

SPECIES INVASION AND SUCCESSION AS COMMUNITY AND ECOSYSTEM RESPONSES TOWARDS CLIMATE CHANGE IN THE ROCKY INTERTIDAL ECOSYSTEMS OF KATHIAWAR PENINSULA



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Abstract: Intertidal zone of Kathiawar peninsular coastline shows a great deal of biological diversity in marine ecosystem. The diversity and distribution pattern of the intertidal macrofauna was observed to be changing over last few years. A lot many changes in the macrofaunal diversity were observed in the vertical zones of the intertidal area off this coastline. Interactions between biotic and abiotic factors may be responsible for this temporal and spatial variability in macrofaunal assemblages. Invasion of a cnidarian species *Zoanthus* and different coral species into the intertidal zone is found to be one of them. The diversity of *Zoanthus* species were earlier reported to be low along this coastline. The present work reports the expansion and setting up of new significantly large colonies of *Zoanthus* and few hard corals in the intertidal zone of the South Saurashtra Coastline, eradicating the existing algal or faunal species. Apart from that, there are new records of three species of Nudibranchia (Mollusca), three species of echinoderm and seven species of scleractinian corals in this area suggesting species invasion and /or species succession. Thus, the question arises that the changing scenario of intertidal diversity in this area is a clear indication of climate change?

Key words: Climate change, Intertidal zone, Macrofaunal assemblage, Invasion, Succession

INTRODUCTION

The planet has always been changing: current patterns of biodiversity are the result of past environmental conditions and ecological and evolutionary constraints (Benton, 2010; Clarke and Crame 2010; Lyons *et al.*, 2010). Species may also respond to climate change by changing their elevational range to track their optimal environmental conditions. However, it is not just the species but also the interactions between them and the networks they form that are important in ecosystem function. The most critical (current or potential) contributors to changes in marine ecosystem and biodiversity are now recognized to be the following: fishing and removal of the ocean's invertebrate and plant stocks, many of which are overexploited; chemical pollution and eutrophication; physical alterations to coastal habitat; invasions of exotic species; and global climate change, including increased ultraviolet radiation and potentially rising temperatures, resulting in possible changes to ocean circulation (and thus nutrient supply and distribution). These stresses to the marine environment have affected and may yet affect life from the intertidal zone to the deep sea.

We know that biological diversity changes through time over both large and small temporal as well as spatial scales. These natural changes show the environmental conditions, and reflect ecological and evolutionary processes. However, anthropogenic activities, including overexploitation, habitat loss and climate change, are currently causing intense changes in ecosystems and exceptional loss of biological diversity. There is an extensive literature relating to spatial patterns such as latitudinal gradients of diversity (Willig *et al.*, 2003), species area relationships (Arrhenius, 1921) and range size distributions (Gaston, 1996) while less attention has been paid to temporal patterns of biodiversity (Magurran and Dornelas, 2010).

Gujarat, situated at the extreme west of India is located between latitudes 20°1'N to 24°7'N and longitudes 68°4'E to 74°4'E. The State has India's longest coastline of around 1,650 km and enjoys the status of having two out of the three gulfs, those of the Kutch and Khambhat. The literature surveyed reveals that coastline of Kathiawar peninsula of Gujarat state has

been extensively studied by various researchers like Patel (1984), Prasad (1984), Malli (1993), Desai (1987), Misra and Kundu (2005), Gohil (2007), Vaghera (2008), Bhadja (2010), Joshi (2010), Poriya (2010), Vaghela (2010), Vaghela *et al.* (2010), Gohil *et al.* (2011), Bhadja and Kundu (2012) etc. The aspects that were frequently analyzed include species specific study and effect of anthropogenic pressure on intertidal fauna. The realization of the importance of continues monitoring of intertidal fauna in association with the ecological aspects emphasized the need for the present study. Hence, present work was carried out to documents the temporal variation in biological diversity and examines the natural changes to build up tools and strategy towards a sustainable future.

MATERIALS AND METHODS

The entire intertidal belt of the selected sites on The Kathiawar Peninsula of Saurashtra coastline off the Arabian Sea was thoroughly surveyed for macrofaunal diversity and intertidal assemblages. During present study intertidal zones of four different coasts like Dwarka, Mangrol, Veraval and Diu were intensively surveyed to check the present status of intertidal macrofaunal diversity. A map of the study location has been made based on the survey and the entire area was vertically divided into few sampling sites. Detailed survey has been done to understand the biological nature of the entire study area. The intertidal zones of the sites were visited regularly during the lowest tide and the encountered macrofauna were recorded. Some macrofauna were identified on the site itself following prior identification information or

from the photographs of the specimens. Thus, a checklist of encountered macrofauna was prepared. The finding of the study was compared with earlier similar studies.

RESULTS AND DISCUSSION

Intertidal zone of Kathiawar peninsular coastline shows a great deal of biological diversity in marine ecosystem. There are total 82 invertebrate species were recorded during present species among them 4 species of phylum porifera, 20 species of coelenterate, 5 species of annelid, 11 species of arthropoda, 40 species of mollusca and 3 species of echinodermata were recorded (Table 1). This scenario was however, observed to be changing over last few year. A lot many changes in the macrofaunal diversity were observed in the intertidal area off this coastline. Invasion of a cnidarian species *Zoanthus* and different coral species into the intertidal zone is one of them. The diversity of *Zoanthus* species were less before along this coastline. The present work reports the expansion and setting up of new and significantly large colonies of *Zoanthus* and few hard corals in the intertidal zone of the south Saurashtra Coastline, with new records of three species of *Nudibranchia* (Mollusca), one species of echinoderm and seven species of scleractinian corals for this area.

Major changes in intertidal macrofaunal diversity:-

(1) **Invasion/spreading out of *Zoanthus* colony:** - The diversity of *Zoanthus* species were less before along this coastline. The present work reports the expansion and setting up of new and significantly large colonies of *Zoanthus*

Table1. Current scenario of Intertidal diversity

| No. | Phylum | No. of species recorded previously | No. of species recorded in 2012-13 | Addition | Deletion |
|-----|-----------------|------------------------------------|------------------------------------|----------|----------|
| 1. | Porifera | 5 | 4 | 0 | 1 |
| 2. | Coelenterata | 11 | 20 | 9 | 0 |
| 3 | Platyhelminthes | 2 | 0 | 0 | 2 |
| 4. | Annelida | 6 | 5 | 0 | 1 |
| 5. | Arthropoda | 8 | 11 | 3 | 0 |
| 6. | Mollusca | 47 | 40 | 8 | 15 |
| 7. | Echinodermata | 3 | 3 | 2 | 2 |

throughout intertidal zone of Kathiawar peninsula which create the hardcore competition for space and survival in coexisting macrofauna as well as seaweeds. Fig. 1 indicates clear cut spreading out of *Zoanthus* colony in intertidal zone which gives competition to some sedentary benthos like corals and barnacles and also to seaweeds.

(2) First record of some macrofauna for Kathiawar peninsular coastline: The present work reports three species of Nudibranchia (Mollusca), three species of echinoderm and seven species of scleractinian corals for this area.

Nudibranchia: Among them *Flabellina bicolor* was first time reported in April-2010 from Gujarat (Gulf of Kutch) and distributed only in Gulf of Kutch and Lakshadweep. *Phidiana militaris* is seasonally common in Gulf of Kutch but special affinity to *Goniopora* coral and distributed only in Gulf of Kutch and Ratnagiri while *Sakuraeolis gujaratica* is endemic to Gulf of Kutch only

reported earlier in 1971 and 2010 and now in 2012 by this study.

Echinodermata : Three species of echinoderm were reported first time form this area which are *Arbacia lixula*, *Holothuria sp.* and a sea star species *Asterina miniata*.

Scleractinian corals: Many small to medium sized colonies of seven hard coral species were reported which indicating invasion of new species in this coastline. Numerous small to big colonies of *Porites lutea* were found widely distributed throughout intertidal zone of Kathiawar peninsular coastline. While small to medium sized colonies of *Goniopora columna*, *Montipora venosa*, *Porites stephensoni*, *Psammocora superficialis*, *Psammocora vaughani*, *Pseudosiderastrea tayami* and *Turbinaria peltata* were reported. These new records of many intertidal macrofauna in this area suggesting species invasion and/or species succession. Invasion



Fig. 1. Possible succession of *Zoanthus* colony in intertidal zone and its competition with other organisms.

of coral and spreading out of *Zoanthus* colonies also invites their predator like nudibranchs which gives supports to unlike presence of nudibranch in this area. Thus, the question arises that the changing scenario of intertidal diversity in this area is a clear indication of climate change? When it is clear that global biodiversity is declining as a result of anthropogenic activities, there may be considerable variation among species and populations which needed proper and continues documentation of temporal as well as spatial patterns of diversity at regional level that will enable us to predict where and when changes will occur, what the cost might be for the conservation and sustainable use of biodiversity and what we can do practically in order to maintain those systems in as good condition as possible.

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