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A Study on Abu Mullet (*Liza abu* Heckel, 1843) (Diyarbakir), Turkey

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Abstract: In this study, population structure, growth and reproduction properties of *Liza abu* which lives in Devegecidi Dam Lake and its inlets were observed between November 2008 and January 2010 and totally 1005 individuals sampled. Maximum age, fork length and weight were determined as IV, 21.8 cm, 122 g, respectively. Sex ratio (male:female) was calculated as 1:0.94. Condition factor was found as 1.261±0.003. No any mature sample could be caught from the dam lake tributaries between April and July. At the same period abundantly mature samples could be caught from the dam lake. This situation has led to the opinion that reproduction go on in the dam lake. Fecundity was found 26393±1375 eggs per female and 538±21 eggs per gram gonad weight. The eggs diameters were calculated as 0.6±0.02 mm.

Key words: Abu mullet, growth, reproduction, Devegecidi Dam Lake, eggs

INTRODUCTION

Determination of properties like reproduction and growth is needed to ensure the continuity of populations. For this purpose, many studies are continued in freshwater and marine environments (Sen and Saygin, 2008; Ozvarol *et al*., 2010; Basusta *et al*., 2013).

The Devegecidi Dam Lake was made for irrigation purposes and located in the northwest of the Tigris Basin in the province of Diyarbakir. Altitude of the lake is 670 m and it is fed by rain water and stream of Sarge, Cegenek, Cay, Hatun and Ayse Streams. Surface area of the lake is 11 km^2 and maximum depth is 30 m. Various species from different families are naturally distributed in the Devegecidi Dam Lake (*Barbus esocinus*, *B. plebejus lacerta*, *B. rajonorum*, *Chalchalburnus mossulensis*, *Capoeta trutta*, *C. capoeta umbla*, *Cyprinus carpio*, *Acantobrama marmid* ve *Leuciscus cephalus orientalis*). Researchers were also observed in the presence of species of *Garra variabilis*, *Chondrostoma regium*, *Mystus halepensis*, *Mastacembelus simack* ve *Scardinius erythrophthalmus* during the sampling.

Abu mullet is an unusual and interesting species in Mugillidae family because of reproductin in freshwater. This species was reported first time in Mosul and it was reported in the borders of Turkey from the Habur River (Kuru, 1979). The distribution areas are the Tigris-Euphrates and the Asi River Systems (Kuru, 1979).

Although, Abu mullet is a marine form it can be enter to inland waters. This shows that Abu mullet have a wide ecological adaptation ability. Although, this species origin is Indian Ocean it has entered to upper part of The Tigris Basin System. Therefore it has a great privilege compared to other species, especially in terms of its zoogeographical distribution. Even though it is not very large has a economic importance for human food like other species of mullet. There is no study on the biology of Abu mullet in Devegecidi Dam Lake yet. This study was aimed to determine the growth and reproduction properties of Abu mullet.

MATERIALS AND METHODS

A total 1005 samples was captured with trammel nets from Devegecidi Dam Lake between November 2008 and January 2010 in this research. On the samples, total (W) and Gonad weights (Gw) (±0.1 g), fork Lengths (L) (±1 mm) were recorded. Sex was determined via examination of specimens gonads. The eggs numbers were counted by the gravimetric method and the eggs diameters were measured with ocular micrometer (Karatas *et al*., 2005). The ages were determined by otholit (Turkmen *et al*., 2005). The age-length and age-weight relationships were calculated by equations:

$$L_t = L_\infty \times [1-e^{-k\times(t-to)}]$$

And:

$$W_t = W_\infty \times [1-e^{-k\times(t-to)})]^b$$

The length-weight relationship ($W = a\times L^b$) and Condition Factor (CF) of the samples ($CF = W/L^3\times 100$)

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were calculated (Cetinkaya and Elp, 2005). Gonadosomatic Index values (GSI) were calculated by using the formula ((GW/W)×100). The eggs were counted by the gravimetric method. The parameters examined in this study were analysed using standard statistical methods.

RESULTS

In this study, 1005 individuals were sampled and age was determined 1002 individuals. The samples were 1-4 years old. The highest percentage in the samples was at III. age group (81.63%) and it was followed by II. age group (15.56%). Age-length relation values were calculated as in the Table 1. The differences of fork lengths between male and female individuals were important in III. age group in favour of females ($p<0.05$).

Age-weight relationship values were calculated as in the Table 2. The average weight difference between male and female in III. age group individuals and in the all samples were important in favour of females ($p<0.05$). In the other age groups, the differences were not significant between sampled male and female individuals ($p>0.05$). Length-weight relationship in males, females and general were calculated as logW = -2.014+3.091 logL, logW = -2.131+3.198 logL and logW = -2.088+3.158 logL, respectively.

Age-length and age-weight relationships were calculated as in the Table 3. Condition factor of the all samples, male and females were calculated as 1.261±0.003 (0.746-1.910), 1.248±0.005 (0.776-1.706) and 1.274±0.005 (0.746-1.910), respectively. The differences of condition factor between sexes were higher in favour of females ($p<0.05$).

The 1005 individuals were sampled and determined as 23 individuals were juvenile, 477 individuals were female and 505 individuals were male. Male:female ratio was calculated as 1:0.94. Reproduction in female and male found at II (52.8%) and III ages (67.8%), respectively. Sexual maturity size group in males and females were 14.0-14.9 cm (54.5%) and 13.0-13.9 cm (55%), respectively. Female individuals matured earlier than male. No mature individuals were observed smaller than 12 cm fork length.

GSI value decreased to minimum value in September (in males 0.366±0.035 and in females (0.790±0.065). During this period, it is difficult to recognize ovary or testes with the naked eye. The GSI has started to rise in December to January. GSI value in males was 2.424 and in females was 1.788 in December in 2009. Ovaries which are in the reproductive period in June reached maximum size (12.805±0.906). The testicles reached the maximum size (9.764±0.272) in the second half of April at the beginning of the reproductive period. After the reproduction a little immature eggs in females gonads and a lot of sperm in males remained. After a few day these eggs and sperm have been lost and the gonads took the shape of a thin rope. It was concluded depend on the GSI that reproduction period of Abu mullet in Devegecidi Dam Lake happened first half of August to second half of April.

Abu mullet did not migrate for reproduction in Devegecidi Dam Lake. Reproduction area of Abu mullet was identified as in Devegecidi Dam Lake. Mature individuals were founded at the dam lake during the reproduction season but egg could not found.

The average individual fecundity was calculated as 26393±1375 (7770-84543) egg/female and 1 g gonad weight had 538±21 eggs. Abu mullet eggs which obtained captured mature females from natural environment observed to be round, spherical shape, pale yellow colour and demersal. An oil drop was observed in the egg. There is no bulge or the holding organelle on the egg. The eggs were not have adhesive properties. The average diameter of eggs was measured as 0.6±0.013 mm. The maximum diameter was measured as 0.8 mm.

Table 1: Fork length (cm) of Abu mullet depend on sex and age in Devegecidi Dam Lake

	Male		Female		General	
Age groups	n	L±SEM (Min.-Max.)	n	L±SEM (Min.-Max.)	n	L±SEM (Min.-Max.)
I	9	9.68±2.62 (8.6-10.7)	12	9.44±4.67 (7.3-14.2)	21	9.54±2.85 (7.3-14.2)
II	84	13.91±0.97 (10.0-15.8)	72	13.88±1.32 (9.1-15.0)	156	13.90±0.80 (9.1-15.8)
III	410	15.78±0.51 (13.8-19.4)	388	15.94±0.56 (13.5-19.5)	818	15.89±0.38 (13.5-19.5)
IV	1	19.50	3	19.80±10.14 (18.5-21.8)	7	19.71±4.16 (18.5-21.8)
General	504	15.36±0.64 (8.6-19.5)	475	15.49±0.77 (7.3-21.8)	1002	15.47±0.50 (7.3-21.8)

Table 2: Weight (g) of abu mullet depend on sex and age in Devegecidi Dam Lake

	Male		Female		General	
Age groups	n	W±SEM (Min.-Max.)	n	W±SEM (Min.-Max.)	n	W±SEM (Min.-Max.)
I	9	9.55±0.98 (6.0-14.0)	12	9.66±2.87 (4.0-41.0)	21	9.61±1.66 (4.0-41.0)
II	84	34.75±0.85 (10.0-51.0)	72	35.47±0.98 (9.0-55.0)	156	35.08±0.64 (9.0-55.0)
III	410	49.51±0.48 (31.0-90.8)	388	52.44±0.56 (29.0-99.0)	818	51.34±0.38 (29.0-99.0)
IV	1	98.00	3	99.23±11.38 (87.7-122.0)	7	100.24±6.03 (80.0-122.0)
General	504	46.43±0.54 (6.0-98.0)	475	49.08±0.66 (4.0-122.0)	1002	48.28±0.44 (4.0-122.0)

Table 3: Von bertalanffy growth equations of Abu mullet in Devegecidi Dam Lake

Genders	FL_∞	W_∞	b	K	t_0
Male	32.96	476.54	0.84	0.18	-1.02
Female	34.55	615.12	0.84	0.17	-0.87
General	34.18	569.71	0.84	0.17	-0.94

DISCUSSION

Depend on the investigation, the samples were found 1-4 years old. Unlu *et al.* (2000) reported that age of *Liza abu* range was between 1-4 years in Tigris River the result have been similar to the researchers.

Maximum fork length of males and females was found 19.5 and 21.8 cm, respectively in this study. Maximum weight of males and females were found 98 and 122 g respectively. Unlu *et al.* (2000) reported that the maximum fork length of males and females were found 18.8 and 19.2 cm, respectively. Unlu *et al.* (2000) reported that the maximum fork weight of males and females was found 97.0 and 98.0 g, respectively. The size of values determined by researchers was similar to the research. But the samples weight was heavier than the researchers record. The reason of this situation could be weight losses of samples. Because the samples begin to weight losses after the catch.

Unlu *et al.* (2000) studied the length-weight relationship and they reported that the value of b in male, female and all samples was b = 3.2165, b = 3.3796 and b = 3.3022, respectively. The results were similar to the researchers record and b value is calculated on 3 in both studies. This was showed that with the increases of length of Abu mullet body was become a stocky structure.

Unlu *et al.* (2000) reported that Von bertalanffy growth equations of *Lisa abu* values of female, male and all samples were $L_t = 20.427\ [1-e^{-0.304531\ (t+2.507883)}]$, $L_t = 19.898\ [1-e^{-0.513397\ (t+0.855108)}]$ and $L_t = 19.577\ [1-e^{-0.383129\ (t+1.95500)}]$, respectively. The values different from the results. The reason of the differences could be habitat variety. Researchers took the samples from Tigris River. In the samples were collected from the dam lake so, the dam samples had a chance to show a better growth performance. The obtained maximum length, weight and age was harmonic with the values but the cutch pressure of the sampling environment was higher than Tigris River. So the L_∞ and K values are quite different.

Condition factor values of Abu mullet changed between 0.746-1.910 and reaches its maximum value in September. Average condition factor value of male and female were calculated as 1.248±0.005 and 1.274±0.005, respectively. The condition factor value was determined as 1261±0003 in generally. Unlu *et al.* (2000) reported that condition factor reached its maximum values during August to September and average condition factor value in males and females reported as 1.000±0.087 and 1.004±0.089, respectively. This difference is due to the loss of weight from the catch until the measurement or differences in habitat.

Male:female ratio was calculated as 1:0.94. It was reported as 1:1.21 by Unlu *et al.* (2000) as 1:2.7 by Chelemal *et al.* (2009) and as 1:1.3 by Naama *et al.* (1986). Sex ratio in fish populations could change from species to species, between years and regions as well as sex ratin could be found different depend on sampling methods (Nikolsky, 1963).

In the study, the smallest mature female individuals length and weight were 12 cm and 25 g and the same results were also found in males. Unlu *et al.* (2000) reported that the length and weight of the smallest mature individuals were 11.7 cm and 17 g in female and 11.5 cm and 14 g in male. Although, the minimum maturity size that researchers have observed was similar with Unlu *et al.* (2000), weight values were different. The reason of these situation could be weight loss from the catch until the measurement in the laboratory. In fact, the condition factor value strengthened this idea.

It was observed that of males in III age were sexually mature of females in the II age were sexually mature. Unlu *et al.* (2000) reported that gonads began to develop at the II age both sexes. This reports supported the result.

Reproduction period of the population was determined between April 15 and August 15 depending on GSI and field observations. Unlu *et al.* (2000) reported that Abu mullet migrated to the upper part of the river from March to August so they did not determined reproduction period. The reported migration time overlap with reproduction period in the Devegecidi Dam Lake. Chelemal *et al.* (2009), reported that reproduction period of Abu mullet was occur between January and May. This difference in the reports could be due to differences in the habitats.

Individual fecundity determined between 7,770 and 84,543 in this study. The average individual fecundity was calculated as 26,393±1,375. Unlu *et al.* (2000) reported that individual fecundity of abu mullet was 12.175-56.400 and average individual fecundity of Abu mullet was 21.641±1860. Mean diameter of the eggs were measured as 0.6±0.013 mm. Unlu *et al.* (2000) reported that average egg diameter were 0.05 and 0.5 mm. Naama *et al.* (1986) reported that average egg diameters were between 0.1-0.70 mm.

CONCLUSION

It is concluded that Devegecidi Dam Lake is a suitable habitat for Abu mullet to reproduction and growth. While the fishing embodiments were applied minimum hunting length must be 14 cm (fork length) and the fishing ban season must be cover April 15 to August 15 time period.

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