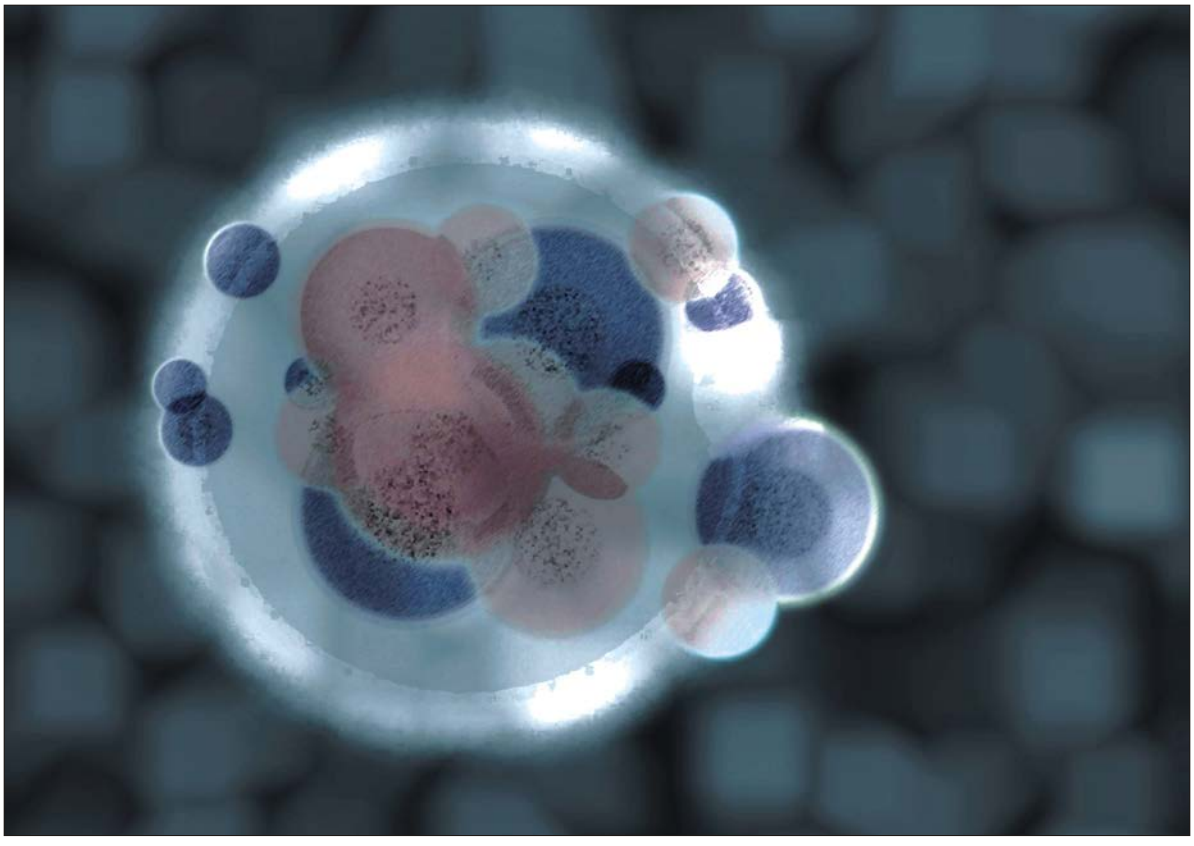

Journal of Biological Sciences

ISSN 1727-3048

science alert

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Journal of Biological Sciences 7 (4): 685-688, 2007
ISSN 1727-3048

The Growth Features of Pontic Shad *Alosa pontica* (Eichwald, 1838) in the Sea of Marmara, Turkey

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Abstract: In this study the growth properties of shad *Alosa pontica* (Eichwald, 1838) in the Sea of Marmara coasts between November 2005 and January 2006 were studied. A total of 307 samples (156 males and 151 females) were examined. Age compositions of the individuals varied between I-V. The first age group was the dominant in the population. The fork length distribution ranged from 12 to 33 cm and the average weight distribution ranged from 19.73 to 367.35 g. Length-weight relationship was found to be $W = 0.0163\ L^{2.8511}$ ($R = 0.92$).

Key words: Pontic shad, *Alosa pontica*, Sea of Marmara, growth

INTRODUCTION

The pontic shad *Alosa pontica* is herring-like fishes with a few differences regarding their external aspect. Belonging to the Clupeidae family, they are old forms of fish, attested from the Tertiary Period (Ciolac, 2004). The pontic shad lives in Black Sea and sea of Marmara. It is a pelagic species and generally prefers the Southern areas of the Black Sea. Its behaviour in the marine environment is not well studied but it is known that in the winter, the shad can be found along the South-Eastern Coast of the Black Sea in the relative deep locations (more than 40 m) (Antonescu, 1957). They feed crustaceans and small fishes. These fish are widespread in Black Sea, Sea of Marmara, Sea of Azov and Caspian Sea. In Turkey, It is reported in Black Sea and Sea of Marmara coasts (Erazi, 1942; Aksiray, 1954; Slastanenko, 1956; Whitehead, 1984; Eryilmaz, 2001; Kuru, 2004).

The Sea of Marmara is a marine basin in northwest Turkey that connects the Aegean Sea with the Black Sea. It is 275 km long and 80 km wide with a broad shallow shelf to the south and a series of deep (up to 1250 m) subbasins to the north. Though the Sea of Marmara has the smallest surface area and volume of the seas surrounding Turkey, It is holds the second position, after the Black Sea in terms of fishing (Eryilmaz, 2001).

The pontic shad (*Alosa pontica* Eichwald, 1838) has obtained commercial importance due to decreasing stocks of other economically important species inhabiting the Black Sea after the mid-80s. Some 76% of the shad production of Turkey is provided from the Black Sea and Sea of Marmara. The shad has the lowest fishing rate among the other commercial species with a rate of production of 0.4% in the Black Sea and Sea of Marmara. An organization for shad fishing has not been established yet. In the future, research on the determination of the stock and bio-ecological characteristics of the shad must be started in order to profit from the optimum level of stocks and to provide continuity of stocks (Zengin *et al*., 1998).

Although several studies have already been conducted on these fish by Năvodaru (1996), Ciolac (2004), Ciolac and Patriche (2004), in Turkey there are very few, such as Samsun (1995), Yilmaz and Polat (2002). The present study was conducted to observe the population structure and growth features of *A. pontica* in the Sea of Marmara coasts (Istanbul).

MATERIALS AND METHODS

A total of 307 specimens (156 males and 151 females) shad were caught using gill nets with mesh sizes ranging from 28 to 60 mm. The sampling was done at three stations on the Sea of Marmara (Istanbul) between November 2005 and February 2006 (Fig. 1). The Fork length of each specimen was measured to the nearest 1.0 mm and fish were weighed to nearest 0.1 g. The ages of the specimens were calculated according to Lagler (1966) by checking the scales. The age reading was carried out under a stereo microscope with a 2×10 and 4.5×10 zooming. In order to determine the age, annulus determination way suggested by Bagliniere and Louarn (1987) was

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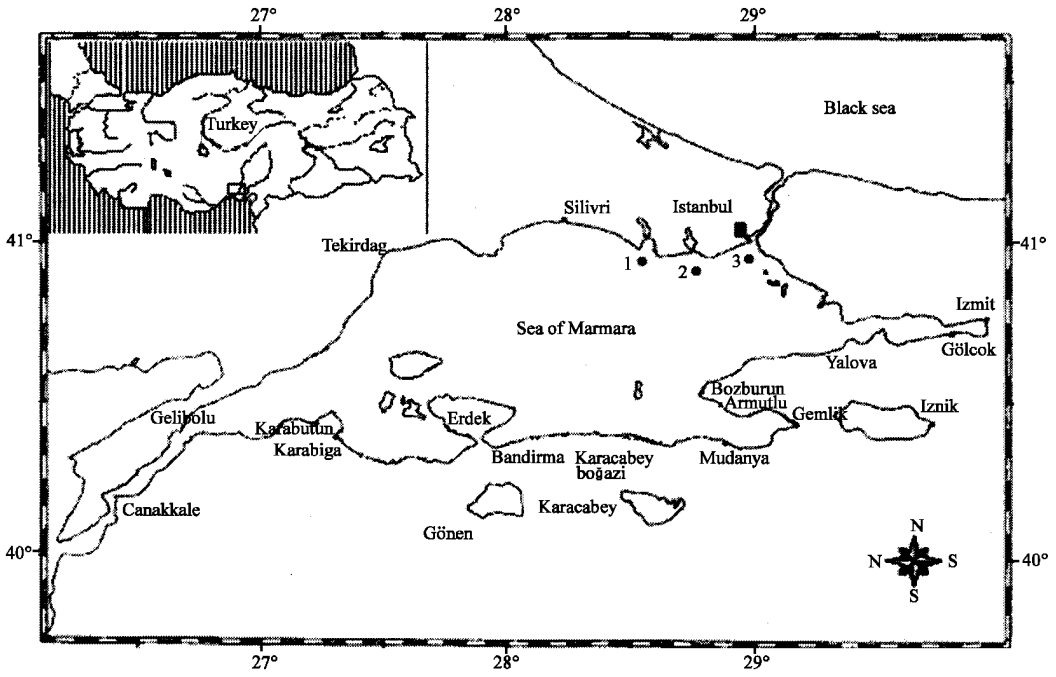

Fig. 1: The location of the Sea of Marmara and sampling sites

followed. Using the values for fork length (cm) and weight (g) as per individual the length-weight relationship was calculated according to Le Crens (1951) equation: $W = aL^b$ The rational increases in length and weight were determined with the formulas given Chuqunova (1963). $OL = L_t - L_{t-1}/L_{t-1}$ and for proportional weight increase $OW = W_t - W_{t-1}/W_{t-1}$.

In calculation of condition factor (K), also known as fatness coefficient, $K = (W/L^3) \times 100$ was used (Ricker, 1975).

Differences between growth and condition factor for the female and male groups within the same age groups and differences between measured and theoretical values for length were tested with a t-test at $p \bullet 0.05$.

RESULTS

Population structure: Overall, 50.82% were males and 49.18% females (Table 1). Age variation ranged from groups I to V. It was determined that fish in group I were the group common, (32.57%), followed by group V (31.59%). Age groups contained I, V 64.16% of all specimens studied.

Length and weight composition: Length and weight distributions of the 307 *A. pontica* specimens examined, were as follows: female individuals were 12.6 (I age group) -30.8 cm (V age group), while male specimens were 12 (I age group)-33 cm (V age group) in length. Weighed varied as follows: females 22.3 (I age group)-367.3 g (V age group) and males 19.7 (I age group)-304.6 g (V age group).

Table 1: The age and sex ratio of the shad from the Sea of Marmara

Age groups	Female N	Female %	Male N	Male %	Female+Male N	Female+Male %
I	44	14.33	56	18.24	100	32.57
II	17	5.54	22	7.17	39	12.71
III	18	5.86	12	3.91	30	9.77
IV	21	6.84	20	6.52	41	13.36
V	51	16.61	46	14.98	97	31.59
Total	151	49.18	156	50.82	307	100.00

Age-length relationship: The average fork length of the age group and relative annual increase in length of females, males and combined sexes are given in Table 2.

Age-weight relationship: The growth (age-weight) parameters and equations of females and males were obtained in weight both theoretically and empirically for females, males and both combined in the different age groups. The relative annual increase and the age-weight relationship of fish examined are shown in Table 3.

Length-weight relationship: The length of an individual whose weight is known and the weight of an individual whose length is known were calculated with the logarithmic length-weight relationship using the regression coefficient of length and weight ($W = aL^b$). The length-weight relationship curve is depicted in Fig. 2.

Table 2: The average fork length (cm) of the age group and the relative annual increase in length of the shad from the Sea of Marmara

		Female			Male			Female+Male		
		FL (cm)±SD			FL (cm)±SD			FL (cm)±SD		
Age groups	N	(Min-Max)	RFL (%)	N	(Min-Max)	RFL (%)	N	(Min-Max)	RFL (%)	t-test
I	44	16.43±1.55	0.265	56	15.93±2.14	0.312	100	16.15±1.91	0.291	p• 0.05
		(12.6-19.6)			(12.0-20.2)			(12.0-20.22)		
II	17	20.80±0.77	0.074	22	20.91±1.06	0.078	39	20.86±0.93	0.075	p• 0.05
		(19.6-21.8)			(18.1-22.5)			(18.1-22.5)		
III	18	22.35±0.89	0.077	12	22.55±0.77	0.054	30	22.43±0.84	0.066	p• 0.05
		(20.7-24.2)			(20.7-23.8)			(20.7-24.2)		
IV	21	24.08±1.14	0.151	20	23.77±0.76)	0.154	41	23.93±0.97	0.153	p• 0.05
		(22.7-26.5)			(22.7-25.5)			(22.7-26.5)		
V	51	27.73±1.42	-	46	27.45±1.95)	-	97	27.60±1.69	-	p• 0.05
		(25.2-30.8)			(24.3-33.0)			(24.3-33.0)		

Table 3: The average weight (g) of different the age group and the relative annual increase in weight of the shad from the Sea of Marmara

		Female			Male			Female+Male		
		W (g)±SD			W (g)±SD			W (g)±SD		
Age groups	N	(Min-Max)	RW (%)	N	(Min-Max)	RW (%)	N	(Min-Max)	RW (%)	t-test
I	44	49.14±12.62	1.018	56	44.29±17.26	1.060	100	46.43±15.53	1.040	p• 0.05
		(22.3-82.2)			(19.7-80.1)			(19.7-82.2)		
II	17	99.17±18.74	0.236	22	91.28±19.92	0.223	39	94.72±19.57	0.248	p• 0.05
		(71.8-153.6)			(72.4-135.3)			(71.8-153.6)		
III	18	122.64±28.75	0.163	12	111.70±21.33	0.306	30	118.27±26.86	0.220	p• 0.05
		(76.8-176.4)			(87.6-152.0)			(76.8-176.40)		
IV	21	142.74±39.50	0.562	20	145.99±39.97	0.440	41	144.33±39.26	0.503	p• 0.05
		(100.3-249.4)			(100.9-252.5)			(100.3-252.5)		
V	51	222.98±53.98	-	46	210.24±47.02	-	97	216.94±50.94	-	p• 0.05
		(116.7-367.3)			(118.6-304.6)			(116.7-367.3)		

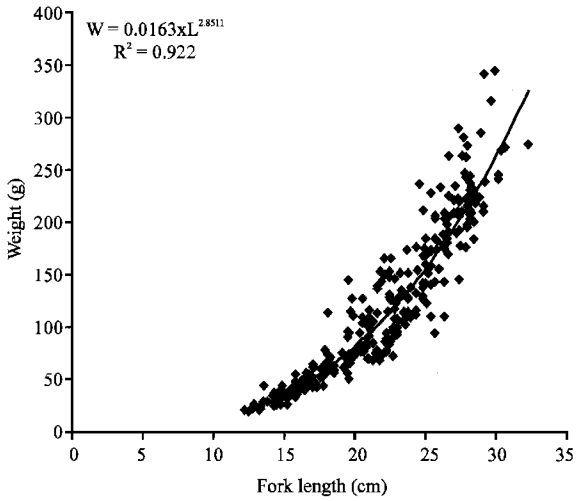

Fig. 2: Weight-length correlation of *A. pontica* individuals

Condition factor: The condition factor of *A. pontica* was found to be 1.10 for females, 1.05 for males and 1.08 for both sexes combined. In general condition values showed a gradual increase with length.

DISCUSSION

In this study, a total of 307 specimens of *A. pontica* from Sea of Marmara coasts were examined. The age of captured fish ranged between I and V. The age groups were 49.18% females and 50.82% males. In the mid of the Turkish Black Sea the age distribution between the same age groups was 54.71% for females and 45.29% males (Samsun, 1995). The differences may be attributed to the use of various nets of different mesh sizes, natural interspesific competition in the shad population and changes in the hunting pressure. Length distribution in the shad population in the Sea of Marmara was 12.6-30.8 and 12-33 cm for females and males, respectively. In the mid of Turkish Black Sea It was 11.7-34 and 11.0-31.6 cm for females and males, respectively (Samsun, 1995). The reason for the in length distribution may be the same, the use of nets of different mesh sizes.

The weight in total of the shad population examined was 22.3-367.3 and 19.7-304.6 g for females and males, respectively. In the mid of Turkish Black Sea it was 10.56-318.19 and 6.85-226.02 g for females and males, respectively (Samsun, 1995). The differences in variations in weight in these studies may be due to the use of nets of different mesh sizes.

The length-weight relationship in fish may change with age, season, nutrition, sexual maturity and species (Ricker, 1975; Bagenal, 1978). It was determined that the length-weight relationship was $W = 0.00163 \times L^{2.8511}$ ($r = 0.922$). The b values found *A. pontica* individuals was 2.814, 2.866 and 2.851 for females, males and both sexes combined, respectively. In the mid of Turkish Black Sea these values for females, males and both sexes combined were 3.3931, 3.3393 and 3.3887, respectively. The reason

for the different b values in the shad populations may have been the high numbers of sexually mature and aged fish. The b value, showing the type of growth in fish, has been shown to range from 2 to 4 (Le Cren, 1951; Brown, 1957; Ricker, 1975). The b values in fish differ according to species, sex, age, sexual maturity of fish, season and fish feeding (Ricker, 1975).

The condition factor of the fish population shows changes with gonadal development, age, seasonal changes in growth and net mesh size (Le Cren, 1951; Ricker, 1975). The condition factor of shad population in the Sea of Marmara was 1.10, 1.05 and 1.08 for females, males and both sexes combined, respectively. In the mid Turkish Black Sea the condition factor for females, males and both sexes combined was 1.21, 1.02 and 1.12, respectively (Samsun, 1995). Compare with these values, the condition factor of the shad population in the Sea of Marmara for females and both sexes is low. This decrease in the condition factor may be attributed to the decreased food abundance, different mesh size of the nets used and an extensive fishing. Furthermore, the environmental and geographical condition of the studied region and climatic factors can affect the condition factor considerably.

In light of these results and evaluations, it was aimed to determine some biological features such as growth rate, condition factor and size of *A. pontica* and to obtain some significant data to benefit optimally from natural fish population.

Consequently, as no studies have been done on the growth of the *A. pontica* population living in the Sea of Marmara. The present study provides basic information about the growth and population structure of shad in Turkish coasts.

ACKNOWLEDGMENT

This authors wish to thank University of Cukurova Research Fund for supporting this study.

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