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INTERTIDAL ECOLOGY OF THE SEA SHORE NEAR TARAPUR ATOMIC POWER STATION*

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ABSTRACT

Surveys were carried out between March 1969 and August 1970 to study the fauna and flora in the littoral zone of the sea shore near the Tarapur Atomic Power Station.

The beach adjacent to the station is rocky with a number of tidal pools inhabited by a variety of organisms whereas the beach to the south is mostly sandy and barren except for a small rocky stretch. The tidal range is 6 m and over a mile of beach is exposed during low tide. The near shore currents are very strong and have a clear north-south oscillation with the changing tides.

Less *Atherina* sp. fry were available near the Power Station in March 1970 than during the previous year. Possible reasons for these differences are discussed, including the effect of heated discharges on biota. The need is also emphasized to monitor the biota (Plankton, Nekton and Benthos) systematically for content of fission products released by the Power Station.

INTRODUCTION

THE Tarapur Atomic Power Station (TAPS) is situated on a rocky promontory, south of the Tarapur light house located about 100 kms north of Bombay (Fig. 1). The sea adjacent to the Power Station receives heated effluents as well as low radioactive wastes from the Power Station. Intertidal communities are known to play a significant role in the cycling of radionuclides in the marine ecosystem. Moreover some organisms of the intertidal community like oysters and clams which are consumed by the local fisherfolk are well known concentrators of radionuclides like Mn^{54} and Zn^{65} (Chipman *et al.*, 1958; Nair *et al.*, 1969) constituting thereby a health hazard to the local population.

The present paper reports results of periodical ecological surveys of the 6 kms stretch of sea shore near the TAPS extending from Uchhedi creek in the south to Tarapur light house on the north.

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TOPOGRAPHY OF THE AREA

Cartwright and Spanne (1964), have studied the major features in the topography of the area. They have assigned an arbitrary elevation of 100 feet to a

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beach mark on the plinth of the Tarapur light house (Fig. 2). Landward of the 100 feet contour the slopes range from 1 to 2% and the surface material consists of sand with occassional outcroppings of rocks. Seaward of the 100 feet contour upto 92 feet contour the slopes range from 4-6%. The slope of the foreshore segment between 92 and 76 feet contour is 1% and is marked by numerous pools and depressions formed by natural and man made barriers and the area is made up of basaltic rocks and breccia. Seaward of the 76 feet contour for a distance of about 1,500 feet (3 fathom line) the average slope is again 1% and the bottom is irregular in this stretch.

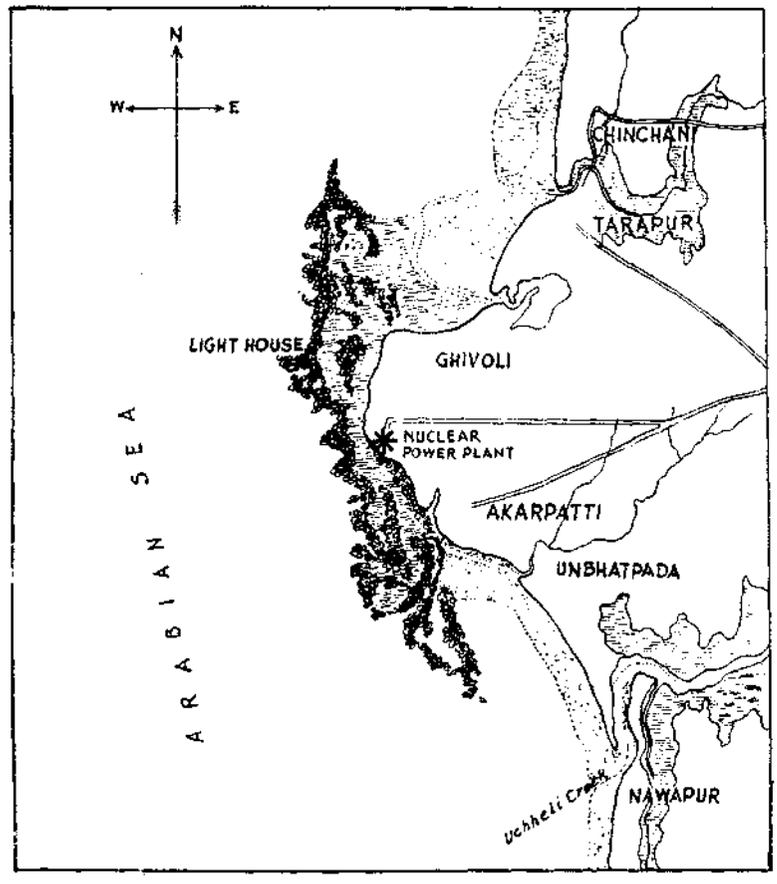

Fig. 1. Site map showing the Power Station and the near by sea environment.

DESCRIPTION OF THE BEACH

The sea shore from Tarapur light house to 2 kms south of the Power Station is rocky, the rock principally of the basaltic type. The rocky shore shows no evidence of any accretion of sand or silt. To the south of this is the sandy beach (3 kms) extending upto Uchheli creek. To the north and south of the Power Station, over

a mile of the shore (intertidal area) is exposed during a spring lowtide. This stretch of the shore is interspersed with several tide pools. The shore narrows down further south at the confluence of the rocky and sandy shores. The sandy shore upto Uchheli creek is about 1 km wide. It is wider at both the extremities and narrows down in the middle.

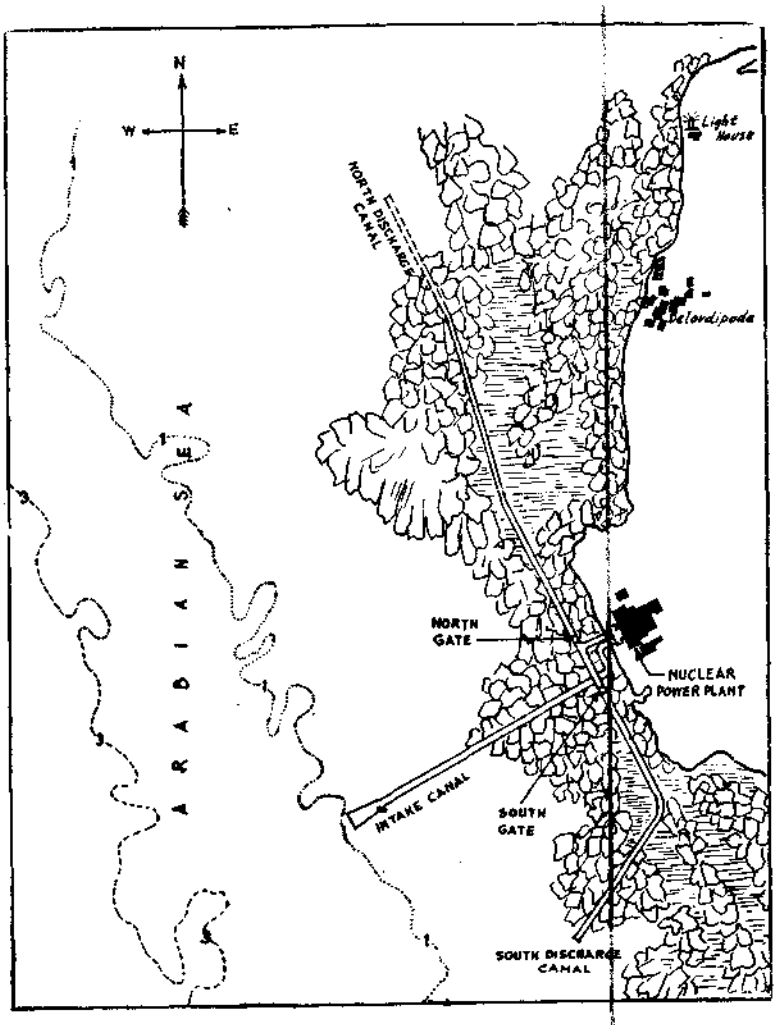

Fig. 2. Intake and discharge Canal System of the Power Station.

HYDROGRAPHIC CHARACTERISTICS OF THE NEARSHORE WATERS

The sea adjacent to the Tarayur Coast is very shallow and is characterised by large tidal differences, about 6 m for spring tides (Cartwright and Spanne, *loc. cit.*). Associated with the tides are strong north-south tidal currents which reverse directions every six hours. A hydrobiological survey (Nair, 1968) conducted

during March and October 1966 showed salinities ranging from 36.15 to 37.29‰ in March and 35.68‰ to 35.95‰ in October. Sea surface temperatures ranged from 27.3° C in March to 31.5° C in October.

Temperature measurements were carried out along the intake and discharge canal systems (Fig. 2) during December 1969. The discharged water at its point of release from the reactor had a temperature 5.5° C higher than the intake water.

The Rocky Shore

The rocky intertidal area at Tarapur can be divided into an upper littoral, mid-littoral and sub-littoral zones. The upper littoral is that area covered by the 100 and 92 feet contours, mid-littoral is that covered by 92 and 76 feet contours and sub-littoral, seaward of the 76 feet contour upto the 3 fathom line.

Upper Littoral

The upper littoral region remains practically dry except during high water springs when it gets covered. This area abounds in an Anomuran crab—*Eupagurus* sp. The density of population of this species was found to be as much as 28/sq. feet and they seem to breed in the month of December. Other less common inhabitants of this region included crabs like *Carybdis orientalis*, *Dotilla myctiroides*, *Leptodius* sp. and *Grapsus striagasus*. Gastropods were represented by *Finella Cerithinia* and *Nerita oryzarum* in fair abundance respectively during the months December and July. Other gastropods recorded from this zone included *Astria stellata*, *Euchelus indicus* and *Bursa tuberculata*.

Mid Littoral

The mid-littoral zone remains exposed during low tide but gets covered invariably during high tides. The cirripede crustacean *Balanus amphitrite* is the most abundant inhabitant of this zone (density of population 120–140/sq foot), although most of them were found dead during the month of December. Among gastropods *Cellana radiatia* was the most common. Other less common gastropods included *Onchidium veraculatum* and *chiton* sp.

Tide Pools

The receding high tide leaves behind several tide pools. The tide pools harbour a variety of forms. Coelenterates were represented by coral *Favia* sp. and sea anemones. Among errant polychaetes *Perinereis* sp. was recorded. *Acetes indicus* a macruran decapod was also common during March 1969. Among the fishes recorded were Gobiids — *Periophthalmus* sp. *Atherina* sp. (Teleostei) fry were in abundance during March 1969 and were less common when the area was revisited in March 1970, possibly due to the higher temperatures of warm water discharges from the reactors.

Among the seaweeds (chlorophyceae) recorded were *Caulerpa sertularoides* abundantly encrusted with carbonate of lime, *Derbesia* sp., *Ulva lactuca* and *Enteromorpha intestinalis*.

Rhodophyceae were represented by *Gracilaria* sp. which were found attached to the rocky bottom.

Sub-Littoral

The sub-littoral region is covered throughout the year. The bottom is hard and coralline with attached algae, *Sargassum* sp. (Phaeophyceae). The dominant coral found in this zone is *Favia* sp.

SEASONAL DISAPPEARANCE OF FAUNA AND FLORA

A survey during the monsoon months indicated total absence of seaweeds and most of the dominant fauna possibly due to the salinity changes during monsoon, however, gastropods *Cellana radiata* and *Onchidium verruculatum* were available in abundance on the rocks of mid littoral region. Upper littoral region had *Nerita oryzarum* in abundance during this period.

ZONATION

Although the distribution of fauna is over the entire rocky stretch some semblance of a zonation is noticeable. In the upper littoral *Eupagurus* species are evenly distributed and this zone can be described as the *Eupagurus* zone. The mid-littoral has an upper Balanoid zone and a lower zone dominated by *Cellana radiata.*

The rocky intertidal surface generally provides a firm substratum for many an intertidal community to thrive well. But the intertidal surfaces near Tarapur in general seem to have much less density of fauna compared to, other similar shores on the west coast of India. This could possibly be due to the constant reworking of the shore for site development purposes for the Power Station during the past four years.

Sandy shore

The sandy shore is in many ways less favourable to life than the rocky intertidal surface, yet some organisms have been remarkably successful in colonising it. Analogous to the rocky shore the sandy shore also can be classified into upper, mid, and sub-littoral zones.

Anomuran crab *Gelasimus marionis* is found distributed widely in the upper littoral region. A tube dwelling polychaete, *Eunice* sp. was also recorded from this zone, although its regular occurrence appears rather doubtful.

The mid-littoral zone abounds in the tube dwelling polychaete *Eunice* sp. although rare gastropods *Conus* sp. and echinoderms represented by crinoids were also recorded. Sponges *Adosia* sp. was also found attached to isolated projections on the sandy beach.

SEAWEEDS WASHED ASHORE

The seaweeds cast ashore included *Codium* sp. and *Ulva* sp. (Chlorophyceae), *Dictyota* sp. and *Sargassum* sp. (Phaeophyceae) and *Spyridia* sp. (Rhodophyceae).

ECOLOGY OF THE UCHHELI CREEK

The creek lies about 5 kms south of the reactor site and is of importance because of its oyster and clam fisheries.

Among the Pelecypods, clams like *Meretrix meretrix, M. Costa* and *Katelysia opima* were found in abundance in the upper reaches of the creek. *Onchidium verraculatum* was a common gastropod found on the rocky shore line of the creek. *Aplysia benedicti* was recorded during March and their eggs in the form of long strings attached to the stones and seaweeds were obtained in the month of December possibly indicative of their breeding season.

Two species of oysters, *Ostrea, gryphoides* and *Ostrea crenulifera* constitute the oyster fisheries, the most important fishery in the creek.

These oysters and clams are significant concentrators of induced radionuclides like Mn^{54} and Zn^{65} and would serve as useful indicators for build up of induced Mn^{54} and Zn^{65} radioactivity in the shore waters at Tarapur (Kamath *et al.*, 1966). Similarly P^{32} is accumulated in soft tissues of fishes. I^{131} by fish and phaeophyceae. Fe^{59} is accumulated by plankton, Sr^{90} by brown algae in preference to Ca and Co^{60} and Mn^{54} by marine crustacea. The ability to accumulate radionuclides is related to the position of the particular organism in the intertidal zone as well as in the food chain of the area. For instance *Aplysia benedicti* accumulates Co^{60} from the environment (Patel and Valanju, 1970) 10^4 times than that in the environment mainly through its food which consists of chlorophycean algae which are sub-littoral in habitat.

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