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THE OVERWINTERING OF LEAPING MULLET (*LIZA SALIENS* RISSO, 1810) IN FRESH WATER

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Abstract

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The overwintering of leaping mullet (*Liza saliens* Risso, 1810) juveniles (average live weight (W) 5.20±0.02 g and average total length (L) 8.11±0.08 cm) was investigated, in this study. The trial was planned in 2 groups and triplicate. One of the trial groups (the Group 1) comprised of the fish stocked in ponds in the open area and the other group (the Group 2) of the fish stocked in the ponds covered with greenhouses.

The average W and L values of the Group 2 after a period of 3 months were 8.70±0.04 g and 9.62±0.05 cm, respectively. The mortality rate (M) in this group was 0.95±0.1 % and 12.86±0.1 % in the Group 1. The difference among the W and L values, specific growth rates (SGR) and M averages obtained from the groups was found to be statistically significant ($P<0.05$).

As a result of this study, it can be recommended that mullet species can be polycultured as a side product with aforementioned species in large scale businesses by efficient use of pond layers.

Key words: leaping mullet, overwintering, fresh water
Abbreviations: W - Average live weight (g), L - Average total length (cm), M - Mortality rate (%), SGR - Specific growth rates (%), FWRCS - Fresh Water Fish Research and Culture Station at the Fisheries Faculty of Cukurova University

Introduction

The species belonging to the Mugilidae family are widely found in tropical and subtropical seas. They live in schools in all the seas, river, fresh, salt and brackish water lakes connected to these seas in our country. They densely populate especially the shallow waters and the lagoons with varying levels of salinity.

There are 11 genus and 120 species belonging to the Mugilidae family (Benli and Uçal, 1990; Demirsoy, 1997; Tekelioglu, 1998). They are tolerant to a wide interval of temperature and salinity (eurythermal and eutyhaline) and adult individuals can adapt to a temperature interval of 0-38 ºC and 60-70 $\%_0$ salinity levels. They can survive in waters with low oxygen levels (Korringa, 1976; Collins, 1985; Dikel, 1990; Atay, 1994; Alpbaz, 1996; Hotos and Vlahos, 1996; Demirsoy, 1997; Lee, 1997; Agiragac and Kalma, 1998; Tekelioglu, 1998).

Approximately 20 species of mullet fish are

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cultured in many parts of the world (Lee, 1997), and especially its extensive culture is very common for a long time (Agiragac and Kalma, 1998). But, mullet fisheries in our country are mainly based on lagoon fisheries (Dikel, 1990; Alpbaz, 1996; Buhan, 1998). This happens by catching the fish entering into lagoons from seas for feeding. Mullet are cultured by means of various techniques in countries such as Israel, Italy, Yugoslavia, Greece, The United Arab Emirates, Tunisia, India, China, Indonesia, Taiwan, The Philippines, Bengal, Japan, Hawaii, Bangladesh, French and Egypt (Alpbaz, 1996; Lee, 1997; Tekelioglu, 1998).

The Aegean and Mediterranean Regions of our country show characteristics of a subtropical climate and have a lot of fresh water resources. Even though mullets are reported to grow the best at temperatures from 20 to 28ºC and not feed at below 10ºC, they continue to feed and grow at lower temperatures. It can be stated that mullet culture, like other aquaculture products such as sea bream, sea bass, trout, salmon, turbot and shrimp culture, will increase since mullet populations diminish as a result of various causes in their natural habitats. For this reason, mullet culture can be recommended in the afore-mentioned regions. But, growth performances of mullets in all seasons, not only in summer and spring seasons have to be determined, firstly.

Material and Method

The study was conducted at the Fresh Water Fish Research and Culture Station at the Fisheries Faculty of Cukurova University (FWRCS) between November 23, 2002 and February 20, 2003. Fingerlings (W, 5.20±0.02 g and L, 8.11±0.08 cm) of the leaping mullet (*Liza saliens* Risso, 1810), which belongs to the Mugilidae family, were used. The fish used in the trial were caught with tulle seine net from the Dipsiz Lagoon (Karatas, Adana, Turkey) and they were brought to the FWRCS.

Firstly, the fish were stocked in ponds with the same salinity (15 ‰) as the waters they were taken from. Acclimatization of the fish to the fresh water was done in a cylindrical fiberglass tanks with a diameter of 3.90 m and a depth of 0.90 m. The salinity of the ponds was decreased to 0 ‰ (fresh water) gradually in two days for the adaptation of the fish (Polat et al., 1995). Then, they were kept, observed and adapt to mixed feed in these ponds for a few days and taken to trial ponds.

Cylindrical fiberglass tanks with a diameter of 3.90 m and a depth of 0.90 m were used in the overwintering of the fish. A greenhouse was built by covering the ponds by nylon covers (Group 2). The ponds in the open area were used for the other group (Group 1).

Carp mixed feed containing 42 % crude protein (Pinar CO. Ltd., IZMIR) was used for the fish. The fish were fed three times a day by free feeding method.

Water temperatures and dissolved oxygen values (Table 1) were measured with an oxygen meter (Mettler Toledo) once a day.

Pond floors were cleaned with a siphon method, when residues and remains were observed and the ponds were continually supplied with clean water to the effect that 50 % of the pond water is changed daily. Since the fish are known to be sensitive to handling, procedures were carried out without handling as much as possible and within the water. Samplings were done randomly and within 45-day intervals and their W and L values were noted. A 0.01 g sensitive scale (Shinko) and an mm ruler were used for measurement.

W and L averages obtained from the groups and the discrepancies between SGR and M values were calculated. The data relating to the groups at the end of the trial was investigated with T Test and evaluated at a 0.05 significance level.

Results and Discussion

The fish were acclimatized to the fresh water, when they were brought to FWRCS by using the 2-day gradual adaptation method which Polat et al. (1995) specified for *Liza saliens,* polycultured

Table 1
Average temperature (ºC) and dissolved oxygen (mg/l) values of pond water of groups

Weeks	1. Group		2. Group	
	Temperature, ºC	Oxigen, mg/l	Temperature, ºC	Oxigen, mg/l
1	13.87±0.45	12.20±0.62	18.55±0.61	10.96±1.28
2	12.46±0.56	11.33±0.47	16.92±0.45	9.44±1.09
3	9.03±1.60	10.78±0.19	14.88±0.81	9.35±0.39
4	8.19±0.54	10.46±0.29	12.54±0.49	9.46±0.67
5	7.98±0.56	11.18±0.53	12.00±0.40	10.91±1.04
6	9.92±0.43	10.46±0.42	12.74±0.29	8.95±1.27
7	13.28±0.29	9.28±0.49	15.17±0.53	8.92±0.88
8	12.34±0.61	9.47±0.98	16.34±0.48	10.11±1.17
9	11.97±0.88	11.65±1.12	15.42±0.28	12.53±1.05
10	13.37±0.64	11.41±0.66	16.85±0.31	13.08±0.77
11	12.55±0.35	10.05±1.59	15.00±0.70	10.03±1.39

± Standard error of means

with tilapia species. Mortality rate was 0 % during the adaptation.

The average temperatures for the group 1 during the trial were 11.30±0.34ºC and 15.10±0.3ºC for the group 2. Mullet species can tolerate temperatures between 0 and 38ºC. Temperatures between 20 and 30ºC are optimal temperatures for both spawning and feeding (Tekelioglu, 1998).

The average dissolved oxygen values during the trial were 10.82±0.23 mg/l for group 1 and 10.46+0.34 mg/l for group 2. The optimal dissolved oxygen level for mullets is reported to be at least 4.5 mg/l (Tekelioglu, 1998). The levels obtained from this study are congruent with the level reported.

The W and L values for groups 1 and 2 were measured periodically (Table 2) and the groups were found statistically different at the end of the trial ($P<0.05$). The differences between the SGR and M values of the groups (Table 3) were found to be statistically different ($P<0.05$).

The M value in group 1 remained in the rates of 12.86±0.1 % and 0.95±0.1 % in group 2. The low M rate was 1.6 %. Tekelioglu et al. (1988) obtained from the study they did on the overwintering of *Tilapia zilli* juveniles under Cukurova conditions supports this result.

According to the result of the trial, the data obtained from group 2 were found more significant compared to those obtained from group 1 in terms of both growth parameters and M ($P<0.05$). The obtained results show that group 2 had a growth rate 2.5 times greater than group 1 and had a 13 times better performance than group 1 in terms of survival rate.

Bozkurt and Secer (2001) grew *Chelon labrosus* juveniles (average initial W was 3.460±0.323 g and L was 7.484±0.211 cm) to 4.510±0.404 g

Table 2
Weight (g) and length (cm) averages of the groups in terms

Terms	1. Group		2. Group	
	Weight, g	Length, cm	Weight, g	Length, cm
1	5.20±0.30	8.11±0.24	5.20±0.30	8.11±0.24
2	6.22±0.10	8.44±0.00	7.57±0.0	9.16±0.0
3	6.53±0.0	8.96±0.0	8.70±0.0	9.29±0.0

± Standard error of means

Table 3
Specific growth rate (%) and mortality (%) averages of the groups in study

Groups	SGR, %	M, %
1. Group	0.253±0.01	12.86±0.1
2. Group	0.572±0.01	0.95±0.1

± Standard error of means

Table 4
Growth rates of various mullet species for a three-year period (g)

Species	I. Year, g	II. Year, g	III. Year, g
Mugil cephalus	150	300	600
Mugil chelo (*Chelon labrasus*)	75	250	500
Mugil capito (*Liza ramada*)	40	90	250
Mugil (*Protomugil*) *saliens*	40	100	250
Mugil auratus	90	180	300

W and 7.683±0.211 cm L in a three-month study between November and January which took place in their natural habitats. It was reported that the growth and development of *M. capito* mullets depended on temperature and salinity levels and that a temperature between 20 and 30ºC and low levels of salinity accelerated growth (Hossucu, 1995: Bozkurt and Secer, 2001). In the present study, low water temperatures (even below 10^0C in certain periods) caused a decrease in growth. So, the increase in weight under these conditions can be regarded as quite high.

Various studies on the growth performances of mullet species in our country have been done and the data obtained from these studies are given in Table 4 (Buhan, 1998).

These studies show that mullets grow two or three years for consumption. For this reason, mullet species can safely be used in long term farming projects by using this method.

Conclusion

This study has shown that fish can survive cold winter seasons with both a very low M and weight gain, if the ponds they are kept in, is covered.

According to data of 2000, mullet production was 27.698 tons while Turkey's total fish production was 582.376 tons and amounted to 4.76 % of Turkey' total fish production (TUIK, 2002). This amount dwindled to 0.68 % (646.310 t / 4.368 t) according to 2008 data (TUIK, 2010).

Market size for mullets in our country along with many other countries is 250 g and above. But, mullets reach this size in two or three years and their overwintering is a way they can survive cold seasons during their farming. This will facilitate both mullet farming in our country where it has not been widespread so far and its polyculture with widely cultured species such as carp, tilapia, etc.

As a result of this study, it can be recommended that mullet species can be polycultured as a side product with aforementioned species in large scale businesses by efficient use of pond layers. This way, the decrease in mullet production in our country in only 8 years will be reversed and production will be increased by farming.

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