Study of Seaweed Diversity along the islands of gulf of Kachchh, Gujarat
The Gujarat Ecology Commission has carried out study on “Sea weed diversity along the islands of Gulf of Kachchh” during the year 2012 under the Integrated Coastal Zone Management Project. Total 42 islands are proposed for undertaken this study. Out of 42, total 12 islands have been covered in this phase. Entire study was carried out during February – 12 to April – 12.

At this juncture, the Commission would like to acknowledge officials of Marine National Park & Sanctuary, Jamnagar for providing support, and necessary permission to visit islands during field trip.

A special thanks to Dr H V Joshi Ex-Scientist CSMCRI Bhavnagar for the technical support in finalization of methodology and guideline to collect primary data, identification and documentation of seaweeds as well as continuous support throughout the project.

I would also like to extend my sincere thanks to the research team of Gujarat Ecology Commission for carried out this valuable research and documentation.

Last but not the least, our special thanks to Shri Habib bhai, Mofik, Hussen and Mahubub (boatmen) for properly navigation and providing logistic support during field trip on boat.

Director
Gujarat Ecology Commission,
Gandhinagar
In the vast ocean realm, several forms of life, starting from unicellular to multi-cellular flourish, multiply and disintegrate. It is believed that the first living cell that appeared on the planet Earth emerged from the ocean. In all its form, the life has developed from the growth of unicellular algae. About 90% of the species of marine plants are algae and about 50% of the global photosynthesis is algal derived. Thus, every second molecule of oxygen we inhale comes from algae and algae reuse every second molecule of carbon dioxide we exhale (Dhargalkar and Pereira 2005). As per the name seaweed means plant growing in sea which is not wanted. But it is very important for the marine environment and ecosystem. The health of marine algae (Seaweeds) is directly related to health of coastal water or marine ecosystem. Seaweeds are found in the coastal region between high tide to low tide which is known as intertidal area and in the sub-tidal region up to a depth where photosynthetic light is available. Based on their pigmentation, the seaweeds are broadly classified into Chlorophyceae (Green algae) Phaeophyceae (Brown algae) and Rhodophyceae (Red algae). They distinguish form micro-algae (Cyanophycceae) which are microscopic in size, often unicellular, and are best known as blue-green algae that sometime causes eutrophication in water body. Plant pigments, light, exposure, depth, temperature, tides and the shore characteristic combine to create different environment that determine the distribution and variety among seaweeds. Seaweeds do not have true roots, stem or leaves and whole body of the plant is called thallus that consists of the holdfast, stipe and blade.

Seaweeds are harvested for centuries, particularly in Japan and China, where they
Study of seaweed diversity along the Islands of Gulf of Kachchh, Gujarat

Gujarat Ecology Commission

Seaweed diversity along the Islands of Gulf of Kachchh, Gujarat

Seaweed diversity along the Islands of Gulf of Kachchh, Gujarat

Ecology of Seaweeds

In marine ecosystem, seaweeds play very important ecological roles. They provide shelter and a home for numerous fishes, invertebrate, birds, and mammals. They are source of food for many animals such as sea urchins and fishes. Seaweed like Asparphyllum, Macrocystis, Laminaria, etc. form under water forest called Kelp forest. These forests provide a physical structure that supports marine communities by providing animal with food and shelter. These forests can also be nurseries for many species of fishes and snails. Seaweed provides shelter to live coral during exposure (during low tide) thus it protect from stresses condition in nature. Many sea slugs and kelp crab can be seen on the blade and stipe, while the smaller marine animals, like worms find shelter in the holdfast of seaweed.

Many seaweeds live in rocky intertidal area. They are often exposing to stresses condition such as air and weather condition. To survive under intertidal conditions, they must be able to tolerate or minimize the effect of evaporative water loss and temperature and salinity changes. Some seaweeds can completely dry out during low tide or minus tide then absorb water and fully recover during high tide or water comes back. Seaweeds living in tide pools are exposed to changes in temperature and salinity on hot sunny days; no doubt they suffer. But when it rains, the living environment in tide pools changes and they revive. During cold days they are prone to freezing.
It has been estimated that the seaweed resources of the world comprise about 1460 million tonnes wet weight brown algae and 261 million tonnes wet weight red algae. The total seaweed production may be about 1721 x 104 tonnes wet weight annually (Michanek 1975). The major sources of seaweeds are in the northeast, western central and southwest Atlantic and the eastern-central and northwest Pacific area. There is not much information regarding the Antarctic and Arctic regions. India, with a long coastline (7517 km) has a vast resource of seaweeds along many open coasts and estuarine areas. The total standing stocks along the different coastal states of India is reported 6,77,308.87 tonnes (wet weight) including 1260.18 tonnes of drift seaweed (Krishnamurthy 1969). The first check-list of Indian marine benthic algae was published in 1970 by Krishnamurthy and Joshi (1970) with 520 species. This list describes only 153 species belonging to 95 genera of seaweeds from Gujarat coast. Subsequently Unnawale et al. (1983) and Sahoo et al. 2001 and Oza and Zaidi (2001) prepared the updated check-lists based on the reports published in different journals. The check-list by Sahoo et al. (2001) comprises total 770 species from Indian coast of which 280 species (36%) were reported from Gujarat coast. The latest systematic account lists 1153 species distributed among 271 genera (Krishnamurthy, 2005). Recently, Jha et al. (2009), reported 198 species belonging to 101 genera of seaweeds along the Gujarat coast, in western India. Among these 109 are Rhodophyta belonging to 62 genera, followed by the Chlorophyta with 54 species belonging to 23 genera and Phaeophyta with 35 species belonging to 16 genera.
Seaweeds are used as food, feed, fodder and biofertilizers, besides they form a source of iodine and bioactive substances. The important polysaccharides like agar-agar, alginate, and carrageenan are also obtained from the seaweeds. Total 222 species of seaweeds are commercially used in the world for various uses. Out of that 145 species are used as food among that 79 Red, 38 Brown and 28 Green seaweeds, whereas 101 species are used for the extraction of phycocolloids. Out of them 38 are used for Agar, 27 for Carrageenan and 41 for Alginates production. Out of total 24 species are used for Medicines, 25 species are used in Agriculture and 2 species are used for paper manufacturing. The various products obtained from Indian seaweeds and their uses are dealt with here.

### 4.1 Seaweeds for Phycocolloids

Three types of phycocolloids are extracted from seaweeds. They are used widely as gelling agents with many applications in food industries. International demand for phycocolloids agar, alginate and carrageenan has grown rapidly.

#### 4.1.1 Agar:

Three types of phycocolloids are extracted from seaweeds. They are used widely as gelling agents with many applications in food industries. International demand for phycocolloids agar, alginate and carrageenan has grown rapidly.
4.1.2 Alginate
Alginate acid and alginates find a wide variety of uses in industries such as food and bakery pharmaceuticals, cosmetics, textile, rubber, paint, paper etc. Sodium alginate owes its varied industrial uses to its ability to function as thickeners, as an emulsifying stabilizing, defloculating and creaming agent. Alginates are derived from large brown seaweeds generally growing in colder water areas of the world. The main commercial sources of phaeophytes are Ascothryum, Laminaria and Macrocystis. Other minor sources include Sargassum, Durvillea and Turbinaria. Total dry tonnes of harvested alginophytes were reported to be 126,000 tonnes, while India produces 1900-3800 dry tonnes of Sargassum and Turbinaria (Crichtle and Ohne 1998). Indian requirement of alginate is 1000 tonnes per annum, and indigenous production is less than 40%. Among 25 alginate industries, only 12 are actively involved in production. (Subba Rao et al. 2006).

4.1.3 Carrageenan:
There are three main types of carrageenan, lambda, kappa and iota each having their own gel characteristics. The greatest market demand is for kappa-carrageenan. The different forms of the phycocolloids are extracted from different species and genera of red seaweeds. Carrageenan is used in toothpaste, salad dressings, ice creams, processed cheese and other dairy products. Acanthophora spicifera, Grateloupia indica, Halymena purpurea, Halymena venusta, Hypnea muscosiformis, Hypnea valentiae, Laurencia papillosa, Sarconema filiforme and Salaria robusta are indigenous source of different types of carrageenan. On the basis of gel characteristics some species of the genus Eucheuma have been recently transferred to the genus Kappaphycus. Philippines is the world’s biggest producer of cultivated Kappaphycus and Eucheuma seaweeds supplying about 60% of the world raw material requirements for carrageenan production.

4.2 Algal Proteins
Some green and red seaweed such as Ulva fasciata, U. rigidia, Porphyra vietnamensis and Centrocer asclavatum contain very rich proteins. These algal proteins have many essential amino acids including iodine containing amino acids. Studies revealed that these seaweeds contain 16-30% of protein on dry weight basis. The powders of Ulva, Porphyra and Acanthophora can be added to various foods deficient in protein or taken along with other food stuffs in small quantities.

4.3 Seaweed as food:
Fresh, dried and processed seaweeds are utilized for human consumption. The algal carbohydrates are not easily digestible and the food value of the seaweeds depends on the presence of the minerals, trace elements, proteins and vitamins. From a nutritional standpoint, the main properties of seaweeds are their high mineral (iodine, calcium) and soluble dietary fibre contents, the occurrence of vitamin B12, and specific components such as fucoanthyth, fucosterol and phlorotannin. Many types of seaweeds such as Caulerpa, Codium, Hydroclathrus, Sargassum, Porphyra, Gracilaria, Acanthophora, and Laurencia are used as food in Japan, Indonesia, China, Philippines and other countries of Indo-Pacific regions (Subba Rao, 1965; Levring et al 1969; Michael, 1975 and Chapman and Chapman, 1980). Seaweeds are eaten in form of salads, curry, soup or vegetables. In Japan, there are many industries which cultivate edible seaweeds Porphyra on commercial scale. Seaweed foods and their supplementation to other foods are quite safe to human health. They are also rich free, however, their over consumption may rarely create some problems (A. Tewari & Y.Khamrhit, 2006). In India, however, seaweed consumption is negligible except in the preparation of porridge from Gracilaria sp. and Acanthophora sp. in coastal states of Kerala and Tamil Nadu (Dhargalkar & Pereira 2005).
4.4 Seaweeds as Fodder

Seaweeds are cheap source of minerals and trace elements. Hence the meals prepared from seaweeds can be given as supplements to the daily rations of the cattle, poultry and other farm animals. Cleaned and washed seaweeds such as Ulva, Sargassum, Padina, Dictyota, Gracilaria and Hypnea can be given to cattle as meal after grinding.

4.5 Seaweed as Bio-fertilizer

Uses of seaweeds as bio-fertilizer is a common practice in coastal areas throughout the world. In India it is used for coconut plantations especially in coastal Tamil Nadu and Kerala. Seaweeds used as excellent fertilizer because of presence of an adequate amount of potassium, nitrogen, growth promoting hormones, micronutrients, humic acids etc. In India, many industries have started production of SLF on a commercial scale using indigenous seaweeds like Sargassum and Turbinaria.

4.6 Seaweed as medicine:

Seaweeds were considered to be of medicinal value in the Orient as early as 3000 B.C. The Romans, China and Japan used seaweeds in the treatment of goiter and other glandular diseases. It is also used to cure wounds, burns, scurvy and rashes. Laminaria and Sargassum have been used in China for treatment of cancer. Antiviral compounds from Undaria have been found to inhibit the herpes simplex virus, which are now sold in capsule form. Research is being carried out into using Undaria extract to treat breast cancer and HIV (Khan and Satam 2003). Some calcareous species of Corallina have been used in bone replacement therapy (Stein and Borden, 1984). Asparagopsis taxiformis and Sarconema species are used to control and cure goiter while heparin, a seaweed extract, is used in cardiovascular surgery. Carrageenan is used as medicinal ingredient in the preparation of surgical jellies, demulcents and anti-acid tablets for checking hepatitis and curing ulcer according to DA-AMAS (Agribusiness and Marketing Assistance Services, Philippines).

In India, many industries have started production of SLF on a commercial scale using indigenous seaweeds like Sargassum and Turbinaria.

4.7 Seaweed as Source of energy

Study of seaweed diversity along the Islands of Gulf of Kachchh, Gujarat

Fuel gas for domestic use can be produced utilising the brown seaweed Sargassum as raw material. A mixture of about six microorganisms mostly derived from marine environments can be used in digesters. Addition of indole acetic acid stimulated anaerobic digesters. Salinity of the liquid above 20% was stated to be detrimental to production of fuel gas (Chennubhotla et al., 1987a).
Uses of seaweeds will demand continuous supply of good quality seaweeds as raw materials. To meet these challenges it is required to develop an appropriate cultivation technology, suited to Indian conditions that must have a blend of traditional knowledge and modern biotechnological tools. Recent biotechnological methods such as tissue culture, protoplast fusion, genetic engineering, etc., are being employed to produce genetically altered and improved strains with faster growth rate, altered phycocolloids composition and high yield. Japan, China, and some South East Asian countries have mastered seaweed cultivation technique for commercial exploitation. However, in India no commercial cultivation being done, except for the cultivation of carrageenan yielding seaweeds, Eucheuma and Kappaphycus has been introduced for cultivation in Mandapam, Tamil Nadu. Development of seaweed cultivation technology in India will be a precursor to sustainable development of marine resources, as mankind will have to depend on them for their livelihood in future. It is envisaged that the industries based on seaweeds have the potential to contribute to the socioeconomic upliftment of the coastal inhabitants. Over the last twenty years there have been some large projects that investigated the possible use of seaweeds as an indirect source of fuel.

There are potential uses for seaweed in wastewater treatment. Some seaweed is able to absorb heavy metal ions such as zinc and cadmium from polluted water. The effluent water from fish farms usually contains high levels of waste that can cause problems to other aquatic life in adjacent waters. Seaweeds can often use much of this waste material as nutrient, so trials have been undertaken to farm seaweed in areas adjacent to fish farms.
The Climate change and global warming will have considerable adverse impacts over the natural resources of Gulf of Kachchh. Gulf of Kachchh is famous for its seaweed diversity. Seaweeds are important sources of food, feed and chemicals. The study is carried out to assess the basic status of seaweed diversity occurring on 42 islands of Gulf of Kachchh. In this context, a study on Seaweed diversity along the islands of Gulf of Kachchh, Gujarat is undertaken. To carry out above work the following objectives are set forth for the present work.

- To know the current status of seaweeds and their diversity occurring on intertidal area of 42 islands of Gulf of Kachchh.
- To preserve collected seaweeds in form of herbarium for further reference work.
- To publish illustrated book on seaweeds diversity of Islands of Gulf of Kachchh.

6.1 Significance of Work

The information obtain through this work will be helpful to academic institutions, research workers, industrialists, law enforcing authorities like Central and State Pollution Control Boards etc. In addition, to identify the needs of research assignment consists of the following tasks:

- Review and update of existing available information & literature to be used in identify.

- Review and documentation of existing data available in Gujarat State and out of the state for reference and identify available species. This will include collecting preserving as herbarium of available species and photographs.

- Preparation of the preliminary report outlining the methodology to be adopted.

The study is carried out based on available species and identify through morphological characters and preserved as herbarium as documentation.
Gujarat is situated on the north-westernmost part of peninsular India between 20° 1' to 24° 7' N and 68° 4' to 74° 4' E (Fig 1). It has total area of 1,96,024 Sq. km and a coastline of 1,650 km - the longest coastline of the country - with a continental shelf of 164,200 Sq. km (35.3% of the continental shelf of India) and an Exclusive Economic Zone (EEZ) of 214,000 Sq. km which is 9.9% of EEZ of the country. Further, the state has also got two major gulfs namely Gulf of Kambhat and Gulf of Kachchh which embrace diverse coastal habitats as well as biota of ecological significance. The Gulf of Kachchh is the biggest gulf on the west coast of India in the Arabian Sea and contains 42 islands fringing with corals and mangroves which provide a congenial habitats for proliferation of seaweeds as well as nesting birds and breeding grounds for animals. However, the coastal parts of both Gulf of Kambhat and Kachchh region have extensive areas of intertidal mud and sand flats, coastal salt marshes, and degraded mangrove associations, particularly in the river deltas of Gulf of Kambhat. The long stretches of rocky, coralline and limestone substrata of both intertidal and shallow sub tidal waters along Gujarat coast and more particularly Saurashtra coast make it suitable for rich biota.

7.1 Study area

Gulf of Kachchh (GoK) is very rich in terms of biodiversity values. The GoK support varied habitats including coral reefs, mangroves, creeks, mud flats, islands, rocky shore, sandy shore etc., which in turn provide suitable environment for wide range of flora and fauna. The Gulf of Kachchh (GoK) is lying between Kachchh mainland and the Saurashtra Peninsula (22°15'-23°40' N Latitude and 68°20'-70°40' East Longitude). The Gulf is aligned approximately E-W direction. The northern side shares the boundary with Kachchh while the southern border touches with Rajkot andJamnagar districts in Saurashtra region.
While, in the east-west direction, the GoK is about 170 km long, towards the western end, the Gulf is about 75 km wide at the mouth near Okha which narrows down to 18 km near Kandla at the head (Fig. 1). The western open boundary of the Gulf interacts with the northern Arabian Sea, while the eastern Gulf opens into the shallow creeks of the Little Rann of Kachchh.

The GoK encompasses an area of 7350 km² and a volume of about 220,000 Mm³. The depth of the GoK ranges from a maximum of about 60 m at the mouth to less than 20 m at the head of the Gulf, with an average depth of about 30 meters. The minimum depth of Gulf is up to 5 m. The Gulf consists of a vast complex of marshlands crisscrossed by numerous creeks. The intertidal region is sandy and muddy or rocky. Geo-physical parameters (Table-2) suggest that Gulf of Kachchh is quite different.

The seaweeds are widely distributed along the west coast of India and are mostly found attached to substratum of dead coral or rock. The Gulf contributes to the maximum species and biomass of seaweeds for the west coast of India. Between two coasts of GoK, the northern and the southern—the latter supports luxuriant growth of marine algae because shoreline has gradual slope with high tidal amplitude, moderate wave action and low turbidity. Also, presence of hard substratum both due to coral reefs and other rocks, provide suitable habitat for most of the algal species. The northern shore of the Gulf has very poor algal growth, as the muddy substratum associated with relatively high turbidity does not support the species. There are many islands in the Gulf of Kachchh, supporting rich biodiversity. According to official records, there are 42 islands & some islets in the GoK, covering a total area of about 410.6 km². These islands and islets varied in their size. Of the total area of islands, 148.9 km² have been notified under MNPS. Among all the islands, only two are having human habitations viz. Beyt and Ajad.

7.2 Marine National Park & Sanctuary

The GoK is quite diverse in their ecological systems, especially the coral reefs and mangroves, and thus form critical habitats for rich diversity in flora and fauna. Realizing the ecological and geomorphological importance of the area and the conservation significance of coral reefs and mangroves, the state government declared quite a large area of the southern part of the Gulf as Protected Area. In 1980 an area of 220.71 km² was notified as Marine Sanctuary. Superseding 1980 notification, in 1982, another 237.21 km² area was added into the sanctuary. However, in order to provide higher protection level, in 1982, out of total 457.92 km² area of the Marine Sanctuary, an area of 162.89 km² was notified as Marine National Park (MNP), which happened to be the first Marine National Park of the country. Interestingly, the 162.89 km² area of MNP is actually distributed amongst 37 islands and their coasts. Whereas, the 295.03 km² are of Marine Sanctuary covers sub-tidal areas around 5 islands and inter-tidal zone from Navlakh to Okha. Out of total 42 islands in MNPS, 20 islands have mangroves and 33 support coral reefs. Thus, GoK Marine National Park and Sanctuary (MNP) include 148.92 sq. km of islands and 309 sq. km of intertidal zone along the coast (Fig. 2.).
Importantly, the open water between the islands is not included in either MNP or Marine Sanctuary. However, the management plan of MNPS suggested that about 1450 km² area up to 10 fathom depth need to be considered as part of the PA system to manage various anthropogenic activities and thus strengthen the function of MNPS. Interpretation of satellite imageries of 1998 identified various land use/land cover types in the MNPS. MNPS included three major categories of areas: reserved forest (11.82 sq. km.), unclassified forests (347.90 sq. km.) and Indian territorial waters (98.20 sq. km.). While, the overall responsibility of management of MNPS lies with State Forest Department, in effect there is serious overlapping of jurisdiction. Actually, there are quite a few agencies that had jurisdictional authority e.g., the Gujarat Maritime Board, Indian Coast Guard, Custom and Fisheries Departments.

Random sampling method was used to assess the diversity of the seaweeds along the coast of Islands. The sampling point is selected according to availability of seaweeds and accessibility of area. It is required to cover maximum area of the island within low tide time. The survey carried out at zigzag form in the intertidal area. The sampling point also placed parallel to the coast for more accuracy.

Maximum area of Islands is assessed during low-tide time. Seaweed samples are collected with holdfast and kept into polythene bag with seawater and taken to the Boat. The photograph is taken as natural condition and in plastic tray with white background in laboratory condition. The herbarium is prepared in the field itself and unidentified species brought to laboratory in live condition. To study internal structure of the thallus microscope is used. Standard taxonomic books were referred to identify the plant.

8.1 Preparation of Herbarium

- The collected specimens are taken into plastic tray which contains filtered seawater. The specimen was cleaned of sand particles, small shells, mud, epiphytes and adhering other materials with gentle force using small smooth painting brush.

- After cleaning, specimen spread over in other plates for taking photograph and same was mounted on Herbarium sheet (12" x 19"). For the mounting of specimen herbarium sheet should be submerged in the water and then spread the specimen on it.

- After mounting the specimen on herbarium sheet is lifted slowly and tilted one side to allow water to drain gradually without disturbing the sample. The specimen is given fine touch with the help of forceps and brush if required. Now placed the cotton cloth on the specimen and followed by blotting paper for remove access water.
Once, all the specimen to be mounted are ready, herbaria are piled one above the other and then placed between the two sheets of the wooden press. The press is tied tightly using screw and nuts.

The press is kept in the sun light for drying the water after 24 hours blotting paper should be changed and remove the cotton cloths carefully. New cloths and blotting papers are required to place and again press between the wooden plates.

After drying of the specimen, the specimen sticks to the sheet due to the phycocollodin present in the seaweed, in some case specimens are thick and can’t stick on the sheet, use gum/glue to stick the specimen on sheet.

After drying all specimens completely then spread the anti-fungal powder on the specimen to prevent fungus attack. Finally write all the information on the right bottom corner of the sheet and kept into air tight cupboard for long time preservation.

The field visit divided in to two groups of islands and six islands covered in each group. The names of the islands are as follow:

<table>
<thead>
<tr>
<th>Name of Islands</th>
<th>GPS Location of sample collection site.</th>
<th>Name of Islands</th>
<th>GPS Location of sample collection site.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chank</td>
<td>22 30 34.10 69 24 10.30 69 24 09.30 69 24 30.20</td>
<td>Boriya</td>
<td>22 24 33.7 69 13 22.00</td>
</tr>
<tr>
<td>Noru</td>
<td>22 29 52.60 69 22 48.30 69 22 39.00 69 22 55.40</td>
<td>Kalumbhur</td>
<td>22 27 58.6 69 36 48.90</td>
</tr>
<tr>
<td>Bhaider</td>
<td>22 30 25.00 69 20 10.60 69 19 50.50 69 18 52.95</td>
<td>Kalumbhur</td>
<td>22 25 09.7 69 35 07.60</td>
</tr>
<tr>
<td>Khara chusana</td>
<td>22 25 34.50 69 17 05.20 69 16 56.80 69 16 48.60</td>
<td>Dhani Beyt</td>
<td>22 26 09.30 69 32 09.80</td>
</tr>
<tr>
<td>Azad</td>
<td>22 22 41.80 69 18 58.90 69 20 29.90 69 22 38.50</td>
<td>Gandhiya Kado</td>
<td>22 23 13.10 69 29 17.80</td>
</tr>
<tr>
<td>Pashu Islands</td>
<td>22 23 08.90 69 14 56.60 69 14 56.60 69 14 30.90</td>
<td>Panero Islands</td>
<td>22 20 54.00 69 25 14.30</td>
</tr>
</tbody>
</table>

8.2 Collection sites of study area

Group-1 (Chank Island, Noru, Bhaider, Khara chusana, Azad and Pashu Islands)

Fig 3: collection sites of Gulf of Khachchh

Fig 4: collection sites at Chank Island

Fig 5: collection sites at Noru Bhaidersland

Fig 6: collection sites at Khara-chusana Island

Fig 7: collection sites at Azad

Fig 8: collection sites at Pashu Island
Group -II (Boriya, Kalumbhar (Korad), Kalumbhar (Southern part), Gandhiya Kado, Dhani Beyt, and Panero Islands)

View different seaweed collection sites along Islands of Gulf of Kutch

Fig:9 collection sites of Gulf of Kutch

Fig:10 collection sites at Kalumbhar Island
Fig:11 collection sites at Dhani Beyt Island
Fig:12 collection sites at Gandhiya Kado
Fig:13 collection sites at Panero Island
Fig:14 collection sites at Boriya Island

Noru Island-Bhaider

Chank Island
Kalubhar (Korad) Island

Kalubhar (Southern) Island

Gandhiya Kado

Dhani Beyt

Seaweed diversity along the Islands of Gulf of Kachchh, Gujarat
A study was carried out for study of Seaweeds diversity along the Islands of Gulf of Kutch, Gujarat under ICZM Project for preparing of baseline data. Under this project team has visited 12 Islands of Gulf of Kutch comes under Marine National Parks and Sanctuary from February 2012 to April 2012. During the summer season most of the intertidal Zone at Islands of Gulf of Kachchh is barren except in the lower fringes of the intertidal, where they are not exposed to the intense radiation of the summer heat during the period of emergence. This period extend up to late monsoon i.e. July to middle of September. During this period the seaweeds spores settled down at random at suitable substratum. However, most of the sporlings yet unrooted due to the wind. Where monsoon is recedes during the late August or September, most of the seaweeds beginning to grow at all levels of the intertidal belt i.e. upper, middle, and lower part of the intertidal area. With the advent of winter associated with low temperature in the seawater, there growth is accelerated. Pick growth of the seaweeds is attained during the winter month of December to March. Therefore, the present study was confined only to the growing season of the seaweed i.e. from February to April.

The entire intertidal area of 12 islands has been first thoroughly surveyed to get an idea of the coast characteristics and to make qualitative assessment of the seaweed flora in habiting there, throughout the period of study. A list of different seaweed species recorded during the period of investigation is presented class wise in the following table. From the table it is cleared that 26 species of Chlorophyceae, 17 species of Phaeophyceae and 35 species of Rhodophyceae belonging to 43 genera have been recorded from 12 islands making a total of 78 species in the present study. This list shows the mere presence of a species on the intertidal, irrespective of its numbers and growths. The ratio of Chlorophyceae: Phaeophyceae: Rhodophyceae is 26:17:35. Thus Rhodophyceae shows more preponderance in the seaweed flora at 12 Islands. In the previous study from Saurashtra coast Jha et al. (2009) also observed more number of Rhodophyceae members as compare to the Phaeophyceae or the Chlorophyceae.
## Chlorophyceae

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Species</th>
<th>Order</th>
<th>Family</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ulva boiyiensis Thivy &amp; Sharma</td>
<td>Ulvales</td>
<td>Monostromataceae</td>
<td>Bo, Ka, Da, Ga</td>
</tr>
<tr>
<td>2</td>
<td>Ulva lactuca Linnaeus</td>
<td>Ulvales</td>
<td>Monostromataceae</td>
<td>Az, Ka, Da, Pn</td>
</tr>
<tr>
<td>3</td>
<td>Ulva reticulata Forskål</td>
<td>Ulvales</td>
<td>Monostromataceae</td>
<td>No, Ka, Da</td>
</tr>
<tr>
<td>4</td>
<td>Ulva compressa Linnaeus</td>
<td>Ulvales</td>
<td>Ulvaceae</td>
<td>No-Bh, Ka, Da, Pn</td>
</tr>
<tr>
<td>5</td>
<td>Ulva clothinota Roth.</td>
<td>Ulvales</td>
<td>Ulvaceae</td>
<td>No-Bh, Ga</td>
</tr>
<tr>
<td>6</td>
<td>Ulva flexuosa Wulf.</td>
<td>Ulvales</td>
<td>Ulvaceae</td>
<td>No-Bh, Da, Pn</td>
</tr>
<tr>
<td>7</td>
<td>Ulva intestiniflata Linnaeus</td>
<td>Ulvales</td>
<td>Ulvaceae</td>
<td>Ch</td>
</tr>
<tr>
<td>8</td>
<td>Ulva longipinnata Linnaeus.</td>
<td>Ulvales</td>
<td>Ulvaceae</td>
<td>Ch, Pn</td>
</tr>
<tr>
<td>9</td>
<td>Ulva prolifera Muller.</td>
<td>Ulvales</td>
<td>Ulvaceae</td>
<td>No-Bh, Da</td>
</tr>
<tr>
<td>10</td>
<td>Chara tamtophila Okumura</td>
<td>Cladogonales</td>
<td>Cladochroaceae</td>
<td>No</td>
</tr>
<tr>
<td>11</td>
<td>Cledophora glomerata (Linnaeus) Kützing</td>
<td>Cladogonales</td>
<td>Cladochroaceae</td>
<td>Bo</td>
</tr>
<tr>
<td>12</td>
<td>Cledophora sp.</td>
<td>Cledogonales</td>
<td>Cladochroaceae</td>
<td>Ka</td>
</tr>
<tr>
<td>13</td>
<td>Boudreaea composita (Harvey) Brand</td>
<td>Cledogonales</td>
<td>Siphonocladae</td>
<td>Az, Bo, Da, Pn</td>
</tr>
<tr>
<td>14</td>
<td>Struvaea anastomosa (Harvey) Picone &amp; Grunow</td>
<td>Cledogonales</td>
<td>Siphonocladae</td>
<td>No, Pn</td>
</tr>
<tr>
<td>15</td>
<td>Caulerpa microphyta (Webber van Borsse) J. Feldmann</td>
<td>Bryopsidales</td>
<td>Caulerpaceae</td>
<td>Az, Pn</td>
</tr>
<tr>
<td>16</td>
<td>Caulerpa racemosa var. occidentalis (U. Aarath) Barraez</td>
<td>Bryopsidales</td>
<td>Caulerpaceae</td>
<td>Ch, Ka, Da</td>
</tr>
<tr>
<td>17</td>
<td>Caulerpa racemosa (Forskål) J. Aarath</td>
<td>Bryopsidales</td>
<td>Caulerpaceae</td>
<td>Ch, Ka, Da</td>
</tr>
<tr>
<td>18</td>
<td>Caulerpa scapelliiformis var. denticulata</td>
<td>Bryopsidales</td>
<td>Caulerpaceae</td>
<td>Br</td>
</tr>
<tr>
<td>19</td>
<td>Caulerpa serrulatoides (S. Gmelin) How. f. brevipes (J. Aarath) Svedillus</td>
<td>Bryopsidales</td>
<td>Caulerpaceae</td>
<td>Az, Ka, Pn</td>
</tr>
<tr>
<td>20</td>
<td>Caulerpa taxifolia (Vahl) C. Aarath</td>
<td>Bryopsidales</td>
<td>Caulerpaceae</td>
<td>Bh, Kh, Ka</td>
</tr>
<tr>
<td>21</td>
<td>Caulerpa verzalensis Thivy &amp; Chauhan</td>
<td>Bryopsidales</td>
<td>Caulerpaceae</td>
<td>Bo</td>
</tr>
<tr>
<td>22</td>
<td>Codium decorticatum (Woodward) How.</td>
<td>Bryopsidales</td>
<td>Codiceae</td>
<td>Bo, Da</td>
</tr>
<tr>
<td>23</td>
<td>Codium geophorum O. Schmidt</td>
<td>Bryopsidales</td>
<td>Codiceae</td>
<td>Bo, Da</td>
</tr>
<tr>
<td>24</td>
<td>Codium sp.</td>
<td>Bryopsidales</td>
<td>Codiceae</td>
<td>Bo, Ka</td>
</tr>
<tr>
<td>25</td>
<td>Halimeda maccaroloba Decaisne</td>
<td>Bryopsidales</td>
<td>Udoteaceae</td>
<td>Bo, Ka</td>
</tr>
<tr>
<td>26</td>
<td>Halimeda tuna</td>
<td>Bryopsidales</td>
<td>Udoteaceae</td>
<td>Az, Bo, Ka, Da</td>
</tr>
</tbody>
</table>

**Table No. 5** List of Chlorophyceae

<table>
<thead>
<tr>
<th>Location Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bo</td>
</tr>
<tr>
<td>Ka</td>
</tr>
<tr>
<td>Da</td>
</tr>
<tr>
<td>Bh</td>
</tr>
<tr>
<td>Az</td>
</tr>
<tr>
<td>Ch</td>
</tr>
<tr>
<td>Nh</td>
</tr>
<tr>
<td>Kh</td>
</tr>
<tr>
<td>Dh</td>
</tr>
<tr>
<td>Pn</td>
</tr>
<tr>
<td>Ps</td>
</tr>
<tr>
<td>Ga</td>
</tr>
</tbody>
</table>

Speciose seabed diversity along the Islands of Gulf of Kachchh, Gujarat
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Species</th>
<th>Order</th>
<th>Family</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ectocarpus confervoides</td>
<td>Ectocarpales</td>
<td>Ectocarpaceae</td>
<td>Bh-Kh</td>
</tr>
<tr>
<td>2</td>
<td>Ectocarpus siliculosus (Dillwynii) matay</td>
<td>Ectocarpales</td>
<td>Ectocarpaceae</td>
<td>Ch, Da, Ga</td>
</tr>
<tr>
<td>3</td>
<td>Giffordia micheillii</td>
<td>Ectocarpales</td>
<td>Ectocarpaceae</td>
<td>Bh-Kh, Da</td>
</tr>
<tr>
<td>4</td>
<td>Dictyoasteris delicatula Lamouroux</td>
<td>Dictyotales</td>
<td>Dictyotaceae</td>
<td>Az, Ka, Pr</td>
</tr>
<tr>
<td>5</td>
<td>Dictyoasteris cervicornis Kutting</td>
<td>Dictyotales</td>
<td>Dictyotaceae</td>
<td>Bh-Kh, Da, Ga, Pr</td>
</tr>
<tr>
<td>6</td>
<td>Dictyoasteris ciliolata Kutting Syn.</td>
<td>Dictyotales</td>
<td>Dictyotaceae</td>
<td>No-Bh</td>
</tr>
<tr>
<td>7</td>
<td>Frustulina dichotoma Hudson Lamouroux</td>
<td>Dictyotales</td>
<td>Dictyotaceae</td>
<td>Az, Ka, Da</td>
</tr>
<tr>
<td>8</td>
<td>Padina boergesenii Allender &amp; Kraft</td>
<td>Dictyotales</td>
<td>Dictyotaceae</td>
<td>Ch, Ka, Da, Pr</td>
</tr>
<tr>
<td>9</td>
<td>Padina tetrastromatica Hauck</td>
<td>Dictyotales</td>
<td>Dictyotaceae</td>
<td>Da, Ka, Ga</td>
</tr>
<tr>
<td>10</td>
<td>Spatoglossumasperum J. Agardh</td>
<td>Dictyotales</td>
<td>Dictyotaceae</td>
<td>Bo, Ka, Da, Pr</td>
</tr>
<tr>
<td>11</td>
<td>Hydrodictyon elatum (C.Agardh) Howo</td>
<td>Scytophales</td>
<td>Chnoosporaceae</td>
<td>Ch, Ka, Da, Pr</td>
</tr>
<tr>
<td>12</td>
<td>Hydrolithon stellata (Boreasen) Boreasen</td>
<td>Scytophales</td>
<td>Chnoosporaceae</td>
<td>Ch, Ka, Da, Pr</td>
</tr>
<tr>
<td>13</td>
<td>Cystosira indica (Tiny &amp; Doshi) Malik</td>
<td>Fucales</td>
<td>Cystosiraceae</td>
<td>No-Bh, Da</td>
</tr>
<tr>
<td>14</td>
<td>Cystosira cirriads (Frossard J. Agardh)</td>
<td>Fucales</td>
<td>Cystosiraceae</td>
<td>No-Bh, Da</td>
</tr>
<tr>
<td>15</td>
<td>Sargassum cinctum</td>
<td>Fucales</td>
<td>Sargassaceae</td>
<td>Ps, Da</td>
</tr>
<tr>
<td>16</td>
<td>Sargassum cinereum J. Agardh</td>
<td>Fucales</td>
<td>Sargassaceae</td>
<td>Ps, Ka, Da</td>
</tr>
<tr>
<td>17</td>
<td>Sargassum tenerissimum J. Agardh</td>
<td>Fucales</td>
<td>Sargassaceae</td>
<td>No-Bh, Da</td>
</tr>
</tbody>
</table>
# RHODOPHYCEAE

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Species</th>
<th>Order</th>
<th>Family</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scinaia cornosa (Kützing) J. Agardh</td>
<td>Nemaliales</td>
<td>Galaxauraceae</td>
<td>Az</td>
</tr>
<tr>
<td>2</td>
<td>Scinaia complanata (Collins) Cotton</td>
<td>Nemaliales</td>
<td>Galaxauraceae</td>
<td>Bh-Kh, Da</td>
</tr>
<tr>
<td>3</td>
<td>Scinaia heder Burgess</td>
<td>Nemaliales</td>
<td>Galaxauraceae</td>
<td>Bo, Ka, Da</td>
</tr>
<tr>
<td>4</td>
<td>Demanema viridis (J. Agardh) Pedroche &amp; Avila Ortiz</td>
<td>Nemaliales</td>
<td>Lioconaraceae</td>
<td>Bo, Ka, Pr</td>
</tr>
<tr>
<td>5</td>
<td>Ahnfeltia plicata (Hudson)Tories.</td>
<td>Ahnfeltiales</td>
<td>Ahnfeltiaceae</td>
<td>Bo, Pr</td>
</tr>
<tr>
<td>6</td>
<td>Gelidiurn pulvillus (Stackhouse) Le Jolis</td>
<td>Gelidiales</td>
<td>Gelidiaceae</td>
<td>Az, Da</td>
</tr>
<tr>
<td>7</td>
<td>Gracilaria corticata (J.Agardh) J. Agardh</td>
<td>Gracillariales</td>
<td>Graciliaceae</td>
<td>Ch, Ka, Da</td>
</tr>
<tr>
<td>8</td>
<td>Gracilaria foliifera (Forsskål) Bergesen</td>
<td>Gracillariales</td>
<td>Graciliaceae</td>
<td>Bo</td>
</tr>
<tr>
<td>9</td>
<td>Gracilaria selicocnia (C. Agardh) Davesson</td>
<td>Gracillariales</td>
<td>Graciliaceae</td>
<td>Pr</td>
</tr>
<tr>
<td>10</td>
<td>Gracilaria texensis (Suringar) De Toni</td>
<td>Gracillariales</td>
<td>Graciliaceae</td>
<td>Bo</td>
</tr>
<tr>
<td>11</td>
<td>Asparagopsis taxiformis(Dill)Treviranus</td>
<td>Bornemialesızles</td>
<td>Bornemisalaceae</td>
<td>Bo, Ka</td>
</tr>
<tr>
<td>12</td>
<td>Hyalotheca porphyraformis Parkinson</td>
<td>Cryptonemiales</td>
<td>Hyalothecaceae</td>
<td>Ps</td>
</tr>
<tr>
<td>13</td>
<td>Hyalotheca venusta Bergesen</td>
<td>Cryptonemiales</td>
<td>Hyalothecaceae</td>
<td>Bo, Ka</td>
</tr>
<tr>
<td>14</td>
<td>Amphimedus encetes(Lamk) Decaisne</td>
<td>Corallinales</td>
<td>Corallinaceae</td>
<td>Bo, Ka, Pr</td>
</tr>
<tr>
<td>15</td>
<td>Amphimedus frasiliensis(Linnaeus) Lamouroux</td>
<td>Corallinales</td>
<td>Corallinaceae</td>
<td>Pr, Ka</td>
</tr>
<tr>
<td>16</td>
<td>Hypnea valentiae (Turner)Montagne</td>
<td>Gastrocliales</td>
<td>Hypnaceae</td>
<td>Na-Bh, Ka, Da</td>
</tr>
<tr>
<td>17</td>
<td>Sarcoceras filiforme (Sonnerat) Kylin</td>
<td>Gastrocliales</td>
<td>Scleritaceae</td>
<td>Bo, Ka</td>
</tr>
<tr>
<td>18</td>
<td>Solieria robusta (Greville) Kylin</td>
<td>Gastrocliales</td>
<td>Scleritaceae</td>
<td>Bo, Da, Pr</td>
</tr>
<tr>
<td>19</td>
<td>Solieria chordalis (C.Agardh)Agardh</td>
<td>Gastrocliales</td>
<td>Scleritaceae</td>
<td>Da, Pr</td>
</tr>
<tr>
<td>20</td>
<td>Chondrophyta indico Bergesen,</td>
<td>Rhodomniiales</td>
<td>Chondrophytaceae</td>
<td>Bo, Pr</td>
</tr>
<tr>
<td>21</td>
<td>Gastroclonium bengalense (S. Srinivasan) Srinivasan</td>
<td>Rhodomniiales</td>
<td>Chondrophytaceae</td>
<td>Da, Pr</td>
</tr>
<tr>
<td>22</td>
<td>Brevirochetale ascophyta (Endlicher)Ferogenen,</td>
<td>Rhodomniiales</td>
<td>Rhodomniaceae</td>
<td>Az, Da, Pr</td>
</tr>
<tr>
<td>23</td>
<td>Gelidiopsis reepsi (Kützing) Shiniz</td>
<td>Rhodomniiales</td>
<td>Rhodomniaceae</td>
<td>Ps, Da</td>
</tr>
<tr>
<td>24</td>
<td>Dicranella simplex (Wulfen)C.Agardh</td>
<td>Ceramiales</td>
<td>Rhodomelaceae</td>
<td>Ka</td>
</tr>
<tr>
<td>25</td>
<td>Acanthophora speciosa (Yahil) Bergesen</td>
<td>Ceramiales</td>
<td>Rhodomelaceae</td>
<td>Bo, Ka</td>
</tr>
<tr>
<td>26</td>
<td>Centriceros clavatum (C.Agardh) Montagne</td>
<td>Ceramiales</td>
<td>Ceramiaceae</td>
<td>Ch</td>
</tr>
<tr>
<td>27</td>
<td>Ceramium Spinosum (G.Martens)Okamura</td>
<td>Ceramiales</td>
<td>Ceramiaceae</td>
<td>No-Bh</td>
</tr>
<tr>
<td>28</td>
<td>Sporodina alternans Bergesen</td>
<td>Ceramiales</td>
<td>Ceramiaceae</td>
<td>A2</td>
</tr>
<tr>
<td>29</td>
<td>Sporodina Filamentosa (Wulfen) Harvey</td>
<td>Ceramiales</td>
<td>Ceramiaceae</td>
<td>No-Bh</td>
</tr>
<tr>
<td>30</td>
<td>Wrangelli tenebrosa Harvey</td>
<td>Ceramiales</td>
<td>Ceramiaceae</td>
<td>No-Bh, Da</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table No. 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of</td>
</tr>
<tr>
<td>Rhodophyceae</td>
</tr>
</tbody>
</table>

---

Spicedeed diversity along the Islands of
Gulf of Khambhāt, Gujārat

---

Gujarat Ecology Commission
Ulva beytensis Thivy & Sharma

Order: Ulvales
Family: Monostromataceae
Distribution: Bo, Ka, Da, Ga

Ulva lactuca Linnaeus

Order: Ulvales
Family: Monostromataceae
Distribution: Az, Ka, Da, Pn
Ulva intestinalis Linnaeus

Order: Ulvales
Family: Ulvaceae
Distribution: Ch

Ulva prolifera Muller

Order: Ulvales
Family: Ulvaceae
Distribution: No-Bh, Da

Ulva linza Linnaeus

Order: Ulvales
Family: Ulvaceae
Distribution: Ch, Pr

Chaetomorpha spiralis Okamura

Order: Cladophorales
Family: Cladophoraceae
Distribution: No
**Cladophora glomerata (Linnaeus) Kützing**

- **Order:** Cladophorales
- **Family:** Cladophoraceae
- **Distribution:** Bo

**Cladophora sp.**

- **Order:** Cladophorales
- **Family:** Cladophoraceae
- **Distribution:** Ka

**Boodlea composita (Harvey) Brand**

- **Order:** Cladophorales
- **Family:** Siphonocladaeaceae
- **Distribution:** Az, Bo, Da, Pn

**Struvea anastomosans (Harvey) Piccone & Grunow**

- **Order:** Cladophorales
- **Family:** Siphonocladaeaceae
- **Distribution:** No, Pn
Caulerpa microphysa (Webber van Bosse) J. Feldmann

Order: Bryopsidales
Family: Caulerpaceae
Distribution: Az, Bo, Da, Pn

Caulerpa racemosa (Forsskål) J. Agardh

Order: Bryopsidales
Family: Caulerpaceae
Distribution: Ch, Ka, Da

Caulerpa racemosa var. occidentalis (J. Agardh) Børgeesen

Order: Bryopsidales
Family: Caulerpaceae
Distribution: Ch, Ka, Da

Caulerpa scalpelliformis var. denticulata

Order: Bryopsidales
Family: Caulerpaceae
Distribution: Br
Caulerpa serrularioides (S. Gmelin) Howe f. brevipes (J. Agardh) Svedelius

Order: Bryopsidales
Family: Caulerpaceae
Distribution: Az, Ka, Pn

Caulerpa venavalensis Thivy & Chauhan

Order: Bryopsidales
Family: Caulerpaceae
Distribution: Bo

Caulerpa taxifolia (Vahl) C. Agardh

Order: Bryopsidales
Family: Caulerpaceae
Distribution: Blt-Kh, Ka

Codium decorticatum (Woodward) Howe

Order: Bryopsidales
Family: Codiaceae
Distribution: Bo, Da
Ectocarpus confervoides

Order: Ectocarpales
Family: Ectocarpaceae
Distribution: Nil-Kh

Ectocarpus siliculosus (Dillwyn) Lyngbye

Order: Ectocarpales
Family: Ectocarpaceae
Distribution: Ch. Da. Ga
**Giffordia mitchellae**

- **Order:** Ectocarpales
- **Family:** Ectocarpaceae
- **Distribution:** Bh-Kh, Da

**Dictyota cervicornis** Kutzing

- **Order:** Dictyotales
- **Family:** Dictyotaceae
- **Distribution:** Bh-Kh, Da, Ga, Ph

**Dictyopteris delicatula** Lamouroux

- **Order:** Dictyotales
- **Family:** Dictyotaceae
- **Distribution:** Az, Ka, Pn

**Dictyota ciliolata** Kutzing Syn. D. ciliata J.G. Agardh

- **Order:** Dictyotales
- **Family:** Dictyotaceae
- **Distribution:** No-Bh
**Dictyota dichotoma (Hudson) Lamouroux**
- Order: Dictyotales
- Family: Dictyotaceae
- Distribution: Az, Ka, Da, Prn

**Padina tetrastromatica Hauck**
- Order: Dictyotales
- Family: Dictyotaceae
- Distribution: Da, Ka, Ga

**Padina boergeseniai Allender & Kraft**
- Order: Dictyotales
- Family: Dictyotaceae
- Distribution: Ch, Ka, Da, Prn

**Spatoglossum asperum J. Agardh**
- Order: Dictyotales
- Family: Dictyotaceae
- Distribution: Bo, Ka, Da, Prn
Hydroclathrus clathratus (C.Agardh) Howe

Order: Scytosphonales
Family: Chnoosporaceae
Distribution: Ch, Ka, Da, Ph

Cystoseira indica (Thivy & Doshi) Mairh

Order: Fucales
Family: Cystoseiraceae
Distribution: No-Bh, Da

Iyengaria stellata (Borgesen) Borgesen

Order: Scytosphonales
Family: Chnoosporaceae
Distribution: Ch, Ka, Da, Ph

Cystoseira trinodis (Frosskal) C.Agardh

Order: Fucales
Family: Cystoseiraceae
Distribution: No-Bh, Da
Scinaia carnosa (Kützing) J. Agardh

Order: Nemaliales
Family: Galaxauraceae
Distribution: Az.

Scinaia complanata (Collins) Cotton

Order: Nemaliales
Family: Galaxauraceae
Distribution: Bh-Kh, Da

RHODOPHYCEAE

Sessile diversity along the islands of Gulf of Kachchh, Gujarat.
**Scinaia hatei** Borgen

**Order:** Nemaliales

**Family:** Galaxauraceae

**Distribution:** Bo, Ka, Da

---

**Ahnfeltia plicata** (Hudson) Fries.

**Order:** Ahnfeltiales

**Family:** Ahnfeltiaceae

**Distribution:** Bo, Pn

---

**Dermonea viriaes** (J. Agardh) Pedroche & Avila Ortiz

**Order:** Nemaliales

**Family:** Liagoraceae

**Distribution:** Bo, Ka, Pn

---

**Gelidium pusillum** (Stackhouse) Le Jolis

**Order:** Gelidiiales

**Family:** Gelidiaceae

**Distribution:** Az, Da
**Gracilaria corticata (J. Agardh) J. Agardh**

Order: Gracilariales  
Family: Graciliariaceae  
Distribution: Ch, Ka, Da

**Gracilaria salicornia (C. Agardh) Dawson**

Order: Gracilariales  
Family: Graciliariaceae  
Distribution: Ph

**Gracilaria foliifera (Forsskål) Børgesen**

Order: Gracilariales  
Family: Graciliariaceae  
Distribution: Bo

**Gracilaria textorii (Suringar) De Toni**

Order: Gracilariales  
Family: Graciliariaceae  
Distribution: Bo
Asparagopsis taxiformis (Delile) Trevisan
- Order: Bonnemaisoniales
- Family: Bonnemaisoniacae
- Distribution: Bo, Ka

Halymenia venusta Borgesen
- Order: Cryptonemiales
- Family: Halymeniaceae
- Distribution: Bo, Ka

Halymenia porphyraeformis Parkinson
- Order: Cryptonemiales
- Family: Halymeniaceae
- Distribution: Pn

Amphiroa aniceps (Lamark) Decaisne
- Order: Corallinales
- Family: Corallinaceae
- Distribution: Bo, Ka, Pn
**Amphiroa fragilisima (Linnaeus) Lamouraux**

- **Order:** Corallinales
- **Family:** Corallinaceae
- **Distribution:** Pn, Ka

---

**Sarcocornia filiforme (Sonder) Kylin**

- **Order:** Gigartinales
- **Family:** Solieriaceae
- **Distribution:** Bo, Ka, Da

---

**Hypnea valentiae (Turner) Montagne**

- **Order:** Gigartinales
- **Family:** Hypneaceae
- **Distribution:** No-Bh, Ka, Da

---

**Solieria robusta (Greville) Kylin**

- **Order:** Gigartinales
- **Family:** Solieriaceae
- **Distribution:** Bo, Da, Pn
**Solieria chordalis** (C.Agardh) J.Agardh

*Order:* Gigartinales  
*Family:* Solieriaceae  
*Distribution:* Da, Pn

**Gastroclonium iyengari** K. Srinivasan

*Order:* Rhodymeniales  
*Family:* Champiaceae  
*Distribution:* Da, Pn

**Champia indica** Borgesen

*Order:* Rhodymeniales  
*Family:* Champiaceae  
*Distribution:* Bo, Da, Pn

**Botryocladia leptopoda** (J. Agardh) Kylin

*Order:* Rhodymeniales  
*Family:* Rhodymeniaceae  
*Distribution:* Bo, Da
Coelarhtrum opuntia (Endlicher) Borgesen

Order: Rhodymeniales
Family: Rhodymeniaceae
Distribution: Az, Da, Pn

Digenea simplex (Wulfen) C. Agardh

Order: Ceramiales
Family: Rhodomelaceae
Distribution: Ka

Gelidiopsis repens (Kützing) Shmitz

Order: Rhodymeniales
Family: Rhodymeniaceae
Distribution: Ps, Da

Acanthophora specifera (Vahl) Bægnesen

Order: Ceramiales
Family: Rhodomelaceae
Distribution: Bo, Ka
**Centrocera clavulatum** (C. Agardh) Montagne

- **Order:** Ceramiales
- **Family:** Ceramiaceae
- **Distribution:** Ch

**Spyridia alternans** Borgesen

- **Order:** Ceramiales
- **Family:** Ceramiaceae
- **Distribution:** Az

**Ceramium tenerrimum** (G. Martens) Okamura

- **Order:** Ceramiales
- **Family:** Ceramiaceae
- **Distribution:** No-Bh

**Spyridia filamentosa** (Wulfen) Harvey

- **Order:** Ceramiales
- **Family:** Ceramiaceae
- **Distribution:** No-Bh
**Wrangelia tanegana Harvey**
- **Order:** Ceramiaceae
- **Family:** Ceramiaceae
- **Distribution:** No-Bh, Da

**Hypoglossum heterocystideum (J. Agardh) J. Agardh**
- **Order:** Ceramiaceae
- **Family:** Delesseriaceae
- **Distribution:** Ps, Ka

**Laurencia platyclada Borgesen**
- **Order:** Ceramiaceae
- **Family:** Rhodomelaceae
- **Distribution:** Bo

**Laurencia obtusa (Hudson) Lamouroux**
- **Order:** Ceramiaceae
- **Family:** Rhodomelaceae
- **Distribution:** Bo, Ka
References


A.

_Acanthophora specifera_ (Vahl) Børgesen 75
_Ahnfeltia picata_ (Hudson)Fries. 65
_Amphiroa anceps_ (Lamarck) Decaisne 69
_Amphiroa fragilisima_ (Linnaeus) Lamouraux 70
_Asparagopsis taxiformis_ (Delile) Trevisan 68

B.

_Boodlea composita_ (Harvey) Brand 45
_Botryocladia leptopoda_ (J. Agardh) Kylin 73

C.

_Caulerpa microphysa_ (Webber von Bosse) J. Feldmann 46
_Caulerpa racemosa_ Var. _occidentalis_ (J. Agardh) Børgesen 46
_Caulerpa racemosa_ (Forsskal) J. Agardh 47
_Caulerpa scalpelliformis_ Var. _dentiquita_ 47
_Caulerpa setularioides_ (S. Gmelin) Howe f. _brevipes_ (J. Agardh) Svedelius 48
_Caulerpa taxifolia_ (Vahl) C. Agardh 48
_Caulerpa verawalensis_ Thivy & Chauhan 49
_Centroceras clovatum_ (C. Agardh) Montagne 76
_Ceramium tenerrimum_ (G. martens) Okamura 76
_Chaetomorpha spiralis_ Okamura 43

GLOSSARY
Champia indica Borgesen.
Chondria dasyphylla (Woodward) C. Agardh
Cladophora glomerata (Linnaeus) Kützing
Cladophora sp.
Codium decorticum (Woodward) Howe
Codium geppiorum O. Schmidt
Codium sp.
Coelothamnion opuntia (Endlicher) Borgesen.
Cystoseira indica (Thivy & Doshi) Maihr
Cystoseira trinodis (Foskall) C. Agardh
D.
Dermonea virens (J. Agardh) Pedroche & Avila Ortiz
Dictyota delicata Lamouroux
Dictyota cervicornis Kützing
Dictyota ciliolata Kützing Syn. D. ciliata J. G. Agardh
Dictyota dichotoma (Hudson) Lamouroux
Digenea simplex (Wulfen) C. Agardh
E.
Ectocarpus confervoides
Ectocarpus siliculosus (Dillwyn) Lyngbye
G.
Gastroclonium iyengari K. Srinivasan
Geidiopsis repens (Kützing) Shimitz
Geidium pusillum (Stackhouse) Le Jolis
Giffordia micheliana
Gracilaria corticata (J. Agardh) J. Agardh
Gracilaria foliifera (Forskål) Borgesen
Gracilaria salicornia (C. Agardh) Dawson
Gracilaria textori (Suringar) De Toni
H.
Halimeda macroloba Decaisne
Halimeda tuna
Halyomenia porphyraformis Parkinson
Halyomenia venusta Borgesen
Hydroclathrus clathratus (C. Agardh) Howe
Hypnea valentiae (Turner) Montagne
Hypoglossum heterocystideum (J. Agardh) J. Agardh
I.
Iyengoria steffata (Borgesen) Borgesen
J.
Laurencia obtusa (Hudson) Lamouroux
Laurencia platyclada Borgesen
K.
Padina boergeseni Allender & Kraft
Padina tetrastromatica Hauck
S.
Sarcocoma filiforme (Sonder) Kylin
Sargassum cinctum
Sargassum cinereum J. Agardh
Sargassum tenerimum J. G. Agardh
Scinaia carnosa (Kützing) J. Agardh
Scinaia complanata (Collins) Cotton
Scinaia hartei Borgesen
Salacia chordalis (C. Agardh) J. Agardh
Salacia robusta (Greville) Kylin
Spotaglossum asperum J. Agardh
**Spyridia alternans** Borgesen.

**Spyridia filamentososa** (Wulfen) Harvey

**Struvea anastomosans** (Harvey) Piccone & Grunow

**U.**

**Ulva beytensis** Thivy & Sharma

**Ulva clathrata** Roth.

**Ulva compressa** Linnaeus

**Ulva flexuosa** Wulf.

**Ulva lactuca** Linnaeus

**Ulva linza** Linnaeus.

**Ulva prolifera** Muller.

**Ulva reticulata** Forsskål

**W.**

**Wrangelia tanegana** Harvey

77

77

45

U.

39

41

40

41

39

42

43

40

78