

Marine algae of Ko Si Chang, eastern Thailand

Anong Chirapart¹, Masao Ohno² & Padermsak Jarayapund³

¹*Department of Fishery Biology, Faculty of Fisheries, Kasetsart University, Chatuchak, Bangkok 10900, Thailand*

²*Usa Marine Biological Institute, Kochi University, Usa, Tosa, Kochi 783, Japan*

³*Institute of Marine Science, Chularonkon University, Ko Si Chang, Chonburi province, Thailand*

Introduction

Ko Si Chang is a large island in the middle of the sea about 12 kilometers from the Sri Racha shore, Chonburi province, eastern Thailand. There is only one town on the island facing the mainland; the rest of the tiny island is practically deserted and fun to explore. The small population is made up of fisher folk, retired and working mariners and government workers who are stationed with the customs office or with one of the aquaculture projects on the island. Although there has been talk of a building a deep-water port on the island, so far Ko Si Chang has remained free of this type of industry.

The Ko Si Chang coastal regions are characterized by the presence of rocky shores, shallow bays and coves that support a variety of marine plants and animals. In 2002 the Marine Resources Research Institute, Chulalongkon University in collaboration with the Usa Marine Biological Institute, Kochi University, Japan conducted a survey of marine organisms at the Ko Si Chang coastal region in the Gulf of Thailand. The objectives were to gather environmental data and collect samples of marine organisms for systematic, ecological, and distributional studies. The present paper reports on the species diversity of marine algae and their distribution on the coast of Ko Si Chang.

Materials and methods

Samples were collected randomly by hand or by free-diving in shallow waters. Specimens were collected from 2 April (hot season) to 11 August (monsoon season) in 2002, at the 4 study sites (Fig.1). The specimens collected were preserved in a solution of 4% formaldehyde and seawater or as dried specimens on herbarium sheets. The specimens studied are deposited in the herbarium of the Department of Fishery Biology, Faculty of Fisheries, Kasetsart University. All mounts of specimens collected were made using 50% corn syrup (Karo Syrup, Corn Products, Inc.) solution in distilled water and containing a trace of phenol. Cross sections were prepared by

This survey has been conducted as the project of "Scientific and education cooperation between Usa Marine Biological Institute, Kochi University and Aquatic Resources Research Institute, Chulalongkon University."

hand, stained with 1% aniline blue and in 25% Karo Syrup. They were analyzed under an optical microscope (Nikon, Eclipse E600, Nikon Inc.) at 4, 10, 20, 40 (magnification.

SMITH (1951), DESIKACHARY (1959), PHAM-HOANG HO (1969), TAYLOR (1972), ABBOTT & HOLLENBERG (1976), TRONO & GANZON-FORTES (1988), SCHNEIDER & SEARLES (1991), KGUYEN HUU DINH *ET AL.* (1993), LEWMANOMONT & OGAWA (1995), were used for taxonomic determinations, supplemented by SILVA *ET AL.* (1987), SANTELICES (1988), ZHANG & XIA (1988), RODRIGUIZ & SANTELICES (1988) , LEWMANOMONT (1994), LEWMANOMONT *ET AL.* (1995), SILVA *ET AL.* (1996).

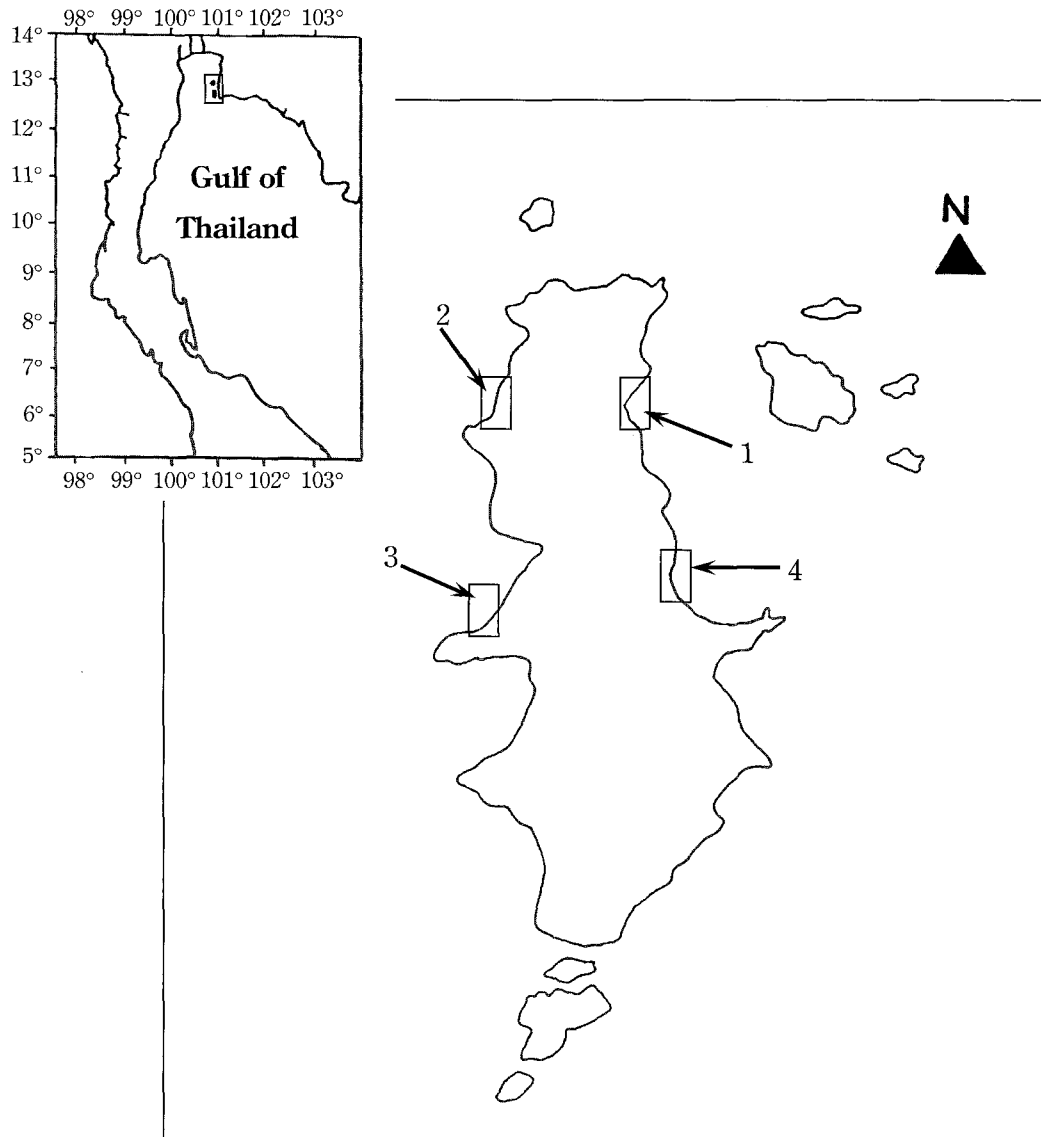


Fig. 1 Map showing the collection sites of seaweed survey in Ko Sichang, Thailand.

1 = Amphoe Ko Sichang, 2 = Khao Khat Pass, 3 = Hat Tham Phang,
4 = Aquatic Resources Research Institute

Results and Discussion

General observation

Ko Si Chang is located on the eastcoast at Lat. 13° 09' 30" N and Long. 100° 48' 41" E. This region is influenced annually by monsoon rains (June-October). Annual temperature vary between 18.7 - 35.4 °C in hot season (March - May), 22.1 - 33.9°C during monsoon season (June - October), and 12.9 - 30.4°C during cool season from November to February (<http://www.nso.go.th/provweb/cwdweb/chonburi/aboutpro.htm>, 2003). Our report is based on samples collected from hot season (April), and monsoon season (August) in 2002. Four study sites were selected in the intertidal regions.

Site 1. Amphoe Ko Si Chang, this site establish on the eastern coast closed to the Si Chang harbor, which is characterized by sandy-rocky shore and sand-mud, normally exposed to domestic effluents and polluted seawater from the harbor.

Site 2. Khao Khat Pass, this region establish on the western coast of the island, which characterized by rocky-sandy shore. Some parts are steep rocks and directly exposed to strong waves and westerly wind that normally comes from March to September.

Site 3, Hat Tham Phang is a widely sloping beach consist of rocky-sandy shore alternate with sand-mud shore. This site is on the un-windy side.

Site 4. Institute of Marine Sciences, which established along the eastern coast of the island. This site is characterized by sandy-mud shore, with some rocky areas.

Taxonomic study

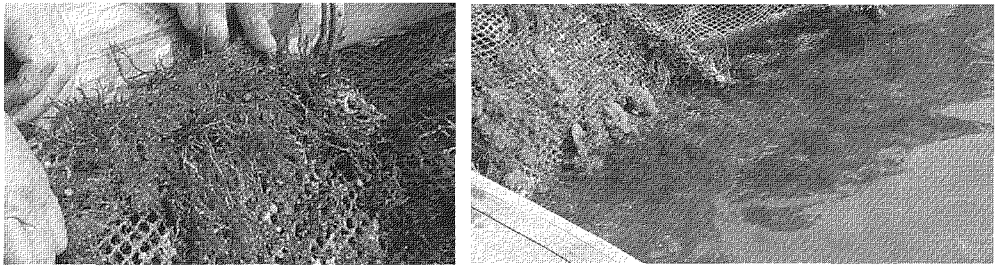
Thirty-six taxa at specific and infraspecific level of marine algae, distributed into 28 genera, were identified (Table 1). Of the identified species, there are 2 genera and 2 species of blue-green algae (cyanobacteria), 7 genera and 10 species of green algae, 4 genera and 5 species of brown algae, and 15 genera and 19 species of red algae. The total number of species found per site is also presented in Table 1. The greatest number was observed from Site 3 (Hat Tham Phang), whereas the smallest was from Site 2 (Khao Khat Pass). The red algae were the most numerous.

Our present knowledge of the marine algae of the Thai coast is indeed imperfect. There is very little information regarding the marine flora of the Ko Si Chang coast. For instance, EGEROD (1974) reported 28 species of green algae and 9 species of brown algae from Phuket, Andaman Sea, of which 20 species were additional records for Thailand. In 1975, she included an other 31 species of green algae, 19 of which were new records for the Andaman Sea coast of Thailand (EGEROD, 1975). CHRISTENSEN & WIUM-ANDERSEN (1977) reported 39 species of benthic marine algae from Surin Island, west coast of Thailand. Furthermore, LEWMANOMONT *ET AL.* (1995) summarized the total number of marine algae known in Thai waters: 132 genera and 333 species.

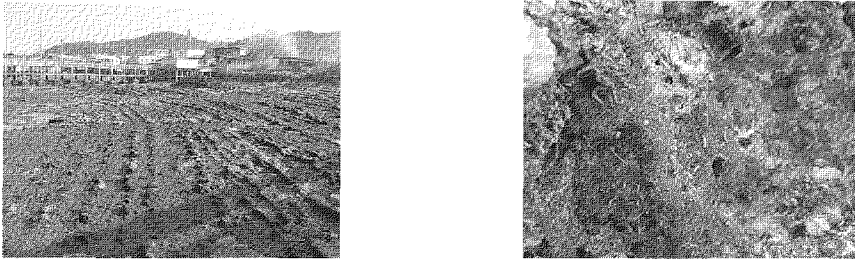
The present study of species diversity of the Ko Si Chang marine algae is mostly based on red, green, and brown algal species, but a few species of cyanobacteria were also observed in the areas (Figure 2-1~2-7). Moreover, a newly contribution of red algae, *Centroceras inerme* is reported from the island at St. 1 and St. 3. This species has been reported from the coast of Vietnam (PHAM-HOANG HO, 1969). They have not been reported until now from the coast of Thailand.

Table 1. Distribution of marine algal species in Ko Si Chang, eastern Thailand. (1= Amphoe Ko Si Chang, 2= Khao Khat Pass, 3= Hat Tham Phang, 4= Aquatic Resources Research Institute). A symbol plus “+” represent degree of appearance and abundance of the seaweed “+” : degree of appearance and abundance of the seaweed; “-” absent

| Species | Localities | | | | Habitat |
|---|------------|-----|-----|------|---|
| | 1 | 2 | 3 | 4 | |
| CYANOBACTERIA | | | | | |
| <i>Brachytrichia quoyi</i> (C. Ag.) Born. Et Flah. | - | - | - | +++ | Rocky-sandy shore. Plants attached to stones, exposed during low tide |
| <i>Lynghya majuscula</i> (Dillwyn) Harvey | ++ | - | + | - | Rocky-sandy shore, epiphyte on other seaweeds |
| CHLOROPHYTA | | | | | |
| <i>Avrainvillea erecta</i> (Berk.) A.Gepp et E.S.Gepp | ++++ | - | - | ++++ | Growing in muddy sandy substrates, exposed during low tide |
| <i>Avrainvillea obscura</i> (G. Agardh) J. Ag. | ++ | - | - | - | Growing in muddy sandy substrates in shallow waters, mixed with <i>A. erecta</i> |
| <i>Cladophora fascicularis</i> (Mert.) Kuetz. | - | - | - | +++ | Plants grow on fish cages |
| <i>Cladophora</i> sp. | + | ++ | + | - | grows on rocky-sandy shore, entangled with <i>Enteromorpha clathrata</i> |
| <i>Cladophoropsis</i> sp. | - | - | + | - | Rocky-sandy shore, entangled with <i>Enteromorpha clathrata</i> |
| <i>Enteromorpha clathrata</i> (Roth) Greville | - | +++ | ++ | - | Plants growing attached to rocks about low tide level, or in tide pool |
| <i>Dictyosphaeria cavernosa</i> (Forsskål) Borg. | - | - | ++ | ++ | Growing attached to rocks on shallow waters or in tidepools, forming large convoluted mats. |
| <i>Dictyosphaeria versluysii</i> Weber van Bosse | - | - | ++ | - | Plant is found in the same calm habitats as <i>D. cavernosa</i> , attached to rocks, exposed during low tide |
| <i>Microdictyon japonicum</i> Setchell | - | - | - | +++ | Plant cushion attached on fish cages, mixed with other seaweeds |
| <i>Valonia aegagrophila</i> C. Ag. | - | - | + | - | Attached to rocks in intertidal marks, exposed during low tide. |
| PHAEOPHYTA | | | | | |
| <i>Padina australis</i> Hauck | +++ | - | - | +++ | On rocks or small pebbles in intertidal areas together with <i>P. minor</i> |
| <i>Padina minor</i> Yamada | ++++ | - | - | +++ | On rocks or small pebbles in intertidal areas |
| <i>Sargassum</i> sp. | - | - | - | + | Plant is found in floating form. |
| <i>Sphacelaria furcigera</i> Kützting | - | - | ++ | - | Grows on rope entangled with Gelidiales |
| <i>Turbinaria decurrens</i> Bory de Saint-Vincent | - | - | - | + | Plant was crashed ashore. |
| RHODOPHYTA | | | | | |
| <i>Acanthophora spicifera</i> (Vahl) Borg. | + | - | - | + | Growing on pebbles in intertidal areas, or attached to fish cages |
| <i>Acrochaetium</i> sp. | - | - | + | - | grows on rope mixed with brown seaweed, <i>Sphacelaria furcigera</i> , or epiphyte on other seaweeds |
| <i>Amphiroa fragilissima</i> (Linn.) Lamour. | ++++ | - | +++ | - | Sandy-rocky shore habitat, attached on dead coral, in shallow water entangled with <i>Gracilaria salicornia</i> |
| <i>Ceramium</i> sp.1 | + | - | + | - | epiphyte on <i>Amphiroa fragilissima</i> , or attached to pebbles on sandy-rocky shores. |
| <i>Ceramium</i> sp.2 | + | - | + | - | epiphyte on the Gelidiales, <i>Amphiroa fragilissima</i> , and <i>Cladophora</i> sp. or attached to pebbles on sandy-rocky shores. |
| <i>Centroceras clavulatum</i> (Ag.) Mont. | + | - | + | + | Epiphyte on <i>Hypnea pannosa</i> , or growing together with <i>Ceramium</i> on small pebbles on rocky-sandy or sandy-rocky shores. |
| <i>Centroceras inerme</i> Kuetz. | + | - | + | - | epiphyte on <i>Hypnea pannosa</i> , or attached to small pebbled on small pebbles on rocky-sandy or sandy-rocky shores. |
| <i>Champia parvula</i> (Ag.) J. Ag. | - | - | + | - | Rocky-sandy habitat, attached to fishing net, mixed with <i>Ceramium</i> , <i>Centroceras</i> and <i>Hypnea</i> |
| <i>Herposiphonia tenella</i> (C.Ag.) Ambronn | + | - | - | + | Growing on pebbles in intertidal areas, mixed with <i>Ceramium</i> |
| <i>Hypnea pannosa</i> J. Ag. | - | - | + | ++ | grows on fish cages |
| <i>Hypnea</i> sp. | + | - | + | - | Entangled with <i>Amphiroa fragilissima</i> |
| <i>Gelidium pusillum</i> (Stackhouse) Le Jolis | +++ | ++ | ++ | - | Rocky-sandy shore, growing on rocks in intertidal zone, exposed during low tide |
| <i>Gracilaria salicornia</i> (C. Ag.) Dawson | ++++ | - | - | - | Rocky-sandy shore, sand-mud area, growing on rocks in intertidal zone, exposed during low tide |
| <i>Gracilaria edulis</i> (Gmelin) Silva | - | - | - | +++ | Grows on fish cages, together with other seaweeds |
| <i>Laurencia</i> sp. | - | - | ++ | - | On rocky-sandy shore, growing on rocks in subtidal habitat |
| <i>Peyssonnelia rubra</i> (Greville) J. Ag. | - | - | ++ | + | Grows on rocks in intertidal habitats, exposed during low tide |
| <i>Polysiphonia</i> sp. | - | - | - | +++ | Grows on fish cages, entangled with <i>Hypnea pannosa</i> |
| <i>Tolypocladia glomerulata</i> (C. Ag.) Schmitz | - | - | - | +++ | Epiphyte on <i>Padina minor</i> |
| <i>Spyridia filamentosa</i> (Wulf.) Harvey | - | - | - | + | Grows on fishing nets, or fish cages |
| Total number | 15 | 3 | 20 | 18 | |



Red and green seaweeds grow on fish cage during dry season, a photo taken in April 2, 2002



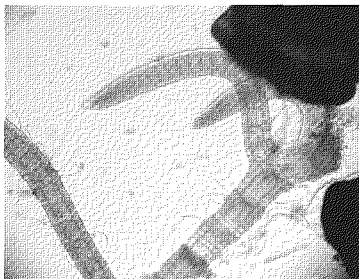
Ecological characteristics of Si Chang coast, photos taken in front of the district office of Si Chang Island in April 2, 2002



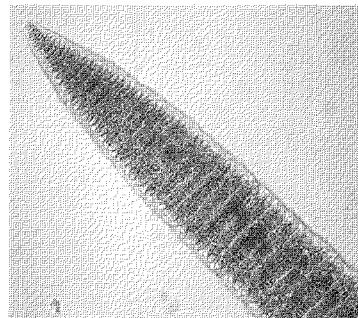
Centroceras clavulatum (Ag.) Mont.
(20x, DIC M)



Centroceras clavulatum (Ag.) Mont.
(10x, DIC L)

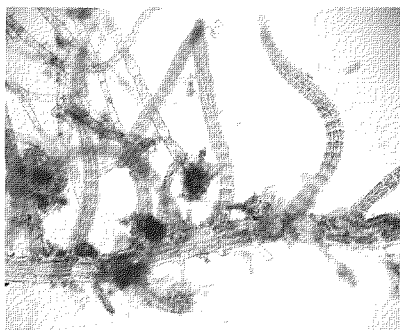


Centroceras inerme Kuetz. (10x, DIC M)

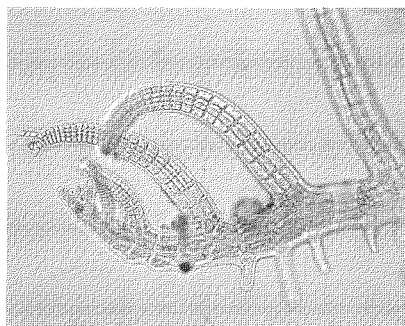


Centroceras inerme Kuetz. (20x, DIC M)

Fig. 2-1 Marine algae collected at the survey station in KO Sichang Island.



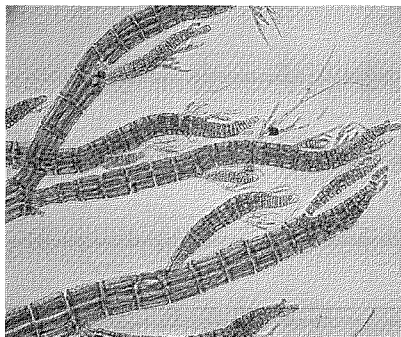
Herposiphonia tenella (C.Ag.) Ambronn
(10x DIC L)



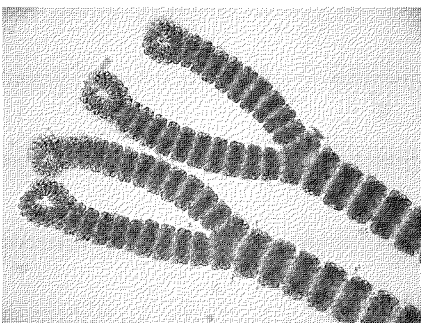
Herposiphonia tenella (C.Ag.) Ambronn
(20x DIC M)



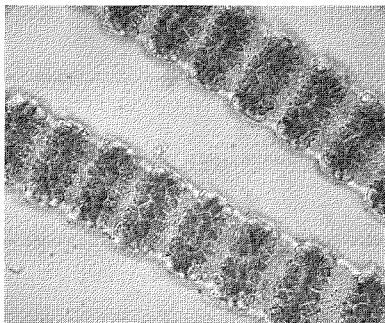
Tolypocladia glomerulata (Ag.)
Schmitz (40x, DIC M)



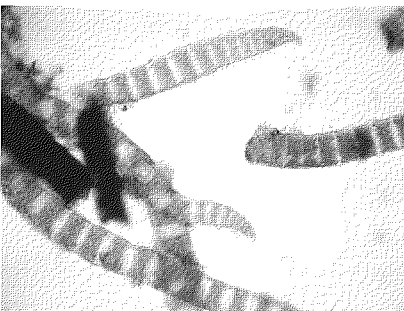
Polysiphonia sp. (10x, DIC M)



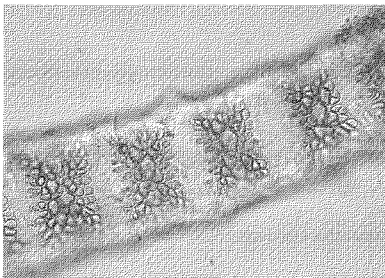
Ceramium sp.1 (20x DIC M)



Ceramium sp.1 (40x DIC M)

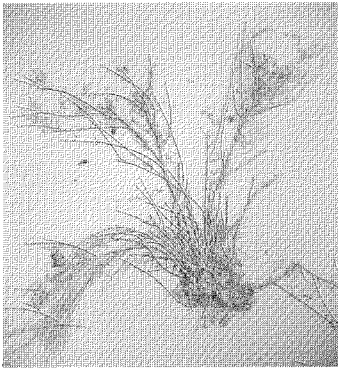


Ceramium sp.2 (10x DIC M)

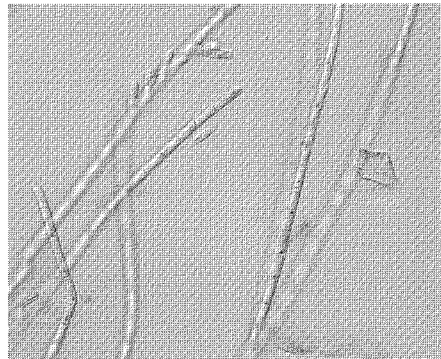


Ceramium sp.2 (40x DIC M)

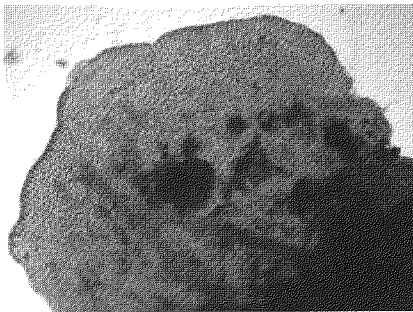
Fig. 2-2 Marine algae collected at the survey station in KO Sichang Island.



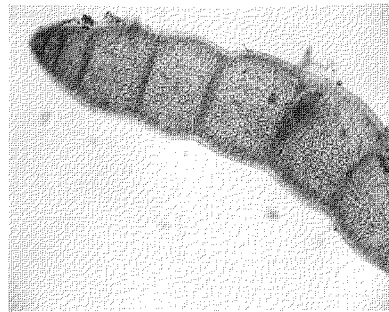
Habit of *Acrochaetium* sp.
(10x DIC L)



Acrochaetium sp. (40x DIC M)



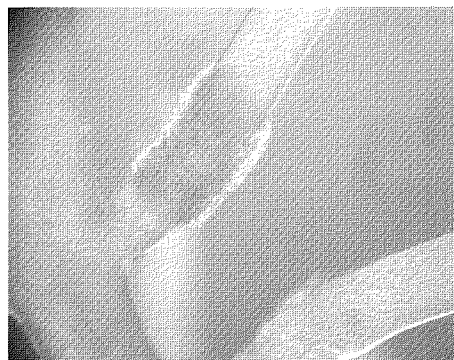
Habit of *Peyssonnelia rubra* (Grev.) J. Ag. (4x)



Champia parvula (Ag.) J. Ag. (10x, DIC L)



Habit of *Hypnea pannosa* J. Ag. (1.25x)



Hypnea pannosa J. Ag. showing stichidia
branchlet (4x)

Fig. 2-3 Marine algae collected at the survey station in KO Sichang Island.



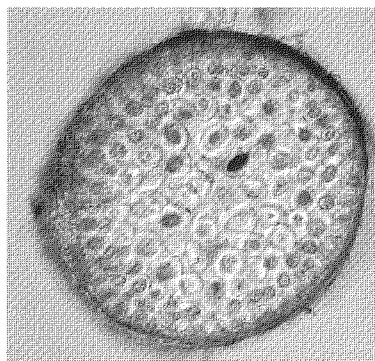
Habit of *Amphiroa fragilissima*
(L.) Lamx. (3x)



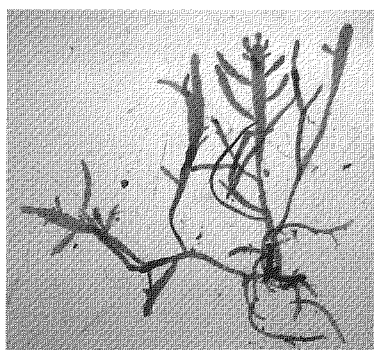
Amphiroa fragilissima (L.) Lamx. showing
portion of dichotomous branching and
geniculum (40x, DIC M)



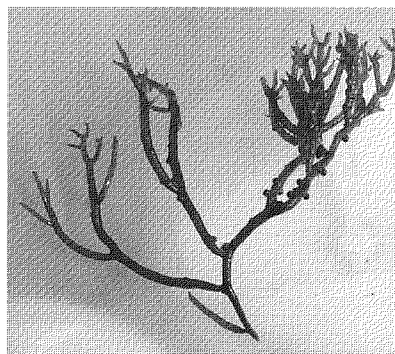
Habit of *Laurencia* sp. (1.25x)



Cross-section of *Laurencia* sp.
(20x, DIC M)

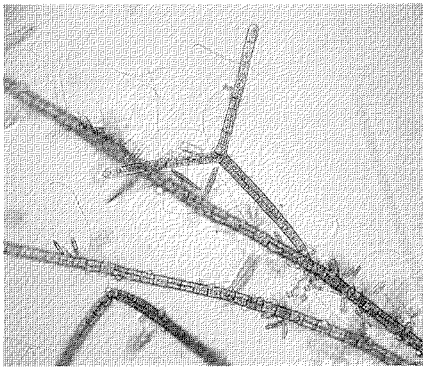


Habit of *Gelidium pusillum* (Stackh.)
Le Jolis (0.67x)

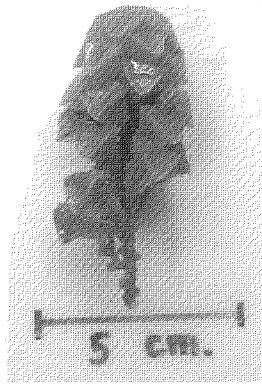


Habit of *Gracilaria edulis* (Gmelin) Silva

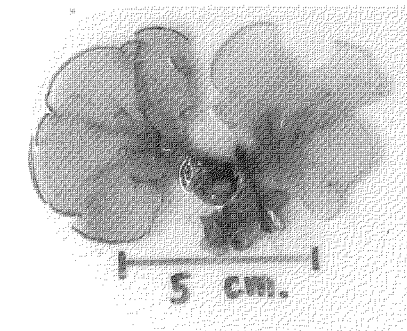
Fig. 2-4 Marine algae collected at the survey station in KO Sichang Island.



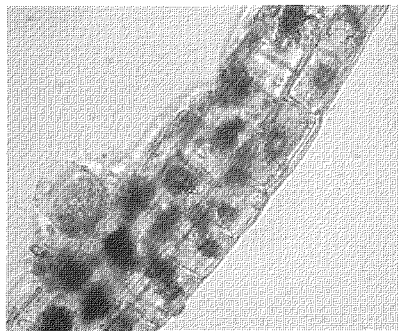
Sphacelaria furcigera Kützting
(20x, DIC M)



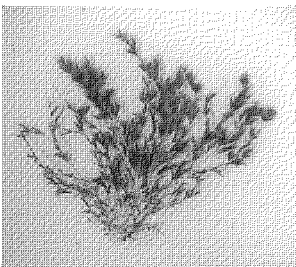
Turbinaria decurrens Bory



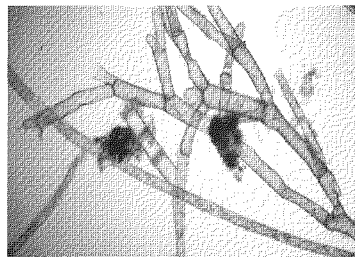
Padina minor Yamada



Cross-section of *Padina minor* showing
two layers of cell (40x, DIC M)



Cladophora fascicularis (Mert.) Kuetz.

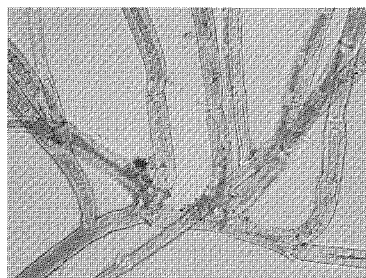


Cladophora fascicularis (Mert.) Kuetz. (4x)

Fig. 2-5 Marine algae collected at the survey station in KO Sichang Island.



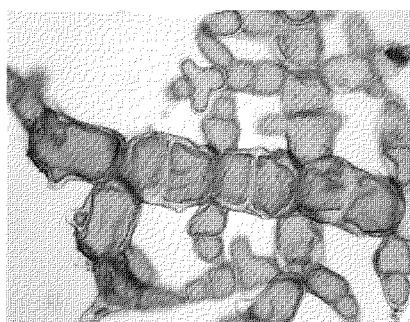
Cladophora sp. (10x DIC L)



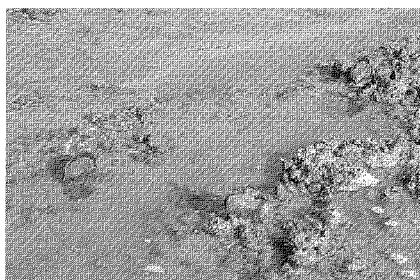
Cladophora sp. (20x DIC M)



Habit of *Microdictyon japonicum*



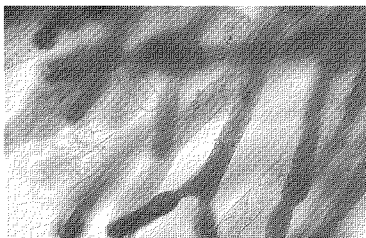
Microdictyon japonicum Setchell, portion of thallus showing cross walls at the base of branches and anastomosing branches (10x, DIC L)



Avrainvillea erecta A. et E.S. Gepp showing siphonous structure (left 20x DIC M, right 40x DIC M)

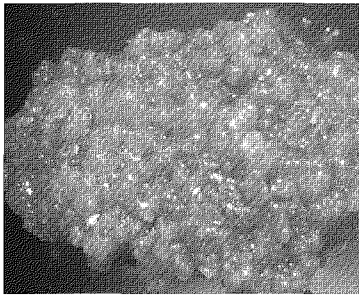


Dictyosphaeria cavernosa (Forsskål)
Børgesen (0.8x)

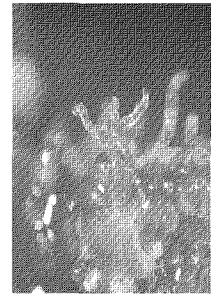
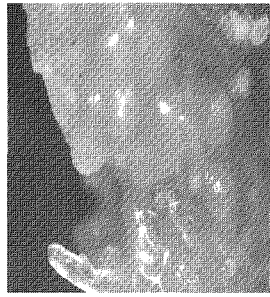


Dictyosphaeria cavernosa (Forsskål)
Børgesen (3.2x), showing branched rhizoid

Fig. 2-6 Marine algae collected at the survey station in KO Sichang Island.



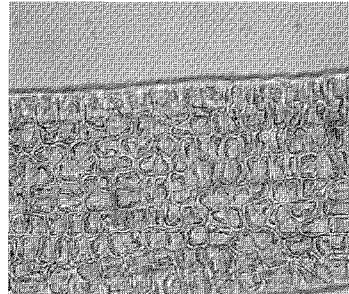
Dictyosphaeria versluisii Weber van Bosse (0.67x)



Dictyosphaeria versluisii Weber van Bosse (2.4x), showing unbranched rhizoid



Habit of *Enteromorpha clathrata* (Roth) Greville (10x, DIC L)



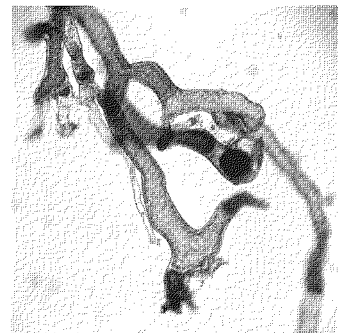
Surface view : showing parenchyma cell (40x, DIC M)



Cladophoropsis sp.



Cladophoropsis sp. (10x DIC L)



Cladophoropsis sp. (10x DIC L) showing branched rhizoid

Fig. 2-7 Marine algae collected at the survey station in KO Sichang Island.

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