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BIOMETRY OF THE ONTOGENIC DEVELOPMENT OF FIVE CHAETOGNATH SPECIES IN GREEK WATERS (EASTERN MEDITERRANEAN)

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Abstract: Sagitta enflata, Sagitta serratodentata atlantica, Sagitta bipunctata, Sagitta minima and *Sagitta setosa* were numerically the most important chaetognath species in two neritic areas, Kisamos and Patraikos Gulf, in Greek waters (eastern Mediterranean). By the use of biometrical data, that came from seasonal studies in the above areas, the variation of some morphological characters during the development of all the above five species was estimated. The relation of body length to tail length, the ovary length and the seminal vesicle width was studied in order to get informations about the growth and development of these species and to reveal their differences. The tail length and the seminal vesicle width showed a linear increase with the increase of body length, while the length of the ovaries increased as a power function of the body length. This was true for all five species studied although there were differences in the equation coefficients between them reflecting differences in their growth and development.

Key-words: *Chaetognaths, biometry, ontogeny, development, Eastern Mediterranean*

Introduction

Chaetognaths are protandric hermaphrodite animals that live exclusively in the sea. The female and male gonads appear in different locations in the body and arrive in maturity at different phases of the life cycle (Alvariño, 1992). Newly hatched chaetognaths do not undergo a metamorphosis and the growth and develompent after attainment of juvenile form are straightforward (Pearre, 1991). During the growth and development of chaetognaths most of their morphological characters change. Chaetognaths are characterized by a species specific development because there is considerable variation on the degree of protandry among them (Alvariño, 1992). The study of the relation among the different morphological charačters of the chaetognath species provides information about their growth and development. Morphometrical studies in relation to the ontogenic development of the chaetognaths in the Mediterranean Sea are rather scarce (Furnestin, 1957; Massuti-Oliver, 1958).

Sagitta enflata (Grassi, 1881), *Sagitta bipunctata* (Quoy & Gaimard, 1827), *Sagitta serratodentata* (Krohn) *atlantica* (Thomson, 1947), *Sagitta minima* (Grassi, 1881) and *Sagitta setosa* (Müller, 1847) were numerically the most important species in two areas of Eastern Mediterranean, Kisamos and Patraikos Gulf (Kehayias, 1996). In the present study the relation of body length to some morphological characters such as tail length, ovary length and seminal vesicle width of the above five chaetognath species was studied in order to attain informations about the growth and development of the various species and to reveal their differences.

Materials and Methods

Zooplankton samples were collected from two neritic areas in Eastern Mediterranean (Fig. 1). Kisamos Gulf (23° 40' E, 34° 35' N) located in NW of Crete Island (Cretan Sea) and Patraikos Gulf (21° 43' E, 38° 14' N) located in western Greece (Ionian Sea). In Kisamos Gulf zooplankton was sampled in five stations on six sampling occasions (25 September and 20 November 1988, and 22 February, 8 April, 23 May and 29 July 1989). On each occasion double oblique hauls were conducted in the upper 50m with a WP-2 net (200μm mesh size). The towing speed of the two nets was approximately 2.5 knots. In Patraikos Gulf the samples were collected in two stations on six sampling occasions (28 February, 19 March, 3 April, 22 May, 23 June and 28 August 1992), with the same net (WP-2 net, 200μm mesh size). The net was towed vertically from 50m to the surface with a speed of about $1 m.s^{-1}$. After collection all samples were preserved in 4% formaldehyde buffered solution. In the laboratory, chaetognath specimens were extracted from the samples, and they were further sorted to species. The chaetognaths were then classified to maturity stages based on the development of the ovary and the seminal vesicles, using Kehayias *et al.* (1992) classification key, as follows: Stage I, young without visible ovaries; Stage II, immature with visible ovaries but no visible seminal vesicles; Stage III, seminal vesicles present, ova visible, a few large; Stage IV, filled seminal vesicles and large ova.

From each sample a number of random selected chaetognath specimens were examined and measured under a Wild M5 stereomicroscope. Body length (BL) was measured from the top of the head to the end of the tail, excluding the tail fin.

Fig. 1. The two sampling locations. A: Patraikos Gulf and B: Kisamos Gulf.

Measurements were also taken on tail length (TL), ovary length (OL) and seminal vesicle width (SVW) as shown in Fig. 2. All specimens with damaged both ovaries or both seminal vesicles were excluded from the counts, but specimens that had only one ovary or seminal vesicle damaged were considered. The ratio of tail length to body length (TL/BL) and ovary length to body length (OL/BL) was computed for all specimens. Regression analysis was applied to relate all the morphological characters to body length.

Results

Sagitta enflata (Grassi, 1881), *Sagitta serratodentata* (Krohn) *atlantica* (Thomson, 1947) and *Sagitta bipunctata* (Quoy & Gaimard, 1827) were the three most abundant species in Kisamos Gulf (Kehayias *et al.*, 1992), while *Sagitta minima* (Grassi, 1881) and *Sagitta setosa* (Müller, 1847) were the most abundant species in Patraikos Gulf (Kehayias, 1996). Among the above only *S. setosa* is a pure neritic species.

Table 1 shows the size range, the mean and the standard deviation of the morphological characters studied for each species and developmental stage. *Sagitta enflata* was the largest in length among the five species studied while *Sagitta minima* was the smallest. The tail length (TL) of all five species showed a linear increase with the increase of body length (BL), as shown in Figures 3-7. This linear increase was described by the equation:

$$\mathrm{TL} = a + b\mathrm{BL} \qquad (1)$$

The parameters *a*, *b* of this linear model as well as the correlation coefficient and the standard error of the estimates is presented in Table 2. Equation 1 leads to TL/BL = *a*/BL + *b*. From this second equation derive that the ratio of tail length to body length (TL/BL) becomes lower as the chaetognath grows and this was the fact for all five species studied. The ovaries first appear in specimens having body length greater than 5mm in *Sagittta enflata*, *Sagitta bipunctata* and *Sagitta serratodentata atlantica*, while in the smaller species they first appear in specimens having body length greater than 3mm (*Sagitta minima*) and 2mm (*Sagitta setosa*). The ovaries can reach to a considerable length in *S. serratodentata atlantica* (the max OL measured was 5.05 mm) being as much as the 41% of the BL. On the contrary, in *S. enflata* the ovaries can be only 10% of its BL, while for the rest three species the proportion of the OL/BL lies between the above values. The length of the ovaries (OL) increases as a power function of the body length for all five species (Figures 3-7), giving the general equation:

$$\mathrm{OL} = a\mathrm{BL}^{b} \qquad (2)$$

Considering that the coefficient *b* in most cases is greater than 2 (Table 2) it

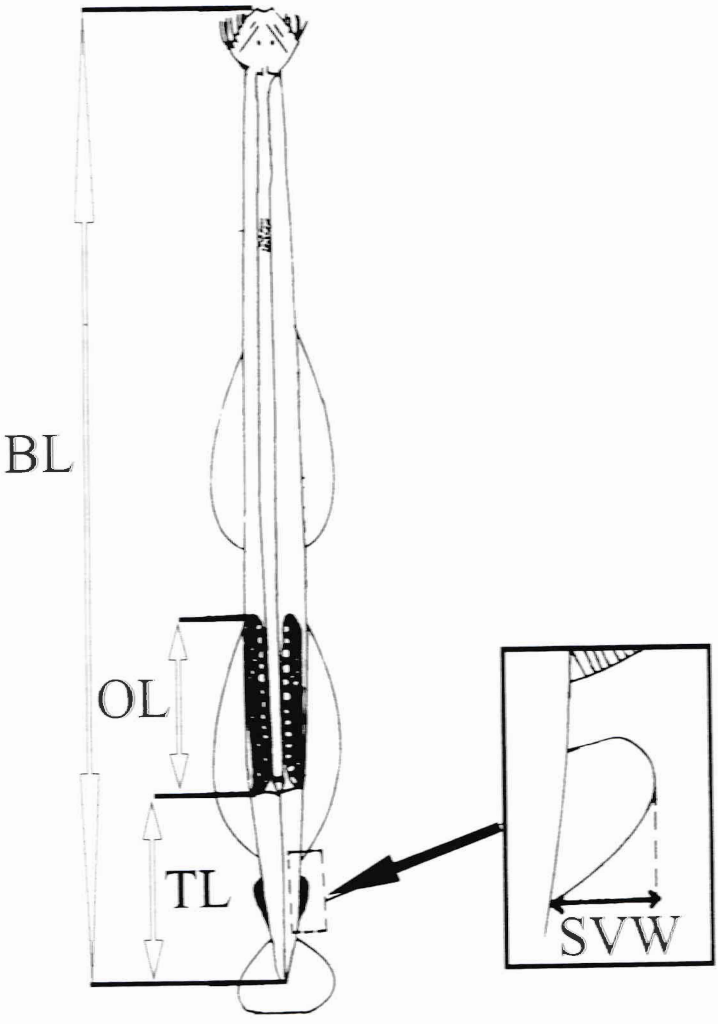

Fig. 2. Definition of the morphological characters measured: BL, body length. TL, tail length. OL, ovary length. SVW, seminal vesicle width.

Table 1. The range, mean and standard deviation of the morphological characters studied in *Sagitta enflata, Sagitta bipunctata, Sagitta serratodentata atlantica, Sagitta minima* and *Sagitta setosa.*

		Body length			Tail length			Ovary length			Seminal vesicle width			No. of specimens counted
SPECIES	Stage	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	
	I	4.4-7.8	6.1	0.68	0.85-1.54	1.21	0.14	-	-	-	-	-	-	98
Sagitta	II	5.1-12.6	8.9	1.64	1.08-2.15	1.60	0.23	0.03-0.5	0.20	0.08	-	-	-	222
enflata	III	9.4-16.3	12.9	1.41	1.48-2.66	2.14	0.22	0.14-1.00	0.47	0.17	0.05-0.27	0.17	0.04	153
	IV	12.3-20.9	15.7	1.51	1.95-3.30	2.56	0.24	0.35-2.05	0.92	0.31	0.10-0.30	0.23	0.04	178
	I	4.5-7.8	5.8	0.78	1.25-2.10	1.54	0.19	-	-	-	-	-	-	38
Sagitta	II	5.4-9.4	6.9	0.94	1.40-2.30	1.76	0.18	0.15-0.70	0.29	0.12	-	-	-	64
bipunctata	III	6.5-13.8	10.0	1.58	1.70-3.20	2.37	0.32	0.30-2.10	0.72	0.30	0.03-0.22	0.08	0.05	145
	IV	9.6-17.2	13.1	1.77	2.24-3.85	3.03	0.38	0.70-4.90	2.57	0.97	0.09-0.28	0.21	0.04	37
	I	4.2-7.7	5.8	0.78	1.2-1.95	1.53	0.18	-	-	-	-	-	-	45
Sagitta	II	5.1-7.9	6.5	0.63	1.37-2.00	1.70	0.14	0.15-0.5	0.28	0.09	-	-	-	48
serratodentata	III	6.0-11.9	8.5	1.11	1.40-2.85	2.10	0.23	0.30-3.55	0.92	0.59	0.03-0.23	0.09	0.04	131
atlantica	IV	8.8-12.3	10.5	0.85	2.15-2.95	2.52	0.23	1.95-5.05	3.17	0.79	0.13-0.30	0.22	0.04	30
	I	2.7-4.3	3.3	0.41	0.70-1.08	0.84	0.10	-	-	-	-	-	-	15
Sagitta	II	2.9-5.6	3.8	0.66	0.71-1.26	0.92	0.13	0.07-0.4	0.16	0.08	-	-	-	35
minima	III	3.2-7.7	5.4	1.23	0.74-1.46	1.17	0.19	0.08-0.85	0.38	0.21	-	-	-	141
	IV	5.32-7.8	7.0	0.65	1.17-1.48	1.38	0.07	0.33-1.15	0.77	0.18	-	-	-	32
	I	2.5-4.2	3.2	0.53	0.70-1.12	0.92	0.11	-	-	-	-	-	-	15
Sagitta	II	3.0-5.5	4.1	0.61	0.77-1.39	1.07	0.14	0.07-0.18	0.11	0.31	-	-	-	28
setosa	III	3.7-10.3	6.3	1.76	0.98-2.17	1.48	0.31	0.09-0.8	0.29	0.17	0.03-0.10	0.06	0.02	55
	IV	7.8-10.9	9.9	0.71	1.82-2.31	2.11	0.12	0.56-1.34	0.78	0.16	0.07-0.14	0.10	0.02	16

appears that the proportion of the ovaries in the body increases as the cheatognath grows (from equation 2: $OL/BL = aBL^{b-1}$). The only exception concerns *Sagitta setosa* for which *b* is less than 2. The seminal vesicles first appear in specimens having body length greater than 10mm in *Sagitta enflata* and 6mm in *Sagitta bipunctata*, *Sagitta serratodentata atlantica* and *Sagitta setosa*. The width of the seminal vesicles (SVW) increases directly with the body length (Figures 3-7), giving the general equation:

$$SVW = a + bBL \qquad (3)$$

In *S. enflata*, *S. bipunctata* and *S. serratodentata atlantica* the SVW was on average slightly higher than 0.20mm in mature specimens that belong to stage IV according to the present classification system. In *S. setosa* the mean SVW was 0.10mm, while no measurements of the seminal vesicles for *S. minima* specimens were taken because of their small size (less than 0.05mm).

Discussion

Sagitta enflata, *Sagitta serratodentata atlantica*, *Sagitta bipunctata* and *Sagitta minima* are chaetognath species common throughout the Eastern Mediterranean Sea, while *Sagitta setosa* has a rather limited geographical distribution: it has been found abundant in the North Adriatic Sea and the Black Sea (Furnestin, 1979), while it showed low abundance in parts of the North Aegean Sea (Kehayias, 1996). This species is characterising the low salinity areas, such as the N. Adriatic Sea, while its abundance decreases from northern to southern areas (Ghirardelli, 1975). In Patraikos Gulf, which is in direct contact with the Ionian Sea, the population of *S. setosa* must has came from this Adriatic reservoir (Kehayias, 1996).

There are only few studies concerning changes in morphological characters during the ontogenic development of the above chaetognath species in the Mediterranean Sea. Furnestin (1957) and Massuti-Oliver (1958) have presented this type of information for *S. enflata*, *S. serratodentata atlantica*, *S. bipunctata* and *S. minima* in Western Mediterranean and Furnestin (1958) for *S. setosa* in the Black Sea. Indeed, there are several references providing data on morphological characters such as the body, tail and ovary length for the five chaetognath species. There are small differences between our data and those of previous studies (Table 3), probably due to the different sampling strategies (gear, sampling depth, season) used in each of the above studies, as well as to the different number of chaetognath specimens examined. There was only one substantial disagreement between our data and those of Furnestin's (1961) for *Sagitta setosa* (Table 3). She found that this species in the Black Sea could reach 22mm in body length having ovaries as long as 6.1mm. Considering Black Sea a part of the Mediterranean Sea, these

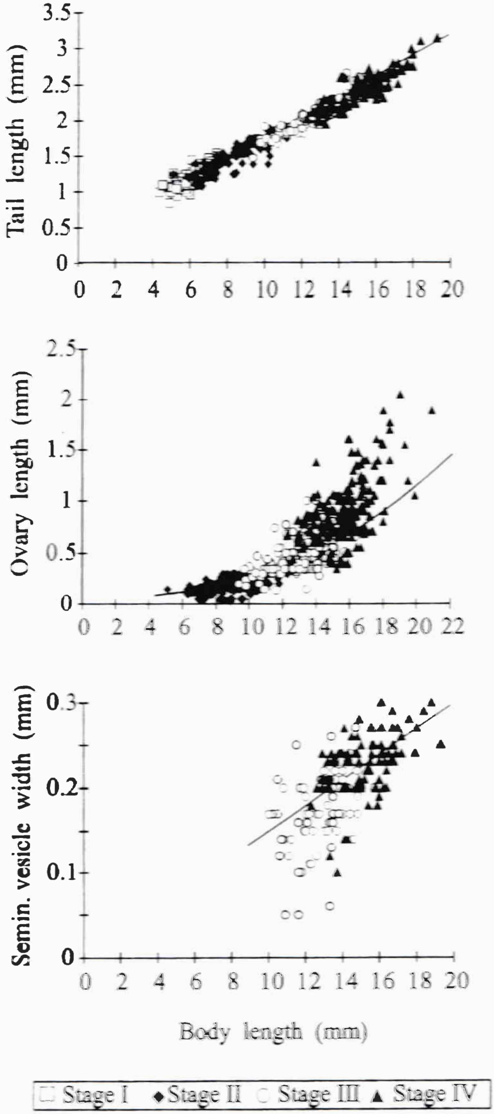

Fig. 3. The relation of body length (BL) to tail length (TL), ovary length (OL) and seminal vesicle width (SVW) for *Sagitta enflata*.

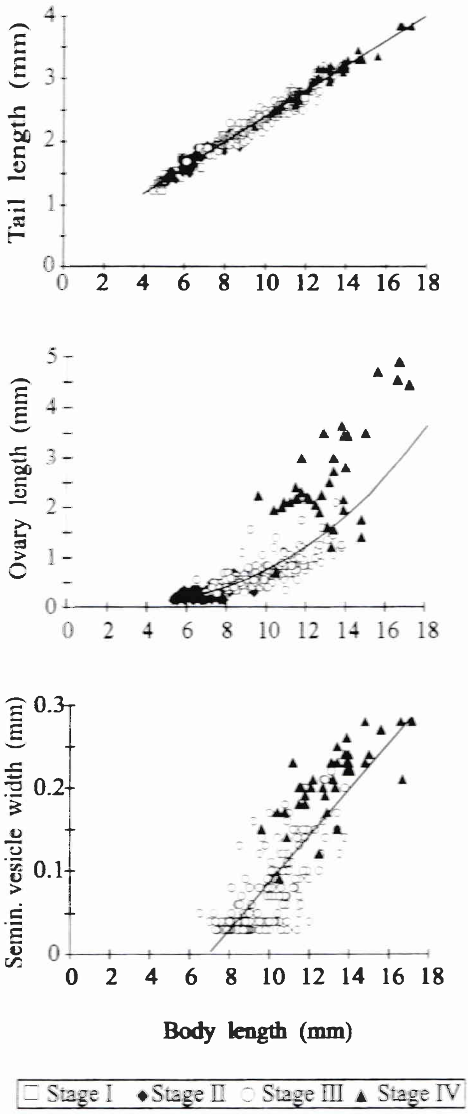

Fig. 4. The relation of body length (BL) to tail length (TL), ovary length (OL) and seminal vesicle width (SVW) for *Sagitta bipunctata*.

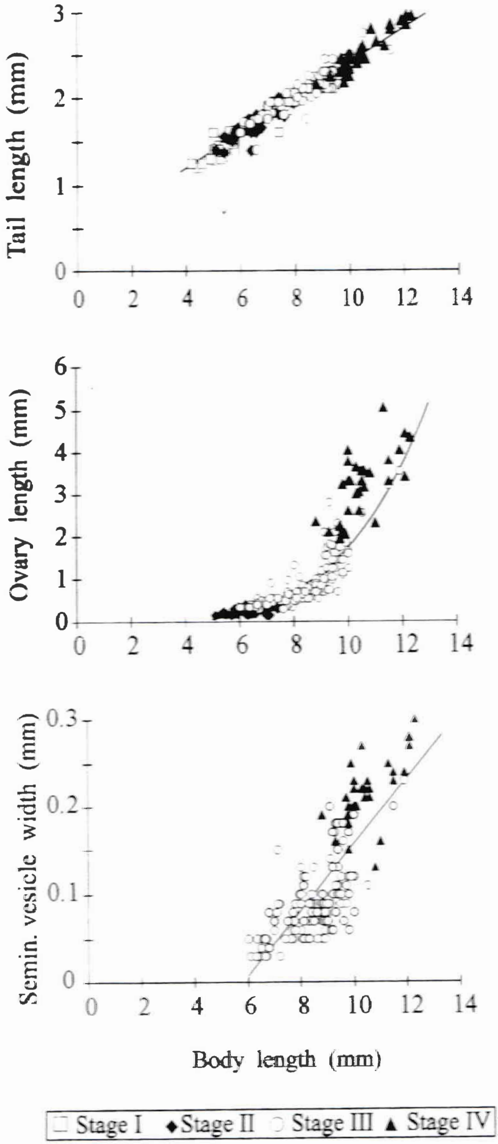

Fig. 5. The relation of body length (BL) to tail length (TL), ovary length (OL) and seminal vesicle width (SVW) for *Sagitta serratodentata atlantica*.

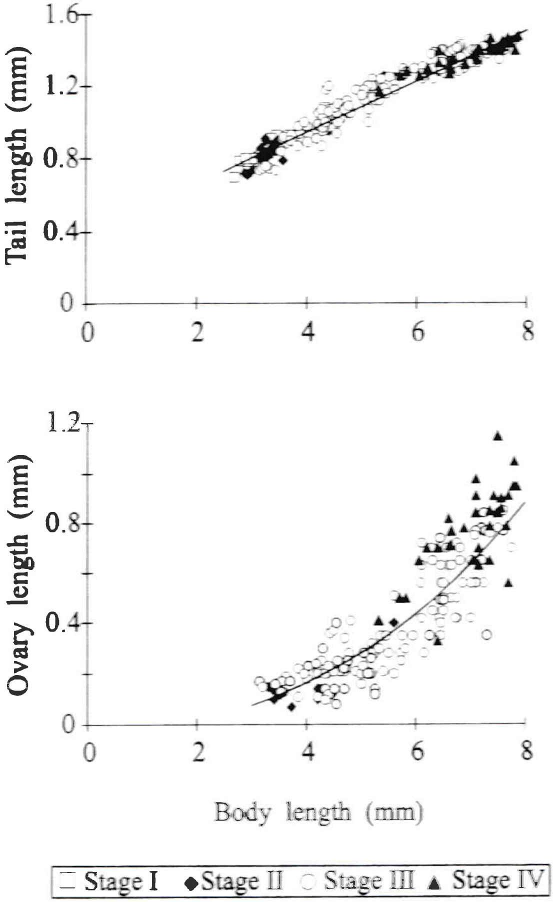

Fig. 6. The relation of body length (BL) to tail length (TL) and ovary length (OL) for *Sagitta minima*.

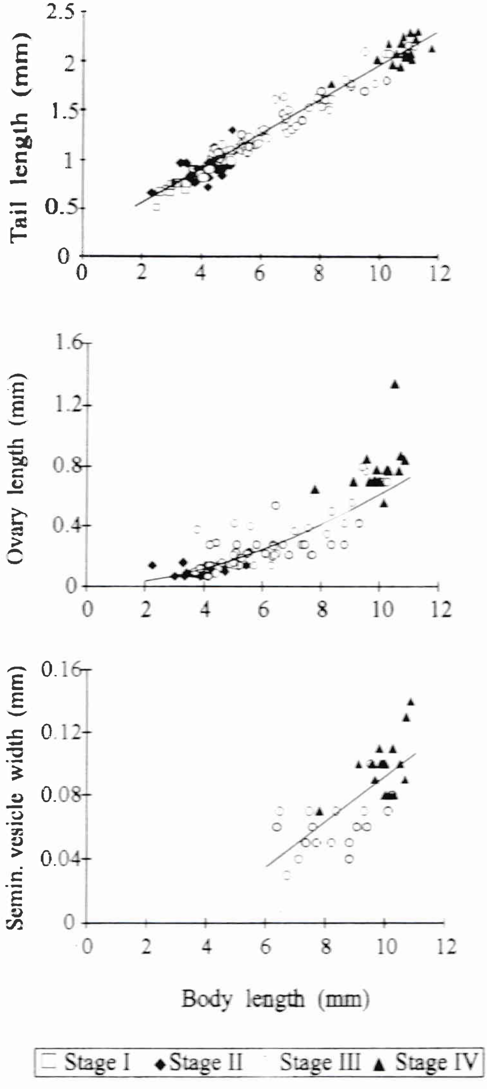

Fig. 7. The relation of body length (BL) to tail length (TL), ovary length (OL) and seminal vesicle width (SVW) for *Sagitta setosa*.

Table 2. Relation between body length (BL) and the other morphological parameters (TL, tail length; OL, ovary length; SVW, seminal vesicle width) for the five chaetognath species studied. Model, correlation coefficient (r), standard error of the estimate (SE) and number of specimens counted.

SPECIES	Equation	Correlation coef. (r)	Stand. error (SE)	No of specim. counted
S. enflata	$TL = 0.360551 + 0.139225\ BL$	r = 0.983	SE = 0.687	651
	$OL = 0.00095 * BL^{2.4366}$	r = 0.878	SE = 1.287	539
	$SVW = -0.00085 + 0.01487\ BL$	r = 0.645	SE = 1.423	165
S. bipunctata	$TL = 0.36384 + 0.201577\ BL$	r = 0.975	SE = 0.589	284
	$OL = 0.00159 * BL^{2.6812}$	r = 0.872	SE = 0.126	246
	$SVW = -0.19474 + 0.02819\ BL$	r = 0.819	SE = 1.179	182
S. serratodentata atlantica	$TL = 0.394062 + 0.20018\ BL$	r = 0.953	SE = 0.474	254
	$OL = 0.000122 * BL^{4.1501}$	r = 0.902	SE = 0.082	209
	$SVW = -0.2202 + 0.03792\ BL$	r = 0.731	SE = 0.917	161
S. minima	$TL = 0.373562 + 0.14332\ BL$	r = 0.955	SE = 0.436	223
	$OL = 0.0049 * BL^{2.4965}$	r = 0.880	SE = 0.115	181
S. setosa	$TL = 0.372314 + 0.174679\ BL$	r = 0.957	SE = 0.705	114
	$OL = 0.0099 * BL^{1.7943}$	r = 0.887	SE = 0.167	92
	$SVW = -0.050836 + 0.0142784\ BL$	r = 0.685	SE = 0.980	35

values are the highest found for this species in this area (Andreu & Riera, 1990).

Warm water chaetognaths are known to produce more than one clutch of eggs spawning in batches over several days or weeks (Reeve, 1970 and Reeve and Cosper, 1975). Spawning leads to the reduction of the ovary and seminal vesicle size in adult individuals having reproductive activity. Thus, during this process, there must be a constant underestimation of the size of the ovary and the fullness of the seminal vesicles in the adult chaetognaths. However, the fact that in the present study we have used measurements taken during several periods of time, reduces the influence of this phenomenon.

The development of chaetognaths is characterised by the increase in direct proportion to overall length of the most body sections, except the size of the ovaries (Pearre, 1991). Our results confirm this fact showing that the tail length and the seminal vesicle's width increased linearly to body length while the ovary's length exponentially. This was true for all five species. The study of the ovary length in relation to the body length revealed some discrepancies in the relative growth rate of the ovaries betweeen species. The exponent (coefficient *b* of the equation 2 is 4.15 for *Sagitta serratodentata atlantica* and only 1.79 for *Sagitta setosa*. This means that the proportion of ovaries in the body increases faster in *S. serratodentata atlantica* and covers a great part of the body in mature animals. Whether or not these differences reflect different species specific reproductive strategy remains unknown. Furnestin (1957) studied biometrical characters in *S. enflata*, *S. bipunctata*, *S. serratodentata atlantica* and *S. minima* in Western Mediterranean and found that the tail length increased linearly with the body length in all species. The ovary length increased exponentially in the first two species and linearly in the two last probably because of the low number of specimens that she had measured. Massuti-Oliver (1958) also found that the tail length of *S. enflata* increased linearly with the body length while the ovary length gave a parabolic curve. There were no references concerning the seminal vesicle width of chaetognath species in the Mediterranean Sea or in other locations. The seminal vesicles are the places where the mature sperm of chaetognaths is kept and they break during copulation. Because of their fragility are often damaged and this must be the reason why their size has not been considered in biometrical studies. Only Furnestin (1957) has given some information about them, measuring their length, but we consider their width to be a better developmental index because they «swell» during their maturation.

In conclusion, the information provided by the present study is in agreement with previous studies, but some new elements concerning the biometry of chaetognaths in the Eastern Mediterranean, where no previous observations have been reported, are provided.

Table 3. Compilation of morphological parameters of the five chaetognath species studied revealed from different authors and regions of the Mediterranean Sea and comparison with the results of the present study. (BL, body length; TL, tail length; OL, ovary length and SVW, seminal vesicle width).

Species	Morphological character	Present study (1999) Greek Waters	Furnestin (1957-61) Western Medit. & Black Sea	Chirardelli (1952) Gulf of Naples	Massuti-Oliver (1958) Western Mediterr.	Lakkis (1977) Lebanon coasts	Andreu & Riera (1990) Western Mediterr.
Sagitta enflata	BL (mm)	4.4-20.9	4.0-29.0	7.0-18.0	6.0-21.0	10.0-20.0	–
	TL (mm)	0.85-3.30	0.8-3.5	–	1.50-3.10	–	–
	TL/BL	0.13-0.25	0.13-0.23	0.14-0.17	–	0.15-0.19	–
	OL	0.03-2.05	0.1-3.0	–	0.31-1.35	–	–
	OL/BL	0.01-0.11	0.02-0.17	–	–	0.08-0.17	–
	SVW (mm)	0.05-0.30	–	–	–	–	–
Sagitta bipunctata	BL (mm)	4.5-17.2	6.5-18.0	6.0-12.0	–	8.5-12.7	–
	TL (mm)	1.25-3.85	1.9-4.0	–	–	–	–
	TL/BL	0.17-0.32	0.23-0.27	0.21-0.27	–	0.22-0.27	–
	OL	0.15-4.90	0.25-7.3	–	–	–	–
	OL/BL	0.02-0.26	0.04-0.4	–	–	0.07-0.15	–
	SVW (mm)	0.03-0.28	–	–	–	–	–
Sagitta serratodentata atlantica	BL (mm)	4.2-12.3	up to 12.0	–	–	7.8-11.4	–
	TL (mm)	1.2-2.95	1.6-2.4	–	–	–	–
	TL/BL	0.20-0.28	0.22-0.27	–	–	0.25-0.26	–
	OL	0.15-5.05	0.3-4.3	–	–	–	–
	OL/BL	0.03-0.45	0.05-0.38	–	–	0.17-0.35	–
	SVW (mm)	0.03-0.30	up to 0.20	–	–	–	–
Sagitta minima	BL (mm)	2.7-7.8	5.0-8.0	4.0-6.0	–	5.0-7.0	–
	TL (mm)	0.70-1.48	1.05-1.36	–	–	–	–
	TL/BL	0.17-0.28	0.17-0.21	0.17-0.20	–	0.18-0.21	–
	OL	0.07-1.15	0.27-0.76	–	–	–	–
	OL/BL	0.02-0.15	0.06-0.1	–	–	0.06-0.09	–
	SVW (mm)	–	–	–	–	–	–
Sagitta setosa	BL (mm)	2.50-10.9	11.0-22.0	6.0-8.0	–	–	7.8-12.0
	TL (mm)	0.70-2.31	–	–	–	–	0.8-1.3
	TL/BL	0.2-0.38	0.14-0.23	0.2-0.24	–	–	–
	OL	0.07-1.34	2.7-6.1	–	–	–	1.9-4.1
	OL/BL	0.02-0.13	up to 0.14	–	–	–	–
	SVW (mm)	0.03-0.14	up to 0.10	–	–	–	–

Περίληψη

Τα είδη *Sagitta enflata*, *Sagitta serratodentata atlantica*, *Sagitta bipunctata*, *Sagitta minima* και *Sagitta setosa* ήταν τα αφθονότερα είδη χαιτογνάθων σε δύο νηριτικές περιοχές της Ανατολικής Μεσογείου, τον Κόλπο Κισσάμου και τον Πατραϊκό Κόλπο. Με τη χρήση βιομετρικών δεδομένων, τα οποία προήλθαν από εποχιακές δειγματοληψίες στις παραπάνω περιοχές, μελετήθηκε η μεταβολή ορισμένων μορφολογικών χαρακτήρων κατά τη διαδικασία της ανάπτυξης των παραπάνω ειδών. Ειδικότερα, μελετήθηκαν οι σχέσεις του μήκους σώματος με το μήκος της ουράς, το μήκος των ωοθηκών και το πλάτος των σπερματικών κύστεων με σκοπό την άντληση πληροφοριών για την αύξηση και την ανάπτυξη των πέντε ειδών χαιτογνάθων και τη διερεύνηση των πιθανών διαφορών τους. Το μήκος της ουράς, όπως επίσης και το πλάτος των σπερματικών κύστεων έδειξαν να αυξάνουν γραμμικά με την αύξηση του μήκους του σώματος, ενώ το μήκος των ωοθηκών αυξήθηκε ακολουθώντας εκθετικό πρότυπο. Τα αποτελέσματα αυτά ήταν κοινά και για τα πέντε είδη χαιτογνάθων που μελετήθηκαν παρότι υπήρξαν διαφορές στους συντελεστές των εξισώσεων οι οποίες αντανακλούν στις διαφορές τους στην αύξηση και την ανάπτυξη.

REFERENCES

ALVARIÑO, A. 1992. Chaetognatha. Sexual differentiation and behaviour. In *Reproductive Biology of Invertebrates*, vol. 5 (ed. K.G. & R.G. Adiyodi), pp. 425-470. New Delhi: Oxford & IBH.

ANDREU, P & T. Riera. 1990. Morphometric relationships in the Chaetognath *Sagitta setosa* Müller 1847: within population versus between population variability. *Scientia Marina*, 54: 101-105.

FURNESTIN, M.-L. 1957. Chaetognathes et zooplancton du secteur Atlantique marocain. *Revue de Travaux de l'Institut des Pêches Maritimes*, 21, 1-356.

FURNESTIN, M.-L. 1961. Compléments à l'étude de *Sagitta euxina* variété de *Sagitta setosa*. *Rapports et Procès-verbaux des Réunions. Commision Internationale pour l'Exploration Scientifique de la Mer Méditerannée*, 16(2), 97-101.

FURNESTIN, M.-L. 1979. Aspects of the zoogeography of the Mediterranean plankton. In *Zoogeography and diversity in plankton*, vol. 11 (ed. S. van der Spoel and A. C. Pierrot-Bults), pp. 191-253. Utrecht: Bunge Scientific Publications.

CHIRARDELLI, E. 1952. Osservazioni biologiche e sistematiche sui Chetognati del Golfo di Napoli. *Pubbl. Sta. zool. Napoli*, 23, 296-312.

CHIRARDELLI, E. 1975. North Adriatic plankton - Chaetognatha, occurence and distribution. In *Proceedings of the 9th european marine Bilogy Symposium* (ed. H. Barnes). pp. 609-627. Aberdeen: University Press.

KEHAYIAS, G., J. LYKAKIS & N. FRAGOPOULU. 1992. Temporal variation of the different developmental stages of Chaetognaths in the Gulf of Kisamos (Cretan Sea). *Rapports et Procès-verbaux des Réunions Commision Internationale pour l'Exploration Scientifique de la Mer Méditerannée*, 33, 254.

KEHAYIAS, G. 1996. Contribution on the study of the ecology of chaetognaths in Greek Waters. *PhD Thesis*, University of Patra, pp. 211.

LAKKIS, S. 1977. Les Chaetognathes des eaux Libanaises. (Observations faunistiques et écologiques). *Rapp. Comm. int. Mer Medit.* 24 (10), 137-138.

MASSUTI-OLIVER, M. 1958. Estudio del crecimiento relativo de *Sagitta enflata* Grassi del plankton de Castellon. *Investigacion Pesquera*, XIII, 37-48.

PEARRE, S. Jr. 1991. Growth and reproduction. Chapter 7. In *The Biology of Chaetognaths*, (ed. Q. Bone, H. Kapp & A.C. Pierrot-Bults), pp. 61-75. Oxford: Oxford University Press.

REEVE, M.R. 1970. The biology of Chaetognatha. I. Quantitative aspects of growth and egg production in *Sagitta hispida*. In *Marine food chains*, (ed. J. H. Steele), pp. 168-189. Edinburgh: Oliver & Boyed Press.

REEVE, M.R. & T. C. COSPER. 1975. Chaetognatha. *In Reproduction of marine invertebrates*, vol. 2 (ed. A.C.GIESE & J.S. PEARSE), pp. 157-184. New York: Academic Press.

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