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Developmental stages of chaetognaths in the coastal environs of Bombay

Neelam Ramaiah & Vijayalakshmi R Nair*
National Institute of Oceanography, Dona Paula, Goa 403 004, India
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Abundances of developmental stages -- juveniles, developing and mature – of *Sagitta bedoti, S. oceania, S. enflata* and *S. robusta* were recorded from the coastal, estuarine and creek environs of Bombay from October 1985 to September 1986. It was seen from this study that all these species breed continuously in these environs, though periods of heavy spawning varies with each.

Little is known about the developmental biology of chaetognaths from the Indian waters although several studies have emphasized their importance in the food chain in general, and as indicators of water masses in particular. Information available from different parts of the world suggests that the breeding cycles of *Sagitta* spp. appear to vary from place to place[1-3]. From the tropical oceans these species have been reported to breed continuously[4-6]. Studies available on the chaetognaths from the coastal waters of Bombay[7-9] have dealt with only the population density, seasonal variations and species composition of this group. None of these studies has considered their developmental biology. Recent studies have shown that the interior environs of the Bombay harbour-Thana creek-Bassein system receive substantial quantities of industrial effluents (180 mld) and urban wastes (350 mld) which are expected to hamper the growth and development of aquatic organisms. Since there is a total lacuna of information on the developmental biology, an attempt was made to document different stages of development of *Sagitta bedoti, S. oceania, S. enflata* and *S. robusta*.

Materials and Methods

Zooplankton samples were collected from October 1985 to September 1986 by towing the Heron Tranter net obliquely for 6 min from 8 stations (Fig.1) located along the 87 km stretch of the Bombay harbour-Thana creek- Bassein system and representing the coastal (sts 1,8), estuarine (sts 2, 3 and 7) and creek or interior locations (sts 4-6). Details of the area of study, sampling, hydrography, seasonal variations, population density and species composition of chaetognaths have been reported[10] separately. Different species of chaetognaths were separated into 3 maturity stages namely juveniles (ovary not yet seen), developing (ovary seen with undeveloped eggs) and mature (fully developed ovary with mature ova). For ascertaining the seasonal variations, the data from different months were clubbed into 3 distinct seasons viz. premonsoon (Feb.-May), monsoon (June-Sept.) and postmonsoon (Oct.-Jan.).

Results and Discussion

Spawning periodicity of chaetognaths can be evaluated either by considering the population density

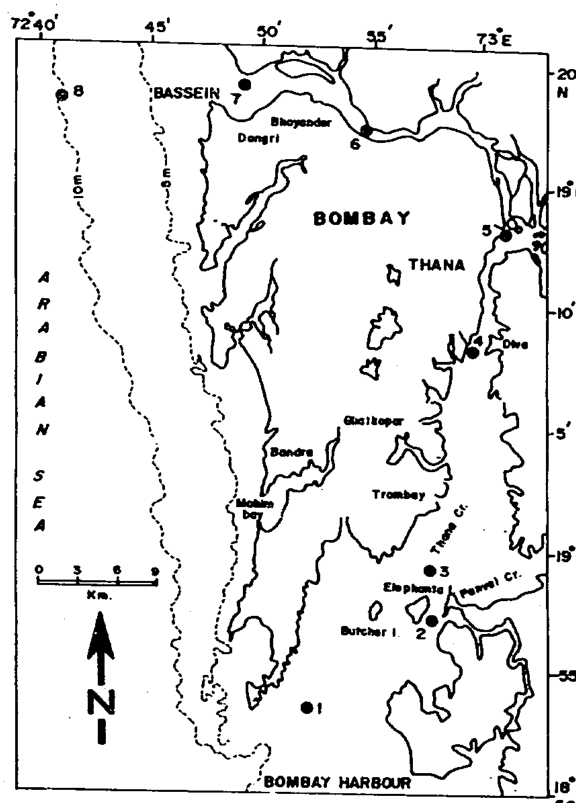

Fig. 1—Locations of stations

* Regional Centre of NIO, Versova, Bombay 400 061, India

of individuals bearing mature ova or by the total counts of juveniles. Normally, mature individuals occupy lower strata during day time and even an oblique haul from a shallow region may not effectively sample the population. Hence, the collective representation of juveniles (in terms of percentage) is considered as an index to evaluate the period of intense breeding[6]. Mean percentages of juveniles for a particular location covering the entire period of study is taken as the level at and above which abundance indicates a period of heavy spawning.

Contribution of the different stages of maturity to the population of *S. bedoti* for the entire period of study is depicted in Fig.2. At st 1, periods of heavy spawning were during December, February to June and August. Although such peaks were discernible at all other stations, a definite seasonal pattern in the occurrence of other maturity stages of *S. bedoti* was not observed. These observations might imply a continuous breeding.

Evaluation of the spawning periodicity of *S. oceania* and *S. enflata* was difficult due to the discontinuous occurrence of these species. *S. oceania* was well represented at sts 1-4 and less common at other stations (Fig.3). Percentage contribution of juveniles was maximum at sts 1, 6, 7 and 8, moderate at sts 2 and 3 and least at sts 4 and 5. Mature stages of *S. oceania* were restricted to sts 2 to 4, with a higher contribution of developing stages at the latter station. Only juveniles were observed at sts 1 and 8 during the premonsoon and monsoon. At some stations there were higher numbers of developing stages during postmonsoon possibly due to intense breeding.

S. enflata being an oceanic species showed relatively higher frequency of occurrence at sts 1, 2, 3 and 8 (Fig.4). At sts 1 and 8, juveniles were more abundant. At sts 2 and 3, developing and mature stages formed the bulk of its population (Fig.4). This species was not found in the collections made at st 4 during the entire period of study. At st 5 (2 animals·100 m^{-3} consisting only of juveniles) and st 6 (20 animals·100 m^{-3}, comprising of the juveniles, developing and mature specimens), this species was observed only once during December. At st 7, only juveniles were recorded during December and January.

S. robusta showed a very low frequency of occurrence with low population density. Whenever this species was observed, the major portion of the population was constituted by juveniles (Table 1). Maximum abundance of this species (6294 individuals 100 m^{-3})

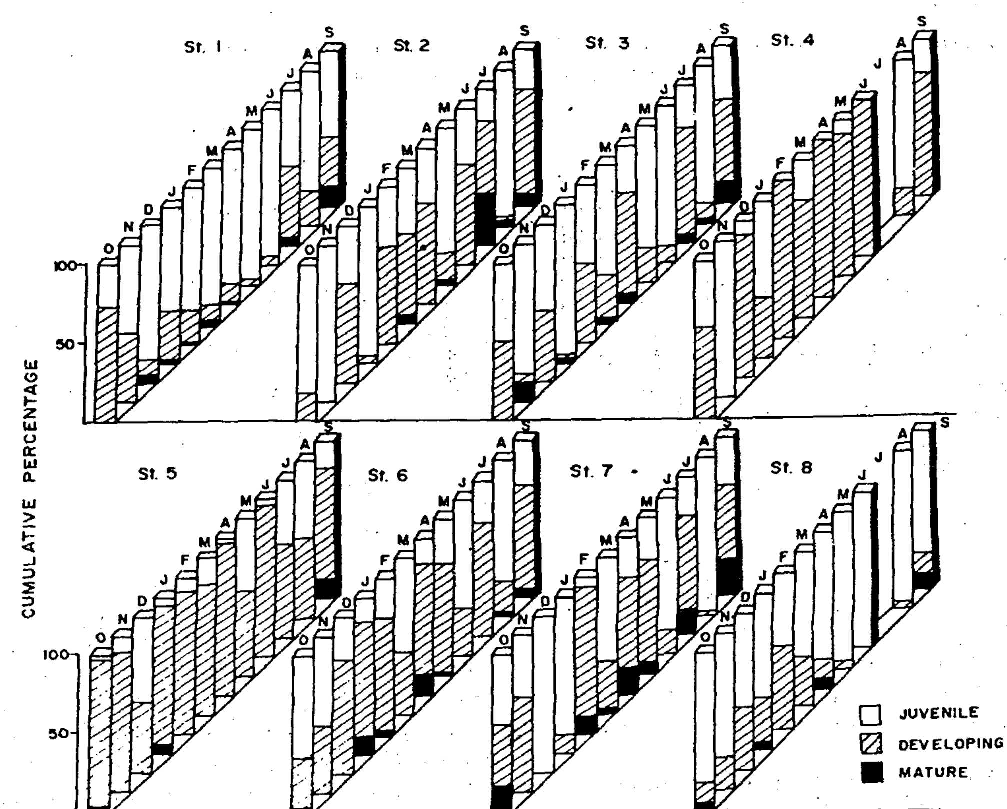

Fig. 2—Percentage contribution of the different maturity stages of *Sagitta bedoti* [premonsoon (Feb.-May); monsoon (June-Sept.); postmonsoon (Oct.-Jan.)]

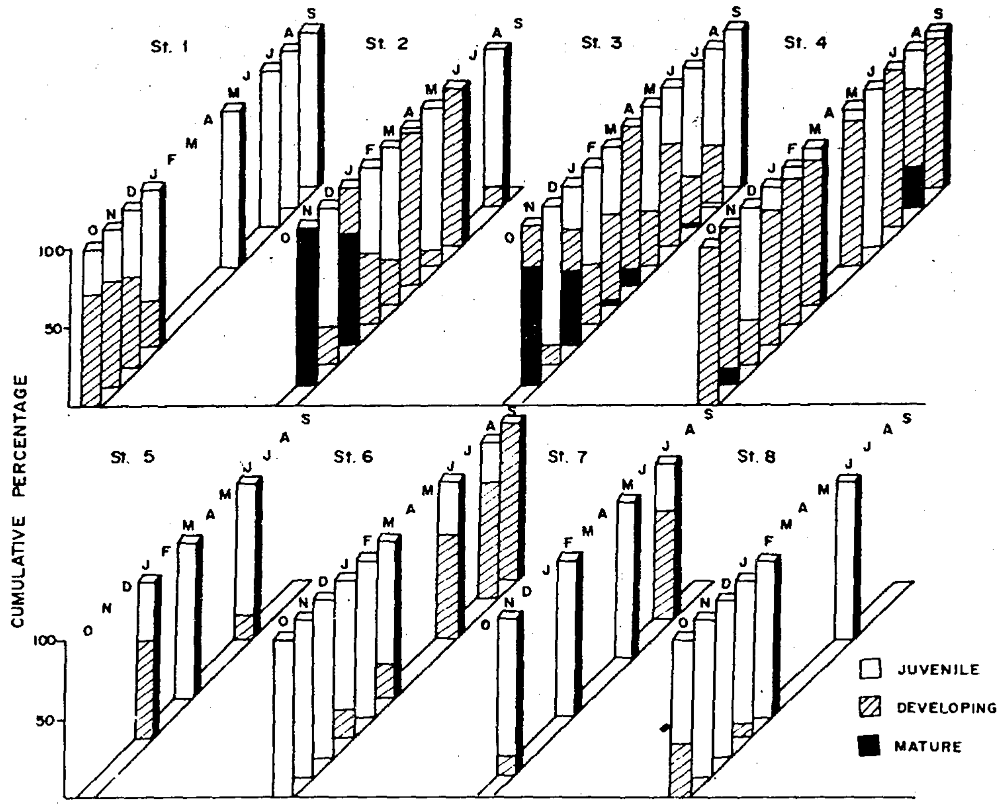

Fig. 3—Percentage contribution of different maturity stages of *S. oceania* at different stations [premonsoon (Feb.-May); monsoon (June-Sept.); postmonsoon (Oct.-Jan.)]

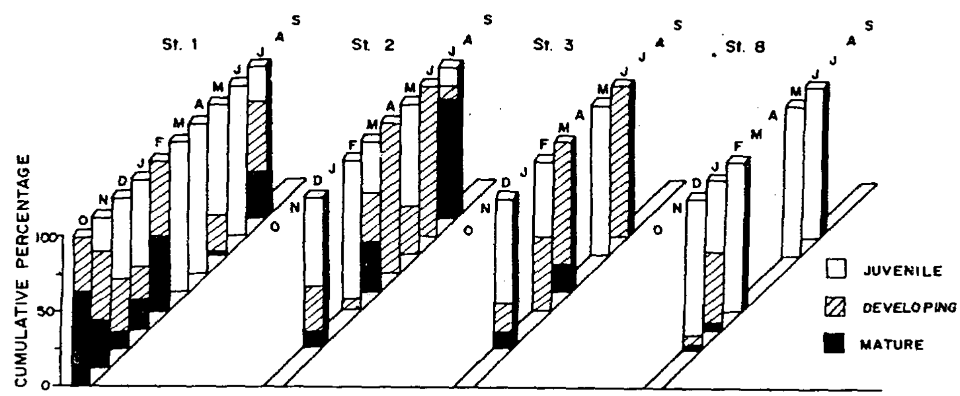

Fig. 4—Occurrence of the maturity stages of *S. enflata* at different stations [premonsoon (Feb.-May); monsoon (June-Sept.); postmonsoon (Oct.-Jan.)]

was recorded at st 4, being contributed only by the developing stages. This species was not recorded at st 5. Mature specimens were very sparse in the collections and were recorded only once at st 3 (4 specimens·100 m^{-3}) during March.

Studies of Nair[6] on the breeding and growth of chaetognaths in the Cochin backwaters, have demonstrated that the occurrence of juveniles in most of the collections is suggestive of continuous breeding. It is evident from the present observations that, like in many tropical regions, the breeding of chaetognaths is continuous in the environs of Bombay. This is particularly true for *S. bedoti*, which is found to have adapted itself to the existing conditions. It was found to be distributed throughout this system. Higher percentage contribution of juveniles and developing stages of most chaetognath species is suggestive of the fact that they prefer estuarine environs for their

Table 1—Annual variations in the percentage contribution of different maturity stages of *S. robusta* at different stations

St. no.		1985		1986			
		Oct.	Dec.	Jan.	Feb.	March	July
1	J	—	—	26.1	100	—	100
	D	—	—	73.9	—	—	—
2	J	—	—	—	—	100	—
3	J	—	—	—	—	50.2	—
	D	—	—	—	—	48.2	100
	M	—	—	—	—	1.6	—
4	J	—	100	—	—	—	—
	D	100	—	—	100	—	—
6	J	—	—	50.0	50.0	70.8	—
	D	—	—	50.0	50.0	29.2	—
7	J	—	—	87.3	—	—	—
	D	—	—	12.7	—	—	—
8	J	—	—	31.3	100	51.81	—
	D	—	—	68.7	—	48.2	—

J- Juveniles, D- Developing, and M- Mature

(Note: This species was absent at all the stations during Nov. 1985; April-June and Aug.-Sept. 1986)

development. It appears that the anthropogenic activities might be hampering the distribution pattern and developmental biology of less tolerant species of chaetognaths. This observation therefore emphasises the importance of environmental regulations that help in permitting the normal growth and development of many plankton species. These measures are important in the maintenance of healthy and productive fishery around Bombay.

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