IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 9, Issue 12 Ver. II (Dec. 2016), PP 24-28
www.iosrjournals.org

Population characteristics of Aristeus antennatus (Risso, 1816) (Decapoda: Aristeidae) from the Levantine Sea coast of Turkey

Aydın Demirci[1*], Hikmet Hoşsucu[2]
[1]*Department of Marine Technologies, Marine Sciences and Technologies Faculty, Iskenderun Technical University 31200, Iskenderun, Hatay/TURKEY*
[2]*Department of Fish Capture and Processing Technology, Faculty of Fisheries, Ege University, 35100, Bornova, Izmir/TURKEY*

Abstract: *The aim of present study was to provide preliminary information about the population characteristics and the abundance of red shrimp, Aristeus antennatus, inhabiting the deep sea of Levantine sea, Mediterranean. Data were collected during 86 commercial bottom trawl hauls carried at depths from 240 m to 920 m between May 2005 and September 2005 by making use of two commercial trawlers. A total of 1943 individuals of A. antennatus (1575 males and 368 females) were caught. The catch per unit effort the mean CPUE (± SD) and its coefficient of variation were calculated as 4.76 ± 2.41 and 50.73 %, respectively. The ratio of red shrimp in the total catch and total shrimp catch were calculated as 22.45 % and 64.61 %, respectively. The von Bertalanffy growth curve parameters were estimated as: L30.6 mm, K0.31 year in females and L 28.2 mm, K^{-year} 0.53 in males.*

Keywords: *Red shrimp, Aristeus antennatus, Levantine Sea, Mediterranean, Deep Sea Fishery*

I. Introduction

The overexploitation of the continental shelves in most of the world has led to an increasing interest in deep water fisheries. In the Mediterranean, deep waters are exploited by trawling [1].The red shrimp, A.antennatusoccurrs in upper and middle slope of the western Mediterranean and adjacent areas [2]. According to [3], the species distributes all Levantine Sea and Aegean Sea coast of Turkey. This species is commonly caught on muddy and sandy bottoms and its bathymetric distribution extends from 80 m to more than 3300 m, in the whole the Mediterranean basin [4]. The red shrimp was known to be a scarce resource in the eastern Mediterranean [5]. But, recentlystudies in the Levantine and Aegean Sea, it is reported to be adequate stock of this species catch[6,7]. According to [8], *A. antennatus*'s stock has a commercial importance on the Levantine sea coast of Turkey. The aim of present study was to provide first data on the population structure and the abundance of *A. antennatus* inhabiting the deep sea of the area. Yet, there is no information on the population structure and the quantity of the economically important resource red shrimp in this area.

II. Materials and methods

Data were collected during 86 commercial bottom trawl hauls carried out at depths from 240 m to 920 m between May 2005 and September 2005 (Fig. 1). The hauls have gone ahead along predetermined lines at varying depths between start and finishing points (possibly >300 m). During the study, we participated in two of fourteen commercial trawler operations. The cod-end mesh size of both trawls was 44 mm (stretched). The towing speed for both vessels was 2.0-2.4 nm/h. The haul duration was approx. five hours. The number of hauling operations for each trawler was usually four daily, two of which carried out at night time. The catch per unit effort (CPUE) in weight per fishing hour was estimated as follows for each haul:

CPUE= $\sum W_n / \sum t_n$

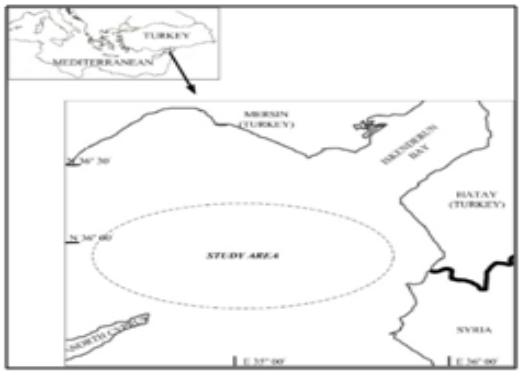

Figure 1. Study area

Where $\sum W_n$; Total weight of individuals captured in nth hauling and $\sum t_n$; time for that hauling.
A total of 1943 individuals of *A. antennatus* (1575 males and 368 females) were caught. Sex ratio was calculated. The carapace length (CL, in mm) and weight (g) were recorded for each individual.

Growth was studied using length-frequency distributions by sex according to the Petersen method [9]. This is based on the identification of peaks representing cohorts spawned at known or assumed time intervals. Bhattacharya's method was used to identify normal distributions (cohorts) included in polymodal length frequency distributions. The separation index between different cohorts was estimated. Values less than 2 denoted a large overlap between cohorts and were considered to be statistically unacceptable [9]. The von Bertalanffy growth parameters were estimated separately for males and females using ELEFAN I in the FiSAT II program [10]. As the growth parameters L_∞ and K are inversely correlated, the growth performance index [11] was employed to compare growth rates of the two sexes and with other fishing areas of the Mediterranean Sea.

III. Results

Population Abundance and Sex ratio

The total CPUE ranging from 1.54 kg/day to 97.21 kg/day, the mean CPUE (± SD) and its coefficient of variation were calculated as 41.42 kg/day 24.02, respectively. The ratio of the red shrimp in the total catch and total shrimp catch were calculated as 11.05 % and 15.76 %, respectively. Totally, 108.74 kg/day deep sea red shrimps were caught during the investigation. A total of 1943 individuals of *A. antennatus* (1575 males and 368 females) were caught.Sex ratio was (1 ♂: 4.36 ♀) was significantly biased towards females (♂= 1575; ♀= 368) ($P<0.05$) calculated. Sex ratios on monthly basis are given in Table 1.

Tablo1. Sex Ratios for *A. antennatus*

	N	♂	♀
May 2005	423	1	4,72
June 2005	623	1	4,08
July 2005	387	1	5,12
August 2005	232	1	3,24
September 2005	278	1	4,34
Total	**1943**	**1**	**4,36**

Length-Frequency Distributions

Monthly size frequency distributions, by sex are given in figure 2. One-way ANOVA showed statistically significant differences between the mean monthly carapace length of both sexes ($F = 24.5$, $P < 0.001$ for males and $F = 21.2$, $P < 0.001$ for females). Females had a CL range of 12–62 mm, with the bulk of the stock being between 27 mm and 45 mm (mean CL = 37.8 ± 3.2 mm).

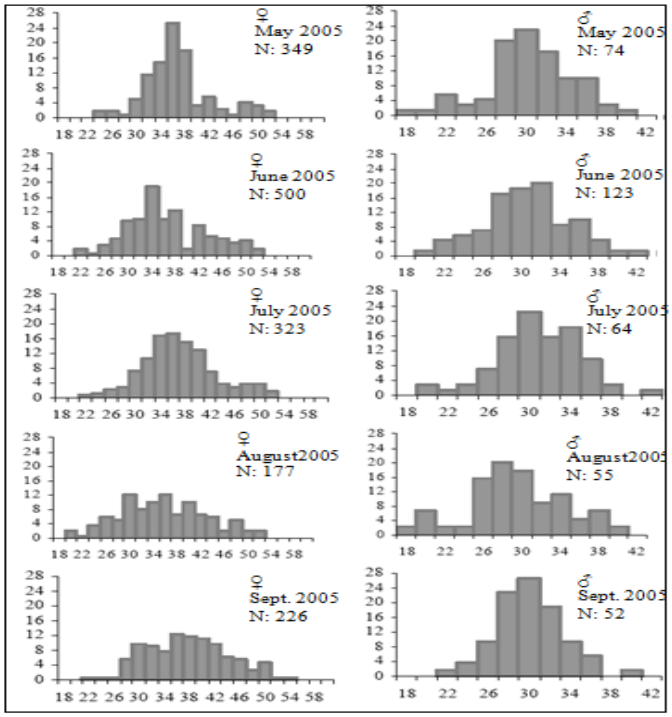

Figure 2. MonthlyLengthFrequency of *A. antennatus*

Estimation of Age Groups

The age groups and their abundance, from the totally LFD analyses showed that the increments between consecutive groups generally decrease in both sexes of red shrimp (Table 2). More year classes were detected in females than in males. S.I. values were high for both sexes.

Table 2. Age Groups Estimation for *A. antennatus*

Age Groups	CL (mm)		SD		Ratio (%)		SI	
	Female	Male	Female	Male	Female	Male	Female	Male
1	25.00	22.33	2.40	1.39	7.46	12.50		
2	33.80	29.18	2.51	1.66	5.,72	58.93	3.59	4,.49
3	41.97	35.06	1.57	1.76	20.90	28.57	4.01	3.44
4	48.79		1.37		14.93		4.64	

Estimation of Growth Parameters

Analysis of the length-frequency data of both sexes of *A.antennatus*provides L_∞ and K values, which were determined as L_∞ and K^{-1}56.33 mm and 0.4 $year^{-1}$ in female and 46.85 mm and 0.53 $year^{-1}$ in male.

Estimation of Mortality Parameters

The estimations of mortality parameter for males and females are observed in Table 3. Total mortality, Z calculated by the method [12] was estimated to be 1.03 for females and 1.59 for males. Natural mortality, M calculated according to [13]method was 0.72 for males and 0.62 for females (*T*: 13 ^oC). According to these estimated results, the losses of fishing pressure (F) were estimated as 0.41 and 0.86 for females and males respectively. The exploitation ratios were calculated 0.39 for females and 0.54 males, which is fishing mortality ratios in total mortality.

Table 3. Mortality Parameter and Exploitation Ratios for *A. antennatus*

Sex	Mortality Ratios			Exploitation Ratios (E)
	Total (Z)	Fishing (F)	Natural (M)	
Female	1.03	0.41	0.62	0.39
Male	1.59	0.86	0.72	0.54

IV. Discussion

There are no available studies to compare the results of this research in this area, because no historical information is yet available on the red shrimp. The size structure of the population in this area consists of a relatively higher percentage of large specimens than in other Mediterranean areas, which reflects the new exploited status of the population. =The red shrimp growth from the fishing area exhibited significant differences between sexes and the maximum age of females exceeded that of males. In the first year-growth for both sexes was most rapid. The growth increment estimated during the first year and the maximum age of the sexes are in close agreement with studies in other Mediterranean regions, such as the Ionian Sea (Otranto Cape) [14], Algeria [14], Tyrrhenian Sea [15], Murcia (SE Spain) [16,17], Catalan Sea[18,19] and the Mediterranean coast of France [20]. The values of L∞ and K-1year, reinforce the view that growth is faster in females than in males. The growth performance index of red shrimp in the fishing area exhibited an intermediate value in relation to those appearing in other areas in the Mediterranean (Table 4). Estimated mortality ratios from fishing data are available in this table. This comparison appears to have great potential for use with exploited populations. The analysis of the various parameters values showed small differences between the fishing areas, where the red shrimp stock is not sufficiently exploited, and the shrimp stock are similarly unexploited in Greek fishery stock, in contrast to the west Mediterranean, where a high fishing pressure is exerted on the stock.The extension of Turkish bottom trawling to deeper waters is expected to lead to a reduction in fishing pressure in shallow waters and to provide new produces to markets. Although Turkish fishermen are not experienced in deep sea fishery and until recently it was believed that no marketable resources existed in deeper waters, they showed a high interest in fishing on these stocks. Financial difficulties and relatively short fishing period limited by two months (May and June) by government lead to insufficient exploitation of the red shrimp by fishermen. The fishing ground is in the international waters. Hence, this stock may be exploited by different countries. The Syrian fishing fleet is not big compared with Turkish fleet, but they are fishing the same stock all year around without any restriction. Thus it is difficult to formulate an effective management scheme in a sustainable way for this stock in the short term.

Table 4. Growth parameters and mortality ratios for the East Mediterranean population of *A. antennatus*

Sex	CL□ (mm)	$K^{-1\ year}$	t_0	Region	References	M	Z	Ø′
F	65	0.36	0.05	Algeria	[15]			3.2
M	44-45	0.27-0.29	0.5-0.8	CatalanSea	[21]	0.41	1.46	
F	68-76	0.20-0.29	0.7-1.1				1.33	
F	87	0.53		Sicily Canal	[22]			3.6
M	55	0.99		IonianSea	[14]			3.5
F	66	0.93						3.6
M	54	0.25	-0.50	West Mediterranean	[23]	0.98		2.9
F	76	0.3	-0.07			0.80		3.2
F	67	0.6	-0.23	TayranSea	[24]			3.4
M	46	0.47	0.13	Moykar Island	[25]			3.0
F	74	0.38	0.07					3.3
All	69	0.25		Sicily Canal	[26]			3.1
M	55	0.38	-0.43	Balearic Island	[2]	0.56		3.1
F	73	0.36	-0.41			0.54		3.3
M	58	0.43	-0.46	IonianSea	[27]	0.65	0.79	3.2
F	66	0.39	0.38			0.62	0.70	3.2
F	76	0.30	-0.50	West Mediterranean	[28]	0.50		
M	54	0.24	-0.07			0.80		
F	65	0.28		Antalya Bay	[29]	0.45	0.95	3.07
F	56.33	0.45	-0.62	East Mediterranean	PresentStudy	0.62	1.03	3.2
M	46.85	0.53	-0.54			0.72	1.59	3.1

V. Conclusion

In conclusion, the red shrimp, *A. antennatus* is a target species of the deep-water demersal trawl fishery in the Levantine Sea of the Mediterranean.

Acknowledgements

The authors sincerely thank the crews of the NİHAT BABA and SÜLEYMAN DEDE, the head of Fisheries Cooperative Nihat BEYAZIT for their help during the work at sea.

References

[1] C.Politou, S.Kavadas, C.Mytilineou, A.Tursi, R. Carlucciand G. Lembo, Fisheries resources in the deep waters of the eastern Mediterranean (Greek Ionian Sea),*Journal of Northwest Atlantic Fishery Science, 31*,2003, 35.

[2] A.Carbonell, M.Carbonell, M.Demestre, A.Grau, and S. Monserrat, The red shrimp *Aristeus antennatus* (Risso, 1816) fishery and biology in the Balearic Islands, Western Mediterranean,*Fisheries Research, 44,* 1999, 1-13.

[3] T.Ozcan, E. Irmak, A. S.AtesandT.Katagan, First record of the red shrimp, *Aristeus antennatus* (Risso, 1816)(Decapoda: Aristeidae) from the Aegean Sea coast of Turkey,*Mediterranean Marine Science, 10(1),*2009, 121-124.

[4] F.Sardà, A. Calafat, A.Flexas, A.Tselepides, M. Canals, M. Espino and A. Tursi, An introduction to Mediterranean deep-sea biology,*Scientia Marina 68,*2004,7-38.

[5] M.Thessalou-Legaki, Distribution of *Aristeus antennatus* and *Aristaeomorphafoliacea*in the Eastern Mediterranean. Proceedings of the life cycles and fisheries of the deep-water red shrimps *Aristaeomorphafoliacea*and*Aristeus antennatus, Istituto di TecnologiadellaPesca e del Pescato, Mazzara del Vallo,* Italy,1994, 61-62.

[6] C. MytilineouandC.Y.Politou, New references for the presence of the red shrimp *Aristaeomorphafoliacea*in the Greek waters, *Proceedings of the 5th Hellenic Symposium on Oceanography & Fisheries. National Centre for Marine Research,* Kavala, Greece, 1997, 87-89.

[7] A. Demirci, *A Study The North East Mediterranean deep Sea Trawl Fishery* (in Turkish), PhD Thesis, Institute of scienceDepartment of Fishing and Processing Technology, Ege University, Izmir, TURKEY,2006, 137pp.

[8] A. KocataşandT.Katağan, The Decapod Crustacean fauna of the Turkish Seas,*Zoology in the Middle East, 29*, 2003, 63-74.

[9] P.Sparre, E. Ursin and S.C.Venema, Introduction to tropicalfish stock assessment Part 1, *FAO Fisheries Technical Paper, 306/1*,1989, 337.

[10] F. C.Gayanilo, P.Sparre and D.Pauly, The FAOICLARMStock Assessment Tools (FiSAT) User's Guide, *FAO Computerized Information Series, Fisheries. FAO,*Rome,1996.

[11] J. L.MunroandD.Pauly, A simple method for comparing the growth of fishes and invertebrates. *Fishbyte, 1(1),* 1983, 5-6.

[12] D. Pauly, Some simple methods for the assessment of tropical fish stocks,*Food & Agriculture Organization,* Roma,1983, 234.

[13] D. Pauly, On the interrelationships between natural mortality, growth parameters, and mean environmental temperature in 175 fish stocks,*Journal du Conseil, 39(2),*1980, 175-192.

[14] A.Matarrese, G.D'onghia, A.Tursi and P.Maiorano, Vulnerabilità e resilienza di *Aristaeomorphafoliacea* (Risso, 1827) e *Aristeus antennatus* (Risso, 1816)(Crostacei, Decapodi) nel mar Ionio,*S. It. E. Atti, 18,*1997, 535-538.

[15] M. Yahiaoui, Distribution and reproduction cycle of *Aristeus antennatus* and *Aristaeomorphafoliacea* in Algeria. Life cycles and fisheries of the deep-water red shrimps *Aristaeomorphafoliacea* and *Aristeus antennatus,NTR-ITPP, Special Publication, 3*,1994, 51-52.

[16] M.T. Spedicato, G.Lembo, T.Silecchia and P. Carbonara, Contribution to the stock assessment of the giant red shrimp (*Aristaeomorphafoliacea*, Risso 1827) in the Middle-Southern Tyrrhenian Sea, *Biologia Marina Mediterranea, 5 (2),* 1998,252-261.

[17] P. Martínez-Baños, F. Vizuete and J.Mas, Aspectosbiológicos de la GambaRoja*Aristeus antennatus* (Risso, 1816) a partir de las pesqueriasdel SE de la Peninsula Ibérica,*Actas VIº Simp. Ibér. Est. Bentos Marino,*1990, 235-243.

[18] M.Demestre and P. Martin, Optimum exploitation of ademersal resource in the western Mediterranean: the fishery of the deep-water shrimp *Aristeus antennatus* (Risso, 1816), *Scientia Marina, 57*,1993, 175-182.

[19] M. Demestre, Moult activity-related spawning success in the Mediterranean deep-water shrimp *Aristeus antennatus* (Decapoda: Dendrobranchiata),*Marine Ecology Progress Series, 127,*1995, 57-64.
[20] A.Campillo, P. Y.Dremiere, B.Liorzou and J. L. Bigot, Observations on two deep water crustaceans in the Gulf of Lions, *Aristeus antennatus* (R.) and *Nephropsnorvegicus* (L.),*FAO, Rapport sur les Peches (FAO),*1991.
[21] F. Sardà and M. Demestre, Estudiobiologico de lagambaAristeus antennatus(Risso, 1816) en el mar Catalan (N.E. de Espana), *Invest. Pesq. 51 (Suppl. 1),*1987, 213–232.
[22] M.Arculeo, R.Baino, A.Abella and S.Riggio, Accrescimento e riproduzione di Aristeus antennatus (Crustacea, Decapoda) nelGolfo di Castellammare (Sicilia N/W). *Oebalia,17(Suppl. 2),*1992, 117-118.
[23] M.Demestre and P. Martin, Optimum exploitation of ademersal resource in the western Mediterranean: the fisheryof the deep-water shrimp *Aristeus antennatus* (Risso, 1816), *Scientia Marina, 57,*1993, 175-182.
[24] M. T.Spedicato, G.Lembo, P. Carbonara and T.Silecchia, Biological parameters and dynamics of *Aristaeomorphafoliacea* in southern Tyrrhenian Sea,*Life Cycles and Fisheries of the Deep-Water Red Shrimps Aristaeomorphafoliacea and Aristeus antennatus*, 1994, 35-36.
[25] A.Carbonell and F. Alvarez, Fishery and biology of *Aristeus antennatus*, Risso, 1816 on Majorca Island waters,*Rapp. Comm. Int. Mer. Medit. 34,* 1995,22.
[26] S.Ragonese and M. L. Bianchini, Growth, mortality and yield-per-recruit of the deep-water shrimp *Aristeus antennatus* (Crustacea-Aristeidae) of the Strait of Sicily (Mediterranean Sea),*Fisheries research, 26(1),*1996, 125-137.
[27] C.Papaconstantinou and K. Kapiris, Distribution and population structure of the red shrimp (*Aristeus antennatus*) on an unexploited fishing ground in the Greek Ionian Sea,*Aquatic Living Resources, 14(5),*2001, 303-312.
[28] G.Gorelli, F. Sardà and J. B. Company, Fishing Effort Increase and Resource Status of the Deep-Sea Red Shrimp *Aristeus antennatus* (Risso 1816) in the Northwest Mediterranean Sea Since the 1950s, *Reviews in Fisheries Science & Aquaculture, 24(2),*2016, 192-202
[29] M. C.Deval and K.Kapiris, A review of biological patterns of the blue-red shrimp *Aristeus antennatus* in the Mediterranean Sea: a case study of the population of Antalya Bay, eastern Mediterranean Sea,*Scientia Marina, 80(3),*2016, 339-348.