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Observations on the distribution of the *Echinoid Stomopneustes variolaris* (Lamarck) along the Visakhapatnam Coast, India*

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ABSTRACT

The sea urchin *Stomopneustes variolaris* (Lamarck) is a common inhabitant of rocky shores of Visakhapatnam, East Coast of India. It is common at 0.2 m CD and lower in the Infralittoral Fringe with abudance of algae. High densities up to 6.4/0.2 sq.m. were noticed in rock pools, crevices , gullies and other Protected habitat on shores with severe wave action. The density was lowest (4.7/0.2 sq.m.) where the wave action is low to moderate. Significant aggregations were noticed at shores with pronounced to severe wave action as a responce to environmental factors such as wave action , water circulation and availability of protected habitats.

The sea urchin *stomopneutes variolaris* (Lamarck) is a common inhabitant of rocky and coral habitats of the Indo–west Pacific region. It has a wide distribution ranging from east coast of Africa to as far east as south pacific Island (Clark and Rowe, 1971). Bathymetrically, the species is "limited to the littoral region within the tide zone" according to Mortensen (1935). However, Clarck (1925) rerported the species from a depth of 18 m (10 fms) near Wasin Island, British East Africa. Though there have been several works on the distribution of a number of sea urchins occuring elsewhere (see Boolotian, 1966 and Nichols 1962). There has been no such study on any Indian sea urchin or on *Stomopneustes variolaris* from any of the localities throughout its range of wide geographical distribution. Hence, a study of the distribution of the species commonly occuring along the rocky shores of Visakhapatnam was undertaken. The study included different aspects of distribution and the methods wherever applicable are give under each aspect along with observations.

MATERIALS & METHODS

The study was made at six stations along the Visakhapatnam coast representing different rock types and impact of wave action. *Station I Mangamaripeta* : Large rocky platforms with crevices. fissures, and rock pools; severe wave action.

Station II Kailasa Hill : Jetting rocks ranging from 0.2 to 0.5 m in height to huge boulders of 2-4 m above high water mark, rocky platforms with gullies, crevices and rock pools; pronounced wave action.

Station III Waltair Point : Predominantly single beach with scattered boulders completely

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submerged during high tide period; moderate wave action.

Station IV Palm Beach : Jetting rocks and boulders ranging from 0.5 to 3 m above high water mark, with exposed, semi-exposed and protected surfaces and shady over hangs; wave action pronounced.

Station V Yarda : Rocky platforms with gullies rock pools, wave exposed and protected habitats; pronounced wave action.

Station VI Pudimadaka : Huge boulders with protected, semi- exposed and exposed surfaces, gullies and crevices pronounced wave action. Ocassional observation on general distribution and habitats were also made at Kalingapatnam, Bhimunipatnam and Rishikonda.

RESULTS AND DISCUSSION

ZONATION : The vertical zonation and faunal composition at rocky shores of Vishakapatnam were studied by Rao and Rao (1962). As per their studies, there are three principal zones as defined by Stephensen and Stephensen (1949) namely the *Littorina* Zone corresponding to the Supralittoral Fringe (above 1.4 m CD) with the periwinkles, *Littorina undulata* and *L. subgranosa* as the dominant inhabitants; the Balanoid Zone corresponding to the Midittoral Zone (0.4 to 1.4 m CD) with bands of Chthamalus, Cellana and algae like *Ulva, Chaetomorpha* and Enteromorpha. (Oyesters, muriciids and turbon shells also occupy this zone) and the Seaweed Zone corresponding to the infralittoral Fringe (Below 0.4 m CD) dominated by the perennial algae such as *Gracilaria Caulerpa, Spongomorpha, Amphiroa, Sargassum* etc. The fanual component of this zone includes *Gemmaria, Pomatoleios, Thalamoporella* and several other groups constituting the microbenthos.

The sea urchin *Stomponeustes variolaris* is a member of the seaweed Zone in the Infralittoral Fringe. It is abundant at 0.2 m CD and below. The other echinoderms of this of this zone are *Tropimoetra carinata, Asterina lorioli, Ophiactis savignyi, Macrophiothrix* sp. and *Holothuria* sp.

HABITAT : The sea urchin inhabits the protected habitats of the rocky shore such as crevices, rock pools, bores, overhangs and the like. The individuals prefer shady areas with constant water circulation brought about by the waves. They avoid however, direct wave action. They occupy the protected habitats located at 0.2 m CD and below to avoid exposure to desiccation during loe tides. They extend higher only while feeding during high tide up to 0.6 m CD and also in rock pools located higher on the shore.

DENSITY : A study of the density distribution of the sea urchin was made at five stations of the study area, namely Stations, I, II, III, V, and VI. Station IV with high wave action supports in the accessible area, only a small population of sea urchins. The study was carried out during December, 1970 - January, 1971 period. A metallc ricg of 0.2 sq.m. area was used as a quadrate and the number of individuals in each quadrate conted at 2 m intervals along different transects of the accessible area at each station. The average number of sea urchins per 0.2 sq.m. is experssed as density following Ebert (1977).

The density was minimum with 4.7 individuals on average per 0.2 sq.m. at Station 111 subjected to low wave action and maximum with 6.4 individuals per 0.2 sq.m. at Station I exposed to severe wave action. At other stations, the value reanged in between. The maximum number of sea urchins per quadrate was 10 at Station III, while it was 14 at the remaining stations. The results show dense populations at shores with high wave action and dispersed distribution associated with low wave action.

AGGREGATION : To test whether the high densities observed above were due to significant aggregation, the index of dispersion (D) was calculated using the formula : $D = \Sigma (X-\bar{X})^2 / \bar{X} (N-1)^2$ where X number of individuals in each quadrate, N-number of quadrates counted and $\bar{X}$ = mean number of individuals pèr qauadrate. The significance of dispersion was tested by the formlua : $\sqrt{8}N/(N-1)^2$ following Moore *et al* (1963). Significant aggregations were considered to occur when D is greater than $1+\sqrt{8}N/(N-1)^2$ It can be seen from Table-1 that the sea urchin occurs in significant aggregations at all stations other than Station III.

The sea urchin *Stomopneustes variolaris* (Lamarck) is a common inhabitant of rock shores along the Visakhapatnam coast occupying the seaweed zone of Infralittoral Fringe. It is abundant at 0.2 m CD and lower during low tide periods when occurring in bores, they occupy higher levels exposed to direct wave action. when occurring on open platforms, the habitat is gradually sloping or is portected by huge boulders on the side of the on coming waves to minimise exposure to direct wave action.

The sea urchin is a herbivore feeding on a variety of algae such as *Gracilaria, Spongomrpha, Sargassum, Ulva* etc. and occupies the habitats in close proximity to the rich algal growth.

The sea urchin prefers constant circulatuon of water brough about by the wave action but avoids direct wave action. Hence, it occupies areas protected from wave action but within the range of water circulation like crevices, gullies, fissures etc. As a result, high densities are

Table 1 : Density and aggregation of Stomopneustes variolaris at different stations along the Visakhapatnam coast.

	Stn I	Stn II	Stn III	Stn IV	Stn V
No. of quadrates	93	109	74	126	187
No. of sea urchins	600	590	349	650	1033
Density	6.4	5.4	4.7	5.2	5.5
Index of dispersion	1.7345	1.9521	1.1692	2.0478	2.1278
$\sqrt{8}\,N/(N-1)^2$	0.2965	0.2734	0.3333	0.254	0.2079

encountered at shores experiencing wave action and offering portected habitats. At station 1V, the wave action is pronouced but there are no sufficient protected habitats. As a result the area supports a small population in spite of sufficient water circulation and algal growth. The highest density was encountered at Station I exposed to severe wave action as it offers a good variety of protected habitats. At Station III, the sea urchin is evenly distributed as there in no threat from battering waves. The high densities in protected habitats from significant aggregations.

The causes for aggregations may be various ranging from physiological to behavioural. Aggregation of mature adults increase the chances of fertilization. However, *Lytechinus* was found to aggregate outside the breeding period also (Moore *et al*, 1963) and *Evechinus* aggregated independent was believed not to be due to reproductive behaviour. In the present study, even immature specimens about 16-20 per 0.4 sq.m. ranging in diameter from 9 to 22 mm (mean = 16.5) were found at station IV, and on and on another occasion as many as 25 sea urchins ranging in diameter from 13 to 42 mm (mean–23.8 mm) were noticed in a quadrate of 0.2 sq.m. at Station V. Further, the aggregations can be noticed even during the non-breeding seasons of the year. Thus, the aggregations do not seem to be associated with reproductive activity.

Leighto (1966) noticed *Strongylocentortus* aggregatios to result from their feeding activity. The observations on *Stomopneustes* were made during low tide period when there was no feeding activity and the individulas were stationary in theri niches. The observed aggregations connot be attributed to their feeding response. That they are the result of passive transport is also not tenable since they were not washed at shore but firmly attached to the rocks in their natural habitat.

Aggregations brought about by the active locomotion arise from oriented response to environment or from mutual attraction of the individuals. If all the individuals of a species respond similarly to some environmental stimulus, their locomotion brings them all to the same locality resulting in aggregations. Individuals of *Lytechinus* in captivity congregated where the flow of water was strongest and in the field they were abundant in places where there was considerable tidal flow (Moore and Mc, Pherson, 1965).

The shore at Station III consists of shingles with minimum wave action owing to the almost flat nature of the beach. All other stations are characterised by rocks exposed to pronounced wave action. At these places, the sea urchin formed dense aggregations in crevices, fissures, gullies and rock pools protected from wave action and with sufficient water circulation. In such habitats as many as 10 individuals were counted per linear metre. At Station III, because of low were action, the individuals were evenly dispersed. Thus the aggregations of *Stomopneustes* seem to result from the animal's preference to protected habitats in response to environmental factors, particularly the wave action.

Dix (1969) found *Evechius* to aggregate as a result of mutual attraction of the indiduals involving a chemical stimulus. No attempt was made to find out the mutual attraction involving a chemical stimulus in *Stomopneustes*. Pearse and Arch (1969) saw the aggregations to have a protective function in *Diaema setosum*. Individuals of *Stomopneustes* in aggregations occur in so close proximity to one another that at times their spines overlap. The spines are of protective nature by themselves and aggregations no doubt increased their threat by several folds.

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