Abc Taxa

Sri Lankan Seaweeds
Methodologies and field guide to the dominant species

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Frederik Leliaert
Olivier Dargent
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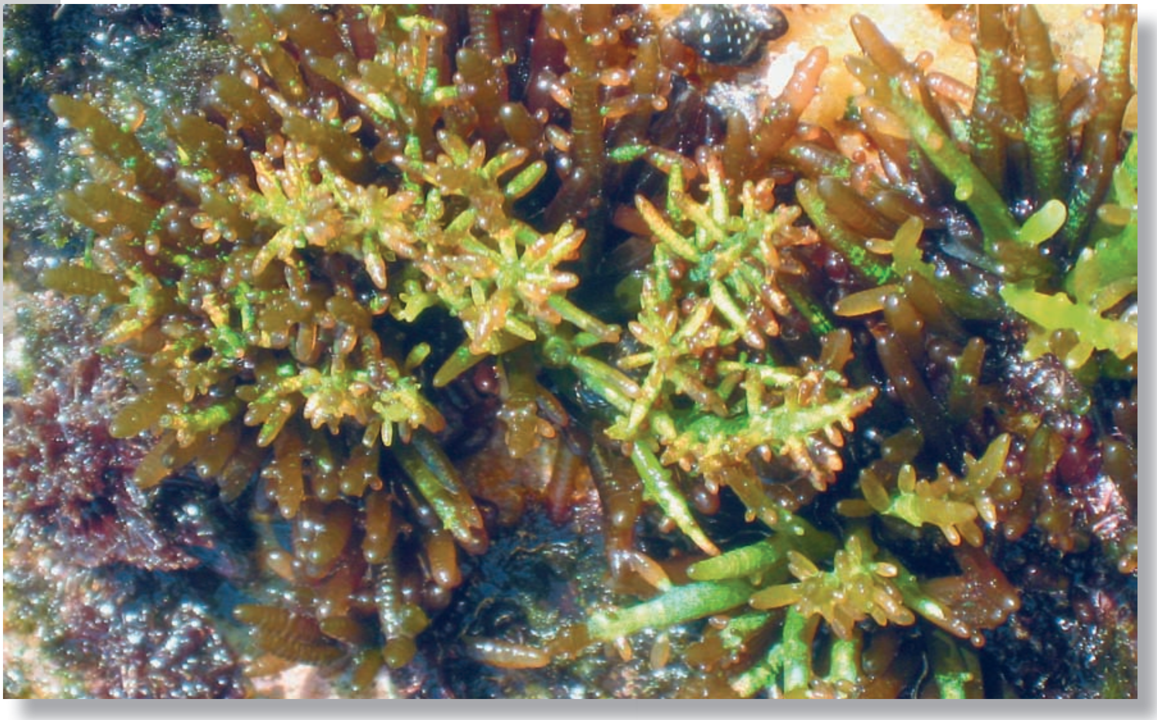

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in Taxonomy and
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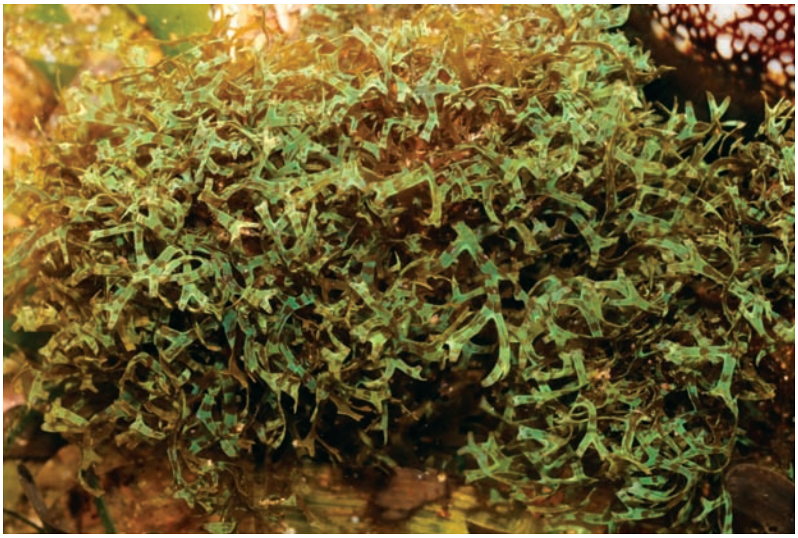

by

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Cover illustration: Iridescent *Champia ceylanica*. This page, *Dictyota ceylanica* with banded iridescence.

Preface

The 2008 Olympic Games held in China had been prepared with an unprecedented sense to perfection. However, a couple of months before the start, marine algae belonging to the genus *Ulva*, were at the point to obstruct the games' sailing events.

A gigantic bloom that struck Qingdao bay in late June marked its presence. Some 130,000 people and more than 1,000 boats were mobilised to clear an astounding 13,000 km^2 slick of algae. At the end, more than one million tons of sea lettuce was removed and buried.

Such an algal bloom can happen anywhere and anytime if the conditions are right: excess of nutrients (particularly phosphorus ran-off from fertilised agricultural land), warm coastal water, and plenty of sunlight. Some algal blooms can be very harmful when excreted toxins contaminate the water. In such cases, mussels and other edible bivalves turn detrimental induced by their filtering mode of life.

Algae have an important and direct impact on our daily life for many reasons. In Asian countries, they form a direct food source for millions of people. In western societies, cell wall extracts, better known as carrageenans, agar and alginates, are widely used in cosmometics, food and pharmaceutical industries, where they are used as emulgators, stabilisers and gelling agents.

Professor Eric Coppejans of Ghent University has studied marine algae for more than 40 years. His collecting trips encompass virtually all seas, with a special focus on the Indian and West Pacific ocean. Eric Coppejans is not only a renowned scholar; he also has that invaluable quality to disseminate his state of the art knowledge with zeal towards fellow scientists and students, especially those from developing countries.

All authors combine a thorough knowledge of the field with an exquisite taxonomic experience including molecular systematics. It thus comes as no surprise that one of them, Dr Frederik Leliaert, was key to the identification of the Qingdao bay algae. As for the algal reference collections of Ghent University, they are so rich in taxa and so well managed that they act as a world-class showcase towards the value of a taxonomic collection.

Abc Taxa offers an excellent opportunity to present the authors summary of field and laboratory techniques for the study of seaweeds, complemented with a detailed taxonomic overview of the dominant marine algal species living along Sri Lanka's 1,600 km coastline.

This sixth volume of *Abc Taxa* offers students and researchers a practical and comprehensive guide to a diversity rich group of marine organisms of utmost importance as primary producers and biological indicators, but often neglected due to lack of accessible and pertinent literature. The numerous excellent illustrations, mainly by Olivier Dargent, make this volume attractive even to the layman.

Dr Jackie L. Van Goethem

Honorary Head of Department at RBINS

ප්‍රස්තාවනාව

වර්ෂ 2008 දී චීනයේ පැවති ඔලිම්පික් තරඟ පෙර විරු නොවූ උත්කර්ශවත් අන්දමින් පැවැත්වීමට කටයුතු සූදානම් කරන ලදී. කෙසේ නමුදු එම උළෙල ආරම්භ කිරීමට මාස දෙකකට පමණ ප්‍රථම උල්වා ඝනයට අයත් කරදිය ඇල්ගාවක් ඔරු පැදීමේ තරඟ ඉසව්වලට බාධා කරන තත්ත්වයට පත්විණ.

තරඟ පැවැත්වීමට නියමිතව පැවති කුයින්ඩාඕ බොක්ක අවහිර වන පරිදි මෙම ඇල්ගාව අති විශාල ලෙස වර්ධනය වීම ඊට හේතුවයි. වගී කිලෝමීටර් 13000 ක වපසරියක් ගත් මෙම විශ්මය ජනක ඇල්ගාව ඉවත් කිරීමට මිනිසුන් 130000 ක් හා බෝට්ටු 1000 ක් යෙදවීමට සිදුවිය. අවසානයේදී ඇල්ගේ ටොන් මිලියනයකට වඩා ඉවත් කොට වලලා දමන ලදී.

අතිරික්ත පෝෂ්‍ය ද්‍රව්‍ය (විශේෂයෙන්ම පොහොර යෙදු වගාබිම්වලින් සේදී එන පොස්පරස්), වෙරළාසන්න උණුසුම් ජලය, සහ ඕනෑතරම් හිරු එළිය, ඇතුළු අවශ්‍ය තත්ත්වයන් නිසි පරිදි ඇතිවිට මෙබඳු ඇල්ගී අධිවර්ධනයන් ඕනෑ තැනක ඕනෑම කාලයක ඇතිවිය හැක. ජලයට විෂ ද්‍රව්‍ය මුදා හරින ඇතැම් ඇල්ගීවල මෙබඳු අධිවර්ධනයන් ඉතා හානිකර වීමට පුළුවන. එබඳු අවස්ථාවල බෙල්ලන් සහ ආහාරයට ගතහැකි වෙනත් ද්වි කපාටිකයින් ඔවුන්ගේ පෙරා බුදින චර්යාව හේතුකොට ගෙන ආහාරටය නුසුදුසු හානිකර තත්ත්වයට පත්වේ.

කරුණු රාශියක් හේතුකොටගෙන ඇල්ගී අපගේ දෛනික ජීවිතයට වැදගත්වන සෘජු බලපෑම් ඇති කරයි. ආසියාතික රටවල මිලියන සංඛ්‍යාත ජනතාවකට එය සෘජු ආහාර ප්‍රභවයක් වේ. බටහිර සමාජය කැරජිනේස්, ඒගාර්, හා ඇල්ජිනේට්, ආදී වශයෙන් දන්නා සෛල බිත්ති නිස්සාරකයන් ඇල්ගීවලින් ලබාගෙන බහුල වශයෙන්ම සුවඳ විලවුන්, ආහාර, සහ ඖෂධ කර්මාන්තයන්හිදී තෛලෝදකරණය, ස්ථිරකරණය හා ජෙල තැනීම ආදී අරමුණු සඳහා යොදා ගනී.

ගෙන්ට් විශ්වවිද්‍යාලයේ මහාචාර්ය එරික් කොපජෙන්ස් වසර 40කට වඩා වැඩි කාලයක් ඇල්ගී සම්බන්ධව අධ්‍යයන කටයුතු සිදු කොට ඇත. ඔහු ඉන්දියානු හා බටහිර පැසිපික් සාගර කෙරෙහි විශේෂ අවධානයක් සහිතව සත්‍ය වශයෙන් ලෝකයේ සියළුම සාගරවල ඇල්ගී නිදර්ශක එකතු කිරීමේ චාරිකාවල නියැලී ඇත. මහාචාර්ය එරික් කොපජෙන්ස් හුදෙක් කීර්තිධර විද්‍යාර්ථයෙකු පමණක් නොව තම සුවිශේෂී දැනුම විශේෂයෙන්ම සංවර්ධනය වන රටවල සමකාලීන විද්‍යාඥයින් හා ශිෂ්‍යයින් අතර බෙදා හැරීමේ අමිල ගුණයෙන් ද යුක්ත මහත්මයෙකි.

මෙම ග්‍රන්ථයෙහි සියළුම කතුවරයන් අණුක වර්ගීකරණය ඇතුළු වර්ගීකරණයන්හි අත් දැකීම් සහිතව මෙම ක්ෂේත්‍රයේ හසල දැනුමක් ඇති විශ්ෂ්ටයෝ වෙති. එය පුදුමයට කරුණක් නොවන්නේ චීනයේ කුයින්ඩාඕ බොක්කෙහි ඇල්ගාව හඳුනාගත් ආචාර්ය ෆෙඩ්රික් ලෙලියට්ද ඔවුන් අතරෙන් එක් අයෙකු වීම නිසාය. ගෙන්ට් විශ්ව විද්‍යාලය සතු ඇල්ගී තක්සෝන රාශියකින් පොහොසත් මනාව පවත්වාගෙන යන නිදර්ශක එකතුව ලොව විශ්ෂ්ට වටිනාකමකින් යුතු ඇල්ගී වර්ගීකරණ එකතුවක් ලෙස සැලකිය හැක.

ශ්‍රී ලංකාව වටා වර්ග කිලෝමීටර් 1600 ක් වූ සමුද්‍ර තීරයේ පවතින ඇල්ගී විශේෂවල වර්ගීකරණය සම්බන්ධව දල විශ්ලේෂණයක් ක්ෂේත්‍රයේදී හා පරීක්ෂණාගාරයේදී ඒවා අධ්‍යයනය කරන ආකාරය සම්බන්ධ කරුණු සාරාංශ ගත කොට ඉදිරිපත් කිරීමට ලැබීම ඒබීසී ටැක්සා (*Abc Taxa*) ලද අනර්ඝ අවස්ථාවක් ලෙස සලකනු ලබයි.

ශ්‍රී ලංකාවේ කිලෝමීටර් 1600 ක දිගින් යුත් වෙරළ තීරයේ ප්‍රමුඛ ඇල්ගී විශේෂවල සාගරවල විස්තරාත්මක තක්සෝන විද්‍යාත්මක විවරණයකින් ද සම්පූර්ණ වූ මුහුදු ඇල්ගී අධ්‍යනයට යොදා ගනු ලබන ක්ෂේත්‍ර හා විද්‍යාගාර තාක්ෂණයන් පිළිබඳව සාරාංශයක් ඉදිරිපත් කිරීමට ඒබීසී ටැක්සා (*Abc Taxa*) මගින් කතුවරයන්ට මහඟු අවස්ථාවක් ලබාදී ඇත .

ඒබීසී ටැක්සා හි මෙම හයවන වෙළුම පර්යේෂකයන් හා ශිෂ්‍යයින් හට ජෛව නිදර්ශක හා ප්‍රාථමික නිෂ්පාදකයින් ලෙස පරම වැදගත්කමක් සහිත කරදිය ජීව කාණ්ඩයක් පිළිබඳව සවිස්තරාත්මක මග පෙන්වීමක් කරනු ලබයි. ප්‍රධාන වශයෙන් Olivier Dargent විසින් ඉදිරිපත් කර ඇති අනර්ඝ ඡායාරූප හා රූප සටහන් විශාල සංඛ්‍යාවකින් ද සමන්විත මෙම වෙළුම ආධුනිකයන්ට පවා ආකර්ශනීය වනු ඇත .

ආචාර්ය ජැකී එල් වැන් ගොතම්,
RBINS හි සම්මාන අංශ ප්‍රධාන

முகவுரை :-

2008 ம் ஆண்டு சீனாவில் நடைபெற்ற ஒலிம்பிக் போட்டு எப்போதாவது ஏற்பாடு செய்யாதவாறு மிக ஒபர்வான மட்டத்தில் நடைபெற்றது. எனினும் போட்டி சடைபெற இரு மாதங்களுக்கு முன்னர் உல்வா வர்க்கத்துக்குறிய கடற்பாசி, படகுப் போட்டி நிகழ்ச்சிக்கு இடையூராகிவிட்டது.

போட்டி நிகழ்ச்சி நடைபெற நியமிக்கப்பட்ட குயின்டாஒ பொக்கையில் கடற்பாசி அடர்த்தியாய் கடர்ங்குந்தமை இத்தடைக்கு காரணமாயிற்று 13,000 கி மி^{2} அடர்ந்த இப்பாசிற் தட்டை அகந்ந 130000 பேர்களையும்1000 படகுகளையும் ஈடுபடுத்தலாயின. எற்றில் ஒரு தொன் மிலியனுக்கும் அதிகளவு பாசி நீக்கப்பட்டு புதைக்கப்பட்டன.

மிகுந்த போஷாக்குகள் (குறிப்பாக உரமிடப்பட்ட விதைநிலங்கள் குழுவுண்டு வரும் பொசுபரஸ்) கரையோர வெப்பநீர், அதிக சூரிய ஒளி ஆகியன போதியளவு பெறப்படும் போது இவ்வாறான பாசிகள் படர்ந்து வளரும். சிலவகை கடற்பாசி நச்சுத் திரவத்தை வெளியிடும் போது அது நீரில் கலந்து பல ஆபத்துக்களை வினைவிக்கும். இவ்வேளைகளில் சிப்பிகள் உற்கொள்ளக்கூடிய இருகவாடங்களுடையன வடித்து உண்ணும் முறையினால் உண்ணும் போது தீய விளைவுகள் ஏற்படும்.

பல காரணங்களை முன்னிட்டு கடற்பாசி எம் அன்றாட வாழ்வில் நேரடியான தாக்கங்களை உண்டாக்கும். ஆசியான் கண்டத்தைச் சார்ந்த நாட்டு பல்லாயிரக் கணக்கான மக்களுக்கு அது உணவு உற்பத்தி ஸ்தானமாகிறது. மேற்கதிய நாட்டவர்கள் கரஜீனன்ஸ், ஏகார், ஆல்ஜினேட்ஸ் போன்ற மருந்து தொழிற்சாலைகளில் அவற்றை திரவமாக்கல், ஸ்திரப்படுத்தல் போன்றவிற்றுக்குப் ரிரயோகிப்பர்.

கென்ட பல்கலைக்கலகப் பேராசிரியர் எரிக் கொபர்ஜீன்ஸ் 40 வருடங்களுக்கும் அதிகமாக கடற்பாசி கம்பந்தமாக ஆராய்ந்துள்ளார். அவர் எல்லாக் கடல்களிலும், இந்து, பசுபிக் சமுத்திரங்களில் விஷேடகவனத்துடன் கடல் பாசி சூழ்வதை ஆராயும் பயனத்தை மேற்கொண்டார். இவர் பிரபல்யம் வாயிந்த ஒரு விஞ்ஞானி மட்டுமல்லாது தனது நுன்னறிவை விஷேடமாக வளர்ச்சியடையும் நாடுகளிலுள்ள சமகால விஞ்ஞானிகளுக்கும் மாணவர்களுக்கும் புகட்டக் கூடிய நற்குணசீளாராகவும் விளங்கிளர்.

இந்நூயின் எல்லா ஆசிரியர்களும் அனுமூலக்கூறுகளை இனங்காணுதல் சம்பந்தமாக நேர்த்தியான அனுபவத்தைப் பெற்றவர்களாவர். சீனாவில் குயின்டாஒ பொக்கை பாசியை கண்டு பிடித்தவர் ஆசிரியர் ப்ரெட்ரிக் லேலியட் என்பவர் என்பதால் இது அதிசயமல்லவே.
கென்ட் பல்பலைக்கலகத்துக்குரிய மிகுந்த கடற்பாசிப் பரிசீலனைத் தொகுப்பு உலக அதி உன்னத இனங்காணல் தொடுப்பாபப் பருதப்படும்.

இவங்கையைச் சூழ வர்க கி. மி. 1600 சமுத்திரஅருகிலுள்ள பாசி வர்க்கத்தை இணங்காணுதல் தொடர்பாக ஆய்வுகூடங்களில் மேற்கொள்ளப்பட்ட ஆய்வுகளின் சாராம்சத்தை முன்வைக்க ஏபீசீ டாக்சா மூலம் ஆசிரியர் குலாமுக்கு பெரும் சந்தர்பம் கிட்டியது.

ஏபீசீ டாக்சாவின் ஆறாம் பகுதி ஆராய்ச்சியாளர்களையும் மாணவர்களைளும் அக்கஜீவி வேற்றுமையின் ஆரம்ப சிட்டிக்காட்டிகளாள, அதன் முக்கி வழிகாட்டியளாக கருதுகின்றது. எனினும், பொருத்தமான போதனைகளின் பற்றாக்குறையும் சிலவேளைகளில் தென்பட்டன. ஒலீவியர் டாகன்ட் மூலம் வெளியிடப்பட்ட உன்னதமான எண்ணற்ற விளக்கப்படங்கள் பயிற்றுனருக்கும் பாமாருக்கும் மிக்க கவர்ச்சிகரமானவை.

ஆசிரியர் ஜாகீ எல் வான் கோதமி
RBINS இலாகா தலைவர்

Table of contents

1. Purpose of this book

In the first place, this book is meant to provide a summary of field and laboratory techniques in phycology (the study of algae), and their ecosystems. It also gives a glance to the dominant species of marine algae present along the coast of Sri Lanka. In addition, it should, therefore, be clear that the species described and illustrated here are only part of the marine flora of Sri Lanka, not at all a comprehensive Flora. It is an easy-to-use guide to the identification of the most frequent seaweeds, intended to be used by biologists, students, amateur naturalists, and others interested in the marine life of this island.

The taxonomic part covers the different groups of marine macroalgae (Chlorophyta or green algae, Phaeophyceae or brown algae and Rhodophyta or red algae). Numerous smaller seaweeds (mostly epiphytic ones) and turf algae (low, dense mats of grazed algae) are omitted although they can locally be a very important component of tropical and subtropical marine ecosystems, especially in heavily grazed areas. Encrusting coralline algae are not included as they are not well studied in the region and are mostly not easily identified by simple observation and descriptions. The prokaryotic blue-green algae (= Cyanophyta or Cyanobacteria) are not covered either.

Although the Sri Lankan seaweed flora has only been sporadically studied, it seems to be relatively rich, with about 440 taxa, belonging to 148 genera currently recorded along a coastline of 1585 km (Baldwin *ed*., 1991; Silva *et al*., electronic version).
The correct identification of seaweeds mostly requires the study of microscopic structures (see chapter 8.7). Therefore this guide represents a compromise between ease of use and technical detail. The photographs of the macroalgae in their natural environment, sometimes combined with herbarium and/or microscope pictures as well as the relatively detailed descriptions should enable anybody to identify these most frequent seaweeds in the field.

We do hope that this book may lead to an increased interest of local scientists and enhance the study of these beautiful and intriguing marine organisms. Although they generally go unnoticed, they are extremely important as primary producers along the shores as well as providing food, shelter, spawning areas and living biotopes for numerous animals.

2. Sri Lanka

2.1. Introduction (after Wright, 1994; Höfer, 1995; Perera, 2006)

According to the *Mahavamsa*, the modern history of Sri Lanka starts in the fifth century AC, with the arrival of Prince Vijaya together with 700 followers in Mannar. They called the island ‘Thambapanni’ (copper-coloured sand). These Buddhist Simhalese (originally from N India) are the ancestors of the actual Sinhalese majority of the population of the island who replaced the prior inhabitants, the Veddahs. The Greek sailors could not pronounce ‘Thambapanni’ and called the island ‘Taprobane’. The seafarers of old Arabia called her ‘Serendib’, a word that has since evolved into the soothing state of mind known as serendipity (the faculty of making happy and unexpected discoveries by accident). Latter-day adventurers came up with the nickname ‘Pearl of the Orient’. Another romantic, descriptive name for the island is ‘The teardrop of India’. Marco

Polo called it ‘the finest island of its size in the world’. In the 8th and 9th centuries the Moors had achieved a dominant commercial position but remained unobtrusive.

The first permanent Tamil settlements (coming from the Indian mainland) occurred in the 10th century AD, but mostly in the 12th century, without dislodgement of the original Sinhalese population. In the 13th century more violent invasions took place with the help of Tamil and Kerala mercenaries, resulting in the permanent dislodgement of the Sinhalese power from N Sri Lanka and the confiscation of lands and properties. These factors lead to the foundation of a Tamil Kingdom in that part of the island, next to several other Kingdoms, with a deliberate policy of peaceful migration of more Tamils.

The island was later called ‘Ceilao’, a corruption of ‘Sinhala-dvipa’ by the Portuguese, who ruled the coastal provinces during less than 60 years in the early 16th century; they introduced Roman Catholicism. The Dutch drove the last Portuguese from the island in 1658. They called the island ‘Ceylan’ and introduced Dutch Calvinism. In 1796 the British supplanted the Dutch in the coastal areas. They managed to control the Kingdom of Kandy in the Highlands in 1815, becoming the first European power to rule the whole island, now called ‘Ceylon’. They introduced English calvinism. The British were unable to persuade the Sinhalese to work cheaply and willingly on the plantations, so they imported large number of Tamil labourers.

In February 1948 the island celebrated the return to its independence from foreign domination in a smooth and peaceful way. In May 1972 the country’s name was finally changed to ‘Sri Lanka’ (officially the Democratic Socialist Republic of Sri Lanka), meaning ‘Island of Happiness’. Its capital is Sri Jayawardenepura Kotte, the commercial capital being Colombo where the international airport and major marine harbour are situated. The population was about 20 million people in 2005. The languages are Sinhala, Tamil and English, each with their own alphabet. The religions are mostly Buddhist, but also Hindu, Christian and Muslim. The time zone is GMT + 5 ½ hours.

2.2. Location

Sri Lanka is located in the Bay of Bengal, in the northern Indian Ocean (Fig. 1), sharing the same continental shelf as India. The northernmost point of the island is Point Pedro. Talaimannar (at the tip of Mannar peninsula) is only 48 km apart (SE) from Dhanushkodi in India, separated from it by the Palk Strait in which numerous sandbanks and small limestone shoals form ‘Adam’s Bridge’. According to temple records, this natural causeway was formerly complete, but was breached by a violent storm in 1480. The island is situated between 5° 55’ and 9° 50’ N latitude and 79° 42’ and 81° 52’ E longitude. The drop-like island is 435 km long and 225 km at its widest part, totaling a surface of 65 610 km^2 and a coastline of 1585 km. Dambulla, famous for its ancient cave temple, marks the geographical centre of the island. The old harbour town of Dondra represents the island’s southernmost tip. Beyond the lighthouse of Dondra Head there is not a single speck of land before the ice of Antarctica.

2.3. Geography and geology

The northernmost half of Sri Lanka is composed of a huge plain. The central part of the island is dominated by hills and mountains, culminating to 2524 m (Pidurutalagala, close to Nuwara Eliya). In some parts of the south, hills almost reach the coastline.

Fig. 1. General position and map of Sri Lanka with indication of sampling sites (red dots). Modified from map Base 802514 6-00, Library of Congress, Geography and Map Division, Washington, D.C.: Central Intelligence Agency, 2000 (digital id: http://hdl.loc.gov/loc.gmd/g7750.ct001762).

More than 90 percent of Sri Lanka's surface lies on Precambrian strata, some of it dating back 2 billion years. The metamorphic rock surface was created by the transformation of ancient sediments under intense heat and pressure during mountain-building processes. The theory of plate tectonics suggests that these and related rocks forming most of south India were part of a single southern landmass called Gondwanaland. Beginning about 200 million years ago, forces within the earth's mantle began to separate the lands of the Southern Hemisphere, and a crustal plate supporting both India and Sri Lanka moved toward the northeast. About 45 million years ago, the Indian plate collided with the Asian landmass, raising the Himalayas in northern India, and continuing to advance slowly to the present time. Sri Lanka experiences few earthquakes or major volcanic events because it rides on the center of the plate.

Actually, the rock floor of Sri Lanka is composed of gneisses and schists topped with a layer of graphite, crystalline limestone and quartzites. Several places are rich in gems (rubies, sapphire, amethyst, zircons, tourmalines, topaz, …) resulting in numerous gem pits in the middle of paddy fields (e.g. in the Ratnapura area).

The substratum of the sandy beaches (Fig. 2A) and lagoon bottoms can either be fine grained and of geological origin (erosion of rocks, Fig. 2B), coarser coral sand (Fig. 2C) or be composed of large calcified segments of decayed *Halimeda*, a green seaweed, the so-called *Halimeda*-sand (Figs 2D, E). The pore diameter increases relative to the amount of each sand-type, resulting in a different interstitial fauna.

Fig. 2. Sandy beach and soft substrates. A. Sandy beach (Kalutara); B. Colourfull, fine-grained sand of geological origin (Batheegama); C. Coarse coral sand, partly covered with some drift *Halimeda gracilis* plants and *Halimeda* sand (Weligama); D. Pure *Halimeda*-sand (Weligama); E. Seagrasses (*Cymodocea rotundata*) growing in *Halimeda* sand in a lagoon (Weligama).

2.4. The coastline

The major part of the West coast N of Colombo as well as of the E coast is composed of extensive sandy beaches (Fig. 3A), lagoons (Fig. 3D) and estuaries (Figs 3E, F). Along the sandy beaches, interrupted beachrock platforms can be present over long stretches, mostly parallel to the beach and close to low water mark (Fig. 4A). The landward margin of the visible part of these beachrock platforms is frequently covered by a thin layer of sand, evolving in a mostly rather steep beach (Fig. 4B). Some of the beachrock platforms are provided with numerous rock pools (Figs 4C, D). Locally a narrow, shallow lagoon can be present between the platform and the beach (Figs 4E-H). The seaward side of the platforms, generally abruptly ends with small vertical cliffs (0.5-2 m high), split up by crevices (Figs 5A, B). They are exposed to severe surf, forming a habitat with surf-resistant species (Fig. 5C).

Fig. 3. Coast types. A. Sandy beach and a few rock outcrops in the sea (Hambantota); B. A wide bay (Dickwella); C. An enclosed bay (Nilwella); D. Chilaw lagoon; E. An estuary; F. Estuary, sandy beach and small dunes (Hambantota).

Fig. 4. Beachrock platforms. A. Extended beachrock platforms at about low tide level (Chilaw); B. Extended beachrock platforms breaking down, at the foot of a steep beach (Chilaw); C. Intertidal pools on the beachrock platform (Chilaw); D. Intertidal pools on the beachrock platform and lagoon (on the right hand side; Beruwela); E, F. Broken-up beachrock platform and small lagoon (next to Dickwella Resort peninsula); G. Beachrock platform and narrow lagoon (Koggala); H. Beachrock platform and broad lagoon (Beruwela).

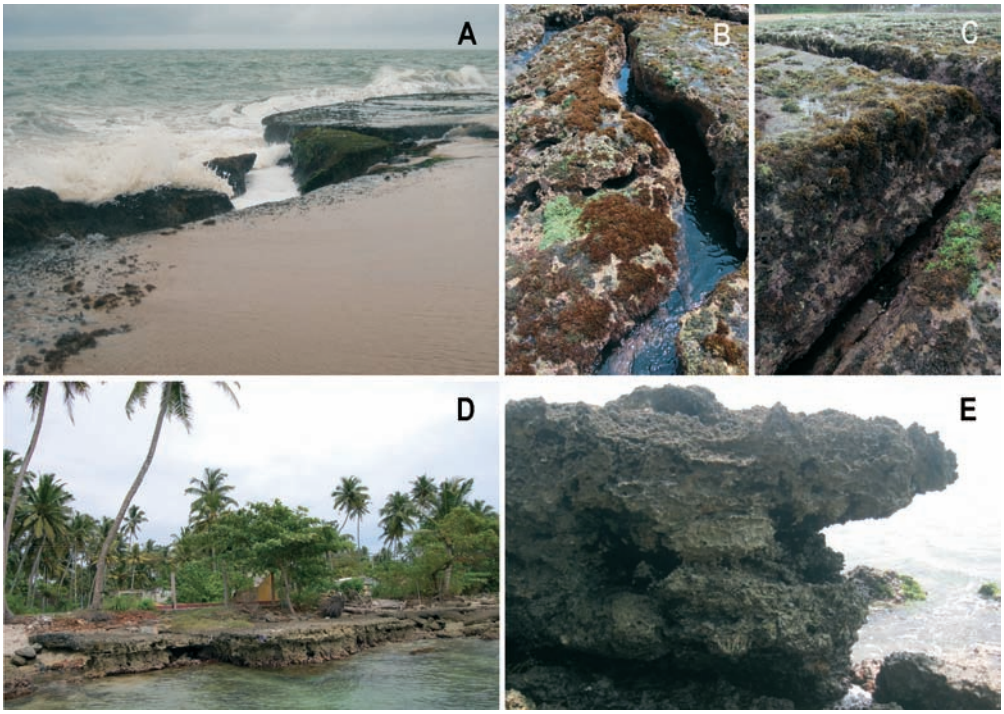


Fig. 5. Coast types. A-C. Broken-up beachrock platform with vertical walls covered by a typical surf-resistant seaweed vegetation (A, B. Chilaw; C. Hikkaduwa); D. Small cliff wall as the result of the erosion of a fossil reef (Polhena Beach, Matara); remark: the effects of the 2004 tsunami are still visible on land; E. Detail of a small eroded cliff wall of a fossil reef (Polhena Beach, Matara).

The southern coastline is characterized by the alternation of rocky coasts (Fig. 6A), rocky peninsulas (Fig. 6B), rock boulder areas (Fig. 6C) and wide or narrow sandy bays (Figs 3B, C; 6D, E). Some coast stretches are composed of small cliffs of eroded fossil coral (Figs 5D, E). A few places (Weligama, Hambantota/Usangoda) are characterized by short but high cliff walls (Figs 6F, G). Coastal dunes are rare, but if present they can be well-developed as in parts of Yala Park (Fig. 6H). Small islands (Figs 7A, B) or protruding rock boulders (Figs 7C, D) are scattered along the coast.

Submarine rock reefs and isolated submerged rocks are present all around the island. Real coral reefs are rather rare (e.g. Bar Reef at Kalpitiya (Fig. 7E), the lagoon reefs of Galle, Weligama, …). The once famous Coral Gardens in Hikkaduwa almost completely died off after the 1998 El Niño. In general, the sublittoral coastline drops gradually.

Fig. 6. Coast types. A. Rocky coast during the SW-monsoon (Dickwella); B. Surf-exposed peninsula (Tangalle); C. Rock boulders with a dense seaweed vegetation and marked zonation (Nilwella); D, E. Rocky peninsulas alternating with sandy bays fringed by beachrock platforms (Tangalle); F. Cliffs at Weligama; G. Cliffs alternating with sandy beaches (Usangoda protected area, Hambantota); H. Dunes alternating with beachrock and intertidal rocks (Yala).

Fig. 7. Coast types. A. Coastal islands (Beruwela); B, D. Large rocky outcrops in the sea and coastal beachrock platform (B. Koggala; D. Beruwela); C. Coastal island in Weligama Bay; E. Healthy coral reef close to Kalpitiya (Bar Reef).

2.5. Climate and seasons

Sri Lanka's climate is tropical. In the north-western parts of the island, there are some extremely hot areas, where temperatures occasionally climb above 38°C. Frost can occur on the highest mountain peaks, and snow has only rarely been observed. The coastal areas are subject to an almost continuous seabreeze, limiting the temperature to 30°C in daytime most of the year (up to 33°C in April) and 27°C at night (with a rare 22°C occurring occasionally). At Kandy (altitude 450 m) mean temperature drops to 20°C, whereas Nuwara Eliya (altitude 1890 m) can be as cool as 16°C. The 'seasons' are defined by the monsoons. They are seasonal winds that carry rain with them. These 'trade winds' were already used by the Greeks (1st century A.D.) for sailing.

The SW-monsoon brings heavy and prolonged rains from the Indian Ocean along the SW-coast between mid (to late) May and September. It enters the island in an area between Chilaw (N of Colombo) and Hambantota (in the south). The clouds hit the central highlands where they cause huge rains (locally up to 5000 mm per year) resulting in turbid coastal water (Figs 8A, 7B). On the other side of the mountain crest there is a rainshadow resulting in a dry season along the East coast. The second season (the Convectional Cyclonic Period or intermonsoonal months) occurs in October and November. Even then, sudden afternoon showers and thunderstorms can be abundant (Figs 8B, C), resulting in inundations, landslides and more turbid coastal water. Inversely, the NE-monsoon brings agriculturally significant rainfall from the Bay of Bengal to the northern and eastern parts of the country between December and March. The West coast is mostly dry in that period, but even then, late afternoon or night showers can periodically be frequent. During the convectional convergence period (mid April to late May) the island comes under the influence of the Inter Tropical Convergence zone. This is a constant daily weather sequence with bright clear mornings that induce convectional activities leading to the formation of rain clouds by early afternoon and thunderstorms in the late afternoon. The pre-monsoonal period (mid April to late May) has transitional weather patterns. During this time Convectional weather is gradually suppressed by the surges of the South West monsoon.

The coastal region East of Hambantota is much drier, resulting in a different, 'savanna-like' coastal vegetation.

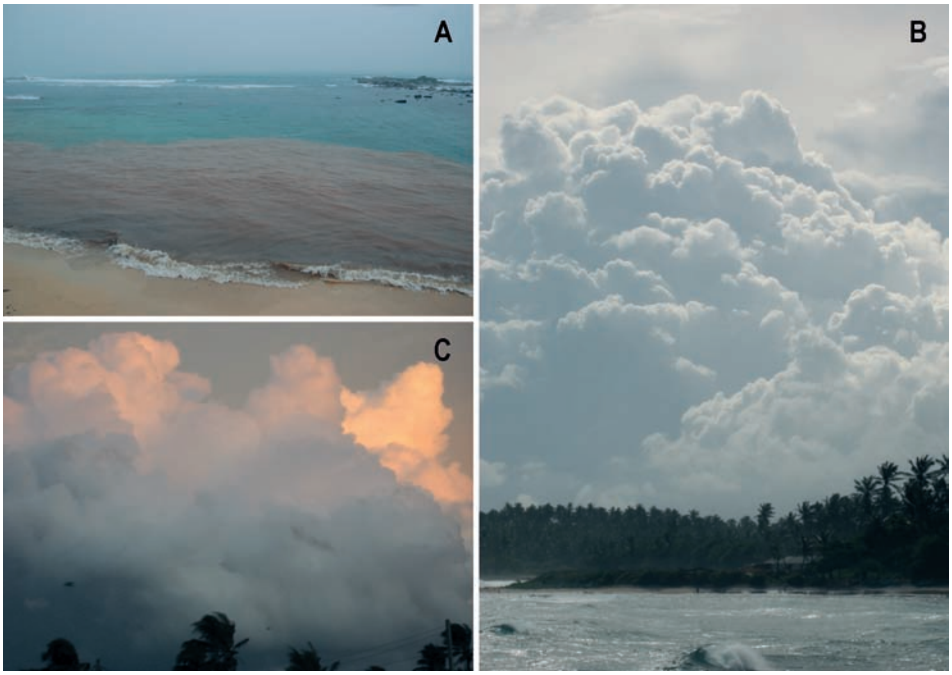


Fig. 8. Thunderstorms and effect on coastal water turbidity. A. Turbid coastal water after heavy rains (Unawatuna); B, C. Late afternoon thunderstorms arriving during the SW-monsoon (Dickwella).

2.6. Currents, seawater temperature, salinity, tides and wave action

Indian Ocean surface currents are mainly controlled by the monsoon. Two large circular currents, one in the northern hemisphere flowing clockwise and one south of the equator moving anticlockwise, constitute the dominant flow pattern. During the winter monsoon, however, currents in the north are reversed.

Satellite images show that the average seawater surface temperature around Sri Lanka is between 26 and 28°C, being somewhat higher along the northern coast. It has been shown that individual seaweed species distributions over a biogeographic scale are overwhelmingly limited by seawater temperature regimes. Several tropical species are present in the Jaffna area but have not been observed south of Kalpitiya.

The maximum tidal range for the Sri Lankan coast is about 70 cm (Dayananda, 1992). There are two tidal cycles per day.

Along the southwest coast, both the swell and the waves are highest between May and September, this is during the SW-monsoon. The direction of the swell is very constant all over the year, approaching from the south, being 2.5 to 3.0 m high and with a frequence of about 16 seconds. The direction of the short waves is strongly influenced by the monsoons. During the SW-monsoon they vary from SW to W. Their height increases from April onward, reaching a peak in June-August and decreasing again to November (Scheffer *et al*., 1994).

Best underwater visibility is from March to April.

2.7. Biodiversity – General

As a result of the early edicts of the country's Buddhist leaders, Sri Lanka can boast the world's first wildlife sanctuary, created by King Devanampiya Tissa in the 3rd century BC. Up to the colonial period large areas were put aside as Forbidden Forests: wilderness areas and watersheds. Deforestation started with the onset of the colonial era when the rulers were more bent on exploiting rather than conserving the natural resources. Under British rule large surfaces were cleared for their coffee, tea and rubber plantations and the slaughter of 'big game'. Also in the post-colonial era, the rate of deforestation remained alarming with the total forest cover being reduced to 50% over the last 4 decennia.

Nevertheless, biodiversity in Sri Lanka is still very high, as a result of an impressive habitat diversity caused by differences in temperature and rainfall according to altitude. Most groups of organisms include a large number of endemics. The vegetation supports over 3368 species of flowering plants (of which 26 per cent are endemic) and 314 species of ferns and fern allies (of which 57 species are endemic). Similarly, the country supports a high faunal diversity due to the varied climatic and topographic conditions prevailing in the island.

Within the territorial waters of the country, there are 38 species of marine mammals, including the sperm whale, the blue whale and a rare species of dugong. When compared to the extent of its shoreline Sri Lanka has limited true coral reefs. It is estimated that only 2% of the coastline has fringing coral reefs. There are widespread areas of patch reefs, but the extent of these has not been determined in detail. Most fringing reefs are found on the South-western, southern (e.g. Hikkaduwa, Unawatuna, Weligama) and eastern coasts (e.g. Pigeon Islands, Trincomalee). Well-developed offshore coral reefs occur in the Gulf of Mannar and west of the Kalpitiya Peninsula (Bar Reef). Coral reefs around the Jaffna Peninsula are less well developed, and occur mainly around the coastal islands. At present, only two coral reef areas have been afforded legal protection as Marine Protected Areas (MPA's) in Sri Lanka, namely the Hikkaduwa National Park in the south and Bar Reef Marine Sanctuary in the north west of the country. In addition, the area around the Great Basses and Little Basses reefs has been designated a Fisheries Protected Area. The coral reefs include 193 species of coral, over 300 species of fish and over 200 species of crabs. Five out of the eight existing marine turtle species (worldwide) regularly visit the sandy beaches of Sri Lanka to nest.

3. Main communities containing seaweeds

Seaweeds occur in three major marine communities: seaweed vegetations s.s., seagrass beds and mangrove forests.

Seaweed vegetations sensu stricto. They are best developed on rocky substratum; most benthic marine macroalgae are thus epilithic. Here they occur in the intertidal zone as well as above (in the spray zone) and under it (in the subtidal, on submerged reefs and rock boulders). Their development depends on the season and the surf (see chapters 4 and 5). Monospecific vegetations can occur, e.g. *Ulva fasciata* (Fig. 9A), *Sargassum* sp. (Fig. 9B), *Gracilaria corticata* (Fig. 9C), *Chaetomorpha antennina* (Fig. 9D) or *Dermonema virens* (Fig. 9E), but mostly tufts of different species are mixed or contiguous (Figs 10A-C), or different genera/species can really be intricated (Figs 10D-F). Mid and low intertidal rock pools generally contain a rich, continuously submerged seaweed flora which is different from the air-exposed substratum at low tide. High intertidal pools warm up too much and mostly contain coloured water (blooms of specific phytoplankters) with an elevated salinity (as a result of evaporation).

Fig. 9. Monospecific vegetations. A. Monospecific vegetation of *Ulva fasciata* (Dickwella); B. Monospecific vegetation of *Sargassum* sp. (Beruwela); C. Monospecific vegetation of *Gracilaria corticata* (Chilaw); D. Monospecific vegetation of *Chaetomorpha antennina* (Unawatuna); E. Monospecific vegetation of *Dermonema virens* (Nilwella).

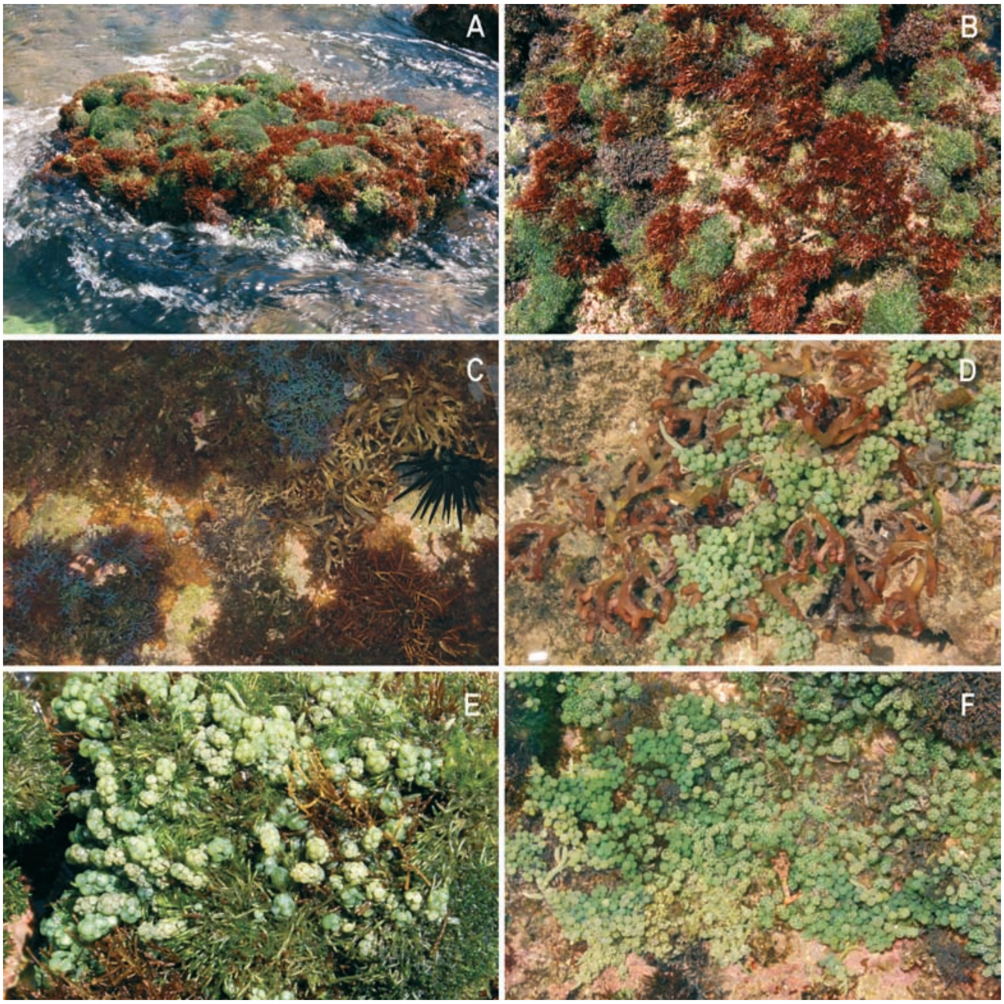


Fig. 10. Mixed vegetations and intricated seaweeds. A. Mixed vegetation of contiguous tufts of *Valoniopsis pachynema* (green bumps) and *Pterocladiella caerulescens* (Hikkaduwa); B. Detail of a mixed vegetation of *Valoniopsis pachynema*, *Pterocladiella caerulescens*, *Hypnea pannosa*, *Gracilaria corticata* and *Gelidiella acerosa* (Hikkaduwa); C. Detail of a mixed vegetation of *Hypnea pannosa*, *Polyopes ligulatus*, *Gelidiella acerosa, Laurencia* sp., *Laurencia natalensis* and others (Hikkaduwa); D. The green alga *Caulerpa racemosa* intricated to the red alga *Gracilaria crassa*; E. Intricated seaweeds: *Valoniopsis pachynema*, *Caulerpa imbricata*, *Gelidiella acerosa*, *Pterocladiella caerulescens*, *Ulva* sp.; F. Intricated seaweeds: *Caulerpa racemosa*, *C. imbricata*, *Chondria armata*, *Hypnea pannosa*.

In sheltered areas with sandy substratum, seaweed growth is limited due to erosion by shifting sands, but some seaweed genera can grow in this subtidal habitat (*Ulva*, *Padina*, *Acanthophora*, *Hypnea*, *Centroceras*, …), being attached to shell or coral fragments.

Fig. 11. Epiphytism. A. *Asteronema breviarticulata* forming epiphytic tufts on *Chnoospora minima*; B. Crustose Corallinaceae epiphytic on *Sargassum*; C. *Ceramium* cf. *taylori* epiphytic on *Caulerpa peltata* var.; D. *Laurencia* sp. epiphytic on *Sargassum*.

Many small algae (e.g. *Ceramium* spp., *Laurencia* spp., crustose Corallines) grow as epiphytes on different other seaweeds (Figs 11A-D).

Fig. 12. Seagrass meadows and associated seaweeds. A, B. Seagrass meadows becoming air-exposed at extreme low water (Nilwella); C. *Halimeda gracilis* growing between the submerged seagrasses in the lagoon (Weligama); D. *Caulerpa racemosa* partly growing between the seagrass *Thalassia hemprichii*, air-exposed at extreme low tide (Nilwella); E, F. Leaves of the seagrass *Cymodocea serrulata* covered by crustose Corallinaceae.

Seagrass ecosystems develop in surf-sheltered, subtidal biotopes. They thrive best in shallow lagoons (e.g. Puttalam Bay, Chilaw and Weligama lagoon) and protected bays. Some seagrass meadows become air-exposed at extreme low water (Figs 12A, B). Larger seaweeds (e.g. some species of *Chaetomorpha*, *Avrainvillea*, *Halimeda*, *Caulerpa*, *Codium, Tolypiocladia*) grow between the seagrass plants (Figs 12C, D) or on their stolons (e.g. *Hypnea* spp.); smaller ones grow as epiphytes on the seagrass stipes and leaves (e.g. species of *Dictyota*, *Laurencia*, *Ceramium*, *Polysiphonia*, small encrusting corallines, Figs 12E, F).

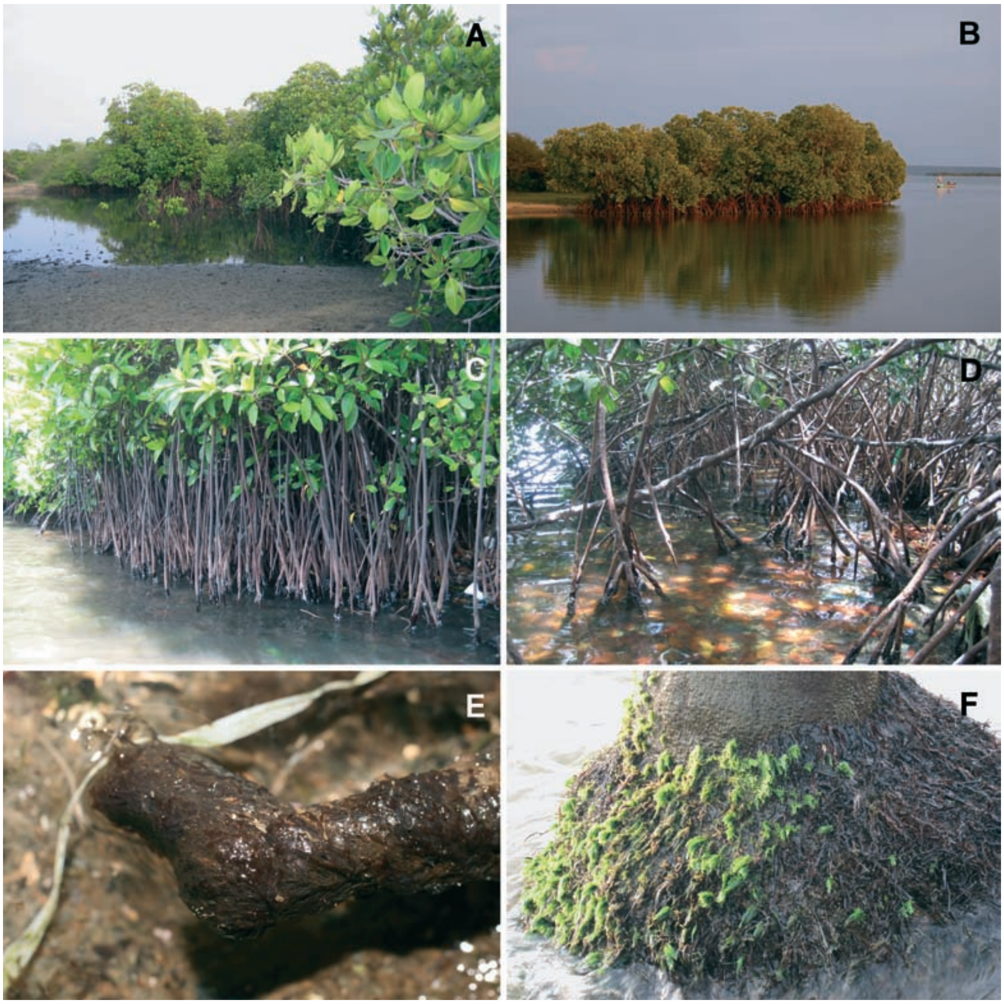


Fig. 13. Mangrove and associated seaweeds. A, B. *Rhizophora* mangrove (Kalpitiya); C, D. Rhizophores of *Rhizophora* sp. on which epiphytic algae develop (Chilaw lagoon); E. Detail of a rhizophore covered by *Caloglossa leprieurii* and *Polysiphonia* sp. (Chilaw lagoon); F. Basal part of a palm tree standing in the sea after coastal erosion and covered by seaweeds (Wattale).

Mangrove forests (Figs 13A, B) are best developed in sheltered, high intertidal to supralittoral zones. They occur mainly around lagoons and in estuaries. Some macroalgae develop in the mangrove tide channels (e.g. *Caulerpa* spp.), others in the silty pools in the mangrove vegetation (e.g. filamentous *Chaetomorpha* spp., tubular and blade-like *Ulva* species), others again on the aerial roots (rhizophores (Figs 13C, D) and pneumatophores) and the basis of the tree trunks (e.g. species of *Laurencia*, *Caloglossa*, *Catenella*, *Murrayella* and *Bostrychia*, Fig. 13E). As these algae are rather small and largely covered by sediments, they often go unnoticed. Even basal parts of palm trees standing in the sea after coastal erosion can be covered by seaweeds (Fig. 13F).

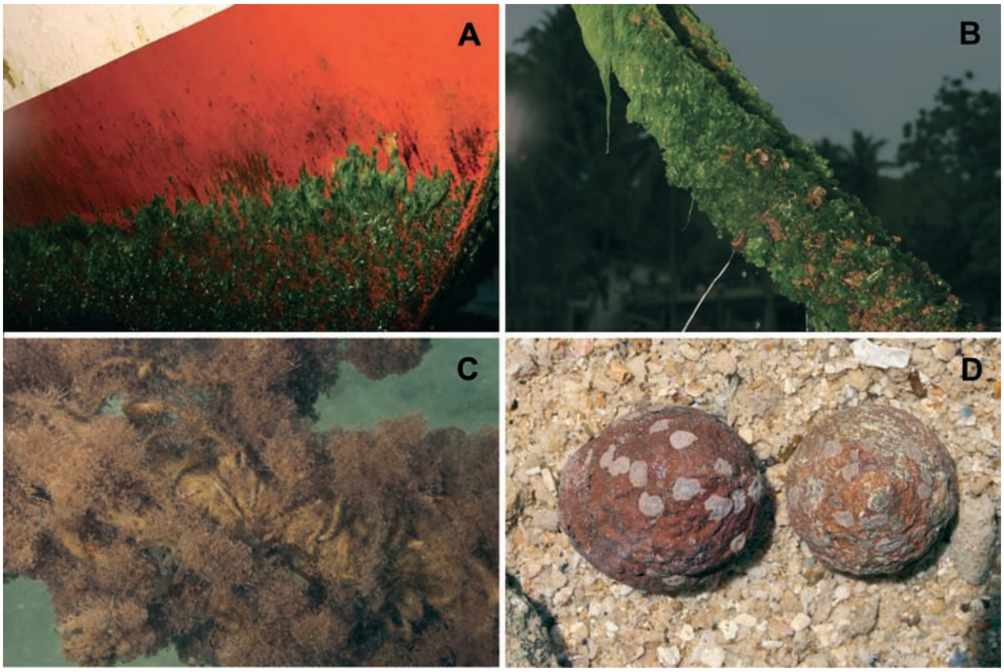


Fig. 14. Fouling and epizoic algae. A. Fouling on a boat: tubular and blade-like *Ulva* spp. (Beruwela); B. Fouling on a rope: tubular and blade-like *Ulva* spp. and *Padina* sp. (Beruwela); C. Fouling on a rope: dense vegetation of *Jania* (Weligama); D. A shell of a Gastropod covered by crustose coralline algae.

Fouling. Some seaweeds grow very well on floating hard substrata which are submerged or at least continuously wave-swept, such as boats and ropes (Figs 14A-C).

Seaweeds can also develop on animals (they are then called epizoic), such as shells of Gastropods (Fig. 14D).

4. Seasonality

As a result of the seasonal monsoons, the macroalgae of the intertidal and supralittoral zones show a well-marked seasonality. From June to November these parts of surf-exposed rock outcrops show a very dense seaweed cover (*Porphyra* spp., *Dermonema virens*, *Chnoospora minima*, *Asteronema breviarticulata*, *Chaetomorpha antennina*, *Ulva fasciata*, *Jania intermedia*, *Champia ceylanica*, …) (Fig. 15A). In the dry season (November onwards) these species ‘disappear’ due to overheating and desiccation. As a matter of fact, most of them are still there, but reduced to their crustose basis or present as a short algal turf. Some small specimens can still be found under rock overhangs, in crevices or in shaded intertidal pools. The mid to low intertidal pools on the sheltered, landward side of the rock outcrops also show a very different aspect over the seasons. In the cooler rain season, with huge surf, they are regularly flushed by seawater, stabilizing temperature as well as salinity. They then contain dense vegetations of tubular *Ulva* spp. which disappear in the dry season, when these pools heat up and salinity rises too much due to evaporation.

The first observations of the algal seasonality in Sri Lanka were formulated by Svedelius (1906b). Gunasekara (in prep.) carried out a study on seasonality of seaweed vegetations on rocky outcrops (mainly a beachrock platform in Dickwella) in the framework of his MSc-thesis at the University of Ruhuna (Matara).

Because of this pronounced seasonality of seaweed development, it is absolutely necessary to visit study sites in different seasons to get a complete view of the alpha-diversity of the area.

The seaweeds from the low intertidal and subtidal biotopes are less sensitive to seasonality as they are submerged (or at least continuously wave-swept) most of the time and the seawater temperature does not vary as much as the air temperature. On the other hand, presence of reproductive structures (frequently needed for identification) is mostly seasonal, even in these lower zones.

The seasonality of seagrasses and mangroves is limited to the discrete flowering seasons and the more pronounced loss of leaves in some periods of the year.

5. Zonation

The marine environment can be subdivided in two fundamentally different ecosystems: the intertidal that undergoes the tides twice a day and the subtidal that is continuously submerged.

The seaweeds occurring in the intertidal are subject to variable periods of emersion and submersion from high tide to low tide level. As a result, there is a strong variation of ecophysiological factors such as temperature, salinity, surf, light and desiccation depending on the level in the intertidal. Moreover, competition between different organisms (both plants and animals) also influences the distribution of algae along a shore.

The combination of all these factors results in the presence of superposed zones, mostly parallel to the height of the shore, each with a characteristic species composition of seaweeds and animals. The species from the upper zones are more tolerant to variation of the ecophysiological factors (they are eurytherm, euryhaline and euryionic). Those from the lower zones are less tolerant (they are stenotherm, stenohaline and stenoionic). It is clear that along wave-swept coasts the spray- and splash-zones will be much higher than along sheltered coasts, proving that zonation is not exclusively dictated by tidal levels. So for example, along a harbour wall, the same species will be present in a higher zone along the surf-exposed seaward side, than on the sheltered, harbour side.

In the subtidal and circalittoral zones light, hydrodynamics and siltation are the main factors defining the presence and the distribution of marine organisms.

In the description of the ecological distribution of the taxa included in this book the following zonation terminology is used:

- The **supralittoral**, corresponding with the spray-zone, is dominated by crustose lichens and some blue-greens (Figs 15B, C); it is never submerged by seawater, even at extreme high tide.

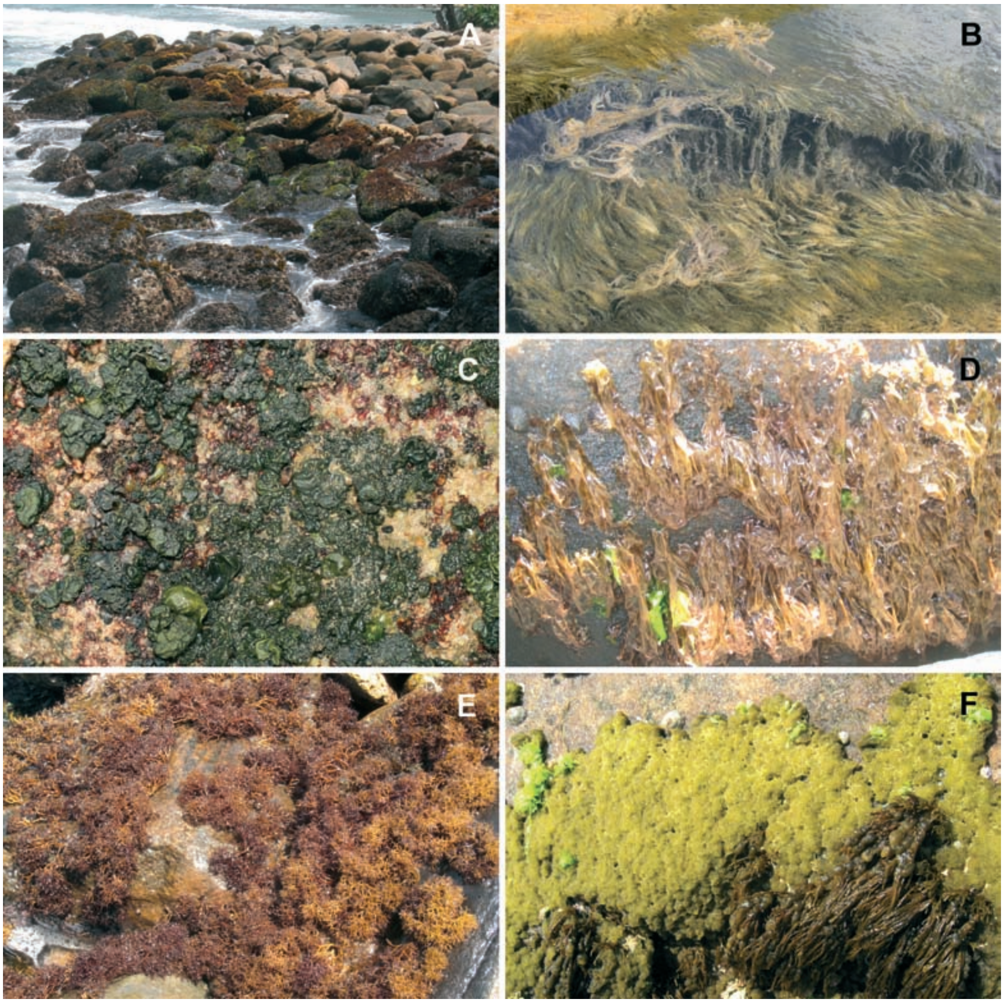


Fig. 15. Seaweed vegetations in the upper intertidal. A. Surf-exposed rocks with dense seaweed cover during the SW-monsoon (Nilwella); B. High intertidal rockpool covered by filamentous blue-greens (Dickwella Resort peninsula); C. The blue-green *Brachytrichia quoyi* on high intertidal rocks (Beruwela); D. *Porphyra* sp. in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Dickwella); E. *Dermonema virens* in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Nilwella); F. A zone of bleached, short tufts of *Centroceras clavulatum* on top of *Chnoospora minima* in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Dickwella Resort peninsula).

- The **supralittoral fringe** (the lowermost part of the supralittoral), corresponding with the <u>splash-zone</u> is a relatively arid zone transitional between land and sea; it is only submerged at spring high tides. Relatively few species occupy this zone (and only during the SW monsoon with rough seas, as they completely dry out once the sea is getting calmer). Typical seaweeds in this zone are: *Porphyra* spp. (Fig 15D), *Dermonema virens* (Fig. 15E), *Centroceras clavulatum* (Fig. 15F), *Chnoospora minima*

(Figs 16A, C), *Asteronema breviarticulata* (Fig. 16B), *Ralfsia ceylanica* (Fig. 16C). On the shaded, overhanging walls of the eroded fossil beachrock cliffs, *Rhizoclonium africanum* (Fig. 16D), *Bostrychia tenella* (Fig. 16E) and *Murrayella periclados* (Fig. 16F) form extensive coverings in marked superposed zones.

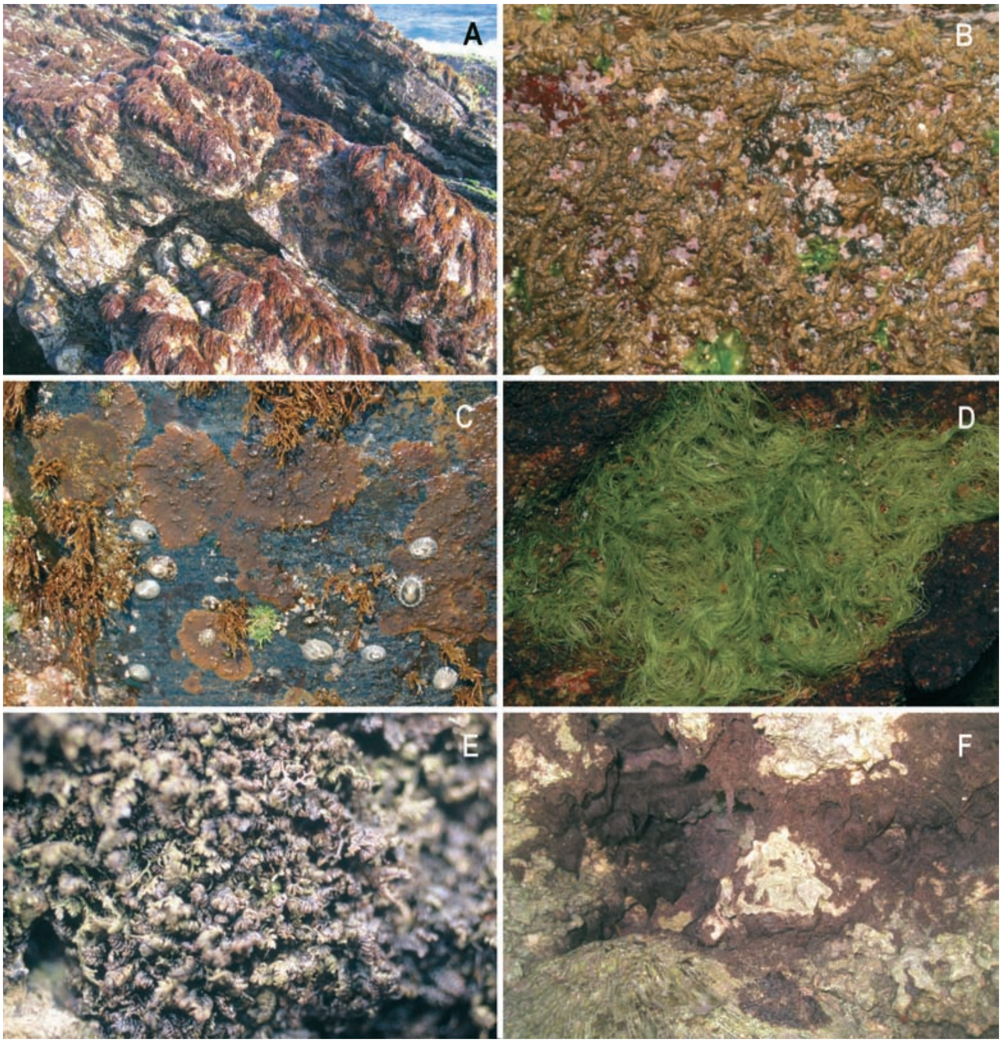


Fig. 16. Seaweed vegetations in the upper intertidal. A. Extensive vegetations of *Chnoospora minima* in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Dickwella Resort peninsula); B. The zone of *Asteronema breviarticula* in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Unawatuna); C. Brown crusts of *Ralfsia ceylanica*, between *Chnoospora minima* in the supralittoral fringe of surf-exposed coasts (Dickwella Resort peninsula); D. *Rhizoclonium africanum* in the supralittoral fringe of surf-exposed coasts (Unawatuna); E. *Bostrychia tenella* forming dense vegetations on shaded (mostly vertical) rock walls in the supralittoral fringe (Unawatuna); F. *Murrayella periclados* (and other filamentous red algae) forming dense vegetations on shaded (mostly vertical) rock walls in the supralittoral fringe (Matara, Polhena Beach).

Fig. 17. Seaweed vegetations in the upper and mid intertidal. A. *Chaetomorpha antennina* in the upper intertidal of surf-exposed coasts (Unawatuna); B. *Cladophora sericea* in the upper intertidal of the landward side of surf-exposed rocks (Wattale); C. *Ulva fasciata* in the upper intertidal of the landward side of surf-exposed rocks (Dickwella); D. *Jania intermedia* forming extensive vegetations in the middle intertidal along surf-exposed coasts (Dickwella); E. *Champia ceylanica* and *Laurencia natalensis* on crustose *Ralfsia* and Corallinaceae in the middle intertidal along surf-exposed coasts (Nilwella); F. Cascades between low intertidal rock pools (Dickwella); G. Densely intricate, low tufts of *Caulerpa sertularioides* and *C. racemosa* in the cascades between the rock pools (Dickwella); H. Detail of a densely intricated tuft of *C. sertularioides* from a low intertidal cascade (Dickwella).

- The **intertidal**, frequently called eulittoral in anglosaxon literature, roughly corresponds with the zone between mean high water and mean low water levels. On surf-exposed rock outcrops the intertidal is densely covered by macroalgae during the SW monsoon: in the upper intertidal, *Chaetomorpha antennina* (Fig. 17A) is extremely well developed along the seaward, surf-exposed side of rocky shores, whereas *Cladophora sericea* (Fig. 17B) and *Ulva fasciata* (Fig. 17C) are abundant on the landward, more sheltered but still continuously wave-swept side. The middle intertidal is characterized by extensive vegetations of the articulated coralline *Jania intermedia* (Fig. 17D) at sites exposed to extreme surf. Along medium exposed sites, *Laurencia* spp. and *Champia ceylanica* (Fig. 17E) are abundant. In the cascading overflows between intertidal pools, *Caulerpa sertularioides* and *C. racemosa* locally grow in densely intricated, low tufts (Figs 17F-H). In the lower intertidal, large barnacles can be abundant (quite often covered by *Gelidium* sp., Fig. 18A), together with some *Pterocladiella caerulescens* (Fig. 18B), *Ahnfeltiopsis* spp., *Jania cultrata*, … Vertical and overhanging (mostly shaded) walls can be covered by *Botryocladia skottsbergii* (Fig. 18C), and *Codium arabicum* (Fig. 18D).

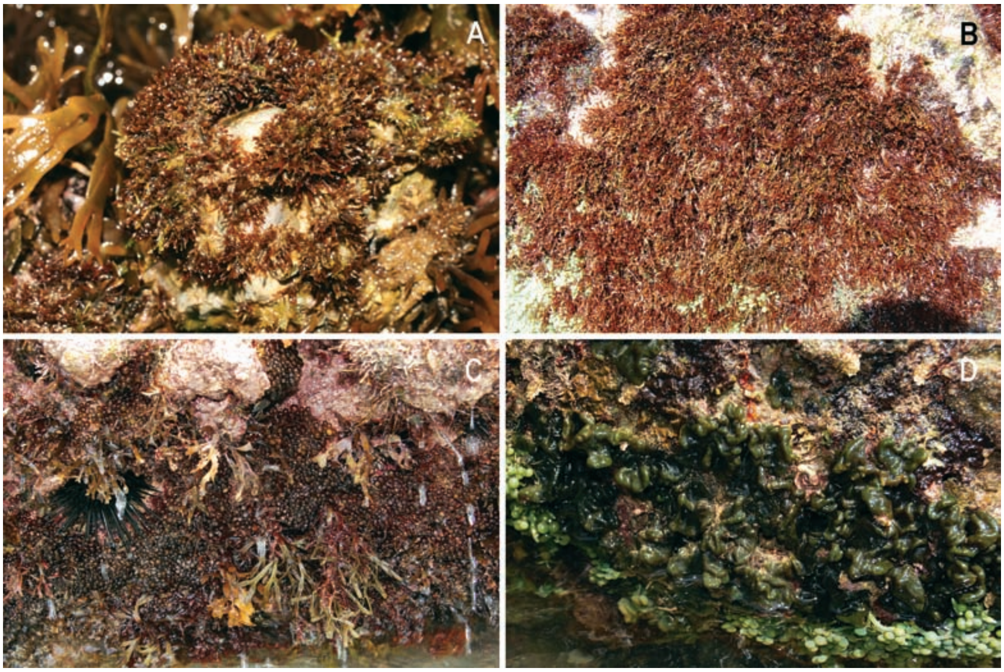


Fig. 18. Seaweed vegetations in the low intertidal. A. A large barnacle covered by a small *Gelidium* sp. and surrounded by *Gracilaria corticata*; B. *Pterocladiella caerulescens* growing in extensive vegetations in the lower intertidal along surf-exposed coasts (Unawatuna); C. *Botryocladia skottsbergii* growing in extensive vegetations on vertical walls in the lower intertidal along surf-exposed coasts (Unawatuna); D. *Codium arabicum* on a vertical wall in the lower intertidal along surf-exposed coasts (Galle).

At about low tide level, continuously wave-swept sloping to horizontal rock surfaces are covered by vegetations of different composition from the seaward to the landward side (Fig. 19A). On the extremely wave-swept seaward side, *Dictyosphaeria versluysii* (Fig. 19B) can be abundant, whereas *Turbinaria ornata* f. *evesiculosa* develops on seaward horizontal surfaces (Figs 19C, D), followed by a zone of *Sargassum turbinatifolium* (Fig. 19E). The middle part is covered by mixed seaweed vegetations where some species can be dominant, e.g. *Sargassum* sp. (Fig. 19F),

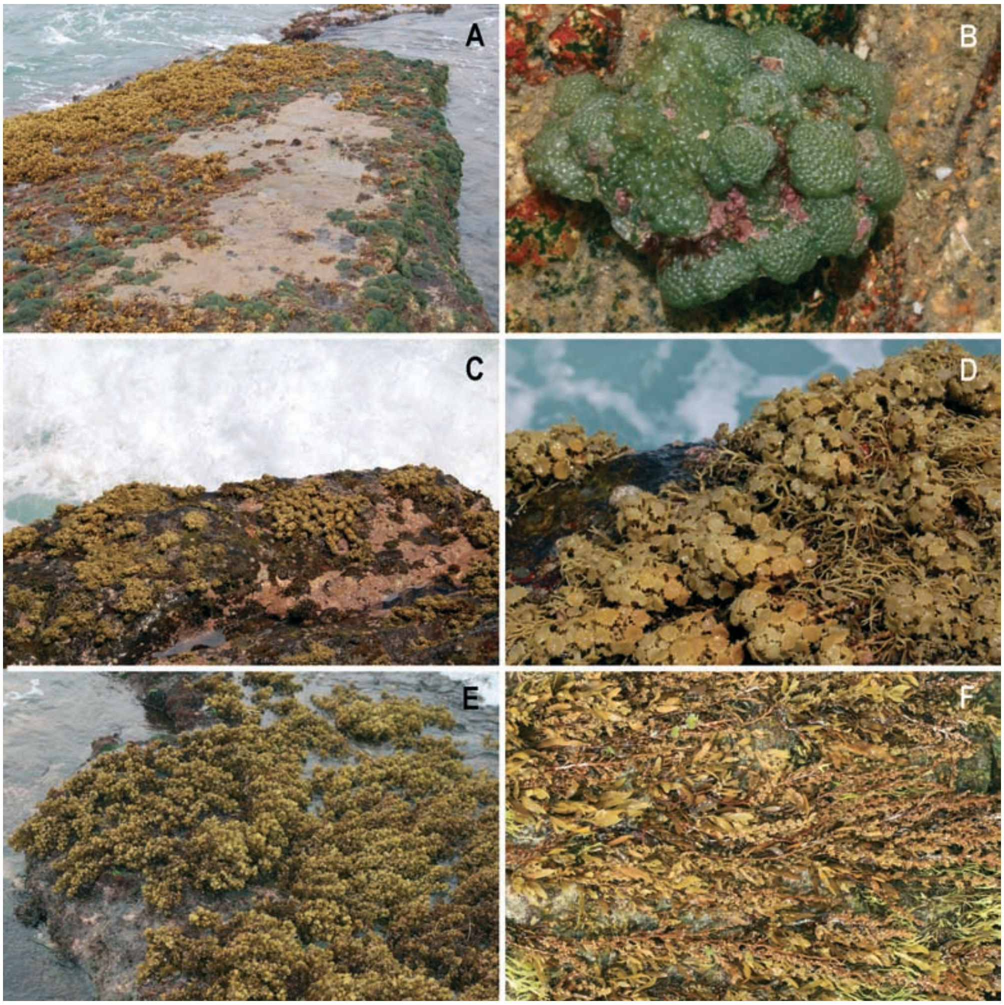


Fig. 19. Seaweed vegetations at about low tide level. A. Lower intertidal of a beachrock platform with *Sargassum turbinatifolium* on the seaward (surf-exposed) side and *Valoniopsis pachynema* on the landward (more surf-sheltered) side (Beruwela); B. *Dictyosphaeria versluysii* in the lower intertidal on the surf-exposed, seaward side of the beachrock platform (Beruwela); C, D. *Turbinaria ornata* f. *evesiculosa* at low tide level along extremely surf-exposed rocky coasts; E. *Sargassum turbinatifolium* at low tide tide level along surf-exposed rocky coasts; F. *Sargassum* sp.-vegetations in the middle part of beachrock platforms at about low tide level.

Hypnea pannosa (Fig. 20A), *Pterocladiella caerulescens*, *Caulerpa racemosa* f. *macrophysa* (Fig. 20B), *C. imbricata* (Fig. 20C) or combined with numerous species such as *Polyopes ligulatus*, *Gracilaria corticata*, *G. salicornia*, *Laurencia* spp., *Caulerpa sertularioides*, *Dictyopteris delicatula*, *Bryopsis pennata*, *Chlorodesmis caespitosa*, *Gelidiella acerosa, Spyridia hypnoides*, … On the more sheltered, landward side, *Valoniopsis pachynema* is a common green alga forming extensive cushions (Fig. 20D) next to *Dictyosphaeria cavernosa* (Fig. 20E). On vertical walls, *Portieria tripinnata* develops on the seaward side, whereas *Caulerpa lentillifera* (Fig. 20F) and *Dictyurus purpurascens* grow on the more sheltered, landward walls.

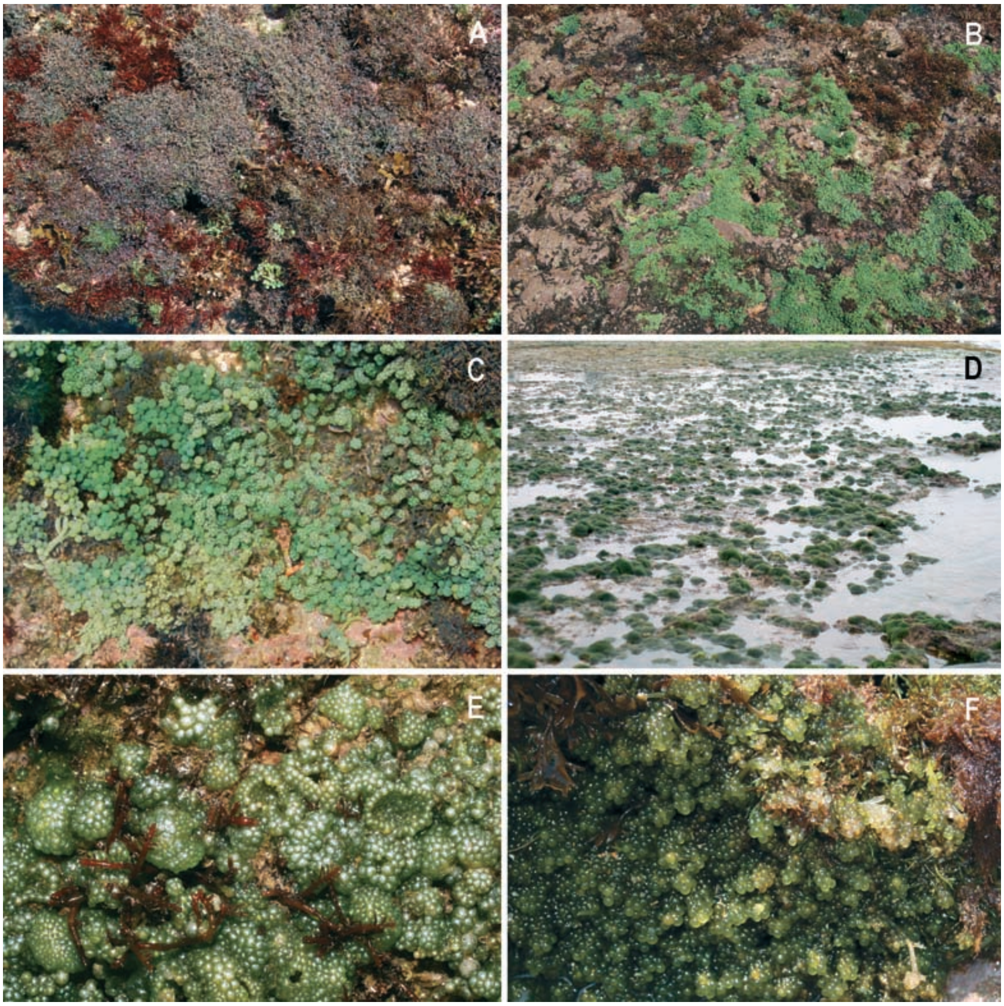


Fig. 20. Seaweed vegetations at about low tide level. A. Mixed seaweed vegetation with dominance of *Hypnea pannosa* and *Pterocladiella caerulescens* in the lower part of beachrock platforms at about low tide level; B. Mixed seaweed vegetation with dominance of *Caulerpa racemosa* and *Polyopes ligulatus* in the lower part of beachrock platforms at about low tide level; C. Mixed vegetation of *Caulerpa racemosa* and *C. imbricata* in the lower part of beachrock platforms at about low tide level; D. Numerous hemispherical cushions of *Valoniopsis pachynema* at about low tide level; E. *Dictyosphaeria cavernosa* (mixed with some *Gelidiella acerosa*) at about low tide level along more sheltered coasts (Beruwela); F. *Caulerpa lentillifera* on sheltered, landward vertical walls of the beachrock platform (Dickwella).

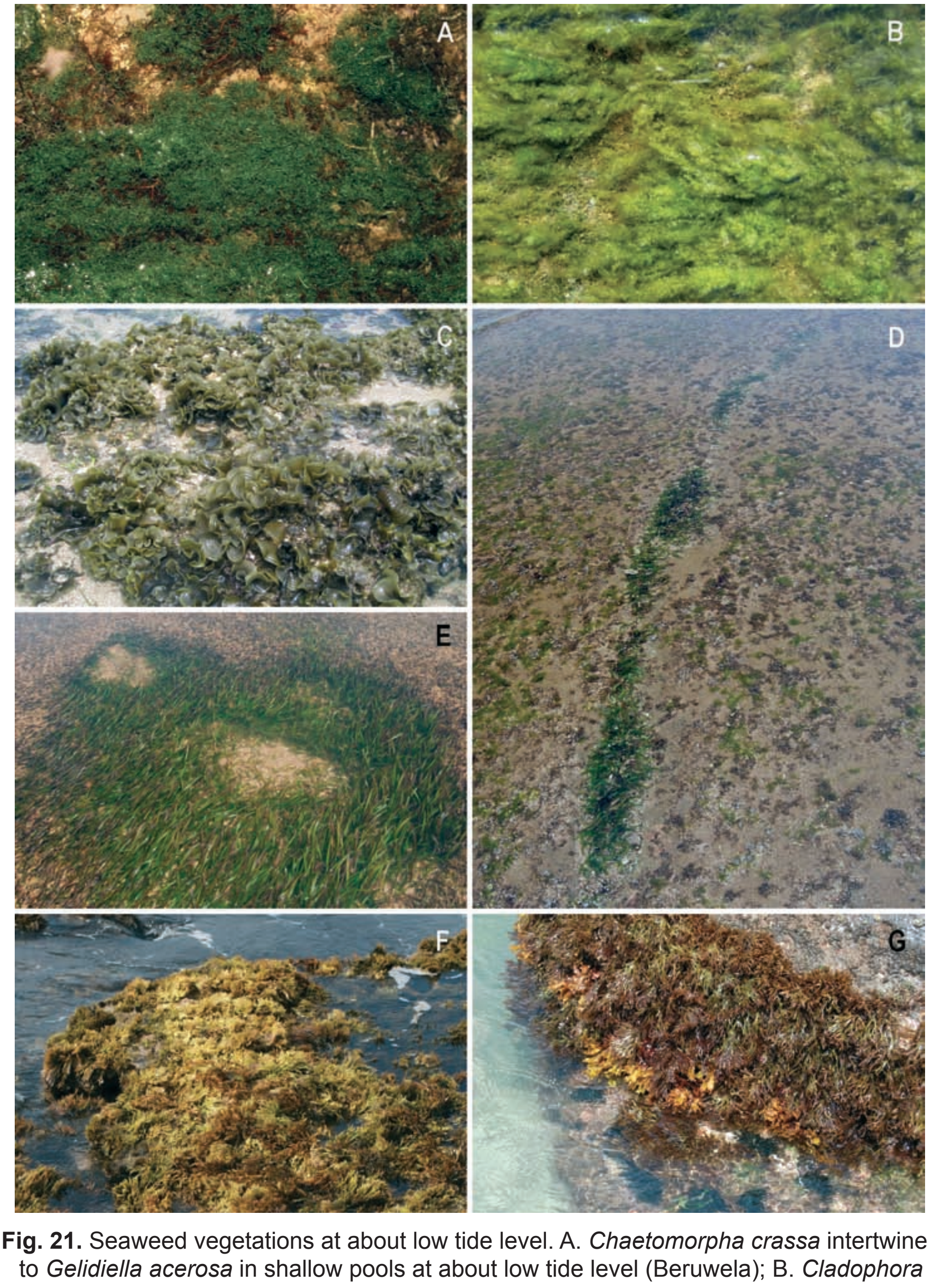


Fig. 21. Seaweed vegetations at about low tide level. A. *Chaetomorpha crassa* intertwined to *Gelidiella acerosa* in shallow pools at about low tide level (Beruwela); B. *Cladophora vagabunda* populations in shallow, rather sheltered but regularly wave-swept low intertidal pools (Beruwela); C. *Padina boergesenii* populations in shallow, rather sheltered low intertidal pools; D. A sand-filled crevice of the beachrock platform at about low tide with development of seagrasses (Beruwela); E. A low intertidal rock pool with sandy bottom covered by seagrasses (Beruwela); F. Subhorizontal surface of the beachrock platform at low water level, covered by extensive vegetations of *Gracilaria corticata* and *Sargassum* (Chilaw); G. A vertical wall at low water level, covered by a vegetation of *Gracilaria corticata* and some *Sarcodia montagneana* plants (Unawatuna).

In places, low intertidal pools contain large amounts of *Chaetomorpha crassa* (Fig. 21A) intertwined to *Sargassum* spp. and *Gelidiella acerosa*. Other low intertidal pools are covered by *Cladophora vagabunda* (Fig. 21B) or *Padina* spp. (Fig. 21C). In sand-filled crevices and pools with a sandy bottom seagrasses can develop (Figs 21D, E). In other areas, the subhorizontal surface of the beachrock platform at low water level is covered by extensive vegetations of *Gracilaria corticata* (Figs 21F, G).

- The **infralittoral fringe** is air-exposed only during spring tides when the sea is smooth, but generally this zone is continuously wave-swept, even at low tide. Subtidal species survive in rock pools and surge channels close to extreme low water level. *Amphiroa foliacea* (Fig. 22A), *Halimeda discoidea* (Fig. 22B), *Valonia fastigiata* (Fig. 22C), *Caulerpa verticillata* (Fig. 22D), *C. taxifolia* (Fig. 22E), *Halimeda opuntia* (Fig. 22F), *Polyopes ligulatus* (Fig. 22G), *Sarcodia montagneana*, *Carpopeltis maillardii*, *Chondria armata* (Fig. 22H), *Jania cultrata, Laurencia* spp. (Fig. 22I) are among the numerous air-exposed algae between waves at low water. *Dictyota ceylanica* (Fig. 23A), *Asparagopsis taxiformis* (Fig. 23B) and *Spyridia hypnoides* (Fig. 23C) can be frequent algae forming isolated tufts, mainly in pools. In surge channels, *Gracilaria canaliculata* can be well developed (Fig. 23D). On sand-covered rock substratum, a typical seaweed vegetation can be observed, composed of *Bryocladia thwaitesii* (Fig. 23E), *Grateloupia lithophila* (Fig. 23F), *Ulva fasciata*.

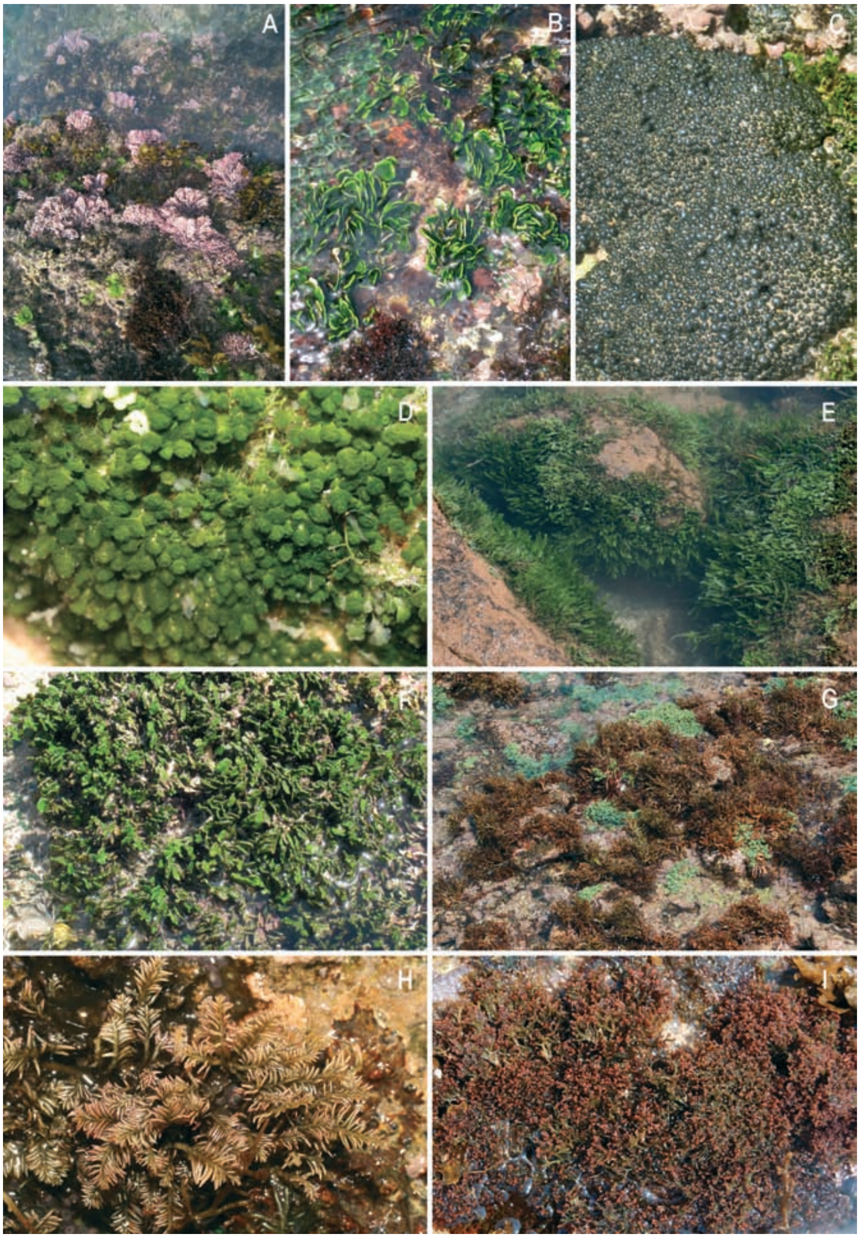


Fig. 22. Seaweed vegetations at and just under low tide level. A. *Amphiroa foliacea* just under low water level in surge channels; B. *Halimeda discoidea* in the infralittoral fringe (Nilwella); C. *Valonia fastigiata* in the infralittoral fringe (Nilwella); D. *Caulerpa verticillata* on sheltered, landward vertical walls of the beachrock platform (Dickwella); E. *Caulerpa taxifolia* mainly on vertical walls just under low water level (Weligama); F. *Halimeda opuntia* in the infralittoral fringe, partly air-exposed at extreme low water (Nilwella); G. *Polyopes ligulatus* (mixed to *Caulerpa racemosa* and *Gracilaria* crassa) in the infralittoral fringe, partly air-exposed at extreme low water (Galle); H. *Chondria armata* in the infralittoral fringe, air-exposed at extreme low water; I. *Laurencia natalensis* in the infralittoral fringe, partly air-exposed at extreme low water (Batheegama).

Fig. 23. Seaweed vegetations at and just under low tide level. A. Cushions of *Dictyota ceylanica* in the infralittoral fringe (Hikkaduwa); B. *Asparagopsis taxiformis* in a rock pool at about low water level (Nilwella); C. Populations of *Spyridia hypnoides* in the infralittoral fringe (Nilwella); D. *Gracilaria crassa* (together with *Polyopes* ligulatus) in surge channels in the infralittoral fringe (Galle); E. Monospecific vegetations of *Bryocladia thwaitesii* on partly sand-covered rocks in the infralittoral fringe of sheltered bays (Dickwella); F. Monospecific vegetations of *Grateloupia lithophila* on partly sand-covered rocks in the infralittoral fringe of sheltered bays (Dickwella).

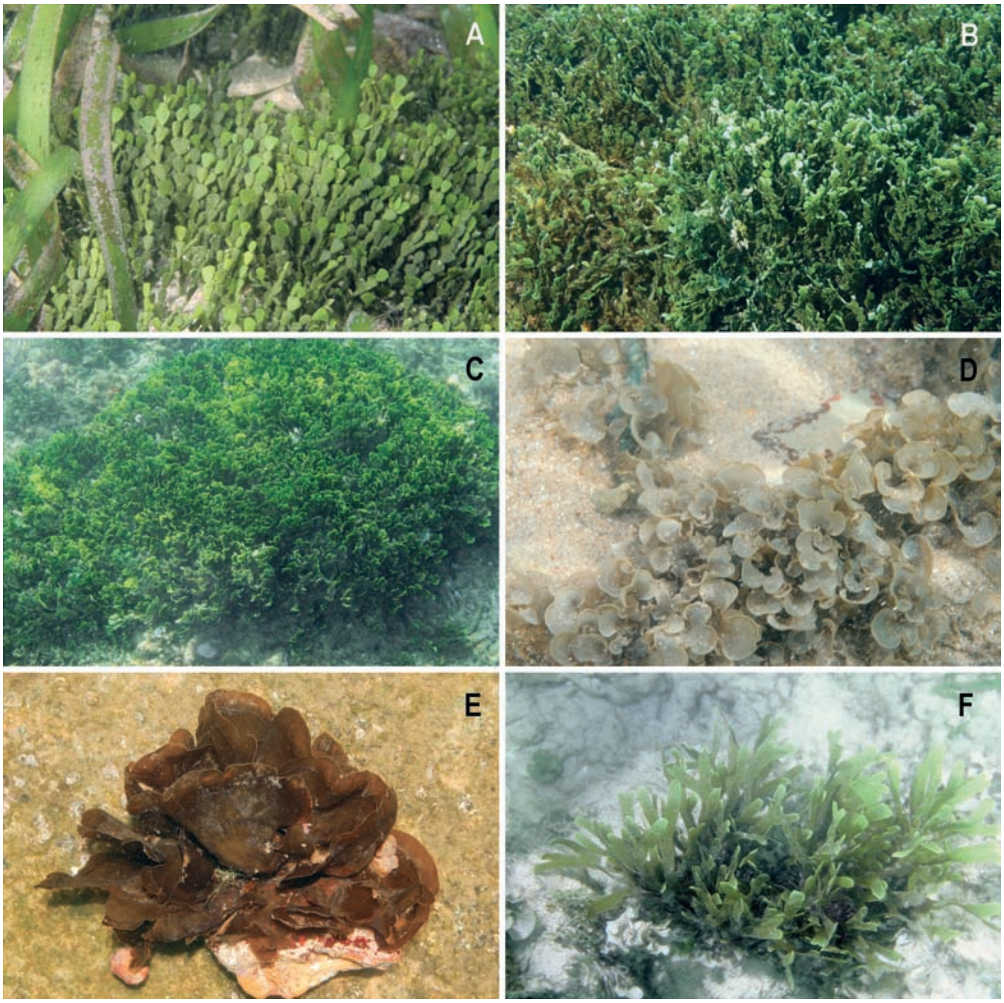


Fig. 24. Seaweed vegetations in the shallow subtidal. A. *Halimeda gracilis* populations mixed to seagrasses in the subtidal (Weligama); B. Dense *Halimeda gracilis* vegetations on coral rubble (Kalpitiya); C. Dense *Halimeda discoidea* vegetations on coral rubble (Kalpitiya); D. *Padina boergesenii* on coral debris in the subtidal of a lagoon (Weligama); E. A large, erect plant of *Lobophora variegata* on a dead coral fragment on the bottom of a lagoon (Beruwela); F. *Stoechospermum polypodioides* on dead coral in the lagoon (Weligama).

- The **infralittoral** or **subtidal** is continuously covered by seawater. On sand-covered rocky substratum *Caulerpa racemosa* var. *cylindracea* f. *laxa* can locally form nice populations.

In lagoons with sandy substratum, seagrass meadows develop, with the associated macro-algae on the sand (mainly *Halimeda gracilis*, Fig. 24A) or epiphytic on the seagrasses. When coral rubble is present on the lagoon bottom *Halimeda gracilis* and *H. discoidea* can grow in extensive vegetations (Figs 24B, C); tufts of *Padina* spp. (Fig. 24D),

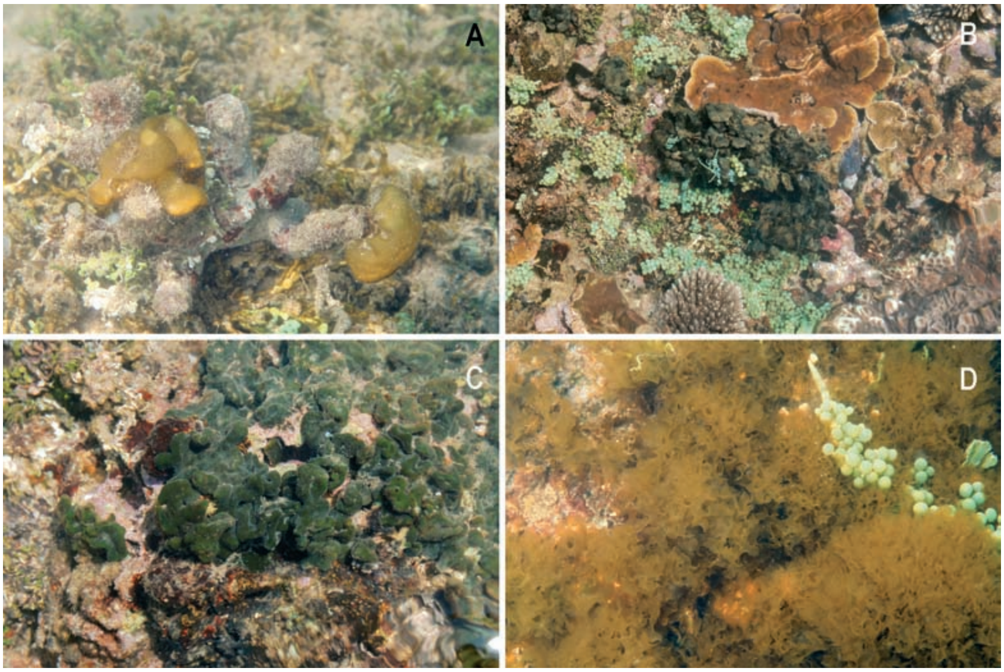


Fig. 25. Seaweed vegetations in the shallow subtidal. A. *Colpomenia sinuosa* on dead coral in the lagoon (Weligama); B. *Avrainvillea amadelpha* next to *Caulerpa racemosa* and *Halimeda opuntia* on hard substrate in the shallow subtidal (Galle); C. Extensive vegetations of *Codium arabicum* on hard substrate in the shallow subtidal (Galle); D. A dense cover of *Nitophyllum marginatum* on hard substrate in the shallow subtidal (Galle).

Lobophora variegata (Fig. 24E) and *Dictyota* spp. can also develop. Locally, extensive populations of *Stoechospermum polypodioides* (Fig. 24F) are present and *Colpomenia sinuosa* can be abundant (Fig. 25A).

In lagoons with hard substratum (Galle), corals develop, together with *Halimeda opuntia*, *Avrainvillea amadelpha* (Fig. 25B), and locally populations of *Caulerpa sertularioides*, *C. racemosa*, *C. imbricata*, *Codium arabicum* (Fig. 25C), *C. geppiorum, Dictyota ceylanica*, *Nitophyllum marginale* (Fig. 25D), *Claudea multifida*.

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).

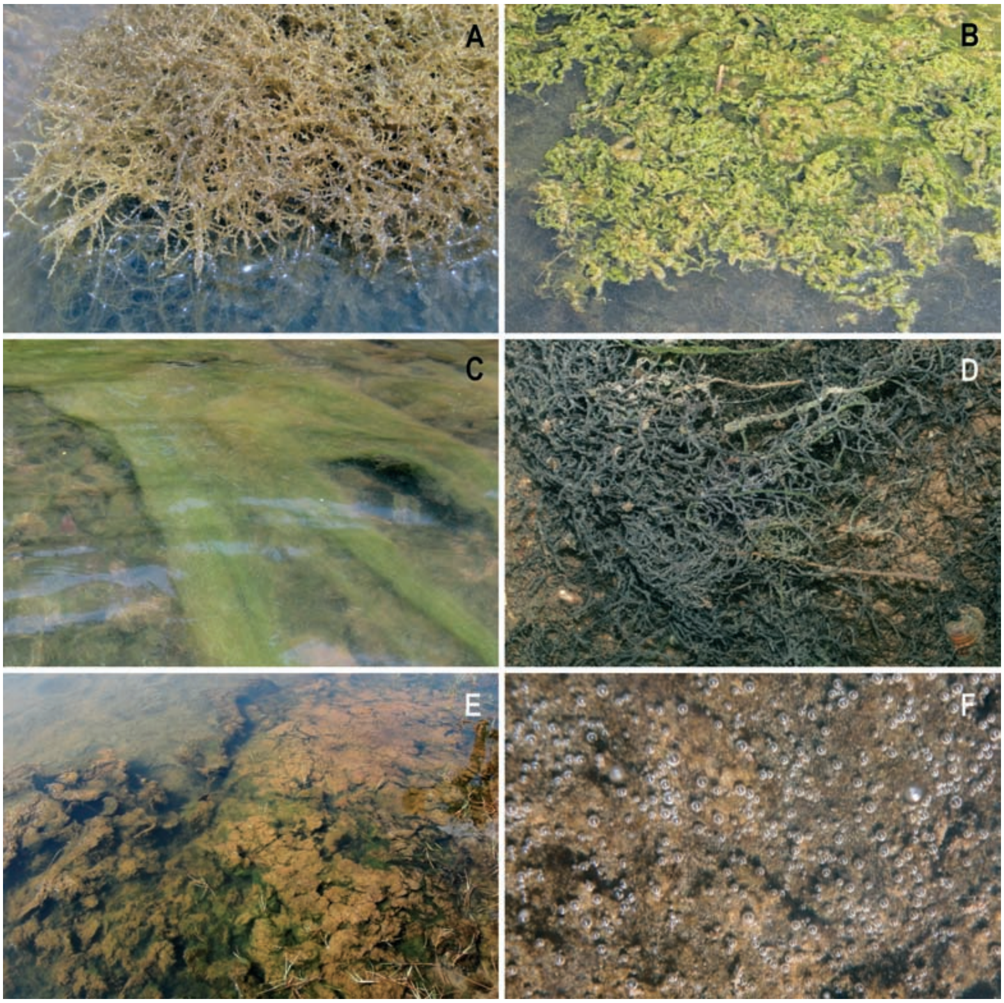


Fig. 26. Algae in shallow, isolated lagoons. Large tufts of *Acanthophora spicifera* close to the estuary; B. *Ulva intestinalis* in more sheltered, inward sites; C. Entangled *Chaetomorpha linum*-strands; D. Entangled *Gracilaria*; E. Mats of blue-greens in the most isolated parts, partly floating;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

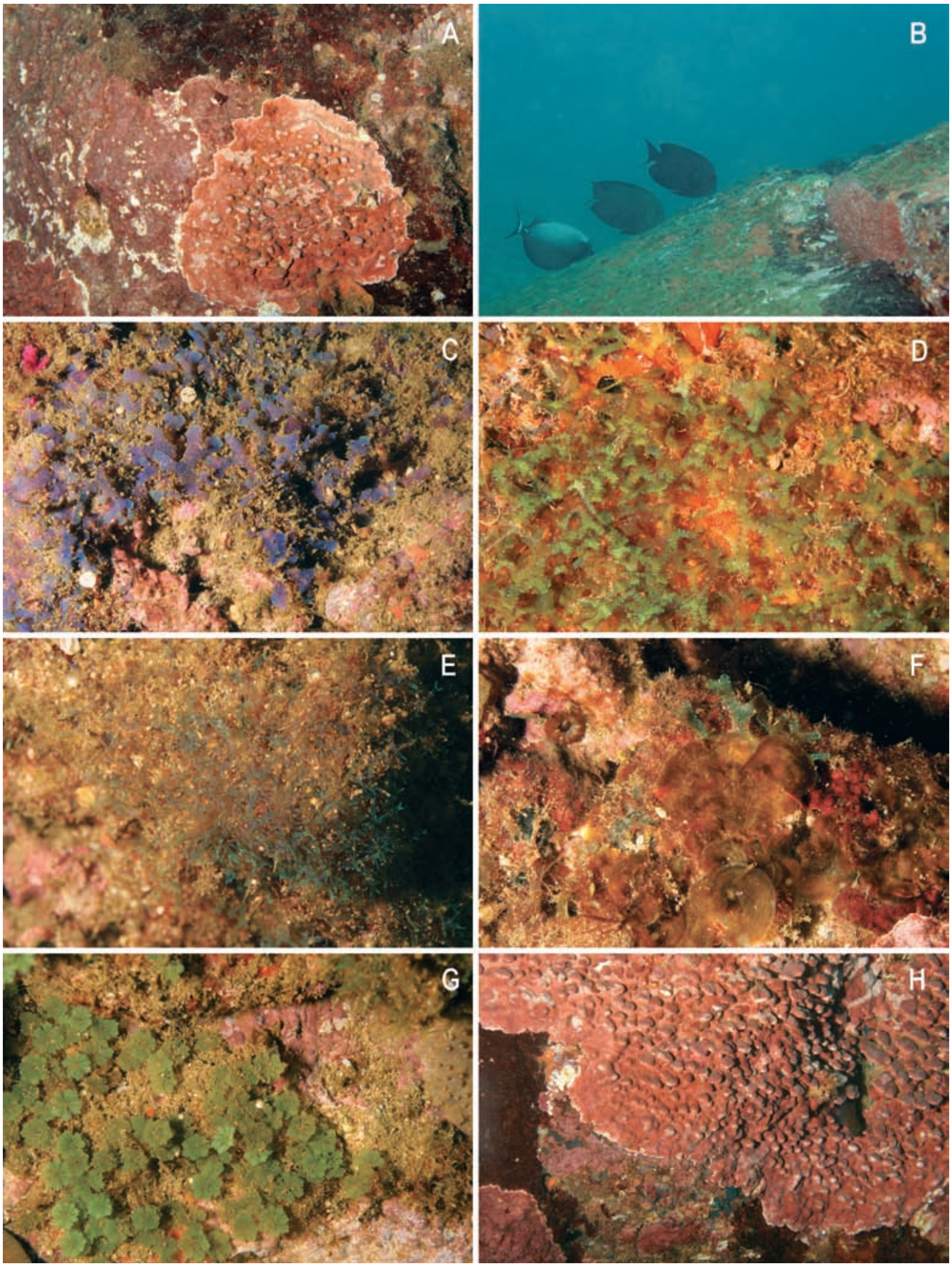


Fig. 27. Seaweeds on deepwater boulders (-25 m). A. In areas with high grazing pressure by herbivorous fish, only crustose corallines survive (Beruwela); B. In some areas, grazing fish limit the development of soft, erect algae (Beruwela); C-E. Representatives of *Dictyota* seem to be resistant to herbivory; 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).

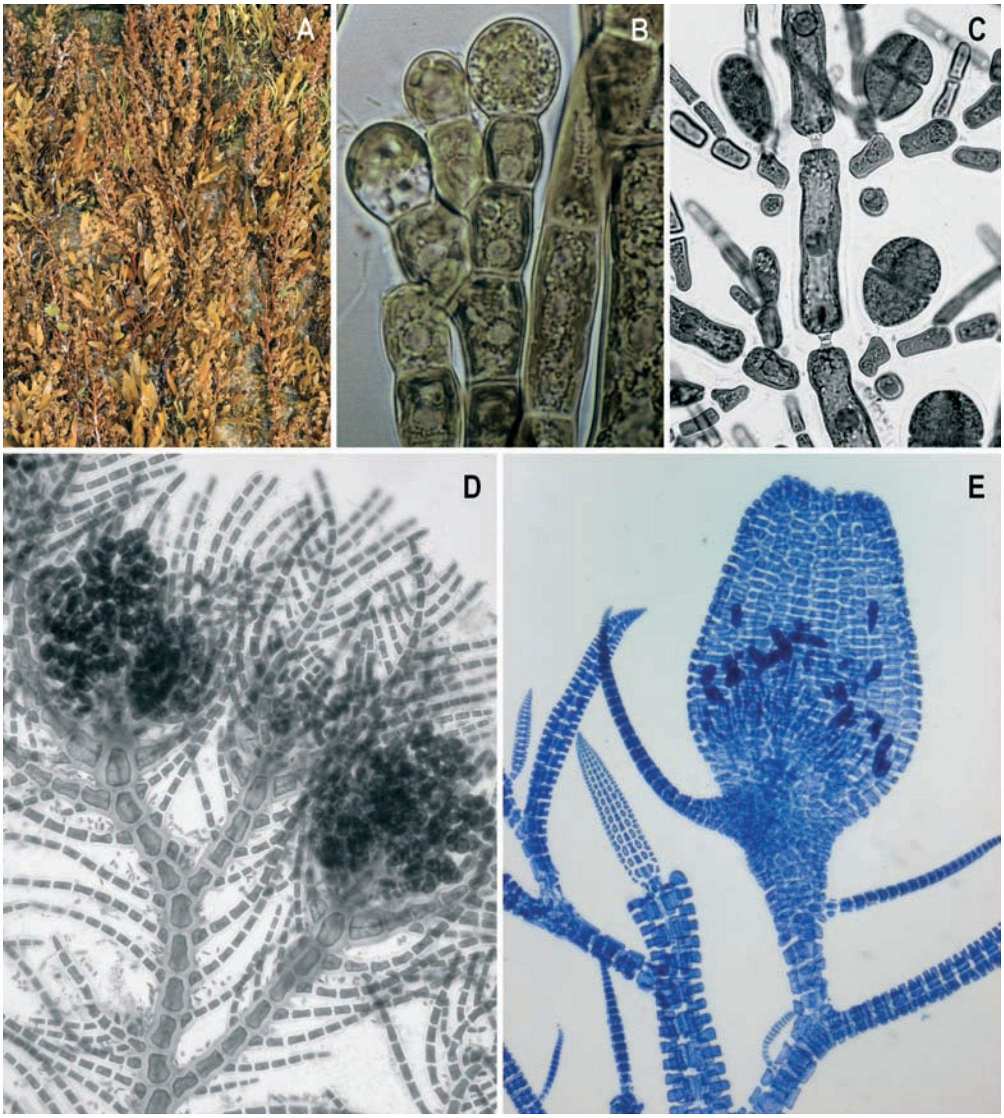


Fig. 31. General characters of seaweeds. A. Some seaweeds look similar to higher plants, with 'stems' (stipes), 'leaves' (blades) and inflorescences (receptacles) (*Sargassum* sp.); B. Monosporangia in the red alga *Acrochaetium* sp.; C. Tetrasporangia in the red alga *Balliella crouanioides*; D. Carpospores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

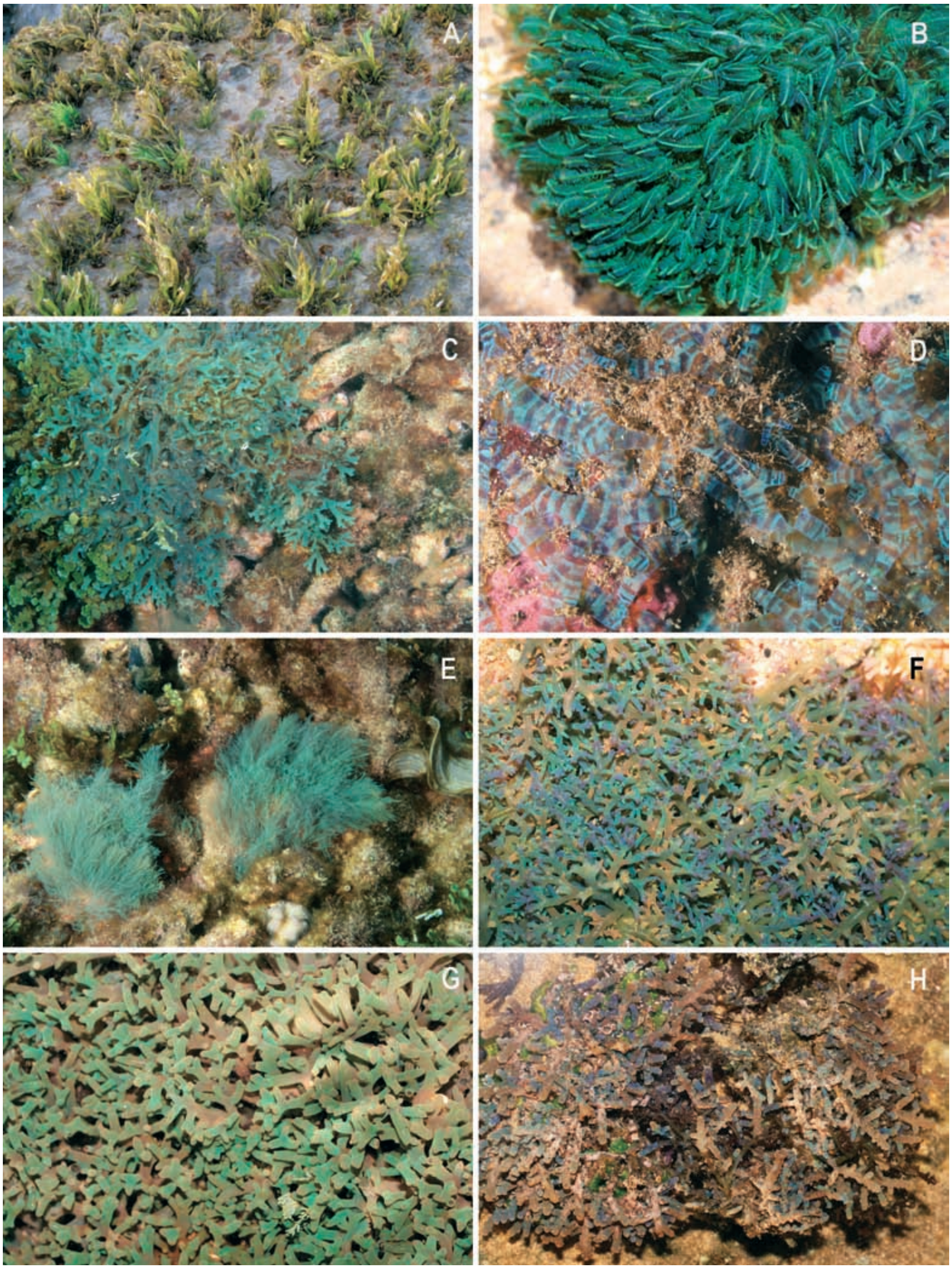


Fig. 32. Seaweed colours. A. Red algae, exposed to strong sunlight can become greenish because of the dominance of chlorophyll, rather than purplish red as a result of the phycobilines; B. Green iridescence in *Bryopsis pennata*; C. Blue iridescence of the whole thallus of *Canistrocarpus magneanus*; 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).

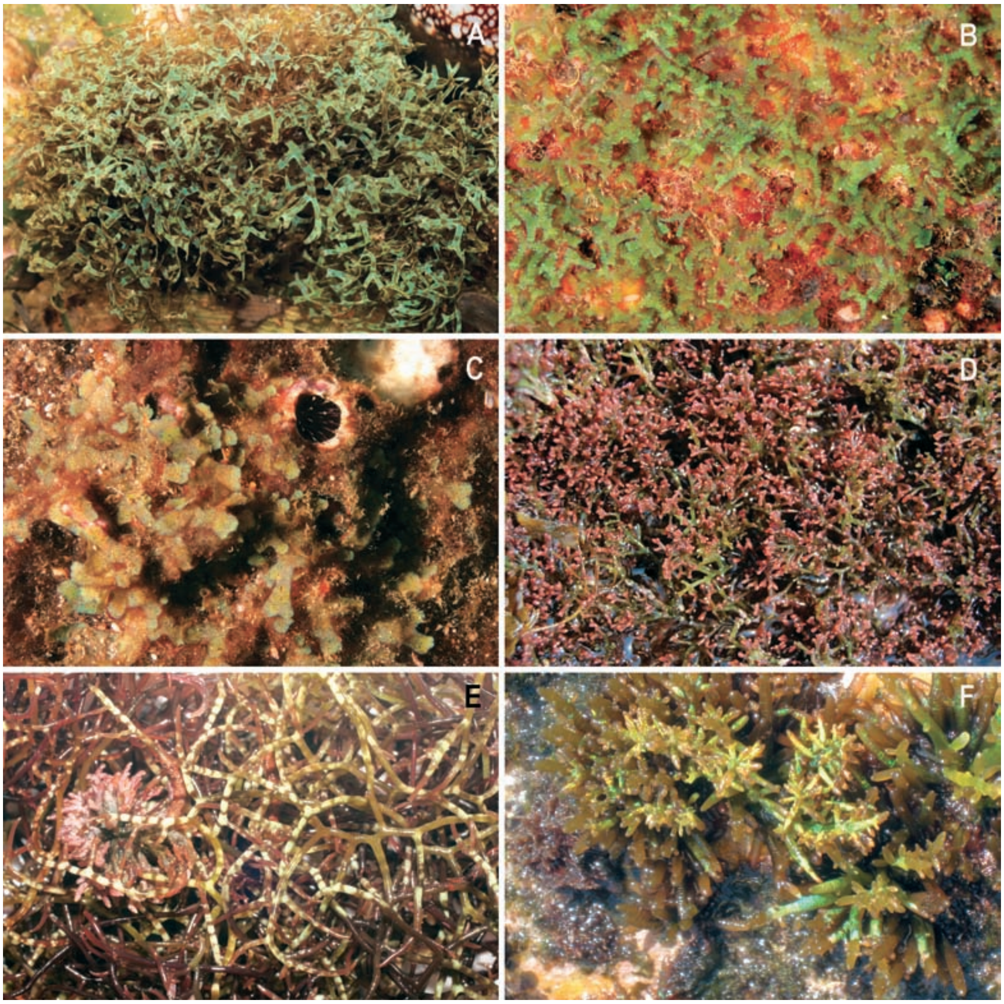


Fig. 33. Seaweeds colours. A. Brown and blue-greenish banded iridescent *Dictyota ceylanica*; B. Marginally banded iridescent *Dictyota* sp.; C. Spotted iridescent *Dictyota* sp.; D. *Laurencia natalensis* with pinkish iridescent tips; E. *Chondracanthus acicularis* with banded creamy-coloured iridescence;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

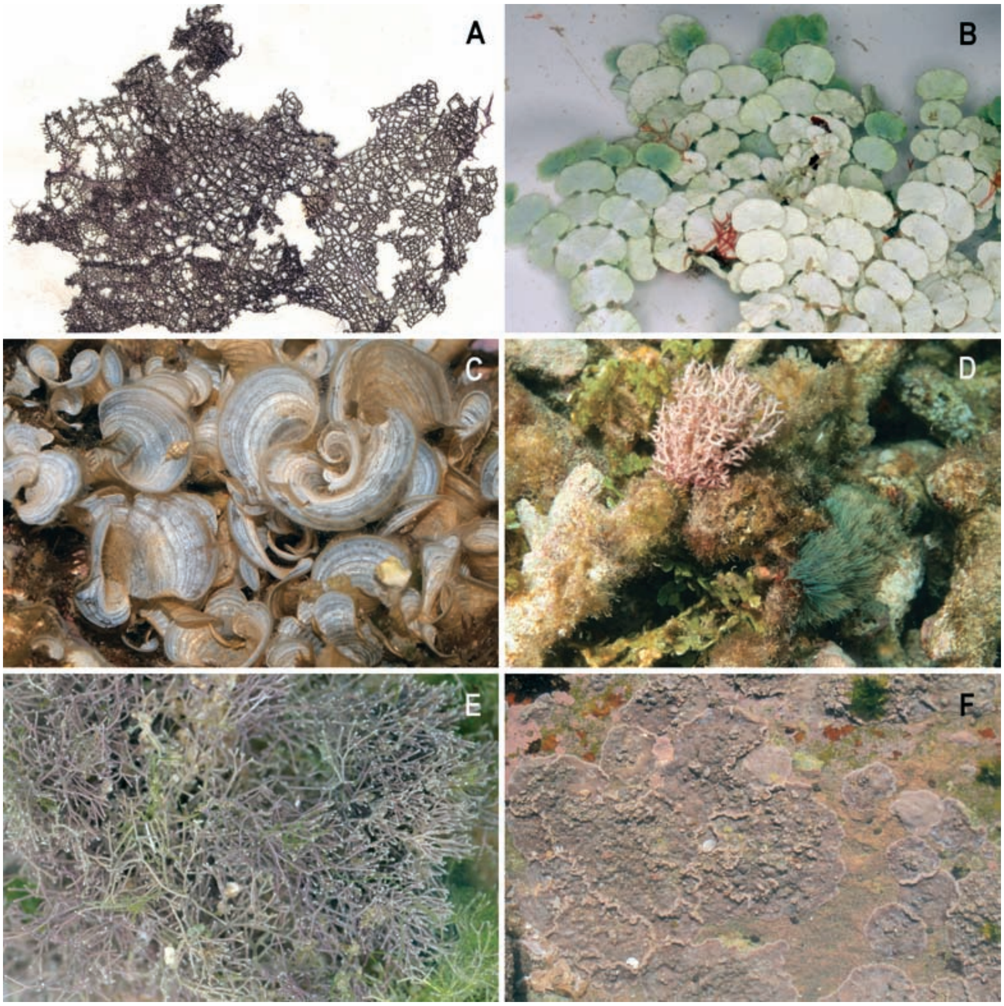


Fig. 34. Seaweed colours. A. Some *Microdictyon* species (e.g. *M. okamurae*), being green *in situ* become black upon drying; B. Whitish segments of the green alga *Halimeda* as a result of intracellular calcification; C. Whitish upper surface of the blades of the brown alga *Padina*, as a result of 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).

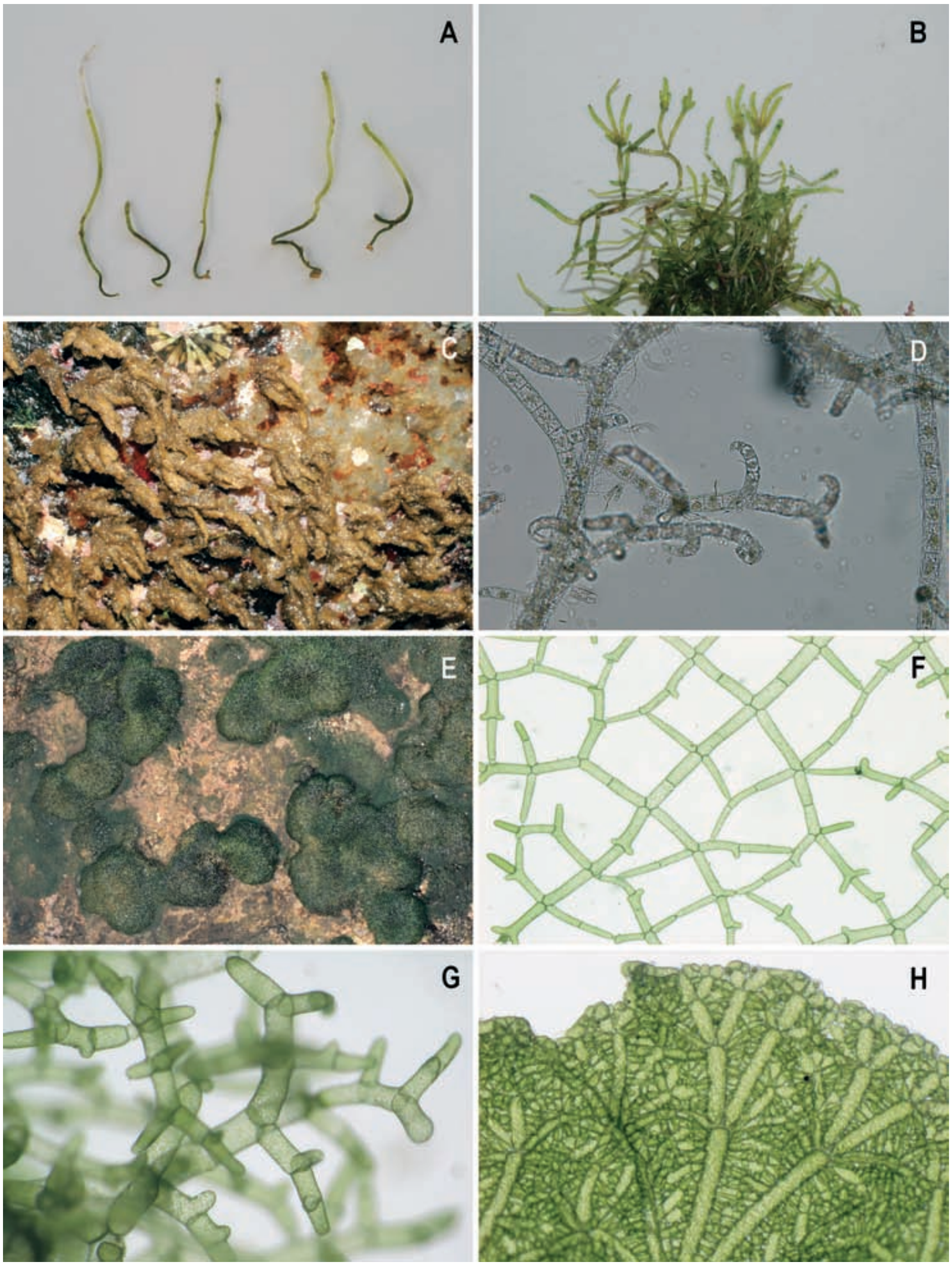


Fig. 35. Seaweed morphology: filaments. A. Unbranched filaments in *Chaetomorpha spiralis*; B. Branched filaments in *Valoniopsis pachynema*; C. 'Rope-like structures' in *Asteronema breviarticulata* as a result of the longitudinal intertwining of filaments and mutual attachment by hook-like branchlets; 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*).

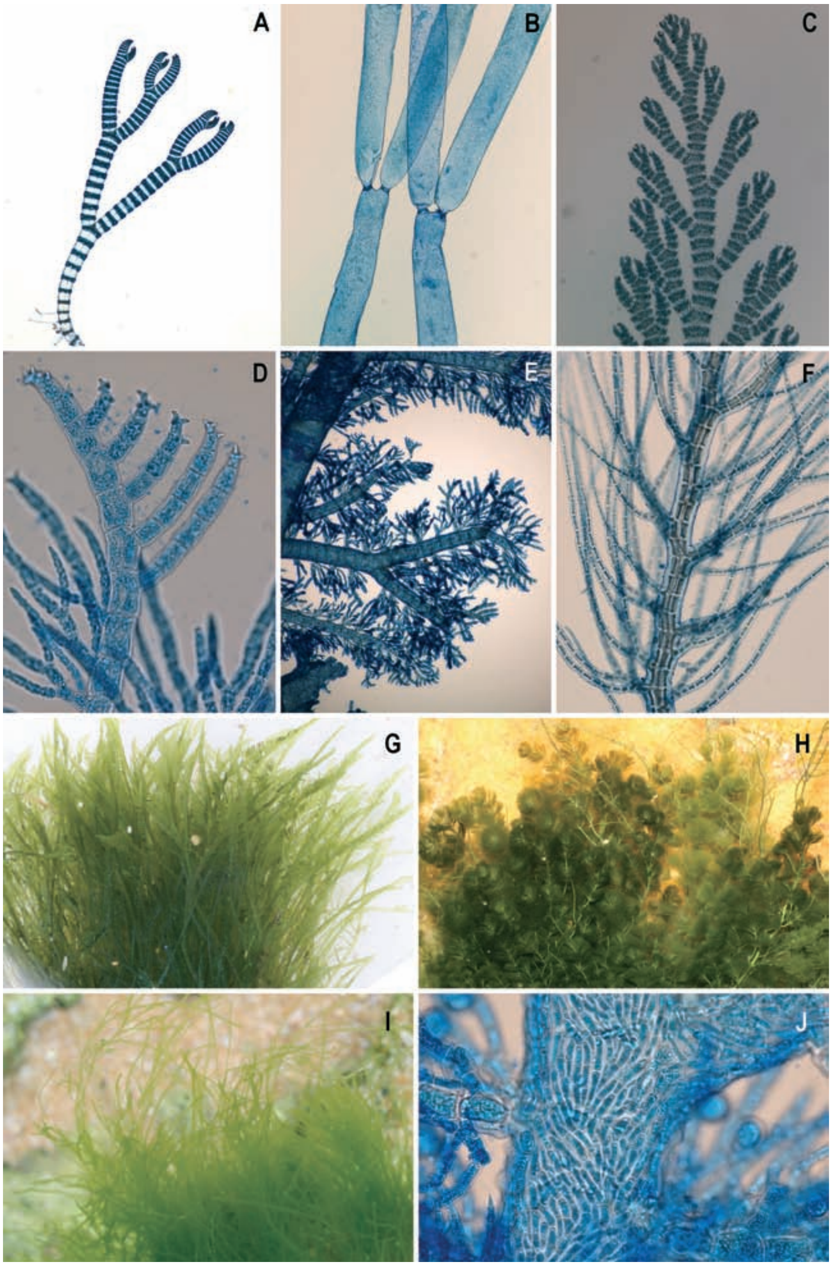


Fig. 36. Seaweed morphology: branching pattern; cortication. A. Dichotomous branching in *Ceramium* sp.; B. Dichotomous branching of the coenocytic filaments of *Chlorodesmis*; C. Sympodial branching in *Ceramium* sp.; D. Unilateral branching in terminal branches of *Euptilota fergusonii*; E. Alternate 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.

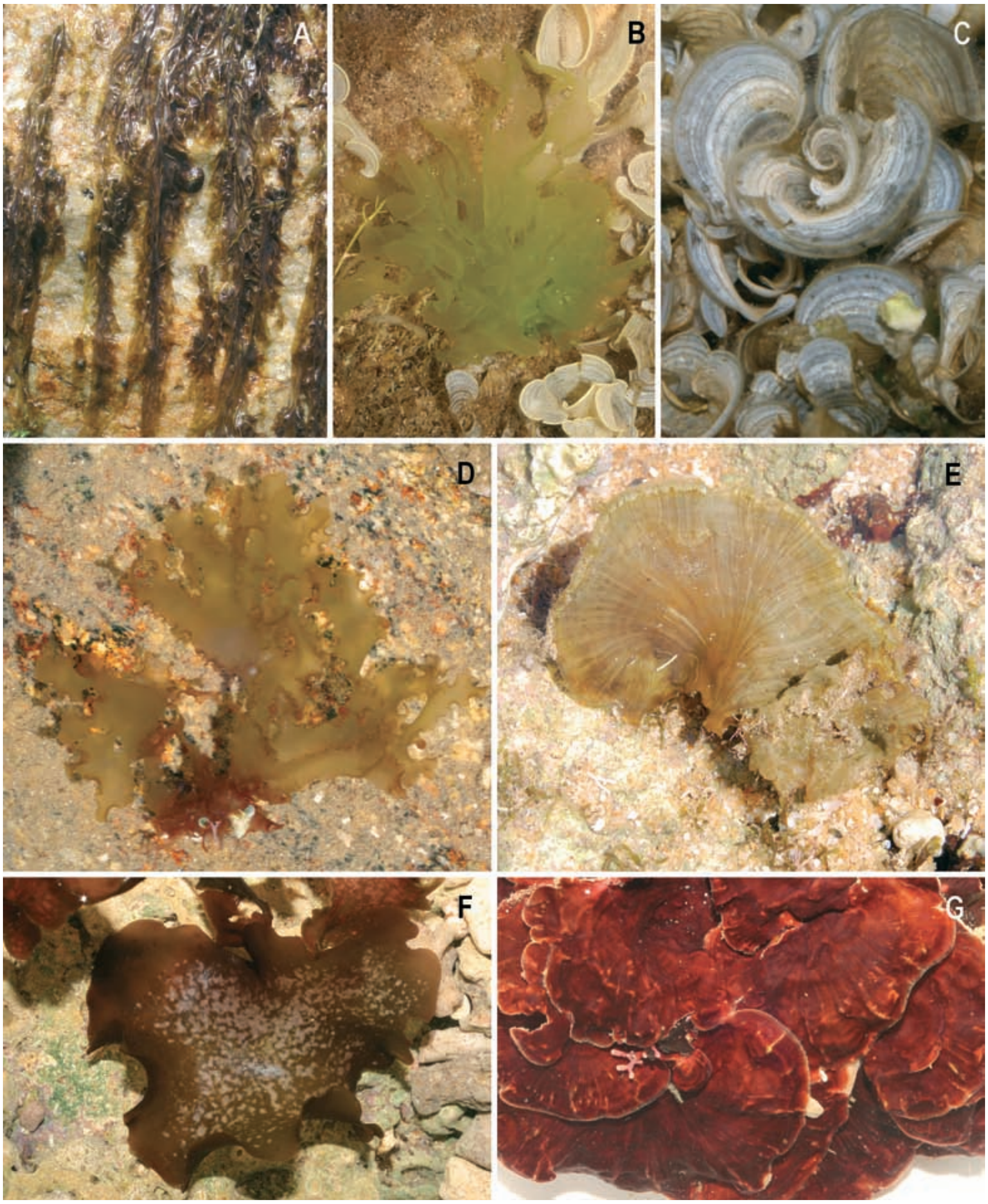


Fig. 37. Seaweed morphology: blades. A, B. Blade-like species can be very thin and membranous, a single cell-layer thick: A. *Porphyra*; B. A blade-like *Ulva*, two cell layers thick, surrounded by blades of *Padina*, 3 to 4 cell layers thick; C. Funnel-shaped blades of *Padina*, 3 to 4 cell layers thick; 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.

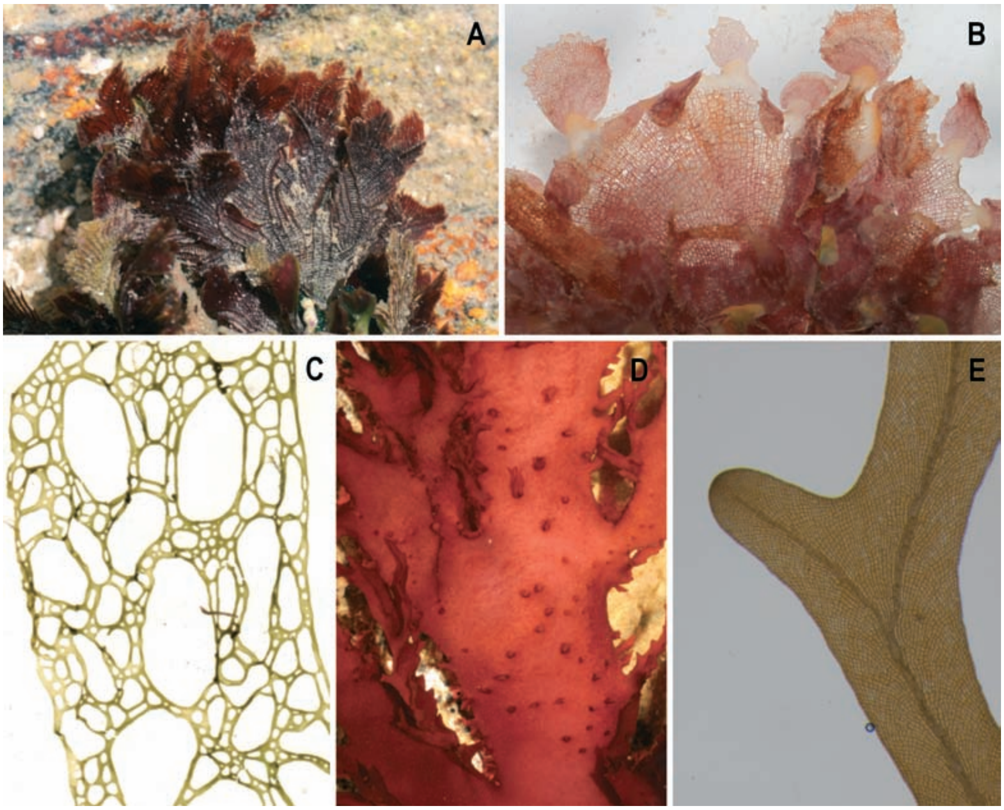


Fig. 39. Seaweed morphology: anastomosing blades; perforations; proliferations; midvein. A, B. The straps can anastomose and form a two-dimensional reticulum (A: *Claudea multifida*, B: *Martensia fragilis*); C. The blades can be (regularly) perforated (*Ulva reticulata*); D. The blades can present surface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

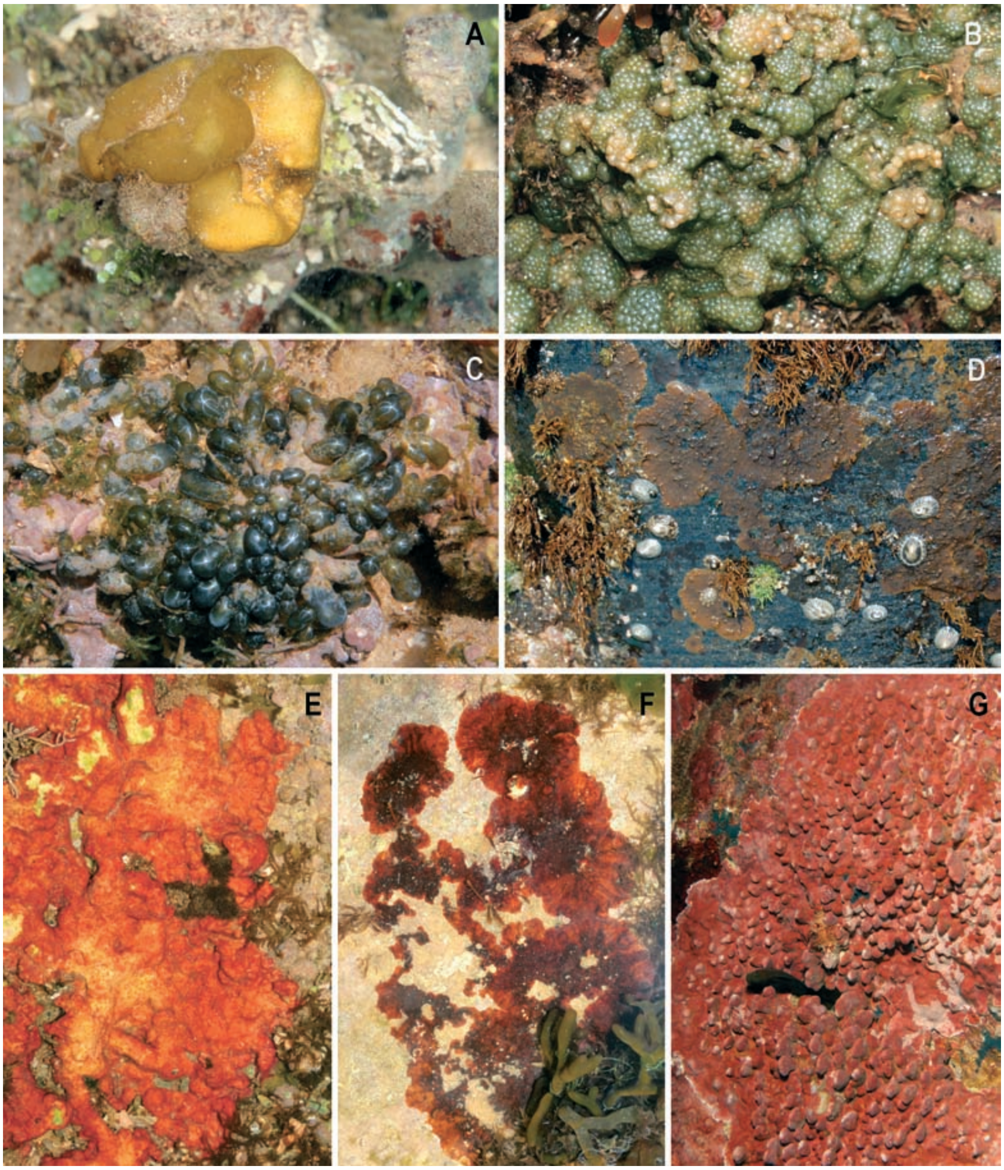


Fig. 40. Seaweed morphology: inflated and crustose. A. Some seaweeds look like brains (cerebriform): *Colpomenia sinuosa*; B. Cerebriform thalli of young *Dictyosphaeria cavernosa*; C. Thalli composed of large inflated cells: *Valonia utricularis*; D-G. Crustose algae: D. *Ralfsia ceylanica* (between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

The most complex seaweeds are composed by holdfast(s), stipe(s) and frond(s). A typical example of this morphology is the genus *Sargassum* (Fig. 41A). The function of the holdfast is solely attachment (as opposed to roots in higher plants which also play a role in extracting water and nutrients from the soil). It can be rhizoids (thin filamentous structures: *Caulerpa* spp., Fig. 41B). In *Avrainvillea erecta* (Fig. 41C) and *Halimeda macroloba*, these filamentous structures get intricated and hold large amounts of sand, resulting in a 'bulbous holdfast' which is completely sunken in the soft substratum. Attachment can also be performed by a disc (most *Sargassum* spp., most red algae, Fig. 41D). The stem-like portion (stipe) of the thallus can be cylindrical or compressed, unbranched or branched, supple or rigid. It bears one or several blades (the genus *Sargassum*, Fig. 41G) which are wider than the stipe and are the main photosynthetic part of the seaweed. At the basis of the stipe, horizontally spread branches can be present (stolons or rhizomes, Figs 19D, 41E, F), spreading across the substratum, possibly attaching to the substratum again and giving rise to new uprights. In some species (*Sargassum*) the uprights bear air bladders (Fig. 41H) as 'floaters', to keep the plant upright and optimalize the surface for photosynthesis.

Fig. 41. Seaweed morphology: holdfasts, leaf-like structures, air bladders. A. *Sargassum* sp.: a thallus with holdfasts, stipes and blades; B. *Caulerpa sertularioides* with prostrate rhizomes attached by numerous rhizoids; C. *Avrainvillea amadelpha* with a bulbous holdfast composed of intertwined filaments; D. *Halymenia durvillei*: discoid holdfast; E. *Turbinaria* sp. with stolons; F. *Gracilaria corticata*, with basal stolons; G. *Sargassum crassifolium* with leaf-like blades on the stipes; H. *Sargassum crassifolium* with air bladders (aerocysts).

The growth direction of seaweeds can vary: most are erect (*Dermonema virens*, Fig. 42A), at least when they are submerged. Others grow horizontally and mostly have numerous attachment points to the substratum (*Dictyota* sp., Fig. 42B): they are prostrate. Some are horizontally spread in the basal portion, but upwardly curved towards their apices (*Halimeda gracilis*, Fig. 42C): they are ascending, or downwardly curved: they are arcuate (*Valoniopsis pachynema*, Fig. 42D). Others again are horizontally spread from a vertical wall (*Peyssonnelia* spp., some *Halimeda* spp. Fig. 42E): they are resupinate. Finally some seaweeds hang down from vertical or overhanging walls (some *Halimeda* spp., Fig. 42F): they are pendulous.

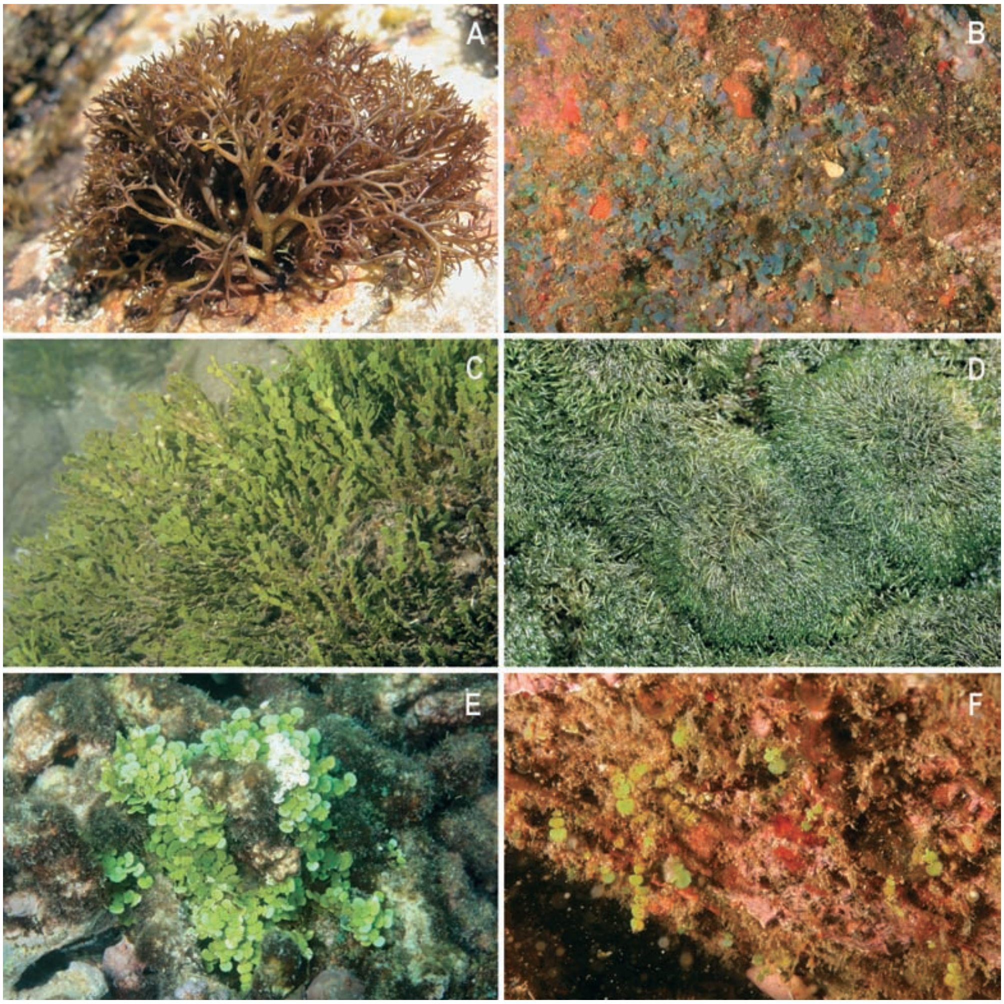


Fig. 42. Growth forms. A. Erect: *Dermonema virens*; B. Prostrate: *Dictyota*; C. Ascending: *Halimeda gracilis*; D. Arched branches of *Valoniopsis pachynema*; E. Resupinate: *Halimeda* sp.; F. Pendulous: *Halimeda* sp. hanging down from an overhang.

Another vegetative character that can be used in some groups of seaweeds is the way of cell division. In most cases, the apical cell undergoes a transverse division, the daughter cells grow longitudinally, elongating the main axes. A successive inclined division at the apical pole results in a lateral branch. If this cell division process is repeated, the result is an acropetal organization of the thallus: the side branches are progressively longer from the apex to the basis (Fig. 43A). In other taxa, intercalary cell divisions occur: older cells undergo cell divisions. This results in a non acropetal organization of the thallus: longer side branches alternate with shorter ones (Fig. 43B). In other green algae, the formation of a transverse wall at the basis of the side branch is delayed (*Cladophoropsis sundanensis*, Fig. 43C). In some green algae (the genera *Siphonocladus*, *Struvea*, *Dictyosphaeria*) a special kind of cell division occurs, called segregative cell division. A multinucleate protoplast divides into several, rounded daughter protoplasts within the mother cell (Figs 43D, E), which subsequently become surrounded by a wall (Fig. 43F). The newly formed cells are either released after rupture of the mother cell (*Valonia ventricosa*), remain *in situ* and form parenchymatic thalli (*Dictyosphaeria* spp.), or rupture old parental walls and form branches (*Struvea* spp., *Siphonocladus* spp., Figs 43G-H). In the genera *Ernodesmis* (Fig. 43I) and *Valonia*, small, lens-like cells are formed at the apex of the mature cells, growing out to new cells.

A major problem in describing or identifying seaweeds is their morphological plasticity. Depending on the ecological conditions, the same species can become larger (in a sheltered lagoon) or smaller (on the seaward, surf-exposed rock wall), less or more densely branched, plane or spirally twisted, without or with hook-like branches. An extreme example is the *Caulerpa racemosa*-complex, where on the same stolon (thus the same individual) the erect branches can have a different morphology from the proximal to the distal part of that stolon. Sometimes the side branchlets of a single upright can be different from the basis to the tip, being cylindrical at the basis, club-shaped higher up, becoming turbinate or even peltate at the tip. As the morphology of these side branchlets has been used in the past to describe taxa (species, varieties or forms), the presence of a mixture of morphologies creates major identification problems. Other seaweeds change their morphology by ageing or show sexual dimorphism (the genus *Sargassum*, *Boodlea composita*-*Phyllodictyon anastomosans* complex).

On the other hand, molecular systematics frequently points out to ‘cryptic diversity’: seaweeds with a similar morphology appear to belong to different taxa, based on the DNA-information. As a result, new species will have to be described, preferably with (at least) a distinguishing morphological or anatomical character or a different geographical distribution (the different taxa being present in different oceans).

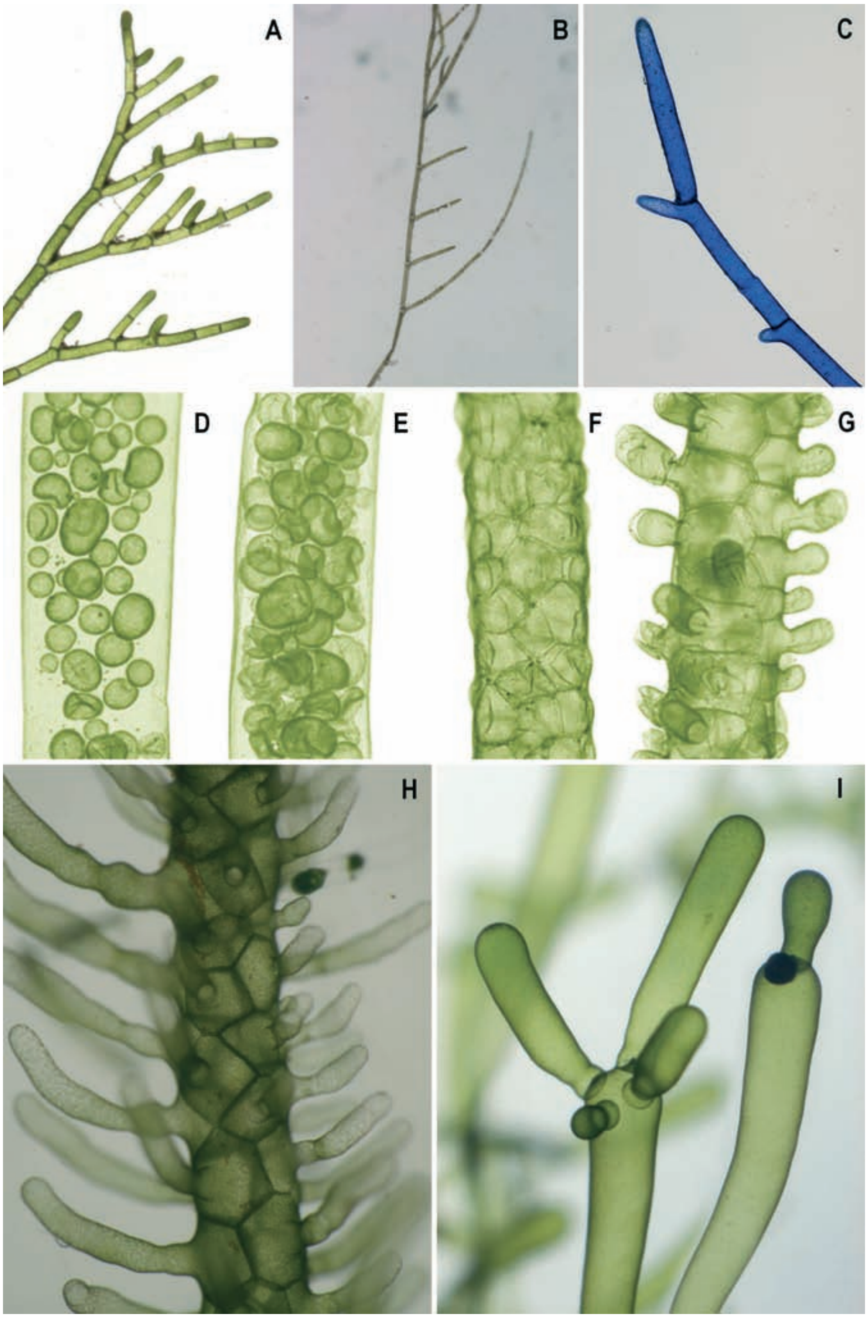


Fig. 43. Cell division. A. Acropetal organization: the branchlets gradually become more developed proximally; B. Non acropetal organization, with short branchlets alternating with longer ones (*Cladophora sericea*); C. Postponed transverse cell wall formation after the formation of a lateral branch (*Cladophoropsis sundanensis*); D-G. Segregative cell division in *Siphonocladus* sp.; H. Final stage of segregative cell division: numerous side branchlets growing out of the parental cell; I. Formation of apical lenticular cells from where new cells grow out (*Ernodesmis* sp.).

8.4. Life histories and reproduction

Life histories in seaweeds are complex; moreover they vary among and even within groups. Therefore only a general scheme can be given here, although characters of the reproductive structures can be critical for the identification on species or even on genus level. In most green and brown algae there is an alternation of two generations: the haploid gametophytes and the diploid sporophytes. The gametophytes produce gametes in gametangia, specialized structures which, in general, can only be observed by microscope. In several brown algae however, where reproductive structures are often grouped in sori (*Dictyota* sp., Figs 44A-D) or in receptacles with gametangia in *Sargassum* sp. (Fig. 44E) and *Turbinaria* sp. (Fig. 44F) which can be observed with the naked eye. The male and female gametangia are mostly produced on different plants, but in some cases they are both present on the same plant. The gametes will fuse and produce a diploid zygote which germinates into a diploid sporophyte. On the sporophyte, meiosis takes place and haploid spores are produced (*Dictyota* spp., Figs 44G, H), developing into new gametophytes. In some rare cases (*Codium* spp., *Caulerpa* spp.), the life cycle is reduced to a single diplont generation, the only haploid stages being the gametes. Moreover, in the genera *Halimeda, Caulerpa* and other green algae, the whole cytoplasmic content of the thallus is being transformed to gametes (= holocarpy, Fig. 44I).

In red algae, the life history is even more complex by the addition of a third generation: fertilisation of the female gamete (carpogonium) attached on a carpogonial branch, is performed by a male gamete (spermatium), produced in a spermatangium (Fig. 45A); spermatangia can be grouped in sori (Fig. 45B). The diploid zygote remains attached to the haploid female gametophyte and develops in a diploid carposporophyte. This part of the life history (a generation) usually has only small dimensions, but generally visible with the naked eye, as globular structures, called gonimoblasts (Fig. 45C) or as lateral, ball-like structures, called cystocarps (Figs 45D-F). In some cases, the cystocarps are embedded in the thallus and therefore more difficult to see in the field. The carposporophytes produce diploid carpospores which germinate after liberation into tetrasporophytes in which meiosis takes place with the production of haploid tetraspores (Fig. 45G) which in some cases can be grouped in stichidia (Fig. 45H) or in sori (Fig. 45I). The tetraspores germinate into haploid gametophytes. In most of the red algae, the life cycle thus consists of three generations, of which the gametophyte and the tetrasporophyte are often (almost) identical. In some cases (*Asparagopsis taxiformis*), the tetrasporophyte (*Falkenbergia hildenbrandii*) is markedly different from the gametophyte (Fig. 45J). In the past, both generations of that seaweed have been described as different algae, placed in different genera, as phycologists then were unaware of the fact that they represent two phases of the same seaweed. It is only after culture experiments in aquaria that this was discovered. In some brown (*Sargassum*) and red algal genera (*Liagora*) one of the phases can be microscopic or crustose.

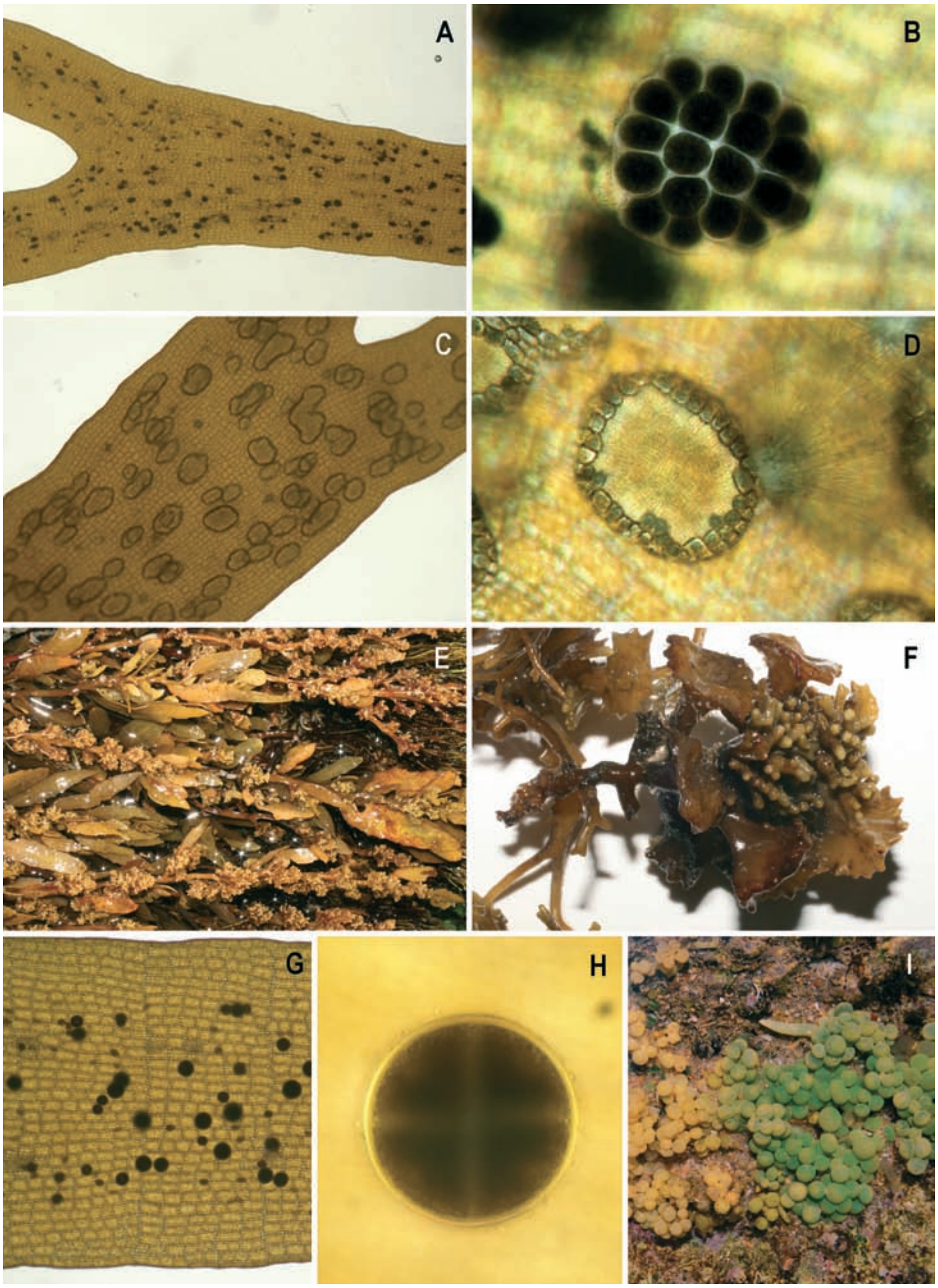


Fig. 44. Reproduction structures in brown and green algae. A. Sori of female gametangia (oogonia) on the haploid gametophyte of a *Dictyota*; B. Detail of a sorus of oogonia of a *Dictyota*; C. Sori of male gametangia (spermatangia) on the haploid gametophyte of a *Dictyota*; D. Detail of a sorus of spermatangia of a *Dictyota*; E. Receptacles of a *Sargassum*, containing the gametangia; F. Receptacles of a *Turbinaria*, containing the gametangia; G. Tetrasporangia on the diploid sporophyte of a *Dictyota*; H. Detail of a cruciately divided tetrasporangium of a *Dictyota*; I. A *Caulerpa*-plant in which the formation of gametes is taking place (the yellowish part of the thallus).

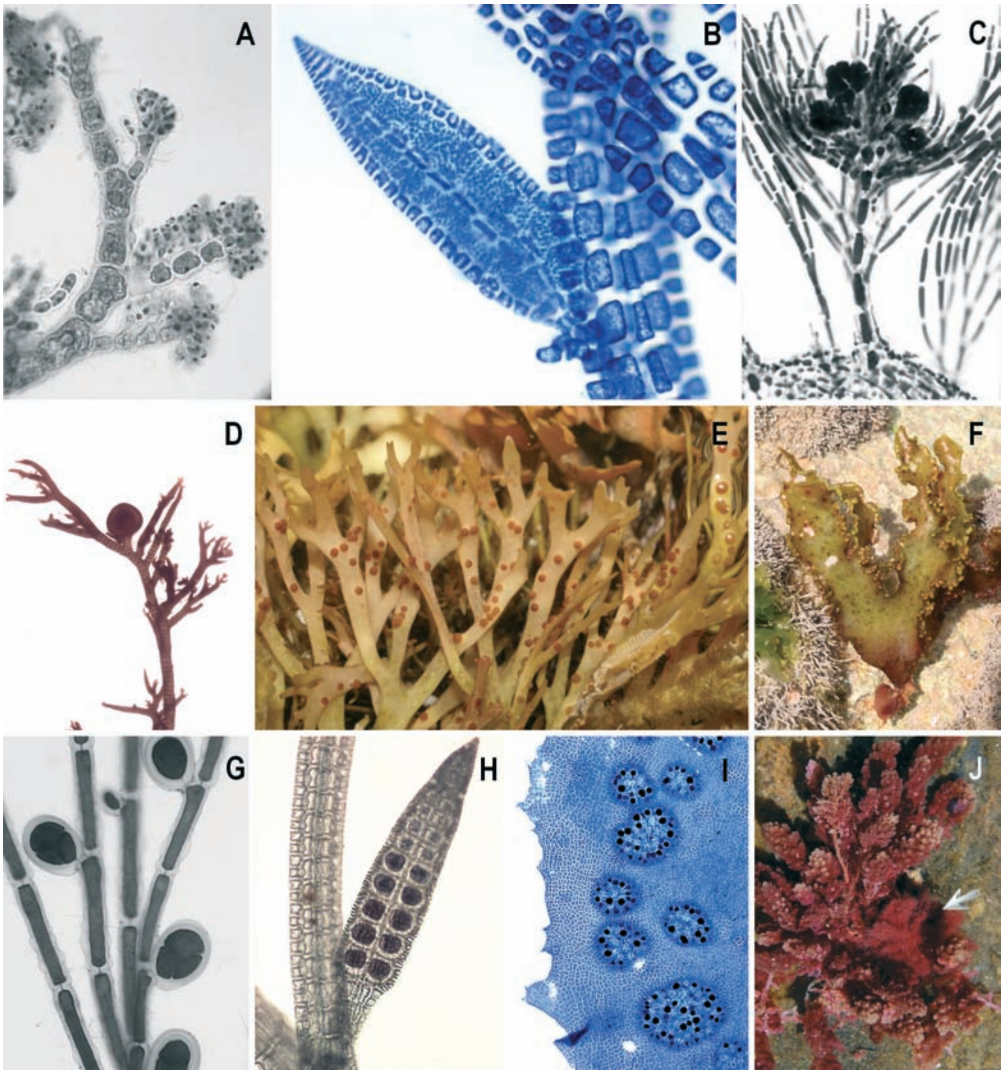


Fig. 45. Reproduction structures in red algae (mainly shown by African examples). A. Spermatangia in *Sciurothamnion stegengae*; B. A sorus of spermatangia in *Platysiphonia delicata*; C. Gonimoblasts (groups of diploid carpospores) in *Sciurothamnion stegengae*; D. A cystocarp on *Rhodomelopsis africana*; E. Cystocarps as wart-like protrusions on *Gracilaria corticata*; F. Cystocarps (mainly) on the margin of the female blade of *Sarcodia montagneana*; G. Tetraspores in *Sciurothamnion stegengae*, produced after meiosis in tetrasorangia on the diploid sporophyte; H. Tetrasporangia in a stichidium of *Platysiphonia delicata*; I. Sori of tetrasporangia in *Augophyllum marginifructum*; J. *Asparagopsis taxiformis*: the large gametophyte with cystocarps and the filamentous tetrasporophyte (*Falkenbergia hildenbrandii*) in the centre (arrow).

Reproductive structures, or even the presence of a particular life history phase, are generally seasonal. It is therefore imperative to carry out collecting in different seasons as reproductive characters are mostly needed for correct identification (as flowers are in higher plants).

Many seaweeds also reproduce asexually (without formation of gametes), by the production of asexual spores. Some even multiply vegetatively, by fragmentation (some branches break off, stay alive, attach to the substratum and go on growing to new plants) or by production of propagules (*Sphacelaria* spp.: branchlets with a special morphology, detaching from the mother plant and each of them producing a new juvenile; Fig. 104). Others again, growing in soft substratum, can produce underground, horizontally growing bundles of rhizoids from which new erect plants develop (genera like *Udotea*, *Halimeda*, …).

8.5. Biodiversity of seaweeds

In most biodiversity studies the algae are omitted, probably because they are 'invisible' as a result of their submersed habitat. The total number of species of algae is difficult to assess: the important environmentally induced morphological plasticity and variability results in major identification problems: some entities are classified on different taxonomic levels, depending on the author (species, variety, form). The total number of Algae [including (freshwater) microalgae] would be approximately 350 000 spp. (Brodie & Lewis, 2007).

Some areas in the world are more species rich than others. In the Pacific Ocean, species-rich areas are the Philippines and Japan; in the Atlantic Ocean: Europe (N-Spain, France, United Kingdom), the Caribbean Sea. The Red Sea and the Indian Ocean are still understudied, but South Africa and southern Australia seem to have a high seaweed diversity. In South Africa this could be the result of the presence of different climate zones.

Maximum seaweed endemism is present in Antarctica, southern Australia and New Zealand.

Based on data from the literature, Silva *et al*. (1996) mention 455 taxa belonging to 410 species and 161 genera for Sri Lanka. However, as already mentioned in the chapter on the history of seaweed research in Sri Lanka, this island is absolutely understudied. Historical collections from sublittoral biotopes are sporadic, and recent ones are still under study. A study by Mallikarachchi (2004) shows that a large percentage of the known seaweed flora of the island is present along a limited SW-shoreline. This conclusion is partly biased as this part of Sri Lanka has been most frequently visited by phycologists, whereas collections from the N and East coast are scarce and therefore even more fragmentary.

Smaller species (such as turf-forming algae and epiphytes) are more numerous, adding to the species diversity, but they are not readily observable/identifiable and therefore most of these are not included in this Field Guide.

8.6. Nomenclature, taxonomy and classification of seaweeds

The nomenclature of algae (giving scientific names to organisms and groups to which they belong), similarly to higher plants, follows the International Code of Botanical Nomenclature (ICBN, 2006). Macroscopic seaweeds belong to 4 Divisions (or Phyla) if the blue-greens are included: Cyanophyta (Cyanobacteria) - Blue-green algae (prokaryotic), Chlorophyta - Green algae, Phaeophyceae - Brown algae, Rhodophyta - Red algae. The divisions are subdivided in classes, which names end on -phyceae (exclusively for Algae). The classes contain orders, ending on -ales, subdivided in families, ending on -aceae. The nomenclature in botany (including flowering plants, ferns, mosses, algae and fungi) is binomial, meaning that the name is composed of two words: the genus name (e.g. *Rhodymenia*), with a capital initial followed by the species epithet (e.g. *Rhodymenia tripinnata*) written in lower case. The genus and species names are usually written in italics. They are followed by the name of the author who described the species (e.g. *Rhodymenia tripinnata* Hering). Sometimes, further research shows that the original author placed the species in a wrong genus. In this case, the name of the first author is placed between brackets and the name of the author who makes the new combination (putting the species in the correct genus) is added (e.g. *Portieria tripinnata* (Hering) De Clerck). In some species, subentities (infraspecific taxa) are distinguished which are called varieties (var.) or forms (f.), the names of which are again usually written in italics.

When proposing a new species, a type specimen is designated after which the species is described. For seaweeds this is generally a herbarium specimen, which is then deposited in a registered herbarium. Quite frequently isotype specimens are deposited in other important herbaria. These isotype specimens were collected at the same type locality (place where the type specimen is coming from), on the same day as the type specimen and were regarded as 'duplicates' by the original author (= form part of a single collection). Type specimens are extremely important for subsequent studies of the species (checking for new characters, for DNA-analysis, …). Preferably, several specimens should be mounted on a 'type sheet', with the indication of the real type specimen, the holotype, as to show the morphological variation of the species (sometimes gametophytes and sporophytes are (slightly) different, or different ecological situations induce a morphological change).

The description of a new species of seaweed has to include the reference to the type specimen as well as a diagnosis in Latin (what are the characters of this species, distinguishing it from other species of the same genus). Illustrations also have to be added.

Subsequent analysis sometimes indicate that two 'species', each with their own name, described from different areas (even from different oceans) are identical. Only a single name can be applied for that species, and the name from the oldest description has to be chosen; the other name then becoming a synonym. Opposite to this, molecular analysis sometimes proves that a species, present in different oceans (with a similar morphology at the different locations), belongs to different species according to the locality (cryptic species). The specimens from the type locality then keep the original name, whereas the other ones have to be described as new species. A thorough study of morphological and anatomical characters then 'hopefully' leads to discriminating characters for each species. All this means that names of seaweeds change in time and that the same taxon can have different names in different books, depending on the time of publication. If one is compiling a species list from a region, he should be aware of these synonymies for not including the same species several times under different names.

As a result of ongoing molecular research, the higher rank classification of seaweeds also changes on a regular basis. We here follow the Index Nominum Algarum (http://ucjeps.berkeley.edu/INA.html) and Guiry & Guiry (2009; www.algaebase.org) which are both excellent sources for keeping up with recent taxonomic revisions as they are continuously updated (see remark at introduction of Rhodophyta). Silva *et al*. (1996, http://ucjeps.berkeley.edu/rlmoe/tioc/ioctoc.html) is also an excellent basis to find synonymies, taxonomic remarks, and a systematic classification of the seaweeds of the Indian Ocean. Be aware, however, that since 1996 a surprisingly large number of names have changed already.

As opposed to terrestrial plants, seaweeds rarely have common (vernacular) names. Moreover, they sometimes induce confusion, such as ‘Ceylon Moss’ which is not a moss at all, but a red alga, *Hydropuntia edulis* (not included in the present book).

8.7. Identification of seaweeds

If possible, one should start by following a training course where specialists can introduce you to the most common genera and species of the area. If this is not possible, Field Guides on the area (such as this book) or from the same ocean or from an adjacent tropical region should be used. They are becoming more numerous nowadays. Useful recent guides for Sri Lanka are: Huisman (2000) on Marine Plants of Australia, Littler & Littler (2003) on South Pacific reef plants, De Clerck *et al.* (2005a) on the seaweeds of Kwazulu-Natal, Oliveira *et al*. (2005) on Marine Plants of Tanzania, Huisman *et al*. (2007) on Hawaiian Reef Plants, Ohba *et al*. (2007) on Marine Plants of Palau, Skelton & South (2007) on Samoan Benthic Marine Algae. For the identification of red turf algae, Price & Scott (1992) is very useful. Anyway, one should remain cautious with identifying organisms solely based on field guides: as opposed to a real ‘Flora’ they only contain the dominant species! The possibility that a different, closely related species was collected cannot be excluded. Therefore, the next step is the use of (preferably recent) monographs of a group (e.g. De Clerck, 2003 on the genus *Dictyota* in the Indian Ocean, or Leliaert & Coppejans, 2006 on the genus *Cladophoropsis*) or detailed regional publications (e.g. Van den Heede & Coppejans, 1995 on the genus *Codium* from Kenya, Tanzania and the Seychelles; Kraft, 2007 on the marine green algae of the Lord Howe Island area), as well as comparison with specimens from existing herbaria with trustworthy identifications.

Anyway, for the identification of macroalgae on species-level, morphological and anatomical characters are needed (e.g. in the genus *Codium*, measurements of utricles have to be made; in *Ulva* spp., the number of pyrenoids per cell have to be counted, …). In brown and red algae, quite often the analysis of reproductive structures is important for identification on genus and/or species level (just like flowers in higher plants!). The analysis of these characters can only be carried out in a laboratory, with the use of a microscope with a calibration plate. Sterile specimens therefore frequently remain unidentified because critical characters for species (or even genus) distinction are absent.

8.8. Seaweed resources from Sri Lanka

Natural populations of the red alga Ceylon Moss (*Hydropuntia edulis* (S.G. Gmelin) Gurgel et Fredericq) were harvested in the past for extraction of agar from its cell walls. This seaweed is quite abundant in Puttalam lagoon, but it is not collected anymore and not included in this guide.

9. Survey methods for seaweeds

For this chapter we also refer to Leliaert & Coppejans (2004); http://www.persga.org/.

9.1. Qualitative assessment of the macroalgal flora of an area

Qualitative assessment of the marine flora of a coastal area implies general collecting in a specific area, resulting in a more or less complete list of species. Depending on the study, the coastal area can vary from a small area (e.g. a coastal strip of 10 m, a rock outcrop, etc.) to a large area (e.g. one to several km of coastline, a small offshore island, etc.). When comparing species numbers or biodiversity indices of different coastal areas, these areas should be of comparable size. The resulting species list is important for calculating biodiversity indices of an area. A major disadvantage of qualitative collection data is that species abundance is not taken into account. This can partially be corrected by making the sampling method semi-quantitative. This implies that each species is ranked based on its abundance, evaluated by visual observations. An example of such a ranking is the Tansley scale (Table 1 in Appendix). The growth form (sociability) of the seaweeds can also be taken into account; here the Braun-Blanquet's sociability scale can be used for each species (Table 2 in Appendix). As a matter of fact, Braun-Blanquet's cover-abundance scale is most used (Table 3 in Appendix). These data can be added on the herbarium labels.

9.1.1. Getting ready for fieldwork

It is evident that adapted clothing (protection against the sun/rain) is needed. In this respect good footwear is extremely important. The use of booties (tight, ankle-high, rubber boots with a thick sole and a zipper) is advisable, as well on rocky as on sandy or even muddy substratum, because they completely protect the feet against sharp obstacles (barnacles, oysters, coral fragments, …). If snorkeling is planned, a (thin) rubber wetsuit is useful for protection against sharp walls or irritating animals (jelly fishes, siphonophores, …), or at least knee pads. The availability of a towel also comes out handy.

The value of a report/publication on the biodiversity of an area largely depends on the presence of reference (voucher) specimens which allow ulterior control of the identifications. On its turn, the value of these specimens depends on the field data which are added to them. Therefore, a notebook (intertidal work) or a white plexiglass plate (in the subtidal and in intertidal pools) and a pencil are indispensable (Fig. 46A). Collecting gear includes a bucket, plastic vials, plastic bags, prenumbered labels on hard paper. Many algae and some seagrasses can be removed by hand, but a scraper or a stout knife may be handy or even necessary. Some thick encrusting algae can be removed with a knife, but many (especially the crustose coralline algae) must be collected along with the substratum. This can only be done by use of a heavy instrument such as a hammer and a chisel.

Fig. 46. Field work. A. Using a plexiglass plate and a pencil for taking notes in the water; B. Collecting by wading at low tide; C. Even with a seemingly smooth sea, a sudden big wave can emerge; D. Fully equipped for SCUBA-diving and underwater photography; E. Putting specimens in zip-lock bags during SCUBA-diving; F, G. Sorting out specimens on the field.

If available, a camera, a map, and a Global Positioning System (GPS) can be extremely useful. Be careful in this wet environment: put them in a watertight camerabox or (ziplock) bags!

Intertidal habitats can be sampled by wading (Fig. 46B) during (extreme) low tide or by snorkeling at high tide. Therefore, check the time of low tide as to get organized for the sampling. If snorkeling is planned (deep intertidal pools or subtidal) mask, snorkel, fins, mesh bag, plastic collecting bags and labels shouldn't be forgotten. For extensive collecting or observation in the subtidal, SCUBA diving is advisable. Next to the snorkeling gear, a rubber suit, a belt, weights, the full air-cylinder, regulator, diving watch, depth gauge, inflatable backpack (= BCD, buoyancy control device), and a buoy should be brought or hired at a diving center (Figs 46D, E). These generally check the diving license, so don't forget to bring it.

Freshly collected specimens should be processed as soon as possible to minimize decay. If the way back to the laboratory is long, the specimens might decay under way. It then is preferable to prepare the collected specimens in the field (Figs 46F, G) or to store them in a cool box. If specimens are sorted at the collecting site, bring sorting and preparation trays, a floater, herbarium paper, a plant press with straps, card board, newspaper and fleeces, jars (Eppendorfs) and silicagel, formalin, zip-lock bags and hermetically closed jars (e.g. ice cream boxes).

9.1.2. Arriving in the field

Note the date, the locality (name of the closest town or village + eventually local name of the collecting site). If you have a GPS-system: add the GPS and longitude-latitude coordinates.

Make a general description of the site: is it a peninsula (Fig. 6B), a straight coastline, eventually with a beachrock platform (Fig. 4), a wide bay (Fig. 3B), an enclosed bay (Fig. 3C), isolated rocky outcrops (Figs 7C, D), an island (Figs 7B, C), a lagoon (Fig. 3D)? Describe the substratum: solid rock (Fig. 6A), boulders (Fig. 6C), sand, mud. Rate the general coast inclination: overhanging, vertical, sloping, subhorizontal. Give a general description of the biotope(s): seaweed vegetation (Fig. 6C), seagrasses (Figs 12A, B), mangrove (Figs 13A-C), coral reef (Fig. 7E).

Eventually add pictures.

9.1.3. Field collecting

Extensive and well-prepared collections are the basis of diversity based studies of (marine) organisms. The importance of good collections for taxonomic studies is evident, but it is equally important that representative collections - often referred to as voucher specimens - be kept of each species recorded in ecological surveys. Without such specimens, there is little or no possibility of later checking on the basis of names used in publications. Such specimens should be numbered, labeled and be deposited in a recognized herbarium (Womersley, 1984).

Take the time of low tide into account, certainly if you want to collect by wading. If it is already low tide upon arrival, go to the lowermost part first and come up with the tide. Take care not to get encircled by water. If the tide is still going down, go down with the tide and do the uppermost parts on your way back.

Collecting can be done by species (a single species and label per bag: numerous bags will be needed, but sorting out will be much easier); note the field identification of each number. Sometimes preference is given to collecting by biotope (a pool, a rock wall, a phorophyte: several species in a single bag, but with a single label). In species-rich areas or time shortage the latter method is being used. Always add ample seawater in the bags as to avoid decay by temperature rise or desiccation. Also add a label, which corresponds with a number in your note book (plexiglass plate) where you add: the detailed ecology of the collecting site (air-exposed/submerged at low tide;

pool: vertical/overhanging/sloping wall/(sand-covered) bottom; epilithic/epiphytic (on what?); the level relative to the tides (above high tide level (supralittoral); between high and low tide (intertidal (high -, mid -, low -)); under low water mark (subtidal)). Make notes on morphological characters which will be lost after processing the specimens, such as growth form (isolated plants, individual tufts, gregarious, forming intricated cushions); growth direction (erect, ascendant, prostrate, pendulous); *in situ* colour: some seaweeds are iridescent when alive; some seaweeds change colour upon drying; consistency: membranous, gelatinous, cartilaginous, stiff, brittle; eventually, presence of reproductive structures.

ALWAYS collect several specimens as to illustrate morphological variability and to be able to look for fertile specimens. ALWAYS collect complete specimens, including the holdfast as this might be a character needed for identification: presence of a disc, haptera, rhizoids, a bulbous structure.

While collecting, be aware of possible danger: even with a seemingly smooth sea, a sudden big wave can emerge (Fig. 46C).

9.1.4. Coming back from the field

If the laboratory is far from the sea and not provided with seawater, collect a (plastic) drum with seawater for sorting out the specimens, or … sort out in the field! (Figs 46F, G).

9.1.5. Sorting out the specimens

If the species have been collected individually, put them in separate trays (vials) and add the field number. If the collecting was made by collecting site, put the collection of one bag and its label in a large tray and sort out the different species in smaller trays (vials) giving them each a subnumber (e.g. collection from site 3: species 3a, 3b, 3c, 3d) (Fig. 47A).

9.1.6. Finally numbering and labelling the species

Copy the data from your field notebook or from the plexiglass plate on the computer or in the final notebook: date, place, general description of the site.
Each species gets a final serial number, preferably preceded by the collector's initials (e.g. HEC = Herbarium Eric Coppejans). Start with 0001 and go on all of your life: e.g. day 1: HEC 0001-0024, day 2 HEC 0025 – 0056 and so on). Add the detailed ecological data from the field as well as the morphological data (eventually add observations carried out in the laboratory). A HERBARIUM SPECIMEN WITHOUT A (complete) LABEL IS SCIENTIFICALLY (almost) USELESS!

Individual labels are printed out and added to the herbarium specimens. All these label data are introduced in a database. This way data can be retrieved by: collector, place, period, genus or species level (over different regions, oceans); herbarium, formalin preserved, silicagel, culture specimens.

The final label

Number: HEC 16128 (eventually +F, +S, +L; see further)
Name: *Caulerpa racemosa* (Forsskål) J. Agardh
Locality: Sri Lanka, Galle, in front of the lighthouse
Collection date: 15 August 2008
Ecology: on the sand-covered bottom of a low intertidal pool
Morphology: thallus fleshy, dark green, with starlike, slightly iridescent light green stripes; well attached to the substratum by numerous rhizoids; stolons prostrate, intricated; uprights with short rachis and densely set vesicular branchlets, resulting in a grape-like appearance
Collector: Eric Coppejans
Identification: W.F. Prud'homme van Reine (+ date of identification)

9.1.7. Preparation of a herbarium specimen

- Take a tray and fill it with clean SEAwater;

- Put a (cork)floater in the water (or an inclined smooth surface; Fig. 47B); take a bristol card (or strong drawing paper) of the size adapted to that of the specimen that you want to prepare;

- Write the serial number IN PENCIL in the right down corner;

- Put the bristol paper and the seaweed in the tray, on the floater (Fig. 47C);

- Choose (a) nice, complete specimen(s) (with holdfast; eventually fertile);

- Arrange the specimen(s) in an optimal way, by pushing the floater under water (Figs 47D, E); filamentous, supple specimens can be spread by a small brush;

- Take the floater, bristol card and specimen slightly inclined out of the water and let the surplus of water run off (Fig. 47F);

- Put the bristol card + specimen on a newspaper on a horizontal surface and let it air-dry somewhat (Fig. 47G); don't leave it in the sun and don't wait too long: the specimens should not shrivel!

- Put the air-dried specimens between newspapers, covered by a fleece (Figs 48A-E), preferably regularly alternated by corrugated cardboard (for aeration);

- Close the plantpress with belts or put weights on them (Fig. 48F);

- Keeping the plant press in the sun or adding a ventilator directed on the press increases the drying speed, avoiding molding of the specimens; NEVER put the plant press in an oven (unless it is a drying oven with ventilation)!

- Change the newspapers (not the flieces) daily until the specimens are dry;

- Mount the herbarium specimen on standard dimension sheets (eventually stick the loose plants with glued paper strips, never directly with glue; certainly don't plastify them!!!) together with the label (Figs 49A, G);
- Store in a dry room, sheltered from direct sunlight (Figs 49B-F).

Fig. 47. Preparing herbarium specimens. A. Sorting out specimens in trays filled with seawater; B. The cork floater in the tray filled with seawater; C. The numbered bristol card on the floater; D. Arranging the specimens of the bristol card; E. Specimens arranged on the bristol card, on the floater, still in the tray with seawater; F. Taking the floater and the bristol card with specimens out of the water, letting drip off most of the water; G. The bristol card with specimens is (shortly) air dried.

Fig. 48. Preparing herbarium specimens. A. In the plant press a corrugated cardboard and dry newspaper is placed; B. Placing the bristol card with specimens on the newspaper; C. Putting a fleece on the specimens; D. Adding a newspaper on the fleece; E. Adding a corrugated cardboard on top; F. Closing the plant press.

Fig. 49. Storing specimens. A. Example of a seaweed herbarium specimen (*Grateloupia lithophila*) and label in the ring binder at the GENT herbarium; B. The National Herbarium of Sri Lanka in Peradeniya; C. The inside of the National Herbarium of Sri Lanka; D. The cupboards where the specimens are kept in the National Herbarium of Sri Lanka; E. Cupboard with the large herbarium specimens at the GENT herbarium; F. Cupboard with smaller herbarium specimens classified in ring binders at the GENT herbarium; G. A mounted specimen of *Acrosorium ciliolatum* (Harvey) Kylin, with field identification on the full label and final identification on the 'Determinavit-label'.

9.1.8. Formalin-preserved specimens

Most herbarium specimens can be resoaked for anatomical analysis, but most of the time cells remain shrivelled and cytological details (e.g. plasts) difficult to observe. Therefore it is better to keep (part of) a specimen in 4% formaldehyde (pure formalin = 40%, so 1 part of formalin + 9 parts of SEAwater; the concentration is not critical and even half the above will usually give good preservation). Add the same label (number) as the serial number of the herbarium specimen and add '+F' on the herbarium label and in your data set as to indicate that there is a formalin-preserved specimen.

Formalin is a strong irritant and carcinogenic and therefore should be handled with care, avoiding inhalation or direct contact with the skin. Store the formalin preserved specimens in hermetically closed vials, out of the light, in a (preferably cool) room with ventilation and NEVER in a room where persons are working on a regular basis (separate store room)!!!

9.1.9. Silica-preserved specimens

Fragments of most herbarium specimens can be used for molecular analysis (in as far as they have not been previously stored in formalin), but most of the time results are (much) better when fragments are immediately dried in silicagel. Therefore, Eppendorfs are being used, (almost) filled with fine-grained silicagel. The Eppendorfs should be kept closed at all times, otherwise the silicagel would attract air humidity. Only a small fragment (a few mm only) of an apical part of the specimen should be cut off and cleaned and dried with a paper tissue. The young apices are less epiphytized but still have to be cleaned as to remove the eventual single-celled epiphytes (e.g. diatoms). The fragment is put in the Eppendorf and a tiny label with the same serial number as the herbarium specimen is added (Fig. 50A). The Eppendorf should be closed immediately (Fig. 50B) and somewhat shaked, as to completely surround the fragment by silicagel: the quicker the drying process, the better the molecular extraction will proceed. Some scientists prefer to dry two fragments for the case that the DNA-extraction on the first fragment didn't succeed. It is useful to indicate on the top of the Eppendorf that it has been used (Fig. 50C). On the herbarium label and in the data set '+S' should be added as to indicate that there is a silicagel-preserved portion. Of course this should be deleted from the data set as soon as the fragment(s) have been used.

Fig. 50. Silicagel dried specimens. A. Putting a specimen in a labeled Eppendorf; B. Closing the Eppendorf; C. Indicating that the Eppendorf has been used.

Molecular techniques are outside the scope of this field guide. For details we refer to Hillis & Moritz (1996).

9.1.10. Living specimens

Sometimes, research is carried out on living specimens. They are put into culture for the study of life cycles, cell division, morphological variation in response to temperature, light, salinity, eutrophication, ... Therefore, small fragments (e.g. an apical branch) are isolated, delicately cleaned (to take away most of the epiphytes) and put in a large amount of seawater (+ same serial number as the herbarium specimen). In the laboratory, the fragments are brought in special vials (depending on the size of the seaweed), with enriched seawater. Depending on the research to be carried out they are brought into culture rooms with controlled light intensity, light cycle, temperature, … This is a very intensive and time-consuming work as contamination by Bacteria or microalgae has to be checked continuously. On the herbarium label and in the data set '+L' should be added as to indicate that there is a living portion in culture. Of course this should be deleted from the data set as soon as the fragment died or is not kept in culture anymore. For further information on algal cultures, we refer to Andersen (2005).

9.1.11. Important remark

Although seaweeds are not included on the CITES-list of protected organisms, most countries require official authorisations for the export of specimens. The administration of an export permit can take up to several months. Furthermore, one should pay attention to import regulations specific to certain countries which may prohibit bringing living as well as dead plant material into the country (e.g. Australia, New Zealand). Therefore, inform yourself well and take care of starting up the necessary procedures well in advance.

9.2. Quantitative assessment of the macroalgal and seagrass flora of an area

For this chapter we refer to Leliaert & Coppejans (2004).

10. Divisions of Algae from Sri Lanka and general remarks

Voucher specimens of the taxa included in this Field Guide, collected by Eric Coppejans have been deposited in the herbarium of the Ghent University, Belgium (GENT); many more specimens, of taxa not included in this book, are also deposited in GENT. Specimens collected by Upali Mallikarachchi are deposited in the herbarium of the Botanical Garden of Peradeniya (PDA) and at the University of Ruhuna (Matara).

We do not provide identification keys as they may give the false impression that all taxa occurring along the Sri Lankan coast are included. This is definitely not the case: only the dominant species are presented.

Several genera are under monographic study in different research institutes all over the world. Molecular data indicate that the actual species concept in some of these genera (*Sargassum*, *Laurencia* / *Chondrophycus*, *Portieria*, *Gelidium, Jania,* …) have been superseded. In those cases we include some species without final identification but eventually with indication of their 'traditionally used' names.

10.1. Chlorophyta, Ulvophyceae - Green algae

Taxonomic overview of the species included in this guide. Taxa indicated with an asterisk have their type locality in Sri Lanka.

ULVALES

Ulvaceae

CLADOPHORALES

Cladophoraceae

Siphonocladaceae

Valoniaceae

BRYOPSIDALES

Bryopsidaceae

Codiaceae

Caulerpaceae

Halimedaceae

Udoteaceae

Ulva compressa Linnaeus
1753: 1163 Fig. 51

References: Tseng (1984: 254, pl. 126, fig. 1, as *Enteromorpha*), Huisman (2000: 230, + figs, as *Enteromorpha*), Abbott & Huisman (2004: 48, fig. 5D, as *Enteromorpha*), Huisman *et al*. (2007: 162, + figs), Kraft (2007: 35, fig. 13).

Type locality: Probably Bognor, Sussex, England according to Hayden *et al.* (2003: 289).

Description - Plants gregarious, mostly in extensive (frequently monospecific) populations; thallus tubular to slightly compressed towards the apices, erect, 2-3 (-5) cm long, with some side branches or at least smaller proliferations at the (extreme) basis, generally unbranched in the upper part, monostromatic, light green to almost transparent (bleached); in surface view, the polygonal cells with rounded corners are not systematically arranged in longitudinal rows; they are about 10-15 µm in diameter; 1 (-2) pyrenoid(s) per cell.

Ecology - Epilithic on the bottom of shallow intertidal pools.

Distribution - Reported to occur globally.

Notes - *Ulva* was circumscribed to consist of green seaweeds with distromatic blades, and *Enteromorpha* was established for tubular forms. The taxonomy of both genera in Europe has been studied by Bliding (1963, 1969) and more recently by Maggs *et al*. (2007). Molecular phylogenetic studies have demonstrated that *Ulva* and *Enteromorpha* are not distinct evolutionary entities and therefore a single genus, *Ulva*, is presently recognized (Hayden *et al*. 2003).
Numerous tubular *Ulva* species have been collected in Sri Lanka, especially in lagoons. Only some are included here.

Fig. 51. *Ulva compressa*.

Ulva fasciata Delile
1813: 297, pl. 58: fig. 5 Figs 9A; 17C; 38A; 52

References: Jaasund (1976: 5, fig. 9), Tseng (1984: 256, pl. 127, fig. 4), Trono (1997: 10, fig. 3), Abbott & Huisman (2004: 55, figs 10A-D), Coppejans *et al*. (2005: 42, fig. 9), Oliveira *et al*. (2005: 190, fig. p. 191), Huisman *et al*. (2007: 164, + fig.).

Type locality: Alexandria, Egypt.

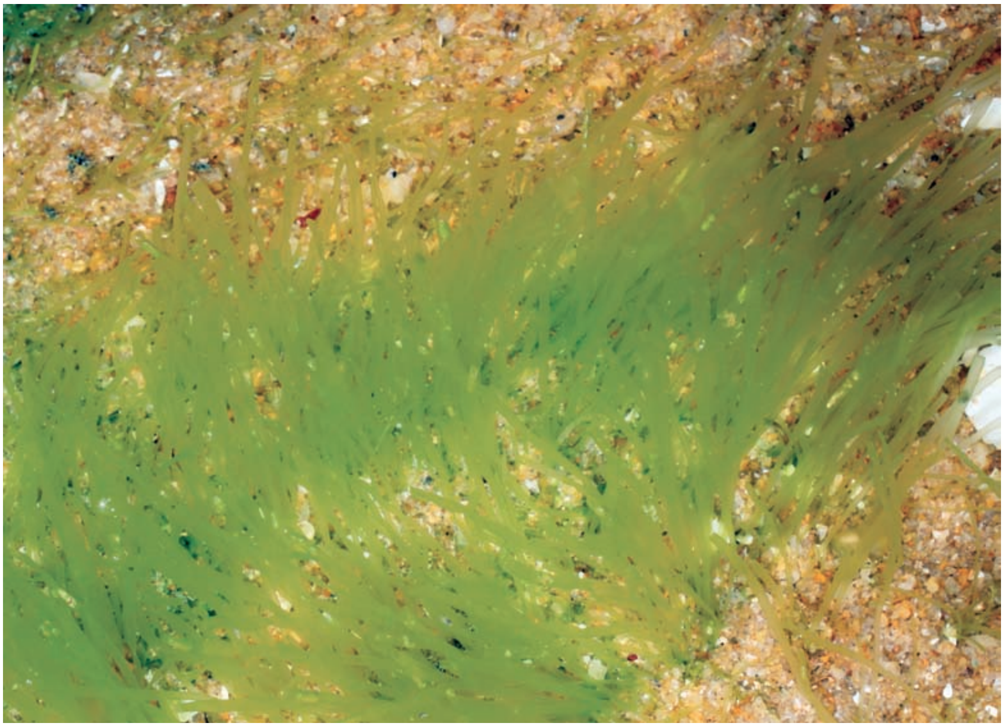
Description - Plants mostly gregarious, composed of rather tough blades, irregularly divided in long (up to 30 cm) strap-like divisions, 1-3 cm broad, gradually tapering towards their apices, undulated, especially at the margins (more rarely completely flat) and sometimes longitudinally contorted, bright green. Cells, in cross section, in two adhering layers, isodiametric or broader (parallel with the surface) than long; one (occasionally two) pyrenoid(s) per cell. Young specimens as well as plants growing in their upper ecological range, have rounded lobes and form pompon-like structures.

Ecology - Epilithic in the high intertidal zone, as well in pools as air-exposed and continuously wave-swept, frequently hanging down from vertical walls.

Distribution - Widespread in tropical to warm-temperate regions.

Note - Taxonomic details of *U. fasciata* are provided by Aguilar-Rosas (2005).

Fig. 52. *Ulva fasciata*.



Ulva intestinalis Linnaeus

1753: 1163

Figs 26B; 53

REFERENCES: Tseng (1984: 254, pl. 126, fig. 3, as *Enteromorpha*), Trono (1997: 8, fig. 2, as *Enteromorpha*), Abbott & Huisman (2004: 49, figs 7A-C, as *Enteromorpha*), Coppejans *et al.* (2005: 42), Skelton & South (2007: 231, figs 636-640).

TYPE LOCALITY: 'in Mari omni'.

Description - Plants gregarious, mostly in extensive (monospecific) vegetations, unbranched, but small proliferations can be present; thin cylindrical at the basis, becoming inflated to irregularly bullose and constricted higher up, monostromatic; in sheltered lagoons, specimens become up to 30 cm long, the lumen being inflated with air bubbles, making the upper parts of the thallus floating on the water surface; bright green when young, bleached and yellowish green in older specimens. Cells in surface view irregularly arranged, 1-2 pyrenoids per cell.

Ecology - Epilithic in sheltered intertidal pools but best developed in sheltered lagoons where it can grow in huge quantities and seem loose-lying.

Distribution - Widespread globally.

Fig. 53. *Ulva intestinalis*.

Ulva lactuca Linnaeus

1753: 1163, pl. 2

Fig. 54

REFERENCES: Trono (1997: 12, fig. 4), Payri *et al*. (2000: 64, figs p. 65), Oliveira *et al*. (2005: 190, fig. p. 191), Kraft (2007: 46, fig. 18).

TYPE LOCALITY: Sweden.

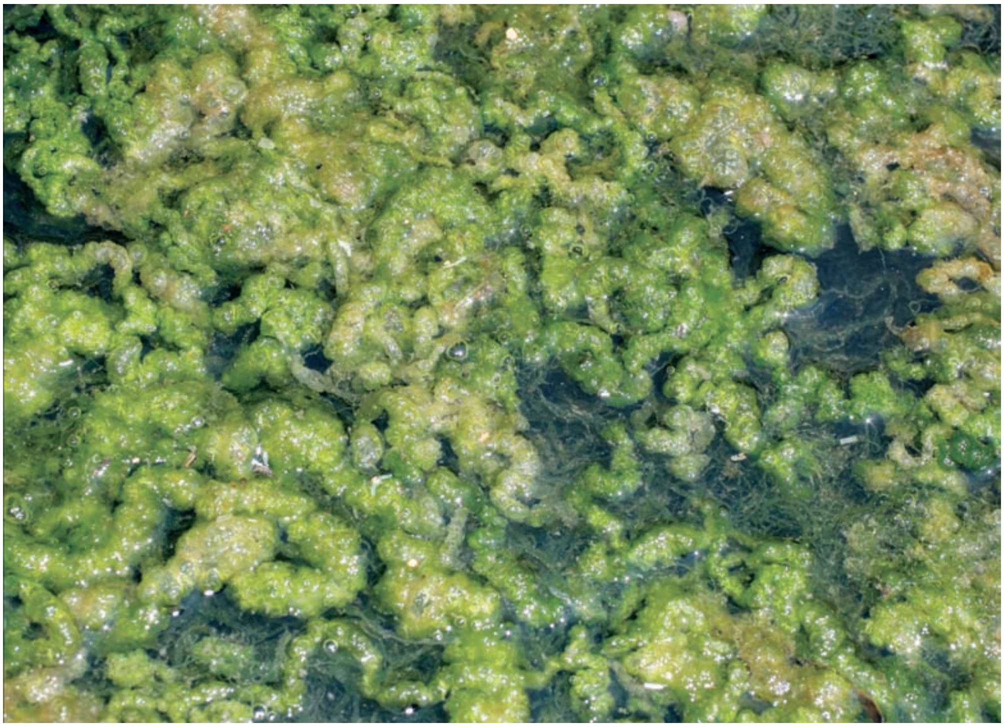
Description - Plants forming large, supple, orbicular to lobed, shortly stipitate blades, up to 20 cm long, markedly undulated all over, bright green; round perforations can be present; cells in surface view angular, mostly containing a single (but up to 2) pyrenoid(s); in transverse section the blade is 50-60 µm thick in the median part, up to 80-100 µm in the basal part where rhizoid-producing cells are abundant; cells isodiametric to slightly elongated, perpendicular to the blade surface.

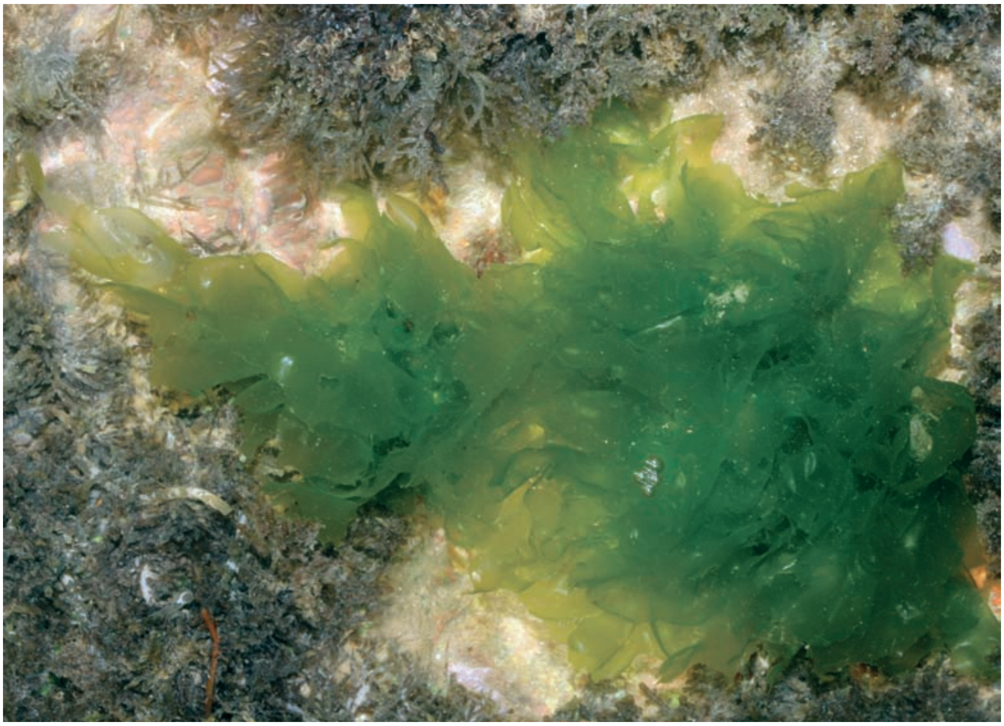
Ecology - Epilithic in shallow intertidal pools.

Distribution - Reported globally.

Note - Extremely abundant in pools along the beach as a result of eutrophication, at sites with numerous hotels.

Fig. 54. *Ulva lactuca*.





Ulva pertusa Kjellman

1897b: 4-7, pl. 1, pl. 3: figs 1-8 Fig. 55

REFERENCES: Jaasund (1976: 3, fig. 7), Tseng (1984: 258, pl. 128, fig. 2), Trono (1997: 13, fig. 5).

SYNTYPE LOCALITIES: Various in Japan.

Description - Thallus blade-like, rather thick and stiff, especially at the basis, thinner upwards, oval, suborbicular to irregularly lobed and lacerated, 10-15 cm long, undulated and wrinkled at the basis and at the margin, irregularly perforated with smaller and larger holes with smooth margin, light green when fully grown. Basis of the blade up to 500 µm thick as a result of the numerous rhizoids being formed between the two adhering cell layers, median parts about 100 µm, without internal rhizoids; on transverse section, cells elongated, perpendicular to the blade surface, about two to three times as long as wide resulting in a palisade-like appearance; chloroplasts 'cap-like' in surface view, those of cell pairs away from each other resulting in almost transparent lines where cells are arranged in short rows; 1-2 (-3) pyrenoids per cell.

Ecology - Epilithic in the intertidal and on coral debris on sand about mean low tide.

Distribution - Mentioned from several localities in the Indian Ocean, but also from the Pacific and Atlantic Ocean (California, Europe).

Notes - The morphology and distribution of *U. pertusa* is specified in López *et al*. (2007).
Typical for this species are the irregularly placed, isolated, small perforations of different sizes, with a smooth margin. Durairatnam (1961: 17, pl. 1: fig. 2, pl. 21, fig. 1) mentions *U. fenestrata* Postels et Ruprecht from Sri Lanka, a species described from Siberia. The perforations in the blades of the latter species are crenulate. *Ulva lactuca* Linnaeus, morphologically similar to *U. pertusa*, has only a single pyrenoid per cell (only rarely 2).

Fig. 55. *Ulva pertusa*.

Ulva prolifera O.F. Müller

1778: 7, pl. DCCLXIII(1) Fig. 56

REFERENCES: Tseng (1984: 256, pl. 127, fig. 1, as *Enteromorpha*), Abbott & Huisman (2004: 52, fig. 8D, as *Enteromorpha*).

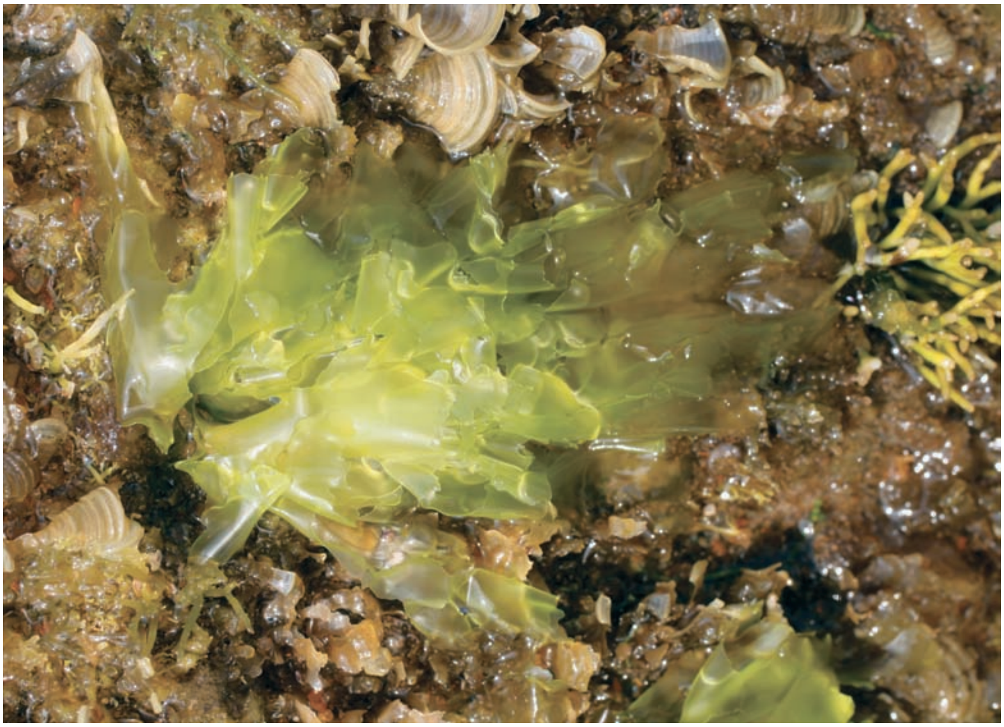
TYPE LOCALITY: Denmark.

Description - Plants growing in densely intricated masses, where individual specimens are difficult to separate, up to 10 cm long, light green; thalli regularly tubular (not contricted nor compressed), all axes extremely thin, slender and supple, with rather similar diameter (1 mm or less), the main axis richly, radially branched, the side branchlets not branched again; cells small, rectangular (about 9-12 x 8-9 µm) to square, markedly arranged in longitudinal rows and partly also in transverse rows; one (rarely two) pyrenoid(s) per cell.

Ecology - On shell fragments on the shallow, silty-sandy bottom at the margin of a sheltered lagoon.

Distribution - Reported worldwide.

Fig. 56. *Ulva prolifera*.



Ulva reticulata Forsskål
1775: 187

Figs 39C; 57

REFERENCES: Jaasund (1976: 3, fig. 5), Magruder & Hunt (1979: 33, fig. 2, p. 32), Moorjani & Simpson (1988: 16, pl. 29c), Calumpong & Meñez (1997: 101, + fig.), Trono (1997: 15, fig. 6), Abbott & Huisman (2004: 57, figs 11A-B), Oliveira *et al.* (2005: 190, fig. p. 191), Huisman *et al.* (2007: 163, + figs).

SYNTYPE LOCALITIES: «Gomfodae» (Al-Qunfudhah), Saudi Arabia, Mokha, Yemen.

Description - Thallus without recognizable holdfast, mostly strap-shaped, less frequently irregularly lobed, exceeding 30 cm in diameter, completely perforated, with larger and smaller holes side by side, up to the blade margin, resulting in a bright green net-like structure, the hole area exceeding the blade network; straps 3-10 mm wide; blade 40-80 µm thick, composed of two adhering layers of rectangular cells, perpendicular to the blade surface, resulting in a palisade-like appearance.

Ecology - Entangled to other algae in the whole intertidal zone and shallow subtidal.

Distribution - Reported from all over the Indian Ocean as well as from the western Pacific Ocean and South America (Chile and Venezuela).

Fig. 57. *Ulva reticulata*.

Ulva rigida C. Agardh
1823: 410-411

Fig. 58

REFERENCES: Jaasund (1976: 3, fig. 8), Littler & Littler (2000: 306, fig. p. 307), Abbott & Huisman (2004: 57, figs 12A-D), Coppejans *et al.* (2005: 44, fig. 11), Oliveira *et al.* (2005: 190, fig. p. 191), Kraft (2007: 46, fig. 19).

LECTOTYPE LOCALITY: Cádiz, Spain.

Description - Plants mostly gregarious, forming small rosettes of relatively stiff bladelets 2-3 cm in diameter at air- and surf-exposed sites, becoming up to 10 cm in more sheltered pools; bladelets orbicular, undulated, lobed, with smooth surface and small, pluricellular, marginal teeth; dark green. Cells, in cross section in two adhering layers, broader (parallel with the surface) than long to isodiametric close to the blade margins, to narrower than long towards the central part of the blades, then resulting in a palisade-like appearance. Two to five pyrenoids per cell.

Ecology - Epilithic, along surf-exposed coasts, mostly in the upper intertidal.

Distribution - Reported worldwide.

Fig. 58. *Ulva rigida*.

Chaetomorpha antennina (Bory de Saint-Vincent) Kützing
1847: 166. Figs 9D; 13F; 17A; 59

References: Tseng (1984: 262, pl. 130, fig. 1), Lewmanomont & Ogawa (1995: 41, + fig.), Cribb (1996: 21, bottom fig. p. 20), Payri *et al*. (2000: 68, top fig. p. 69), Abbott & Huisman (2004: 66, figs 18A-D), Coppejans *et al*. (2005: 46, fig. 14), Huisman *et al*. (2007: 170, + figs), Kraft (2007: 51, figs 21A-D).

Type locality: Réunion.

Description - Plants forming 1-10 cm high, erect, isolated, characteristic brush-like tufts, composed of rigid, unbranched, septate filaments, dark to bright green. Attachment to the substratum by rhizoids sprouting from the base of the basal cells, resulting in a profusely branched, stoloniferous rhizoidal system. Basal holdfast cells elongated, thick walled, with proximal, annular constrictions, 400-700 µm in diameter at the distal end, up to 7.5 mm long. Other cells of the filaments subcylindrical, 400-750 µm in diameter, 700-1000 µm long, gradually becoming broader and barrel-shaped upwards. Filaments of reproductive specimens with white tips that erode easily, resulting in a gradual diminishing size of the plants.

Ecology - Epilithic in high intertidal, best developed on the seaward side of rocks along surf-exposed coasts.

Distribution - Widespread in tropical and subtropical seas.

Notes - Ten *Chaetomorpha* species have been recorded for Sri Lanka (Silva *et al*. 1996). *Chaetomorpha antennina* can be easily distinguished from other attached *Chaetomorpha* species in the region (e.g. *C. aerea*, *C. indica*) by the characteristic brush-like tufts and basal cell with annular constrictions. Some common *Chaetomorpha* species occurring in the Indian Ocean are discussed by Sartoni (1992).
Some tufts of *Chaetomorpha antennina* are pinkish as a result of numerous tiny red algal epiphytes (*Acrochaetium*).

Fig. 59. *Chaetomorpha antennina*.

Chaetomorpha crassa (C. Agardh) Kützing
1845: 204 Figs 21A; 60

References: Jaasund (1976: 5, fig. 10), Lawson & John (1987: 66), Moorjani & Simpson (1988: 14, pl. 19), Littler *et al.* (1989: 32, fig. 2, p. 33), Sartoni (1992: 299, fig. 4E), Lewmanomont & Ogawa (1995: 42, + fig.), Calumpong & Meñez (1997: 110, fig. p. 111), Trono (1997: 18, fig. 8), Oliveira *et al*. (2005: 194, figs p. 194).

Syntype localities: Trieste and Venezia, Italy; England.

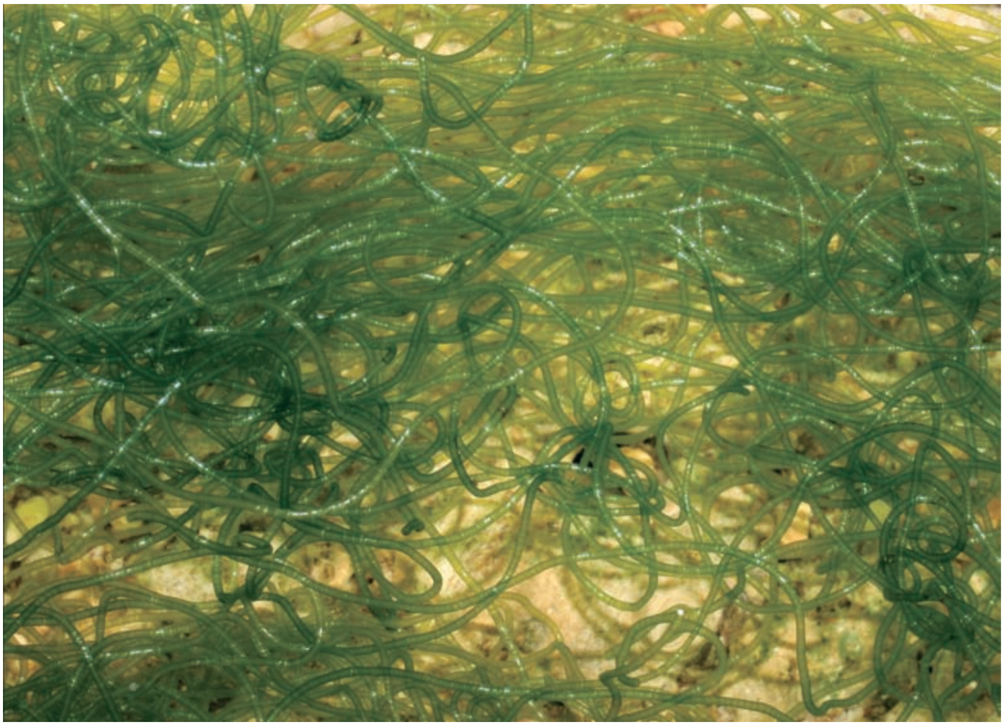
Description - Plants forming loose-lying clumps or entangled tufts with other algae of intricated, thick, tough, curly, unbranched, mostly dark green filaments (sometimes with a bluish hue). Cells visible with the naked eye, (395-) 450-650 (-685) µm in diameter, mostly as long as broad, but up to twice as long (just before cell division even sometimes up to 1 mm long). Some specimens with marked constrictions at the transverse walls (resulting in barrel-shaped cells), others more cylindrical.

Ecology - Present in the whole intertidal zone, most frequent in low to middle intertidal pools, entangled with other algae.

Distribution - Pantropical.

Note - DNA sequence data has shown that *C. crassa* from Europe is conspecific with *C. linum* and that the tropical species, referred to as *C. crassa* constitutes a new species (Leliaert & Boedeker 2007). The latter can be easily distinguished from other unattached *Chaetomorpha* species by the coarse filaments.

Fig. 60. *Chaetomorpha crassa*.



Cladophorales – Cladophoraceae **_Chaetomorpha_** Kützing 1845: 203

Chaetomorpha spiralis Okamura
1903: 131-132, pl. XCV Figs 35A; 61

References: Tseng (1984: 262, pl. 130, fig. 3), Sartoni (1992: 299, fig. 5A), Coppejans *et al*. (2000: 62, fig. 24), Abbott & Huisman (2004: 70, fig. 19B).

Type locality: Nemoto, Boshu Province (Chiba Prefecture), Japan.

Description - Some plants gregarious, others solitary, 5-20 (-30) cm long, growing in open populations between other algae; basal parts of the stiff, unbranched filaments coiled or at least markedly sinuous, dark green; upper parts straight or slightly sinuous, light green; diameter in the basal parts 500-750 µm, where the cells are cylindrical and isodiametric, gradually becoming beadlike and reaching a diameter of 1 mm at the filament apices.

Ecology - In shallow, low intertidal rock pools with sandy bottom; continuously wave-swept.

Distribution - Tropical and temperate Indian and Pacific Ocean.

Fig. 61. *Chaetomorpha spiralis*.

Cladophorales – Cladophoraceae **_Cladophora_** Kützing 1843: 262

Cladophora herpestica (Montagne) Kützing
1849: 415 Fig. 62

References: Huisman (2000: 239, + figs), Coppejans *et al*. (2005: 54, fig. 22, as *Cladophoropsis herpestica*), Kraft (2007: 85-89, fig. 36), Skelton & South (2007: 245, figs 676-677).

Type locality: Bay of Islands, New Zealand.

Description - Plants forming compact, rigid, hemispherical to horizontally spread cushions, firmly attached to the substratum, about 2 cm thick, composed of densely set, rather stiff, straight, erect, radially arranged, strongly entangled branchlets; upper part light green, inner part dark green; attachment to the substratum by basal hapteroid rhizoids and by rhizoids sprouting from the proximal pole of cells in any part of the thallus; rhizoids in upper parts of the cushions horizontally directed and hereby consolidating the structure. Cells of the filaments generally each producing a single lateral at their apical pole, mostly unilaterally placed; at increasing distance from the apex a cell may give off a second branch; cross wall formation at the base of the laterals markedly delayed; older laterals eventually displacing the main axes, which then appear as lateral appendages. Filaments generally branching to the 1st or 2nd order. Apical cells and cells of the terminal branch systems subcylindrical, generally curved or sinuous, 120-450 µm in diameter, up to 10 mm long. Cell walls up to 90 µm thick in the basal cells, coarsely striated longitudinally. Tetrahedral protein crystals present in most cells.

Ecology - Epilithic, just above low water mark, air-exposed at low tide but continuously wave-swept; surf exposed coasts.

Distribution - Widely distributed in the tropical to subtropical Indo-Pacific.

Notes - This species has been placed in *Cladophoropsis* based on the typical branching pattern but is returned to its original genus by Leliaert *et al*. (2007) based on DNA sequence data.
Cladophora is a large and common green algal genus with a worldwide distribution in marine as well as freshwater habitats. The taxonomy of the genus has been studied by van den Hoek (1963, 1982), van den Hoek & Chihara (2000), Leliaert & Coppejans (2003) and Leliaert & Boedeker (2007). Molecular phylogenetic studies have demonstrated that the genus is polyphyletic (Leliaert *et al*. 2003, 2007).
This is a new species for Sri Lanka.

Fig. 62. *Cladophora herpestica*.

Cladophora prolifera (Roth) Kützing
1843: 271

Fig. 63

References: Lawson & John (1987: 75, pl. 4, fig. 5); Moorjani & Simpson (1988: 14, pl. 22); Lewmanomont & Ogawa (1993: 44, + fig.); Leliaert & Coppejans (2003: 32-33, figs 6A-C), Oliveira *et al*. (2005: 195, fig. p. 195); Leliaert & Boedeker (2007: 166-167, figs 78, 79).

Type locality: "in mare Corsicam".

Description - Plants erect, coarse, growing as stiff tufts, 2-4 cm high, locally in extensive populations; thallus composed of densely branched, fastigiated filaments, dark green (blackish when dried); old cells in the basal and middle part of the thallus each giving off one rhizoid with annular constrictions at their basal poles; these rhizoids growing down along the cell or cells below, where they entangle and form a conspicuous stipe attaching to the substratum; growth by apical cell division, later combined with intercalary growth; each subapical cell forming a lateral, often immediately after being cut off from the apical cell: lower down a second or even a third lateral can be formed; apical cells cylindrical with rounded tip, 90-130 µm in diameter, length/width ratio 2,5-5,5; cells of the terminal branch systems cylindrical, 150-200 µm in diameter, l/w ratio 2,5-8, increasing towards the base of the thallus; cells of the main axes and basal cells elongated and club-shaped, up to 200 µm in diameter, l/w ratio 7-10; basal parts often with annular constrictions; rhizoids 40-100 µm in diameter.

Ecology - Epilithic in surf channels just under low water mark or in the wave-exposed lower intertidal.

Distribution - Widespread in tropical to warm temperate seas. Also recorded from the British Isles.

Fig. 63. *Cladophora prolifera*.

Cladophora sericea (Hudson) Kützing
1843: 264

Figs 17B; 64

References: van den Hoek (1963: 77-92, pls 17-21), Abbott & Huisman (2004: 77, fig. 22E), Leliaert & Boedeker (2007: 172-174, fig. 84).

Type locality: Sheerness, Kent, Great Britain.

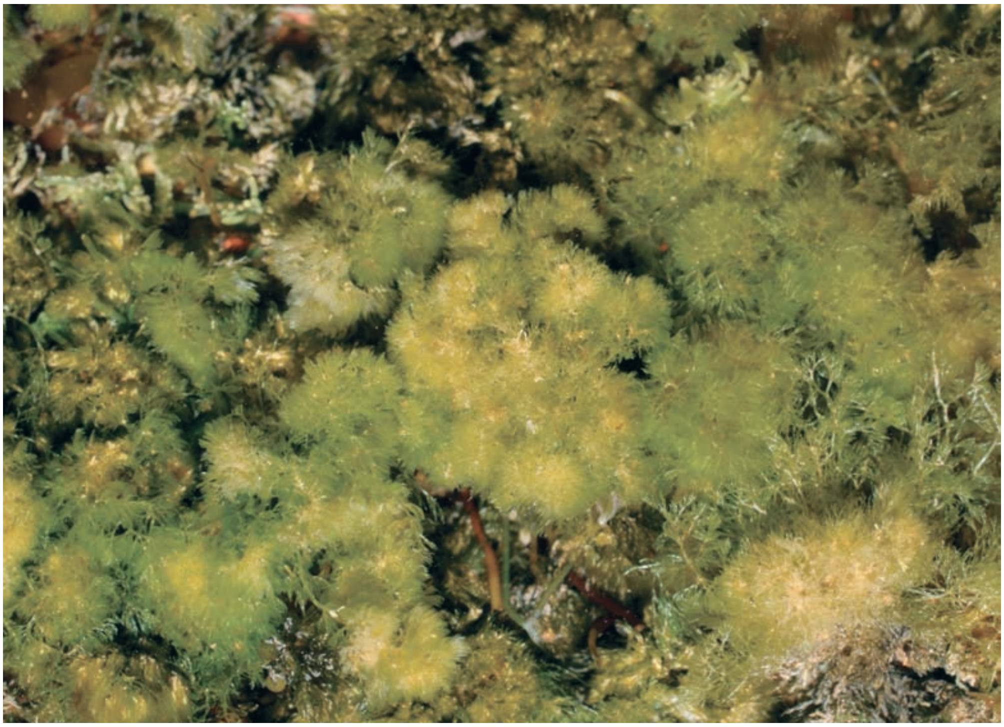
Description - Plants light green, forming lax tufts or threads, to 7 cm tall, frequently in dense populations covering large areas of rocks; thallus composed of pseudodichotomously branching main axes, densely set with branches of various lengths; attachment to the substratum by branching rhizoids developing from the basal cells; growth mainly by intercalary cell division, many new cells each producing a branch at their apical pole, thus giving rise to rows of branches that are similar in age, or young (shorter) ones intercalated between older (longer) ones. Cells generally producing a single branch, but older cells may produce a second or sometimes a third branch. Apical cells cylindrical to slightly tapering, diameter (22-) 25-35 (-38) µm; cells of the main axes cylindrical, up to 100 µm in diameter.

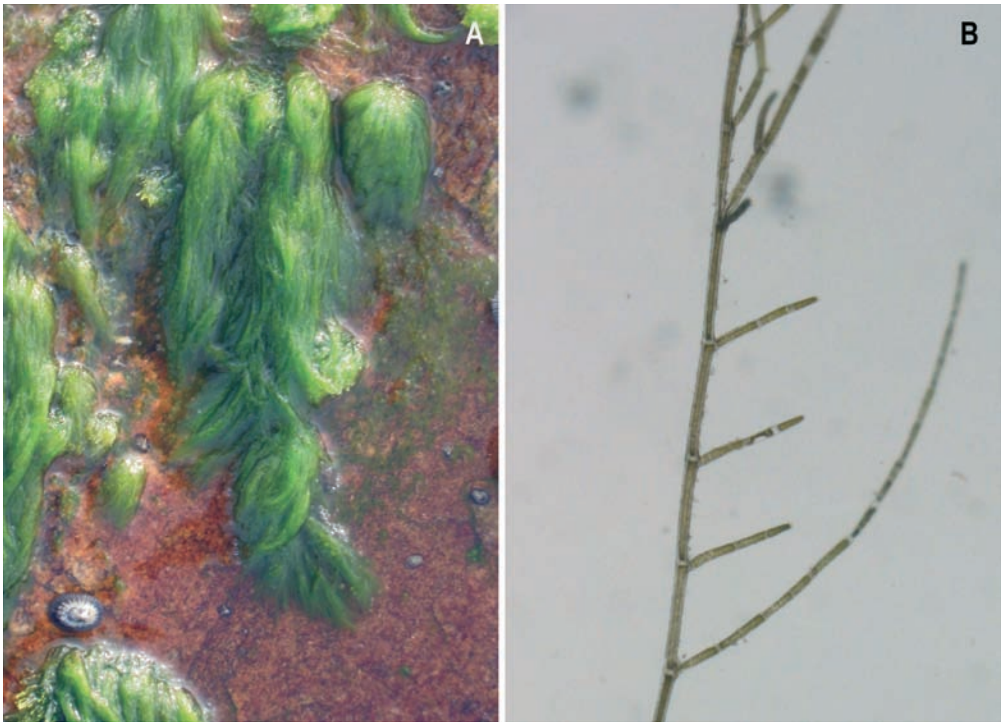
Ecology - Epilithic in the high intertidal, on the landward side of rock boulders along surf-exposed coasts; continuously wave-swept, but rarely really inundated.

Distribution - Reported worldwide; in the Indian Ocean this species has until now only been reported from Réunion, Singapore and South Africa.

Note - *Cladophora sericea* is part of a closely related species complex, also including *C. albida, C. capensis, C. flexuosa* and *C. opaca* (Bakker *et al.* 1995).

Fig. 64. *Cladophora sericea***.** A. A population *in situ***;** B. Detail of non-acropetal growth.




A
B

Cladophora socialis Kützing
1849: 416 Fig. 65

References: Leliaert & Coppejans (2003: 51, fig. 3), Abbott & Huisman (2004: 78, figs 23A-C), Oliveira *et al*. (2005: 196, + fig.).

Type locality: Tahiti.

Description - Plants forming a dense, supple filamentous cover on the phorophyte, dark green; filaments densely branched, interwoven, well attached by uni- and multicellular rhizoids arising from the proximal poles of the short basal cells; upright branch systems 1-1.5 cm high, branching at wide angles (45-90°); mostly a single lateral per cell; newly formed laterals often without cross-walls at their base; in older laterals cross-walls are steeply inclined to the parent cell; apical cells cylindrical with rounded tip, 23-27 µm in diameter, l/w ratio 10-25; basal cells cylindrical, 60-120 µm in diameter.

Ecology - Epiphytic on *Galaxaura filamentosa*, in a rock pool in the low intertidal, continuously wave-swept.

Distribution - Widespread in tropical and subtropical waters.

Notes - *C. socialis* closely resembles *C. coelothrix* Kützing from which it differs by its smaller cell diameter. The latter is more frequent along the Sri Lankan shores.
A new species for Sri Lanka.

Fig. 65. *Cladophora socialis*.

Cladophora vagabunda (Linnaeus) van den Hoek
1963: 144 Figs 21B; 66

References: Sartoni (1992: 304; figs 6C-E), Trono (1997: 20, fig. 9), Coppejans *et al.* (2005: 50, fig. 19), Abbott & Huisman (2004: 79, figs 24A-D), Oliveira *et al*. (2005: 196, fig. p. 196), Kraft (2007: 80, fig. 33).

Lectotype locality: Selsey, Sussex, England.

Description - Plants forming lax tufts, 1 to 3 cm tall, frequently in extensive populations; thallus composed of pseudodichotomously branching main axes, typically ending in densely branched fasciculate terminal branch systems, light green; attached to the substratum by branching rhizoids developing from the basal cells; terminal branch systems distinctly acropetally organized, (refracto-) falcate. Cells producing one to three (sometimes four) branches. Apical cells cylindrical, with rounded tips or slightly tapering, diameter (35-) 45-55 µm; cells of the main axes cylindrical, 180-210 µm in diameter.

Ecology - Epilithic or epiphytic (on *Gracilaria corticata*) in shallow, low intertidal pools.

Distribution - Reported worldwide.

Fig. 66. *Cladophora vagabunda* (herbarium specimens).

Rhizoclonium africanum Kützing
1853: 21, pl. 67: fig. II Figs 16D; 67

REFERENCES: Egerod (1974: 135-136, figs 10-12), Sartoni (1986: 361, fig. 3C; 1992: 305, fig. 7A), Lawson & John (1987: 80, pl. 5, figs 2-3), Cribb (1996: 35, top fig. p. 34), Payri *et al.* (2000: 70, top fig. p. 71), Abbott & Huisman (2004: 82, fig. 25A), Kraft (2007: 56, figs 22F-H), Skelton & South (2007: 241, figs 650-658).

TYPE LOCALITY: "Senegambien" (Senegal or Zambia).

Description - Forming woolly structures as a result of the intertwined, unbranched, curled filaments; light green; extremely well attached to the substratum by basal and intercalary hapteroidal holdfasts; filaments 70-85 µm in diameter, cells 2-3 times as long as wide with a stratified wall, 12-15 µm thick; remarkable are the abrupt changes in growth direction (frequently perpendicular) often after an enlarged cell.

Ecology - Crevices of eroded fossil coral platforms or beach sandstone, above high tide level (higher than the *Bostrychia* level and just under the lowermost terrestrial plants); not covered by seawater for long periods; accumulating terrestrial debris; mostly along vertical walls, the tips of the filaments hanging like beard-like structures out of the crevices, but also in small cavities of the horizontal surface where the plants form woolly tufts.

Distribution - Widespread in tropical regions.

Fig. 67. *Rhizoclonium africanum***.** A. Habit *in situ***;** B. Microscopic detail.

Boergesenia forbesii (Harvey) J. Feldmann
1938: 1503-1504 Fig. 68

REFERENCES: Jaasund (1976: 15, fig. 31), Tseng (1984: 272, pl. 135, fig. 3), Sartoni (1992: 306, fig. 7b), Lewmanomont & Ogawa (1995: 27, + fig.), Cribb (1996: 11, bottom fig. p. 10), Calumpong & Meñez (1997: 92, fig. p. 93), Trono (1997: 21, fig. 10), Leliaert *et al.* (1998: 184, fig. 13), Huisman (2000: 237, + fig.), Littler & Littler (2003: 202, middle fig. p. 203), Oliveira *et al.* (2005: 198, + fig.), Ohba *et al.* (2007: 18, + figs), Skelton & South (2007: 249, fig. 669).

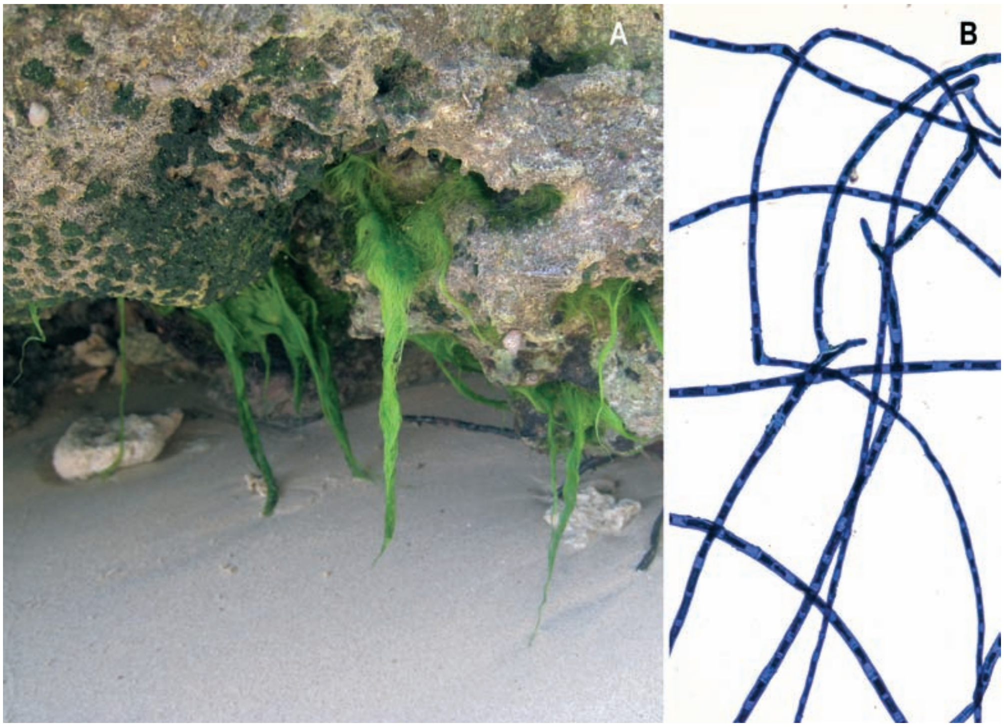
SYNTYPE LOCALITIES: Ryukyu-retto, Japan; Sri Lanka.

Description - Plants mostly gregarious, radially arranged, more rarely solitary; thalli composed of a single, inflated, club-shaped and curved cell (at least at the basis), 2-4 cm long, 10-15 mm in diameter at the widest part, bright light green; presence of basal annular constrictions differentiating them from *Valonia*-species; attachment by small pad-like structures but clustered cells connected with each other by a septate stoloniferous rhizoidal system.

Ecology - Epilithic in the mid-intertidal, air-exposed at low tide but continuously wave-swept. Not frequently observed along the studied Sri Lankan coast.

Distribution - Widespread in the tropical Indo-Pacific.

Fig. 68. *Boergesenia forbesii*.


A
B

CLADOPHORALES – Siphonocladaceae

Boodlea (Dickie) G. Murray et De Toni
in G. Murray 1889: 243.

Boodlea composita (Harvey) Brand
1904: 187-190

Figs 35G; 69

REFERENCES: Jaasund (1976: 11, fig. 23), Magruder & Hunt (1979: 17, top fig. p. 16), Tseng (1984: 276, pl. 137, fig. 1), Lewmanomont & Ogawa (1995: 26, + fig.), Cribb (1996: 13, top fig. p. 10), Calumpong & Meñez (1997: 110, + fig.), Trono (1997: 22, fig. 11), Huisman (2000: 238, + figs), Littler & Littler (2003: 200, top fig. p. 201), Abbott & Huisman (2004: 85, figs 26A-B), Coppejans *et al*. (2005: 52, fig. 21), Oliveira *et al*. (2005: 198, figs. p. 199), Kraft (2007: 94, pl. 3C, fig. 39), Leliaert & Coppejans (2007), Ohba *et al*. (2007: 19, + figs), Skelton & South (2007: 249, figs 670-672).

TYPE LOCALITY: Mauritius.

Description - Plants forming light green, spongy cushions, 3-5 cm across, composed of tightly interwoven filaments, forming a three-dimensional network; attachment by rhizoids and tenacular cells, produced in any part of the thallus; branching rather sparse in the basal portions, more abundant above; side branches originally in one plane, opposite, resulting in fanshaped structures; later side branchlets are formed in planes, perpendicular on the orginal net-like blade; reinforcement of the thallus by tightly interweaving curved branch systems and attachment of adjacent branches by tenacular cells, borne singly on the tips of the apical cells. Main axes up to 350 µm in diameter, terminal branchlets 75-125 µm. Plants breaking up in small fractions after squeezing, possibly representing a mode of vegetative reproduction.

Ecology - Attached at the basis of other algae or on algal turf in low intertidal pools and in the shallow subtidal; rather rare.

Distribution - Widespread in all tropical to subtropical waters.

Fig. 69. *Boodlea composita*.

CLADOPHORALES – Siphonocladaceae

Cladophoropsis Børgesen 1905: 288

Cladophoropsis sundanensis Reinbold
1905: 147

Fig. 70

REFERENCES: Børgesen (1935: 10-11, fig. 1), Egerod (1974: 141, figs 32-36; 1975: 46, figs 8-10), Jaasund (1976: 11, fig. 24), Tseng (1984: 274, pl. 136, fig. 1), Payri *et al.* (2000: 72, fig. p. 63), Leliaert *et al.* (2001: 452, figs 6-8), Abbott & Huisman (2004: 88, fig. 28B), Oliveira *et al*. (2005: 201, fig. p. 201), Leliaert & Coppejans (2006: 666, figs 40-46), Kraft (2007: 110, fig. 47), Skelton & South (2007: 252, figs 673-675).

LECTOTYPE LOCALITY: Kangean, Indonesia.

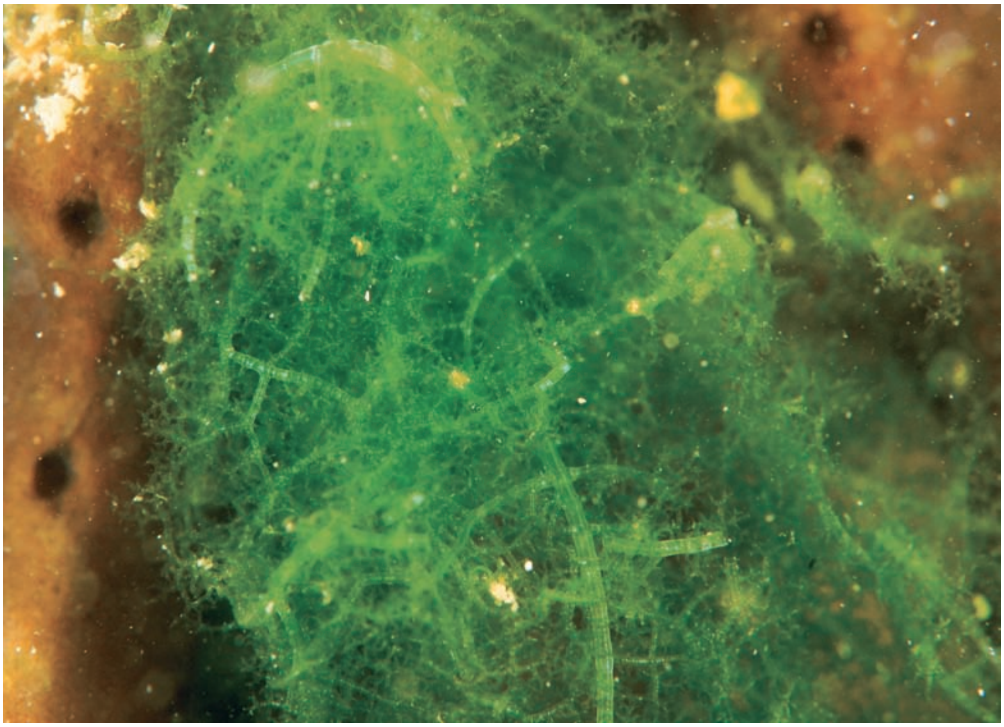
Description - Thalli forming compact, spongy cushions or moss-like mats, firmly attached to the substratum, often sand and sediment-trapping, 2-7 cm across (occasionally up to 15 cm), 1-1.5 cm thick, composed of strongly entangled branch systems, light to medium green. Attachment to the substratum by branched, multicellular rhizoids arising from the proximal pole of the basal cells and other cells in the basal region. Growth by apical and intercalary cell division, followed by cell elongation and limited cell enlargement; apical cells frequently dividing more or less simultaneously into 3-7 cells followed by the development of laterals (mostly a single one per cell, more rarely an opposite pair); laterals not displacing the main axis; cross wall formation at the base of the laterals usually delayed; side branches mostly unilaterally arranged in the terminal branch systems, more irregularly lower down. Structural reinforcement of the thallus by interweaving of the filaments and by anastomosis of the cells by hapteroid rhizoids and tenacular cells. Apical cells (sub)cylindrical, with rounded tip, slightly curved or sinuous, (40-) 60-120 (-140) µm in diameter, length up to 6 mm; cells of terminal branch systems straight or slightly curved, 80-140 µm in diameter (l/w ratio 3-40).

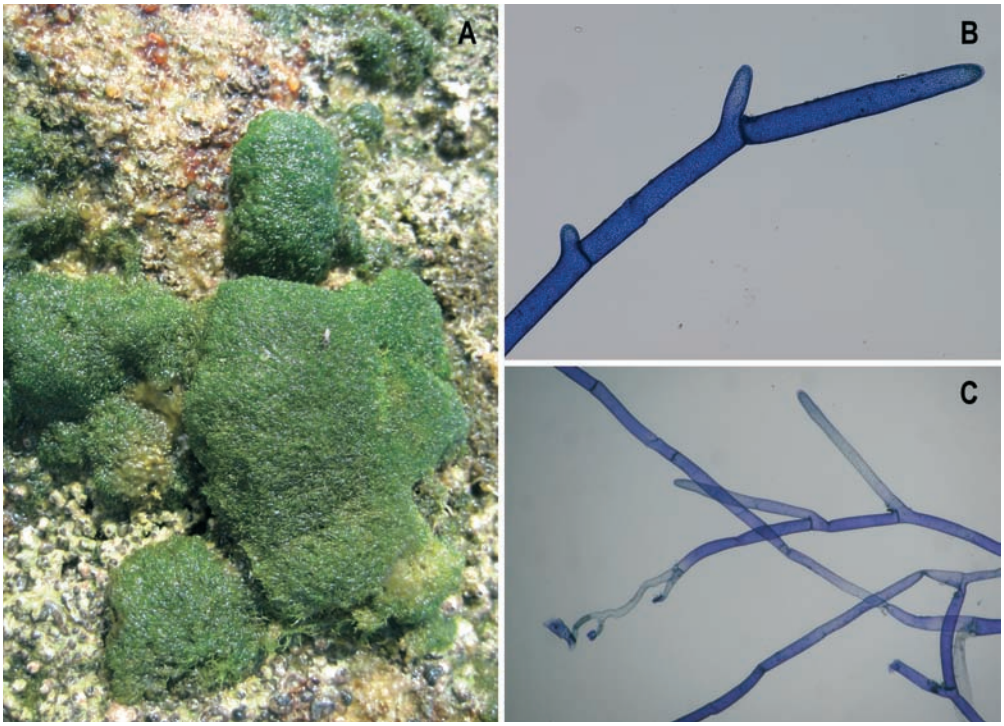
Ecology - Horizontal, sand-covered rock substratum in the intertidal, air-exposed at low tide but continuously wave-swept.

Distribution - Widely distributed in the Indo-Pacific.

Notes - *C. sundanensis* closely resembles *C. membranacea* (Hofman Bang ex C. Agardh) Børgesen, also present along the Sri Lankan coast, from which it differs by the larger cell diameter of the latter (70-) 110-290 (-340) µm. The genus *Cladophoropsis* has recently been reassessed by Leliaert & Coppejans (2006), who recognized six species, only two of which (*C. membranacea* and *C. sundanensis*) occur in Sri Lanka.

Fig. 70. *Cladophoropsis sundanensis* A. Habit *in situ*; B. Microscopic detail of apical growth; C. Apex with secondary attachment structures.




A
B
C

Dictyosphaeria cavernosa (Forsskål) Børgesen 1932: 2

Figs 20E; 40B; 71

REFERENCES: Egerod (1952: 350-351, figs 1b-f, 2f-g), Jaasund (1976: 15, fig. 32), Magruder & Hunt (1979: 27, fig. 1, p. 26), Tseng (1984: 268, pl. 133, fig. 5), Moorjani & Simpson (1988: 15, pl. 24), Sartoni (1992: 319, fig. 13A), Lewmanomont & Ogawa (1993: 48, + fig.), Cribb (1996: 29, top fig. p. 28), Calumpong & Meñez (1997: 98, fig. p. 99), Leliaert *et al.* (1998: 188, figs 30-33), Huisman (2000: 240, + fig.), Kraft (2000: 578, figs 27A-B), Littler & Littler (2000: 332, bottom fig. p. 333), Payri *et al.* (2000: 76, fig. p. 77), Littler & Littler (2003: 202, bottom fig. p. 203), Abbott & Huisman (2004: 89, fig. 29A), Coppejans *et al*. (2005: 54, fig. 23), Oliveira *et al*. (2005: 202, figs p. 203), Huisman *et al*. (2007: 173, + figs), Kraft (2007: 118, pl. 4E, fig. 49), Ohba *et al*. (2007: 21, + figs), Skelton & South (2007: 253, figs 737, 792).

SYNTYPE LOCALITIES: Red Sea (Saudi Arabia, Yemen).

Description - Thalli forming stiff-brittle, hollow structures composed of large, polygonal cells (visible with the naked eye), arranged in a monostromatic layer, dark green; young specimens spherical, 1-2 cm across, later becoming convoluted and ruptured when the 'roofs' disappear, looking like bowls, up to 6 cm across; in old specimens large clumps of several hollow and bowl-like structures are combined. Attachment by numerous, minute hapteroidal cells produced by the basal cells in contact with the substratum. Cells isodiametric, polygonal in surface view, 1-2.8 mm in diameter; margins of the cells joined by rows of contiguous, minute, tenacular cells arising alternately from the two opposing cells; inner cell walls without trabecular spines.

Ecology - Epilithic in the lower part of the intertidal zone, more frequent on sloping and vertical walls on the landward side of beachrock platforms; air-exposed at low tide but continuously wave-swept.

Distribution - Pantropical.

Note - Leliaert *et al*. (2007) showed that the pantropical *D. cavernosa* consists of several cryptic species, with *D. versluysii* (which differs from *D. cavernosa* by the formation of solid thalli) being more closely allied to Indian Ocean representatives of *D. cavernosa* than to *D. cavernosa* from the Pacific Ocean.

Fig. 71. *Dictyosphaeria cavernosa*.

Dictyosphaeria versluysii Weber-van Bosse 1905: 144

Figs 19B; 72

REFERENCES: Egerod (1952: 351, 354-355, figs 1a, 2h-k), Jaasund (1976: 15, fig. 33), Magruder & Hunt (1979: 27, fig. 2, p. 26), Tseng (1984: 270, pl. 134, fig. 2), Moorjani & Simpson (1988: 15, pl. 24), Sartoni (1992: 319-321, figs 13B, 14A,B), Cribb (1996: 29, middle fig. p. 28), Leliaert *et al.* (1998: 188, 190, figs 37-39), Littler & Littler (2000: 334, middle fig. p. 335), Payri *et al.* (2000: 76, bottom fig. p. 77), Skelton & South (2002: 162, figs 23C-D), Littler & Littler (2003: 200, bottom fig. p. 201), Abbott & Huisman (2004: 89, fig. 29B), Coppejans *et al*. (2005: 56, fig. 24), Oliveira *et al*. (2005: 202, fig. p. 203), Huisman *et al*. (2007: 173, + fig.), Kraft (2007: 117, pl. 4F, fig. 48), Ohba *et al*. (2007: 22, + figs), Skelton & South (2007: 254, figs 738, 791).

SYNTYPE LOCALITIES: 'Plusieurs récifs dans l'Archipel Malaisien'.

Description - Thallus, forming isolated or clustered, solid, tough, button-shaped cushions, 1-2.5 cm across, composed of polygonal cells; when several specimens are clustered, they sometimes have a jigsaw morphology; light grey-green. Attachment by basal, rhizoidal cells in contact with the substratum; the thallus tissue is formed by diffuse segregative cell division with daughter cells maturing in many planes; adjacent cells held together by rows of contiguous, minute, bi- or trifurcate tenacular cells arising alternately from the two opposing cells. Inner cell walls producing simple or bifurcate trabecular spines; cells 0.8-1.2 µm in diameter.

Ecology - On horizontal to sloping rock substratum in middle to low intertidal, in crevices, more frequent on the wave-exposed, seaward side of beachrock platforms; air-exposed at low tide but continuously wave-swept.

Distribution - Widespread in the Indo-Pacific. Also reported from the Caribbean Sea.

Fig. 72. *Dictyosphaeria versluysii*.

Valonia fastigiata Harvey ex J. Agardh
1887: 101 Figs 22C; 73

REFERENCES: Jaasund (1976: 15, fig. 30), Leliaert *et al.* (1998: 192, figs 42-44), Payri *et al.* (2000: 78, bottom fig. p. 79), Littler & Littler (2003: 206, middle fig. p. 207), Oliveira *et al.* (2005: 204, figs p. 204), Ohba *et al.* (2007: 23, + figs), Skelton & South (2007: 258, figs 688, 793-794).

SYNTYPE LOCALITIES: Sri Lanka, Tonga.

Description - Thallus forming a hemispherical dome or a more flattened solid cushion, glossy translucent dark green, 5-15 cm across, composed of densely packed, erect, radially arranged vesicle-like, cylindrical cells, sometimes slightly inflated at the apical part; anchored by small, aseptate rhizoids; daughter vesicles produced by small lenticular cells; main branching regularly di- to polychotomous at the distal end of the parent cells; when a cushion is broken up, concentric layers of vesicles are visible; small lateral branchlets can also be formed. Cells subcylindrical to clavate, (5-) 8-15 (-22) mm long, diameter 2,5-5 mm, l/w ratio 2-3,5 (-4,5); adjacent cells cohering by circular clusters of tenacula. Septa without trabeculae.

Ecology - At about low water mark; air-exposed at low tide but continuously wave-swept.

Distribution - Widespread in the Indo-Pacific.

Notes - *Valonia fastigiata* is very similar in outer morphology to *Valonia aegagropila* C. Agardh, but the main branching in the latter is more irregular (not markedly di- or polychotomous, no concentric layers of cells), with numerous lateral, smaller branchlets.
Many workers have commented on the lack of clarity of species concepts within the genus (Børgesen, 1905, 1912, 1913; Egerod, 1952; Olsen & West, 1988) and this was recently reflected in a molecular phylogenetic study, which revealed convergence of morphological characters in the genus *Valonia* (Leliaert *et al*. 2007).

Fig. 73. *Valonia fastigiata***.** A. Superficial view; B. Transverse section.

Valonia utricularis (Roth) C. Agardh
1823: 431 Fig. 74

REFERENCES: Tseng (1984: 270, pl. 134, fig. 4), Leliaert *et al.* (1998: 192, fig. 45), Littler & Littler (2003: 208, top fig. p. 209), Skelton & South (2007: 260, fig. 689).

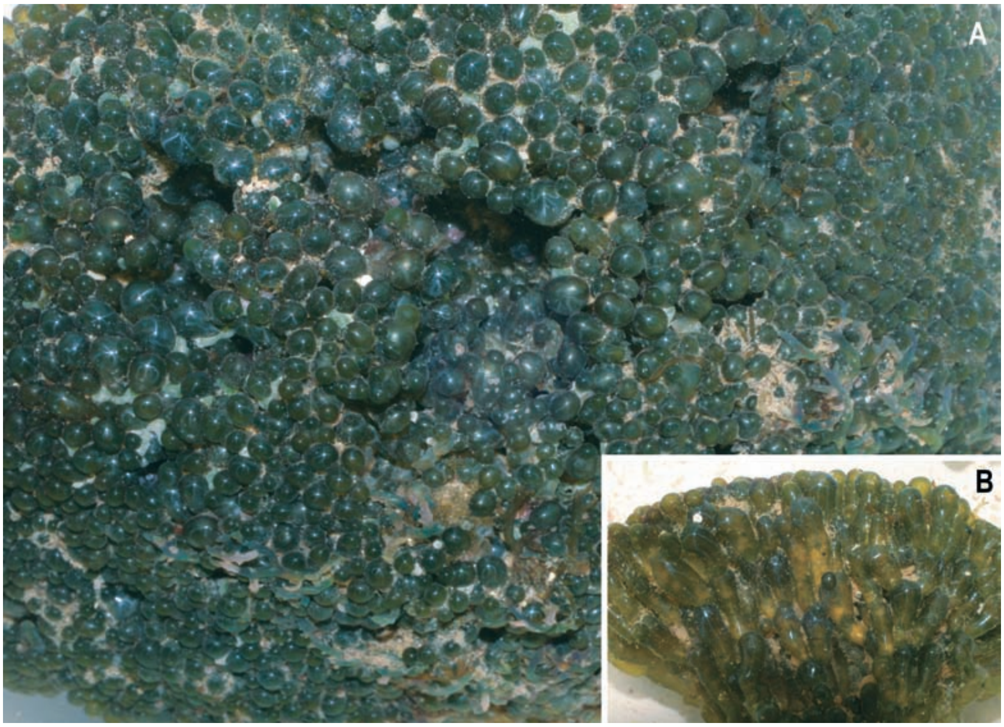
TYPE LOCALITY: Mediterranean Sea.

Description - Thallus forming succulent, stiff-brittle, compact or diffuse repent structures, 7-14 cm across, composed of vesicular cells, dark green with a bluish sheen. Branching irregular, di- polychotomous, distal or lateral. Cells horizontally arranged, clavate, arcuate or irregularly shaped (3-) 5-20 (-30) mm long, diameter (3-) 4-6 (-8) mm, l/w ratio 1-4. Adjacent cells laterally cohering by tenacula which are randomly arranged along the cell walls.

Ecology - In wave-swept, low intertidal pools or on vertical walls in the shallow subtidal.

Distribution - Widespread in tropical to warm-temperate regions.

Fig. 74. *Valonia utricularis***,** partly covered by crustose corallines.


A
B

Cladophorales – Valoniaceae **_Valoniopsis_** Børgesen 1934: 10

Valoniopsis pachynema (G. Martens) Børgesen

1934: 10-16, figs 1, 2 Figs 10A, B; 11E; 19A; 20D; 35B, E; 42D; 75

References: Jaasund (1976: 13, fig. 26), Tseng (1984: 272, pl. 132, fig. 2), Sartoni (1992: 323, fig. 14D), Cribb (1996: 37, middle fig. p. 36), Coppejans *et al.* (2005: 58, fig. 27), Oliveira *et al.* (2005: 205, fig. p. 205), Kraft (2007: 126, fig. 52).

Syntype localities: Bengkulu and Pulau Tikus, near Bengkulu, Sumatra, Indonesia.

Description - Thallus forming stiff and crisp hemisherical to more flattened and elongated mats, about 2-3 cm thick and up to 20 cm in diameter, composed of branched, interwoven cylindrical filaments, erect in the central part of the cushion, radially downwardly arcuate, the branchlets at the surface of the cushions being contiguous; dark-green. Attachment to the substratum by irregularly branched and septate basal rhizoids or by downwardly growing, gradually attenuated branch tips in contact with the substratum forming adventitious rhizoidal cells. Branches initiated from lenticular cells, up to 7 from the apex (resulting in typical apical hand-shaped structures), and laterally. Filaments 310-950 µm in diameter, apical cells up to 1150 µm in diameter.

Ecology - Extremely abundant on beachrock platforms, just above low water mark.

Distribution - Widespread in the Indo-Pacific; also occuring in the Caribbean Sea.

Note - *Valoniopsis pachynema* can be confused with *Cladophora herpestica* from which it can be distinguished by its lenticular cells and thicker filaments (310-950 µm vs. 120-450 µm in diameter) and the palmate apical branch systems.

Fig. 75. *Valoniopsis pachynema***.** A. Superficial view of several plants; B. Detail of apical branching.

Bryopsidales – Bryopsidaceae **_Bryopsis_** J.V. Lamouroux 1809a: 333

Bryopsis pennata J.V. Lamouroux

1809a: 333 Figs 32B; 36G; 76

References: Dawson (1954: 393, fig. 11b), Lawson & John, (1987: 92, pl. 10, fig. 5), Lewmanomont & Ogawa (1993: 28, + fig.), Coppejans & Van den Heede (1996: 52-54, figs 8, 9, 12, 16, 20), Littler & Littler (2000: 342, fig. p. 343), Payri *et al.* (2000: 82, top fig. p. 83), Skelton & South (2002: 163, fig. 24E), Littler & Littler (2003: 208, middle fig. p. 209), Abbott & Huisman (2004: 98, figs 33B-C), Coppejans *et al.* (2004: 2976, figs 3-5), Huisman *et al.* (2007: 179, + figs), Skelton & South (2007: 263, figs 690-691).

Type locality: Antilles, West Indies.

Description - Thalli gregarious, frequently in dense tufts, (2-) 3-10 (-15) cm high; main axis generally unbranched, length of the naked part (“stipe”) variable; plumule linear-lanceolate, with an acute apex, distichous, 1.5-2 (-3) cm long, 2-5 (-7) mm broad; dark green, sometimes with a bluish iridescence. Diameter of the main axis increasing towards the base, 200-690 µm; pinnules acropetally directed, with a rather constant length (1-3 mm), resulting in the linear aspect of the plumule, and a diameter of (90-) 155-185 (-295) µm, constricted at their base (38-75 µm) and with a truncated apex. Plumule distichous, but position of the ramuli either on 2 opposite, single, straight rows, or on a single and a double row or on 2 opposite double rows. Plastids rounded, oval or irregular, 3.5-11.5 µm long, each one with a single pyrenoid.

Ecology - Epilithic, at about spring low water level, exposed to strong surf.

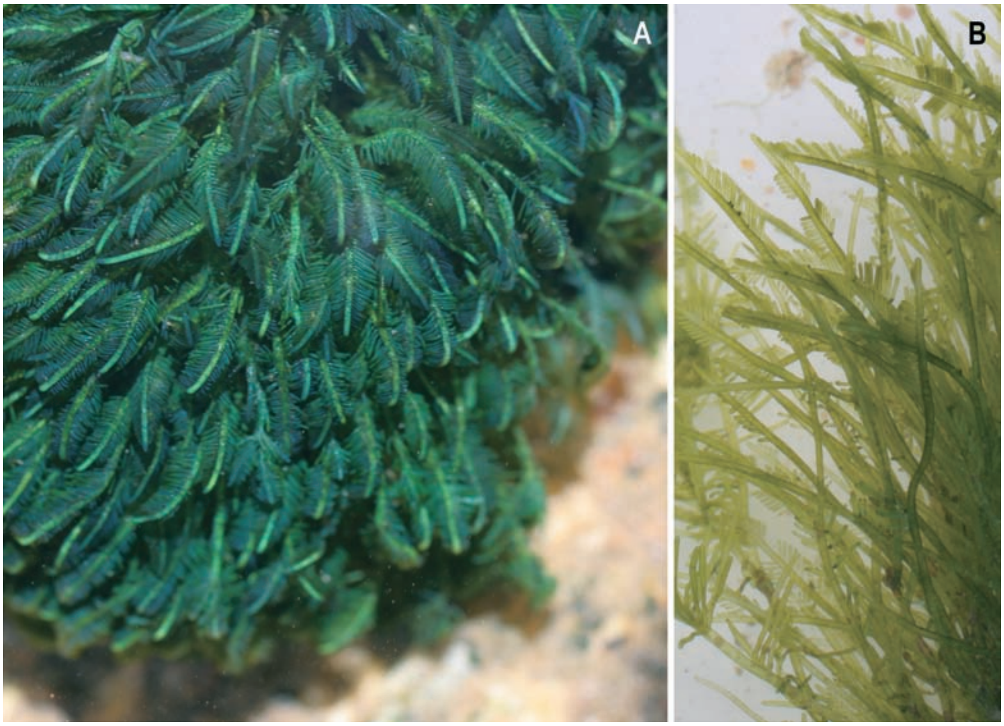
Distribution - Widespread in tropical to warm-temperate regions.

Notes - *Bryopsis* is a large genus with a worldwide distribution in tropical to temperate marine waters. More than 50 species are currently accepted. The genus has been studied in the Indian Ocean by Coppejans & Van den Heede (1996).

Some collected tufts, dominated by *B. pennata* var. *pennata* with typical plumules, also contain specimens with unilaterally bent branchlets, corresponding with *B. pennata* var. *secunda* (Harvey) Collins et Hervey, and specimens with bare parts along the rachis (interrupted plumules), corresponding to *B. pennata* var. *leprieurii* (Kützing) Collins et Hervey. Some even have the combination of unilaterally bent and interrupted branchlets. We therefore follow Skelton & South (2007: 264) in not distinguishing these varieties as these growth forms can occur together in the same tuft.

Fig. 76. *Bryopsis pennata***.** A. Whole tuft with densely pinnate axes (var. *pennata*); B. Detail with some axes with interrupted side branchlets (var. *leprieurii*).


A
B


A
B

Codium arabicum Kützing
1856: 35, pl. 100, fig. II Figs 18D; 25C; 77

REFERENCES: Jaasund (1976: 33, fig. 66), Magruder & Hunt (1979: 25, fig. 1, p. 24), Tseng (1984: 296, pl. 147, fig. 2), Lewmanomont & Ogawa (1995: 46, + fig.), Calumpong & Meñez (1997: 118, fig. p. 119), Trono (1997: 45, fig. 28), Payri *et al.* (2000: 102, top fig. p. 103), Littler & Littler (2003: 210, bottom fig. p. 211), Abbott & Huisman (2004: 102, figs 35A-B), Oliveira *et al.* (2005: 217, figs p. 217), Huisman *et al.* (2007: 186, + fig.), Kraft (2007: 146, pl. 5B, fig. 54), Skelton & South (2007: 270, figs 700, 706-710).

TYPE LOCALITY: Tor, Sinai Peninsula, Egypt.

Description - Thallus crustose, firm, with superficial knobs when young, developing irregular, contorted, upright lobes with age and thus becoming convoluted; up to 10 cm long, tightly adherent to the rocky substratum; olive to dark green. Thallus dissecting out into large clusters of utricles varying greatly in size among plants and from the margin to the center of individual specimens; large primary utricles (sub)cylindrical to clavate (75-) 150-250 (-350) µm in diameter, (400-) 500-900 (-1100) µm long; secondary utricles arising as buds from the lower part of primary utricles, (sub)cylindrical to capitate, markedly more elegant than the primary utricles. Utricular wall slightly (6 µm) to markedly (15 µm) thickened at the rounded to truncate apices, pitted, at least in the central portions of the plants. Hairs or hair scars common on older utricles (max. 20 per utricle), borne in the zone 55-155 µm below the apex. Gametangia fusiform, elliptical to oval, shortly pedicellate, on both primary and secondary utricles.

Ecology - Epilithic, mostly on horizontal substratum, but also observed on vertical walls, in the shallow subtidal (from low water level down to 50 cm depth; locally extremely abundant.

Distribution - Common in the Indian Ocean and western Pacific Ocean; also mentioned from Chile.

Note - The genus *Codium* is distributed throughout the world's seas, and contains about 150 species. *Codium* thalli can spread out over hard surfaces as mats, form spheres or grow upright, either unbranched and finger-like, or branched, with cylindrical or flattened branches. The taxonomy of the genus has been studied by Silva (1959, 1960) and Silva & Womersley (1956). Species boundaries and phylogenetic relationships within the genus have been studied by Verbruggen *et al.* (2007).

Fig. 77. *Codium arabicum*.

Codium geppiorum O.C. Schmidt
1923: 50, fig. 33 (*'geppii'*) Fig. 78

REFERENCES: Jaasund (1976: 33, fig. 67), Tseng (1984: 300, pl. 149, fig. 1), Lewmanomont & Ogawa (1993: 47, + fig., as *C. geppei*), Cribb (1996: 27, top fig. p. 26, as *C. geppii*), Calumpong & Meñez (1997: 119, fig. p. 120, as *C. geppii*), Payri *et al.* (2000: 102, bottom fig. p. 103), Oliveira *et al.* (2005: 218, fig. p. 218), Kraft (2007: 153, pl. 5G, fig. 57), Skelton & South (2007: 273, figs 701, 711-715).

SYNTYPE LOCALITIES: Kai Islands and Celebes, Indonesia.

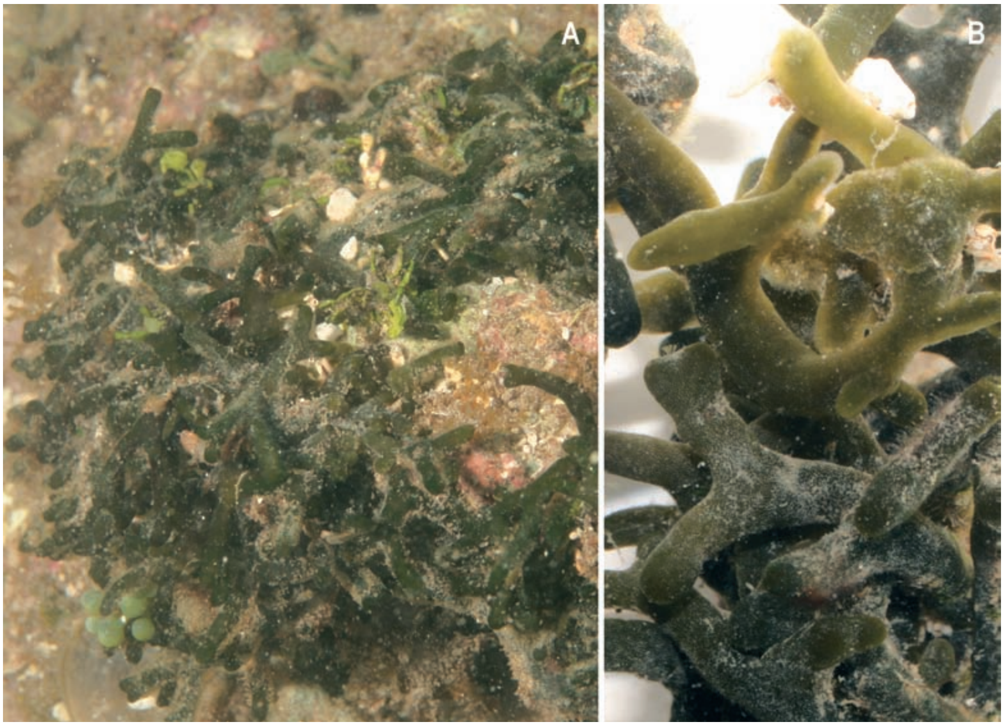
Description - Thallus repent, frequently with downwardly directed apices but other plants ascendant or even erect; branching dense, irregularly divaricately (sub)dichotomous (sometimes trichotomous); branches cylindrical, anastomosing, about 3 mm in diameter, repeatedly attached to the substratum by means of indiscriminately placed rhizoids; olive- to dark green. Thallus dissecting out into individual utricles; these clavate, elongate pyriform or (sub)cylindrical; mature utricles (50-) 150-225 (-320) µm diameter and (300-) 500-750 (-900) µm long; apices rounded or more rarely truncate; utricular wall 2 µm thick all over, without any ornamentation. Hairs or hair scars in small numbers, borne in the zone just below the apex. Gametangia fusiform (with or without a nozzle) to ellipsoidal, 50-75 µm in diameter, 230-300 µm long, generally 1 per utricle, each borne on a short pedicel (4 µm).

Ecology - Mostly in sand-covered, sheltered habitats such as lagoons, from a few cm under low water level down to 1 m depth and frequently growing in extensive populations. More rarely observed in sand-covered low intertidal pools.

Distribution - Reported worldwide in tropical to warm-temperate seas (but see note).

Note - Verbruggen *et al.* (2007) showed that *C. geppiorum* consists of at least five cryptic species, with the Sri Lankan representatives being more closely related to *C. isthmocladum* than to *C. geppiorum* from other geographical regions (Red Sea, SE Africa, Pacific Ocean and Caribbean Sea).
Slender growth forms of *C. repens* (Crouan) Vickers are morphologically very similar to *C. geppiorum*; they can be distinguished from the latter by the presence of inflated pyriform utricles, being slender pyriform in *C. geppiorum.*
Several other species of cylindrical *Codium* species have been collected along the Sri Lankan coast.

Fig. 78. *Codium geppiorum*. A. General view; B. Detail with numerous attachment points.


A
B

Caulerpa fergusonii G. Murray
1891: 212, pl. LIII: figs 1, 2 Fig. 79

REFERENCES: Svedelius (1906a: 140, fig. 51), Coppejans & Prud'homme van Reine (1992: 690, figs 1D-E, 13A-B), Littler & Littler (2003: 218, middle fig. p. 219).

TYPE LOCALITY: Sri Lanka.

Description - Stolons 1.5-2 mm in diameter in shallow-water specimens, only 1 mm in deep-water plants, densely branched in central parts of the former, almost unbranched in the latter, attached by numerous tufts of rhizoids at the tips of downwardly growing rhizoidal branchlets; uprights composed of slightly compressed, mostly unbranched rachis, 3 (-4) cm high in the former, only 1-2 cm high in the latter, slightly constricted above the implantation of the laterals; each segment widening towards the apical part; some uprights with a single or several constriction(s) in the bare, basal part, especially in the shallow-water populations, the other uprights being without bare basal part, with 5-7 (-10) pairs of laterals in shallow-water plants, 2-5 pairs in the deep-water specimens; laterals subspherical, being somewhat dorso-ventrally compressed, roundish to oval in surface view, about 3 mm in diameter, upwardly directed; dark green.

Ecology - Shallow-water plants on vertical rock walls, just under low water; deep-water specimens between 20 and 23 m depth, on partly sand-covered coral rubble.

Distribution - Indian Ocean: India, Indonesia, Malaysia, Sri Lanka; Pacific Ocean: Fiji, Japan, Papua New Guinea.

Note - *Caulerpa* is a common genus of (sub)-tropical coastal waters throughout the world. The *Caulerpa* plant body shows a complex external morphology, differentiated into creeping stolons, rhizophores with rhizoid clusters, and erect assimilators. The assimilators usually bear numerous branchlets termed ramuli. The genus includes about 75 species worldwide, with numerous varieties, forms or ecads, which are primarily defined on the basis of their assimilator morphology (Weber-van Bosse 1898, Coppejans & Meinesz 1988, Coppejans 1992, Coppejans & Prud'homme van Reine 1992). Taxon boundaries and phylogenetic relationships within *Caulerpa* have recently been studied by Famà *et al*. (2002), de Senerpont Domis *et al*. (2003) and Stam *et al*. (2006).

Fig. 79. *Caulerpa fergusonii***.** A. Small specimens *in situ* at great depth; B. Large specimens from shallow water (herbarium).

Caulerpa filicoides Yamada var. ***andamanensis*** W.R. Taylor
1966: 154-156, fig. 1 Figs 27G; 80

REFERENCES: Coppejans & Meinesz (1988: 184, figs 12-14), Littler & Littler (2003: 218, bottom fig. p. 219), Kraft (2007: 176, pl. 6B, figs 65A-D), Ohba *et al.* (2007: 28, + figs).

TYPE LOCALITY: Andaman Islands.

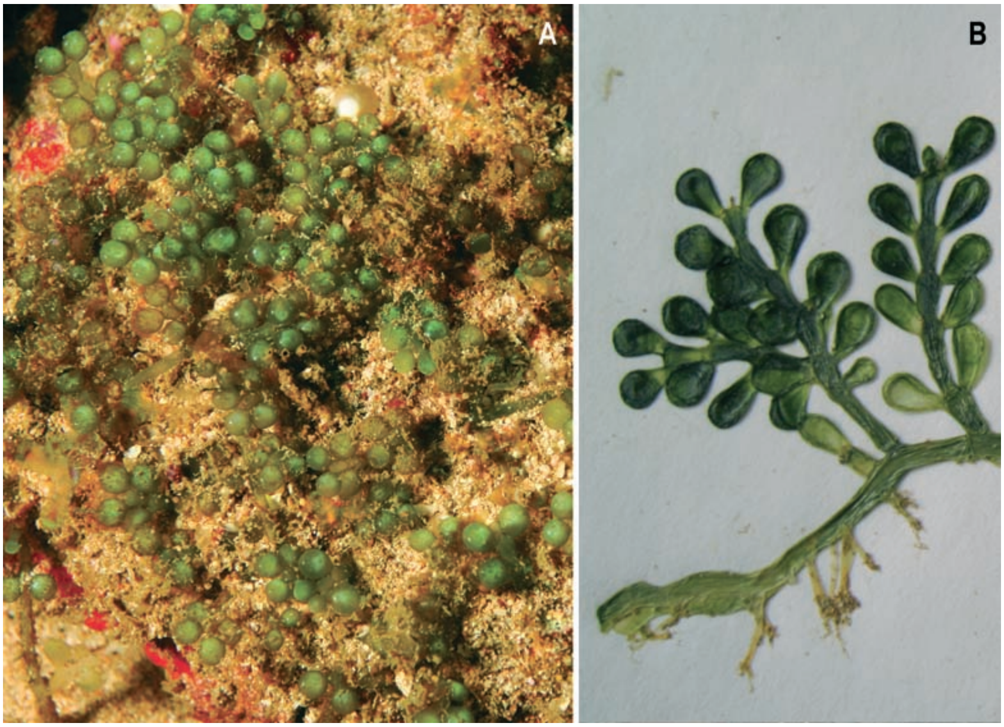
Description - A very delicate, dark green species; stolons thin, up to 0,2 mm in diameter, branching, covered by small, inconspicuous, sharply pointed spines with some developing to form rhizoids, resulting in a rather good attachment to the substratum. Assimilators peltate, the thin, vertically placed stipe 5-15 mm long, mostly simple, more rarely branched, terminally bearing a single, horizontally placed whorl of 6-8 branchlets with the general outlook of a snow crystal; each branchlet dichotomous at the base, alternately branched higher up, with acute apices.

Ecology - Abundant on coral rubble and rock boulders at 19-25 m depth.

Distribution - Indian Ocean: Andaman Islands, India, Tanzania; Pacific Ocean: Fiji, Papua New Guinea.

Notes - The var. *filicoides*, with several, superposed whorls of more funnel-shaped, but morphologically similar branchlets as in var. *andamensis* was collected in shallow lagoons.
New record for Sri Lanka.

Fig. 80. *Caulerpa filicoides* var. *andamanensis*.


A
B

Caulerpa imbricata G. Murray

1887: 37-38 Figs 10E, F; 20C; 81

Reference: Svedelius (1906a: 134-136, figs 37-39).

Type locality: Galle, Sri Lanka.

Description - Plants mostly growing in very dense bluish green clumps, with intricated fleshy stolons and a stiff-fleshy texture; erect branches very densely set, in such a way that they are contiguous, 1-2 (-3) cm high, unbranched, completely and very densely set by radially placed side branchlets of similar morphology over the whole length of the rachis which is not visible in these smaller specimens; plants of some collections are less dense and taller (3-5 cm high), the rachis sometimes branched once, with less densely placed side branchlets in the taller specimens, where the rachis becomes visible; side branchlets roughly trumpet-shaped, upwardly directed, shortly stalked, the inflated apical part being typically asymmetrically (tilted apically) compressed (turbinate with a convex tip) to almost complanate (peltate); light green.

Ecology - Epilithic in the low intertidal and shallow subtidal.

Distribution - Sri Lanka and tropical Atlantic Ocean (Brazil, Florida, Lesser Antilles, Mexico).

Note - The branchlets are most typically inflated and asymmetrically compressed, less frequently peltate and then rarely as thin as in *C. peltata* var. *peltata* or *C. racemosa* var. *peltata* where the stipes of the peltate discs are also very slender; the branchlets are of similar morphology from the base to the apex of the rachis as opposed to *C. peltata* var. *laetevirens* (also present in our collections from Sri Lanka), where the basal branchlets are cylindrical, median ones clavate and top ones turbinate. Taylor (1960) considers this entity as *Caulerpa peltata* f. *imbricata* (G. Murray) Weber-van Bosse. Morphologically, this taxon also resembles *Caulerpa racemosa* var. *chemnitzia* (Esper) Weber-van Bosse. Molecular research should indicate if this is really an individual species or a variety, form or growth form of *C. peltata* or *C. racemosa*.

Fig. 81. *Caulerpa imbricata.*

Caulerpa lentillifera J. Agardh

1837: 173 Figs 20F; 82

References: Jaasund (1976: 25, fig. 49), Coppejans & Meinesz (1988: 184, figs 39-41), Moorjani & Simpson (1988: 13, pl. 13), Coppejans & Beeckman (1989: 383, figs 1-3), Coppejans & Prud'homme van Reine (1992: 690, figs 4E-F, 14A, B), Lewmanomont & Ogawa (1995: 31, + fig.), Cribb (1996: 17, fig. p. 16), Calumpong & Meñez (1997: 114, fig. p. 115), Trono (1997: 33, fig. 19), Huisman (2000: 253, + fig.), Littler & Littler (2003: 220, middle fig. p. 221), Abbott & Huisman (2004: 118, fig. 43D), Oliveira *et al*. (2005: 210, fig. p. 211), Kraft (2007: 186, pl. 6C, figs 68A-C), Ohba *et al*. (2007: 29, + figs).

Type locality: Eritrea.

Description - Stolons terete, irregularly branched (branching density variable), 1-1.5 (-2) mm in diameter; erect fronds rather densely set, up to 3 cm long and unbranched in rather exposed habitats, up to 12 cm long and rather frequently branched in sheltered habitats; rachis terete, completely and densely covered by (sub)spherical ramelli of 1 (-2) mm in diameter, frequently placed on 5-8 longitudinal rows or more irregularly and imbricately placed, supported by pedicels, clearly constricted at the basis of the spherical part; very dark bluish green. The larger growth forms can locally have a naked rachis over a few mm at the basis. Chloroplasts with a single pyrenoid.

Ecology - Mainly on vertical or overhanhanging rock walls at about low water mark, air-exposed at low tide but continuously wave-swept.

Distribution - Tropical Indian and Pacific Ocean.

Note - This species is very similar to *C. microphysa* (Weber-van Bosse) J. Feldmann, but the latter lacks the constrictions between the pedicels and the spherical part of the branchlets, although this character seems to be variable.

Fig. 82. *Caulerpa lentillifera*.

Caulerpa mexicana Sonder ex Kützing f. ***exposita*** (Børgesen) Coppejans *in Coppejans et al*. 2004: 2983 Fig. 83

REFERENCES: Børgesen (1954: 8, figs 1, 2), Littler & Littler (2003: 216, top fig. p. 217, as *C. crassifolia* f. *exposita*)

TYPE LOCALITY: Riambel, near Souillac, Mauritius.

Description - Plants rather stiff; stolons densely branched and very well attached by numerous rhizoid-bearing branchlets; uprights short (1-1.5 cm long), alternately placed obliquely upwards (V-shaped) and downwardly curved, rachis compressed, bearing pinnately placed compressed branchlets, broadly spindle-shaped, perpendicularly placed on the rachis and upwardly curved in their apical part, acuminate; the successive branchlets overlap each other in their middle part; light green *in situ*, darkening upon drying.

Ecology - On coral rubble between healthy coral boulders, -3 m.

Distribution - Indian Ocean: Mauritius, Rodrigues, Sri Lanka; South Pacific.

Fig. 83. *Caulerpa mexicana* f. *exposita*.

Caulerpa parvula Svedelius

1906a: 136, figs 43, 44 Fig. 84

SYNTYPE LOCALITIES: Pamban, Tamil Nadu, India; Beruwela, Sri Lanka.

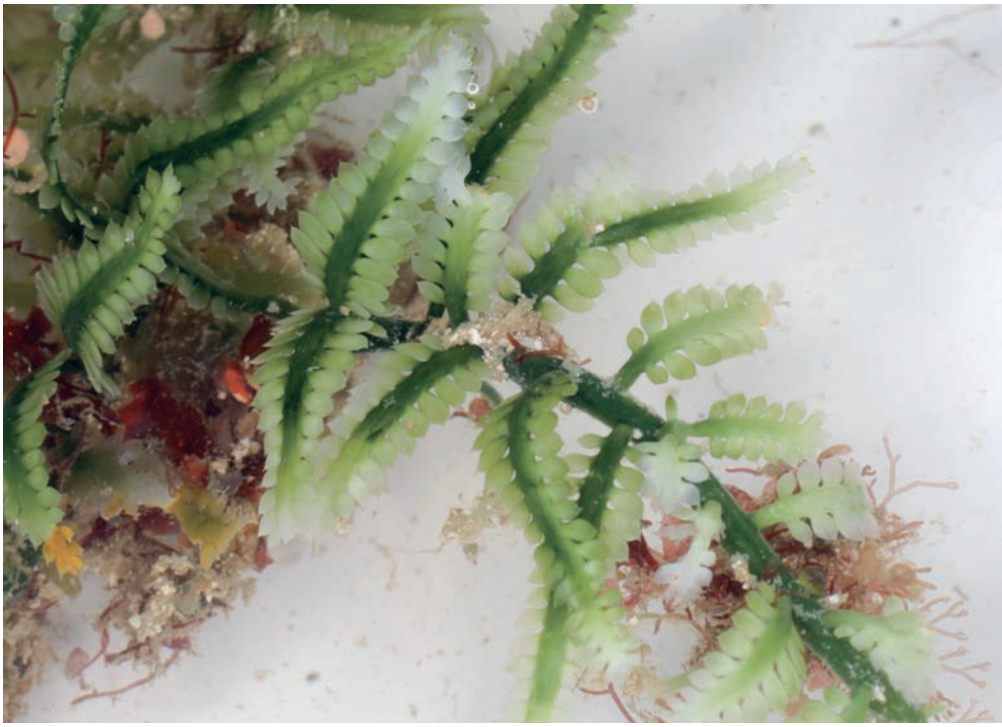
Description - Plants extremely densely intricated and prostrate, forming extremely well adhering, mat-like, fleshy plants; dark, slightly bluish green; stolons richly branched, with numerous rhizoidal holdfasts; uprights composed of single, peltate, fleshy branchlets, 1-2 mm in diameter or by several of these, radially arranged on very short rachis; peltate structures extremely densely placed, forming contiguous mats.

Ecology - Epilithic on horizontal beachrock at about low water mark at surf-exposed sites, air-exposed at low tide, but continuously wave-swept.

Distribution - Only known from India, Indonesia and Sri Lanka.

Note - A few branches of HEC 11809 are taller and look like small *Caulerpa imbricata*, possibly indicating that *C. parvula* might just be a dwarf growth form from surf-exposed sites of the former.

Fig. 84. *Caulerpa parvula*.



Caulerpa peltata var. ***peltata*** J.V. Lamouroux 1809a: 332

Fig. 85

REFERENCES: Jaasund (1976: 27, fig. 53), Tseng (1984: 282, pl. 140, fig. 3), Coppejans & Beeckman (1989: 388; figs 27-29, as *C.* var. *peltata*), Coppejans & Prud'homme van Reine (1992: 696, 17B, as *C. racemosa* ecad *peltata*), Coppejans (1992: 401), Lewmanomont & Ogawa (1993: 36, + fig., as *C. racemosa* var. *peltata*), Payri *et al.* (2000: 92, top fig. p. 93), Littler & Littler (2003: 228, bottom fig. p. 229, as *C. racemosa* var. *peltata*), Coppejans *et al.* (2005: 68, fig. 38, as *C. nummularia*), Ohba *et al.* (2007: 34, + figs), Kraft (2007: 171, figs 64A-C), Skelton & South (2007: 265, fig. 692).

TYPE LOCALITY: Antilles, West Indies.

Description - Thallus prostrate; stolons thin (about 0.5 mm in diameter), variably branched; erect fronds as isolated, thin peltate discs of up to 3 mm in diameter, born on unbranched, erect stipes, 5-10 mm long; margin of the discs smooth; bluish green.

Ecology - Shallow subtidal, mostly somewhat shaded, under overhangs.

Distribution - Pantropical.

Notes - *Caulerpa* specimens with peltate discoid branchlets, radially arranged around longer erect rachis are here being identified as *C. racemosa* var. *peltata*.

Fig. 85. *Caulerpa peltata* var. *peltata* next to some *Caulerpa microphysa* (Weber-van Bosse) J. Feldmann (left under).

Caulerpa peltata var.

Figs 11C; 86

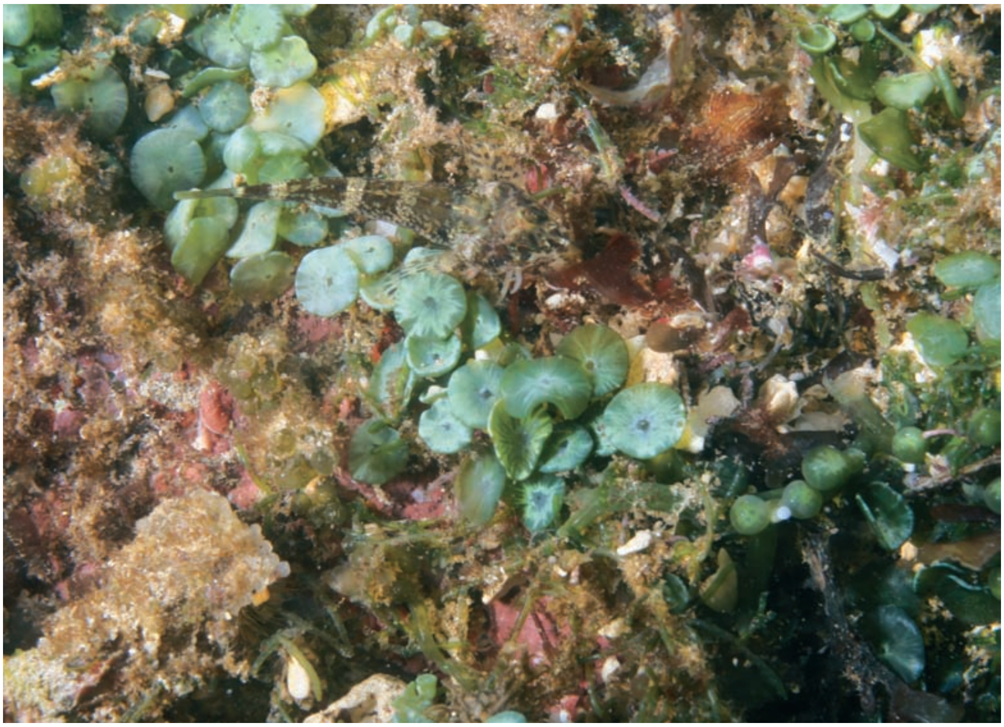
REFERENCES: Svedelius (1906: 132, fig. 34, as *C. peltata* f. *ad claviferam*); South & N'Yeurt (1993: 131, fig. 24, as *C. racemosa* var. *turbinata*), Littler & Littler (2003: 228, bottom fig. p. 229, as *C. racemosa* var. *peltata*; 236, middle fig. p. 237 and top fig. backpage, as *Caulerpa* sp.), N'Yeurt & Payri (2007: 43, fig. 61).

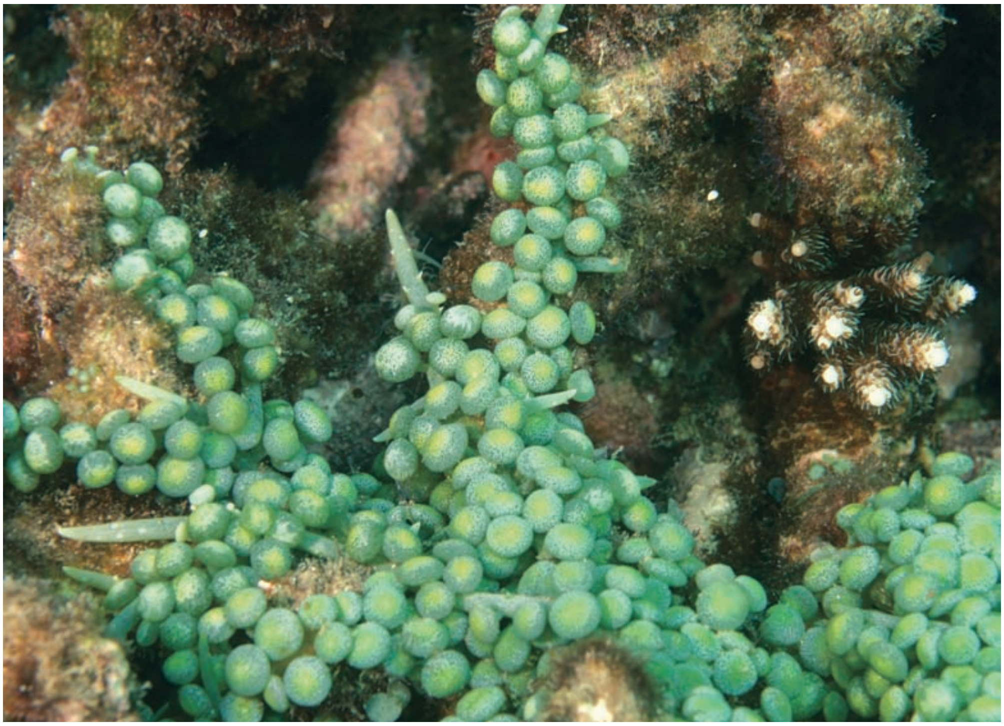
Description - Plants fleshy and rather stiff, repent, very well attached to the substratum by numerous rhizoidal branchlets, bluish green with creamy spots or veins; stolons 2 mm thick, with a percurrent axis and several shorter side axes; branchlets individually placed on the stolon or in small groups on a very short rachis, very densely set, contiguous, stipitate, the heads typically 'mushroom-shaped', with a flat (to somewhat funnel-shaped) lower part and umbonate, rounded upper part.

Ecology - On coral rubble between living coral heads, 1 m deep.

Notes - Peterson (1972) and Ohba & Enomoto (1987) have experimentally shown that light and temperature greatly influence the morphology of clonal grown specimens of *Caulerpa racemosa.* They both illustrate similar growth forms (ecads) to our specimens described above, although somewhat more slender.
Awaiting further (molecular) research, we prefer to distinguish this taxon from others, but not to assign it to a described one.

Fig. 86. *Caulerpa peltata* var.





Caulerpa racemosa var. ***racemosa*** (Forsskål) J. Agardh 1873: 35-36 Figs 10D, F; 12D; 44I; 87

References: Magruder & Hunt (1979: 19, fig. 1, p. 18), Tseng (1984: 282, pl. 140, fig. 4, as var. *clavifera*), Coppejans & Meinesz (1988: 191, fig. 23, as var. *clavifera*), Coppejans & Prud'homme van Reine (1992: 698, figs 18A, B), Coppejans (1992: 401, figs 4C, D), Lewmanomont & Ogawa (1993: 35, + fig.), Cribb (1996: 17, bottom fig. p. 16), Calumpong & Meñez (1997: 115, + fig.), Littler & Littler (2003: 226, middle fig. p. 227), Payri *et al.* (2000: 94, top fig. p. 95), Oliveira *et al*. (2005: 212, fig. p. 213, left under), Skelton & South (2007: 267, figs 694-696, 790).

Type locality: Suez, Egypt.

Description - Thallus forming intricated coverings because of the richly ramified, 2 mm thick stolons, very well fixed to the substratum by numerous, well developed rhizoidal holdfasts; erect parts densely grape-like: rachis short: up to 2 cm, bearing irregularly, closely packed, pearshaped to subspherical, shortly stipitate branchlets with a diameter of (2-) 3 mm and rounded apex, generally resulting in a single layer of contiguous round branchlets, completely hiding the rachis; stalks of the branchlets shorter than the spherical part; bright yellowish green in strongly insolated pools, darker green in subtidal biotopes, where the rachis becomes slightly longer and the number of vesicular branchlets on them are more numerous, but are still very densely packed; young thallus parts becoming brownish after drying.

Ecology - Epilithic on horizontal substratum, from high intertidal pools along surf-exposed coasts to the shallow subtidal, where it frequently develops between coral branches.

Distribution - Pantropical.

Fig. 87. *Caulerpa racemosa* var. *racemosa*.

Caulerpa racemosa var. ***racemosa*** f. ***macrophysa*** (Sonder ex Kützing) Svedelius 1906a: 120-122, fig. 13 Fig. 88

References: Coppejans & Beeckman (1989: 384; fig 4, as var. *clavifera* (Turner) Weber-van Bosse f. *macrophysa* (Kützing) Weber-van Bosse), Littler & Littler (2000: 362, bottom fig. p. 363, as *C. macrophysa* (Sonder ex Kützing) G. Murray), Payri *et al*. (2000: top fig. p. 95 as *C. racemosa*), Littler & Littler (2003: 220, bottom fig. p. 221, as *C. macrophysa*), Abbott & Huisman (2004: 120, fig. 43E, as *C. macrophysa*).

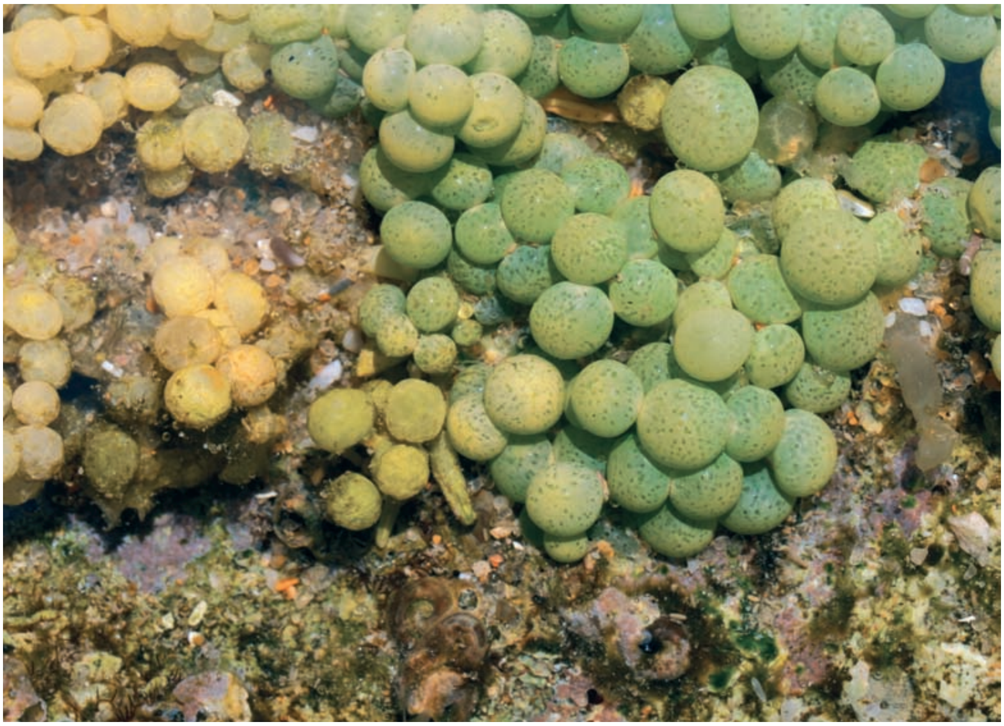
Type locality: Central America.

Description - Stolons thick and fleshy, spreading, very well attached to the substratum by numerous tufts of rhizoids on the rhizoidal branchlets; uprights composed of either single, very shortly stipitate, vesiculate structures up to 5 mm in diameter or of small, almost sessile, clustered groups of such vesicles; creamy to light green, branchlets frequently mottled (according to Littler & Littler, 2000: 486), prior to going reproductive.

Ecology - Mostly in shallow, low intertidal pools, where it can form extensive, monospecific vegetations, but also present on horizontal as well as vertical walls at about low tide level, being partly air-exposed at low tide (but then continuously wave-swept) and in the shallow subtidal.

Distribution - Indian Ocean, tropical Pacific and tropical western Atlantic Ocean.

Fig. 88. *Caulerpa racemosa* var. *racemosa* f. *macrophysa*.



Caulerpa racemosa var. ***racemosa*** f. ***remota*** (Svedelius) Coppejans comb. nov.

Fig. 89

BASIONYM: *Caulerpa clavifera* (Turner) C. Agardh f. *remota* Svedelius 1906a: 120-121, fig. 14.

TYPE LOCALITY: Galle, Sri Lanka.

Description - Very similar to var. *racemosa*, but the upright branches are separated by long intervals on the stolons, the rachis are longer (3-4 cm or even longer in deeper populations), the inflated branchlets are more separated (not completely hiding the rachis) and the stalks of the spherical branchlets are also longer (as long as or longer than the diameter of the spheres), resulting in a less dense, more slender aspect than the typical var. *racemosa*.

Ecology - Epilithic in the subtidal (deeper/more sheltered than the typical variety).

Distribution - Sri Lanka.

Note - In some way this taxon is similar to what some authors are calling *C. racemosa* var. *occidentalis* (J. Agardh) Børgesen (Børgesen (1907: 379, figs 28-29), Coppejans & Meinesz (1988: fig 23), Coppejans & Beeckman (1989: p. 384, pl. 2, figs 5-6), Coppejans (1992: 399, fig. 4B), Skelton & South (2007: 267, figs 694, 696, 790).

Fig. 89. *Caulerpa racemosa* var. *racemosa* f. *remota* (herbarium specimen).

Caulerpa racemosa var. ***cylindracea*** (Sonder) Verlaque, Huisman & Boudouresque f. ***laxa*** (Greville) Weber-van Bosse

1898: 367, pl. XXXIII, fig. 22

Fig. 90

REFERENCES: Svedelius (1906: 124-127, fig. 19, as *C. laetevirens* f. *laxa*), Cribb (1958: 218, pl. 3, fig. 4, as *C. racemosa* var. *laetevirens* f. *cylindracea* (Sonder) Weber-van Bosse), Coppejans & Beeckman (1989: p. 386, pl. 4, fig. 23, as *C. racemosa* var. *laetevirens* f. *cylindracea*).

TYPE LOCALITY: Eastern India.

Description - Plants growing in open populations, sand submerged parts whitish, light exposed parts bright to dark green; stolons thin (1 mm in diameter), rather scarcely branched, extremely well attached to the rock substratum by numerous tufs of rhizoids; assimilators placed at relatively large intervals (1-2.5 cm), 1-3 (-5) cm high, extremely supple and swinging around by the wave action; rachis cylindrical and thin, sometimes branched (especially the taller ones); branchlets radially placed around the rachis, morphologically variable: mostly cylindrical, sometimes clavate (especially the upper ones), or even somewhat laterally compressed and incurved (bean-shaped); some intercalary parts of the rachis can be naked (devoid of branchlets), but otherwise it can also produce new stolons higher up (after that the basal part becomes sand-covered?) which in their turn can form new assimilators.

Ecology - On sand-covered, horizontal rock substratum, -0,5/-1 m under low water mark, exposed to strong underwater wave action and sand scourching.

Distribution - India, Sri Lanka; Mediterranean Sea (introduced?).

Note - According to Silva *et al.* (1996: 830) this taxon lies within the circumscription of *Caulerpa peltata*, but has not yet been transferred or reduced to synonymy. We prefer to wait for the results of molecular analysis before suggesting taxonomic transfers.

Fig. 90. *Caulerpa racemosa* var. *cylindracea* f. *laxa* (herbarium specimens).

Caulerpa serrulata (Forsskål) J. Agardh

1837: 174 Fig. 91

REFERENCES: Jaasund (1976: 23, fig. 48), Magruder & Hunt (1979: 19, fig. 2, p. 18), Tseng (1984: 284, pl. 141, fig. 1), Coppejans & Beeckman (1989: 120; figs 24-25), Coppejans & Meinesz (1988: 191, figs 25-26), Moorjani & Simpson (1988: 13, pl. 16), Coppejans & Prud'homme van Reine (1992: 701, fig. 20B), Lewmanomont & Ogawa (1995: 37, + fig.), Cribb (1996: 19, bottom fig. p. 18), Calumpong & Meñez (1997: 116, + fig.), Trono (1997: 39, fig. 23), Huisman (2000: 257, + fig.), Littler & Littler (2000: 372, figs p. 373), Payri *et al*. (2000: 94, bottom fig. p. 95), Littler & Littler (2003: 230, figs p. 231), Abbott & Huisman (2004: 123, fig. 45A), Coppejans *et al*. (2005: 70, fig. 41), Oliveira *et al*. (2005: 214, figs p. 215), Huisman *et al*. (2007: 182, + fig.), Kraft (2007: 177, pl. 6F, figs 65E-G), Ohba *et al*. (2007: 38, + figs), Skelton & South (2007: 268, figs 697-698, 776, 788).

TYPE LOCALITY: Mokha (Yemen).

Description - Stolons 1.5-2 mm thick, from sparsely to richly branched, with numerous well developed rhizoid-bearing branchlets. Assimilators, (1-) 2-3 (-4) cm high, shortly stipitate (2-5 mm), stipe terete; blade narrow straplike, dichotomous, only slightly (HEC 11850) or even not (HEC 12554) spirally twisted, stiff, with markedly serrate margins, dark green.

Ecology - Epilithic, from just under low water mark, down to -25 m.

Distribution - Tropical Indo-Pacific.

Note - The smaller, not spirally twisted form, with thinner stolons is sometimes considered as a separate variety, *C. serrulata* var. *hummii* (Diaz-Piferrer) Farghaly, but intermediates exist, casting doubt on the value of this variety.

Fig. 91. *Caulerpa serrulata* together with *Halimeda* sp.

Caulerpa sertularioides (S.G. Gmelin) M.A. Howe

1905: 576 Figs 17H; 41B; 92

REFERENCES: Jaasund (1976: 23, fig. 47), Magruder & Hunt (1979: 19, fig. 3, p. 18), Tseng (1984: 284, pl. 141, fig. 2), Lawson & John (1987: 90, pl. 8, fig. 2), Moorjani & Simpson (1988: 13, pl. 17), Coppejans & Beeckman (1990: 120; figs 26-27), Coppejans & Meinesz (1988: 192, fig. 29), Coppejans & Prud'homme van Reine (1992: 704, fig. 21A), Lewmanomont & Ogawa (1993: 38, + fig.), Cribb (1996: 21, top fig. p. 20), Huisman (2000: 258, + fig.), Littler & Littler (2000: 374, figs p. 375), Payri *et al*. (2000: 96, top fig. p. 97), Littler & Littler (2003: 232, middle fig. p. 233), Abbott & Huisman (2004: 124, figs 45B-C), Oliveira *et al*. (2005: 214, + fig.), Huisman *et al*. (2007: 182, + figs), Kraft (2007: 175, pl. 6G, figs 64F-G), Ohba *et al*. (2007: 39, + figs).

TYPE LOCALITY: "in coralliis americanis".

Description - Uprights feather-like with cylindrical ramuli, light to dark green. Two extreme growth forms occur along the Sri Lankan coast: a small, very intricate one (form 1), and a larger, more elegant and less dense one (form 2), but intermediates have also been collected.

Form 1 (forma *brevipes* (J. Agardh) Svedelius). Stolons thin (0.25-0.5 mm), richly branched, forming rather dense, intricate, rather stiff tufts; upright branches 1-2 cm high, 3-5 mm wide, main axis mostly unbranched, naked at the base (2-3 mm), provided with pinnately disposed branchlets; pinnae cylindrical, not contracted at the base, elegantly upcurved, with mucronate tips.

Form 2 (forma *longiseta* (Bory de Saint-Vincent) Svedelius). General aspect less dense and markedly more supple and elegant than form 1; stolons 1-1.5 mm thick, sparsely branched; upright branches up to 10 cm high and 10 mm wide, rachis simple or irregularly to subdichotomously branched once or twice. Pinnae as in form 1 but longer.

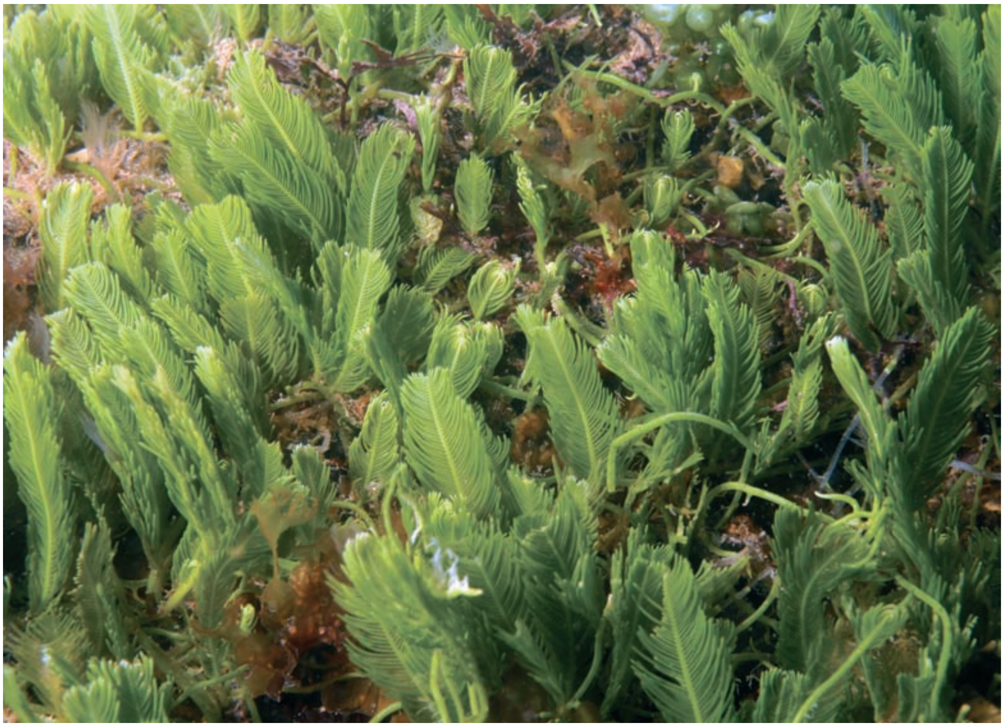
Some specimens, mainly of form 2 show repeated regrowth (longer pinnae being formed after gradually shorter ones), resulting in a Christmas-tree-like aspect (forma *umbellata* (Weber-van Bosse) Svedelius).

Ecology - Form 1: Growing in surf-exposed intertidal areas or in the small cascades between intertidal pools. Form 2: Subtidal in sheltered lagoons or harbours.

Distribution - Tropical Indo-Pacific and tropical eastern Atlantic Ocean.

Note - Several forms have been described in literature but as intermediates are frequently observed we prefer to consider them merely as growth forms (ecads).

Fig. 92. *Caulerpa sertularioides*.



Caulerpa taxifolia (Vahl) C. Agardh
1817: XXII Figs 22E; 93

REFERENCES: Jaasund (1976: 23, fig. 46), Magruder & Hunt (1979: 21, fig. 1, p. 20), Tseng (1984: 284, pl. 141, fig. 3), Coppejans & Beeckman (1990: 122; figs 36-39), Lawson & John (1987: 90, pl. 8, fig. 3), Coppejans & Prud'homme van Reine (1992: 706, figs 6B, 22B), Coppejans (1992: 406, figs 8A-B), Lewmanomont & Ogawa (1993: 39, + fig.), Cribb (1996: 21, middle fig. p. 20), Huisman (2000: 258, + fig. p. 259), Littler & Littler (2000: 376, top fig. p. 377), Payri *et al.* (2000: 98, top fig. p. 99), Littler & Littler (2003: 234, top fig. p. 235), Abbott & Huisman (2004: 124, figs 46A-B), Huisman *et al.* (2007: 183, + figs), Kraft (2007: 177, pls 6D, 7C-D, figs 66A-C), Ohba *et al.* (2007: 41, + figs).

TYPE LOCALITY: St. Croix, Virgin Islands.

Description - Uprights feather-like with markedly compressed ramuli, dark green. Stolons densely branched, bearing numerous downward growing branchlets with terminal groups of rhizoids and mostly closely packed, pinnate erect fronds, varying from 10-20 (-25) cm high, (5-) 7-10 mm wide; rachis slightly compressed, 0,5-1 mm wide, only exceptionally and irregularly branched up to two orders, naked at the base (3-10 mm) resulting in a stipitate aspect; pinnae 2-5 mm long, closely placed on 2 opposite rows in a single plane, almost perpendicular on the rachis, dorso-ventrally compressed, upwardly curved in their upper part, slightly constricted at the base, with parallel sides and gradually tapering to the acuminate apex; pinnae very densely set, but not overlapping.

Ecology - The typical (tall) growth form locally develops in large, almost monospecific vegetations between rock boulders, in the lagoon, from just under low water mark down to 1 m depth; the small growth form (f. *asplenioides*) somewhat deeper (-3 m).

Distribution - Pantropical (and Mediterranean Sea, introduced).

Note - Some collections are composed of plants with less branched stolons, short (1-2 cm high), horizontally curved uprights which are placed on two upwardly directed oblique rows and short ramelli; this form has been described as *C. taxifolia* f. *asplenioides* (Greville) Weber-van Bosse. Some specimens of this form show the same repeated regrowth as described in *C. sertularioides*, which Svedelius (1906a: 113, fig. 6) called *C. taxifolia* f. *interrupta*.

Fig. 93. *Caulerpa taxifolia*.

Caulerpa verticillata J. Agardh
1847: 6 Figs 22D; 36H; 94

REFERENCES: Tseng (1984: 284, pl. 141, fig. 4), Coppejans & Beeckman (1990: 124; figs 28-32), Coppejans & Prud'homme van Reine (1992: 708, fig. 21B), Lewmanomont & Ogawa (1995: 40, + fig.), Trono (1997: 44, fig. 27), Littler & Littler (2000: 376, middle figure p. 377), Littler & Littler (2003: 234, bottom fig. p. 235), Abbott & Huisman (2004: 125, fig. 46C), Oliveira *et al.* (2005: 214, + fig), Ohba *et al.* (2007: 43, + figs).

TYPE LOCALITY: Not specified (West Indies).

Description - Growing in dense, extremely soft and slender, very dark green tufts. Stolons thin (up to 250 µm in diameter), very densely branched, well fixed by very numerous groups of rhizoids; upright branches densely set, 1-2 (-3) cm high, with a naked base and conspicuous whorls of determinate branchlets higher up; (1-2) 3-5 (-10) superposed whorls, 2-3 (-4) mm in diameter, 2-3 mm apart; ramelli tubular, branching dichotomously 4-6 times, not constricted at the dichotomies, approximately 80 µm in diameter at the base, tapering to 25 µm at the rounded apices.

Ecology - Either on sand-covered rock substratum in shallow lagoons, or on the vertical, lagoon side of the beachrock platform; at about or just under low water level.

Distribution - Indian Ocean, tropical Pacific Ocean and Caribbean Sea.

Fig. 94. *Caulerpa verticillata*.

Halimeda discoidea Decaisne 1842: 102

Figs 22B; 24C; 95

References: Jaasund (1976: 31, fig. 62), Magruder & Hunt (1979: 29, fig. 1 p. 28), Hillis-Colinvaux (1980: 136-139, fig. 41), Tseng (1984: 288, pl. 143, fig. 2), Cribb (1996: 31, middle fig. p. 30), Calumpong & Meñez (1997: 105, fig. p. 106), Littler & Littler (2000: 400, bottom fig. p. 401), Payri *et al.* (2000: 108, top fig. p. 109), Littler & Littler (2003: 244, middle fig. p. 245), Oliveira *et al*. (2005: 219, fig. p. 219), Huisman *et al*. (2007: 190, + fig.), Kraft (2007: 202, figs 72E-L), Ohba *et al*. (2007: 45, + figs).

Type locality: Stated as Kamchatka, but highly improbable; true provenance not known.

Description - Plants mostly growing in isolated, limited populations, only locally forming huge, monospecific vegetations. Thallus erect, generally bushy, mostly 5-10 cm high, but up to 18 cm, attached by a generally well-developed felty structure; branching mainly di- trichotomous mostly in a single plane but also polychotomous from large segments and then in several planes, resulting in a dense habit; segments only slightly calcified, mostly thick and fleshy, without ribs or inflated upper rim, morphologically variable (even within a single specimen): the basal one(s) (sub)terete, resulting in a stipitate aspect, the upper ones most typically rounded, but frequently reniform or cuneate, flat, 15-22 mm broad, 10-15 (-20) mm long; bright green.

Ecology - Epilithic, mostly in lagoons from low water mark down to 1 m depth. Around Kalpityia, huge (several hundreds of square meters), monospecific populations are present with erect, contiguous plants, all directed in the same direction, all moving together with the waves.

Distribution - Indian Ocean, tropical Pacific Ocean, eastern Atlantic Ocean.

Note - *Halimeda* is characterized by thalli composed of calcified green segments and occurs throughout the tropics and subtropics. Important taxonomic studies include the monographs of Barton (1901), Hillis (1959) and Hillis-Colinvaux (1980). Phylogenetic relationships and species boundaries within the genus have been studied in detail by Kooistra *et al*. (2002) and Verbruggen (2005). For correct identification on species level, anatomical analysis is needed.

Fig. 95. *Halimeda discoidea*.

Halimeda gracilis Harvey ex J. Agardh 1887: 82

Figs 12C; 24A, B; 42C; 96

References: Hillis-Colinvaux (1980: 144; figs 44a-b), Littler & Littler (2000: 402, middle fig. p. 403), Littler & Littler (2003: 246, middle fig. p. 247), Coppejans *et al*. (2005: 84, figs 57-58), Kraft (2007: 204, figs 73A, B, D, I), Ohba *et al*. (2007: 47, + figs).

Type locality: Sri Lanka.

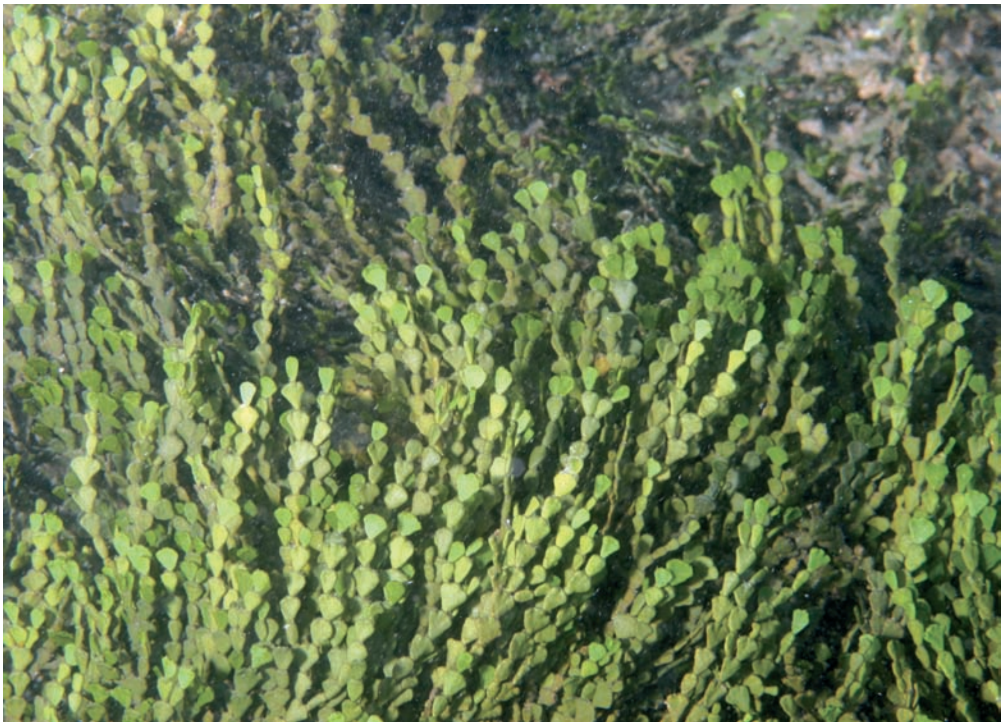
Description - Plants mostly in large, densely intricated populations forming thick cushions on the substratum. Thallus ascendant, 20 (-25) cm long, lax; the basal parts rather stiff, the upper parts being supple and moving along with the waves, white (in the basal parts) to bluish green; branching sparse but some segments supporting 4 to 5 branches; attachment by groups of rhizoids at several places where the sprawling thallus contacts the substratum; segments strongly calcified and brittle, in most populations small, cuneate, flabellate, diamond-shaped to somewhat rounded or subterete, smooth, 2-3 (-5) mm long and 2-3 mm wide. Other populations (f. *triloba*) have wider (up to 5 mm broad) trilobed segments with radial ribs

Ecology - Epipsammic, extremely abundant on the sandy substratum of sheltered lagoons or sheltered depressions in submerged reefs (Bar Reef), from 1 to 4 m depth; frequently growing mixed to seagrasses (Fig. 12C). As a result of sand fixation between the sprawling branches, bumps develop on the lagoon bottom with the more supple branch tips being radially arranged and swaying around with the waves.

Distribution - Indian Ocean, tropical Pacific Ocean, Caribbean Sea.

Note - This *Halimeda* species is the most abundant one along Sri Lankan coasts, especially in lagoons. Along some Sri Lankan shores the substratum is mainly composed of loose segments of decayed specimens of *H. gracilis* (Figs 2D, E).

Fig. 96. *Halimeda gracilis*.



Halimeda opuntia (Linnaeus) J.V. Lamouroux
1816: 308 Figs 22F; 97

REFERENCES: Jaasund (1976: 33, fig. 65), Magruder & Hunt (1979: 29, fig. 2, p. 28), Hillis-Colinvaux (1980: 110-112, figs 19, 51, 92), Tseng (1984: 290, pl. 144, fig. 2), Moorjani & Simpson (1988: 15, pl. 26, right), Lewmanomont & Ogawa (1993: 52, + fig.), Cribb (1996: 33, top fig. p. 32), Calumpong & Meñez (1997: 103, fig. p. 104), Payri *et al*. (2000: 114, bottom fig. p. 115), Oliveira *et al*. (2005: 220, fig. p. 221), Huisman *et al*. (2007: 190, + fig.), Kraft (2007: 220, pl. 8G, figs 77H-L), Ohba *et al*. (2007: 54, + figs).

LECTOTYPE LOCALITY: Jamaica.

Description - Plants forming very dense, stiff-brittle, hemispherical clumps, 10-15 cm in diameter, or more extensive mounds, exceeding 20 cm in diameter, with numerous points of attachment, whitish in the clump, light to dark green at the periphery. Branches radially arranged, segments reniform (sometimes even auriculate) to trilobate, 3-4 mm long, 5-7 mm broad, sometimes ribbed, old ones strongly calcified and brittle, successive segments not in a single plane, sometimes even at right angles with each other; branching extremely dense, in all directions, resulting in a radial growth of the extremely intricate clumps.

Ecology - From shallow rock pools of the lower intertidal to the shallow subtidal of sheltered lagoons and bays.

Distribution - Pantropical.

Note - The absence of a well defined, single attachment point, the dense, cushion-like growth form and the strongly calcified segments distinguish this species from the others in Sri Lanka.

Fig. 97. *Halimeda opuntia*.

Avrainvillea amadelpha (Montagne) A. Gepp et E. Gepp
1908: 178-179, pl.23: fig. 20, pl. 24: figs 21, 22 Figs 25B; 41C; 98

REFERENCES: Olson-Stojkovich (1985: 36-38, fig. 19), Coppejans & Prud'homme van Reine (1989: 121, pl. 1, figs 1-17), Littler & Littler (2003: 236, bottom fig. p. 237), Abbott & Huisman (2004: 137, fig. 51A), Huisman *et al*. (2007: 192, + fig.), Ohba *et al*. (2007: 57, + figs).

TYPE LOCALITY: Agalega Islands.

Description - Plants gregarious, in dense clusters, arising from an extensive felted holdfast; stipes cylindrical in the basal part, becoming compressed towards the blades; in most collections stipes 0.5 to 1 cm long, more rarely up to 2 cm widening up to the fan- to wedge-shaped blades, 2-3 (-4) cm long and wide, soft and spongy, with a smoothly rounded margin, more rarely ragged or composed of loose filaments, dark green; intertwined filaments of the blades dichotomous, markedly constricted at the dichotomies, 18-25 µm in diameter. In some specimens the blade filaments are really loosely entangled, resulting in spongy, obconical structures.

Ecology - In rock crevices just under low water mark; locally abundant.

Distribution - Indian and tropical Pacific Ocean.

Note - *Avrainvillea* includes about 25 species, which are distributed in tropical waters. The genus has been monographed by Littler & Littler (1992) (tropical western Atlantic) and Olson-Stojkovich (1985).

Fig. 98. *Avrainvillea amadelpha*.

Avrainvillea erecta (Berkeley) A. Gepp et E. Gepp
1911: 29-32, pl. X: fig. 89 Fig. 99

REFERENCES: Tseng (1984: 286, pl. 142, fig. 1), Coppejans & Prud'homme van Reine (1989: 123, pl. 2, figs 18-37, as *A. erecta-A. obscura*), Trono (1997: 66, fig. 43), Payri *et al.* (2000: 118, top fig. p. 119), Littler & Littler (2003: 238, top fig. p. 239), Oliveira *et al.* (2005: 222, figs p. 222), Ohba *et al.* (2007: 58, + figs).

TYPE LOCALITY: Philippines.

Description - Plants generally solitary, but mostly growing in open populations; in some cases a few, closely gathered specimens anastomose laterally; fully grown thalli consisting of a flabellate (more rarely reniform), spongy-felted blade that can be longitudinally undulated, up to 3 cm high and 4.5 cm wide, dirty dark green, supported by a very short, stout, unbranched stalk (5-10 mm long, 5-8 mm in diameter); plants attached by a well-developed more or less cylindrical, bulbous holdfast, up to 9 cm long and 15 mm in diameter; blade siphons loosely intricated, from greenish orange to yellowish brown (under microscope), 30-50 µm in diameter, cylindrical with deeply constricted equal dichotomies and rounded apices. Juvenile specimens only forming a small, hemispherical tuft of radially arranged loose filaments on top of a very short stipe; young plants forming a more or less cylindrical flabellum; only fully developed specimens are 'typically' flabellate.

Ecology - Close to the beach in a sheltered lagoon; in the seagrass vegetation and the beach-side channel (20 cm deep); continuously submerged plants flabellate; air-exposed specimens at low tide very small and like shaving brushes.

Distribution - Indian and tropical Pacific Ocean.

Fig. 99. *Avrainvillea erecta* partly sticking out of the water at extreme low tide.

Boodleopsis pusilla (Collins) W.R. Taylor, Joly et Bernatowicz
1953: 105-106 Fig. 100

REFERENCES: Leliaert *et al.* (2001: 455, figs 17-21); Oliveira *et al.* (2005: 222, + fig.).

TYPE LOCALITY: West Indies.

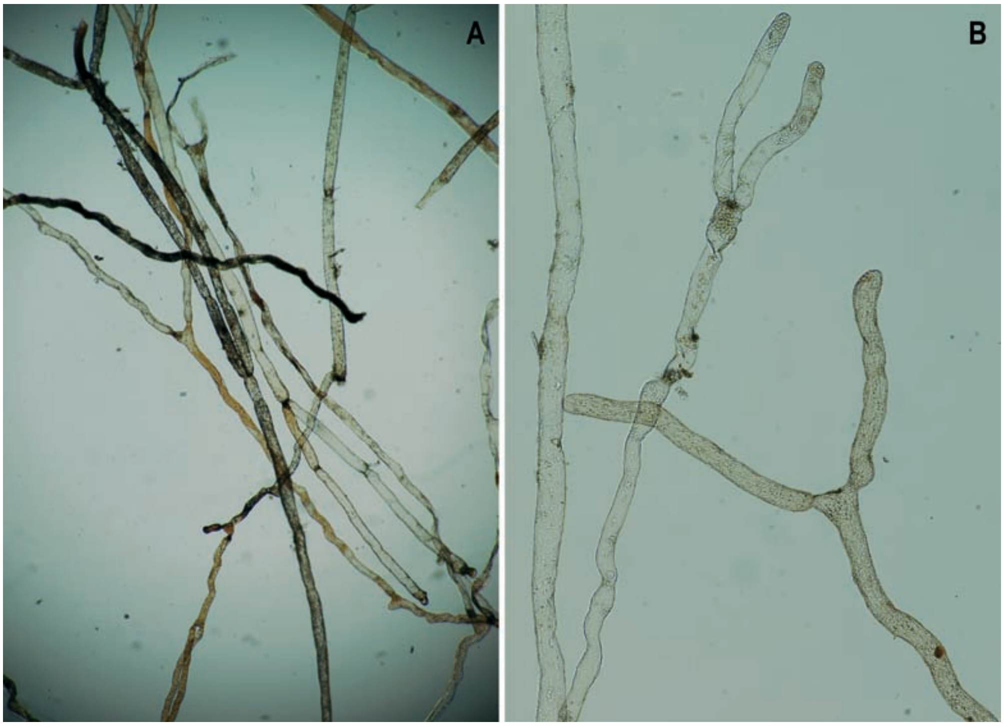
Description - Plants forming silty bumps from where the dark green tips of the filaments radially stick out; basal part composed of loosely interwoven siphonous filaments, 75-105 µm in diameter in the middle parts, 75-90 µm in the apical parts, repeatedly branching (sub-)dichotomously with a wide angle; branching angle rounded to flat; constrictions present just above the dichotomies but also between succeeding dichotomies; some filaments markedly sinuous; basal filaments almost colourless, filament tips very dark green; attachment by thinner, more densely and pseudodichotomously to irregularly branched, colourless rhizoids developing throughout the plant; rhizoids with a marked smaller diameter (10-30 µm) than the siphons.

Ecology - On horizontal rock substratum in a shaded crevice at about low tide level, continuously submerged.

Distribution - Pantropical.

Note - *Boodleopsis* species are separated mainly on filament diameter, but as West (1991) stated, this a variable character highly influenced by environmental factors.

Fig. 100. *Boodleopsis pusilla***,** microscopic details.


A
B

Chlorodesmis caespitosa J. Agardh
1887: 49-50 Fig. 101

REFERENCES: Ducker (1967: 157; pls 3, 12-14, 19), Coppejans *et al.* (2001: 420, figs 11-14).

TYPE LOCALITY: Colombo, Sri Lanka.

Description - Thallus composed of erect, gregarious, bright green filaments 2-6,5 cm long, (125-) 270 (-585) µm diameter; branching dichotomous, mainly apical, resulting in a fastigiate appearance; segment supporting the dichotomy truncate and sometimes even slightly swollen at the distal end; both filaments arising from a dichotomy constricted at the same level; intercalary constrictions possible but not frequent. Needle-shaped crystals always present in the photosynthetic filaments and locally abundant. Rhizoids hyaline, with dense dichotomous branching.

Ecology - On horizontal, sand-covered rocks just above low water mark, continuously wave-swept.

Distribution - Indian Ocean, tropical Pacific Ocean.

Note - *Chlorodesmis*, including about 11 species, is widely distributed in tropical marine waters. The genus has been monographed by Ducker (1967). Several species occur along Sri Lankan coasts.

Fig. 101. *Chlorodesmis caespitosa***:** A. *In situ* view; B. Supradichotomic constrictions; C, D. Crystals in the siphons.

BRYOPSIDALES – Udoteaceae **Rhipidosiphon** Montagne 1842a: 15

Rhipidosiphon javensis Montagne
1842a: 15 Fig. 102

REFERENCES: Jaasund (1976: 29, fig. 60, as *Udotea javensis*), Tseng (1984: 294, pl. 146, fig. 2, as *Udotea*), Coppejans & Prud'homme van Reine (1989: 139, pl. 10, figs 3-9, as *Udotea*), Trono (1997: 77, fig. 52, as *Udotea*), Payri *et al*. (2000: 120, bottom fig. p. 121), Littler & Littler (2003: 254, middle fig. p. 255), Oliveira *et al.* (2005: 224, fig. p. 224), Huisman *et al*. (2007: 191, + figs), Kraft (2007: 233, fig. 83), Skelton & South (2007: 289, figs 739-740, 795).

TYPE LOCALITY: Leiden Island (Nyamuk besar), Java, Indonesia.

Description - Thalli erect, 5-10 mm high, isolated, but more frequently growing in open populations, composed of hyaline rhizoids, and a slightly calcified stipe and flabellum; green to greyish green (depending on the degree of calcification). Stipe monosiphonous, unbranched, smooth, 1-4 mm long, 100 µm diameter; flabellum cuneate to flabellate, 2-6 mm wide, 4-6 mm long, unistratose, composed of parallel, contiguous, dichotomous (rarely trichotomous) filaments, radiating from the stipe to the margin, 45-60 µm diameter, with unequal constrictions above the dichotomies, without lateral appendages, kept together by the calcification; crystals sometimes present in the blade siphons.

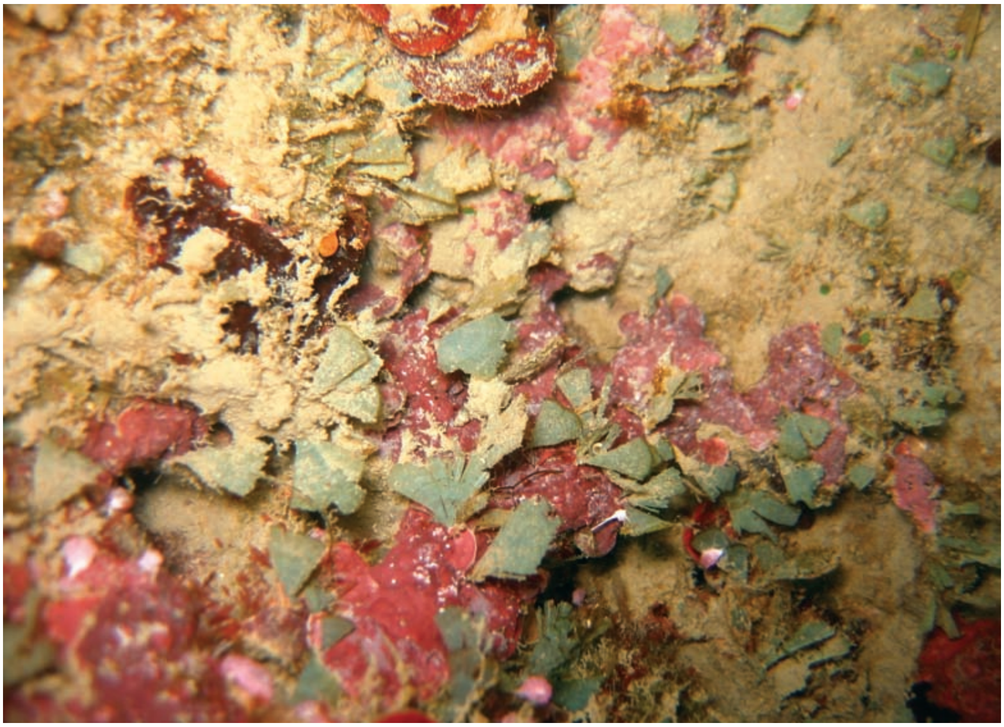
Ecology - On vertical rock wall, -20 m.

Distribution - Indian Ocean, tropical Pacific Ocean.

Note - *Rhipidosiphon* is a small tropical genus, including only two species: *R. javensis*, occurring in the Indo-Pacific and *R. floridensis* Gepp et Gepp, which is only known from the Caribbean Sea. The genus has been studied by Gepp & Gepp (1904), Littler & Littler (1990) and Vroom *et al.* (2001).

Fig. 102. *Rhipidosiphon javensis*.


A
B
C
D



10.2. Phaeophyceae - Brown algae

Taxonomic overview of the species included in this guide. Taxa indicated with an asterisk have their type locality in Sri Lanka.

RALFSIALES
Ralfsiaceae

SPHACELARIALES
Sphacelariaceae

DICTYOTALES
Dictyotaceae

SCYTOSIPHONALES
Chnoosporaceae

Scytosiphonaceae

FUCALES
Sargassaceae

SCYTOTHAMNALES
Scytothamnaceae

RALFSIALES – Ralfsiaceae ***Ralfsia*** Berkeley *in* J.E.Smith et Sowerby 1843: pl. 2866

Ralfsia ceylanica Harvey ex Barton
1903: 477-478, pl. 13: figs 1-4 Figs 16C; 40D; 103

TYPE LOCALITY: Sri Lanka.

Description - Young specimens form well-attached, circular crusts, a few cm in diameter, on the rocky substratum; older ones become contiguous, confluent, resulting in irregularly lobed crusts, medium brown when wet, becoming darker upon drying; slippery surface when wet; the radially arranged, creeping filaments adjacent, about 15 µm in diameter, upwardly curving, still adjacent and becoming vertical and 10 µm in diameter.

Ecology - Epilithic on surf-exposed rocks in the upper intertidal zone and supralittoral fringe, mostly among *Chnoospora minima* and *Dermonema virens*.

Distribution - India, Laccadive Islands, Pakistan, Sri Lanka.

Note - Further studies should determine if this species is really different from other *Ralfsia* species.

Fig. 103. *Ralfsia ceylanica*.

SPHACELARIALES – Sphacelariaceae ***Sphacelaria*** Lyngbye *in* Hornemann 1819: xxxi, 103

Sphacelaria novae-hollandiae Sonder
1845: 50 Fig. 104

REFERENCES: Tseng (1984: 202, pl. 102, fig. 4), Keum *et al.*, (2003: 113-124), Abbott & Huisman (2004: 189, figs 72A-B), Oliveira *et al.* (2005: 155 + figs), Huisman *et al.* (2007: 211, + fig.), Skelton & South (2007: 204, figs 562-565), Littler *et al.* (2008: 143 + figs).

TYPE LOCALITY: Western Australia (probably Fremantle).

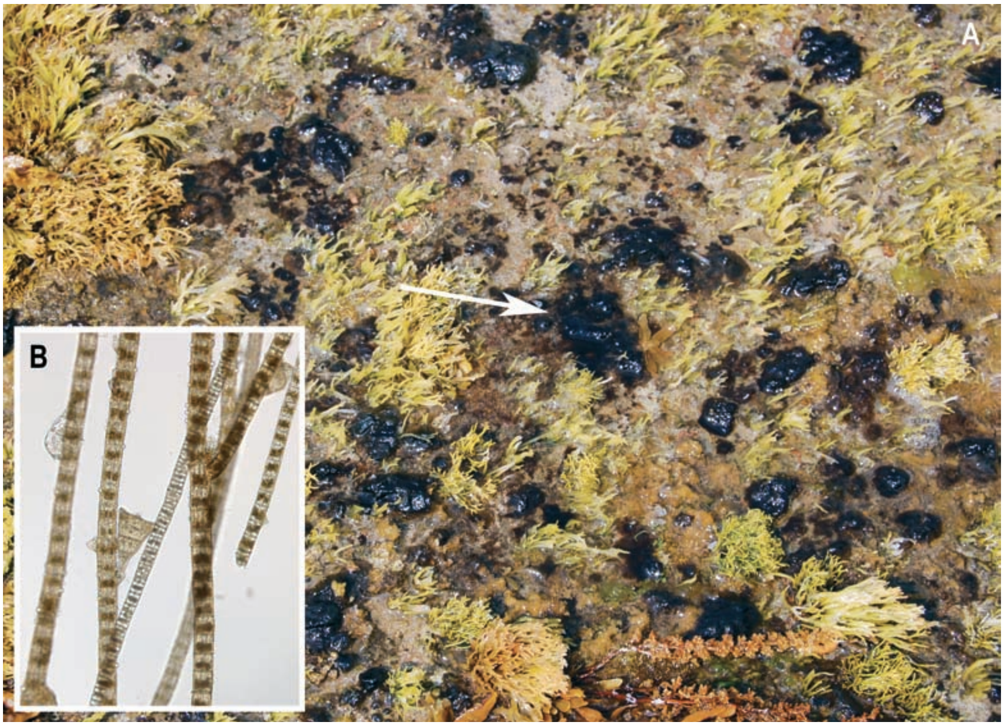
Description - Plants gregarious, in discrete hemispherical stiff tufts, with radially placed rather straight branchlets, 1-2.5 cm long, 35-60 µm in diameter near the base, dark brown; attachment by stoloniferous filaments; branching of erect, straight filaments relatively sparse with laterals similar to or somewhat thinner than the parent filaments, all filaments growing to an equal height; segments L/W 0.75-1 and showing 2-4 longitudinal walls; secondary transverse walls absent; phaeophycean hairs common but soon breaking off. Propagules tribuliform with obscure horns, 120-140 µm long and 110-120 µm at the distal end, borne on a 1-3 celled pedicel; the apical cells of the horns cut off by a straight cross wall; presence of a small lenticular cell midway between the horns. Uni- or plurilocular sporangia not observed.

Ecology - Epilithic on the bottom of a very shallow intertidal rock pool on the beachrock platform.

Distribution - Tropical and warm temperate waters.

Notes - According to Keum *et al*. (2006: 122) the closest allie of *S. novae-hollandiae* is *S. novae-caledoniae* Sauvageau. The latter, that has only been reported from New Caledonia and southern Australia, has more slender filaments (21-34 µm) and the propagules are composed of smaller rectangular cells. In *S. californica* Sauvageau ex Setchell et Garner, the propagules are considerably larger in almost all measurements than in S. *novae-hollandiae.* The other *Sphacelaria*-species with tribuliform propagules (*S. brachygona* Montagne, *S. plumula* Zanardini and *S. tribuloides* Meneghini) are characterized by propagules with more pronounced horns.
A new species for Sri Lanka.

Fig. 104. *Sphacelaria novae-hollandiae*. A. Tufts *in situ* (the dark brown tufts, arrow); B. Microscopic details with propagules.


A
B

Canistrocarpus crispatus (J.V. Lamouroux) De Paula et De Clerck *in* De Clerck *et al*. 2006: 1285 Fig. 105

References: Jaasund (1976: 39, fig. 78, as *Dictyota bartayresii* J.V. Lamouroux sensu Vickers; 39, fig. 79 as *D. friabilis* Setchell), Lewmanomont & Ogawa (1993: 69, + fig., as *D. bartayresiana*), De Clerck (2003: 66-75, figs 20-22, as *Dictyota crispata* J.V. Lamouroux), Littler & Littler (2000: 262, bottom fig. p. 263, as *D. crispata*), Oliveira *et al*. (2005: 160, fig. p. 159, as *D. bartayresiana*, fig. p. 161), Tronchin & De Clerck (2005: 102, fig. 73, as *Dictyota*).

Type locality: Caribbean Sea, Antilles.

Description - Thallus ascending with a small prostrate base giving rise to several stiff and crisp, erect straps which are somewhat harsh to the touch, 9-20 cm long; rhizoids limited to the lower part of the thallus; pale to dark brown, not iridescent; width of the straps constant over a single plant, or slightly widening towards the apices; average width: 5-10 mm; apices typically apiculate to rounded; the apical segments often with strongly rounded axils; branching anisotomous dichotomous, especially in the upper part of the thallus where the central straps are longer than the peripheral ones, possibly resulting in an alternate branching; branching angle broader towards the base (50-70°), than near the apical parts (30-50°). Margins smooth, sometimes appearing dentate but this because of submarginal surface proliferations; surface proliferations abundant, evenly distributed over both surfaces. Cortex and medulla unilayered (occasionally a duplication of a medullary cell at the base of a surface proliferation). Sporangia scattered on both surfaces of the straps, single or grouped in small longitudinal sori (up to 6 sporangia), surrounded by an involucrum, supported by a single stalk cell Gametangia not observed.

Ecology - On coral fragments on the bottom of a lagoon, 3 to 4 m deep. Abundant where collected, not observed since then, not even at the same locality in the same season.

Distribution - Pantropical.

Fig. 105. *Canistrocarpus crispatus* (herbarium specimen).

Canistrocarpus magneanus (De Clerck et Coppejans) De Paula et De Clerck *in* De Clerck *et al*. 2006: 1285 Figs 32C; 106

References: Coppejans *et al*. (2001: 23-25, pl. I, as *Dictyota magneana*), Littler & Littler (2003: 170, middle fig. p. 171, as *Dictyota magneana*).

Type locality: Lion Island, Port Moresby, Papua New Guinea.

Description - Plants forming prostrate mats, about 20 cm in diameter, composed of interwoven, brittle straps, exhibiting a bluish iridescence in situ; straps 3-4 mm wide, attached by means of patches of marginal rhizoids present from the basal to the apical parts, lacking a conspicuous base; straps frequently attached to neighbouring ones by marginal patches of rhizoids; branching dichotomous, branching angle 50-70°; the apical segments often with one branch more developed than the other; margins smooth, possibly appearing dentate due to submarginal surface proliferations; surface proliferations, tooth-like, restricted to the margins of the upper surface of the thallus and perpendicular on the strap surface. Whole plant tristromatic, cortex and medulla unilayered. Reproductive structures not observed.

Ecology - Epilithic on horizontal dead coral, 2-3 m depth.

Distribution - Papua New Guinea, Sri Lanka.

Fig. 106. *Canistrocarpus magneanus*.

DICTYOTALES – Dictyotaceae **_Dictyopteris_** J.V. Lamouroux 1809: 332

Dictyopteris delicatula J.V. Lamouroux
1809: 332, pl. 6, fig. 2B Figs 39E; 107

REFERENCES: Jaasund (1976: 43, fig. 87), Cribb (1996: 43, top fig. p. 42), Calumpong & Meñez (1997: 129, + fig.), Littler & Littler (2000: 254, middle fig. p. 255), Payri *et al*. (2000: 128, figs p. 129), Littler & Littler (2003: 166, top fig. p. 167), Tronchin & De Clerck (2005: 98, fig. 70), Oliveira *et al*. (2005: 156, fig. p. 157).

TYPE LOCALITY: Antilles, West Indies.

Description - Plants erect to repent, up to 4 cm tall, composed of complanate strap-like axes with a distinct midrib, pale to dark brown in colour; attached by rhizoids arising from the blade margin; straps 0.7-2 mm broad, regularly dichotomously to irregularly branched; branching angle 30-90°; margins smooth; apices rounded; hairs in small tufts on both sides of midrib. Internal structure: midrib composed of a central core of small, thick-walled cells, 4-6 cells thick and 4 cells wide; wings 2 cells thick but with a distinctive submarginal vein, 3-6 cells thick. Sporangia forming a band along both sides of the midrib in the upper part of the thallus.

Ecology - Epilithic in shaded crevices close to low water level; always in small numbers.

Distribution - Pantropical.

Note - *Dictyopteris delicatula* is morphologically basically identical to *D. repens* (Okamura) Børgesen, a species reported from several localities in the western Indian Ocean. Both species are distinguished by the relative presence of a submarginal midrib (Wysor & De Clerck 2003).

Fig. 107. *Dictyopteris delicatula*.

DICTYOTALES – Dictyotaceae **_Dictyota_** J.V. Lamouroux 1809b: 331

Dictyota ceylanica Kützing
1859: 11, pl. 25: fig. 1 Figs 23A; 33A; 38D; 108

REFERENCES: Jaasund (1976: 41, fig. 83, as *D. divaricata*, fig. 84), Payri *et al*. (2000: 134, top fig. p. 135, as *D. divaricata*), De Clerck (2003: 52-57, figs 15-16), Littler & Littler (2003: 168, top fig. p. 169), Abbott & Huisman (2004: 202, fig. 77B), Oliveira *et al*. (2005: 159, + fig., fig. p. 161, as *D. divaricata*), Huisman *et al.* (2007: 219, + fig.).

TYPE LOCALITY: Sri Lanka.

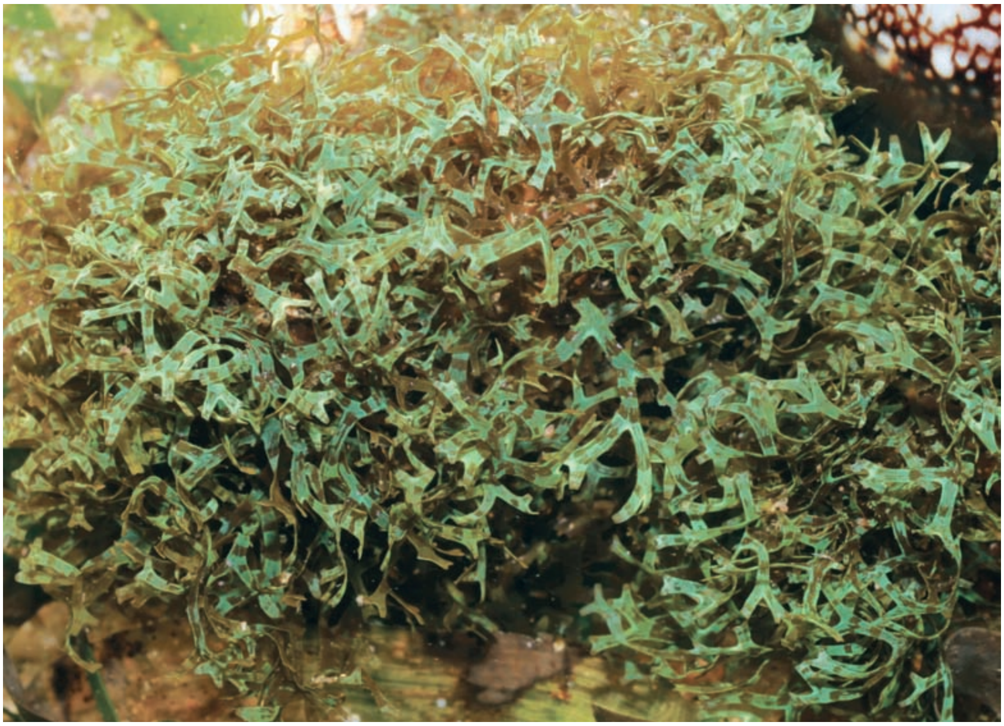
Description - Thalli within a single tuft relatively heterogenous, but generally with a rather slender appearance and supple in the typical filiform growth form, relatively crisp in the specimens with broader straps; composed of relatively small (3-4 cm) ascending plants, without a conspicuous base, basal straps procumbent to repent, becoming erect higher up; erect straps frequently filiform, resulting in an intricate appearance; sometimes forming dense, low mats; often bluish or greenish iridescent, sometimes with marked yellowish axils; repent straps attached at various points by marginal rhizoids but rhizoid patches also present higher up along the erect straps; branching isotomous dichotomous all over the thallus, but the possible presence of numerous marginal proliferations can obscure the original branching system; branch angle broadly divaricate, of (60-) 70-90 (-100)°; straps of variable width, the basal ones up to 2 mm wide, tapering gradually or abruptly to the filiform apical straps, some specimens without filiform parts other without the broad basal parts; apices of the broad straps rounded, those of the filiform branchlets acute; margins smooth; surface proliferations absent, hair tufts common; marginal proliferations common. Whole plant tristromatic, internal structure composed of a single-layered medulla and cortex; sporangia with a single stalk cell, not surrounded by an involucrum, ca 100 µm wide; gametangia not observed.

Ecology - Epilithic, as well as epiphytic (on e.g. *Gelidiopsis*) in low intertidal rock pools and above and just under low water level.

Distribution - Indian Ocean, tropical Pacific Ocean.

Note - Indian Ocean specimens traditionally attributed to *D. divaricata* J.V. Lamouroux were referred to *Dictyota ceylanica* by De Clerck (2003). Most likely, however, the latter does not represent a natural species. *Dictyota ceylanica* probably may contain several cryptic species characterized by irregular sprawling tufts composed of narrow, divaricate axes.

Fig. 108. *Dictyota ceylanica*.



Dictyota ciliolata Sonder ex Kützing
1859: 12, pl. 27: fig. 1 Fig. 109

REFERENCES: Jaasund (1970: 41, fig. 82), De Clerck (2003: 58-65, figs 17-19), Littler & Littler (2000: 262, top fig. p. 263), Abbott & Huisman (2004: 204, fig. 77C), Tronchin & De Clerck (2005: 102, fig. 74), Oliveira *et al*. (2005: 160, fig. p. 160).

TYPE LOCALITY: La Guaira, Venezuela.

Description - Plants erect, 8-15 cm long, attached by means of a single stupose holdfast giving rise to a crisp, brown frond, slightly iridescent in situ and often with transverse bands; branching dichotomous, never alternate, generally fairly regular and evenly distributed over the thallus; branch angle (30-) 35-50 (-60)°; straps 5-12 mm wide, width generally similar throughout thallus but sometimes widening towards apices; apices rounded, rarely truncate; margins dentate (sometimes smooth), degree of dentation variable but generally less conspicuous near the base, with teeth slightly to prominently directed towards the apices; teeth may give rise to marginal proliferations which grow into new straps of similar aspect and obscure the original branching pattern; hair tufts common. Internal structure composed of single-layered medulla and cortex. Sporangia scattered on both surfaces, occurring singly, most frequently in middle and subapical parts, absent from apical segments, leaving a conspicuous sterile zone near the margin when occurring in high densities, not surrounded by an involucrum, about 100 µm wide. Gametangia not observed.

Ecology - On coral rubble on the lagoon bottom, 3 to 4 m deep.

Distribution - Pantropical and subtropical Atlantic Ocean (Europe).

Note - Diagnostic features of *Dictyota ciliolata* include the stupose base, the regular dichotomous outline of the thallus and the dentate margins. The margins, however, are not always dentate. Individuals with smooth margins are fairly common in the area.

Fig. 109. *Dictyota ciliolata* (herbarium specimen).

Dictyota friabilis Setchell
1926: 91-92, pl. 13: figs 4-7, pl. 20: fig. 1 Figs 32D; 33C; 110

REFERENCES: Jaasund (1976: 39, fig. 79), De Clerck (2003: 89-93, figs 28-29), Payri *et al*. (2000: 132, bottom fig. p. 133), Littler & Littler (2003: 168, middle fig. p. 169), Abbott & Huisman (2004: 205, fig. 77E), Tronchin & De Clerck (2005: 104, fig. 75), Skelton & South (2007: 210, figs. 582-587).

TYPE LOCALITY: Tafaa Point, Tahiti.

Description - Plants completely procumbent, forming dense imbricate mats composed of several layers of somewhat brittle (friable) straps, resulting in a typical jigsaw aspect, medium brown with varying iridescence (yellow-green to blue and often with small non-iridescent stripes or dots, or broader transverse non-iridescent bands); size of individual thalli ca. 3-5 cm in diameter, mats 20-30 cm in diameter; attached by marginal patches of rhizoids; branching dichotomous to somewhat irregular, evenly branched throughout with broad branching angle (60-) 70-90 (110)°, axils rounded; interdichotomies typically short and broad, on average 3.4-4.5 mm wide, 5.7-6.6 mm long, entire thallus of same width; apices rounded to obtuse (rarely acute); margins smooth, rarely with proliferations; hair tufts common. Internal structure composed of a single-layered medulla and cortex. Sporangia scattered on the upper surface, occurring singly, absent from the apical segments, not surrounded by an involucrum, 95-145 µm wide.

Ecology - Mostly on horizontal rock substratum in the deeper subtidal.

Distribution - Indian Ocean, tropical Pacific Ocean.

Note - Other *Dictyota* species in our collections from Sri Lanka are: *D. dumosa* Børgesen, *D. grossedentata* De Clerck et Coppejans and *D. humifusa* Hörnig, Schnetter et Coppejans (see De Clerck 2003 for descriptions and illustrations).

Fig. 110. *Dictyota friabilis*.

Lobophora variegata (J.V. Lamouroux) Womersley ex Oliveira
1977: 217 Figs 24E; 27F; 37E; 111

REFERENCES: Tseng (1984: 196, pl. 99, fig. 2), Lewmanomont & Ogawa (1993: 74, + fig.), Cribb (1996: 49, bottom fig. p. 48), Calumpong & Meñez (1997: 128, + fig.), Trono (1997: 111, fig. 75), Huisman (2000: 193, + figs), Payri *et al*. (2000: 136, figs p. 137), Littler & Littler (2000: 268, 269, bottom fig. p. 269, figs p. 271), Littler & Littler (2003: 172, bottom fig. p. 173), Tronchin & De Clerck (2005: 110, fig. 82), Oliveira *et al*. (2005: 162, figs p. 163), Huisman *et al*. (2007: 221, + figs), Ohba *et al*. (2007: 77, + figs), Skelton & South (2007: 212, figs 595-597).

TYPE LOCALITY: Antilles, West Indies.

Description - Plants ranging from prostrate, resupinate to erect, fan-shaped to irregularly lobed blades; thalli up to 8 cm in diameter and 300 µm thick, pale to dark brown, the prostrate ones frequently radially striped; prostrate thalli attached by moniliform rhizoids arising from the ventral surface; (semi-)erect blades attached by discrete holdfasts and rhizoids, often forming rufous vein-like lines in the basal parts of the thallus; margins not inrolled; growth from a marginal meristem of apical cells, sometimes incised and longitudinally split in places; hairs usually arranged in concentric zones. Internal structure composed of a single-layered central medulla of large, rectangular cells with 2-4 layers of subcortical cells on either side with a single-layered cortex. Sporangia grouped in ovate to irregular and confluent sori, covered by an indusium, clavate, up to 110 µm long and 40 µm wide, lacking a stalk cell, containing 8 spores each.

Ecology - Small, thick, prostrate plants as undergrowth of larger seaweeds in the low intertidal; large, erect plants epilithic on coral debris in lagoons; small, thin, prostrate plants on deep subtidal rocks (20-25 m).

Distribution - Pantropical.

Note - There is molecular evidence that the different 'growth forms' are in fact different taxa.

Fig. 111. *Lobophora variegata.* A. Erect plant from shallow lagoon; B. Prostrate plant from deepwater boulders (20 m depth); C. Sori of tetrasporangia; D. Transverse section.

Padina antillarum (Kützing) Piccone
1886: 36 Fig. 112

REFERENCES: Tseng (1984: 200, pl. 101, fig. 2, as *P. tetrastromatica*), Lewmanomont & Ogawa (1995: 78, as *P. tetrastromatica*), Trono (1997: 116, fig. 80, as *P. tetrastromatica*), Wynne & De Clerck (1999: 286-289, figs 1-10), Oliveira *et al*. (2005: 164, figs p. 165, as *P. tetrastromatica*).

TYPE LOCALITY: Trinidad, West Indies (see Wynne, 1998).

Description - Plants erect, between 4 and 17 cm tall, composed of fan-shaped blades with a distinctive inrolled distal margin; blade surface often appearing concentrically corrugated; larger, older specimens with deeply split blades and rufous patches of rhizoids in the basal parts; upper surface calcified, often with scattered tetrasporangia in the older parts of the thallus; lower surface lacking calcification but with prominent concentric bands composed of 2 tetrasporangial sori abutting both sides of a continuous line of hairs; soral bands evenly spaced at a distance of ca. 1.5-2.5 mm. In transverse section, 3-4 layers thick in the mid-region of the thallus, increasing to 6 layers near the base of the thallus. Tetrasporangia not covered by an indusium.

Ecology - Common in intertidal rock pools where thalli are usually rather small (4-7 cm). Specimens collected in the shallow subtidal are markedly larger (to 17 cm).

Distribution - Tropical and warm temperate.

Note - The species was traditionally referred to as *P. tetrastromatica* Hauck (see Wynne 1998).

Fig. 112. *Padina antillarum*. A. Habit *in situ*; B. Fertile specimen (herbarium).


A
B
C
D


A
B

Padina boergesenii Allender et Kraft
1983: 87-88, figs 6C, H, I, 7C, D Figs 21C; 24D; 113

REFERENCES: De Clerck & Coppejans (1996: 230, figs 48, 50-51), Calumpong & Meñez (1997: 127, + fig., as *P. gymnospora*), Littler & Littler (2000: 272, figs p. 273), Muylle (2000: 84-92, pl. 15-22, tab. 3), Littler & Littler (2003: 174, top fig. p. 175), Tronchin & De Clerck (2005: 112, fig. 83), Oliveira *et al*. (2005: 164, figs p. 165, as *P. gymnospora*).

TYPE LOCALITY: Virgin Islands.

Description - Plants erect, funnel-shaped, between 6 and 20 cm tall, composed of fan-shaped blades with broad lobes and a distinctive inrolled distal margin; basal parts often with rufous patches of rhizoids; blade surface smooth, variably calcified on the upper blade surface, with concentric pale and dark transverse bands; dark bands formed by rows of hairs on the ventral as well as the dorsal blade surface, zone between successive hair bands 0.6-1.4 mm wide; holdfast fibrous, sometimes with some *Vaughaniella*-stage at the basis. Internal structure distromatic in the apical parts, 2-3 cells thick in the middle parts of the thallus, 3-4 cells thick near the base. Tetrasporangial sori produced on the ventral (lower) surface in concentric transverse bands just distal to the hair lines, lacking an indusium; gametophytes not observed.

Ecology - A common species of rocky substratum in the shallow subtidal.

Distribution - Pantropical if *Padina gymnospora* is included.

Note - The species was traditionally referred to as *P. gymnospora* (Kützing) Sonder (Allender & Kraft 1983). It resembles *P. australis* Hauck which has also been collected in Sri Lanka, but can be distinguished by the dioecious (vs monoecious) nature of the gametophytes and the thallus which is generally 3 layers thick in the mid-regions of the thallus rather 2 layers thick in *P. australis*.

Fig. 113. *Padina boergesenii.* A. In an intertidal pool, with well-developed *Vaughaniella*-stage; B. Large subtidal specimens; C. Fertile specimen (herbarium).

Padina minor Yamada
1925: 251-252, fig. V Fig. 114

REFERENCES: Lewmanomont & Ogawa (1995: 78, + fig.), Calumpong & Meñez (1997: 126, + fig.), Trono (1997: 115, fig. 79).

TYPE LOCALITY: Taiwan.

Description - Plants generally up to 6 cm tall, composed of erect fan-shaped blades, pale brown with a white calcified layer on the upper surface; blades flat to strongly funnel-shaped, often longitudinally split, with a distinctive inrolled distal margin; stipe up to 0.5 cm long, usually surrounded by a very well developed, conspicuous *Vaughaniella*-stage; blade up to 4 cm broad, 50 µm thick apically, up to 80 µm proximally. Internal structure invariably 2 layers thick. Tetrasporangial sori produced on the ventral (lower) surface in concentric transverse bands just distal to the hair bands, not covered by an indusium; gametophytes not observed.

Ecology - A common species in low intertidal rock pools and on rocky substratum in the shallow subtidal.

Distribution - Indian Ocean, tropical west Pacific Ocean.

Note - The species is characterized by its 2-layered thallus, with hairs restricted to the ventral surface. It does resemble *P. boryana* Thivy somewhat, which is also known from Sri Lanka, but the latter is more variably calcified and is composed of 2-3 layers of cells rather than 2.

Fig. 114. *Padina minor*. A. Habit with *Vaughaniella*-stage; B. Fertile specimen (herbarium).


A
B
C


A
B

Stoechospermum polypodioides (J.V. Lamouroux) J. Agardh
1848: 100 Figs 24F; 38E; 115

REFERENCES: Tronchin & De Clerck (2005: 114, fig. 86), Oliveira *et al.* (2005: 166, fig. p. 167).

TYPE LOCALITY: Stated Antilles, Caribbean Sea, but most probably Red Sea or Indian Ocean (see De Clerck & Coppejans 1997).

Description - Plants erect, gregarious, up to 10 cm tall, composed of dichotomously branched strap-like blades, orangy-brown and often with distinctive, elongated darker patches (sori) of reproductive structures near the margins; attached by a matted rhizoidal holdfast, giving rise to several erect fronds with a stipe-like basal part; straps complanate, 0.7-1.5 cm wide, dichotomously branched, more or less in a single plane; straps provided with numerous tufts of hairs and with a distinctly inrolled distal margin; growth by a marginal row of meristematic cells. Internal structure composed of 4-6 layers of large medullary cells, surrounded by a single-layered, pigmented cortex; medullary cells irregularly arranged in transverse section. Tetrasporangia grouped in large sori lining the margins of the thallus, teardrop-shaped, 50-70 µm in diameter and 95-135 µm long, subtended by a single stalk cell, associated with sterile paraphyses.

Ecology - Well-developed specimens epilithic in a subtidal lagoon, -0.5 to -2 m; small plants just at low tide level.

Distribution - Widespread in the Indian Ocean.

Fig. 115. *Stoechospermum polypodioides*. A. Group of plants on *Halimeda*-sand; B. Detail of a fertile thallus with marginal sori.

Chnoospora minima (Hering) Papenfuss
1956: 69-70 Figs 11A; 16A; 116

REFERENCES: Tseng (1984: 184, pl. 93, fig. 2), Lewmanomont & Ogawa (1993: 66, + fig.), Cribb (1996: 39, middle fig. p. 38), Trono (1997: 119), Payri *et al.* (2000: 142, bottom fig. p. 143), Littler & Littler (2000: 246, bottom fig. p. 247), Littler & Littler (2003: 176, bottom fig. p. 177), Tronchin & De Clerck (2005: 118, fig. 89), Huisman *et al.* (2007: 233, + figs), Skelton & South (2007: 217, figs 608-612).

TYPE LOCALITY: Port Natal (Durban), South Africa.

Description - Plants erect in the basal part, pendulous in the upper parts, up to 7(-15) cm high, gregarious, forming patches several centimetres across, medium brown; tightly adhering to the substratum by a discoid holdfast; erect axes cylindrical to compressed, 1-2 mm in diameter, 3-6 times dichotomously to irregularly branched; branching angle narrow, 30-50°; apices acute and often bifurcate; hair tufts distinctive, scattered across the entire thallus surface. Plurilocular reproductive structures clavate, up to 55 µm long, grouped in sori, often in association with hair tufts.

Ecology - Confined to extremely wave-exposed habitats in the supralittoral fringe and high intertidal; showing a marked seasonality, (almost) disappearing in the dry season.

Distribution - Widespread in the Indian Ocean, tropical Pacific Ocean and tropical Atlantic Ocean.

Note - Older plants of *C. minima* are frequently provided with spongy, epiphytic tufts of *Asteronema breviarticulatum*.

Fig. 116. *Chnoospora minima*.


A
B

SCYTOSIPHONALES – Scytosiphonaceae **Colpomenia** (Endlicher) Derbès et Solier 1851: 95

Colpomenia sinuosa (Mertens ex Roth) Derbès et Solier 1851: 95 Figs 25A; 117

REFERENCES: Tseng (1984: 184, pl. 93, fig. 4), Lewmanomont & Ogawa (1995: 67, + fig.), Cribb (1996: 39, bottom fig. p. 38), Calumpong & Meñez (1997: 131, fig. p. 132), Trono (1997: 119, fig. 81), Huisman (2000: 203, + fig.), Payri *et al.* (2000: 144, top fig. p. 145), Tronchin & De Clerck (2005: 118, fig. 90), Oliveira *et al.* (2005: 170, fig. p. 171), Huisman *et al.* (2007: 229, + fig.), Skelton & South (2007: 220, figs 613-614, 774).

TYPE LOCALITY: Near Cádiz, Spain.

Description - Plants forming spherical to irregularly convoluted, hollow structures, smooth and fragile, 3-5 cm in diameter, pale to medium brown; attached by rhizoids on the lower surface. In transverse section, 5-6 layers of cells bounding a hollow interior; medulla 4-5 layers thick, composed of large, thin-walled, hyaline cells gradually becoming smaller towards the cortex; cortex composed of 1-2 layers of small, pigmented, isodiametric cells, 10-13 µm in diameter; hair tufts scattered over the thallus surface, in small pits. Plurilocular sporangia forming a discrete sorus surrounding a central hair tuft, covered by an indusium, uni- or biseriate, to 50 µm long and 7 µm wide, associated with sterile, unicellular paraphyses.

Ecology - Mostly epiphytic (either on large algae as *Polyopes ligulatus* or on algal turf) or epilithic in lagoons, between 0.5 and 1 m depth.

Distribution - Widespread in tropical and temperate regions.

Fig. 117. *Colpomenia sinuosa*.

FUCALES – Sargassaceae **Sargassum** C. Agardh 1820: 1

Sargassum crassifolium J. Agardh 1848: 326-327 Figs 19A, E; 41G, H; 118

REFERENCES: Tseng (1984: 226, pl. 114, fig. 2), Lewmanomont & Ogawa (1995: 82, + fig.), Cribb (1996: 55, bottom fig. p. 54), Trono (1997: 131, figs 88A, B), Tronchin & De Clerck (2005: 126, fig. 97), Skelton & South (2007: 223, figs 617-619, 767).

SYNTYPE LOCALITIES: Cape of Good Hope, South Africa; New Ireland; New Zealand.

Description - Plants gregarious, erect, tough, leathery, up to 30 cm high, brown. Holdfast disc-like; main stipes one to several, smooth, bearing radially placed side branches becoming gradually shorter towards the thallus apex; blades fleshy and stiff, frequently upwardly curved, numerous, often crowded, to 1 cm wide, 1 cm long, without midvein; tips rounded, with thickened, two-edged margin; margins with coarse, irregular teeth; air bladders spherical, to 6 mm diameter, often with apical spines forming a crest. Cryptostomata (pits with hairs) as scattered dark dots on blades and air bladders. Receptacles forked, densely branching, spinose, to 5 mm long.

Ecology - Epilithic on horizontal beachrock platforms, along the surf-exposed margins, just above low water; locally forming extensive vegetations; large, more slender growth forms observed on vertical walls in the shallow subtidal.

Distribution - Widespread in the Indo-Pacific region.

Notes - In literature, confusion exists between *S. crassifolium* and *S. cristaefolium* C. Agardh (= *S. duplicatum* J. Agardh). According to Trono (1997, 131-135, fig. 88Ba), the leaves of *S. crassifolium* are coarsely dentate and the vesicles are smooth or with an apical spine (fig. 88Bb) whereas in *S. cristaefolium* the leaves are finely dentate (fig. 89Ba) and the vesicles have 2 horn-like or lateral spines or dentate wings (fig. 89Bb).

Representatives of the genus *Sargassum* are notoriously difficult to identify on species level. The characters, generally used for identification exhibit an extreme variability on several scales: temporal, intraindividual (morphology of the basal leaves different from the apical ones), interindividual, environmental and geographical next to sexual dimorphism and random phenotypic expression (Kilar *et al*. 1992). Moreover, according to Guiry & Guiry (2009), 584 species names are currently accepted worldwide (845 including the synonyms), some of which with numerous varieties. For Sri Lanka, Silva *et al*. (1996: 656-709), mention 35 species (some of which with several varieties) as being recorded in literature.

Fig. 118. *Sargassum crassifolium*. Habit of a whole plant.

Sargassum polycystum C. Agardh
1824: 304 Figs 41A; 119

REFERENCES: Tseng (1984: 236, pl.119, fig. 1), Lewmanomont & Ogawa (1995: 84, + fig.), Cribb (1996: 59, middle fig. p. 58), Calumpong & Meñez (1997: 136, + fig.), Trono (1997: 147, figs 96A-B), Littler & Littler (2003: 184, top fig. p. 185), Oliveira *et al.* (2005: 178, + fig.), Ohba *et al.* (2007: 84, + figs), Skelton & South (2007: 226, figs 624-626, 768).

TYPE LOCALITY: Sunda Strait, Indonesia.

Description - Plants erect, bushy, up to 30 cm long, dark brown. Attachment by a disc, but also presence of basal stolonoidal branches, sprawling over the substratum and bearing alternately, pinnately placed small and narrow cauline leaves. Main stalks muricate with Y-shaped or spiny proliferations; blades scattered on slender main branches, crowded on shorter branchlets, ovate-oblong to narrow lanceolate, to 1 cm wide, 1-3 cm long, dentate; midrib generally extending the entire length of the blade. Air bladders often extremely abundant, small (up to 2.5 mm in diameter), apiculate; cryptostomata scattered on the blades, branches and air bladders. Receptacles crowded, filiform, forked, 6-12 mm long, clustered in the axils of the leaves; some receptacles can be foliaceous towards the apices, resembling linear leaves.

Ecology - Epilithic, mainly in intertidal pools.

Distribution - Widespread in the Indian Ocean, tropical Pacific Ocean, tropical eastern Atlantic Ocean.

Fig. 119. *Sargassum polycystum*. A. Whole thallus with basal stolons; B. Detail of the numerous, small air bladders (herbarium specimens).

Sargassum turbinatifolium Tseng et Lu
1979: 9, 12, fig. 6, pl. VII Fig. 120

REFERENCES: Tseng & Lu (1999: 16, fig. 15).

TYPE LOCALITY: Dongdao, Xisha Islands, South China Sea.

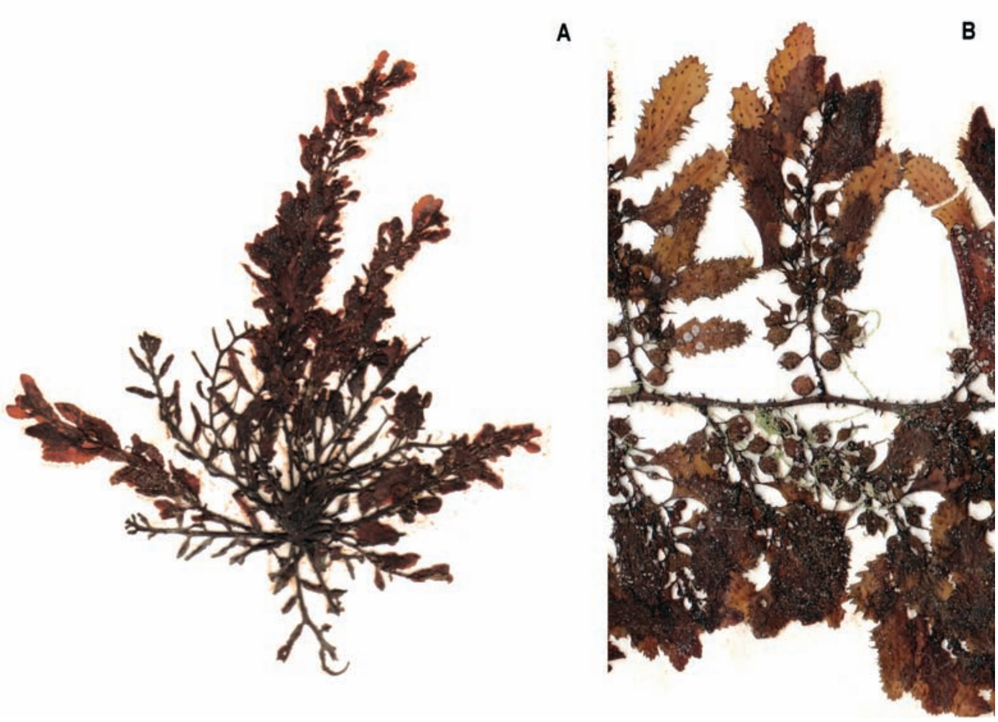
Description - Fully grown plants about 10-20 cm long, attached by a dicoid holdfast from where several erect axes arise. Main axis (sub)cylindrical and smooth, unbranched in small specimens, bearing short (1-2 cm), radially arranged side branchlets. Leaves fleshy and rigid, 0.75 to 15 mm long and 10 mm broad; basal part compressed, roughly toothed at the margin and with a midvein, upper part markedly conduplicate, with a flat to concave upper part, rounded to oval in top view and with a coarsely dentate margin. Air vesicles quite large (4-5 mm in diameter), mostly with marked dentate wings and smooth apex, the wings sometimes being more reduced; vesicles borne on short cylindrical stipes without appendages; receptacles toothed and racemosely arranged; oogonia and antheridia in separate conceptacles, but within the same receptacle.

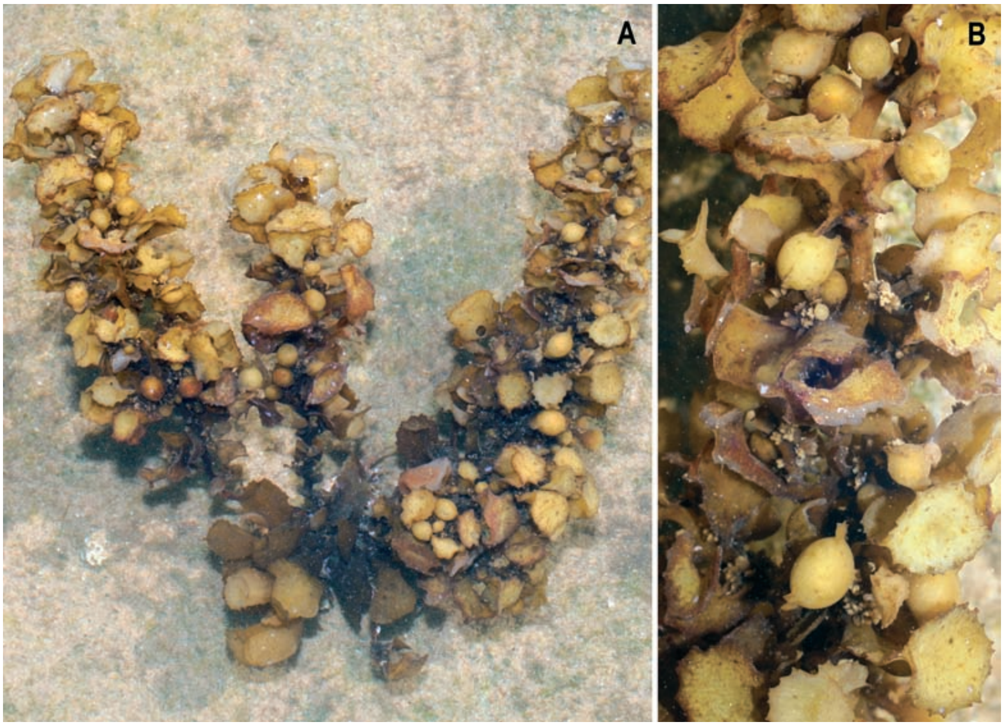
Ecology - Epilithic just above low water level, exposed to severe swell; larger specimens in wave-swept low intertidal pools.

Distribution - Indian Ocean: Comoro Islands; Pacific Ocean: China, Philippines.

Note - *S. turbinatifolium* is morphologically closely related to *S. turbinarioides* Grunow, but the latter is characterized by aerocysts being apically smooth or crowned with a small subfoliaceous apiculum whereas the aerocysts of the former are winged. According to Tseng & Lu (1999: 18), the plants of *S. turbinatifolium* are androgynous, the oogonia and antheridia being in different conceptacles but in the same receptacle.

Fig. 120. *Sargassum turbinatifolium*. A. Habit; B. Detail of blades and aerocysts.


A
B


A
B

Sargassum sp.

Figs 9B; 11B; 19F; 31A; 121

Description - Plants growing in large, dense populations, horizontally spread and very flat at low tide; attachment by a disc; upright branches markedly compressed and smooth, straight or locally somewhat sinuous. Leaves 3-4 cm long, 5-7 mm wide, upwardly directed and alternately placed on the axis in one plane, resulting in very flat plants; leaves thick and stiff-cartilaginous, lanceolate to oblong with a cuneate, asymmetrical basis, basal ones dentate with an acute apex, but most leaves with an entire margin and a broadly rounded apex, straight to slightly undulated in lateral view; some with a faint midrib running up to half to two thirds of the leaf; cryptostomates present but not numerous and often distributed in one row on each side of the midrib. Vesicles not observed. Fertile plants provided with alternately placed, dense clusters of receptacles, branching 3-dimensionally.

Ecology - Extremely abundant in large, shallow pools on horizontal beachrock platforms, just above low water mark, continuously wave-swept.

Note - Taxonomists, currently working on the genus *Sargassum*, suggested that this entity does not correspond to any described taxon. It might be a new one or a growth form of an existing one.

Fig. 121. *Sargassum* sp.

Turbinaria ornata (Turner) J. Agardh
1848: 266

Fig. 122

REFERENCES: Tseng (1984: 242, pl. 122, fig. 1), Lewmanomont & Ogawa (1995: 87, + fig.), Cribb (1996: 63, middle fig. p. 62), Calumpong & Meñez (1997: 137, + fig.), Trono (1997: 155, fig. 100), Huisman (2000: 226, + fig.), Payri *et al*. (2000: 148, figs p. 149), Littler & Littler (2003: 186, bottom fig. p. 187), Tronchin & De Clerck (2005: 128, fig. 99), Oliveira *et al*. (2005: 180, + figs p. 181), Huisman *et al*. (2007: 237, + fig.), Ohba *et al*. (2007: 87, + figs), Skelton & South (2007: 227, figs 627, 765-766).

TYPE LOCALITY: Unknown.

Description - Plants growing in dense populations, 10 (-17) cm high, extremely stiff and rigid, harsh to the touch, medium brown; attached by an inconspicuous conical holdfast forming mostly one, more rarely several erect axes and dichotomously branched, creeping, cylindrical stolons up to a several cm long; main axes cylindrical, unbranched or with a single, basal side branch, radially producing densely placed (contiguous) lateral branches; lateral branches peltate, very stiff, with a distinct smooth stalk without ribs and a typical triangular distal margin with rounded angles, about 6 mm wide; distal margin with a row of irregularly placed teeth and some intramarginal teeth; peltate branches often depressed in the centre where the submerged air bladder is placed; dense clusters of receptacles formed in the axils of the lateral branches.

Ecology - Along surf-exposed coasts, mainly occurring submerged in rock pools in the lower intertidal or the infralittoral fringe.

Distribution - Widespread in the Indian Ocean, tropical Pacific Ocean.

Note - In Sri Lanka, we still did not observe specimens with a complete double row of teeth, as typical for the species. Taylor (1964: 485, pl. 3: figs 7-9) described specimens without or with only a few intramarginal teeth as *Turbinaria ornata* f. *ecoronata* W.R. Taylor. Tsuda (1972) and Skelton & South (2007: 228) on the other hand, state that f. *ecoronata* might be an environmentally induced growth form.

Fig. 122. *Turbinaria ornata*.

Turbinaria ornata f. ***evesiculosa*** (Barton) W.R. Taylor
1964: 485-486

Figs 19C, D; 41E; 44F; 123

REFERENCES: De Clerck & Coppejans (1996: 242, figs 75, 77).

TYPE LOCALITY: Edam/Enkhuizen Shoal, near Jakarta, Java, Indonesia.

Description - Plants locally growing in large, open populations, rather small, 3-4 cm high, rigid but flexible, orangy brown; erect axes cylindrical and unbranched, bearing radially placed lateral, peltate branchlets; stolons cylindrical, dichotomous, numerous and extremely well developed, forming an extended network; the lateral branchlets are densely placed but mostly not really contiguous, peltate, with an elegant, upwardly directed, cylindrical stipe without marked ribs, 1 cm long and a stiff but relatively thin blade; blade triangular to roughly heart- or kidney-shaped in surface view and with a single marginal row of coarse teeth; air vesicles absent. Some better developed plants present a few intramarginal teeth on the blades, indicating an intermediate morphology to the typical growth form of *T. ornata*.

Ecology - Typically occurring on air exposed (at low tide) seaward margin of horizontal rock substratum, subject to extreme surf.

Fig. 123. *Turbinaria ornata* var. *evesiculosa*.

Turbinaria sp.

Fig. 124

Description - Plants very small, 1-2 cm high, growing in open populations, orangy brown; compressed, irregularly branched stolons of variable width dominant, forming an extended open network; stolons mainly bearing isolated *Sargassum*-like bladelets (‘cauline blades’) which are thick fleshy-stiff, longish elliptical, coarsely dentate, recurved or horizontally spread; they frequently apically develop into new, horizontally spread compressed stolons that get attached and produce new cauline blades; locally, isolated erect peltate blades are formed, some of which being elongated triangular (like a basally very wide cauline blade) and irregularly coarsely dentate, others being rounded, kidney-shaped or triangular; erect cylindrical and unbranched axes, bearing a few, radially placed lateral branchlets (with similar morphology as the solitary ones) are rare and very short (1-2 cm); air vesicles absent. Receptacles not observed.

Ecology - In very shallow, low intertidal rock pools.

Note - This dwarf growth form morphologically agrees with *Turbinaria* sp. as described by Ajisaka & Kilar (1990: 236-237, pl. 1). Study of the *Turbinaria* specimens, present in Leiden (L), shows that some of the young plants of *T. ornata* present similar cauline leaves. This may indicate that the taxon described here are juveniles of that species.

Fig. 124. *Turbinaria* sp.

Asteronema breviarticulatum (J. Agardh) Ouriques et Bouzon 2000: 271, figs 2-12, pl. 1 Figs 11A; 16B; 35C, D; 125

References: Tseng (1984: 168, pl. 85, fig. 1, as *Ectocarpus*), Trono (1997: 101, as *Hincksia*), Littler & Littler (2003: 164, top fig. p. 165), Huisman *et al.* (2007: 208, + figs).

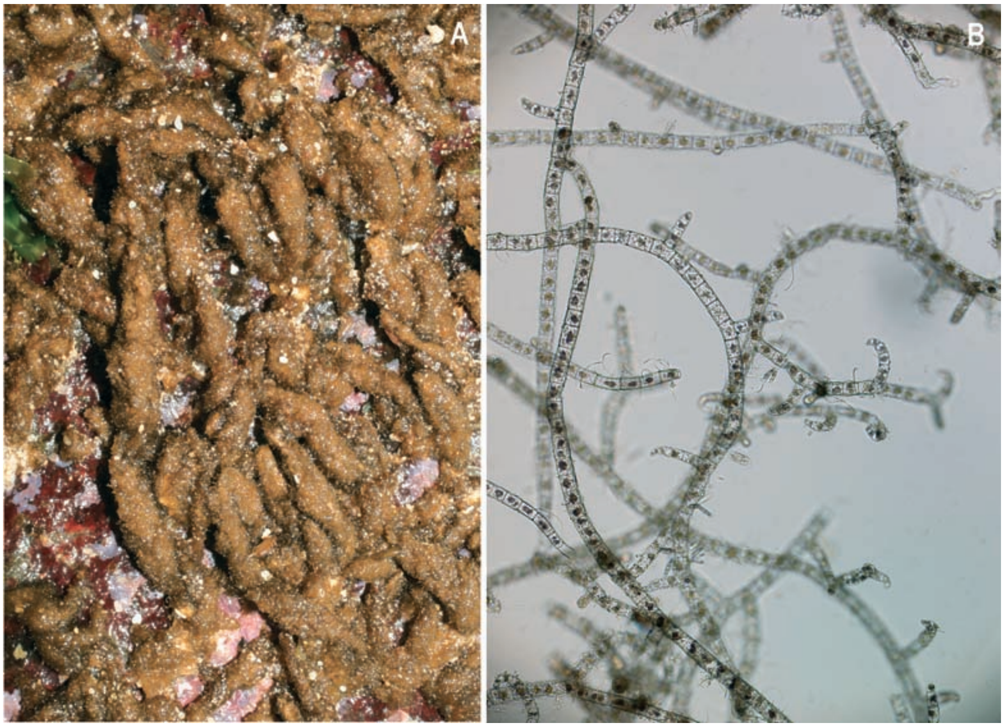
Type locality: San Agustín, Oaxaca, Mexico.

Description - Epilithic plants forming groups of rope-like, woolly structures, up to 2 cm long, composed of densely entangled filaments, light brown to creamy; the main filaments with irregular branching, bearing irregularly placed, spaced, hook-like, curved branchlets, perpendicular on the main filaments, keeping the filaments together, resulting in the rope-like aspect; filaments 20-25 µm in diameter, cells 50-60 µm long, containing net-like chromoplasts. Epiphytic specimens more spherical, lax and smaller. Plurilocular sporangia oval, shortly stipitate, perpendicular on the filaments, 40 µm wide and 50 µm long.

Ecology - Forming a distinct zone in the upper intertidal zone of wave-exposed rock outcrops during the wet season; also frequent as an epiphyte on *Chnoospora minima*, growing in the same habitat.

Distribution - Indian Ocean, tropical Pacific, eastern Atlantic Ocean.

Fig. 125. *Asteronema breviarticulata.* A. Rope-like thalli; B. Hook-like branchlets.


A
B

10.3. Rhodophyta - Red algae

Taxonomic overview of the species included in this guide. Taxa indicated with an asterisk have their type locality in Sri Lanka.

For the classification of twhe red algae we follow Schneider & Wynne (2007), except for the Ceramiaceae (sensu lato) where we follow the more recent paper by Choi *et al*. (2008) who propose a splitting of the family.

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Gigartinaceae

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HALYMENIALES
Halymeniaceae

RHODYMENIALES
Champiaceae

Lomentariaceae

Rhodymeniaceae

CERAMIALES
Ceramiaceae

Callithamniaceae

Spyridiaceae

Wrangeliaceae

Dasyaceae

Delesseriaceae

Rhodomelaceae

Bangiales – Bangiaceae **Porphyra** C. Agardh 1824: xxxii, 190

Porphyra suborbiculata Kjellman
1897a: 10-13, pl. 1: figs 1-3, pl. 2: figs 5-9, pl. 5: figs 4-7 Fig. 126

Reference: Tseng (1984: 48, fig. 3, p. 49).

Type locality: Goto-retto, Nagasaki Prefecture, Japan.

Description - Plants membranous, gregarious, greenish purple; attached by small rhizoids; blade monostromatic, ovate to reniform, 3-4 cm in diameter; margin undulate, with small, spinulose processes which are not in the same plane as the blade; presence of a minute basal stipe. Cells in surface view angular with rounded corners, isodiametric in transverse section, 28-35 µm in diameter, slightly higher than broad, containing a stellate plast with central pyrenoid. Plants monoecious, sori of deep red carpogonia and yellowish spermatangia in irregular patches (sori) arranged along the margin of the frond; after fertilisation 32 carpospores being produced per carpogonium

Ecology - Epilithic in the supralittoral fringe of rock outcrops exposed to extreme surf; only present in the wet season.

Distribution - Mentioned from scattered localities in the tropical Indian, Pacific and Atlantic Oceans and also from the Canary Islands.

Note - Four additional species of *Porphyra* are mentioned from Sri Lanka by Silva *et al.* (1996: 91-94): *P. ceylanica* J. Agardh, *P. laciniata* (Lightfoot) C. Agardh, *P. purpurea* (Roth) C. Agardh and *P. umbilicalis* (Linnaeus) Kützing.

Fig. 126. *Porphyra suborbiculata*. A. Group of thalli *in situ*; B. Detail of blade margin with tiny teeth.

Nemaliales – Galaxauraceae **Actinotrichia** Decaisne 1842: 118

Actinotrichia fragilis (Forsskål) Børgesen
1932: 6 Fig. 127

References: Jaasund (1976: 65, fig. 131), Magruder & Hunt (1979: 57, fig. 2, p. 56), Cribb (1983: 25, pl. 8, fig. 1), Tseng (1984: 58, pl. 32, fig. 1), Verheij & Prud'homme van Reine (1993: 439, pl. 14, fig. 1), Lewmanomont & Ogawa (1995: 91, + fig.), Calumpong & Meñez (1997: 150, bottom fig. p. 93, top fig. p. 151), Trono (1997: 171, fig. 172), Abbott (1999: 64, figs 7A-C), Huisman (2000: 37, + figs), Payri *et al.* (2000: 160, bottom fig. p. 161), Littler & Littler (2003: 62, top fig. p. 63), Oliveira *et al.* (2005: 47, + fig), Huisman *et al.* (2007: 69, + figs), Ohba *et al.* (2007: 90, + figs), Skelton & South (2007: 16, figs 14-15, 780).

Type locality: Mokha, Yemen.

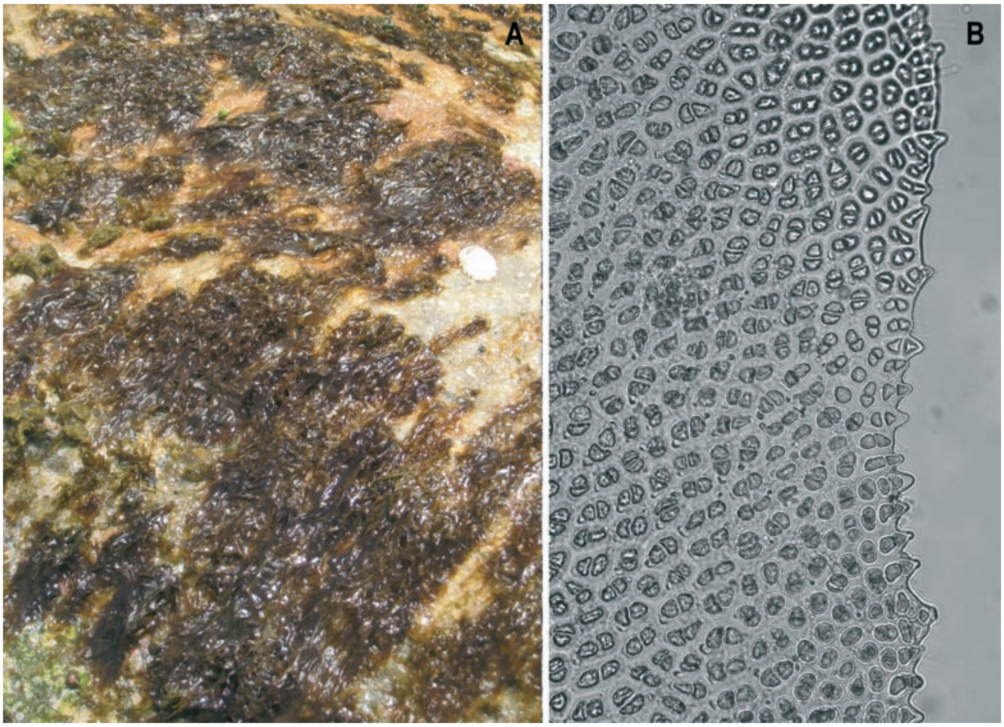
Description - Plants forming rigid, pinkish red to orangy, hemispherical plants of up to 5 cm in diameter, composed of intricated, calcified, cylindrical, stiff axes, repeatedly dichotomously branched in different planes, with wide axils; a single, centrally placed holdfast from where the branches start more or less radially; interdichotomies 0.5-3 cm long, diameter less than 1 mm, blunt apices; presence of typical verticils of tough, unbranched, pigmented hairs, perpendicularly placed on the branches, 0.5 mm long and verticils 0.5 mm apart.

Ecology - Horizontal rock, -2 m, sheltered part behind surf-exposed rock outcrops.

Distribution - Indian Ocean, tropical Pacific Ocean.

Note - With age, the verticils of hairs break off, leaving annular scars; the plant then becomes greyish and its general appearance is then similar to *Amphiroa fragilissima*.

Fig. 127. *Actinotrichia fragilis*.


A
B

Galaxaura filamentosa Chou *in* W.R. Taylor 1945: 139

Fig. 128

REFERENCES: Chou (1945: 39, pl. I, figs 1-6, pl. VI, fig. 1), Magruder & Hunt (1979: 67, lower fig. p. 66), Tseng (1984: 58, pl. 32, fig. 4), Abbott (1999: 67, fig. 7F), Payri *et al*. (2000: 164, top fig. p. 165), Skelton & South (2007: 21, fig. 17).

TYPE LOCALITY: Isla Clarión, Islas Revillagigedo, Mexico.

Description - Plants isolated but growing in open populations; individual specimens more or less spherical, up to 10 cm in diameter; very well attached by a single discoid holdfast; all branches cylindrical, dichotomous in different planes, slightly calcified and rather supple, tomentose, extremely densely covered by supple, bordeaux-red filaments of uniform length (about 4 mm), resulting in a very woolly aspect when submerged.

Ecology - Epilithic in a mid intertidal rockpool, continuously wave-swept even at low tide; mostly on the vertical walls.

Distribution - Scattered locations in the tropical Indian, Pacific and Atlantic Oceans.

Notes - Some specimens of one collection are densely covered by the green alga *Cladophora socialis.*
G. filamentosa is morphologically very similar to *G. fasciculata* Kjellman, but the latter has long and short filaments mixed and a ring of calcification in the axes, whereas the former exclusively bears long filaments and lacks the calcified ring.
A new record for Sri Lanka.

Fig. 128. *Galaxaura filamentosa*.

Galaxaura rugosa (Ellis & Solander) J.V. Lamouroux 1816: 263

Fig. 129

REFERENCES: Abbott (1999: 68, figs 8A-E), Littler & Littler (2003: 66, top and middle figs p. 67), De Clerck *et al*. (2005b: 140, fig. 103), Oliveira *et al*. (2005: 50, + fig.), Huisman *et al*. (2007: 71, + figs).

TYPE LOCALITY: Jamaica.

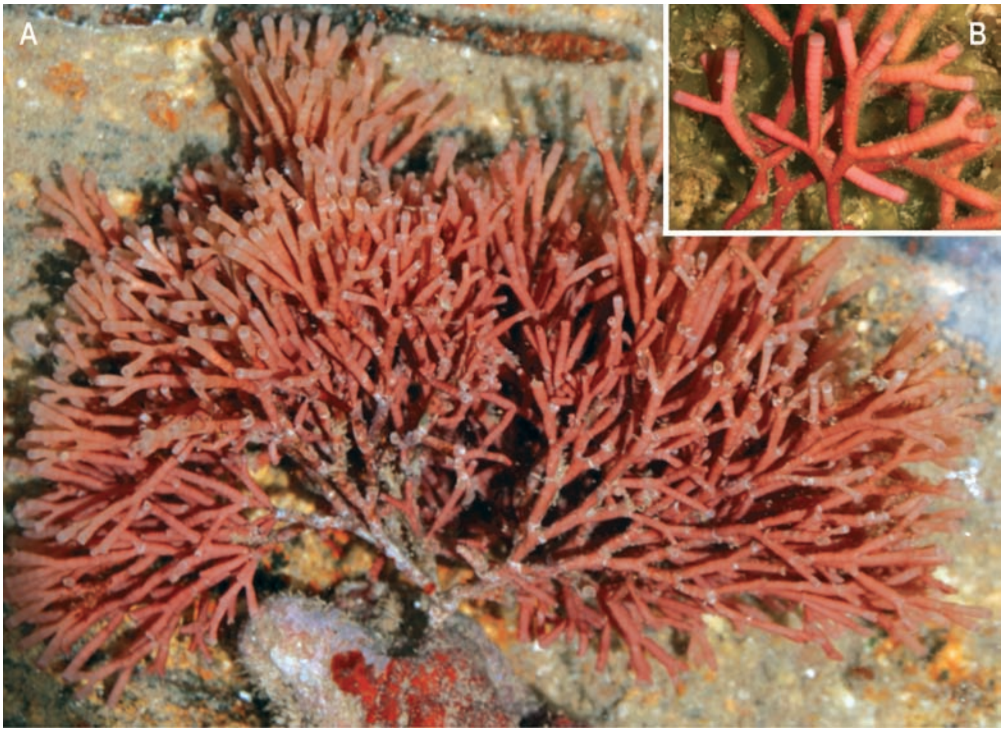
Description - Thallus erect, up to 8 cm high, forming dense, stiff, pinkish to orangy, hemispherical tufts, composed of radially arranged, dichotomously branched, unsegmented, cylindrical axes; axes heavily calcified and brittle, certainly in fully grown specimens, 1-2 mm in diameter with truncated apices; a single attachment point. Gametophytes are glabrous, sometimes with a hirsute basis which then becomes brownish red; apices mostly bleached and with a typical fine transverse striation or annulations. Tetrasporophytes completely covered by rather stiff hairs, evenly and densely placed or verticillate, resulting in darker (more brownish) plants. The internal structure is composed of a central filamentous medulla and a cortex composed of 3-4 layers of large, rounded cells in the gametophytes, the two innermost cortex layers are colourless; sporophytes without the pseudoparenchymatous cortex but with radially arranged, contiguous assimilatory filaments.

Ecology - Subtidal, epilithic in lagoons from -30 cm down to a few meter.

Distribution - Tropical seas.

Note - The Australian representatives of the genera *Galaxaura* and *Tricleocarpa* were studied anatomically by Huisman & Borowitzka (1990). More recent molecular conclusions were published in Huisman *et al*. (2004).

Fig. 129. *Galaxaura rugosa*. A. Fully grown specimen; B. Part of a juvenile specimen.


A
B

Dermonema virens (J. Agardh) Pedroche et Ávila Ortíz
1996: 77 Figs 9E; 13E; 42A; 130

REFERENCES: Durairatnam (1961: 47-48, pl. 28, fig. 1, as *D. frappieri*), Tseng (1984: 50, pl. 28, fig. 4, as *D. frappieri*), Payri *et al.* (2000: 158, top figs p. 159).

TYPE LOCALITY: San Agustín, Oaxaca, Mexico.

Description - Thallus erect, 5 (-7) cm high, brownish-red, becoming orangy or even greenish towards the apices upon ageing; soft and lubricous and rubbery in texture; gregarious, fixed by a large discoid holdfast; base stipitate, bearing axes which are laxly or densely, repeatedly dichotomous and more or less radially arranged; the dichotomies are perpendicular on each other, and more dense towards the periphery, resulting in a (hemi-)spherical habit; the branches cylindrical and gradually decreasing in diameter towards the apices, about 2 mm in diameter near the base. Medulla composed of loosely interwoven filaments, surrounded by a cylinder of peripheral thick-walled cells.

Ecology - High intertidal on surf-exposed rocky outcrops. Very abundant in the wet season, forming a monospecific zone; almost disappearing in the dry season.

Distribution - Scattered localities in the Indian Ocean, widespread in the western tropical Pacific Ocean and Mexico.

Note - Used as food in China. Svedelius (1939) richly illustrates this taxon (as *D. gracile* Weber-van Bosse).

Fig. 130. *Dermonema virens*. A. A monospecific vegetation; B. Detail of a thallus.

Liagora ceranoides J.V. Lamouroux
1816: 239 Fig. 131

REFERENCES: Tseng (1984: 54, pl. 30, fig. 1), Lewmanomont & Ogawa (1995: 130, + fig.), Cribb (1996: 103, middle fig. p. 102), Calumpong & Meñez (1997: 153, + fig.), Trono (1997: 166, fig. 104), Abbott (1999: 84, figs 13I-M), Payri *et al.* (2000: 158, bottom figs p. 159), Littler & Littler (2003: 58, bottom fig. p. 59), De Clerck *et al.* (2005b: 142, fig. 105), Oliveira *et al.* (2005: 52, + fig. p. 53), Huisman *et al.* (2007: 63, + figs), Skelton & South (2007: 24, figs 22-23).

TYPE LOCALITY: St. Thomas, Virgin Islands.

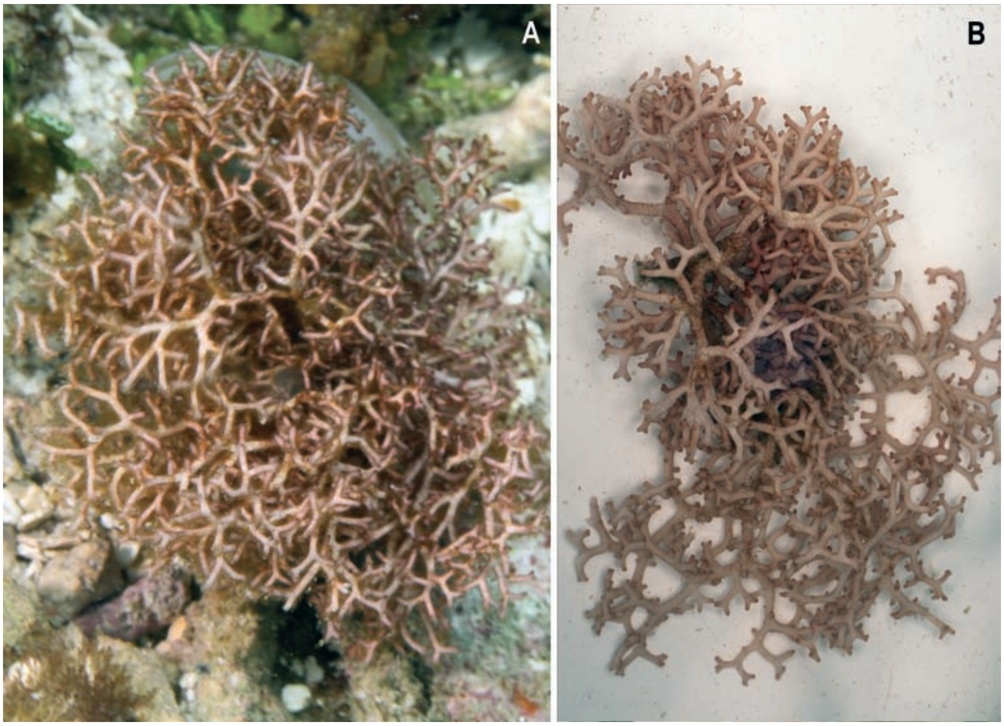
Description - Plants solitary, but growing in open populations, erect, 4-7 cm high, with a lobed, subspherical appearance, extremely supple, lubricous-slippery, pinkish white *in situ* (the branches are more whitish as a result of stronger calcification, the tips more pinkish), becoming greyish upon drying; a single, discoid holdfast; all axes cylindrical, of similar diameter (1 mm) all over the thallus; wide-angled dichotomous branching dense from the basis onwards (interdichotomies about 5 mm at the basis, 2 mm towards the periphery of the thallus), in different planes; older plants presenting basal branches with a rough surface and provided with short unbranched or singly dichotomous proliferations all over the thallus, obscuring the original dichotomous branching of the main axes; apical branchlets frequently recurved, apices rounded to blunt. Medullary filaments of uniform diameter throughout, bearing cortical, assimilatory filaments forming fascicles, nearly moniliform except the basal cells which are subcylindrical; terminal cells often with hairs. Spermatangia stalked, in small clusters on the outer cortical cells. Hemispherical cystocarp with well-developed involucral filaments.

Ecology - Subtidal, on coral rubble in sand-covered reef channels, at 3 m depth.

Distribution - Pantropical.

Fig. 131. *Liagora ceranoides*. A. Small specimen *in situ*; B. Detail.


A
B


A
B

Gelidium J.V. Lamouroux
1813: 128 Figs 18A; 132

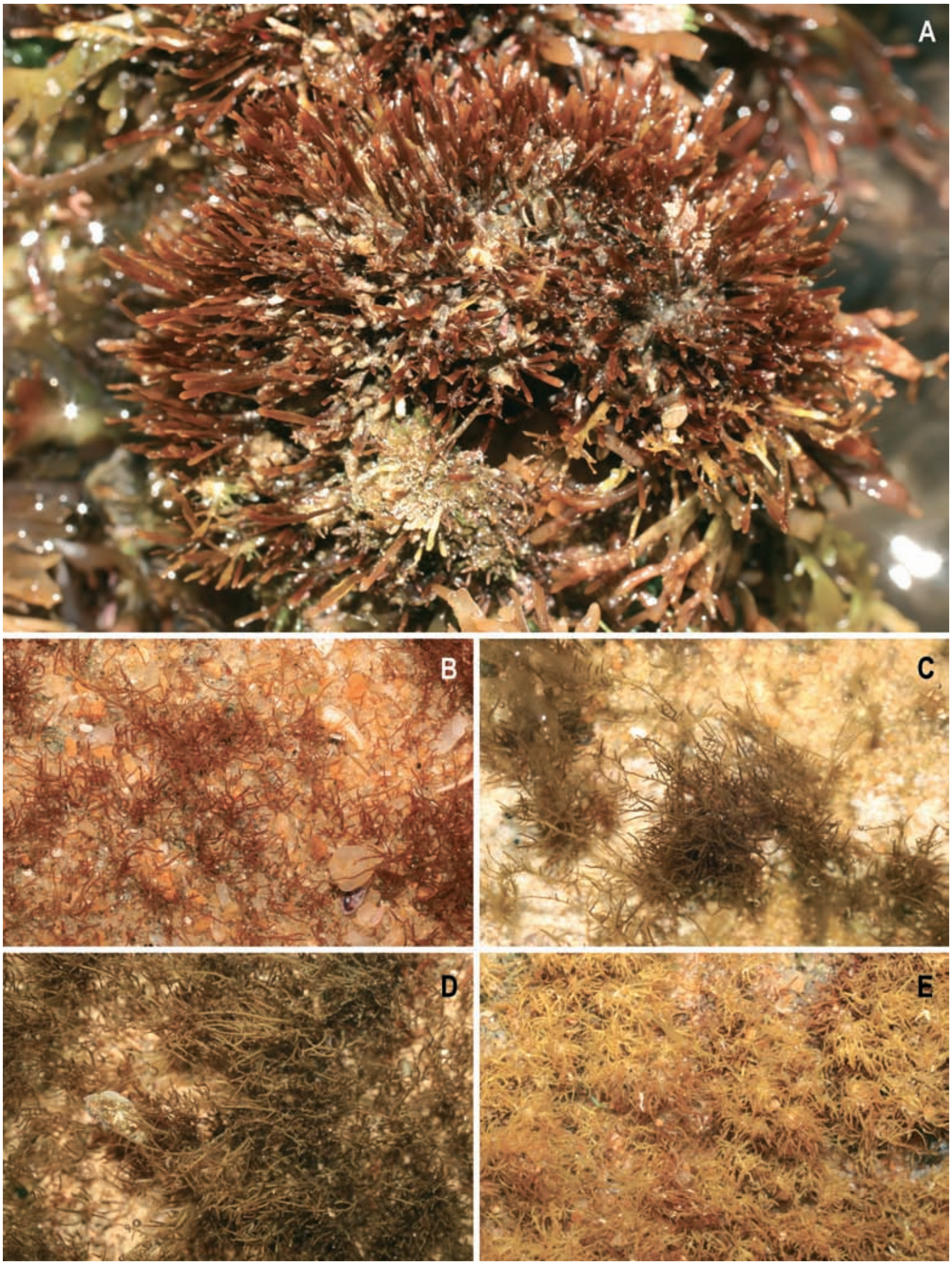
Over 130 taxa are currently recognized worldwide, although many are in need of re-assessment. The genus is characterised by bilocular cystocarps with evenly developed locules (on both surfaces of the blades), but the infrequency of reproductive plants means that most specimens can only provisionally be identified, based on morphological characters. On the other hand, it is known that vegetative characters vary greatly with ecological parameters. Their variability is so big that it is even difficult to separate *Gelidium* from related genera. In the absence of reproductive structures in type material, this genus might still be one of the most confused ones in the red algae.

Freshwater *et al*. (1995) and Shimada *et al*. (1999) have shown a clustering of species into several monophyletic clades, many of which correspond to specific geographical regions.

Based on data from literature, Silva *et al.* (1996) mention four species from Sri Lanka: *Gelidium amansii* (J.V. Lamouroux) J.V. Lamouroux, *G. corneum* (Hudson) J.V. Lamouroux, *G. micropterum* Kützing, *G. pusillum* (Stackhouse) Le Jolis. *G. heteroplatos* Børgesen, mentioned by Durairatnam (1961: 50) has been transferred to the genus *Pterocladia*. It is not to be excluded that more species of *Gelidium* are present on the island.

Representatives of *Gelidium* in Sri Lanka are generally small to tiny, gregarious plants (rarely up to 2 cm high) with cylindrical prostrate axes, very well attached to the substratum by groups of rhizoids; erect plants cartilaginous, supple but tough, partly cylindrical (towards the basis) or completely compressed, variously branched, mostly distichously in one plane; a single, lens-shaped apical cell. In transverse section the axes show small, thick-walled rhizines among the pseudoparenchymatous cells of the medulla. Cruciately divided terasporangia in sori occupying the central part of lateral branchlets.

Figs 132A-E. *Gelidium* spp.


A
B
C
D
E

Gelidiella acerosa (Forsskål) J. Feldmann et G. Hamel
1934: 533 Figs 10C; 133

References: Tseng (1984: 64, pl. 35, fig. 4), Lewmanomont & Ogawa (1995: 105, + fig.), Cribb (1996: 83, bottom fig. p. 82), Calumpong & Meñez (1997: 170, + fig.), Trono (1997: 179, fig. 113), Abbott (1999: 202, figs 53A-C), Huisman (2000: 42, + figs), Payri *et al*. (2000: 170, top fig. p. 171), Littler & Littler (2003: 56, top fig. p. 57), De Clerck *et al*. (2005b: 156, fig. 121), Oliveira *et al*. (2005: 59, + fig.), Huisman *et al*. (2007: 107, + figs).

Type locality: Mokha, Yemen.

Description - Plants growing from a stoloniferous holdfast, uprights 4-7 cm long, forming tufts or clumps of tough and wiry, flexible axes, brownish-black in shaded places to greenish-straw-coloured when directly exposed to sunlight; attached by peg-like haptera or terminating in multicellular rhizoids; erect axes cylindrical, certainly in the basal parts to compressed in the upper parts; to 1 mm in diameter, most often pinnately and distichously branched, more rarely radially or unilaterally branched; main axes frequently recurved, arcuate; pinnae short, 2-6 mm long, perpendicularly placed on the rachis and gradually shorter towards the branch apices; branches sometimes anastomosing, predominantly in the prostrate parts; apices acute, hairs often present. Internal structure consisting of a cortex of small, ovoid, darkly-pigmented cells, centrally grading into larger, irregularly-shaped, thin-walled medullary cells; rhizines consistently absent. Tetrasporangial sori yellowish, borne in expanded apices of lateral branchlets.

Ecology - Epilithic in shallow pools close to low water level, exposed to continuous surf; locally abundant.

Distribution - Pantropical.

Fig. 133. *Gelidiella acerosa*. A. Prostrate growth form; B. Erect growth form.

Pterocladiella caerulescens (Kützing) Santelices et Hommersand
1997: 118 Figs 10A, B; 134

References: Abbott (1999: 197, fig. 51E), Payri *et al*. (2000: 168, bottom fig. p. 169), De Clerck *et al*. (2005b: 150, fig. 113), Huisman *et al*. (2007: 110, + figs), Skelton & South (2007: 28).

Type locality: Wagap, New Caledonia.

Description - Plants gregarious, erect, 3-5 cm high, composed of a stoloniferous holdfast and lanceolate uprights, bordeaux-red; attached by peg-like rhizoidal attachments; erect axes densely placed on the stolons, subcylindrical proximally, flattened and ligulate distally, up to 5 cm high and 1-1.5 mm wide, simple to irregularly bipinnate; pinnae upwardly directed, more or less in a single plane, lanceolate to ligulate, with obtuse or emarginated apices. In transverse section, internal structure consisting of a darkly pigmented outer cortex grading into larger, angular inner cortical cells; medulla consisting of thick-walled filaments; refractive rhizines concentrated in the medulla, scattered in the inner cortex.

Ecology - Epilithic on horizontal substratum at low water level, continuously wave-swept even at low tide; locally in extensive monospecific populations.

Distribution - Pantropical.

Fig. 134. *Pterocladiella caerulescens*.


A
B

Gracilaria canaliculata Sonder
1871: 56 Figs 10D; 23D; 135

REFERENCES: Durairatnam (1961: 59, pl. 14, fig.6, as *G. crassa*), Tseng (1984: 104, pl. 55, fig. 3), Calumpong & Meñez (1997: 179, + fig.), Huisman (2000: 95, + figs), De Clerck *et al*. (2005b: 158, fig. 123), Oliveira *et al*. (2005: 60, + figs p. 36, 61).

TYPE LOCALITY: Wagap, New Caledonia.

Description - Plants gregarious, decumbent, up to 10 cm tall, succulent, stiff cartilaginous and brittle, bright to dark pinkish red, sometimes greenish proximally; attached by a discoid holdfast giving rise to 1-2 arched uprights; axes cylindrical, 2-3 mm in diameter, decumbent, 4-6 times (sub)dichotomously branched, parallel to the substratum; branching angle 45-90°; branches mostly arcuate and slightly basally constricted, sometimes forming secundary attachment points at their broadly rounded apices. Internal structure consisting of 1-2 layers of small, pigmented outer cortical cells surrounding a large-celled medulla with cells of up to 300 µm in diameter; medullary cells decreasing in size toward the periphery, polygonal to spherical; cortex of proximal axes considerably thicker.

Ecology - Epilithic, on surf-exposed rocks at about low tide level, extremely well-developed in surf channels.

Distribution - Widespread throughout the Indian Ocean and western Pacific Ocean.

Note - A much used synonym of this species is *G. crassa* Harvey ex J. Agardh.

Fig. 135. *Gracilaria canaliculata*.

Gracilaria corticata (J. Agardh) J. Agardh
1852: 602-603 Figs 9C; 21F, G; 41F; 45E; 136

REFERENCES: Jaasund (1976: 83, fig. 168), Moorjani & Simpson (1988: 29, pl. 59d), De Clerck *et al*. (2004: 3027, fig. 1), De Clerck *et al*. (2005b: 160, fig. 124), Oliveira *et al*. (2005: 61, + fig.).

TYPE LOCALITY: Sri Lanka.

Description - Plants gregarious, erect, 10 (-15) cm long, cartilaginous but flexible, varying from dark-purple to bright red or creamy, frequently darker in the branch axils; attached by means of a discoid holdfast from which the erect plants develop, as well as numerous stolonoidal structures; axes markedly compressed, linear, strap-like, up to 4 mm wide in the widest specimens, only 2 mm in narrower growth forms, being narrower just above the dichotomies, with smooth margins and obtuse apices, frequently branched up to 6 orders in a single plane; branching originally (sub)dichotomous, with narrow branching angles; numerous specimens bear isolated, marginal, spur-like (recurved) proliferations. Internal structure consisting of 1-3 layers of pigmented outer cortical cells surrounding a large-celled medulla with cells up to 100 µm in diameter; medullary cells decreasing in size toward the periphery, polygonal to spherical. Cystocarps numerous but isolated, hemispherical, markedly extruding on the surface of the straps.

Ecology - Extremely abundant on surf-exposed, horizontal beach rock platforms at about low tide level, where it can form large monospecific populations, but also observed in harbours.

Distribution - Widespread throughout the Indian Ocean, also mentioned from Korea and Peru (Pacific Ocean).

Fig. 136. *Gracilaria corticata*. A. Sterile plants; B. Specimens with numerous cystocarps.


A
B

Gracilaria corticata (J. Agardh) J. Agardh var. ***ramalinoides*** J. Agardh
1852: 602-603 Fig. 137

REFERENCE: Durairatnam (1961: 63, pl. XXX, fig. 2).

TYPE LOCALITY: India.

Description - Plants similar in habit and colour as *G. corticata*, but the axes narrower (1-2 mm), and more rigid, the distal parts of older specimens becoming more irregular as a result of palmate to cervicorn branching towards the apices; these apical branches are subcylindrical and as a result, these plants have a more “spiny” aspect than the typical variety. Fertile (cystocarpic) specimens also present numerous lateral proliferations (in the same plane as the original branching), resulting in a very dense aspect; cystocarps (mostly) produced on the adaxial side of these incurved proliferations but also present on the margins of the main axes.

Ecology - Similar to the typical variety, but less abundant; not observed in sheltered habitats (harbours).

Distribution - India, Kenya, Madagascar, Sri Lanka, Tanzania.

Fig. 137. *Gracilaria corticata* var. *ramalinoides*.

Gracilaria hikkaduwensis Durairatnam
1962: 15, fig. 6 Fig. 138

TYPE LOCALITY: Hikkaduwa, Sri Lanka.

Description - Plants isolated or in small groups, growing in open populations, erect, rather stiff cartilaginous but flexible, straplike, upper parts typically greenish and as such easily recognizable in the field but some specimens completely creamy coloured; attachment by a disc; some specimens with a marked cylindrical stipe, 3-4 mm long; basal stolonoidal structures (illustrated by Durairatnam, but not mentioned in his description) sometimes present; blades 4-5 (-7) cm high, straps cuneate, up to 3-4 (-5) mm wide just under the dichotomy, markedly undulated; branching subdichotomous to irregular, becoming extremely irregular and dense in older specimens as a result of the numerous proliferations; apices more or less toothed.

Ecology - Epilithic, horizontal substratum, just above low water mark, continuously wave-swept, frequently among *G. corticata*.

Distribution - Kenya, Mauritius, Sri Lanka.

Note - The morphology of our specimens agrees well with the original description and illustration of Durairatnam (1962, fig. 6) as well as with his specimen deposited in Peradeniya. It also agrees with Harvey’s specimen (1857, n°96), deposited in Sydney, distributed as *Rhodymenia purpurascens* in his Ceylon exsiccata. According to Silva *et al*. (1996: 177), *Gracilaria srilankia* (Chang & B Xia) Withell, Millar & Kraft would be the correct name of Harvey’s specimen. Further study should make clear if *G. hikkaduwensis* and *G. srilankia* are the same or different taxa.

Fig. 138. *Gracilaria hikkaduwensis*.

GRACILARIALES – Gracilariaceae **_Gracilaria_** Greville 1830: 121

Gracilaria salicornia (C. Agardh) Dawson
1954: 4 Fig. 139

REFERENCES: Magruder & Hunt (1974: 73, middle fig. p. 72), Jaasund (1976: 85, fig. 171), Tseng (1984: 108, pl. 57, fig. 1), Lewmanomont & Ogawa (1995: 116, + fig.), Cribb (1996: 87, middle fig. p. 86), Calumpong & Meñez (1997: 177, + fig. p. 178), Trono (1997: 217, fig. 139), Abbott (1999: 214, figs 59D-H), Littler & Littler (2003: 100, middle fig. p. 101), De Clerck *et al*. (2005b: 162, fig. 126), Oliveira *et al*. (2005: 62, + fig. p. 63), Huisman *et al*. (2007: 114, + figs), Ohba *et al*. (2007: 93, + figs).

TYPE LOCALITY: Probably Manila, Philippines.

Description - Plants mainly prostrate, up to 10 cm long, succulent, stiff cartilaginous and brittle, orangy to yellowish green; attachment by numerous, small discoid holdfasts; axes cylindrical, 1.5-2 mm in diameter, with a few, irregularly placed constrictions; apices straight or downwardly bent, rounded; branching (sub) dichotomous to irregular with wide branching angles.

Ecology - Epilithic on horizontal substratum close to low water level and locally growing in extensive populations, even in places which are continuously trampled by fishermen and tourists.

Distribution - Widespread in the tropical Indo-Pacific.

Note - Abbott (1999: 216) mentions that this species is used as food in Hawai'i, when there is shortage of cultured *Gracilaria* species.

Fig. 139. *Gracilaria salicornia*.

BONNEMAISONIALES – Bonnemaisoniaceae **_Asparagopsis_** Montagne *in* Barker-Webb et Berthelot 1840: xv

Asparagopsis taxiformis (Delile) Trevisan
1845: 45 Figs 23B; 45J; 140

REFERENCES: Tseng (1984: 64, pl. 35, fig. 3), Cribb (1996: 69, bottom fig. p. 68), Calumpong & Meñez (1997: 161, + fig. p. 162), Trono (1997: 169, fig. 106), Abbott (1999: 174, figs 43A-D), Huisman (2000: 47, + figs), Payri *et al*. (2000: 160, top fig. p. 161), Littler & Littler (2003: 68, middle fig. p. 69), De Clerck *et al*. (2005b: 164, fig. 128, 129), Oliveira *et al*. (2005: 64, + figs p. 65), Huisman *et al*. (2007: 83, + figs).

TYPE LOCALITY: Alexandria, Egypt.

Description - *Gametophytic plants* erect, gregarious, forming extensive greyish pink patches, mostly 2-4, but up to 11 cm high; attached to the substratum by cylindrical, irregularly branched stolons, 1.5-2 mm in diameter; uprights plumose with a single percurrent axis forming densely branched determinate branches in all directions, with the basal part often denuded and stalk-like; in larger specimens indeterminate side branches can be present in the upper, plumose part; branchlets divided to several orders, the divisions becoming progressively finer so plants are soft and silky. *Tetrasporangial plants* ('*Falkenbergia*' stage) forming isolated pinkish-red tufts, 1-3 cm in diameter, consisting of radially placed, finely branched polysiphonous filaments, 30-40 µm in diameter, composed of a central axial filament surrounded by 3 pericentral cells; each of these cells containing a single, markedly refringent, iodine containing cell inclusion; segments at maturity 65-80 µm long. Tetrasporangia one per segment in short series, 35-40 µm in diameter, tetrahedrally divided.

Ecology - Gametophyte: Mostly epilithic in the subtidal (-3/-4 m) where it locally forms extensive vegetations together with *Portieria hornemannii*. More rarely observed in the infralittoral fringe. Tetrasporophyte: often entangled among other algae or attached to algal turf in intertidal pools and the shallow subtidal.

Distribution - Pantropical and warm temperate regions.

Note - When taken out of the water, the plants have a very strong iodine smell. Abbott (1999: 175) mentions that this species probably is the most favoured (and expensive) seaweed food for Hawaiians.

Fig. 140. *Asparagopsis taxiformis*. Gametophytes among *Halimeda*.

Amphiroa foliacea J.V. Lamouroux *in* Quoy et Gaimard 1824: 628, pl. 93: figs 2, 3 Figs 22A; 141

REFERENCES: Tseng (1984: 86, pl. 46, fig. 1), Lewmanomont & Ogawa (1995: 93, + fig.), Abbott (1999: 178, figs 44C, 45B), Littler & Littler (2003: 26, top fig. p. 27), Ohba *et al.* (2007: 104, + figs), Skelton & South (2007: 40, figs 47-51, 796).

TYPE LOCALITY: Mariana Islands.

Description - Plants gregarious, horizontally spread from a central point from which different specimens spread out; heavily calcified and brittle, pink; individual plants up to 5 cm long, branching irregular, some segments not branching, others di- or trichotomous; a single basal, cylindrical segment (intergeniculum); other segments markedly compressed, 3-4 mm long, 2-3 mm wide, and all in the same (or parallel) plane(s); in some specimens the proximal segments with raised central rib; segments extremely variable in morphology, mostly bi- or trifurcate, frequently with a (sub-)apical lateral lobe; the supple joints (genicula) are very obvious dark brown and surrounded on both sides by auricular outgrowths of the supporting and/or the upper segment; fertile specimens with very numerous, contiguous conceptacles on both faces of the intergenicula, but more numerous on the upper surface, not strongly elevated, with a single ostiolum each.

Ecology - Epilithic, from just under low water mark down to 2 m depth, locally abundant in continuously wave-swept gulleys parallel with the sea and in direct contact with the open sea.

Distribution - Tropical Pacific and Indian Ocean.

Note - Abbott (1999: 178) states that the taxonomy and nomenclature of *A. foliacea* need study. Moreover it may be that *A. foliacea*, *A. tribulus* (Ellis et Solander) J.V. Lamouroux and *A. misakiensis* Yendo represent a single polymorphic species.

Fig. 141. *Amphiroa foliacea*. A. Specimen from just under low water mark; B. Specimen from a lagoon, 2 m depth; C, D. Details.

Amphiroa fragilissima (Linnaeus) J.V. Lamouroux 1816: 298 Fig. 142

REFERENCES: Magruder & Hunt (1979: 59, middle fig. p. 58), Lewmanomont & Ogawa (1995: 92, + fig.), Payri *et al.* (2000: 182, top fig. p. 183), Littler & Littler (2003: 26, middle fig. p. 27), Ohba *et al.* (2007: 105, + figs).

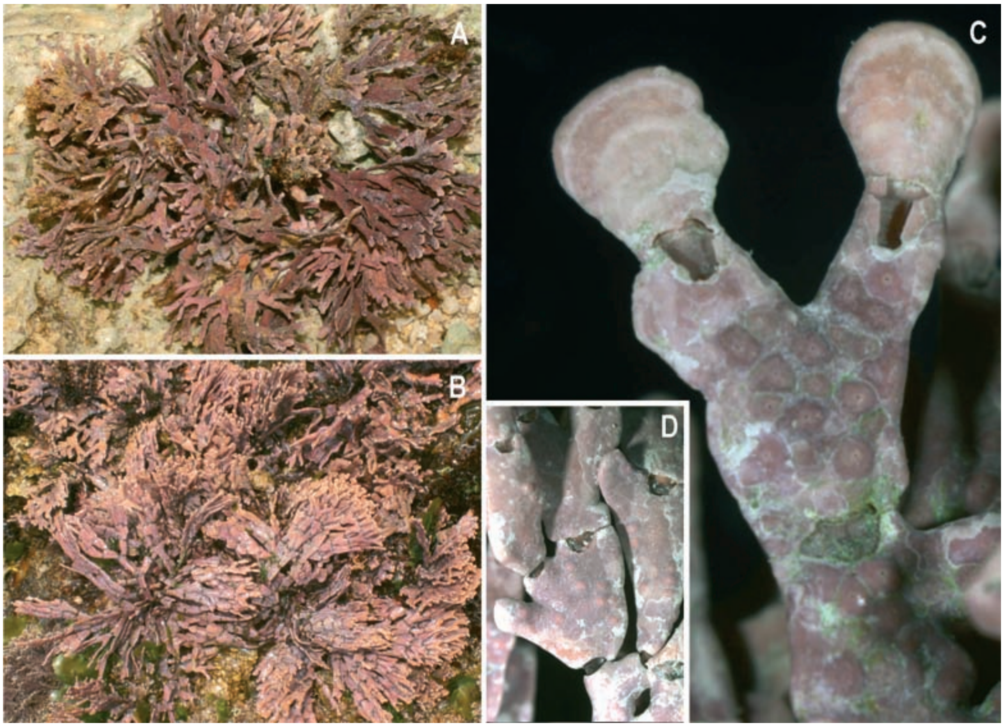
TYPE LOCALITY: Jamaica.

Description - Plants forming hemispherical tufts to more elongated cushions, composed of radially arranged, calcified and brittle branches, pinkish grey to yellowish white; all branches cylindrical, intergenicula extremely thin (100-500 µm), up to 1 cm long, branching divaricately dichotomous (Y-shaped, rarely trichotomous) at the genicula, more lax in sheltered, subtidal habitats, more dense in pools in the intertidal. Conceptacles small but conspicuous, as raised hemispherical projections, lateral on the intergenicula.

Ecology - Best developed in the subtidal of lagoons, frequent between seagrasses; somewhat coarser, more dense specimens in intertidal pools.

Distribution - Pantropical and Mediterranean Sea.

Fig. 142. *Amphiroa fragilissima*.


A
B
C
D

CORALLINALES – Corallinaceae **Amphiroa** J.V. Lamouroux 1812: 185

Amphiroa sp.

Fig. 143

Description - Plants forming hemispherical, stiff and brittle tufts, 3-5 cm in diameter, pinkish red, composed of radially placed intergenicula, dichotomous in various planes, straight, calcified; attachment by a stoloniferous holdfast; branching angles small, resulting in closely packed branches, (almost) contiguous at the basis of the thallus; intergenicula cylindrical, smooth, diameter uniform throughout, 250-750 mm in diameter, 5-10 mm long; genicula uncalcified, small and not obvious. No reproductive structures observed.

Ecology - On horizontal, slightly sand-covered rock substrate close to low water mark along rather sheltered coasts; tufts frequently containing small shell fragments.

Fig. 143. *Amphiroa* sp. A. Surface view; B. Longitudinal section of a hemispherical tuft.

CORALLINALES – Corallinaceae **Jania** J.V. Lamouroux 1812: 186

Jania adhaerens J.V. Lamouroux
1816: 270

Figs 14C; 144

REFERENCES: Tseng (1984: 90, pl. 48, fig. 2), Cribb (1996: 97, bottom fig. p. 96), Calumpong & Meñez (1997: 149, + fig.), Abbott (1999: 187, fig. 48A), Littler & Littler (2003: 32, bottom fig. p. 33), De Clerck *et al*. (2005b: 176, figs 147, 148), Oliveira *et al*. (2005: 79, + figs), Skelton & South (2007: 45, figs 66-69).

TYPE LOCALITY: Mediterranean Sea.

Description - Plants forming lax, delicate, irregularly lobed (sub)spherical tufts; individual plants 2-4 cm in diameter, greyish pink with more whitish tips, attached by basal discs; all branches very thin (90-120 µm, somewhat thicker at the basis), branching divaricate (>45°), dichotomous to irregular in various planes, resulting in a very intricated aspect; some intergenicula not branching (number of unbranched ones larger in the basal parts, but also variable among specimens); intergenicula cylindrical, 300-700 µm long; secondary adhesion discs present. Conceptacles in amphora-shaped intergenicula which are markedly broader than vegetative intergenicula and mostly bearing two short branchlets at the upper angles; pore in the middle of the upper margin of the conceptacle.

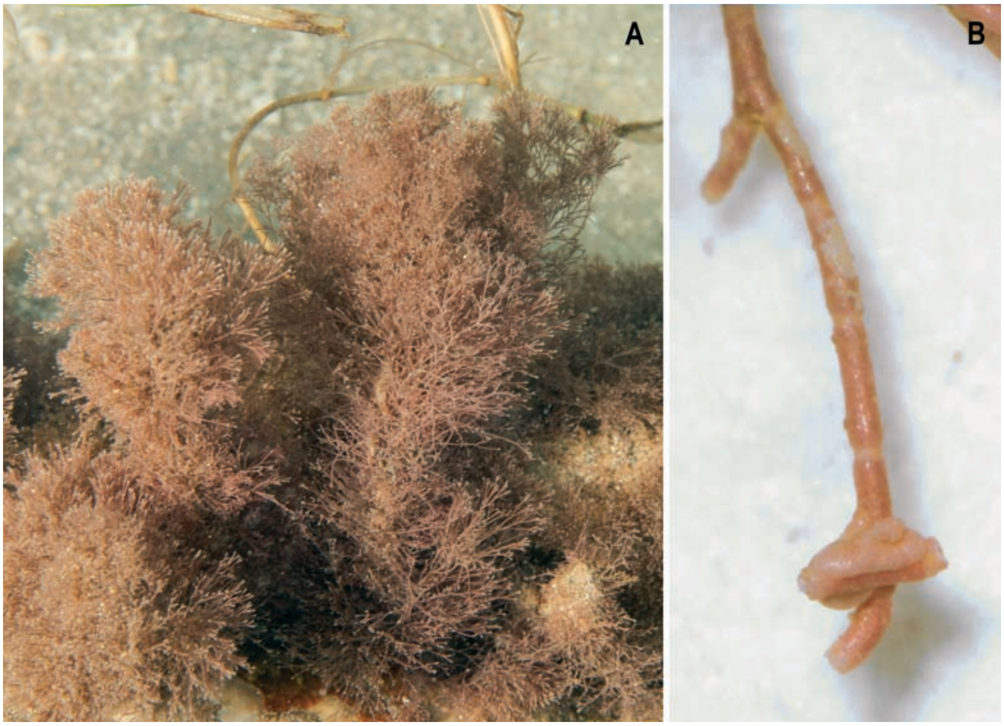
Ecology - Mostly epiphytic on other seaweeds (as *Sargassum*), or on stolons of seagrasses, in deep intertidal pools and the subtidal; locally in large quantities on submerged boat ropes in lagoons.

Distribution - Pantropical and warm temperate; widespread.

Note - Skelton & South (2007: 46) state that specimens from Pacific Islands, previously identified as *J. capillacea* Harvey and *J. micrarthrodia* are indistinguishable from *J. adhaerens*, and therefore most probably are referable to that taxon.

Fig. 144. *Jania adhaerens*. A. *In situ* habit; B. Detail of a secondary attachment pad.


A
B


A
B

Jania cultrata (Harvey) J.H. Kim, Guiry et H.-G. Choi
2007: 1317 Fig. 145

REFERENCES: Trono (1997: 191, fig. 122, as *Cheilosporum cultratum*), De Clerck *et al*. (2005b: 170, figs 138, 139, as *Cheilosporum cultratum*).

LECTOTYPE LOCALITY: Durban, South Africa.

Description - Plants decumbant, up to 2 cm tall, usually densely branched and caespitose, rarely sparsely branched, chalky pink to greenish- or brownish-pink; holdfast composed of entangled stolons with cylindrical to compressed, unlobed intergenicula 200-500 µm in diameter; axes complanate, dichotomously branched every few segments, in a single plane, articulated with calcified intergenicula; adventitious branching from intergeniculum surface rare; branch apices rounded, bleached; intergenicula near the base cylindrical, 0.3-0.8 mm long, 0.3-0.5 mm in diameter; intergenicula in the upper parts compressed, bilobed to winged, 0.6-1 mm long, 1.5-2(-3.5) mm wide between lobe apices; lobes strongly developed with acute apices, lobe angle ca 30-40(-50)°, upper margin up to 1.5 mm long; genicula appearing as hairline cracks, composed of a single tier of medullary cells up to 240 µm long. Reproductive conceptacles swollen, borne adaxially on lobes with pore opening on the upper edge of intergenicula.

Ecology - Epilithic at about low tide level, on rocks exposed to strong surf.

Distribution - Reported from several localities in the Indian Ocean and western Pacific Ocean.

Note - Kim *et al*. (2007) studied the phylogenetic relationships within the tribe Janieae based on molecular and morphological data and came to a reappraisal of the genus *Jania*. They conclude that the genus *Cheilosporum* should be included in the genus *Jania*.

Fig. 145. *Jania cultrata*.

Jania intermedia (Kützing) P. Silva
in Silva *et al*. 1996: 242 Figs 17D; 146

REFERENCE: De Clerck *et al*. (2005b: 176, fig. 149).

TYPE LOCALITY: ‘Cape of Good Hope’, South Africa.

Description - Plants growing in extensive populations, but as isolated tufts, 2-3 cm long, hanging down along the sloping rocks; attachment by a basal disc, all intergenicula cylindrical, about 100-150 µm in diameter and 200-400 µm long, dichotomous but unbranched segments are present; branching angle small, resulting in a global fasciate aspect with rounded periphery, all axes being parallel to each other. Greyish pink in the wet season, becoming bleached whitish in the beginning of the dry season and largely dying off when the sea is becoming smooth.

Ecology - Growing in large, rather dense, (almost) monospecific populations (several m²) on vertical and sloping surfaces in the mid to low intertidal, exposed to extreme surf.

Distribution - South Africa, Mozambique.

Note - This is the most abundant intertidal *Jania* species along the coast of Sri Lanka. In the absence of reproductive structures and awaiting the results of ongoing molecular study of the genus, we tentatively identify this taxon as *J. intermedia,* as the material from Sri Lanka very well corresponds to that from Kwazulu-Natal. *Jania natalensis* var. *tenuior* was distributed by Harvey in his Ceylon exsiccata (1857: n° 25). According to Silva *et al*. (1996: 245) this name was used, without a description. They also state that this taxon apparently lies within the circumscription of *Jania verrucosa*, but it might even be that *J. intermedia* and *J. natalensis* var. *tenuior* have to be reduced to synonymy. Durairatnam (1961: 51) very briefly describes it (without giving any dimensions of the intergenicula), adding that he did not find any reproductive structures ‘in spite of careful examination’.

Fig. 146. *Jania intermedia*. A. Population; B. Detail.


A
B

Corallinales – Corallinaceae **_Jania_** J.V. Lamouroux 1812: 186

Jania ungulata (Yendo) Yendo
1905: 38 Fig. 147

References: Littler & Littler (2003: 36, top fig. p. 37), Oliveira *et al*. (2005: 80, + fig.).

Syntype localities: Japan: Wakasa Province (Fukui Prefecture) and Misaki, Kanagawa Prefecture.

Description - Plants forming small, spherical tufts, 1 cm in diameter, whitish pink; branching divaricately dichotomous, some intergenicula not branching; branches composed of an alternation of calcified, cylindrical intergenicula, 80-120µm in diameter, and uncalcified genicula. The most typical character of this species is the presence of compressed, wedge- to hoof-shaped terminal intergenicula.

Ecology - Epiphytic on submerged seaweeds and on submerged ropes.

Distribution - Tropical and subtropical Indian and Pacific Ocean.

Fig. 147. *Jania ungulata*.

Gigartinales – Cystocloniaceae **_Hypnea_** J.V. Lamouroux 1813: 131

Hypnea charoides J.V. Lamouroux
1813: 132, pl. 10, figs 1-3 Fig. 148

References: Abbott (1999: 119, fig. 25F, as *H. valentiae*), Littler & Littler (2000: 78, middle fig. p. 79, as *H. valentiae*), Yamagishi & Masuda (2000: 31, figs 10-15).

Type locality: “Novae Hollandiae”.

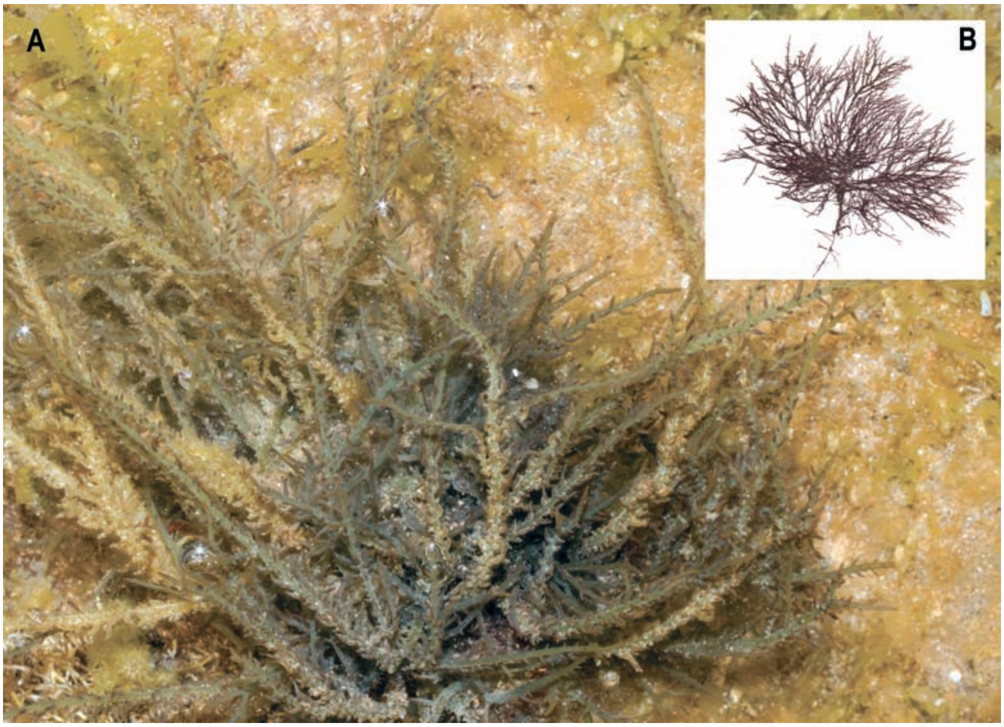
Description - Plants gregarious, growing as isolated tufts, 4-7 cm high, subcartilaginous, cylindrical all over, greenish- to brownish red; original discoid holdfast mostly unclear because of the presence of numerous, entangled, creeping branches forming secondary discoid holdfasts; erect branches with marked percurrent, straight axes being longer than any lateral branches which are also straight, upwardly directed and up to 3-4 orders; main axes and side branches of lower order very densely set with very short, acute, adventitious branchlets (1-2 mm long); these are unbranched or branched one time, upwardly directed, abruptly curved in the adaxial direction to become parallel to the bearing branch. No lenticular wall thickenings visible on transverse sections.

Ecology - Epilithic in mid- to low intertidal, shallow rock pools, continuously wave-swept.

Distribution - Tropical Indian and Pacific Ocean.

Notes - Durairatnam (1961: 56) includes this taxon in *H. valentiae*, but mentions that ‘I have some specimens which agree with *H. charoides* … but I have placed them under *H. valentiae*’.
Yamagishi & Masuda (2000) studied the *H. charoides-valentiae* complex in Japan, concluding that *H. charoides* have tufted thalli with an entangled base, whereas this is not the case in *C. valentiae*.
The absence of lenticular cell wall thickenings on transverse sections of medullary cells in the basal portion of the thallus distinguishes *H. charoides* from *H. boergesenii* that has a similar gross morphology.

Fig. 148. *Hypnea charoides*. A. Habit *in situ*; B. Herbarium specimen.


A
B

Hypnea pannosa J. Agardh

1847: 14

Figs 10C; 20A; 32F; 149

REFERENCES: Tseng (1984: 100, pl. 53, fig. 1), Lewmanomont & Ogawa (1995: 125, + fig.), Cribb (1996: 95, middle fig. p. 94), Trono (1997: 238, fig. 150), Abbott (1999: 117, fig. 25A), Huisman (2000: 78, + fig.), Payri *et al*. (2000: 222, bottom fig. p. 223), Littler & Littler (2003: 76, top fig. p. 77), Oliveira *et al*. (2005: 90, + figs p. 91), Skelton & South (2007: 57, figs 100-102, 769, 770).

TYPE LOCALITY: San Agustín, Oaxaca, Mexico.

Description - Plants forming stiff-brittle prostrate clumps, 5-10 cm in diameter, 2-3 cm thick, composed of densely entangled and frequently anastomosing branches, greenish to purplish red, but mostly with a pronounced bluish iridescence; all axes subcylindrical to compressed, up to 1.5 mm wide at their basal part, gradually tapering to acute tips; branching irregular; presence of numerous short side branchlets, resulting in a spiny aspect. Anatomy parenchymatous, with prominent axial cells, 12-30 µm in diameter, surrounded by medullary cells, 40-70 µm in diameter and cortical cells, 15-25 µm in diameter; no lenticular cell wall thickenings. Tetrasporangial sori in mid to lower parts of fertile branchlets, initially on the abaxial side, later sometimes encircling the branchlet; tetrasporangia zonate, 10-20 µm in diameter, 25-40 µm long.

Ecology - Locally extremely abundant on horizontal beachrock, in the low intertidal, continuously wave-swept and attached in crevices; in the shallow subtidal, frequent between coral (*Acropora*) branches. Some specimens have been heavily grazed on.

Distribution - Indian Ocean and tropical Pacific Ocean.

Note - Molecular research indicates that different entities are comprised in *H. pannosa* s.l. In Sri Lanka two morphologically different entities can be easily distinguished: one with the typical acute apices (Figs 10C; 20A; 32F; 149) and one with rounded apices (Fig. 32G).

Fig. 149. *Hypnea pannosa*.

Hypnea spinella (C. Agardh) Kützing

1847: 23

Fig. 150

REFERENCES: Magruder & Hunt (1979: 79, top fig. p. 78, as *H. cervicornis*), Tseng (1984: 98, pl. 52, fig. 2), Cribb (1996: 97, top fig. p. 96), Abbott (1999: 117, figs 25B-E, 113, fig. 24A, as *H. cervicornis*), Huisman (2000: 79, + figs), Payri *et al*. (2000: 224, bottom fig. p. 225), Littler & Littler (2003: 76, middle fig. p. 77), Huisman *et al*. (2007: 86, + fig., as *H. cervicornis*).

SYNTYPE LOCALITIES: Brazil, Mauritius, Mexico, West Indies.

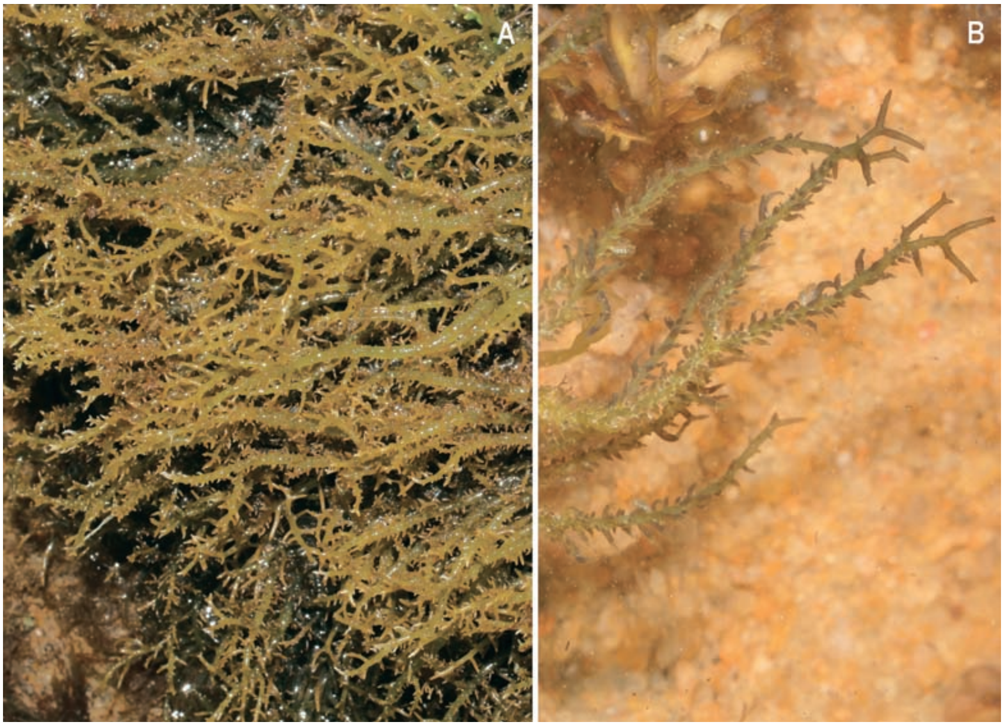
Description - Plants growing just above low water level and being continuously wave-swept form rather stiff, red to yellowish green cushion-like clumps of intricated branches, up to 3 cm high from where a few erect branches are poking out; specimens from deeper intertidal pools and lagoons form laxly branched, supple, yellowish, entangled erect plants, up to 20 cm long. In both growth forms secondary attachments points are possible, all axes are cylindrical, branching (sub)dichotomous, without main axes, widely divaricate, the two divergent branches sometimes horizontally spread before bending upward or curling downward, resulting in the characteristic entangled plants; in the spinella ecomorph, the diameter at the basis is markedly larger than in the upper parts whereas in the cervicornis ecomorph the diameter is more homogeneous in a single plant, but can be rather different between populations, from 0.5 mm in slender specimens up to 1.5 mm in coarser ones; mostly presence of numerous short (1-2 mm) branchlets, perpendicularly placed, mostly simple, bifurcate or more rarely branched 2 to 3 times; branchlets more frequent in the basal parts of the plants.

Ecology - The spinella ecomorph close to low water level and continuously wave-swept; the cervicornis ecomorph in deeper intertidal pools and lagoons.

Distribution - Pantropical.

Notes - This species is edible, boiled in coconut milk, being eaten in several parts of the Pacific Ocean. Although Haroun & Prud'homme van Reine (1993) synonymized *H. cervicornis* J. Agardh with *H. spinella* because of the existence of numerous intermediates, some authors prefer to keep both entities separate (Abbott, 1999).

Fig. 150. *Hypnea spinella*. A. Habit *in situ*; B. Detail of some branches.


A
B

GIGARTINALES – Gigartinaceae **Chondracanthus** Kützing 1843: 399

Chondracanthus acicularis (Roth) Fredericq
in Hommersand *et al*. 1993: 117

Figs 33E; 151

REFERENCES: Abbott (1999: 131, figs 31A-D), Oliveira *et al*. (2005: 87, + fig. p. 86).

LECTOTYPE LOCALITY: Adriatic Sea.

Description - Plants growing in loosely intricated, prostrate tufts up to 10 cm in diameter, with typical rubbery texture; dark brownish red, but some collections with a very marked transversely striped creamy iridescence; attachment by a discoid holdfast from which several axes start; all branches decumbent, with secundary attachment points, cylindrical, 0.5-1 mm in diameter, with irregular branching in different planes, but side branchlets mostly perpendicular on the main branches and with acute apices; branches sometimes anastomosing. Medulla composed of delicate, often cobwebby anastomosing filaments; cortex formed by anticlinal rows of small, oval to spherical cells.

Ecology - Epilithic on horizontal substratum in the low intertidal; locally in quite large populations.

Distribution - Pantropical and temperate regions.

Note - Abbott (1999: 131) mentions that the report of this temperate species in the tropics is questionable. Skelton & South (2007: 56) state that *C. tenellus* (Harvey) Hommersand and *C. acicularis* appear to be at opposite ends of a fairly broad morphological spectrum. The branches of *C. tenellus* are markedly compressed, of a smaller diameter (0.35-0.5 mm) and present opposite laterals.

Fig. 151. *Chondracanthus acicularis*.

CLADOPHORALES – Siphonocladaceae ***Cladophoropsis*** Børgesen 1905: 288

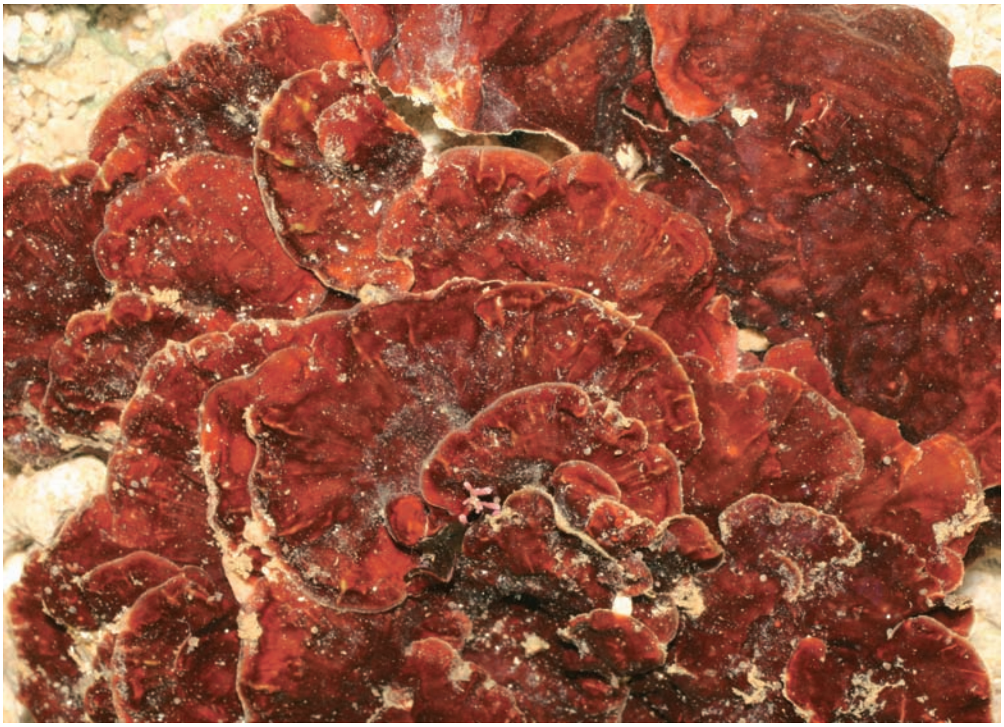
Peyssonnelia sp.

Figs 37G; 152

Most species of *Peyssonnelia* are prostrate or resupinate, composed of tightly adherent to loosely attached, horizontally spread (rarely erect) lobes, either with concentric zones or with radially arranged stripes on the upper surface, calcified on the lower surface between the rhizoids. Basal layer of the thallus (hypothallus) composed of radially aligned, contiguous filaments, producing uni- or multicellular rhizoids downwardly and upcurved, contiguous, branching filaments (the perithallus) becoming vertical towards the upper surface. In some species calcified cells (cystoliths) can be present in these filaments. Tetrasporangia in sori; sexual reproductive structures rare.

Worldwide, over 60 species have been reported but many of them have to be critically studied to determine the variability of characters. According to Silva *et al*. (1996: 209-214), only *P. rubra* (Greville) J. Agardh has been mentioned from Sri Lanka so far, but in our collections we definitely have several entities. Awaiting more detailed studies of the material we refrain from identifying the illustrated one to species level.

Fig. 152. *Peyssonnelia* sp.



GIGARTINALES – Phyllophoraceae **_Ahnfeltiopsis_** P.C. Silva et DeCew 1992: 576

Ahnfeltiopsis pygmaea (J. Agardh) P.C. Silva et DeCew
1992: 578 Fig. 153

REFERENCES: Abbott (1999: 162, fig. 39H).

TYPE LOCALITY: India.

Description - Plants gregarious, growing in isolated bushy clusters; well developed specimens in hemispherical tufts in which the individuals are densely intricated; very well attached by means of discoid holdfasts; thalli erect, 2-2.5 cm high, of rubbery texture, cylindrical at the basis, slightly compressed higher up, 0.5 mm in diameter, repeatedly dichotomously branched in a single plane with wide axils; marginal proliferations absent; dark red. Medulla pseudoparenchymatous, with all cells approximately of the same size and shape; cortex thick and composed of radially arranged filaments of small cells. Cystocarps intercalary on slightly widened parts of branches, often situated proximal to a dichotomy, deeply embedded in branches, with multiple carpostomes.

Ecology - Sloping rock surfaces along surf-exposed coasts, at about mid intertidal; continuously wave-swept.

Distribution - Scattered localities in the Indo-Pacific.

Note - *Ahnfeltiopsis vermicularis* (C. Agardh) P.C. Silva et DeCew, also present in Sri Lanka, is markedly thicker (Fig. 154).

Fig. 153 (left). *Ahnfeltiopsis pygmaea*.
Fig. 154 (right). *Ahnfeltiopsis vermicularis*.

GIGARTINALES – Rhizophyllidaceae **_Portieria_** Zanardini 1851: 33

Portieria hornemannii (Lyngbye) P.C. Silva
in Silva *et al.* 1987: 39, 129 Fig. 155

REFERENCES: Tseng (1984: 70, pl. 38, fig. 2), Cribb (1996: 113, middle fig. p. 112), Calumpong & Meñez (1997: 181, + fig.), Trono (1997: 201, fig. 129), Huisman (2000: 92, + figs), Littler & Littler (2003: 84, top fig. p. 85), De Clerck *et al.* (2005b: 190, fig. 164), Oliveira *et al.* (2005: 72, + fig.), Huisman *et al.* (2007: 95, + figs).

TYPE LOCALITY: Probably Red Sea.

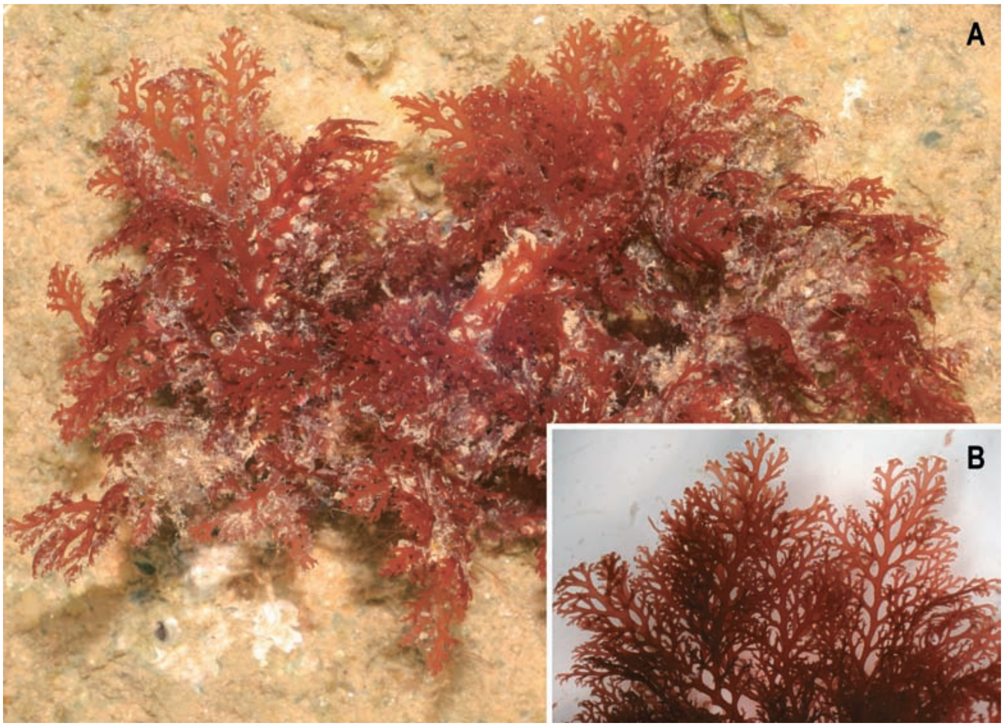
Description - Plants erect, up to 3-5 cm high, growing in isolated tufts composed of complanate, flat fronds, as broad as long, arising from a discoid holdfast, bright red to somewhat orangy; axes compressed to flattened, 1-2 mm wide; branching alternate-distichous to subdichotomous in a single plane, with one or several percurrent axes and wide branching angles; indeterminate branches irregularly formed; ultimate pinnae usually less than 1 mm long, appearing like distichous denticulations near the frond apices; margins smooth; apices inrolled. Internal structure uniaxial; in transverse section axial cell ovoid, thick-walled, conspicuous, up to 170 µm in diameter; each axial cell producing a lateral branch; medullary cells globose, decreasing in diameter toward the periphery, quickly grading into a pigmented cortex; cortical cells rounded, often elongate, small, arranged in anticlinal filaments. Tetrasporangia grouped in nemathecia, irregularly cruciately to irregularly zonately divided; cystocarps wart-like, borne on the surface of terminal branchlets.

Ecology - Epilithic in the subtidal, from just under low water mark down to 2-5 m; locally abundant or even dominant; also collected at 25 m depth.

Distribution - Widespread in the Indo-Pacific and tropical eastern Atlantic.

Note - *Portieria* fundamentally differs from *Plocamium* by the absence of pectinate branching, the inrolled apices and the tetrasporangia being formed in nemathecia (in stichidia in the latter).

Fig. 155. *Portieria hornemannii*. A. Habit *in situ*; B. Detail.


A
B

GIGARTINALES – Rhizophyllidaceae **_Portieria_** Zanardini 1851: 33

Portieria tripinnata (Hering) De Clerck
in De Clerck *et al.* 2005: 192, figs 165, 166 Fig. 156

TYPE LOCALITY: Durban, South Africa.

Description - Plants erect, 2-3 cm high, forming dense little tufts of markedly incurved thalli, composed of complanate fronds, markedly narrower than long, arising from a discoid, brick- to orangy-red; axes compressed to flattened; branching distichous alternate to subopposite, with one or a few percurrent axes and small branching angles; indeterminate branches irregularly placed; axes broadest in the mid thallus, generally 0.5-1 mm; ultimate pinnae usually less than 0.5 mm long, appearing like denticulations near the frond apices; margins smooth; apices inrolled. Internal structure uniaxial; in transverse section axial cell ovoid, thick-walled, conspicuous, up to 120 µm in diameter; each axial cell producing a lateral branch; medullary cells globose, decreasing in diameter toward the periphery, quickly grading into a pigmented cortex usually 2-3 cells thick; cortical cells rounded, sometimes anticlinally elongate, small. Reproductive structures as in *P. hornemannii*.

Ecology - Epilithic on surf-exposed, continuously wave-swept rock walls in the mid intertidal.

Distribution - Mauritius, South Africa, Sri Lanka.

Note - A new record for Sri Lanka.

Fig. 156. *Portieria tripinnata*.

GIGARTINALES – Solieriaceae **_Euryomma_** F. Schmitz *in* Engler et Prantl 1896: 374

Euryomma platycarpa Schmitz
in Schmitz & Hauptfleisch 1897: 374 Figs 37F; 157

REFERENCE: Kylin (1932: 30-31, pl. 13, figs 30-31).

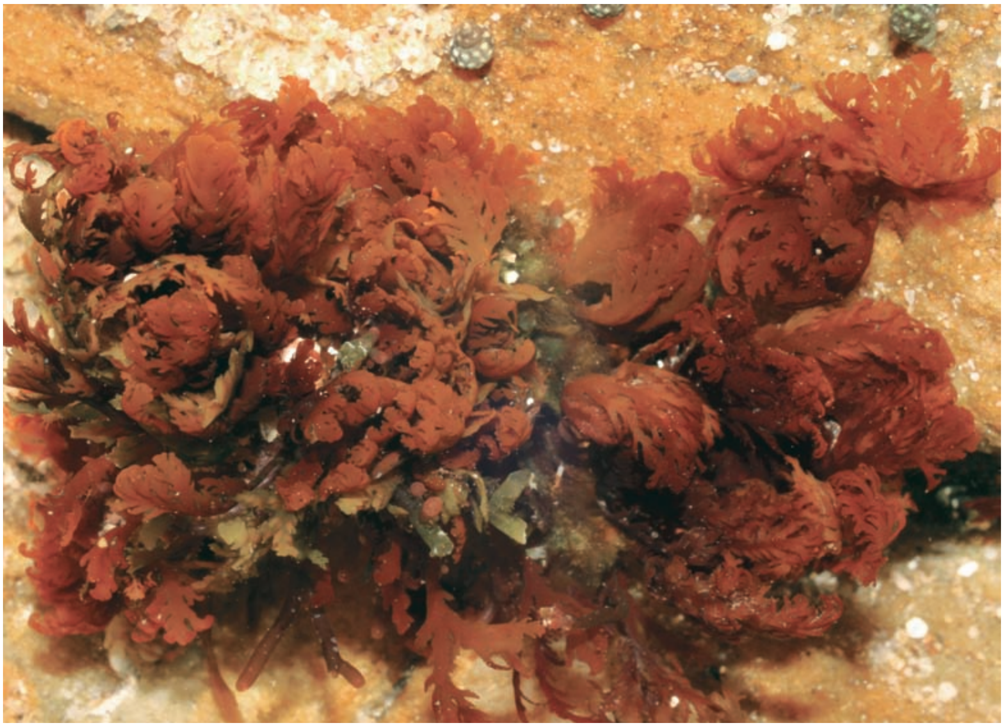
TYPE LOCALITY: Sri Lanka.

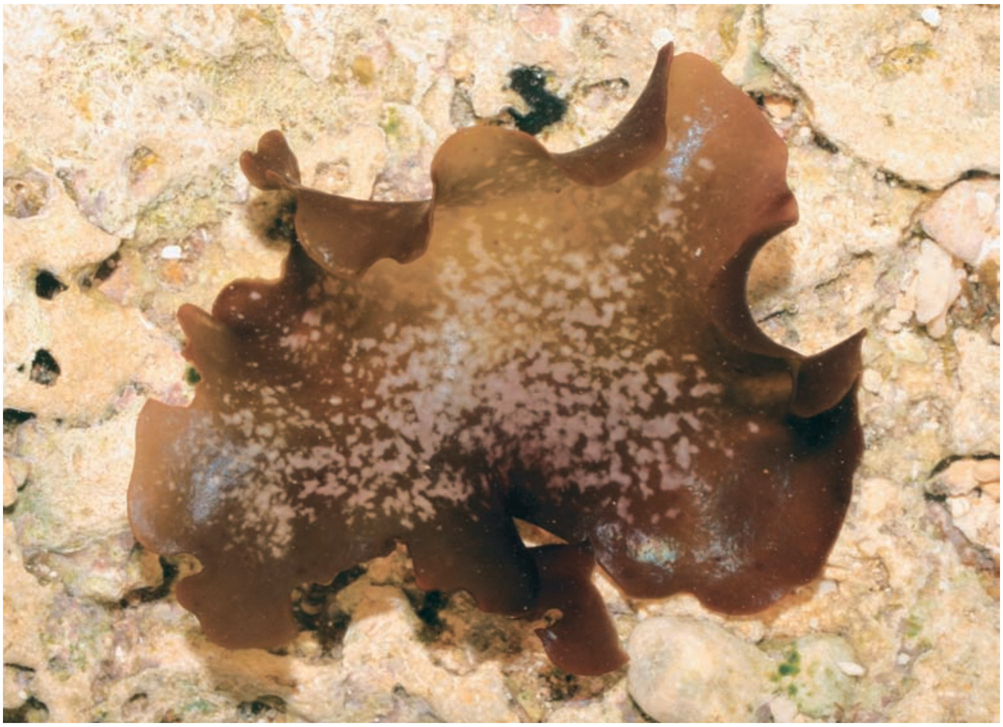
Description - Plants composed of a single blade or gregarious, 3-4 cm in diameter; relatively stiff and slippery, flexible cartilaginous, irregularly lobed and markedly undulated; very well attached by a discoid holdfast; dark purple to brownish, sometimes maculate, with creamy dots; cross section about 450 µm thick, composed of a filamentous medulla, 180-200 µm thick, surrounded by a cortex, 90-120 µm thick, composed of 5-6 cell layers, the outermost ones 9 µm long and 5 µm broad; cystocarps numerous and marginal.

Ecology - Epilithic, under rocky overhangs at about low water level. Rather rare.

Distribution - Sri Lanka.

Fig. 157. *Euryomma platycarpa*.





PLOCAMIALES – Sarcodiaceae **Sarcodia** J. Agardh 1852: 622

Sarcodia montagneana (J.D. Hooker et Harvey) J. Agardh
1852: 623-624 Figs 21G; 158

REFERENCES: Moorjani & Simpson (1988: 31, pl. 66), Oliveira *et al.* (2005: 92, + figs p. 93).

TYPE LOCALITY: Bay of Islands, New Zealand.

Description - Thalli generally clustered in small groups, arising from a crustose base, with a very short cylindrical stipe bearing 5-10 cm long, fleshy-cartilaginous straps, 1-3 cm broad; these more or less dichotomously branched in a single plane, with rounded axils and apices, irregularly undulated, with greater or lesser numbers of marginal wart-like to papulose proliferations; dark red to purplish. Medulla filamentous with a combination of thin-walled primary and thick-walled rhizoidal filaments; cortex composed of 2-3 layers of isodiametric unpigmented subcortical cells and a single layer of very small pigmented cells. Cystocarps markedly protruding, scattered across the blades (but mostly grouped) or confined to the margins.

Ecology - Epilithic, mostly on vertical substratum, but also collected from horizontal walls of the low intertidal, exposed to surf.

Distribution - Scattered localities in the Indian and tropical Pacific Oceans, but also mentioned from Antarctic regions.

Note - *Sarcodia ceylanica* Harvey ex Kützing has been synonimized with *S. montagneana* by Yendo (1917: 82-83).

Fig. 158. *Sarcodia montagneana*. A. *In situ*, between *Gracilaria corticata*; B. Male plant.

HALYMENIALES – Halymeniaceae **Carpopeltis** F. Schmitz 1895: 168

Carpopeltis maillardii (Montagne et Millardet) Chiang
1970: 68-69, pl. XXIV Fig. 159

REFERENCES: Desikachary *et al.* (1990: 264, pl. 39), Littler & Littler (2003: 92, middle fig. p. 93), De Clerck *et al.* (2005b: 200, fig. 174), Oliveira *et al.* (2005: 66, fig. p. 67).

TYPE LOCALITY: Réunion.

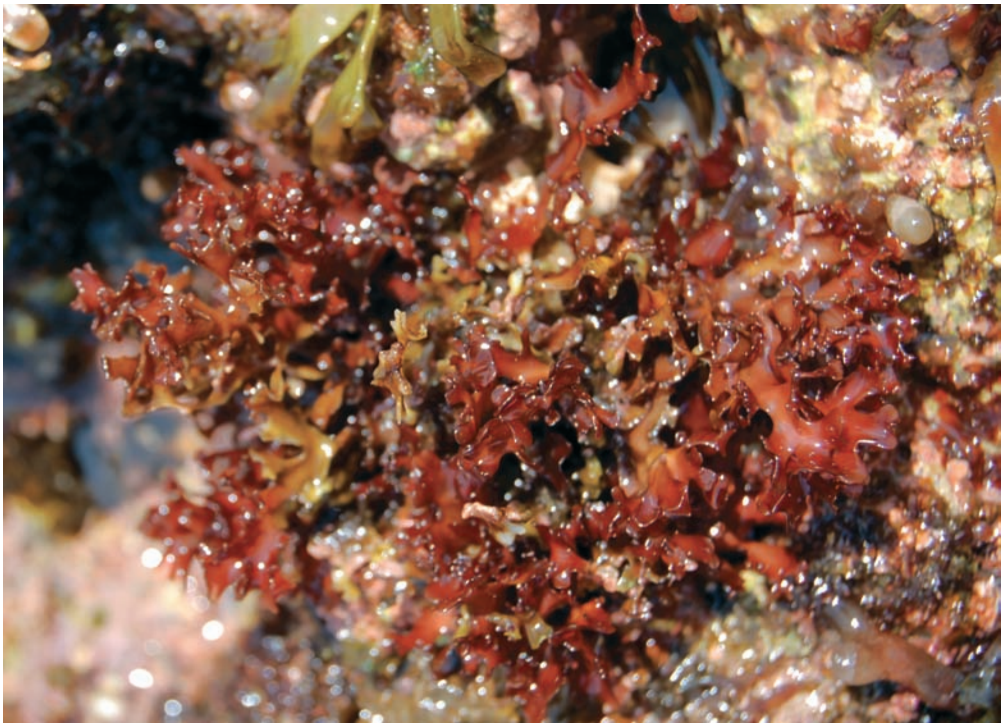
Description - Plants creeping with erect portions, 4-9 (up to 11) cm high, composed of complanate fronds, cartilaginous, stiff and tough but flexible, very well attached by a discoid holdfast, dark bordeaux-red; a short stipe present, especially in older specimens; upper parts strap-like, 0.5-4 mm wide, with a faint proximal midrib, thin but crisp, undulated, with rounded to curled apices and rounded axils; branching dichotomous to irregular. Internal structure composed of a narrow medulla consisting of densely packed filaments, lacking ganglionic cells; cortex 4-8 cells thick, composed of anticlinally directed filaments; inner cortical cells roughly isodiametric; outer cortical cells slightly elongate.

Ecology - Epilithic, mostly on shaded, extremely surf-exposed sites between rock boulders or in surf gulleys at about low tide level and shallow subtidal. Locally forming a well-marked, narrow belt.

Distribution - Indian Ocean and tropical Pacific Ocean.

Fig. 159. *Carpopeltis maillardii*.


A
B



Grateloupia lithophila Børgesen
1938b: 215-216, pl. VII Figs 23F; 32A; 160

REFERENCE: Desikachary *et al*. (1990: 238, pl. XXXI C, XXXIV A, fig. 46).

TYPE LOCALITY: Madras, India.

Description - Plants gregarious, specimens in the higher intertidal zone rather stiff and erect, 3-6 cm high, those from close to low water mark extremely supple and slippery, laying down on the substrate, 5-10 (-22) cm long; morphologically extremely variable within a single population, from yellowish green to purplish or bordeaux red; attachment by a small basal disc; basal part cylindrical, flattening upwardly; frond linear-lanceolate to curved or even sinuous, composed of a narrow strap, 2-5 (-8) mm wide at its widest (middle) part, tapering proximally as well as distally, 200-250 µm thick, flat to undulated, with straight to sinuous margins, unbranched or di (tri-) chotomous once or twice near the basis; margins bare or with marginal, upwardly curved proliferations which can be small and unilateral to large and pinnately placed; the large proliferations can again be provided with proliferations, finally resulting in a bushy aspect, but still branched in a single plane; apices originally acute, sometimes becoming truncate and bearing several apical proliferations of the same size. Medulla composed of intertwined filaments and stellate cells; inner cortical cells loosely arranged, outer cortex more compact and composed of smaller cells (5-8 x 3-4 µm).

Ecology - Epilithic, mainly on horizontal (sometimes sand-covered) rock substratum but also on vertical walls, along surf-exposed coasts, from high (extremely surf-exposed) to low (more sheltered) intertidal. Locally forming a well-defined belt.

Distribution - India, Sri Lanka, Yemen.

Note - Molecular research (De Clerck *et al*. 2005: 396) shows that the specimens of *Grateloupia* from Sri Lanka and Madagascar form a separate clade within the *G*. '*filicina*' group worldwide.

Fig. 160. *Grateloupia lithophila*.

Halymenia durvillei Bory de Saint-Vincent
1828: 180-181, pl. 15 Figs 38C; 39D; 41D; 161

REFERENCES: Lewmanomont & Ogawa (1995: 121, + fig.), Calumpong & Meñez (1997: 169, + fig. p. 170), Trono (1997: 185, fig. 118), Littler & Littler (2003: 94, bottom fig. p. 95), De Clerck *et al*. (2005b: 204, fig. 178), Oliveira *et al*. (2005: 68, + fig. p. 69), Ohba *et al*. (2007: 99, + figs).

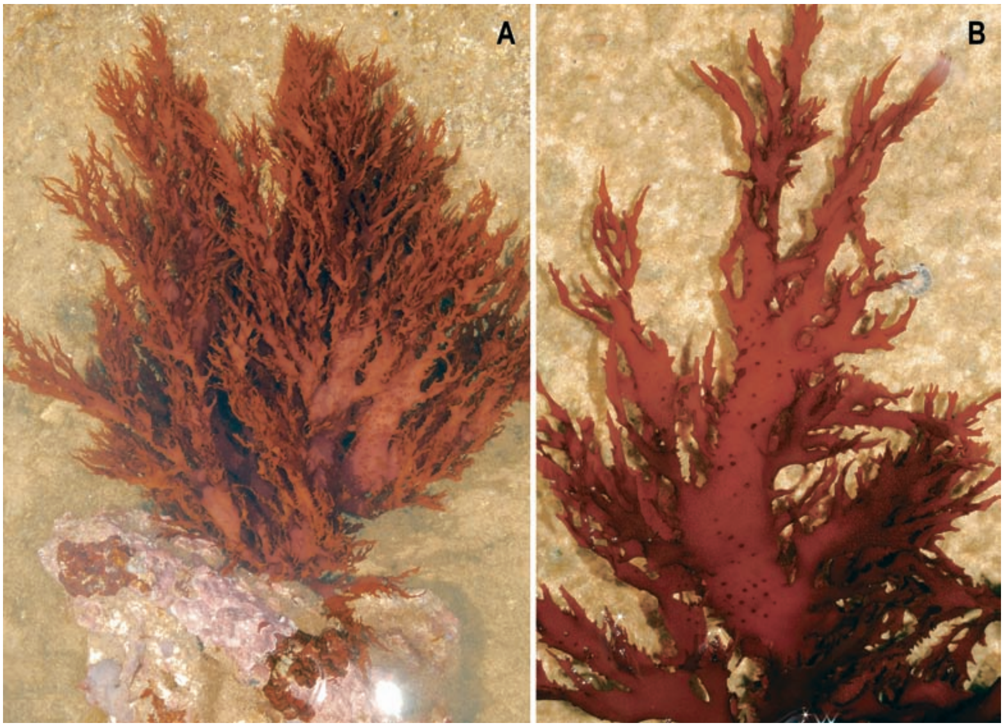
TYPE LOCALITY: New Ireland, Papua New Guinea.

Description - Plants erect, up to 30 cm high, lubricous and slippery to the touch, composed of a supple foliose frond arising from a discoid holdfast, medium red; stipe short, less than 1 cm long, expanding abruptly in a flattened blade; blade irregularly cleft up to 5 orders, resulting in straps 4-20 mm in width and ca 600 µm thick; apices acute and the surface covered with acute proliferations, which may develop into new axes. Internal structure composed of a pseudoparenchymatous cortex and a filamentous medulla; cortex 60-80 µm thick, 6-8 cells thick, arranged in anticlinal rows; medullary filaments 8-12 µm in diameter, with relatively abundant inner-cortical refractive ganglionic cells. Tetrasporangia scattered over the thallus surface, cruciately or decussately divided, 14-20 µm long and 12-15 µm wide.

Ecology - Epilithic in the subtidal, between 1 and 4 m depth, mostly in lagoons.

Distribution - Indian Ocean and tropical Pacific Ocean.

Fig. 161. *Halymenia durvillei*. A. Habit; B. Detail of a blade.


A
B

Polyopes ligulatus (Harvey ex Kützing) De Toni
1905: 1596 Figs 10C; 22G; 38B; 162

REFERENCES: Desikachary *et al*. (1990: 266, pl. 41), Coppejans & Millar (2000: figs 11-12).

TYPE LOCALITY: Sri Lanka.

Description - Submerged plants gregarious and locally in impressive populations, very well attached by a discoid holdfast from where several strap-shaped fronds arise,10-15 (-20) cm long; the straps tough cartilaginous, rather stiff, blackish purplish red; originally dichotomously branched in a single plane, but as a result of the sometimes numerous proliferations the original dichotomies become obscure; strap width most generally about 3-4 (-5) mm, with irregular constrictions and broadly rounded apices; marginal proliferations mostly numerous and serial, from small and wart-like over small, dichotomous straps up to almost the size of the mother thallus; other specimens only 1-2 mm wide. Intertidal specimens isolated, much smaller, much more densely branched and with narrow straps. On transverse section, the dense netlike, filamentous medulla is surrounded by a dense cortex of anticlinal rows of cells, gradually becoming smaller towards the periphery. Tetrasporangia in nemathecia confined to the terminal leafy segments, cruciately divided; cystocarps small, immersed in thickened branch tips.

Ecology - Epilithic, mostly and best developed on surf-exposed, vertical walls, just under low water, or on inclined continuously wave-swept rocks just above low water; specimens growing higher up (but still continuously wave-swept) much smaller.

Distribution - Indonesia, Kenya, Papua New Guinea, Sri Lanka, Tanzania, Vietnam.

Fig. 162. *Polyopes ligulatus*. Dense growth form in a low intertidal rock pool.

Champia ceylanica Harvey
1857: no. 92, nom. inval. Figs 17E; 33F; 163

REFERENCES: Svedelius (1906b: 190, 214, 217, fig. 10).

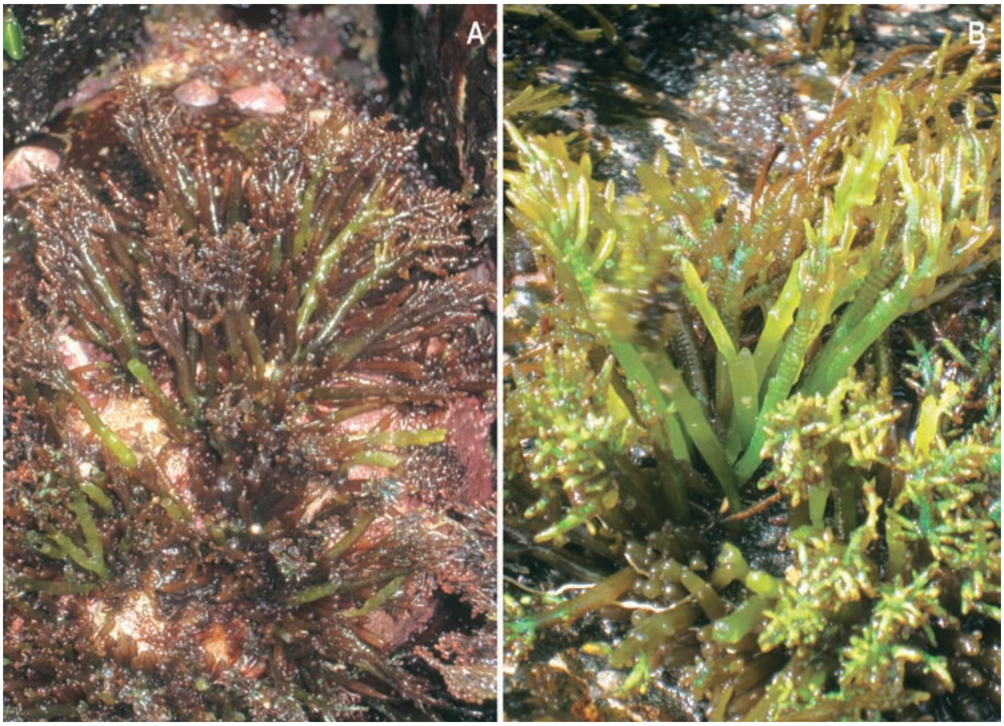
TYPE LOCALITY: Sri Lanka.

Description - Thalli gregarious, in separated groups, but in rather extensive populations; individual plants vertical, straight, 2-3 (-4) cm high, relatively stiff though flexible, lubricous, mostly cylindrical but some plants somewhat compressed; basal parts of the marked main axis unbranched, upper parts either radially branched (the specimens with cylindrical axes) or more or less pinnate to alternate (the more compressed specimens); side branches tapering towards the basis as well as to the apices, resulting in a spindle-shaped appearance; all branches slightly constricted into short, regular segments by septa, all apices acute; dark brownish red, the upper parts markedly goldish-bluish iridescent; central cavity filled with jelly.
According to Svedelius (1906b: 214) only fertile in August.

Ecology - Epilithic on rather steep to subhorizontal rock slopes, at mid tide level along coasts exposed to extreme surf. Continuously wave-swept, even at low tide. A seasonal species. Its observation and collection is therefore rather difficult.

Distribution - Sri Lanka.

Fig. 163. *Champia ceylanica*. A. Almost non-iridescent specimen; B. Strongly iridescent specimen.


A
B

Gelidiopsis repens (Kützing) Weber-van Bosse
1928: 425-426

Fig. 164

REFERENCES: Payri *et al*. (2000: 232, bottom fig. p. 233), Littler & Littler (2003: 104, bottom fig. p. 105), De Clerck *et al*. (2005b: 216, fig. 190), Oliveira *et al*. (2005: 105, + fig.), Huisman *et al*. (2007: 117, + fig., as *G. scoparia*), Skelton & South (2007: 79, figs 168-174).

TYPE LOCALITY: Wagap, New Caledonia.

Description - Plants very well attached by terete, creeping stolons; erect fronds, 2-4 cm high, dark red, tough and stiff but flexible, with a basal, cylindrical, unbranched portion giving rise to markedly compressed to flattened branches, 0.5-1 mm wide and ca 120 µm thick, with 2-5 dichotomies in a single plane; branching often strongly condensed, giving the axes a typical pseudopalmate appearance. Internal structure consisting of a darkly pigmented outer cortex composed of up to 4 layers of small cells grading into larger, angular inner cortical cells; medulla composed of hyaline cells of mixed size; rhizines lacking.

Ecology - Small groups on vertical walls, frequently under rock overhangs, in the lower intertidal, frequently in surf-exposed gulleys; larger populations in the 'fish gardens' in the shallow subtidal down to -1 m.

Distribution - Indian Ocean, tropical Pacific Ocean.

Note - According to Skelton & South (2007: 81), the confusion between *G. repens* and *G. scoparia* (Montagne et Millardet) De Toni is unlikely to be resolved until the presently unlocated type materials are studied.

Fig. 164. *Gelidiopsis repens*.

Gelidiopsis variabilis (J. Agardh) Schmitz
1895: 148

Fig. 165

REFERENCES: Cribb (1996: 85, top fig. p. 84), Oliveira *et al*. (2005: 105, + fig.).

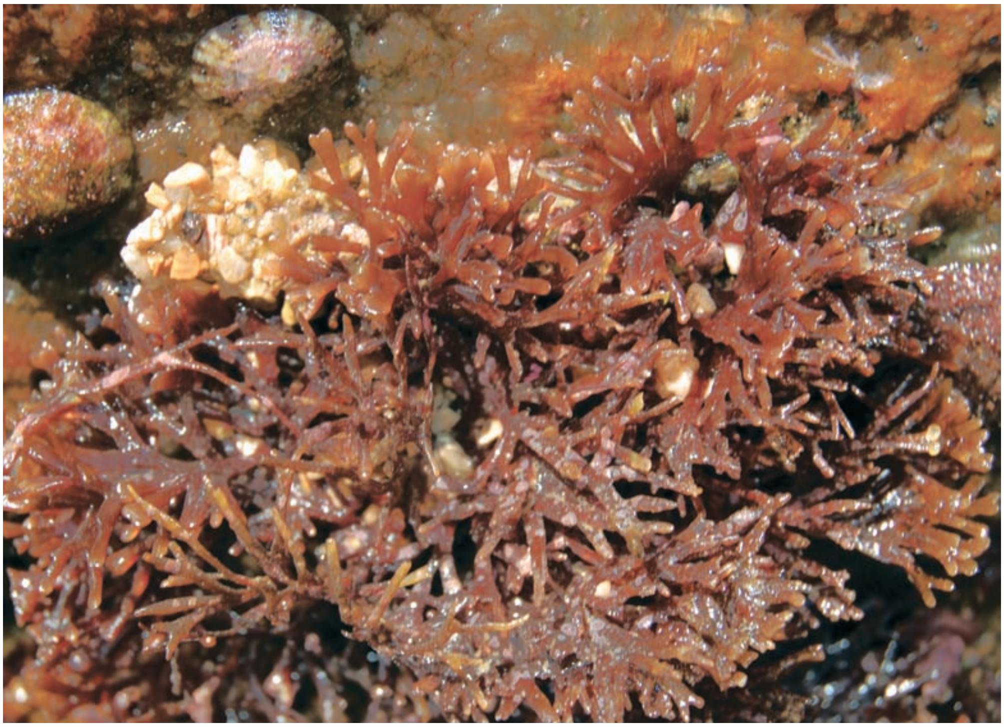
TYPE LOCALITY: Madras, India.

Description - Plants very well attached by very well branched, thin, pinkish stolons; erect fronds, 5-8 cm high, dark (blackish) red, tough and stiff but flexible, all axes cylindrical and very thin, sometimes slightly compressed in the upper portions; branching lax, irregular or opposite, especially in the upper parts, resulting in typical 'cross-like' apices. Anatomy similar to that of *G. repens*.

Ecology - Mosly in low intertidal rockpools, on the sand-covered bottom, continuously wave-swept.

Distribution - Pantropical.

Fig. 165. *Gelidiopsis variabilis*.



RHODYMENIALES – Rhodymeniaceae ***Botryocladia*** (J. Agardh) Kylin 1931: 17

Botryocladia skottsbergii (Børgesen) Levring
1941: 645, footnote Figs 18C; 166

References: Tseng (1984: 118, pl. 62, fig. 3), Trono (1997: 241, fig. 152), Payri *et al*. (2000: 228, + figs p. 229), Oliveira *et al*. (2005: 102, + fig. p. 103), Huisman *et al*. (2007: 118, + figs), Ohba *et al*. (2007: 115, + figs), Skelton & South (2007: 76, figs 156-158).

Type locality: Easter Island, Chile.

Description - Plants densely clustered, more rarely solitary, firmly attached by a discoid holdfast; thallus up to 20 mm high, deep brownish red, consisting of an irregularly branched, firm stipe bearing ovate to pyriform, hollow, shortly stipitate vesicles 2-4 mm wide and 3-10 mm long, filled with jelly. Walls of the vesicle consisting of 2 layers of inner, ovate, colourless cells, 30-70 μm in diameter and 1-2 layers of outermost ovate to subrectangular cortical cells, 2.5-4 μm wide and 4-11 μm long; medulla hollow; elongate and pyriform 'gland cells' up to 60 μm long often projecting in the cavity of the vesicles.

Ecology - Epilithic on vertical walls just above low water level, frequently under overhangs, mostly on the landward side of rocks; continuously wave-swept.

Distribution - Indo-Pacific.

Fig. 166. *Botryocladia skottsbergii*. A. *In situ* view of a dense population; B. Detail of one thallus.

CERAMIALES – Ceramiaceae ***Centroceras*** Kützing 1841: 731

Centroceras clavulatum (C. Agardh) Montagne
1846: 2 Fig. 167

References: Tseng (1984: 126, pl. 66, fig. 2), Lewmanomont & Ogawa (1995: 98, + fig.), Abbott (1999: 261, figs 73A-F), Huisman (2000: 134, + fig.), Littler & Littler (2000: 144, bottom figs p. 145), Payri *et al*. (2000: 240, bottom figs p. 241), Oliveira *et al*. (2005: 108, + figs), Huisman *et al*. (2007: 123, + figs), South & Skelton (2007: 89, figs 192-197).

Type locality: Callao, Peru.

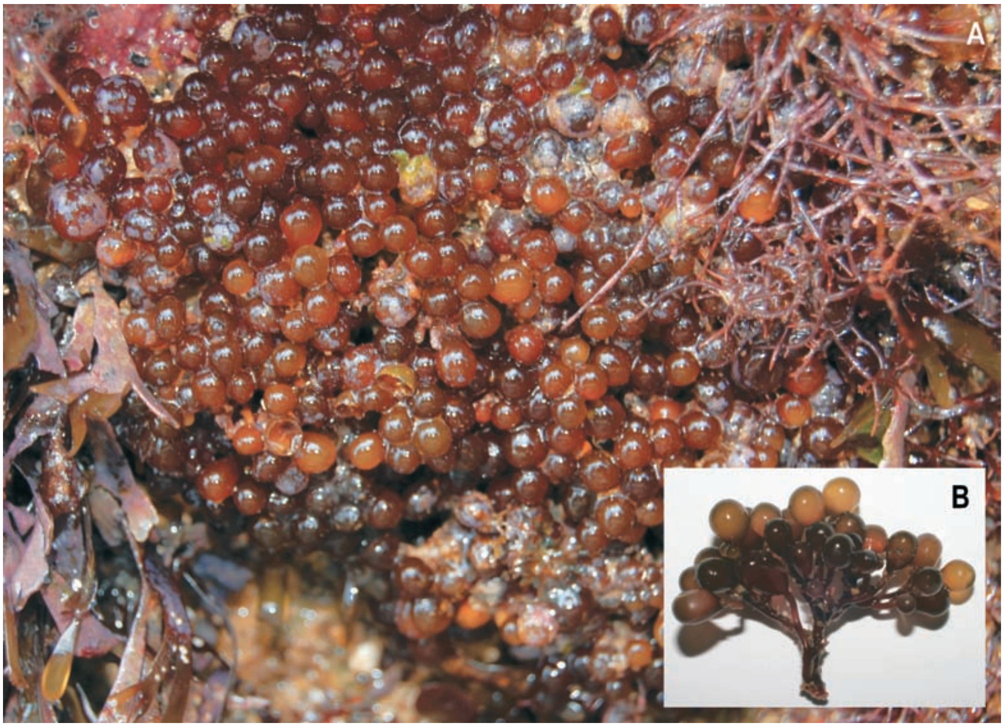
Description - Thalli gregarious, forming isolated tufts or intricated mats, 1 cm high along surf-exposed shores, up to 4 cm long in more sheltered pools, composed of supple filaments; pinkish red to creamy; attachment by clustered rhizoids arising from periaxial cells and ending in a multicellular pad; axes cylindrical, up to 300 μm in diameter, sub-dichotomously branched, successive branches 8-12 segments apart, apices mostly forcipate, more rarely unbranched and slightly incurved; adventitious branches often present; axial cells cylindrical to barrel-shaped, up to 750 μm long; nodes with 14 periaxial cells, each giving rise to 3 corticating filaments: 2 acropetal and 1 longer basipetal; nodes provided with whorled, 1-3-celled spines; internodes covered by 28 major basipetal cortical filaments composed of square cells which are arranged on longitudinal as well as on transverse rows. Tetrasporangia emergent, loosely enclosed by 3-4-celled colourless involucral filaments, surrounding the nodes, mainly of the main axes (occasionally also of lateral branches).

Ecology - Epilithic in the high to mid-intertidal; as individual tufts or cushions along surf-exposed coasts; as continuous coverings in sand-covered intertidal pools.

Distribution - Pantropical and warm temperate.

Note - Molecular findings (Won *et al*. 2004) have shown *Centroceras clavulatum* as a complex of many species.

Fig. 167. *Centroceras clavulatum*. A. Dense growth form of air-exposed plants at low tide; B. Lax growth form in intertidal pools; C. Microscopic details.


A
B


A
B
C

Ceramium marshallense Dawson
1957: 120-121, figs 27a, b

Fig. 168

REFERENCE: Wynne (1995: 294, figs 38-39).

TYPE LOCALITY: Rigili Island, Eniwetok, Marshall Islands.

Description - Plants extremely elegant and supple, up to 10 mm high, composed of limited prostrate and well-developed erect axes, dark red; attachment by pluricellular rhizoids with discoid ends; prostrate axes 200-300 µm in diameter, erect axes about 150 µm in diameter; all axes with marked nodes (50-70 µm high) and internodes; branching pseudosympodial, with the less developed branches alternating in a single plane, resulting in a sympodial appearance; side branches formed every third node; side branches with 3 unbranched basal nodes, then again branching alternately at every third node; all branches tapering and slightly forcipate. Axial cells bilenticular; nodes twice as broad as high, composed of irregularly placed, small cortical cells, completely covering the periaxial cells; mature internodes shorter than the nodes; tetrasporangia slightly projecting from the nodes and covered by a layer of involucral cells; nodes of the branchlets with tetrasporangia markedly inflated.

Ecology - Epiphytic on diverse red algae; best developed specimens on old plants of *Grateloupia lithophila*, in the mid intertidal zone, but continuously wave-swept.

Distribution - In the Indian Ocean only mentioned from the Maldives and Seychelles.

Note - This identification is the best match with our specimens and very similar to Wynne's description and illustrations (l.c.).

Fig. 168. *Ceramium marshallense*. A. Apex of a sterile specimen with sympodial growth form; B. Apex of a tetrasporophyte with the tetrasporangia in the nodes of short, inflated branchlets.

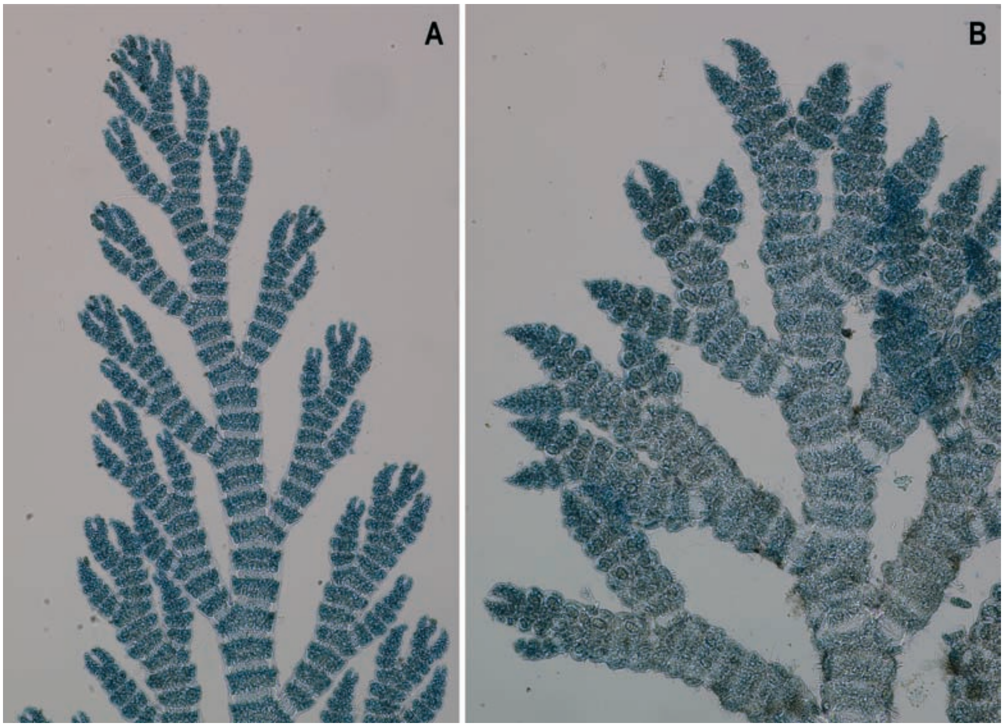
Ceramium sp.

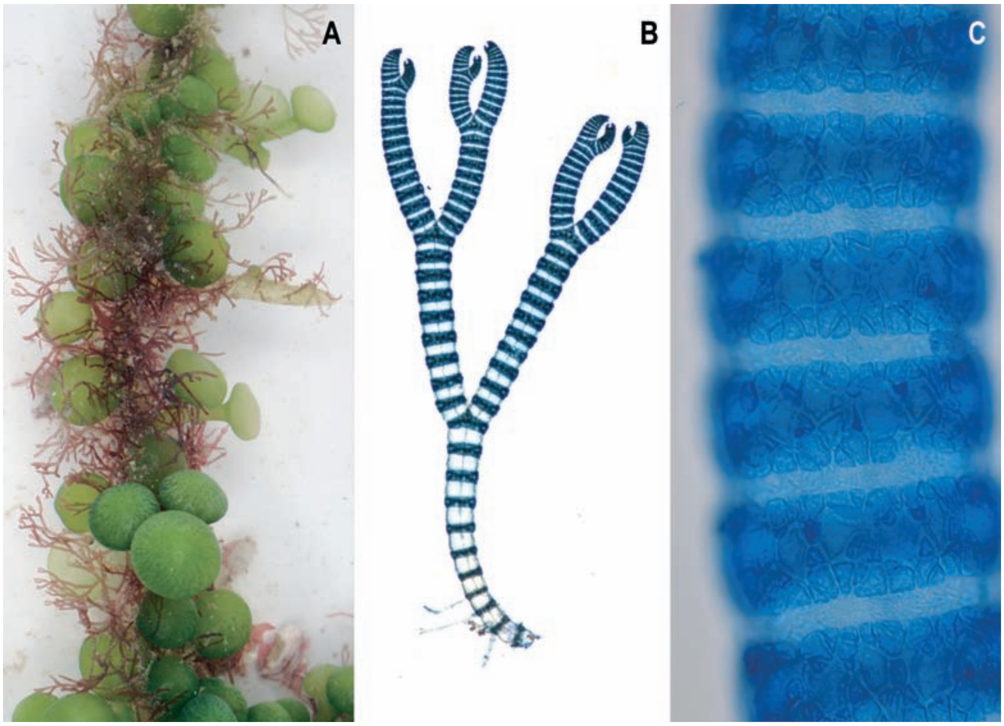
Figs 11C; 169

In the absence of reproductive structures, we prefer not to identify this entity on species level, but based on its morphology and placement of cortical cells it comes close to *C. taylorii* Dawson which is considered a synonym of *C. flaccidum* (Kützing) Ardissone by Silva *et al.* (1996: 397). In our specimens, the transversely elongated cells in the lower part of the cortical bands, typical for *C. flaccidum*, are absent.

Note - According to Guiry & Guiry (2009), 216 species names of *Ceramium* are currently in use worldwide. Based on records from literature, Silva *et al.* (1996: 390-405) mention 59 species from the Indian Ocean, some of which with several varieties. Only 4 are reported from Sri Lanka. We observed several species, mostly as small epiphytes or growing in algal turf.

Fig. 169. *Ceramium* **sp**. A. Epiphytic on a *Caulerpa*; B. Whole plant under microscope; C. Microscopic detail of the cortical bands.


A
B


A
B
C

Euptilota fergusonii Cotton
1907: 262-264, figs 1-6 Figs 36E, J; 170

REFERENCE: De Clerck *et al*. (2005b: 224, fig. 202).

TYPE LOCALITY: “Pantura” [Panadura?], Sri Lanka.

Description - Plants erect or with an erect basis and horizontally spread upper part, reaching a length of 10 cm, bushy, composed of irregularly branched axes, densely clothed with distichously arranged determinate laterals, medium red to pinkish, with a vivid bluish iridescence *in situ*; attached by a small discoid holdfast giving rise to several erect axes; determinate laterals remaining completely uncorticated, 800-1100 µm long, with a main filament curving toward the apex, apical cells of the main filament of the determinate lateral typically with 2-4 slightly hooked spinose cells; indeterminate branches formed at irregular intervals along the axes, cylindrical, heavily corticated to within a few mm of the apex, ca 0.8-1.2 mm in diameter near the base. Tetrasporangia sessile, formed singly at the distal ends of cells of the ultimate branches of determinate laterals, tetrahedrally divided, ovoid, 40-55 x 55-65 µm.

Ecology - Epilithic, exclusively recorded from the subtidal, from 1 m down to 25 m depth.

Distribution - Widely distributed in the western Indian Ocean.

Fig. 170. *Euptilota fergusonii*. A. Habit of a herbarium specimen; B. Microscopic detail.

Spyridia fusiformis Børgesen
1937: 338-341, figs 12-14 Fig. 171

REFERENCE: Oliveira *et al*. (2005: 116, + figs p. 117).

TYPE LOCALITY: Krusadi Island, near Pamban, Tamil Nadu, India.

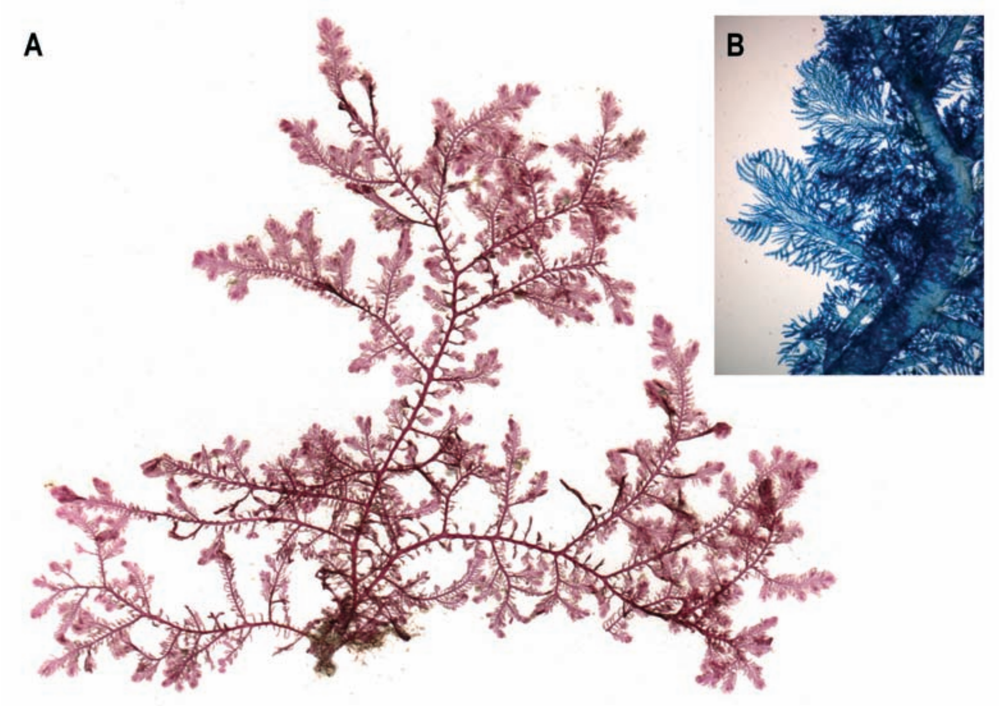
Description - Plants gregarious, forming isolated tufts, erect, 5-10 cm long, bright pinkish red; attachment by well-developed stolonoidal structures; all axes cylindrical, the side branchlets markedly fusiform; basal parts of the main axes (almost) bare, about 1 mm in diameter, the upper parts more densely branched, in some specimens even becoming densely intricated, resulting in a bushy aspect, gradually tapering towards the apices. Main axes and indeterminate side branches completely corticated, but the segments still clearly visible in transparency with the naked eye in the field, cortical cells markedly elongated. All axes bearing relatively stiff, straight, uniseriate filaments, 600-750 µm long, 20 µm in diameter, composed of cells about 60 µm long, presenting a single tier of small cortical cells, 10 µm high at their transverse walls; apices of these filaments rounded, without a terminal spine. Tetrasporangia formed at the basal nodes of the uniseriate filaments, singly or in groups of 3-4, oval, 100 µm long and 70 µm broad.

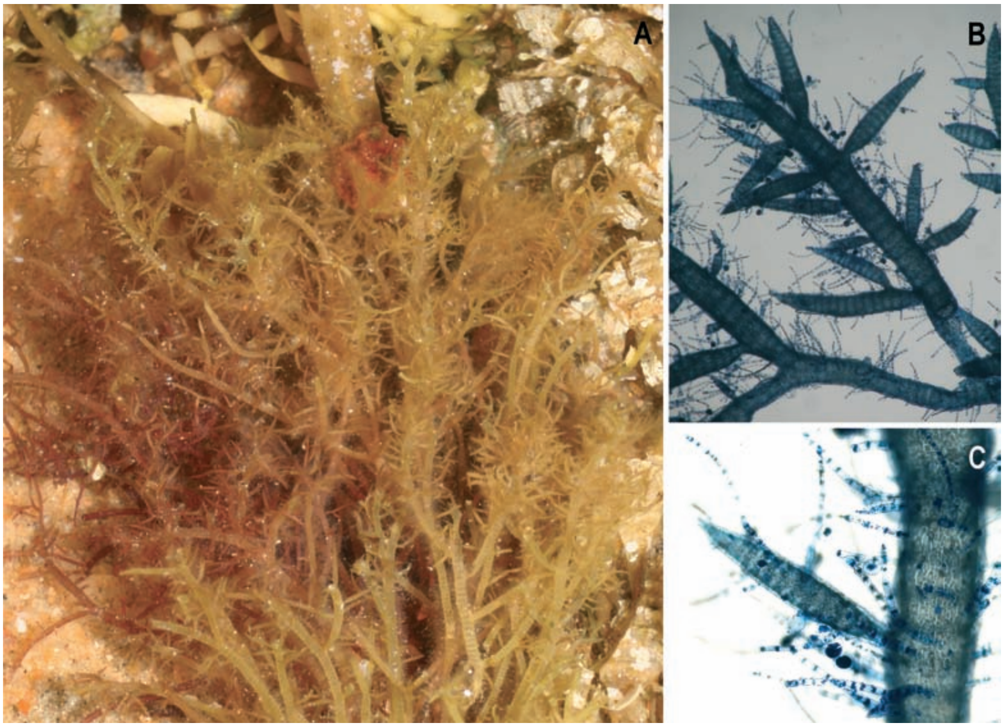
Ecology - Epilithic, on the sand-covered bottom of shallow rock pools at mid intertidal level; continuously wave-swept.

Distribution - Andaman Islands, India, Tanzania.

Note - In the field, the plants look like *Chondria dasyphylla*, but the presence of the *Ceramium*-like lateral filaments with interrupted cortication are typical for *Spyridia*.

Fig. 171. *Spyridia fusiformis*. A. Habit; B, C. Microscopic details of main axis, side branches and branchlets, tetrasporangia.


A
B


A
B
C

Spyridia hypnoides (Bory de Saint-Vincent) Papenfuss 1968: 281-282

Figs 23C; 172

REFERENCES: De Clerck *et al*. (2005b: 230, fig. 211), Oliveira *et al*. (2005: 116, + figs p. 117).

TYPE LOCALITY: Cape Comorin, Tamil Nadu, India.

Description - Plants erect, robust and densely branched, composed of percurrent, plumose axes, attached by means of a conspicuous stupose holdfast to 1.5 cm in diameter, brownish-red with orangy apices; axes completely corticated up to immediately below the apices, ca 2 mm in diameter in the proximal parts, spirally branched, every segment producing a determinate lateral at 60° angles; determinate laterals straight, 300-900 µm long, proximally 150-280 µm in diameter, gradually tapering toward the apices, terminating in a single erect spine subtended by a variable number (2-5) of recurved spines on subterminal cells. Internal structure of the axes composed of a central axial filament and whorls of (12-) 14-15 (-17) periaxial cells which give rise to 2 basipetal cortical filaments each; primary cortex obscured by secondary cortical cells; determinate branchlets with a smaller number of periaxial cells (6-8) and only just becoming completely corticated, always with the initial cortical bands readily discernable. Tetrasporangia sessile, on the nodes of the proximal segments of determinate laterals, tetrahedrally divided, 45-65 µm in diameter. Sexual reproductive structures not observed.

Ecology - Epilithic, at about low water mark.

Distribution - Pantropical and some temperate regions.

Note - It is striking that *S. filamentosa* (Wulfen) Harvey is not present in our collections; Durairatnam (1961) mentions it from Hambantota.

Fig. 172. *Spyridia hypnoides*. A. Lax growth form from an intertidal pool; B. Dense growth form from wave-swept low intertidal; C, D. Microscopic details of last order branchlets with apical spines.

Wrangelia argus (Montagne) Montagne 1856: 444

Fig. 173

REFERENCES: Lewmanomont & Ogawa (1995: 140, + fig.), De Clerck *et al*. (2005b: 232, figs 214-216), Oliveira *et al*. (2005: 118, + figs).

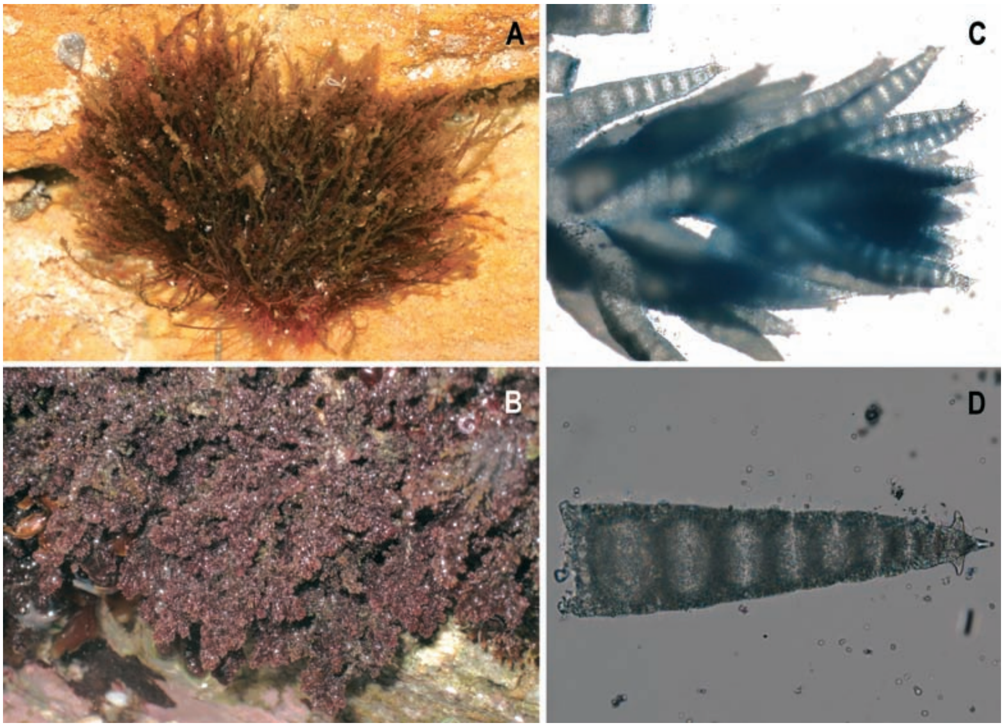
TYPE LOCALITY: Roque del Gando, Islas Canarias.

Description - Plants decumbent, soft and fluffy, penicillate, entirely uniseriate, composed of prostrate and erect axes, up to 5-8 mm high, iridescent purplish-red; prostrate axes composed of cells 120-250 µm in diameter and up to 700 µm long; erect axes with determinate branchlets produced in whorls of 4 from every axial cell; determinate laterals unequally developed with one lateral being much smaller than the remaining three, 1-3 times dichotomously branched, up to 400 µm long, proximally 30 µm in diameter, tapering gradually toward the apices, with acute apical cells; cortication loose and rag-like. Tetrasporangia produced on the proximal cells of whorl-branchlets, enclosed by two involucral filaments of 2 cells each. Sexual reproductive structures not observed.

Ecology - Epilithic in the low intertidal, continuously wave-swept.

Distribution - Widespread in tropical and warm temperate regions.

Fig. 173. *Wrangelia argus*. A, B. Microscopic details of the verticillate branchlets.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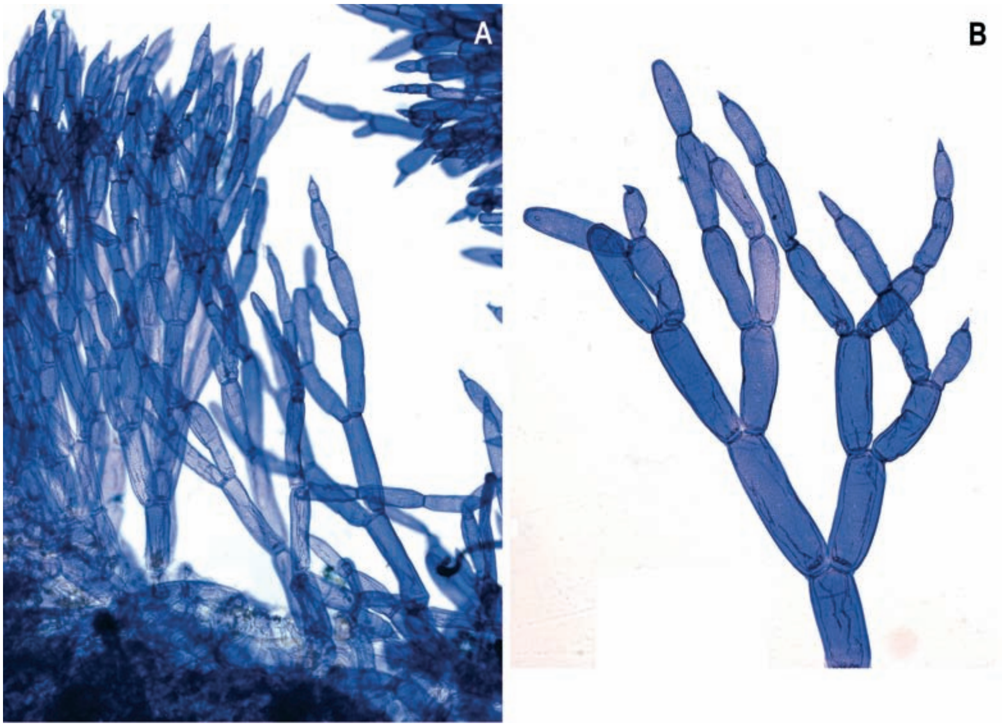

A
B

Dictyurus purpurascens Bory de Saint-Vincent
in Bélanger et Bory de Saint-Vincent 1834: 170-171, pl. 15: fig. 2 Fig. 174

References: De Clerck & Coppejans (2002: 102, fig. p. 103), Oliveira *et al.* (2005: 120, + figs).

Type locality: Cape Comorin, Tamil Nadu, India.

Description - Plants gregarious, erect from prostrate axes, up to 4 cm high, erect parts spongy, pinkish red in the field, becoming blackish upon drying; main axes (prostrate as well as erect) cylindrical and firm cartilaginous, with axial cells surrounded by 4 periaxials which are quickly enclosed by descending rhizoidal filaments, collectively forming a thick cortex. These indeterminate axes bearing determinate branches, produced alternately and distichously from every other polysiphonous segment of the indeterminate axes; determinate branches densely branching and becoming interlinked with maturity by growth of connective cells, resulting in spirally disposed networks surrounding the axes. Final spongy structure composed of a complex, threedimensional reticulum, elongate, longitudinally 4-ribbed along the four flat sides, coarsely dentate on the ribs.

Ecology - On vertical walls at the landward (lagoon) side of beachrock platforms at about low tide level.

Distribution - Tropical Indo-Pacific.

Fig. 174. *Dictyurus purpurascens*. A. Habit; B, C. Details of the reticulum.

Caloglossa leprieurii (Montagne) G. Martens
1869: 234, 237 Figs 13E; 175

References: De Clerck & Coppejans (2002: 102, fig. p. 103), Oliveira *et al.* (2005: 122, + fig.), Skelton & South (2007: 153, figs 411-413).

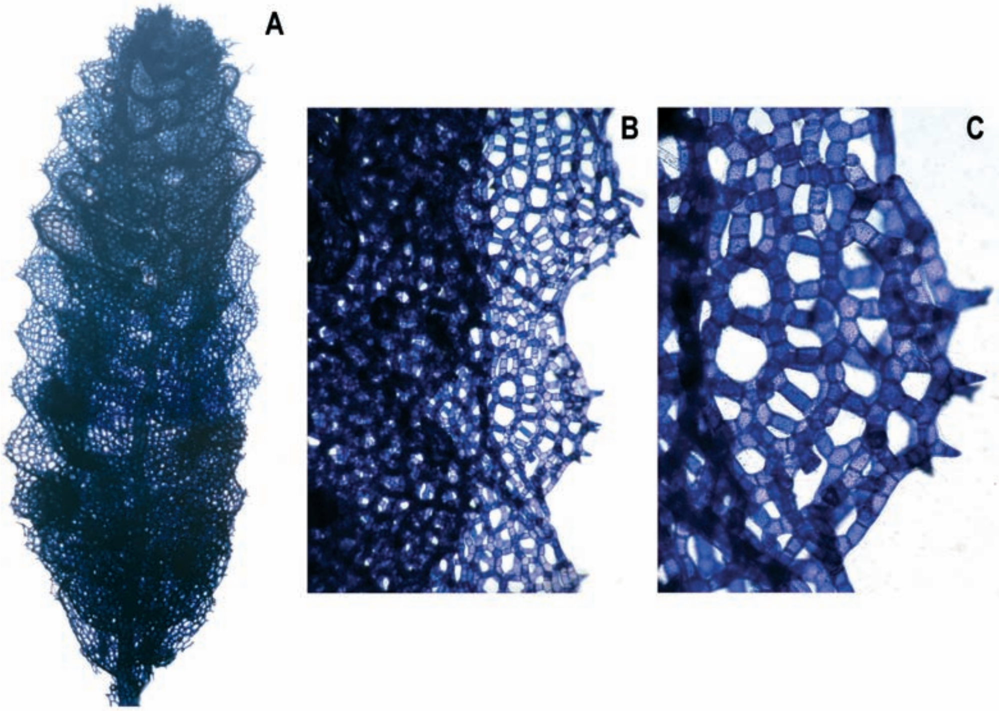
Type locality: Near Cayenne, French Guiana.

Description - Plants growing in dense populations, hanging down along the substrate, overlapping each other like roof tiles, dark red; individual thalli small, up to 17 mm long, delicate, monostromatic except for the midrib, leafy, 1 mm broad and 2-3 mm long with regular constrictions separating the oval segments; branching mainly pseudodichotomous, but locally opposite in a single plane; attachment by multicellular rhizoids departing from the nodes; microscopically, a midvein is visible, composed of a central axis surrounded by 4 periaxial cells; only the basal (5-6) cells of second order bear third order cell rows, all reaching the blade margin. Tetrasporangia in V-shaped sori on the terminal bladelets.

Ecology - Hanging down from the lower part of mangrove tree trunks and aerial roots; extremely shaded and sheltered; air-exposed at low tide.

Distribution - Pantropical and some warm temperate regions.

Fig. 175. *Caloglossa leprieurii*.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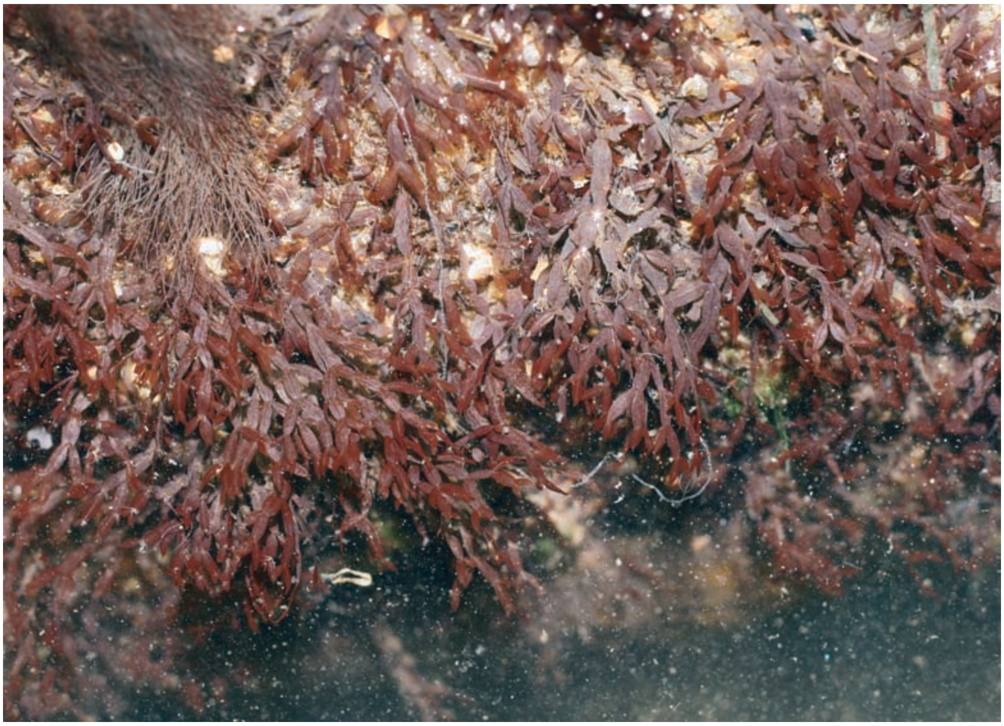


Claudea multifida Harvey
1854: 145, pl. VI Figs 39A; 176

REFERENCES: Papenfuss (1937: 5-30, figs 1-27), Krishnamurthy & Varadarajan (1990: 15-17, figs 1-4).

TYPE LOCALITY: Weligama, Sri Lanka.

Description - Plants gregarious, generally growing in large populations; individual thalli stiff-brittle, erect, 2-3 cm high, composed of a short, parenchymatous, cylindrical, perennial stipe that can be branched in older specimens, supporting annual, divided, net-like fronds situated in a single plane; attachment by numerous multicellular rhizoids. The initial gives rise to a primary blade, the proximal part of which is becoming heavily corticated, resulting in a stipe, the distal part developing in the blade of the first order. The ventral surface of this primary blade gives (unilaterally) rise to a regular series of upwardly directed, secondary blades from each segment of the midrib; as a result, the thallus becomes asymmetrical, with a narrow membranous blade on one side of the midrib and a long series of long, parallel secondary blades on the other side. A series of tertiary blades is formed in a similar way on the topward side of each secondary blade; they have a limited growth and anastomose at their tips with the lower surface of the secondary blade immediately above them, resulting in a net-like structure with a sympodial appearance. In older fronds a fourth order of blades can be formed but they are associated with the formation of secundary growth regions. All third order cell rows of all the bladelets reach the margin.

Ecology - Epilithic on horizontal substratum, just under low water level, in lagoons but in places with regular wave action or marked tidal currents.

Distribution - Indian Ocean: Andaman Islands, India, Mauritius, Sri Lanka; Pacific Ocean: Micronesia, Philippines, Taiwan.

Fig. 176. *Claudea multifida*.

Cottoniella amamiensis Itono
1972: 57-59, fig. 4 Figs 32E; 177

REFERENCES: Islam (1976: 63, pl. 59, figs 354-358, pl. 70, figs 403-406, as *C. filamentosa* (Howe) Børgesen), Wynne & Norris (1991: 263-265, figs 7-8).

TYPE LOCALITY: Tatsugo, Amami-oshima, Kagoshima Prefecture, Japan.

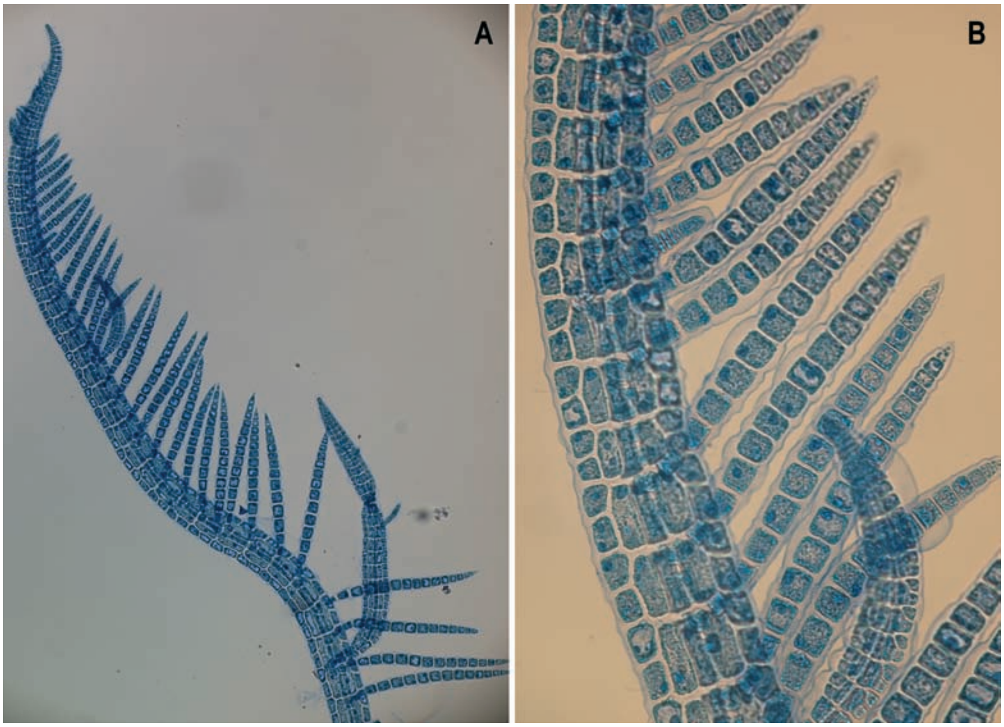
Description - Plants growing in isolated, very delicate tufts, composed of erect, radially placed, extremely supple filamentous-looking narrow straps, 3-4 cm long; purplish iridescent. Prostrate parts terete, polysiphonous with 4 pericentral cells, attached by rhizoids with pads at the tips; erect parts compressed, like extremely narrow straps, fusiform, with slightly incurved apex; two opposed pericentral cells of each segment bearing 2 lengthwise superposed cells (all in the same plane of the 'strap'); the basis of the plants have some rhizoidal corticating filaments; the side branches bear series of unilaterally (adaxially) placed monosiphonous filaments, 12-13 (-16) cells long (250-500 µm), very narrow at the base, broad in the middle part and terminating in a very abruptly pointed apex, departing from the axial cell.

Ecology - Epilithic, on coral rubble, between 0.5 to 1 m depth. Only observed at a single site of Bar Reef, Kalpitiya, but abundant at that location.

Distribution - Indian Ocean: Bangladesh, South Africa, Sri Lanka; Pacific Ocean: Japan, Western Australia.

Notes - *C. amamiensis* differs from *C. filamentosa* by its short and stubby monosiphonous filaments.
This is a new record for Sri Lanka.

Fig. 177. *Cottoniella amamiensis*. A, B. Microscopic details.


A
B

Martensia fragilis Harvey 1854: 145

Figs 39B; 178

REFERENCES: Magruder & Hunt (1979: 85, middle fig. p. 84), Cribb (1996: 105, bottom fig. p. 104), Abbott (1999: 344, figs 99C-E), Huisman (2000: 150, + figs), Littler & Littler (2003: 136, middle and lower figs p. 137), Huisman *et al.* (2007: 137, + figs), Skelton & South (2007: 162, figs 436-440).

TYPE LOCALITY: Weligama, Sri Lanka.

Description - Thallus membranous, extremely supple, fan-shaped and undulated, up to 9 cm high and 10 cm wide, divided in numerous fan-shaped straps, erect when submerged, creamy-pink in shallow water, pinkish red with a slight bluish iridescence deeper down or in shaded places; attached by rhizoids from the lower stipe-like part of the plant; basal part of the blade entire, followed by a net-like zone composed of radial and transversal lamellae, the interstices being radially rectangular; in well-developed blades, several new lobes develop from the margin of the basal blade, again with alternation of entire and grid-like portions; in the largest specimens up to 5 alternations are present; all parts of the blade are composed of a single cell layer and outer blade margin entire. Cystocarps very densely placed and only produced on the net-like parts.

Ecology - Epilithic in low intertidal pools (very small specimens), on dead corals at -1/-2 m as well as at -20 m. In February 2008, a limited surface of the coral reef between 1 and 2 m depth of Bar Reef was densely covered by large tufts of this species, waving with the waves.

Distribution - Indian Ocean and tropical western Pacific Ocean, but also mentioned from Cuba.

Note - Millar (1990: 418-420) synonymized *M. denticulata* Harvey with *M. fragilis*, but Littler & Littler (2003: 136) distinguish both taxa on the basis of the presence of marginal teeth in *M. denticulata*.

Fig. 178. *Martensia fragilis*. A. Habit *in situ*; B. Detail.

Nitophyllum marginale (Kützing) J. Agardh 1872: 51

Figs 25D; 37B; 179

REFERENCES: Krishnamurthy et Varadarajan (1991b: 61-63, figs 1-8).

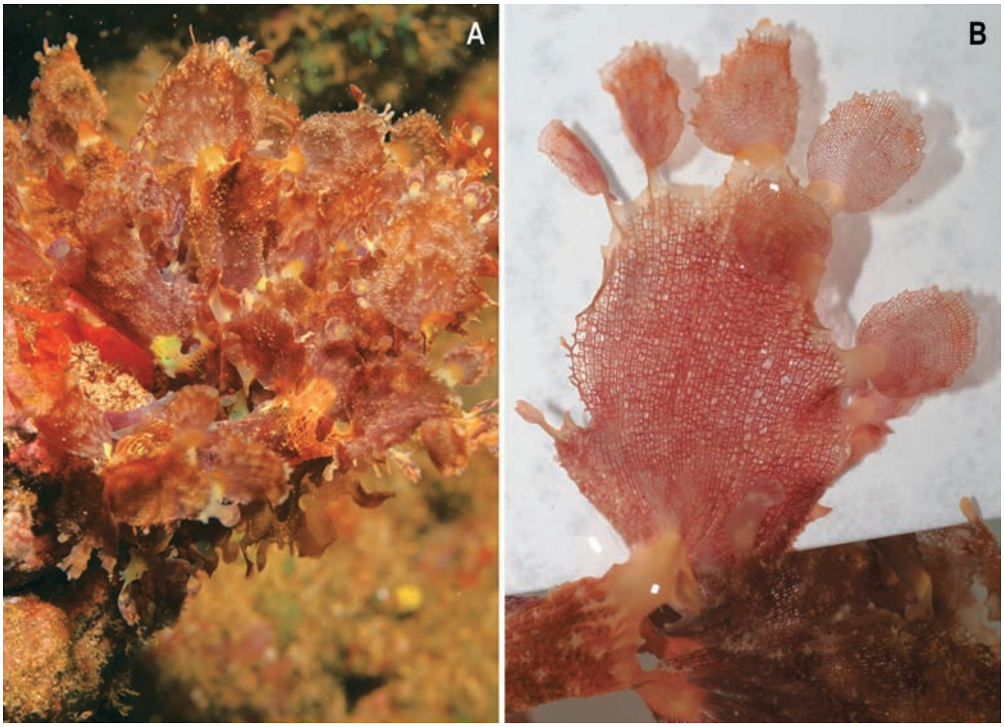
TYPE LOCALITY: Sri Lanka.

Description - Thalli membranous, extremely supple and delicate, either shallowly to deeply lobed or more strapshaped and then pseudodichotomously to irregularly branched, 3-5 cm long, the straps 5-10 mm wide, with markedly undulated margins provided with very fine teeth, (orangy-) pink; estipitate; some specimens isolated, others clustered in ponpon-like, hemispherical tufts. Whole thallus monostromatic except for the extreme basis where the blade can be up to 3 layers thick; veins absent. Cystocarps, sori of spermatangia and tetrasporangia, abundant in the collected material, most of them situated along the blade margins, a few being submarginal.

Ecology - Epilithic in the shallow subtidal (-0.5 to -1 m), mostly in lagoons and most frequent close to the barrier reef, where it can be extremely abundant.

Distribution - India, Sri Lanka.

Fig. 179. *Nitophyllum marginale*. A. Habit *in situ*; B. A cystocarpic specimen;
C. Herbarium specimen with sori of tetrasporangia.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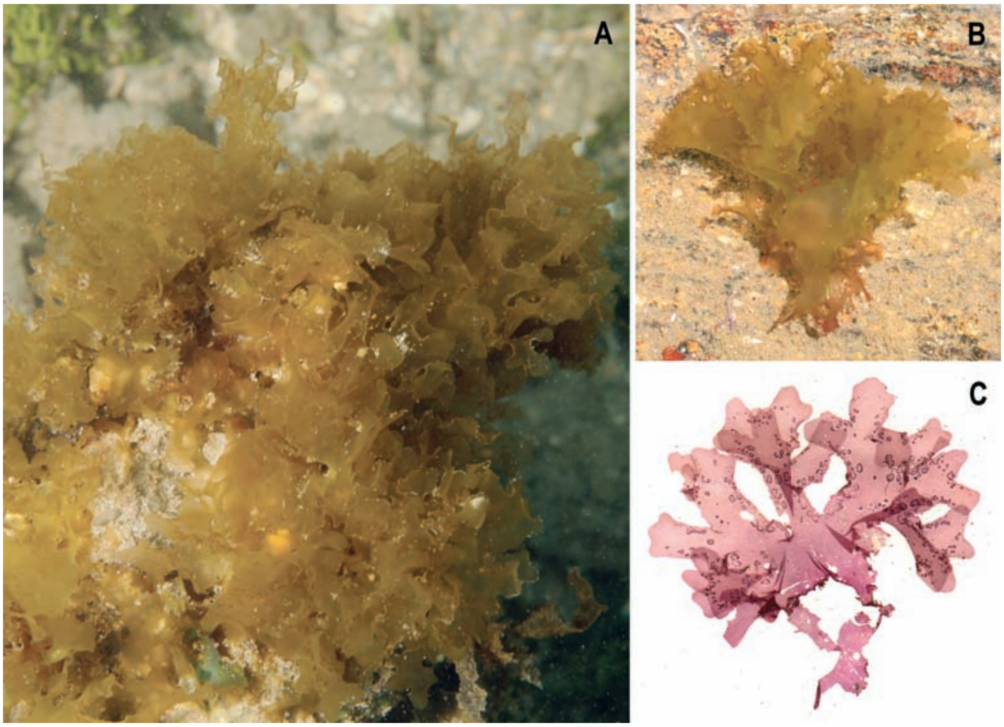
B


A
B
C

Taenioma perpusillum (J. Agardh) J. Agardh 1863: 1257

Fig. 180

REFERENCES: Abbott (1999: 348, figs 101A-E), Skelton & South (2007: 165, figs 445-446).

TYPE LOCALITY: San Agustín, Oaxaca, Mexico.

Description - Plants forming a short turf, a few mm high, composed of prostrate and erect parts with a central axis and 4 pericentral cells, dark red; prostrate axes 100-150 µm in diameter, repeatedly branched, anchored by unicellular rhizoids, up to 1 mm long, with rounded apex or terminal pad-like structure; erect axes about 80 µm diameter, issuing short, determinate branches which are flattened, two opposed periaxial cells of every segment each producing two isodiametric flanking cells, each again producing two tangentially elongated marginal cells, resulting in bladelets 7 cells (80-100 µm) wide; apex of fully grown determinate branchlets bearing (2-) 3 (-4) cylindrical, non-pigmented, unbranched, hairs.

Ecology - Epilithic on horizontal rock surface, just above low water mark, but continuously wave-swept.

Distribution - Pantropical to subtropical.

Note - According to Abbott (1999: 350) *T. dotyi* Hollenberg is a synonym of *T. perpusillum*, as the number of terminal monosiphonous filaments, which is used as a main distinguishing character (3 in *T. perpusillum* and 4-5 (occasionally 3) in *T. dotyi*), seems to be more variable than previously recognized. *T. nanum* (Kützing) Papenfuss and *T. macrourum* Thuret, both with 2-haired apices were merged by Papenfuss (1952). Hollenberg (1967) has argued that even the grounds for separating *T. nanum* and *T. perpusillum* are insufficient.

Fig. 180. *Taenioma perpusillum*. Microscopic details. A. Whole specimen; B, C. Details of apical parts.

Vanvoorstia coccinea Harvey ex J. Agardh 1863: 1271-1272

Fig. 181

REFERENCES: Papenfuss (1937: 55-60, figs 62-72), Abbott (1999: 350, fig. 101F), Littler & Littler (2003: 140, middle fig. p. 141).

TYPE LOCALITY: Sri Lanka.

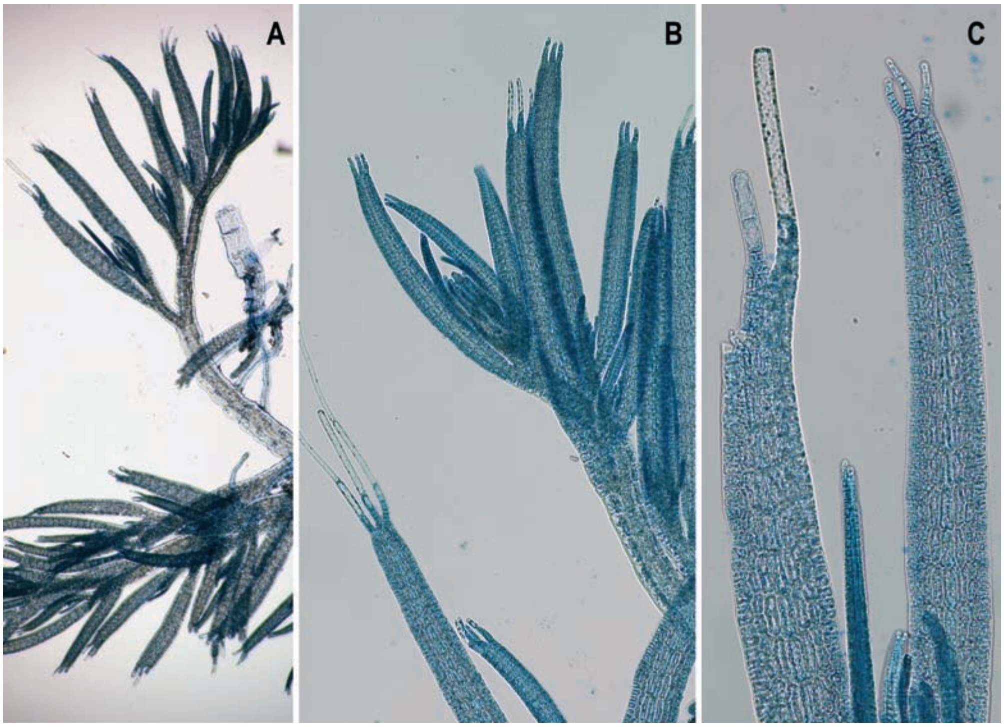
Description - Plants stiff-crispy, to 3 cm tall, dark red with some bluish iridescence, consisting of a sessile, coarse, net-like frond, frequently horizontally placed and downwardly bent like a watchglass or irregularly contorted; attachment by pad-like structures, at the base and where the thallus contacts the substratum; frond composed of two orders of long, curved 'blades', which soon become cylindrical and thickened as a result of heavy cortication, and several orders of anastomosing short blades, all of them being in a single plane; the penultimate and ultimate orders of branching are flattened blades, but corticating cells are quickly produced, thickening them; the blades of one order develop on the dorsal side of blades of the preceding order and are initiated by the central cells in alternate segments. The first-formed interstices of the net are progressively subdivided by the anastomoses of the subsequent orders of short blades. Tetrasporangia in bladelets of last order, placed in the net interstices.

Ecology - Epilithic on horizontal surfaces just above low water mark, mostly in mixed seaweed vegetations; continuously wave-swept, even at low tide; rather rare.

Distribution - Scattered regions in the Indian Ocean and western tropical Pacific Ocean.

Note - *Vanvoorstia spectabilis* Harvey, type locality also Sri Lanka, differs from *V. coccinea* on the basis of its more elegant stature and the more supple consistancy as a result of the absence of cortication of the bladelets.

Fig. 181. *Vanvoorstia coccinea*. A. Habit *in situ*. B. Herbarium specimen.


A
B
C


A
B

Acanthophora spicifera (Vahl) Børgesen
1910: 44 Figs 26A; 182

REFERENCES: Tseng (1984: 142, pl. 74, fig. 2), Lewmanomont & Ogawa (1995: 90, + fig.), Cribb (1996: 65, middle fig. p. 64), Calumpong & Meñez (1997: 167, + fig.), Trono (1997: 255, fig. 159), Abbott (1999: 355, figs 102D-E), Huisman (2000: 154, + fig.), Payri *et al*. (2000: 270, fig. p. 271), Littler & Littler (2003: 142, bottom fig. p. 143), Oliveira *et al.* (2005: 126, + figs), Huisman *et al*. (2007: 139, + figs), Ohba *et al*. (2007: 120, + figs), Skelton & South (2007: 170, figs 455-458).

TYPE LOCALITY: St. Croix, Virgin Islands.

Description - Plants gregarious, erect, about 10 cm high, stiff-brittle, greenish to purplish red; thalli attached by digitate holdfasts that may produce rhizomatous branches; main branching irregular, from sparse to dense, axes cylindrical, 2-3 mm in diameter; determinate branches spirally arranged, bearing spirally arranged spine-like laterals; branch apices pyramidal with branched trichoblasts which are fugacious. Structure seemingly pseudoparenchymatous but in fact polysiphonous, with 5 pericentral cells covered by a thick cortex; outer cortical cells rectangular and longitudinally oriented. Lenticular thickenings in walls of pericentral and inner cortical cells may occur. Reproductive structures borne on the short, spine-like branchlets; tetrasporangial branchlets swollen, very spiny, without trichoblasts; 1 tetrasporangium per fertile segment, developing in tiers in the 'stichidium'.
'Loose-lying' specimens in the lagoon of Chilaw are ball-like, up to 30 cm in diameter, with much more slender and supple branches which are less branched.

Ecology - Best developed in the subtidal, on dead coral heads or coral fragments on sand, in lagoons; smaller, tougher and more densely branched specimens in low intertidal pools.

Distribution - Pantropical.

Fig. 182. *Acanthophora spicifera*.

Bostrychia tenella (J.V. Lamouroux) J. Agardh
1863: 869-871 Figs 16E; 183

REFERENCES: Tseng (1984: 144, pl. 75, fig. 3), Lewmanomont & Ogawa (1995: 96, + fig., as *B. binderi*), Cribb (1996: 71, top fig. p. 70), Trono (1997: 259, fig. 161, as *B. binderi*), Calumpong & Meñez (1997: 159, 160, + figs), Huisman (2000: 156, + fig.), De Clerck *et al*. (2005b: 248, fig. 250), Oliveira *et al.* (2005: 128, + figs p. 129), Skelton & South (2007: 169, figs 451-454).

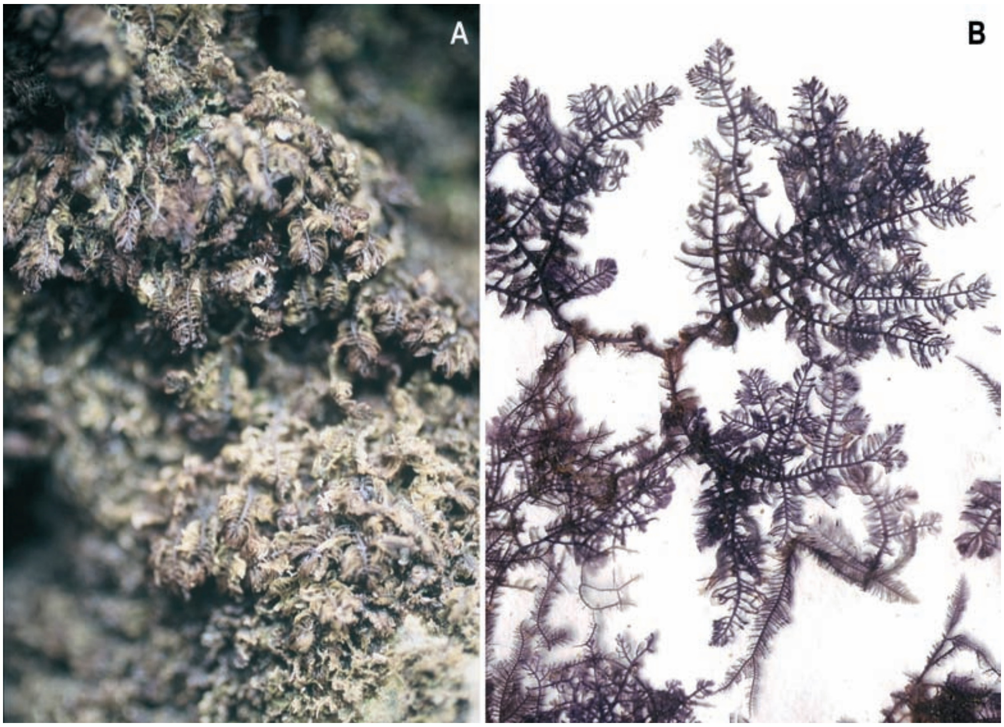
TYPE LOCALITY: St. Croix, Virgin Islands.

Description - Plants prostrate, forming mats up to 40 cm in diameter, dark purple to brown; attached by rhizoids developing from the ventral side of the prostrate axes, associated with bifurcations of the axes; axes cylindrical, to 500 µm in diameter; up to 3-4 orders alternately branched, from every to every fourth axial cell. Internal structure polysiphonous except for ultimate and penultimate branches; composed of an axial filament surrounded by 5-7 pericentral cells; major axes covered by a cortex 2-3 cells thick; pericentral cells dividing transversely, resulting in 2 tiers of pericentral cells per axial cell. Tetrasporangia formed in series in inflated ultimate branchlets (stichidia), produced in whorls of 4 and covered by (2-)3 cover cells, tetrahedrally divided, 30-70 µm in diameter.

Ecology - On shaded vertical and overhanging walls, upper intertidal zone (supralittoral fringe).

Distribution - Pantropical.

Fig. 183. *Bostrychia tenella*. A. Habit *in situ*; B. Detail of a herbarium specimen with various branch morphologies.


A
B

Bryocladia thwaitesii (Harvey ex J. Agardh) De Toni
1903: 968 Figs 23E; 184

REFERENCES: Durairatnam (1961: 70, pl. xviii, figs 1-3).

TYPE LOCALITY: Sri Lanka.

Description - Plants growing as almost continuous, monospecific populations of isolated tufts; individual plants composed of intricated, prostrate axes, attached by unicellular rhizoids with pad-like tips and erect branches, 3 to 5 cm long, having a percurrent axis with few secondary axes. Stolons ramified and bending upwards at their apices, giving rise to the erect thalli; all axes ecorticate, densely clothed with isolated groups of short, determinate, spine-like, upwardly directed, exogenous, polysiphonous branchlets, spirally arranged, and with a variable number of pericentral cells (up to 11 in vigorous specimens). Secondary, endogenous branchlets bearing trichoblasts, adventitiously formed in axils of some spine-like branchlets on upright axes. Reproductive structures borne on secondary, endogenously derived branchlets. Tetrasporangia single in a segment, in a straight series, stichidia in clusters on short axes.

Ecology - On (frequently sand-covered) rocks, close to the sandy substratum at about low tide level; sometimes together with *Grateloupia lithophila*.

Distribution - India, Sri Lanka.

Fig. 184. *Bryocladia thwaitesii*. A. Habit *in situ*; B. Microscopic detail of apical part; C. Cystocarp.

Chondria armata (Kützing) Okamura
1907: 69-71, pl. XVI, figs 9-19 Figs 22H; 185

REFERENCES: Tseng (1984: 144, pl. 75, fig. 4), Cribb (1996: 75, middle fig. p. 74), Calumpong & Meñez (1997: 166, + fig. p. 167), Trono (1997: 260, fig. 162), Huisman (2000: 157, + fig.), Littler & Littler (2003: 144, bottom fig. p. 145), De Clerck *et al.* (2005b: 248, fig. 251), Oliveira *et al.* (2005: 130, + fig. p. 131).

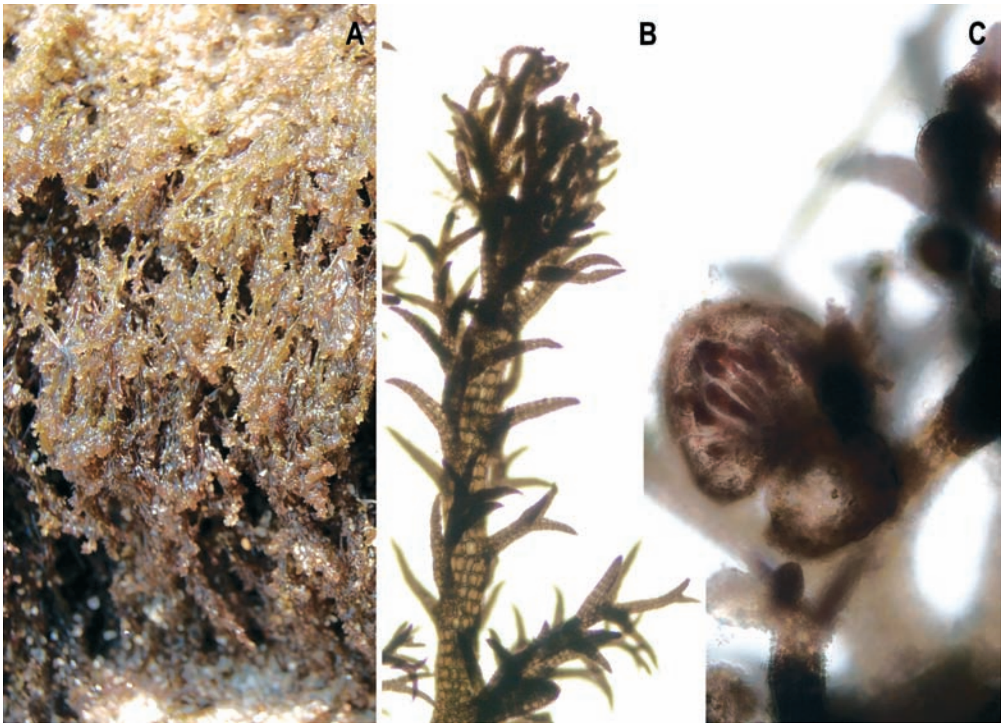
TYPE LOCALITY: Wagap, New Caledonia.

Description - Plants generally gregarious, more rarely isolated, up to 4 cm high, the basal parts rather stiff, the upper parts more supple, all axes being cylindrical; pinkish red, sometimes with creamy tips, turning dark brown upon drying; very well attached by thick, fleshy discoid holdfasts; individual thalli composed of irregularly branched prostrate axes, up to 1.5 mm in diameter bearing closely placed perennial upright axes, ca 1 mm in diameter near the base, gradually tapering to the apex, bearing markedly thinner, annual branches, provided with radially placed side branches of rather uniform length; these ultimate branchlets 3-5 mm long and 400 µm in diameter, not tapered proximally; apices acute, with a prominent apical cell, not depressed; trichoblasts caducous, but present in the distal thallus parts. Internal structure composed of an axial filament surrounded by 5 pericentral cells which remain discernable throughout the thallus, and a medulla composed of isodiametric cells decreasing in size toward the periphery; cortical layer cells 20 µm in diameter wide and 60-80 µm long. Tetrasporangia formed in ultimate branchlets, tetrahedrally divided, ca 100 µm in diameter.

Ecology - Epilithic, just above low water level, along surf-exposed coasts and thus continuously wave-swept.

Distribution - Widespread in the Indian Ocean and the tropical western Pacific Ocean.

Fig. 185. *Chondria armata*.


A
B
C

Laurencioids

Fig. 186

Recently, several papers have been published on representatives of the *Laurencia*-complex. Morphological and anatomical characters as well as molecular data led to the description or resurrection of three additional genera (*Chondrophycus*, *Osmundea* and *Palisada*) and the subsequent transfer of many species formerly placed in *Laurencia*. As an example, *Laurencia papillosa* (C. Agardh) Greville was transferred to the genus *Chondrophycus* by Garbary & Harper in 1998. In 2006, Nam transferred it to the genus *Palisada*. Most of these studies were based on specimens from a given area or selected specimens worldwide, not including material from Sri Lanka. Awaiting a thorough study of Sri Lankan representatives of the *Laurencia*-complex, we are using tentative identifications for some entities and illustrate some unidentified representatives.
Silva *et al*. (1996: 503-521) mention 13 species of *Laurencia* as being reported from Sri Lanka (some of which with several varieties), but many more from India.

Laurencia natalensis Kylin

1938: 24, pl. 8: fig. 21

Figs 11D; 22I; 186E

This is the most abundant *Laurencia*-species just above low tide level, growing in extensive vegetations with the basal parts being greenish and the apices orangy-red. The Sri Lankan specimens agree morphologically with the description and illustration of *L. natalensis* in De Clerck *et al*. (2005: 256, fig. 263). This taxon has been recorded from South Africa (type locality), Mozambique, Kenya and Mauritius. Additional research is needed to ascertain conspecificity of the Sri Lankan specimens with the *L. natalensis* from southern Africa.

Laurencia sp.

Fig. 186D

This representative has only been collected on deep water rock boulders, between 18 and 20 m depth. The specimens agree well with material from Papua New Guinea housed in GENT, identified as *Laurencia pedicularioides* Børgesen (see Millar *et al*. 1999: 573, fig. 6D and Coppejans & Millar, 2000: 333). Interestingly, a recent study of the species by Furnari *et al*. (2004) indicates that our specimens may after all not belong to this taxon.

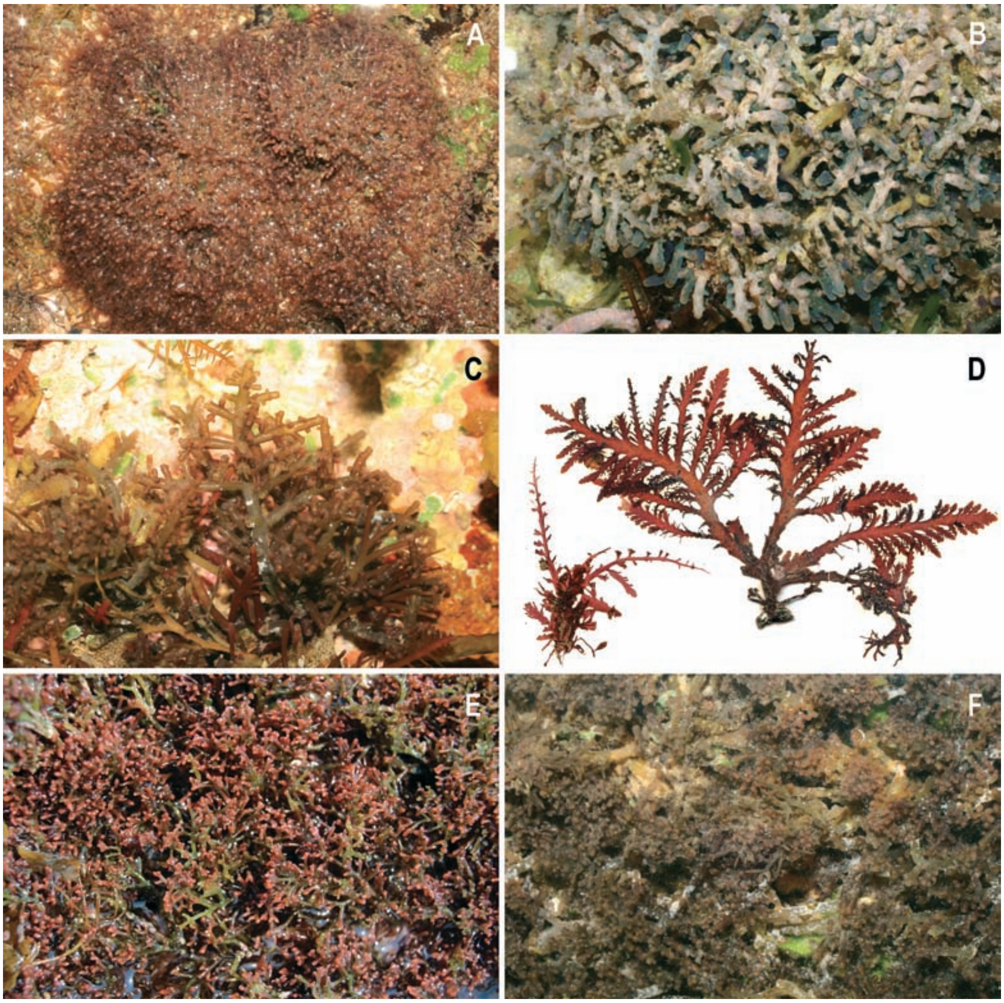
Palisada papillosa (C. Agardh) K.W. Nam

2007: 54

Fig. 186F

Our specimens grossly resemble typical specimens of this taxon, but they are smaller and rather repent than erect.

Fig. 186. Laurencioids (*Chondrophycus / Laurencia / Osmundea*-complex). A. Prostrate cushion-like Laurencioid; B. Iridescent, coarse cushion-like Laurencioid; C. Laurencioid with long, perpendicularly placed side branches; D. Deepwater Laurencioid; E. *Laurencia natalensis*; F. *Palisada papillosa*.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B
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F

CERAMIALES – Rhodomelaceae **Chondrophycus** (J. Tokida et Y. Saito) Garbary et J.T. Harper 1998: 194

Chondrophycus ceylanicus (J. Agardh) M.J. Wynne, Serio, Cormaci et G. Furnari 2005: 499, figs 1-4 Fig. 187

REFERENCES: Svedelius (1906: fig. 2, 8, as *Laurencia ceylanica*), Durairatnam (1961: 74, pl. xvii, figs 6, 7, as *Laurencia ceylanica*), Wynne *et al.* (2005: 499, figs 1-4).

TYPE LOCALITY: Sri Lanka.

Description - Thalli gregarious, composed of densely arranged robust, rigid, cartilaginous, compressed axes arising from aggregated discoid holdfasts, 3-5 cm high, dark red; axes 3-4 mm wide and 2.2-2.4 mm thick, irregularly ramified (up to two orders), bearing upwardly directed, alternate and distichous to sub-opposite branches and branchlets. Axes and branches often provided with short wart-like branchlets. Epidermal cells not secondarily pit-connected, radially arranged in palisades on transverse section, 24-26 µm long by 5-8 µm broad; no lenticular thickenings on the medullary cells; two pericentral cells per axial cell.

Ecology - Epilithic just above low water mark, on rocks exposed to severe surf.

Distribution - Indian Ocean and western tropical Pacific Ocean.

Note - Numerous species of *Chondrophycus* and *Laurencia* occur along the Sri Lankan coasts. They are actually under study.

Fig. 187. *Chondrophycus ceylanicus*.

CERAMIALES – Rhodomelaceae **Leveillea** Decaisne 1839: 375

Leveillea jungermannioides (Hering et G. Martens) Harvey 1855: 539 Fig. 188

REFERENCES: Tseng (1984: 156, pl. 81, fig. 3), Lewmanomont & Ogawa (1995: 129, + figs), De Clerck & Coppejans (1996: 265, figs 127-128), Calumpong & Meñez (1997: 165, + fig.), Abbott (1999: 396, figs 116A-D), Huisman (2000: 173, + fig.), Oliveira *et al.* (2005: 140, + fig. p. 141), Skelton & South (2007: 181, figs 480-484).

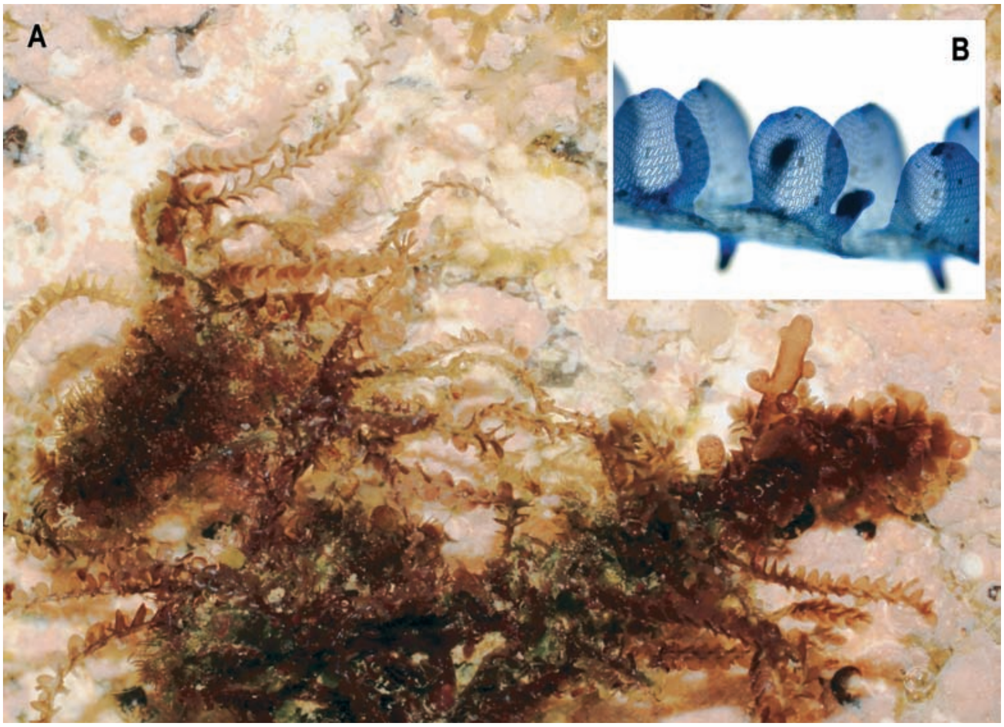
TYPE LOCALITY: Tor, Sinai Peninsula, Egypt.

Description - Plants prostrate, up to 5 cm long, blackish red, composed of branched axes bearing 2 rows of erect, broadly ovate, membranous branches; thallus decumbent, with cylindrical main axes with inrolled apices cutting off alternate indeterminate side axes with similar morphology; these axes with 4 pericentral cells in the juvenile parts and 7 pericentral cells in mature parts; attachment at intervals by groups of multicellular rhizoids with well-adhering terminal pad-like structures; prostrate axes bearing bilaterally arranged, erect, asymmetrical, broadly ovate, monostromatic (except midrib) bladelets, 650-800 µm broad and 500-1000 µm high, arranged in an alternate sequence, partly overlapping one another and bearing colourless, deciduous trichoblasts at the apices; cells of these bladelets more or less arranged in vertical and horizontal rows. Four to eight tetrasporangia formed in short, curved, stichidia-like branchlets that replace indeterminate branches; each tetrasporangium in own 'chamber' demarcated by vertical elongate cells and surrounded distally by 2-3 cover cells: only 4-6 tetrasporangia mature.

Ecology - Epiphytic, mostly on *Sargassum* in low intertidal rock pools. Mostly overlooked as a result of its small size and similar colour to the phorophyte.

Distribution - Widespread in the Indian Ocean and western tropical Pacific Ocean.

Fig. 188. *Leveillea jungermannioides*. A. Habit, epiphytic on *Laurencia* sp.; B. Microscopic detail.


A
B

CERAMIALES – Rhodomelaceae **_Murrayella_** Schmitz 1893: 227

Murrayella periclados (C. Agardh) Schmitz
1893: 227 footnote

Figs 16F; 189

REFERENCES: Littler & Littler (2000: 222, top figs p. 223), Oliveira *et al.* (2005: 142, + fig. p. 143), Skelton & South (2007: 184, figs 488-492).

TYPE LOCALITY: Mahé Island, Seychelles.

Description - Thalli forming densely felted coverings in which the individual filamentous plants are not recognizable with the naked eye; dull dark red-brown. Filaments composed of a prostrate sytem giving rise to erect filaments to 2 cm tall; attachment by rhizoids produced by the ventral periaxial cells, terminating into a disc; main axes polysiphonous, dichotomous below, alternate higher up, with 4 periaxial cells, slightly corticated near the base, ecorticate above; spirally placed branchlets monosiphonous, originally one per segment, deciduous, slightly upcurved, very thin (25-30 µm) and slender, unbranched or branched at their basis.

Ecology - Epilithic on shaded vertical and overhanging walls of fossil coral platforms at high water level, just under the *Bostrychia*-zone.

Distribution - Pantropical.

Fig. 189. *Murrayella periclados*. A. Whole plant; B. Detail of branching pattern.

CERAMIALES – Rhodomelaceae **_Tolypiocladia_** F. Schmitz *in* F.Schmitz et Falkenberg 1897: 441

Tolypiocladia calodictyon (Harvey ex Kützing) P.C. Silva
1952: 308

Fig. 190

REFERENCES: Oliveira *et al.* (2005: 147), Ohba *et al.* (2007: 124, + figs).

TYPE LOCALITY: Tonga.

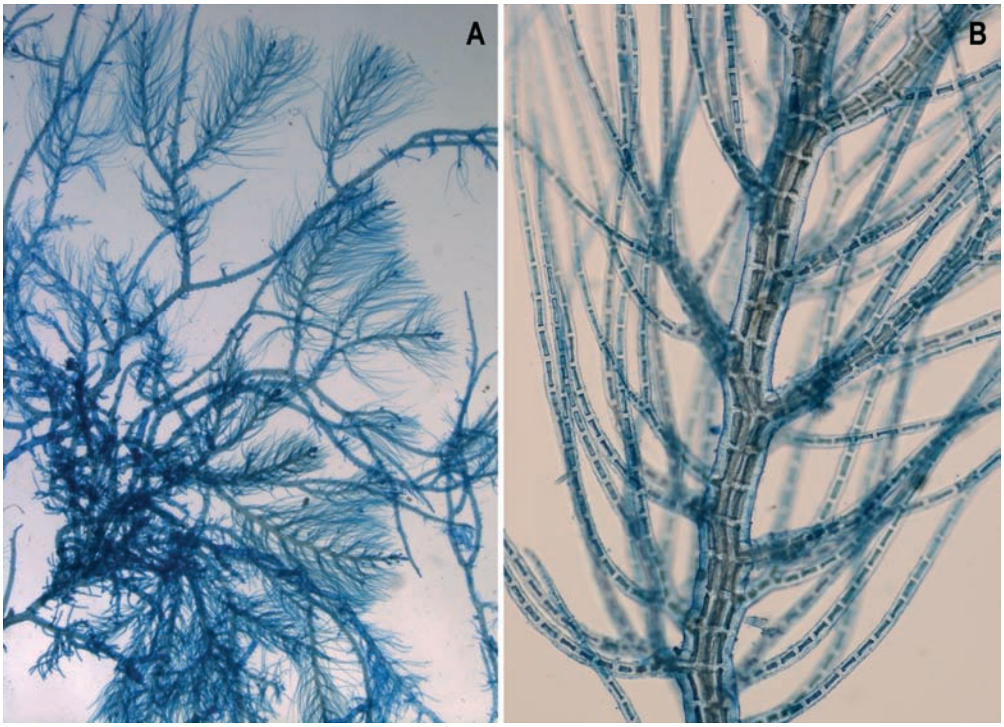
Description - Plants forming hemispherical tufts of up to 20 cm in diameter, composed of radially placed, entangled, supple, spongy branches; dark red, becoming black upon drying; main axes irregularly branched, longer and shorter indeterminate side branches mixed; total diameter of the branches at the basis up to 5 mm, gradually tapering towards the pointed apices; all axes polysiphonous, with 4 pericentral cells, devoid of any cortication; segments shorter than wide; axes and indeterminate branches densely clothed with numerous determinate, branchlets, perpendicularly placed on the axes; branchlets exogenously formed on most segments in a 1/4 spiral sequence, dichotomously branching at wide angles, the distal ends being divided 1-2 (or more) times into 1-several short spine-like branchlets; unbranched trichoblast borne on branchlet in early stages, young cells of trichoblast pigmented, later becoming colourless and deciduous; apices of a determinate branchlet anastomosing with those of the previous and following determinate branchlet, resulting in a threedimensional network and a spongy texture in the major part of the thallus, but some thinner indeterminate branches of the same thallus with isolated (non-anastomosing) determinate branchlets.

Ecology - Epiphytic on seagrasses (mainly *Halodule wrightii*) just under low water level on a sandbank in Puttalam lagoon; locally abundant.

Distribution - Indian Ocean and western tropical Pacific Ocean.

Note - In *T. calodictyon* most of the determinate side branchlets are anastomosing whereas they remain completely free in *T. glomerulata* (C. Agardh) F. Schmitz. Skelton & South (2007: 191) state that the features used to distinguish the four species of *Tolypiocladia* are yet to be properly tested. Falkenberg (1901) already suggested they may all be conspecific, belonging to *T. glomerulata*.

Fig. 190. *Tolypiocladia calodictyon*. A. Habit (herbarium specimen); B. Apex with numerous hairs; C. Intercalary portion with anastomoses; D. Branch with tetrasporangia.


A
B


A
B
C
D

11. Glossary

abaxial: away from the axis

abutting: lying adjacent or bordering on

acropetal: in the direction from the base toward the apex

acuminate: tapering gradually to a point

acute: with a sharp angle; ending in a point

adaxial: towards the axis

adherent: (well) attached or sticking

adventitious (branching): supplementary to the normal (branching) pattern

air bladder = **aerocyst**: air-filled vesicle in several brown algae

algal turf: short vegetation mats composed of several intricate seaweed species

alpha diversity: or local diversity, is the species diversity within a site

alternate-distichous: branches on two rows but the individual branches of both rows on different levels, not opposite to each other

anastomosing: locally (regularly or irregularly) united, resulting in a network

anastomosis: point of junction of two branches

annular: ring-like

anticlinal(ly): perpendicular to the surface or periphery of a structure

apex (apices): tip, summit

apical: at or near the summit

apiculate: with a short, abrupt point

arcuate: like an arch of a bridge, bent or curved like a bow

articulated: jointed; composed of stiff parts attached to each other by (more or less) flexible parts

ascending: basal part horizontally spread, apical part upwardly directed (= decumbent)

aseptate: without transverse walls

assimilator: in *Caulerpa* used as the upright frond

auriculate: with ear-like appendages

axis (axes): main stem or major branch (theoretically with infinite growth)

basipetal: from the apex downward toward the base

beta diversity: or species turnover, the change in species composition from site to site

bifurcate: divided into two branches; forked

bilocular: composed of two parts (cells, compartments or lobes)

bipinnate: with two opposite rows of branches which again bear two opposite rows of branchlets

blade: a relatively broad, thin part of the thallus; leaf-like (or foliar) portion of an alga (sometimes also called lamina)

branch: main side structure on the axes (with limited growth)

branchlet: smaller side structure on the branches (with limited growth)

bulbous holdfast: rhizoids getting densely intricated and holding large amounts of sand, resulting in (sub-)cylindrical structures submerged in the sand

bullose: markedly inflated

bushy: densely branched, forming small bushes

caducous: falling off easily

caespitose: forming a dense, short turf; matted

calcareous: with obvious calcification

capitate: having a globular or spherical apical part

carpogonial branch: the short, specialised branch bearing the female reproductive cell (carpogonium) in red algae

carpogonium: female reproductive cell, egg cell in red algae

carposporangium: sporangia producing diploid carpospores, developed after the fertilisation of the carpogonium in red algae

carpospore: diploid spore formed in carposporangia, by the carposporophyte

carposporophyte: the diploid generation developing on the female gametophyte after fertilisation of a carpogonium and producing diploid carpospores

cartilaginous: firm, tough but flexible

cauline leaves: blade-like structures in juveniles, or on stolons and the basal portion of the stipe of fully grown specimens of *Sargassum* spp. and *Turbinaria* spp. They (mostly) have a different morphology than the ‘adult’ leaves

cerebriform: in the shape of brains

cervicorn: resembling the antlers of a deer; dichotomous branching where repeatedly one branch of the dichotomy is less developed on the same side of the main axis which can become recurved

circalittoral: continuously submerged part of the coastal zone, from the lower limit of seagrass development down to the lower limit of seaweed growth

classification: delimitation of natural groups of organisms (taxa) which are placed in a category of a hierarchic system (species, genus, family, order, class, division)

clavate: club-shaped

coenocytic: possessing a cell or a filament without septa between the numerous nuclei

complanate: strongly flattened (with parallel sides in transverse section)

complanate branching: branching in a single plane

compressed: slightly flattened (oval in transverse section)

conceptacle: a hollow structure or a cavity enclosing reproductive structures

conduplicate: folded together lengthwise

constriction: contraction, narrower part

contiguous: touching, adjoining, neighbouring

contorted: sinuous, with numerous bends

convolute: twisted and rolled up longitudinally

coralline (alga): calcified red alga

corrugated: undulated

cortex: outer tissue layers of algae

crenate: margin with shallow, rounded or blunt teeth

crenulate: (margin) provided with small teeth

cruciate (division): with transverse walls perpendicular to each other; in the same plane, resulting in a cross-like appearance

crustose: forming a crust

cryptic diversity: organisms with a similar morphology appear to belong to different taxa, based on their DNA-information

cryptic species: different species on a molecular basis, but morphologically and anatomically (almost) indistinguishable

cuneate: wedge-shaped; broad at one end, tapering by nearly straight lines to the tip

cylindrical: circular in transverse section

cystocarp: the complex structure resulting from fertilization in red algae, composed of the internal gonimoblast and the enveloping sterile involucral branches or the pericarp

cystolith: an isolated calcified cell

deciduous: falling off easily; not permanent

decumbent: lying flat and loose on the substratum, with an upright apical part (= ascendent; ≠ prostrate: flat and well attached)

decussate division: a sporangium with alternating pairs of sporangia, crossing at right angles to the next pair above or below

dentate: toothed, with rather large, sharp teeth directed outwards (≠ crenate: blunt teeth)

determinate (lateral, - branch): lateral or branch with a limited growth, fixed in length

diagnosis: description of a new species in Latin (mainly including which are the characters of this species, distinguishing it from other species of the same genus)

dichotomous: forked into two similar parts as a result of the equal division of the apex

digitate: branching like the fingers on a hand, with numerous branches radiating from the same point

dioecious: unisexual; male and female reproductive structures produced on separate individuals

diploid: with two homologous sets of chromosomes in each nucleus (2n)

discoid: having the form of a disc, being flat and circular

distal: away from the place of attachment; towards the apex

distichous: on two opposite rows and therefore in one plane; the branchlets of both rows can then either be opposite or alternate

distromatic: having two cell layers

divaricate: branching at wide angles, widely divergent

emarginated: shallowly notched (generally at the apex)

encrusting: forming a crust

endemic: a species only occurring in a single region

endogenous: originating from the internal part of the thallus, not from the surface

entire: with a smooth margin

epilithic: growing attached to rocks and stones (including corals)

epiphytic: growing on another plant (seaweed, seagrass, mangrove), but not as a parasite

epipsammic: growing on sand

epithet: last part of a scientific name of a species, of a variety and of a forma

epizoic: growing on animals (barnacles, shells of gastropods, ...)

eradication: uprooting

erect: upright

estipitate: without a stipe, sessile

eulittoral: see intertidal

euryhaline: tolerant of changing salinity

euryionic: tolerant of changing concentrations in ions

eurytherm: tolerant of changing temperatures

exsiccata: a set of dried specimens, usually provided with printed labels

falcate: branch system curved like a sickle

fasciculate: arranged in small clusters or bundles

fastigiate: with numerous branches spreading from a compactly clustered point of origin; when the branches are parallel and all point upward

felt: densely intricated mass of thin filaments

fertile: being or containing a reproductive structure

fibrous: consisting of structures resembling fibers (holdfast)

filamentous: thin, elegant, supple threadlike structure composed of a single or a few rows of cells

filiform: thread-like

flabellate: fan-shaped

flabellum: fan-shaped part of the thallus

foliose: leaf-like

forcipate: markedly incurved, like a forceps or pincers

fragmentation: some branches break off from the mother plant, stay alive, attach to the substratum and go on growing to new plants

frond: erect (upright), mostly compressed part of an alga

fusiform: spindle-shaped, thicker centrally and tapering to both ends

gametangium (-angia): structure from or in which the gametes (sexual reproductive cells) are formed

gamete: a sexual reproductive cell having the haploid number of chromosomes, e.g. a sperm or an egg cell

gametophyte: the gamete-producing phase of a plant

gamma diversity: or regional diversity, is the diversity of a landscape, or of all sites combined

ganglionic cell: a darkly staining cell in certain red algae (e.g. *Halymenia*, *Cryptonemia*) characterized by a central swelling and long and slender arms

gelatinous: with large amounts of jelly, gluey

geniculum (-ula): the uncalcified joint(s) between segments (intergenicula) of coralline algae

glabrous: smooth, containing no hairs or projections

gland cell: a small cell with highly refractive content in red algae

globose: (sub-)spherical, rounded

gonimoblast: diploid structure, developed after fertilization of the carpogonium, composed of branched filaments producing carposporangia

gregarious: growing in groups; clustered

haploid: with only one set of chromosomes in each nucleus (n)

hapters: branched, multicellular attachment structures

heteromorphic: with a different morphology, often used with regard to gametophytic and sporophytic phases in a life cycle

hirsute: covered with stiff, long, straight hairs

holdfast: basal attachment structure

holocarpy: when the entire cytoplasmic content of a thallus is being transformed in gametes

holotype: the single specimen on which an author based the description of a new taxon

hue: tinge, colour

hyaline: colourless, transparent

hydrophyte: plant growing (partly) submerged in water

incurved: bent towards the main axis

indeterminate (- lateral, - branch): lateral or branch with a (theoretically) unlimited growth

infralittoral: subtidal

infralittoral fringe: coastal zone between mean and spring low tide levels

infraspecific epithet: scientific name for a variety or a forma

intercalary: between the basis and the apex

interdichotomy: part of the thallus between two dichotomies

intergeniculum (-ula): the calcified segments of articulated coralline algae; parts between the uncalcified joints

internodium: part of a stem or rhizome between 2 nodes

intertidal: the coastal zone between mean high and mean low tide levels

involucre (involucrum): radially arranged and generally incurved filaments surrounding reproductive structures in red algae

iridescence: glowing or shining; reflecting an interplay or rainbow-like colours as when seen from different angles

isodiametric: with (approximately) equal dimensions in two or more directions

isomorphic: with the same (or similar) morphology; often used with regard to gametophytic and sporophytic phases in a life cycle

isotype: duplicate specimen of the holotype

juvenile: young specimen

lacerate: irregularly divided by deep incisions

lateral (adj.): on the side of

lateral (subst.): a side axis or side branch

leathery: tough, but still flexible

lectotype: a specimen or illustration designated from the original material as the nomenclatural type if no holotype was indicated at the time of publication, or if it is missing, or if it is found to belong to more than one taxon

lenticular: looking like a lens, double convex

ligulate: strap-shaped, relatively broad when compared to its length

linear: narrow, with parallel sides and several times longer than broad, like a grass-leaf

lobed: with rounded (fan-shaped) parts or margins

lubricous: smooth and slippery

lumen: central cavity in a cell or a thallus

macroalgae: algae visible with the naked eye, as opposed to microalgae for which a microscope is needed for their observation

maculate: speckled, spotted, with darker or lighter dots on a lighter versus darker background

mangrove: evergreen forest growing in the upper intertidal in estuaries or coastal zones

medulla: inner tissue, the central region of the thallus, internal to the cortex; the pith

meiosis: nuclear division by which the number of sets of chromosomes is reduced from two (2n) to one (n)

membranous: (membranaceous), forming a thin blade or membrane

midrib: a central, longitudinal thicker part of a (mostly strap-like) blade

moniliform: resembling a string of beads

monoecious: bisexual; male and female reproductive structures produced on a single individual

monosiphonous: composed of a single tubular structure

monospecific: composed of a single species

monostromatic: composed of a single layer of cells

morphology: form

mucronate: abruptly ending in a short, stiff point

multinucleate: with numerous nuclei

muricate: rough, provided with short and hard tubercles

nemathecium (-cia): an elevation on the thallus surface containing reproductive structures

node: place of the axes where laterals or branches arise; in *Ceramium*: where the pericentral cells are placed around the central axis

nomenclature: giving a name to an organism; this happens according to rules which have been internationally recognized. For Algae the International Code of Botanical Nomenclature applies

notched: with marginal indentations (angular cuts)

opposite: a type of branching in which there are two structures (branchlets) at the same level

orbicular: circular and flat

ostiolum: a narrow pore-like opening (in a reproductive structure as e.g. a conceptacle)

ovoid: egg-shaped in outline

palmate: divided in the manner of an outspread hand

parasite: an organism that lives and grows at the expense of a host organism

paraphyse: sterile filament between or around reproductive cells

pectinate: with closely packed side branchlets on one side, like the teeth of a comb

pedicel: short stalk

pedicellate: provided with a short stalk

peg-like: like a pin, a nail

peltate: umbrella-shaped, horizontal disc with a perpendicular stalk attached at the center

pendulous: hanging down from a vertical wall or an overhang

penicillate: like an artist's paint brush

penultimate: before last

percurrent: extending through the entire length

perforated: presenting holes

periaxial cell: a cell cut off from an axial cell but shorter and orientated obliquely or at right angles to it (e.g. *Ceramium*)

pericarp: a sterile envelope surrounding the gonimoblast in a cystocarp

pericentral cell: a cell cut off from an axial cell and remaining similar in size and orientation to it (e.g. *Polysiphonia, Dasya*)

perithallus: the upper layer of tissue of a crustose alga

phaeophycean hair: a filament (without phaeoplasts) of uniseriate cells developing from a basal meristem

phorophyte: plant that carries epiphytes

phycobilins: water soluble, accessory pigments in the red algae, mainly phycoerythrin (red) and phycocyanin (blue)

phycologist: scientist studying macroalgae (as opposed to protistologist, studying microalgae)

phycology: the study of macroalgae (as opposed to protistology, the study of micro-algae)

pinna(e): a compressed to complanate side branch

pinnate: feather-like, with a main axis and branchlets on two opposite rows in one plane

pinnule: a lateral (branchlet) of a pinnate branch

pitted: provided with small depressions

plastid: cell organelle in which photosynthesis takes place

plumose: like a plume, feather-like

pluricellular: composed of several cells

plurilocular: many-celled, each cell containing a single spore

pneumatophore: a (mangrove) root growing vertically and upwardly

polychotomous: dividing in several (sub)equal parts from a single point

polygonal: a plane geometric figure with numerous sides

polyphyletic: descended from several, unrelated ancestors

polysiphonous: axes composed of a central axis surrounded by a series (at least 3) pericentral cells (eventually covered by a cortex), visible on a transverse section. In surface view, those algae without a cortex, seem to be composed of several, closely packed filaments (‘siphons’)

primitive plant body: with a relatively simple structure

procumbent: horizontally spread over the substratum but only attached at the basis

prokaryotic: organism lacking a nuclear membrane around the chromosomes

proliferation: a branchlet (or bladelet) formed as irregularly offshoots, smaller than side branches; frequently formed after grazing or erosion of the original branch (or blade)

propagule: branchlet with a special morphology, detaching from the mother plant and each of them producing a new juvenile; typical in *Sphacelaria*

prostrate: lying down on and tightly adhering to the substratum

protrusion: protuberance; bulging part

proximal: nearest to the point of attachment

pseudolateral: a lateral branch derived from a displaced apex

pyramidal: shaped like a pyramid

pyrenoid: an intracellular refractive cytoplasmic body associated with plasts in many algae (e.g. *Ulva*), associated in starch formation in green algae

pyriform: pear-shaped, with the broadest part toward the top end

quadrangular: with four corners

rachis: mainly used in *Caulerpa*; the main axis of the erect frond (assimilator)

radial: radiating (or developing uniformly) from a central point or from an axis

ramelli (or **ramuli**): (last order) branchlets

receptacle: swollen part of a branch bearing reproductive structures

recurved: bent away from the main axis (frequently = bent downwards to the substratum

reniform: kidney-shaped

repent: creeping along the substrate

reproduction: the formation of new individuals by sexual or non-sexual means

resupinate: thallus horizontally spreading from a vertical wall

reticulate: in the form of a two- or threedimensional net-like structure

reticulum: a two- or threedimensional network

rhizine: an unbranched filament with small diameter and very thick cell wall, resulting in a very small central opening (lumen); strongly refractive on transverse section

rhizoid: a single- or few-celled attachment structure of an alga

rhizome: a creeping (mostly cylindrical) structure from which erect branches arise

rhizophore: an aerial root of a mangrove tree, starting from the basal part of the stem or a branch, bending downwardly and reaching the bottom

rosette: (bladelets) arranged around a central point

rufous: brownish red

sand-dwelling: attached in the sandy substratum

segment: 1. in calcified algae: the large calcified part between the non-calcified joints; 2. in (some) red algae: one central cell and surrounding pericentral cells (if present) and cortex (if present)

segregative cell division: a form of cell division in which a multinucleate protoplast divides into several, rounded daughter protoplasts, which subsequently become surrounded by a wall. The newly formed cells are either released after rupture of the mother cell (*Valonia ventricosa*), remain in situ and form parenchymatic thalli (*Dictyosphaeria*), or rupture old parental walls and form branches (*Struvea*, *Siphonocladus*)

septate: with transverse walls

serrate: saw-edged, with sharp teeth pointing forwards

sessile: not stalked; attached directly to the axis or to a substratum

sinuous: irregularly curving in and out in one plane (a filament or a blade margin)

siphon: aseptate, tubular structure

sorus (sori): a well demarcated surface patch containing a group or cluster of reproductive structures

species: a basic unit of classification; a set of organisms with similar characteristics and which can breed with each other

speckled: with darker (lighter) dots on a lighter (darker) background

spermatangium (-gia): the cell producing the male reproductive cell (spermatium) in red algae

spermatium (-a): non-motile male reproductive cell in red algae

spindle-shaped: thicker centrally and tapering to both ends (= fusiform)

spinose: bearing spines; provided with stiff, sharp-pointed projections

spinulose: bearing small spines

spiralized: coiled

sporangium: a cell producing one or several spores

spore: asexual cell able to germinate into a new plant

sporophyte: the spore-producing phase of a plant

stellate: star-shaped

stenohaline: tolerant only for a narrow range of salinity

stenoionic: tolerant only for a narrow range of ion concentration

stenotherm: tolerant only for a narrow range of temperature

stichidium (-dia): a specialized, generally inflated branch producing tetrasporangia

stipe: stalk; part between the holdfast and the frond

stipitate: provided with a stalk

stolon: a creeping (mostly cylindrical) structure from which erect branches arise

stoloniferous: bearing stolon-like structures

strap-shaped: ribbon-like or girdle-like

stupose: having a tuft of matted filaments

subspherical: almost spherical

subtidal: coastal area under low water level, down to the circalittoral = lower limit of development of seagrasses

subtidal fringe: between mean and spring low tide levels; a narrow zone with some typical organisms

succulent: full of juice or sap

supralittoral: the coastal zone above high tide level

supralittoral fringe: the coastal zone between mean and spring high tide levels

sympodial: branching of an axis where the apex is continually replaced by a lateral from below (alternately left and right of the axis), resulting in a zigzag aspect

syntype: any one of two or more specimens cited in the original description when no holotype was designated or any one of two or more specimens simultaneously designated as type

tapering: gradually narrowing toward a point

taxonomy: the principles and methods for the classification of living organisms

tenacular cell: specialized cell achieving attachment with adjacing cells or filaments

tetrahedral: cells contiguously placed as at the tips of a four-sided pyramid; - crystal: pyramid-shaped crystal

tetrasporangium (-gia): cell in which four spores are formed by meiosis

tetraspore: haploid spore, formed by meiosis (therefore mostly grouped by four) on the diploid tetrasporophyte

tetrasporophyte: diploid plant in red algae originating from the diploid carpospore, in which meiosis will take place resulting in the haploid tetraspores

thallus: the relatively undifferentiated multicellular plant body of a non vascular plant (e.g. an alga)

tomentose: thickly and evenly covered with hairs

trabecular spine: a spine-like projection of cell wall material in the cell

tribuliform: inverted triangular in surface view, with rounded upper angles and a small bulge in the middle of the upper side

trichoblast: a colourless, usually (dichotomously) branched, hair-like appendage, produced near branch apices in Rhodophyta

trichotomous: dividing in three (similar) parts

trifurcate: with three forks or branches

trilobate: presenting three lobes

tristromatic: composed of three cell-layers (visible on cross section)

truncate: cut off rather abruptly at the tip

tubular: apparently a cylindrical figure and hollow

turbinate: obconical; as an inverted cone

turf algae: short, mat-forming, densely intricated seaweeds

type locality: the place where the type specimen of a taxon has been collected

type specimen: specimen after which the original description of an organism is based (remark: this does not mean that this specimen is 'typical')

undulate: being wavy, regularly curving up and down in a threedimensional way (margin of a blade)

unilateral: along a single side of an axis

unilocular: one-chambered

uniseriate: composed of a single linear row of cells; a filament

unistratose: composed of a single layer

utricle: swollen end of siphons forming a palisade-like surface layer in *Codium* and various Udoteaceae (e.g. *Halimeda*)

vein: series of larger cells (mostly longer as compared to the neighbouring ones) forming longitudinal rows within a smaller-celled tissue

ventral: at the lower side

verticil: whorl

verticillate: in whorls; whorled

vesicular: bladder-like

whorl: structures arranged in a circle or vertical around the axis

xanthophylls: brown accessory pigments in the brown algae

zonate: with the cross walls parallel to each other; in a tetrasporangium resulting in the four tetraspores being in a series of four

zygote: diploid cell, formed after fertilisation of an egg cell

12. References

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14. Photographic credits

The pictures were made during numerous stays in Sri Lanka between 1998 and 2008. Most habit pictures were taken *in situ* in February 2008 by O. Dargent. High magnification details were photographed after formalin preserved specimens by F. Leliaert and O. De Clerck, either using a dissecting microscope or a light microscope provided with a digital camera in the laboratory in Ghent. The material was first stained, green algae with methylene blue, red algae with aniline blue. The herbarium specimens were scanned.

Coppejans Eric: 2A-D; 3A-F; 5E; 6A-H; 7B; 8B, C; 9A, E; 11A; 12C, E, F; 13A-D, F; 15A, B, D-F; 16A, C, E, F; 17B-H; 22A-C, F, I; 23B, C; 26A, C; 28A-F; 29A-G; 32A; 33D, F; 37A; 42A; 46A, C, D, F, G; 47A-G; 48A-F; 49A-G; 67A; 69; 70A; 125A; 129A, B; 145A, B; 151A, B; 161A, B; 171B.

Dargent Olivier: 2E; 4A-G; 5A-D; 7A, C-E; 9B-D; 8A; 10A-F; 11B-D; 12A, B, D; 13E; 14A-D; 15C; 16B, D; 17A; 18A-D; 19A-F; 20A-F; 21A-G; 22D, E, G; 23A, D-F; 24A-F; 25A-D; 26B, D-F; 27A-H; 30A-D; 31A, B; 32B-H; 33A-C, E; 34B-F; 35A-C, E, G-I; 37B-G; 39A, B, D; 40A-G; 41A, C-H; 42B-F; 44E, F, I; 45E, F, J; 46B, E; 50A-C; 51-63; 64A; 65; 68; 71-87; 90-103; 106-108; 110; 111A, B; 112A; 113A, B; 114A; 115A; 116-118; 120-124A; 126-128, 130-144; 146-148A; 149; 152-154A; 155-160; 162-166A, B; 168A; 170A; 171A; 174, 175; 177, 178A, B; 180A; 181; 182A; 183A; 184; 185.

De Clerck Olivier: 31C-E; 35D, F-H; 39E; 44A-D, G, H; 45A-D, G-I; 105; 109; 111C, D; 112B; 113C; 114B.

Leliaert Frederik: 34A; 36A-F, J; 39C; 41B; 64B; 66; 67B; 70B, C; 88; 89; 104; 115B; 119A, B; 124B; 125B; 145C, D; 148B; 150; 154B; 166C; 167A, B; 168B, C; 169; 170B, C; 172; 173; 176; 178C; 179; 180B; 182B; 183B, C.

15. About the authors

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16. Appendix 1 – Taxonomic index

Taxa described in this book are **bold**, taxa illustrated (but not described) are underlined, taxa only mentioned in the text are in normal font, recent synonyms only discussed in relation to identification and to names of species are in smaller font. Species epithets, as well as infraspecific epithets, are followed (between brackets) by genus and/or species names. Numbers in bold indicate the page the taxa are described.

17. Appendix 2

Table 1. The Tansley scale for indication of species abundance in a quadrat (quantitative sampling) or larger area (semi-quantitative sampling).

Tansley scale	
d	dominant
c	co-dominant
a	abundant
f	frequent
o	occasional
r	rare
s	sporadic

Table 2. The Braun-Blanquet's sociability scale for the indication of a species' life form.

Braun-Blanquet's sociability scale	
1	solitary
2	in small groups or tufts
3	in larger groups, cushions or humps
4	in mats or very large groups
5	covering approx. the entire quadrat

Table 3. Braun-Blanquet cover-abundance scale.

Braun-Blanquet scale	Range of cover
r	< 5 %; very few individuals
+	< 5 %; few individuals
1	< 5%; numerous individuals
2	5 – 25 %
3	25 – 50 %
4	50 – 75 %
5	75 – 100 %

Sri Lankan Seaweeds

Methodologies and field guide to the dominant species

Abc Taxa

Seaweeds are macroalgae that are important primary producers in coastal zones. The many species belong to different and unrelated groups of organisms, classified as the red, green and brown algae. These colours are of relevance, because they reflect their different photosynthetic pigments. Nice colour photographs of seaweeds in these different groups are included in the present work. Professor Coppejans and his team, however, have, amongst others, also elaborated on survey methodologies, seaweed communities, seasonality and zonation. These important chapters are richly illustrated and as such provide an apt entry point to marine phycological research. These chapters are of great importance in capacity building in research on seaweeds. For more experienced phycologists the descriptions and photographs of the different species form certainly the backbone of the book. Next to generously illustrated taxonomic information, this work also provides additional insight on ecology and distribution of the treated taxa.

This book will serve the phycological community well as collected material will become readily identifiable thanks to the concise descriptions and the appropriately chosen pictures. As also stressed by the authors, this work covers only a fraction of the rich marine flora of Sri Lanka, but it will form a solid fundament on which future studies can be built. It is certain that the present book will be of great help during these so necessary future studies. And not only for Sri Lanka, but for all surrounding maritime countries that can use this book as an agreeable addition to the possibility to identify their often so colourful and splendid seaweeds.

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