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# Diversityof Mollusc at Disturbed & undisturbed Intertidal Region of Sikka Coast, Marine National Park, Gulf of Kachchh, Gujarat, India

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**Abstract**

Ever-increasing industrialization in the Gulf of Kachchh (GoK) presents multiple issues of habitat destruction and biodiversity loss. One of many issues is port, harbor, and jetty development. The present paper highlights the siltation load in the middle Gulf of Kachchh due to the presence of a GSFC jetty. GoK inundates tide from the west (mouth of GoK) hence west side of the intertidal GSFC jetty received a high siltation load and the east side of the intertidal area got shelter due to the GSFC jetty. We have selected two sites; west (Vador) and east (GSFC Jetty) side intertidal are of GSFC jetty to compare the diversity of mollusc fauna. Site Vador site considers a disturbed site and GSFC jetty is considered an undisturbed site with reference to siltation load. A molluscan study was carried out during the post-monsoon, winter, and pre-summer season of 2018-19 at both sites. Dead molluscs were collected and live molluscs were photographed then sorted and identified as per the standard method and standard key. A total of 34 species of molluscs were recorded from Vador (16 species) and GSFC sites (24 species). Only 6 species were common among the two sites though both the sites are very near to each other. This result shows that heavy siltation load at Vador site alters the microhabitat while shelter at GSFC jetty site provides a low current of water and low siltation resulted in differences in the species recorded. Our results support the well-known fact that changes in the substrate quality lead to changes in the structure of a benthic community.

The tropical coastal environments are the most biologically diverse of all marine ecosystems. The molluscs are among the most diverse and are the second largest phylum of invertebrates in the coastal tropical environments and the vast majorities are found in intertidal, estuaries and coastal lagoons, and in the shallow areas on the continental shell[8]. Molluscs recorded from the world range from 80,000 to 1, 00,000 species, out of which 50,000 are Gastropods, 15,000 Bivalves, 500 Polyplacophora, 400 Cephalopods, 130 Aplacophora and 5 Monoplacophora. There are 31,463 marine, 8,765 fresh water and 24,503 land molluscs reported from different parts of the world. In India, 5,070 species of molluscs have been recorded of which, 3,370 are from marine habitat[16].

Humans have valued marine mollusc shells since prehistoric times. Shells have been used for currency, jewelry, ornaments, tools, horns, games, medicine and as magical or religious symbols[13]. Even though tropical bivalves and gastropods have lost much of their historical meaning as medicine, tools or religious symbols, they may be used in even larger quantities today. Shell-craft industries in Southeast Asia may still use thousands of tons of shells annually[18]. The ornamental shell trade primarily includes shells exploited for their decorative or rareness value. The ornamental shell trade might even have intensified in recent years with the rise of the Internet. Tourism has become an important economic activity in many tropical countries. The tourists' interest in 'portable memories' has also brought a curio trade into existence, often involving gastropod and bivalve shells, corals, shark teeth and other parts of marine species[7]. Shells seem highly demanded-souvenirs because of their varied forms, attractive colouring or smoothness. Apart from their aesthetic and commercial value, Molluscs are under pressure due to tremendous anthropological activity in and around coastal habitat.

India's coastline of 7,500 km, spread across nine states, borders a 2.02 million sq km area of Exclusive Economic Zone (EEZ) in the sea. The nine coastal states of India have a population of 420 million. Of this, about 330 million live on or within 150 km of a coast. The coastal states in India have a population density ranging from 600 per sq km to over 2,000 per sq km (as in Kerala) against the national average density of 300 per sq km. The population load and the multifaceted activity in the region have led to the deterioration in the quality of coastal life. Gujarat has a 1600 km long coastline, which is the longest of any state in India. The coastal zone is the most significant area in terms of marine biodiversity, the Gulf of Kachchh. The ever-growing industrialization in this coastal region is believed to be a major threat to sensitive marine ecosystems. Further, ecosystem degradation and destruction are taking place due to the conversion of habitats to other forms of land use, over exploitation of species and associated destructive harvesting practices, the spread of invasive alien species and the impacts of agricultural, domestic and industrial sewage and waste. Moreover, the mushrooming of ports and harbours all along the coast is also threatening the coastal biodiversity of the state[14]. GoK is a rapidly developing area of Gujarat state, particularly in the oil and port sectors. The coastal zone of the gulf is host to a wide range of activities, such as human settlement, industries, ports, salt production, harbours,

navigation, fishing, tourism, *etc*., and features various types of coastal habitats, such as mangroves, coral reefs, sea grass beds, beaches, lagoons, tidal flats, salt marshes, *etc*.[10]. There are many environmental problems associated with increased port development and maritime activity, including tanker spills and accidents, as well as sediment deposition on corals due to deep-sea dredging activities. The accelerated development of ports and harbours will also greatly increase the problems that fishing communities face, further restricting their fishing grounds and depleting the availability of fish[4]. At ports apart from cargo handling, the major environmental activity is the dredging of navigational channels. The amount of dredging carried out around Sikka ports[12] in past 20 years is 15171676$m^3$.

Being placed in the middle of the southern Gulf of Kachchh, Offshore Sikka conferred with many development plans including GSFC jetty and Reliance Jetty. Being funnel shaped Gulf received amplification of tides towards east[19]. The Mouth of GoK is towards the west side and hence the west side of GSFC jetty received heavy load of siltation while the east side of jetty getting shelter from current and siltation load. As being towards the safe site, east side of GSFC jetty remain undisturbed site while west side of jetty (Vador Site) acquiring disturbance of siltation load. The present paper investigates the diversity and distribution of Gastropod and Bivalve of intertidal area of selected sites along the Sikka Coast. We have selected two sites with reference to the nature of disturbance to compare the diversity of gastropod and bivalve fauna.

*Study area :*

The Gulf of Kachchh is the richest coastal region of Gujarat having an assemblage of different ecologically sensitive ecosystems such as coral reefs, mangroves and sea grass. It is the largest inlet (7350 sq km approx.) of the Arabian Sea, about 60 km wide at its widest and tapering north east wards for 170 km. The southern shores of the Gulf of Kachchh in Jamnagar district are demarcated as the Marine National Park and Sanctuary.The annual rainfall in this area is less than 5 cm with maximum precipitation in July-August. As there are no major river openings, land runoff is minimal. The relative humidity is highest in August (82%) and lowest in December-January (60%). Atmospheric temperature varies from 10° C (January) to 35° C (May-June).The mean spring tidal influx, extends from the mouth to the closed end of the Gulf and it has a range between 2.1 m and 6.2 m [15]. The mean spring tidal range increases from mouth to head: 3.06 m at Okha, 4.67 m at Sikka, 5.82 m at Kandla and 6.43 m at Navlakhi[19] Funnel shape of the Gulf, coastal configuration and orientation of the coast are the reasons for amplification of tides. In the current study two sites have been selected on the basis of nature of disturbance at offshore Sikka.

*Site 1:* Vador area of Sikka coast (Latitude: 22.44284, Longitude: 69.83196) (Figure 1). This site is located in the middle of the southern belt of GoK. The sandy beach partially covered with mud flats and mangrove vegetation and narrow creak was prominent in width 1 – 2 m. Water remains in the area even during low tide due to the slope and networks of small

creeks.This site is on the west side of GSFC jetty so it receives heavy load of silt along with the water current during the high tide hence we consider this site as a disturbed site.

*Site 2:* GSFC Jetty area of Sikka coast (Latitude: 22.46904, Longitude: 69.80616) (Figure 1). This site area is situated at the right side of GSFC jetty, Sikka. The site consists of live coral reef with sandy and muddy patches followed by mangrove forests[6]. This site is east of GSFC Jetty so load of silt is halt by jetty at other side during high tide and hence site got shelters during high tide and hence we consider this site as undisturbed site.

The study has been carried out from October, 2018 to March 2019 for six months. Dead molluscs samples were collected by handpicking during low tide. Live animals were photographed precisely so all the morphological characters shall be recorded for identification. They were brought to the laboratory and the shells were brushed to clean the fouling biomass and mud. They were then dried using filter paper in the laboratory for Taxonomical identification of morphological characters. Animals were identified using standard identification keys[1-3]. Systematic Classification of identified species has been adopted from sealifebase.ca and marinespecies.org.

To describe biodiversity in studies total number of species has been used so here we used total diversity of molluscs as a simple measure to compare two sites[11]. Total 34 molluscan species from 20 families were recorded from selected sited of southern gulf of Kachchh (Table 1 & Plate 1).

Maximum 7 species were recorded from family Veneridae while 4 species were recorded from nassariidae family. 3 species were recorded from family Turbinidae. Two species each recorded from family potamididae, family Trochidae, and family colimbellidae while rest other family have one represented species (Figure 2).

A total 24 species were recorded from site 2 GSFC Jetty and a total 16 species were recorded from site 1 Vador. *Babylonia spirata, Paphia malabarica, Dosinia exoleta, Venus verrucosa, Paphia vernicosa, Venus* sp., *Vasticardium flavumflavum, Ergalatax heptagonalis, Turbo intercostalis, Angaria plicata, Scutus unguis, Pinna bicolor, Patella vulgata, Cypraea* sp., *Littoraria undulata, Nassarius sufflatus, Nassarius distortus* and *Nerita chamaeleon* were only recorded from site 2 GSFC jetty whereas *Telescopium telescopium, Trochus maculatus, Trochus tentorium,, Melomelo, Dosinia cretacea, Mactra turgida, Gari radiata, Mitrella blanda, Lunella granulata* and *Bullia* sp. were only recorded from site 1 Vador. Only six species *Cerithidea cingulata, Dosinia* sp., *Pyrene versicolor, Turbo bruneus, Nassarius* sp., and *Bursa granularis* were recorded from both the sites.

Many scientists have earlier described that undisturbed areas are usually characterized by high species richness and an abundance of benthic fauna, which also creates a complex of microhabitats available for other species. On the other hand, disturbed areas, suffer from reduced structural diversity and heterogeneity of the habitat and a dominance of thick-shelled bivalves and scavengers[9]. This phenomenon is found here also as Site 2 has higher diversity

Table-1. List of Molluscs' species recorded from Vador and GSFC Jetty

| Sr. No. | Family | S.no. | Species name | Vador | GSFC Jetty |
|---|---|---|---|---|---|
| 1 | Potamididae (Family) | 1 | *Cerithidea cingulata* **(Gmelin, 1791)** | + | + |
| | | 2 | *Telescopium telescopium* **(Linnaeus, 1758)** | + | - |
| 2 | Babyloniidae | 3 | *Babylonia spirata* **(Linnaeus, 1758)** | - | + |
| 3 | Trochidae (Family | 4 | *Trochus maculatus* **Linnaeus, 1758** | + | - |
| | | 5 | *Trochus tentorium* **Gmelin, 1791** | + | - |
| 4 | Volutidae (Family) | 6 | *Melomelo* **(Lightfoot, 1786** | + | - |
| 5 | Veneridae (Family | 7 | *Dosinia* sp. **Scopoli, 1777** | + | + |
| | | 8 | *Dosinia cretacea* **(Reeve, 1850)** | + | - |
| | | 9 | *Dosinia exoleta* **(Linnaeus, 1758)** | - | + |
| | | 10 | *Paphia malabarica* **(Dillwyn, 1817)** | - | + |
| | | 11 | *Venus verrucosa* **Linnaeus, 1758** | — | + |
| | | 12 | *Paphia vernicosa* **(Gould, 1861)** | - | + |
| | | 13 | *Venus* sp. **Linnaeus, 1758** | - | + |
| 6 | Cardiidae (Family) | 14 | *Vasticardium flavumflavum* (Linnaeus, 1758) | - | + |
| 7 | Mactridae (Family) | 15 | *Mactra turgida* **Gmelin, 1791** | + | - |
| 8 | Psammobiidae (Family) | 16 | *Gari radiata* **(Dunker in Philippi, 1845)** | + | |
| 9 | Muricidae (Family) | 17 | *Ergalatax heptagonalis* **(Reeve, 1846)** | - | + |
| 10 | Columbellidae (Family) | 18 | *Pyrene versicolor* **(G. B. Sowerby I, 1832)** | + | + |
| | | 19 | *Mitrella blanda* **(G. B. Sowerby I, 1844)** | + | - |
| 11 | Turbinidae (Family) | 20 | *Lunella granulata* **(Gmelin, 1791)** | + | - |
| | | 21 | *Turbo bruneus* **(Röding, 1798)** | + | + |
| | | 22 | *Turbo intercostalis***Menke, 1846** | - | + |
| 12 | Angariidae (Family) | 23 | *Angaria plicata* **(Kiener, 1838)** | - | + |
| 13 | Fissurellidae (Family) | 24 | *Scutus unguis* **(Linnaeus, 1758)** | - | + |
| 14 | Pinnidae (Family) | 25 | *Pinna (Subitopinna) bicolor* **Gmelin, 1791** | - | + |
| 15 | Patellidae (Family) | 26 | *Patella vulgata* **Linnaeus, 1758** | - | + |
| 16 | Cypraeidae (Family) | 27 | *Cypraea* sp. **Linnaeus, 1758** | - | + |
| 17 | Littorinidae (Family | 28 | *Littoraria undulata* **(Gray, 1839)** | - | + |
| 18 | Nassariidae (Family) | 29 | *Nassarius* sp. **Duméril, 1805** | + | + |
| | | 30 | *Bullia* sp. **Gray, 1833** | + | - |
| | | 31 | *Nassarius (Telasco) sufflatus* **(Gould, 1860)** | - | + |
| | | 32 | *Nassarius (Niotha) distortus* **(A. Adams, 1852)** | - | + |
| 19 | Neritidae (Family) | 33 | *Nerita (Argonerita) chamaeleon* **Linnaeus, 1758** | - | + |
| 20 | Bursidae (Family) | 34 | *Bursa granularis* **(Röding, 1798)** | + | + |

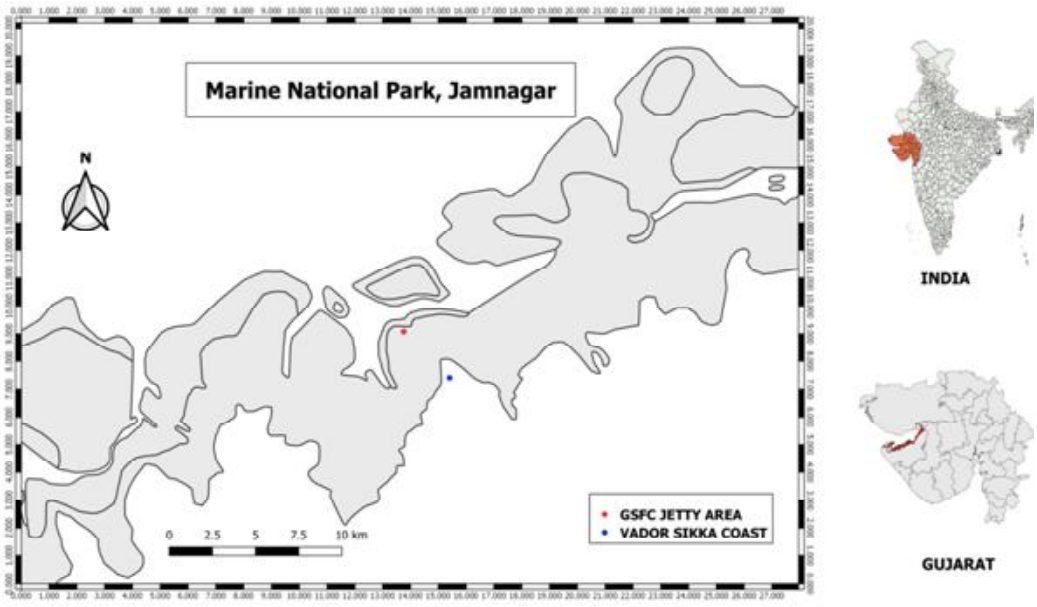


Figure 1: Vador and GSFC Site, Off shore Sikka

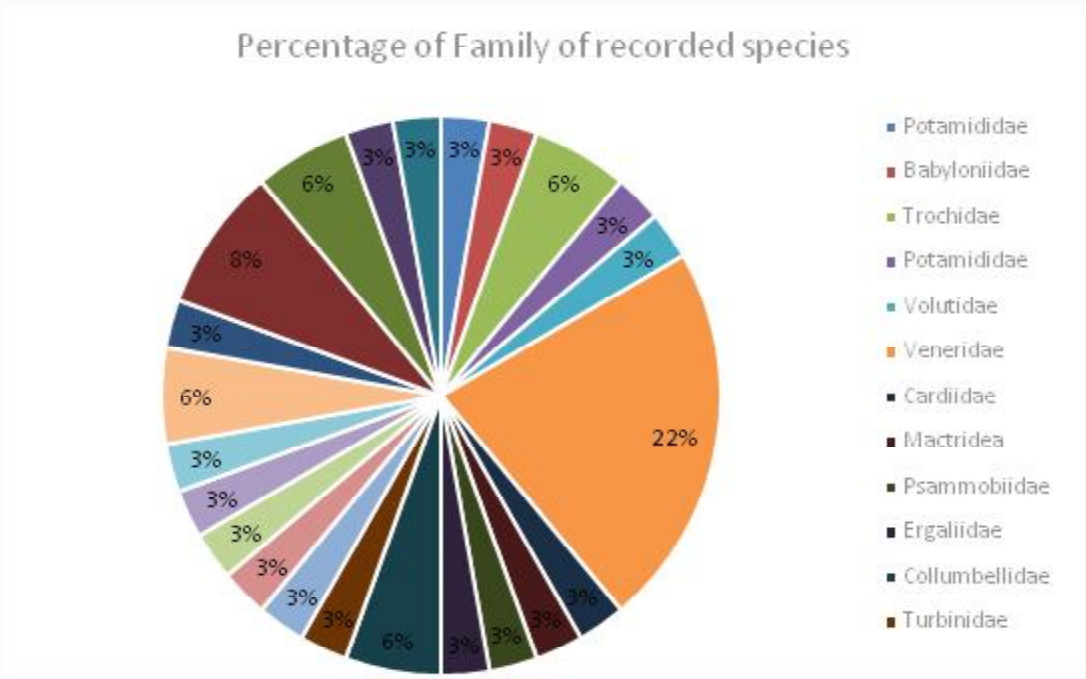


Figure 2. Percentage of family of recorded species

Plate 1. Photographed of Identified mollusc from Vador and GSFC Jetty

| | | | | | | |
|---|---|---|---|---|---|---|
| *1. Cerithidea cingulata* | *2. Telescopium telescopium* | *3. Babylonia spirata* | *4. Trochus maculatus* | *5. Trochus tentorium* | *6. Melo melo* | *7. Dosinia* sp. |
| *8. Dosinia cretacea* | *9. Dosinia exoleta* | *10. Paphia malabarica* | *11. Venus verrucosa* | *12. Paphia vernicosa* | *13. Venus* sp. | *14. Vasticardium flavumflavum* |
| *15. Mactra turgid* | *16. Ergalatax heptagonalis* | *17. Pyrene versicolor* | *18. Mitrella blanda* | *19. Lunella granulata* | *20. Turbo bruneus* | *21. Turbo intercostalis* |
| *22. Angaria plicata* | *23. Scutus unguis* | *24. Pinna (Subitopinna) bicolor* | *25. Patella vulgata* | *26. Cypraea* sp. | *27. Littoraria undulata* | *28. Nassarius* sp. |
| *29. Bullia* sp. | *30. Nassarius (Telasco) sufflatus* | *31. Nassarius (Niotha) distortus* | *32. Nerita (Argonerita) chamaeleon* | | | |

(25 species) which is undisturbed site compared to Site 1 Vador (16 species).

The most striking result found here is that only six species among the 34 recorded species were recorded from both the sites though this two sites were only divided by GSFC jetty. This result shows that heavy load of siltation at Vador sites alter the microhabitats hence we found differences in the species recorded from both sites. Construction engineering activities often cause permanent destruction of habitats or decrease and fragmentation of habitats, due to land claim, coastal protection, and extraction of bottom material, dumping and disposal.

Ducrotoy and Jean-Paul[5] have discussed in an article that dredging mainly causes physical disturbance and sand mining for beach nourishment and land reclamation and aggregate extraction for the construction industry causes temporary disturbance of benthic communities and in some cases permanent loss of habitats. Any increase in the suspended matter will impede the growth of filter feeding organisms (bivalves)[5]. It is well known that changes in substrate quality lead to changes in the structure of benthic communities and that is seen in the present results.

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