small pods in young plants and cut lengthwise section). Branching basically dichotomous but appearing alternate, as most branches are of limited growth, ending in air bladders or receptacles. Often with ‘zig-zag’ appearance to main axis. To 2 m  
**Halidrys siliquosa** (Fig. 17)  
No air bladders  

35. Plant irregularly dichotomous, divided into narrow sections often wedge-shaped and markedly split at the ends (‘frayed’ appearance). Spores not arranged in wavy rows, but scattered as small spots. Sublittoral only. (Beware **Dictyota dichotoma** narrow form.) To 40 cm  
**Cutleria multifida** (Fig. 8)  
Plant regularly dichotomous; frond tips may be narrow but entire, not split and frayed  

36. Frond strap-like, arising from the centre of a stalked button.  
Mid and lower shore. To 150 cm  
**Himanthalia elongata** (Fig. 17)  
Not arising from a stalked button  

37. Frond thin, usually flat but may be spiral in narrow specimens. Usually very regularly dichotomous and much branched. Frond width varies from plant to plant. Frond tips usually bifid.  
Common in rock pools and sublittorally. To 30 cm  
**Dictyota dichotoma** (Fig. 9)  
Similar to **Dictyota** (above), but few dichotomies, frond tips rounded, slightly enlarged. Rare. To 20 cm  
**Dilophus spiralis** (Fig. 9)  

38. Plant with chalky deposit on surface. Less than 10 cm. Little divided into wide fan-shaped segments, distal margin inrolled. Frond banded. S coast. To 12 cm  
**Padina pavonia** (Fig. 8)  
No chalky deposit  

39. Frond cone-shaped and membranous when young, lobed or split and leathery when older. Attached at centre. Margin has a fringe of hairs. Sublittoral only, S coast. To 20 cm across  
**Zanardinia prototypus** (Fig. 8)  
Plant not as **Zanardinia prototypus**
40. Plant split into wide and narrow wedge-shaped sections, broadest near frond tips. Spores borne in wavy lines across the frond. Not gelatinous. To 40 cm

Taonia atomaria (Fig. 8)

Plant divided into narrow sections, irregularly dichotomous. Frond tips markedly split into narrow sections giving a 'frayed' appearance. Spores scattered over frond, not in wavy rows. Texture fleshy, slightly gelatinous. To 40 cm

Cutleria multifida (Fig. 8)

KEY TO Fucus SPECIES

41. Plant with paired (sometimes single) air bladders, common on sheltered shores. Beware 'false' bladders—see fucoid note 3, p. 6. To 150 cm

Fucus vesiculosus (Fig. 13)

No air bladders

42. Serrated edge to frond. To 150 cm

Fucus serratus (Fig. 14)

Frond edge entire (i.e. not serrated—although may be wave-damaged)

43. Frond flat, usually wider than 4 mm. Midrih and lamina distinct

Frusround rounded or flattened, very narrow, usually less than 4 mm except for fruiting bodies. Midrib may be indistinct

44. Frond usually spirally twisted when held up by base. Fruiting bodies often with a rim of sterile material. Upper shore. Difficult to distinguish from Fucus vesiculosus var linearis on some shores—see fucoid notes 1 and 2, p. 6. To 70 cm

Fucus spiralis (Fig. 13)

Frond flat, not spiralling when held up by base

45. Frond membranous and relatively thin, midrib narrow. Dichotomies often close together distally, giving a broad fan-shape. In areas of freshwater runoff. See fucoid note 1, p. 6. To 60 cm

Fucus ceranoides (Fig. 13)

Frond tough and leathery

46. Receptacles terminal. Frond often battered and with small new fronds regenerating from the base. Exposed rocky shores, often abundant, easily confused with F. spiralis—see fucoid notes 1, 2 and 3, p. 6. To 30 cm

Fucus vesiculosus var. linearis (Fig. 13)

Receptacles often with sterile tips where frond continues growth beyond receptacle. Extreme N of Scotland, sheltered harbours in a few localities. See fucoid note 4, p. 6. To 60 cm

Fucus distichus subsp. edentatus (Fig. 12)
47. Plants less than 4 cm long, 0.5-2 mm wide, forming a turf at the top of very sheltered shores and saltmarshes. Branching often irregular, receptacles small, ovoid. See fucoid note 5, p. 7

\[\text{Fucus muscoides (Fig. 12)}\]

Plant usually more than 4 cm long, 2-4 mm wide, not growing in saltmarsh 48

48. Stipe stout and stiff, stands erect with rest of frond arching over. Stout midrib, very narrow wings. On the upper parts of extremely exposed shores in N Scotland and Ireland. See fucoid note 4, p. 6.

To 15 cm

\[\text{Fucus distichus subsp. anceps (Fig. 12)}\]

Stipe thin, not standing erect. Narrow wings and midrib. Usually in rock pools. See fucoid note 4, p. 6. To 20 cm

\[\text{Fucus distichus subsp. distichus (Fig. 12)}\]

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**GROUP B**

1. Plant a stalked button or 'mushroom' from which arises a long strap-shaped, dichotomously branched reproductive organ.

Mid and lower shore. To 150 cm

\[\text{Himanthalia elongata (Fig. 17)}\]

Plant not arising from a button or 'mushroom' 2

2. Plant an unbranched, cylindrical bootlace up to 8 m in length.

Lower shore and sublittoral, on unstable substrates.

\[\text{Chorda (2 spp) (Fig. 17)}\]

Plant variously branched, 3

3. Plants small, less than 4 cm, forming a turf at the top of extremely sheltered shores and saltmarshes. Branching dichotomous or irregular, frond rounded or flattened, midrib may be visible on widest fronds. Fruiting bodies ovoid. See fucoid note 5, p. 7

\[\text{Fucus muscoides (Fig. 12)}\]

Plants not as Fucus muscoides; variously branched 4

4. Read 4 alternatives:

- Branching mostly dichotomous 5
- Branching mostly alternate 12
- Branching mostly opposite 16
- Branching irregular 18

5. Plant with air bladders 6

Plant without air bladders 9
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6. Plant with pod-shaped air bladders divided internally by cross-walls (look carefully for small pods in young plants and cut lengthwise section). Branching basically dichotomous but appearing alternate, as most branches are of limited growth, ending in air bladders or receptacles. Rock pools and sublittoral. To 2 m

**Halidrys siliquosa** (Fig. 17)

7. Holdfast expanded and knobbly, frond rounded and forking dichotomously. Sterile tips to fronds rounded and slightly enlarged. Air bladders small, if present. Receptacles long and narrow. Usually in rock pools SW Britain. To 50 cm

**Bifurcaria bifurcata** (Fig. 17)

Holdfast not tuberous; may be absent, plant living unattached

8. Frond strap-shaped, large (1-5 cm) ovoid air bladders arranged singly along axis. Receptacles stalked, in marginal notches. Sheltered shores. To 150 cm

**Ascophyllum nodosum** (Fig. 15)

(Small dark red tufts of the red alga *Polysiphonia* are often found growing on this seaweed)

Frond rounded or flattened, few small ovoid air bladders. Much branched, regularly dichotomous. Frond tips squared. Unattached, in sheltered sea lochs in Scotland and Ireland. To 40 cm

**Ascophyllum nodosum** var. *mackaii* (Fig. 15)

9. Frond soft, **sporangia** as scattered small spots or in rows. To 30 cm

**Stilophora** (2 spp.) (Fig. 19)

**Spermatochnus** and **Stilopsis**

10. Holdfast expanded and knobbly, frond cylindrical and smooth. Sterile tips to fronds rounded and slightly enlarged. Receptacles long and narrow. Usually in rock pools. SW Britain. To 50 cm

**Bifurcaria bifurcata** (Fig. 17)

Plant with a disc holdfast, or unattached

11. Plant growing unattached in sheltered sea lochs in Scotland and Ireland. Much branched, rounded, frond tips squared. To 30 cm

**Ascophyllum nodosum** var. *mackaii* (Fig. 15)

Plant growing on the upper part of extremely exposed shores in N Scotland and Ireland. Stipe stout and stiff, stands erect with rest of frond arching over. Stout midrib, very narrow wings. See fucoid note 4, p. 6. To 20 cm

**Fucus distichus** subsp. *anceps* (Fig. 12)
12. Plant with pod-like air bladders divided internally by cross-walls (look carefully for small bladders in young plants and cut lengthwise section). Regularly alternately branched, giving pronounced 'zig-zag' appearance to main axis. Rock pools and sublittoral. To 2 m

\[\text{Halidrys siliquosa (Fig. 17)}\]

Air bladders small or absent

13. Holdfast expanded and knobbly, frond cylindrical and smooth. Branching basically dichotomous but may appear alternate. Often with few branches. Sterile tips to fronds rounded and slightly enlarged. Receptacles lanceolate. Usually in rock pools. SW Britain. To 50 cm

\[\text{Bifurcaria bifurcata (Fig. 17)}\]

Holdfast not expanded and knobbly, plants usually much branched. Not as \textit{Bifurcaria bifurcata}

14. No air bladders. Frond narrow, to 2 mm, flattened, much branched with long main axis and long side branches. Older plants have regularly alternate, short spine-like branchlets along frond margins giving a serrated appearance. Alternate tufts of hairs in summer and on young plants. Mainly sublittoral. To 180 cm

\[\text{Desmarestia aculeata (Fig. 19)}\]

May have small, ovate air bladders. Frond wider than 2 mm in older parts, mainly cylindrical

15. Branching pinnate in younger parts, regularly alternate. S and SW coasts. To 60 cm

\[\text{Cystoseira foeniculacea (Fig. 16)}\]

Branching not pinnate in younger parts, frond often with short spine-like branchlets all around giving a 'prickly' or 'heathery' appearance. Mainly S and SW coasts. To 90 cm

\[\text{Cystoseira spp.} \quad 26\]

16. Single ovoid bladders. Stalked receptacles in marginal notches opposite, but strap-shaped frond branched dichotomously. To 150 cm

\[\text{Ascophyllum nodosum (Fig. 15)}\]

(Small dark red tufts of the red alga \textit{Polysiphonia} are often found growing on this seaweed)

No air bladders
A Field Key to the British Brown Seaweeds (Phaeophyta)

17. Frond narrow, less than 1 mm, cylindrical with widely spreading opposite branches with whorls of hairs. Sublittoral. To 90 cm
   
   ![Arthrocladia villosa](Fig. 18)
   
   Frond narrow, less than 2 mm, flattened, with branches gradually shorter towards the distal end. Often with delicate hairs along frond margins in summer and on young plants. Soon turns green and flaccid out of water. To 40 cm
   
   ![Desmarestia viridis](Fig. 18)

18. Plant with air bladders
   
   Plant without air bladders

19. Air bladders small, 2-6 mm, spherical and stalked. If long main axis is held horizontally, many side branches and leaf-like appendages hang down like washing from a clothes line. S coast, spreading. To 4 m

   ![Sargassum muticum](Fig. 15)

   Air bladders set in frond, not stalked

20. Frond strap-shaped with single large (1-5 cm) ovoid air bladders. Sheltered shores. To 150 cm

   ![Ascophyllum nodosum](Fig. 15)

   (Small dark-red tufts of the red alga Polysiphonia are often found growing on this seaweed)

   Frond usually much branched, often with short spine-like branchlets arranged all round axis, giving a 'prickly' or 'heathery' appearance. Air bladders small, less than 5 mm. Rock pools and sublittoral. Mainly S and SW coasts. To 90 cm. Cystoseira spp

21. Frond soft, easily squashed between fingers
   
   Frond firm, not easily squashed between fingers

22. Plant very soft and worm-like, gelatinous to the touch. Branching irregular. To 50 cm

   ![EUDESME aggregate](Fig. 22)

   (Includes Eudesme, Mesogloia (3 spp.), Sphaerotrichia, Liebmannia, Cladosiphon (2 spp.), Sauvageaugloia (2 spp.) and Myriocladia. This is a difficult group even with a microscope.)

   Plants soft, but not worm-like and gelatinous. Often irregularly dichotomous. Spore patches may show as small dots. To 40 cm

   ![Stilophora](2 spp.) (Fig. 19)

   Spermatochnus and Stilopsis

23. Frond with short spine-like branches arranged all around axis, giving a 'prickly' or 'heathery' appearance. Mainly S and SW coasts. To 90 cm. Cystoseira spp.

   Frond not prickly
24. Plant with narrow (less than 1 mm) cylindrical main axes bearing short side branches ending in a small swelling and a tuft of hairs. Sublittoral. To 45 cm

\[ \text{Sporochnus pedunculatus (Fig. 18)} \]

Side branches without small swelling

25. Axes with whorls of hairs. Sublittoral

\[ \text{Arthrocladia villosa (Fig. 18)} \]

Axes may have an all-over covering of fine hairs, but not arranged in distinct whorls. Usually much-branched. To 70 cm

\[ \text{Chordaria, Acrothrix} \] and \[ \text{Dictyosiphon (3 spp.) (Fig. 17)} \]

26. Frond strongly iridescent (bright blue or green sheen) underwater. Mainly S and SW coasts. To 45 cm

\[ \text{Cystoseira tamariscifolia (Fig. 16)} \]

Frond not iridescent underwater

27. Bases of main branches swollen where they join the main axis. S and SW coasts. To 45 cm

\[ \text{Cystoseira nodicaulis (Fig. 16)} \]

Bases of branches not swollen

28. Younger branches pinnate, flattened, regularly alternate. S and SW coasts. To 60 cm

\[ \text{Cystoseira foeniculacea (Fig. 16)} \]

Younger branches not pinnate. S and SW coasts. To 90 cm

\[ \text{Cystoseira baccatia and Cystoseira myriophylloides (Fig. 16)} \]

GROUP C

The detailed structure of plants in this group is often best seen when they are floating in water.

1. Plants with simple unbranched filaments (hairs) growing as small tufts on larger seaweeds

2. Plant with branched filaments, may be tangled together into woolly cords
A Field Key to the British Brown Seaweeds (Phaeophyta)

2. Dense patches, or tufts like small wigs with a lump at the base of each tuft. Less than 1 cm. **Growing on:**
   - *Fucus* spp.
   - *Halidrys siliquosa* and *Cystoseira* spp.
   - *Himanthalia elongata*
   - *Arthrocladia villosa* and others

Small tufts (usually less than 5 mm) on larger brown algae

**LITOSIPHON aggregate**

(Includes *Litosiphon* and many others which cannot be identified without careful use of a microscope.)

3. **Plant stiff, smaller branches keeping shape when moved about in water**
   - **Plant limp, floppy when moved about in water**

4. Branching irregular, plants usually less than 2-3 cm.
   - Often on other algae
     - *Sphacelaria* spp. (Fig. 20)
       - (12 spp. *S. plumosa* and *S. radicans* can be keyed out separately.)

   Ultimate branching regularly pinnate (alternate or opposite) or whorled (use lens). Plants usually more than 2-3 cm

5. Ultimate tiny branchlets whorled (use lens), like a bottle brush.
   - To 25 cm
     - **Cladostephus spongiosus** (Fig. 21)

   Ultimate tiny branchlets pinnate (use lens)

6. Branchlets opposite (use lens). To 10 cm
   - **Sphacelaria plumosa** (Fig. 21)

   Branchlets alternate (use lens)

7. Plant densely tufted, individual tufts like small shaving brushes.
   - Summer form more densely tufted than winter. To 15 cm
     - **Halopteris scoparia** (Fig. 21)

   Plant flattened in 1 plane, with branchlets pinnate and very regularly alternate. To 10 cm
     - **Halopteris filicina** (Fig. 21)

8. Filaments tangled into distinct woolly cords.
   - To 20 cm
     - **Spongonema tomentosum** (Fig. 20)

Filaments may be slightly tangled, but not into distinct woolly cords
9. Whorls of hairs along main axis and opposite (sometimes irregular) side branches. To 90 cm

Arthrocladia villosa (Fig. 18)

No whorls of hairs

10. Side branches short and regularly opposite (use lens). Fruiting bodies form small swelling in filament. To 30 cm

Tilopteris mertensii (Fig. 20)

Branching not regularly opposite

11. Distinct main axes bearing short side branches ending in a small swelling and a tuft of hairs. To 45 cm

Sporochnus pedunculatus (Fig. 18)

No distinct main axes. Plant consisting of profusely branched, very fine hairs. Often growing on other algae. To 50 cm

ECTOCARPUS aggregate (Fig. 20)

(Includes Ectocarpus (2 spp.), Giffordia (7 spp.), Acinetospora, Pilayella and others impossible to separate without a microscope and difficult with one!)

GROUP D

1. Plant a sometimes hollow arid inflated stalked button or 'mushroom' which may or may not have a long dichotomously branched, strap-shaped reproductive organ. To 150 cm

Wimanthalia elongata (Fig. 17)

Plant not arising from a stalked button or 'mushroom'

2. Plant roughly spherical, may be convoluted

Plant elongated

3. Plant gelatinous, easily disintegrates under finger and thumb. Solid and spherical when young, hollow and convoluted when older. On other seaweeds, particularly Laurencia and Corallina spp. To 5 cm

Leathesia difformis (Fig. 22)

Plant membranous, does not disintegrate under finger and thumb pressure, but can be torn like paper. To 20 cm

Colpomenia peregrina (Fig. 22)

(Beware young Asperococcus spp.—see 5)

4. Plant unbranched or branched only from the base

Plant variously branched, usually profusely
5. Fronds narrow, usually with pronounced constrictions at intervals like a string of sausages; often on limpets. Fairly tough. To 45 cm
   *Scytosiphon lomentaria* (Fig. 22)
   Fronds may be irregular in width but not with regular pronounced constrictions. Frond width varies with species; long and narrow to short and bulbous. Sori appear as small scattered spots. Fairly delicate, easily torn. To 30 cm
   *Asperococcus* (4 spp.) (Fig. 22)

6. Plant hollow throughout
   7

7. Branching opposite, rarely irregular. Frond branches narrow at each end. Sporangia visible as small spots, often in rows across the frond. To 30 cm
   *Striaria attenuata* (Fig. 19)
   Branching dichotomous. Sporangia as scattered small spots.
   To 40 cm
   *Stilophora* (2 spp.) (Fig. 19)
   *Spermatochnus* and *Stilopsis*
   (The above 4 species should be checked using microscopic features.)

8. Branching dichotomous, sporangia as scattered small spots.
   To 40 cm
   *Stilophora* (2 spp.) (Fig. 19)
   *Spermatochnus* and *Stilopsis*
   Branching irregular. To 70 cm
   A diverse group including *Stilophora* (2 spp.), *Acrothrix*, *Dictyosiphon* (3 spp.), *Myriocladia* and others. Microscope needed for accurate identification. (Figs. 17 and 19.)

GROUP E

1. Plant forming a brown crust or cushion on rock or other seaweeds. Littoral and sublittoral
   2
   Plant a membrane attached to rock by rhizoids. Usually sublittoral
   4

2. Plant a cushion on rock or other algae. Several species may key out here, the most common being:
   *Leathesia* difformis — spherical, gelatinous, on other algae, particularly *Laurenza* and *Corallina* spp. Older plants hollow and convoluted. To 5 cm across (Fig. 22).
   *Corynophlaea crispa* — small, 2 mm, on *Chondrus crispus*.
   *Sphacelaria* radicans — dense irregular tufts, typically in cave mouths.
   *Cylindrocarpus* berkelsyi — hemispherical, on exposed shores only. To 2 cm across (Fig. 22).
   Plant a dark brown crust
   3
3. Massive dark brown crust to 4 cm thick. Rare

**Battensia mirabilis**

Thin dark brown crust, smooth or warty, forming small to extensive patches on rock. Usually *Ralfsia* (5 spp.) (Fig. 22). But very similar are *Pseudolithodera* (2 spp.), *Sorapion, Petroderma* and *Chilionema* (2 spp.). Encrusting brown algae can often be distinguished from red algae and lichens of similar habit by scraping a bit off and examining the colour under a hand lens.

4. Thallus margin without fringe of hairs, thallus delicate, membranous, creeping. Margin lobed (lobes at edge to 1 cm across). Plants to 10 cm or many plants forming extensive patches. Sublittoral

**Sporophyte phase of Cutleria multifida, ‘Aglaozonia’** (Fig. 8)

Thallus margin with fringe of hairs (may be worn away in winter). Young plants membranous, cane-shaped, attached at centre; older plants leathery, irregularly lobed, attached at many points. Sublittoral, SW Britain. To 20 cm

**Zanardinia prototypus** (Fig. 8)
A Field Key to the British Brown Seaweeds (Phaeophyta)

Padina pavonia PEACOCK'S TAIL

Cutieria multifida

Taonie atornaria

Zanardinia prototypus

Aglaozonia phase of Cutieria multifida
A Field Key to the British Brown Seaweeds (Phaeophyta)

Fig. 10 Kelps
young Laminaria spp.

Laminaria saccharina
SEA BELT, SUGAR KELP,
POOR MAN'S WEATHER GLASS

Alaria esculenta
DABBERLOCKS

Desmarestia dresnayi

FIG. 11
Fucus serratus
SAW, SERRATED OR TOOTHED WRACK

Pelvetia canaliculata
CHANNEL WRACK

Dictyopteris membranacea

1 cm
Sargassum muticum
JAPWEED

Ascophyllum nodosum
EGG OR KNOTTED WRACK

Ascophyllum nodosum var. rnackaii

FIG. 15
A Field Key to the British Brown Seaweeds (Phaeophyta)

Cystoseira foeniculacea

Cystoseira baccata and C. myriophylloides

Cystoseira tamariscifolia

Cystoseira nodicaulis
Fig. 17

Chorda spp.  
DEAD MEN'S ROPE,  
MERMAID'S FISHING LINES.  
MERMAID'S TRESSES

Himanthalia elongata  
THONGWEED

Dictyosiphon aggregate

Halidrys siliquosa  
PODWEED, SEA OAK

Bifurcaria bifurcata
A Field Key to the British Brown Seaweeds (Phaeophyta)

Carpomitra costata
Arthrocladia villosa
Sporochnus pedunculatus
young or summer plant
Desmarestia viridis
summer and winter

Desmarestia aculeata
LANDLADY'S WIG

Desmarestia ligulata

Striaria attenuata

Stilophora spp.

Fig. 19
A Field Key to the British Brown Seaweeds (Phaeophyta)

Elachista fucicola

ECTOCARPUS aggregate

Sphacelaria spp. (on Corallina)

Spongonema tomentosum

Tilopteris mertensii
Sphacelaria plumosa

Cladostephus spongiosus

Halopteris filicina

Halopteris scoparia

FIG. 21
A Field Key to the British Brown Seaweeds (Phaeophyta)
### NOMENCLATURE CHANGES SINCE NEWTON (1931)

Nomenclature of target species in this key follows that of Parke and Dixon (1976). As Newton (1931) is still the best textbook for checking identifications of British species, changes in nomenclature since this book was published are given below for the main species in the Key. Parke and Dixon give a complete list of British species with names in Newton in square brackets.

<table>
<thead>
<tr>
<th>Name in key</th>
<th>Name in Newton</th>
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<td>Acrothrix gracilis</td>
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<td>Elachista spp.</td>
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<td>L. ochroleuca</td>
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<td>Bifurcaria tuberculata</td>
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<td>Castagnea spp.</td>
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<td>Leathesia crispa</td>
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<td>C. ericoides</td>
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<tr>
<td>Elachistea spp.</td>
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<td>Castagnea virescens</td>
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<td>'A doubtful British species'</td>
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<td>Spermatochnus lejolisi</td>
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<tr>
<td>Zanardinia collaris</td>
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</table>
Newton (1931) is still by far the best textbook for identification, although nomenclature is now largely out of date and the book is unfortunately out of print. Most university libraries have a copy. A work in preparation to be published by the British Museum (Natural History), 'Seaweeds of the British Isles', will form a comprehensive new British marine algal flora replacing Newton. Volume 1 part 1 (on red seaweeds) has already been published; the brown seaweed volume is in preparation and should be published in the not too distant future. At the moment information is scattered through various journals and publications. Several other books are useful, but none is complete; often the rarer species are omitted even if they are easily identified in the field. These books are listed below.

The best general key is that by W. E. Jones. The key (1962:64) is to genera only, and contains a useful glossary and notes. A very useful set of keys to species, including all British green, brown and red seaweeds, is being prepared by D. E. G. Irvine et al for the Hulton Group Keys Series. The estimated date of publication is 1979180. Some other keys to small groups are listed below.

The check lists published by Parke, and Parke and Dixon at intervals since 1953 are complete lists of known British species and contain nomenclatural changes and useful references. The latest of these was published in 1976.

The bibliographies listed below contain references to most of the published information on British benthic marine algae.

**BOOKS**


**KEYS, CHECK LISTS AND OTHER REFERENCES**


ACKNOWLEDGEMENT

This key was partially financed by the Nature Conservancy Council as part of its Commissioned Research Programme.
The AIDGAP Publications

The following AIDGAP titles have been published by the Field Studies Council:

- *A key to the adults of British lacewings and their allies* Colin Plant (1997)
- *A key to the major groups of marine invertebrates* John Crothers (1997)
- *A field key to the shore fishes of the British Isles* Alwyne Wheeler (1994)
- *Random-access identification guides for a microcomputer* (includes a sedges database) Colin Legg (1992)
- *A field guide to the sharks of British coastal waters* Philip Vas (1991)
- *A key to the woodlice of Britain and Ireland* Stephen Hopkin (1991)
- *Insects of the British cow-dung community* Peter Skidmore (1991)
- *British Sawflies (Hymenoptera: Symphyta): a key to adults of the genera occurring in Britain* Adam Wright (1990)
- *Keys to the families of British Spiders* Lawrence Jones-Waiters (1989)
- *A key to adults of British Water Beetles* L.E. Friday (1988)
- *A key to the major groups of British Terrestrial Invertebrates* S.M. Tilling (1987)
- *A key to the major groups of British Freshwater Invertebrates* P.S. Croft (1986)
- *Sea Spiders. A revised key to the adults of littoral Pycnogonida in the British Isles* Phil King (1986)
- *A field guide to the British Red Seaweeds (Rhodophyta)* Sue Hiscock (1986)
- *British Grasses, a punched-card key to Grasses in the vegetative state* Richard Pankhurst & Judith Allinson (1985)
- *Bees, Ants & Wasps – the British Aculeates* Pat Willmer (1985)
- *A key to the families of British Coleoptera (beetles) and Strepsiptera* Dennis Unwin (1984: revised 1988)
- *A key to the Crabs and Crab-like Animals of British inshore waters* John & Marilyn Crothers (1983: revised 1988)
- *A key to families of British Diptera* Dennis Unwin (1981)
- *A Field key to the British Brown Seaweeds* Sue Hiscock (1979) OUT OF PRINT

These, and many other FSC titles, may be purchased when visiting Field Studies Council Centres or may be ordered through the post from:

**FSC Publications, Field Studies Council, Preston Montford, Shrewsbury SY4 1HW**
**Tel: 01743 850370 • Fax: 01743 850178**

A complete list of titles and prices is also available from this address.
The accurate identification of specimens is a fundamental part of most forms of biological fieldwork. Although the "popular" groups, such as butterflies, moths, birds and wild flowers, are well-served by numerous aids to identification, other groups are often neglected. The principal objectives of the AIDGAP project are to identify those groups for which the difficulty in identification is due to the absence of a simple and accurate key rather than being due to insuperable taxonomic problems and, subsequently, to produce simple, well-written aids to identification. These aids avoid obscure terminology, are clearly illustrated and need not be restricted to traditional methods of presentation. For example, the AIDGAE keys to willows and grasses have used multi-access tabular and punched-card formats.

A significant feature of all the keys is the extent to which they are "tested" before final publication. In addition to routine editing and refereeing by acknowledged experts, the keys are subjected to extensive field tests. Several hundred copies of a preliminary draft – the "test" version – are sent to potential users: school and university staff; students; amateur naturalists; research workers; and others involved in surveys who need to identify organisms in groups outside their own sphere of interest. The authors are asked to amend the keys in the light of feedback from these "testers" before final publication.

The success of any project such as this depends on feedback from the public. Most people who have experience of fieldwork are aware of "gaps" in the literature but unless these are communicated to the project co-ordinator, AIDGAP can do little to help alleviate the situation. Anyone wishing to contribute identification aids, or to suggest possible subjects for future projects, should contact the co-ordinator at the address alongside. Projects need not be confined to the biological field; AIDGAP would be equally interested in geological, palaeontological and geographical subjects.
GLOSSARY

Axis—see Fig. 23 below.
Bifid—divided into 2, usually by a V-shaped notch.
Branching—can be of several main types; those mentioned in the key are illustrated below:

![Diagrams of branching types]

**Fig. 23 Branching**

Cartilaginous—of firm and elastic texture.
Dichotomous—(see Fig. 23) repeatedly divided into 2.
Digitate—divided into fingers.
Distal—away from the holdfast.
Epiphytic—growing on other plants.
Filamentous—hair-like; a linear series of cells.
Filiform—thread-like, but thicker than above. (Up to 5 mm wide in this key.)
Holdfast—structure for attachment to substrate. Of various types.
Iridescent—frond surface reflecting light as a blue or green sheen.
Lamina—flat expanded part of thallus.
Lanceolate—long and pointed. Lance-shaped.
Littoral—The seashore approximately above the mean low water level of the spring tides. This is a biological zone defined by Lewis (1964) as the area between the top of the kelps and the top of the black lichens/marine snails. The sublittoral zone is the area approximately below the top of the kelps. For further discussion regarding these terms see Lewis (1964).
Pinnate—(see Fig. 23) flattened in one plane, with pinnae or side branches.
Receptacle—often swollen part of the thallus bearing reproductive structures called coriceptacles (particularly in the Fucaceae). 'Fruiting bodies'.
Rhizoid—a root-like structure.
Sorus—a group of sporangia.
Sporangium—a cell in which spores are produced.
Spore—a small asexual reproductive structure.
Sterile—without reproductive structures.
Stipe—stalk-like portion arising from a holdfast, and bearing a lamina.
Sublittoral—see Littoral above.
Thallus—the whole algal plant body. A plant structure not differentiated into root, stem and leaf.