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Marine Biodiversity at Shankodhar Point, Dahanu Taluk, Maharashtra

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1. Introduction

1.1. Background

Jawaharlal Nehru Port Trust (JNPT) has proposed to construct a multipurpose, all weather port at Vadhavan, near Dahanu Taluka in Palghar District, Maharashtra with state of Art facilities. The primary objective is to augment and develop a Green field port to handle growing traffic demand of major ports along west coast. The proposed port is envisaged to be the one among the top 10 container ports in the world due to its naturally deep waters and ability to handle large container ships of size 16000 TEU. The port developmental plan includes reclamation of 1473 ha of land within the port limit for which the environmental clearance from Ministry of Environment, Forest & Climate change is essential. The CSIR-National Institute of Oceanography has conducted a comprehensive assessment on the ecological status and biodiversity of the proposed project location and analyzed the probable impacts on the biodiversity due to the proposed port development. Based on the impact assessment, CSIR NIO has suggested mitigation measures that will be implemented by JNPT.

Shankodhar point (19°56'44.78'N; 72°38'14.6" E), that falls within the Port limit, is a small rocky island that remains submerged throughout the year and gets exposed only during the extreme low tides. The place is of religious significance and attracts pilgrims during a particular day in a year when the tides are negative. The native people claim that there were ecologically sensitive organisms present in this environment which was not covered in the earlier biodiversity study. Therefore, the Dahanu Taluka Environment Protection Authority (DTEPA) had entrusted CSIR-National Institute of Oceanography, Goa to conduct a study on the biodiversity of the Shankodhar point and document the ecologically sensitive organisms.

1.2. Objectives of the study

The present study involves the following objectives

- Assessment of the habitat characteristics and biodiversity at Shankodhar Point, Dahanu Taluka.
- To assess the probable impacts on Biodiversity due to the proposed port development.
- To suggest mitigation measures to minimize/alleviate the envisaged impacts due to the port development.

1.3. Scope of the work

The scope of the study is limited to the terms of reference (ToR) suggested by the Expert Appraisal Committee (EAC) during its 241th meeting which emphasized the following.

- To conduct a detailed study on the impact of dredging and dumping on marine ecology and draw up a management plan.
- To prepare a detailed biodiversity impact assessment report including the intertidal biotopes, corals and associated communities, Molluscs, seagrass, macroalgae, fish, cetaceans, and other marine flora and fauna including benthos, turtles, birds, plankton, etc.
- Impact of undersea noise on cetaceans.
- Concentration of petroleum hydrocarbons in seawater at low tide and high tide.
- Disaster management plan for the project.

Whilst, the ecological status and biodiversity of the selected sites within the port limit has been well documented during the earlier biodiversity assessment, the presence/absence of ecologically sensitive organisms at Shankodhar point, a submerged rocky patch is not addressed. Therefore, the aim of the present study is limited to documenting the biodiversity at Shankodhar point in terms of presence/absence of sensitive marine organisms such as corals, seagrass, seaweeds, and the associated flora and fauna. In addition, the relative abundance of these organisms were estimated following the standard methods.

2. Methods

2.1. Study area

Shankodhar point (19°56’44.78”N; 72°38’14.6”E), is a small rocky patch that remain submerged throughout the year and gets exposed during the extreme low tides (Fig. 1). This rocky intertidal area is located ~1 km east of the port limit and this place is of religious significance and attracts pilgrims during a particular day in a year when the tides are negative. Besides, Shankodhar point is also considered to be an ecologically sensitive area due to the presence of diverse group of marine organisms as claimed by the local people. However, there is no published literature available on the biodiversity of the Shankodhar point.

Figure 1: A view of the Shankodhar point exposed during the low tide.

2.2. Accessing Shankodhar area

A large trawler boat was used to access the Shankodhar area from Dahanu jetty. As such, the trawl boat was anchored at least 1 km away from the Shankodhar area and a small dinghy boat was used to reach in the vicinity of Shankodhar point. From there, the Shankodhar point was reached by foot and by swimming (Fig. 2).

Figure 2: Shankodhar point accessed by swimming for assessing the biodiversity.

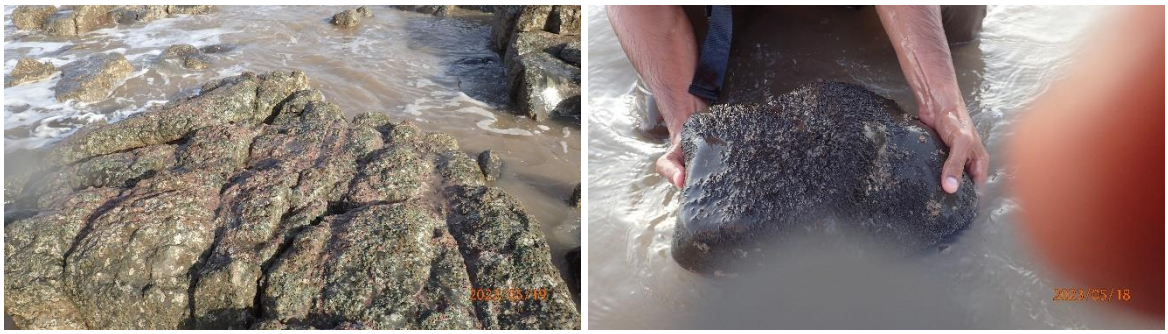
2.3. Biodiversity survey

As such the sampling was carried for two days on 18/05/2023 and 19/05/2023 during the low tide between 06:30 AM and 08:30 AM. The tide levels were 0.23 m and 0.17 m during the survey days, respectively. Given the challenges in the study site, a random search technique was adopted to assess the biodiversity of the study area. Different species of marine flora and fauna observed on the rocks were digitally recorded and their abundance was estimated within 0.5 sq. m area in quadruplicates. The organisms were photographed using an Olympus digital camera and the photographs were used to recognize the taxonomic identity of the organisms to maximum possible resolution. In addition, the habitat characteristics of the study area was assessed.

3. Results

3.1. Habitat characteristics

The exposed rocky patch was 5-20 m wide. The substratum is comprised of small and large rocks with intermittent sand patches below the sea level. Whereas the rocky patch exposed above the sea level (approximately, 1m above the sea level) comprised large rocky boulders with intermittent tide pools. The tide pools were shallow (1-2 ft depth) filled with turbid water. The rocks were covered with a thin layer of cyanobacteria and crustose coralline algae. The rocks are non-coralline in nature and are covered with other fauna including barnacles and hairy tube like structures inhabited by Tanaidaceans (Fig. 3).



A **B**

Figure 3: View of the exposed rock patch covered with crustose coralline algae (CCA) (a) and hair like tubes inhabited by Tanaidaceans (b).

3.2. Fauna

Our survey at Shankodhar point revealed few species of flora and fauna which were abundant in the exposed rock patch. In total, 12 species of fauna and one species of crustose coralline algae was recorded during the survey as per the details below.

3.2.1. Molluscs

A total of five different species of Gastropods was recorded and identified from the Shankodhar point of which two species *Gyrineum natator,* and *Indothais sacellum* was consistent with the previous report. Additionally, three species, *Semiricinula tissoti*, *Chicoreus maurus*, and *Trochus maculatus* were recorded during the present study. In total, 81 individuals of Molluscs were recorded of which *Indothais sacellum* was the most abundant species. The density of these organisms varied between 2 and 11 individuals 0.25 m^{-2} with a mean of 6.1 individuals 0.25 m^{-2}.

Systematics

KINGDOM*: Animalia*

PHYLUM*: Mollusca*

CLASS*: Gastropoda*

ORDER*: Littorinimorpha*

FAMILY*: Cymatiidae*

a. Gyrineum natator

ORDER*: Neogastropoda*

FAMILY: Muricidae

b. Indothais sacellum

c. Chicoreus maurus

d. Semiricinula tissoti

ORDER*: Trochida*

FAMILY*: Trochidae*

e. Trochus sp.

3.2.2. Cnidarians

Two species, *Paracyathus profundus* and *Pennaria disticha*, under the phylum Cnidaria was recorded during the present survey. As such, no scleractinian corals were recorded over the exposed

rocky patches during the survey. The tide pools were turbid likely due to turbid waters and zero visibility and only very few organisms of other phyla were recorded.

The hydroids *Pennaria disticha*, commonly known as Christmas tree hydroid, consists of branched stems up to 10 cm height. It occurs in cluster on the vertical walls of the rocks in the exposed region. Each cluster consists of 12-18 stems with lateral branches and each rock contains at least 3-4 clusters. Having its origin in the western Atlantic Ocean, it is widespread across the tropical countries due to the maritime activities. It is also known to cause clinical symptoms on humans upon physical contact (Pezcan and Sarp 2013).

Only one species of a azooxanthellate coral, *Paracyathus profundus* was recorded on the exposed tidal channels. They are commonly called as solitary cup coral with a flat base and a cylindrical stalk measuring up to 1 – 1.5 cm. The density of *P. profundus* ranged between 3-8 individuals 0.25 m^{-2}. As such, the *Paracyathus profundus* was included in the Schedule I list of animals under the Wildlife Protection Act (1972).

Systematics

KINGDOM Animalia

PHYLUM Cnidaria

CLASS Anthozoa

ORDER Anthoathecata

FAMILY Pennariide

a. *Pennaria disticha*

ORDER Sleractinia

FAMILY Caryophylliidae

b. *Paracyathus profundus*

3.2.3. Arthropods

Two species of barnacles, *Chthamalus* sp. and *Megabalanus* sp. and one species of crab *Petrolisthes boscii*. was recorded from the exposed rocks in Shankodhar point. The barnacle *Chthamalus* sp. dominate the exposed rocks and the individuals measured up to 8-15 mm in diameter. The shell of the barnacle *Chthamalus* sp. was grey and brown in color with an operculum that measure 3-6 mm in diameter. The population density ranged between 56 – 70 individuals 0.25 m^{-2}.

The other barnacle *Megabalanus* sp. was present in isolation amidst the *Chthamalus* sp. over the exposed rocks. The shells of *Megabalanus* sp. measured up to 28 mm - 50 mm in diameter and the shells were globular in shape and pink in color with black stripes at regular intervals around the shell. The individuals measured up to 5 cm in height with an operculum size measuring 5-10 mm in diameter. The population density of these barnacles ranged between 1 – 4 individuals 0.25 m^{-2}. Unlike *Chthamalus* sp. which were present all over the rocks, *Megabalanus* sp. was predominantly present on the vertical walls of the rocks on the splash zone.

Only one individual of the crab *Petrolisthes boscii* was recorded during the survey. Multiple species of crabs are likely to be present which couldn't be recorded due to turbid waters inside the tide pools.

Systematics

KINGDOM Animalia

PHYLUM Arthropoda

CLASS Thecostraca

ORDER Balanomorpha

FAMILY Chthamalidae

a. *Chthamalus* sp.

FAMILY Balanidae

b. *Megabalanus* sp.

CLASS Malacostraca

ORDER Decapoda

FAMILY Porcellanidae

c. *Petrolisthes bosci*

3.2.4. Annelida

Two species of tube worms belonging to the genus *Sabellaria* and *Serpula* species were recorded during the survey. The *Serpula* sp. are commonly known as calcareous marine tube worm are sessile organisms belonging to the family Serpulidae. They were abundant and predominantly present in the holes and crevices of the rocks. The density of the *Serpula* sp. ranged between 18 – 34 individuals 0.25 m^{-2}. The *Sabellaria* belongs to the genus of marine polychaete worms in the family Sabellariidae. The tubes of these worms are attached to the rocks especially under the holes and crevices in between the *Serpula* tubes. Unlike *Serpula*, the tubes of *Sabellaria* were composed

of sand and broken shells. The population density of the *Sabellaria* species ranged between 6-11 individuals 0.25 m^{-2}.

Systematics

KINGDOM Animalia

PHYLUM Annelida

CLASS Polychaeta

ORDER Sabellida

a. FAMILY Serpularidae

b. FAMILY Sabellariidae

3.3. Marine Flora

Crustose coralline algae (CCA): The CCA occur in patches amidst the *Chthamalus* sp. on the rocks. They are more prevalent on the horizontal surface of the exposed rocks. In general, CCA are the important primary producers distributed over a wide range of habitats ranging from Intertidal rocks, coral reefs, and other subtidal marine habitats. They play a major role in building the reef by cementing together the fragmented corals, rocks and other hard substrates. The presence of CCA over the rocks will attract the settlement of other benthic organisms including the corals.

Systematics

KINGDOM Plantae

PHYLUM Rhodophyta

CLASS Florideophyceae

ORDER Corallinales

FAMILY Corallinacea

Figure 4: Diversity of invertebrates recorded at Shankodhar point, Dahanu. (a) *Chthamalus* sp; (b) *Megabalanus* sp; (c) *Pennaria disticha*; (d) *Petrolisthes boscii*; (e) *Paracyathus profundus*.; (f) Crustose coralline algae; (g) *Gyrineum natator;* (h) *Chicoreus maurus*; (i) *Indothais sacellum;* (j) *Semiricinula tissoti*; (k) *Trochus* sp. (l) Gastropod egg capsules; (m) *Sabellaria* sp; (n) *Serpula* sp.

4. Discussion

The present study documented the biodiversity at Shankodhar point over a period of two days during the low tide. Though only 12 species of fauna and one species of flora was recorded, the number of organisms within the given area were abundant supporting the fact that Shankodhar point is biologically rich. The rocky outcrops at Shankodhar point serves as a habitat for variety of organisms including the barnacles, molluscs, hydroids, and corals. Presence of molluscs egg capsule mass over the rocks indicates that this site could be the breeding ground for those organisms. In addition, there are numerous tide pools and tide channels which provide additional niches for more marine organisms. Majority of rocks were smothered with a thin tube like structures which are found to be inhabited by Tanaidacean crustacean. However, the origin and formation of these tube like structures on the rocks needs further investigation. In addition to this, a school of three dolphins were sighted in the subtidal area of the Shankodhar point indicating the presence of cetaceans in the vicinity of Shankodhar point. The dolphins couldn't be identified due to short sighting time. The diversity described in this report is consistent with the previous report submitted by CSIR-NIO, RC-Mumbai, with an addition of few other species. The presence of crustose coralline algae over the rocks is a positive sign since CCA is the preferred settlement substrate for majority of the sessile benthic organisms. Among other organisms recorded at Shankodhar point, the solitary cup coral *Paracyathus profundus* is listed under Schedule I list of protected animals under the Wildlife Protection Act (1972).

5. Impact Assessment

- Land reclamation may alter the coastal hydrology which in turn could affect the larval dispersal, availability of food resources, and migration of marine mammals.
- In case of dredging and further dispersion of sediments towards the Shankodhar point, the tide pools in Shankodhar point might be filled with excessive sediments which in turn can impact the benthic communities through smothering and reducing the absorption of light for photosynthesis.
- Increased turbidity and sedimentation might affect the fish community present in the area, with impacts including behavioural changes, where species will avoid area of impact, reduced foraging behaviour and physiological changes, where more suspended sediments can reduce ability to absorb oxygen, with prolonged exposure leading to reduced growth and development.

- Movement of vessels and discharge of ship waste might possibly introduce pests which could settle in to that region and threaten the native species.
- Dispersal of leachates containing harmful chemicals such as Tributyltin from the vessels towards Shankodhar point can affect the Molluscs community which were abundant in this region. Tributyltin is a common ingredient of antifouling paints and it is known to affect the spatfall and shell development in the molluscs (Alzieu and Portmann 1984). On the other hand, increased load of suspended sediments has been shown to affect the mucus production by the gastropod *Haliotis iris* (Raea 2013). The mucus secreted by gastropods helps in crawling and coat external part of gastropod body.
- Oil spill, if any, and its dispersion towards the Shankodhar area will have deleterious impact on marine organisms. For example, oil spill and accumulation of oil has been shown to reduce the density and species number of molluscan community in the intertidal reef flats (Garrity and Levings 1990).
- Underwater noise generated due to vessel movement, dredging, and construction might result in temporary behavioural changes of marine organisms especially cetaceans, the most common change is simply avoiding the area. Other possible impacts include temporary and permanent loss of hearing.

6. Recommendations

- Continuous monitoring of the ecological characteristics of the habitat during and after the port construction, dredging, and land reclamation to assess the changes in the water quality, coastal hydrology, bottom contamination and diversity & abundance of marine organisms.
- Deployment of artificial reefs as a measure of compensation for the loss of fishing grounds, if any, due to dredging and land reclamation.
- Marine mammals such as dolphins were sighted near Shankodhar point. Induct a marine mammal observer in to the ships to monitor the movement of marine mammals and ensure a safe distance between the moving vessels and mammals by limiting the speed of the vessels.
- Include measures recommended in the EIA and other studies to (i) prevent water pollution; (ii) limit disturbance of sediment, and (iii) limit the movement of barge/vessel movements.

- Underwater noise can be minimized by using bubble curtains which can reduce the noise emission up to 95% and ensure that marine mammals reliant on sound wave communications are not distressed.
- The work time can be reduced to minimize the sediment disbursal during adverse weather conditions.
- Establish 'no wash zone' based on the local hydrodynamics between the port and Shankodhar point to prevent the introduction of marine pests due to washing/cleaning of ship hulls and release of ship waste.
- All vessels coming to the port shall be checked for the presence/absence of invasive species on the hull.

7. Acknowledgement

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