ANNUAL CYCLE OF THE CHAETOGNATHA OF LOS CRISTIANOS (SW OF TENERIFE, CANARY ISLANDS)

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With 26 figures & 2 tables

RESUMEN: Se realiza el estudio de las variaciones cualitativas y cuantitativas a lo largo del año 1990 de los Quetognatos de Los Cristianos (SW de Tenerife). Un total de 1424 ejemplares se han examinado del conjunto de las muestras, mostrándose el comportamiento de las veinte especies halladas, tanto en superficie como en profundidad.

SUMMARY: In the course of 1990 a study of the qualitative and quantitative variations of the Chaetognatha of Los Cristianos (SW of Tenerife) is presented. A total of 1424 specimens were examined from the total samples, and the behaviour of the twenty species found, both on surface and in depth, were recorded.

INTRODUCTION

The fauna of the Chaetognatha of the Canarian waters has recently been the subject of profound taxonomical and ecological surveys (HERNANDEZ and LOZANO, 1984; 1987a; HERNANDEZ, 1985a and b; 1986a and c; 1987b, 1990 and 1991) which at present extends to other groups of zooplankton (LOZANO *et al.*, 1988; HERNANDEZ *et al.*, 1991).

The study of the annual cycle of the Chaetognatha of the SW of Tenerife was carried out within the project of the Museo de Ciencias Naturales TFMCBM (Canary Islands) for the study of plankton, which was included in the program for 1990, and the qualitative and quantitative variations of the sample of the stations were recorded. Other groups of zooplankton of the same area have been surveyed previously (HERNANDEZ and JIMENEZ, in press).

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MATERIAL AND METHODS

Twenty-three samples of plankton containing 1424 specimens of Chaetognatha corresponding to twenty species were studied.

The plankton-net used was WP-2 (modified) with a 200 μm mesh. The samples were collected during all the months with the exception of December, at a rate of two per month ranging from 500 and 200 metres to the surface. Once collected they were placed in 5% formalin on board.

The sample stations were located to the SW of Tenerife, in the area between Los Cristianos and Punta Rasca, with the following coordinates: TFMCBM002 = 28° 01' 06" N and 16° 44' 18" W, and TFMCBM0003 = 28° 01' 06" N and 16° 45' 18" W, and situated between the isobaths of 500 and 2000 m. See figure 1 and table 1.

Each specimen was determined taxonomically (ALVARIÑO, 1969; BOLTOVSKOY, 1981; HERNANDEZ, 1985a, MICHEL, 1984 and MORENO, 1973), and each was assigned a sexual stage based on a simplified scale.

The information was processed using the following programs: DBASE III plus version 1.0, IBM/MSDOS, HARVARD GRAPHICS and MICROSTAT. Diversity was also studied and compared with other stations (MARGALEF, 1974).

RESULTS

Twenty species belonging to four genera were captured: *Sagitta bierii*, *Sagitta bipunctata*, *Sagitta decipiens*, *Sagitta friderici*, *Sagitta hexaptera*, *Sagitta inflata*, *Sagitta lyra*, *Sagitta macrocephala*, *Sagitta minima*, *Sagitta planctonis*, *Sagitta serratodentata*, *Sagitta sibogae*, *Sagitta tasmanica*, *Sagitta zetesios*, *Sagitta sp.*, *Krohnitta pacifica*, *Krohnitta subtilis*, *Pterosagitta draco*, *Eukrohnia fowleri* and *Eukrohnia hamata*. See table 2.

Biometric and ecological characteristics of the species.

Sagitta serratodentata

Oceanic, epiplanktonic and halophillus, its average size is 7.81 mm, and were present near the surface during the whole year, with a quantitative peak in July in stage II and another in April in stage I. It was abundant during hauls. Figures 2 and 3.

Sagitta bierii

Pelagic and halophillus, its average size was 8.06 mm. in Canarian waters. It was not collected during any of the months being its presence rare. Figure 4.

Pterosagitta draco

Epiplanktonic or mesoplanktonic (depending on the author), in the Canaries its average size is of 6.43 mm. It was collected during all the sampling months. Figures 5 and 6.

Krohnitta pacifica

Mesoplanktonic and semineritic. It is rare and of an average size of 6.48 mm; no young specimens were caught. It was not present on the surface during April and May. Figures 7 and 8.

Sagitta minima

Epiplanktonic and pelagic. Its average size is 5.88 mm and is considered the most abundant chaetognath in Canarian waters. It was seen during all months except October, during which no specimens were detected in the samples. Figures 9 and 10.

Sagitta sibogae

Mesoplanktonic and rarely present, its average size in the Canaries being 11.75 mm (HERNANDEZ, 1986c). It was not detected during any of the months although, contrary to what is the case in other areas (PIERROT-BULTS, 1982), it has been more abundant in deep rather than in superficial waters. In deep waters it was not observed during July, October and November.

Sagitta lyra

Cosmopolitan and typical of deep water mesoplankton, its average size being 13.66 mm. It was collected during all the months, with the exception of April on surface. The species which is quite numerous, behaves in a homogeneous manner. Figures 13 and 14.

Sagitta inflata

Its average size is 11.04 mm. It was present during all the months except

March. Figures 15 and 16.

Sagitta hexaptera

This species was collected mainly in stage I. The highest number of specimens was observed in the summer and the lowest in spring. Figures 17, 18 and 19.

Sagitta decipiens

Mesoplanktonic and oceanic, it attains a size of 7.66 mm. Deep water samples were taken the whole year round, with the exception of April. Although of a mesoplanktonic nature, during the phase of the survey it lives nearer the surface than *S. sibogae*, contrary to what happens in other areas where the species prefers to live at greater depths (PIERROT-BULTS, 1982). Figures 20 and 21.

Krohnitta subtilis

This species is characteristic of the mesoplankton, is of an average size of 9.65 mm. and is considered to be rare. It has been collected at the stations, but was not present during the month of July. Figures 22.

Eukrohnia hamata

Cosmopolitan and typical of batiplankton, it has only been found in its younger stage (I), with a maximum number of specimens in the spring. Figure 23.

Sagitta bipuntata

Epiplanktonic and oceanic, it has been observed in its three stages, with the exception of April and May. The three stages have coincided with the highest number in the summer and the lowest in spring. Figure 24.

Sagitta tasmanica

Oceanic and epiplanktonic, it has been scarce in our samples, for only two specimens were collected, thus confirming *Sagitta tasmanica* as a very rare planktonic Chaetognath in the Canary Islands, and the scarcest of the "***serratodentata* group"** to the west of the islands. To the east, however, the species is larger and more abundant (larger in phase III) due to the lower temperatures of the waters (HERNANDEZ, 1986c).

Sagitta friderici

Neritic and epiplanktonic with an average size of 7.86 mm, its presence is rare. Only a very reduced number (two specimens/sample) was collected in deep waters.

Sagitta planctonis

Oceanic and characteristic of batiplankton, its presence in hauls below 200 m. during the months of February and March seems to bear some relation to ascents, mixture of cold waters or decreases in temperature.

Sagitta macrocephala, Eukrohnia fowleri and *Sagitta zetesios*

These species were only collected in small numbers, and in the case of the first two, during the months of January and February below 500, which leads us to believe that these species seem to prefer even deeper waters in the Canaries.

With regard to the cyclogram (see figure 25) for the species of epiplankton, we have observed that the data do not coincide with those of other stations (HERNANDEZ, 1986c). A point of interest is the prevalence of *Sagitta serratodentata* and *Pterosagitta draco*, as opposed to *Sagitta minima*, which in other surveys has shown itself to be the most abundant of epiplanktonic Chaetognatha (HERNANDEZ, 1986c).

With regard to diversity, the Shannon-Weaver index was used for hauls below 200 m. These were the values found:

MONTH	DIVERSITY
JANUARY	2.81
FEBRUARY	2.65
MARCH	3.07
APRIL	2.02
MAY	2.57
JUNE	2.35
JULY	2.52
AUGUST	2.74
SEPTEMBER	3.01
OCTOBER	2.46
NOVEMBER	2.76

March and September were the months with the highest degree of diversity.

With regard to abundance, we observed a notable increase of specimens during the month of July and a decrease in November, which coincided with the hauls below 500 m., as well as for the rest of the surveyed zooplankton groups (HERNANDEZ and JIMENEZ, in press). Figure 26.

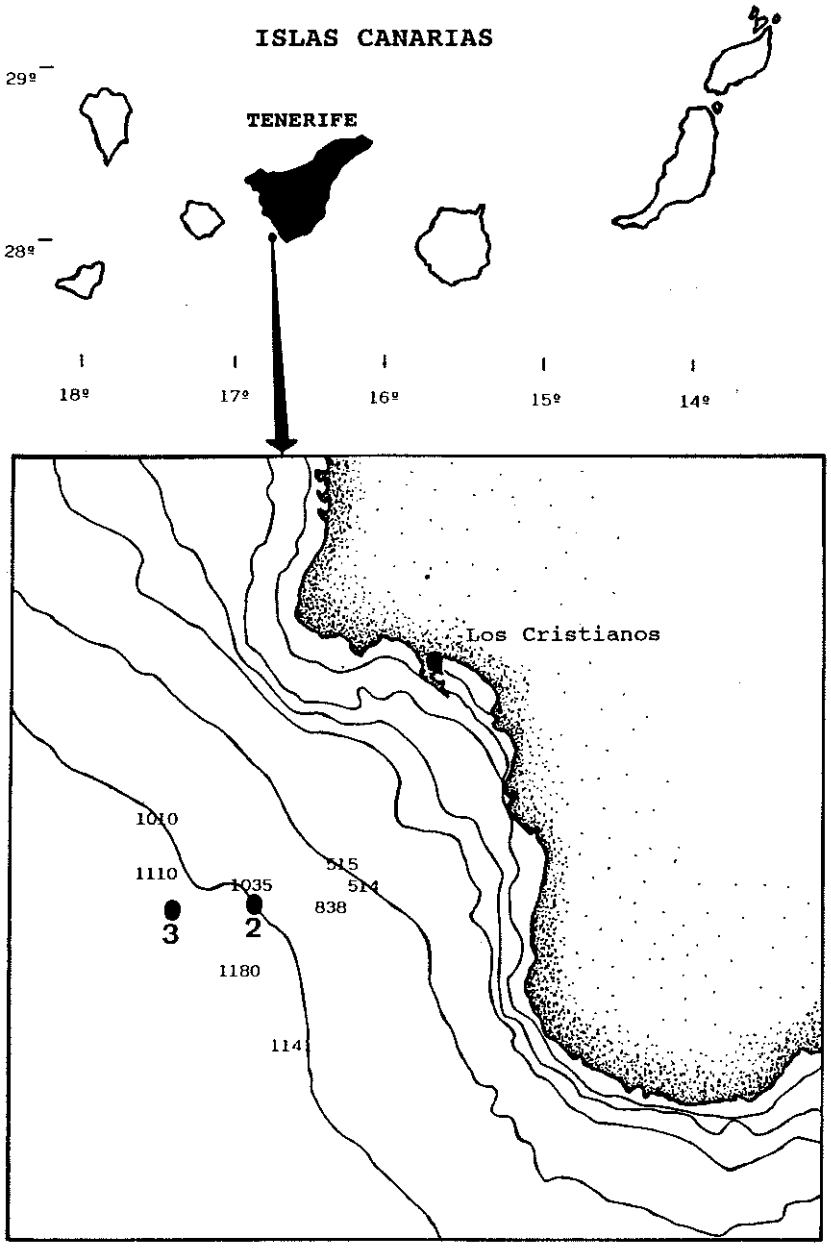

Figure 1.-Situation of the sampling station.

Annual evolution of the sexual stages of *Sagitta serratodentata* (200-0 m)

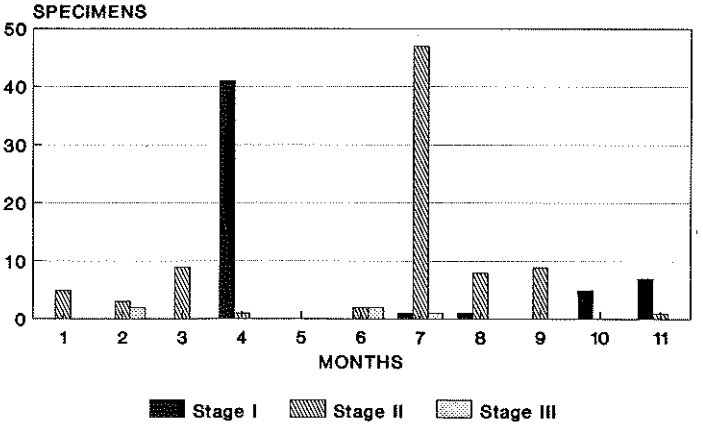

Figure 2

Annual evolution of the sexual stages of *Sagitta serratodentata* (200-0 m)

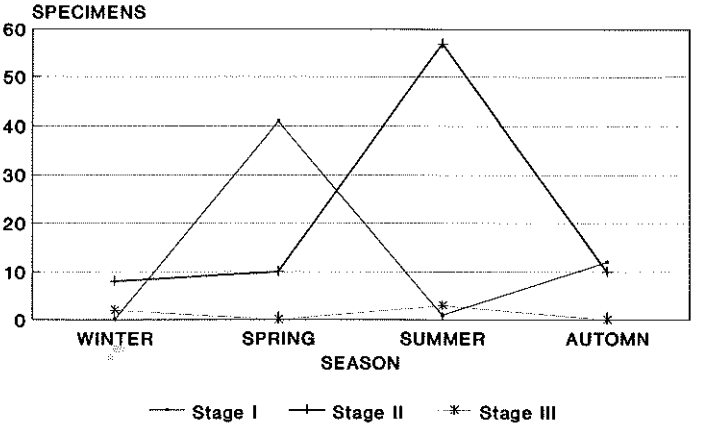

Figure 3

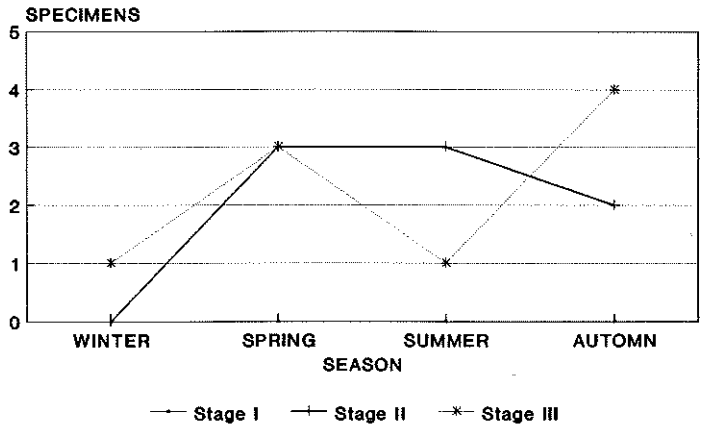

Figure 4

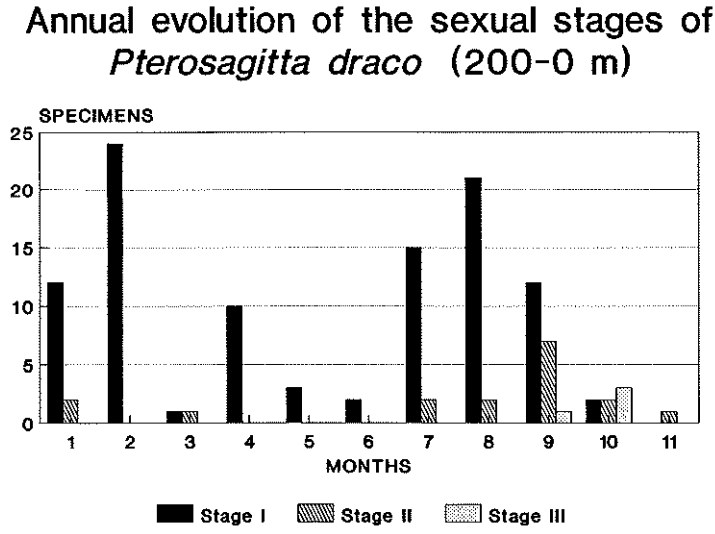

Figure 5

Annual evolution of the sexual stages of *Pterosagitta draco* (200-0 m)

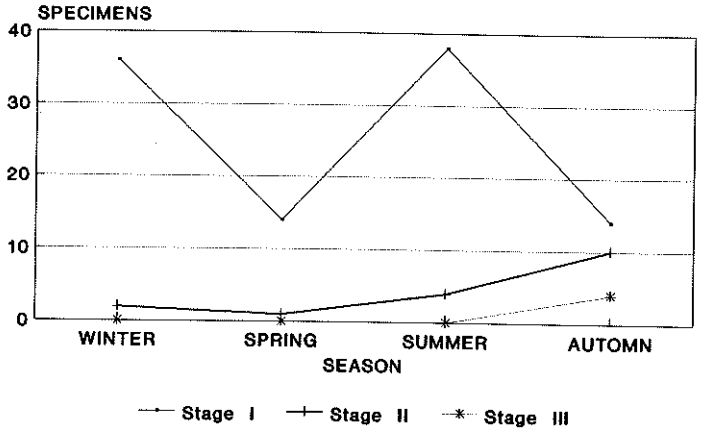

Figure 6

Annual evolution of the sexual stages of *Krohnitta pacifica* (200-0 m)

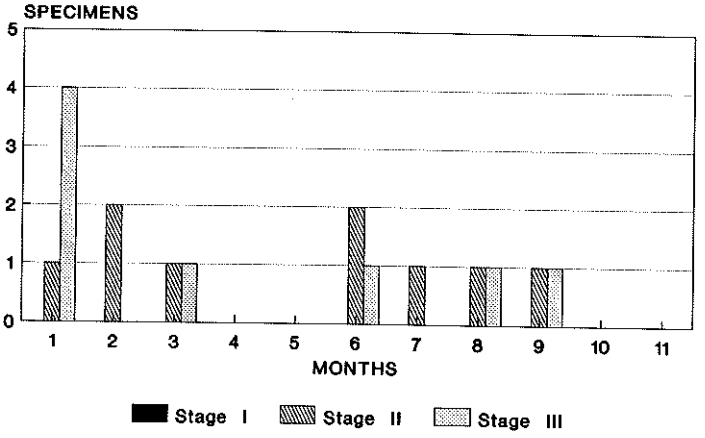

Figure 7

Annual evolution of the sexual stages of *Krohnitta pacifica* (200-0 m)

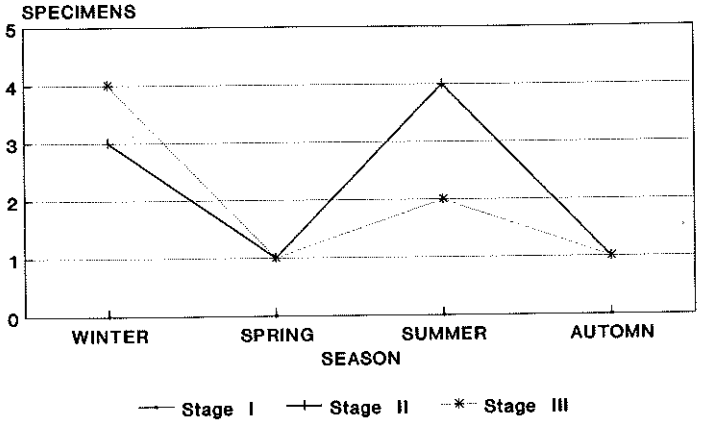

Figure 8

Annual evolution of the sexual stages of *Sagitta minima* (200-0 m)

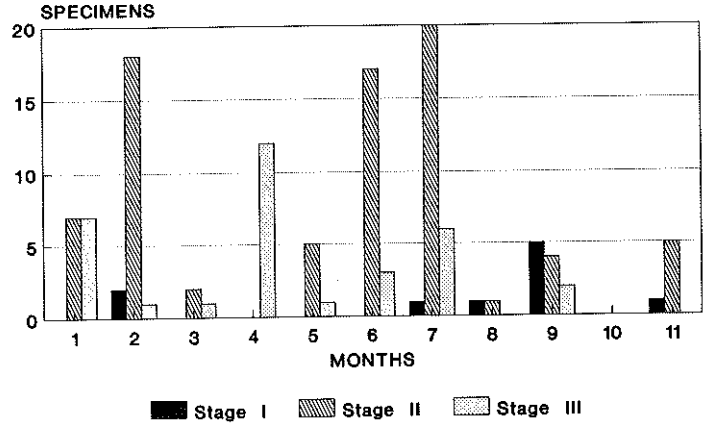

Figure 9

Annual evolution of the sexual stages of *Sagitta minima* (200-0 m)

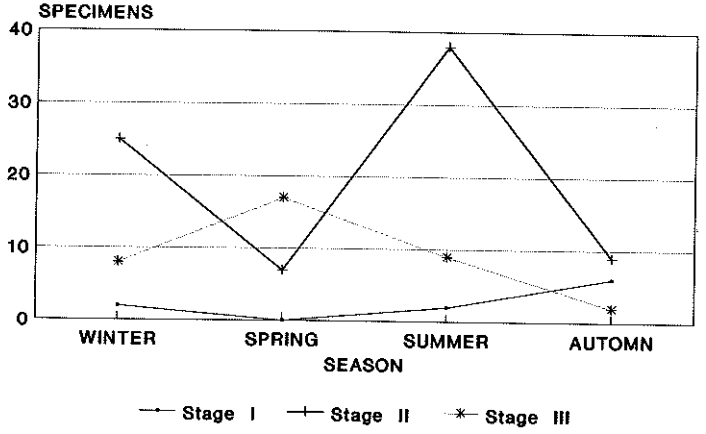

Figure 10

Annual evolution of the sexual stages of *Sagitta sibogae* (500-0 m)

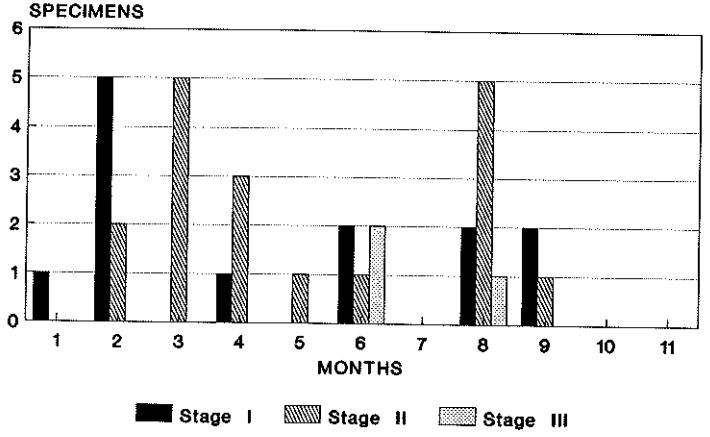

Figure 11

Annual evolution of the sexual stages of *Sagitta sibogae* (500-0 m)

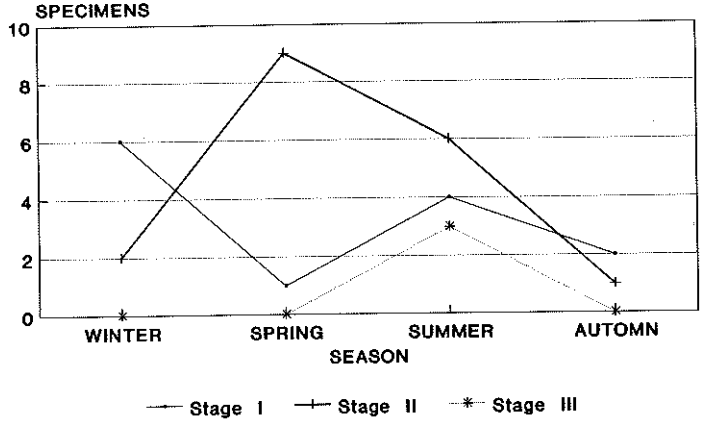

Figure 12

Annual evolution of the sexual stages of *Sagitta lyra* (200-0 m)

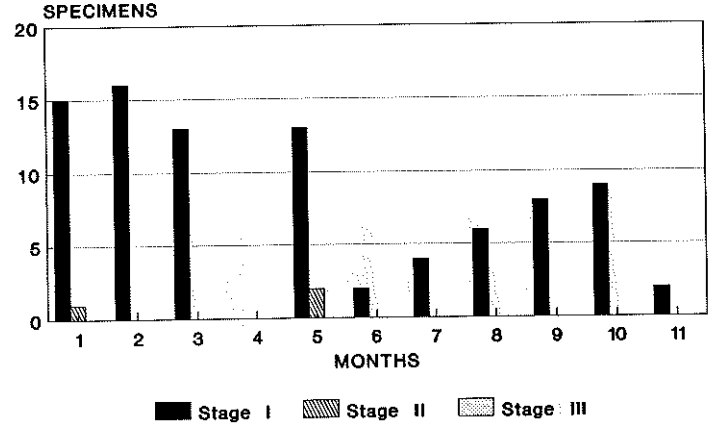

Figure 13

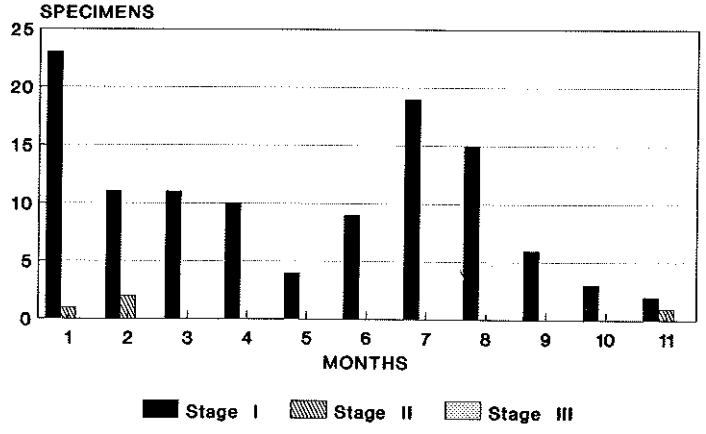

Figure 14

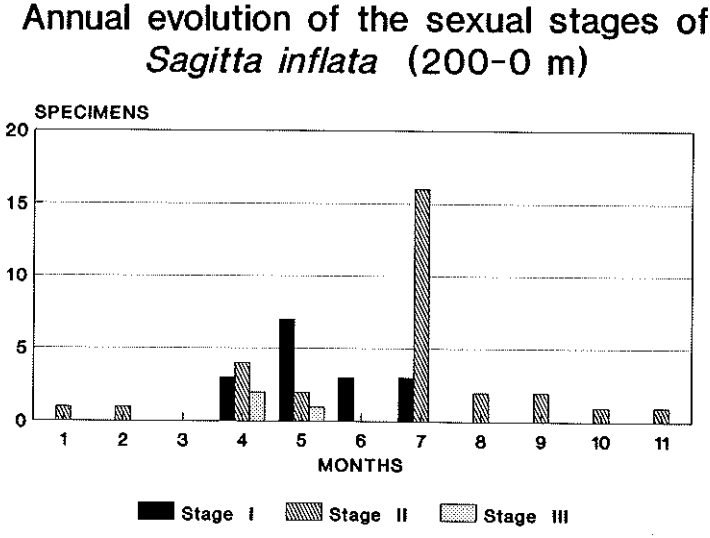

Figure 15

Annual evolution of the sexual stages of *Sagitta inflata* (200-0 m)

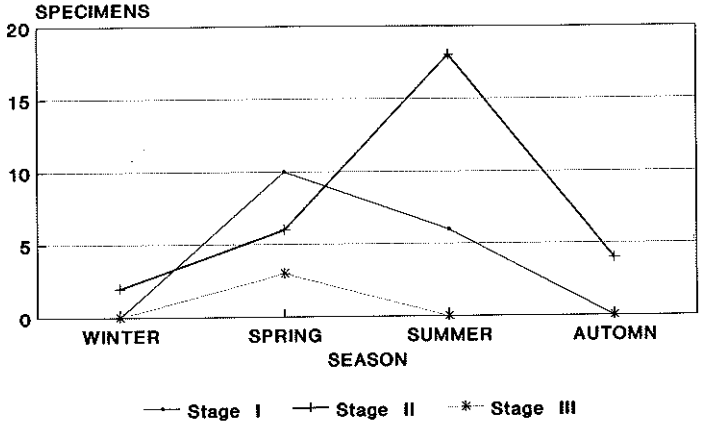

Figure 16

Annual evolution of the sexual stages of *Sagitta hexaptera* (200-0 m)

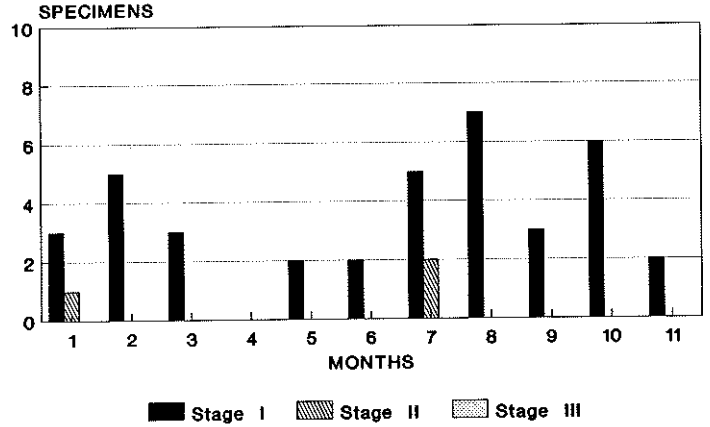

Figure 17

Annual evolution of the sexual stages of *Sagitta hexaptera* (200-0 m)

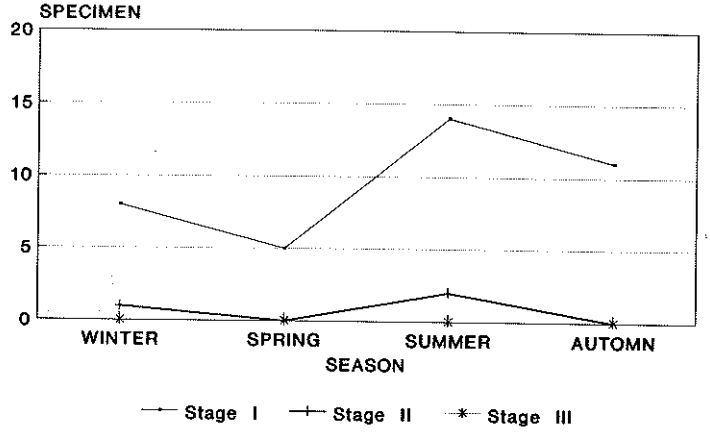

Figure 18

Annual evolution of the sexual stages of *Sagitta hexaptera* (500-0 m)

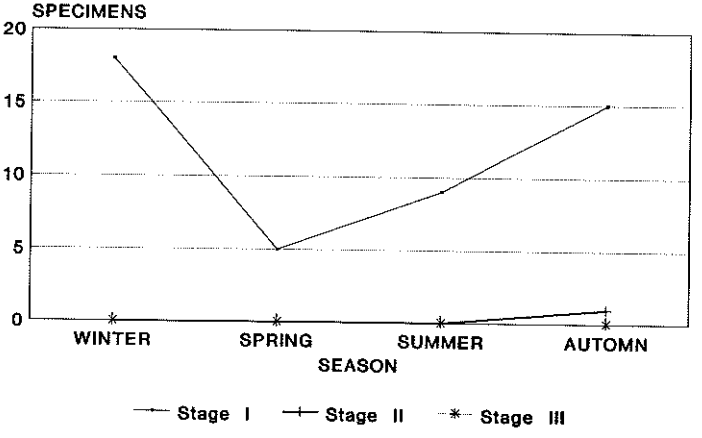

Figure 19

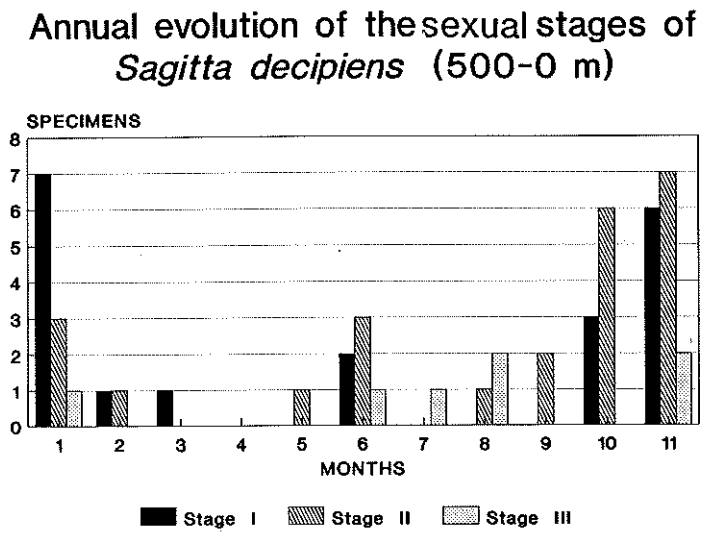

Figure 20

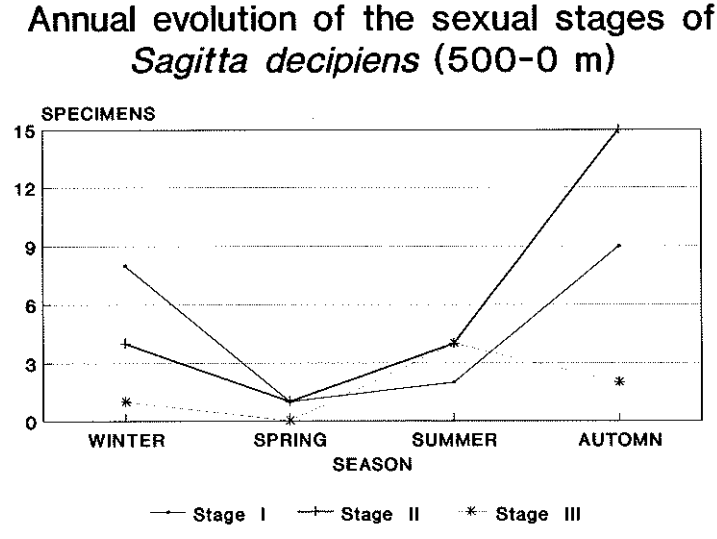

Figure 21

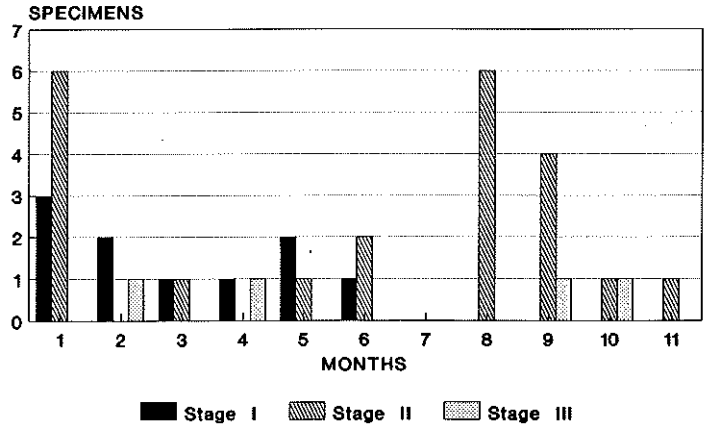

Figure 22

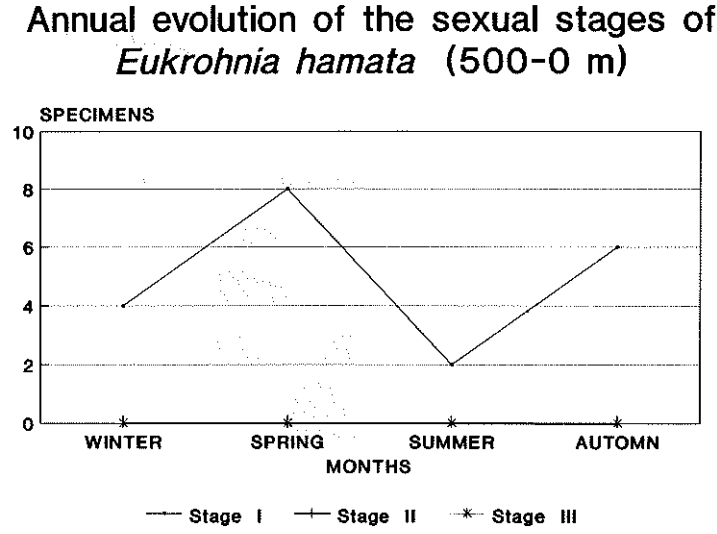

Figure 23

Annual evolution of the sexual stages of *Sagitta bipunctata* (500-0 m)

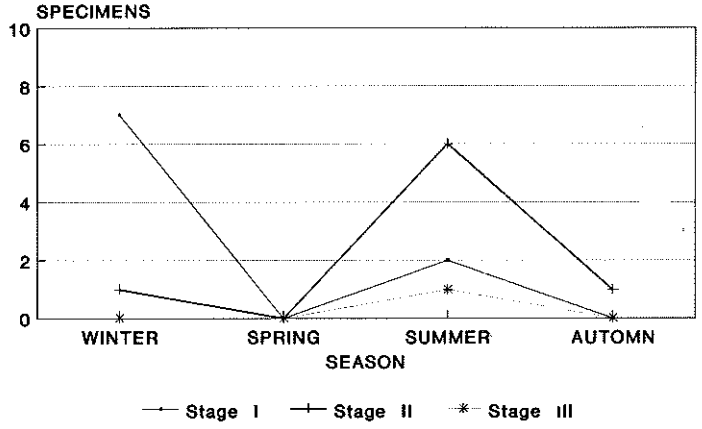

Figure 24

Epiplanktonic Chaetognaths

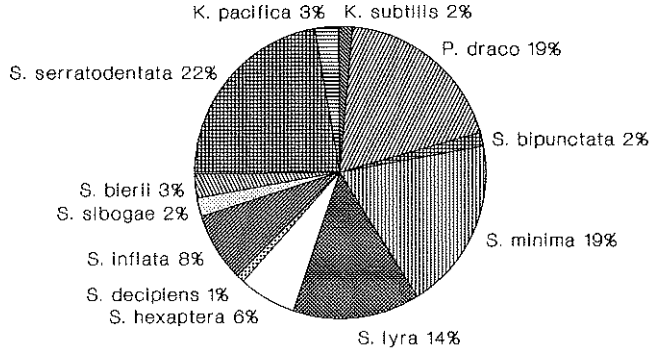

Figure 25

Monthly evolution of Chaetognaths (TFMCBM/90 CRUISE)

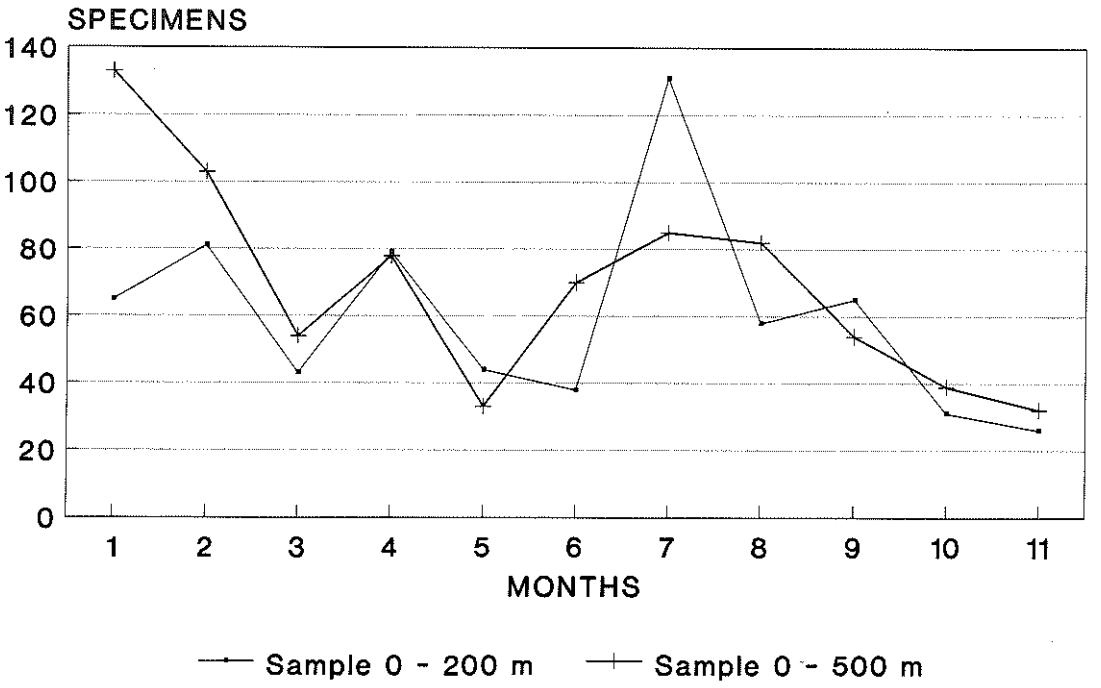

Figure 26

MONTH	SAMPLE	DATE	SEA	SKY	WIND STRENGTH	WIND DIRECTION	TEMPERATURE AT.
JANUARY	A,B	25/1/90	Plain	Clear	Weak	NE	25° C
FEBRUARY	A,B,C	21/2/90	Ridged	Clear	Weak	NE	27° C
MARCH	A,B	8/3/90	Plain	Cloudy	Slight	N	25° C
APRIL	A,B	4/4/90	Rough	Overcast	Moderate	SW	17° C
MAY	A,B	9/5/90	Rough	Cloudy	Moderate	NW	20° C
JUNE	A,B	7/6/90	Plain	Cloudy	Calm		24° C
JULY	A,B	10/7/90	Plain	Clear	Calm		26-27° C
AUGUST	A,B	30/8/90	Plain	Clear	Breaze	Variable	25° C
SEPTEMBER	A,B	4/9/90	Plain	Cloudy	Calm		24° C
OCTOBER	A,B	23/10/90	Plain	Cloudy	Moderate	NE	24° C
NOVEMBER	A,B	15/11/90	Plain	Clear	Calm		27° C

Table 1.-Characteristics of the hauls.

ESPECIES / MES	1		2		3		4		5		6		7		8		9		10		11		TOTAL		%	
A: 0-200 m / B: 0-500 m	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Sagitta serratodentata (A)	5	10	5	10	9	17	42	37		4	4	16	48	20	9	9	9	12	5	1	8	1	144	137	21,78	17,95
Sagitta tasmanica (MR)			1						1														2		0,30	
Sagitta bierii (R)			1	2	3	1			3	7	1	4			3		3			2	3		17	16	2,57	2,09
Sagita sibogae (R)		1		7	2	5	2	4	4	1		5				8	3	3			2		13	34	1,96	4,45
Sagitta decipiens (MR)		11		2	2	1	1			1		6		1		3	1	2	2	9		15	6	51	0,90	6,68
Sagitta inflata (E)	1	2	1			2	9	7	10	1	3	13	19	16	2	2	2	1	1	2	1	1	49	47	7,41	6,15
Sagitta hexaptera (E)	4	2	5	16	3	2		1	2	2	2	2	7	1	7	6	3	4	9	6	2	3	41	48	6,20	6,29
Sagitta lyra (F)	16	24	16	13	13	11		10	15	4	2	9	4	19	6	15	8	6	9	3	2	3	91	117	13,76	15,33
Sagitta minima (F)	14	41	21	20	3	5	12	7	6	6	20	3	27	16	2	4	11	4		5	6	2	122	113	18,45	14,80
Sagitta planctonis (MR)			3		1	1				1													4	2	0,60	0,26
Sagitta zetesios (MR)	1								1														1	1	0,15	0,13
Sagitta bipunctata (R)		1		7	1		3					1	4	3	1	5	1			1			10	18	1,51	2,35
Sagitta friderici																		2						2		0,26
Sagitta macrocephala		1		1																				2		0,26
Eukrohnia fowleri		2																						2		0,26
Eukrohnia hamata (MR)		4				5		1		2		2					1	2		1		3	1	20	0,15	2,62
Pterosagitta draco (F)	14	16	24	15	2	2	10	9	3		2	5	17	9	23	13	20	13	7	4	1	3	123	89	18,60	11,66
Krohnitta subtilis (R)	3	9	2	3		2		2		3	1	3			1	6	1	5	1	2	1	1	10	36	1,51	4,71
Krohnitta pacifica (R)	5	6	2	5	2						3	1	1		2	1	2						17	13	2,57	1,70
Sagitta sp. (R)	2	3		2	2								4		2	10							10	15	1,51	1,96
SUBTOTAL	65	133	81	103	43	54	79	78	44	33	38	70	131	85	58	82	65	54	31	39	26	32	661	763	100	100
TOTAL	198		184		97		157		77		108		216		140		119		70		58		1424			

Table 2.-Distribution of Chaetognatha in the anual study, and their abundance (MAIDANA Y MOSTAJO, 1980).

CONCLUSIONS

A total of 1424 specimens of Chaetognatha were examined on a monthly basis during the year 1990 (with the exception of December). Twenty specimens belonging to four genera were found. Year-round fluctuations of the specimens in each of their sexual stages were observed to the SW of Los Cristianos. Table 2.

Chaetognatha have been well represented in the hauls, with the exception of the month of November, which reflected a notable descent of the number of specimens, which coincided with other groups of surveyed zooplankton (HERNANDEZ and JIMENEZ, *op.cit.*).

Sagitta serratodentata and *Pterosagitta draco* were the most abundant epiplankton, with *Sagitta minima* in third place, contrary to the situation at other stations where this species prevails (HERNANDEZ, 1986c).

With regard to diversity, March followed by September, were the months with the highest degree of diversity (D=3.07 b/i).

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