Growth and Survival of Golden Grey Mullet (*Mugil aurata* RISSO, 1810) in Different Salinity Levels

**Abd el-Latif Shaaban Ali and Adib Ali Saad**

**ABSTRACT**

The effect of different salinity levels on the growth performance, feed conversion ratio and survival ratio of Golden grey mullet (*Mugil aurata*), was investigated.

Nine hundred fries (5.74 ± 0.28 g) were stocked in 9 (4 m$^3$) tanks (2×2 ×1 m) concrete tanks with salinities of 38%, 18% and 0%, respectively and fed 3 times for a period of 60 days.

Final body weight and SGR were measured at the end of the incubation period and were significantly lower at C (0%) than A (38%) and B (18%) treatments (P> 0.05). The results indicate that Golden grey mullet fry show best performance when reared at a salinity of 18%.

**Keywords:** Golden grey mullet, *Mugil aurata*, salinity, growth, survival ratio.

1. **INTRODUCTION**

Aquaculture plays increasingly important role in the world fishery production. It has been the world’s fastest growing food production systems for the past decade. The total world fish production of aquaculture increased from about 35.5 million tons in 2000 to about 51.7 million tons in 2006 (FAO, 2008). The increase was a result of intensification of production of the existing farms and the expansion of areas under cultivation.

Grey mullets are mainly catadromous fish family, excluding a few member species. They live in schools on the coasts, lagoons and rivers of tropical and subtropical waters (McDowal, 1988). They are important food fishes. The euryhalinity, eurythermality and their simpler diet, as well as the rapid growth of some species, have made them the object of aquaculture in many parts of the world, including the Mediterranean (Oren, 1981). In 2003, 42,738 tons of grey mullets (about 60% of their total production) were produced by aquaculture in marine, brackish and fresh waters (Sadek and Mires, 2000). Fish development, growth and survival are influenced by various physiological factors among which water salinity is an important parameter. Many studies have indicated that the various developmental stages during fish embryogenesis depend on water salinity. Salinity also plays a key role in growth control, influencing growth rate, metabolic rate, feed intake and feed conversion. Mullets is euryhaline capable of living in environments of different salinities ranging from 0% to 60-70%, (Collins, 1985). In low salinity adapted fish, the passive outward flux of ions such as Na$^+$ and Cl$^-$ from the fish to the external medium, via the gills, fases, and renal system, must be overcome by active uptake of ions (e.g., Na$^+$, Cl$^-$, K$^+$, and Ca$^{2+}$) from the water and/or from the diet (Schmidt-Nielsen, 1997). The gill is a major osmoregulatory organ in fish, undergoes large morphological changes, even at low salinities (Laiz-Carrion et al., 2005). Adaptation to salinity regimes markedly lower than sea water is an important physiological ability in many marine fish species (Blaber, 1997).

There are 8 mullet species in Syrian water 7 species in marine and brackish water (Hammoud, 1996), and one species in fresh water (Bekman, 1962), but any mullet has...
not yet been cultured commercially there. Mullets in Syria generally are obtained from Mediterranean and inland water fisheries.

This study was carried out with the aim of determining the effects of different salinity levels on growth of *Liza aurata* and contributing to its culture researches in Syrian water.

2. MATERIALS AND METHODS

This study was performed at Al Sen fresh water fish farm in Tartus governorate, which is belonging to the general establishment of fishery, Syria.

Golden grey mullets 900 individual fish (5.74 ± 0.28 g, 8.23 ± 0.14 cm) were caught from the estuary of Al Sen River on the Mediterranean Sea shore. They were then divided into 3 groups. After that the mullets were stocked into 3 acclimating concrete tanks having water with salinity of 18%. The first group was acclimated gradually to sea water within two days by changing 50% (in first day) and 100% (in second day) of the tank water with sea water. The second group was acclimated to brackish water 18% for two days, while the third group was acclimated to fresh water within two days. Fish in all groups were not fed in the first day but were given a small amount of food in the second day of the acclimation (Polat et al., 1995). Each tank was connected with water flow through system separately, after fish were maintained there one day more because of providing of the feed intake, fish are divided into 3 equal groups (100 individual fish) and the experiment was conducted in nine (3 treatment ×3 triplicates) different concrete tanks (2×2×1 m) for 60 days. All fish groups were fed ad libitum with (30% crude protein unified diet) three times daily. Velocity of water entering the tanks was 201/min.

Temperature and dissolved oxygen (DO) were measured daily at 8 am, by the use of WTW oxi 340i oxygen meter, salinity by WTW condi 340i salinometer and pH by Hanna model pH- meter.

Once every 20 days, 25 fish from each tank was removed randomly and then weighed and measured for their length individually. At the end of the study, growth performance parameters and mortality were calculated using the following equations.

\[ FCR = \frac{W_f}{W_w} \]
\[ SGR = \frac{(LW_t - LW_0)}{t} \times 100 \]
\[ DGR = \frac{(W_t - W_0)}{t} \]
\[ M = \frac{Nd}{Nt} \times 100 \]

Where: \(W\): weight (g), \(W_f\): dry feed intake (g), \(W_w\): wet weight gain (g), FCR: feed conversion ratio, SGR: specific growth rate (%), \(W_t\): final weight value (g), \(W_0\): initial weight value (g), \(t\): treatment time (day), WG: weight gain (g), DGR: daily growth rate (g), M: mortality (%), Nd: dead fish number, Nt: total fish number.

All statistical analyses of final weight and length values and the values of growth performance parameters of the groups were performed using Duncan Multiple Range Test in Stat View Program and 0.05 significance level.

<table>
<thead>
<tr>
<th>Table 1. Mean Body Weight of the fish Groups at Each Sampling Period. Values within the same row followed by the same superscript are not significantly different ((p &gt; 0.05))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Groups</strong></td>
</tr>
<tr>
<td><strong>Sampling Periods (days)</strong></td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
</tbody>
</table>

3. RESULTS

Means of the body weight and total length of the fish in each sampling period are presented in Tables 1 and 2. FCR, SGR, DGR and survival rate values are presented in Table 3.

The present study showed that, fish in treatment B (18%) had superior growth (\(P > 0.05\)), best survival rate and FCR compared to other treatments. In treatment A, weight gains, SGR, FCR, DGR and survival rate were
significantly higher than in treatment C (P> 0.05). By comparison, treatment C had the lowest growth, survival rate and FCR.

The results indicate that the most favorable conditions for maximum growth of Golden grey mullets fries are the low salinities (brackish water) 18% rather than sea water 38% and fresh water 0%.

Table 2. Mean Total Length of fish Groups at Each Sampling Period. Values within the same row followed by the same superscript are not significantly different (p> 0.05)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Sampling Periods (days)</th>
<th>20 days</th>
<th>40 days</th>
<th>60 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9.13±0.12a</td>
<td>9.65±0.12a</td>
<td>10.17±0.19a</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>8.26±0.25b</td>
<td>9.27±0.17b</td>
<td>10.11±0.21b</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>8.82±0.14a</td>
<td>9.95±0.22a</td>
<td>10.83±0.18a</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Mean FCR, SGR, DGR, M, and WG Values of the Fish in Each Group. Values within the same row followed by the same superscript are not significantly different (p> 0.05)

<table>
<thead>
<tr>
<th>Groups</th>
<th>FCR</th>
<th>SGR (%)</th>
<th>DGR(g)</th>
<th>M (%)</th>
<th>WG (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.33±0.11a</td>
<td>1.41±0.16a</td>
<td>0.12±0.02a</td>
<td>8±2a</td>
<td>7.7±0.11b</td>
</tr>
<tr>
<td>B</td>
<td>2.11±0.12a</td>
<td>1.63±0.06a</td>
<td>0.15±0.01a</td>
<td>5±3a</td>
<td>9.98±0.41a</td>
</tr>
<tr>
<td>C</td>
<td>2.5±0.18b</td>
<td>0.95±0.17b</td>
<td>0.07±0.03b</td>
<td>29±6b</td>
<td>4.4±0.73c</td>
</tr>
</tbody>
</table>

4. DISCUSSION

The present work represents the first study on the effect of salinity levels on the growth of Golden grey mullets (*Mugil aurata*). Previous studies on mullets in Syria were mainly on classification and reproductive cycle and feeding habit of mullets (Hammond and Saad, 1996, Hammond, 1996), in sea water.

Studying the characteristics of water in the experimental tanks is very important to assessing its suitability for fish rearing. Water temperature must suitable for the biological requirements of fish, because the influence of temperature is significant on fish feeding and growth (Boyd, 1979). In the present study minimum water temperature value was reached in May (24.41±0.33°C) while the maximum temperature was measured in June (25.52 ± 0.65°C). This is in agreement with (Nagel, 1979) who reported that, water temperature over 18°C was best for fish survival and growth.

Dissolved oxygen (DO) values in the experimental tanks seemed to be suitable and ranged from 6.74-7.34 ppm. It has been reported that, mullets are sensitive to low oxygen concentration less than 4 ppm (Salama, 1994). Water in the experimental tanks was slightly alkaline (pH 7.5-8.9), which may be due to the phytoplankton activity and the utilization of CO2 and HCO3-. Alabaster and Lioyd (1984) reported that, water having pH between 6.5 and 9.0 is most suitable for fish production. Accordingly, it can be stated that, water in the present study was proper for the fish growth. Difference in values of temperature, dissolved oxygen and pH in all experimental water tanks were found insignificant statistically (P>0.05).

Tolerance of mullets to fresh or salt water during acclimatization is limited according to species (Cardona, 2000), fish size (Nordlie et al., 1982), water temperature and salinity (Atay, 1994).

The results of the present study showed that, Golden grey mullet (*Mugil aurata*) was able to acclimate to different salinity levels of rearing water and began to feed in a short time. In general, individuals reared in water having 18% salinity had superior growth to the other.
treatments (P> 0.05). They also showed the best survival rate and FCR. The reasons may be due to greenish water in B treatment tanks which resulted from mixed fresh water and sea water. It was very suitable for fish growth and rearing. Bard et al. (1976) mentioned that, when ponds were well fed or fertilized, the color of the water turned into dark green and became satisfactory for fish rearing. It was noticed that, Chironomid midges were found in high density at the surface of water in B treatment tanks. The results of the present work is agreement with the general knowledge on the biology of this species, which may indicates that, Golden grey mullet, usually lives inshore (in sea water), enters lagoons and estuaries, but rarely moves into freshwater (Ben-Tuvia,1986). Bozkurt and Seçer (2001) mentioned that, growth of Mugil capito increases when water temperature increases and salinity decreases, and post larva of Mugil capito reached the size of 1.3-2.3 mm to 6.7mm (4.17 g) between 8-26°C water temperature and 28-38% salinity during a one year period. Bozkurt and Seçer (2001), reported that Alpbaz and Hoşşucu (1979) found that, M. capito fries grew out from 0.64 g to 12.58 g body weight in 17°C water temperature and 15.1% salinity during a period of 5 months. M. aurata fries grew out from 23.9 g to 70.47 g body weight with 95% survival rate in cages in salt water in a hot period between June and August (Mamali, 1993). The ability to adapt to lower salinities is based on the rapid reversion of the osmoregulatory mechanism on the cell membrane level (Davenport and Stene, 1986). Differences in survival ability are attributed to the ability of fish to conclude this reversion successfully as quickly as possible. The iso-osmotic point for marine species between body fluids and the sea water was found to be around 10 ± 2% below which the reversion of the osmoregulatory mechanism occurs (Brett, 1979).

In conclusion it can be stated that although, fresh water rearing of mullets and its polyculture has been performed in some European and Far East countries and Egypt, mullets culture in Syria has not been carried out yet and therefore, this study is expected to help in developing a system for mullet rearing culture project, and initiate more future research on this field.

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الصدأ النهر هو نوع من أسماك الشعاب (Mugil aurata RISSO, 1810)。


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