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MEDITERRANEAN MARINE DEMERSAL RESOURCES: THE MEDITS INTERNATIONAL TRAWL SURVEY (1994-1999).
P. ABELLÓ, J.A. BERTRAND, L. GIL DE SOLA, C. PAPACONSTANTINOU, G. RELINI and A. SOUPLET (eds.)

MEDITS-based information on the deep-water red shrimps *Aristaeomorpha foliacea* and *Aristeus antennatus* (Crustacea: Decapoda: Aristeidae)*

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SUMMARY: The application of statistical models on a time series of data arising from the MEDITS International Trawl Survey, an experimental demersal resources survey carried out during six years (1994-1999) in the same season of the year (late spring - early summer) using the same fishing gear in a large part of the Mediterranean, has allowed for a study to compare, for the first time, the space-time distribution, abundance, and size structure of the two Aristeids *Aristaeomorpha foliacea* and *Aristeus antennatus* throughout most of the Mediterranean Sea. This research has shown a large variability among the six reference areas, that were arbitrarily defined within the basin. In particular the two shrimps do not seem to present any correlation or yield continuity in the years. The same lack of homogeneity was also observed in the time trend of the abundances and frequencies of each of the two species. These data seem to confirm the intrinsic variability of the species, the cause of which is still unknown and undocumented. Nevertheless, a longitudinal gradient of catches has been observed where *A. antennatus* is more abundant in the west and *A. foliacea* in the east of the basin.

Key words: red shrimps, *Aristaeomorpha foliacea*, *Aristeus antennatus*, bottom trawls, distribution, biology, Mediterranean

INTRODUCTION

The red shrimps *Aristeus antennatus* and *Aristaeomorpha foliacea* are the main target species of Mediterranean deep trawling. Both species were described in the Ligurian Sea, in the early nineteenth century by Risso, but were first exploited less than a century ago, while in some eastern areas of the Mediterranean their exploitation has just started.

In updated systematic approaches (Pérez-Farfante and Kensley, 1997) *A. antennatus* and *A. foliacea* are the only Mediterranean representatives of the Aristeidae family. Important morphological characteristics of both species are i) light exoskeletons and long pleopods suggesting good swimming ability; ii) secondary sexual dimorphism concerning

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body size and the rostrum, which is short in adult males and long in juveniles and adult females; and iii) an open telicum. The spermatophores are larger in *A. antennatus*, in relation to a greater fecundity: in fact the females of *A. antennatus* produce about four times more eggs than *A. foliacea* females of the same size (Orsi Relini and Semeria, 1983). The life history of the two species therefore begins with a very different energy budget and probably body development.

The distribution of the red shrimp recalls its origin in the Mesozoic basin of Tethys, which extended approximately from the present Caribbean to the Indian Ocean and included areas corresponding to the present Mediterranean. Red shrimps are therefore present in the Eastern Atlantic, the Mediterranean, and the Indian Ocean, but *A. foliacea* reaches as far as the Western Atlantic and New Zealand.

Information on their larval and early juvenile stages is scarce and particularly the distribution of larvae is still unknown. As a matter of fact, very young shrimps, less than 15 mm carapace length have been found generally in small quantities both in very deep waters (Sardà *et al*., 1994) and on fishing grounds (Martínez-Baños and Mas, 1994, D'Onghia *et al.*, 1997). Large numbers of juveniles have been followed regularly only in Sardinian waters (Mura *et al.*, 1997).

What appears to be recruitment to the fishery (i.e. the first large group identified in length frequency distributions) are shrimps of both species of about 24-25 mm CL, but especially in *A. antennatus*, this pattern is not found in all fishing areas, and does not appear regularly in any given area each year. Sudden changes in the size structure of the fished stock of *A. antennatus* may occur also for sizes larger than those mentioned above (Orsi Relini and Relini, 1998a).

Consequently, though the population dynamics of *A. foliacea* seems a little clearer than that of *A. antennatus* (Ragonese *et al*., 1994; Spedicato *et al*., 1998; D'Onghia *et al.*, 1998), given a more regular identification of cohorts in the fished stocks, the absolute age of recruits (i.e. if individuals of 24 mm CL represent the 0 group or the I or II group) remains an open issue.

Assessments of *A. antennatus* and *A. foliacea* have been attempted repeatedly. Table 1 (Fiorentino, 2000) gives the parameters used by different authors and their conclusions. It is well known that formulae for natural mortality (M) have been developed generally for fish stocks, in which the Von Bertalanffy parameters, and at times also longevity, have been introduced. Therefore the assessment of life span and growth can be the key to these attempts. Considering the evolution of growth studies, the emerging trend is to assign to red shrimps an increasingly longer life span and obviously a slower growth and a lower natural mortality rate. At present, the results of the first tagging attempts (Relini *et al*., 2000) are apparently supporting this new trend.

The main objective of this paper is to process MEDITS trawl survey data on depth distribution, abundance, length structure, and general biology (reproductive aspects excluded) of *Aristeus anten-*

TABLE 1. – Summary of biological parameters employed in assessment attempts for red shrimps in the Mediterranean (first part on *A. antennatus* from Fiorentino, 2000)

Geographic area	Sex	L_∞CL (mm)	K (y^{-1})	t_0(y)	M	Assessment	Authors
Aristeus antennatus							
Algeria	F	65.10	0.37	0.00	0.47	Fully exploitation	Yahiaoui *et al.* (1986)
Catalonia and Valencia	F	76.00	0.30	-0.07	0.50	Fully or under exploitation	Demestre and Lleonart (1993)
	M	54.00	0.25	-0.50	0.80		
Campania and Calabria	F	66.80	0.56	-0.23	0.65	Light overexploitation	Spedicato *et al.* (1995)
Sicily Strait	F	69.10	0.53	0.00	0.50	Under exploitation	Ragonese and Bianchini (1996)
	F	69.10	0.53	0.00	0.80	Fully exploitation	
Latium	F	67.65	0.49	0.00	0.45	Overexploitation	Colloca *et al.* (1998)
Ligurian Sea	F	71.21	0.32	-0.05	0.3	Overexploitation (risk of	Fiorentino *et al.* (1998)
	F	76.90	0.21	-0.02	0.3	recruitment overfishing)*	
Ionian Sea	M	51.50	0.40	-0.35	0.66	Fully exploitation	Tursi *et al.* (1998)
	F	77.20	0.35	-0.36	0.66		
Aristaeomorpha foliacea							
Sicily Strait	F	65.5	-0.67		0.42		Ragonese *et al.* (1994)
Campania and Calabria	F	76.29	0.45		0.78**	Light overexploitation	Spedicato *et al.* (1998)
Ionian Sea	F	69.80	0.45	-0.18	0.65	Overexploitation	Tursi *et al.* (1998)
	M	49.70	0.42	-0.34	0.67		

*Reference point $F_{0.1}$ instead of F_{max}; ** mean of 7 values obtained by different formulae

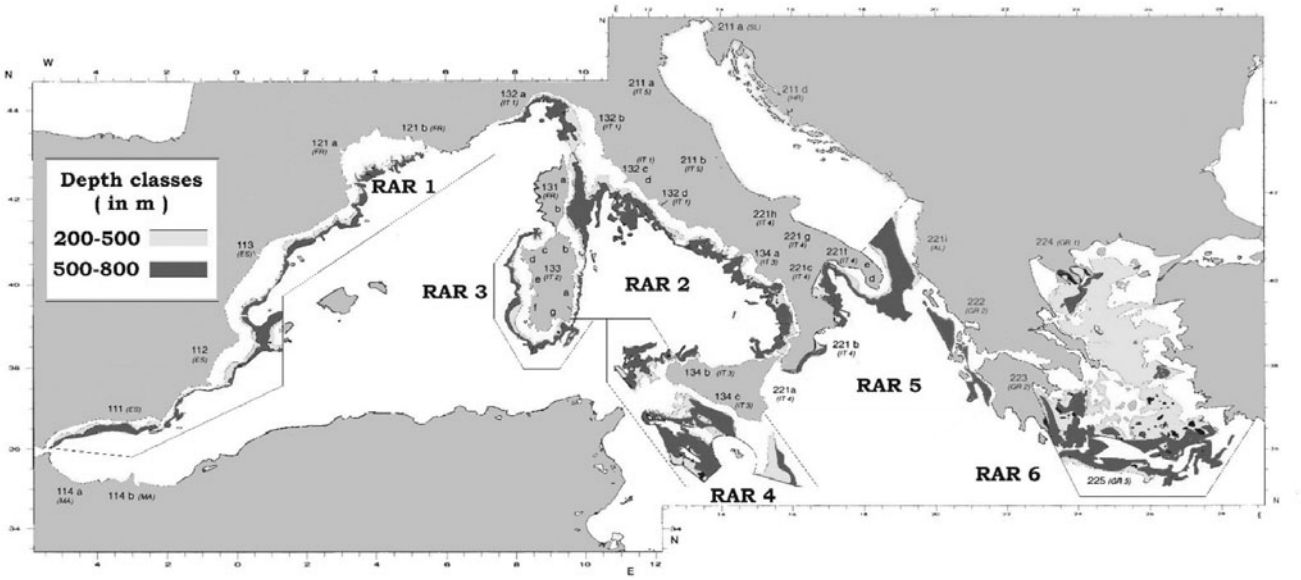

FIG. 1. – Map of the study area according to the MEDITS programme, with an indication of the Reference Areas (RAR) studied.

natus and *Aristaeomorpha foliacea* to support future assessment procedures.

MATERIALS AND METHODS

A data base gathered in six surveys (1994 to 1999) during the international MEDITS Trawl survey (MEDITS programme, Bertrand *et al*., 2000, 2002) from late spring to early summer was considered. In total, an average 360 hauls per year were carried out according to a depth stratified random methodology. An experimental net (with 20 mm cod end stretched mesh size) was used in the survey. The hauls had an average duration of 1 h, and were carried out only during daylight at depths of between 201 and 800 m. Further details on the methodology can be found in Bertrand *et al*. (2000, 2002).

Basically, considering the homogeneity of the Mediterranean, the specific figures were pooled within six predefined basins (hereby defined as "reference areas"; RAR) (Fig. 1):

RAR 1) Algerian Provencial (western Mediterranean, Gulf of Lions);

RAR 2) Tyrrhenian Sea (Tyrrhenian Sea, Ligurian Sea, eastern coast of Sardinia and Corsica);

RAR 3) Sardinian Sea (western coast of Sardinia and Gulf of Cagliari);

RAR 4) Strait of Sicily;

RAR 5) Ionian Sea (Ionian Sea, western coast of Hellas, southern Adriatic Sea);

RAR 6) Aegean Sea.

The north and central Adriatic Sea was left out due to the scarce presence of the target species.

For each RAR, year, and species, the Biomass Indices (BI; kg/km^2) were estimated by single and pooled strata falling in the species/area distribution (i.e., 201-500 m, 501-800 m, and overall slope: 201-800 m) and presented in a synoptic table together with the corresponding coefficient of variation (CV%). These CV% were expressed as the percentage ratio between the standard deviation (S) of the sample and the mean (CV=S/X*100). Original data are presented in Appendices 1-4.

For each shrimp specimen, sex was determined and the carapace length (CL) was measured to the nearest mm, from behind the orbit of the eye to the posterior border of the carapace. The percentage contribution of both females and males to the sex ratio of the samples was estimated by species and survey. The Length Frequency Distributions (hereafter LFD) were derived and graphically represented by sex and year, both as percentage frequency per length class and as box plots of median, minimum and maximum CL.

The similarity and homogeneity among the LFD of the different years were tested by comparing the medians with the non-parametric test of Kruskal Wallis (herein KW). The KW test was applied using STATISTICA software (StatSoft, Inc., 1995). The KW test statistics is a function of the ranks of the observations in the combined sample for K>2 independent samples (Conover, 1980; Zar, 1996). The hypotheses are as follows:

H_0= all of the K sample distribution functions are identical;

H_1= at least one of the samples tends to yield a higher observed value than at least one of the other samples.

In the event of the H_0 hypothesis being refused, a multiple comparison procedure (Tukey test) was used to check which years contributed most to the difference of the medians. The probability level of significant difference was set at p=0.05.

The growth curves for the females of the two species of each RAR were identified. To this purpose the Modal class Progression Analysis (MPA) routine available within the software "FiSAT"

TABLE 2. – Mean biomass index (kg/km²) and corresponding coefficient of variation (CV%) of *Aristaeomorpha foliacea* for each RAR according to MEDITS trawl database

	1994		1995		1996		1997		1998		1999		
	kg/km²	CV%	kg/km²	CV%	kg/km²	CV%	kg/km²	CV%	kg/km²	CV%	kg/km²	CV%	
Depth 201-500 m													
Algerian-Provencial -RAR1	0.00	n. c.	0.00	-	0.01	95.51	0.00	-	0.00	-	0.00	-	
Tyrrhenian sea - RAR 2	0.17	n. c.	0.17	41.91	0.16	65.41	0.27	66.23	0.92	51.52	0.54	54.56	
Sardinian sea - RAR 3	0.46	88.53	0.09	86.91	0.07	103.17	1.15	96.99	3.85	81.49	0.06	96.90	
Strait of Sicily - RAR 4	0.03	95.49	0.00	-	0.00	-	0.00	-	0.04	81.58	0.01	72.53	
Ionian sea - RAR 5	0.06	n. c.	0.24	47.07	0.45	32.79	0.38	54.63	0.07	51.96	0.46	92.26	
Aegean sea - RAR 6	0.00	-	0.00	-	0.02	60.19	0.06	108.28	0.00	-	0.00	-	
Depth 501-800 m													
Algerian-Provencial -RAR1	0.00	-	0.04	73.11	0.06	92.88	0.00	-	0.00	-	0.03	67.50	
Tyrrhenian sea - RAR 2	11.10	n. c.	6.17	19.39	7.08	14.10	13.59	20.58	13.02	13.05	15.03	17.30	
Sardinian sea - RAR 3	9.64	42.15	10.22	23.85	23.86	23.24	22.61	22.89	31.65	27.01	27.94	16.89	
Strait of Sicily - RAR 4	38.89	24.24	11.43	25.59	15.12	24.17	16.67	25.77	19.41	21.79	25.62	20.78	
Ionian sea - RAR 5	0.57	n. c.	0.67	29.86	0.60	41.09	0.23	17.45	3.71	55.08	10.55	84.70	Overall
Aegean sea - RAR 6	0.00	-	0.24	46.74	0.40	66.41	3.11	49.33	23.89	88.71	10.73	30.97	Mean Index
Depth 201-800 m													
Algerian-Provencial -RAR1	0.00	-	0.02	73.11	0.03	78.95	0.00	-	0.00	0.00	0.02	67.50	0.01
Tyrrhenian sea - RAR 2	4.61	n. c.	2.37	26.35	2.31	22.66	5.65	25.81	4.96	18.43	6.01	22.67	4.32
Sardinian sea - RAR 3	4.44	40.00	4.48	23.59	10.37	23.16	10.45	22.30	15.89	25.84	12.14	16.84	9.63
Strait of Sicily - RAR 4	20.95	24.22	6.15	25.59	8.14	24.17	8.97	25.77	10.47	21.75	13.80	20.77	11.41
Ionian sea - RAR 5	0.34	n. c.	0.47	25.39	0.53	28.27	0.30	32.34	2.04	54.25	5.92	81.77	1.6
Aegean sea - RAR 6	0.00	-	0.12	46.74	0.22	63.77	1.63	48.48	12.26	88.71	5.51	30.97	3.29

n.c. not computable given limitation of the original database

TABLE 3. – Mean biomass index (kg/km²) and corresponding coefficient of variation (CV %) of *Aristeus antennatus* for each RAR according to MEDITS trawl database.

	1994		1995		1996		1997		1998		1999		
	kg/km²	CV%	kg/km²	CV%	kg/km²	CV%	kg/km²	CV%	kg/km²	CV%	kg/km²	CV%	
Depth 201-500 m													
Algerian-Provencial –RAR 1	1.19	n. c.	0.00	-	0.06	82.22	1.28	93.90	0.10	39.26	0.19	52.92	
Tyrrhenian sea - RAR 2	0.02	n. c.	0.00	-	0.33	100.46	0.00	126.97	0.00	-	0.00	-	
Sardinian sea - RAR 3	0.00	-	0.51	86.91	0.00	-	0.02	68.04	0.09	77.10	0.00	-	
Strait of Sicily - RAR 4	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	
Ionian sea - RAR 5	0.64	n. c.	0.21	108.65	1.21	85.03	0.44	85.67	0.01	172.61	1.41	321.25	
Aegean sea - RAR 6	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	
Depth 501-800													
Algerian-Provencial -RAR1	6.19	26.85	9.06	27.86	9.63	29.55	9.01	26.10	7.09	22.99	4.64	29.01	
Tyrrhenian sea - RAR 2	6.98	n. c.	2.46	29.71	2.07	37.99	5.20	31.52	4.46	14.64	3.22	26.27	
Sardinian sea - RAR 3	7.04	36.24	5.52	21.22	11.21	25.50	13.00	17.45	18.20	22.63	19.24	57.39	
Strait of Sicily - RAR 4	1.73	81.38	0.92	85.29	0.44	88.33	1.02	52.99	1.59	66.67	0.76	86.56	
Ionian sea - RAR 5	8.78	n. c.	2.44	34.89	6.01	30.12	10.71	27.33	8.15	19.37	7.44	31.59	Overall
Aegean sea - RAR 6	0.00	-	0.00	-	0.01	96.54	0.03	66.84	0.03	96.64	0.93	70.87	Mean Index
Depth 201-800													
Algerian-Provencial -RAR1	3.61	n. c.	4.39	27.86	4.70	29.35	5.03	25.81	3.49	22.66	2.35	27.90	3.93
Tyrrhenian sea - RAR 2	1.66	n. c.	0.05	771.49	0.32	138.07	1.04	82.07	0.70	48.30	0.41	106.61	0.70
Sardinian sea - RAR 3	3.05	36.24	2.68	21.13	4.85	25.50	5.64	17.41	7.94	22.49	8.33	57.39	5.42
Strait of Sicily - RAR 4	0.93	60.94	0.50	64.70	0.24	65.27	0.55	39.16	0.86	49.69	0.41	64.52	0.58
Ionian sea - RAR 5	5.04	n. c.	1.42	33.33	3.81	28.56	6.00	26.57	4.42	19.35	4.68	52.15	4.23
Aegean sea - RAR 6	0.00	-	0.00	-	0.00	96.54	0.02	66.84	0.01	96.64	0.48	70.87	0.08

n.c. not computable given limitation of the original database

(Gayanilo *et al.*, 1996) was used. This routine was employed to discriminate the components of the LFD. Subsequently, using the means of each identified age group, we made a non-linear estimate of the growth parameters of the von Bertalanffy Growth Function (Analysis of length at age data in FiSAT). When it was not possible to calculate the growth parameters directly from MEDITS data, the corresponding estimates were derived from the specific literature in order to allow a general comparison.

A two-by-two comparison of the growth curves for each species was carried out considering two RARs each time and calculating the area between the two curves. The calculation was performed using the integral of the absolute distances between the integration extremes, t_1 and t_2, where t_1 = age of fishing recruitment and t_2= maximum age hypothesised per species.

For *Aristeus antennatus,* t_1 was assigned a value of 0.75 and t_2 a value of 6.0, while for *Aristaeomorpha foliacea,* t_1 was assigned 0.75 and t_2 3.5. The values obtained represent the distances between two curves that are proposed as comparison indices: a high index value indicates a broader distance and so a higher diversity between two curves.

TABLE 4. – Percentage contribution (in biomass) for *Aristaeomorpha foliacea* and *Aristeus antennatus* in each of the reference areas.

	RAR 1 Algerian Provencial	RAR 2 Tyrrhenian Sea	RAR 3 Sardinian Sea	RAR 4 Strait of Sicily	RAR 5 Ionian Sea	RAR 6 Aegean Sea
Aristaeomorpha foliacea	0.36	79.53	63.81	92.36	20.06	96.31
Aristeus antennatus	99.64	20.47	36.19	7.64	79.94	3.69

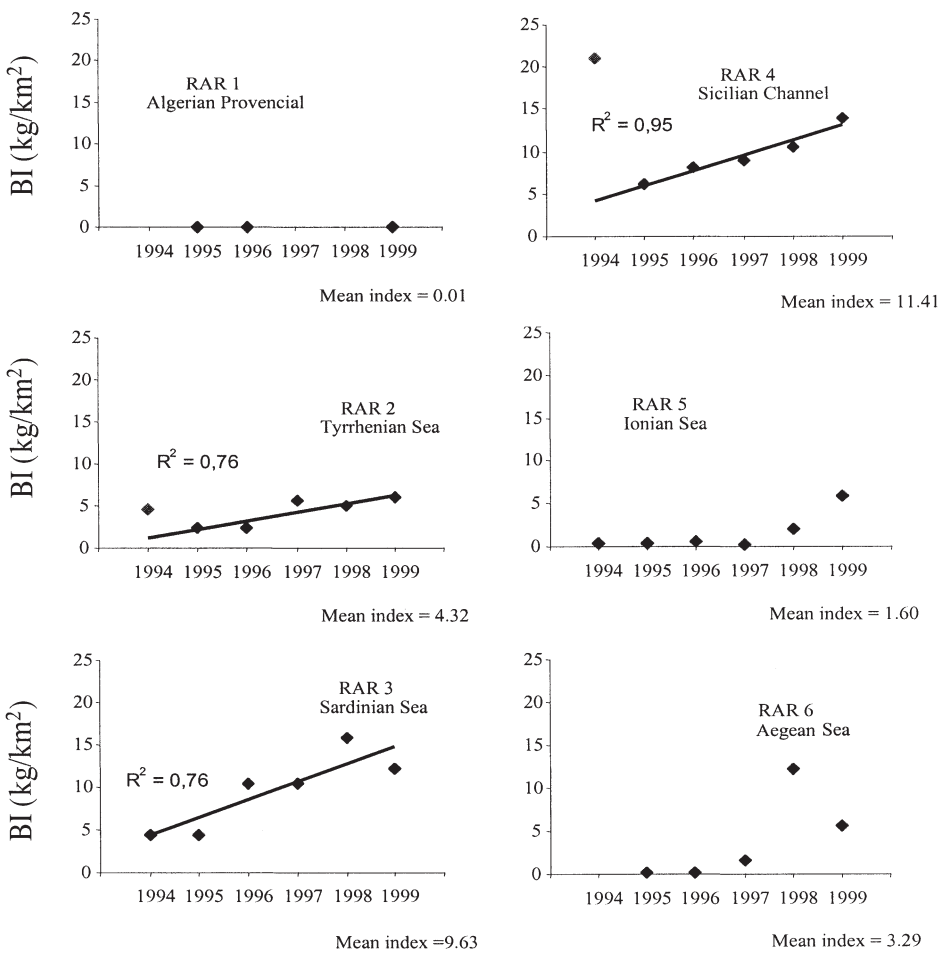

FIG. 2. – Trends in biomass index (kg/km^2), from 1994 to 1999, of *Aristaeomorpha foliacea* for each reference area. The regression line is also shown when there is a significant correlation.

RESULTS

Distribution and abundance

Based on the quantitative analysis of the space distribution of the catches (kg/km^2), the MEDITS data reflect a different distribution pattern for the two species.

The trend of the mean biomass indices recorded at depths of between 201 and 800 m in the six years on the whole (1994-1999) (Tables 2-3: overall mean index) showed that *A. antennatus* was most abundant in the Sardinian Sea (RAR 3 with 5.42 kg/km^2), and least abundant in the easternmost part of the Mediterranean (Aegean Sea - RAR 6). On the contrary, *A. foliacea* showed fewer catches in the westernmost areas (Algerian Provencial - RAR 1) and greater yields in the centre (Strait of Sicily -RAR 4) (Tables 2-4).

In this macrostratum the most abundant catches of *A. foliacea* were recorded for RAR 2, 3, and 4. For these macroareas, the regression between biomass indices (except in 1994 for RAR 2 and 4) and the different MEDITS years showed a significant correlation (p>0.05) (Fig. 2). Concerning *A. antennatus,* high biomasses were estimated in RAR 1, 3, and 5, but the increase in catches in the years (positive trend) can only be seen in the Sardinian Sea (RAR 3) (p>0.05) (Fig. 3).

On analysing the single strata (201-500 and 501-800 m) we observed that the largest catches in both species were made at 501-800 m, while above this depth (201-500 m) the catches were smaller (Tables 2-3).

Sex ratio

A total of 60,460 specimens of *A. foliacea* were measured and sexed throughout the MEDITS area.

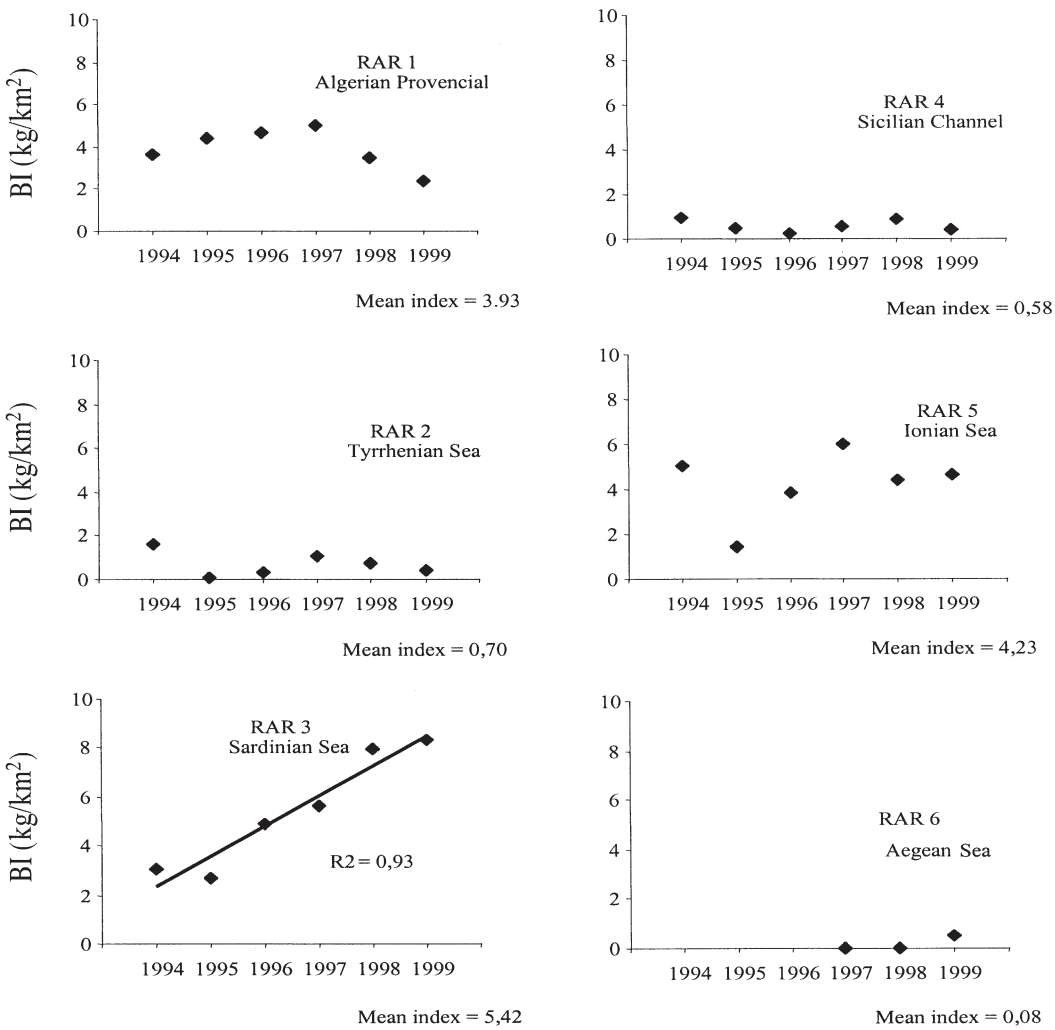

FIG. 3. – Trends in biomass index (kg/km^2), from 1994 to 1999, of *Aristeus antennatus* for each reference area. The regression line is also shown when there is a significant correlation.

TABLE 5. – Annual and overall contribution (%) of males and females and basic descriptive statistics for the sizes (CL, mm) of *Aristaeomorpha foliacea* in each RAR. Letters in the Tukey test column indicate the pairwise similarity with the corresponding years.

				MALES						FEMALES					
	Sample size	% MM	% FF	Sample size	Min	Max	Median	Tukey test(*)	Mean	Sample size	Min	Max	Median	Tukey test(*)	Mean
Algerian-Provencial - RAR 1															
a 1994	0	0	0												
b 1995	7	86	14	6	35	41	39		39	1	16	16	16		
c 1996	3	100	0	2	31	32	31		-	1	38	38	38		
d 1997	0	0	0												
e 1998	0	0	0												
f 1999	4	25	75	1	24	24	24		-	3	33	44	40		39
TOT%		69	31												
TOT N	14	9	5												
Tyrrhenian sea - RAR 2															
a 1994	2638	42	58	1098	17	45	35		34	1540	22	71	46	c	44
b 1995	3945	38	62	1516	16	49	26	d	27	2429	15	65	26		29
c 1996	2194	47	53	1036	19	58	34		33	1158	19	72	45	a	42
d 1997	9061	42	58	3786	19	48	26	b	27	5275	17	69	26		29
e 1998	5710	40	60	2261	13	45	32	f	30	3449	10	68	28	f	34
f 1999	7271	40	60	2942	15	45	32	e	30	4329	13	68	29	e	33
TOT %		41	59												
TOT N	30819	12639	18180												
Sardinian sea - RAR 3															
a 1994	640	36	64	229	15	44	35		34	411	18	68	44		41
b 1995	1679	43	57	720	14	49	25		26	959	15	70	24		28
c 1996	2066	49	51	1015	20	49	33	d,f	33	1051	19	67	42	f	39
d 1997	2371	35	65	836	20	44	34	c,f	32	1535	18	65	28		34
e 1998	5622	20	80	1137	9	44	28		30	4485	12	65	23		26
f 1999	2282	47	53	1065	21	49	33	c,d	33	1217	17	69	43	c	39
TOT %		34	66												
TOT N	14660	5002	9658												
Strait of Sicily - RAR 4															
a 1994	2904	38	62	1098	18	43	35	b,c,f	34	1806	18	74	41	d	38
b 1995	811	47	53	382	16	48	35	a,c,d,e,f	33	429	17	71	46	c,d,f	42
c 1996	1066	48	52	507	20	49	35	a,b,d,e,f	34	559	17	67	46	b,d,f	43
d 1997	1265	53	47	668	19	45	34	b,c,e	33	597	20	69	44	a,b,c,f	41
e 1998	1316	47	53	619	20	45	35	b,c,d,f	34	697	20	66	48		47
f 1999	1833	46	54	844	20	45	35	a,b,c,e	34	989	17	69	46	b,c,d	42
TOT %		45	55												
TOT N	9195	4118	5077												
Ionian sea - RAR 5															
a 1994	392	51	49	201	13	44	23	b,d	25	191	13	54	24	c,d,e,f	30
b 1995	722	23	77	163	14	36	31	a,d	28	559	11	63	22		26
c 1996	507	35	65	179	18	42	32	f	30	328	10	65	24	a,d,e	30
d 1997	377	29	71	111	18	38	26	a,b	28	266	15	66	26	a,c,e,f	29
e 1998	460	34	66	156	12	43	34		33	304	11	69	25	a,c,d,f	32
f 1999	1353	55	45	742	15	44	31	c	30	611	13	64	26	a,d,e	30
TOT %		41	59												
TOTN	3811	1552	2259												
Aegean sea - RAR 6															
a 1994	0	0	0												
b 1995	20	35	65	7	25	30	30	c,d	28	13	20	45	25	c,d	29
c 1996	43	42	58	18	24	36	27	b,d	28	25	23	51	29	b	31
d 1997	177	55	45	97	30	40	34	b,c	34	80	20	53	44	b	43
e 1998	1150	57	43	655	24	51	38		38	495	23	56	50	f	47
f 1999	573	48	52	272	23	58	36		36	301	19	60	48	e	43
TOT %		54	46												
TOT N	1963	1049	914												

TABLE 6. – Annual and overall contribution (%) of males and females and basic descriptive statistics for the sizes (CL, mm) of *Aristeus antennatus* in each RAR. Letters in the Tukey test column indicate the pairwise similarity with the corresponding years.

				MALES						FEMALES					
	Sample size	% MM	% FF	Sample size	Min	Max	Median	Tukey test(*)	Mean	Sample size	Min	Max	Median	Tukey test(*)	Mean
Algerian Provencial - RAR 1															
a 1994	1015	14	86	146	21	31	26	b,c,d,e	26	869	23	63	41		42
b 1995	1667	17	83	288	16	36	25	a,d	26	1379	19	62	34	d,e	36
c 1996	1155	28	72	326	16	38	26	a,d,e	26	829	16	63	37	e	38
d 1997	1050	34	66	361	15	36	25	a,b,c	26	689	18	66	34	b,e	36
e 1998	1006	47	53	470	17	42	26	a,c	27	536	17	62	35	b,c,d	36
f 1999	1069	25	75	270	15	33	23		23	799	14	60	31		33
TOT%		27	73												
TOT N	6962	1861	5101												
Tyrrhenian sea - RAR 2															
a 1994	2171	13	87	282	18	38	24	d,f	25	1889	18	64	38	c,f	39
b 1995	864	12	88	101	14	35	23	c,d,f	23	763	18	63	40	e	41
c 1996	772	12	88	96	18	41	22	b	23	676	17	63	37	a,f	38
d 1997	2361	27	73	628	11	36	25	a,b,f	24	1733	17	62	33		35
e 1998	1383	11	89	149	17	39	26		26	1234	19	63	40	b	40
f 1999	1283	15	85	198	17	37	24	a,b,d	25	1085	17	62	38	a,c	39
TOT %		16	84												
TOT N	8834	1454	7380												
Sardinian sea - RAR 3															
a 1994	857	14	86	118	17	44	21	b,c,e	22	739	14	54	31	d,e	31
b 1995	797	25	75	199	13	30	21	a,c,e	21	598	11	63	28		30
c 1996	1459	10	90	150	17	31	20	a,b,d,e	21	1309	15	56	31	e	33
d 1997	2011	19	81	390	16	39	20	c	21	1621	16	58	29	a	32
e 1998	2301	24	76	562	16	30	21	a,b,c	21	1739	15	60	31	a,c	33
f 1999	2027	9	91	181	18	31	23		24	1846	18	59	35		35
TOT %		17	83												
TOT N	9452	1600	7852												
Strait of Sicily - RAR 4															
a 1994	118	19	81	23	18	33	27	b,c,d,f	26	95	20	60	43	b,c,d,f	42
b 1995	53	15	85	8	21	30	28	a,c,d,e,f	26	45	31	57	46	a,c,d,f	45
c 1996	23	13	87	3	26	32	27	a,b,d,e,f	28	20	22	64	49	a,b,d,e,f	48
d 1997	66	20	80	13	21	32	28	a,b,c,e,f	28	53	23	57	45	a,b,c,f	44
e 1998	74	8	92	6	30	40	32	b,c,d,f	33	68	30	66	51	c,f	49
f 1999	53	21	79	11	20	32	27	a,b,c,d,e	26	42	22	59	45	a,b,c,d,e	44
TOT %		17	83												
TOT N	387	64	323												
Ionian sea - RAR 5															
a 1994	2000	20	80	393	18	33	26	d	26	1607	16	63	43		41
b 1995	969	29	71	278	17	34	24	b,c	25	691	14	63	37	c	38
c 1996	2321	22	78	511	17	34	24		24	1810	17	65	38	b	38
d 1997	2766	19	81	512	17	39	25	a,e	26	2254	16	66	38		38
e 1998	4118	39	61	1600	15	39	25	d	25	2518	14	64	33		34
f 1999	2962	32	68	954	15	38	27		27	2008	15	63	39		39
TOT %		28	72												
TOT N	15136	4248	10888												
Aegean sea - RAR 6															
a 1994	0	0	0												
b 1995	0	0	0												
c 1996	1	0	100							1					
d 1997	5	20	80	1						4	14	19	16		17
e 1998	1	0	100							1					
f 1999	39	33	67	13	24	37	32		31	26	42	58	53		51
TOT %		31	69												
TOT N	45	14	31												

A prevalence of females can be generally observed, representing 60% of the sampled total, except for the Aegean Sea (RAR 6), where only 46% out of a total of 1,961 individuals were females (Table 5).

A sharp prevalence of the number of females was always observed for *A. antennatus*, where they represented 77.4% out of a total of 40,827 specimens (Table 6).

Size frequency distributions and median analysis

Aristaeomorpha foliacea

The size frequency distributions analysed for the six years of the study in *A. foliacea* showed a trend in which for both sexes in all RAR's (except RAR 1), the fishing recruits are clearly distinct from the

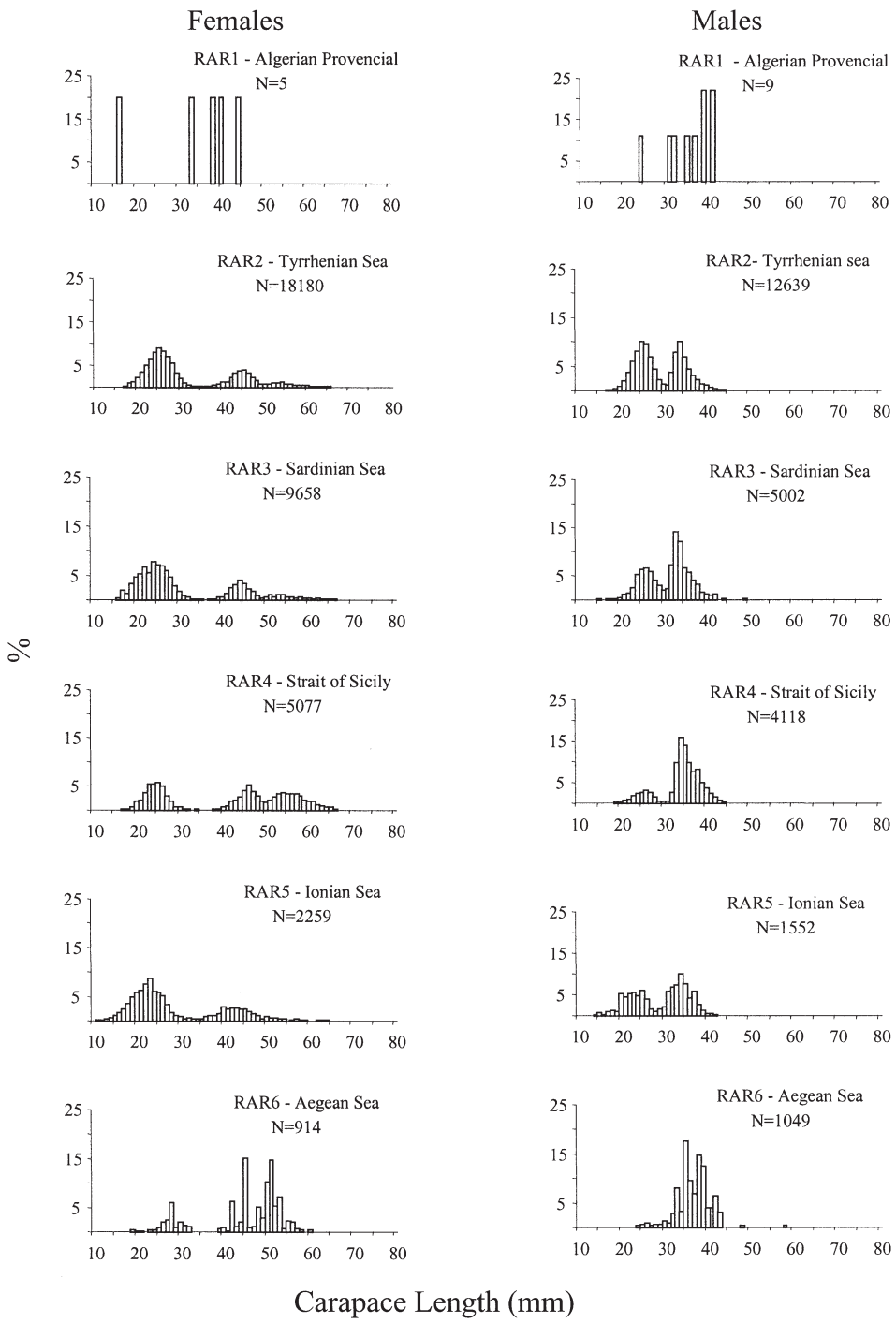

FIG. 4. – Overall length frequency distribution of *Aristaeomorpha foliacea* by sex for each RAR.

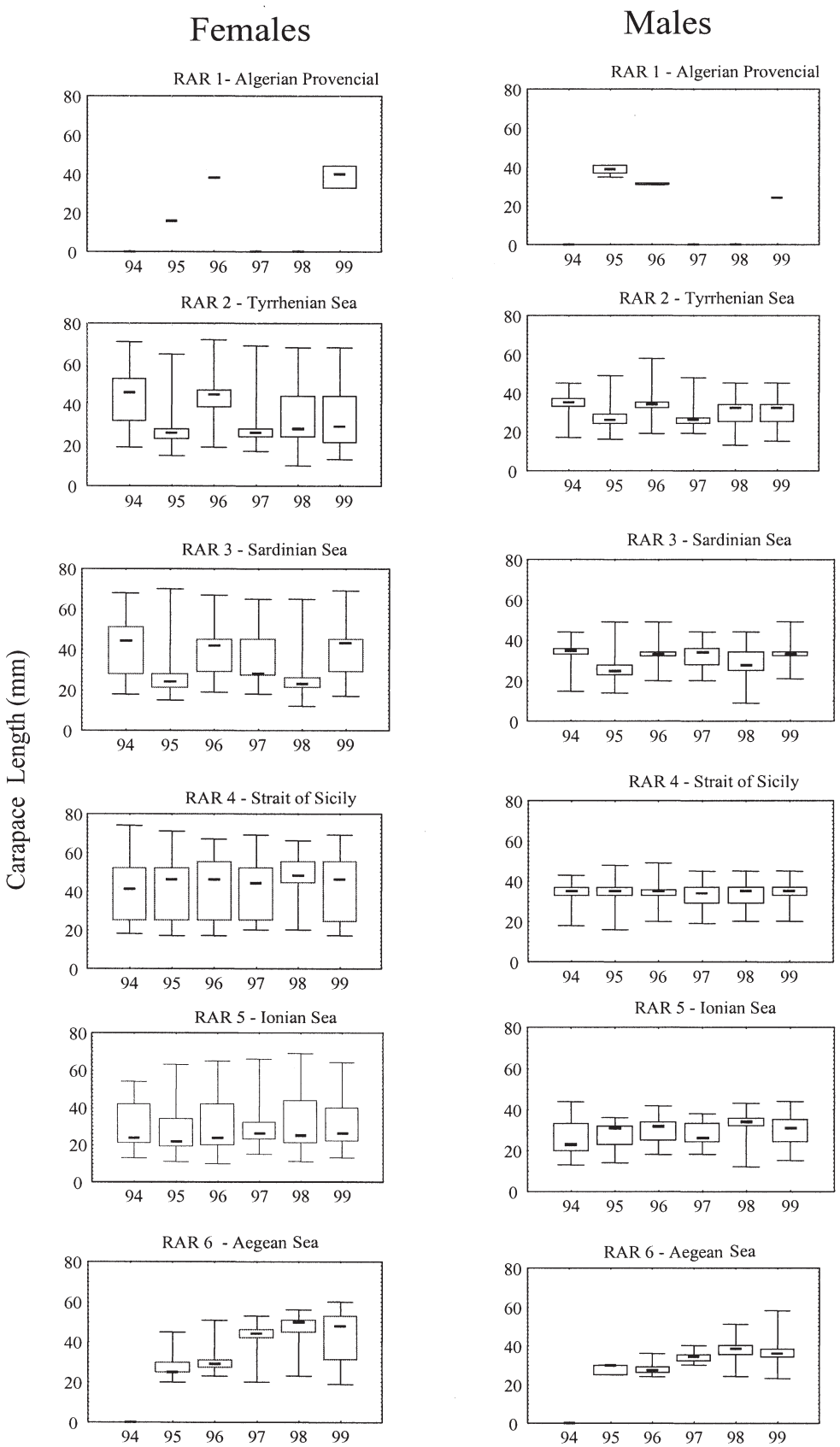

FIG. 5. – Box plot representation of minimum, maximum, and median (±SD) Carapace Length (mm) for male and female *Aristaeomorpha foliacea* in each RAR.

parental stock section, which presents multiple modes in the females and a strong asymmetry in the males (Fig. 4).

From an analysis of the basic statistics, it can be shown that, in the entire investigated area, the largest size found in the six years was 74 mm CL for the females (Straits of Sicily - RAR 4). From a more detailed analysis of the individual macroareas, the largest sizes were always larger than 60 mm CL, except in the Aegean Sea (RAR 6) and in 1994 in the Ionian Sea (RAR 5). The smallest sizes, on the other hand, measured between 10 and 25 mm CL (Table 5; Fig. 5).

Except for RAR 1, for which a statistical comparison was not possible because the catches were too few, the medians were significantly different for all RAR's, considering the general comparison among all the years of the survey (KW test, $p<0.05$) (Fig. 5). Statistically significant similarities were found in the Tukey test multiple comparison for pairs of years (Table 5).

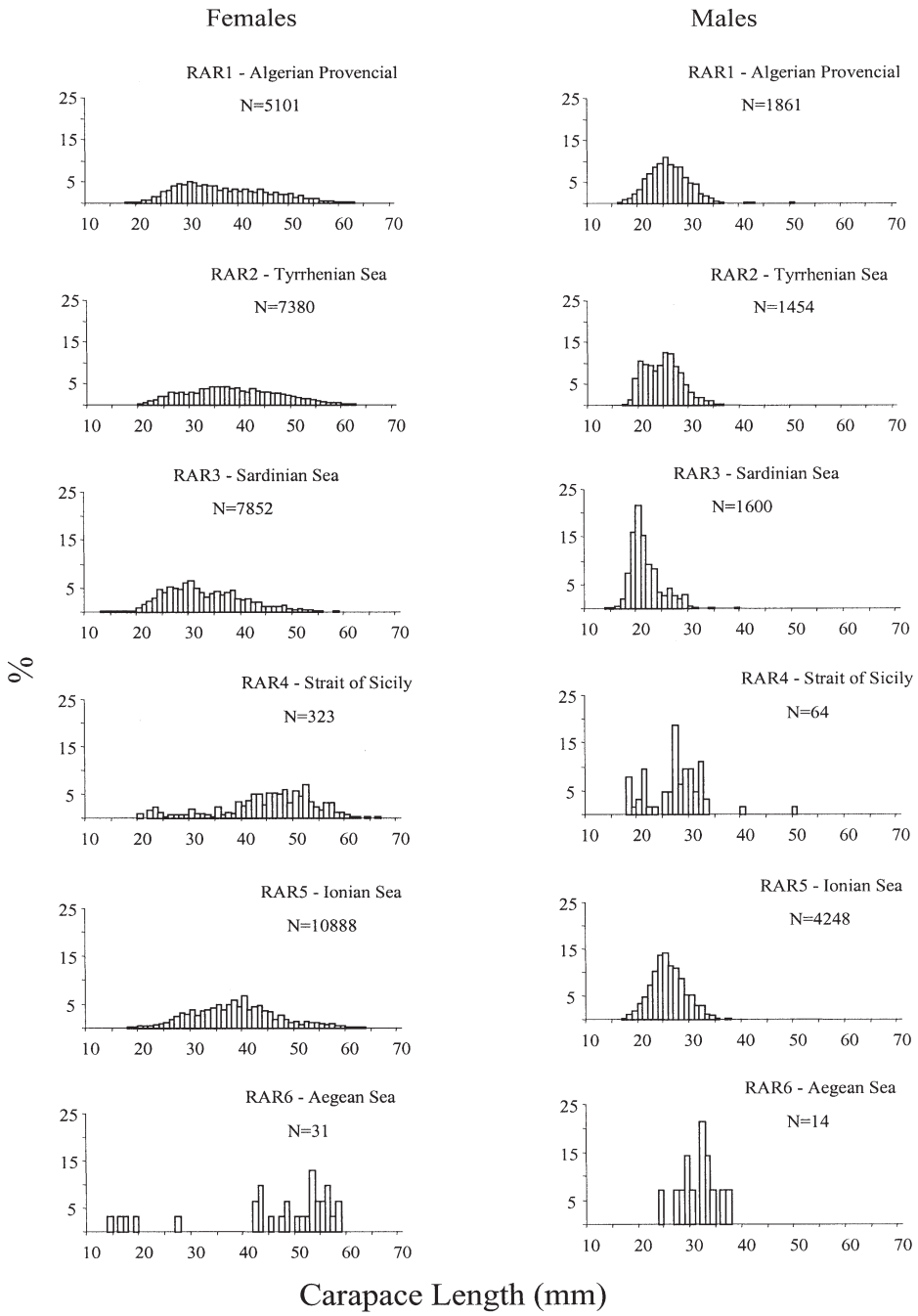

FIG. 6. – Overall length frequency distribution of *Aristeus antennatus* by sex for each RAR.

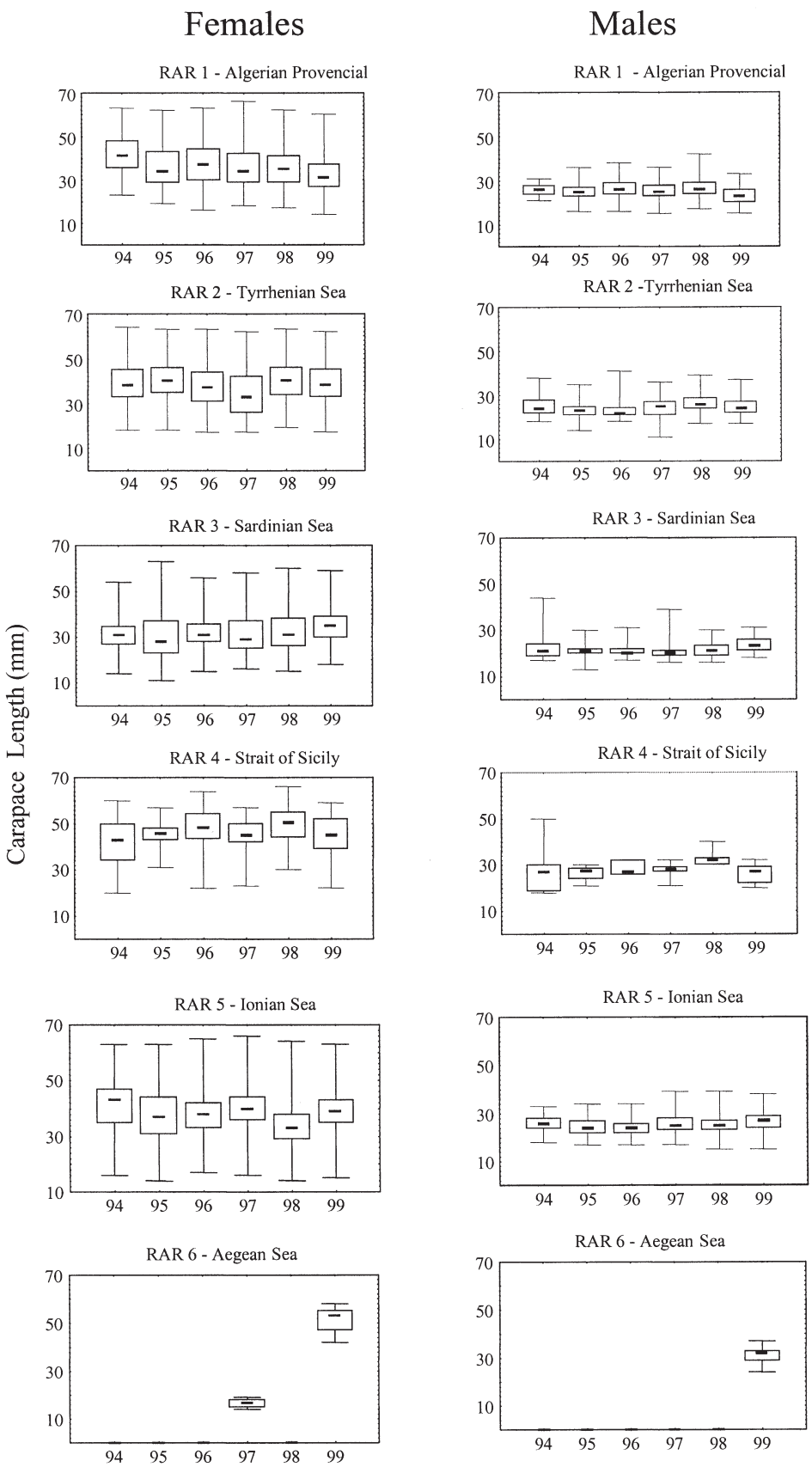

FIG. 7. – Box plot representation of minimum, maximum, and median (±SD) Carapace Length (mm) for male and female *Aristeus antennatus* in each RAR.

TABLE 7. – The VBGF parameters of *Aristaeomorpha foliacea* and *Aristeus antennatus* females for each RAR.

	Aristaeomorpha foliacea			*Aristeus antennatus*		
	Linf	K	t_0	Linf	K	t_0
RAR 1- Algerian Provencial	-	-	-	76.0	0.382	0.1954
RAR 2 - Tyrrhenian sea	72.0	0.396	0.004	75.6	0.197	-0.289
RAR 3 - Sardinian sea	70.7	0.538	0.266	79.4	0.214	-0.082
RAR 4 - Strait of Sicily	65.5	0.670		(+) 69.1	(+) 0.532	-
RAR 5 - Ionian sea	(*) 69.8	(*) 0.450	(*) –0.180	(*) 77.2	(*) 0.350	(*) -0.360
RAR 6 - Aegean sea	62.1	0.60	-0.340	-	-	-

(*) from Tursi *et al*., 1998; (+) from Levi *et al*., 1998

In the Tyrrhenian Sea (RAR 2) the median was significantly similar in 1998 and 1999 both for the males and for the females (Tukey test, p>0.05) (Table 5, Fig. 5), while in the Sardinian Sea (RAR 3) the same similarity was observed between 1996 and 1999 for both sexes, and for the males also in 1997. In the Straits of Sicily (RAR 4), except for the 1994 and 1998 surveys, the medians in the females did not show and significant differences, while in the males there was a reduced variability. In the Ionian Sea (RAR 5), except for 1995, the females always showed similarities between medians (p>0.05), which also presented values indicating the presence of a high percentage of small individuals. Finally, in the Aegean Sea (RAR 6), the median showed a gradual, but not significant, increase in years.

Aristeus antennatus

Contrary to *A. foliacea*, in *A. antennatus* it has not been possible to define clear modes, corresponding to different cohorts, in the size frequency distributions of the individuals of both sexes in each RAR (Fig. 6).

The maximum size (66 mm CL) was recorded in the Strait of Sicily and in the Ionian Sea (RAR 4 and RAR 5, respectively). However, in all macroareas, these measurements were about 60 mm CL, except for RAR 3 (Sardinian Sea), where remarkably lower values were recorded (54 mm CL) (Table 6; Fig. 6).

In the Strait of Sicily and the Aegean Sea (RAR 4 and RAR 6, respectively), given the small number of samples, it was not possible to make statistical comparisons among medians. In the remaining macroareas no statistical affinity was found with the KW test, while the Tukey test showed a few similarities among medians.

For 1994 in particular, the values for the females of RAR 1 were quite high (41 mm CL), and were remarkably different from those found for subsequent years. On the other hand, the median found for the males in 1994 had the greatest number of significant similarities (Table 6; Fig. 7).

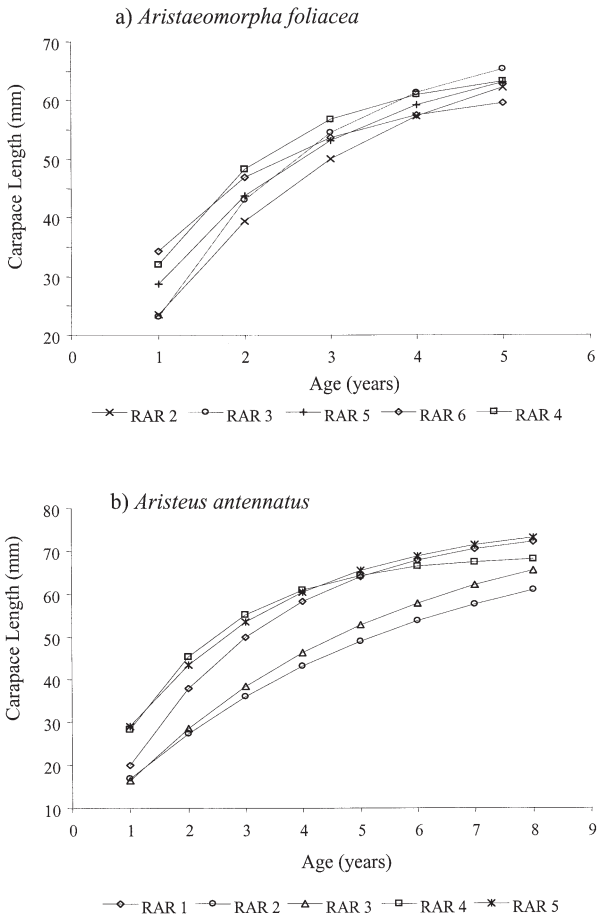

FIG. 8. - Von Bertalanffy growth curve of females for each RAR: a) *Aristaeomorpha foliacea, b) Aristeus antennatus.*

It should be pointed out, moreover, that the Sardinian Sea (RAR 3) showed the lowest median values for both sexes, and together with the Tyrrhenian Sea (RAR 2), it also showed few statistical similarities. In the Ionian Sea (RAR 5) the females showed very different median values that were statistically comparable only for 1995 and 1996. The males presented a greater number of similarities (1997-1994; 1997-1998).

TABLE 8. – Growth curve comparison indices (The comparison indices indicate the distance between two curves).

Aristaeomorpha foliacea

RAR 1						
RAR 2	64.37					
RAR 3	52.42	12.50				
RAR 4	22.46	85.61	73.66			
RAR 5	19.83	84.20	72.25	6.74		
RAR 6	-	-	-	-	-	
	RAR 1	RAR 2	RAR 3	RAR 4	RAR 5	RAR 6

Aristeus antennatus

RAR 1						
RAR 2	-					
RAR 3	-	8.64				
RAR 4	-	22.12	14.14			
RAR 5	-	11.27	6.00	10.81		
RAR 6	-	19.07	12.82	5.67	7.94	
	RAR 1	RAR 2	RAR 3	RAR 4	RAR 5	RAR 6

Growth

The Von Bertalanffy growth parameters for females of *A. foliacea* and *A. antennatus* are presented for each RAR area in Table 7, and graphically presented in Fig. 8.

For the females of *A. foliacea* in the Algerian Provencial region (RAR 1) and those of *A. antennatus* in the Strait of Sicily and the Aegean Sea (RAR 4 and RAR 6, respectively), we could not carry out a modal progression because the data were too scarce. The VBGF parameters for these areas were therefore not calculated.

The growth curves of *A. foliacea* are all quite similar. The results of the comparison using the integral of the absolute distance between the integration extremes show quite low values (Table 7) (especially for RAR4-RAR6 and RAR3-RAR5).

In *A. antennatus*, on the other hand, a similar slow growth in the specimens of the Tyrrhenian (RAR2) and Sardinian seas (RAR3) can be observed (Tables 7-8), while a faster growth is observed in those of the Ionian Sea (RAR5) and the Algerian-Provencial region (RAR1) (Tables 7-8). At any rate, *A. antennatus* appears to be the longer-lived species.

DISCUSSION

With the MEDITS international trawl surveys, which were carried out using a common sampling methodology, it was possible to carry out, for the first time at a large scale area, a global study of the distribution and abundance of the two species of red shrimps *A. antennatus* and *A. foliacea*, and therefore to have a comparative picture of the resources present in the different areas of the Mediterranean.

The two shrimps were prevalently caught in the deepest (501-800 m) depth stratum sampled. These depths are preferred by these species (Carpine, 1970; Pérès, 1985; Ragonese, 1989; Sardà *et al.*, 1994), though *A. foliacea*, especially in the central and western part of the Mediterranean (Tyrrhenian Sea, Sardinian Sea, and Straits of Sicily), was often found also at shallower depths (201-500 m) (Maurin, 1960, 1965; D'Onghia *et al.*, 1994; Yahiaoui, 1994; Sardà *et al.*, 1994) and *A. antennatus* can also be found much deeper (Cartes, 1994; Sardà *et al.*, 1994, 1997; Colloca *et al.*, 1998).

Based on the quantitative analysis of the space distribution of the catches (kg/km^2), a different longitudinal gradient was found: *A. antennatus* was relatively more abundant in the westernmost part of the Mediterranean, while *A. foliacea* prevailed in the central and easternmost part (D'Onghia *et al.*, 1998). This distribution trend is also confirmed in several references, which show: 1) a clearly majority presence of *A. antennatus* in the Spanish Mediterranean (Abelló *et al.*, 1988; Martín, 1991; Demestre, 1994 a,b; Martínez-Baños and Mas, 1994; Sardà and Cartes, 1994; Carbonell, 1994 a,b; Carbonell *et al.*, 2000); 2) dominance of *A. antennatus,* as a result of the disappearance of *A. foliacea,* in the Gulf of Lions (Campillo, 1994); 3) contemporaneous presence of the two shrimps with a remarkable decline in *A. foliacea* in the Ligurian Sea (Orsi Relini and Relini, 1985, 1994; Relini and Orsi Relini, 1987); and 4) a gradual decrease in the percentages of *A. antennatus* in the Tyrrhenian and Sardinian Seas, until clear dominance of *A. foliacea* is reached in the Straits of Sicily and the eastern Mediterranean (Ardizzone *et al.*, 1994; Campillo, 1994; Mura *et al.*, 1992; Ragonese, 1993; Spedicato *et al.*, 1994; Thessalou-Legaki, 1994; Petrakis, 1998). In this gradient the Ionian Sea is an exception, since here *A. foliacea* was less abundant than *A. antennatus*, as also found by several authors (D'Onghia *et al.*, 1998; Matarrese *et al.*, 1992; Tursi *et al.*, 1993). Generally, it has been possible to observe, for the different RARs, an extreme interannual variability in abundance indices (kg/km^2). This could undoubtedly be related to several independent and at times uncontrollable ecological factors, such as overexploitation, adverse hydrological conditions, predatory pressure on young forms (Orsi Relini and Relini, 1985; Relini and Orsi Relini, 1987), and migratory phenomena (Matarrese *et al.*, 1992), which by affecting the stocks would change the rela-

tive and absolute abundance of the species over time. Only in a few cases (Tyrrhenian Sea and Straits of Sicily for *A. foliacea,* and Sardinian Sea also for *A. antennatus*) has it been possible to locate a positive trend in the catches. On the other hand, the data from the Aegean Sea are difficult to interpret. Here a fundamental role has probably been played by the fishermen's lack of experience in catching shrimps (Thessalou-Legaki, 1994; Politou *et al*., 1998).

The extreme variability of the data can also be seen when comparing the median sizes. For the different analysed years, it has not been possible to find any statistical similarity among the years for either species (KW test). With multiple comparison, on the other hand, it has been possible to find similarities for the pairs of investigated years (Tukey test). In particular, the results obtained for the females of *A. foliacea* have almost always been confirmed also for the males, which could be justified by a similar recruiting frequency for both sexes, though a similar trend was not found for *A. antennatus*.

In *A. foliacea*, the sex ratio was in favour of the females in the entire Mediterranean, except in the Aegean Sea, where a prevalence of male individuals was found. Also, the females of *A. antennatus* were more numerous, as recorded in the literature (Orsi Relini, 1980; Arrobas and Ribeiro Cascalho, 1987; Sardà and Demestre, 1987; Mura and Cau, 1989; Matarrese *et al.*, 1992; Demestre and Martín, 1993; Campillo, 1994; Ragonese *et al.*, 1994; Sardà *et al*., 1994; Yahiaoui, 1994; Matarrese *et al.*, 1995; Spedicato *et al.,*1995; Sardà *et al*., 1997). This female prevalence, especially in *A. antennatus*, could be justified by the segregation of sexes along the bathymetric gradient, i.e. by the fact that the males are located at a deeper range than the females (Mura and Cau, 1989; Sardà and Cartes, 1993; Sardà *et al*., 1994; Matarrese *et al.*, 1995; Relini *et al*., 1999).

An analysis of the size frequency distribution and subsequent modal progression of female individuals in all studied regional areas has pointed out a similar pattern in the growth curve of *A. foliacea*, although, as seen from the comparison indices, slight differences in growth parameters were observed. As a matter of fact, the variance of L_{inf} and K tend to compensate each other. For *A. antennatus*, a different situation is observed: in fact, in spite of similar values of L_{inf}, the differences in K and t_o determine two apparently different growth patterns. The latter could be due to the fact that it was not possible to properly segregate the size frequency distribution of *A. antennatus* into distinct cohorts (D'Onghia *et al*., 1994; Orsi-Relini and Relini, 1998b), and to the occurrence of a long, non-discrete recruiting season, which is not easy to determine on account of the difficulty of catching young shrimps at greater depths (Orsi-Relini and Relini, 1998a). In fact, the main differences between the growth curves appear in the younger individuals (age class 0+), which do not seem to have been fully recruited, except in RAR 2 and 3 (Tyrrhenian and Sardinian Seas). From all the VBGFs, it appears that this species has a long life cycle (more than 5 years) (Sardà and Demestre, 1987; Ragonese and Bianchini, 1996).

From a general analysis of these data, it can actually be concluded that variability, both in the yields and in the sizes, appears particularly high for these two Mediterranean species (Caddy and Gulland, 1983; Laevastu and Favorite, 1988; Greco *et al*., 1994), though in fact the causes that triggered the phenomenon do not seem to be well known or documented.

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APPENDIX 1. – *Aristeus antennatus*: Mean biomass (in kg per square km) estimated from the MEDITS trawl surveys by depth stratum, geographical sector and year (1994-1999). Not sampled strata are indicated by '*'.

		1994 Depth (m)					1995 Depth (m)					1996 Depth (m)				
Sector code	Sector	10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800
111a	Alborán Sea	0	0	0	0	2.0	0	0	0	0	5.9	0	0	0	0.1	3.0
112a	Alicante	0	0	0	0	2.7	0	0	1.6	0	5.7	0	0	0	0.1	13.3
113a	Catalan Sea	0	0	0	0.6	15.5	0	0	0	0	12.5	0	0	0	0	19.0
114a	W Morocco	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
114b	E Morocco	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
121a	W Gulf of Lions	0	0	0	0	31.5	0	0	0	0	7.2	0	0	0	0	11.7
121b	E Gulf of Lions	0	0	0	19.3	11.7	0	0	0	0	49.6	0	0	0	0	24.7
131a	NE Corsica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.0
131b	SE Corsica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132a	N Ligurian Sea	0	0	0	0	17.5	0	0	0	0	12.5	0	0	0	0	0.6
132b	E Ligurian Sea	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0
132c	N Tyrrhenian	0	0	0	0	0.2	0	0	0	0	0.2	0	0	0	0	0.2
132d	C Tyrrhenian	0	0	0	0.1	2.1	0	0	0	0	0.4	0	0	0	1.7	7.4
133a	SE Sardinia	0	0	0	0	27.2	0	0	0	0	14.8	0	0	0	0	8.3
133b	NE Sardinia	0	0	0	0	21.2	0	0	0	0	12.9	0	0	0	0	4.2
133c	N Sardinia	0	0	0	0	5.4	0	0	0	4.2	35.2	0	0	0	0	0
133d	NW Sardinia	0	0	0	0	21.1	0	0	0	0	0.4	0	0	0	0	9.1
133e	W Sardinia	0	0	0	0	3.2	0	0	0	0	0	0	0	0	0	24.5
133f	SW Sardinia	0	0	0	0	5.7	0	0	0	0	7.6	0	0	0	0	13.6
133g	S Sardinia	0	0	2.1	0	5.5	0	0	0	0	0.5	0	0	0	0	9.2
134a	SE Tyrrhenian	0	0	0	0.0	9.4	0	0	0	0	0.3	0	0	0	0	1.0
134b	SW Tyrrhenian	0	0	0	0	6.1	0	0	0	0	0.6	0	0	0	0	1.2
134c	Sicilian Chan.	0	0	0	0	1.7	0	0	0	0	0.9	0	0	0	0	0.4
211a	N Adriatic Sea	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211b	Central Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
211c	N Adriatic-Slov	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211d	NE Adri Croatia	0	0	*	*	*	0	0	*	*	*	0	0	0	0	*
221a	E Sicily	0	0	0	5.3	0.2	0	0	0	1.9	0.2	0	0	0	8.7	8.7
221b	NW Ionian Sea	0	0	0	0	15.5	0	0	0	0	8.3	0	0	0	0	7.1
221c	N Ionian Sea	0	0	0	0	48.9	0	0	0	0	10.3	0	0	0	1.3	7.0
221d	N Ionian Sea	0	0	0	0	21.3	0	0	0	0.1	5.3	0	0	0	0	28.3
221e	SW Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	4.8
221f	SW Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
221g	SW Adriatic	0	0	0	*	0	0	0	0	*	0	0	0	0	*	0
221h	SW Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
221i	SE Adriatic	0	0	*	*	*	0	0	*	*	*	0	0	0	0	1.12
222a	E Ionian Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
223a	Argosaronikos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
224a	N Aegean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
225a	S Aegean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0

APPENDIX 1 (Cont.). – *Aristeus antennatus*: Mean biomass (in kg per square km) estimated from the MEDITS trawl surveys by depth stratum, geographical sector and year (1994-1999). Not sampled strata are indicated by '*'.

Sector code	Sector	1997 Depth (m)					1998 Depth (m)					1999 Depth (m)				
		10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800
111a	Alborán Sea	0	0	0	4.0	4.0	0	0	0	0.1	5.1	0	0	0	0.2	3.8
112a	Alicante	0	0	0	0.1	15.8	0	0	0	0	7.4	0	0	0	0	6.1
113a	Catalan Sea	0	0	0	0	15.3	0	0	0	*	12.1	0	0	0	0	4.0
114a	W Morocco	0	0	*	*	*	0	0	*	*	*	0	0	0	0.1	0.3
114b	E Morocco	0	0	*	*	*	0	0	*	*	*	0	0	0	0.1	4.4
121a	W Gulf of Lions	0	0	0	0	3.4	0	0	0	4.4	3.4	0	0	0	0.6	10.7
121b	E Gulf of Lions	0	0	0	0	8.3	0	0	0	0	15.7	0	0	0	1.5	*
131a	NE Corsica	0	0	*	0	0	0	0	0	0	0	0	0	0	0	0
131b	SE Corsica	0	0	0	0	*	0	0	0	0	0	0	0	0	0	0
132a	N Ligurian Sea	0	0	0	0	13.5	0	0	0	0	11.2	0	0	0	0	12.6
132b	E Ligurian Sea	0	0	0	0	0.3	0	0	0	0	0.2	0	0	0	0	0.0
132c	N Tyrrhenian	0	0	0	0.0	1.8	0	0	0	0	1.2	0	0	0	0	1.1
132d	C Tyrrhenian	0	0	0	0	5.3	0	0	0	0	3.3	0	0	0	0	0.4
133a	SE Sardinia	0	0	0	0	17.3	0	0	0	0	16.8	0	0	0	0	9.6
133b	NE Sardinia	0	0	0	0	3.5	0	0	0	0	14.6	0	0	0	0	7.4
133c	N Sardinia	0	0	0	0.1	14.7	0	0	0	0.6	6.6	0	0	0	0	32.7
133d	NW Sardinia	0	0	0	0	19.9	0	0	0	0.0	12.1	0	0	0	0	4.8
133e	W Sardinia	0	0	0	0.1	9.0	0	0	0	0.2	10.5	0	0	0	0	4.8
133f	SW Sardinia	0	0	0	0	21.7	0	0	0	0	33.3	0	0	0	0	41.0
133g	S Sardinia	0	0	0	0	4.3	0	0	0	0	11.0	0	0	0	0	5.1
134a	SE Tyrrhenian	0	0	0	0	3.4	0	0	0	0	4.4	0	0	0	0	2.5
134b	SW Tyrrhenian	0	0	0	0	10.2	0	0	0	0	3.3	0	0	0	0	3.8
134c	Sicilian Chan.	0	0	0	0	1.0	0	0	0	0	1.6	0	0	0	0	0.8
211a	N Adriatic Sea	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211b	Central Adriatic	0	0	0	0	0	0	0	0	0	*	0	0	0	0	*
211c	N Adriatic-Slov	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211d	NE Adri Croatia	0	0	0	0	*	0	0	0	0	*	0	0	*	*	*
221a	E Sicily	0	0	0	0.7	24.3	0	0	0	0	0.8	0	0	0	11.5	0.2
221b	NW Ionian Sea	0	0	0	0	13.9	0	0	0	0	24.0	0	0	0	0	14.0
221c	N Ionian Sea	0	0	0	0	8.0	0	0	0	0.1	18.1	0	0	0	0	2.1
221d	N Ionian Sea	0	0	0	0	9.0	0	0	0	0	12.0	0	0	0	0	26.3
221e	SW Adriatic	0	0	0	9.6	53.9	0	0	0	0.9	9.5	0	0	0	0	8.4
221f	SW Adriatic	0	0	0	0.2	2.7	0	0	0	0	1.4	0	0	0	0	0.2
221g	SW Adriatic	0	0	0	*	0	0	0	0	*	0	0	0	0	*	0
221h	SW Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
221i	SE Adriatic	0	0	0	0	0.2	0	0	0	0	0.1	0	0	0	0	0
222a	E Ionian Sea	0	0	0	0	0	0	0	0	0	4.8	0	0	0	0	6.0
223a	Argosaronikos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.4
224a	N Aegean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
225a	S Aegean Sea	0	0	0	0	0.1	0	0	0	0	0.1	0	0	0	0	1.4

APPENDIX 2. – *Aristeus antennatus*: Mean abundance (in number of individuals per square km) estimated from the MEDITS trawl surveys by depth stratum, geographical sector and year (1994-1999).Not sampled strata are indicated by '*'.

Sector code	Sector	1994 Depth (m)					1995 Depth (m)					1996 Depth (m)				
		10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800
111a	Alborán Sea	0	0	0	0	113	0	0	0	0	446	0	0	0	9	191
112a	Alicante	0	0	0	0	172	0	0	84	0	392	0	0	0	4	861
113a	Catalan Sea	0	0	0	40	796	0	0	0	0	920	0	0	0	0	999
114a	W Morocco	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
114b	E Morocco	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
121a	W Gulf of Lions	0	0	0	0	1309	0	0	0	0	303	0	0	0	0	431
121b	E Gulf of Lions	0	0	0	677	321	0	0	0	0	1915	0	0	0	0	926
131a	NE Corsica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45
131b	SE Corsica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132a	N Ligurian Sea	0	0	0	0	649	0	0	0	0	518	0	0	0	0	25
132b	E Ligurian Sea	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
132c	N Tyrrhenian	0	0	0	0	8	0	0	0	0	3	0	0	0	0	8
132d	C Tyrrhenian	0	0	0	3	84	0	0	0	0	12	0	0	0	67	285
133a	SE Sardinia	0	0	0	0	1626	0	0	0	0	638	0	0	0	0	509
133b	NE Sardinia	0	0	0	0	1009	0	0	0	0	497	0	0	0	0	207
133c	N Sardinia	0	0	0	0	410	0	0	0	231	2144	0	0	0	0	0
133d	NW Sardinia	0	0	0	0	1615	0	0	0	0	35	0	0	0	0	721
133e	W Sardinia	0	0	0	0	430	0	0	0	0	0	0	0	0	0	1593

APPENDIX 2 (Cont.). – *Aristeus antennatus*: Mean abundance (in number of individuals per square km) estimated from the MEDITS trawl surveys by depth stratum, geographical sector and year (1994-1999). Not sampled strata are indicated by '*'.

Sector code	Sector	1994 Depth (m) 10-50	50-100	100-200	200-500	500-800	1995 Depth (m) 10-50	50-100	100-200	200-500	500-800	1996 Depth (m) 10-50	50-100	100-200	200-500	500-800
133f	SW Sardinia	0	0	0	0	421	0	0	0	0	734	0	0	0	0	751
133g	S Sardinia	0	0	162	0	351	0	0	0	0	30	0	0	0	0	714
134a	SE Tyrrhenian	0	0	0	1	451	0	0	0	0	16	0	0	0	0	58
134b	SW Tyrrhenian	0	0	0	0	318	0	0	0	0	30	0	0	0	0	88
134c	Sicilian Chan.	0	0	0	0	66	0	0	0	0	31	0	0	0	0	13
211a	N Adriatic Sea	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211b	Central Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
211c	N Adriatic-Slov	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211d	NE Adri Croatia	0	0	*	*	*	0	0	*	*	*	0	0	0	0	*
221a	E Sicily	0	0	0	381	6	0	0	0	97	24	0	0	0	796	787
221b	NW Ionian Sea	0	0	0	0	716	0	0	0	0	414	0	0	0	0	396
221c	N Ionian Sea	0	0	0	0	1598	0	0	0	0	371	0	0	0	60	403
221d	N Ionian Sea	0	0	0	0	498	0	0	0	2	164	0	0	0	0	1117
221e	SW Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	3	4	213
221f	SW Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
221g	SW Adriatic	0	0	0	*	0	0	0	0	*	0	0	0	0	*	0
221h	SW Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
221i	SE Adriatic	0	0	*	*	*	0	0	*	*	*	0	0	0	0	31
222a	E Ionian Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
223a	Argosaronikos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
224a	N Aegean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
225a	S Aegean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2

Sector code	Sector	1997 Depth (m) 10-50	50-100	100-200	200-500	500-800	1998 Depth (m) 10-50	50-100	100-200	200-500	500-800	1999 Depth (m) 10-50	50-100	100-200	200-500	500-800
111a	Alborán Sea	0	0	0	329	360	0	0	0	5	443	0	0	0	20	237
112a	Alicante	0	0	0	10	908	0	0	0	0	555	0	0	0	0	490
113a	Catalan Sea	0	0	0	0	795	0	0	0	*	684	0	0	0	0	370
114a	W Morocco	0	0	*	*	*	0	0	*	*	*	0	0	0	30	27
114b	E Morocco	0	0	*	*	*	0	0	*	*	*	0	0	0	24	1263
121a	W Gulf of Lions	0	0	0	0	162	0	0	0	496	127	0	0	0	42	765
121b	E Gulf of Lions	0	0	0	0	365	0	0	0	0	566	0	0	0	53	*
131a	NE Corsica	0	0	*	0	0	0	0	0	0	0	0	0	0	0	0
131b	SE Corsica	0	0	0	0	*	0	0	0	0	0	0	0	0	0	0
132a	N Ligurian Sea	0	0	0	0	795	0	0	0	0	420	0	0	0	0	566
132b	E Ligurian Sea	0	0	0	0	9	0	0	0	0	5	0	0	0	0	2
132c	N Tyrrhenian	0	0	0	1	45	0	0	0	0	35	0	0	0	0	27
132d	C Tyrrhenian	0	0	0	0	157	0	0	0	0	102	0	0	0	0	18
133a	SE Sardinia	0	0	0	0	1041	0	0	0	0	797	0	0	0	0	490
133b	NE Sardinia	0	0	0	0	169	0	0	0	0	494	0	0	0	0	309
133c	N Sardinia	0	0	0	11	1280	0	0	0	23	469	0	0	0	0	1309
133d	NW Sardinia	0	0	0	0	1873	0	0	0	5	1527	0	0	0	0	355
133e	W Sardinia	0	0	0	5	731	0	0	0	17	710	0	0	0	0	180
133f	SW Sardinia	0	0	0	0	1608	0	0	0	0	2331	0	0	0	0	2554
133g	S Sardinia	0	0	0	0	219	0	0	0	0	587	0	0	0	0	259
134a	SE Tyrrhenian	0	0	0	0	138	0	0	0	0	202	0	0	0	0	147
134b	SW Tyrrhenian	0	0	0	0	1276	0	0	0	0	160	0	0	0	0	218
134c	Sicilian Chan.	0	0	0	0	36	0	0	0	0	41	0	0	0	0	30
211a	N Adriatic Sea	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211b	Central Adriatic	0	0	0	0	0	0	0	0	0	*	0	0	0	0	*
211c	N Adriatic-Slov	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211d	NE Adri Croatia	0	0	0	0	*	0	0	0	0	*	0	0	*	*	*
221a	E Sicily	0	0	0	35	1659	0	0	0	0	41	0	0	0	712	10
221b	NW Ionian Sea	0	0	0	0	650	0	0	0	0	1947	0	0	0	0	646
221c	N Ionian Sea	0	0	0	0	299	0	0	0	10	1193	0	0	0	0	136
221d	N Ionian Sea	0	0	0	0	307	0	0	0	0	573	0	0	0	0	1364
221e	SW Adriatic	0	0	0	376	2094	0	0	0	23	510	0	0	0	0	556
221f	SW Adriatic	0	0	0	11	78	0	0	0	0	62	0	0	0	0	11
221g	SW Adriatic	0	0	0	*	0	0	0	0	*	0	0	0	0	*	0
221h	SW Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
221i	SE Adriatic	0	0	0	0	6	0	0	0	0	2	0	0	0	0	0
222a	E Ionian Sea	0	0	0	0	0	0	0	0	0	271	0	0	0	0	290
223a	Argosaronikos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50
224a	N Aegean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
225a	S Aegean Sea	0	0	0	0	9	0	0	0	0	2	0	0	0	0	36

APPENDIX 3. – *Aristaeomorpha foliacea:* Mean biomass (in kg per square km) estimated from the MEDITS trawl surveys by depth stratum, geographical sector and year (1994-1999). Not sampled strata are indicated by '*'.

Sector code	Sector	1994 Depth (m) 10-50	50-100	100-200	200-500	500-800	1995 Depth (m) 10-50	50-100	100-200	200-500	500-800	1996 Depth (m) 10-50	50-100	100-200	200-500	500-800
111a	Alborán Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112a	Alicante	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0.0	0.2
113a	Catalan Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114a	W Morocco	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
114b	E Morocco	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
121a	W Gulf of Lions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121b	E Gulf of Lions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
131a	NE Corsica	0	0	0	0	8.8	0	0	0	0.1	2.6	0	0	0	0	0
131b	SE Corsica	0	0	0	0	0.2	0	0	0	0.3	0.6	0	0	0	0	0
132a	N Ligurian Sea	0	0	0	0	0.8	0	0	0	0	1.0	0	0	0	0	1.8
132b	E Ligurian Sea	0	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0
132c	N Tyrrhenian	0	0	0	0	6.6	0	0	0.1	0	6.7	0	0	0	0	12.5
132d	C Tyrrhenian	0	0	0	0.7	4.2	0	0	0	0.3	2.7	0	0	0	0.8	4.8
133a	SE Sardinia	0	0	0	0	11.7	0	0	0	0	13.7	0	0	0	0	7.4
133b	NE Sardinia	0	0	0	0.6	5.6	0	0	0	0.3	0.4	0	0	0	0.1	6.5
133c	N Sardinia	0	0	0	0	4.9	0	0	0	0.8	1.0	0	0	0	0	0
133d	NW Sardinia	0	0	0	0	27.1	0	0	0	0	1.7	0	0	0	0	12.3
133e	W Sardinia	0	0	0	0.1	2.3	0	0	0	0	0	0	0	0	0	4.7
133f	SW Sardinia	0	0	0	1.2	4.8	0	0	0	0	19.5	0	0	0	0.2	31.1
133g	S Sardinia	0	0	0	0	11.5	0	0	0	0	8.7	0	0	0	0	29.7
134a	SE Tyrrhenian	0	0	0	0.1	21.0	0	0	0	0.5	8.2	0	0	0	0	9.6
134b	SW Tyrrhenian	0	0	0	0	24.1	0	0	0	0	16.2	0	0	0	0	10.3
134c	Sicilian Chan.	0	0	0	0.0	38.9	0	0	0	0	11.4	0	0	0	0	15.1
211a	N Adriatic Sea	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211b	Central Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.9
211c	N Adriatic-Slov	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211d	NE Adri Croatia	0	0	*	*	*	0	0	*	*	*	0	0	0	0	*
221a	E Sicily	0	0	0	0.7	0	0	0	0	0.8	0.9	0	0	0	0.8	0
221b	NW Ionian Sea	0	0	0	0	2.5	0	0	0	0	3.3	0	0	0	0	1.0
221c	N Ionian Sea	0	0	0	0.0	0.7	0	0	0	0.9	0	0	0	0	0.4	0.5
221d	N Ionian Sea	0	0	0	0	0.9	0	0	0	0.2	1.3	0	0	0	2.1	3.3
221e	SW Adriatic	0	0	0	0	0.9	0	0	0	0.1	0.5	0	0	0	0.2	0.7
221f	SW Adriatic	0	0	0	0	0	0	0	0	0.9	1.8	0	0	0	2.2	0
221g	SW Adriatic	0	0	0	*	2.3	0	0	0	*	0	0	0	0	*	0.5
221h	SW Adriatic	0	0	0	0	0.4	0	0	0	0	0.2	0	0	0	0	0.4
221i	SE Adriatic	0	0	*	*	*	0	0	*	*	*	0	0	0	0	10.1
222a	E Ionian Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
223a	Argosaronikos	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.3
224a	N Aegean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
225a	S Aegean Sea	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0.7

Sector code	Sector	1997 Depth (m) 10-50	50-100	100-200	200-500	500-800	1998 Depth (m) 10-50	50-100	100-200	200-500	500-800	1999 Depth (m) 10-50	50-100	100-200	200-500	500-800
111a	Alborán Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112a	Alicante	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
113a	Catalan Sea	0	0	0	0	0	0	0	0	*	0	0	0	0	0	0
114a	W Morocco	0	0	*	*	*	0	0	*	*	*	0	0	0	0	0
114b	E Morocco	0	0	*	*	*	0	0	*	*	*	0	0	0	0	0
121a	W Gulf of Lions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121b	E Gulf of Lions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*
131a	NE Corsica	0	0	*	0	1.8	0	0	0	0.1	1.2	0	0	0	0.5	7.0
131b	SE Corsica	0	0	0	0.1	*	0	0	0	0.0	1.3	0	0	0	2.7	4.6
132a	N Ligurian Sea	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	1.0
132b	E Ligurian Sea	0	0	0	0	0.7	0	0	0	0	0.7	0	0	0	0	0.8
132c	N Tyrrhenian	0	0	0	0	10.3	0	0	0	0	15.4	0	0	0	0.0	6.3
132d	C Tyrrhenian	0	0	0	0	12.0	0	0	0	3.6	15.4	0	0	0	1.4	22.3
133a	SE Sardinia	0	0	0	0	6.9	0	0	0	0.0	18.8	0	0	0	0	10.8
133b	NE Sardinia	0	0	0	0	1.6	0	0	0	0	5.8	0	0	0	0	14.7
133c	N Sardinia	0	0	0	0.1	1.6	0	0	0	2.9	12.0	0	0	0	0	6.2
133d	NW Sardinia	0	0	0	0	6.9	0	0	0	0	3.9	0	0	0	0	17.1
133e	W Sardinia	0	0	0	0	5.0	0	0	0	1.4	17.9	0	0	0	0.5	15.4
133f	SW Sardinia	0	0	0	2.9	29.6	0	0	0	8.4	22.7	0	0	0	0	21.4
133g	S Sardinia	0	0	0	0	28.8	0	0	0	0	53.6	0	0	0	0.1	43.4
134a	SE Tyrrhenian	0	0	0	1.5	26.9	0	0	0	1.1	18.9	0	0	0	1.0	25.1
134b	SW Tyrrhenian	0	0	0	0	23.1	0	0	0	0.3	19.7	0	0	0	0	20.2
134c	Sicilian Chan.	0	0	0	0	16.7	0	0	0	0.0	19.4	0	0	0	0.01	25.6

APPENDIX 3 (Cont.). – *Aristaeomorpha foliacea:* Mean biomass (in kg per square km) estimated from the MEDITS trawl surveys by depth stratum, geographical sector and year (1994-1999). Not sampled strata are indicated by '*'.

		1997 Depth (m)					1998 Depth (m)					1999 Depth (m)				
Sector code	Sector	10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800
211a	N Adriatic Sea	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211b	Central Adriatic	0	0	0	0	0.1	0	0	0	0	*	0	0	0	0	*
211c	N Adriatic-Slov	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211d	NE Adri Croatia	0	0	0	0	*	0	0	0	0	*	0	0	*	*	*
221a	E Sicily	0	0	0	0.6	0.1	0	0	0	0.2	0.5	0	0	0	0.1	0.9
221b	NW Ionian Sea	0	0	0	1.9	0.5	0	0	0	0	0.9	0	0	0	0	0.8
221c	N Ionian Sea	0	0	0	0.7	0.0	0	0	0	0.3	0.1	0	0	0	0.3	0.4
221d	N Ionian Sea	0	0	0	0.3	0.7	0	0	0	0.2	0.7	0	0	0	4.2	0.8
221e	SW Adriatic	0	0	0	0.8	0.6	0	0	0	0.3	1.4	0	0	0	0.3	2.6
221f	SW Adriatic	0	0	0	0.1	1.0	0	0	0	0.1	0	0	0	0	0.1	2.5
221g	SW Adriatic	0	0	0	*	0	0	0	0	*	0	0	0	0	*	0.5
221h	SW Adriatic	0	0	0	0	0.3	0	0	0	0	0.3	0	0	0	0	3.8
221i	SE Adriatic	0	0	0	0	14.6	0	0	0	0.1	8.1	0	0	0	0	11.2
222a	E Ionian Sea	0	0	0	0	0	0	0	0	0	9.0	0	0	0	0	26.2
223a	Argosaronikos	0	0	0	0.4	0.1	0	0	0	0	0.5	0	0	0	0	6.1
224a	N Aegean Sea	0	0	0	0	1.1	0	0	0	0	0.4	0	0	0	0	0.3
225a	S Aegean Sea	0	0	0	0	5.7	0	0	0	0	49.3	0	0	0	0	19.8

APPENDIX 4. – *Aristaeomorpha foliacea*: Mean abundance (in number of individuals per square km) estimated from the MEDITS trawl surveys by depth stratum, geographical sector and year (1994-1999). Not sampled strata are indicated by '*'.

		1994 Depth (m)					1995 Depth (m)					1996 Depth (m)				
Sector code	Sector	10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800
111a	Alborán Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112a	Alicante	0	0	0	0	0	0	0	0	1	7	0	0	0	2	11
113a	Catalan Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114a	W Morocco	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
114b	E Morocco	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
121a	W Gulf of Lions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121b	E Gulf of Lions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
131a	NE Corsica	0	0	0	0	310	0	0	0	4	237	0	0	0	0	0
131b	SE Corsica	0	0	0	0	28	0	0	0	30	29	0	0	0	0	0
132a	N Ligurian Sea	0		0	0	21	0		0	0	21	0		0	0	63
132b	E Ligurian Sea	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0
132c	N Tyrrhenian	0	0	0	0	261	0	0	2	0	329	0	0	0	0	509
132d	C Tyrrhenian	0	0	0	50	134	0	0	0	36	107	0	0	0	67	153
133a	SE Sardinia	0	0	0	0	657	0	0	0	0	1341	0	0	0	0	407
133b	NE Sardinia	0	0	0	76	225	0	0	0	36	18	0	0	0	3	190
133c	N Sardinia	0	0	0	0	162	0	0	0	30	91	0	0	0	0	0
133d	NW Sardinia	0	0	0	0	958	0	0	0	0	174	0	0	0	0	487
133e	W Sardinia	0	0	0	12	228	0	0	0	0	0	0	0	0	0	222
133f	SW Sardinia	0	0	0	113	156	0	0	0	0	1859	0	0	0	36	1729
133g	S Sardinia	0	0	0	0	427	0	0	0	0	611	0	0	0	0	1479
134a	SE Tyrrhenian	0	0	0	2	663	0	0	0	64	919	0	0	0	0	439
134b	SW Tyrrhenian	0	0	0	0	1192	0	0	0	0	1677	0	0	0	0	527
134c	Sicilian Chan.	0	0	0	2	1627	0	0	0	0	467	0	0	0	0	583
211a	N Adriatic Sea	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211b	Central Adriatic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86
211c	N Adriatic-Slov	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211d	NE Adri Croatia	0	0	*	*	*	0	0	*	*	*	0	0	0	0	*
221a	E Sicily	0	0	0	115	0	0	0	0	134	132	0	0	0	34	0
221b	NW Ionian Sea	0	0	0	0	199	0	0	0	0	302	0	0	0	0	80
221c	N Ionian Sea	0	0	0	5	28	0	0	0	226	0	0	0	0	26	31
221d	N Ionian Sea	0	0	0	0	53	0	0	0	36	49	0	0	0	408	126
221e	SW Adriatic	0	0	0	0	58	0	0	0	30	15	0	0	0	11	33
221f	SW Adriatic	0	0	0	0	0	0	0	0	49	79	0	0	0	100	0
221g	SW Adriatic	0	0	0	*	116	0	0	0	*	0	0	0	0	*	20
221h	SW Adriatic	0	0	0	0	23	0	0	0	0	5	0	0	0	0	14
221i	SE Adriatic	0	0	*	*	*	0	0	*	*	*	0	0	0	0	396
222a	E Ionian Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
223a	Argosaronikos	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7
224a	N Aegean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
225a	S Aegean Sea	0	0	0	0	0	0	0	0	0	39	0	0	0	0	68

APPENDIX 4 (Cont.). – *Aristaeomorpha foliacea*: Mean abundance (in number of individuals per square km) estimated from the MEDITS trawl surveys by depth stratum, geographical sector and year (1994-1999). Not sampled strata are indicated by '*'.

Sector code	Sector	1997 Depth (m)					1998 Depth (m)					1999 Depth (m)				
		10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800	10-50	50-100	100-200	200-500	500-800
111a	Alborán Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112a	Alicante	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
113a	Catalan Sea	0	0	0	0	0	0	0	0	*	0	0	0	0	0	0
114a	W Morocco	0	0	*	*	*	0	0	*	*	*	0	0	0	0	0
114b	E Morocco	0	0	*	*	*	0	0	*	*	*	0	0	0	0	0
121a	W Gulf of Lions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121b	E Gulf of Lions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*
131a	NE Corsica	0	0	*	0	62	0	0	0	22	49	0	0	0	29	304
131b	SE Corsica	0	0	0	18	*	0	0	0	5	147	0	0	0	475	820
132a	N Ligurian Sea	0		0	0	0	0		0	0	20	0		0	0	45
132b	E Ligurian Sea	0	0	0	0	19	0	0	0	0	40	0	0	0	0	65
132c	N Tyrrhenian	0	0	0	0	357	0	0	0	0	556	0	0	0	5	287
132d	C Tyrrhenian	0	0	0	0	540	0	0	0	350	747	0	0	0	135	1466
133a	SE Sardinia	0	0	0	0	529	0	0	0	4	1210	0	0	0	0	696
133b	NE Sardinia	0	0	0	0	153	0	0	0	0	230	0	0	0	0	475
133c	N Sardinia	0	0	0	16	71	0	0	0	465	557	0	0	0	0	270
133d	NW Sardinia	0	0	0	0	182	0	0	0	0	227	0	0	0	0	680
133e	W Sardinia	0	0	0	0	161	0	0	0	137	858	0	0	0	24	758
133f	SW Sardinia	0	0	0	188	1558	0	0	0	1269	1303	0	0	0	0	1167
133g	S Sardinia	0	0	0	0	2223	0	0	0	0	6621	0	0	0	10	2218
134a	SE Tyrrhenian	0	0	0	207	3154	0	0	0	127	1091	0	0	0	188	1811
134b	SW Tyrrhenian	0	0	0	0	2223	0	0	0	91	1696	0	0	0	0	883
134c	Sicilian Chan.	0	0	0	0	690	0	0	0	6	725	0	0	0	2	1019
211a	N Adriatic Sea	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211b	Central Adriatic	0	0	0	0	10	0	0	0	0	*	0	0	0	0	*
211c	N Adriatic-Slov	0	0	*	*	*	0	0	*	*	*	0	0	*	*	*
211d	NE Adri Croatia	0	0	0	0	*	0	0	0	0	*	0	0	*	*	*
221a	E Sicily	0	0	0	28	11	0	0	0	50	10	0	0	0	7	197
221b	NW Ionian Sea	0	0	0	571	31	0	0	0	0	37	0	0	0	0	51
221c	N Ionian Sea	0	0	0	170	4	0	0	0	102	3	0	0	0	131	31
221d	N Ionian Sea	0	0	0	45	56	0	0	0	76	37	0	0	0	791	36
221e	SW Adriatic	0	0	0	62	14	0	0	0	11	79	0	0	0	34	35
221f	SW Adriatic	0	0	0	22	22	0	0	0	21	0	0	0	0	25	177
221g	SW Adriatic	0	0	0	*	0	0	0	0	*	0	0	0	0	*	107
221h	SW Adriatic	0	0	0	0	16	0	0	0	0	15	0	0	0	0	236
221i	SE Adriatic	0	0	0	0	457	0	0	0	1	326	0	0	0	0	649
222a	E Ionian Sea	0	0	0	0	0	0	0	0	0	524	0	0	0	0	1745
223a	Argosaronikos	0	0	0	19	10	0	0	0	0	21	0	0	0	0	216
224a	N Aegean Sea	0	0	0	0	46	0	0	0	0	14	0	0	0	0	13
225a	S Aegean Sea	0	0	0	0	251	0	0	0	0	2090	0	0	0	0	862