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THE SEASONAL OCCURRENCE AND ABUNDANCE OF CHAETOGNATHA IN MISSISSIPPI SOUND

by

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INTRODUCTION

The Chaetognatha as "biological indicators" have attracted attention from various fields of oceanography and fisheries biology because various species of Chaetognatha are associated with different water masses, and their distribution and numerical abundance are used to infer biological productivity and movements of water with their inherent temperature, salinity, sediment load pH, and other variables (Legaré and Zoppi 1961, Redfield 1950). The Chaetognatha populations, therefore, tend to fluctuate following the seasonal changes and the influx of water masses from different sources.

The present work is a study of seasonal changes in the numerical abundance of the Chaetognatha species during a yearly cycle in Mississippi Sound. A comparison is made with the seasonal abundance of calanoid copepods, an important zooplankton component, for a possible correlation.

MATERIAL AND METHODS

Samples were collected at one station near the middle of Mississippi Sound at approximately 30° 17′ N and 80° 45′ W. The area receives open Gulf waters through the Dog Keys Pass and brackish water from the Bay of Biloxi.

Plankton samples were collected at monthly intervals with Clarke–Bumpus plankton samplers, equipped with silk bolting nets #2 and #10. The nets were towed 15 min. for each haul, and the amount of water filtered was recorded by means of calibrated flow meters attached to the samplers. Both types of nets were used at the surface and at a depth of 10 ft. which is near the bottom. Occasionally the efficiency of the plankton nets decreased due to large amounts of suspended clay particles, phytoplankton blooms, ctenophores and medusoid coelenterates.

Data on temperature, salinity and transparency were recorded at each sampling. Surface temperatures were taken with a precision mercury thermometer (Fig. 1). Water transparency was recorded by

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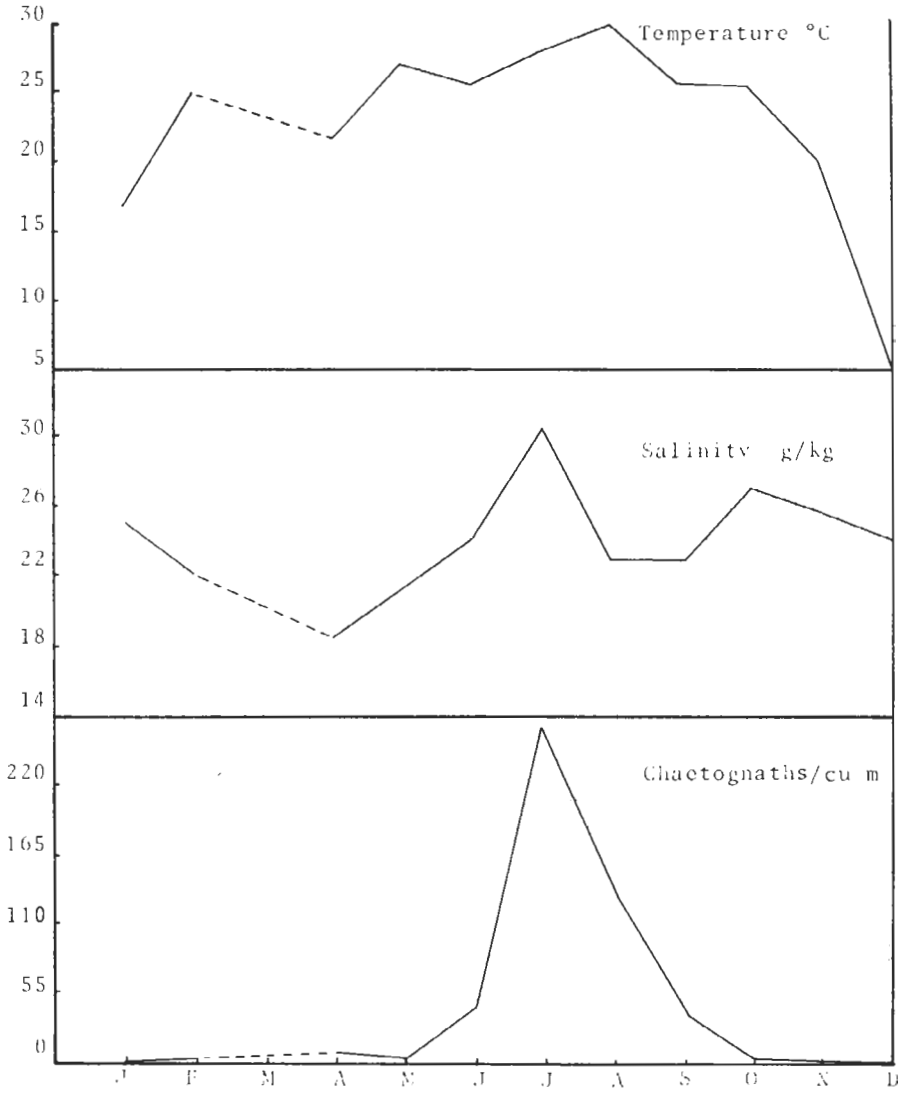

Figure 1. Seasonal variations in temperature, salinity and numerical abundance of chaetognaths in Mississippi Sound from January to December 1965.

means of a Secchi disc. Salinity was determined from hydrometer readings.

The identification of Chaetognatha is difficult when body sizes overlap, and morphological characters vary with age and size. The important characters used in classification were size, extent of collarette, number of hooks, number of anterior and posterior teeth, size and shape of the seminal vesicles, presence or absence of anterior fin, T.C. ratio (the ratio of posterior fin along the trunk to the posterior fins along the caudal segment multiplied by 100) the completeness of the fins, the ventral ganglion and presence or absence of the gut diverticulum (Cf. Grant 1963, Legaré and Zoppi 1961, Pierce 1947, and Thomson 1947).

RESULTS AND DISCUSSIONS

Eight species of Chaetognatha belonging to two genera, *Sagitta* and *Krohnitta*, were identified in the samples (Table 1).

Pierce (1947) reported the occurrence of *Sagitta tenuis, S. hispida, S. enflata, S. helenae* and *Krohnitta pacifica* off the west coast of Florida. All these species were present in our samples. *Sagitta tenuis* and *S. hispida* were most abundant and formed the major part of the chaetognath populations (Tables 1 and 2). Although both of these species are considered warm water neritic forms, they also occur in the Atlantic, but their northern limits have not been determined. *S. tenuis* is found as far north as Delaware Bay and *S. hispida* has been reported to occur as far north as Cape Hatteras in the Atlantic (Deevey 1960). *Sagitta enflata* and *S. bipunctata* were comparatively less abundant. *Sagitta enflata* is an epiplanktonic, warm-water form, but occurs north of Cape Hatteras, where it seems to be a stray form from the Gulf stream. *Sagitta enflata* is abundant in Florida waters (Grant 1963). *Sagitta bipunctata* is an oceanic form and its presence indicates mixed oceanic and neritic waters. Grant (personal communication) has suggested that the Gulf of Mexico chaetognath fauna includes most, if not all, the forms found in the central and equatorial Atlantic. *Sagitta helenae* has restricted distribution and is limited to the waters off the Atlantic coast of the United States and the Gulf of Mexico. *Sagitta hexaptera, S. serratodentata* and *Krohnitta pacifica* were found in fewer number and probably occur as stray forms.

Surface and bottom samples were analyzed separately to see if there was any variation in these shallow depths. A significant numerical abundance was observed only during the summer period (Table 2). In June and August a greater number of organisms occurred in the bottom samples, while in July a comparatively higher number was found in the surface samples. In June and August transparency was low (McIlwain 1968), apparently because of pronounced mixing of

Table 1.

Occurrence, Abundance and Seasonal Variations of Chaetognatha from January to December 1965 in Mississippi Sound

DATE	WATER FILTERED IN CU M	*Sagitta tenuis*	*Sagitta hispida*	*Sagitta enflata*	*Sagitta helenae*	*Sagitta bipunctata*	*Sagitta hexaptera*	*Sagitta serratodentata*	*Krohnitta pacifica*
Jan.	13	-	-	-	-	-	-	-	-
Feb.	43	-	1	-	1	-	-	-	-
Mar.									
Apr.	28	-	186	-	-	-	-	-	-
May	23	-	6	-	2	-	-	-	-
June	23	126	673	-	-	-	6	-	-
July	31	5632	2089	295	-	119	-	-	-
Aug.	24	796	1687	192	17	208	-	5	6
Sept.	22	262	375	9	49	-	-	-	-
Oct.	11	-	2	-	2	-	-	-	-
Nov.	35	1	1	1	-	-	-	-	-
Dec.	51	51	-	-	-	-	-	-	-

Table 2.

Variations in Seasonal Abundance of Chaetognatha Found at Surface and at Bottom, 10 Feet Deep

DATE	NUMBER IN SAMPLES		
	Surface	Bottom	Total
January	0	0	0
February	2	0	2
March			
April	0	186	186
May	8	0	8
June	763	48	811
July	78	8048	8126
August	2501	440	2941
September	195	500	695
October	4	0	4
November	1	1	2
December	0	0	0

Bay and incoming Gulf waters resulting in a turbid condition in the Sound. Such a condition would stir up the normally negatively phototropic plankton which would then be distributed in the water column. In calm waters with greater light penetration chaetognaths, like most plankton forms, would tend to be close to the bottom, which seems true of the samples collected in July (Table 2). During the rest of the year numerical abundance of chaetognaths in the plankton samples was low, and no conclusions could be made about depth distribution.

SEASONAL VARIATIONS

The chaetognath populations indicated marked fluctuations, with changes brought about by the climatological factors and surface drift. The temperature increased from 16.5°C in January to 29.3°C in August (Fig. 1), and decreased rapidly to 12.5°C in December. Salinity showed a rapid decrease from 25.1 g/kg in January to 16.0 g/kg in May 1965. A sharp increase was noticed again beginning in May, reaching a peak of 30.5 g/kg in July. The salinity then decreased, with a sharp decline in August and September 1965.

According to available information, the surface drift in the

northern Gulf of Mexico predominates as a northeast flow from the area east of the Mississippi Delta from March to June and from northeast to southeast from July to August (Drennan 1963).

The chaetognath populations showed a sharp rise and decline following the general pattern of salinity and temperature contours (Fig. 1). Although with warming climatological conditions the reproductive activities of most organisms ensue and the populations increase, the maximum numerical abundance is not noticed at the highest temperature at any one time (Richards 1963, Mulkana 1964). No studies related to the maximum abundance of chaetognath populations at maximum salinity are available, but during the summer, under dry conditions, salinity tends to follow a rising trend and the greatest abundance at the station studied clearly came at a period of high temperature and high salinity.

Life studies of Chaetognatha are now well known. Redfield (1940) has indicated that fluctuations of Chaetognatha will be most marked if the adult does not survive its first breeding, and less pronounced if the adult survives through several breeding seasons. The sharp rise and fall of chaetognath populations in the present study seems to indicate the former condition (Fig. 1). Bigelow and Sears (1939), however, have pointed out that marked occurrence of *S. serratodentata* and periodic occurrence of *S. enflata* in the Cape Cod area appear to depend upon environmental conditions rather than the biology of the reproductive cycle.

Russell (1952), Hardy (1963) and other workers have termed arrow-worms as "biological indicators" because of their usual presence in great abundance when productivity of other organisms is at its maximum. McIlwain (1968) has also shown that the calanoid copepods which form a large part of the zooplankton component in Mississippi Sound were at their maximum during the greatest abundance of Chaetognatha (Table 3).

Other workers attribute the seasonal abundance and fluctuation to hydrographical factors. Redfield (1940) considered that in regions which do not develop permanent eddies, populations of chaetognaths come by immigration from the adjoining areas. In such areas seasonal fluctuations become greater and little time is required to wash away the dense populations. The populations are, therefore, pseudo-endemic and depend upon immigration. The surface drift in Mississippi Sound water changes periodically (Drennan 1963) and perhaps it contributes to the pronounced seasonal fluctuations by immigration.

Table 3.

Comparison of Seasonal Abundance of Chaetognatha and Calanoid Copepods from January to December 1965 in Mississippi Sound

DATE	WATER FILTERED IN CU M	NUMBER OF COPEPODS PER CU M	NUMBER OF CHAETOGNATHS PER CU M
January	13	56	0
February	43	20	.05
March			
April	28	106	6.7
May	23	83	.3
June	23	178	35.3
July	31	385	262
August	24	314	123
September	22	53	31.6
October	11	165	.4
November	38	100	.05
December	51	2	0

REGENERATION

During the course of identifications some specimens were found with a missing head region. Close examination showed the heads were cut off, but the cut ends indicated signs of regeneration. Apparently, some chaetognaths can survive at least for a while after accidental removal of the head region. One other such observation has been reported (Pierce 1947).

Plankton samples collected by Mr. J. Y. Christmas and Mr. C. B. Subrahmanyam in 1966 also showed occasional specimens of *S. enflata* and *Sagitta* sp. with regenerating head regions.

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