Study on Farming Practicability and Growth Performance of Rainbow Trout, *Oncorhynchus mykiss*, in Aygır Lake (Bitlis, Türkiye)

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**Abstract:** This study was carried out to determine the farming practicability and growth performance of rainbow trout, *Oncorhynchus mykiss*, in cages in Aygır Lake, Bitlis, Türkiye. The research was conducted on two groups (A and B), each having 1800 rainbow trout with average weights of 79.21±2.05 g (the group A) and 77.62±1.45 g (the group B) throughout 84 days and in two cages, each having 40 m³ of water capacity. In the research, the temperature ranged between 8.6±0.6 and 13.8±1.3°C. The rainbow trout fed with commercial pellets were measured by sampling method. At the end of the study, the weights of fish were found as 261.31±7.33 g for the group A and 253.89±6.91 g for the group B. The specific growth rates of the groups A and B were calculated as 1.42 and 1.41, respectively. Their condition factors were calculated as 1.54±0.13 and 1.52±0.13, respectively. Their food conversion rates were calculated as 0.97 and 1.05, respectively. Moreover, the most suitable farming months for rainbow trout in Aygır Lake were determined from July to September.

**Key words:** Aygır Lake, *Oncorhynchus mykiss*, cage, growth

**INTRODUCTION**

The aquaculture production of Turkey has been too behind of many other countries because of inefficient utilization and management strategies although Turkey has abundant areas for aquaculture. The aquaculture production amount met 42.3 millions tones in the world total fish production, 132.5 millions tones, in 2003. However in Turkey, aquaculture production met 79.9 thousands tones out of 587.7 thousands tones of the national total fish production in 2003. The aquaculture production of Turkey is 40.217 tons in fresh water fisheries (rainbow trout, mirror carp) and 39.726 tons in sea fisheries (sea bream, sea bass, rainbow trout, shrimp and mussel). Turkey is in the 27th row among world countries as fish production in aquaculture[1].

There are 17 natural lakes, only 3 of them contain soda in their water and others have fresh water, 40 artificial lakes and several rivers and creeks in Lake Van Basin where the study was conducted[2]. Aygır Lake is one of these water sources and is a crater lake located at the southern part of the Mount Suphan. The *Capoeta sp.* and Carp, *Cyprinus carpio*, live in this lake whose deepest part is 120m. Moreover, the water of Lake Aygır is an important water resource employed in the irrigation facilities of nearby agricultural areas[3]. The new scientific researches having practical aquaculture application opportunities will certainly increase the economical value of Lake Aygır and similar lakes.

The aquaculture practices in cages date back to 1980’s in Turkey. At the beginning, the cages were employed in aquaculture farms in sea, but nowadays, they have been especially employed in fresh water resources[5]. Bircan[6] fed rainbow trout having 113.5 g for 3 months and the fish reached to the weight of 270 g. Hartavi[7] reported that rainbow trout having 40 g for 110 days and the fish reached to the weight of 240 g. Emre[8] stated that rainbow trout having 50 g for 90 days and the fish reached to the weight of 250 g. Büyükçapar[9] found that rainbow trout having 48 g for 115 days and the fish reached to the weight of 245 g. Asır[10] reported that rainbow trout having 150 g for 56 days and the fish reached to the weight of 245 g. Kayım[11] reported that rainbow trout having 15 g for 197 days and the fish reached to the weight of 240 g.

The present study funded Turkish Scientific Research Council, TSRC (Project number: VHAG-1375/1073), CORDADID (Catholic Organization for Relief and Development, project no: H-333/1073) and the Social Help Organization of Adilcevaz town of Bitlis province. The study aimed to establish and improve the rainbow trout in net-cages in Lake Aygır located in Adilcevaz town, Bitlis, Turkey in order to increase the life standard of the nearby village’s people.

**MATERIALS AND METHODS**

The physical and chemical properties of Lake Aygır water were analyzed at The Department of Fisheries, The University of Yuzuncu Yil and are presented in Table 1. The study was carried out in three periods (two of them had 31 days and one of them had 22 days) and total
experiment ended in 84 days from July 3rd to September 25th in 1999. Two cages with 4 m x 4 m sized wooden skeleton and with 3.5 m x 3.5 m x 3.5 m sized net were employed in the study. The cages were positioned at a place having 15 to 20 m depth in the lake. The rainbow trout used in the study was obtained from a free enterprise. The study had two replication and fish was randomly divided into the two cages and the sampling method (n=100) was used in the measurements and weighing. The 0.05 mg L\(^{-1}\) of Quinaldine solution was used to make the sampled fish faint. Fish lengths were measured based on their fork lengths. The oxygen amount used to make the sampled fish faint. Fish lengths were measured based on their fork lengths. The total oxygen amount of the water was daily measured. The initial average body weights of the fish in the cages (named the cage A and B) were 79.21±2.05 g (the group A) and 77.62±1.45 g (the group B) and their initial average fork lengths were 18.08±0.17 cm and 18.27±0.11 cm, respectively. The number of the dead fish and given food amount were daily recorded in cards for each cages.

The commercial pellet feed used in the study contained 42% crude protein, 12% crude oil, 10% crude ash, 3% crude cellulose and 3200 kcal kg\(^{-1}\) metabolic energy. Fish were fed three times a day by hand. Daily given feed amount was calculated based on fish weight and water temperature criteria.

In the study, condition factor (C), Specific Growth Rate (SGR), Food Conversion Rate (FCR) and Survival Rate (SR) were calculated with the following formulae\[^{[12,13]}\]. Gram (g) values in weight and centimeter (cm) values in length measurements were used in this study.

\[ C = \frac{W}{L^3} \times 100 \]

Where, C is the condition factor; W is the weight of fish; and L is the length of fish

\[ SGR = \frac{\ln W_f - \ln W_i}{t} \times 100 \]

Where, SGR is specific growth rate; \( W_f \) is the final live body weight; \( W_i \) is the initial live body weight; \( t \) is the time; and \( \ln \) is the natural logarithm.

\[ FCR = \frac{F}{W_i + m} - W_f \]

Where, FCR is food conversion rate; \( W_f \) is the final live body weight; \( W_i \) is the initial live body weight; and \( F \) is the given food amount.

\[ SR = \frac{(N_f - N_i) \times 100}{N_i} \]

Where, \( N_f \) is the final number of fish and \( N_i \) is the initial number of fish.

Data were statistically analyzed by SPSS package program.

RESULTS AND DISCUSSIONS

Water temperature of Lake Aygır in July and August were similar, but was lower in September (Table 2). The mean and F values of each groups’ lengths (L), weights (W), condition factors (C) are presented in Table 3. At the beginning of the study, there was no significant difference between the body weights and fork lengths of the groups A and B. After 84 days of feeding, the fish in the group A and B reached to the weights of 261.31±7.33 g and 253.89±6.91 g, respectively. Their last average fork lengths were 25.62±0.26 cm and 25.50±0.24 cm, respectively. Their condition factors at the end of the study were calculated as 1.54±0.13 and 1.52±0.13, respectively. There was no significant difference between both groups at the end of the study for these criteria (Table 3).

Specific growth rates, food conversion rates and survival rates in each group are presented in Table 4. Specific growth rates (SGR) of the group A and B were calculated as 1.42% and 1.41%, respectively. Their food conversion rates (FCR) were calculated as 0.97 and 1.05, respectively. The survival rates (SR) in each group were

**Table 1: Some physical and chemical properties of Lake Aygır water**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>8.0</td>
</tr>
<tr>
<td>Ca</td>
<td>45 mg L(^{-1})</td>
</tr>
<tr>
<td>CO(_3)</td>
<td>30 mg L(^{-1})</td>
</tr>
<tr>
<td>Cl</td>
<td>16.7 mg L(^{-1})</td>
</tr>
<tr>
<td>Salinity</td>
<td>% 0</td>
</tr>
<tr>
<td>Mg</td>
<td>50.5 mg L(^{-1})</td>
</tr>
<tr>
<td>HCO(_3)</td>
<td>358.4 mg L(^{-1})</td>
</tr>
<tr>
<td>CaCO(_3)</td>
<td>320 mg L(^{-1})</td>
</tr>
<tr>
<td>Total Alkalinity</td>
<td>364.2 mg L(^{-1})</td>
</tr>
</tbody>
</table>

**Table 2: Monthly average water temperature and oxygen amount in Lake Aygır from July to September in 1999.**

<table>
<thead>
<tr>
<th>Months</th>
<th>Water temperature (°C)</th>
<th>Oxygen amount (mg L(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>18.6±0.6</td>
<td>7.5</td>
</tr>
<tr>
<td>August</td>
<td>18.9±0.9</td>
<td>7.2</td>
</tr>
<tr>
<td>September</td>
<td>13.3±1.3</td>
<td>8.1</td>
</tr>
</tbody>
</table>

**Table 3: Mean and F values of the fish in the group A and B based on Length (L), Weight (W) and Condition Factor (C).**

<table>
<thead>
<tr>
<th>Periods</th>
<th>Parameters</th>
<th>A</th>
<th>B</th>
<th>F-test (p=0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>L±SE</td>
<td>18.08±0.17</td>
<td>18.27±0.11</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>W±SE</td>
<td>79.31±2.05</td>
<td>77.62±1.45</td>
<td>0.501</td>
</tr>
<tr>
<td></td>
<td>C±SE</td>
<td>1.31±0.10</td>
<td>1.26±0.07</td>
<td></td>
</tr>
<tr>
<td>1st period (31 days)</td>
<td>L±SE</td>
<td>20.82±0.23</td>
<td>21.30±0.17</td>
<td>0.092</td>
</tr>
<tr>
<td></td>
<td>W±SE</td>
<td>130.51±4.21</td>
<td>140.39±3.26</td>
<td>0.063</td>
</tr>
<tr>
<td></td>
<td>C±SE</td>
<td>1.44±0.12</td>
<td>1.44±0.13</td>
<td>0.882</td>
</tr>
<tr>
<td>2nd period (31 days)</td>
<td>L±SE</td>
<td>23.43±0.25</td>
<td>23.98±0.18</td>
<td>0.078</td>
</tr>
<tr>
<td></td>
<td>W±SE</td>
<td>203.50±5.99</td>
<td>210.85±4.80</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td>C±SE</td>
<td>1.56±0.12</td>
<td>1.53±0.13</td>
<td>0.102</td>
</tr>
<tr>
<td>3rd period (22 days)</td>
<td>L±SE</td>
<td>25.62±0.26</td>
<td>25.50±0.24</td>
<td>0.742</td>
</tr>
<tr>
<td></td>
<td>W±SE</td>
<td>261.57±7.33</td>
<td>253.89±6.91</td>
<td>0.447</td>
</tr>
<tr>
<td></td>
<td>C±SE</td>
<td>1.54±0.13</td>
<td>1.52±0.13</td>
<td>0.404</td>
</tr>
</tbody>
</table>
significant difference between both groups at the end of the study for these criteria (p<0.05).

Lake Aygr seems to be quite suitable for rainbow trout production based on its physical and chemical structure and the criteria of EIFAC, The European Inland Fisheries Advisory Commission and TSE, The Institute of Turkish Standards. It has been reported that the water temperature should be ranged from 12-20°C[14] and the soluble oxygen amount should be over 7 mg L-1[15] for the best development of rainbow trout. Therefore, the measured water temperature and oxygen amounts in the present study for Lake Aygr were in the range of the recommended values.

At the end of the study lasted in 84 days, the rainbow trout having approximately 78 g initial body weight reached to average 257 g weight, which is considered as serviceable portion in meals. There were similar increases in the other studies[6,11] carried out several other inland fresh water resources with net cages when we took into the consideration the length of the studies and the initial body weights. The small differences might be caused by the different working conditions and the environment.

The condition factor (C) obtained from the present study was found to be similar to the C of Bircan[6], but was higher than that of Büyükçapar[9] and was lower than that of Kayım[11]. If the C value is higher than the 1.00 means, fish is properly fed[16,17]. Mentioned these researchers found that C of their studies ranged from 1.39 to 1.79. Based on the relatively high C values found in the present study (about 1.53), it could be said that rainbow trout grew well in Lake Aygr.

The SGR value obtained in the present study was found to be similar to that of Kayım[11], but was higher than that of Bircan[6]. It is thought that this difference might have been caused by the different environment conditions and the initial body weights of these studies. The FCR value obtained in the present study (0.97-1.05) was in agreement with those of Hartavi[7] and Büyükçapar[9]. Some other researchers[6,11] found much higher FCR values (1.8-1.9, 1.7, respectively) in their studies. It is thought that the FCR value is affected by some factors such as environment, feed quality, stock intensity, fish size.

The Survival Rate (SR) of the present study (about 97%) was close to those of Bircan[6] and Büyükçapar[9] and was higher than that of Kayım[11]. The differences might have been caused by the time periods of the experiments and environmental conditions. The SR of the present study (about 97%) was a normal range and expected in such condition.

In overall, it is concluded that Lake Aygr is suitable for rainbow trout production in the period of the study (from July to September) and fish grows adequately and its performance is quite well. In the future, it will be logical that other months of the year should be tried for the trout production.

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