In rather isolated, shallow lagoons with soft substrate (Chilaw), seagrasses can be abundant. Close to the estuaries, where the salinity is still about the same as seawater, *Acanthophora spicifera* locally grows in large loose-lying ball-like tufts (Fig. 26A). More land-inward, where salinity is lower and the water temperature higher, *Ulva intestinalis* (Fig. 26B), *Chaetomorpha linum* (Fig. 26C) become abundant, together with cylindrical *Gracilaria* spp. (Fig. 26D). In the most isolated pools, mats of blue-greens develop on the silty substratum, drifting at mid-day (Fig. 26E) as a result of the numerous oxygen bubbles being produced by photosynthesis (Fig. 26F).

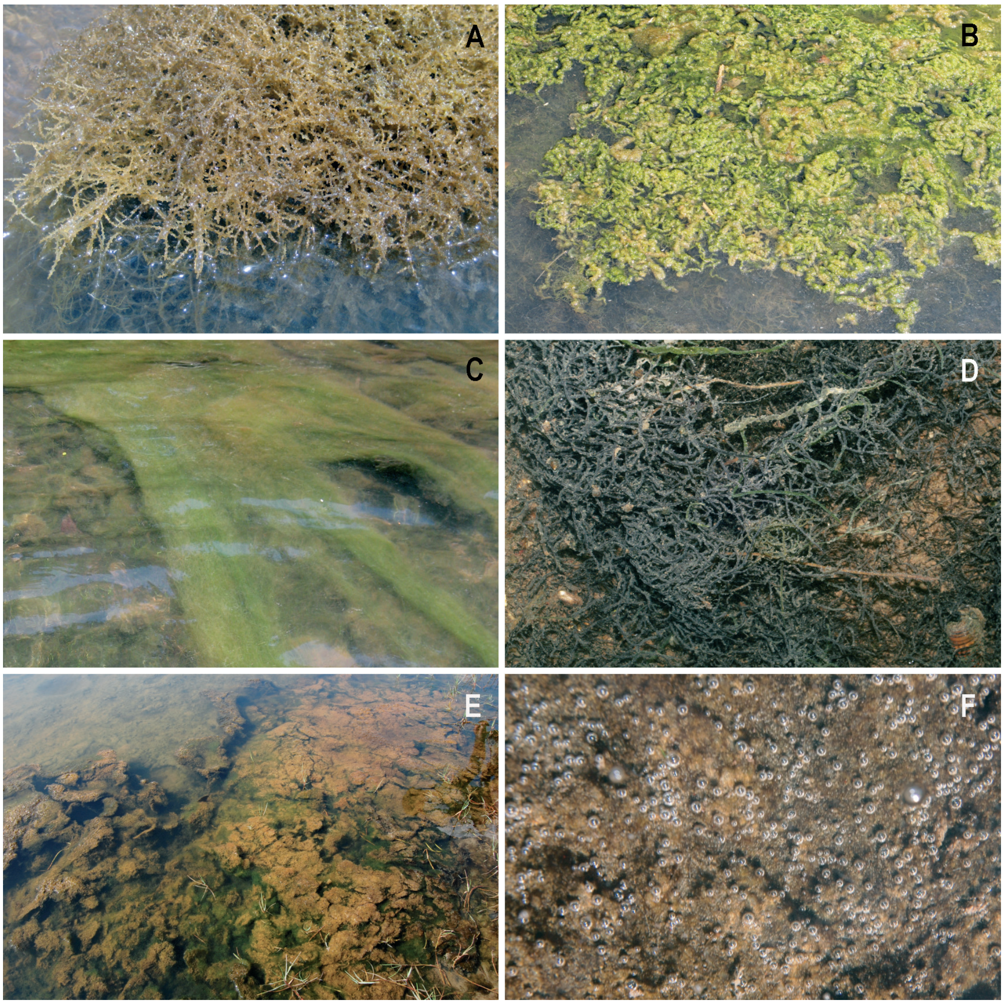

Fig. 26. Algae in shallow, isolated lagoons. Large tufts of *Acanthophora spicifera* close to the estuary; B. *Ulva intestinalis* in more sheltered, inward sites; C. Entangled *Chaetomorpha linum*-strands; D. Entangled *Gracilaria*; E. Mats of blue-greens in the most isolated parts, partly floating; F. Oxygen bubbles produced by photosynthesis of the mats of blue-greens.

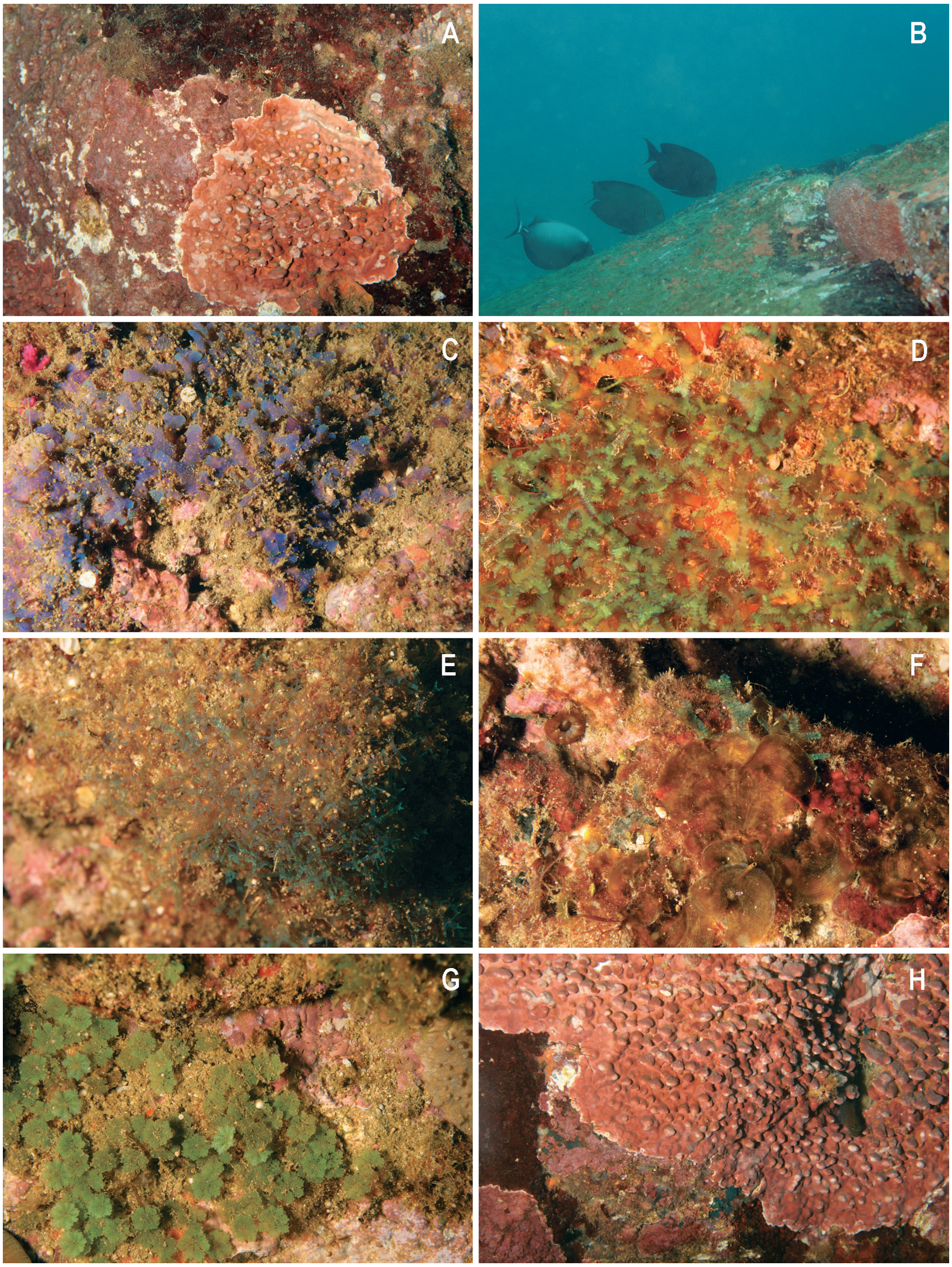

Fig. 27. Seaweeds on deepwater boulders (-25 m). A. In areas with high grazing pressure by herbivorous fish, only crustose corallines survive (Beruwela); B. In some areas, grazing fish limit the development of soft, erect algae (Beruwela); C-E. Representatives of *Dictyota* seem to be resistant to herbivory; F. The prostrate growth form of *Lobophora variegata* also escapes herbivory; G. *Caulerpa filicoides* is the most frequent uncalcified seaweed on and around rock boulders between 20 and 25 m depth; H. Crustose corallines locally cover almost 100% of the rock substrate on the boulders between 20 and 25 m depth.

On rocky substratum on the seaward side of the beach rock platform, healthy coral reefs can develop, but they are rare (Bar Reef in the Kalpitiya area). Mostly, the rocks are covered by seaweed vegetations. These can be species poor: exclusively composed of encrusting corallines (Fig. 27A) in places with numerous herbivores (Fig. 27B) or *Portieria hornemannii*-*Asparagopsis taxiformis* dominated vegetations.

Other areas again show a very diversified seaweed vegetation.

The isolated rock boulders in deeper parts of the subtidal (15-30 m depth) are intensively grazed by herbivorous fish. The dominant algae which seem to be resistant to this herbivory are several species of *Dictyota* (Figs 27C-E), *Lobophora variegata* (the prostrate growth form, Fig. 27F) and *Caulerpa filicoides* (Fig. 27G), next to encrusting corallines (Fig. 27H).

6. Accessibility and threats

As a result of the unstable geopolitical situation, large areas of Sri Lanka were, while preparing the present guide, not accessible for visitors. Along the West coast, the area north of Puttalam, including Jaffna, was closed down. Collecting in the Kalpitiya area was almost excluded and visiting the East coast was also strongly discouraged. As a result, the marine plants included in this book are mainly coming from the southwest and south coast of the island. Some larger, typically tropical species, reported by previous phycologists from the Jaffna area, have not been collected south of Kalpitiya (e.g. *Anadyomene wrightii, Caulerpa cupressoides*, *C. scalpelliformis*, *Udotea flabellum*, *Cystoseira trinodis*, *Hormophysa cuneiformis*, *Dictyopteris polypodioides*, *Neurymenia fraxinifolia*).

One should also be aware that surf-exposed rocky outcrops along the SW-coast are not accessible during the SW-monsoon as a result of the continuous huge waves and swells (Figs 28A-F).

The big tsunami of 27 December 2004 locally uprooted part of the coastal mangroves but did not result in a noticeable change of the epilithic algal flora.

Fig. 28. Inaccessibility of the coast. A, B. During the SW-monsoon, most of the southern and western coastline is not accessible due to the surf; C-E. The spray caused by the huge surf during the SW-monsoon results in well developed seaweed vegetations in the upper tidal zones (*Ulva fasciata*, *Dermonema virens*, *Turbinaria ornata* var. *evesiculosa* respectively); F. Locally the waves result in huge fountains through the blow holes.

A real, severe threat to coastal areas is the use of lagoons as well as beaches as waste disposals, resulting in huge amounts of mainly plastic at high tide level and above (Figs 29B-G) or plastic bags or sheets wrapped around subtidal rocks and corals. In the neighbourhood of estuaries the beach can be covered by organic detritus (tree trunks, water hyacinth, …) mixed to plastic detritus (Fig. 29A).

Fig. 29. Pollution. A. In the neighbourhood of estuaries, mostly organic material drifts ashore (Wattale); B. Lagoons are frequently used as waste disposals, resulting in huge amounts of mainly plastic at high tide level and above (Chilaw lagoon); C. Close to the estuaries of the lagoons, rubbish is concentrated (Chilaw lagoon); D-G. Beaches are also frequently used as waste disposals (D, E: Chilaw; F: close to Mount Lavinia; G: close to Colombo).

An invisible threat to coastal habitats is the eutrophication of intertidal rockpools and lagoons by wastewater, mainly in touristic areas. The constant release of nutrient-rich effluents in these biotopes has a profound effect on the biodiversity. In a first phase the abundance and composition of algal assemblages changes drastically whereby fast growing foliose algae such as *Ulva* spp. become dominant (Fig. 30A), attracting opportunistic herbivores such as sea urchins. The effect of this herbivory is striking: in the haloes around the sea urchin's crevice all germinating seaweeds are grazed, only leaving a crust of coralline algae (Figs 30C, D). The resulting barrens habitat is much lower in biodiversity.

Fig. 30. Eutrophication. A. Eutrophication results in a first stage in the massive development of *Ulva* populations in the intertidal pools (Hikkaduwa); B. Some eutrophicated intertidal pools can be completely populated by sea urchins, grazing all germlings of soft algae. Only a crust of coralline algae remains on the bottom; C. Along the seaward side of the beachrock platform sea urchins can also become very abundant as a result of eutrophication (Beruwela); D. As a result of the continuous grazing by the sea urchins, the algal cover of the substratum is limited to coralline algae within their grazing area.

Man-made (anthropogenic) as well as natural pressures have contributed to the degradation of Sri Lanka's coral reefs. Some of the anthropogenic pressures are coral mining and dynamite fishing in areas as Kalpitiya. Blast fishing has a long-term dramatic effect on the ecosystems originally present as it completely destroys the original substratum. Even the presence of authorities such as Coast Conservation Department does not seem to be able to stop these destructive practices.

The main natural threats to Sri Lanka's reefs are predator plagues such as the spread of Crown of Thorns Starfish and coral bleaching - the death of corals due to the exceptional rise in surface sea temperature, as a result of an El Niño-effect which occurred in 1998.

The plans for dredging a deeper canal between N Sri Lanka and SE India (Palk Strait) to make the passage of large ocean boats possible, thus avoiding the circular trip around Sri Lanka, possibly will also have a huge impact on the ecology of the northern marine habitats.

7. History of phycological research in Sri Lanka

The first collections of seaweeds in Sri Lanka were carried out by the Dutch botanist Paul Hermann (1646-1695). His collection formed the basis of Linnaeus' Flora Zeylanica (1747). Linnaeus' son (Linnaeus fil., 1782) described *Fucus pinnatus* (*Caulerpa pinnata*) from the island. William Ferguson (1820-1887), a British civil servant and amateur botanist in Ceylon from 1839 until his death in Colombo, issued informal exsiccatae, Algae Ceylanicae, with specimens identified by Albert Grunow (1826-1914), an Austrian phycologist and diatomologist. The first set of these exsiccatae, which are deposited in the Natural History Museum, London (BM), were included in the list of Ceylon algae, compiled by G. Murray (1887), but some duplicates are present in the Herbarium of the Botanic Gardens in Peradeniya (PDA), Sri Lanka and the Nationaal Herbarium Nederland in Leiden.

By far the most celebrated collector in the Indian Ocean was the Irish botanist William Henry Harvey (1811-1866), who provided entertaining accounts of his adventures in letters to family and friends (Ducker, 1988). Harvey stopped in Ceylon on his way to Swan Colony (Western Australia), arriving on the 5th of September and leaving the 25th of December 1853. During this period he collected sufficient specimens in Trincomalee, Weligama and Galle, to be distributed as exsiccatae (Harvey, 1857). While in Australia, he published a paper (Harvey, 1854) describing three spectacular reticulate Delesseriaceae from Ceylon: *Claudea multifida*, *Martensia fragilis* and *Vanvoorstia spectabilis*, the latter representing a new genus named after John Van Voorst, the London publisher of some of his books (including Harvey, 1841; 1849). Harvey's eloquent dedication of *Vanvoorstia* goes as follows (Harvey, 1854: 143-144): "Among the marine algae, perhaps none are more curious and few more beautiful than those net-like or lacework Florideae of which several genera, as *Claudea*, *Dictyurus*, *Martensia*, *Hanowia*, *Haloplegma*, *Thuretia* etc., have been discovered in the warmer seas… I have now the pleasure to introduce to botanists, from the south coast of Ceylon, not only a new species of *Claudea* and of *Martensia*, but also add to this interesting group a new genus, which yields to none of its associates in beauty and delicacy of structure. This genus I wish to dedicate to John Van Voorst, Esq., F.L.S., the well-known Natural History publisher, who, though not himself a working naturalist, is a notable instigator of work in others, and, as originator of a noble series of Monographs illustrating the Natural History of Great Britain, deserves the respect and thanks of his countrymen. The crest of the Van Voorst's (a family of no mean standing in Holland) is a mermaid from whose toilet the exquisitely delicate lacework now to be described may have been stolen; and I have peculiar pleasure in associating with so charming a sea-plant the name of a friend for whom, personally, I have a cordial regard and esteem". Most of Harvey's Ceylon collections, however, were treated by Kützing (1807-1893) and J. Agardh (1813-1901), as Harvey was busy pursuing other projects. His collection is deposited at the Trinity College in Dublin. Duplicate specimens, deposited in the National Herbarium of New South Wales (NSW), in Sydney can be seen online on: http://www.aussiealgae.org/HarveyColl/ceylon.php

Martens (1868) reported seven species from Galle, on the south coast of Ceylon, on the basis of material collected during the Prussian Expedition to eastern Asia.

Zanardini (1872) recorded eight species and Piccone (1886; 1889) listed a few species from Ceylon obtained during the round-the-world cruise of the corvette Pisani from 1882 to 1885. G. Murray (1887) provided the first extensive catalogue of Ceylon algae, based largely on collections made by Ferguson and Harvey. Barton (1903) reported 18 taxa on the basis of material collected by Herdman. Svedelius (1906a, b; 1945) published on the seasonality of the seaweeds of Ceylon and on Ceylon species of *Caulerpa* and *Galaxaura* respectively.

Børgesen, like Svedelius and others, collected algae at Galle and gave (1936) an extensive list of species obtained by him and others at this classical locality and a few other places in Ceylon.

Finally, there are the extremely valuable papers by Durairatnam (1961; 1962; 1963) on the marine algae of Ceylon, in which he treats all the species previously reported as well as some new species, that had not been reported before, totalling 174 taxa belonging to the Chloro-, Phaeo- and Rhodophyceae.

In recent times no algal diversity studies have been carried out anymore. Coppejans collected extensively along the SW coast since 1997 on a yearly basis. The specimens are deposited in the herbarium of Ghent University (Belgium) (GENT) and are currently under study. De Silva (1995) and De Silva & Mallikarachchi (2002) recently published on the effects of some environmental factors on the distribution pattern of algae on the south coast of Sri Lanka. Finally Mallikarachchi wrote his MPh thesis (2004) on anthropogenic effects on the distribution patterns of algae along the SW coast of Sri Lanka. His work includes 125 macroalgal taxa of which 44 Chlorophyta, 10 Phaeophyceae and 71 Rhodophyta. Some of these are new records for Sri Lanka. Voucher specimens of this study are deposited in the herbarium of the University of Ruhuna (Matara) and the National Herbarium in Peradeniya (PDA), Sri Lanka.

8. Marine plants and seaweeds

Marine plants are photosynthetic organisms in different evolutionary lineages (only macroscopic ones are included here): they are represented by the seaweeds, the seagrasses and the mangroves. Only the seaweeds are treated in the present book. Marine micro-algae, prokaryotic blue-greens (Cyanobacteria), seagrasses and mangroves are not included in this guide. For more information we refer to the more general work on Marine Botany by Dawes (1998) and more specialized, recent books such as Graham and Wilcox (2000) on seaweeds, Larkum *et al*. (1989; 2006) on seagrasses and Tomlinson (1986), De Lasserda (2002) on mangroves. The website http://www.seaweed.ie/ offers a concise but highly informative introduction on seaweeds and their uses.

8.1. Seaweeds - What are they?

Seaweeds are marine macroscopic (mostly visible with the naked eye), photosynthetic (carrying out oxygen-producing photosynthesis) eukaryotic organisms. They are non-vascular, which means no vascular bundles present as in higher plants, the uptake of nutrients from the surrounding seawater succeeding through diffusion through the whole plant surface.

Their primitive plant body, called a thallus, is not composed of roots, stems and leaves (like in terrestrial plants and seagrasses), although some structures can look like them (Fig. 31A). They do not produce flowers nor seeds but reproduce by spores (Figs 31B-E).

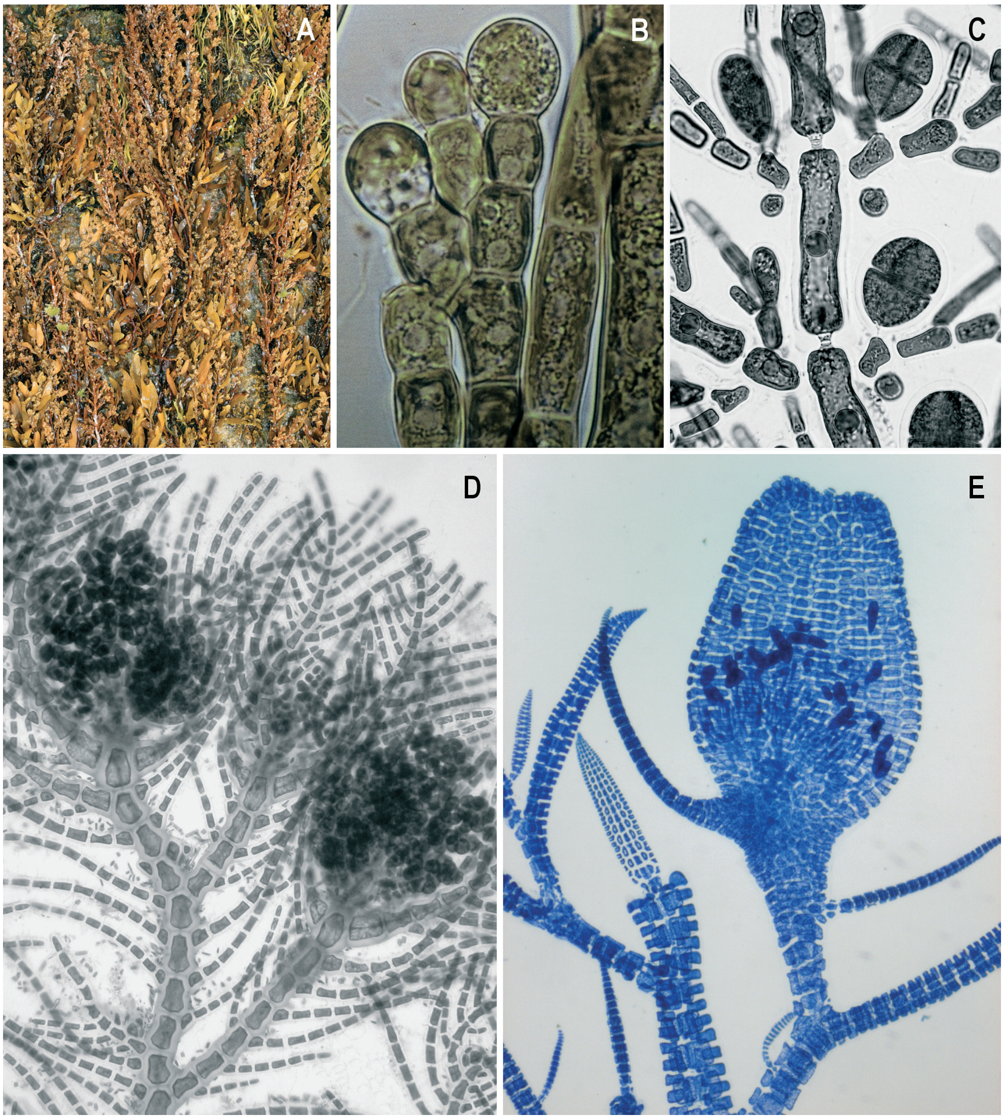

Fig. 31. General characters of seaweeds. A. Some seaweeds look similar to higher plants, with 'stems' (stipes), 'leaves' (blades) and inflorescences (receptacles) (*Sargassum* sp.); B. Monosporangia in the red alga *Acrochaetium* sp.; C. Tetrasporangia in the red alga *Balliella crouanioides*; D. Carpospores in the gonimoblast of *Skeletonella nelsoniae*; E. Carpospores in the cystocarp of *Platysiphonia delicata*.

The Chlorophyta (green algae), Phaeophyceae (brown algae) and Rhodophyta (red algae) originated separately, spaced in time. The seaweeds therefore are not a natural group as they have different ancestors: evolutionary they are polyphyletic. This is also reflected in the different pigments, cell wall components and storage products of the three groups of seaweeds. The Chlorophyta are more closely related to the land plants than to the other two groups of seaweeds (they also contain chlorophyll a and b, their main cell wall component is also cellulose and their storage product is also starch). 'Seaweeds' therefore refers to an ecological grouping of organisms which look similar because these forms occur in the same environment, and have similar roles in the ecosystem (equivalent to groupings as 'herbs', 'shrubs', 'trees' or 'succulents' on land).

8.2. Seaweed colour and classification

Although seaweeds are classified in green, brown and red algae, it is not always easy to determine in the field to which of these groups a certain specimen belongs. They all contain chlorophyll a (the primary photosynthetic pigment) and therefore can all be green(ish) if this pigment is dominant. Brown algae contain additional brown coloured compounds (accessory pigments) which are called xanthophylls. Depending on the amount of xanthophylls, brown algae can vary from yellowish orange to blackish brown. Red algae have accessory pigments belonging to the phycobilins. The most important ones are phycoerythrin (red) and phycocyanin (blue). Depending on the balance of the chlorophyll and the various phycobilins, red algae vary from pink to purplish red. In specimens growing in sun-lit sites, chlorophyll can become dominant and the red alga then can become greenish (Fig. 32A). Looking at the specimen in transparency (holding it against the sunlight) sometimes more clearly reveals the real colour of the seaweed.

Some seaweeds show the phenomenon of iridescence. As a result of layered cell walls or cell inclusions, some of the light reaching these algae is diffracted, certainly when they are submerged (or wet). These specimens then iridesce, either completely or only the branch tips, or in a banded or spotted pattern, in shiny greenish as in *Bryopsis* (Fig. 32B), bluish as in *Canistrocarpus magneanus* (Fig. 32C), *Dictyota* sp. (Fig. 32D), *Cottoniella amamiensis* (Fig. 32E), *Hypnea pannosa* (Fig. 32F), green-pinkish as in *Hypnea* sp. (Fig. 32G), blue-pinkish as in *Laurencia* sp. (Fig. 32H), brownish-yellowish as in some *Dictyota* species (Figs 33A-C), pinkish as in *Laurencia natalensis* (Fig. 33D), creamy as in *Chondracanthus acicularis* (Fig. 33E) or even golden shades in *Champia ceylanica* (Fig. 33F). Iridescence generally disappears as soon as the specimen is out of the water or dries out. It definitely cannot be observed on herbarium specimens and it therefore is important to mention this iridescence and even the original colour of the seaweed on the herbarium label, as this can dramatically change upon drying: some bright green *Microdictyon* species *in situ* become black (Fig. 34A), but also many brown and red algae change colour (mostly become darker) upon drying. If species are spotted (*Euryomma platycarpa*, Fig. 37F), they can keep this design even after drying.

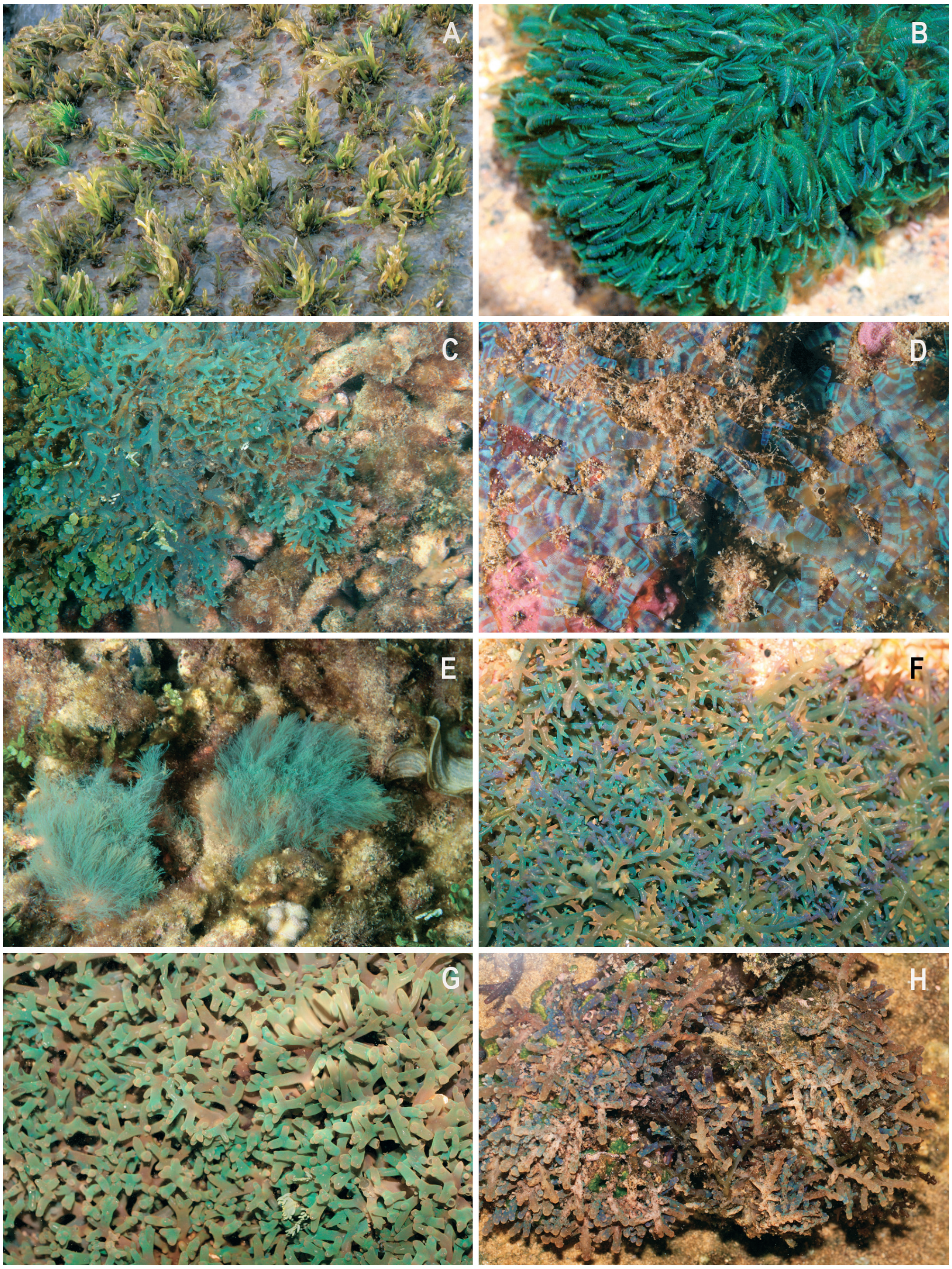

Fig. 32. Seaweed colours. A. Red algae, exposed to strong sunlight can become greenish because of the dominance of chlorophyll, rather than purplish red as a result of the phycobilines; B. Green iridescence in *Bryopsis pennata*; C. Blue iridescence of the whole thallus of *Canistrocarpus magneanus*; D. Banded blue iridescence in *Dictyota* sp.; E. Bluish iridescent *Cottoniella amamiensis*; F. A plant of *Hypnea pannosa* with blue iridescent tips; G. A plant of *Hypnea* sp. with green-pinkish iridescence; H. Partly iridescent *Laurencia* sp. in the infralittoral fringe, air-exposed at extreme low water (Hikkaduwa).

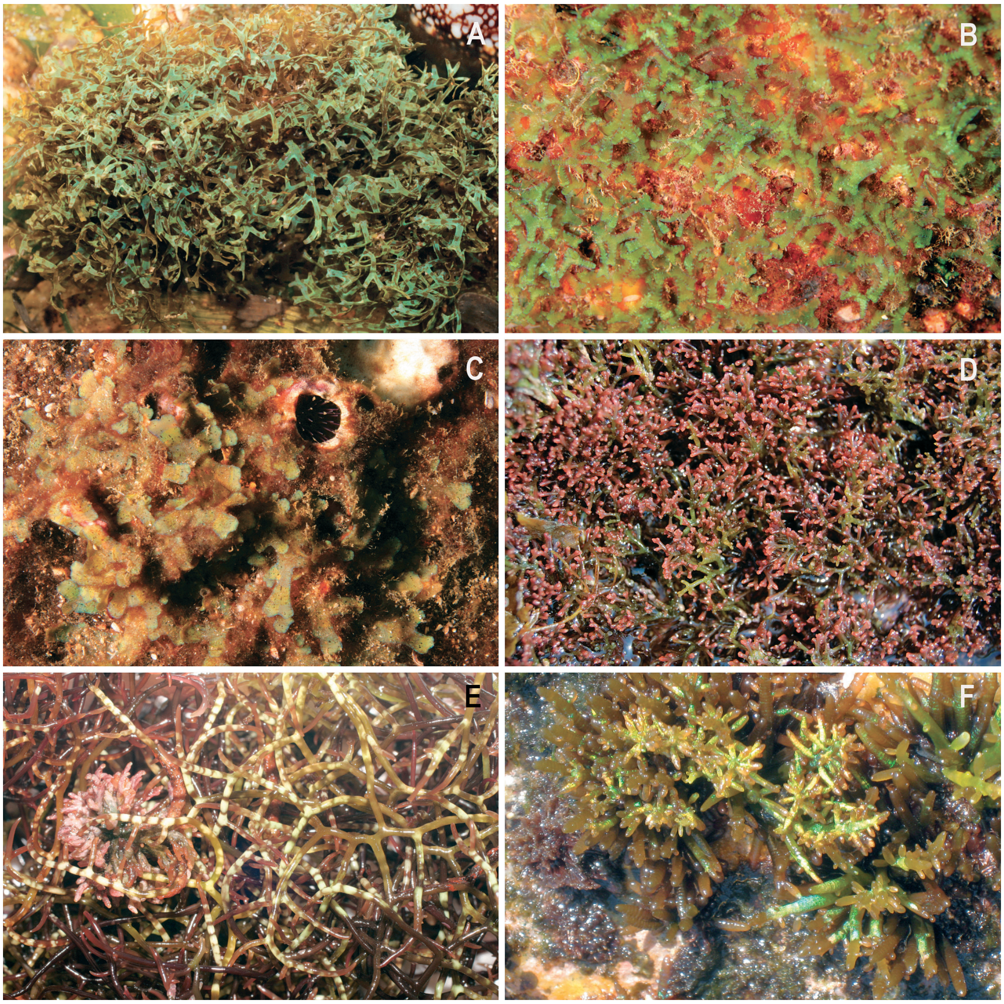

Fig. 33. Seaweeds colours. A. Brown and blue-greenish banded iridescent *Dictyota ceylanica*; B. Marginally banded iridescent *Dictyota* sp.; C. Spotted iridescent *Dictyota* sp.; D. *Laurencia natalensis* with pinkish iridescent tips; E. *Chondracanthus acicularis* with banded creamy-coloured iridescence; F. *Champia ceylanica* with golden iridescence.

Some green algae (e.g. *Acetabularia*, *Neomeris*, *Halimeda*) can be completely or partly (towards the basis) white (Fig. 34B) as a result of intracellular calcification. The brown alga *Padina* (Fig. 34C) can also be whitish, mostly on the upper surface by extracellular calcification. *Liagora* (Fig. 32D), *Dichotomaria*, *Tricleocarpa* and *Galaxaura* species are pinkish white depending on the degree of calcification. Articulated corallines (red algae) such as *Amphiroa* spp. (Fig. 34E), *Jania* spp. as well as crustose corallines (Fig. 34F) also become whitish by calcification, especially when they get older and grow in sun-lit biotopes.

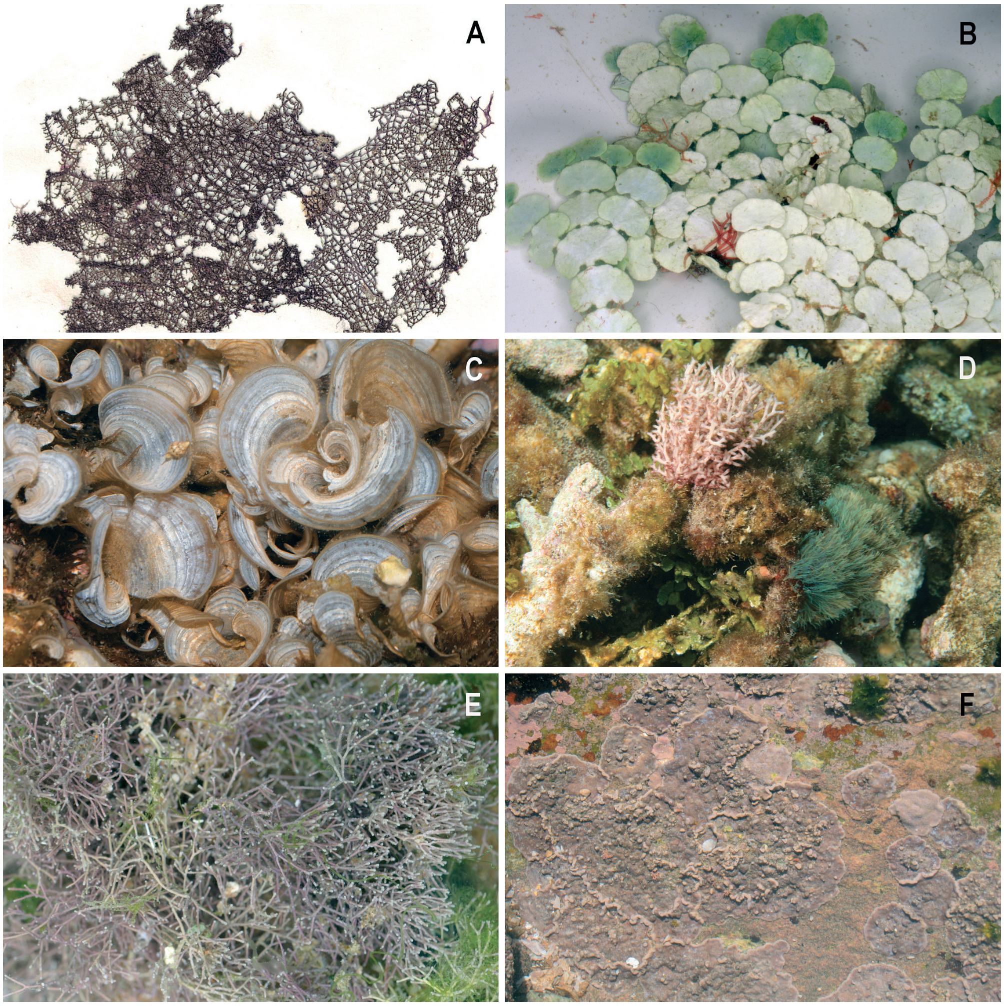

Fig. 34. Seaweed colours. A. Some *Microdictyon* species (e.g. *M. okamurae*), being green *in situ* become black upon drying; B. Whitish segments of the green alga *Halimeda* as a result of intracellular calcification; C. Whitish upper surface of the blades of the brown alga *Padina*, as a result of calcification on the upper surface; D. The thallus of the slippery red alga *Liagora* is whitish because of slight calcification; E. The brittle thallus of the coralline red alga *Amphiroa* is greyish white as a result of heavy calcification; F. Crustose coralline red algae are also greyish pink because of the heavy calcification.

Some brown algae, such as species of *Dictyopteris* or *Spatoglossum*, can become (partly) bluish after collecting as a result of chemical reactions of the plants themselves. Again, this effect disappears after drying. In some cases even the paper on which the specimens are drying may colour bluish.

8.3. Morphology

The form of seaweeds is extremely diverse: from filamentous and only a few mm high to complex fronds of up to more than 60 m long in colder water (in the tropics they rarely reach 1 m). They can be supple, stiff to even brittle or stone-like.

Filamentous algae are mostly composed of a single row of cells (= uniseriate). They can be unbranched (*Chaetomorpha* spp., Fig. 35A) or branched (species of *Cladophora*, *Valoniopsis*, *Acrochaetium*, Fig. 35B). In some species, several filaments get intertwined and form "rope-like" structures (*Asteronema breviarticulatum*, Figs 35C, D) because of the presence of hook-like side branchlets. In other species the filaments become stiff, intertwined and creeping over the substratum, resulting in crispy, spongy cushions (*Cladophoropsis* spp., *Valoniopsis pachynema*, Fig. 35E). Sometimes the branches anastomose and form a two- or threedimensional reticulum (*Microdictyon* sp., *Phyllodictyon* sp., Fig. 35F, *Boodlea composita*, Fig. 35G, *Tolypiocladia calodictyon*, Fig. 190C, *Dictyurus purpurascens*, Fig. 174) or blades (*Anadyomene wrightii*, Fig. 35H). The branching of these filamentous representatives can be very diverse: from irregular over dichotomous (*Ceramium* spp., Fig. 36A, *Chlorodesmis* spp., Fig. 36B, *Centroceras clavulatum*), sympodial (*Ceramium* sp., Fig. 36C), unilateral (*Euptilota fergusonii*, Fig. 36D), alternate (*Euptilota fergusonii*, Fig. 36E), spiralized (*Murrayella periclados*, Fig. 36F), opposite (*Phyllodictyon* sp., Fig. 35F, *Boodlea* sp., Fig. 35G, *Bryopsis* sp., Fig. 36G, *Callithamnion* sp., Fig. 31C), to whorled (= verticillate, *Caulerpa verticillata*, Fig. 36H). In some taxa, the filaments can be covered by a rhizoidal cortex (*Euptilota fergusonii*, Fig. 36J). Sometimes the filamentous species are composed of unicellular, siphonal, coenocytic structures (*Bryopsis* spp., Fig. 36G). More rarely, filamentous thalli are composed of a few cell rows (some elegant, tubular *Ulva* species, Fig. 36I, *Polysiphonia* sp., …).

Blade-like species can be very thin, membranous and supple (*Porphyra* spp., Fig. 37A and some Delesseriaceae: a single cell layer , Fig. 37D, *Ulva* spp.: 2 cell layers, Fig. 37B, *Padina*: 3 to several cell layers depending on the species, Fig. 37C). Others are somewhat thicker, becoming fleshy, cartilaginous (*Lobophora variegata*, Fig. 37E, *Euryomma platycarpa*, Fig. 37F), composed of an inner medulla and an outer cortex, gelatinous or spongy in texture. Some are entire (some *Porphyra* spp.), others lobed (*Nitophyllum marginale*, *Euryomma platycarpa, Peyssonnelia* spp., Fig. 37G) or branched and being composed of compressed to flattened axes (*Ulva fasciata*, Fig. 38A; *Polyopes ligulatus*, Fig. 38B, *Halymenia durvillei*, Fig. 38C; *Dictyota* spp., Fig. 38D; *Stoechospermum polypodioides*, Fig. 38E, *Gracilaria* spp., Fig. 38F). Their branching type can be as diversified as in the filamentous type. The flattened axes can also anastomose and form a two-dimensional reticulum (*Claudea multifida*, Fig. 39A; *Martensia fragilis*, Fig. 39B). Some blades are somewhat (*Ulva pertusa*) or (locally) profusely perforated (*Ulva reticulata*, Fig. 39C). They can be smooth or show smaller or larger surface proliferations (*Halymenia durvillei*, Fig. 39D). The fronds may have a marked, thickened central portion (= midrib) as in the genus *Dictyopteris* (Fig. 39E).

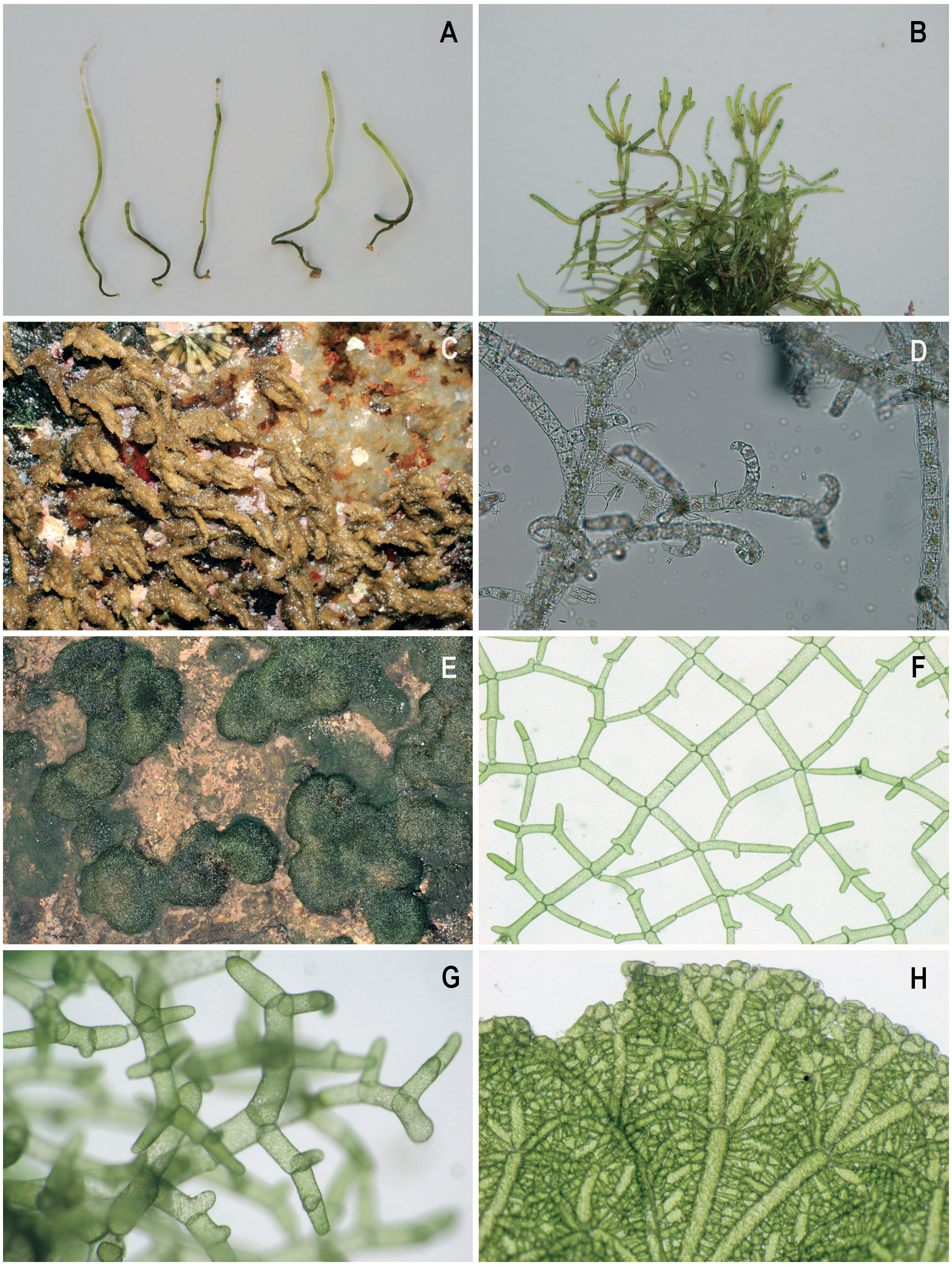

Fig. 35. Seaweed morphology: filaments. A. Unbranched filaments in *Chaetomorpha spiralis*; B. Branched filaments in *Valoniopsis pachynema*; C. 'Rope-like structures' in *Asteronema breviarticulata* as a result of the longitudinal intertwining of filaments and mutual attachment by hook-like branchlets; D. Detail of the hook-like branchlets in *Asteronema breviarticulata*; E. Stiff, intertwined, branched filaments creeping over the substratum, resulting in crispy, spongy cushion-like structures (*Valoniopsis pachynema*); F. Branches anastomosing and forming a reticulum in a single plane (*Boodlea montagnei*); G. Branches anastomosing and forming a three-dimensional reticulum (*Boodlea composita*); H. Branches anastomosing and forming blades (*Anadyomene*).

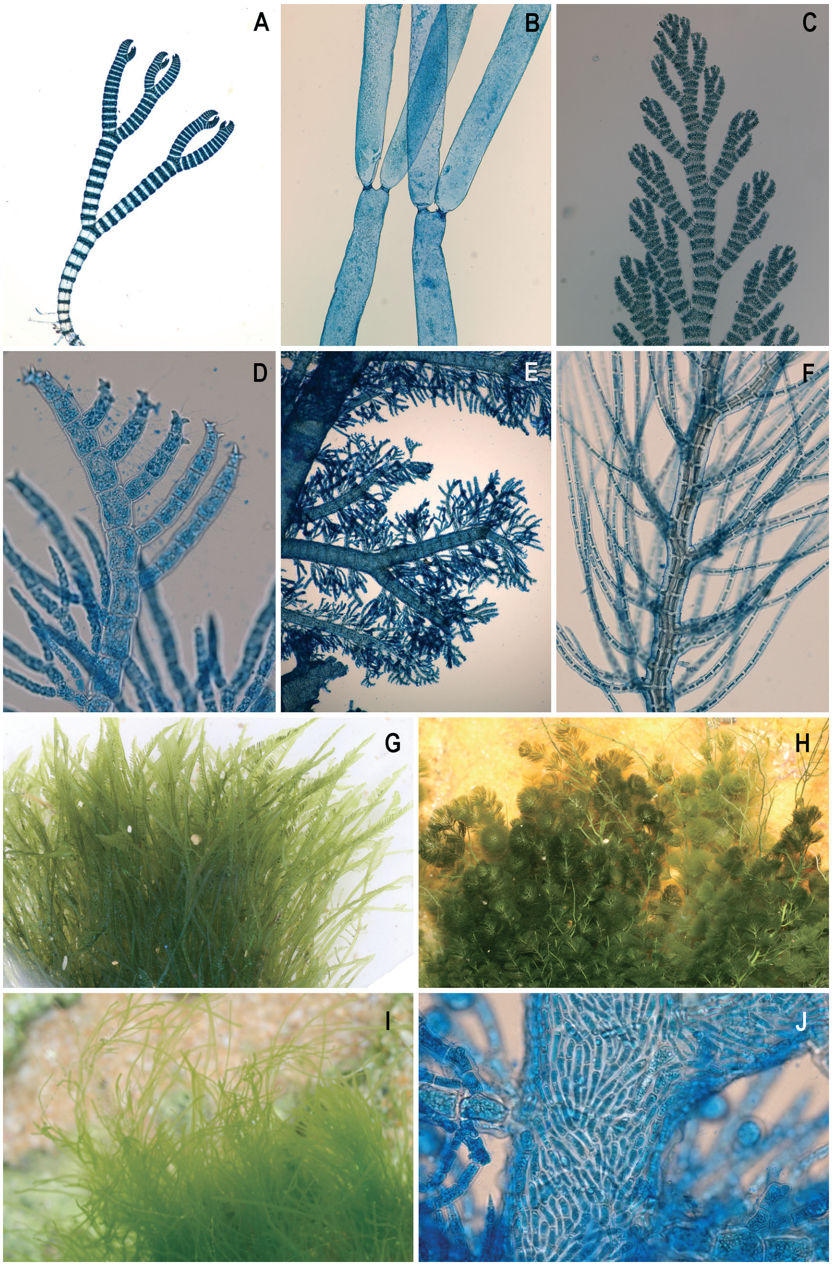

Fig. 36. Seaweed morphology: branching pattern; cortication. A. Dichotomous branching in *Ceramium* sp.; B. Dichotomous branching of the coenocytic filaments of *Chlorodesmis*; C. Sympodial branching in *Ceramium* sp.; D. Unilateral branching in terminal branches of *Euptilota fergusonii*; E. Alternate branching in subterminal branches of *Euptilota fergusonii*; F. Spiralized branching in *Murrayella periclados*; G. *Bryopsis* sp.: thallus composed of coenocytic, unicellular, pinnately branched structures; H. Whorled (verticillate) branching in *Caulerpa verticillata*; I. Irregularly branching tubular *Ulva*: branches composed of a few cell rows surrounding a central cavity; J. In some taxa (*Euptilota fergusonii*) the main axes can be covered by a rhizoidal cortex.

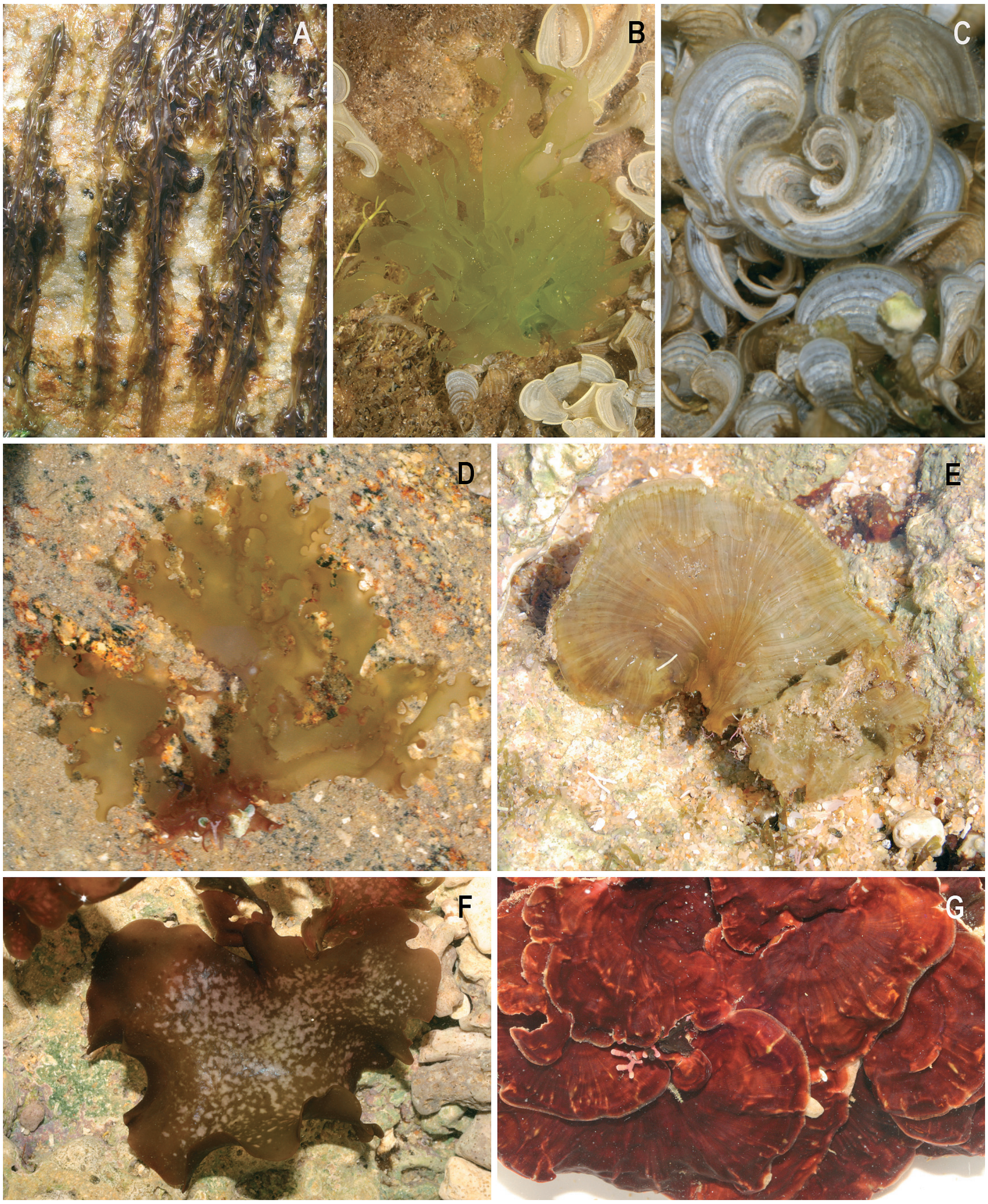

Fig. 37. Seaweed morphology: blades. A, B. Blade-like species can be very thin and membranous, a single cell-layer thick: A. *Porphyra*; B. A blade-like *Ulva*, two cell layers thick, surrounded by blades of *Padina*, 3 to 4 cell layers thick; C. Funnel-shaped blades of *Padina*, 3 to 4 cell layers thick; D. *Nitophyllum marginatum*; E, F. Cartilaginous blades are composed of an internal medulla and an outer cortex: E. *Lobophora variegata*; F. *Euryomma platycarpa* with spotted blades; G. Lobed blades of *Peyssonnelia*.

Fig. 38. Seaweed morphology: strap-like blades. A. *Ulva fasciata*; B. *Polyopes ligulatus*; C. *Halymenia durvillei*; D. *Dictyota ceylanica*; E. *Stoechospermum polypodioides*; F. *Gracilaria* sp.

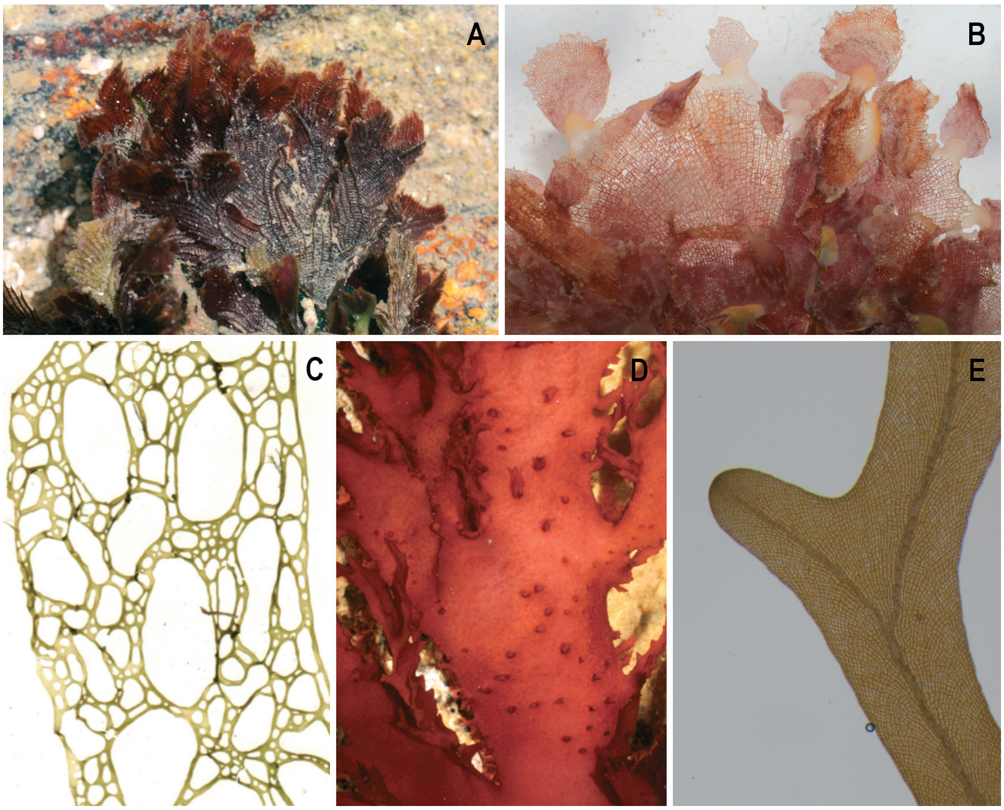

Fig. 39. Seaweed morphology: anastomosing blades; perforations; proliferations; midvein. A, B. The straps can anastomose and form a two-dimensional reticulum (A: *Claudea multifida*, B: *Martensia fragilis*); C. The blades can be (regularly) perforated (*Ulva reticulata*); D. The blades can present surface proliferations (*Halymenia durvillei*); E. Strap-like thallus with midvein (*Dictyopteris delicatula*).

Some seaweeds look like brains (cerebriform): *Colpomenia sinuosa*, Fig. 40A; *Dictyosphaeria cavernosa* (young specimens, Fig. 40B), *Hydroclathrus clathratus* (which is profusely perforated). Others again are composed by large, inflated cells (*Boergesenia forbesii*, Fig. 68; *Valonia* spp., Fig. 40C) or are crustose (like crusts) (*Ralfsia*, Fig. 40D; crustose reds, Figs 40E-G).

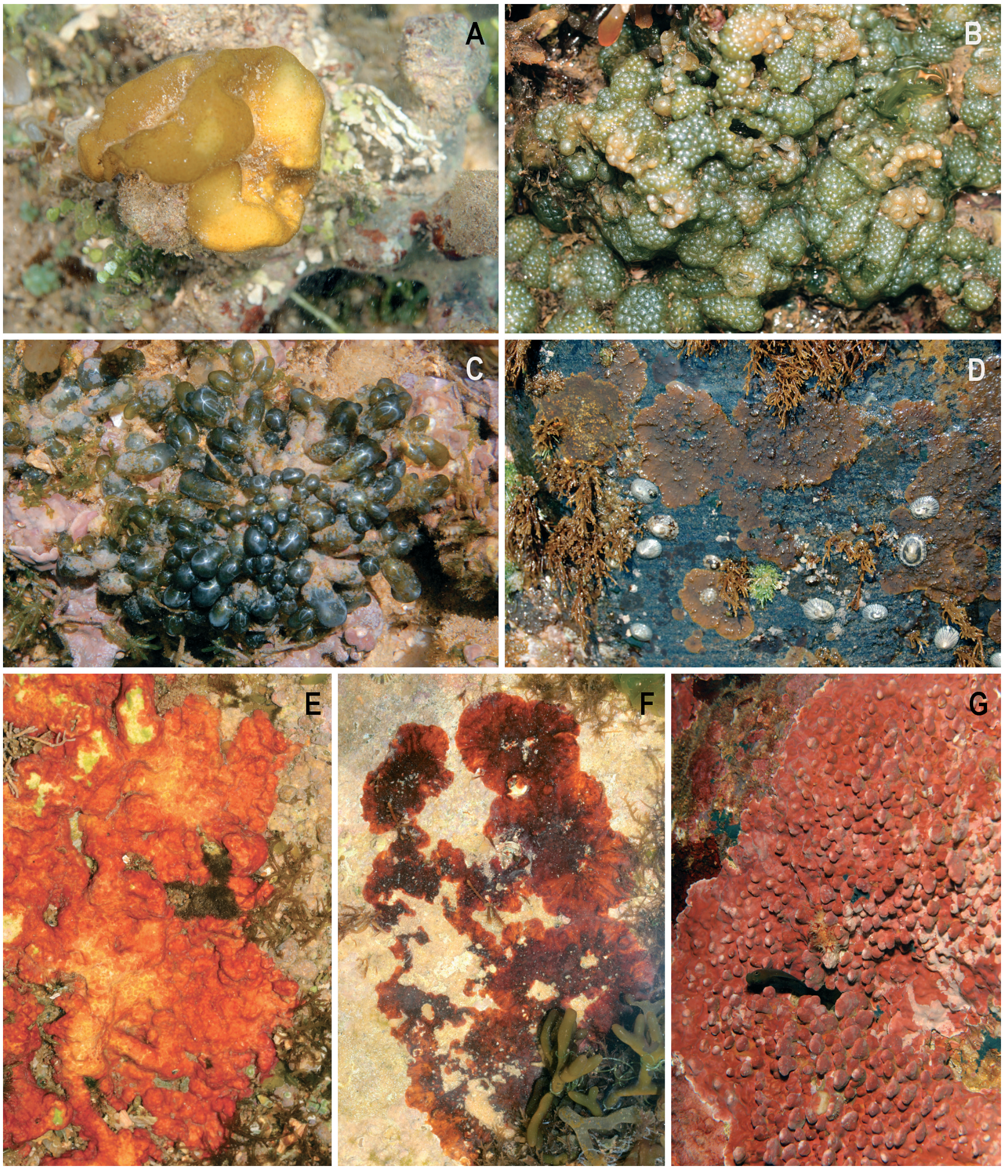

Fig. 40. Seaweed morphology: inflated and crustose. A. Some seaweeds look like brains (cerebriform): *Colpomenia sinuosa*; B. Cerebriform thalli of young *Dictyosphaeria cavernosa*; C. Thalli composed of large inflated cells: *Valonia utricularis*; D-G. Crustose algae: D. *Ralfsia ceylanica* (between *Chnoospora minima*); E-G. Crustose red algae.