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Marine algal flora and sea grasses of the coast of Kuwait

R. H. AL-HASAN AND W. E. JONES

Department of Botany and Microbiology, University of Kuwait, P.O. Box 5969, Safat 13060, Kuwait, and School of Ocean Studies, Marine Science Laboratories, University College of North Wales, Menai Bridge, Gwynedd, UK.

ABSTRACT

The marine algal flora of the coasts of Kuwait has been studied from September 1983 to December 1986. The number of species recorded is 105, of which 89 species are new to Kuwait: Chlorophyta (total 26, new 24), Phaeophyta (total 22, new 16), Rhodophyta (total 39, new 32), Xanthophyta (total 1, new 1), Haptophyta (total 1, new 1), Cyanophyta (total 16, new 15). In addition to the marine algal flora two marine angiosperms new to Kuwait are recorded. Seasonal changes in the floral elements at various stations are recorded. Some peculiarities in the distribution pattern of certain algae are discussed.

CONTENTS

INTRODUCTION

The first published list of the marine algal flora of Kuwait was by Newton (1955a) and is based on a collection from Al-Ahmadi Port (Mina Al-Ahmadi) by Mrs F. H. Kellet in April–June 1951. This was followed by another list of algae from Bahrain by the same author (Newton 1955b), based on the collections of R. Good. Jones

(1986 b) published a field guide to the sea shores of Kuwait and the Arabian Gulf in which he listed the common species of algae. However, he did not particularly specify which species were recorded from Kuwait and which were from other areas in the Gulf. Therefore, in the present work the species which had not been previously recorded with cited localities and vouchers and deposited in a herbarium, will be considered as new to Kuwait or Arabian Gulf. Basson (1979) has listed the marine algae of the eastern coast of Saudi Arabia. Børgesen (1939) and Nizamuddin & Gessner (1970) studied the algal flora of the eastern side of the Gulf. Obviously, the above mentioned works were based on occasional collections with no mention of the seasonal variations.

The present work is based on collections made over a period of three years (September 1983–December 1986), covering the entire coast of Kuwait from Bubiyan Island to Al-Nuwaiseeb (Fig. 1). However, the present authors do not claim that this study covers the entire marine algal flora of Kuwait, as the smaller epiphytic algae and the occurrence of short-lived species are not properly covered.

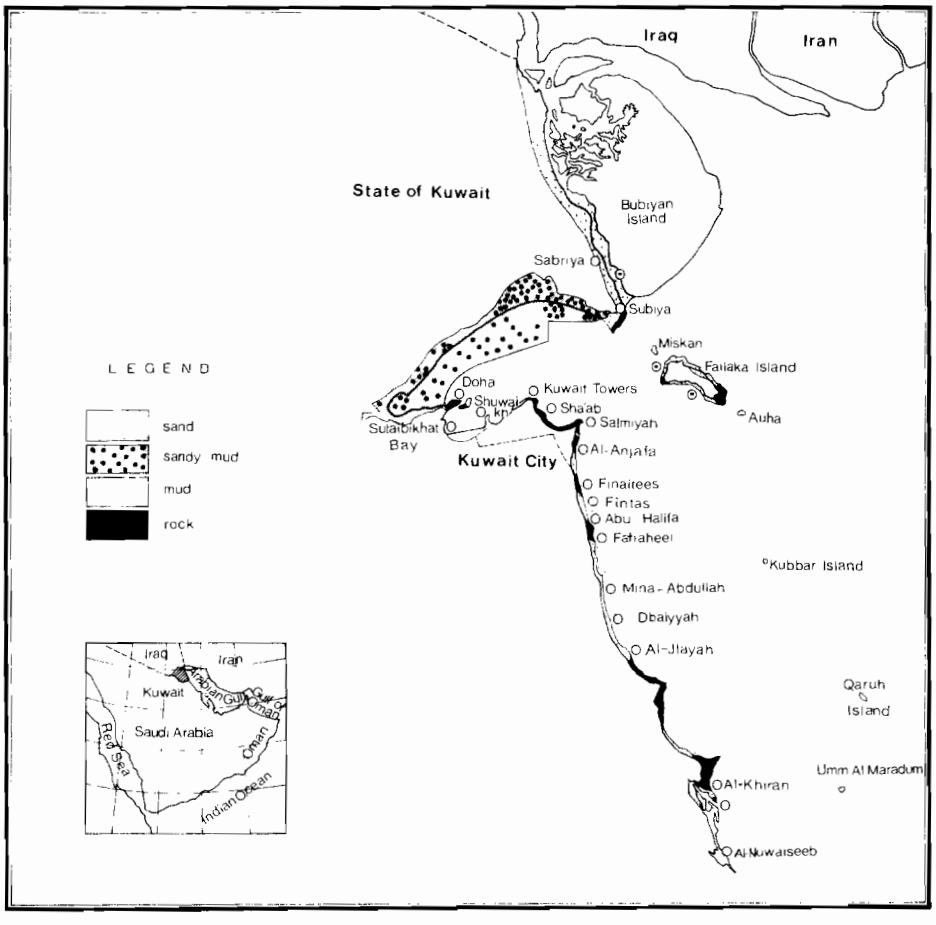

Fig. 1. Coastline of Kuwait showing the sampling sites. Inset shows Kuwait in a broader geographical context.

CLIMATIC AND ENVIRONMENTAL CONDITIONS

The climate of Kuwait, with its very hot summer and mild winter (from below 0 to above 50°C) affects the shallow waters of the northern end of the Arabian Gulf and results in a wide range of water temperature (mean annual range: 16–22°C in winter and 22–36°C in summer). The range is narrower south of Kuwait City but is still twice that encountered in most of the world's coastal waters.

Salinity of the surface layer is about 40‰ near the northwest end of the Gulf, and decreases to about 36·6‰ southwards near the Strait of Hormuz. Intertidal salinity levels in pools and interstitial water may rise dramatically above that of the open sea. For example, interstitial salinities of 130‰ at high water neap tides and 65‰ at low water neaps were recorded on beaches in Kuwait Bay (Jones 1986a). Such salinities together with the wide range of sea water temperature and the tidal regime result in unusual environmental conditions. The regional algal flora is therefore highly adapted and exhibits high diversity.

Since Kellett collected at Al-Ahmadi in 1951, the area has been subjected to considerable changes. The shoreline has suffered major changes due to large-scale coastal engineering, harbour building and industrial developments with the consequent loss of some habitats. Therefore, it is important to record the present state of the algal flora.

METHODOLOGY

Periodic visits to the sites (see Fig. 1) were organized to provide a seasonal coverage of the algal vegetation. Visits were chosen to coincide with the best possible tidal conditions, i.e. low water of spring tides. Laboratory examinations of collected specimens were carried out to determine their identity and to note any features of special interest. After examination, the material was pressed and dried as herbarium specimens or preserved in a solution of 5% formalin and seawater. Samples are deposited in the Herbarium of the Department of Botany and Microbiology, Kuwait University (KTUH).

RESULTS

A single asterisk (*) denotes a genus or species not previously recorded for Kuwait, and two asterisks (**) a first record for the Gulf.

SYSTEMATIC ACCOUNT

CHLOROPHYTA

CHLOROPYCEAE

VOLVOCALES

POLYBLEPHARIDACEAE

Dunaliella Teodoresco (*)
Dunaliella salina (Dunal) Teodoresco
Nasr 1947, p. 18; Smith 1969, p. 28, Pl. 1, Fig. 1; Basson 1979, p. 47.

Salt marshes in Al-Khiran; in wet salt pockets coloured orange red due to carotene production by the alga; February–October.

ULVALES

ULVACEAE

Blidingia Kylin (**)
Blidingia minima (Nägeli ex Kützing) Kylin Pl. 1, Fig. 9.
Bliding 1963; Smith 1969, p. 620, Fig. 1.
Abu-Halifa, Al-Anjafa, Bubiyan Island; on shore rocks; December, March, April.

Enteromorpha Link
Enteromorpha clathrata (Roth) Greville (*) Pl. 1, Fig. 1.
Børgesen 1913, p. 7; Børgesen 1939, p. 57; Smith 1969, p. 51; Nizamuddin & Gessner 1970, p. 3; Edwards 1976, pp. 17–18, Fig. 23; Jaasund 1976, p. 1, Fig. 2; Saifullah & Nizamuddin 1977, p. 532, Pl. 4-D, Figs 33–36; Basson 1979, p. 47, Pl. 1, Fig. 1.
Subiya, Bubiyan Island, Failaka Island; on littoral sand and stones; December–March.

Enteromorpha compressa (Linn.) Greville (*) Pl. 1, Fig. 2.
Børgesen 1939, p. 57; Nasr 1947, p. 21; Newton 1955b, p. 141; Smith 1969, p. 52, Pl. 5; Nizamuddin & Gessner 1970, p. 3; Srinivasan 1973, p. 51, Pl. 51; Anand 1981a, p. 11, Fig. 1-A.
Doha, Mina Abdullah; common on littoral sand and stones; November–January.

Enteromorpha flexuosa (Wulfen ex Roth) J. Agardh (*) Pl. 1, Fig. 3.
Børgesen 1913, p. 5; Nasr 1947, pp. 21–22; Edwards 1976, p. 18, Fig. 24; Jaasund 1976, p. 1, Fig. 4; Basson 1979, p. 48, Pl. 1, Fig. 2.
Sabriya, Doha, Shuwaikh, Abu-Halifa; common on littoral sand and stones; October–March.

Enteromorpha intestinalis (Linn.) Link (*) Pl. 1, Fig. 4.
Nasr 1947, p. 22; Smith 1969, p. 49, Pl. 5; Nizamuddin & Gessner 1970, p. 3; Srinivasan 1973, p. 50, Pl. 50; Saifullah & Nizamuddin 1977, p. 529, Pl. 3-C, Figs 24, 25.
Sabriya, Bubiyan Island, Doha, Mina Abdullah; common on littoral sand and stones; January–April.

Enteromorpha prolifera (Müll.) J. Agardh (**) Pl. 1, Fig. 5.
Børgesen 1935, p. 9; Edwards 1976, p. 18, Figs 26, 28, 29; Saifullah & Nizamuddin 1977, p. 533, Pl. 5-C, Figs 29–32; Anand 1981a, p. 13, Fig. 2A.
Sabriya; on stones and shells in upshore pools; September–March.

Ulva Linn. (*)
Ulva lactuca Linn. Pl. 1, Fig. 6.
Børgesen 1939, p. 57; Nasr 1947, p. 23; Smith 1969, p. 45, Pl. 3; Srinivasan 1969, p. 49, Pl. 49; Edwards 1976, p. 19, Figs 31, 33; Saifullah & Nizamuddin 1977, p. 525, Pl. 2-D, Figs 18–20; Anand 1981a, p. 16, Fig. 3-B.
Shuwaikh, Kuwait Towers, Sha'ab; common on littoral sand and stones; February–March.

Ulva reticulata Forsskål (*) Pl. 1, Fig. 7.
Børgesen 1939, p. 58; Nasr 1947, p. 22; Srinivasan 1969, p. 50, Pl. 50; Jaasund 1976, p. 3, Fig. 5; Saifullah & Nizamuddin 1977, p. 522, Pl. 1-A, Figs 1, 2.
Shuwaikh, Sha'ab; on rocks and stones; plentiful in February–June.

Ulva rigida C. Agardh (**) Pl. 1, Fig. 8.
Smith 1969, p. 47; Jaasund 1976, p. 3, Fig. 8; Dawes 1974, p. 70; Saifullah & Nizamuddin 1977, p. 524, Pl. 2-C, Figs 15–17.
Doha, Shuwaikh; common on littoral sand and stones; March–April.

CLADOPHORALES

CLADOPHORACEAE

Chaetomorpha Kützing
Chaetomorpha aerea (Dillwyn) Kützing Pl. 2, Fig. 10.
Børgesen 1939, p. 63; Nasr 1947, p. 37; Newton 1955a, p. 100; Newton 1955b, p. 141; Smith 1969, p. 56, Pl. 6; Dawes 1974, p. 87; Basson 1979, p. 48, Pl. 1, Fig. 3.
Salmiyah, Al-Nuwaiseeb; plentiful on midshore rocks; December–February.

Chaetomorpha capillaris (Kützing) Børgesen (*)
Børgesen 1939, p. 64.
Al-Khiran, Al-Nuwaiseeb; entangled in other algae as woolly masses; December.

Chaetomorpha crassa (C. Agardh) Kützing (**) Pl. 2, Fig. 11.
Nizamuddin & Begum 1973, p. 14, Fig. 61; Jaasund 1976, p. 5, Fig. 10.
Sabriya; on stones in upshore muddy pools; September–December.

Chaetomorpha linum (Müll.) Kützing (*) Pl. 2, Fig. 12.
Børgesen 1939, p. 63; Nasr 1947, p. 36; Newton 1955b, p. 141; Nizamuddin & Begum 1973, p. 15, Fig. 62; Dawes 1974, p. 87; Edwards 1976, p. 19, Figs 34–38; Basson 1979, p. 50, Pl. 1, Fig. 4.
Al-Khiran; as drift entangled with other algae; December.

Cladophora Kützing (*)
Cladophora coelothrix Kützing Pl. 2, Fig. 13.
Børgesen 1939, p. 3, Fig. 15; Nizamuddin & Begum 1973, p. 3, Figs 11–13.
Dbaiyyah, Mina Abdullah; on rocks as dark cushions; November.

Cladophora colabense Børgesen (**) Pl. 2, Fig. 14.
Børgesen 1935, p. 19; Nizamuddin & Begum 1973, p. 3, Figs 14–19.
Al-Khiran; epiphytic on *Spyridia* and other algae; February.

Cladophora nitellopsis Børgesen (*) Pl. 2, Fig. 15.
Børgesen 1939, p. 69; Newton 1955b, p. 141; Nizamuddin & Gessner 1970, p. 4, Pl. 2, Figs 5, 6.
Doha; on rocks and stones; January.

Cladophora sericoides Børgesen (*) Pl. 2, Fig. 16.
Børgesen 1939, p. 64; Newton 1955b, p. 141; Nizamuddin & Gessner 1970, p. 4, Fig. 10; Basson 1979, p. 50, Pl. 2, Fig. 7.
Sabriya, Failaka Island, Sha'ab; on rocks, thickly covered by diatoms; March, September.

SIPHONOCLADALES

SIPHONOCLADACEAE

Cladophoropsis Børgesen
Cladophoropsis zollingeri (Kützing) Børgesen Pl. 2, Fig. 17.
Børgesen 1939, p. 62; Nasr 1947, p. 31; Newton 1955a, p. 100; Basson 1979, p. 51, Pl. 2, Fig. 9; Anand 1981a, p. 46, Fig. 24.
Mina Abdullah, Dbaiyyah, Al-Nuwaiseeb; on rocks or epiphytic on *Digenia*; May, November.

VALONIACEAE

Dictyosphaeria Decaisne ex Endlicher (*)
Dictyosphaeria cavernosa (Forsskål) Børgesen Pl. 2, Fig. 18.
Børgesen 1936, p. 63; Nasr 1947, p. 29; Srinivasan 1973, p. 37, Pl. 37; Jaasund 1976, p. 15, Fig. 32; Basson 1979, p. 51, Pl. 2, Fig. 10.
Failaka Island, Al-Nuwaiseeb; on lower shore rocks; October–December, May.

Siphonocladus Schmitz (*)
Siphonocladus feldmannii Børgesen Pl. 3, Fig. 19.
Børgesen 1939, p. 60, Fig. 5.
Doha; on stones in muddy sand; October.

SIPHONALES

BRYOPSIDACEAE

Bryopsis Lamouroux (*)
Bryopsis hypnoides Lamouroux Pl. 3, Fig. 20.
Børgesen 1939, p. 74; Nsar 1947, p. 44; Smith 1969, p. 73, Pl. 9; Nizamuddin & Gessner 1970, p. 3; Dawes 1974, p. 72; Edwards 1976, p. 22, Figs 51–55; Jaasund 1976, p. 17, Fig. 34.
Sha'ab; with *Enteromorpha* on stones in sand; common in February.

CAULERPACEAE

Caulerpa Lamouroux (*)
Caulerpa sertularioides (Gmelin) Howe Pl. 3, Fig. 21.
Srinivasan 1969, p. 48, Pl. 48; Nizamuddin & Gessner 1970, p. 3, Pl. 5, Fig. 13; Dawes 1974, p. 77; Jaasund 1976, p. 23, Fig. 47; Basson 1979, p. 51, Pl. 3, Fig. 12.
Doha, Shuwaikh, Al-Nuwaiseeb, Failaka Island; in pools and channels, seldom uncovered; August–December also in February, May.

CODIACEAE

Codium Stackhouse (**)
Codium papillatum Tseng & Gilbert Pl. 3, Fig. 22.
Tseng & Gilbert 1942, p. 293.
Agrees with *C. papillatum* specimen of Iyengaria in B.M. (Nat. Hist.) collected from Cape Comarin, India.
Abu-Halifa, Fintas, Salmiyah, Shuwaikh, Kuwait Sea Front; attached on rocks and plentiful in drift; common in October–March.

UDOTEACEAE

Avrainvillea Decaisne (*)
Avrainvillea amadelpha (Montagne) A. & E. Gepp Pl. 3, Fig. 23.
Nasr 1947, p. 48, Pl. 1, Fig. 2; Basson 1979, p. 51, Pl. 3, Fig. 13.
Doha, Al-Nuwaiseeb; grows in sand; May, October.

DASYCLADALES

DASYCLADACEAE

Acetabularia Lamouroux (*)
Acetabularia calyculus Quoy & Gaimard Pl. 3, Fig. 24.
Nasr 1947, p. 40, Fig. 10; Basson 1979, p. 53, Pl. 3, Fig. 14.
Doha, Al-Khiran, Al-Nuwaiseeb; attached to shells and stones in tidal pools; May, September.

PHAEOPHYTA

ECTOCARPALES

ECTOCARPACEAE

Ectocarpus Lyngbye
Ectocarpus siliculosus (Dillwyn) Lyngbye (**) Pl. 3, Fig. 25
Nasr 1947, p. 60; Dawes 1974, p. 98; Edwards 1976, p. 23, Figs 58–61; Humm 1979, p. 137, Fig. 35.
Kuwait Towers, Subiya; in mid-shore pools; October–February.

Giffordia Batters
Giffordia indica (Sonder) Papenfuss & Chihara (**) Pl. 3, Fig. 26.
Edwards 1976, p. 24, Figs 62, 66; Jaasund 1976, p. 35, Fig. 69; Humm 1979, p. 141.
Abu-Halifa, Kuwait Towers, Doha; epiphytic on other algae; January–March, October.

Giffordia mitchelliae (Harvey) Hamel Pls 3, 4, Figs 27, 28
Newton 1955a, p. 100; Newton 1955b, p. 141; Edwards 1976, p. 25, Figs 63, 65, 67–69; Jaasund 1976, p. 35, Fig. 70; Basson 1979, p. 53, Pl. 3, Fig. 16; Humm 1979, p. 140, Fig. 58.
Mina Abdullah, Al-Jlayah, Abu-Halifa, Fahaheel, Al-Anjafa; epiphytic on various algae; February–April.

CHORDARIALES

SPERMATOCHNACEAE

Stilophora J. Agardh
Stilophora rhizodes (Ehrenb.) J. Agardh (**) Pl. 4, Fig. 29.
Nasr 1940, Pl. 11, Fig. 4; Nasr 1947, p. 67; Humm 1979, p. 156, Fig. 65.
Failaka Island; epiphyte on larger brown algae; March.

Cladosiphon Kützing (**)
Cladosiphon occidentale Kylin Pl. 4. Fig. 30.
Dawes 1974, p. 105, Fig. 47; Edwards 1976, p. 27, Figs 80–83; Jaasund 1976, p. 47, Fig. 94.
Al-Khiran, Doha; epiphyte on *Sargassum*; January–April.

SPHACELARIALES

SPHACELARIACEAE

Sphacelaria Lyngbye

Sphacelaria nova-hollandiae Sonder (**) Pl. 4, Fig. 32.
Jaasund 1976, p. 37, Fig. 77.
Shuwaikh, Kuwait Towers, Salmiyah; epiphyte on other brown algae; October–March.

Sphacelaria rigidula Kützing Pl. 4, Fig. 31.
Prud' homme Van Reine 1982
= *S. furcigera*
Børgesen 1937, p. 99; Nasr 1947, p. 73; Newton 1955a, p. 100; Newton 1955b, p. 141; Nizamuddin & Gessner 1970, p. 5; Dawes 1974, p. 99; Jaasund 1976, p. 37, Fig. 75; Basson 1979, p. 53, Pl. 4, Figs 17, 18.
Subiya, Kuwait Towers, Salmiyah, Mina Abdullah; epiphyte on *Sargassum*; October–March.

Sphacelaria tribuloides Meneghini (*) Pl. 4, Fig. 33.
Nasr 1947, p. 74; Dawes 1974, p. 99; Jaasund 1976, p. 37, Fig. 76; Basson 1979, p. 55, Pl. 4, Fig. 19.

Kuwait Towers; epiphyte on *Sargassum*; February, March, October.

DICTYOTALES

DICTYOTACEAE

Dictyota Lamouroux
Dictyota ciliolata Kützing (**) Pl. 4, Fig. 34.
Dawes 1974, p. 100; Jaasund 1976, p. 41, Fig. 82.
Subiya, Sha'ab, Shuwaikh; on littoral stones in sand; May, August–January.

Dictyota divaricata Lamouroux (*) Pl. 4, Fig. 35.
Børgesen 1939, p. 81; Nasr 1947, p. 80; Newton 1955b, p. 142; Nizamuddin & Gessner 1970, p. 5, Pl. 8, Fig. 23; Jaasund 1976, p. 41, Fig. 83; Basson 1979, p. 55, Pl. 4, Fig. 20.
Mina Abdullah, Dbaiyyah, Al-Khiran, Al-Nuwaiseeb; on littoral stones in sand; April–May, August–November.

Padina Adanson
Padina australis Hauck Pl. 4, Fig. 36.
Misra 1966.
=*P. gymnospora* (Kützing) Vickers
Newton 1955a, p. 10; Nizamuddin & Gessner 1970, p. 6; Jaasund 1976, p. 45, Fig. 89; Basson 1979, p. 55, Pl. 4, Fig. 21.
Doha, Shuwaikh, Kuwait City shore, Al-Anjafa, Mina Abdullah, Al-Khiran, Al-Nuwaiseeb, Failaka Island; on littoral stones and rocks; all year round but common in spring.

DICTYOSIPHONALES

PUNCTARIACEAE

Colpomenia (Endl.) Derbès & Solier
Colpomenia sinuosa (Roth) Derbès & Solier Pl. 5, Fig. 37.
Børgesen 1939, p. 89; Nasr 1947, p. 71; Newton 1955a, p. 101; Newton 1955b, p. 142; Smith 1969, p. 128, Pl. 20; Srinivasan 1969, p. 28, Pl. 28; Nizamuddin & Gessner 1970, p. 6, Pl. 6, Fig. 18; Jaasund 1976, p. 47, Fig. 95; Basson 1979, p. 57.
Doha, Kuwait City shores, Fintas, Abu-Halifa, Fahaheel, Mina Abdullah, Al-Khiran, Failaka Island; on littoral stones; January–May.

Iyengaria Børgesen (*)
Iyengaria stellata Børgesen Pl. 5, Fig. 39.
Børgesen 1939, p. 91, Fig. 23; Nizamuddin & Gessner 1970, p. 6, Pl. 8, Fig. 25.
Salmiyah, Al-Anjafa, Abu-Halifa; in mid pools on stones; January–April.

Scytosiphon C. Agardh (**)
Scytosiphon lomentaria (Lyngbye) J. Agardh Pl. 5, Fig. 38.
Nasr 1949, p. 12, Pl. 2, Fig. 5; Smith 1969, p. 129, Pl. 19.

Kuwait Towers, Al-Anjafa, Al-Khiran; on stones in tidal pools; January–March.

FUCALES

CYSTOSEIRACEAE

Cystoseira C. Agardh

Cystoseira myrica (Gmelin) C. Agardh Pl. 5, Fig. 40.

Børgesen 1939, p. 95; Nasr 1947, p. 83; Newton 1955a, p. 101; Newton 1955b, p. 142; Jaasund 1976, p. 53, Fig. 107; Basson 1979, p. 57, Pl. 5, Fig. 26.

Doha, Shuwaikh, Fintas, Abu-Halifa, Al-Khiran, Al-Nuwaiseeb; attached to littoral and sublittoral rocks; July–January, April–May.

Cystoseira trinodis (Forsskål) C. Agardh (*) Pl. 5, Fig. 41.

Jaasund 1976, p. 53, Fig. 108; Basson 1979, pp. 57, 59.

Doha, Shuwaikh, Failaka Island, Fintas, Al-Khiran, Al-Nuwaiseeb; on stones and drift; September–December.

Hormophysa Kützing (*)

Hormophysa triquetra (C. Agardh) Kützing Pl. 5, Fig. 42.

Børgesen 1939, p. 96; Nasr 1947, p. 82; Newton 1955b, p. 142; Srinivasan 1969, p. 37, Pl. 37; Jaasund 1976, p. 53, Fig. 109; Basson 1979, p. 59, Pl. 5, Fig. 27.

Shuwaikh, Dbaiyyah, Al-Khiran; hermaphrodite plant attached to stones in tidal pools; September–December.

SARGASSACEAE

Sargassum C. Agardh

Sargassum angustifolium (Turner) J. Agardh Pl. 5, Fig. 43.

Endlicher & Diesing 1845, p. 268; Børgesen 1939, p. 100; Newton 1955a, p. 101; Newton 1955b, p. 142; Nizamuddin & Gessner 1970, p. 7, Pl. 10, Fig. 28; Basson 1979, p. 59, Pl. 6, Fig. 28.

Fintas, Finaitees, Al-Khiran; on sublittoral rocks; November–December.

Sargassum asperifolium (Her. & Mart.) J. Agardh (*) Pl. 5, Fig. 44.

Børgesen 1939, p. 98; Nasr 1947, p. 87, Pl. 7; Newton 1955b, p. 142; Jaasund 1976, p. 55, Fig. 110.

Shuwaikh, Al-Khiran; on sublittoral rocks and drifted; September–May.

Sargassum binderi Sonder (*) Pl. 5, Fig. 45.

Jaasund 1976, p. 57, Fig. 112; Basson 1979, p. 59, Pl. 6, Fig. 29.

Doha, Shuwaikh, Kuwait City shores, Salmiyah, Failaka Island, Al-Bidde, Al-Anjafa, Fintas, Mina Abdullah, Dbaiyyah, Al-Khiran, Al-Nuwaiseeb; throughout the year in sublittoral zone, frequent in winter.

Sargassum boveanum J. Agardh (*) Pl. 6, Fig. 46.

Børgesen 1939, p. 97; Newton 1955b, p. 142; Nizamuddin & Gessner 1970, p. 7, Pl. 10, Fig. 29; Basson 1979, p. 59, Pl. 6, Fig. 30.

Doha, Kuwait Towers, Salmiyah, Al-Anjafa, Fintas, Abu-Halifa, Al-Jlayah, Al-Khiran; on sublittoral rocks and drifted; October–April.

Sargassum heteromorphum J. Agardh (*) Pl. 6, Fig. 47.
Basson 1979, p. 60, Pl. 7, Fig. 33.
Al-Khiran, Al-Nuwaiseeb; rare, occurs as drifted materials; May, October.

XANTHOPHYTA

XANTHOPHYCEAE

VAUCHERIALES

VAUCHERIACEAE

Vaucheria De Candolle (**)
Vaucheria piloboloides Thuret Pl. 6, Fig. 48.
Fritsch 1935, I, p. 428, Fig. 143; Christensen 1987, p. 27; Shameel 1987, p. 512.
Kuwait Towers, Al-Khiran; binding sand in tufts, 15 cm across; September, February.

HAPTOPHYTA

PRYMNESIOPHYCEAE (HAPTOPHYCEAE)

PRYMNESIALES

PHAEOCYSTACEAE

Phaeocystis Lagerh. (**)
Phaeocystis pouchetii (Hariot) Lagerh. Pl. 6, Fig. 49.
Fritsch 1935, I, p. 542, Fig. 179; Raymont 1963, p. 115, Fig. 5.31; Bätje & Michaelis 1986.
Salmiyah, Al-Anjafa; floating brown coloured bladders occur from November–May, causing extensive bloom in February–March.

RHODOPHYTA

GONIOTRICHALES

GONIOTRICHACEAE

Chroodactylon Hansgirg
Chroodactylon ornatum (C. Agardh) Basson
Børgesen 1939, p. 102; Newton 1955a, p. 101; Newton 1955b, p. 142. (as

Asterocystis ornata); Basson 1979, p. 67, Pl. 9, Fig. 52.
Al-Khiran; epiphyte on *Sargassum* spp.; February.

BANGIALES

ERYTHROPELTIDACEAE

Erythrotrichia J. E. Areschoug (*)
Erythrotrichia carnea (Dillwyn) J. Agardh Pl. 6, Fig. 50.
Børgesen 1939, p. 101; Nasr 1947, pp. 90, 91; Smith 1969, p. 164. Pl. 35; Edwards 1976, p. 30, Fig. 95; Basson 1979, Pl. 10, Fig. 54; Humm 1979, p. 61, Fig. 28.
Al-Anjafa; epiphyte on *Gelidium* spp.; March–April.

BANGIACEAE

Bangia Lyngbye (**)
Bangia atropurpurea (Roth) C. Agadh Pl. 6, Fig. 51.
Geesink 1973
$=B.$ *fuscopurpurea* (Dillwyn) Lyngbye
Fritsch 1945, II, p. 426, Fig. 142; Smith 1969, p. 168; Edwards 1976, p. 30, Figs 98–101; Humm 1979, p. 66.
Failaka Island, Salmiyah; epiphyte on *Padina*; February–April.

NEMALIALES

ACROCHAETIACEAE

Acrochaetium Nägeli
Acrochaetium bahreinii Børgensen
Børgensen 1939, pp. 102–104, Fig. 26; Newton 1955a, p. 101; Newton 1955b, p. 143; Basson 1979, p. 67, Pl. 10, Fig. 55.
Al-Khiran; epiphyte on other algae; February.

BONNEMAISONIALES

BONNEMAISONIACEAE

Asparagopsis Montagne (*)
Asparagopsis taxiformis (Delile) Trevisan Pl. 6, Fig. 52.
Only the asexual stage (=*Falkenbergia hillebrandii*) has yet been discovered.
Fritsch 1945, II, p. 549, Fig. 219D; Nizamuddin & Gessner 1970, p. 12, Pl. 22, Fig. 69; Jaasund 1976, p. 69, Fig. 140; Woelkerling 1976, p. 126, Figs 209–215.
Al-Khiran; epiphyte on *Sargassum*; February.

GELIDIALES

GELIDIACEAE

Gelidium Lamouroux (*)
Gelidium crinale (Turn.) Lamouroux Pl. 6, Fig. 53.
Børgesen 1939, p. 106, Figs 27, 28; Fritsch 1945, II, p. 463, Fig. 153; Edwards 1979, p. 33, Figs 115–119; Humm 1979, p. 78, Fig. 32.
Sha'ab; on rocks; March.

Gelidium heteroplatos Børgesen (**) Pl. 6, Fig. 54.
Jaasund 1976, p. 73, Fig. 145.
Al-Anjafa; plentiful as turf on rocks, particularly in shade; February–April.

Gelidium pusillum (Stackhouse) Le Jolis Pl. 7, Fig. 55.
Børgesen 1939, p. 105; Nasr 1947, p. 101; Smith 1969, p. 195, Pl. 44; Jaasund 1976, p. 71, Fig. 144; Anand 1981a, II, p. 11, Fig. 4.
Kuwait Towers, Failaka Island, Al-Anjafa, Abu-Halifa, Mina Abdullah; as turf on stones, often best in shade; October–March.

CRYPTONEMIALES

PEYSSONNELIACEAE

Peyssonnelia Decaisne (**)
Peyssonnelia simulans Weber-van Bosse Pl. 7, Fig. 56.
Jaasund 1976, p. 75, Fig. 152.
Kuwait City shores, Salmiyah, Al-Anjafa, Kubbar Island; common on rocks and stones; October–December.

CORALLINALES

CORALLINACEAE

Jania Lamouroux (*)
Jania pumila Lamouroux Pl. 7, Fig. 58.
Børgesen 1939, p. 107; Nasr 1947, p. 107; Newton 1955b, p. 143; Jaasund 1976, p. 77, Fig. 156.
Doha, Shuwaikh, Mina Abdullah, Dbaiyyah, Al-Khiran, Al-Nuwaiseeb; epiphyte on *Digenea*, *Hormophysa* and other algae, also on sponges; October–December, also March, May.

Pneophyllum Kützing (*)
Pneophyllum lejolisii (Rosanoff) Chamberlain 1983, Pl. 7, Fig. 57.
= *Melobesia lejolisii* Rosanoff
Børgensen 1939, p. 108; Fritsch 1945, II, p. 506, Fig. 179.
Failaka Island; epiphyte on *Sargassum* and other algae; October.

GIGARTINALES

GRACILARIACEAE

Gracilaria Greville (*)
Gracilaria corticata J. Agardh Pl. 7, Fig. 59.
Børgesen 1939, p. 110; Nizamuddin & Gessner 1970, p. 9, Pl. 21, Figs 62–63; Srinivasan 1973, p. 17, Pl. 17; Jaasund 1976, p. 83, Fig. 168; Anand 1981b, II, p. 57.
Doha, Shuwaikh, Failaka Island; on rocks at low tide; August–November.

Gracilaria foliifera (Forsskål) Børgesen Pl. 7, Fig. 60.
Børgesen 1939, p. 109, Fig. 29; Nasr 1947, p. 112; Nizamuddin & Gessner 1970, p. 9; Edwards 1976, p. 38, Figs 149–151, 153–155; Humm 1979, p. 89, Fig. 35.
Doha; on rocks at low tide; April.

Gracilaria salicornia (J. Agardh) Dawson (**) Pl. 7, Fig. 61.
Jaasund 1976, p. 85, Fig. 171.
Failaka Island; on corals and in shallow tide pools; October–November, also in March.

SOLIERIACEAE

Solieria J. Agardh (**)
Solieria robusta (Greville) Kylin Pl. 7, Fig. 62.
Srinivasan 1969, p. 15, Pl. 15; Jaasund 1976, p. 93, Fig. 188.
Doha; on rocks and stones; April.

HYPNEACEAE

Hypnea Lamouroux
Hypnea cornuta (Lamouroux) J. Agardh (*) Pl. 7, Fig. 63.
Nasr 1947, p. 114; Nizamuddin & Gessner 1970, p. 10; Dawes 1974, p. 138; Edwards 1976, p. 37, Figs 141–142; Jaasund 1976, p. 99, Fig. 200; Basson 1979, p. 70, Pl. 11, Fig. 63.
Doha, Kuwait Towers, Sha'ab, Failaka Island, Mina Abdullah, Al-Khiran; in sand; February–November.

RHODYMENIALES

CHAMPIACEAE

Champia Desvaux
Champia indica Børgensen (**) Pl. 8, Fig. 64.
Srinivasan 1973, p. 12, Pl. 12; Jaasund 1976, p. 101, Fig. 207.
Failaka Island; on rocks in tide pools; May, October, November.

Champia kotschyana Endl. & Dies. Pl. 8, Fig. 65.
Børgesen 1939, p. 116; Newton 1955a, p. 101.
Al-Jlayah, Failaka Island; on stones in tide pools; November.

Champia parvula (C. Agardh) Harvey (*) Pl. 8, Figs 66, 67.
Børgesen 1939, p. 116; Nizamuddin & Gessner 1970, p. 10; Edwards 1976, p. 39, Figs 162, 163; Jaasund 1976, p. 99, Fig. 203; Humm 1979, p. 94, Fig. 38; Anand 1981b, II, p. 67, Fig. 46.
Doha, Al-Nuwaiseeb; epiphyte or attached to rocks in tide pools; April, October, November.

CERAMIALES

CERAMIACEAE

Centroceras Kützing
Centroceras clavulatum (C. Agardh) Montagne Pl. 8, Fig. 69.
Børgesen 1939, p. 118; Newton 1955a, p. 10; Newton 1955b, p. 143; Smith 1969, p. 328, Pl. 84; Nizamuddin & Gessner 1970, p. 11; Edwards 1976, p. 41, Figs 179–182; Jaasund 1976, p. 109, Fig. 222; Basson 1979, p. 72, Pl. 12, Fig. 65; Anand 1981b, II, p. 25, Fig. 16.
Failaka Island, Doha, Shuwaikh; binding sand in tufts up to 10 cm across; September–December.

Ceramium Roth (*)
Ceramium luetzelburgii Schmidt Pl. 8, Fig. 70.
Schmidt 1924, pp. 98–99, Fig. 6; Nizamuddin & Gessner 1970, p. 11, Pl. 16, Fig. 47; Pl. 17, Figs 48, 49; Pl. 18, Figs 53, 55; Basson 1979, p. 72, Pl. 12, Fig. 70.
Doha, Shuwaikh, Failaka Island; epiphyte on *Hypnea*; March–April, also October–November.

Ceramium masonii Dawson Pl. 8, Fig. 71.
Jaasund 1976, p. 105, Fig. 213; Basson 1979, p. 75, Pl. 14, Fig. 77.
Records of this species in the Indian Ocean and the Arabian Gulf appear under names such as *C. transversale*, and *C. byssoideum.*
Failaka Island; epiphyte on *Halodule*; March.

Griffithsia C. Agardh (*)
Griffithsia tenuis (Harvey) C. Agardh Pl. 8, Fig. 68.
Børgesen 1939, p. 117; Nasr 1947, p. 122; Edwards 1976, p. 40, Fig. 169; Jaasund 1976, p. 113, Fig. 229; Humm 1979, p. 102.
Doha, Al-Nuwaiseeb; epiphyte on *Cystoseira* and *Digenea*; January–March.

Spyridia Harvey (*)
Spyridia filamentosa (Wulfen) Harvey Pl. 8, Fig. 72.
Børgesen 1939, p. 117; Nasr 1947, p. 128; Newton 1955b, p. 143; Edwards 1976, p. 42, Fig. 184; Jaasund 1976, p. 111, Fig. 224; Basson 1979, p. 75, Pl. 14, Figs 78–80; Humm 1979, p. 107, Fig. 42.

Doha, Shuwaikh, Al-Jlayah, Al-Nuwaiseeb; epiphyte on *Jania* and *Hyphea*; January–April, October.

DASYACEAE

Dasya C. Agardh (*)
Dasya baillouviana (S. Gmelin) Montagne Pl. 9, Fig. 73.
= *D. pedicellata* C. Agardh.
Børgesen 1934a, pp. 50–52, Fig. 7; Børgesen 1937, pp. 345–346, Fig. 16; Børgesen 1945, pp. 28–29; Jaasund 1976, p. 119, Fig. 243; Basson 1979, p. 75, Pl. 14, Fig. 82.
Shuwaikh, Kuwait Towers, Failaka Island; drift or dredged off Kuwait Sea Front; February–March.

Dasyopsis Zanardini (*)
Dasyopsis pilosa Werber-van Bosse Pl. 9, Fig. 74.
Jaasund 1976, p. 121, Fig. 245; Basson 1979, p. 75, Pl. 14, Fig. 83.
Kubber Island; dredged, on old coral; April.

Heterosiphonia Montagne (*)
Heterosiphonia crispella (C. Agardh) Wynne Pl. 9, Fig. 75.
Wynne 1985.
= *H. wurdemannii* (Bail.) Falkenberg
Børgesen 1939, p. 132; Nasr 1947, p. 142; Nizamuddin & Gessner 1970, p. 12; Jaasund 1976, p. 121, Fig. 246; Anand 1981b, II, p. 39, Fig. 28A, B.
Doha; epiphyte on *Digenea* and *Cystoseira*; January, October.

RHODOMELACEAE

Acanthophora Lamouroux
Acanthophora muscoides (Linn.) Bory (**) Pl. 9, Fig. 81.
Jaasund 1976, p. 137, Fig. 278.
Failaka Island; on stones in sand from mid-tide level downwards; September, October.

Acanthophora spicifera (Vahl) Børgesen (*) Pl. 10, Fig. 82.
Børgesen 1945, p. 61; Nizamuddin & Gessner 1970, p. 13; Jaasund 1976, p. 137, Fig. 276; Basson 1979, p. 78, Pl. 15, Figs 84, 85; Anand 1981b, II, p. 37, Fig. 26.
Shuwaikh, Failaka Island, Al-Nuwaiseeb; on stones in sand from mid-tide level downwards; November–December, May.

Herposiphonia Nägeli (*)
Herposiphonia dendroidea Hollenberg Pl. 10, Fig. 83.
Hollenberg 1968, p. 543, Figs 1c, 1d, 1e, 9; Basson 1979, p. 78, Pl. 15, Figs 89, 90.
Doha, Al-Nuwaiseeb; on stones; December–April.

Chondria C. Agardh

Chondria dasyphylla (Woodward) C. Agardh Pl. 10, Fig. 84.

Børgesen 1939, p. 121; Newton 1955a, p. 101; Newton 1955b, p. 143; Edwards 1976, p. 47, Figs 212, 214, 216; Jaasund 1976, p. 135, Fig. 274; Basson 1979, p. 78, Pl. 15, Figs 86–88; Anand 1981b, II, p. 35.

Doha, Sha'ab, Failaka Island, Al-Jlayah, Al-Nuwaiseeb; epiphyte on *Digenea* and *Laurencia*; December–May.

Digenea C. Agardh (*)

Digenea simplex (Wulfen) C. Agardh Pl. 10, Fig. 85.

Børgesen 1939, p. 121; Nasr 1947, p. 137; Newton 1955b, p. 143; Edwards 1976, p. 46, Figs 207–209; Jaasund 1976, p. 125, Fig. 254.

Doha, Failaka Island, Mina Abdullah, Dbaiyyah; on stones in muddy pools, heavily infested with epiphytes; July–November.

Laurencia Lamouroux

Laurencia obtusa (Huds.) Lamouroux (*) Pl. 10, Fig. 86.

Børgesen 1939, p. 120; Nasr 1947, p. 134, Pl. 14, Fig. 2; Newton 1955b, p. 143; Jaasund 1976, p. 143, Fig. 289; Anand 1981b, II, p. 31, Figs 22A–D.

Doha, Kuwait Towers, Failaka Island, Al-Jlayah; epiphyte on *Gracilaria* and other algae; February–November.

Laurencia papillosa (Forsskål) Greville Pl. 10, Fig. 87.

Børgesen 1939, p. 118; Nasr 1947, p. 134; Newton 1955a, p. 101; Jaasund 1976, p. 139, Fig. 281.

Doha, Shuwaikh, Sha'ab, Failaka Island, Al-Nuwaiseeb; on stones in tidal pools; March–May, October–December.

Murrayella (**)

Murrayella periclados (C. Agardh) Schmitz Pl. 10, Fig. 88.

Fritsch 1945, II, p. 549; Dawes 1974, p. 160; Jaasund 1976, p. 127, Fig. 256.

Kubbar Island; on coral reef; March.

Polysiphonia Greville

Polysiphonia coacta Tseng (**) Pl. 9, Fig. 76.

Jaasund 1976, p. 125, Fig. 252.

Shuwaikh, Sha'ab; on littoral sand; March.

Polysiphonia crassicollis Børgesen Pl. 9, Figs 77, 78.

Børgesen 1939, pp. 126–129, Figs 39, 40; Newton 1955a, p. 101; Newton 1955b, p. 143; Nizamuddin & Gessner 1970, p. 13; Jaasund 1976, p. 123, Fig. 249; Basson 1979, p. 79, Pl. 16, Figs 93, 94.

Kuwait Towers, Sha'ab; epiphyte on other algae; March–May.

Polysiphonia platycarpa Børgesen (**) Pl. 9, Fig. 79.

Jaasund 1976, p. 123, Fig. 251; Anand 1981b, II, p. 38, Fig. 27.

Kubbar Island; on old coral; May.

Polysiphonia variegata (C. Agardh) Zanardini (*) Pl. 9, Fig. 80.

Børgesen 1934b, pp. 26–28, Fig. 18; Nizamuddin & Gessner 1970, p. 13, Pl. 24, Fig. 79; Pl. 26, Fig. 86; Srinivasan 1973, p. 6; Jaasund 1976, p. 123, Fig. 248; Basson 1979, p. 79, Pl. 16, Fig. 96; Anand 1981b, II, p. 39.

Subiya, Shuwaikh, Kuwait Towers, Failaka Island; common on stones and rocks in sand; January–March.

CYANOPHYTA

CYANOPHYCEAE

CHROOCOCCALES

CHROOCOCCACEAE

Chroococcus Nägeli
Chroococcus minor (Kützing) Nägeli (**)
Desikachary 1959, p. 105, Pl. 24, Fig. 1; Dawes 1974, p. 50, Fig. 9.
Al-Anjafa, Al-Jlayah, Al-Khiran; on intertidal rocks; in all seasons.

Synechocystis Sauvageau (**)
Synechocystis sp.
Desikachary 1959, p. 144;
Shows close agreement with the description of *S. pevalekii* Ercegović; Desikachary 1959, p. 145, Pl. 25, Fig. 11.
Al-Khiran; in upper intertidal flats under salt crusts; in all seasons.

NOSTOCALES

OSCILLATORIACEAE

Lyngbya C. Agardh ex Gomont
Lyngbya aestuarii Liebmann ex Gomont (*) Pl. 10, Fig. 89.
Desikachary 1959, pp. 305, 307, Pl. 52, Fig. 8; Basson 1979, p. 63, Pl. 8, Fig. 39.
Salmiyah, Al-Anjafa, Al-Jlayah, Al-Khiran; on stones in tidal pools and epiphytic on other algae; October–June.

Lyngbya ceylanica Wille var. *constricta* Frémy (*) Pl. 10, Fig. 90.
Desikachary 1959, p. 299, Pl. 54, Fig. 5; Basson 1979, p. 63, Pl. 8, Fig. 40.
Salmiyah, Al-Anjafa; epiphyte on other algae; October–June.

Lyngbya confervoides C. Agardh ex Gomont (*) Pl. 11, Fig. 91.
Børgesen 1939, p. 55; Nasr 1947, p. 10; Desikachary 1959, p. 314, Pl. 49, Fig. 9; Pl. 52, Fig. 13; Dawes 1974, p. 52; Basson 1979, p. 63, Pl. 8, Fig. 41.
Al-Khiran; attached to shells and epiphytic on *Padina*: October–June.

Microcoleus Desmazières ex Gomont (*) Pl. 11, Fig. 92.
Microcoleus chthonoplastes Thuret ex Gomont
Desikachary 1959, p. 343, Pl. 60, Figs 7–9; Basson 1979, p. 63, Pl. 8, Fig. 42.
Al-Anjafa, Al-Khiran; on rocks, also forming tufted living stromatolites in intertidal flats; October–June.

Oscillatoria Vaucher ex Gomont (*)
Oscillatoria limnetica Lemmermann (**)
Desikachary 1959, p. 226, Pl. 37, Fig. 3.
Al-Jlayah, Al-Khiran; on rocks, also forming crinkled living stromatolites in intertidal flats; October–June.

Oscillatoria nigro-viridis Thwaites ex Gomont Pl. 11, Fig. 93.
Børgesen 1939, p. 56; Desikachary 1959, p. 202, Pl. 42, Fig. 6, Pl. 49, Fig. 2; Nizamuddin & Gessner 1970, p. 8; Basson 1979, p. 65, Pl. 8, Fig. 44.
Shuwaikh, Al-Anjafa; on rocks, stones and epiphyte on other algae; September–June.

Oscillatoria princeps Vaucher ex Gomont Pl. 11, Fig. 94.
Desikachary 1959, p. 210, Pl. 37, Figs 1, 10, 11, 14; Dawes 1974, p. 55; Basson 1979, p. 65, Pl. 8, Fig. 45.
Shuwaikh; on soil in intertidal flats: September–November.

Phormidium Kützing ex Gomont (*)
Phormidium corium (J. Agardh) Gomont (**) Pl. 11, Fig. 95.
Geitler 1925, p. 384, Fig. 487; Desikachary 1959, p. 269, Pl. 44, Figs 10, 11.
Al-Khiran; in soil of salt pools; October–June.

Phormidium jenkelianum G. Schmid
Desikachary 1959, pp. 255–256, Pl. 54, Fig. 7; Basson 1979, p. 65, Pl. 8, Fig. 46.
Al-Khiran; in soil of salt pools; October–June.

Spirulina Kützing ex Gomont (*)
Spirulina labyrinthiformis (Meneghini) Gomont
Desikachary 1959, p. 195, Pl. 36, Fig. 11; Basson 1979, p. 65, Pl. 9, Fig. 47.
Al-Khiran; in the intertidal and supratidal flats forming smooth living stromatolites; October–June.

Spirulina subsalsa Oersted ex Gomont Pl. 11, Fig. 96.
Desikachary 1959, p. 193, Pl. 36, Figs 3, 9; Dawes 1974, p. 58, Fig. 20; Basson 1979, p. 65, Pl. 9, Fig. 49.
Al-Khiran; in the upper intertidal flats under salt crust; October–June.

NOSTOCACEAE

Anabaena Bory (**)
Anabaena constricta (Szafer) Geitler (*) Pl. 11, Fig. 97.
= *Pseudanabaena constricta* (Szafer) Lauterb.
Geitler 1925, p. 312, Fig. 360; Desikachary 1959, p. 419, Pl. 71, Figs 1, 2, 3.
Al-Khiran; in the upper intertidal flats on silt and under salt crust; October–June.

RIVULARIACEAE

Calothrix C. Agardh ex Bornet & Flahault
Calothrix confervicola (Roth) C. Agardh ex Bornet & Flahault Pl. 11, Fig. 98.
Børgesen 1939, p. 56; Nasr 1947, p. 13; Newton 1955a, p. 102; Newton 1955b, p. 144; Dawes 1974, p. 60; Basson 1979, p. 67, Pl. 9, Fig. 50.
Al-Khiran, Al-Nuwaiseeb; epiphyte on *Padina*; November–April.

Calothrix scopulorum (Weber & Mohr.) C. Agardh ex Bornet & Flahault (*) Pl. 11, Fig. 99.
Nasr 1947, p. 13, Fig. 2; Desikachary 1959, pp. 524, 525, Pl. 111, Fig. 9; Basson 1979, p. 67, Pl. 9, Fig. 51.
Al-Khiran; epiphyte on *Padina*; November–April.

MARINE PHANEROGAMS

HALOPHILACEAE

Halophila Thou (*)
Halophila ovalis (R. Brown) Hook.f. Pl. 12, Fig. 100.
Nizamuddin & Gessner 1970, p. 1, Pl. 1, Fig. 3; Tackholm 1974, p. 613, Pl. 222.
Doha, Dbaiyyah, Al-Khiran, Al-Nuwaiseeb; on sheltered sand beaches and extending into the sublittoral; all seasons.

CYMODOCEACEAE

Halodule Endl. (*)
Halodule uninervis (Forsskål) Aschers. Pl. 12, Fig. 101.
Nizamuddin & Gessner 1970, p. 1, Pl. 1, Fig. 1, Pl. 2, Fig. 4; Tackholm 1974, p. 626, Pl. 229.
Doha, Al-Khiran, Al-Nuwaiseeb; on sheltered sand beaches, extending into the sublittoral; all seasons.

DISCUSSION

The present work records 105 species of marine algae as well as 2 marine angiosperms. Of the marine algae, 41 genera and 89 species are reported new to Kuwait; 12 genera and 30 species are new to the Arabian Gulf. Chlorophyta are represented by 26 species of which 24 are new to Kuwait; Phaeophyta (total 22, with 16 new species); Rhodophyta (total 39, of which 32 are new); Xanthophyta (total 1, new 1); Haptophyta (total 1, new 1); Cyanophyta (total 16, new 15). This list is incomplete, particularly as regards some shores in Failaka and Kubbar islands which have a rich algal flora but are rather inaccessible.

The elements of the algal flora show an interesting pattern of distribution along the coastline of Kuwait. In general, the number of species is highest in Doha, Shuwaikh, Failaka Island and Al-Nuwaiseeb, and lowest in the intermediate stations, particularly at Mina Abdullah. This pattern can be attributed to several ecological and environmental factors. Jacob *et al.* (1979) divided the coastline of Kuwait into three distinct areas which offer three different ecological niches: 1) semi-enclosed Kuwait Bay with highest levels of salinity and primary productivity; 2) a more open sea area directly influenced by the Shatt Al-Arab river, extending from the southern shores of Bubiyan Island to the western parts of Failaka Island, with high levels of productivity and lowest salinity; 3) the open area comprising the eastern coast of Kuwait extending from Salmiyah to Al-Nuwaiseeb, with lowest levels of productivity and average salinity.

The open coastline of the Gulf is more exposed to wave action and consequently to erosion effects. Sandy shores are more subjected to erosion than rocky shores. Furthermore, in the Arabian Gulf, the tidal regime is complex due to the semi-enclosed nature of the water mass (Hunter 1986). In Kuwait, the tidal range varies from 3·5 m in the north where semi-diurnal tides occur, to less than 2 m in the south where diurnal tides predominate. The human impact has also to be considered; the population in the north is denser than that in the south. It appears that

these factors act collectively and lead to the pattern of distribution described above (see Fig. 2).

Other records are more puzzling: *Codium papillatum* is frequently found, mainly in drift, and always in the northern coastal regions of Kuwait (Shuwaikh, Salmiyah, Fintas, Abu-Halifa). The genus *Codium* was not mentioned by Børgesen (1939), a surprising absence from his list, nor does the genus occur in Basson's list (1979). The

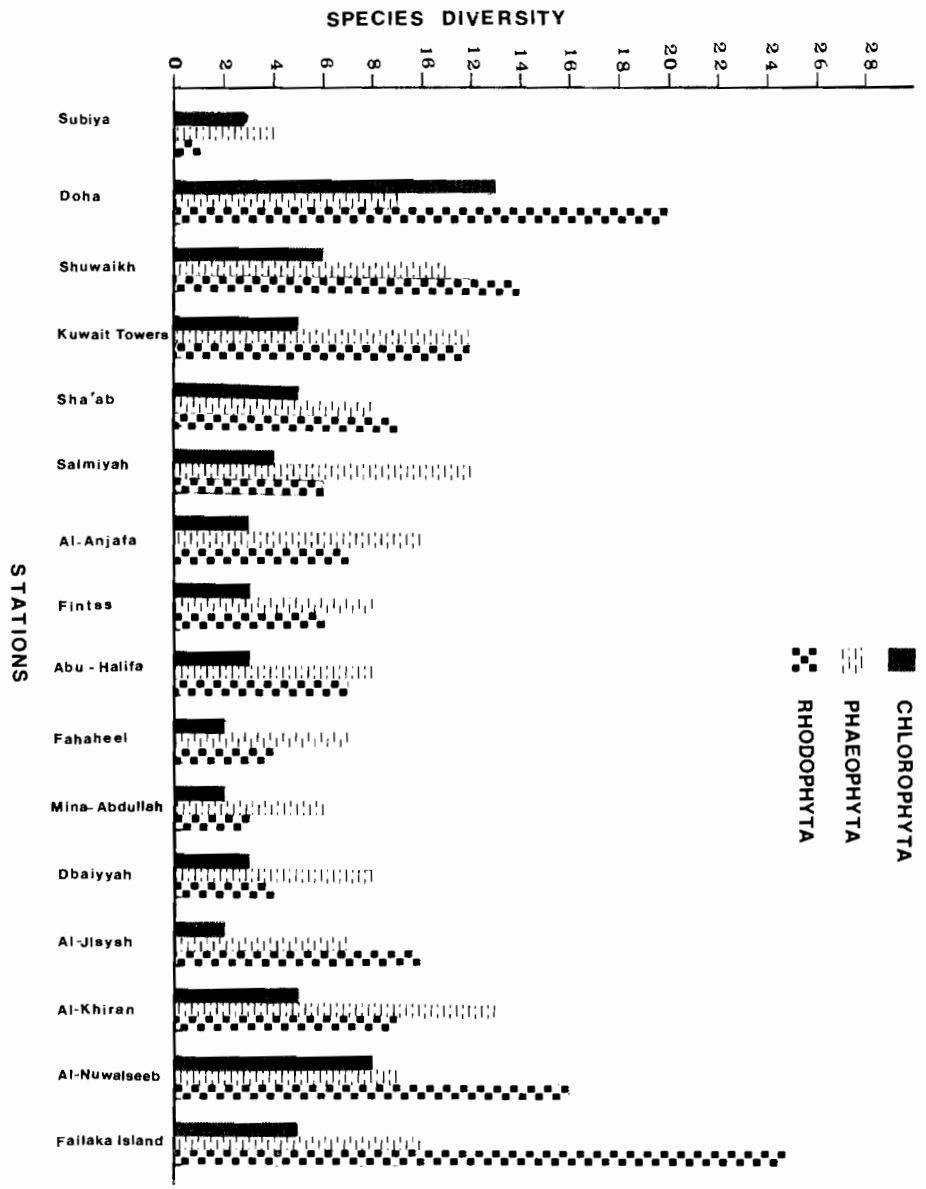

Fig. 2. Distribution pattern of algal species (species diversity of the main algal divisions at the stations studied).

nearest locality to Kuwait from which records of *Codium papillatum* are known is Cape Comorin, southern India; the species was originally described from the Philippines. This discontinuity in the geographical distribution may be attributed to inadequate collecting from the coastal area between southern India and Kuwait. However, Børgesen (1939), and Nizamuddin & Gessner (1970) stress that the impoverished nature of the algal flora of the northern region of the Gulf is mainly due to high temperature and salinity and the lack of rocky substrates. Jones (1986a) explained that the coast of Kuwait has no direct connection with the intertidal algae of the temperate zone, which may explain the lack of certain floral elements. Therefore, colonization of the warm temperate shores of Kuwait can only occur by eurythermal species which can survive passage through tropical waters. Much the same can be said about *Sargassum heteromorphum* and *Iyengaria stellata*. One of the discrepancies between our records and the Kellett collection of 1951 is the absence of *Hydroclathrus clathratus*, though a conspicuous and easily recognised alga. Despite our frequent visits and intensive collecting on the northern shores which was extended as far as Fahaheel, we failed to find *H. clathratus*. This may be attributed to intensive urbanization and industrialization in the coast since 1951, which apparently disturbed the habitat and resulted in the disappearance of other species as well.

Table 1 shows the seasonal variation in the floristic elements of the Kuwaiti algal flora. Some species, e.g. *Padina australis*, have a main season from April–May with a rapid decline followed by a gradual re-establishment. In other algae a rapid build up occurs in the population from January to March as is the case with *Colpomenia sinuosa*. Some others such as *Enteromorpha* spp. and *Ulva* spp. grow extensively and blanket some shores from February to March.

Besides the changes in the algal mass, morphological changes may take place. This is best demonstrated in the genus *Sargassum*. As has been observed by other workers (e.g. Chauhan & Krishnamurthy 1971) this genus is particularly prone to marked changes when defoliation occurs after fruiting. Thus *Sargassum binderi* and other species known from Kuwait are well developed and dominate most of the shores during autumn. The fruiting plants usually possess quite a different aspect in mid-winter, and after defoliation when large masses drift ashore, the residual bases are large-leaved and could be easily confused with *S. latifolium*. This variation emphasises the need for a revision of the genus *Sargassum* on a world-wide basis.

Within the short coastline of Kuwait (about 200 km), marine algae are restricted to about 10% of its total length where suitable substrates occur. Considerable losses of habitat have been recorded: Shuwaikh port and Doha power station have certainly "obliterated" some valuable shores. Similarly, the new shoreline of the Water Front Project covered one that originally supported rich algal populations in the 1970's. However, some interesting algal populations are now occupying the rocky platforms towards the northern part of Shuwaikh port and Doha power station. The impact of new sites in Al-Khiran area may offer an interesting study of colonization and subsequent development.

The coastline and its natural life provide a unique and fragile feature of Kuwait's heritage and consideration should be given to its conservation.

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(Received 20 May 1988, revised 19 October 1988)

Table 1. Seasonal occurrence of algal species along the coast of Kuwait (September 1983 to December 1986).

Table 1a.

DURATION	JAN.				FEB.				MAR.				APR.				MAY.				JUN.				JUL.				AUG.				SEP.				OCT.				NOV.				DEC.			
ALGAE	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86
I. Chlorophyta																																																
Dunaliella salina					X	X	X		X	X	X		X	X	X		X	X	X										X	X	X		X	X	X	X	X	X	X	X								
Enteromorpha clathrata		X	X	X		X	X	X		X	X	X																														X	X	X	X			
Enteromorpha compressa		X	X	X		X	X	X		X	X	X																														X	X	X	X	X		
Enteromorpha flexuosa		X	X	X		X	X	X		X	X	X																								X	X		X	X	X	X	X	X		
Enteromorpha intestinalis		X	X	X		X	X	X		X	X	X		X	X	X																														
Enteromorpha prolifera		X	X			X	X	X		X	X	X																				X				X	X	X	X	X	X	X	X	X	X	X	X	
Ulva lactuca				X		X	X	X		X	X	X																																			
Ulva reticulata						X	X	X		X	X	X		X	X	X		X	X	X	X	X	X	X								X															
Ulva rigida							X	X		X	X	X		X	X	X																															
Blidingia minima										X	X			X	X																		X											X	X		
Chaetomorpha aerea		X	X			X	X																																				X		X		
Chaetomorpha capillaris														X																														X		X		
Chaetomorpha crassa																																	X		X			X	X		X	X		X				
Chaetomorpha linum																																			X			X					X		X			
Cladophora coelothrix																																									X				X			
Cladophora colabnse								X																																							
Cladophora nitelopsis		X				X									X				X																									X	X		
Cladophora sericoides										X																							X														
Cladophoropsis zollingeri																		X										X								X		X		X							
Dictyosphaeria cavernosa																		X																		X		X			X		X				
Siphonocladus feldmanni																																				X											
Bryopsis hypnoides						X	X	X			X	X																																			
Caulerpa sertularioides						X	X	X			X	X		X	X	X											X			X			X			X	X	X			X		X				
Codium papillatum		X	X			X	X			X	X																									X	X			X	X	X		X				
Avrainvillea amadipna																		X																				X	X								
Acetabularia calyculus																		X								X								X	X											

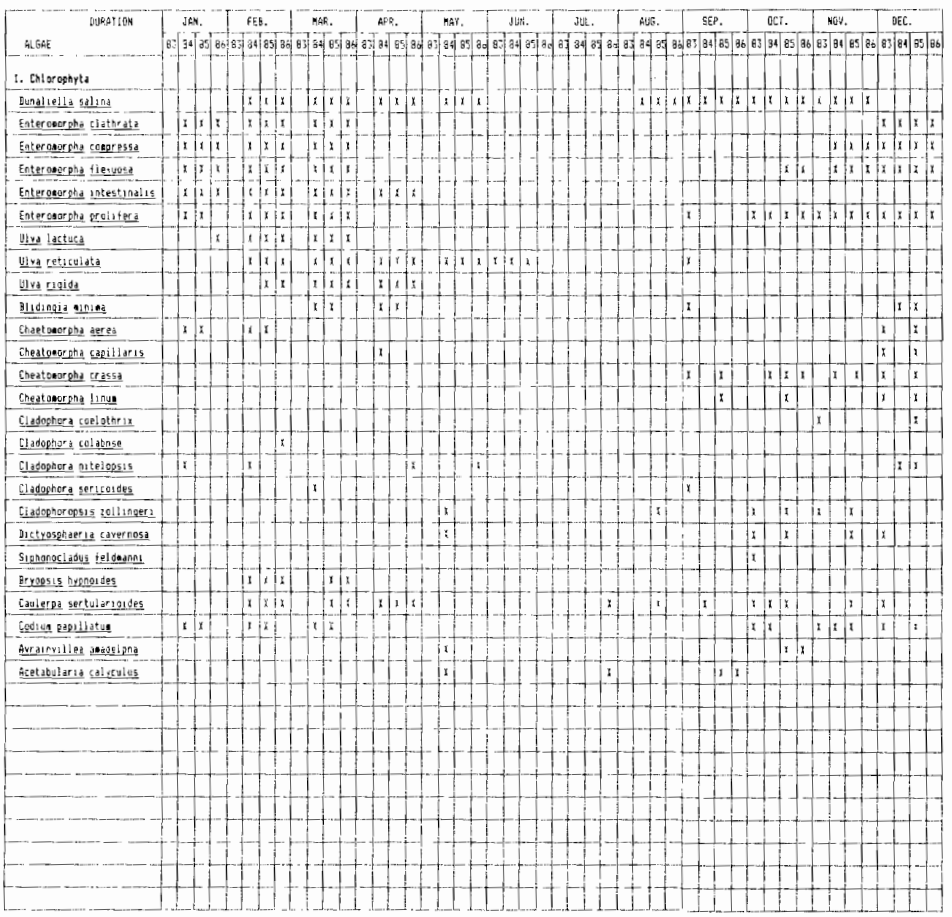

Table 1b.

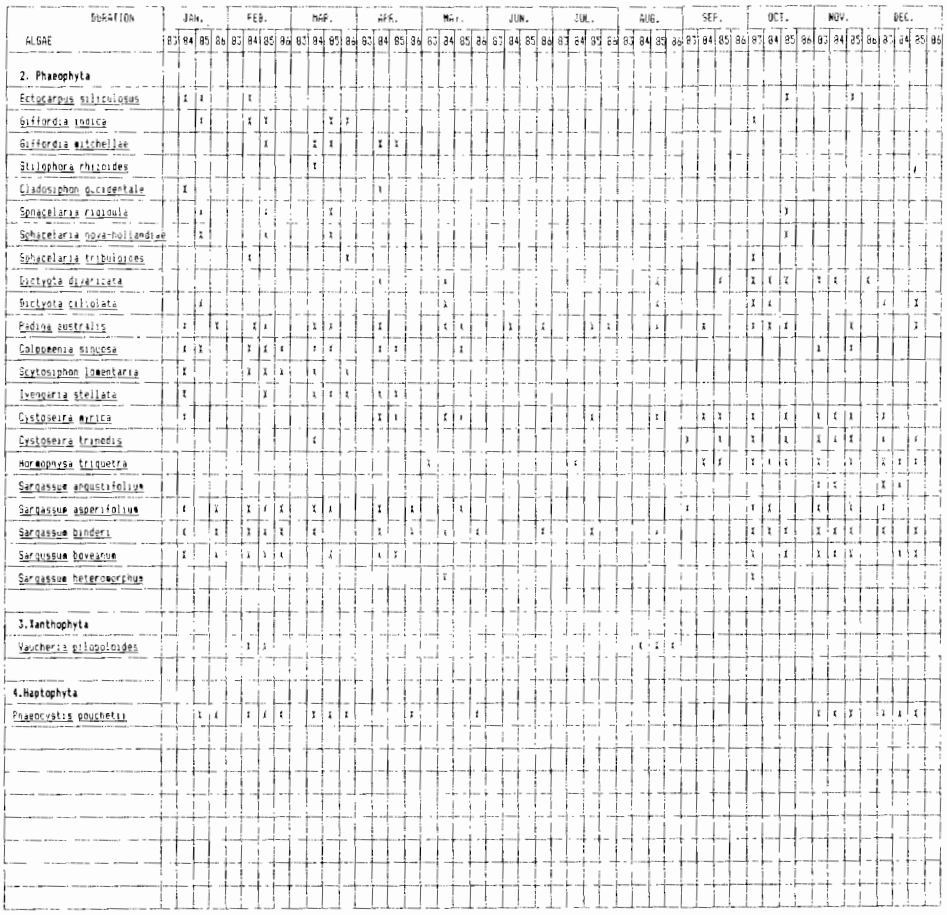
OBSERVATION
ALGAE
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
2. Phaeophyta
Ectocarpus siliculosus
Giffordia sedoides
Giffordia mitchelliae
Stilophora rhizoides
Cladosiphon occidentale
Sphacelaria rigidula
Sphacelaria nova-hollandiae
Sphacelaria tribuloides
Dictyota divaricata
Dictyota ciliolata
Padina australis
Colpomenia sinuosa
Scytosiphon lomentaria
Ivengaria stellata
Cystoseira myrica
Cystoseira trinodis
Hormophysa triquetra
Sargassum angustifolium
Sargassum asperifolium
Sargassum binderi
Sargassum boveanum
Sargassum heterocarpum
3. Xanthophyta
Vaucheria pilogoloides
4. Haptophyta
Phaeocystis poucheti

Table 1c.

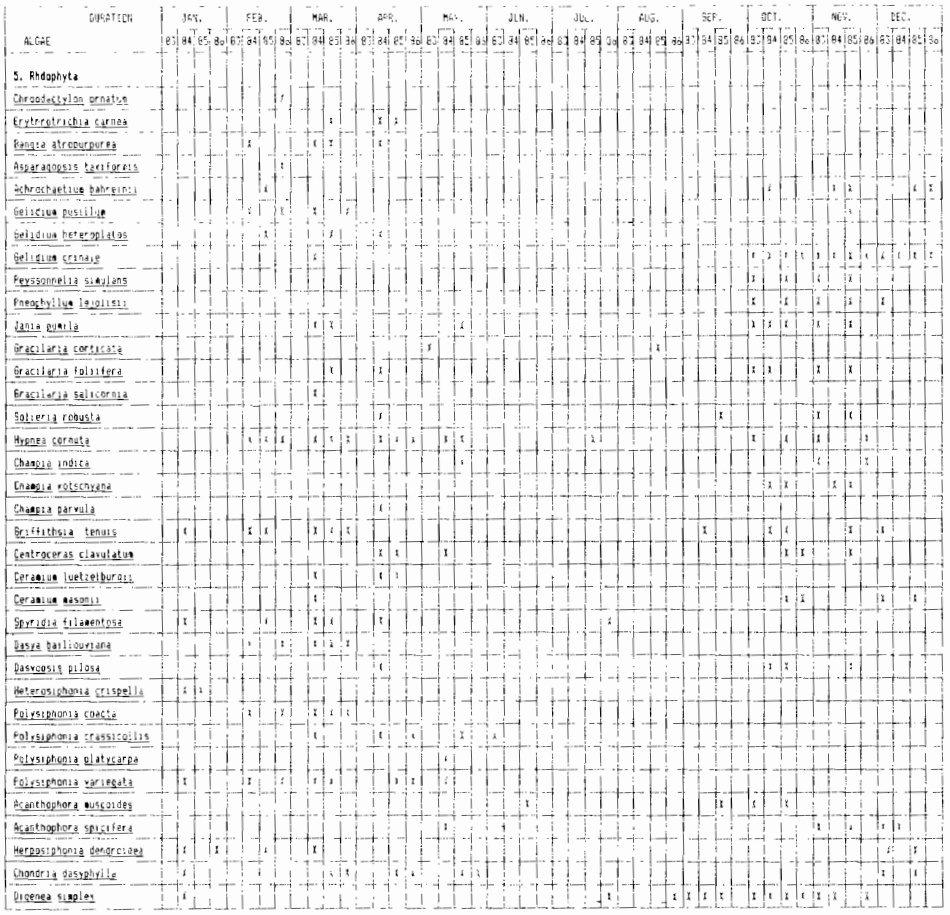
DURATION
ALGAE
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
5. Rhodophyta
Chrondactylon ornatum
Erythrotrichia carnea
Bangia atropurpurea
Asparagopsis taxiformis
Ochrochaetium bahrainii
Gelidium pusillum
Gelidium heteroplatos
Gelidium crinale
Feyssonnelia simulans
Pneophyllum lejolisii
Jania pumila
Gracilaria corticata
Gracilaria foliifera
Gracilaria salicornia
Solieria robusta
Hypnea cornuta
Champia indica
Champia kotschyana
Champia parvula
Griffithsia tenuis
Centroceras clavulatum
Ceramium luetzelburgii
Ceramium nasonii
Spyridia filamentosa
Dasya baillouviana
Dasycosis pilosa
Heterosiphonia crispella
Polysiphonia coacta
Polysiphonia crassicolis
Polysiphonia platycarpa
Polysiphonia variegata
Acanthophora muscoides
Acanthophora spicifera
Herposiphonia denegrioides
Chondria dasyphylla
Digenea simplex

Table 1d.

DURATION	JAN.				FEB.				MAR.				APR.				MAY.				JUN.			
ALGAE	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86
Laurencia obtusa						X	X			X	X	X		X	X				X	X				
Laurencia papillosa										X			X		X			X	X					
Murrayella periclados										X														
6. Cyanophyta																								
Chrococcus minor			X	X			X	X			X	X												
Synechocystis sp.			X	X			X	X			X	X			X	X								
Lyngbya aesturii		X		X			X	X			X	X		X	X	X								
Lyngbya ceylancia		X		X			X	X			X				X	X								
Lyngbya confervoides			X	X			X	X			X	X			X	X			X	X				
Microcoleus chthonoplastes		X		X			X	X			X	X		X		X			X	X				X
Oscillatoria limnetica											X													
Oscillatoria nigroviridis		X		X			X	X			X	X			X	X			X	X				X
Oscillatoria princeges				X			X	X				X			X	X			X	X			X	X
Phormidium corium				X			X	X			X	X			X	X				X				X
Phormedium jenkelianum			X				X				X													
Spirulina labeyrinthiformis				X			X	X			X	X			X	X				X				X
Spirulina subsalsa								X			X	X		X	X	X		X	X				X	X
Anabaena constricta				X			X	X				X		X	X	X			X	X			X	X
Calothrix confervicola			X	X			X	X			X	X			X	X								
Calothrix scopulorum			X	X			X	X			X	X			X	X								

DURATION	JUL.				AUG.				SEP.				OCT.				NOV.				DEC.			
ALGAE	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86	83	84	85	86
Laurencia obtusa			X									X	X	X			X		X					
Laurencia papillosa													X		X			X		X	X			
Murrayella periclados																								
6. Cyanophyta																								
Chrococcus minor															X	X		X	X	X		X	X	X
Synechocystis sp.							X	X			X	X		X	X	X		X	X	X			X	X
Lyngbya aesturii														X		X		X	X	X		X	X	X
Lyngbya ceylancia														X				X	X				X	X
Lyngbya confervoides															X	X		X	X	X			X	X
Microcoleus chthonoplastes																	X		X				X	X
Oscillatoria limnetica																			X				X	
Oscillatoria nigroviridis										X				X			X			X				X
Oscillatoria princeges											X	X		X	X	X			X	X			X	X
Phormidium corium											X	X		X	X	X			X	X			X	X
Phormedium jenkelianum											X	X			X	X			X	X			X	X
Spirulina labeyrinthiformis															X	X			X	X			X	X
Spirulina subsalsa			X											X	X	X		X	X	X			X	X
Anabaena constricta														X	X	X		X	X	X			X	X
Calothrix confervicola																			X	X	X		X	X
Calothrix scopulorum																			X	X	X		X	X

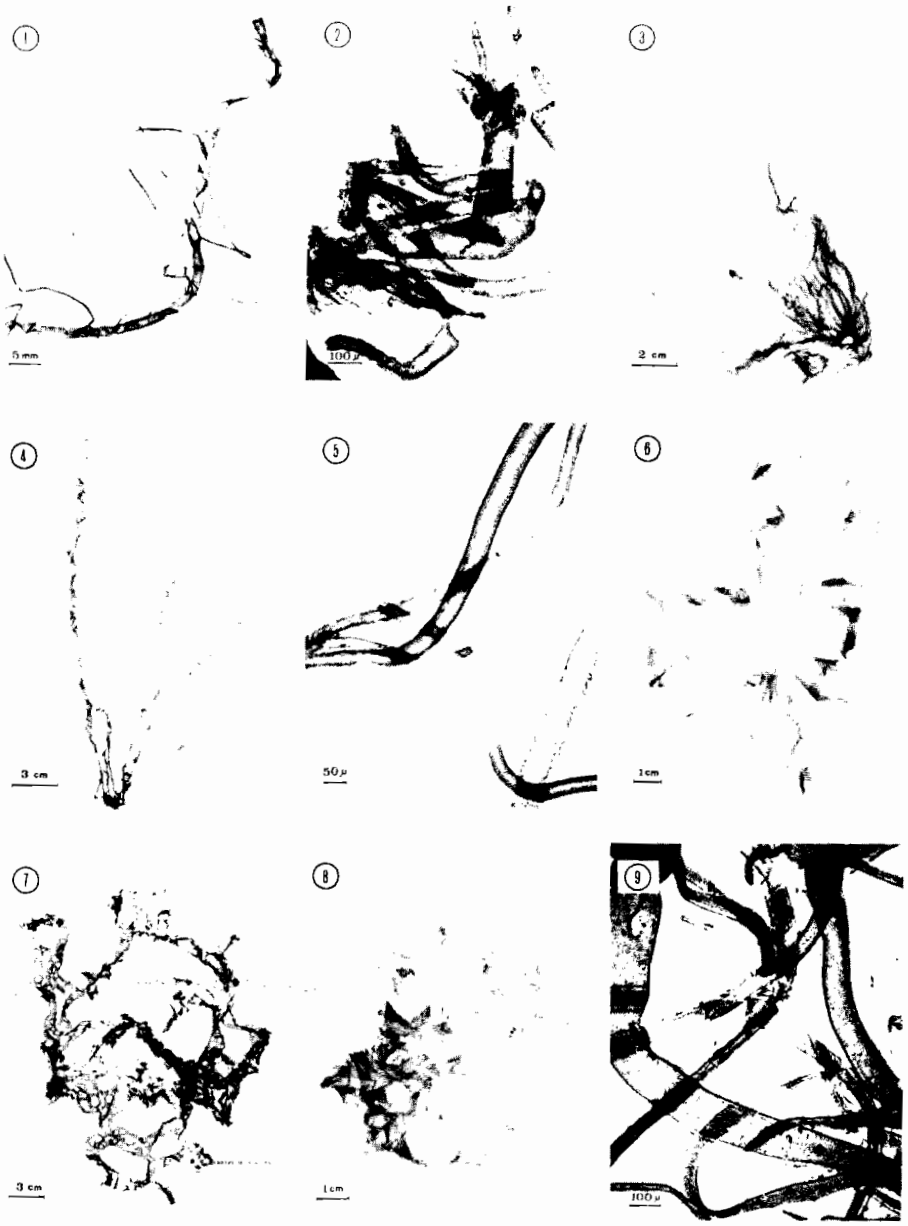

Plate 1

Plate 1

Fig. 1. *Enteromorpha clathrata* (Roth) Greville
Ultimate branches elongated.

Fig. 2. *Enteromorpha compressa* (Linn.) Greville
Basal narrow branches with broad apex.

Fig. 3. *Enteromorpha flexuosa* (Wulfen ex Roth) J. Agardh
Thallus sparsely branched, axes taper downwards to a filiform stipe, inflated distally.

Fig. 4. *Enteromorpha intestinalis* (Linn.) Link
Profusely branched at the base, ribbon-like blade with constrictions.

Fig. 5. *Enteromorpha prolifera* (Müll.) J. Agardh
Thallus slender with proliferous branches.

Fig. 6. *Ulva lactuca* Linn.
Thallus foliaceous and orbicular, young plant illustrated.

Fig. 7. *Ulva reticulata* Forsskål
Thallus perforated with mixed large and small holes.

Fig. 8. *Ulva rigida* C. Agardh
Blade orbicular with a short distinct stipe.

Fig. 9. *Blidingia minima* (Nägeli) Kylin var. *minima*
Several erect portions of the thallus, arising from a prostrate discoid base.

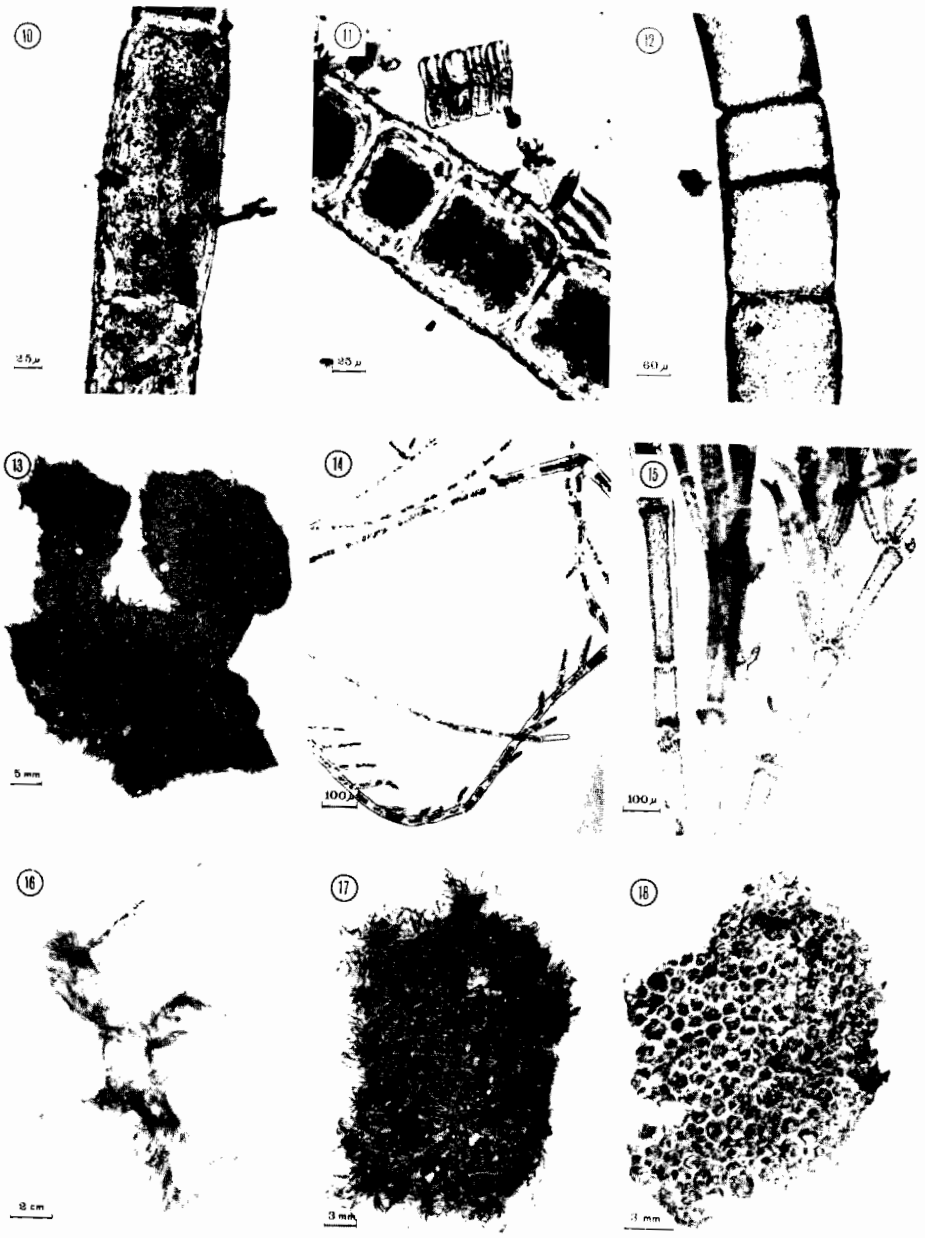

Plate 2

Plate 2

Fig. 10. *Chaetomorpha aerea* (Dillwyn) Kützing
Portion of filament showing cells 3 times longer than broad.

Fig. 11. *Chaetomorpha crassa* (C. Agardh) Kützing
Portion of the unbranched filament showing thick-walled cells and constrictions at transverse walls.

Fig. 12. *Chaetomorpha linum* (Müll.) Kützing
Portion of filament with constrictions at transverse walls.

Fig. 13. *Cladophora coelothrix* Kützing
Filaments stiff, aggregated to form a ball, branches unilateral.

Fig. 14. *Cladophora colabense* Børgesen
Ramuli unilateral, or alternate, 1-4 segmented.

Fig. 15. *Cladophora nitellopsis* Børgesen
Branches mostly opposite, 2–4 branches arise from the same articulation of the main axis, ramuli alternate and slightly curved.

Fig. 16. *Cladophora sericoides* Børgesen
Plant forming tufts, highly entangled, with branches produced at the joints.

Fig. 17. *Cladophoropsis zollingeri* (Kützing) Børgesen
Cushion-like, filaments ramified from one side.

Fig. 18. *Dictosphaeria cavernosa* (Forsskål) Børgesen
Plant globular, hollow, sessile, irregularly lobed.

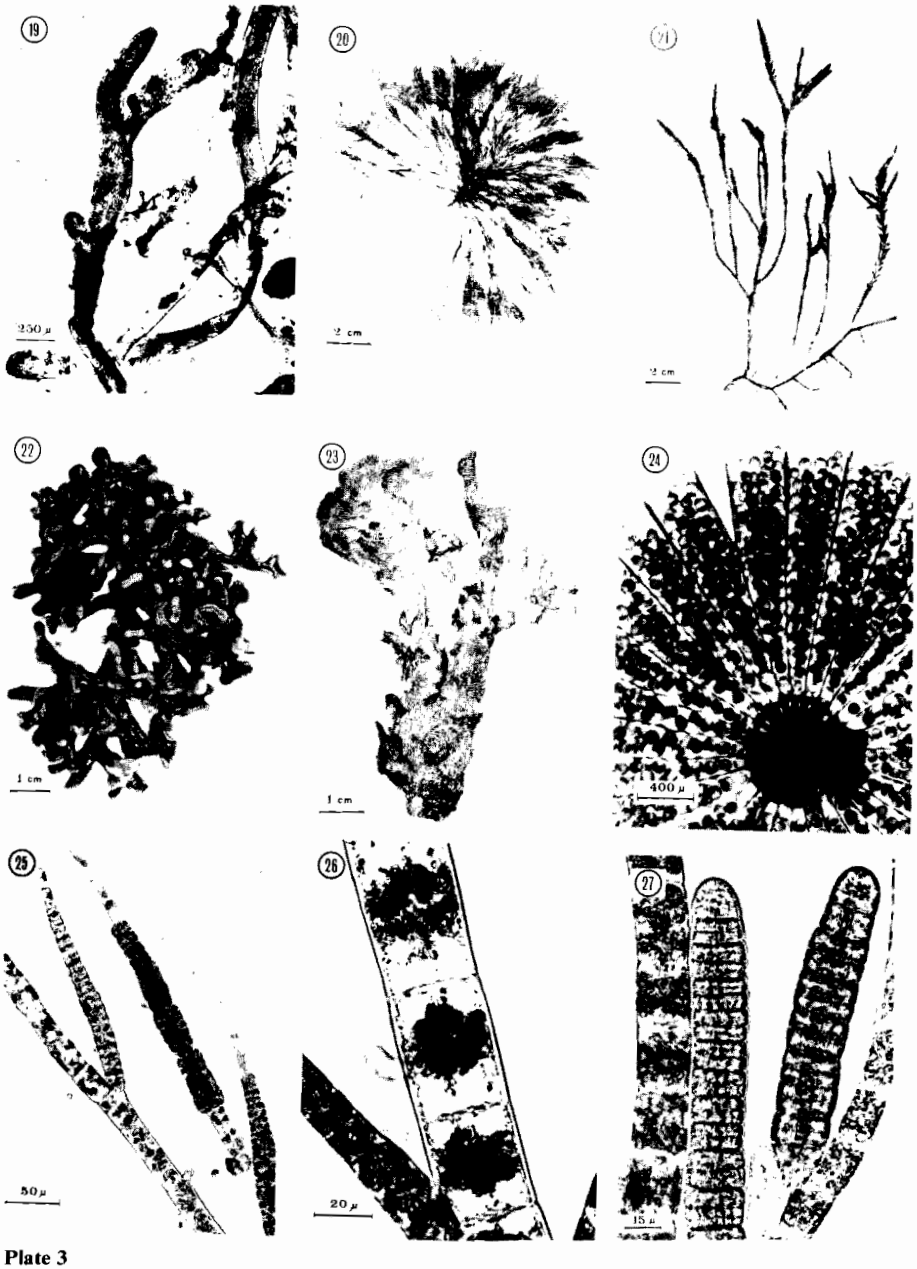

Plate 3

Plate 3

Fig. 19. *Siphonocladus feldmanni* Børgesen
Portion of the filament showing the terminal cell slightly swollen below the apex.

Fig. 20. *Bryopsis hypnoides* Lamouroux
Shoots erect, axis percurrent, branching profuse, ultimate branchlets tapered at the upper end and abruptly constricted at the base.

Fig. 21. *Caulerpa sertulariodes* (Gmelin) Howe
Feather-like blades, branchlets arranged in two opposite ranks, curved upwards, with mucronate tips.

Fig. 22. *Codium papillatum* Tseng & Gilbert
Plant appears as a large rounded structure, slightly flattened at the base, repeatedly dichotomously branched, shoots elongated.

Fig. 23. *Avrainvillea amadelpha* (Montagne) A. & E. Gepp
Thallus erect, flattened, fan-shaped blade, bulbous base.

Fig. 24. *Acetabularia calyculus* Quoy & Gaimard
Portion of a disc showing the gametangial rays containing cysts.

Fig. 25. *Ectocarpus siliculosus* (Dillwyn) Lyngbye
Typical plurilocular reproductive organs, greatly elongated and terminated by colourless hairs.

Fig. 26. *Giffordia indica* (Sonder) Papenfuss & Chihara
Greatly elongated plurilocular sporangium.

Fig. 27. *Giffordia mitchelliae* (Harvey) Hamel
Plurilocular sporangia barrel-shaped to cylindrical, sessile.

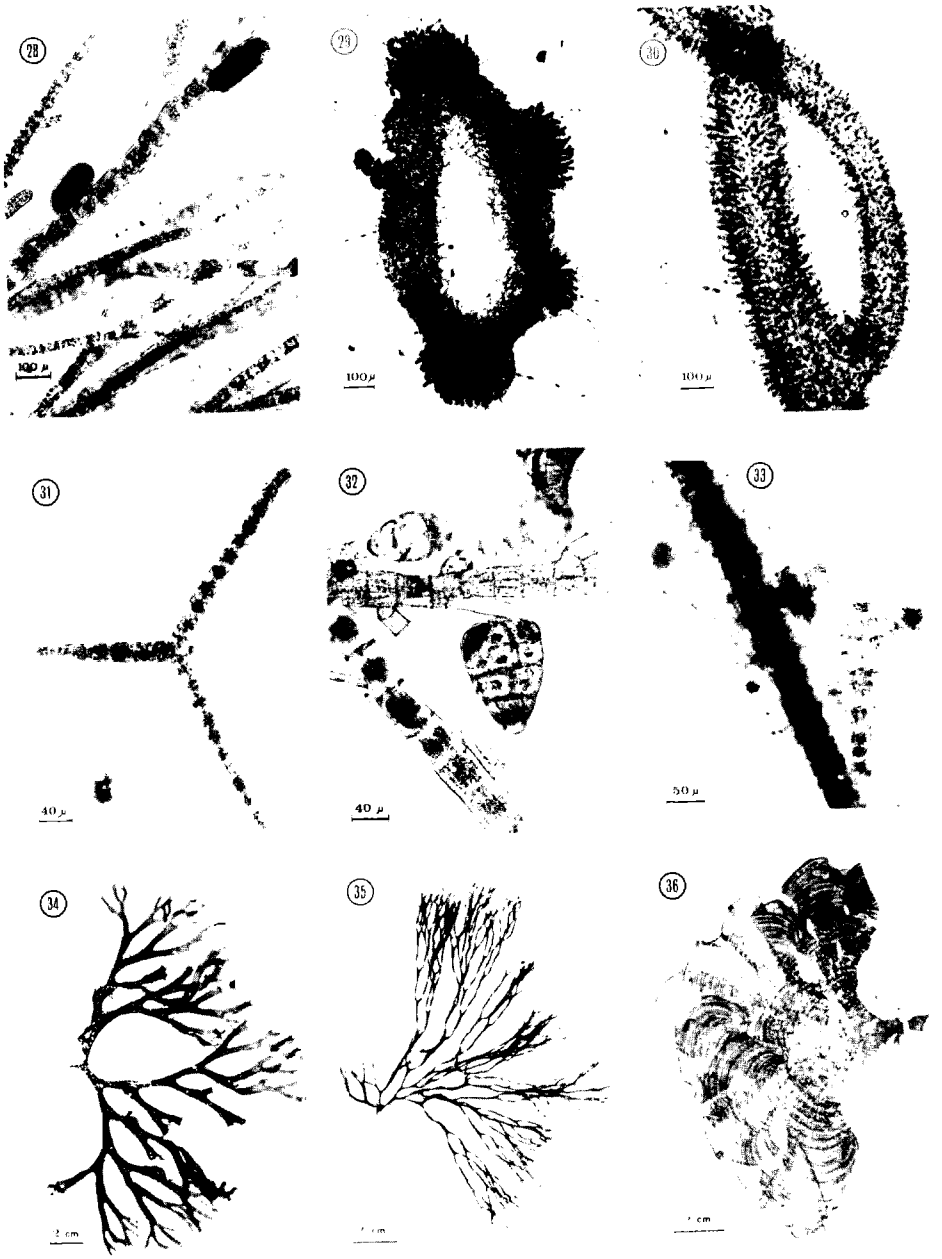

Plate 4

Plate 4

Fig. 28. *Giffordia mitchelliae* (Harvey) Hamel
Unilocular sporangia on irregularly branched thallus.

Fig. 29. *Stilophora rhizodes* (Ehrenb.) J. Agardh
Cross section of thallus showing peripheral part with a similar fertile tuft.

Fig. 30. *Cladosiphon occidentale* Kylin
Terete axes showing the assimilating filaments.

Fig. 31. *Sphacelaria rigidula* Kützing
V-shaped propagula.

Fig. 32. *Sphacelaria nova-hollandiae* Sonder
Portion of plant bearing the triangular propagula with their dark brown corner cells.

Fig. 33. *Sphacelaria tribuloides* Meneghini
Portion of plant bearing long triangular propagula on short stalk.

Fig. 34. *Dictyota ciliolata* Kützing
Dichotomously branched thallus, margins dentate.

Fig. 35. *Dictyota divaricata* Lamouroux
Narrow, twisted, dichotomously branched thallus, upper bifid ends acute.

Fig. 36. *Padina australis* Hauck
Fan-shaped thallus showing strong concentric banding.

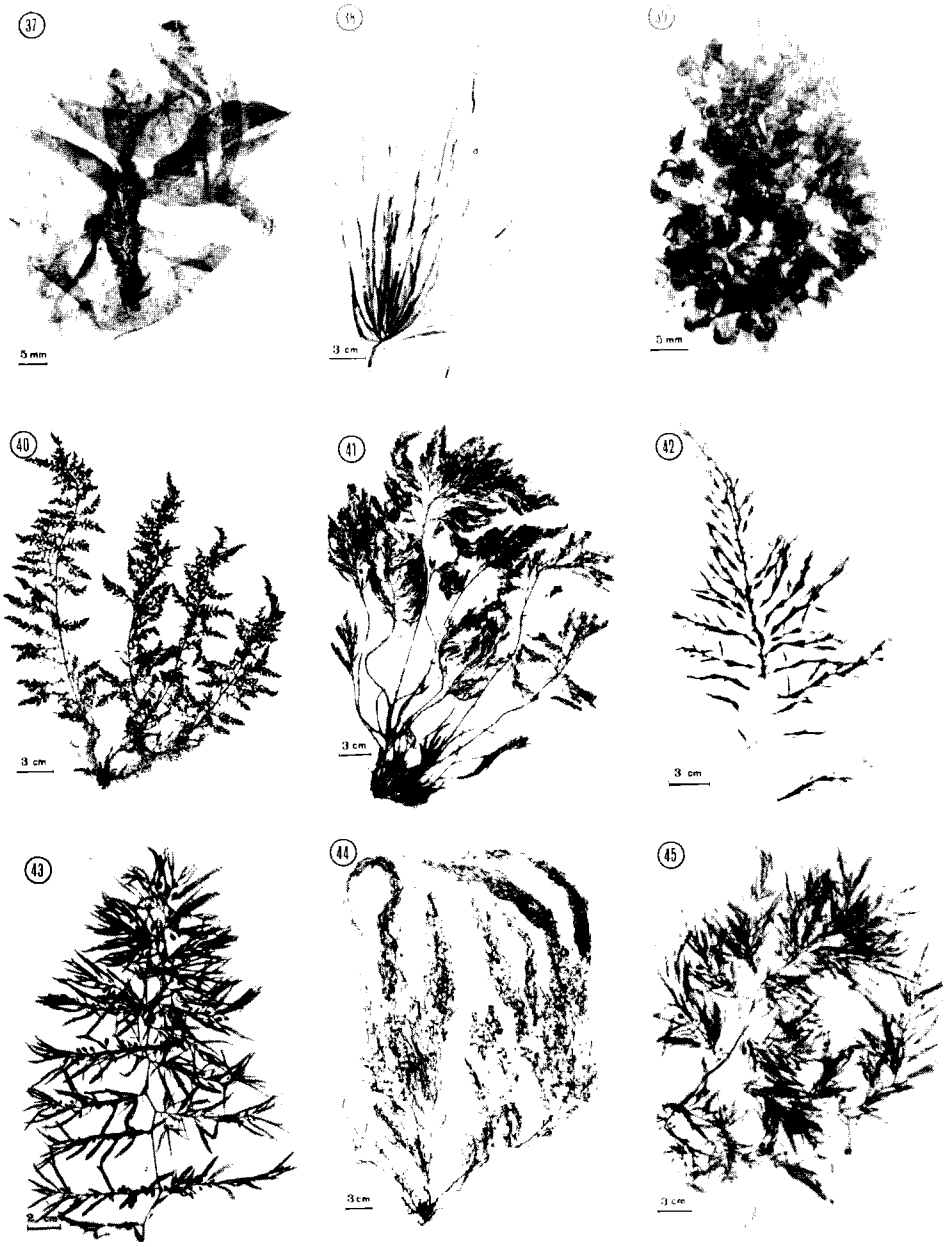

Plate 5

Plate 5

Fig. 37. *Colpomenia sinuosa* (Mertens ex Roth) Derbes & Solier
Plant hollow, subspherical-irregularly lobed, sessile and attached by a broad basal disc.

Fig. 38. *Scytosiphon lomentaria* (Lyngbye) J. Agardh.
Thalli with erect cylindrical unbranched shoots, constricted at intervals.

Fig. 39. *Iyengaria stellata* Børgesen
Thallus semiglobular with solid conical projections, providing stellate appearance.

Fig. 40. *Cystoseira myrica* (Gmelin) C. Agardh
Thallus alternately branched with numerous spherical-oval vesicles.

Fig. 41. *Cystoseira trinodis* (Forsskål) C. Agardh
Thallus alternately branched, ramuli filiform, bearing ellipsoid vesicles.

Fig. 42. *Hormophysa triquetra* (C. Agardh) Kützing
Thallus with terete basal axis, branches stalked, triquetrously winged, margins membranous, more or less dentate, vesicles arise within the winged branches.

Fig. 43. *Sargassum angustifolium* (Turner) J. Agardh
Thallus alternately branched, leaves linear with serrate margins, cylindrical receptacles and spherical vesicles arise on leaf stipe.

Fig. 44. *Sargassum asperifolium* (Her. & Mart.) J. Agardh
Leaves linear without midrib and with a wart-like structure, vesicles spherical, receptacles simple or branched, short-stalked.

Fig. 45. *Sargassum binderi* Sonder
Thallus possessing large disc-shaped hold-fast, thin translucent leaves with serrate margins.

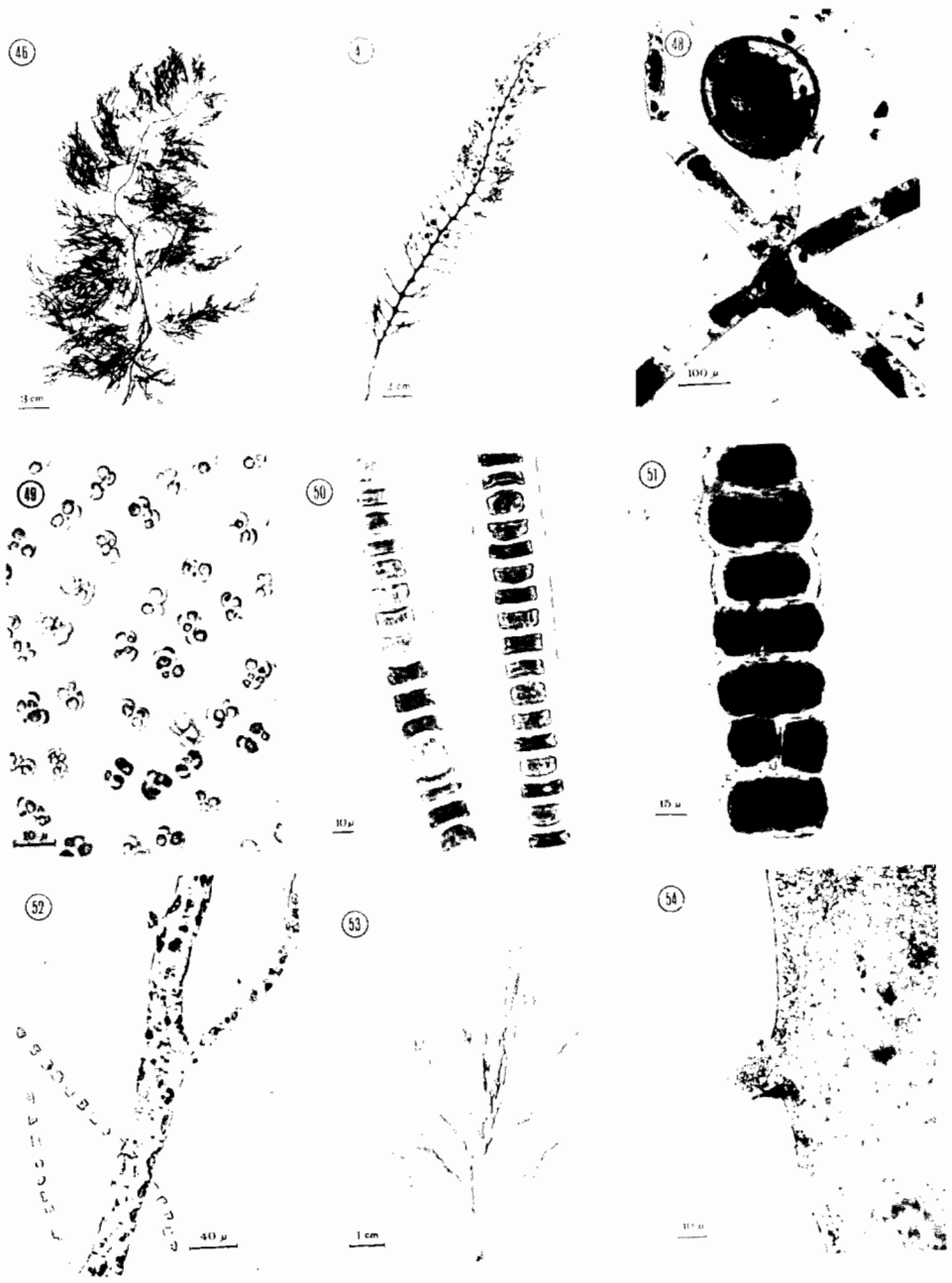

Plate 6

Plate 6

Fig. 46. *Sargassum boveanum* J. Agardh
Thallus flexuous, terete, alternately branched, leaves alternate, petiolate, linear-lanceolate, strongly serrate margined, apex acute, midrib thin but slightly conspicuous in mature leaves, vesicles pedicellate, supra-auxillary.

Fig. 47. *Sargassum heteromorphum* J. Agardh
Thallus with complanate branching, flattened, basal axis wide, terminal branches cylindrical.

Fig. 48. *Vaucheria piloboloides* Thuret
Oogonia and antheridia borne on a lateral branch.

Fig. 49. *Phaeocystis pouchetii* (Hariot) Lagerh.
Magnified portion of the colony showing the cells embedded in mucilaginous capsules.

Fig. 50. *Erythrotrichia carnea* (Dillwyn) J. Agardh
Filament unbranched, uniseriate.

Fig. 51. *Bangia atropurpurea* (Roth) C. Agardh
Young filament, unbranched, uniseriate.

Fig. 52. *Asparagopsis taxiformis* (Delile) Trevisar
Small filamentous thallus of asexual stage in life history, alternately branched, apical cells elongated with flat base.

Fig. 53. *Gelidium crinale* (Turn.) Lamouroux
Thallus terete, irregularly branched, terminal branches compressed with scattered tetrasporangia.

Fig. 54. *Gelidium heteroplatos* Børgesen
Magnified portion of the thallus showing young outgrowth.

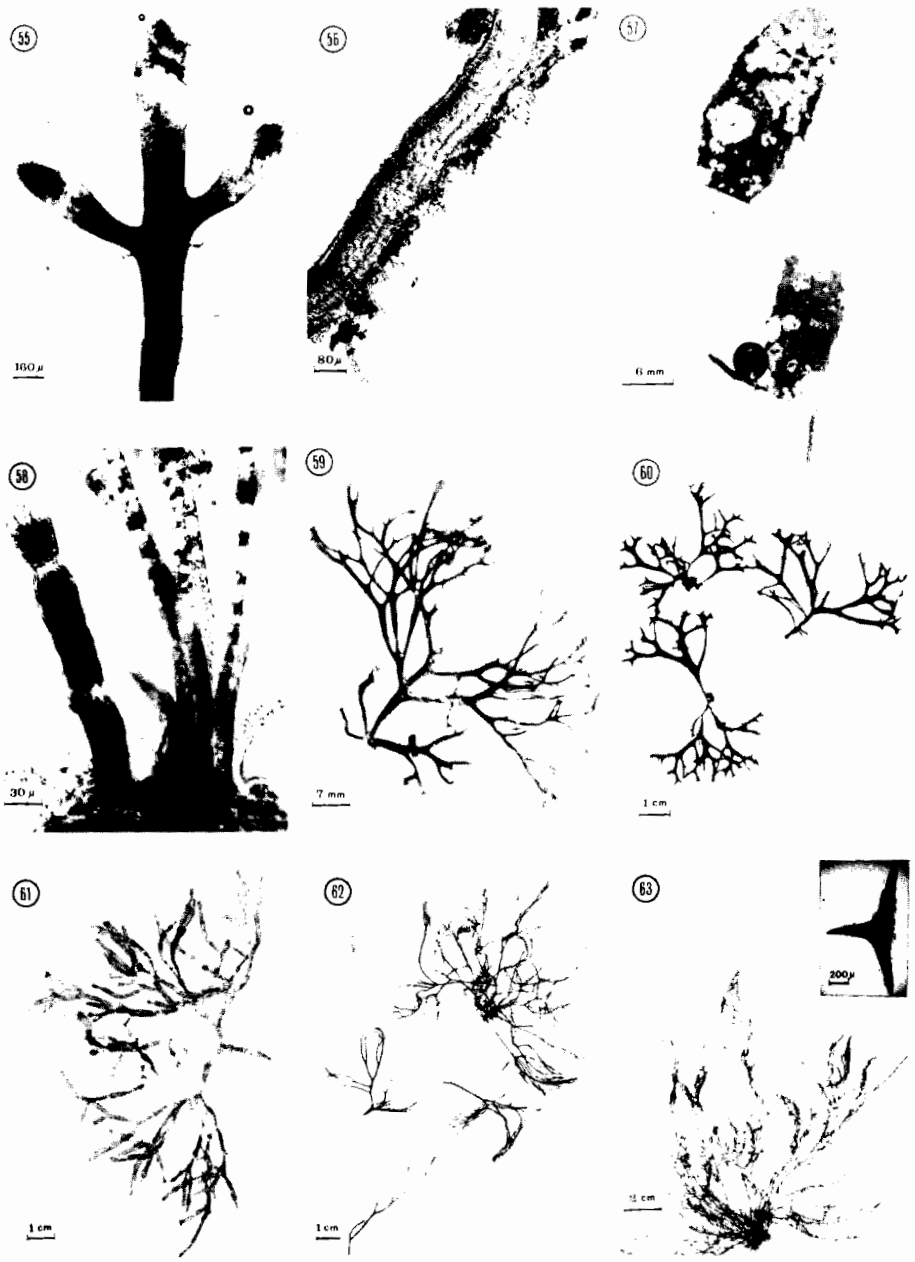
55
160 μ
56
80 μ
57
6 mm
58
30 μ
59
7 mm
60
1 cm
61
1 cm
62
1 cm
63
200 μ
1 cm

Plate 7

Plate 7

Fig. 55. *Gelidium pusillum* (Stackhouse) Le Jolis
Distal portion showing the stichidia bearing patches of tetrasporangia.

Fig. 56. *Peyssonnelia simulans* Werber-van Bosse
Cross section of the thallus showing unicellular rhizoids.

Fig. 57. *Pneophyllum lejolisii* (Rosanoff) Chamberlain
Pink crusts of the thallus forming irregular lobed discs, epiphytic on *Sargassum* spp.

Fig. 58. *Jania pumila* Lamouroux
Portion of thallus showing segments and uncalcified zones.

Fig. 59. *Gracilaria corticata* J. Agardh
Thallus with lobed hold-fast, dichotomously branched, apex acute, furcate.

Fig. 60. *Gracilaria foliifera* (Forsskål) Børgesen
Thallus with the upper part much divided and palmately expanded and compressed.

Fig. 61. *Gracilaria salicornia* (J. Agardh) Dawson
Thallus irregularly branched, irregularly constricted.

Fig. 62. *Solieria robusta* (Greville) Kylin
Branches alternate with tapering ends.

Fig. 63. *Hypnea cornuta* (Lamouroux) J. Agardh
Simple and slender branchlets clothing the axes of the thallus, branches alternate with stellate spiny processes.

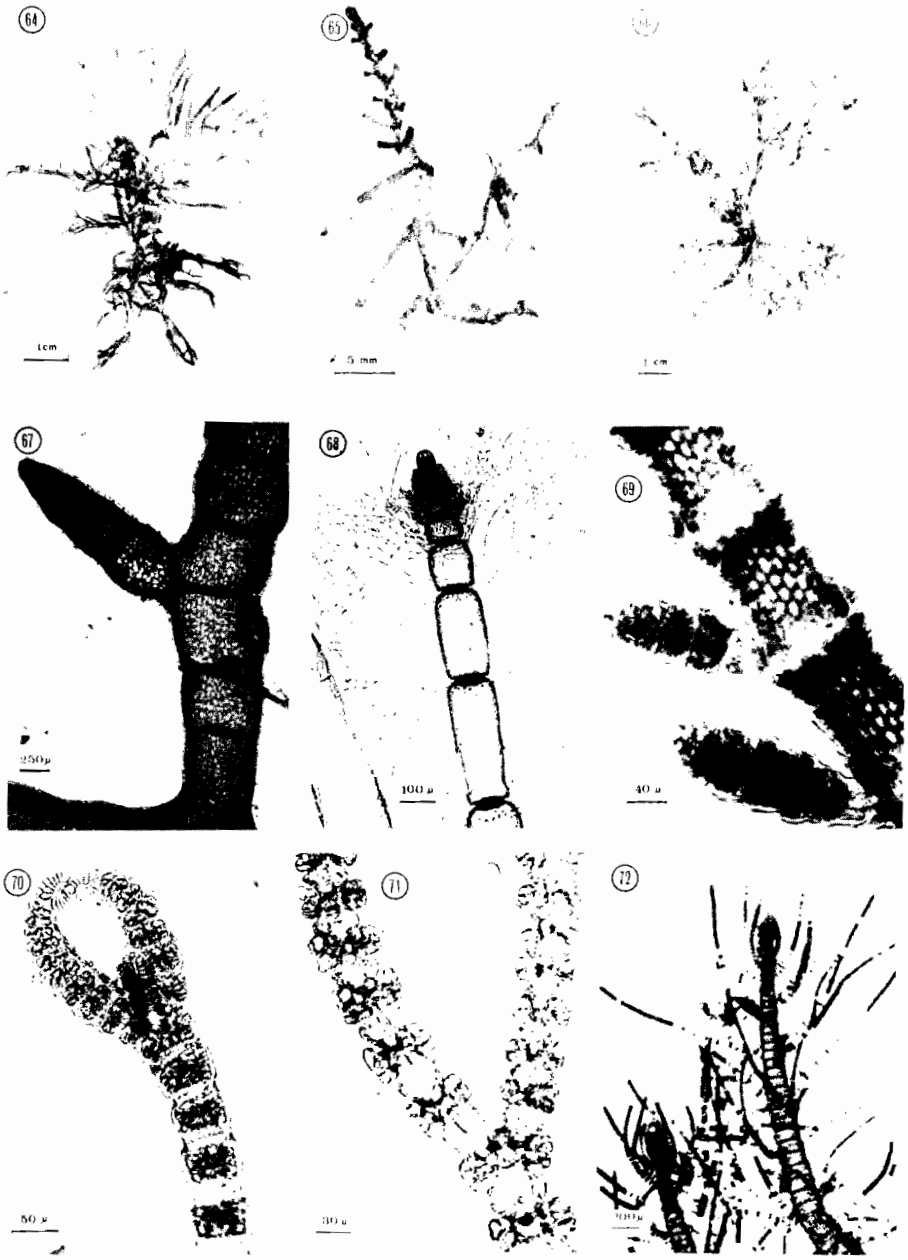

Plate 8

Plate 8

Fig. 64. *Champia indica* Børgesen
Richly branched, feather-like thallus.

Fig. 65. *Champia kotschyana* Endl. & Dies.
Portion of thallus showing alternate ramification.

Fig. 66. *Champia parvula* (C. Agardh) Harvey
Thallus more or less creeping, irregularly branched, constricted at nodes.

Fig. 67. *Champia parvula* (C. Agardh) Harvey
Detail of thallus showing segments as long as broad.

Fig. 68. *Griffithsia tenuis* (Harvey) C. Agardh
Subapical cells with whorls of colourless branches or trichoblasts.

Fig. 69. *Centroceras clavulatum* (C. Agardh) Montagne
Portion of a filament showing spiny nodes, corticated internodes with cells in longitudinal raws.

Fig. 70. *Ceramium luetzelburgii* Schmidt
Apical portion of thallus incurved and furcate, nodes corticated.

Fig. 71. *Ceramium masonii* Dawson
Nodal cortical belts of the filament with two raws of transversally elongated cells.

Fig. 72. *Spyridia filamentosa* (Wulfen) Harvey
Ultimate branches uniseriate with narrow cortical belts and pointed ends.

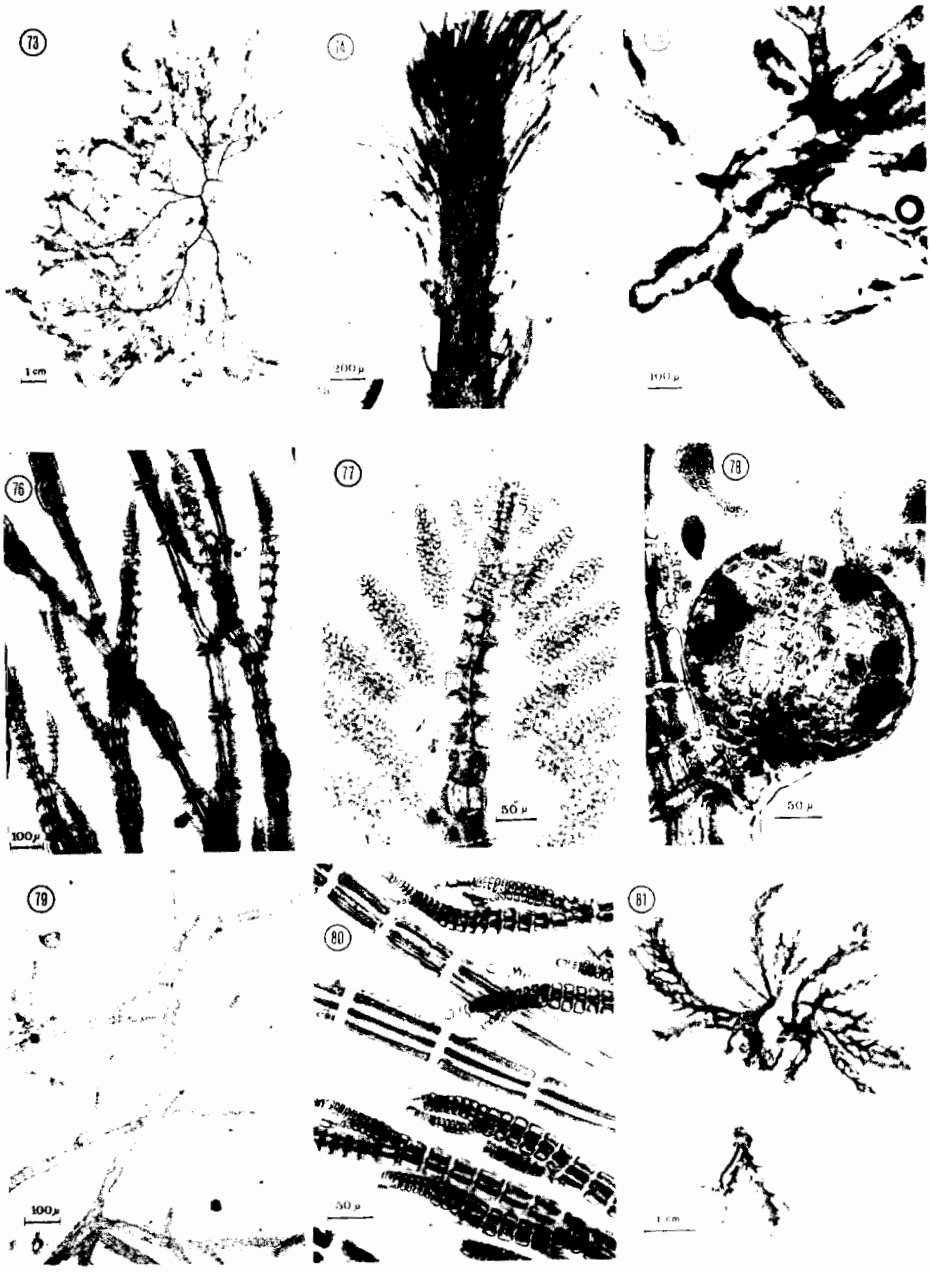

Plate 9

Plate 9

Fig. 73. *Dasya baillouviana* (S. Gmelin) Montagne
Filamentous thallus with corticated stem, branchlets dichotomously branched.

Fig. 74. *Dasyopsis pilosa* Werber-van Bosse
Axes cylindrical, clothed with long ramuli.

Fig. 75. *Heterosiphonia crispella* (C. Agardh) Wynne
Thallus creeping, profusely branched, stem polysiphonous, ultimate ramuli dichotomously branched.

Fig. 76. *Polysiphonia coacta* Tseng
Filaments with tetrasporangia.

Fig. 77. *Polysiphonia crassicollis* Børgesen
Male filament with antheridial clusters and trichoblasts.

Fig. 78. *Polysiphonia crassicollis* Børgesen
Female filament with a globular cystocarp on a thick, short stalk.

Fig. 79. *Polysiphonia platycarpa* Børgesen
Procumbent filament, branching partly dichotomous.

Fig. 80. *Polysiphonia variegata* (C. Agardh) Zanardini
Thallus ecorticate, with 5–6 pericentral elongated cells, shorter in the upper part.

Fig. 81. *Acanthophora muscoides* (Linn.) Bory
Thallus densely branched with spiny outgrowths also on the main axes.

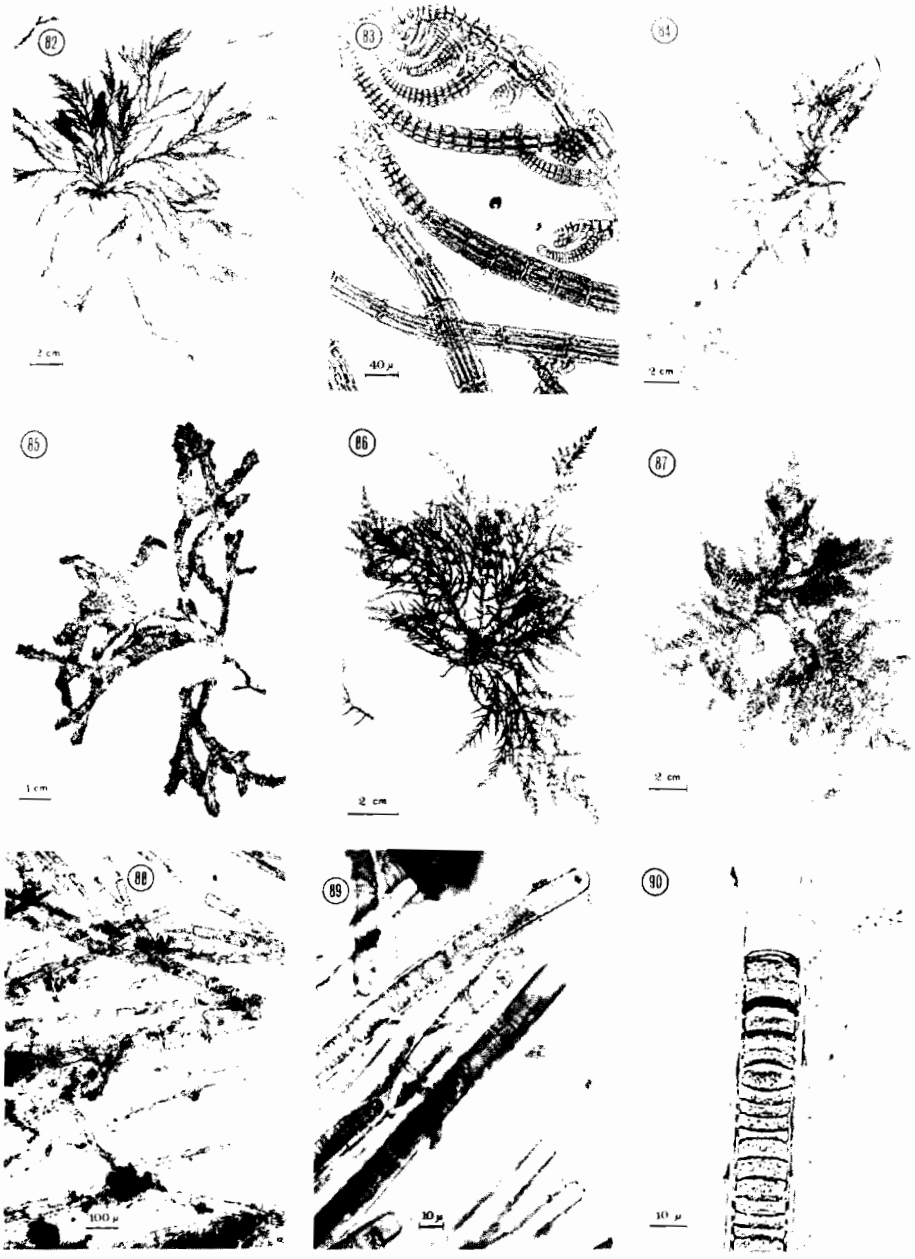

Plate 10

Plate 10

Fig. 82. *Acanthophora spicifera* (Vahl) Børgesen
Thallus with main axes lacking spines, sparingly branched, branchlets short and spiny.

Fig. 83. *Herposiphonia dendroidea* Hollenberg
Thallus alternately branched, pericentral cells 6–10, decumbent axis bearing determinate and indeterminate branches.

Fig. 84. *Chondria dasyphylla* (Woodward) C. Agardh
Branchlets club-shaped, apex truncate, covered with numerous ramuli.

Fig. 85. *Digenea simplex* (Wulfen) C. Agardh
Irregularly branched thallus, main axes clothed with stiff branchlets, heavily infested with epiphytes.

Fig. 86. *Laurencia obtusa* (Huds.) Lamouroux
Base thick, ultimate branchlets subcylindrical truncate.

Fig. 87. *Laurencia papillosa* (Forsskål) Greville
Thallus with terete axes, irregularly branched, upper branches covered with papillose outgrowths.

Fig. 88. *Murrayella periclados* (C. Agardh) Schmitz
Richly branched thallus, partly alternate, partly dichotomous, axes polysiphonous with 4 pericentral cells, ultimate branchlets, radially arranged, monosiphonous.

Fig. 89. *Lyngbya aestuarii* Liebmann ex Gomont
Filaments with extended sheath, cross walls not constricted, end cells flat, slightly attenuated.

Fig. 90. *Lyngbya ceylanica* Wille var. *constricta* Frémy
Filament straight, trichome slightly constricted at cross walls, apical cells rounded.

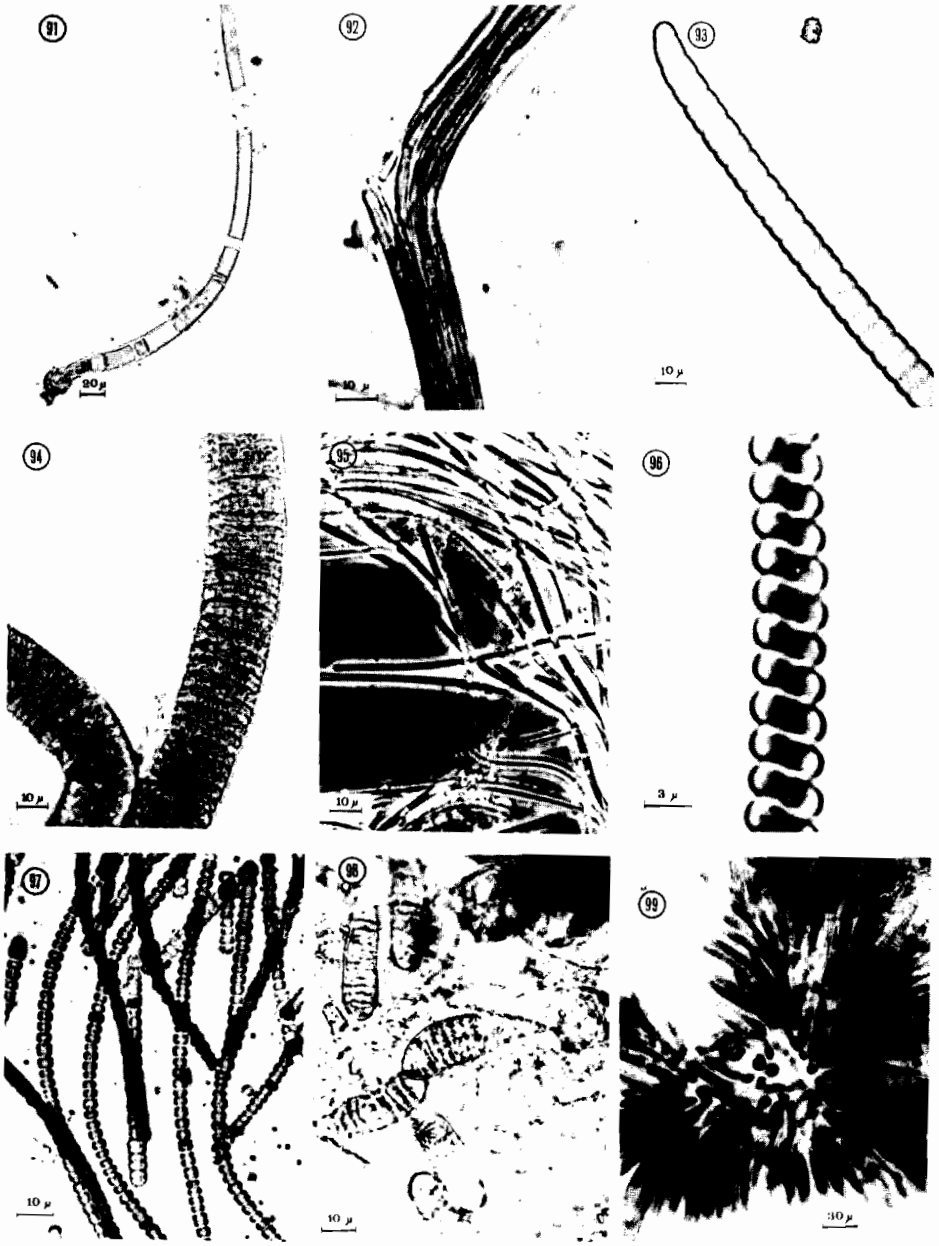

Plate 11

Plate 11

Fig. 91. *Lyngbya confervoides* C. Agardh ex Gomont
Filament with thickened sheath of two distinct layers.

Fig. 92. *Microcoleus chthonoplastes* Thuret ex Gomont
Filament thick with many interwoven trichomes.

Fig. 93. *Oscillatoria nigro-viridis* Thwaites ex Gomont
Apical portion of filament, tip curved, attenuated.

Fig. 94. *Oscillatoria princeps* Vaucher ex Gomont
Filament slightly curved, not constricted at cross walls, hyaline sheath material not distinct.

Fig. 95. *Phormidium corium* (J. Agardh) Gomont
Filaments flexuous, densely entangled, sheath thin, trichome not constricted at the cross walls, end cells obtuse.

Fig. 96. *Spirulina subsalsa* Oersted ex Gomont
Trichome without sheath, coiled or spiraled.

Fig. 97. *Anabaena constricta* (Szafer) Geitler
Trichome single, without sheath, cells barrel-shaped to cylindrical, clearly constricted at the cross walls.

Fig. 98. *Calothrix confervicola* (Roth) C. Agardh ex Bornet & Flahault
Trichomes unbranched with basal heterocyst.

Fig. 99. *Calothrix scopulorum* (Weber & Mohr.) C. Agardh ex Bornet & Flahault
Cluster of trichomes with large basal heterocysts.

Plate 12

Fig. 100. *Halophila ovalis* (R. Brown) Hook. f.
Leaves elliptical, petiole naked, elongated, not hidden in sheaths.

Fig. 101. *Halodule uninervis* (Forsskål) Aschers.
Leaves distinctly one nerved, forming narrow linear clusters from the creeping rhizome.

الطحالب والأعشاب البحرية في سواحل الكويت

رضا الحسن
قسم النبات والميكروبيولوجيا ،
جامعة الكويت ، ص . ب . ٥٩٦٩ ،
الصفاة ١٣٠٦٠ ، الكويت

ايڤيان جونز
مدرسة علوم البحار ،
الكلية الجامعية بشمال ويلز ،
أنجلسي ، المملكة المتحدة

خلاصة

درست الطحالب البحرية في سواحل دولة الكويت خلال الفترة من سبتمبر ١٩٨٣ إلى ديسمبر ١٩٨٦ . وأمكن في هذه الدراسة تسجيل ١٠٥ نوعا من الطحالب التي تعيش في منطقة المد والجزر ، منها ٨٩ نوعا لم تسجل من قبل من سواحل الكويت . وتنتمي معظم هذه الطحالب إلى ٦ طوائف هي الطحالب الخضر (٢٦ نوعا ، تضم ٢٤ نوعا جديدا) والطحالب البنية (٢٢ نوعا ، منها ١٦ نوعا جديدا) والطحالب الحمر (٣٩ نوعا ، منها ٣٢ نوعا جديدا) والطحالب الخضر المصفرة (نوع واحد جديد) والطحالب الذهبية البنية (نوع واحد جديد) والطحالب الخضر المزرقة (١٦ نوعا ، منها ١٥ نوعا جديدا) . كما سجلت هذه الدراسة نوعين جديدين على الكويت ، ينتميان إلى النباتات البحرية كاسيات البذور . وتمت دراسة التغيرات الموسمية للفلورة الطحلبية في المحطات المختلفة ، ومناقشة بعض السمات الخاصة لأنماط توزيع بعض هذه الطحالب .