

## CHAETOGNATHA FROM THE ESTUARIES OF INDIA — A REVIEW

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### ABSTRACT

Chaetognaths from various estuaries and backwaters such as Cochin Backwater, Mandovi-Zuari Estuary along the west coast of India and from Ennore Estuary, Madras, Kakinada Estuary, Godavari Estuary, Hooghly-Matlah Estuary along the east coast of India and the fluctuations of salinity in these estuaries are reported. Seasonal fluctuations of chaetognaths in the estuaries and the role played by the environmental factors in controlling the distribution of species are discussed.

### INTRODUCTION

ESTUARIES play a vital role in the life of human beings and other living organisms, as they form the nearest available biological habitat. They occupy an area connecting the sea and land and most of the harbours and cities are situated on estuaries. Studies on estuarine habitat have become increasingly important and now-a-days great attention is given towards the same in view of the fact that they play a vital role as nursing grounds in the life cycle of many marine organisms.

Though there are many estuaries along the Indian Coasts, chaetognaths have been well studied only from a few estuaries such as Cochin Backwater (Nair, 1972, 1973, 1975; Srinivasan, 1972) and Mandovi-Zuari Estuary (Nair and Selvakumar, 1979) along the west coast and Ennore Estuary (Srinivasan, 1972, 1977, 1980; Srinivasan and Raghunathan, 1978; Raghunathan and Srinivasan, 1983), Kakinada Estuary (Rao, 1960) and Godavary Estuary (Chandramohan, 1963) along the east coast of India. While chaetognaths inhabiting the marine waters received a good deal of attention, but

it is only little known about this group from the estuarine waters. Partly this may be due to the fact that among the known 115 species from the World Oceans, only nine species are at present reported from the estuarine waters of India. Even among these nine species only two species viz. *Sagitta bedoti* Beraneck and *S. enflata* Grassi are commonly seen in estuaries. Chaetognaths known from various Indian estuaries and their seasonal fluctuation along with environmental parameters are reported here.

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### CHAETOGNATHA FROM INDIAN ESTUARIES

Hooghly-Matlah Estuary covers the major portion of the Ganga-Brahmaputra Delta and exhibits a great tidal fluctuations. In this estuary the temperature ranged between 17.7° C and 33.68° C and the salinity from "Traces" to

33.75‰ (Gopalakrishnan, 1972). Dutta *et al.* (1954) and Gopalakrishnan (1972) reported *Sagitta* spp. from this estuary during March, April and May, when the salinity was high.

Sewell and Anandale (1922) have not mentioned about chaetognaths in their exhaustive work on the hydrology and invertebrate fauna of Rambha Bay, Chilka Lake. However, Devasundaram and Roy (1954) reported *Sagitta* from Chilka Lake, where the salinity fluctuated from 5.6 to 24.71‰. But details are lacking about the species involved and on their seasonal fluctuation.

Rao (1960) studied the estuarine chaetognaths from the waters around Kakinada and reported the discontinuous distribution of *S. enflata* and *S. bedoti*. Chaetognaths from Godavari Estuary were reported by Chandramohan (1963).

Kaliyamurthy (1975) studied the plankton of Pulicat Lake, which is a large brackishwater lagoon on the east coast of India, where the salinity ranged from 0.5 to 51.5‰ and temperature from 25.0 to 32.8°C. It is connected to the Bay of Bengal through a narrow mouth of about 200 m wide, which remains closed during the pre-monsoon period (June, July) due to dry season. Kaliyamurthy stated *Sagitta* spp. were common in the lake throughout the year.

Rajendran and Sampath (1975) reported *Sagitta* from the Kovelong Backwater, where the salinity ranged from 7.25 to 41.5‰. Kovelong Backwater gets water supply from the irrigation tanks of Chingleput and Saidaput Taluks and during the rainy seasons it gets water from Palar River and Marakkanam salt swamps through the south Buckingham Canal. The barmouth is normally open for six to eight months in an year.

Santanam *et al.* (1975) recorded *Sagitta enflata* from Vellar Estuary (during September, October 1973) where salinity ranged from 5.2 to 34.8‰. Further, Sundararaj and Kaliyamurthy (1975) reported the occurrence of *Sagitta* spp. in abundance from April to July 1971 in the backwater of Killai and adjoining waters of Pitchavaram mangrove forests.

Evangeline (1975) studied the hydrobiology of estuaries and backwaters of Ramanathapuram District, Tamil Nadu (Pambar Estuary, Kottaikarai Estuary, Vaigai Estuary, Pamban-Chinnapalam Backwater, Kothakudi Estuary, Paliar Estuary and Malattar Estuary) and pointed out the presence of chaetognaths in these estuaries, where the salinity ranged between 8.6 and 36.8‰.

Pillai *et al.* (1975) pointed out the occurrence of chaetognaths from Vembanad Lake, which runs parallel to the Arabian Sea from Alleppey in the south to Azhicode in the north of Kerala. It gets water from the rivers like Muvattupuzha, Manimala, Meenachil, Pamba, Achancoil and Periyar. The salinity varied from 0.9 to 28.7‰.

Nair and Selvakumar (1979) reported the availability of six species of Chaetognatha (*S. bedoti*, *S. enflata*, *S. ferox*, *S. pulchra*, *S. robusta* and *P. draco*) from Mandovi-Zuari Estuary, where the salinity ranged from 0.12 to 36.6‰. They consider only *S. bedoti* as a true estuarine inhabitant and others occur in the estuary due to the influx of sea waters into the system.

Lele and Gae (1936) described three species of *Sagitta* (*S. bedoti*, *S. bombayensis*, *S. enflata* (reported as *S. gardineri*) from Bombay waters, which can be regarded as a shallow water estuary, where the salinity varied from 2.14 to 38.12‰. Silas and Srinivasan (1968) reported *S. bedoti*, *S. bombayensis*, *S. enflata*, *S. regularis*, *S. robusta* and *K. pacifica* from the same Bombay Harbour waters.

Ramamurthy and Dhawan (1963) recorded *S. bedoti* and *S. enflata* at Kandla in the Gulf of Kutch, where the salinity ranged from 15.56 to 40.57‰.

Chaetognaths from the Cochin Backwater were studied by Nair (1972, 1973, 1975) and Srinivasan (1972). Cochin Backwater is a typical tropical estuary connected to the Arabian Sea by a narrow gut and it gets water from the rivers such as Periyar, Pamba and Muvattupuzha. Temperature varied from 27° to 32°C and the salinity from 0.3 to 33.6‰. Only *Sagitta bedoti*, *S. enflata*, *S. oecania*, *S. robusta*, *S. pulchra* and *Krohnitta pacifica* are known from Cochin Backwater. They were found throughout the year, except during the southwest monsoon period (June to August) due to the freshwater influx in the backwater and low salinity conditions (1.4 to 0.3‰).

An interesting observation noted during the study of chaetognaths from the Cochin Backwater, was the retarded growth in the total length of the specimens of *S. enflata*, *S. bedoti* and *S. pulchra* (Srinivasan, 1972). Specimens of *S. enflata* from the backwater measured from 3.5 to 11.2 mm, whereas the specimens from the adjoining coastal waters varied from 5.0 to 20.0 mm.

Nair (1973) studied the breeding and growth of *S. bedoti* and *S. enflata* in Cochin Backwater and stated that the breeding is continuous in this tropical estuary.

Evangeline and Subbiah (1969) while studying the plankton from the Ennore Estuary, pointed out the presence of *Sagitta* spp., but the species composition and their fluctuation were not given. Srinivasan (1977) studied the chaetognaths from the Ennore Estuary and reported *S. bedoti*, *S. enflata*, *S. pulchra* and

*K. pacifica*. Further Srinivasan (1980) studied the life cycle of *S. bedoti* and *S. enflata* and pointed out both are continuous breeders with two or three intensive broods.

#### DISCUSSION

A perusal of literature on the estuarine fauna shows that among 115 known species of chaetognaths from the World Oceans, only nine species viz. *S. bedoti*, *S. bombayensis*, *S. ferox*, *S. oecania*, *S. pulchra*, *S. regularis*, *S. robusta*, *K. pacifica* and *P. draco* are known from the Indian estuaries. However, among the nine species, only *S. bedoti* and *S. enflata* are commonly found in the estuarine waters, whereas the other seven species are occasionally seen in the estuaries and this may be due to the influx of coastal waters into the estuary.

Life-cycle studies on certain chaetognaths in Cochin Backwater and Ennore Estuary (Nair, 1973; Srinivasan, 1980) revealed the absence of fully matured specimens (Stage - IV) of *S. bedoti* and *S. enflata* in the estuarine waters, whereas the specimens of all the other stages of maturity (Stages I - III) were found. The absence of fully matured specimens in both the Cochin and Ennore Estuaries suggests the possibility of migration of these adults towards the deeper layers of the estuaries as pointed out by David (1955).

In tropical estuaries like Cochin Backwater and Ennore Estuary, among the hydrographic factors that generally control the inhabitants, salinity is considered as a primary factor, because the fluctuation of salinity is very wide, whereas the temperature range does not exceed 4° to 5° C at the surface waters. The fluctuation of dissolved oxygen at the surface waters of Cochin Backwater and Ennore Estuary (Silas and Pillai, 1975; Raghunathan and Srinivasan, 1983) is from little to moderate (Cochin

Backwater 3.5 to 6.2 ml/L; Ennore Estuary 1.7 to 7.5 ml/L). There is little fluctuation in the pH at the surface water of Ennore Estuary (7.30 to 7.60).

An interesting observation noted during these studies is the retarded growth in the total length of the specimens of *S. bedoti* and *S. enflata* from the Cochin backwaters and Ennore estuary. Kinne (1964) stated that the marine organisms are known to exhibit a reduction in final size in the areas of their distribution, where the salinity is significantly reduced. This is found to be true in the case of *S. enflata* and *S. bedoti* from the estuarine waters. They

were smaller in size than the specimens from the true marine habitat. The reduced salinity conditions of the estuaries have affected the growth of the total length and not the other morphometric or meristic characters. Thus, chaetognaths of the estuarine habitat adopt themselves for a wide fluctuating salinity conditions (0.3 to 33‰) by the retarded growth of the total length, but at the same time carrying out all the other activities like feeding, breeding and surviving in this interesting habitat, which is subjected to the entry of sea water on one side and influx of fresh water on the other side.

## REFERENCES

- CHANDRAMOHAN, P. 1963. *Studies on zooplankton of Godavari Estuary*. Ph.D. Thesis, Andhra University.
- DAVID, P. M. 1955. The distribution of *Sagitta gazellae*. *Discovery Rep.*, 27 : 235-278.
- DEVASUNDARAM, M. P. AND P. C. ROY 1954. A preliminary report of the plankton of the Chilka Lake for the years 1950-1952. *I.P.F.C. Symposium, Plankton*, pp. 48-54.
- DUTTA, N., J. C. MALHOTRA AND B. B. BOSE 1954. Hydrology and seasonal fluctuation of the plankton in the Hooghly Estuary. *Ibid.*, pp. 35-47.
- EVANGELINE, G. 1975. Hydrobiology of the estuaries and backwaters of Ramanathapuram District, Tamil Nadu. In: R. Natarajan (Ed.) *Recent Researches in estuarine biology*. Hindustan Publishing Corporation, Delhi, pp 193-211.
- AND SUBBIAH 1969. Hydrology and fishery of the Ennore Estuary from June 1965 to May 1967. *Madras J. Fish.*, 5 : 139-151.
- GOPALAKRISHNAN, V. 1972. The biology of Hooghly-Matlah estuarine system (West Bengal, India) with special reference to its fisheries. *J. mar. biol. Ass. India*, 13 : 182-194.
- KALIYAMURTHY, M. 1975. Observations on the plankton ecology of Publicat Lake. *Indian J. Fish.*, 22 : 86-95.
- KINNE, O. 1964. The effect of temperature and salinity on marine and brackishwater animals. II. Salinity and Temperature conditions. *Oceanogr. Mar. Biol. Ann. Rev.*, 2 : 281-339.
- LELE, S. H. AND B. B. GAE 1936. Common *Sagittae* of Bombay Harbour. *J. Univ. Bombay*, 4 : 105-113.
- NAIR, R. VIJAYALAKSHMI 1972. Seasonal fluctuations of chaetognaths in the Cochin Backwater. *J. mar. biol. Ass. India*, 13 : 226-233.
- 1973. Breeding and Growth of chaetognaths in Cochin Backwaters. *I.O.B.C. Handbook*, 5 : 87-96.
- 1974. Distribution of chaetognaths along the salinity gradient in the Cochin Backwaters, an estuary connected to the Arabian Sea. *J. mar. biol. Ass. India*, 16 : 721-730.
- 1975. Chaetognaths from three different environments. *Mahasagar*, 8 : 81-86.
- AND R. A. SELVAKUMAR 1979. The ecology of chaetognaths in the estuarine system of Goa. *Ibid.*, 12 : 17-24.
- PILLAI, V. K. K. J. JOSEPH AND A. K. KESAVAN NAIR 1975. The plankton production in the Vembanad Lake and adjacent waters in relation to environmental parameters. *Bull. Dept. Mar. Sci., Univ. Cochin*, 7 (4) : 137-150.
- RAGHUNATHAN, M. B. AND M. SRINIVASAN 1983. Zooplankton dynamics and hydrographic features of Ennore Estuary, Madras. *Rec. Zool. Surv. India, Occ. Paper*, 40 : 1-40.
- RAJENDRAN, ISSAC AND V. SAMPATH 1975. The prospects of prawn culture in Kovelong Backwater in Tamil Nadu Coast. *Bull. Dept. Mar. Sci. Univ. Cochin*, 7 (4) : 487-501.

- RAMAMURTHY, S. AND DHAWN 1963, On the characteristics of plankton at Kandla in the Gulf of Kutch during August 1958 to July 1960. *Indian J. Fish.*, 9 : 94-101.
- RAO, T. S. S. 1960. Studies on Chaetognatha of the Indian Seas. IV. Distribution of chaetognaths off the Kakinada Coast. *Proc. All India Congress on Zoology*, 2 : 370-375.
- SANTHANAM, R., K. KRISHNAMURTHY AND R. C. SUBBARAJU 1975. Zooplankton of Porto Novo, South India. *Bull. Dept. Mar. Sci., Univ. Cochin*, 7 (4) : 899-911.
- SEWELL R. B. AND N. ANANDALE 1922. Fauna of Chilka Lake. *Mem. Indian Mus.*, 5 : 679-780.
- SILAS, E. G. AND P. P. PILLAI 1975. Dynamics of zooplankton in a tropical estuary with a review of the environment. *Bull. Dept. Mar. Sci., Univ. Cochin*, 7 (4) : 329-356.
- AND M. SRINIVASAN 1968. On the little known Chaetognatha *Sagitta bombayensis* Lele and Gae (1936) from Bombay waters. *J. mar. biol. Ass. India*, 9 : 84-95.
- SRINIVASAN, M. 1972. Biology of chaetognaths of the estuarine waters of India. *Ibid.*, 13 : 173-181.
- 1977. Chaetognaths of the Ennore Estuary, Madras. *Ibid.*, 16 : 836-838.
- 1980. Life cycle and seasonal fluctuation of chaetognaths in Ennore Estuary, Madras. *Bull. Zool. Surv. India*, 3 : 55-61.
- AND M. B. RAGHUNATHAN 1978. Seasonal periodicity of zooplankton in Ennore Estuary, Madras during 1975 and 1976. *Ibid.*, 1 : 161-166.
- SUNDRARAJ, V. AND K. KRISHNAMURTHY 1975. Nutrients and Plankton : Backwaters and Mangrove environment. In : R. Natarajan [Ed.] *Recent Researches in Estuarine Biology*. Hindustan Publishing Corporation, Delhi, pp. 273-290.