

# Marine algal flora of Goa coast

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## Introduction

Research on the distribution and utilization of the marine algae has received much emphasis in recent years. India with a long coastline provides optimum conditions for the cultivation of seaweeds. In spite of the tremendous work on the Indian marine algae, most of our coastline remains to be properly evaluated for the resources. West coast in general and Goa coast in particular has not received much attention from this point of view. Iyengar (1927) published the account on both fresh and marine algal flora of South India and gave a brief account of the flora of Krusadai Island and other places in the Gulf of Mannar and Palk Bay (areas close to Mandapam). Since then, the distribution of marine algae has been reported from other parts of the Indian coast by Boergesen (1928-1938), Biswas (1945), Dixit (1933-1968), Biswas and Sharma (1950), Chalko *et al* (1955), Srinivasan (1946-1969), Rao and Kale (1968) and Krishnamurthy and Josbi (1970). The first contribution of the scientific record on the marine algal vegetation along Goa region was given by Untawale and Dhargalkar (1975).

However, till now there is no report on the complete algal flora of Goa. Therefore, efforts are being made to collect and report the algae of this region, which has been poorly investigated so far.

## Coastal Geomorphology

Goa is located along the west coast of India between lat.  $14^{\circ} 9' - 15^{\circ} 52' N$  and long.  $73^{\circ} 38' - 74^{\circ} 24' E$ . It is 120 km in length.

The geological features of this region show deccan trap appearing upto the northern limits of Goa, but further southward, only the archaen gneisses are found. Some tertiary deposits are also known. The escarpment of the western ghat in Goa mostly consists of Dharwarian quartzites and granite gneisses of the northern parts of Karnataka. Most of the ferruginous quartzites are the result of replacement into laterite which is very commonly found along the Goa coast and give rise to iron and manganese ores (Dhepe, 1953).

As a result of cliffs and estuaries, the coast is segmented. The coastal strip of Goa is dominated by the high sea cliffs (Ahmed, 1972) as at Chapora, Aguada, Cabo raj and Cabo-de-Rama areas. The intertidal expanse is less because of the steep slopes of the rocky hills, abruptly merging with the sea.

Generally the west coast of India shows a greater fluctuation of the tidal levels than the East coast (Srinivasan, 1959). Along this coast the tidal range varies from 0.3-2.5 m and in the monsoon period, the tidal height will be of 4-5 m. The tidal levels at Marmugoa harbour are shown below.

Tide level	Height
Lower low water springs	0.00 m
Mean lower low water	0.37 m
Mean higher low water	1.05 m
Mean sea level	1.30 m
Mean lower high water	1.78 m
Mean higher high water	2.06 m
Higher high water springs	2.30 m

The average rainfall during the season from June to October is 2611 mm, of which the maximum is from June to August. Fluctuations in the atmospheric temperature range from 21-33° C. Seasonal changes in the water temperature, salinity, oxygen and the transparency in the coastal waters are affected by rainfall and fresh water influx from the estuaries. The hydrological data for Dona Paula are given in Table I.

Table 1. Hydrological data at Dona Paula Point, Goa†

Month	Water Temp (°C)	Oxygen ml/l	pH	Salinity (ppt)	(Nutrients) -PO <sub>4</sub>	(µg/l) -NO <sub>3</sub>	Mean* Transparency (Secchi Disc) m
Jan	28.0	6.0	8.1	35.4	1.74	6.88	3.3
Feb	28.0	4.5	7.9	35.5	0.58	6.94	2.5
Mar	29.0	5.8	7.9	35.7	0.97	3.99	2.2
Apr	31.0	4.8	7.7	35.7	1.16	1.57	1.8
May	32.0	4.8	7.9	32.6	1.05	1.88	1.0
June	30.5	3.8	8.1	34.8	0.81	0.21	0.4
July	28.2	4.6	8.0	10.7	0.27	1.32	0.2
Aug	28.5	5.5	7.9	10.4	1.13	1.94	1.0
Sept	28.0	6.0	7.9	6.9	0.85	2.11	1.7
Oct	27.0	6.2	8.2	20.5	0.63	2.94	2.0
Nov	26.0	3.7	7.9	29.0	1.42	2.44	2.3
Dec	26.5	5.9	8.0	32.1	1.83	4.14	2.0

† From Pant et al (1977)

\* From Nagarajan and Varkey. 1977

The samples for the present work were collected from 10 different localities from the Goa coast, representing different ecological conditions. The sites of these localities are shown in Fig. 1.

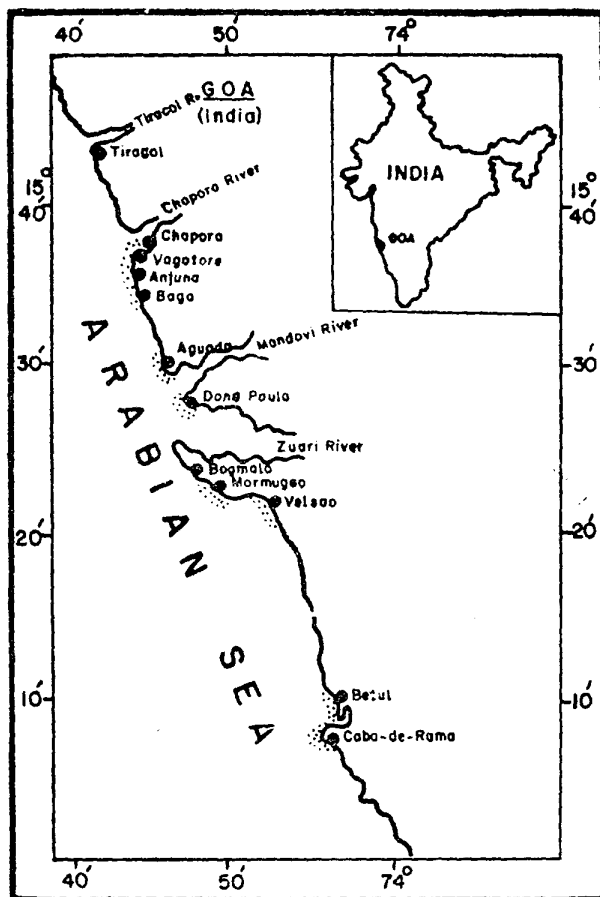


Fig-1 Map of Goa (India) Coast showing sites of Seaweed collection

The important factor for the algal growth is the nature of substratum and the favourable environmental parameters. Along Goa the algal growth mostly occurs along the rocky shores and the sandy beaches are devoid of macrophytes. Luxuriant growth was observed at Anjuna, Baga, Dona Paula and Cabo-de-Rama. The period from November to March was found to be the best season for the growth of marine algae.

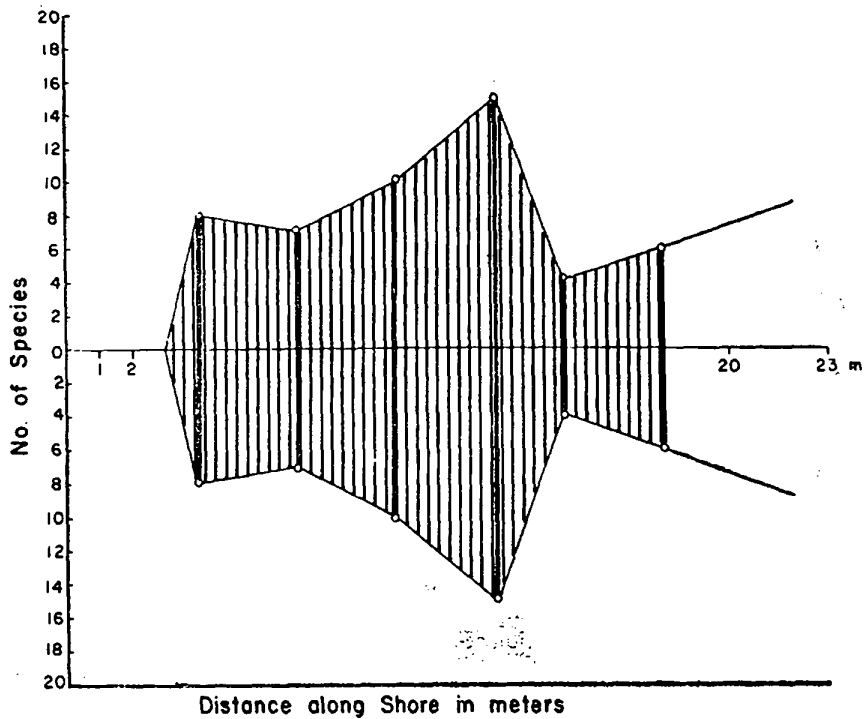


Fig.2 Graphic illustration of number of species occurring horizontally along the Shore.

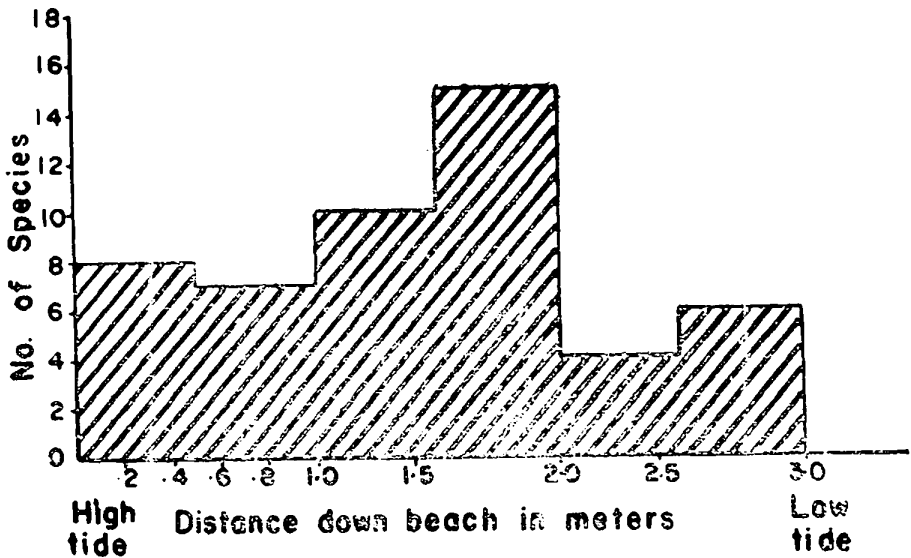


Fig.3 Vertical Distribution of Species

Horizontal and vertical distribution (Fig. 2 & 3) of the algal species from the intertidal zones showed that, in the midlittoral area, the maximum number of species occur between the low tidal mark of 1.5-2 m.

Seasonal occurrence of different algal species were also studied. It was found that some 3-4 species like *Gracilaria*, *Hypnea*, *Chondrococcus*, and *Ceramium* occur throughout the year (Table 2). However, the remaining algal species generally start their growth after the monsoon is over.

About 50 species of algae were recorded in Goa. These belong to 37 genera. Of these, 13 species belong to Chlorophyta, 14 to Phaeophyta, 19 to Rhodophyta and 4 to Cyanophyta. Only 6 species could be identified upto genera only.

### Discussion

Growth and distribution of marine algal flora depends upon several factors such as topography, geological features, physico-chemical characters of water and biological factors (Prescott, 1969). Adaptation of different plants to varying conditions, such as light, temperature, exposure to sea conditions and salinity, along these gradients results in distinct zonation of plants (Dawson, 1966). The zonation seems to be related to physical conditions at different tidal levels and not only get restricted to the intertidal areas, but extends to the physiological high water line, litus line (Venkatraman *et al.*, 1974), depending upon the stations. Much of these occur at much higher levels on rocks exposed to light where only humidity is sufficient for the algal growth. Algae which can grow under such conditions are *Chaetomorpha*, *Ulva* and *Enteromorpha*. Even their zonation corresponds to the local tides and wave action. As mentioned earlier, along the Goa coast, the tidal range varies greatly and these become more pronounced during the monsoon period. Along with the tidal currents waves also affect the growth of the seaweeds. During the monsoon months, when the tidal current and wave action are too severe, most of the seaweeds are washed off except some species like *Chaetomorpha*, *Chondrococcus* and *Ceramium*, which have strong holdfasts. During the monsoon period, because of the turbulent condition of the sea, the seaweed growth is minimum. However, the late monsoon period (Aug-Sept) favours the settlement of young stages, spores, and early September onwards the growth of seaweed enhances.

Algal growth varies according to changes in temperature, salinity, oxygen (Table, 1) and the capacity of algae to tolerate the sea exposure. The changes in the surface water temperature occurs by the variation in cloudiness, air turbidity (Nagarajan and Varkey, 1977) and air temperature. The optimum water temperature for seaweed growth appears to be 28-32°C. During the post-monsoon period, good growth of seaweed was observed. Thus, the temperature directly and indirectly influences the seaweed growth.

Transparency of water largely determines the thickness of the productive zones (Dawson, 1966). The transparency values during monsoon are very low (0.2 m) which is because of seasonal turbulence of the nearshore areas (Nagarajan and Varkey, 1977), whereas in the

Table 2. Seasonal distribution of Marine Algae along the Goa coast ( India )

Species Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
<i>Acanthophora specifera</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Ahnfeltia plicata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Bryopsis plumosa</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Caulerpa peltata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Caulerpa racemosa</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Caulerpa scolopendriiformis</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Caulerpa sertularioides</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Ceramium ciliatum</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Ceramium fastigiatum</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Chaetomorpha media</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Chondrococcus sp</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Cladophora prolifera</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Codium elongatum</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Colpomenia sinuosa</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Corallina sp</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Dictyopteris australis</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Dictyota bartayresiana</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Dictyota dichotoma</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Dictyota dumosa</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Enteromorpha clathrata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Enteromorpha intestinalis</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Ectocarpus sp.</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Gelidium sp.</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Gelidium sp.</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Gastroclonium iyengarii</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Gracilaria corticata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Gracilaria verrucosa</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Hydrocoleus lyngbyaceus</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Hyzynea muscoriformis</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Laurencia papillosa</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Mariensia fragilis</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Oscillatoria sp</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Padina tetraströmatica</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Plectonama battersii</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Pocockella vanogata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Polysiphonia macrocarpa</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Polysiphonia variegata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Rhodymenia australis</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Sargassum ilicifolium</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Sargassum lanerrimum</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Scinda furcellata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Schizothrix craswellii</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Spathoglossum esparum</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Spathoglossum varabile</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Spirocalona furcata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Stoichospermum marginatum</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Ulva fasciata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Ulva lactuca</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Ulva reticulata</i>	■	■	■	■	■	■	■	■	■	■	■	■
<i>Wrangelia pascaliata</i>	■	■	■	■	■	■	■	■	■	■	■	■

post-monsoon period, the transparency values are optimum (3.3 m). Which are favourable for the seaweed growth in the midlittoral zone. Growth gradually decrease towards the infralittoral zone. However, some of the benthic marine algae grow at greater depths.

Algal growth is also influenced by the chemical composition of sea water. The concentrations of nutrients promote the growth of algae, but unlike temperature, tides, these are not controlling factors in the distribution of the algae. The other important factor is the salinity which varies too much during the premonsoon periods. The range was 6-36‰ (Pant *et al.*, 1977), the lowest during rainy season, is due to rainfall and water runoff from estuaries. High values of salinity during premonsoon are due to the high rate of evaporation. In the low saline water, algal growth is scanty. Some of the species which can tolerate low salinity conditions, are found in this zone. In such situations species like *Enteromorpha* and *Ulva* grow well.

Sea water in coastal areas is fully rich in nutrients and trace elements necessary for algal growth. Phosphates and nitrates play an important role in the algal growth. The average values for phosphate along Goa coast ranges from 0.27  $\mu\text{g/l}$  during the postmonsoon period when rich algal growth occurs. Nitrate values along the Goa coast ranges from 0.21-6.8  $\mu\text{g/l}$ , while the pH values vary between 7.8 - 8.2 (Pant *et al.*, 1977).

An interesting feature found was the scarcity of calcareous algae along the Goa coast as compared to the other coasts of India, especially the East coast. Only one species of *Corallina* was found in the intertidal area.

Of the algal species studied seasonally, a few species like *Gracilaria*, *Hypnea*, and *Chondrococcus* occur throughout the year. During monsoon period species like *Enteromorpha* and *Ulva* are predominant, while in other seasons, *Chaetomorpha* is absent and specially agarophytes and alginophytes are dominant.

### Conclusion

1. As compared to the other parts of the Indian coastline, particularly East coast and North-west coast of India, the Goa coast shows poor representation of algae both qualitatively and quantitatively.
2. In all, 50 marine algal species belonging to different groups were recorded from Goa coast. Among these, the Rhodophyta seems dominant, followed by Phaeophyta and Chlorophyta.
3. 28 species of marine algae listed here have been reported for the first time from Goa.
4. *Ulva reticulata*, *Wrangelia penicillata*, *Pocockiella variegata*, *Martensia fragilis* and *Gastroclonium iyengarii* are some of the rare species occurring along the Goa coast.

## Systematic Enumeration of algal species

The following are the names of localities where algae were collected and with the code words which are used in the following description.

Chapora.....	Cpr.	Dona Paula.....	Dnp.
Vagatore.....	Vgt.	Marmugao.....	Mrg.
Anjuna.....	Ajn.	Valsao.....	Vls.
Baga.....	Bga.	Betul.....	Btl.
Aguada.....	Agd.	Cabo-de-Rama.....	Cbd.

The \*marked species were reported earlier by Untawale and Dhargalkar (1975)

## I. CHLOROPHYTA

## Ulvales —

*Enieromorpha clathrata* (Roth) J. Agardh

Upper midlittoral, mostly in brackish waters, epiphytic when young. Cpr.

\* *E. intestinalis* (Linnaeus) Link.

Upper midlittoral, attached to rocks.

Cpr, Ajn, Bga, Dnp, Vls.

\* *Ulva fasciata* Delile.

Upper midlittoral, attached to various substrata. Vgt, Ajn, Bga, Dnp, Vls, Cbd.

*U. lactuca* Linnaeus.

Upper midlittoral, in rock pool and on rocks in less exposed areas, between tide marks.  
Bga.

*U. reticulata* Forsskal.

Upper midlittoral, mostly growing on sandy and muddy areas compactly.

Cpr.

## Cladophorales

\* *Chaetomorpha media* (C. Agardh) Kuetzing.

Sublittoral, on hard rocks and other substrata.

Vgt, Ajn, Bga, Dnp, Cbd.

*Cladophora prolifera* (Roth) Kuetzing

Upper midlittoral, on exposed rocks receiving heavy tide breaks and in some sheltered tide pools.

Ajn, Bga, Dnp, Cbd.



**Siphonales**

- \* *Bryopsis plumosa* (Hudson) C. Agardh.

Midlittoral, growing in rock pools within tide limits and also on sandy or muddy substratum exposed to low tides.

Vgt, Ajn, Bga, Dnp, Mrg, Cbd.

*Caulerpa peltata* Lamouroux.

Lower midlittoral, in shallower rock pools within tide limits, on the sandy substratum.  
Cbd.

*C. racemosa* (Forsskal) J. Agardh.

Sublittoral, extending to midlittoral region, grows in compact patches with *Gracilaria* and *Hypnea*, in the tide pools and on rocks in shallow waters.

Ajn, Bga, Cbd.

*C. scalpelliformis* (R. Br) Weber van Bosse.

Midlittoral, in the tide pools and also on rocks in moderately deep waters.

Ajn, Cbd.

- \* *C. sertularioides* (Gmelin) Howe.

Lower midlittoral, on rocks, tide pools and in shallower waters on sandy substratum.

Vgt, Ajn, Bga, Cbd.

- \* *Codium elongatum* C. Agardh.

Midlittoral, growing on rocks, exposed to sun during low tides and also grows in deep waters.

Dnp, Cbd.

**II. PHAEOPHYTA****Ectocarpales —**

- \* *Ectocarpus* sp.

Sublittoral, on rocks and also epiphytic on other algae, sprinkled during high tides.

Cpr, Agd, Dnp, Mrg, Cbd.

**Sphacelariales —**

*Sphacelaria australis* Kuetzing.

Lower midlittoral, on rocks and also epiphytic on other brown algae.

Cpr, Cbd.

## Dictyotales —

- \* *Dictyopteris australis* Sonder.  
Infralittoral fringe, on submerged stones at sheltered areas, shallow pools and often in association with *Sargassum*, *Stoechospermum* and *Dictyota*, etc:  
Vgt, Ajn, Dnp, Cdb.
- \* *Dictyota bartayresiana* Lamouroux.  
Infralittoral fringe, on rocks, stones, in sheltered areas and also in pools.  
Vgt, Bga, Btl.
- \* *Dictyota dichotoma* (Hudson) Lamouroux.  
Lower midlittoral, on stones in shallow waters.  
Vgt, Bga, Dnp, Cbd.
- \* *D. dumosa* Boergesen.  
Infralittoral fringe, on rocks and in shallower pools.  
Vgt, Ajn, Bga, Agd, Dnp, Btl, Cbd.
- \* *Padina tetrastromatica* Hauck.  
Midlittoral, on rocks, shells, stones, in moderately shallow waters at protected areas exposed to low tides and also in the tide-pools.  
Cpr, Vgt, Ajn, Bga, Dnp, Mrg, Cbd.
- \* *Pocockiella variegata* (Lamouroux) Papenfuss.  
Midlittoral, on rock.  
Rare, Vgt, Bga.
- \* *Spathoglossum asperum* J. Agardh.  
Lower midlittoral, on rocks in sheltered areas and in little deep waters.  
Vgt, Ajn, Dnp, Cbd.  
*S. variabile* Fig. et de Not.  
Lower midlittoral.  
Bga.  
*Stoechospermum marginatum* (Agardh) Kuetzing  
Infralittoral fringe, on rocks in submerged areas and also in shallow pools.  
Ajn, Dnp, Cbd.

## Dictyosiphonales —

- \* *Colpomenia sinuosa* (Roth) Derbes et Solier  
Lower midlittoral, sponge like, grows on rocks, reefs, sometimes epiphytic on macrophytic brown algae.  
Vgt, Bga, Dnp.

**Fucales —**

*Sargassum ilicifolium* (Turner) J. Agardh.

\* *S. tenerrimum* J. Agardh.

Infralittoral, in shallower pools and abundantly on exposed rocks subjected to heavy breaks.

Vgt, Ajn, Bga, Agd, Dnp, Mrg, Cbd.

*S. prismaticum* Chauhan.

No growth was found in this coast, but Untawale collected the drifted material, might drifted from other place.

**RHODOPHYTA****Nemalionales —**

*Scinaia furcellata* Turner.

Infralittoral, on deeper rocks and pools.

Dnp, rare

**Gelidiales —**

*Gelidiella* sp.

rare, rocky shore, Bga.

*Gelidium* sp.

Upper midlittoral, on sandy substratum

Bga.

*Chondrococcus* sp.

Upper midlittoral, on sandy substratum.

Ajn, Bga, Agd, Dnp, Mrg, Cbd.

\* *Corallina* sp.

Lower midlittoral, in little deep waters.

Vgt, Ajn, Bga, Cbd.

**Gigartinales —**

*Gracilaria corticata* J. Agardh.

Lower midlittoral, on rocks exposed to heavy waves in pools in association with *Hypnea*, *Caulerpa* and *Ahnfeltia* etc.

Vgt, Ajn, Bga, Dnp, Cbd.

*G. verrucosa* (Hudson) Papenfuss.

Supralittoral, in rock pools, puddles and in marshy areas.

Rare, Cpr.

\* *Hypnea musciformis* (Wulfen) Lamouroux.

Midlittoral, in moderately deep rock pools.

Vgt, Ajn, Bga, Dnp, Cbd.

*Ahnfeltia plicata* (Hudson) Fries.

Lower midlittoral, in small rock pools, on sandy bottoms.

Ajn, Bga, Dnp, Cbd.

**Rhodymeniales —**\* *Rhodymenia australis* Sonder.

Infralittoral, in deep rock-pools and in protected areas like crevices.

Dnp, Cbd.

*Gastroclonium iyengarii* SrinivasanLower midlittoral, on the edges of the rocks, in association with *Acanthophora* sp.

Ajn, rare.

*Ceramium fastigiatum* (Roth) Harvey.*C. ciliatum* (Ellis) Ducluzeau

Lower midlittoral, on rocks and epiphytic on other algae.

Common to all places.

*Wrangelia penicillata* C. Agardh.Infralittoral, on the edges of the rocks, in association with *Acanthophora* sp.

Rare, Ajn.

*Martensia fragilis* Harvey.

Lower midlittoral, on rocks exposed to heavy surf action and also in rock pools, rare,

Dnp, Cbd.

\* *Acanthophora spicifera* (Vahl.) BoergesenMidlittoral, on the margins of the rocks exposed to the low tides, in rock pools in association with *Laurencia* and *Hypnea* etc. Common.

Vgt, Ajn, Bga, Dnp, Cbd.

*Laurencia papillosa* (Forsskal) GrevilleSupralittoral, extending to lower midlittoral zone, on rocks, in pools in association with *Ceramium*, *Acanthophora* etc.

Ajn, Bga, Dnp, Cbd.

*Polysiphonia macrocarpa* Harvey (?)*P. variegata* (Agardh) Zanardini

Midlittoral, on rocks and also epiphytic.

Ajn, Bga, Dnp, Cbd.

**CYANOPHYTA****Nostocales —**

*Hydrocoleus lyngbyaceus* Kuetzing

Supralittoral, in pools.

Cbd.

*Oscillatoria* sp.

Lower midlittoral, on rocks in association with *Ceramium*.

Rare, Cbd.

*Schizothrix creswellii* Harvey

Supralittoral, in the pools.

Rare, Cpr.

*Plectonema battersii* Gom.

Supralittoral, in muddy rock pools.

Cbd.

**Summary**

Distribution of marine algal species in the intertidal areas along the Goa coast has been studied. In all, 50 algal species have been recorded from the Goa coast, of which 28 have been reported for the first time.

The horizontal and vertical distribution as well as seasonal occurrence of the algal species have been discussed. The intertidal zonation observed along the Goa coast was found to be similar to the other parts of the Indian coast. However, the representation of the algal species was found to be relatively poor both qualitatively and quantitatively, along the Goa coast.

Some of the factors responsible for the optimum seaweed growth have also been discussed in this paper.

**Acknowledgement**

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## References

- Ahmed, E. 1972 *Coastal Geomorphology of India*. Orient Longman, Delhi.
- \*Biswas, K. 1945 A general review of the marine algae of the Western coast of India. *J. Bombay. Nat. Hist. Soc.*, 45 (4): 513—30.
- \*Biswas, K. and Sharma, A. K. 1950 Sargassa of Indian sea. *J. Roy. Asiat. Soc. Bengal (science)*, 16: (1): 79—97.
- \*Boergesen, F. 1930 Some Indian Green and Brown algae, especially from the shores of the Presidency of Bombay—I. *J. Indian. bot. Soc.*, 9: 151—74.
- \*————— 1932 Some Indian Green and Brown algae, especially from the shores of the Presidency of Bombay—II. *J. Indian. bot. Soc.*, 11: 52—70.
- \*————— 1933 Some Indian Green and Brown algae especially from the shores of the Presidency of Bombay—III. *J. Indian. bot. Soc.*, 12: 1—16.
- 1931 Some Indian Rhodophyceae, especially from the shores of the Presidency of Bombay—I. *Kew Bull.*, 1931: 1—24.
- \*————— 1932 Some Indian Rhodophyceae, especially from the shores of the Presidency of Bombay—II. *Ibid.* 1932: 113—34.
- \*————— 1933 Some Indian Rhodophyceae, especially from the shores of the Presidency of Bombay—III. *Ibid.*, 1933: 113—42.
- \*————— 1934 Some Indian Rhodophyceae, especially from the shores of the Presidency of Bombay—IV. *Ibid.*, 1934: 1—30.
- 1935 A list of marine algae from Bombay. *Dansk Vedensk. Selsk. Biol. Meddelel.* 12 (2): 1—64, Kobenhavn.
- \*————— 1937 Contribution to a South Indian Marine Algal flora—I. *J. Indian. Bot. Soc.*, 16: 1—56.
- \*————— 1937 Contribution to a South Indian Marine Algal flora—II. *Ibid.* 16: 311—57.
- \*————— 1938 Contribution to a South Indian Marine Algal flora—III. *Ibid.*, 17: 205—42.
- Chacko, P. I., Mahadevan, S and R. Ganesan 1955 Guide to the field study of the fauna and flora of Krusadai Island, Gulf of Mannar. *Contrib. mar. biol. Sta. Krusadai Island*, 3; 1—16.

- Dhepe, R. D. 1953 A note on Geological and Iron and Manganese ore deposits of Goa. *J. Poona. Uni.*, 1 : 4.
- \*Dixit, S. C. 1933 Caulerpaceae from Malvan Harbour. *J. Uni. Bombay.*, 1 (5) : 35.
- \* \_\_\_\_\_ 1940 Algae of the Malvan Harbour. *J. Uni. Bombay.*, 8 (5) : 1-19
- \* \_\_\_\_\_ 1964 Species list of Indian marine algae determined by Boergesen. *Ibid.*, 32 (2-5) : 1-23.
- \* \_\_\_\_\_ 1968 Species list of Indian marine algae-II. *Ibid.*, 36 (3-5) : 9-24.
- \*Iyengar, M. O. P. 1927 Flora of Krusadai Island. *Bull. Madras Govt. Mus., N. S. Nat Hist. Sect.*, 1 (1) : 185-88.
- Krishnamurthy, V. and Joshi, H. V. 1970 A check List of Indian marine algae. Central Salt and Marin. Chemicals Research Institute, Bhavnagar., 1-37.
- Mitra, J. N. 1959 The ecology, distribution and seasonal succession of the littoral algae on the west coast of India. *Proc. Symp. Algology, ICAR, New Delhi.*
- Nagarajan, R. and Varkey, M. J. 1977 Synoptic surface observations at Dona Paula point, Goa Research report. National Institute of Oceanography. (CSIR), Goa.
- Pant, A. Balasubramanian, T M.D. Rajagopal, Wafar, M.V.M. and Sumitra Vijayaraghavan 1977 Contribution of extracellular production by nannoplankton to 14C fixation in tropical estuary. *Indian J. Mar. Sci.*, (in press)
- Prescott, G. W. 1969 *The Algae : A Review*, Thomas Nelson & Sons, Ltd., London.
- \*Rao, P. S. and Kale, S. R. 1969 Marine algae from the little known places of Gujarat coast-II, Gopnath. *Proc. Fifty-sixth Indian Sci. Congr. Association, Bombay (Abstract)*
- \*Srinivasan, K. S. 1946 Ecology and seasonal succession of the marine algae at Mahabalipuram (Seven pagodas) near Madras. M. O. P. Iyengar Commr. Vol, *J. Indian bot. Soc.*, 47 (Suppl) 267-78
- \* \_\_\_\_\_ 1965 *Algarum species ex India Oriundae*, 67 (1 - 4) : 188-268.
- \* \_\_\_\_\_ 1969 *Phycologia Indica*. Icones of Indian Marine algae. vol-1. *Bot. Surv. India, Calcutta.*
- Untawale, A. G. and Dhargolkar, V.K. 1975 Report on the Seaweed Resources of the Goa coast. *Nat. Inst Oceanography, Panaji (Goa), India.*

\*Original not seen.