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SPECIES ASSOCIATION IN CHAETOGNATHA FROM THE ARABIAN SEA

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ABSTRACT

The percentage of co-occurrence of *Sagitta enflata*, the dominant species in the samples collected from the continental shelf and outside the shelf area of the Arabian Sea, with the remaining species of the genera *Sagitta*, *Pterosagitta* and *Krohnitta* is studied and discussed.

INTRODUCTION

THE TAXONOMY, distribution and seasonal abundance of chaetognaths from the Arabian Sea are well known (Lele and Gae, 1936 ; George 1952 ; Nair, 1972 ; Nair and Rao, 1973 ; Silas and Srinivasan, 1968, 1969, 1970 ; Srinivasan, 1972, 1976, 1979, 1987), but very little is known about the species association and percentage of co-occurrence of one species of Chaetognatha with other. So the percentage of co-occurrence of *Sagitta enflata*, the most abundant species in the samples examined, with the remaining species of the genera *Sagitta*, *Pterosagitta* and *Krohnitta* is studied and presented in this account.

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MATERIAL AND METHODS

This study is based on 167,005 specimens of chaetognaths from 258 zooplankton samples collected during 12 cruises of the Indo-Norweigian Project Research Vessel VARUNA. Among these 12 cruises, seven (V 104, 106, 110, 113, 116, 120 and 122), were conducted within the continental shelf area and the remaining five cruises (V 103, 105, 109, 112 and 117) were conducted outside the shelf area. During each cruise, the plankton samples and hydrographic data were collected from 30 hydrographic stations fixed within the shelf area and from 20 stations, fixed outside the shelf area. However, due to inclement weather and loss of plankton nets, samples could not be collected from 20 of the 30 stations, in the shelf area and from 8 of the 20 stations in the oceanic area during June, 1967 (Fig. 1).

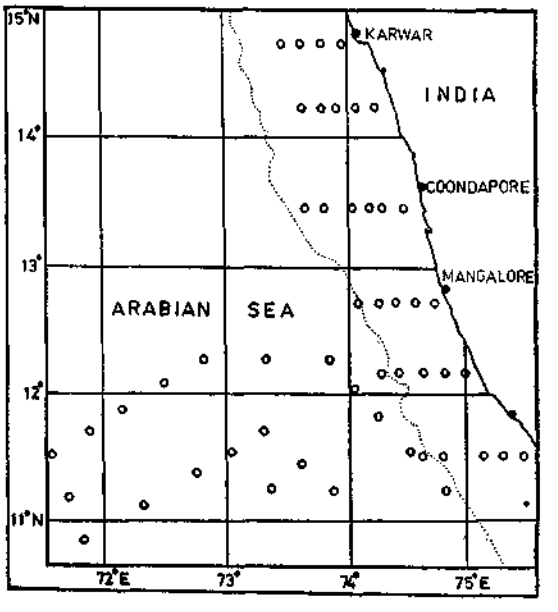

FIG. 1. Zooplankton sampling stations inside and outside the continental shelf area of the Arabian Sea.

The zooplankton samples were collected with the IOS net, between December 1966 and December 1967. In the oceanic area, vertical open tows were operated from 200 metres depth to the surface. In the shelf area; where the depth is generally less than 200 metres, the net was operated from five metres above the bottom to the surface. The samples were preserved in 5% neutralised formalin and the chaetognaths from the entire samples were sorted out and studied.

Results and Discussion

Species association

Altogether, 14 species of Chaetognatha, belonging to the genera *Sagitta* Quoy and Gaimard, *Pterosagitta* Costa and *Krohnitta* Ritter-Zahony are present in the samples studied (Table 1).

From this study, it is obvious that certain species like *S. enflata*, *S. bedoti*, *S. ferox* and *K. subtilis* are more abundant in the shelf area than in the oceanic area, whereas species like *S. pacifica*, *S. neglecta*, *S. robusta*, *S. hexaptera*, *P. draco* and *K. pacifica* are more abundant in the oceanic area. *S. Lyra* is seen only in the oceanic samples and *S. decipiens* occasionally invades the shelf area, during certain seasons, along with the upwelled waters (Srinivasan, 1976).

Among the 258 samples analysed, *S. enflata* is seen in all the samples collected and the association of this species with other species of the genera *Sagitta*, *Pterosagitta* and *Krohnitta* is studied by applying Green's (1971) formula:

$$Pc = \frac{c}{a+b+c} \times 100$$

Where Pc = Percentage of co-occurrence,

c = the number of samples containing both the species 'a' and 'b';

a = the number of samples containing the species 'a'

b = the number of samples containing the species 'b'.

For this study, mainly the epi-planktonic species are considered, because *S. enflata* is

Table 1. *Species of Chaetognatha in the order fo abundance*

Species	Number	%	%	
			Shelf	Oceanic
S. enflata Grassi, 1883	74,420	44.5	56	44
S. bedoti Beraneck, 1895	28,208	17.0	65	35
S. decipiens Fowler, 1905	14,784	9.0	16	84
S. pacifica Tokioka 1940	14,758	9.0	30	70
P. draco (Krohn, 1853)	12,468	7.5	36	64
S. neglecta Aida, 1897	6,951	4.0	31	69
S. regularis Aida, 1897	4,122	2.4	22	78
S. ferox Doncaster, 1902	3,583	2.1	82	18
K. pacifica (Aida, 1897)	2,763	1.6	23	77
S. robusta Doncaster, 1902	2,537	1.5	7	93
S. pulchra Doncaster, 1902	1,181	0.7	49	51
S. hexaptera d'Orbigny, 1851	561	0.3	13	87
K. subtilis (Grassi, 1881)	500	0.3	65	35
S. lyra Krohn, 1853	169	0.1	0	100
Total number	1,67,005	100.0		

an epi-planktonic form. Among the meso-planktonic species, *S. lyra* and *S. decipiens*, the co-occurrence of *S. decipiens* with *S. enflata* is studied, because *S. decipiens* is found in several samples (107), whereas the co-occurrence of *S. lyra* with *S. enflata* is not studied, as *S. lyra* is found only in 22 of the 258 samples.

This study has revealed that the percentage of co-occurrence is very high between *S. enflata* and *S. bedoti* (96%), whereas the same is very low between *S. enflata* and *S. hexaptera* (28%) and *S. enflata* and *K. subtilis* (19%). The percentage of co-occurrence of *S. enflata* with other species of the genera *Sagitta*, *Pterosagitta* and *Krohnitta* is given in Table 2.

TABLE 2. *Percentage of co-occurrence of* S. enflata *with other species*

	Species		c=number of samples containing species 'a' and 'b'	a=No. of samples containing species 'a' *S. enflata*	b=No. of samples containing species 'b'	Percentage of co-occurrence
a	*S. enflata*	..	248	258	248	96.0
b	*S. bedoti*					
a	*S. enflata*	..	185	258	185	71.7
b	*S. pacifica*					
a	*S. enflata*	..	154	258	154	59.7
b	*S. ferox*					
a	*S. enflata*	..	154	258	154	59.7
b	*P. draco*					
a	*S. enflata*	..	153	258	153	59.3
b	*S. neglecta*					
a	*S. enflata*	..	145	258	145	56.0
b	*S. regularis*					
a	*S. enflata*	..	136	258	136	52.6
b	*K. pacifica*					
a	*S. enflata*	..	124	258	124	48.0
b	*S. pulchra*					
a	*S. enflata*	..	114	258	114	44.0
b	*S. robusta*					
a	*S. enflata*	..	107	258	107	41.5
b	*S. decipiens*					
a	*S. enflata*	..	72	258	72	28.0
b	*S. hexaptera*					
a	*S. enflata*	..	50	258	50	19.0
b	*K. subtilis*					

This study shows that species like *S. bedoti* and *S. pacifica*, can successfully co-exist with

S. enflata in a same habitat, whereas the species like *S. hexaptera* and *K. subtilis*, may not prefer to co-exist with *S. enflata*, in a habitat in which *S. enflata* thrives well.

References

GEORGE, P. C. 1952. A systematic account of Chaetognatha of the Indian coastal waters, with observations on their seasonal fluctuations along the Malabar Coast. *Proc. Nat. Inst. Sci. India*, **18** (6) : 657-689.

GREEN, J. 1971. Association of Cladocera in the zooplankton of the lake sources of the White Nile. *J. Zool. London*, **165** : 373-414.

LELE, S. H. AND P. B. GAE 1936. Common *Sagittae* of the Bombay Harbour *J. Univ. Bombay*, **4** (5) : 105-113.

NAIR, V. R. 1972. Variability in distribution of Chaetognatha in the Arabian Sea. *Indian J. Mar. Sci.*, **1** : 84-88.

——— AND T. S. S. RAO 1973. Chaetognatha of the Arabian Sea. In : B. Zeitcel (Ed.) *The Biology of the Indian Ocean*. N.Y. pp. 319-327.

SILAS, E. G. AND M. SRINIVASAN 1968. On the little known Chaetognatha *Sagitta bombayensis* Lele & Gae (1936) from the Indian Seas. *J. mar. biol. Ass. India*, **9** (1) : 84-95.

——— AND ——— 1969. A new speces of *Eukrohnia* from Indian Seas, with notes on three other species of Chaetognatha. *Ibid.*, **10** (1) : 1-33.

——— AND ——— 1970. Chaetognatha of the Indian Ocean with a key for their identification. *Proc. Indian Acad. Sci.*, **71** : 173-181.

SRINIVASAN, M. 1972. Two new records of meso- and bathy-planktonic chaetognatha from the Indian Seas. *J. mar. biol. Ass. India*, **13** (1) : 130-133.

——— 1976. Distribution of Chaetognatha, with special reference to *Sagitta deciplens* as an indicator of upwelling along the west coast of India. *Ibid.*, **16** : 126-141.

——— 1979. Taxonomy and ecology of Chaetognatha of the west coast of India, in relation to their role as indictor organisms of watermasses and their movements. *Zool. Surv. India, Tech. Monogr.*, **3** : 1-47.

——— 1987. Chaetognatha from the northern Arabian Sea collected during the cruises of INS Darshak. *J mar. biol. Ass. India* (1981), **23** (1 & 2) : 151-160.