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A FIELD KEY TO THE BRITISH BROWN SEAWEEDS (PHAEOPHYTA)

By SUE HISCOCK

Field Studies Council Oil Pollution Research Unit, Orielton Field Centre, Pembroke, Dyfed

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.

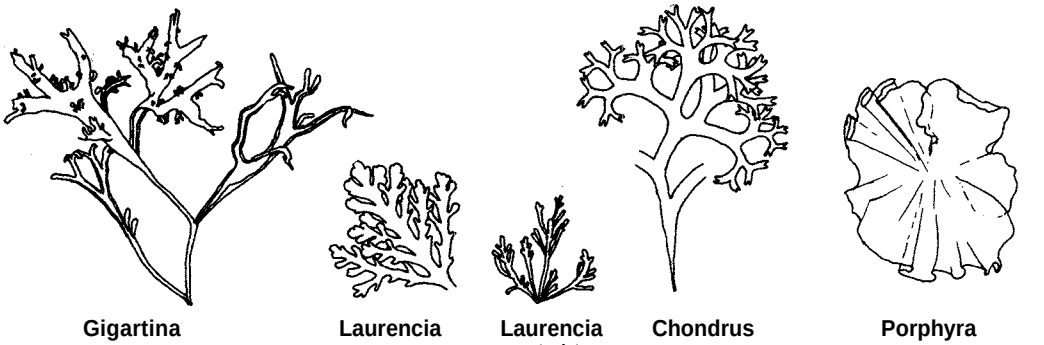


FIG. 1
Some littoral species of red algae that are commonly confused with brown algae.

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

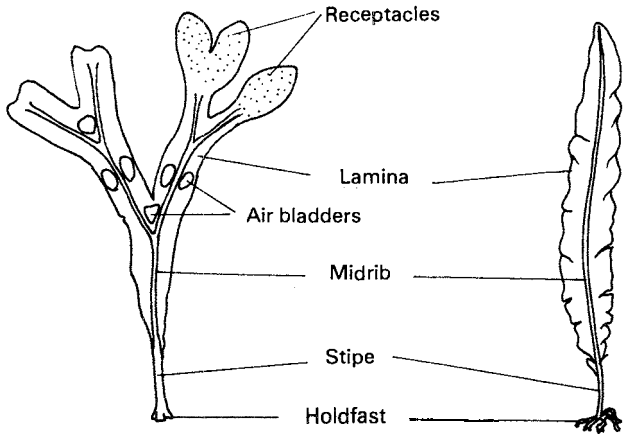


FIG. 2 **Parts of the brown seaweed**

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.

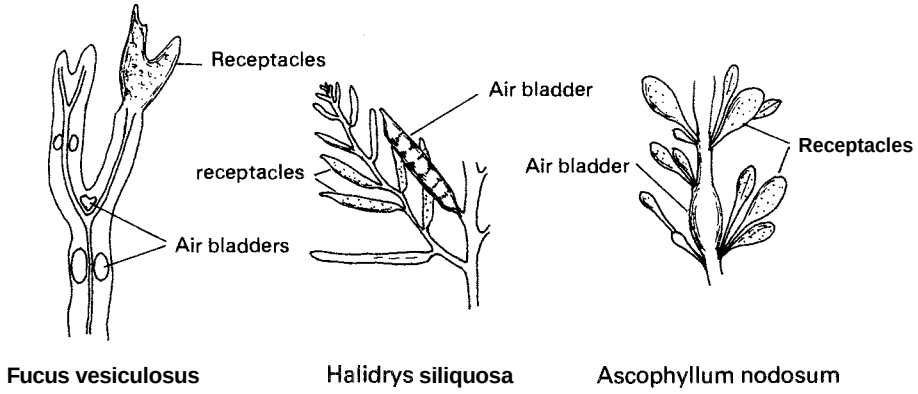


FIG. 3
The differences between air bladders and receptacles in three common species.

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).

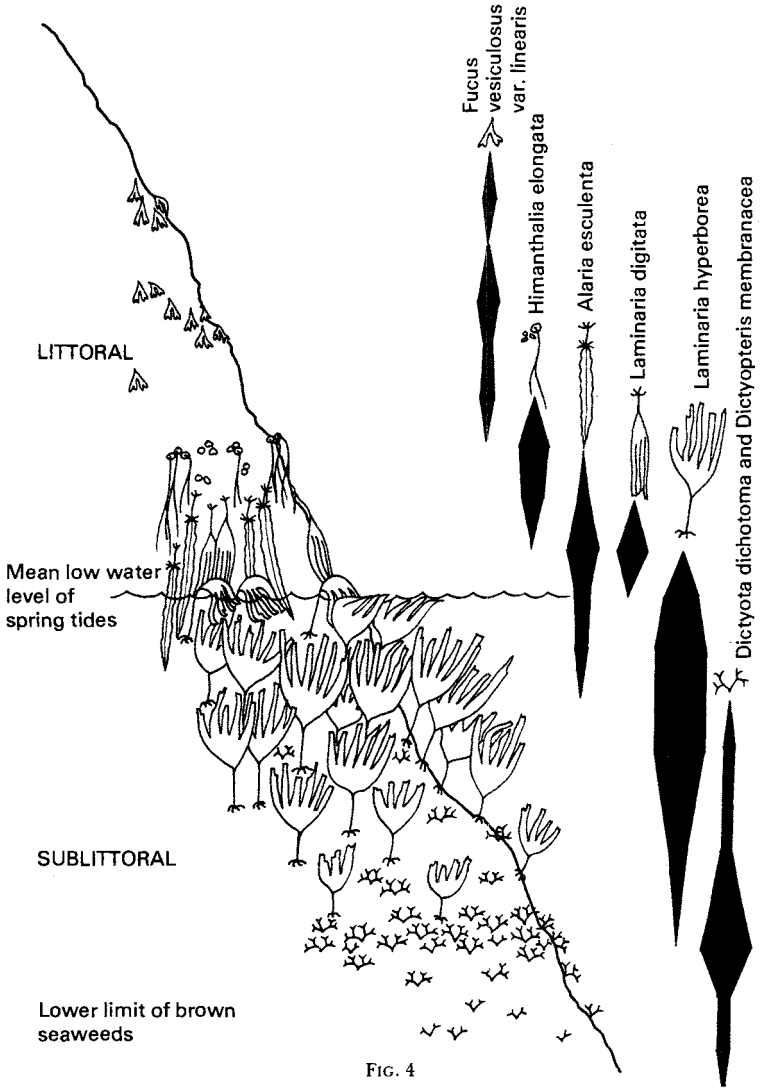


FIG. 4

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.

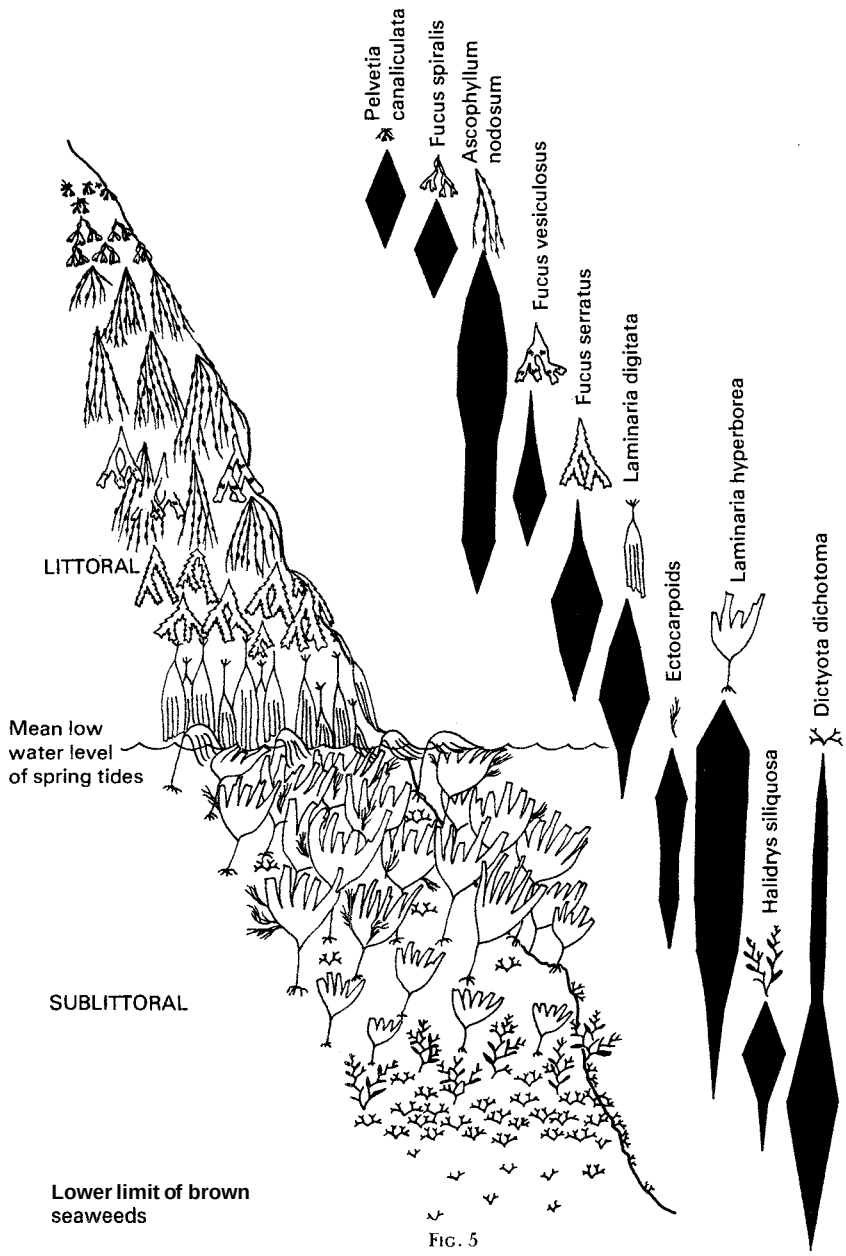


FIG. 5

The vertical zonation of some species of brown seaweed at a typical sheltered rocky site.

Most brown seaweed species normally grow on bedrock or on large stable boulders although in some extremely sheltered areas they can be found unattaiched 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

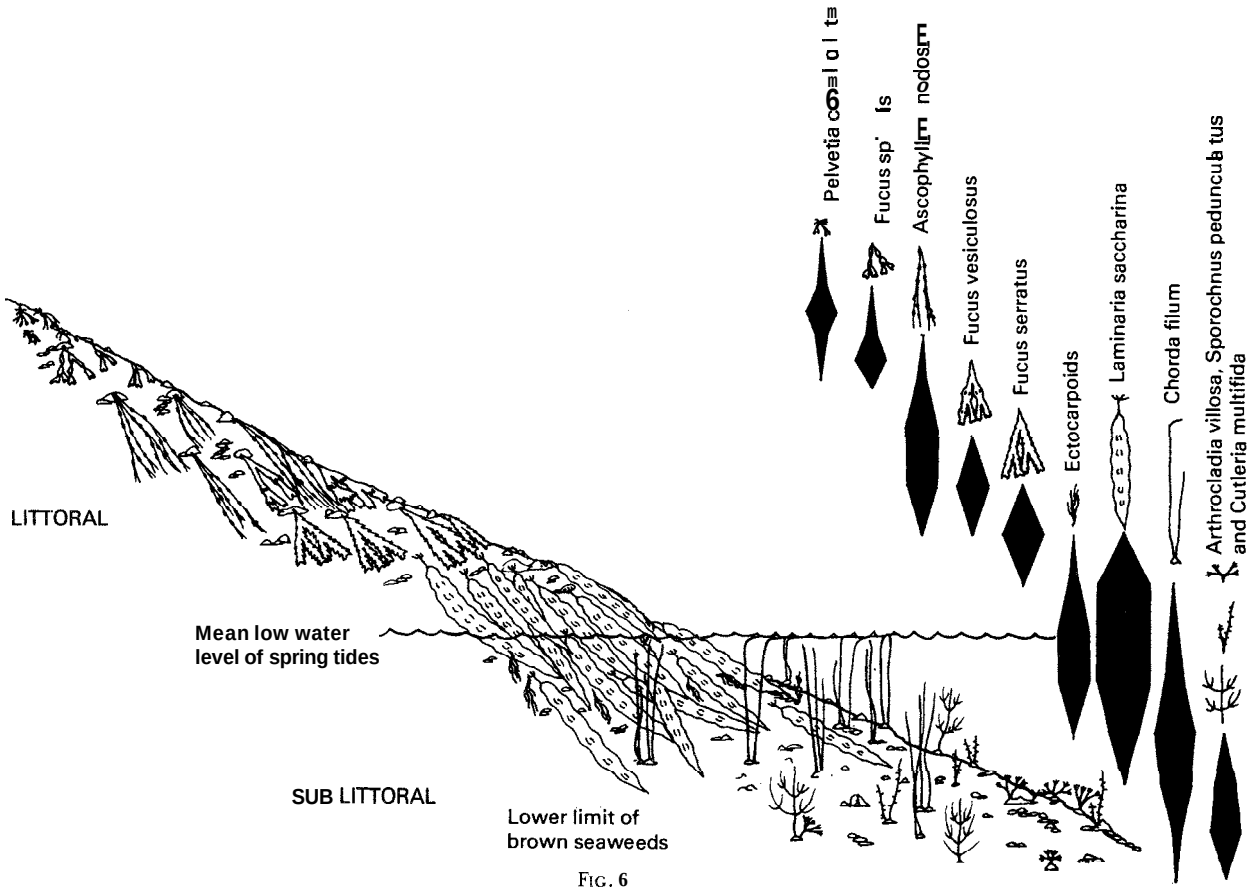


FIG. 6

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. uesiculosus* 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. distzchus* 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. ueszculosus* 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 fbrm and receptacles usually with a sterile rim. Young plants with no receptacles may be impossible to separate from *F. ueszculosus* var. *linearis* on semi-exposed shores. Generally *F. spiralis* occupies the highest *Fucus* zone on the shore, below *Peluetia canalzculata* and above *F. veszculosus,* 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. uesiculosus* 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. uesiculosus* 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.

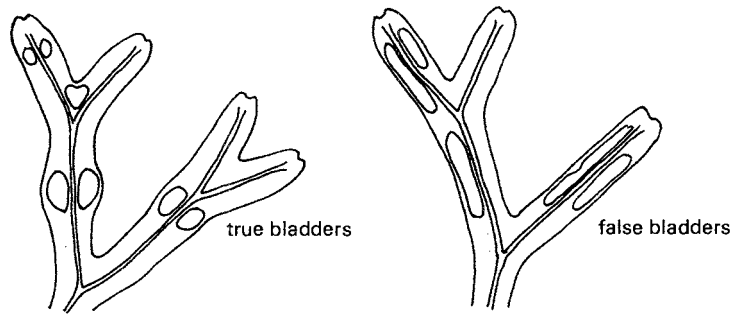


FIG. 7
The differencein appearance between false bladders and true bladders.

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 salt-marshes 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 *Peluetia canalzculata.* 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 macroscopic characteristics. A x10 hand lens may be necessary at times.
3. Nearly all British macroscopic (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 (1931) 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.

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.

Page 9

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.

Page 16

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.

Page 20

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.

Page 22

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

Page 23

CROUP A

1. Plants with midrib (may be indistinct, look carefullyi 2

Plants without midrib 14

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

GROUP B (26) p. **20**

Plant not as *Cystoseira* above **3**

3. Air bladders present 4

Air bladders absent 6

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

Fucus vesiculosus (*Fig. 13*)

Air bladders stalked 5

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) 7

Plant variously branched 10

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

Desrnarestia dresnayi (*Fig.* 11)

No side veins 8

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 5m

Alaria esculenta (Fig. I*1*)

Plant without claw holdifast, less than **10** cm long **9**

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 frorn the rnidrib. Sublittoral, S and W coasts

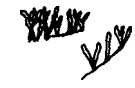
young **Dictyopteris membranacea** (Fig. *14*)

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 11

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**

12. Plant sublittoral, thin and membranous or cartilaginous and brittle **13**

Plant littoral, tough and leathery, often abundant. Fucus spp. 41

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

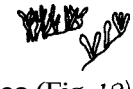
Carpomitra costata (*Fig.* 18)

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 (where frond broad, distal margin may be inrolled) 15

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

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

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

18

Plant without stout cylindrical stipe and claw holdlfast **23**

18. Lamina lanceolate, not divided into fingers  19

Lamina digitate (divided into fingers)  21

19. Lamina crinkly, wavy edged. To 4 m  **Laminaria saccharina** (*Fig.* 11)

Lamina smooth  **20**

20. Stipe with small swelling, which later becomes a large bulb 

young **Saccorhiza polyschides** (Fig. 11)

Stipe without swelling  young **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 

Laminaria digitata (*Fig. 10*)

Stipe stiff, stands up by itself, snaps when bent. Extreme lower shore and sublittoral 22

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 

Laminaria hyperborea (Fig. *10*)

Stipe smooth, without epiphytes; otherwise as L. ***hyperborea*** (above). sand. SW coasts, sublittoral. To 3 m **Laminaria ochroleuca**

23. Frond undivided or divided only from base **24**

Frond variously dividecl, lobed or branched **28**

24. Frond with chalky deposit, distal margins inrolled. Frond banded. S coast 

Padina pavonia (*Fig. 8*)

Frond without chalky deposit **25**

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  **Zanardinia prototypus** (Fig. *8*)

Frond elongated, rounded or ribbon-shaped **26**

26. Strap-shaped frond arising from a stalked button or 'mushroom' 

Himanthalia elongata (*Fig.* 17)

Plant riot arising from a stalked button **27**

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

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**

30. Branching opposite  **31**

Branching various, not opposite **32**

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**

33. Branching basically dichotomous, may appear alternate **34**

Irregularly branched, lobed or split frond **38**

34. Plant with pod-shaped air lbladders 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

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

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

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

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

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

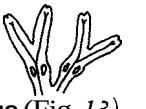
Taonia atomaria (*Fig. 8*)

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*)

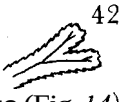
KEY TO Fucus SPECIES

41. Plant with paired (sometimessingle) 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



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**

43. Frond flat, usually wider than 4 mm. Midrih and lamina distinct **44**

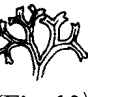
Frond rounded or flattened, very narrow, usually less than 4 mm except for fruiting bodies. Midrib may be indistinct 47

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**

45. Frond membranous and relatively thin, rnidrib 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



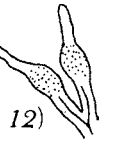
Fucus ceranoides (Fig. *13*)

Frond tough and leathery **46**

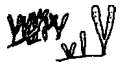
46. Receptacles terminal. Frond often battered and with small new fronds regenerating from the base. Exposed rocky shores, often abundant, easily confused with F. *spiralis*—see fucoid notes 1, 2 and 3, p. **6.** To **30** cm

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 

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 

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 

Fucus distichus subsp. **distichus** *(Fig. 12)*

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 

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. 

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 

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

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*)

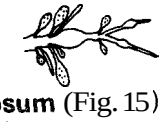
Plant with ovate air bladders not divided by cross-walls 7

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**

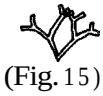
8. Frond strap-shaped, large (1-5cm) ovoid air bladders arranged singly along axis. Receptacles stalked, in marginal notches. Sheltered shores. To **150** cm



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**

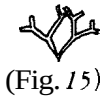
Frond cartilaginous, firm **10**

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

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

Halidrys siliquosa (Fig *17*)

Air bladders small or absent 13

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

Bifurcaria bifurcata (Fig. *17*)

Holdfast not expanded and knolbbly, plants usually much branched. Not as *Bifurcaria bifurcata* 14

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

Desmarestia aculeata (Fig. *19*)

May have small, ovate air bladders. Frond wider than **2** mm in older parts, mainly cylindrical **15**

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

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

Cystoseira spp. 26

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

Ascophyllum nodosum (Fig. 15)

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

No air bladders 17

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 **19**

Plant without air bladders **21**

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**

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 
26

21. Frond soft, easily squashed between fingers **22**

Frond firm, not easily squashed between fingers **23**

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.), *Sphaerotnchia, 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. 
26

Frond not prickly **24**

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 

Sporochnus pedunculatus (Fig. *18*)

Side branches without small swelling **25**

25. Axes with whorls of hairs. Sublittoral 

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 

Chordaria, Acrothrix and **Dictyosiphon** (3 spp.) ***(Fig. 17)***

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

Cystoseira tamariscifolia (Fig. *16*)

Frond not iridescent underwater **27**

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

Cystoseira nodicaulis (Fig. 16)

Bases of branches not swollen **28**

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

Cystoseira foeniculacea (Fig. *16*)

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

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 3

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.	**Elachista fucicola** (Fig. 20)
Halidrys siliquosa and *Cystoseira* spp.	**Elachista flaccida**
Himanthalia elongata	**Elachista scutulata**
Arthrocladia *villosa* and others	**Elachista stellaris**

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 4

Plant limp, floppy when moved about in water **8**

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**

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**

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

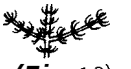
Branchlets alternate (use lens) **7**

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**

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

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

11. Distinct main axes bearing short side branches ending in a small swelling and a tuft of Ihairs. 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

2. Plant roughly spherical, may be convoluted 3

Plant elongated 4

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 nut 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  **5**

Plant variously branched, usually profusely  **6**

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

Plant hollow only in older parts 8

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.)

CROUP 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 *Laurencia* 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

Battersia mirabilis

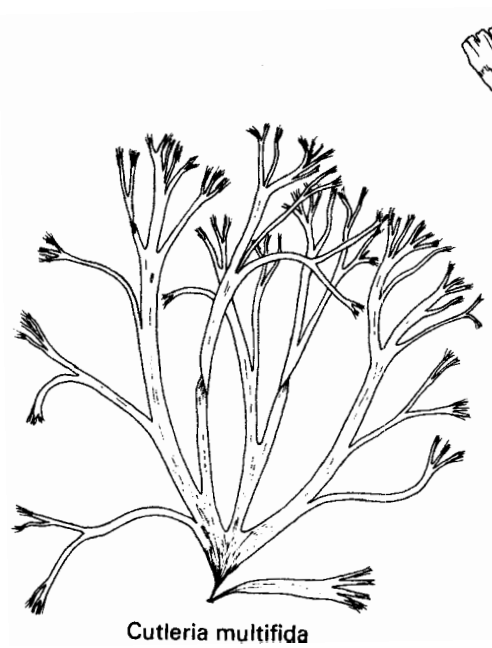
Thin dark brown crust, smooth orwarty, forming small to extensive patches on rock. Usually **Ralfsia** (5 spp.) (*Fig.* 22). But very similar are **Pseudolithoderma** (2 spp.), **Sorapion. Petroderma** and **Chilionema** (2 spp.). Encrusting brown algae can often be distinguished from red algae and lichens 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)*

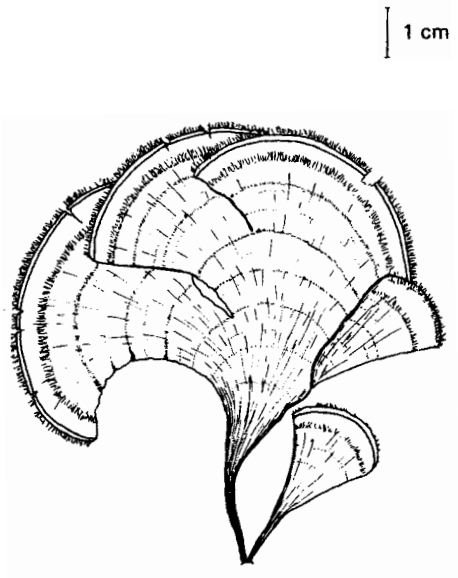
Thallus margin with fringe of hairs (may be worn away in winter). Young plants membranous, cane-shaped, attached at centre; older plants leathery, irregularly lobed, attached at many points. Sublittoral, SW Britain. To 20 cm

Zanardinia prototypus *(Fig. 8)*

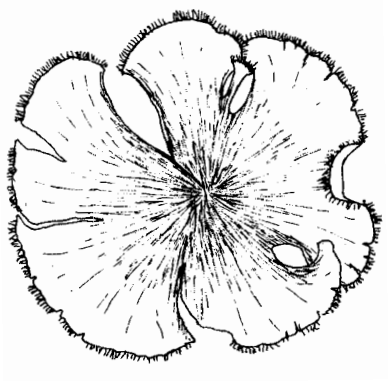


Cutleria multifida

Taonia atornaria



Padina pavonia PEACOCK'S TAIL



Zanardinia prototypus

Aglaozonia phase of Cutleria multifida

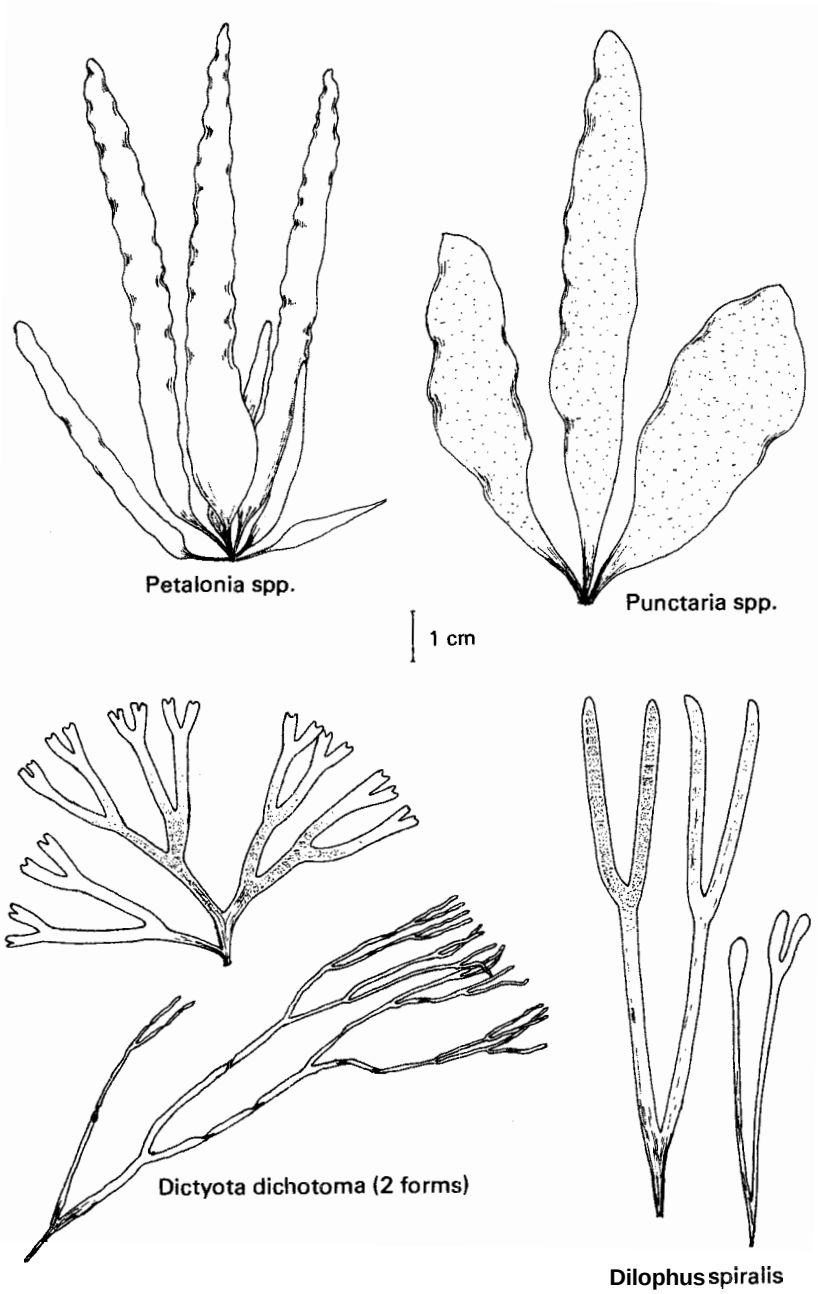

Petalonia spp.
Punctaria spp.
1 cm
Dictyota dichotoma (2 forms)
Dilophus spiralis

FIG. 9

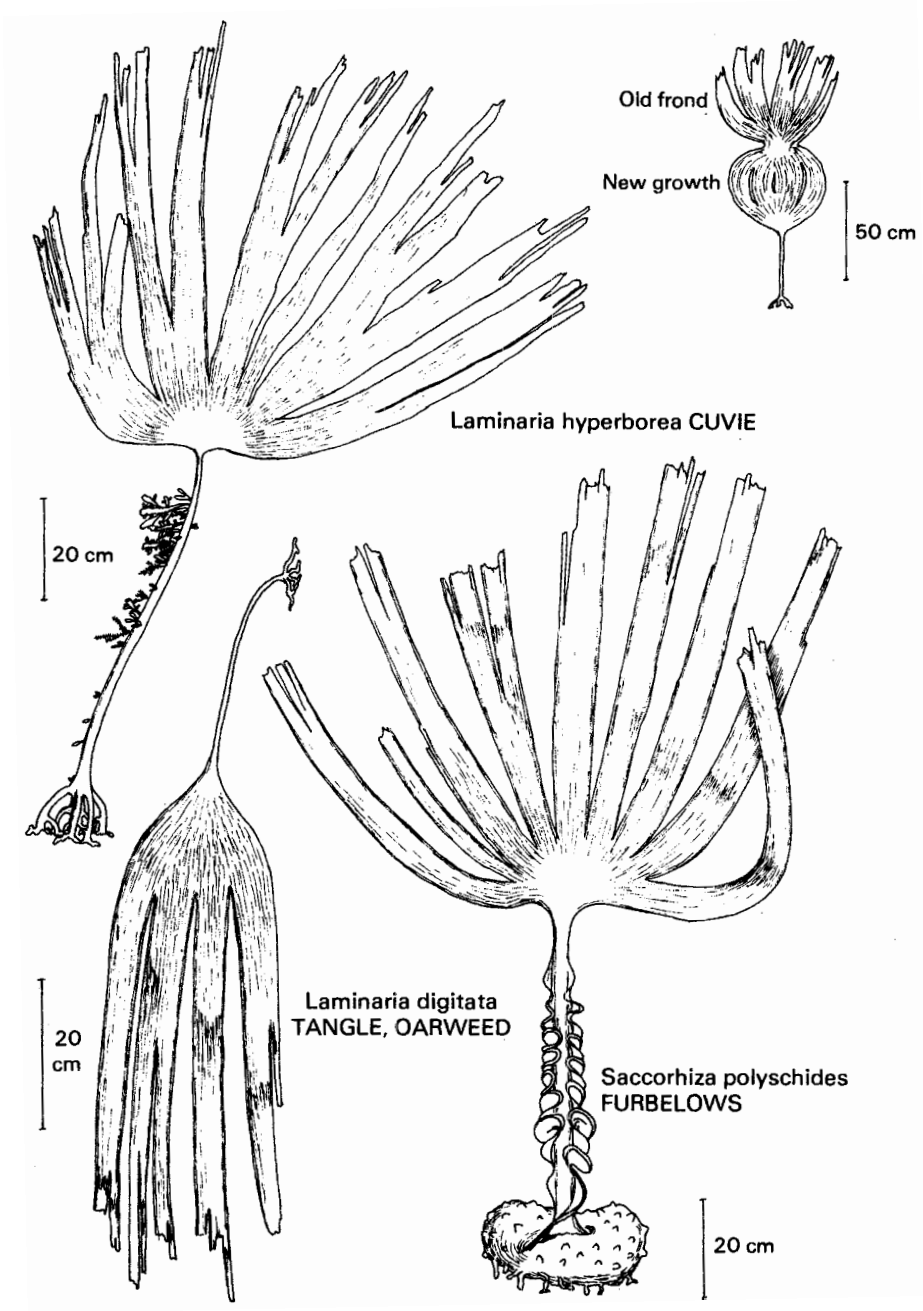

Old frond
New growth
50 cm
Laminaria hyperborea CUVIE
20 cm
Laminaria digitata
TANGLE, OARWEED
20
cm
Saccorhiza polyschides
FURBELOWS
20 cm

FIG. 10 Kelps

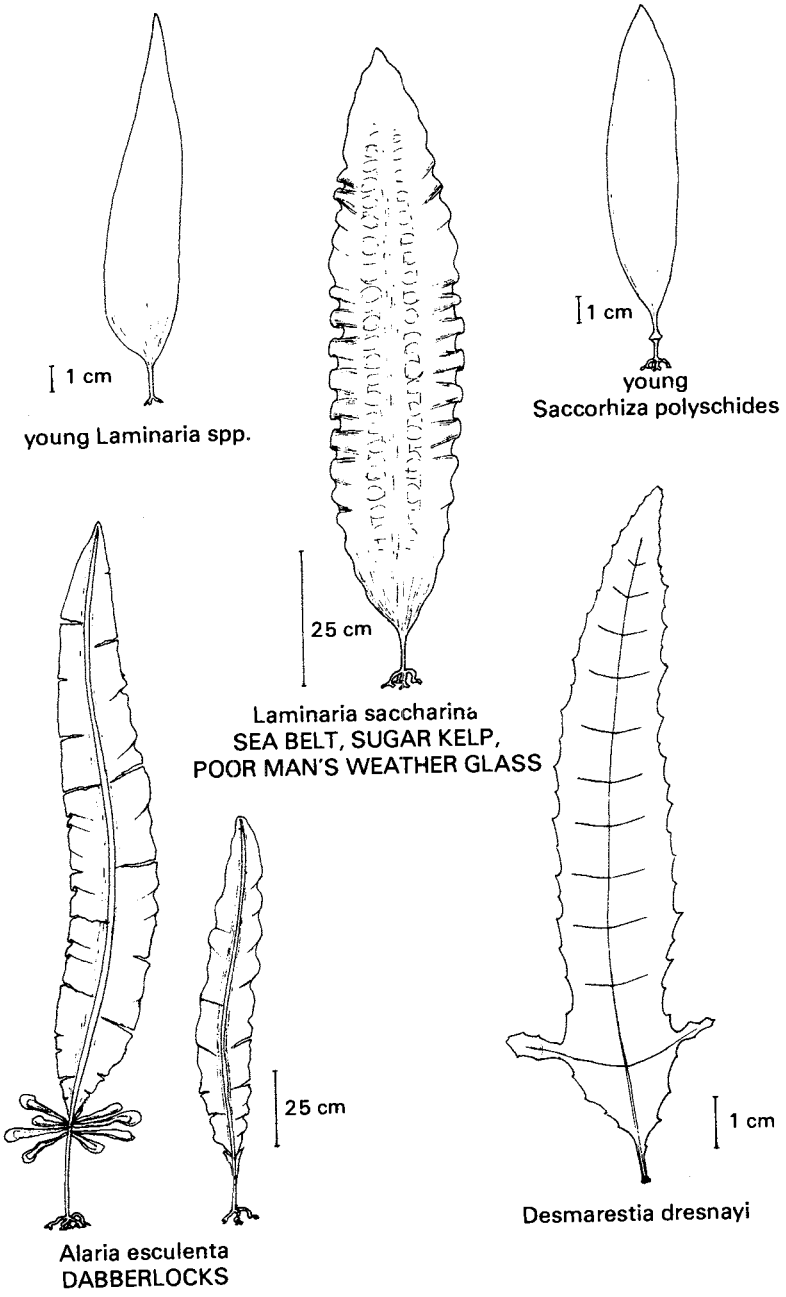
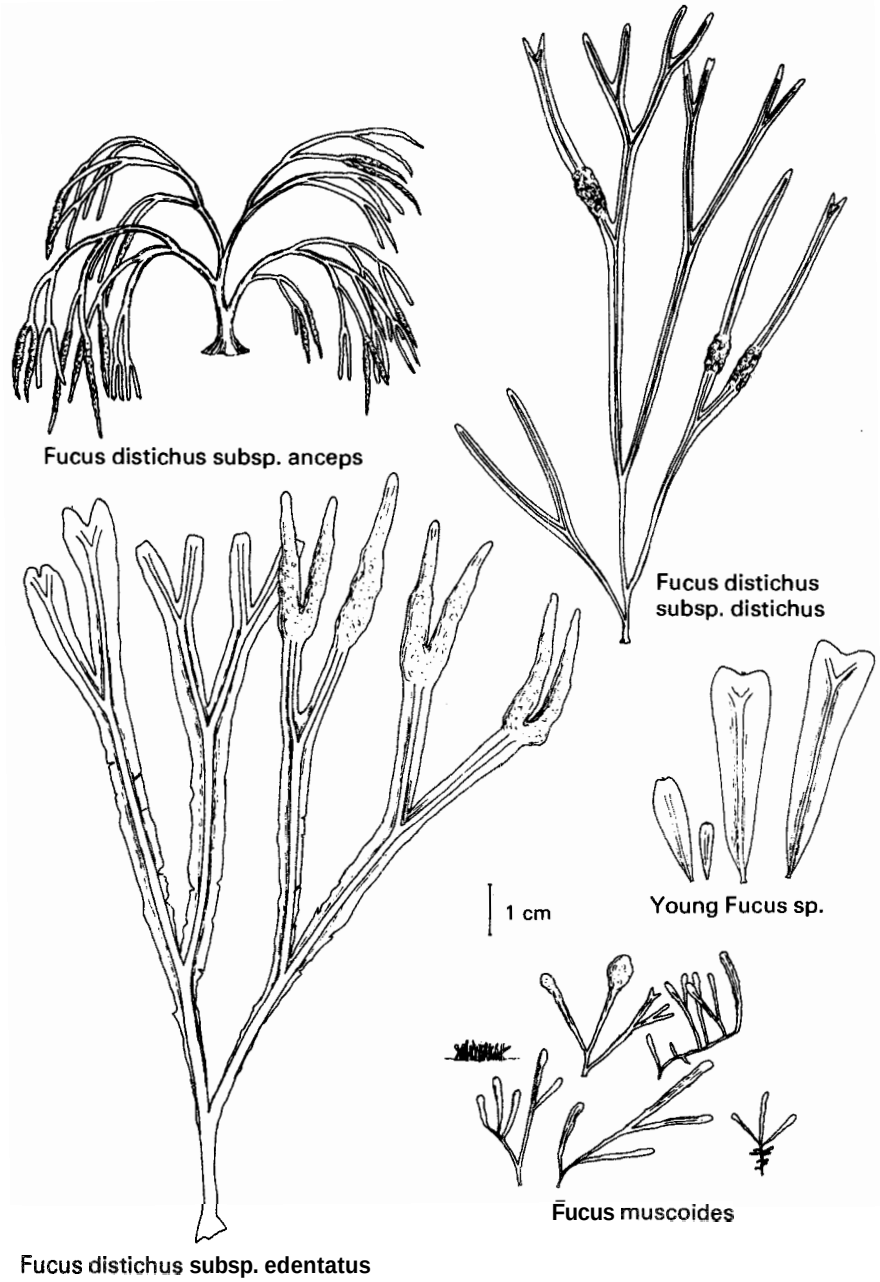

1 cm
young Laminaria spp.
25 cm
Laminaria saccharina
SEA BELT, SUGAR KELP,
POOR MAN'S WEATHER GLASS
1 cm
young
Saccorhiza polyschides
25 cm
Alaria esculenta
DABBERLOCKS
1 cm
Desmarestia dresnayi

FIG. 11


Fucus distichus subsp. anceps
Fucus distichus subsp. distichus
Young Fucus sp.
1 cm
Fucus muscoides
Fucus distichus subsp. edentatus

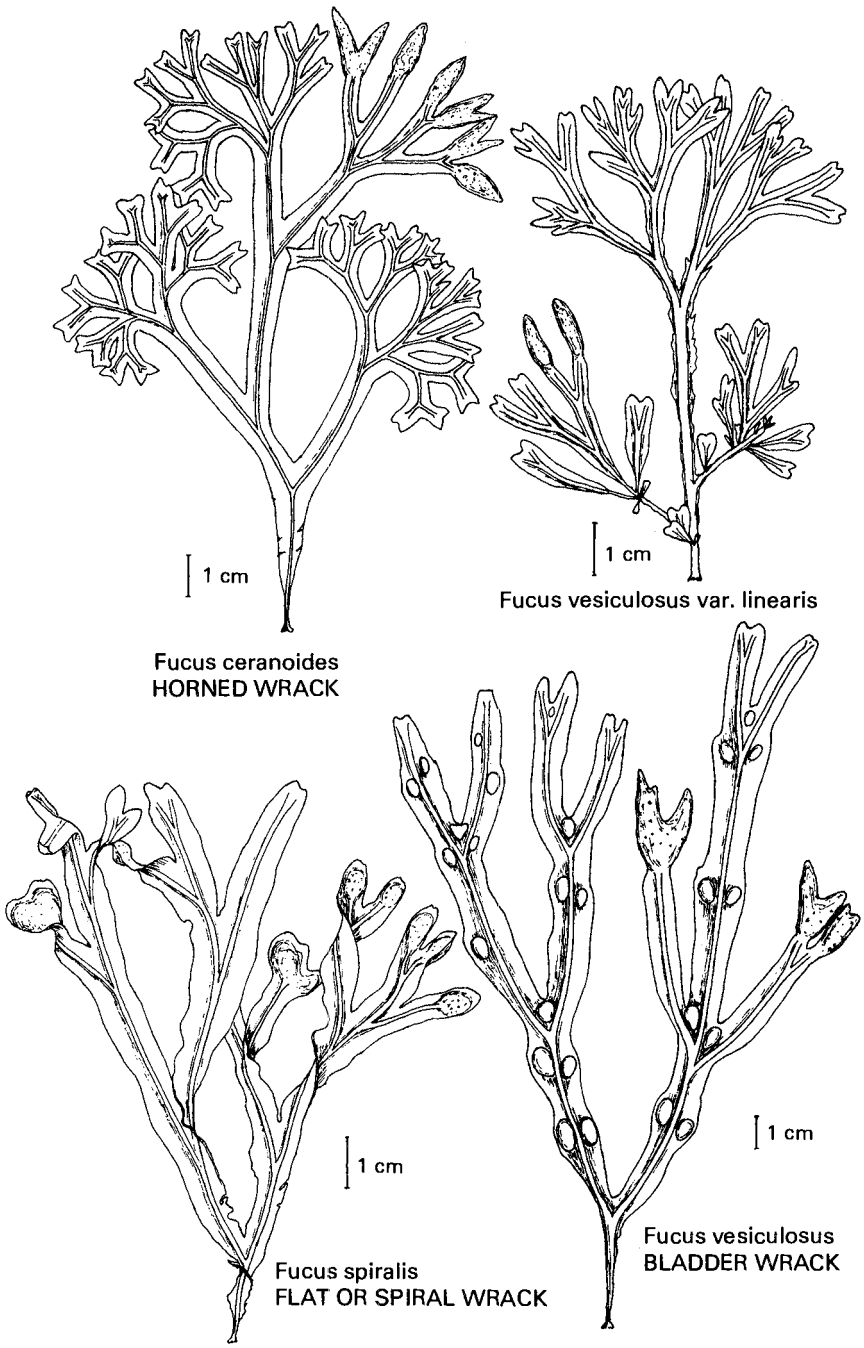
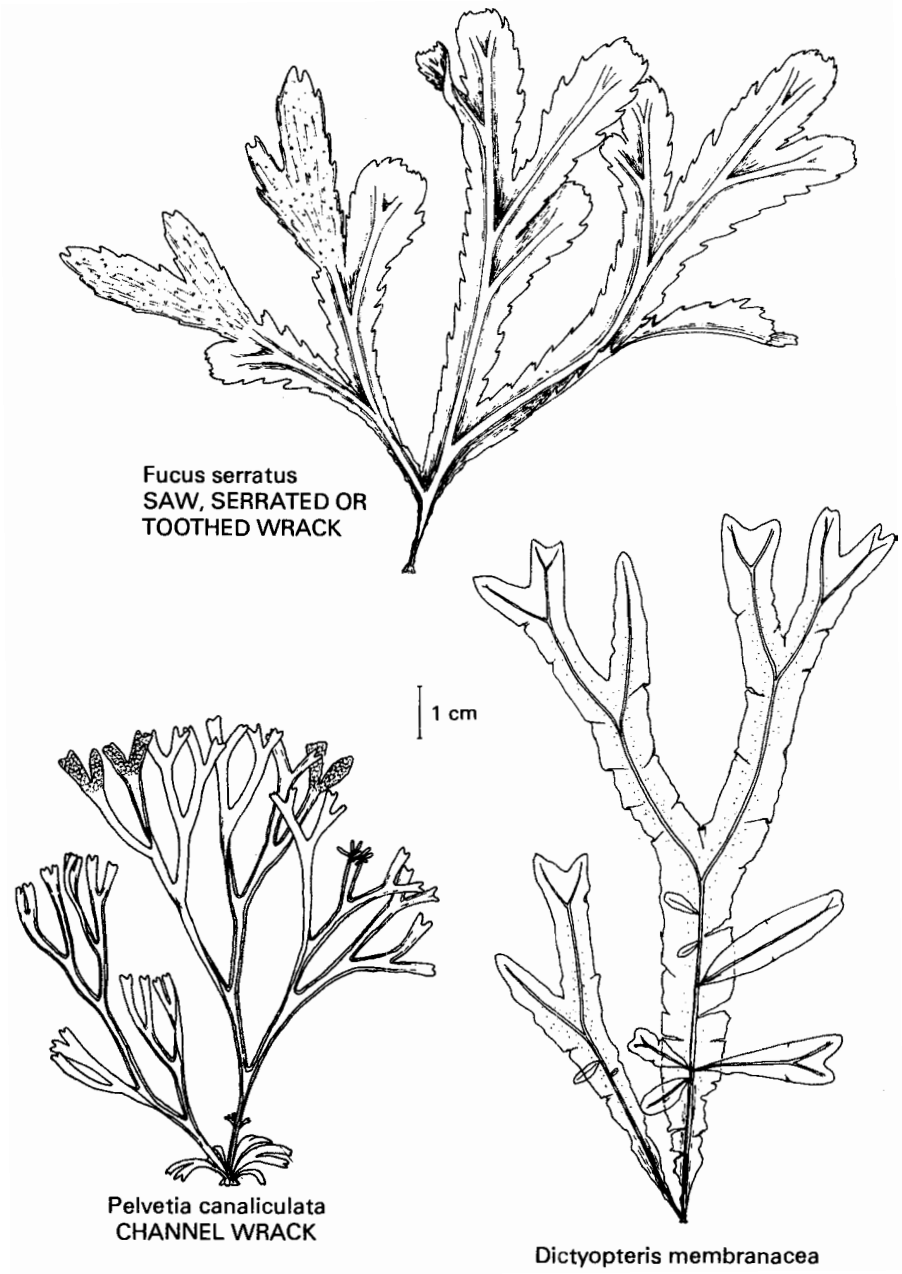
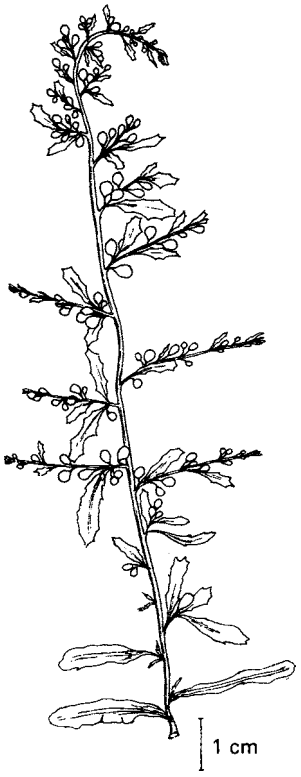
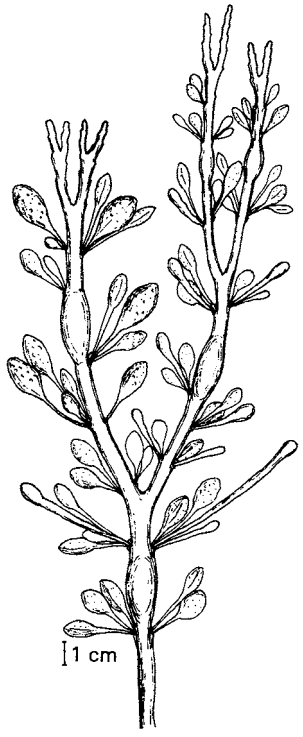

1 cm
Fucus ceranoides
HORNED WRACK
1 cm
Fucus vesiculosus var. linearis
1 cm
Fucus spiralis
FLAT OR SPIRAL WRACK
1 cm
Fucus vesiculosus
BLADDER WRACK

FIG. 13

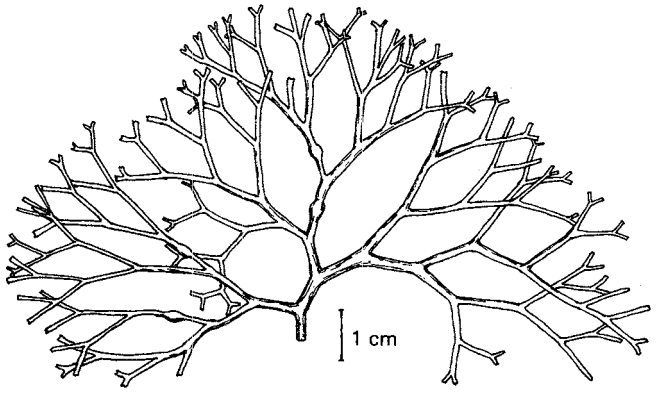

Fucus serratus
SAW, SERRATED OR
TOOTHED WRACK
1 cm
Pelvetia canaliculata
CHANNEL WRACK
Dictyopteris membranacea



Sargassurn muticum
JAPWEED

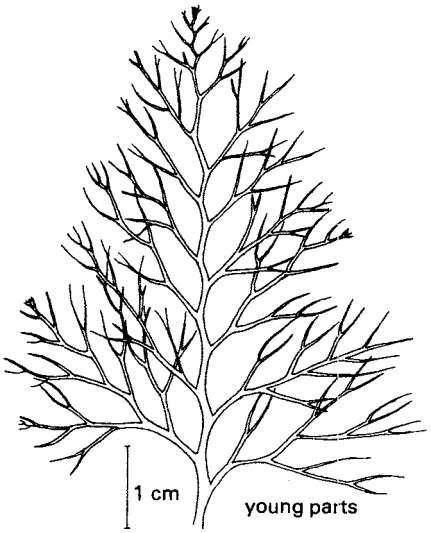


Ascophyllum nodosum
EGG OR KNOTTED WRACK

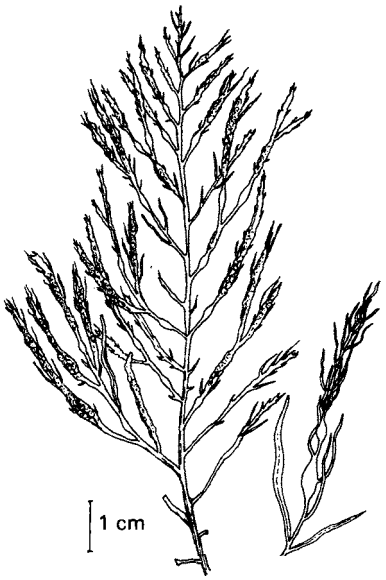


Ascophyllum nodosum var. rnackaii

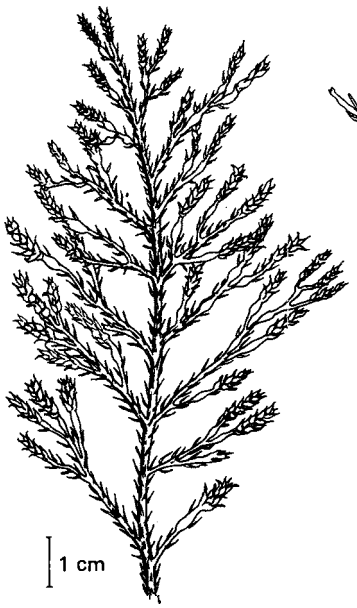
FIG. 15



Cystoseira foeniculacea



Cystoseira baccata and
C. myriophylloides



Cystoseira tarnariscifolia

Cystoseira nodicaulis

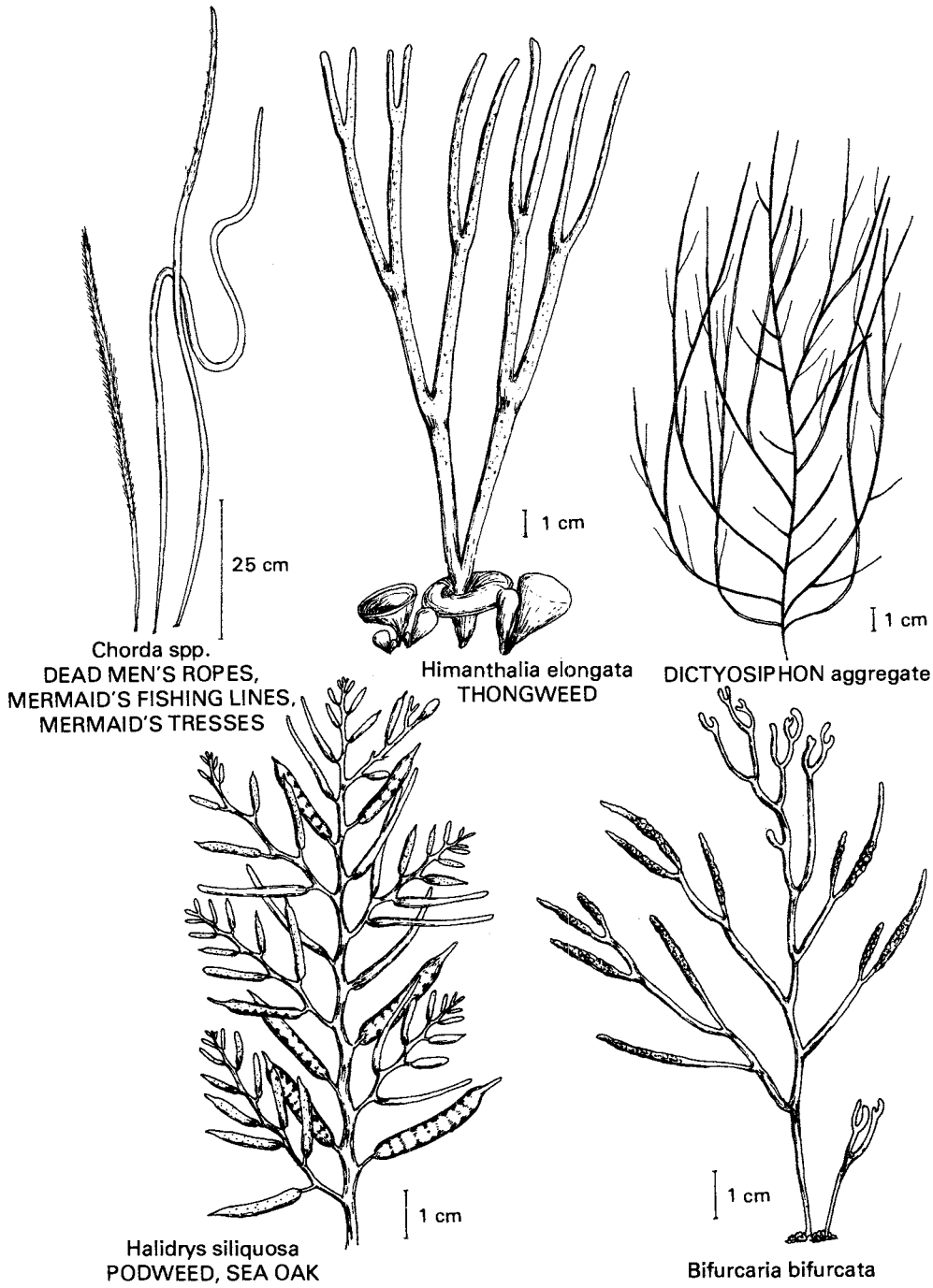
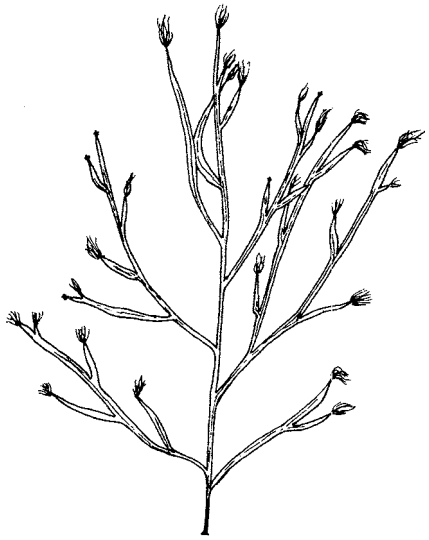
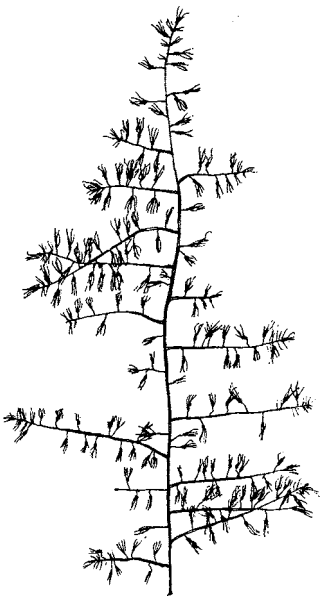

25 cm
Chorda spp.
DEAD MEN'S ROPES,
MERMAID'S FISHING LINES,
MERMAID'S TRESSES
1 cm
Himanthalia elongata
THONGWEED
1 cm
DICTYOSIPHON aggregate
1 cm
Halidrys siliquosa
PODWEED, SEA OAK
1 cm
Bifurcaria bifurcata

FIG. 17

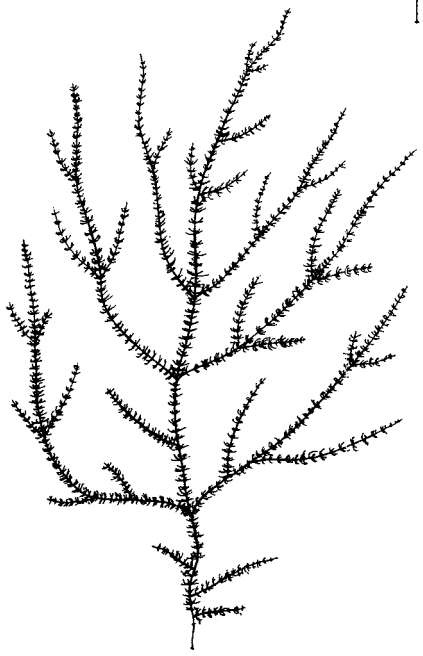


Carpomitra costata

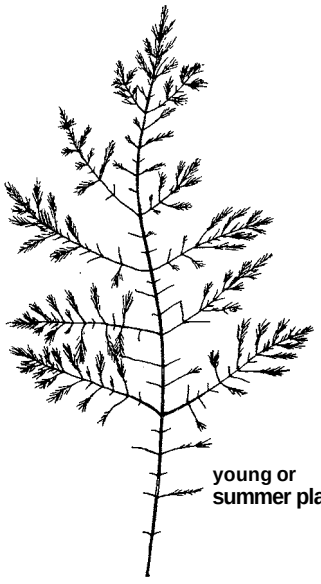
1 cm



Sporochnus pedunculatus



Arthrocladia villosa



young or
summer plant

Desmarestia viridis

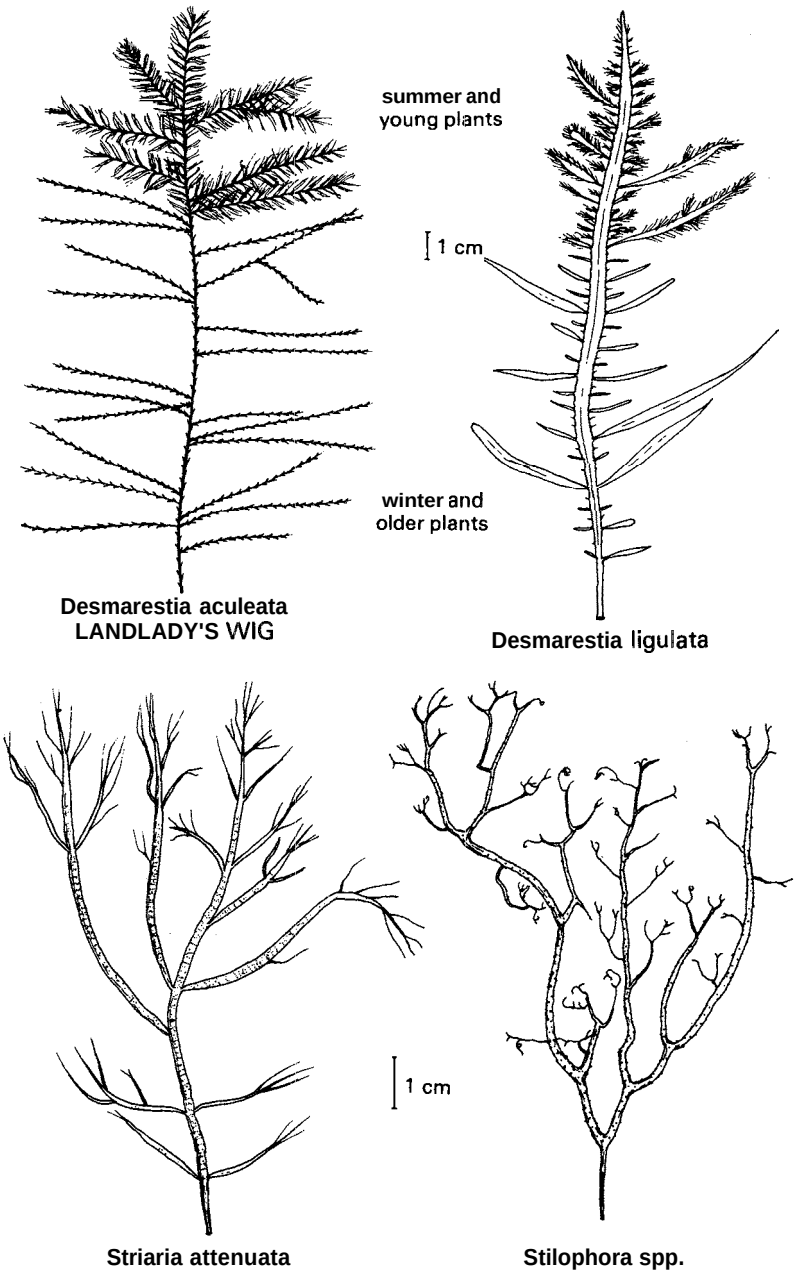
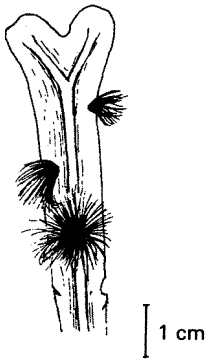

summer and
young plants
1 cm
winter and
older plants
Desmarestia aculeata
LANDLADY'S WIG
Desmarestia ligulata
1 cm
Striaria attenuata
Stilophora spp.

FIG. 19

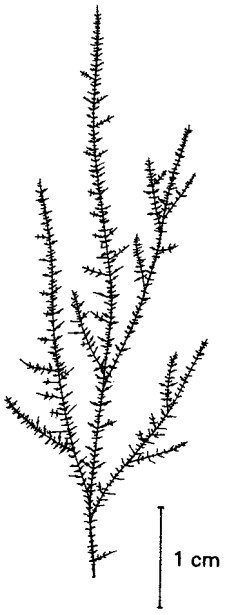


Elachista fucicola

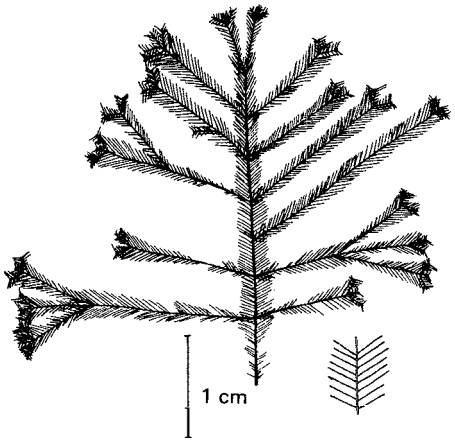
ECTOCARPUS aggregate

Sphacelaria spp. (on Corallina)

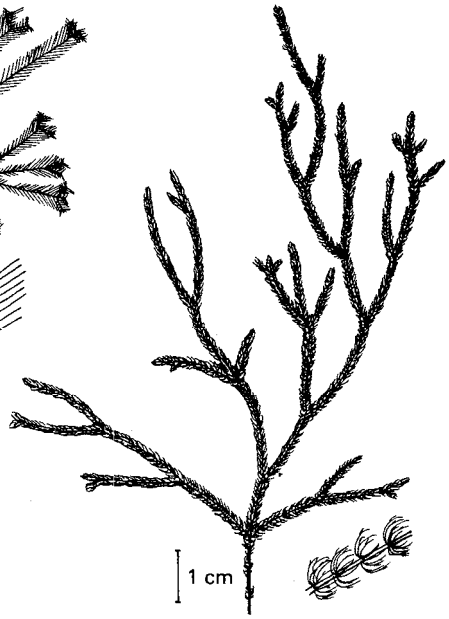
Spongonema tomentosum



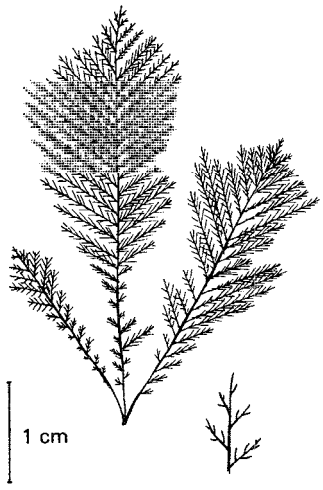
Tilopteris mertensii



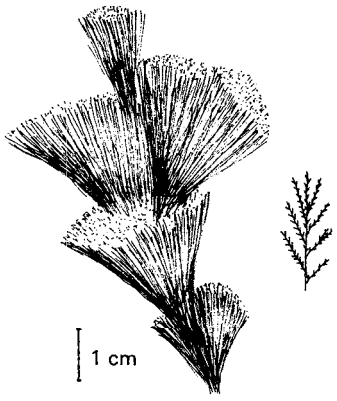
Sphacelaria plumosa



Cladostephus spongiosus

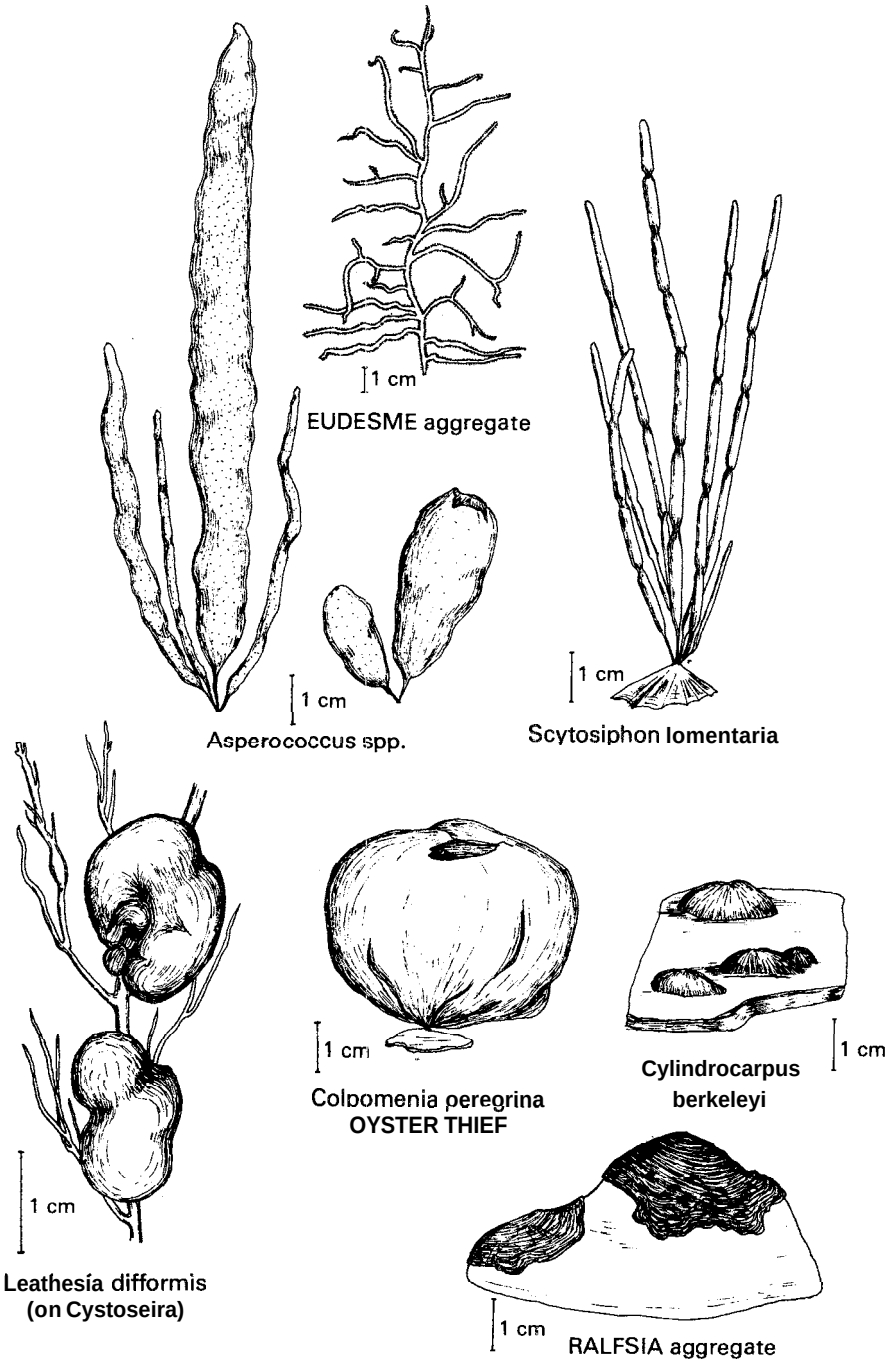


Halopteris filicina



Halopteris scoparia

FIG. 21


1 cm
EUDESME aggregate
1 cm
Asperococcus spp.
1 cm
Scytosiphon lomentaria
1 cm
Leathesia difformis
(on Cystoseira)
1 cm
Colpomenia peregrina
OYSTER THIEF
1 cm
Cylindrocarpus
berkeleyi
1 cm
RALFSIA aggregate

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.

Name in key	Name in Newton
Acrothrix gracilis	Not in Newton
Ascophyllum nodosum var. *mackaii*	*Ascophyllum mackaii*
Bifurcaria bifurcata	*Bifurcaria tuberculata*
Cladosiphon spp.	*Castagnea* spp.
Colpomenia peregrina	Not in Newton
Corynophlaea crispa	*Leathesia crispa*
Cylindrocarpus berkeleyi	*Petrospongium berkeleyi*
Cystoseira baccata	*Cystoseira fibrosa*
C. foeniculacea	*C. discors*
C. myriophylloides	Not in Newton
C. nodicaulis	*C. granulata*
C. tamariscfolia	*C. ericoides*
Desmarestia dresnayi	*Desmarestia dudresnayi*
Dilophus spiralis	*Dictyota ligulata*
Elachista spp.	*Elachistea* spp.
Eudesme virescens	*Castagnea virescens*
Fucus distichus	'A doubtful British species'
F. muscoides	*Fucus vesiculosus* var. *muscoides*
Halopteris scoparia	*Stypocaulon scoparia*
Himanthalia elongata	*Himanthalia lorea*
Laminaria hyperborea	*Laminaria cloustoni*
L. ochroleuca	Not in Newton
Petalonia spp.	*Phyllitis* spp.
Saccorhiza polyschides	*Saccorhiza bulbosa*
Sargassum muticum	Not in Newton
Scytosiphon lomentaria	*Scytosiphon lornentarius*
Spongonema tomentosum	Not in Newton
Stilopsis lejolisii	*Spermatochnus lejolisii*
Zanardinia prototypus	*Zanardinia collaris*

FURTHER READING AND REFERENCES

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

BARRETT, J. H. and YONGE, C. M. (1958). *Collins Pocket Guide to the Sea Shore.* Collins, London.

CAMPBELL, A. C. (1976). *The Hamlyn Guide to the Seashore and Shallow Seas of Britain and Europe.* Hamlyn, London.

DICKINSON, C. 1. (1963). *British Seaweeds.* Kew Series, Eyre and Spottiswoode, London.

DIXON, P. S. and IRVINE, L. M. (1977). *Seaweeds of the British Isles. Volume 1 Rhodophyta. Part 1 Introduction, Nemaliales, Gigartinales*. British Museum (Natural History), London.

FRITSCH, F. E. (1945). *The Structure and Reproduction of the Algae. Vols I and II.* Cambridge University Press.

HARVEY, H. W. (1846-51). *Phycologia Britannica.* London.

KNIGHT, M. and PARKE, M. W. (1931). *Manx Algae.* Liverpool University Press.

LEWIS, J. R. (1964). *The Ecology of Rocky Shores.* The English University Press, London.

NEWTON, L. (1931). *A Handbook of the British Seaweeds.* British Museum (Natural History), London.

KEYS, CHECK LISTS AND OTHER REFERENCES

DIXON, P. S., IRVINE, D. E. G. and PRICE, J. H. (1966). The distribution of benthic marine algae. A bibliography for the British Isles. *British Phycological Bulletin,* **3,** 87-142.

Supplement 1 (PRICE, J. H., 1967). *British Phycological Bulletin,* **3,** 305-315.

Supplement 2 (PRICE, J. H. and TITTLEY, I.,, 1970) British Phycological Journal, 5, 103-112.

Supplement 3 (PRICE, J. H. and TITTLEY, I., 1975) British Phycologzcal Journal, 10, 229-307.

IRVINE, D. E. G. (1956). Notes on British Species of the Genus *Sphacelaria* Lyngb. Transactzons and Proceedings *of the* Botanzcal *Society of Edinburgh,* 37, 24-45.

IRVINE, D. E. G. (1956). Notes on British Species of the Genus *Sphacelaria* Lyngb. Transactions and Proceedings *of the* Botanical Society *of Edinburgh*, 37, 34-45.

JONES, W. E. (1962, reprinted 1964 with revisions). A key to the Genera of the British Seaweeds. Field Studies, 1, (4) 1-32. (Available from Field Studies Council as an offprint.)

PARKE, M. and DIXON, P. S. (1976). Check list of British Marine Algae—third revision. *Journal* of the Marine *Biological* Association *of the* United Kingdom, 56, 527-594.

POWELL, H. T. (1957). Studies in the genus *Fucus* L. I. Fucus *distichus* L. emend. Powell. Journal *of the* Marine Biological Association of the United Kingdom, 36, 407-432.

ROBERTS, M. (1967). Studies on Marine Algae of the British Isles. 3. The Genus Cystoseira. British Phycological Bulletin, 3, 345-366.

RUSSELL, G. (1966). The Genus Ectocarpus in Britain. I. The Attached Forms. Journal *of the* Marzne Biological Association *of the* United Kingdom, 46, 267-294.

RUSSELL, G. (1967). The Genus Ectocarpus in Britain. II. The Free-living Forms. Journal *of the* Marine Biologzcal Association *of the United* Kingdom, 47, 233-250.

RUSSELL, G. and FLETCHER, R. L. (1975). A Numerical Taxonomic Study of the British Phaeophyta. Journal of the Marine *Biological* Association of the United Kingdom, 55, 763-784.

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) Available in BBC and IBM formats, Colin Legg (1992)

The Fern Guide: an introductory guide to the ferns, clubmosses, quillworts and horsetails of the British Isles James Merryweather & Michael Hill (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)

Soil Types: a field identification guide Stephen Trudgill (1989)

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 field guide to the Slugs of the British Isles R.A.D. Cameron, B. Eversham & N. Jackson (1983) OUT OF PRINT

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)

An illustrated guide to the Diatoms of British coastal plankton J. B. Sykes (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:
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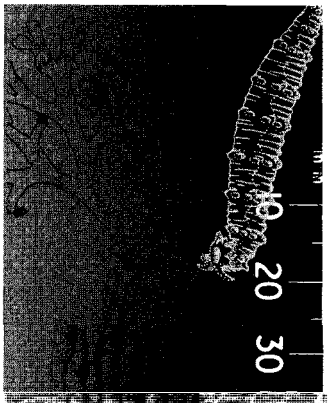
The AIDGAP Project



The accurate identificatiou 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 '"esters" 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.

The Field Studies Council is grateful to the British Ecological Society and Linnean Society of London for support during the testmg and production of AIDGAP guides.

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Telephone: (01743) 850370
Fax: (01743) 850178

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:

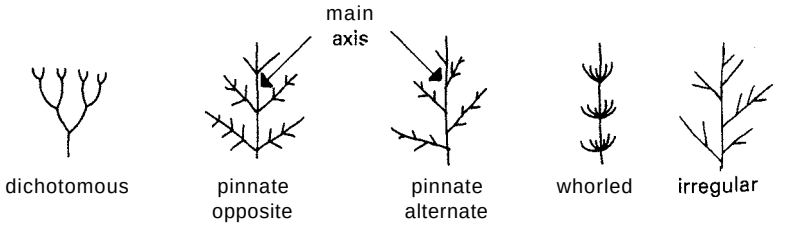

FIG. 23 Branching

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.