SEAWEEDS

by G.C. Trono, Jr.

GENERAL REMARKS

Seaweeds are the macrobenthic (large and attached) forms of marine algae. Together with the seagrasses, mangroves, and phytoplankton, they comprise the most important primary producers in the marine environment. Their thalloid body comes in a variety of forms, although typically it consists of holdfast, stipe, blade, and reproductive structures. Three major groups are distinguished, based on their dominant photosynthetic pigments. These are the Chlorophyta (green algae) with chlorophylls, the Phaeophyta (brown algae) with carotenoids, and the Rhodophyta (red algae) with phycobilins (phycoerythrin). Since they are photosynthesizers utilizing light as a source of energy, they are generally limited in their vertical distribution to shallow areas of coastal environments, and are found from intertidal to shallow subtidal zones. They inhabit a variety of habitats such as reef flats, sheltered bays and coves, and some may be limited to rocky wave-exposed areas along the shore or on the edge of the reef. Many other species are found growing in intermediate environments on various types of substrates. Although the traditional use of some seaweeds as human food in some Asian countries like Japan, China, Hawaii, and the Philippines dates back many decades, the development and utilization of some species as a fishery resource is quite recent. This is primarily due to the discovery of natural substances in these species, which have very important applications in many industries. The farming of several of these species has proved to be a very productive form of livelihood among coastal populations. The depletion of most of the near shore finfish, crustaceans, and other traditional coastal fishery resources is a contributing factor to the shift in livelihood of some coastal populations from fishing to seaweed farming and gathering of natural stocks of seaweeds. A recent interest in seaweeds is biodiversity prospecting for natural products with bioactive properties. These developments are, however, constrained by the lack of information on the identities of seaweed species. The purpose of the present contribution is to ensure correct identification of the more common or economically important species found in the Western Central Pacific.

GLOSSARY OF TECHNICAL TERMS

Acuminate - provided with sharp points.

Aculeate - sharp pointed tip.

Acute - sharp at the end; ending in a point.

Alternate branching - the branches, leaves, etc. are placed singly at different heights on the axis on opposite sides, or at definite angular distances from one another.

Amorphous - having no definite shape or form.

Anastomose - joined together irregularly to form a network.

Annulate - marked with rings; surrounded by rings or bands.

Antheridia (plural), **antheridium** (singular) - male sex organ containing male motile gametes.

Anticlinial - perpendicular to the circumference.

Apex - the tip or summit.

Apiculate - tipped with a short, abrupt point.

Aplanosporangia - sporangia producing non-motile spores.

Aplanospore - a non-motile spore.

Arcuate - bent or curved like a bow.

Assimilatory filaments - pigmented or photosynthetic filaments.

Attenuate - tapering gradually to a narrow extremity.

Axil - the angle between the upper side of a branchlet (or stem or leaf) and the supporting stem or branch.

Bifurcate - divided or forked into 2 branches.

Bistratose - in 2 parallel layers, one placed on top of the other.

Blade - a broad, thin flat part of the thallus.

Bulbous - bulging, enlarged.

Caespitose - forming dense tufts or clumps.

Calcified - made calcareous or hardened by the deposition of calcium salts.

Capitate - having a globular or spherical head.

Capitulate - resembling a close head of sessile flowers; resembling a flower head.

Carpospore - spore produced by the carposporophyte.

Cervicorn - resembling a deer's horn.

Chloroplast - structure which contains photosynthetic pigments.

Clavate - club-shaped.

Coherent - sticking together.

Complanate - on the same plane; flattened.

Coenocyte - an alga consisting of a multinucleated protoplasm resulting from repeated nuclear division, unaccompanied by cell fission.

Concave - curved like the interior of a circle.

Concentric - having a common centre, as circles or spheres.

Conceptacles - an organ or cavity enclosing reproductive bodies.

Constriction - state of being contracted or shrunk.

Coriaceous - leathery texture.

Corona - a crown of lobes or other structures.

Cortex - the outermost cell layer or tissue of an algal thallus.

Corymbose - resembling a flower cluster that has a flat-topped or convex structure.

Crustose - forming a crust; forming a hard external covering or coating.

Cryptostomata - minute cavities in the outer cortex (in members of the order Fucales), bearing tufts of hairs.

Cuneate - wedge-shaped, broad above, tapering by almost straight lines to the base.

Cuspidate - abruptly acuminate; abruptly tapering to a rigid point.

Cyme, cymose - a type of branching where a pair of laterals arise at the same point in an axis opposite to each other.

Cystocarp - the "fruit" resulting from fertilization in Rhodophyta; in Florideophycidae this consists of gonimoblast filaments and carpospores usually within a pericarp.

Decompound - having divisions which are themselves compound.

Decumbent - reclining on the substrate.

Dentate - toothed, with the teeth sharp and pointed outward.

Determinate branchlets - branchlets with limited growth.

Dichotomous - forked in 2 similar parts.

Digitate - finger-like.

Discoid - having the form of a disc.

Distal - remote from the place of attachment.

Distichous - arranged in 2 rows opposite to each other along an axis, 2 ranked.

Divaricate - branching at wide angles.

Elliptical - having the form of an ellipse.

Emarginate - notched at the apex.

Encrusted - formed into a crust.

Entire - having the margin continuous and not broken by division, teeth or serrations.

Epiphyte - a plant that grows on another plant without being parasitic.

Evesiculate - without a vesicle.

Farinose - covered with a mealy powder.

Fascicled, fasciculate - arranged in small bundles.

Fibrous - consisting or resembling fibers.

Filiferous - having hairs.

Filiform - thread-like.

Flabellate - fan-shaped.
Foliaceous - leaf-like.
Furcipate - incurved like a pair of pincers.
Frondose - leafy.
Fuzzy - covered with fibrous or fluffy matter.
Gametangium - an organ or body producing the gametes.
Genicula - the uncalcified joints between segments in a coralline alga.
Glabrous zone - smooth zone, the surface devoid of hairs or pubescence.
Globose - globe-shaped; spherical.
Glomeruliferous - resembling a head-like cluster of flowers (a cyme).
Gonimoblast - filamentous structure producing the carpospores.
Haptera - basal multicellular outgrowths forming a part of a holdfast.
Hapteriod cells - cells modified for attachment.
Holdfast - basal attachment organ of an alga.
Incised - deeply cut.
Indusiate - with a thin outer covering (of a sorus).
Interdichotomy - portion of a branch of segment in between the dichotomies.
Intergenicula - the calcified segments between the uncalcified joints in a coralline alga.
Intertidal - portion of the shore which is alternately covered and exposed during tidal changes.
Isodiametric - having equal diameter throughout.
Lacerate - irregularly divided by deep incisions.
Lanceolate - narrow and tapering toward the apex or each end.
Lateral - pertaining to the side.
Lax - loosely cohering; not compact.
Linear - narrow, short, with the 2 opposite margins parallel.
Lower intertidal - portion of the shore which is exposed only during the lowest low tide.
Lower surface of Padina - associated with the convex surface of the enrolled margin.
Lubricous - slippery.
Mamillate - having a nipple-like structure.
Medulla - the central tissue of an internally differentiated thallus.
Moniliform - consisting of a series of bead-like swellings, alternating with contractions; resembling a string of beads.
Monostromatic - having the cells in a single layer.
Mucronate - abruptly tipped by a small short point.
Muricate - rough with short hard points, like in the shell of *Murex* species.
Nodular - shaped like a tubercle or shaped like a rounded mass or lump.
Notches - indentations; more or less angular cuts.
Oblanceolate - broadest above the middle and tapering downward.
Oblong - 2 or 3 times as long as broad and not conspicuously narrowed, the sides nearly parallel.
Obovate - inversely ovate, with the broad end upward and narrow end at the base.
Obpyramidal - inversely pyramidal.
Obscure - not clear.
Obtuse - slightly rounded at the end.
Octagonal - having 8 angles and 8 sides.
Orbicular - circular in outline.
Ostiole - a small opening.
Oval - egg-shaped.

Ovate - twice (or less) as long as broad, widest below the middle and more or less narrowed upward.

Palisade - a row or layer of elongate cells in the cortex.

Paniculate - arranged in a loosely branching flower cluster.

Papillate - having the form of a small nipple-like projection.

Peltate - having the stalk attached to the lower surface but not at the margin or base.

Percurrent - extending throughout the entire length.

Pericarp - wall of the cystocarp.

Pinnate - feather-like; having parts arranged on each side of a common petiole or axis.

Pinnule - one of the pinnately disposed division of a pinnate structure.

Proliferous - producing new individuals, organs such as branchlets or leaves, from an organ which in itself is normally ultimate.

Polyhedral - many angled cells.

Polystichous - in many ranks.

Prostrate - lying flat on the ground.

Proximal - situated toward the point of origin or attachment.

Pseudocortex - false cortex.

Pyriform - pear-shaped.

Racemose - having the form of a raceme; the organs (receptacles, leaves, etc.) are stalked and attached to a common axis.

Ramuli (plural), **ramulus** (singular) - determinate branchlets.

Receptacle - the specialized fertile portion of the branches.

Reniform - kidney-shaped, broader than long and with a sinus at the base.

Reticulate - net-like.

Rhizoid - a unicellular or multicellular filament functioning as an organ of attachment.

Rhizoidal - resembling rhizoids.

Rugose - rough and wrinkled.

Sagittate - shaped like an arrow-head.

Scuttate - thickened attachment structure (holdfast).

Secondary pit connection - cytoplasmic connection between 2 non-related cells after coming in contact with each other; cytoplasmic strand laterally connecting the cortical cells of some species of *Laurencia*.

Secund - arranged only on one side of the axis.

Serrate - having sharp small teeth that are projected forward.

Sickle - curved, hook-like blade mounted in a short handle used for cutting grain grass, etc.

Sinuate - distinctly wavy; the margin alternately uneven with concavities and convexities.

Sorus - a group or cluster of reproductive organs.

Spherical - having the form of a sphere; globular.

Spongiose - without firmness and readily compressible.

Sporangia (plural), **sporangium** (singular) - reproductive cell producing spores.

Steel green - dark bluish green.

Stichidium (singular), **stichidia** (plural) - inflated, expanded or swollen specialized branch bearing the tetrasporangia (in some Florideophycidae).

Stipe - the stem-like, usually basal part of the thallus above the holdfast.

Stipitate - provided with a stipe.

Stolon - a slender branch or shoot growing out from the base of a parent plant and capable of producing another shoot.

Suborbicular - somewhat circular.

Substipitate - more or less provided with a stipe; stipe not very distinct.

Substrate - the base or material on which the seaweed is attached.

Subtidal - portion of the shore which is always submerged, even at the lowest tides.

Subulate - awl-shaped; linear, very narrow, tapering to a very fine point from the broadest base.

Summit - the apex.

Supratidal - portion of the shore above the high tide line wet by waves; spray zone.

Taper - to become gradually slender towards the apex.

Terete - with a circular transverse section.

Tetrachotomous - divided into 4 branches.

Tetrasporic plant - the asexual, diploid thallus among the red algae which produces the tetrasporangia.

Tetrasporangial branchlets - branchlets bearing tetrasporangia.

Thallus - a simple vegetative plant body which is undifferentiated into true leaves, stems, and roots.

Tidepool - a deep or shallow pool in the intertidal zone that remains flooded even during the lowest tide.

Tocopherols - one of several alcohols which compose the reproductive dietary factor known as vitamin E, occurring in wheat-germ oil, lettuce or spinach leaves, egg yolk, etc.

Tortuous - full of twists, turns or bends, twisting winding or crooked.

Trichotomous - type of branching where two main branches are produced opposite to each other at certain points along the main axes.

Triquetrous - having a triangular cross section; three-sided.

Tristichous - arranged in 3 rows or ranks along an axis.

Truncate - square or broad at the end; as if cut off transversely.

Tubercle - a small rounded projection.

Turbinate - inversely conical; bell-shaped.

Turf - forming low dense growth.

Turgid - swollen with air or water; distended.

Undulate - to have a wavy form or surface.

Ungulate - hooflike-shaped.

Uniseriate - in a single series.

Unistratose - in 1 layer.

Upper intertidal - portion of the shore which is exposed during low tide but submerged during high tide.

Upper surface of Padina - associated with the concave surface of the enrolled margin.

Utricle - a small sac-like body, or vesicle-like cell.

Verticils - whorled, several laterals arising from the same point around an axis.

Verticillate - the leaves, branches, hairs, etc. are arranged around a point or an axis.

Vesicle - a bladder-like structure.

Vesiculate - vesicle-like.

Villose - covered with soft hair.

Virgate - shaped like a rod or wand; long, slender and straight.

Whorl - a circular arrangement of equal parts (i.e., leaves, branches, etc.) round a point on an axis.

KEY TO DIVISIONS

1. Plant generally green to yellowish green in colour due to the dominance of chlorophyll; cell wall consisting of a pectic outer layer and an inner cellulose layer; sometimes calcified; photosynthetic product is starch . . . . . **Chlorophyta**

2. Plant generally brown to pale brown to reddish brown in colour due to the dominance of xanthophyll pigments; cell wall consisting of cellulose and alginic acid; photosynthetic product is laminarin and mannitol . . . . . **Phaeophyta**

3. Plant generally red to yellowish red to dark greenish red in colour due to the the dominance of r-phycoerythrin; cell wall consisting of a small amount of cellulose and gelatinous or amorphous sulphated galactans such as agar, carrageenan, furcellarin, and others; food reserve is floridian starch . . . . . **Rhodophyta**

KEYS TO GENERA AND COMMON AND ECONOMICALLY IMPORTANT SPECIES OCCURRING IN THE AREA

A. CHLOROPHYTA

1a. Thallus forming fan-shaped blades or segments . . . . . → ***2***

1b. Thallus not forming fan-shaped blades or segments . . . . . → ***6***

2a. Thallus consisting of uncalcified fan-shaped blades (Fig. 1) (*Avrainvillea*) . . . . ***Avrainvillea erecta***

2b. Thallus consisting of calcified segments . . . . . → ***3***

3a. Segments consisting of well-defined medulla and cortex . . . . . (***Halimeda)*** → ***4***

3b. Segments not consisting of well-defined medulla and cortex . . . . . (***Udotea)*** → ***5***

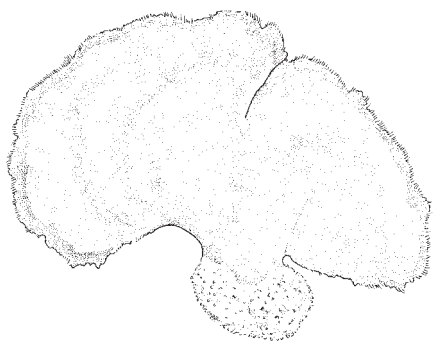


Fig. 1 ***Avrainvillea erecta***

4a. Thallus erect; segments large, flat, arranged in one plane; distal margins of segments undulate to irregularly lobed (Fig. 2) . . . . . ***Halimeda macroloba***

4b. Thallus forming an amorphous mass; segments small, reniform to discoid; main segment generally ribbed (Fig. 3) . . . . . ***Halimeda opuntia***

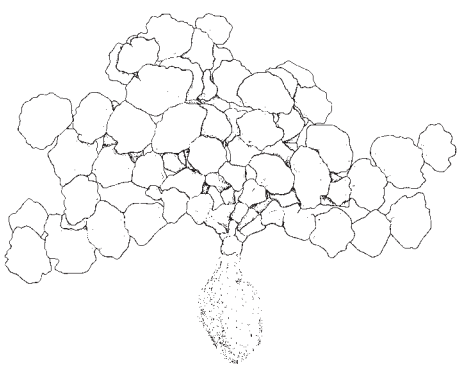


Fig. 2 ***Halimeda macroloba***

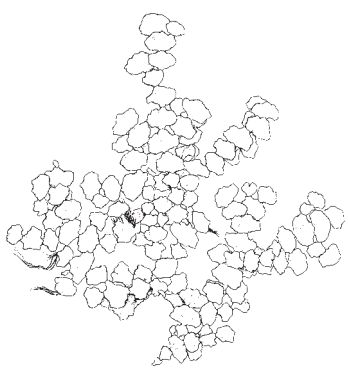


Fig. 3 ***Halimeda opuntia***

5a. Thallus steel grey in colour, consisting of overlapping flabellate to reniform segments; determinate laterals of blade filaments clavate to bell-shaped at the tips (Fig. 4) . . . ***Udotea argentea***

5b. Thallus light green, consisting of flabellate to subreniform segments, the surface of the segments divided into distinct concentric zones; determinate laterals of blade filaments much branched and forming many finger-like branchlets (Fig. 5) . . . . . ***Udotea geppii***

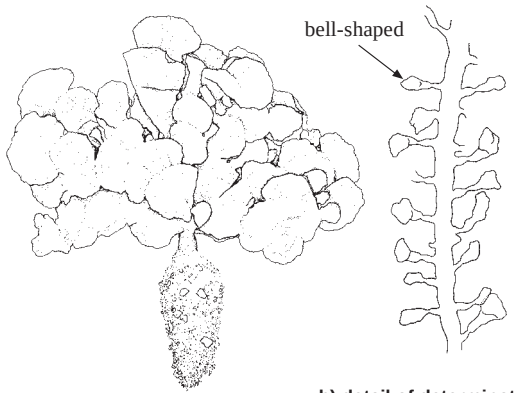


Fig. 4 ***Udotea argentea***

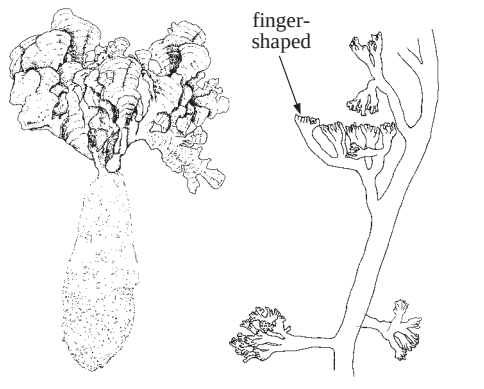


Fig. 5 ***Udotea geppii***

6a. Thallus of radial symmetry or whorled branching . . . . . → ***7***

6b. Thallus not of radial symmetry or whorled branching . . . . . → ***11***

7a. Radial symmetry evident only at the tip of the thallus (Fig. 6) (*Acetabularia*) . . ***Acetabularia major***

7b. Radial symmetry evident along most part of the thallus . . . . . → ***8***

8a. Thallus of free filaments, branching whorled along the main axis (Fig. 7) (*Tydemania*) . . . . . ***Tydemania expeditionis***

8b. Thallus clavate, lateral branches compacted to form a pseudocortex . . . . . → ***9***

9a. Thallus highly calcified (no species included here because of their limited economic importance) . . . . . ***Neomeris***

9b. Thallus not highly calcified . . . . . (***Bornetella)*** → ***10***

10a. Thallus green to reddish, cylindrical and clavate (Fig. 8) . . . . . ***Bornetella oligospora***

10b. Thallus green, spherical (Fig. 9) . . . . . ***Bornetella sphaerica***

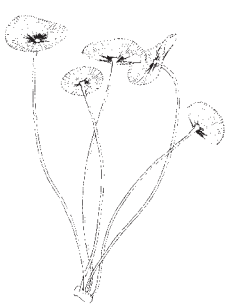


Fig. 6 ***Acetabularia major***

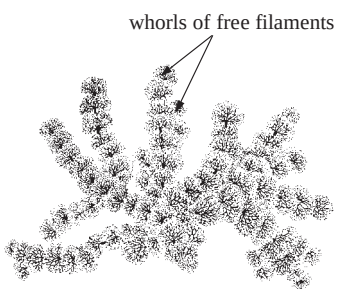


Fig. 7 ***Tydemania expeditionis***

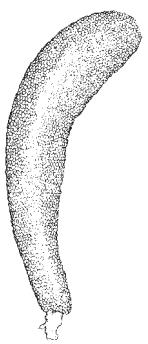


Fig. 8 ***Bornetella oligospora***

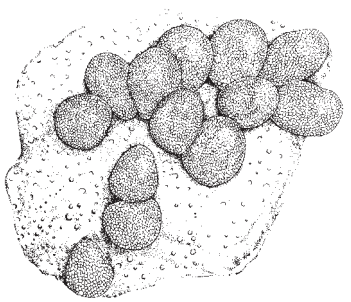


Fig. 9 ***Bornetella sphaerica***

11a. Thallus composed of large vesicles (Fig. 10) (*Valonia*) . . . . . ***Valonia aegagropila***
11b. Thallus not as above . . . . . → ***12***

12a. Thallus of parenchyma cells . . . . . → ***13***
12b. Thallus not as above . . . . . → ***15***

13a. Thallus expanded into thin blades, consisting of 2 layers of cells (Fig. 11) (*Ulva*) . . . . ***Ulva lactua***
13b. Thallus of tubular filaments or branches; walls of tubes consisting of 1 layer of cells . . . . . **(*Enteromorpha*)** → ***14***

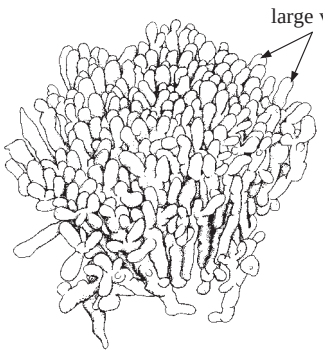


Fig. 10 ***Valonia aegagropila***

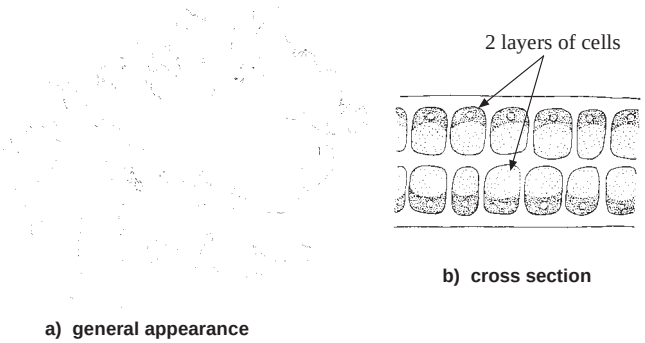


Fig. 11 ***Ulva lactua***

14a. Thallus forming mats of branched hair-like and hollow filaments (Fig. 12) . . . . . ***Enteromorpha clathrata***
14b. Thallus composed of unbranched tubular branches (Fig. 13) . . . . ***Enteromorpha intestinalis***

15a. Thallus basically filamentous, pseudo-cortex consisting of utricles . . . . . (***Codium***) → ***16***
15b. Thallus is a large coenocyte of various forms . . . . . (***Caulerpa***) → ***18***

16a. Thallus unbranched, irregularly lumpy to lobed (Fig. 14) . . . . . ***Codium arabicum***
16b. Thallus branched . . . . . → ***17***

Fig. 12 ***Enteromorpha clathrata***

Fig. 13 ***Enteromorpha intestinalis***

17a. Branches prostrate to decumbent, the segments cylindrical (Fig. 15) . . . . . ***Codium edule***
17b. Branches erect spreading, the segments compressed at the dichotomies (Fig. 16) . . ***Codium bartlettii***

Fig. 14 ***Codium arabicum***

Fig. 15 ***Codium edule***

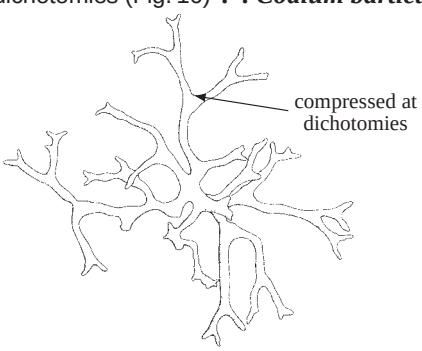


Fig. 16 ***Codium bartlettii***

18a. Erect branches forming broad flat blades (Fig. 17) . . . . . ***Caulerpa brachypus***
18b. Erect branches not as above . . . . . → ***19***

19a. Erect branches with spherical to peltate ramuli . . . . . → ***20***
19b. Erect branches with teeth-like to cylindrical ramuli . . . . . → ***22***

20a. Ramuli peltate (Fig. 18) . . . . . ***Caulerpa peltata***
20b. Ramuli globose . . . . . → ***21***

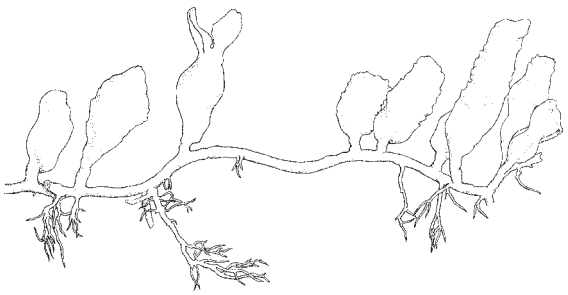


Fig. 17 ***Caulerpa brachypus***

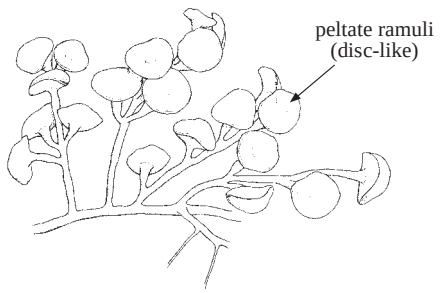


Fig. 18 ***Caulerpa peltata***

21a. Small globose ramuli densely crowded on the erect branches (Fig. 19) . . . . . ***Caulerpa lentillifera***
21b. Large globose ramuli loosely arranged on the erect branches (Fig. 20) . . . . . ***Caulerpa racemosa***

Fig. 19 ***Caulerpa lentillifera***

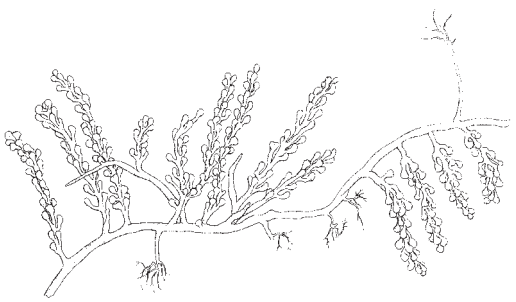


Fig. 20 ***Caulerpa racemosa***

22a. Cylindrical, short, upcurved teeth-like pinnules distichously arranged on the erect branches (Fig. 21) . . . . . ***Caulerpa cupressoides***
22b. Cylindrical to flattened pinnules pinnately arranged on the erect branches to form feather-like blades . . . . . → ***23***

23a. Pinnules cylindrical (Fig. 22) . . . . . ***Caulerpa sertularioides***
23b. Pinnules flattened (Fig. 23) . . . . . ***Caulerpa taxifolia***

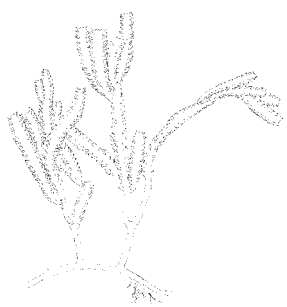


Fig. 21 ***Caulerpa cupressoides***

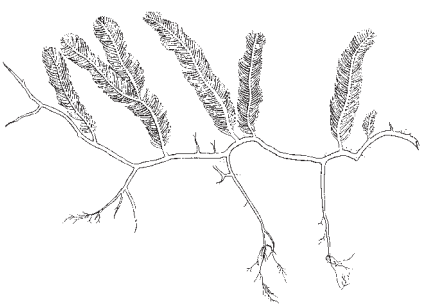


Fig. 22 ***Caulerpa sertularioides***

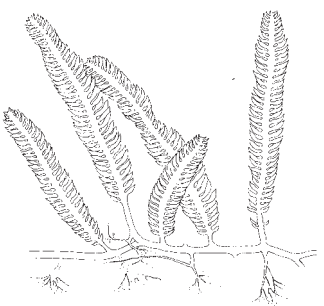


Fig. 23 ***Caulerpa taxifolia***

B. PHAEOPHYTA

1a. Thallus fan-shaped or composed of strap-shaped blades . . . . . → ***2***

1b. Thallus not as above . . . . . → ***5***

2a. Thallus thin, fan-shaped, slightly calcified (Fig. 24) (*Padina*) . . ***Padina minor***

2b. Thallus strap-shaped, dichotomously branched . . . . . → ***3***

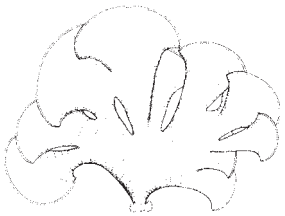


Fig. 24 ***Padina minor***

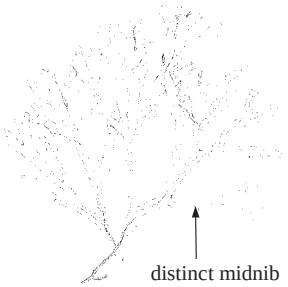


Fig. 25 ***Dictyota jamaicensis***

3a. Thallus with midrib and veins (Fig. 25) (*Dictyopteris*) . . . . . ***Dictyopteris jamaicensis***

3b. Thallus without midrib and veins . . . . . (***Dictyota***) → ***4***

4a. Thallus regularly dichotomously branched, dichotomies with acute angles, segments linear to narrowly cuneate, apices of terminal segments emarginate (Fig. 26) . . . . . ***Dictyota dichotoma***

4b. Thallus unequally dichotomously branched, segments short, cuneate, apices of terminal segments with a pair of teeth (Fig. 27) . . . . . ***Dictyota mertensii***

5a. Thallus reticulate, net-like (Fig. 28) (*Hydroclathrus*) . . . . . ***Hydroclathrus clathratus***

5b. Thallus branching with distinct blades and stipes . . . . . → ***6***

Fig. 26 ***Dictyota dichotoma***

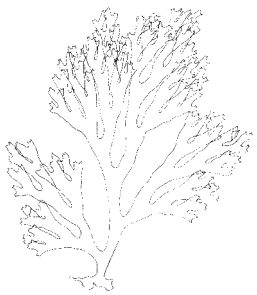


Fig. 27 ***Dictyota mertensii***

Fig. 28 ***Hydroclathnus clathratus***

6a. Leaves bell-shaped or trigonous in shape . . . . . (***Turbinaria***) → ***7***

6b. Leaves flat and expanded, with midrib . . . . . (***Sargassum***) → ***9***

7a. Leaves trigonous in shape with distinctly triangular top (Fig. 29) . . . . . ***Turbinaria decurrens***

7b. Leaves bell-shaped . . . . . → ***8***

8a. Leaves large, more than 1 cm in length, their distal surface concave in top view with partial or full crown of teeth in the centre (Fig. 30) . . . . . ***Turbinaria ornata***

8b. Leaves small, less than 1 cm in length, their distal top margins expanded with coarse teeth at the margins (Fig. 31) . . . . . ***Turbinaria conoides***

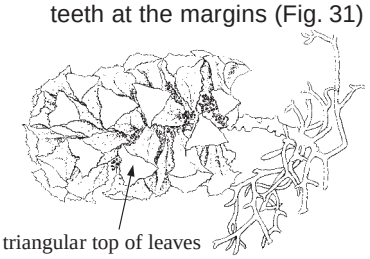


Fig. 29 ***Turbinaria decurrens***

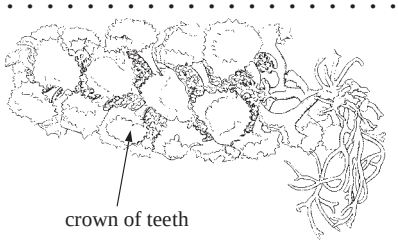


Fig. 30 ***Turbinaria ornata***

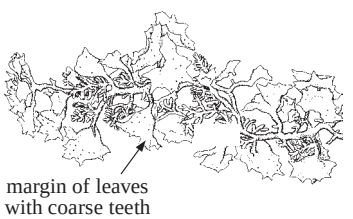


Fig. 31 ***Turbinaria conoides***

9a. Thallus with branching rhizoidal holdfast; branches rough (muricate), due to presence of many small simple or branched protuberances (Fig. 32) . . . . . ***Sargassum polycystum***

9b. Thallus with discoid or scuttate holdfast; branches smooth, without protuberances . . . . . → ***10***

10a. Primary branches distinctly and strongly flattened (Fig. 33) . . . . . ***Sargassum oligocystum***

10b. Primary branches generally cylindrical to slightly compressed . . . . . → ***11***

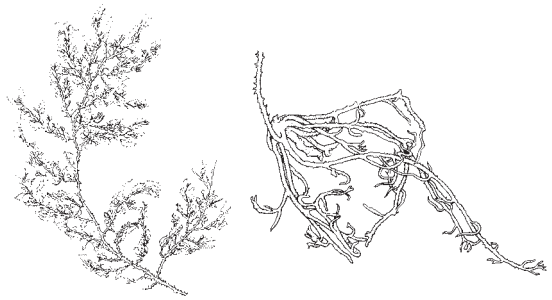


Fig. 32 ***Sargassum polycystum***

Fig. 33 ***Sargassum oligocystum***

11a. Leaves without duplicated margins or blades . . . . . → ***12***

11b. Leaves with duplicated margins or blades . . . . . → ***13***

12a. Leaves of terminal branches associated with the distally compressed female receptacular branches and mainly linear, to linear oblanceolate, lumpy due to the elevated cryptostomata (Fig. 34) . . . . . ***Sargassum gracillimum***

12b. Leaves of terminal branches lanceolate with coarsely serrated margins; female receptacular branches compressed to triquetrous or slightly twisted (Fig. 35) . . . . . ***Sargassum paniculatum***

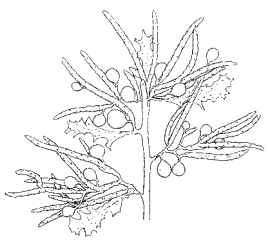


Fig. 34 ***Sargassum gracillimum***

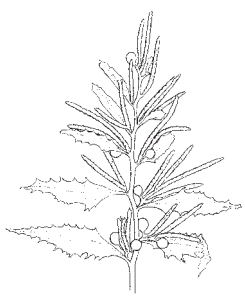


Fig. 35 ***Sargassum paniculatum***

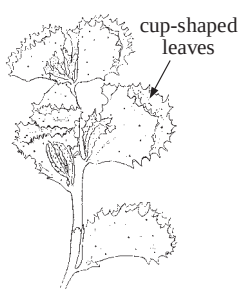


Fig. 36 ***Sargassum turbinarioides***

13a. Leaves thick, lateral margins serrated; serrations in single or double rows, the distal third of most blades double and expanded into a cup-shaped structure (resembling the leaves of *Turbinaria*) (Fig. 36) . . . . . ***Sargassum turbinarioides***

13b. Leaves not as above . . . . . → ***14***

14a. Leaves horizontally attached, mainly oblong in shape, relatively thick, margin finely dentate, tip obtuse-rounded and mostly with thick duplicate margins; receptacle a compound cyme (Fig. 37) . . . . . ***Sargassum cristaefolium***

14b. Leaves vertically attached, thin, mainly obovate in shape, margin coarsely and irregularly single or double dentate; tips rarely duplicated; receptacle a simple cyme, receptacular branch mainly linear and compressed towards the tip (Fig. 38) . . . . . ***Sargassum crassifolium***

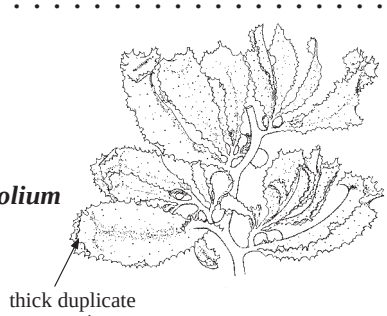


Fig. 37 ***Sargassum cristaefolium***

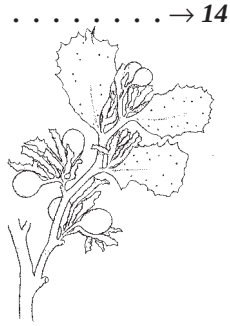


Fig. 38 ***Sargassum crassifolium***

C. Rhodophyta

1a. Thallus calcified . . . . . → ***2***
1b. Thallus not calcified . . . . . → ***3***

2a. Thallus heavily calcified, consisting of flattened segments (Fig. 39) (*Cheilosporum*) . . . . . ***Cheilosporum cultratum***
2b. Thallus lightly calcified, not segmented (Fig. 40) (*Liagora*) . . . . . ***Liagora farinosa***

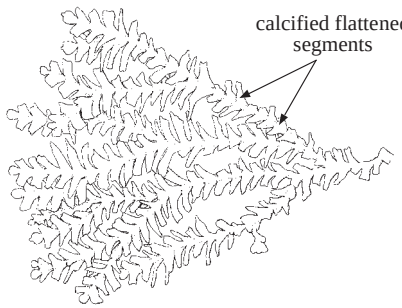


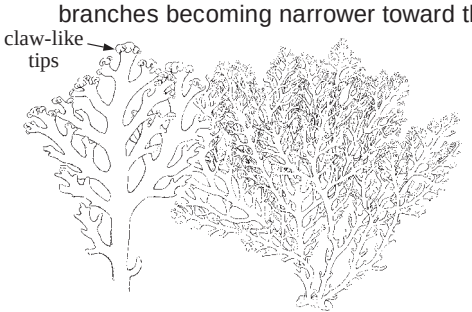
Fig. 39 ***Cheilosporum cultratum***

Fig. 40 ***Liagora farinosa***

3a. Branches compressed, flattened or developed as thin blades . . . . . → ***4***
3b. Branches not as above . . . . . → ***6***

4a. Thallus small, determinate branchlets with claw-like tips (Fig. 41) (*Portieria*) . . . . . ***Portieria hornemannii***
4b. Thallus large, developed as thin, soft, slimy blade or composed of compressed branches with tips of determinate branchlets simple . . . . . (***Halymenia***) → ***5***

5a. Thallus a thin, slimy and delicate blade, simple or divided in lobes of irregular size (Fig. 42) . . . . . ***Halymenia dilitata***
5b. Thallus much branched, the branches flattened and compressed, the width of the branches becoming narrower toward the apices (Fig. 43) . . . . . ***Halymenia durvilleai***



a) terminal portion of thallus **b) general appearance**

Fig. 41 ***Portiera hornemannii***

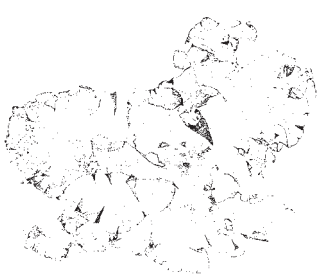


Fig. 42 ***Halymenia dilitata***

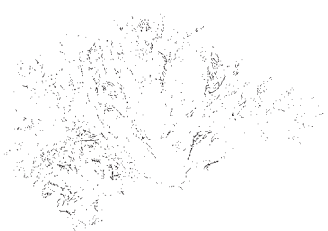


Fig. 43 ***Halymenia durvilleai***

6a. Branches fleshy, soft or highly cartilaginous . . . . . → ***7***
6b. Branches not fleshy, but wiry . . . . . → ***22***

7a. Thallus highly cartilaginous, branches compressed or cylindrical . . . . . → ***8***
7b. Thallus fleshy and soft, branches cylindrical . . . . . → ***12***

8a. Branches cylindrical in cross section . . . . . → ***9***
8b. Branches compressed . . . . . → ***11***

9a. Determinate branchlets large, not in whorls (Fig. 44) . . . . . ***Kappaphycus alvarezii***
9b. Determinate branchlets small, arranged in whorls . . . . . → ***10***

10a. Whorled determinate branchlets are simple spines (Fig. 45) . . . . . ***Eucheuma denticulatum***
10b. Whorled determinate branchlets decompound (Fig. 46) . . . . . ***Eucheuma arnoldii***

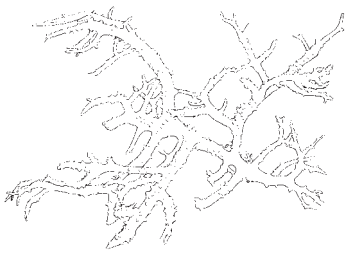


Fig. 44 ***Kappaphycus alvarezii***

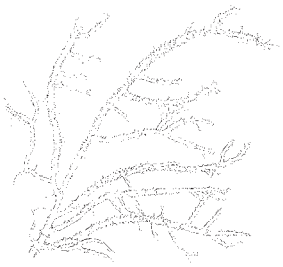


Fig. 45 ***Eucheuma denticulatum***

Fig. 46 ***Eucheuma arnoldii***

11a. Spinose processes both at the margin and the ventral side of the compressed branches (Fig. 47) . . . . . ***Eucheuma gelatinae***
11b. Spinose processes limited to the margin of the compressed branches (Fig. 48) . . . . . ***Gracilaria eucheumoides***

12a. Determinate branches shaped as fine filaments (Fig. 49) . . . . . ***Asparagopsis taxiformis***
12b. Determinate branches not as above . . . . . → ***13***

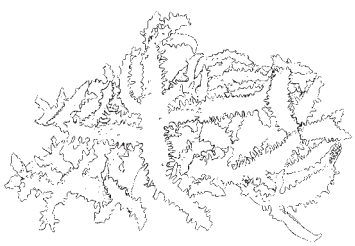


Fig. 47 ***Eucheuma gelatinae***

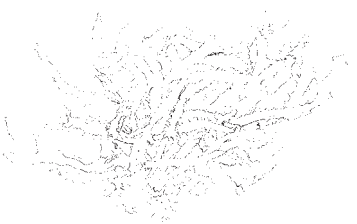
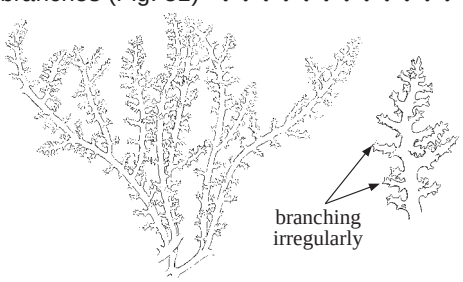


Fig. 48 ***Gracilaria eucheumoides***

Fig. 49 ***Asparagopsis taxiformis***

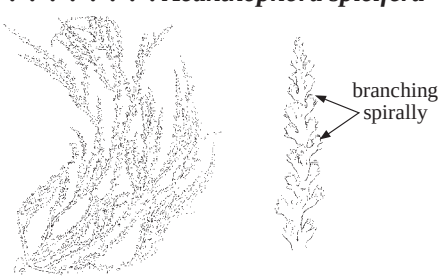
13a. Determinate branchlets spirally arranged . . . . . (***Acanthophora***) → ***14***
13b. Determinate branchlets not arranged as above . . . . . → ***15***

14a. Thallus erect, much branched and forming bushy clumps; branching irregular with tendency to become verticillate towards the terminal portion; spines present both at main and determinate branches (Fig. 50) . . . . . ***Acanthophora muscoides***
14b. Thallus erect, branching irregular and lax; determinate laterals regularly and spirally arranged along the main axes; spines spirally arranged and limited to the determinate branches (Fig. 51) . . . . . ***Acanthophora spicifera***



a) general appearance **b) terminal portion of thallus**

Fig. 50 ***Acanthophora muscoides***



a) general appearance **b) terminal portion of thallus**

Fig. 51 ***Acanthophora spicifera***

15a. Determinate branchlets club-shaped, with apical pits (Fig. 52) (*Laurencia*) . . . . . ***Laurencia papillosa***

15b. Determinate branchlets with sharp spinose or blunt apices . . . . . → ***16***

16a. Tip of determinate branchlets with a single distinct apical cell . . . . . → ***17***

16b. Tip of determinate branches with a group of apical cells . . . . → ***18***

17a. Thallus erect, branches percurrent, with numerous simple to compound spinose determinate branchlets (Fig. 53) . . . . . ***Hypnea boergesenii***

17b. Thallus decumbent, much branched, forming caespitose clumps; determinate branchlets in the form of coarse spines (Fig. 54) . . . . . ***Hypnea pannosa***

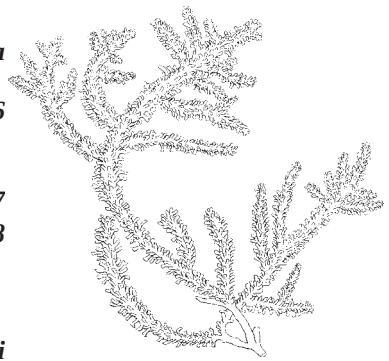


Fig. 52 ***Laurencia papillosa***

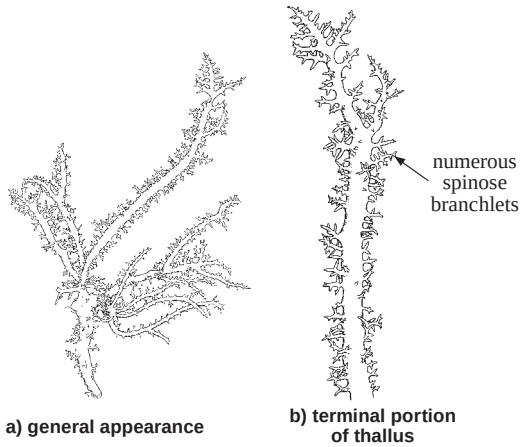


Fig. 53 ***Hypnea boergesenii***

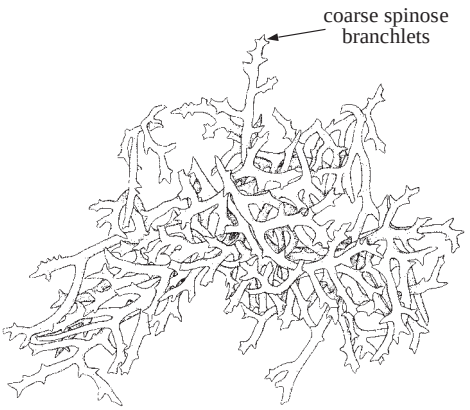


Fig. 54 ***Hypnea pannosa***

18a. Branches moniliform or divided into club-shaped segments . . . . . → ***19***

18b. Branches not as above . . . . . → ***20***

19a. Branches moniliform (Fig. 55) . . . . . ***Scinaia hormoides***

19b. Branches composed of club-shaped segments (Fig. 56) . . . . . ***Gracilaria salicornia***

20a. Branching dichotomous, tip of branch bifurcate (Fig. 57) . . . . . ***Gracilaria edulis***

20b. Branching irregular . . . . . → ***21***

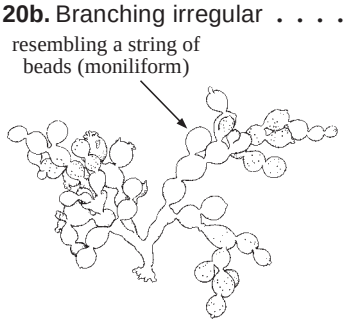


Fig. 55 ***Scinaia hormoides***

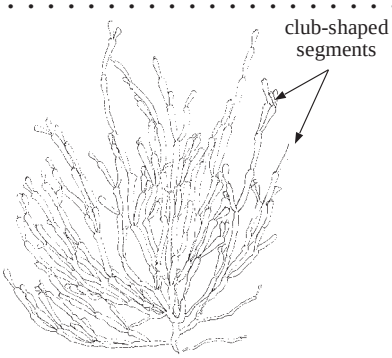


Fig. 56 ***Gracilaria salicornia***

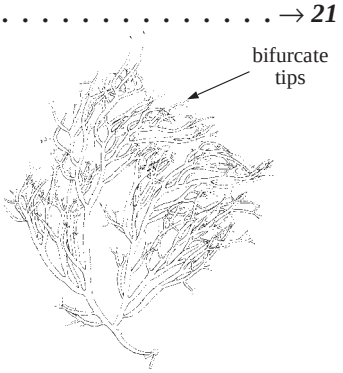


Fig. 57 ***Gracilaria edulis***

21a. Main branches distinct and percurrent, bearing numerous short secondary branches (Fig. 58) . . . . . ***Gracilaria heteroclada***

21b. Main branches not percurrent, lateral branches filiform, distinctly constricted at their base (Fig. 59) . . . . . ***Gracilaria manilaensis***

21c. Main branches not percurrent, mainly arcuate bearing short, stubby, coarse spinose determinate branchlets (Fig. 60) . . . . . ***Gracilaria arcuata***

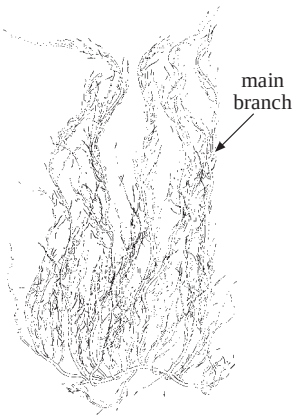


Fig. 58 ***Gracilaria heteroclada***

Fig. 59 ***Gracilaria manilaensis***

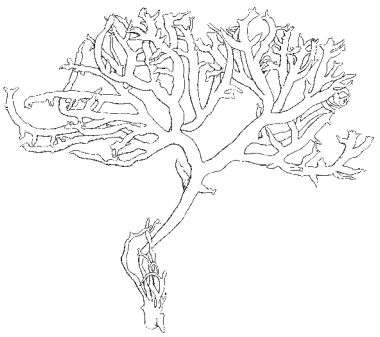


Fig. 60 ***Gracilaria arcuata***

22a. Determinate branchlets densely and irregularly arranged along the branch axis (Fig. 61) (*Digenea*) . . . . . ***Digenea simplex***

22b. Determinate branchlets pinnately arranged along the branch axis (Fig. 62) (*Gelidiella*) . . . . . ***Gelidiella acerosa***

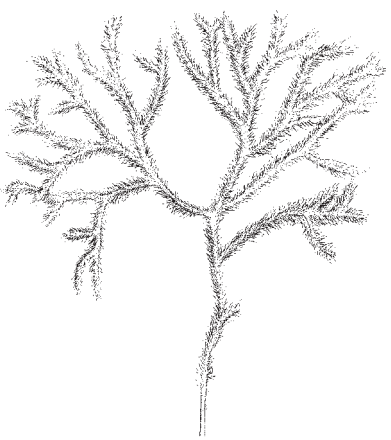


Fig. 61 ***Digenia simplex***

Fig. 62 ***Gelidiella acerosa***

LIST OF FAMILIES AND COMMON AND ECONOMICALLY IMPORTANT SPECIES OCCURRING IN THE AREA[1/]

The symbol is given when species accounts are included.

CHLOROPHYTA (Green algae)

Order ULVALES

Family ULVACEAE
- *Enteromorpha clathrata* (Roth) Greville, 1830
- *Enteromorpha intestinalis* (Linnaeus) Nees, 1820
- *Ulva lactuca* Linnaeus, 1753

Order SIPHONOCLADALES

Family VALONIACEAE
- *Valonia aegagropila* C. Agardh, 1822

Order BRYOPSIDALES

Family CAULERPACEAE
- *Caulerpa brachypus* Harvey, 1860
- *Caulerpa cupressoides* (Vohl) C. Agardh, 1817
- *Caulerpa lentillifera* J. Agardh, 1837
- *Caulerpa peltata* Lamouroux, 1809
- *Caulerpa racemosa* (Forsskål) J. Agardh, 1873
- *Caulerpa sertularioides* (Gmelin) Howe, 1905
- *Caulerpa taxifolia* (Vahl) C. Agardh, 1817

Family CODIACEAE
- *Codium arabicum* Kutzing, 1856
- *Codium bartlettii* Tseng and Gilbert, 1942
- *Codium edule* P.C. Silva, 1952

Family HALIMEDACEAE
- *Halimeda macroloba* Decaisne, 1841
- *Halimeda opuntia* (Linnaeus) Lamouroux, 1816

Family UDOTEACEAE
- *Avrainvillea erecta* (Berkeley) A. and E.S. Gepp, 1911
- *Tydemania expeditionis* Weber-van Bosse, 1901
- *Udotea argentea* Zanardini, 1858
- *Udotea geppii* Yamada, 1930

Order DASYCLADALES

Family DASYCLADACEAE
- *Bornetella oligospora* Solms-Laubach, 1892
- *Bornetella sphaerica* (Zanard.) Solms-Laubach, 1892

Family POLYPHYSACEAE
- *Acetabularia major* Martens, 1868

PHAEOPHYTA (Brown algae)

Order DICTYOTALES

Family DICTYOTACEAE
- *Dictyota dichotoma* (Hudson) Lamouroux, 1809
- *Dictyota mertensii* (Martius) Kutzing, 1859
- *Dictyopteris jamaicensis* Taylor, 1960
- *Padina minor* Yamada, 1925

Order SCYTOSIPHONALES

Family SCYTOSIPHONACEAE
- *Hydroclathrus clathratus* (C. Agardh) Howe, 1920

1/ The classification used follows Silva, P.C., E.G. Meñez and R.L. Moe (1987). Catalog of Benthic Marine Algae of the Philippines. *Smithson. Contrib. Mar. Sci.*, (27):179 p.

Order FUCALES

Family SARGASSACEAE

- *Sargassum crassifolium* J. Agardh, 1848
- *Sargassum cristaefolium* C. Agardh, 1820
- *Sargassum gracillimum* Reinbold, 1913
- *Sargassum oligocystum* Montagne, 1845
- *Sargassum paniculatum* J.G. Agardh, 1848
- *Sargassum polycystum* C. Agardh, 1824
- *Sargassum turbinarioides* Grunow, 1915
- *Turbinaria conoides* (J. Agardh) Kuetzing, 1860
- *Turbinaria decurrens* Bory de Saint Vincent, 1828
- *Turbinaria ornata* (Turner) J. Agardh, 1848

RHODOPHYTA (Red algae)

Subclass FLORIDEOPHYSIDEAE

Order NEMALIALES

Family HELMINTHOCLADIACEAE

- *Liagora farinosa* Lamouroux, 1816

Order BONNEMAISONIALES

Family BONNEMAISONIACEAE

- *Asparagopsis taxiformis* (Delile) Trevisan, 1845

Family GALAXAURACEAE

- *Scinaia hormoides* Setchell, 1914

Order GELIDIALES

Family GELIDIACEAE

- *Gelidiella acerosa* (Forsskål) Feldmann and Hamel, 1934

Order CRYPTONEMIALES

Family CRYPTONEMIACEAE

- *Halymenia dilitata* Zanardini, 1851
- *Halymenia durvillaei* Bory de Saint Vincent, 1828

Order CORALLINALES

Family CORALLINACEAE

- *Cheilosporum cultratum* (Harvey) Aresschoug, 1852

Order GIGARTINALES

Family RHIZOPHYLLIDACEAE

- *Portieria hornemannii* (Lyngbye) P.C. Silva, 1987

Family GRACILARIACEAE

- *Gracilaria arcuata* Zanardini, 1860
- *Gracilaria edulis* (Gmelin) Silva, 1952
- *Gracilaria eucheumoides* Harvey, 1860
- *Gracilaria heteroclada* Zhang and Xia, 1988
- *Gracilaria manilaensis* Yamamoto and Trono, 1994
- *Gracilaria salicornia* (C. Agardh) Dawson, 1854

Family SOLIERIACEAE

- *Eucheuma arnoldii* Weber-van Bosse, 1928
- *Eucheuma denticulatum* (Burman) Collins and Hervey, 1917
- *Eucheuma gelatinae* (Esper) J. Agardh, 1847
- *Kappaphycus alvarezii* (Doty) Doty, 1988

Family HYPNEACEAE

- *Hypnea boergesenii* Tanaka, 1941
- *Hypnea pannosa* J. Agardh, 1847

Order CERAMIALES

Family RHODOMELACEAE

- *Acanthophora muscoides* (Linnaeus) Bory de Saint Vincent, 1828
- *Acanthophora spicifera* (Vahl) Boergesen, 1910
- *Digenea simplex* (Wulfen) C. Agardh, 1822
- *Laurencia papillosa* (Forsskål) Greville, 1839

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