

## Deep water marine algal flora of the submerged banks off west coast of India

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**Abstract-** A survey of submerged banks off west coast of India viz Cora Divh, Sessostis and Bassas de-Pedro resulted in obtaining information on the rich and diverse marine algal flora from various depths ranging from 18-70m. A programme of onboard dredging was undertaken on R.V. Gaveshani, cruise no. 206. Altogether, 72 species of algae were collected from these banks. A groupwise representation is as follows : Chlorophyceae-22, Pheophyceae-11, Rhodophyceae-39. Species of *Halimeda*, *Codium*, *Dictyopteris*, *Lobophora*, *Galaxaura*, *Asparagopsis*, *Hildenbrandtia*, *Peyssonetia* were the predominant forms.

This paper gives the systematic account of deep water algal flora from the submerged banks along the Indian coast.

### INTRODUCTION

Benthic marine algal flora of India has been relatively well investigated. Existing floristic literature mostly deals with the intertidal algae. However, there are stray reports on the subtidal flora (JAGTAP, 1987; UNTAWALE *et al.*, 1989 b). None of these reports deals with the deep water flora which remained unknown till UNTAWALE *et al.*, (1989 a) surveyed Angria Bank (16° 27'N and 72° 05' E).

Prior to this investigation, NAIR and QASIM (1970) discovered Gaveshani Bank and reported coral growth on this bank. However, there is no data available on marine algal flora of any other bank in the Arabian Sea. Such data is important from distribution, physiology and reproduction point of view.

In view of the lack of knowledge in this area, an attempt was made to collect floristic data from three submerged banks viz. Bassas de-Pedro, Cora Divh and Sessostis Bank located in the Arabian Sea off Mangalore, Karnataka (13° 30'N and 72° 35'E, 13° 45'N and 72° 15'E and 12° 55'N and 72° 05'E respectively) Fig. 1. Bassas de-Pedro has an area of 2198 km<sup>2</sup> while Cora Divh and Sessostis banks have areas of 296 and 347 km<sup>2</sup>. Depth range was 20-75 m over these banks. The floor of these banks is mostly a mixture of sand, mud, shell and shell fragments, calcareous limestones and dead coral pieces.

In the present paper, flora of Bassas de-Pedro, Cora Divh and Sessostis Bank is listed. Flora is compared with the well investigated Angria Bank and also with the flora of mainland of Karnataka with the help of existing literature (AGADI, 1986; UNTAWALE, *et al.*, 1989b). Since no data on quantitative abundance was available, this aspect is omitted from the following observations.

### MATERIALS AND METHODS

Dredging data was collected in the cruise no. 206 of R.V. *Gaveshani* in December 1988. A bucket dredge (size 0.7 x 0.5 x 0.25 m) was used for collecting the samples along the preplanned transects so that maximum surface area is represented. Dredging was undertaken at various depths ranging from 18-70 m.

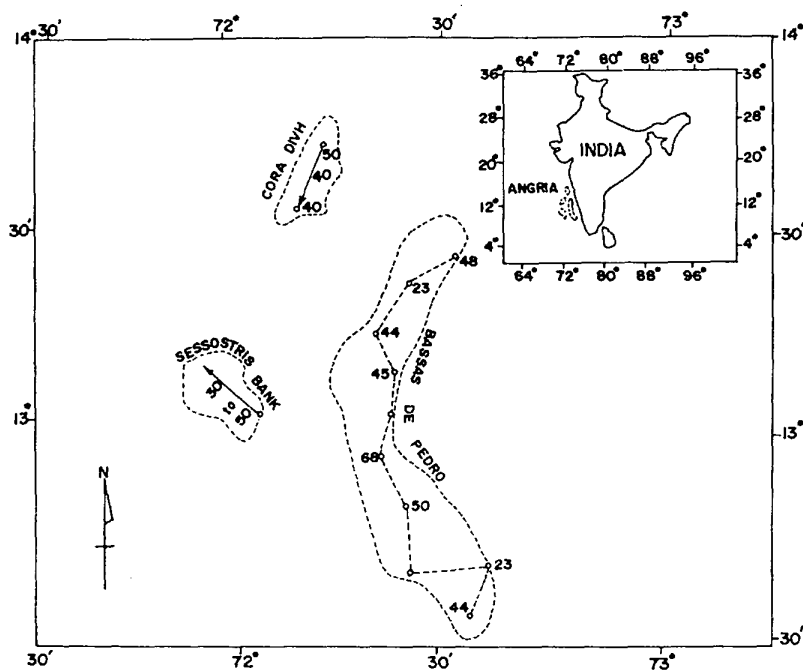


Fig. 1. Banks in the Arabian Sea.

Algal samples were cleaned and preserved as herbaria and also in 6% seawater formalin. All preserved samples are deposited at Marine Algal Reference Centre, NIO, Goa.

## RESULTS

The marine algal flora of Bassas de Pedro, Cora Divh and Sessostiris was observed to be qualitatively rich. It comprises 72 species representing 55 genera of 27 families. Distribution of these algae in various taxa is shown in Table 1.

Table 1. Distribution of algae in various taxa from three submerged banks.

Division	Families	Genera	Species
Chlorophyceae	7	15	22
Phaeophyceae	4	8	11
Rhodophyceae	16	32	39

15 genera with 22 species of Chlorophyceae represent 30.55% of the total algae collected. 8 genera with 11 species of Phaeophyceae make 15.27% while Rhodophyceae represent 54.16% with 39 species of 32 genera. Species of *Halimeda*, *Codium*, *Dictyopteris*, *Lobophora*, *Galaxaura*, *Asparagopsis*, *Hildenbrandtia*, *Anadyomene* were the predominant forms. About 15 species of calcified algae were collected from these banks. Abundance of articulated corallines was quite negligible.

Most of the seaweeds grew luxuriantly on the ridge (Fig.2) towards mainland compared to the other side of the bank. Marine algae collected from these banks are enlisted in Table 2.

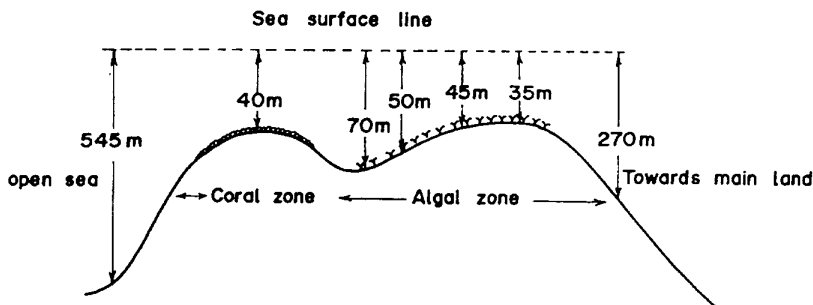


Fig. 2. General profile of the submerged banks showing coral and algal zones.

Table 2. Marine algal flora of Cora Divh, Sessostri and Bassas de-Pedro banks compared with the algal flora of Karnataka and Angria.

Flora from three banks	Karnataka	Angria
CHLOROPHYTA		
<i>Avrainvillea</i> sp.	-	+
<i>Anadyomene stellata</i>	-	-
<i>Boergesenia forbesii</i>	-	+
<i>Caulerpa cupressoides</i>	-	+
<i>C. racemosa</i>	+	+
<i>Clorodesmis hildenbrandtii</i>	-	+
<i>Cladophora</i> sp.	-	+
<i>Codium elongatum</i>	-	+
<i>C. indicum</i>	-	+
<i>Halimeda gracilis</i>	-	+
<i>H. discoidea</i>	-	+
<i>H. tuna</i> f. <i>platydisca</i>	-	+
<i>Microdictyon tenuis</i>	+	+
<i>Neomeris annulata</i>	-	+
<i>Struvea anastomosans</i>	-	+
<i>S. delicatula</i>	-	-
<i>Udotea indica</i>	-	+
<i>U. flabellum</i>	-	-
<i>Ulva rigida</i>	-	-
<i>Valoniopsis pachynema</i>	+	+
<i>Valonia aegagrophila</i>	-	+
<i>V. ventricosa</i>	-	+
PHAEOPHYTA		
<i>Dictyopteris australis</i>	+	+
<i>D. delicatula</i>	-	+
<i>Dictyota atomaria</i>	-	-
<i>D. dichotoma</i>	+	-
<i>Hormophysa</i> sp.	-	-
<i>Lobophora variegata</i>	+	+
<i>Padina pavonica</i>	-	+
<i>Ralfsia</i> sp.	+	+
<i>Sargassum tenerimum</i>	+	+
<i>Sargassum</i> sp.	-	-
<i>Spatoglossum asperum</i>	+	-
RHODOPHYTA		
<i>Acanthophora muscoides</i>	-	+
<i>A. najadiformis</i>	-	+
<i>Acrochaetium</i> sp.	-	+
<i>Agalothamnion byssoides</i>	-	+
<i>Amphiroa anceps</i>	-	-
<i>A. fragilissima</i>	+	+

contd.

Flora from three banks	Karnataka	Angria
<i>Antithamnion</i> sp.	-	-
<i>Asparagopsis taxiformis</i>	-	+
<i>Bostrychia tenella</i>	+	+
<i>Botryocladia skottsbergii</i>	-	+
<i>Ceramium rubrum</i>	-	-
<i>Ceratodictyon variabilis</i>	+	+
<i>Champia parvula</i>	+	+
<i>Cryptonemia undulata</i>	-	+
<i>Corynomorpha prismatica</i>	-	+
<i>Dictyurus purpurescens</i>	-	+
<i>Fosliella farinosa</i>	-	+
<i>Galaxaura lapidescens</i>	-	+
<i>G. lenta</i>	-	+
<i>G. marginata</i>	-	+
<i>G. oblongata</i>	-	+
<i>Gracilaria</i> sp.	-	+
<i>Halymenia</i> sp.	-	-
<i>Herposiphonia tenella</i>	-	+
<i>Hypnea pannosa</i>	-	+
<i>Hildenbrandtia</i> sp.	-	-
<i>Jania rubens</i>	-	+
<i>Laurencia paniculata</i>	-	+
<i>L. obtusa</i>	-	+
<i>Leveillea jungermannoides</i>	-	-
<i>Myriogramme bombayensis</i>	-	+
<i>Nitophyllum punctatum</i>	-	+
<i>Peyssonelia obscura</i>	-	+
<i>Polysiphonia</i> sp.	+	+
<i>Pseudogloiophloea</i> sp.	-	-
<i>Spyridea filamentosa</i>	-	-
<i>Scinaia</i> sp.	-	-
<i>Rhodymenia australis</i>	-	+
<i>R. dissecta</i>	-	-

Flora of above mentioned banks showed close similarities to the flora of Angria bank and little resemblances with the mainland flora of Karnataka coast.

## DISCUSSION

Studies on the distribution of organisms are important as it gives the information regarding the spatial occurrence of organisms, their diversity and also about their adaptations to the environment. Submerged bank is the unique habitat as it is free from destruction by waves or man-made changes. Marine algal flora of the three submerged banks viz. Bassas de-Pedro, Cora Divh and Sessostris showed little similarities with the mainland. Flora of the intertidal region and subtidal region along the Karnataka coast is qualitatively poor and shows total lack of many genera like *Halimeda*, *Udotea*, *Valonia*, *Codium*, *Hormophysa*, *Corynomorpha*, *Dictyurus*, *Galaxaura* etc. (AGADI, 1986; UNTAWALE *et al.*, 1989b) which were dominant at these banks. The poor algal flora of the Karnataka coast can be correlated with the lack of wide intertidal expanse and strong influence of wave actions and pollution (AGADI, 1986). As such, adverse conditions are not existing at these banks and hence the flora is rich. Luxuriant growth of marine algae at the ridge is due to the absence of living corals which usually prevent the algal growth.

Similarity between the flora of Angria bank and the above mentioned submerged banks may be correlated with the similar environmental conditions like absence of wave action and similar suitable substratum. Temperature, nutrients, oxygen, salinity,

pH, transparency, etc. are also equally important in such area for algal growth (UNTAWALE *et al.*, 1989a). Substratum is often considered to be very important factor in the distribution of plants. Many rooting Chlorophytic algae like *Caulerpa*, *Halimeda*, *Udotea*, *Avrainvillea* prefer sandy, soft substratum because of their creeping habit. Though at all the four banks, articulated corallines were present, the abundance was quite poor. According to JOHANSEN (1974), these algae need fairly high light intensity and prefer slightly higher temperature. PEARSE (1972), proved that light stimulates the rate of accretion in these plants. EVANS (1947) also found the positive correlations between the exposure and abundance of articulated corallines. So, very poor growth of articulated corallines at submerged banks can also be reasoned with many factors. These forms get adapted easily by their colony forming habit which helps in minimizing the grazing, by producing short alternating life histories like *Galaxaura* (LITTLER, *et al.*, 1983). According to FENICAL (1980), synthesis of toxic secondary organics by algae increases in herbivore rich tropical and subtropical environments. Abundance of calcified algae in such ecosystems can be discussed with the help of bioactive compounds present in them. Older thalli of *Halimeda* spp. contain Halimeditrial and Halimeditetraacetate making the plant nutritionally useless but useful from the defence point of view (PAUL and FENICAL, 1984). However, these chemicals are lacking in the younger tissues, so younger plants are reported to grow at night when the herbivore fishes are inactive (HAY, *et al.*, 1988).

Depths to which seaweeds grow are determined by the amount of available light. In oceanic waters, coralline and green algae grow at 175 m also when the irradiance is 0.05% of that of surface (LUNING, 1981). Abundance of Rhodophycean forms is due to pigment phycobilioproteins present in them which helps in the absorption of green light from deep water. RAMUS (1978, 1983) has pointed out, if a seaweed has enough pigments or is thick enough to be opaque, it is optically black so in such thalli, there is much scattering and reflection of light. Abundance of various species of *Codium*, *Avrainvillea*, *Valonia*, *Valoniopsis* can be explained with this phenomenon. UNTAWALE *et al.*, (1989a) showed the similarity between the flora of Lakshadweep and submerged Angria bank. Similarity between the flora of lagoons and deep waters can be discussed with the help of a theory put forward by MILLIMAN and EMERY (1968). According to them, holocene transgression of the sea resulted in the rise of sea level at the rate of about 1-1.3 cm yr<sup>-1</sup>. According to NAIR and QASIM (1970), this rise in the sea level is applicable to the entire western continental margin of India, resulting into the submergence of coral reefs. Because of this, formation of banks has taken place. As there is absence of wave action, similar suitable substratum, clear water similar to that of lagoon, flora of bank must be similar to coral reef flora. From the foregoing discussion, it can be concluded that various submerged banks in the Arabian Sea are rich in marine algae and further explorations like SCUBA diving may result in the discovery of various other taxa.

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