

Unusual Congregation of Salps Off Veraval & Bombay, West Coast of India

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During September to October swarming of salps occur along the coasts off Veraval and Bombay. These congregations off Veraval are contributed by the single species *Pegea confoederata* recording an unusual biomass as high as 7.3 ml.m^{-3} . Off Bombay the species contributing to the swarms are *Ritteriella ambonensis* and *Salpa maxima* recording relatively low biomass (2.95 ml.m^{-3}). This appears to be a recurring phenomenon coinciding with the peak fishing season, particularly that of pomret fishery. Importance of such congregation on environmental impact assessment studies has been emphasised.

Unusual congregation of plankton along the coastal marine environment has been reported for a variety of zooplankton, of which a few are related to the fishery¹⁻⁴. Any change in the normal pattern of zooplankton distribution in the coastal area is indicative of a special phenomenon which in turn should exert some change in the production potential of the area. This leads to the assumption that the peak fishing season can be characterised by difference in the faunal composition at lower level, particularly that of zooplankton, as many fishes directly feed on them⁵. With this objective a series of zooplankton samples have been collected off Bombay and Veraval for evaluating variations, if any, in the different constituents of zooplankton community during October-November period. It is anticipated that the synchronised occurrence of any zooplankton group in aggregation should be an index to the advent of the fishing season which starts in October along the central and north west coast of India.

Materials and Methods

Off Sutrapada in Veraval (Gujarat, north west coast of India) three transects were worked out (lat. $20^{\circ} 49' \text{N}$ and long. $70^{\circ} 27' \text{E}$) at 5 to 25 m depth. Locations of station off Bombay (Maharashtra, central west coast of India) were in the Harbour area (lat. $18^{\circ} 53' \text{N}$ and long. $72^{\circ} 55' \text{E}$) having a depth range of 15-18 m. Zooplankton samples were collected by oblique hauls using a HT net (mesh size 0.3 mm; mouth area 0.25 m^2) with an attached TSK flow meter. Sampling was done from October to November 1984 off Veraval and September - November 1985 off Bombay. A total of 4-9 samples were collected separately for each month and the average values tabulated. All the relevant environmental parameters (pH, salinity, DO and nutrients) were monitored during the period of investigation.

Results and Discussion

Off Veraval zooplankton volume and population for October showed a fluctuation of 0.27 to 7.35 ml.m^{-3} and 23 to 258 m^{-3} respectively. The percentage contribution of salps varied from 17 to 85 in terms of population while the biomass amounted to 95-99% of total standing stock. This congregation was contributed by the single species identified as *Pegea confoederata*. The collections included free swimming solitary forms as well as aggregate forms, some forming chains. To evaluate their distribution in the vertical realm samples were collected also by vertical hauls and the results indicated their uniform distribution in the entire water column. Their abundance was relatively more towards the shore side. Offshore sampling from a depth of 35-40 m depth was also done to confirm that the entire area was covered by these gelatinous organisms. The salps could be easily detected on the surface of the water. Many of them reached a size of 5-7 cm in length. The minimum size group found was 2-8 mm in length. The other common groups in the collections were copepods, decapods and chaetognaths (Table 1) with limited incidence of groups like fish eggs and larvae, amphipods, siphonophores, medusae, copepods and gastropods. In November, zooplankton distribution in the area became normal with the dominance of copepods (Table 1) and the recorded biomass ranged from 0.05 to 0.29 ml.m^{-3} . Salps during this period were confined to the 25 m depth showing an average biomass of 0.005 ml.m^{-3} . The physico-chemical parameters indicated some variation. Dissolved oxygen and pH registered a low profile just after the swarm while an opposite trend was observed for the nutrients (Table 2). Chlorophyll *a* and phytoplankton counts were more during the period of swarming. *Coscinodiscus*, *Navicula*, *Nitzs-*

Table 1—Percentage Contribution of Different Groups of Zooplankton at the Two Locations

	Copepods	Decapods	Chaetognaths	Salps	Fish eggs & larvae	Appendicularians	Cirripedia	Medusae, <i>Pleurobrachia</i> & <i>Beroe</i>	Miscellaneous
Off Veraval									
1984									
Oct.	32.71	3.43	0.40	61.20	0.14	—	—	—	1.85
Nov.	93.17	3.80	1.92	0.16	—	—	—	—	0.95
Off Bombay									
1985									
Sept.	91.2	2.07	0.26	0.21	1.37	2.01	2.65	0.07	0.14
Oct.	77.47	11.03	2.50	4.48	—	—	0.03	3.77	1.10
Nov.	86.74	6.14	0.88	—	0.15	0.03	0.56	3.08	2.44

Table 2—Hydrographical and Biological Parameters at the Two Locations

	pH	Salinity ($\times 10^{-3}$)	Dissolved oxygen (mg.l^{-1})	PO ₄ -P ($\mu\text{g-at.l}^{-1}$)	NO ₂ -N ($\mu\text{g-at.l}^{-1}$)	NO ₃ -N ($\mu\text{g-at.l}^{-1}$)	Phytoplankton (no. $\times 10^4 \text{l}^{-1}$)	Chlorophyll <i>a</i> (mg.m^{-3})	Zooplankton biomass (ml.m^{-3})	Zooplankton population (no. m^{-3})
Off Veraval										
1984										
Oct.	8.00	34.06	5.88	0.99	0.55	11.13	23.66	1.41	2.84	180
Nov.	7.77	35.0	5.26	1.41	0.95	13.72	1.51	0.09	0.12	252
Off Bombay										
1985										
Sept.	8.25	34.50	7.69	0.7	0.07	0.9	9.52	1.8	0.36	1857
Oct.	7.68	36.35	4.44	2.66	1.23	2.76	2.68	0.8	2.95	663
Nov.	7.80	35.00	6.06	4.05	3.53	16.04	8.36	1.07	0.23	607

chia and *Thalassiothrix* were the most common phytoplankton genera found in the collection.

The pattern of incidence of salps off Bombay was slightly different with lesser population density. In September the salps started appearing and the species present were *Ritteriella ambonensis* (33.3%) and *Salpa maxima* (66.7%). In October *R. ambonensis* became dominant contributing 92.7% of the salp population. Total biomass of salps for October (av. 1.5 ml.m^{-3}) was much higher than that of September (av. 0.15 ml.m^{-3}). In September 5-8 mm size group was very high and the maximum size obtained was 25 mm. In October 20-25 mm size group became very common with moderate contribution of 10-15 mm size group. The smallest individuals were of 2-5 mm in length. Contribution of different groups of zooplankton indicated higher counts of appendicularians, Cirripedia, Medusae and *Pleurobrachia* compared to the collections made off Veraval. By November the population of salps almost disappeared with strew representation of the group. Dissolved oxygen and pH values were relatively low during the peak swarm period. Nutrient values indicated sharp increase from September to November. Phytoplankton counts and chlorophyll *a*

were maximum at the beginning of the swarm. The most common genera of phytoplankton were *Goni-aulux*, *Thalassiosira*, *Coscinodiscus* and *Thalassiothrix*.

The swarm of salps made their appearance along the nearshore coastal waters in September, reached their peak in October and started dwindling by November. This appears to be a recurring phenomenon and has been confirmed off Veraval by making a few spot collections in September 1985. Being gelatinous organisms, their contribution in terms of organic carbon, to the secondary productivity will be quite low. However, their unusual aggregation indicates the possibility of movement of shoaling fishes in pursuit of prey. Pomfrets, an economically important group, contribute about 10% of the total landings of fish in Maharashtra and Gujarat⁶ and they also feed on zooplankton. The peak fishery of pomfret in the area is in October. Observations on the food of the brown pomfret, *Parastromateus niger* show that salps (42.8%), crustaceans (5.1%), amphipods (3.7%), polychaetes (0.4%) and medusae (0.2%) contribute a significant part of the gut content⁷. It appears that the swarm of salps provide a congenial feeding ground for the pomfrets.

A large swarm of pelagic tunicates associated with a mixed bloom of diatoms and green algae has been reported off Nagapattinam⁸. The highest biomass recorded for the above study (4.8 ml.m^{-3}) is much lower than the present maximum value (7.35 ml.m^{-3}). Even though the highest biomass observed off Bombay is only 2.95 ml.m^{-3} , it is higher than the highest recorded from Bay of Bengal (2.5 ml.m^{-3}) associated with a pteropod bloom⁹ or the highest biomass obtained from Indian Ocean (2.8 ml.m^{-3}) off Kachchh mainly contributed by a swarm of ostracods¹⁰.

When such an abundance of gelatinous organisms prove to be an index on the fishery, some times this may even turn out to be adverse for other purposes. For example, whenever an industrial establishment along the coast requires water for the plant, naturally it is drawn from the marine environment. Such accumulations of gelatinous organisms are bound to create problems as they clog the mouth of the water intake points. Hence, such recurring phenomenon is also significant in the prediction of the quality of water used for industrial purposes.

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