

MARINE MACROALGAE • SEaweEDS

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Regional names: Kis. *Mwani*; Port. *Algas marinhas*; Fr. *Algues*; Mal. *Lomotra*

Seaweeds are macroscopic photosynthetic (light dependent) organisms abundant in the littoral region of the seashore, as well as in the sunlit sublittoral. They belong to the group Algae, structurally simple "plants" lacking conductive tissue and hence true leaves, stems or roots. Some species form morphological structures similar to those of higher plants, with leaf-like structures referred to as "blades" or "fronds", stem-like structures as "stipes", root-like structures as "rhizoids", and the runners (as in pumpkin plants) the "stolons". The entire plant body, the "thallus", may be branched in characteristic patterns (see figure). Algal reproduction generally takes place through the release of different types of spores, or by fragmentation (parts break off and form new plants). In contrast to seagrasses which often grow in the same biotope, algae do not produce flowers or seeds.

Seaweeds occur in all sun-lit marine and brackish water habitats. They are found in estuaries, on littoral rocks, on coral reefs, in mangrove forests and seagrass meadows. Although the majority of seaweeds grow firmly attached to solid surfaces like rock or coral, some occur characteristically as epiphytes attached to other plants such as seagrasses, seaweeds or mangrove aerial roots (e.g. *Bostrychia*). Some grow on sandy substrate (e.g. *Caulerpa*), an absolute minority is free-living (e.g. *Sporolithon episorum*).

Most algae show a marked preference for a given combination of ecological characteristics. This is clearly demonstrated on rocky shores, where most species are restricted to a given horizontal zone related to tidal fluctuations. Shade-loving species grow on vertical or overhanging walls, or under the canopy of larger algae. The degree of exposure to surf also has an impact on the floristic composition (i.e. extremely exposed shores are generally devoid of macroscopic vegetation except for species which form a crust on the substrate surface). In the sublittoral zone, the vertical distribution of algal species is largely controlled by light intensity and to some extent by light quality (wave-length composition). In estuaries and mangrove creeks, salinity is generally the most important factor determining species composition. The amount of nutrients available in the water will also influence the algal flora. Some seaweeds, for example *Ulva*, indicate nutrient enrichment (eutrophication) frequent in waters close to towns and tourist areas (due to run-off of fertilisers or sewage), or may indicate upwelling of nutrient-rich deep water. Species occurrence and composition can be used to monitor biotope condition, and are particularly useful in the study of coral reefs.

Together with seagrasses, seaweeds are the major primary producers in coastal areas. Dense beds of seaweeds are often more productive than an equivalent area of the richest agricultural land. They form the basis of many food webs and are consequently vital to life in the sea, forming the diet of a number of different organisms such that in areas with large populations of herbivorous fish, seaweed development is restricted to rock crevices or overhangs. Certain species, for example *Halimeda*, are composed of calcified segments which after their decay form an important component of the lagoon "sand". Another group of calcified red algae, the Corallinaceae, is very important in cementing together the surf-exposed outer rim of the coral reef (see separate section on this family, page 106). Several seaweeds, typically *Caulerpa* (sea grapes), have been collected in the wild for many centuries and used for human or cattle food, or as fertiliser. Other species are now collected and even "cultivated" for their cell wall components, which are used in the food industry for their emulsifying or gelling characteristics, as in the mariculture of *Eucheuma* and *Gracilaria* in the tropics (see Human Activities section). A recent

overview of the utilisation and cultivation of tropical Indo-Pacific algae is provided Prud'homme van Reine & Trono Jr. (2001, eds.), with detailed descriptions of the dominant tropical algal genera, their chemical properties, mariculture, harvesting and economic potential. Useful web-based resources on diversity and the use of marine algae include: www.seaweed.ie and www.algaebase.org. A general introduction on algae as well as methodological aspects are covered in a volume of the series ABC taxa by Coppejans *et al.* (2009) focusing on the marine flora of Sri Lanka, freely available for download at www.abctaxa.be.

Classification There are four major groups (divisions or phyla) of seaweeds which are phylogenetically distantly related. They are classified according to their pigmentation: blue-green algae or Cyanobacteria (actually bacteria because of their primitive cell organisation, see page 108); green algae or Chlorophyta; brown algae or Phaeophyta, and red algae or Rhodophyta. The morphology within each division varies greatly and includes filamentous forms (unbranched or branched), membranous forms, blade-like forms, diversely branched and fleshy forms, gelatinous forms, or crust-like forms. This diversity is shown in complex structures such as *Sargassum*.

Taxonomy and research It should be emphasised that identification of several seaweeds is only possible by observation of reproductive structures and the (microscopic) study of their anatomy. To achieve this, specimens need to be collected and examined, fresh or preserved, under a dissecting microscope. A collection of dried seaweeds is simple to prepare and usually adequate for precise identification to species level, though some taxa can only be differentiated with the aid of molecular DNA sequence data. Dried seaweed collections (known as herbarium collections) are found at many research institutes in the western Indian Ocean region, notably at the University of Dar es Salaam and the Institute of Marine Sciences, Zanzibar (Tanzania), Station Marine de Tulear (Madagascar), the Herbarium of the University in Nairobi and the Kenya Marine and Fisheries Institute, Mombasa (Kenya), and at the Universidade Eduardo Mondlane (Mozambique). A comprehensive herbarium of western Indian Ocean species is also maintained at the Ghent University (Belgium).

Collecting seaweeds is not a difficult task, but it requires care and patience. To prepare specimens for a herbarium, the seaweed must be pressed and dried, preferably using complete specimens (i.e. including the holdfast). It is advisable to note date, locality and ecology while collecting, and to prepare the specimen as soon as possible (especially relevant in the tropics). The specimen should be arranged on a sheet of good quality drawing paper (ideally heavier than regular typing or photocopying sheets) while submerged in a tray of sea water – not fresh water. Both items should then be carefully removed and air-dried (out of sunlight) for a short time. The specimen, on its sheet of paper and covered by a cloth (to avoid sticking), should then be pressed between newspapers. Both cloth and newspapers need to be replaced with dry ones twice a day until the specimen is completely dry. The dried specimens can be stored in plastic file binder pockets, which will provide adequate protection and easy accessibility.

The WIO boasts a rich history of the study of seaweeds. Important floristic contributions include Jaasund (1976) on Tanzanian eulittoral species; Børgesen (1940 onwards) on Mauritian seaweeds; Wynne (1995) on the marine flora of the Seychelles; Isaac (1960's) on Kenyan and South African species and Moorjani & Simpson (1988) in a book on Kenyan flora. Silva *et al.* (1996) have published a catalogue on the algae of the entire Indian Ocean. In this monumental work all published records of marine algae (Cyan-, Chloro-, Phaeo- and Rhodophyta) are grouped in a single publication, which

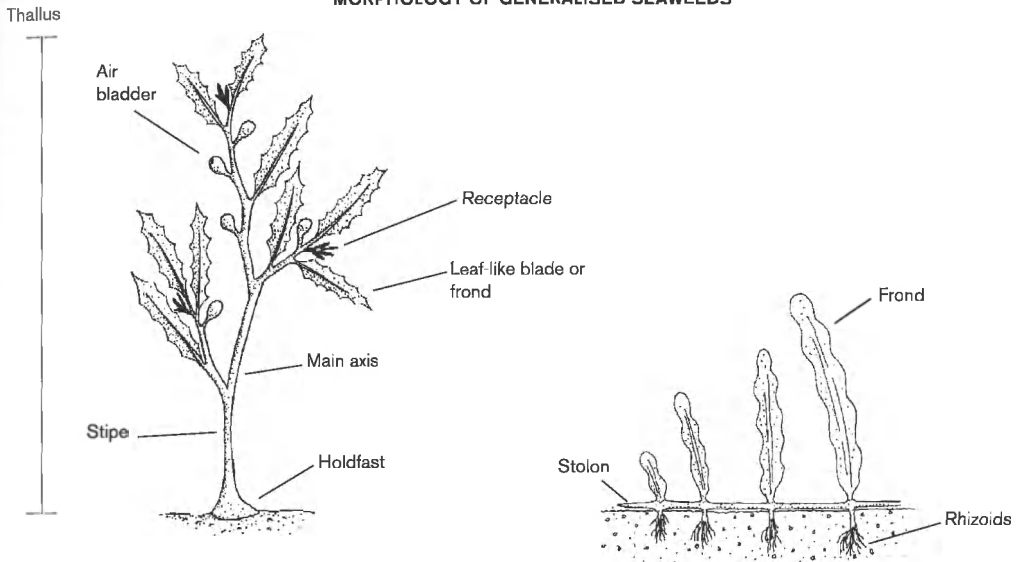
contains nearly 35,000 records assignable to 3,355 species (and intraspecific taxa). The catalogue of the Indian Ocean algae is also available on the web (see Bibliography). More recent additions on the marine benthic algae along the East African coast have been summarized by Coppejans *et al.* (2000; 2001) and field guides with underwater photographs of many of the common species have become available for several regions (Kwazulu-Natal: De Clerck *et al.* 2005; Sri Lanka: Coppejans *et al.* 2009; Tanzania: Oliveira *et al.* 2005).

Other studies have examined the potential use of chemical products derived from seaweeds, such as agar and carrageenans used in the food and pharmaceutical industry (see Seaweed Farming in Human Activities section). Further

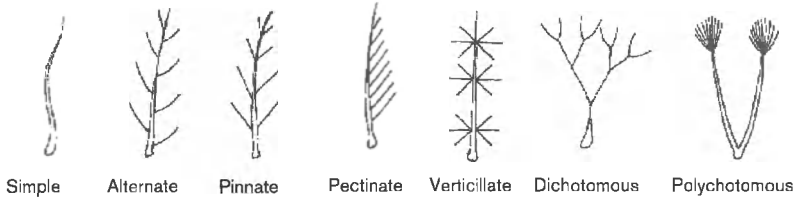
research is needed on species taxonomy, diversity and ecology, especially that of species from deep water; the potential uses of genera other than *Eucheuma* for chemical products, as well as sustainable methods of seaweed cultivation, and the little-known effects of seaweed farming on adjacent marine habitats such as coral reefs.

N.B. With very few exceptions, the algae in this field guide have been presented in the same genus sequence as in Jaasund (1976), despite the seaweed families having been rearranged since his time. The details given on habitat preferences for each species are relevant to the tropical Indian Ocean. Where distribution is given as worldwide, however, species may occur in different habitats in colder waters.

MORPHOLOGY OF GENERALISED SEAWEEDS



TYPES OF BRANCHING



MACROALGAE GLOSSARY (For other common terms see General Glossary)

Ascendant plant with basal part creeping, the apical part erect.
Anastomosing cells or filaments attached to each other, resulting in a network.
Conceptacle roofed "chambers" of the Corallinaceae, containing reproductive structures.
Corticated (with **cortication**) covered by an outer layer of small cells (**cortex**).
Epilithic growing on hard substrata (e.g. rocks, stones, etc.).
Epiphytic growing on a host plant.
Holdfast attachment portion of thallus.
Nodes the point of attachment of a leaf or a branch on a stem.
Proliferation irregularly spaced offshoots (not following original branching pattern).

Propagule multicellular structure for vegetative reproduction formed directly by the thallus.
Receptacle inflated portion of a brown alga containing reproductive structures.
Rhizoid root-like structure.
Sori clusters of reproductive structures.
Sporangia spore-producing cells.
Stipe stem-like structure.
Stolon (oidal) a cylindrical, creeping axis.
Thallus body of plants (algae) not differentiated into roots, leaves or stem tissues.
Vesicle small, membrane-covered organelle.

DIVISION CHLOROPHYTA • GREEN ALGAE

The Chlorophyta are characterised by their grass-green colour resulting from the predominance of the green pigments chlorophyll *a* and *b*. The name Chlorophyta derives from the Greek "chloros" meaning green and "phyton" meaning plant. The green algae are distributed in freshwater, terrestrial and marine environments, and exhibit a wide diversity of forms, ranging from microscopic unicells or colonies to macroscopic filaments, blades or more complex thalli. Notable genera in the tropics include the heavily calcified *Halimeda*, the simple filamentous *Chaetomorpha* or branched *Cladophora*, the blade-like *Ulva* and shoot-bearing *Caulerpa*.

Ulva Thallus blade-like or tubular, simple or branched, sometimes with many thin proliferations; mostly light green. Well adapted to extreme ecological conditions and therefore frequent in strongly insolated, heated eulittoral pools. Great abundance generally indicates eutrophication. Eighteen entities (species and varieties) recorded in the region but their identity needs to be confirmed using DNA sequence data. Historically the genus *Ulva* comprised flattened, blade-like thalli, while the tubular forms were classified in the genus *Enteromorpha*. Current insights dictate that both flattened and tubular forms should be united in a single genus. The *Enteromorpha*-morphology consists of tubular axes, one cell thick. Traditional *Ulva* species are foliose and composed of two cell-layers.

• **Ulva** sp. Plants markedly tubular (the central part frequently contains sand), up to 10–15 cm high, only branching at the base; pale green. **Habitat:** mainly in upper eulittoral pools; epilithic, but also frequent on seagrass stolons or on other seaweeds. **Distribution:** temperate to tropical seas. N.B. Jaasund (1976: 2) named a specimen with this morphology *Enteromorpha kylinii* Bliding and since then his interpretation has been (wrongly) followed by many phycologists. *Ulva kylinii*, a species described from Sweden, forms long unramified, tubular plants. The here illustrated, richly, basally branched specimen could belong to different taxa (e.g. *U. intestinalis*, *U. compressa*) depending on its anatomy (arrangement of the cells) and cytology (number of pyrenoids on the chloroplasts).

• **U. clathrata** (Roth) C. Agardh Thallus thin, tubular with a filamentous aspect, richly branched, resulting in entangled masses; apical branchlets thorn-like and perpendicularly placed; pale to dark green. **Habitat:** mostly in muddy-sandy eulittoral pools (mangrove and seagrass areas). **Distribution:** temperate to tropical seas.

• **U. fasciata** Delile Blades up to 50 cm; divided in numerous, mostly undulated sometimes spirally twisted straps, 1–3 cm broad; relatively supple. **Habitat:** lower eulittoral pools and sublittoral areas of sheltered coasts, mostly epilithic but also epiphytic on seagrasses or larger algae. **Distribution:** subtropical to tropical. N.B. locally used in wound treatment and harvested for use as bait in fish traps.

• **U. pertusa** Kjellman Blades 10–20 cm in diameter, rounded to irregularly lobed, undulated at the margin, relatively tough, with scattered small perforations; light green. **Habitat:** frequent in shallow, strongly insolated eulittoral pools, epilithic. **Distribution:** worldwide.

• **U. pulchra** Jaasund An extremely supple species, composed of rounded, perforated blades resulting in a net-like structure. The central perforations are large, bordered by narrow tissue straps, towards the periphery they become smaller and the tissue straps wider; marginal parts lack perforations; light green. **Habitat:** sublittoral or in large, lower eulittoral pools; mostly epiphytic on larger algae, also epilithic. **Distribution:** Tanzania, Kenya.

• **Ulva reticulata** Forskål Thallus composed of relatively stiff straps of irregular width, densely perforated over the whole surface with a mixture of large and small perforations; dark green. **Habitat:** entangled into other algae and therefore present from high tide level to the sublittoral area. Abundant in the vicinity of large coastal cities (its presence often indicates eutrophication) and in mangrove areas. **Distribution:** Indo-Pacific.

• **Gayralia oxysperma** (Kützling) Vinogradova ex Scagel *et al.* (not illustrated) Foliose and membranous plants, morphologically very similar to *Ulva* but only one cell layer thick and more supple and slippery; light green. **Habitat:** upper eulittoral, epilithic or epiphytic on sunlit mangrove pneumatophores. **Distribution:** worldwide. N.B. this alga is frequently cited as *Monostroma oxyspermum* (Kützling) Doty.

• **Chaetomorpha vieillardii** (Kützling) M.J. Wynne Unbranched, tough filaments, up to 1 m long (often much shorter), forming unattached tangled fishing-line like masses. Filaments up to 0.5 mm in diameter. **Habitat:** growing intertwined around other seaweeds and seagrasses or loose-lying as tufts in eulittoral pools - may form extensive blooms in shallow lagoons (e.g. Chwaka Bay, Zanzibar). **Distribution:** tropical waters. N.B. harvested for use as bait in fish traps. This large-celled *Chaetomorpha* species has generally been cited as *C. crassa*. Six additional species of *Chaetomorpha* are recorded for the region.

Cladophora Plants filamentous, composed of a single series of cells. Predominantly found in eulittoral pools and channels. Ten species recorded in the region.

• **C. vagabunda** (L.) van den Hoek Densely branched plants with clusters of curved branchlets resulting in high water retention properties; light green. **Habitat:** upper eulittoral pools; mostly epiphytic on larger seaweeds, but also epilithic. **Distribution:** worldwide. N.B. *C. vagabunda* represents several species, which can only be distinguished by DNA sequence data.

• **C. horii** van den Hoek & Chihara Plants forming dense, erect, dark green tufts 5–10 cm high; branching angles very acute. **Habitat:** epilithic, in eulittoral pools. **Distribution:** WIO and Japan.

• **Rhizoclonium grande** Børgesen Filamentous and unbranched, creeping, tightly attached to the substrate by rhizoids produced from almost every cell; dark green. **Habitat:** epilithic, in the upper eulittoral but most frequently in tidal channels. **Distribution:** Indo-Pacific. N.B. two species recorded in the region.

• **R. africanum** Kützling (not illustrated) Filamentous and unbranched; the very thin and curly filaments densely intertwined and forming light green, woolly, beard-like strands. **Habitat:** epilithic, in the supralittoral zone (above mean high water, above the *Bostrychia* zone, hanging down from the vertical cliffs or nested in crevices of these cliffs of eroded fossil coral. **Distribution:** Indo-Pacific.

• **Anadyomene wrightii** Harvey ex J.E. Gray Thallus foliaceous with several lobes grouped as a cabbage-like structure, crisp, 2–4 cm in diameter with visible palmate veins; dark green. **Habitat:** epilithic, shallow sublittoral, and on vertical walls of deep lower eulittoral rock pools. **Distribution:** Indo-Pacific. N.B. three species recorded in the region.

Ulva sp.



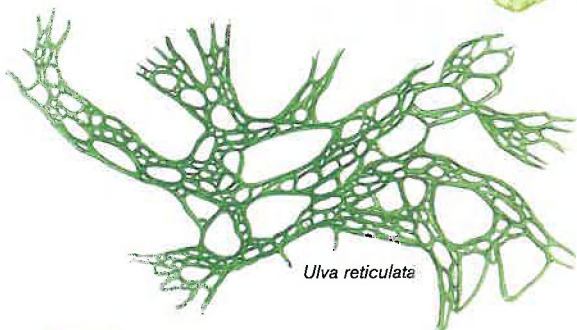
Ulva clathrata



Ulva pulchra



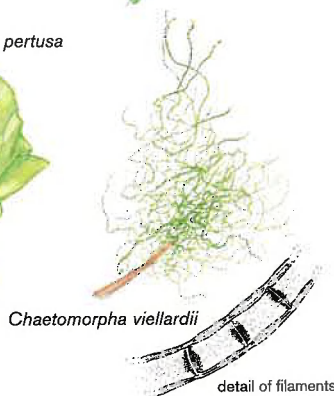
Ulva fasciata



Ulva reticulata



Ulva pertusa



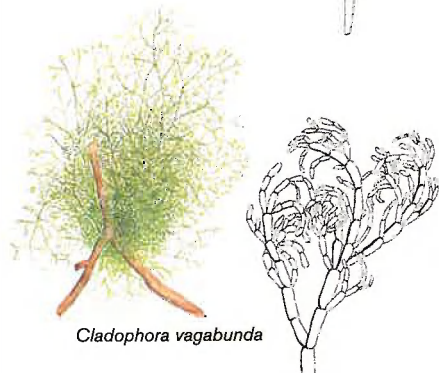
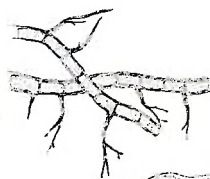
Chaetomorpha viillardii

detail of filaments

Cladophora horii



Rhizoclonium grande



Cladophora vagabunda



Anadyomene wrightii



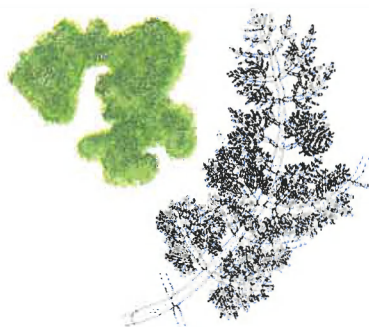
- *Neomeris van-bosseae* Howe Plants club-shaped, erect and unbranched, up to 3.5 cm long, 3 mm in diameter; heavily calcified, resulting in a whitish-greenish, brittle structure; the younger parts covered by whorls of slender green hairs. Specimens gregarious or grouped in loose clusters. **Habitat:** epilithic on sand-covered rock of shallow pools at the sublittoral fringe. **Distribution:** Indo-Pacific. N.B. three species recorded in the region.
- *N. annulata* Dickie (not illustrated) Gross morphology as *N. van-bosseae*, but the base of each plant shows discontinuous annular rings. **Habitat:** as *N. van-bosseae*. **Distribution:** Indo-Pacific.
- *Bornetella oligospora* Solms-Laubach (not illustrated) Gross morphology as *N. van-bosseae*, with a short but marked basal stipe, only slightly calcified and therefore dark green and not really brittle. **Habitat:** vertical walls of reef pools close to low water mark. **Distribution:** Indo-Pacific.
- *B. sphaerica* (Zanardini) Solms-Laubach (not illustrated) Plants spherical, only a few mm in diameter, only slightly calcified, dark green. Mostly growing in open populations but rather rare (or overlooked). **Habitat:** epilithic on horizontal substrate in shallow, intertidal pools (also collected in such pools in mangrove tide channels). **Distribution:** Indo-Pacific.
- *Acetabularia caliculus* Lamouroux The entire plant is one single cell. Thallus with a distinctive umbrella-shape, up to 3 cm high, slightly calcified with a simple stipe bearing one or more (tiered) whorls of approximately 35 segments forming one or several slightly funnelled discs at the apex; white to slightly greenish. **Habitat:** epilithic; on sand-covered bottoms in the lower eulittoral and shallow sublittoral. **Distribution:** subtropical to tropical. N.B. the giant cell of this genus have been used extensively in cell differentiation studies. Three species recorded in the region.
- *Boodlea composita* (Harvey) Brand Brittle, spongy cushions up to 20 cm in diameter and 5 cm thick, composed of filaments branching in three dimensions. Young parts (periphery of the clumps) sometimes feather-like; light green. **Habitat:** lower eulittoral, epilithic or on algal turf; loose-lying balls frequent in tidal channels (especially among mangroves) and in lagoons, where it can form extensive blooms (e.g. Chwaka Bay, Zanzibar). **Distribution:** pantropical. N.B. *B. composita* forms a species complex together with *Cladophoropsis membranacea* and *Phyllocladon anastomosans*, in which at least 10 species can be distinguished based on DNA sequence data.
- Cladophoropsis* Thallus composed of branched filaments, without cross walls at the base of the branchlets. Four species recorded in the region.
- *C. sundanensis* Reinbold Firm cushions or mats, 1 cm thick, up to 15 cm in diameter composed of stiff, horizontal, radially arranged, branched filaments with downwardly bent apices; light to dark green. **Habitat:** epilithic, most abundant at the foot of the fossil coral cliff walls (upper eulittoral) along exposed coasts. **Distribution:** Indo-Pacific. N.B. *C. sundanensis* represents at least three species, which can only be distinguished by DNA sequence data.
- *C. vaucheriiformis* (Areschoug) Papenfuss Thallus of a stiff, spongy texture and an extremely variable morphology, ranging from a smooth creeping mat (diameter up to 30 cm) to a mat with knobby outgrowths or long (5–10 cm) finger-like erect structures. The whole thallus is composed of algal filaments living symbiotically with sponge tissue; usually drab grey-green, giving off an orange-red colour when squeezed. **Habitat:** lower eulittoral and shallow sublittoral. **Distribution:** Indo-Pacific. N.B. syn. *Spongocladia vaucheriaeiformis* Areschoug. *C. vaucheriiformis* is in fact a growth-form of different species in the *Boodlea* species complex, resulting from sponge association.
- *Valonia fastigiata* Harvey ex J. Agardh Thallus extremely firm, hemispherical (loose-lying specimens may be spherical) or cushion-like, 10–20 cm in diameter, composed of radially placed vesicular cells which are club-shaped, rounded or ovoid, up to 7 mm in diameter, branching di- to polychotomously. Colour very dark green. **Habitat:** epilithic in the lower eulittoral; loose-lying balls are frequently found in sandy pools of seagrass beds. **Distribution:** Indo-Pacific.
- *V. aegagropila* C. Agardh (not illustrated) Gross morphology as *V. fastigiata*, but the cells being markedly smaller (up to 2 mm in diameter) and more irregularly branched: when breaking up a plant, the apices of the cells of the same age are not on a marked line, not resulting in concentric lines as in *V. fastigiata*. **Habitat and distribution** as for *V. fastigiata*.
- *V. utricularis* (Roth) C. Agardh (not illustrated) plants prostrate (cells 'creeping'), giant-cells irregularly shaped, often arcuate, up to 7 mm in diameter; branching at the tips or lateral; generally well attached to the substrate. **Habitat:** epilithic, vertical to overhanging walls of reef pools or coral heads close to low water mark. **Distribution:** subtropical and tropical seas.
- *V. ventricosa* J. Agardh Ovoid to subspherical individual giant-cells, extremely tough, up to 5 cm in diameter, resembling dark green glass marbles with a bluish tinge and frequently a star-like reflection at the top of living specimens; old specimens are frequently covered by numerous (mostly encrusting) epiphytes. **Habitat:** under rocks, in crevices, or most frequently between coral branches in lagoons down to 80 m. **Distribution:** pantropical. N.B. allied species *V. macrophysa* Kützing (morphologically very similar to this species, but is characterized by the formation of daughter cells at the subapical part of the plant; when numerous these smaller cells are positioned in a ring close to the top of the cell; *V. ventricosa* never has such daughter cells).
- *Boergesenia forbesii* (Harvey) Feldmann Club-shaped, curved individual giant-cells, 2–4 cm long and 7–11 mm broad, mostly gregarious (more rarely single), with marked constrictions and rhizoids at the pointed base; light or yellowish green. **Habitat:** eulittoral pools. **Distribution:** Indo-Pacific. N.B. the illustrated specimens are epiphytic on an old branch of *Sargassum* but *Boergesenia* generally grows epilithic in relatively large clusters, most frequently in the upper part of the intertidal zone (but sometimes also close to low water mark).
- *Dictyosphaeria cavernosa* (Forskål) Børgesen Young specimens are sub-globular and hollow, stiff-brittle and composed of giant-cells, 1–3 mm in diameter; in older specimens the top part erodes, resulting in cup-like structures; green. **Habitat:** epilithic, in the lower eulittoral and shallow sublittoral. **Distribution:** pantropical.
- *D. versluysii* Weber-van Bosse (not illustrated) Plants solid, extremely tough, very well attached to the substrate and mostly in crevices. Large specimens composed of several jig-saw puzzle-like pieces with a flat top; bluish green and giant-cells visible with the naked eye; lower part of the plants with short rhizoidal cells. **Habitat:** at about and just under low water mark, well developed along coasts exposed to strong wave action. **Distribution:** pantropical.
- *Bryopsis pennata* Lamouroux Feather-like plants 5–10 cm long, gregarious, extremely supple, with a naked basal stipe and an apical elongated plume; dark green with some bluish iridescence. **Habitat:** epilithic on horizontal coral substrate in reef pools, epiphytic on seagrass stems or on sand in the lower eulittoral or in the infralittoral fringe. **Distribution:** pantropical. N.B. six entities (species and varieties) recorded in the region.



Neomeris van-bosseeae



Acetabularia caliculus



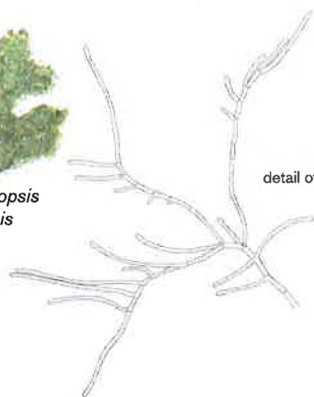
Boodlea composita



Cladophoropsis vaucheriiformis



Cladophoropsis sundanensis



detail of filaments

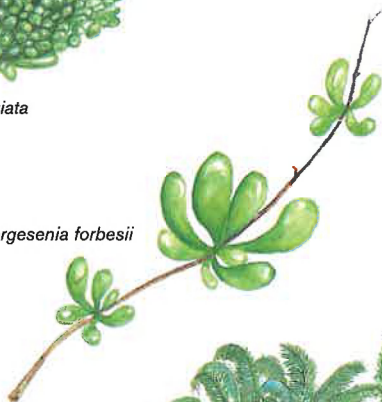


Valonia fastigiata



Valonia ventricosa

Boergesenia forbesii



Dictyosphaeria cavernosa



Bryopsis pennata

Caulerpa Plants differentiate into a creeping rhizome-like basal portion anchored by rhizoids, bearing erect fronts of diverse morphology, including thread-like, blade-like, pinnate, spongy and vesicular structures. The entire plant consists of a single giant-cell. Over 25 entities (species and varieties) recorded in the region. N.B. these plants establish successfully in aquaria.

• ***C. lentillifera*** J. Agardh Erect branches 1–4 cm long, simple or branched, densely covered by grape-like globular branchlets, each 1 mm in diameter, in obvious longitudinal rows. Stipe constricted; rhizomes thin when compared to those of *C. racemosa* (below); colour uniformly green. **Habitat:** in pools of the lower eulittoral and shallow sublittoral. **Distribution:** Indo-Pacific.

• ***C. racemosa*** (Forskål) J. Agardh Well-developed specimens are stout but, depending on the ecological conditions, the morphology can be very variable, 2–8 cm long. The most typical growth form has erect branches covered by (sub)spherical branchlets giving a blue-green, grape-like appearance. Other growth forms have club-, trumpet- or shield-shaped branchlets. Stolons are thick, richly branched and form dense patches. Whole plants are a uniform lighter green. **Habitat:** shallow water, often on vertical surfaces, especially in channels, in the sublittoral fringe and in shallow sublittoral. **Distribution:** pantropical.

• ***C. serrulata*** (Forskål) J. Agardh Fronds 2–9 cm high, relatively stiff, with a short cylindrical stipe; blade narrow strap-like, dichotomous, with a serrate margin, spirally twisted in typical forms, but sometimes in a single plane; light to dark green. **Habitat:** sandy substrate or in crevices of rock substrate in the sublittoral fringe and deeper. **Distribution:** pantropical.

• ***C. sertularioides*** (S.G. Gmelin) Howe Fronds feather-like, supple, 1–15 cm high, 1–2 cm broad; pinnate branchlets cylindrical, straight or upturned, with a sharp tip, not contracted at the base; light to yellowish green. **Habitat:** sandy substrate in eulittoral pools or in seagrass beds; also in shallow sublittoral. **Distribution:** pantropical.

• ***Chlorodesmis fastigiata*** (C. Agardh) Ducker Thalli gregarious, forming conspicuous bright green tufts, 5 cm high, composed of extremely supple, dichotomous filaments without transverse walls. **Habitat:** epilithic (and extremely well attached) in the sublittoral fringe and deeper. **Distribution:** Indo-Pacific. N.B. syn. *C. comosa* Harvey & Bailey.

• ***Udotea indica*** A. Gepp & E.S. Gepp Erect plant, 3–7 cm high, with a short stipe and a fan-shaped blade; very stiff due to calcification; dark green. **Habitat:** epilithic on horizontal sand-covered rock in shallow pools in the sublittoral fringe; growing in isolated loose clusters. **Distribution:** Indo-Pacific. N.B. six species of *Udotea* recorded in the region.

• ***Avrainvillea obscura*** (C. Agardh) J. Agardh Erect thallus composed of a fan-shaped, spongy blade, approximately 5–10 cm in diameter, supported by a very short cylindrical stipe and attached by a long pseudobulbous holdfast; very dark green, sometimes brownish. **Habitat:** sand and sandy mud in the sublittoral fringe; often in seagrass beds, as isolated loose clusters with all the fans arranged in the same direction. **Distribution:** Indian Ocean and W Pacific Ocean. N.B. four species recorded in the region.

Halimeda Conspicuous, cactus-like plants with jointed discoid, superposed, flattened calcified segments of various shapes. The calcareous segments can be round, kidney or wedge-shaped, and white to dark green. They are joined to each other by a flexible hinge. In the tropics these calcareous segments are important contributors to marine sediments and white sand beaches. Ten species recorded in the region.

• ***H. discoidea*** Decaisne Plants erect, 6–10 cm high, solitary, with rounded to wedge-shaped segments, 0.7–1 cm by 0.6–1.6 cm (frequently undulated and with a thickened upper margin). Segments are fleshy and only moderately calcified. **Habitat:** epilithic on the reef edge in the sublittoral fringe zone. **Distribution:** pantropical. N.B. *H. discoidea* represents at least three species, which can only be distinguished by subtle morphological differences and DNA sequence data.

• ***H. macroloba*** Decaisne Plants erect, solitary, up to 20 cm high, with a pseudobulbous holdfast up to 5 cm long. Basal segments fuse to form a fan-shaped structure, upper segments rounded to wedge-shaped, thick and calcified, 3–4 cm by 4 cm, all in a single plane. **Habitat:** seagrass beds and sand in the sublittoral fringe and shallow sublittoral. **Distribution:** Indian Ocean and W Pacific Ocean.

• ***H. opuntia*** (L.) Lamouroux Plants branch randomly, with segments placed perpendicularly on each other and attaching at several points resulting in the absence of a definite base. Extensive clumps, up to 50 cm in diameter, of whitish to dark green, heavily calcified, kidney-shaped segments, about 0.5 cm high and up to 1 cm broad, with characteristic ear-like appendages. **Habitat:** seagrass beds and the reef edge in the sublittoral fringe. **Distribution:** pantropical.

Codium Plants spongy of diverse morphology, including thalli that spread out over hard substrate as mats, form spheres or grow upright, either unbranched and finger-like, or branched (as illustrated here), with cylindrical or flattened branches. Anatomically, plants are composed of a central core (medulla) of branched, intertwined filaments and a peripheral layer (cortex) of inflated siphons (utricles) that may bear hairs, resulting in a halo around the plant, when submerged. The microscopic morphology and size of these utricles, is a key character for the identification of the *Codium* species within a given morphological type.

• ***C. geppiorum*** Schmidt Spreading plant composed of cylindrical, dichotomous, anastomosing branches of stiff spongy structure, 2–3 mm in diameter; composed of a central core of intertwining filaments and a peripheral layer of inflated structures (the utricles); pale to dark green. **Habitat:** epilithic in the sublittoral zone. **Distribution:** Indo-Pacific. N.B. fourteen *Codium* species recorded in the region. *C. geppiorum* consists of at least five species based on DNA sequence data.

*Caulerpa sertularioides**Caulerpa serrulata**Caulerpa lentillifera**Caulerpa racemosa**Chlorodesmis fastigiata**Udotea indica**Halimeda discoidea**Avrainvillea obscura**Halimeda macroloba**Codium geppiorum**Halimeda opuntia*

DIVISION PHAEOPHYTA • BROWN ALGAE

Phaeophyta derives from the Greek "phaios" meaning brown. Most species are obviously brown in colour and attain greatest size and abundance in temperate waters. In the WIO many species are easily visible and may form dense populations, often in clearly visible bands or zones. Notable genera include *Turbinaria*, *Sargassum*, *Padina* and *Dictyota*. None of the species in this region are used commercially though larger, temperate species are harvested for their alginate compounds.

• *Hincksia mitchelliae* (Harvey) P.C. Silva Densely branched, thin brown filamentous tufts up to 1 cm high; filaments less than 0.05 mm in diameter, often bearing sporangia that resemble cobs of corn, each one about 0.1 mm long. **Habitat:** rarely epiphytic on seaweeds (e.g. *Spatoglossum*, see below) and commonly on moderately exposed rocks in the mid-eulittoral zone. **Distribution:** pantropical and warm temperate seas. N.B. syn. *Giffordia mitchelliae* (Harvey) Hamel.

• *Feldmannia indica* (Sonder) Womersley & Bailey Thallus filamentous, but composed of a creeping part and erect filaments, up to 2–3 cm long, 0.02–0.03 mm in diameter, which branch sparsely and show well delimited growth zones. Sporangia are slender and cylindrical, up to 0.3 mm long. **Habitat:** attached to hard substrate in pools; here illustrated as epiphytic on *Spatoglossum* (see below). **Distribution:** worldwide in tropical and warm temperate waters. N.B. syn. *Giffordia indica* (Sonder) Jaasund.

• *Asterocladon rhodochortonoides* (Børgesen) Uwai *et al.* Very similar to *Feldmannia indica* (above), but with diffuse growth (no well delimited growth zones) and extremely thin filaments (about 0.01 mm). **Habitat:** epiphytic, mainly on brown algae such as *Turbinaria* or *Padina*, in the lower eulittoral region. **Distribution:** Indian and Atlantic Ocean. N.B. syn. *Asteronema rhodochortonoides* (Børgesen) Müller & Parodi.

• *Sphacelaria rigidula* Kützling Plants 2–6 cm high, relatively stiff, brown tufts of branched filaments with rounded sporangia and Y-shaped propagules. **Habitat:** on coral rocks, or more frequently as an epiphyte on brown algae and on stems of seagrasses (especially *Thalassodendron ciliatum*) in the sublittoral fringe, but mainly deeper. **Distribution:** tropical and temperate seas. N.B. syn. *S. furcigera* Kützling. Three species recorded in the region.

Canistrocarpus Morphologically very similar to *Dictyota*, but recently segregated from the latter on the basis of subtle differences in the reproductive structures. For the region 2 species have been reported.

• *C. crispata* Lamouroux Plants up to 15 cm high, straps 2–10 mm broad with pointed or rounded tips and typical proliferations on the thallus surface, sporangia frequently on transverse lines; uniformly brown. **Habitat:** mostly epilithic in lagoons, pools of the reef flat and mangrove tidal channels; best developed at the landward side of the reef crest. **Distribution:** pantropical. N.B. syn. *Dictyota crispata* Lamouroux; also identified as *D. bartayresiana* and *D. friabilis* in Jaasund.

• *C. cervicornis* Kützling Thallus up to 20 cm high, slender, 4–6 mm broad near the base and 1–2 mm at spreading apical branches; typically spirally twisted, mostly with backwardly-curved branchlets. **Habitat:** mostly epilithic in lagoons, pools of the reef flat, mangrove tidal channels; best developed at the landward side of the reef crest. **Distribution:** pantropical. N.B. syn. *Dictyota cervicornis* Kützling and *D. pardalis* Kützling.

Dictyota Thalli usually erect, with flattened, mostly dichotomously branched axes, plane or spirally twisted. Growth of each branch initiated by a single lenticular apical cell. *Dictyota* is represented in most regions of the world except near the poles, but reaches its highest diversity in the tropics. For the region more than 15 species have been reported. Due to substantial morphological plasticity delineating species is often extremely difficult. Along the East African coast every biotope has its typical species. The ubiquity of the genus in tropical areas with high grazing activities (by fish, molluscs and other invertebrates) is probably due to the presence of polyphenolic compounds and terpenes.

• *D. friabilis* Setchell (not illustrated) A species that creeps or cascades, with overlapping straps attached to each other by rhizoids, resulting in a friable (easily broken) structure; smooth thallus surface; bluish iridescent. **Habitat:** epilithic in the sublittoral reef slope to 25 m depth; often occurs densely packed among short-branching *Acropora* colonies on shallow, sheltered reefs. **Distribution:** Indo-Pacific. N.B. not as described in Jaasund, where *D. friabilis* is *Canistrocarpus crispata* (see above).

• *D. humifusa* Hörnig, Schnetter & Coppejans Thallus less than 5 cm high, dense dichotomous branching in a horizontal plane; slippery and iridescent blue-green. **Habitat:** on vertical walls of large, lower eulittoral pools and epiphytic on stems of the seagrass *Thalassodendron ciliatum*. **Distribution:** Indian and Atlantic Oceans. N.B. also identified as *D. friabilis* in Jaasund.

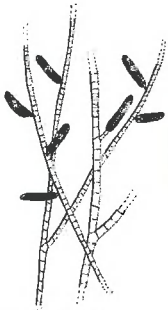
• *Dictyopteris delicatula* Lamouroux Plants creeping, 2–8 cm long, forming low mats, attached at several points (in the eulittoral) or loose clumps (in sheltered deeper water); straps membranous and translucent, 1–3 mm wide; dichotomous with a narrow, characteristic midrib. **Habitat:** lower eulittoral pools, but mostly shallow sublittoral. **Distribution:** pantropical. N.B. four species recorded in the region.

• *Spatoglossum asperum* J. Agardh Plants up to 30 cm, foliaceous, supple, irregularly divided into narrow straps 1–2 cm broad and 10–20 cm long; small side branches protrude from the main blades at irregular intervals; orangy brown, turning to greenish blue after collection and when drying. **Habitat:** mainly sublittoral, to 20 m depth, but also observed in the lower eulittoral. **Distribution:** Indo-Pacific.

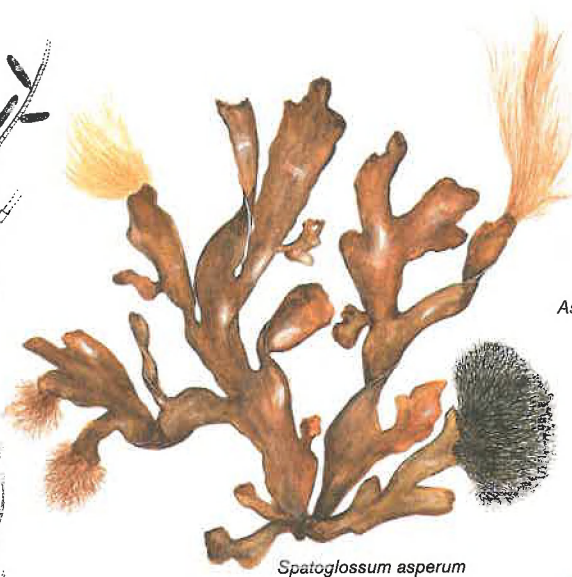
Stypopodium Conspicuous plants with foliaceous thalli, up to 50 cm long, composed of straps or lobes.

• *S. flabelliforme* Weber-van Bosse (not illustrated) Thallus ascendant, up to 40 cm, composed of cabbage leaf like clumps of yellowish to dark brown blades, often with a green-brown sheen. The blades are fan-shaped, split irregularly, and have concentric rings of hair lines (but less marked than in *S. zonale*, see below). **Habitat:** attached to rock or coral substrate in shallow water and down to 20 m depth, where it may cover large areas of coral. **Distribution:** Indian Ocean.

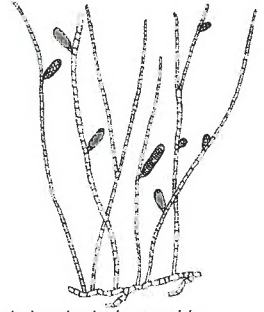
• *S. zonale* (Lamouroux) Papenfuss Erect thallus with a short, but well-marked, stipe; fully grown specimens with numerous wedge-shaped, strap-like segments and with well-marked concentric darker stripes; old specimens with a ruffled surface and a leathery consistency. **Habitat:** shallow sublittoral of the outer reef slope along exposed coasts. **Distribution:** pantropical.



Feldmannia indica



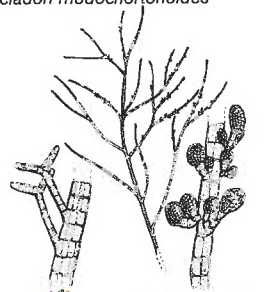
Spatoglossum asperum



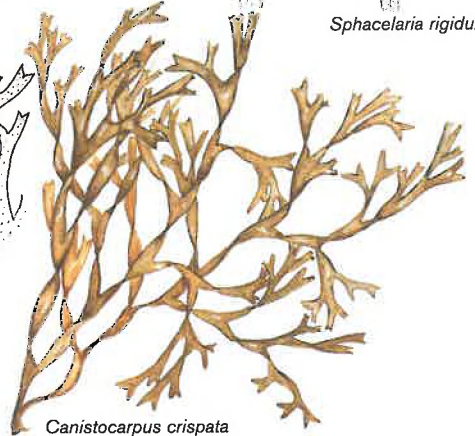
Asterocladon rhodochortonoides



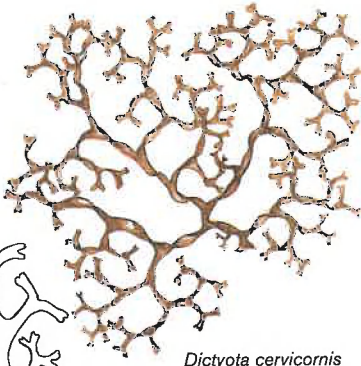
Hincksia mitchelliae



Sphacelaria rigidula



Caristocarpus crispata



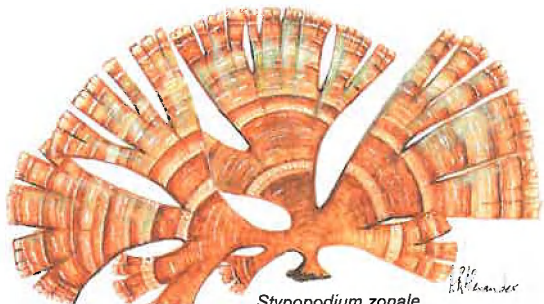
Dictyota cervicornis



Dictyota humifusa



Dictyopteria delicatula



Stytopodium zonale

• *Lobophora variegata* (Lamouroux) Womersley Plants morphologically very variable: creeping, ascendant or even erect; the basal growth forms completely foliose, rounded to fan-shaped, with rhizoids on the lower surface. Upper blades on a short stipe, gregarious, composed of wedge-shaped segments with rhizoids along the stipes; leathery consistency, dark brown to reddish, with concentric lines of hairs. **Habitat:** mainly sublittoral, down to 35 m. **Distribution:** pantropical and warm temperate shores. N.B. syn. *Pocockiella variegata* (Lamouroux) Papenfuss.

Padina Thalli forming erect, brown, funnel-shaped fans with concentric rings of hair lines and often a whitish deposit of lime on the surface. The blade margin composed of the growth zone is inrolled. Five species recorded in the region.

• *P. boergesenii* Allender & Kraft Thallus 10–12 cm in diameter; blades split into several wedge-shaped sections, only slightly calcified and light brown. Hairlines alternate on both sides of the blade and dark lines of sporangia are found above every second hairline. Old specimens often densely covered by epiphytes. **Habitat:** shallow sublittoral, in lagoons and around reefs. **Distribution:** pantropical. N.B. syn. *P. gymnospora* sensu Vickers.

• *P. boryana* Thivy Thallus 2–8 cm in diameter, fan-shaped blades, entire or rarely split; strongly calcified on the upper surface and therefore whitish; lower surface light brown. A line of hairs restricted to the lower surface and situated just under the sporangia lines. **Habitat:** upper eulittoral pools. **Distribution:** pantropical.

• *Stoecosperrum polypodioides* (Lamouroux) J. Agardh Plant 20–30 cm long, erect, relatively stiff, composed of a cylindrical stipe and flat, dichotomous straps with inrolled tips; fertile plants with characteristic marginal dark lines of crowded sporangia. **Habitat:** mostly sublittoral fringe along exposed coasts. **Distribution:** Indian Ocean and Red Sea. N.B. syn. *S. marginatum* (C. Agardh) Kützing

• *Colpomenia sinuosa* (Mertens ex Roth) Derbès & Solier Hollow, smooth, fragile, sac-like plants. Young plants spherical; older plants irregularly lobed to brain-like, up to 10 cm in diameter. Thallus wall 0.4 mm thick consisting of 2–3 cell layers; yellowish brown. Plants solitary or gregarious, mostly epiphytic on various algae. **Habitat:** shallow sublittoral; frequently epiphytic but also epilithic on coral. **Distribution:** pantropical.

• *Hydroclathrus clathratus* (C. Agardh) Howe Hollow, net-like plants. Young plants spherical; older specimens irregularly lobed to cushion-like or foliose, up to 30 cm in diameter, with a perforated surface resulting in a net-like appearance; perforations circular to irregularly oval, 0.1–5 cm in diameter; a distinctive pale orange brown. **Habitat:** lower eulittoral reef flats and seagrass beds; locally abundant at extreme low water mark. **Distribution:** pantropical and warm temperate seas.

• *Rosenvingea intricata* (J. Agardh) Børgesen Ball-like supple to brittle structures, up to 25 cm in diameter. Composed of highly entangled, cylindrical to compressed, hollow, mainly dichotomous, partly anastomosing branches; up to 8 mm in diameter at the base, gradually narrower after each dichotomy and tapering to acute apices. Colour yellowish brown. **Habitat:** epilithic in shallow sublittoral. **Distribution:** pantropical.

Turbinaria Conspicuous and common dark brown or golden, tough, bushy plants. The erect branches are covered by typical stiff lateral branches ("blades") which are funnel-shaped, conical, pyramidal or shield-shaped, solid or hollow, angular or rounded, with entire or dentate ribs. Plants attach themselves with characteristic, generally well-developed, dichotomously branching stolonoid parts. The greatest diversity and growth occurs along exposed coasts (in eulittoral pools, as well as on reef crests and in the shallow sublittoral). Seven species known from the region.

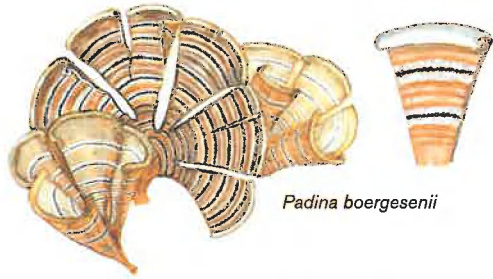
• *T. conoides* (J. Agardh) Kützing Plant height to 60 cm or more; main axes simple or branched and relatively supple. Blades with slender stalks, 12–15 mm long; the apex of each blade is variable and lobed, but generally roughly triangular with marginal teeth and a central vesicle. **Habitat:** large growth forms in eulittoral pools, becoming smaller towards the reef crest. **Distribution:** Indo-Pacific.

• *T. decurrens* Bory de Saint-Vincent Plants 10–15 cm high, extremely stiff and very strongly attached to the substrate. Axis simple, generally with scars of blades at the base; blades in marked longitudinal rows, inverted pyramidal, with triangular outward surface and small marginal teeth along all the ribs. **Habitat:** sublittoral zone of open sea coasts exposed to strong surf. **Distribution:** Indo-Pacific.

• *T. ornata* (Turner) J. Agardh var. *serrata* Jaasund Plants 5–10 cm high, relatively stiff, well attached to the substrate. Axis simple, blades shield-shaped with a cylindrical, smooth stipe and a triangular outward surface with a pronounced dentate margin; no teeth on the surface but a relatively clear vesicle. **Habitat:** epilithic in the sublittoral fringe and shallow sublittoral along exposed shores. **Distribution:** WIO.



Lobophora variegata



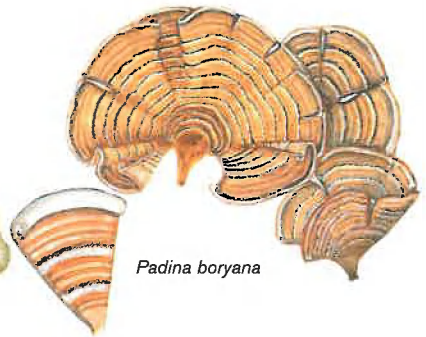
Padina boergesenii



Stoechospermum polypodioides



Colpomenia sinuosa



Padina boryana



Hydroclathrus clathratus



Turbinaria decurrens



Turbinaria conoides



Turbinaria ornata var. serrata



Rosenvingea intricata

• *Cystoseira myrica* (S.G. Gmelin) C. Agardh Plants 10–30 cm high, with a spiny aspect because of numerous, 2 mm long acute branchlets; main axes branched irregularly or alternately pinnate; commonly small spinose air bladders with an apical longer spine; dark brown. **Habitat:** epilithic in pools on the reef flat, sometimes frequent on inner reef crest. **Distribution:** WIO.

• *C. trinodis* (Forsskål) C. Agardh Thallus up to 75 cm long, erect, slender; narrow basal leaf-like blades, 3–5 cm long and about 3 mm broad; brown; blades sometimes absent; axes densely covered by spiny outgrowths and bearing fusiform, smooth air bladders in twos or threes in the apical parts of the plants. **Habitat:** epilithic in pools on reef flats. **Distribution:** Indian Ocean.

• *Hormophysa cuneiformis* (J.F. Gmelin) P.C. Silva Plants 20–50 cm high, stiff, easily recognised by the 3-winged fronds, which are triangular in cross-section; “wings” with a dentate margin, interrupted at intervals where side branches arise, resulting in a segmented aspect; air bladders between the base and the apex (intercalary), sometimes difficult to observe; orangy brown when young, darkening with age. **Habitat:** lower eulittoral, in pools on the reef flat. **Distribution:** Indo-Pacific. N.B. syn. *H. triquetra* (L.) Kützinger.

• *Chnoospora implexa* J. Agardh Stiff, crisp sub-spherical tufts up to 30 cm in diameter, composed of cylindrical, solid, dichotomous, locally anastomosing branches of up to 2 mm in diameter at the base, gradually tapering to the apices; pale yellow to brown, darkens upon drying. **Habitat:** epilithic in shallow sublittoral. **Distribution:** Indian Ocean and W Pacific Ocean.

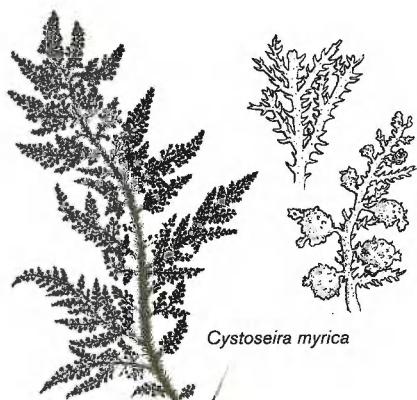
Sargassum Thallus up to 1 m in length, characterised by branched, erect axes bearing leaf-like blades and air bladders (vesicles). Some species are free-floating, and entire communities of plants and animals are known to be associated with such floating rafts. An important source of alginic acid (used as an emulsifying agent in food and cosmetic industry), and material for biogas. Most *Sargassum* species occur in the lower eulittoral and sublittoral where they may grow together with corals, often prolific growth during the cooler months. Species are not easily recognised because their morphology changes with age. Jaasund distinguished ten species in the region.

• *S. asperifolium* Hering & Mertens ex J. Agardh Plants up to 40 cm tall; leaf-like blades, linear but rather fleshy, without midrib, the basal ones coarsely toothed, 6 cm long and 3 mm broad, the upper ones entire, with marginal warty structures, 2–4 cm long, 1–2 mm broad; air bladders 2–4 mm in diameter, bearing small surface warts. Receptacles without spiny outgrowths, simple or branched. **Habitat:** some specimens in deep, lower eulittoral pools, but plants mainly epilithic in the shallow sublittoral along exposed coasts. **Distribution:** WIO.

• *S. oligocystum* Montagne Plants up to 50 cm in length with characteristically compressed branches. Young plants ascendant, older ones erect; basal leaf-like blades 2–5 cm long, 8–10 mm broad, upper blades about 3 cm long, 2–5 mm broad with conspicuous marginal teeth; air bladders 2–3 mm in diameter, with spiny outgrowths or longitudinally winged; bladder stalk (pedicel) also compressed to winged; receptacles palmate and spiny. **Habitat:** mainly epilithic in deep, lower eulittoral pools and in the shallow sublittoral along exposed coasts. **Distribution:** Indo-Pacific. N.B. syn. *S. binderi* Sonder.

• *S. cristaefolium* C. Agardh Plants up to 50 cm length, stiff and rough, somewhat resembling *Turbinaria* plants (see page 90). Easily recognised by the double crested and dentate upper margin of short, broad and fleshy blades, 1–2 cm long and about 1 cm broad. Vesicles about 3 mm in diameter on cylindrical stalks; receptacles spiny. **Habitat:** reef slope of exposed coasts. **Distribution:** Indo-Pacific. N.B. syn. *S. duplicatum* (J. Agardh) J. Agardh.

• *S. ilicifolium* (Turner) C. Agardh Plants up to 40 cm in length. Basal blades long and rounded, reaching 6 cm or more; apical blades elliptical, 1–3 cm long, 8–15 mm broad with a combination of minute and large marginal teeth. Fully grown receptacles with spiny outgrowths; air vesicles subglobular, 3–5 mm in diameter. **Habitat:** deep lower eulittoral pools of the reef-flat, but mainly in shallow sublittoral. **Distribution:** Indo-Pacific. N.B. *S. cristaefolium* (above) is possibly synonymous with *S. ilicifolium*.



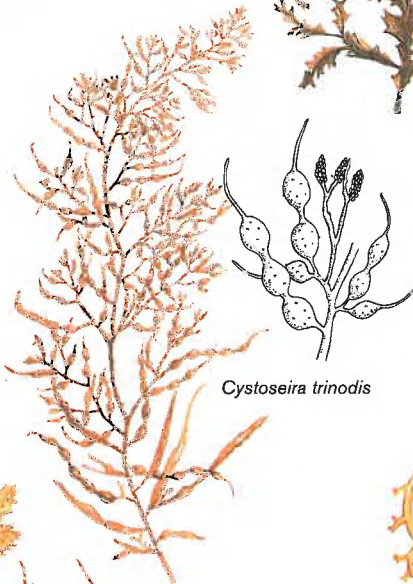
Cystoseira myrica



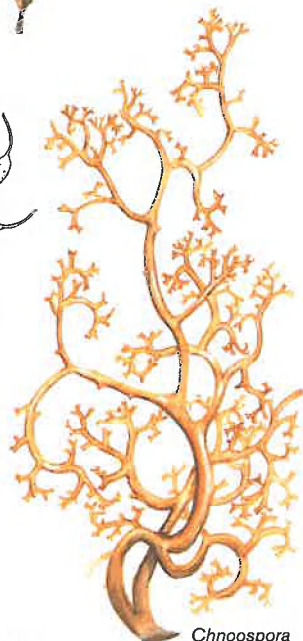
Hormophysa cuneiformis



Sargassum oligocystum



Cystoseira trinodis



Chnoospora implexa

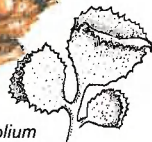


Sargassum asperifolium

Sargassum ilicifolium



Sargassum cristaeifolium



DIVISION RHODOPHYTA • RED ALGAE

From the Greek "rhodo" meaning red. This division is composed mainly of pink, red to purplish (occasionally green or brown) coloured algae due to a combination of the red pigment phycoerythrin and the blue pigment phycocyanin. The division is the largest within the macroalgae, with over 10,000 species described worldwide, mainly occurring in tropical regions. Morphologically, the construction of their thallus varies widely, although the thallus is fundamentally filamentous and there is no true parenchymatous construction as in higher plants. The significance of red algae is evident in the formation of coral reefs, in the food and pharmaceutical industry, and in the promising use of some calcareous forms in human bone implants. Typical genera include the smooth *Gracilaria*, the tough but brittle *Euclheuma*, the fine, filamentous *Polysiphonia*, the branching calcareous *Amphiroa*, and the pink encrusting corallines that are so important as cementing agents on coral reefs (see page 106). Identification of many smaller species requires microscopic analysis of the plant anatomy.

• *Liagora divaricata* Tseng Bushy plants, up to 10 cm high, heavily calcified though supple and slippery to the touch. All axes cylindrical, 1 mm in diameter at the base, gradually narrower after each dichotomy. Dichotomies in all planes, apical branches straight or diverging, not incurved; basal parts whitish due to calcification, upper parts brownish red. **Habitat:** sublittoral along exposed coasts, mostly epiphytic on the stems of the seagrass *Thalassodendron ciliatum*, but also epilithic. **Distribution:** Indo-Pacific. N.B. five species described in the region.

• *Yamadaella caenomyce* (Decaisne) Abbott Stiff bushy plants, 3–4 cm in diameter, with dense dichotomous branching. Branches cylindrical, 1 mm in diameter, strongly calcified, resulting in the stiff appearance and brittle structure when exposed at low tide. Greyish to brownish red. **Habitat:** epilithic in sublittoral fringe; often occurring as isolated clusters of individuals. **Distribution:** Indo-Pacific.

• *Actinotrichia fragilis* (Forskål) Børgesen Very stiff, bushy, erect plants, 5–10 cm high, composed of radially placed, dichotomous, cylindrical, strongly calcified and brittle branches; large branching angle (30–40° at the base, up to more than 90° near the apices); branches characterised by whorls of stiff, coloured filaments; pinkish to brownish red, which bleach and become greenish during decay. **Habitat:** epilithic in lower eulittoral pools and in the shallow sublittoral zone. **Distribution:** Indian Ocean and W Pacific Ocean.

Galaxaura and *Dichotomaria* Plants bushy, dichotomously branched and often jointed, moderate in size, and soft to firm (or even brittle) depending on the degree of calcification. Thallus is cylindrical, with or without constrictions or compressed. *Galaxaura* and *Dichotomaria* differ in details of the reproductive structures. Species of these genera are commonly used as bait in fish traps. Two species of *Galaxaura* and three species of *Dichotomaria* described in the region.

• *Galaxaura rugosa* (J. Ellis & Solander) J.V. Lamouroux Fully grown plants up to 20 cm high, bushy and rather stiff, hairy, with a characteristic whorled arrangement of filaments clearly seen in young shoots; dark brown to black. All axes cylindrical, 1.5–2 mm thick and dichotomous. **Habitat:** lower eulittoral and deeper on moderately exposed shores. **Distribution:** pantropical. N.B. syn. *G. subverticillata* Kjellman.

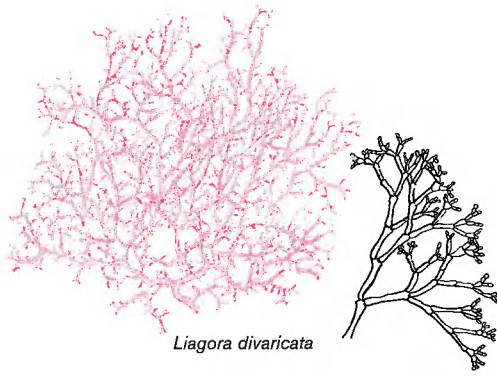
• *Dichotomaria marginata* (Ellis & Solander) Lamarck Plants bushy, fan-shaped to hemi-spherical, 6–10 cm high, relatively tough, but each individual strap supple; major branches emanating from the basal disc, compressed with thickened margins, 1.5–2 mm broad, dichotomous, each dichotomy less than 1 cm apart, with broadly rounded tips; fresh plants dirty red to brownish. **Habitat:** mostly epilithic, in rock pools of lower eulittoral, in the lagoon or on the seaward reef slope; less frequent as epiphyte on stems of the seagrass *Thalassodendron ciliatum*. **Distribution:** pantropical. N.B. syns. *Galaxaura tenera* Kjellman and *G. marginata* (Ellis & Solander) Lamouroux.

• *Tricleocarpa fragilis* (L.) Huisman & Townsend Plants up to 12 cm high, in mounds or inverted cone-shaped formations, composed of cylindrical, uncontracted, dichotomous axes, 1 mm in diameter, which are rather strongly calcified and stiff to brittle; light red or pink, turning grey when pressed. **Habitat:** epilithic on vertical to overhanging rock walls in lower eulittoral pools and shallow reefs. **Distribution:** pantropical and temperate seas. N.B. syns. *Galaxaura oblongata* (Ellis & Solander) Lamouroux and *T. oblongata* (Ellis & Solander) Huisman & Borowitzka.

• *Asparagopsis taxiformis* (Delile) Trevisan A beautiful purple-pink erect to bushy plant with woolly texture, arising from a creeping system of cylindrical axes; erect fronds 15–30 cm high. Branches on the main axis alternating on 4 longitudinal rows and bearing crowded pinnate branchlets, resulting in a ribbed structure. Plants produce a strong smell of iodine. This is the sexual stage of the species; the asexual stage (described as *Falkenbergia hillebrandii* (Bornet) Falkenberg) develops as spherical tufts of thin filaments, 2–3 cm high. **Habitat:** epilithic on shallow reefs, down to 20 m. **Distribution:** pantropical.

• *Gelidiella acerosa* (Forskål) Feldmann & Hamel Plants gregarious, extremely well attached to the substrate and with very tough, erect, mostly recurved and supple main branches up to 7 cm long; branchlets opposite or placed on the concave side of the recurved axes, very stiff, resulting in a prickly appearance; dark red to black, but frequently covered by epiphytes and therefore overlooked in the field. **Habitat:** mainly on the ridges of eulittoral pools and on reef platforms. **Distribution:** worldwide in tropical and temperate waters. N.B. two species described in the region.

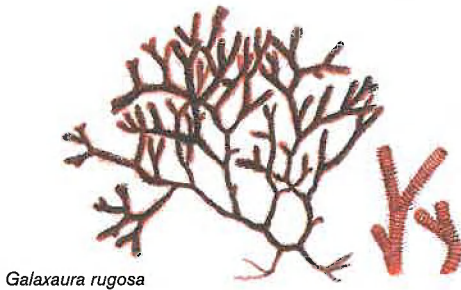
• *Gelidium pusillum* (Stackhouse) Le Jolis Plants gregarious, creeping, composed of well attached creeping stolons and erect fronds, up to 8 mm high. Fronds compressed, irregularly branched and constricted; apical portion of axes rounded and flattened and bearing the reproductive bodies; brownish red. **Habitat:** epilithic, upper eulittoral or higher, mostly under overhanging cliffs. **Distribution:** cosmopolitan in temperate and tropical seas. N.B. three species described in the region.



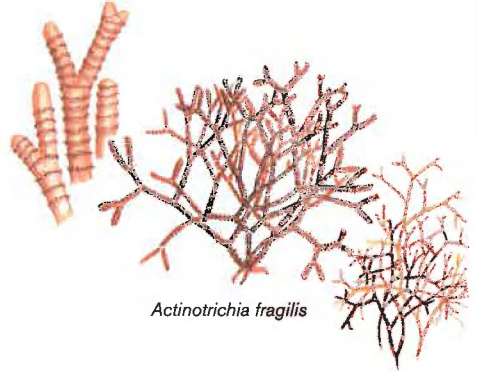
Liagora divaricata



Yamadaella caenomyce



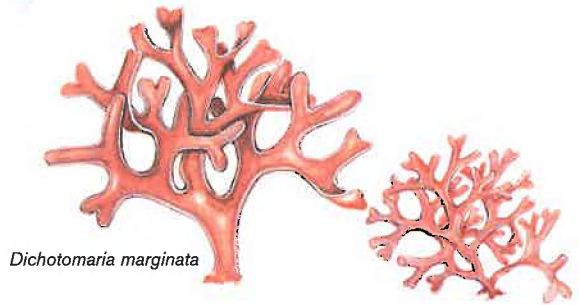
Galaxaura rugosa



Actinotrichia fragilis



Tricleocarpa fragilis



Dichotomaria marginata



Gelidiella acerosa



Gelidium pusillum



Asparagopsis taxiformis

• *Pterocladia nana* Okamura Plants gregarious, firmly attached to the substrate, supple though very tough, 2 cm high. All branches compressed, bipinnately branched, dark purplish red. Sporangia develop in round patches in the upper parts of flat branches. **Habitat:** epilithic, close to the low water line but also present in shaded parts of rocky cliffs in the upper eulittoral. **Distribution:** Indo-Pacific. N.B. three species described in the region.

• *Portieria hornemannii* (Lyngbye) P. C. Silva A conspicuous bright red alga, up to 20 cm in diameter, with compressed axes which branch repeatedly and pinnately in a single plane, resulting in a lacy appearance; branches gradually narrower and with inrolled apices. **Habitat:** epilithic, mainly on the open reefs, from low water level to 5 m depth; also present in reef channels and deep reef platform pools. **Distribution:** Indo-Pacific. N.B. syns. *Desmia pulvinata* J. Agardh, *Chondrococcus hornemannii* (Lyngbye) Schmitz.

• *Peyssonnelia* sp. Members of this genus have a more or less crustaceous thallus attached to the substratum by rhizoidal filaments. The red or brownish crusts or convoluted blades are moderately calcified (depending on the species), stiff to brittle, and easily detached from the substratum. **Habitat:** mostly sublittoral but also present in deep, lower eulittoral pools (mainly on vertical walls). **Distribution:** the genus is widely distributed in cold to tropical seas. The illustrated plants have been collected in Tanzania, but are probably present further afield. At least three species have been reported from the WIO, varying in blade thickness, anatomy and degree of calcification.

Jania Fine and delicate articulate coralline algae, dichotomously branched at intervals of one to several segments; calcified segments cylindrical or flattened, separated by uncalcified genicula.

• *J. adhaerens* Lamouroux Thallus forming spherical, brittle tufts of up to 3 cm in diameter, with radially arranged, dichotomous branches composed of heavily calcified, cylindrical segments; greyish pink to pinkish white. **Habitat:** common epiphyte on coarse algae such as *Sargassum*. Also tolerant of high temperatures (>30°C) in eulittoral rock pools. **Distribution:** pantropical and temperate waters. N.B. three species described in the region.

• *J. subulata* (Ellis & Solander) Sonder Plants gregarious, 3–5 cm long, forming heavily calcified tufts composed of articulated segments; branching regularly pinnate; segments of the main axes as inverted triangles, side branchlets composed of cylindrical segments. Colour pinkish white. **Habitat:** epiphytic on the seagrass *Thalassodendron ciliatum*, also attached to beach rocks in moderately exposed lower eulittoral areas. **Distribution:** tropical coasts. N.B. syn. *Haliptilon subulatum* (Ellis & Solander) Johansen.

Amphiroa All species heavily calcified and brittle, segmented with cylindrical to compressed branches. Live specimens pink, turning white on drying. Five species described in the region.

• *A. anceps* (Lamarck) Decaisne Plants up to 15 cm high, distinctly articulated (jointed) and dichotomously branched in parallel planes, resulting in a fan-shaped form. Branching angles are very narrow in the upper part of the plant; segments typically compressed and nearly all of the same length, 6–8 mm long; articulations very obvious and brownish, segments pink. **Habitat:** sublittoral along surf-exposed coasts, attached to rocks or epiphytic on stems of the seagrass *Thalassodendron ciliatum*, rare in eulittoral pools. **Distribution:** Indo-Pacific.

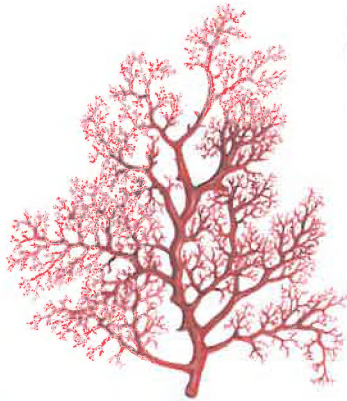
• *A. fragilissima* (L.) Lamouroux Forming 3–5 cm high, loose, brittle cushions of erect, primarily di- or trichotomous branchlets with frequent formation of secondary branchlets at the nodes. Thickness and length of the cylindrical segments vary with age, and have characteristic swellings at the nodes. **Habitat:** middle to lower eulittoral zone; locally abundant as undergrowth of seagrass meadows but also epilithic. **Distribution:** pantropical. N.B. allied species *A. rigida* (lacks the characteristic swellings at the nodes).

• *Halymenia durvillei* Bory de Saint-Vincent Conspicuous plants with a single erect thallus, 30–50 cm high, bushy with flattened, firm but supple straps; branching irregular, mainly from the strap margins, but small proliferations arising from the surface as well; apices acute. Firmly attached to the substrate by a holdfast disc. Live specimens bright red to pale brown; surface slippery to the touch. Specimens become very thin when pressed. **Habitat:** epilithic, mainly sublittoral, down to 5 m depths around reefs, but also present in lower eulittoral pools. **Distribution:** Indo-Pacific. N.B. possible syns. *H. ceylanica* Harvey ex Kützing, *H. formosa* Harvey ex Kützing, and *H. venusta* Borgesen.

• *H. maculata* J. Agardh Foliose thallus up to 30 cm in diameter; firmly attached by a holdfast disc at the base of a short stipe; blade thin, extremely slippery, undulated all over, ruffled in the central part with irregular, marginal lobes resulting in a somewhat lacerated and shaggy appearance; dark red with irregularly placed lighter dots. **Habitat:** shallow sublittoral along exposed coasts. **Distribution:** Indo-Pacific.



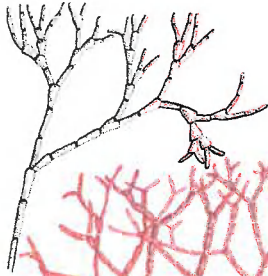
Pterocladia nana



Portieria hornemannii



Peyssonnelia sp.



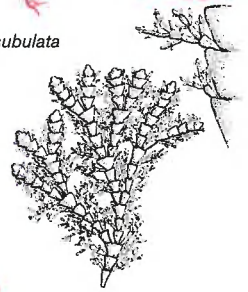
Jania adhaerens



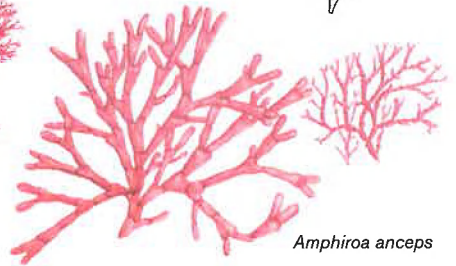
Amphiroa fragilissima



Jania subulata



Halymenia durvillei



Amphiroa anceps



Halymenia maculata

Gracilaria Species identification is often difficult. Thalli are firm, cylindrical or compressed, dichotomously or irregularly branched; one group of species have articulations. Habitat varying from reef platforms, including pools, lagoons, seagrass meadows and mangrove areas to deep water. Some species have commercial value as raw material for agar production. Seven species described in the region.

• **G. canaliculata** Sonder An extremely firm, cartilaginous species, 3–7 cm in length; thallus composed of cylindrical, dichotomously branched, downwardly bent axes; firmly attached to the substrate by a basal disc as well as bundles of rhizoids wherever the thallus touches the substrate; bright red in shaded places, turning dark red on drying, bleached in exposed sites. **Habitat:** sublittoral fringe in exposed areas at reef edges. **Distribution:** Indo-Pacific. N.B. syn. *G. crassa* Harvey ex J. Agardh.

• **G. corticata** (J. Agardh) J. Agardh Thalli gregarious, forming large, dense tufts, cartilaginous to supple, with compressed or flattened branches in single or in several parallel planes, originally dichotomous. Older plants 6–20 cm in length, appearing irregular in their branching pattern due to projections lining the edges of segments. Fresh specimens dark red or deep purple to greenish, black when pressed. **Habitat:** mostly epiphytic on stems of the seagrass *Thalassodendron ciliatum* in the shallow sublittoral zone, but also epilithic in eulittoral rock pools and deeper. **Distribution:** Indian Ocean.

• **G. salicornia** (C. Agardh) Dawson The most common species of the genus in the region. Growth form very variable, depending on the habitat: thallus forming creeping, well attached cushions on surf-exposed rocky surfaces or growing erect in pools and sheltered areas, reaching 25 cm length. "Typical" specimens with characteristic constrictions, resulting in a segmented appearance, others without constrictions; branches cylindrical, succulent and loosely di- or trichotomously branched. Fresh specimens greenish yellow to dark red, depending on exposure to the sun, turning black on pressing. **Habitat:** on eulittoral and shallow sublittoral rock surfaces. **Distribution:** Indo-Pacific.

Ceratodictyon General morphology very variable, plants composed of cylindrical to compressed cartilaginous axes with a creeping and an erect part. Several species grow in close association with sponges, obscuring the original morphology. Two species described in the region.

• **C. spongiosum** Zanardini Thallus prostrate to ascendant, of brittle, sponge-like texture, with cylindrical, irregularly branching and anastomosing axes with conspicuous pores, the tips of the axes are visible at the apices of the thallus branches; dull red to bleached green. The plant is composed of a filamentous red alga living in symbiosis with a sponge (*Sigmatocia symbiotica*, see page 124), hence the structure and appearance. **Habitat:** lower eulittoral, on sand and in pools. **Distribution:** Indo-Pacific.

• **Gelidiopsis variabilis** (J. Agardh) Schmitz Thallus tough, wiry and very well attached to the substrate; erect parts 3–8 cm high. Shape variable with upper parts completely cylindrical or compressed; branching irregular to dichotomous or roughly pinnate. Fresh specimens dark red or purple, black when dry. **Habitat:** epilithic in eulittoral rock pools, at the reef edge and in the shallow sublittoral. **Distribution:** pantropical and subtropics. N.B. syn. *Ceratodictyon variabilis* (J. Agardh) R.E. Norris.

• **Sarcodia montagneana** (J. Hooker & Harvey) J. Agardh Plants distinctive with flat, thick, oblong to triangular blades. Thalli mostly gregarious, supple cartilaginous but tough, 4–8 cm high, irregularly divided or dichotomous; conspicuous marginal rows of irregular rounded projections. Fresh specimens dark red or pinkish red, turning black on drying. **Habitat:** on vertical walls of rock-pools in the sublittoral fringe. **Distribution:** Indo-Pacific.

• **Sarconema filiforme** (Sonder) Kylin Thallus erect, composed of cylindrical, dichotomous, cartilaginous-like, supple branches tapering towards the tips, 3–28 cm high (depending on exposure to surf); attached to the substratum with characteristic hapteroidal holdfast (a short, thick and stumpy "root-like" mass). Yellowish brown or greenish yellow in sun-exposed pools, dark red at shaded sites. **Habitat:** epilithic in the sublittoral fringe. **Distribution:** Indian Ocean and W Pacific Ocean. N.B. two species recorded in the region.

Eucheuma Large, highly variable plants with cylindrical or compressed thalli, fleshy to stiff (cartilage-like), mostly warty or spiny and slippery to touch due to their fleshy nature. Specimens take a long time to press and dry. They are brittle and occur in sheltered reefs and lagoons, exposed only at extreme low spring tide. Many species belonging to this genus are commercially important as raw materials for the production of carrageenan, some are collected for these substances and a few are farmed (see Seaweed Farming in Human Activities section). N.B. the taxonomy is complex and five species have been recorded in the region.

• **E. denticulatum** (N. L. Burman) Collins & Hervey Irregular clumps with spiny, cylindrical branches, 2–5 mm in diameter, forming wide angles with the main axis. Branches develop from spiny outgrowths and are arranged in clear, equidistant whorls in young plants, but as the plant ages the pattern gets progressively obscured. Older plants develop secondary holdfast structures, which help secure the plant at the tips of the curved branches. Colour yellowish brown or green. **Habitat:** attached to corals as loose cushions, lagoons in the lower eulittoral on moderately exposed shores. **Distribution:** Indian Ocean and W Pacific Ocean. N.B. syn. *E. spinosum* J. Agardh. This was the first seaweed species used for commercial farming in the region.

• **E. odontophorum** var. *mauritanium* (Børgesen) Doty ex P. C. Silva Thallus composed of irregularly branching axes; axes compressed; all axes with regular constrictions resulting in an articulated appearance; larger spiny outgrowths on the margins of the segments, smaller ones on the surface. **Habitat:** shallow sublittoral in sheltered sites. **Distribution:** WIO. N.B. syn. *E. speciosum* (Sonder) J. Agardh var. *mauritanium* Børgesen.

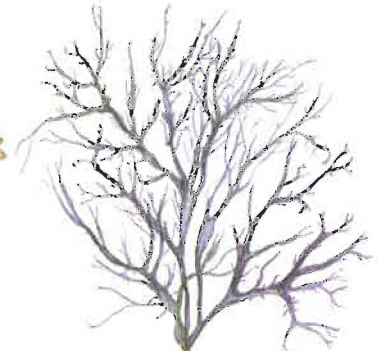
• **Eucheuma** sp. Thallus cylindrical, irregularly branched, with obvious rounded, pitted nodules. Branches 1 cm in diameter at base, tapering towards apices; pale brown in colour. **Habitat:** sheltered shallow lagoons. **Distribution:** collected in Tanzania, possibly more widely distributed.



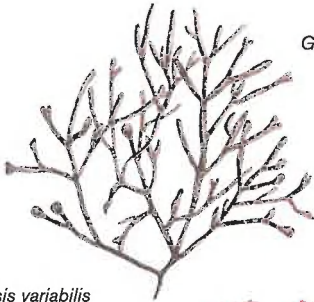
Gracilaria canaliculata



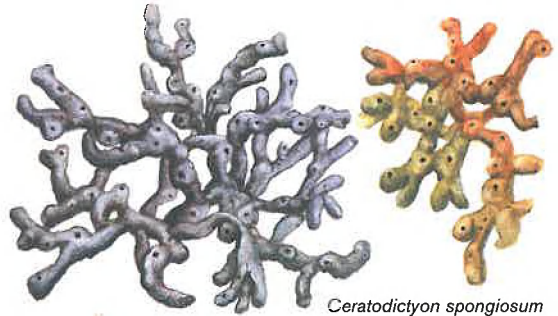
Gracilaria salicornia



Gracilaria corticata



Gelidiopsis variabilis



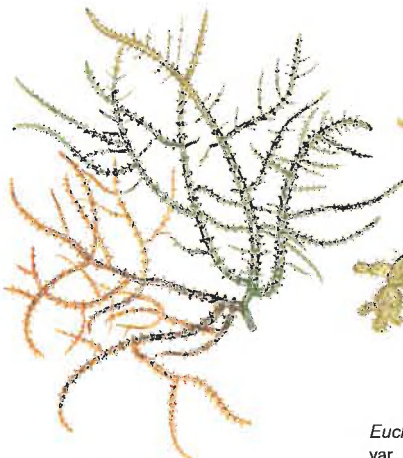
Ceratodictyon spongiosum



Sarcodia montagneana



Sarconema filiforme



Eucheuma denticulatum



Eucheuma odontophorum
var. *mauritianum*



Eucheuma sp.

• *Catenella caespitosa* (Withering) L. Irvine Thalli gregarious, forming cushion-like clumps, up to 1 cm high; creeping parts cylindrical with holdfasts arising from branching points as short stalks with a broad terminal disc; erect fronds compressed, constricted, irregularly branched, more fleshy than *Gelidium pusillum* (see page 94); brownish-purple. **Habitat:** most developed on mangrove aerial roots, but also epilithic in the upper eulittoral zone. **Distribution:** cosmopolitan in temperate and tropical seas.

Hypnea Plants irregularly branched with small spine-like branchlets of variable length. Thallus cylindrical or partly compressed, growing either erect or as firm cushions or mats on rocky surfaces in shallow water. Erect representatives in shallow water often with entwining branches. Over ten species are recorded in the WIO, some of which could be commercially exploited for their carrageenan content.

• *H. cornuta* (Kützting) J. Agardh Supple, bushy plant, up to 40 cm long with short, simple and slender branchlets, 2–4 mm long, sparsely distributed on the thallus; all axes and branches cylindrical; straw-coloured to greenish. A distinguishing feature is the presence of easily detachable star-like propagules, which are shed to produce new plants. Young plants grow erect but entangle as they age. **Habitat:** mostly shallow, sandy areas (attached to shells or coral debris) and occasionally on coral reefs. **Distribution:** Mediterranean Sea and Indo-Pacific.

• *H. pannosa* J. Agardh A stiff to brittle, compact mat-forming species, producing a blue iridescence in water. Thallus partly compressed, 1–2 cm thick, adjacent branches frequently fusing to form an irregular network; all apices spiny. **Habitat:** wave-washed steep rock surfaces in the eulittoral zone and on vertical, shallow sublittoral coral walls. **Distribution:** Indo-Pacific.

• *Champia* sp. Soft, tubular (although sometimes compressed) thallus, 2–15 cm. Side branches with same width as the main axis, mostly opposite, but also irregularly placed, constricted at the base resulting in fusiform branchlets. The whole thallus is regularly constricted, resulting in an articulated appearance. Colour red or pinkish red. **Habitat:** reef platforms, rocky shores and sublittoral. **Distribution:** the genus is globally distributed in cool to tropical seas. The illustrated plant was collected in Tanzania, but is possibly distributed further afield. N.B. at least five representative species have been identified from WIO shores.

• *Botryocladia leptopoda* (J. Agardh) Kylin Thallus erect, 10–20 cm high, firmly attached; main axes cylindrical, branching once or twice; densely set with perpendicularly placed thin-walled, mucilage-filled globular or pear-shaped branchlets, 2–4 mm in diameter. Colour bright red. **Habitat:** epilithic in the sublittoral, rarely in lower eulittoral rock pools. **Distribution:** Indo-Pacific. N.B. two species recorded in the region.

• *Crouania attenuata* (C. Agardh) J. Agardh A small, extremely supple, red epiphytic alga, less than 2 cm high; due to the presence of a gelatinous cover it is very slippery to the touch. The central axis is about 40 µm in diameter and is composed of cylindrical cells, each bearing whorls of 4 short branchlets just below the upper end of the cell; basal cell of each branchlet producing a single reproductive body. **Habitat:** on seagrasses and on other algae in the lower eulittoral. **Distribution:** worldwide in cold to tropical seas. N.B. two species recorded in the region.

Ceramium Filamentous, supple plants growing as epiphytes on the leaves of seagrasses and on other algae, as well as on rocky surfaces in pools and on cliff walls. The filaments generally branch dichotomously and become broader at the nodal regions. A large genus, globally distributed and occurring from intertidal to deep water habitats. The majority of species are minute, less than 1 cm high and need microscopic analysis for identification; a few exceptions reach 20 cm height. Eleven species recorded in the region.

• *C. deslongchampsii* Chauvin ex Duby Thallus up to 5 cm high; main axes about 0.2 mm in diameter; apices almost straight; well-marked nodes with undifferentiated cortical cells. **Habitat:** epiphytic on the seagrass *Thalassodendron ciliatum* and on large algae. **Distribution:** worldwide in cold to tropical seas. N.B. syn. *C. strictum* (Kützting) Harvey.

• *C. mazatlanense* Dawson Tufts up to 1 cm high, entangled with other algae. Tiny filaments, about 100–150 µm in diameter, arising from axes spread over the substrate and anchored by rhizoids; erect branches with claw-like forking tips; each node composed of small cells in the upper part, longitudinally elongated cells in the basal part. **Habitat:** mixed in algal turf and epiphytic in lower eulittoral and the sublittoral fringe, as well as epilithic in the upper eulittoral zone. **Distribution:** pantropical.

• *Centroceras clavulatum* (C. Agardh) Montagne Plants filamentous, gregarious, locally forming extended mats. Thallus 1–6 cm high depending on habitat (plants in sheltered areas grow much taller than those in exposed regions). Filaments about 100–200 µm in diameter, originally branching dichotomously, but old specimens have numerous adventitious branchlets with hooked branch endings. The presence of characteristic whorls of spines around the filaments (hence the generic name meaning "horns around a circle") gives it a banded appearance. Colour reddish brown or purple. **Habitat:** the species appears to be quite tolerant to high temperature and desiccation, and thus is widely distributed in the eulittoral, on sand, on wood surfaces or rocky cliffs, but also epiphytic on other algae. **Distribution:** pantropical and subtropical.

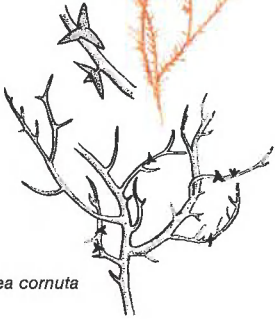
• *Spyridia filamentosa* (Wulfen) Harvey Plants erect, bushy, supple, up to 10 cm high, with distinct main axes and side branchlets in all directions; axes about 1 mm thick at the base, gradually tapering towards the apex, irregularly branched, with a continuous cortication of regularly placed cells, resulting in a segmented aspect; side branchlets perpendicularly placed in all directions, one per segment, resulting in a fuzzy appearance; cortication limited to the nodes. Colour dirty pink to red or creamy. **Habitat:** epilithic in eulittoral pools and shallow sublittoral, but mostly epiphytic on seagrasses and on other algae in the same zone. **Distribution:** pantropical and temperate (Mediterranean Sea, Cape Province of South Africa). N.B. three species recorded in the region.



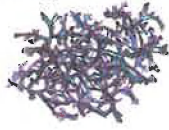
Hypnea pannosa



Champia sp.



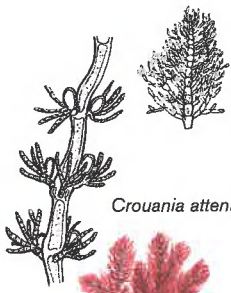
Hypnea cornuta



Catenella caespitosa



Botryocladia leptopoda



Crouania attenuata



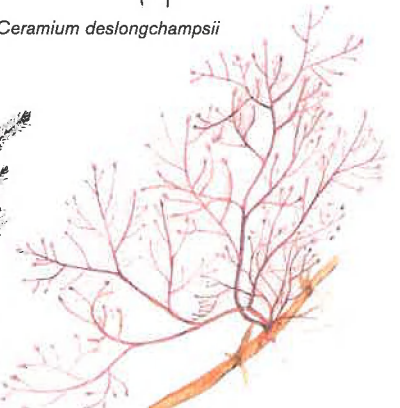
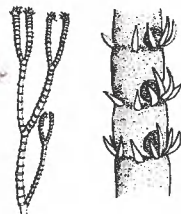
Ceramium mazatlanense



Ceramium deslongchampsii



Centroceras clavulatum



Spyridia filamentosa

- *Euptilota fergusonii* Cotton Thallus erect, extremely supple, up to 15 cm high, with distinct main axes and side branches in a single plane; axes about 1 mm thick at the base, gradually tapering towards the apex, irregularly branched, with a continuous cortication of downwardly growing rhizoids; side branches perpendicular, opposite, without cortication, with apical branchlets on one side of the thallus, and 2–3 spiny outgrowths; bright to dark red, with a bluish iridescence in the water. **Habitat:** epilithic in shallow sublittoral, or hanging from overhanging walls of lower eulittoral rock pools. **Distribution:** WIO.
- *Caloglossa lepreurii* (Montagne) G. Martens Forming dark red to orange-brown glossy mats, thallus narrow foliaceous, membranous, delicate, constricted at regular intervals to form a series of oval segments, each about 3 mm long, with a marked mid-vein. Rhizoids and between 1–3 additional blades growing from each constriction. **Habitat:** upper eulittoral, mostly found in association with mangrove pneumatophores or on overhanging cliffs; mixed with other species such as *Bostrychia* and *Murrayella* (see below). **Distribution:** worldwide in warm temperate seas.
- *Martensia elegans* Hering Delicate net-like blades, 2–15 cm wide, lobed (in young plants) to lacerated (in older plants). The net-like blades are the result of banded areas one cell thick with elongated holes, alternating with thicker areas with solid membranes; the entire thallus is fan- to funnel-shaped, pinkish to brownish red, sometimes with a bluish iridescence. **Habitat:** sheltered pools in the sublittoral fringe; rare, but locally and seasonally abundant. **Distribution:** Indian Ocean and W Pacific Ocean.
- *Dasya elongata* Sonder Thallus erect, supple, 5–10 cm high, with distinct main axes and apical tufts of side branchlets; axes 1–2 mm thick, branching irregularly but lacking branchlets in the lower parts which are covered by a cortication of downwardly growing rhizoids; upper parts covered by tufts of wide-spreading, dichotomous (forking angles up to 90°), curved, tubular branchlets about 1 mm long. Colour uniformly dark red. **Habitat:** epilithic or epiphytic from the sublittoral fringe to the shallow sublittoral or deeper. **Distribution:** Indian Ocean and W Pacific Ocean. N.B. three species recorded in the region.
- *Dictyurus purpurascens* Bory de Saint-Vincent Plants gregarious, erect, up to 10 cm high, composed of firm, fleshy, sparsely branched main axes, bearing whorls of anastomosing branchlets, resulting in a distinctive, three-dimensional lacy web with a 4-ribbed, coarsely dentate outline and a spongy consistency. Colour dark reddish purple. **Habitat:** epilithic in shallow sublittoral, rarely in lower eulittoral; generally rare, but occasionally abundant in certain areas. **Distribution:** Indian Ocean and W Pacific Ocean.
- *Polysiphonia denudata* (Dillwyn) Greville One of the larger representatives of the genus. Filaments extremely supple, up to 8 cm long, gregarious, forming extended mats in sand. Basal parts of filaments creeping, upper parts free; branched hairs sometimes present at the apices of the erect branches. Thallus composed of a central axis surrounded by 6–7 cells (in transverse section as illustrated), resulting in segments which are twice as long as broad in the middle parts of the erect branches, becoming shorter and tapering towards the apices. Plants are light pink to colourless. **Habitat:** sandy areas in upper and middle eulittoral; acting as a sand-binder. **Distribution:** worldwide in tropical and temperate seas. N.B. syn. *P. variegata* (C. Agardh) Zanardini. At least six species recorded in the region.
- *Digenea simplex* (Wulfen) C. Agardh Very firm, partly creeping to erect plants with a stiff, fleshy, hairy, irregularly branched main axes, up to 15 cm long. All axes covered by characteristic short bristles and branchlets but these are usually heavily covered with epiphytes, and the species is often overlooked in the field. Colour dark red. **Habitat:** epilithic in the sublittoral fringe along sheltered coasts. **Distribution:** pantropical.
- *Murrayella pericladus* (C. Agardh) Schmitz Plants elegant and supple, ascending, 2–3 cm high. Erect branches densely ramified, partly dichotomous, partly alternate; side branchlets about 2 mm long, unbranched or dichotomous, radially arranged. Tetrasporangia in specialised, cylindrical branches about 0.5 mm long. Colouration dark red. **Habitat:** overhanging cliffs of the supralittoral fringe and upper eulittoral, and on mangrove pneumatophores; growing in association with *Bostrychia* (see below). **Distribution:** pantropical and the subtropics.
- *Bostrychia tenella* (Lamouroux) J. Agardh Plants gregarious, forming dense, woolly mats, 1–2 cm thick. Thallus with erect branches arising from a creeping axis; side branches alternate on 2 opposite rows, bearing similarly placed branchlets, all apically curved to the same side of the main axis, resulting in a feathery appearance. Colour dark brownish red to yellowish green after long exposure to air. **Habitat:** often in association with *Murrayella pericladus* (above), on cliffs of the supralittoral fringe and high eulittoral, and on mangrove aerial roots, forming a moss-like community known as the Bostrychietum, which also includes numerous Cyanobacteria and filamentous algae. **Distribution:** worldwide in tropical and warm temperate seas. N.B. syn. *B. binderi* Harvey. Two species recorded in the region.



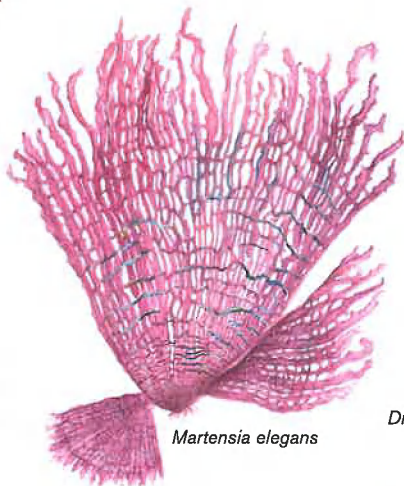
Euphilota fergusonii



Caloglossa lepreurii



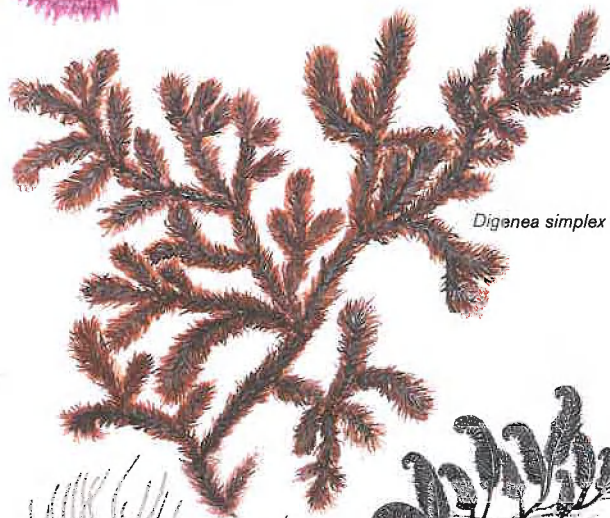
Dasys elongata



Martensia elegans



Dictyurus purpurascens



Digenea simplex



Polysiphonia denudata



Murrayella periclados



Bostrychia tenella



• *Amphisbetema indica* (J. Agardh) Weber-van Bosse Thalli gregarious, growing as isolated, dense, well attached tufts. Stolonoïdal parts bearing upright, well-marked main axes which are very densely, more or less pinnately branched; axes cylindrical, covered by a cortication of downwardly growing rhizoids; apical branchlets not corticated, curved inwards, densely placed, resulting in a spongy aspect. Colour dark red. **Habitat:** epilithic at the sublittoral fringe along surf-exposed coasts. **Distribution:** WIO.

• *Leveillea jungermannioides* (Hering & G. Martens) Harvey Thallus creeping, well attached to the substrate, the creeping axes irregularly branched, reaching 5 cm in length, bearing two semi-erect (45°) rows of alternate, compressed, leaf-like branches, about 1 mm long and 0.5 mm broad, often with an apical tuft of colourless, branched hairs on the young branchlets. **Habitat:** epiphytic on various other algae (frequent on *Sargassum*), but also epilithic. **Distribution:** Indian Ocean and W Pacific Ocean.

• *Amansia rhodanta* (Harvey) J. Agardh Thalli gregarious, erect, forming dense clusters, 4–10 cm high, firmly attached to the substrate. The main plant axes are cylindrical, fleshy, irregularly branched and bear apical clusters of elongated leaf-like branches resulting in a flower-like appearance. The leafy branches, 3–4 mm broad and about 1.5 cm long, have a midrib and inrolled marginal teeth and apex. Colour rose to dark red, the basal parts sometimes strongly obscured due to covering by sponges. **Habitat:** epilithic in shallow sublittoral, sometimes in extended populations, more rare in lower eulittoral rock pools. **Distribution:** Indo-Pacific and Mediterranean Sea. N.B. identified as *A. glomerata* in Jaasund (1976); allied species *A. dietrichiana* (with strap-like branches which lack marginal teeth and are not arranged in apical clusters).

• *Chondria dasyphylla* (Woodward) C. Agardh Thallus erect, 10–20 cm high, supple, cylindrical, with marked, loosely branched main axes bearing gradually shorter side axes in all directions; outer branchlets short and markedly fusiform (gradually tapering towards the base and the apex). Colour dark red to bleached yellow. **Habitat:** upper eulittoral and above, sheltered localities; on rocks and in sandy areas, attached to shells, seagrasses or coral debris. **Distribution:** worldwide in tropical and warm temperate seas. N.B. five species recorded in the region.

• *Palisada perforata* (Bory de Saint-Vincent) Nam Thalli gregarious, erect, 8–15 cm high, relatively stiff to cartilaginous. Axes cylindrical, 1–2 mm thick, irregularly branched in all directions and covered with closely packed, small branchlets which become shorter towards the tips; brownish-green to dark purple. **Habitat:** epilithic in shallow pools on reef platforms, also exposed at low tide in middle and lower eulittoral. **Distribution:** worldwide in tropical and warm temperate seas. N.B. syns. *Laurencia papillosa* (C. Agardh) Greville and *Chondrophycus papillosus* (C. Agardh) Garbary & Harper.

Laurencia Representatives of this genus are present in all tropical marine biotopes, habitats ranging from mangrove aerial roots to the deep open sea. They are epilithic or epiphytic, of wide-ranging colouration from dark green to straw, purple or dark red; diverse in size and shape, some grow erect while others form firm cushions. Thalli have cylindrical or compressed branchlets decreasing in length towards the tips of the branches, apical branchlets are generally small and wart-like. The genus is characterised by a pit-like depression on the tip of each of these warty branchlets. At least 12 species have been recorded in the region.

• *L. obtusa* (Hudson) Lamouroux Plants soft, fleshy and erect, 8–15 cm high. All branches are cylindrical; relatively densely packed and branching in all directions; lowermost branches longer, giving the plant a cone-like shape. Apical branchlets either very small and warty or longer but divided mostly into two or three parts. Colour dark red, frequently at least partly greenish. **Habitat:** mostly epilithic in eulittoral rock pools and in the shallow sublittoral, though small specimens can be epiphytic on other algae. **Distribution:** worldwide in tropical and warm temperate seas.

• *Acanthophora spicifera* (Vahl) Børgesen Thalli gregarious, brittle, erect, 10–15 cm tall (or taller in sheltered localities). Erect axes cylindrical, sparsely branched, homogeneously covered by short branches, rather uniform in length; spines only present on these short branches. Colour purple to straw-yellow. **Habitat:** moderately exposed or sheltered pools in the lower eulittoral, but smaller specimens are frequent on reef crests. **Distribution:** pantropical and Mediterranean Sea. N.B. three species recorded from the region.

• *Acrocystis nana* Zanardini Thalli gregarious, forming dense, well attached clumps of brownish-purple to green, pear-shaped, mucilage-filled bladders. Each bladder is 7–20 mm long and about 5 mm broad, tapering towards the narrow basal end, and irregularly arranged on the cylindrical, stiff branches which are 0.5–1 mm in diameter. Fertile specimens with a warty surface of the bladders. **Habitat:** epilithic, occurring as large dense compact masses on shaded vertical surfaces in the upper eulittoral (below *Bostrychia*); small clumps also occur in the shallow sublittoral zone. **Distribution:** Indian Ocean and W Pacific Ocean.

Amphisbetema indica



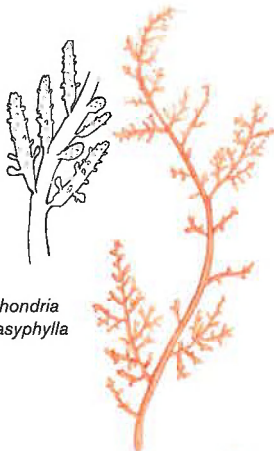
Leveillea jungermannioides



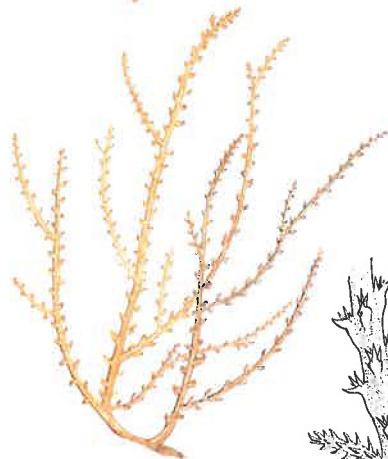
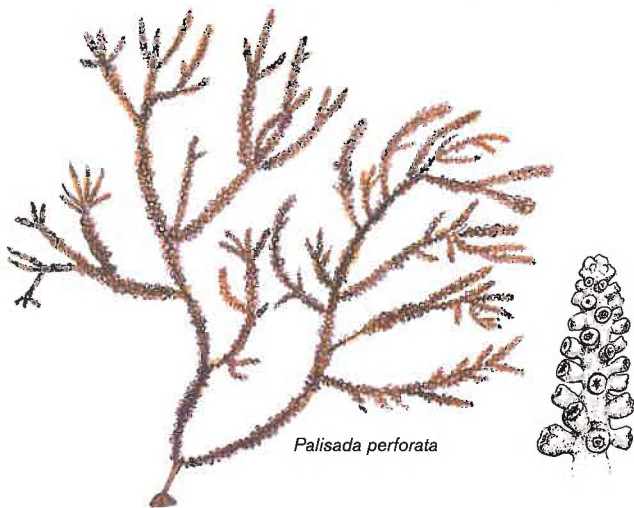
Amansia rhodanta



Chondria dasyphylla



Palisada perforata



Acanthophora spicifera

Laurencia obtusa



Acrocystis nana

