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NOTE

Recruitment of epibenthic communities on artificial reefs in Tuticorin coastal waters, southeast coast of India

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Abstract

Recruitment of epibenthic organisms on artificial reefs deployed in different depths off Tuticorin coastal waters was studied for a period of one year from June 2002 to May 2003. Algal mats were formed all over the modules and the epibenthic communities recruited included barnacles, sponges, hydroids, molluscs, echinoderms and ascidians. The percentage occurrence of organisms varied between the AR sites and was high on the modules deployed in the deeper area with particular domination by barnacles (55 %). The studies indicate that the artificial reefs support a variety of faunal communities belonging to various ecological niches and make the area ecologically sound. The assemblage of epibenthic communities in different AR stations and their seasonal variations are discussed.

Artificial reef (AR) construction is an important tool in the protection, management and enhancement of marine fishery resources (Relini *et al.*, 1995). However, in recent years, many have pointed out the ill effects of AR on fish stocks. The success of an artificial reef is determined by its fishery production, which is, in turn, facilitated by the increase in sessile epibiota. The growth of sessile algae and invertebrates on artificial reef form the food of many organisms and as well provide shelter to finfishes and shellfishes by virtue of its three-dimensional structure (Carlisle *et al.*,1964; Turner *et al*, 1969). The creation of man made structures to enhance marine resources is the basis of a specialized branch of marine technology known as "Artificial reef development" through which fishes could be attracted to within a smaller area, by offering an increased food supply (Pillai, 1996). Reefs when properly located and structured not only enhance the number of fishes, but also increase the biological productivity of the area (Phillipose, 1996). Most of the research on artificial reef construction has focused on their aggregating effect on fish. The benthic communities formed on the reef modules have been less studied. (Bohnsack and Sutherland, 1985; Bohnsack *et al.*, 1991). The composition of hard bottom communities on concrete reefs depends on the location with respect to depth, current speed and direction, surrounding substrate and water conditions (Moffitt *et al.*, 1989; Baynes and Szmant, 1989; Bohnsack *et*

al., 1991; Chang, 1985). The introduction of hard substrates produces the development of a great biomass of sessile fouling organisms (Bombace *et al.*, 1995.). The composition of epifaunal community is altered, significantly by the grazing effect of fish and invertebrates (Hixon and Brostoff, 1985). Attached biota referred to as fouling organisms in marine systems include algae, sponges, barnacles and tunicates among other groups. The present study describes the colonization process of benthic invertebrates on the ferro-cement artificial reef modules deployed in Tuticorin coastal waters.

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Material and methods

The coastal waters off Tuticorin in the Gulf of Mannar along the southeast coast of India were selected for installation of artificial reefs (Fig.1). A total of 70 ferro-cement modules, each with 4′ 6″ length, 3′ height and 3.5cm thickness (Fig.2) were deployed in two sites, station-1 with 5.6 m depth and station -2 with 6.2 m depth. The distance between the two stations is 2.5 km and both stations are located outside the Vaan and Koswari islands. The colonization on the artificial reef surfaces by various organisms was recorded for a period of one year (June 2002 to May 2003) at monthly intervals. The study has been carried out by SCUBA diving to make visual observations and collect samples. Epibenthic invertebrates were surveyed using quadrat method (Stoddart, 1969) and samples were collected from the reef surface and identified. The collected data were analyzed using one-way ANOVA with Duncan test (Post hock). Statistical techniques were implemented with software SPSS.

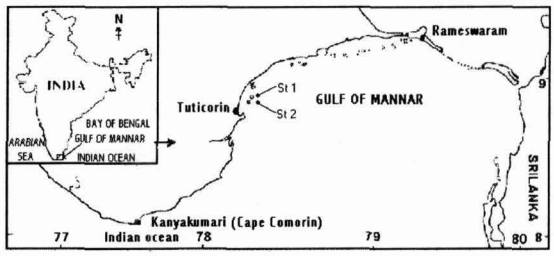

Fig. 1. *Map showing Tuticorin coast of Gulf of Mannar*

Results

After deployment of Artificial reefs at sea floor, a variety of erect organisms (hydroids), ascidians, sponges, encrusting organisms (molluscs, barnacles) and echinoderms began to colonize rapidly on the reef surfaces. After the first month of deployment the modules were covered by

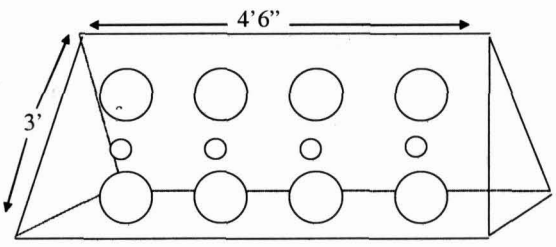

Fig.2. *Ferro-cement module (Holes – 18 cm and 11 cm; Module thickness – 3.5 cm)*

rapid growth of barnacles. The percentage of barnacles attached to the artificial reefs, at station 1 was higher (40%) than station 2 (34%). The occurrence of molluscan fauna was observed in both stations from the second month onwards. Hydroids, sponges and ascidians were observed after six month of deployment. The results were statistically analyzed using one-way ANOVA with Duncan analysis. The occurrence of molluscs, hydroids, sponges, ascidians, barnacles and echinoderms showed no significant differences between stations.

Mollusca

Molluscs were recorded after the second month of deployment at both the stations. A total of ten species (*Cerithidium* sp., *Nassarius glans, Chicoreus virgineus, Thais* sp., *Lambis lambis, Cypraea onyx, Saccostrea cucullata* and three species of Nudibranch) were recorded in station I whereas only eight species (*Conus textile* and all other species as in station 1 except Nudibranch) were observed in station 2. The percentage of molluscan fauna density varied from 1.7% to 6.3% and the percentage density varied from 2.1% to 4.4% at the second station. The highest percentage composition 6.3% was recorded in March 2003 at station 1 whereas for station 2 high percentage (4.4) was recorded in April (Fig. 3. A). Among molluscs, *Cerithidium* sp., *Nassarius glans, C. virgineus* and *Thais* sp. were dominant at both stations. *Certhidium* sp. and *C. virgineus* first appeared during August 2002, where as *Thais* sp. was noticed only during October to December 2002. The cowries, *Cypraea onyx, Nassarius glans* and an unidentified nudibranch appeared on the modules at station 1 during March 2003. At station 2, *C. onyx* and *N. glans* were found only during April and May. A single *C. textile* was recorded only in March at station 2. The rock oyster *S. cucullata* was the only bivalve recorded from both stations.

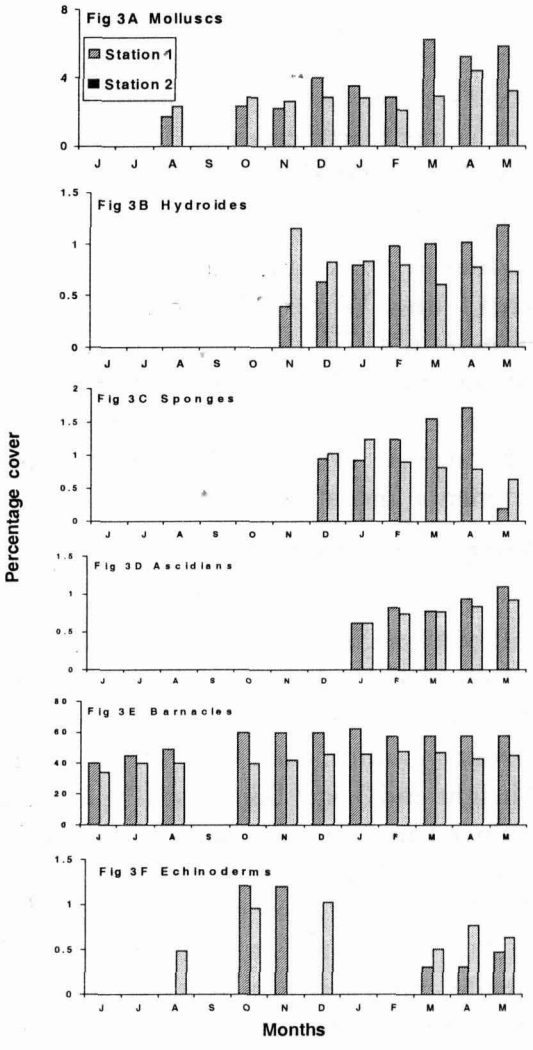

Fig.3. *Percentage of epibenthic organisms on artificial reefs*

Cnidaria – Hydroids

The settlement and growth of hydroids were observed in both stations from November 2002. Only one type of hydroid was noticed. The maximum percentage (1.17%) occurrence of hydroids was recorded at station 1 during May. While at station 2, maximum percentage was observed during November 2002 (1.15%) but unfortunately the hydroids were detached from modules due to the current action and reached a minimum of 0.61% during March (Fig.3B).

Sponge *(Porifera)*

Sponges started appearing on the modules from December at both stations and its occurrence slowly increased from 0.9% to 1.7% (Fig.3C). Only one type of sponge was recorded in both the stations. In station 2, it slowly decreased from 1.0% and at the end of the study period, 0.6% was observed.

Ascidians (Ascidiacea)

Ascidians were observed after the seventh month of deployment at both stations and five species were recorded in the station 1 (*Phallusia nigra, Distaplia nathensis, Didemnum psamathodes, D. candidum* and *P. indicum*) but only four species (as in station 1 except *P. indicum*) were recorded in station 2. The highest percentage composition of Ascidians was found in station -1 (1.1 %) and station - 2 (0.9 %) during May (Fig.3D).

Barnacles

After the first month of deployment, rapid growth of barnacles (*Chthamalus* sp.) was observed in both stations and was the dominating group. The percentage of barnacles varied from 40 to 62 during the study period at station 1. In the second station, the percentage composition of barnacles varied from 34 to 48 (Fig. 3E). The maximum growth was recorded during January, but declined in the following four months at station I. In station 2, the highest percentage composition was recorded during February.

Echinodermata

Echinoderms were present on the top and sides of the artificial reef at both stations. Of the three species observed in both stations (*Diadema savingnyi, Pentaceraster affinis* and *Holothuria scabra),* two species of sea urchins were found grazing on the artificial reef among which *D. savingnyi* was the dominant species in both stations. The percentage composition of echinoderms slowly decreased at station I (Fig.3F). Among starfish *P. affinis* and sea cucumber *H. scabra* were found near the reef module at both stations.

Discussion

The epibenthic faunal diversity after one year of deployment of the artificial reefs showed an increase. The surface topography complexity also increased due to repeated settlement of barnacles and hydroids on whatever space was available. Only one species of barnacle *Chthamalus* sp. was noticed. Polychaetes were negligible (tubiculous polychaetes). The sudden decrease in the barnacle population appeared to be due to the grazing of barnacles by *C.virgineus.*

Sponges and ascidians were the other abundant sessile organisms on the reef. Ascidians were found thriving well on the reef surface where light was available in sufficient quantities contrary to the findings of Miller (1971)

The encrusting organisms were observed to have formed a background community on the artificial reef (Hatcher, 1995). The background communities differ in the area of deployment. Mussels or other bivalves and barnacles have been found to attract echinoderms. But starfish has not been observed on the reef but was found near the reef area on the sea floor. Sea urchin also helps in maintaining a controlled epibenthic community as it also performs the role of grazing. Only one sea cucumber *H. scabra* was found near the reef area. The observations indicated the definite possibility for an increase in settlement of epibenthic community over long periods of time. Studies on long-term changes in faunal settlement would help to record the ecological succession on the reef.

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