

# Biodiversity, Zoogeography And Affinity Of Orissa Sponges

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**Abstract :** In the biology of the sea, the sea floor plays just as important as the open waters in the euphotic regions. Similar substrates in different areas may have quite different associations. Coral communities are immensely important marine ecosystems. Along with coral reefs, the ridge reefs gained importance for the study of different coral populations. With the advent of SCUBA and submersibles scientists have been able to initiate careful studies of subtidal / benthic faunal communities.

With the use of modern techniques viz., marine geophysical scanning of the sea bottom with echosounder, side scan sonar and seismic profiler for locating rocky outcrops and SCUBA diving a new submerged NE-SW trending ridge reef (a paleo shore line) off Gopalpur coast, Orissa (India), Bay of Bengal was reported by us earlier between the isobaths of 25 and 35m. A number of sedentary organisms were collected and taxonomy of 54 sponges was reported earlier.

The present paper reports a new collection of 16 sponge species from these reefs. The diversity, bio-zoo-distribution and affinity of these sponges are discussed. The analysis of data is mainly arrived at by quasi-quantitative sampling supported by observations and video documentation. Community structure is assessed in a number of ways; classification of dominant species, numerical relationship etc.

## Introduction

The collection of marine species from oceans and study of their geographic and ecological diversity is vital to future bioproduct development. Researchers screen each of the organisms for the bioactive chemicals they could contain.

The Orissa coast is endowed with long coastal line, Chilika lagoon and Bhitarkanika mangroves. No sedentary marine organism resources were reported earlier from the Orissa coast though ZSI, Calcutta records of 1915 show collections of a few sponges by dredging. In the biology of the sea, the sea floor plays just as important as the open waters in the euphotic regions. Similar substrates in different areas may have quite different associations. Coral communities are immensely important marine ecosystems. Along with coral reefs, the ridge reefs gained importance for the study of different coral populations. Systematic and multidisciplinary approaches of RRL under the DOD's national project on "Drugs from Ocean" during the past few years resulted in discovering a vast and diverse resource of sedentary organisms. With the use of modern techniques viz., marine geophysical scanning of the sea bottom with echosounder, side scan sonar and seismic profiler for locating rocky outcrops a new submerged NE-SW trending ridge reef (a paleo

shore line) off Gopalpur coast, Orissa , Bay of Bengal was reported by us earlier between the isobaths of 25 and 35m (Mohana Rao et al., 2001). A number of sedentary organisms like sponges, gorgonians, soft corals, antipatharians etc were collected by SCUBA diving from these ridge reefs and taxonomy of 54 sponges was reported already by us (Bapuji et al., 1999).

### Nature of ridge reefs and collection of marine sedentary organisms

The ridge reef is multi-pinnacled NE-SW running off between Gopalpur and Barua (Bay of Bengal, Fig-1) parallel to the coast along 30 m contour line. It includes a 14 km stretch of reef with 3-5m elevation and 150-250 m width between Gopalpur and Sonapurampet ( $19^{\circ} 13.00' N$ ,  $84^{\circ} 57.05' E$  to  $19^{\circ} 08.70' N$ ,  $84^{\circ} 52.70' E$ ) and a further 10 km stretch with multiple peaks, 100-250m wide and 3-8m elevation between Sonapurampet and Barua ( $19^{\circ} 02.80' N$ ,  $84^{\circ} 47.64' E$  and  $18^{\circ} 56.75' N$   $84^{\circ} 43.30' E$ ). There is disconuaction of the reef in between buried under a sediment layer of 5-10m thick in the region off Bahuda river at Sonapurampet. The reef starts at its north at 30m depth slowly moving towards coast at its south end to 25m depth.

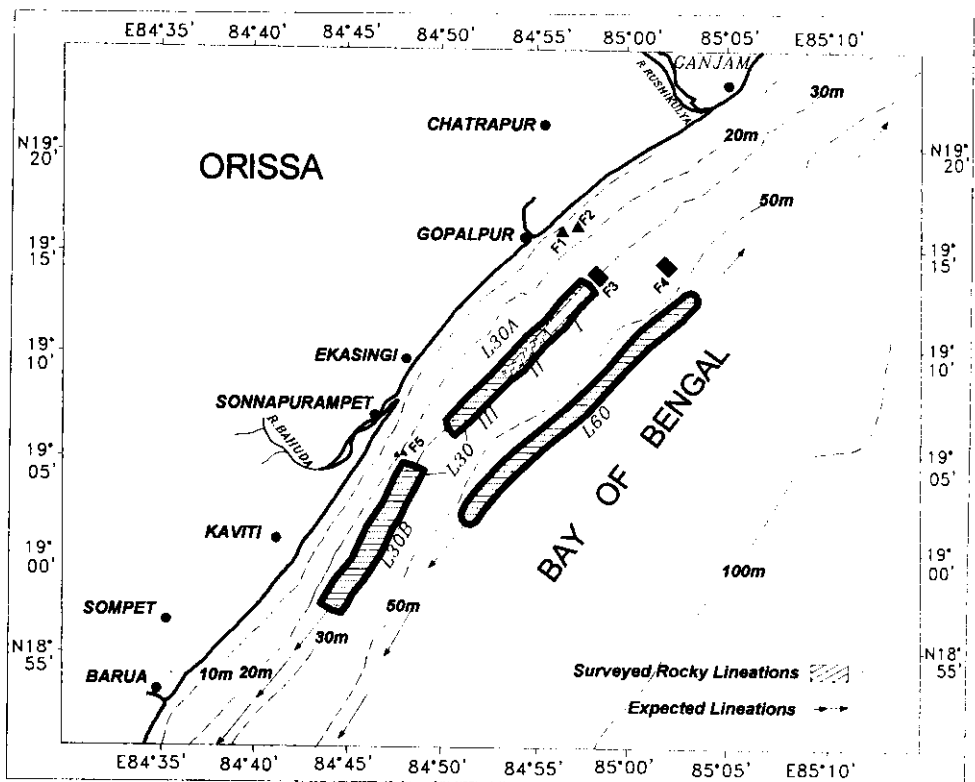


Fig.1 LOCATION MAP OF REEFAL FEATURES.

The morphological features suggested the reef to be of beach sand stone formations (porous). The north and south blocks have different morphological features like relief, slopes, trenches valleys etc. (Mohana Rao et al., 2001).

Collection of marine organisms from this location was done by SCUBA diving method with the help of geophysical methods for scanning and locating the submerged rocky lineation. All the Operations were carried out with the help of Global Positioning System (GPS). The collection and data acquisition and based on SCUBA diving collection through out the pinnacled reef supported by video documentation. The accessibility of the reef tops due various morphological feature like steep fall, seaward slopes, shoulders, deep trenches etc. are to be considered as limitation of collection because of safety of SCUBA diving operations.

In addition to our earlier collection (Bapuji et al. 1999), we report here taxonomy of 16 new sponge collections belonging to six orders of Demospongiae (Table-1). Based on the data available an attempt is made to discuss the diversity, bio-zoo-distribution and affinity of these sponges of Orissa coast. The analysis of data is mainly arrived at by quasi-quantitative sampling supported by observations and video documentation. Community structure is assessed in a number of ways; classification of dominant species, numerical relationship etc. Fig-2 and 3 show the number of dives and video documentations.

### **Table-1 Taxonomy of sponge of New Collections**

#### **Classification details:**

Phylum Porifera Grant

Class Demospongiae Sollas

Order KERATOSIDA Grant

Family Dysideidae Gray

Genus *Dendrilla* Lendenfeld

1. *Dendrilla cactus* (Selenka)

Order HAPLOSCLERIDA Topsent

Family Halicionidae de Laubenfels

Genus *Haliclona* Grant

2. *Haliclona* sp.

Family Adicidae de Laubenfels

Genus *Sigmatocia* de Laubenfels

3. *Sigmatocia ptrosiodes* (Dendy)

Order POECILOSCLERIDA Topsent

Family Coelosphaeidae Hentschel

Genus *Phloeodictyon* Carter

4. *Phloeodictyon* sp.

Family Raspailidae Hentschel

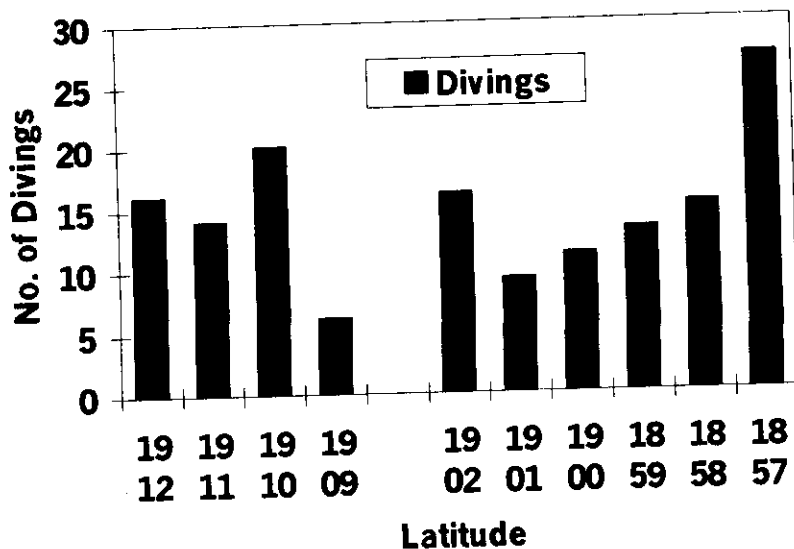
Genus *Aulospongia* Norman

5. *Aulospongius involutum* (Kirkpatrick)  
 Family Microcionidae Henteschel  
 Genus *Microcionia* Bowerbank  
 6. *Microcionia* sp.  
 Family Amphilectidae de Laubenfels  
 Genus *Biemna* Gray  
 7. *Biemna microstyla* Thomas  
 Genus *Toxemna* Hallmann  
 8. *Toxemna tubulata* (Dendy)  
 Order HALICHONDRIDA Vosmaer;  
 Family Axinellidae Ridley & Dendy  
 Genus *Axinella* Schmidt  
 9. *Axinella tenuidigitata* Dendy  
 Genus *Phycopsis* Carter  
 10. *Phycopsis* sp.  
 Genus *Phakellia* Bowerbank  
 11. *Phakellia conulosa* (Dendy)  
 Family Halichondriidae Gray  
 Genus *Tracyopsis* Dendy  
 1. *Tracyopsis aplysinoides* (Dendy)  
 Order HARDOMERIDA,  
 Family Clionidae Gray  
 Genus *Aka* de Laubenfels  
 13. *Aka diagonoxea* Thomas  
 Order CHORISTIDA Sollas  
 Family Anchorinidae Gray  
 Genus *Aurora* Sollas  
 14. *Aurora providentiae* Dendy  
 Family Craniellidae Laubenfels  
 Genus *Cinachyra* Sollas  
 15. *Cinachyra cavernosa* (Lamarck)  
 Genus *Theonella* Gray  
 16. *Theonella swinhoei* Gray

### Structure and Composition of the Sponge Fauna of Orissa Coast

During these surveys spread over several years a total of 70 specimens of sponges was collected, of which 54 could be identified up to specific level. In the present collection of sponges from the Orissa coast, only species of the Class Demospongiae Sollas ( or siliceous sponges) were represented and the collection included species from all the 8 Orders of the Class. An order-wise distribution of species under the above 8 orders of the Class Demospongiae are compared with the Demospongian fauna of some other areas like the Gulf of Mannar, Lakshadweep and the. Gulf of Kutch, i.e. given in Table 2.

**Fig-2 SCUBA Diving collections at different Latitudes**



**Fig-3 Video documentations at different Latitudes**

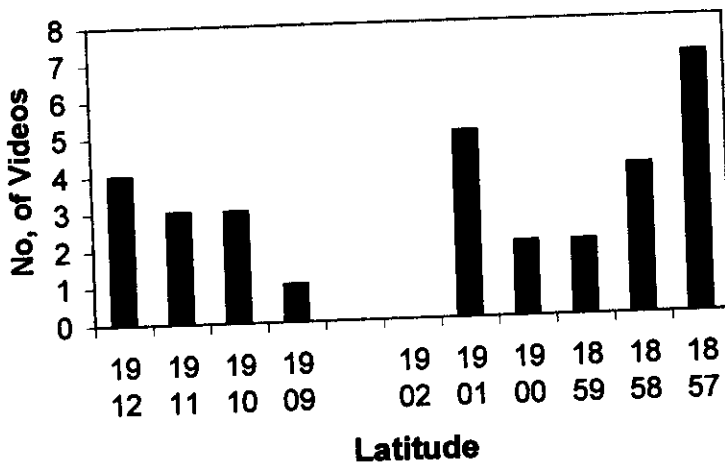


Table 2

Order-wise distribution (%) of species from different areas of the Indian seas

SINo.	Order	Orissa coast	Gulf of Mannar	Lakshadweep	Gulf of Kutch
1	Keratosida	20.5	8.0	13.2	Nil
2	Haplosclerida	11	14.2	13.2	8.0
3	Poecilosclerida	20.4	26.9	19.7	28.0
4	Halichondrida	25	11.3	7.7	Nil
5	Hadromerida	5.5	15.6	23.1	36.0
6	Epipolasida	5.5	6.2	7.7	8.0
7	Choristida	7.0	10.9	11.0	8.0
8	Carnosida	5.6	6.9	4.4	12.0

Since species from all the 8 orders of the Class Demospongiae are represented in the collections, it may be stated that the coast, especially the rocky substrata of the ridge reef may be said to be quite congenial habitat for sponge growth. The out-crop of rocky stretches parallel to the coast with a width ranging from 100 to 250 m act as a deterrent to fishing, especially by bottom trawling, and this situation prompted the colonization of this zone by benthic organisms, including sponges, in the past.

Though species from all the 8 orders of the Class, Demospongiae are recorded in the present collection from the Orissa coast, the sponge fauna, in final analysis, shows considerable deviation in its structure and composition from other parts (here comparison is made with the fauna of the Gulf of Mannar, Lakshadweep and the Gulf of Kutch) of the Indian seas. The dominance of species falling under the Order Poecilosclerida seen in the Gulf of Mannar (Table 19 Col.4) is in full agreement with the natural distribution of the species in the extant seas and this conclusion is arrived at after a careful study of the sponge fauna reported from the area during the last 120 years by the scientists from different countries (Thomas, 1986). But when the sponge fauna of Orissa coast is analyzed order-wise the dominance of species fell on the Order Halichondrida (25%) followed by those of the Order Keratosida (20.5%, Table 1, Col. 3). It is interesting to see that species of the Order, Halichondrida and Keratosida, which occupied the 1<sup>st</sup> and 2<sup>nd</sup> rank respectively in the collections from Orissa coast occupied a much lesser rank (4<sup>th</sup> and 6<sup>th</sup>

respectively) in the collections from the Gulf of Mannar. Since the composition of the sponge fauna of the Gulf of Mannar is in full agreement with that in any part of the extant seas the reason for the deviation in the faunistic composition of Orissa coast lies in the method of collection rather than in the natural distribution or -species abundance.

Qualitative. and quantitative deviations from the natural/ normal distribution are noted in many animal groups from different areas and sponges are, by no way an exception. Studies on sponges made in the past from different localities have shown that any change in. the structure and composition of the sponge fauna can be either ecosystem induced or stress induced or through a combination of both.

The extreme abundance of calcium carbonate in the form of coral skeleton seen in the various atolls of the Lakshadweep group of islands (Thomas, 1989) may be said to be the prime reason for the abundance of coral boring sponges in these islands. As the boring sponges fall mainly under tire Order Hadromerida, the members of this order dominate in Lakshadweep (Table 1,Col-5). However, the species of the Order, Poecilosclerida rank next in abundance to the Order, Hadromerida in Lakshadweep.

Heavy silt-fall is inimical to any filter feeder and sponges being the best example, overcome such a stress situation through physical and physiological adjustments. Sponges inhabiting the Gulf of Kutch zone of Gujarat usually develop drawn-out oscular structures (in 4% of the total number of species) to take in water with minimum silt. Some species may prefer to colonize the under surfaces of rock / coral stone (in 36% of the total number of species) where the silt.- fall is at its minimum. A few species may even show the tendency to incorporate silt / sand into their body (in 24% of the total number of species). It could also be seen (Thomas et.al.,1997) that the fringing reef of the Gulf of Kutch are rich in coral boring sponges as in the atolls of Lakshadweep and about 32 % of the total number of species make use of the coral skeleton, both living and dead, for their luxuriant growth and proliferation. These boring sponges grow, inside calcium carbonate in a cryptic way protected very well from silt-fall. In the Gulf of Kutch also as in the Lakshadweep, the dominance of species under the Order Hadromerida (Table 1, Col.6) is well pronounced and about 36% of the species fall under this order.

No species from the Order Keratosida as also from the order Halichondri.da could be collected from the Gulf of Kutch and this is because the specimens of these two orders usually attach to the substratum and grow vertically up as plants do and hence such specimens will be adversely affected by silt-fall. The extreme paucity of species falling under the above two orders may be attributed to heavy silt-fall prevalent in the Gulf of Kutch.

### **Zoogeography of the Sponge Fauna of Orissa Coast**

Species totaling to 54, collected so far from the Orissa coast, are quite widespread in their distribution in the Indian sea except one, *Aulosporigus involutum* Hooper et.al (1999)

which is a new record to the Indian sea. Three species represented in the present collection are cosmopolitan in distribution while one is circum-equatorial.

Affinity-wise, the sponge fauna of Orissa coast is very close to that of the Australian Region and 17 species (43.6%) are distributed in common with these two areas. The next area with which the fauna of Orissa coast has more in common is the Red Sea; 13 species (33.3%) are common to these two areas. -Relationship of Orissa sponges with that of the Pacific fauna is limited to 10 species (25.6%); with Mediterranean and Atlantic fauna to 3 species (7.7 %) each and with Arctic and Antarctic to one species each.

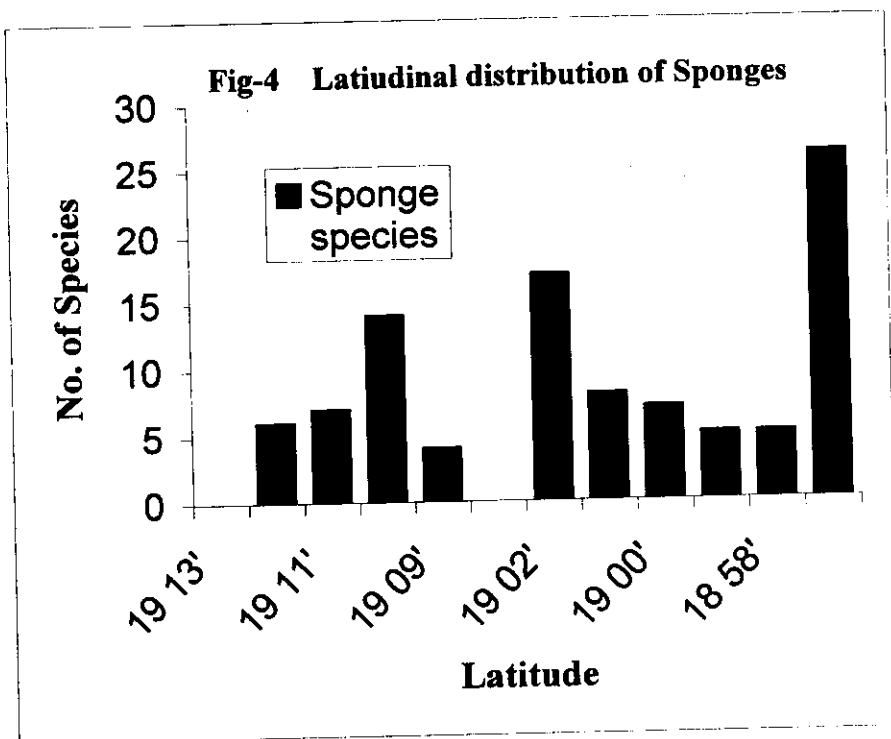
The latitude wise distribution of sponges on the present ridge reef is presented in Fig-3. The data shows 70% of the total sponges are collected from the southern part of the lineation with 25% of total species common to both regions. Exclusive sponge beds are at latitudes 19° 02' & 18° 57' N each representing species of 6 and 8 orders respectively. This area of the ridge comprises prominent multiple pinnacled reef high relief. These are mostly closely spaced and reveal a dense ridge system. The depth here comes down to 25 m whereas most of the rocky outcrops in the northern part of the ridge are at 28-31m depth with low relief peaks and sandy valleys / patches (Mohana Rao et al., 2001).

A number of abiotic factors like water currents, clean water, more light may be favourable for the luxurious growth of the sponges in this region compared to the northern half. More detailed study of the water currents, silt, organic carbon etc and nature of porosity of substratum may give a better picture about the abundance sponge communities here.

## **Discussion and Conclusions**

In this account some comparative information on the structure and composition of the sponge biodiversity from 4 different areas of the Indian seas is presented. Of these 4 areas the sponge fauna of the Gulf of Mannar is well known through the works of spongologists starting from 1880 onwards and hence, may be taken as a fool-proof document of the natural distribution of sponges, which is also in full agreement with the same from any part of our extant seas, dominated by species of the Order, Poecilosclerida. Sufficient deviation with regard to the structure and composition of the fauna is seen from other 3 areas (Orissa coast, Lakshadweep and the Gulf of Kutch). The Lakshadweep sponge fauna is dominated by the species of the Order Hadromerida because all common coral boring sponges, fall under the order and the availability of the calcium carbonate in the form of coral skeleton provides all congenial conditions for coral boring species to flourish well in these coral atolls. Almost the same condition is met with in the Gulf of Kutch also as the coral skeleton, both alive and dead, provided support to about 32% of the total number of sponge species.





Hence the Hadromerida dominance seen in the Gulf of Kutch is only an ecosystem induced deviation in the sponge fauna. Along the Orissa coast the species dominance is getting shifted to the Order Hali.chondrida, an order dominated by massive sponges which grow vertically up from the sea bottom. The species is of the Order Keratocida, which ranks second to Halichondrida, also grow to massive size taking a vertical position as members of the previous order do. In conclusion it may be stated that the collection from Orissa coast was only a selective sampling giving importance only to massive specimens.

For any study on Marine Products Chemistry the method now in vogue in India is the "macromethod" where a minimum of 500 g of source material is a must for running the various experiments. Unfortunately massive specimens constitute only a small fraction of the total species in the phylum Porifera and hence a major fraction of our sponge fauna now fall very well outside the scope of the present Marine Products Chemistry investigations. Keeping in view the difficulty in accessibility of different locations of the multiple peaks, trenches, near vertical slopes of the reefs to the SCUBA divers and their limited knowledge of physical features of the organisms it is necessary to replace the present 'macromethod' with a more effective 'micromethod' for a better coverage of our marine fauna and flora. This would pave the way to a better coverage of the encrusting / inconspicuous biota so abundant in many animal groups.

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