Freshwater fish Fauna and Restock Fish Activities of Reservoir in the Dardanelles (Canakkale-Turkey)

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Abstract

Turkey has, with geographic location including Istanbul and Çanakkale straits the system, 178,000 km in length streams, 906,000 ha of natural lakes, and 411,800 ha of dam lakes, and 28,000 ha of ponds due to richness inland waters which include freshwater fish. The fingerling fish (fry) were restocked approximately 250,000,000 in natural lakes, dam lakes and ponds for fisheries between years of 1979 and 2005. Canakkale has rich freshwater potential with 7 major rivers (Büyükdere, Karamenderes stream, Kavak brook, Kocacay stream, Sancay stream, Tuzla brook, Umurbey brook), 7 Dam Lakes (Atikhisar, Zeytinlikoy, Bayramic, Bakacak, Tayfur, Umurbey and Yenice-Gönen Dam lakes). In the studies, it has been determined that 15 fish species belonging to 6 families (Anguillidae, Atherinidae, Salmonidae, Cobitidae, Cyprinidae and Poecilidae) can be found in reservoirs. Fish restocking of the activities of the reservoir until today approximately 1,120,000 (Cyprinus carpio L., 1758) is introduced. In this study, the activity of Canakkale province in the fish restocking and reservoir exploiting possibilities were discussed in view of reservoir fisheries potential which is used insufficiently today.

Keywords: Fish fauna, Dardanelles, Freshwater fish, Canakkale, Restocking

Introduction

Addition to being surrounded by Black Sea, Aegean Sea and Mediterranean Sea Turkey has a great freshwater potential with 178,000 km long streams and 906,000 ha natural lakes, 439,800 ha dam lakes and pond areas. Since the country is situated in the meeting point of Asia and Europe continents it also possesses Istanbul and Canakkale Straits (Dardanelles) which offer a suitable habitat for a great number of freshwater fish.

In our country ranking the third in dam construction with increasing the number of dams (ICOLD, 1999). These man-made inland water potential offers important fish production capacity and employments.

In the research concerning Turkey’s freshwater, more than 230 species and subspecies of 26 fish families were recorded (Geldiay and Balık, 1996; Kuru, 2004; Tüfek and Yalçın, 2007).
Stocking of reservoirs with fingerlings economically important, suitable and fast growing species to settle all diverse niches of the biotope is necessary prerequisites in reservoirs fisheries management (Jhingran, 1988).

The main tenets of the restocking are; fish selection of the right species depending on the fish food resources available in the system; determination of a stocking density on the basis of the production potential, growth and mortality; Proper stocking and harvesting Schedule allowing maximum grow out period; small irrigation reservoirs with open sluices, the season of overflow and the possibilities of the water level falling too low or completely drying ore taken into consideraiton (Sugunan, 1995).

Materials and Method

Canakkale is a significant port city situated in the northwest of Turkey, east of Balkan Peninsula, between the lands of Gelibolu district and European Biga Peninsula and Continent of Asia (Figure 1). In terms of sea fishery, it is a rich fishing area. It is located in the geographical land covering Western Marmara Sea, Northeast Aegean Sea (Gökçeada, Bozcaada, Saros Gulf, Edremit Gulf) and Dardanelles Strait. In this region more than 110 species of 59 sea fish familia, most of which are of economic importance, were detected. Although many of them lack regular stream flow, it has 11 streams and amongst them the most significant ones are; Karamenderes stream, Koca brook, Kavak brook and Tuzla brook. There are 6 dam lakes and 35 small ponds operating in the streams with regular flows.

Figure 1. Canakkale province map
Results

Canakkale Freshwater Potential

Although there are many stream forms in Canakkale, most of them have irregular flow regimes. The reason for the significance of these streams stems from the fact that they have dams or ponds available or will be available soon. In addition to obtaining drinking water from these dams or ponds, they are densely used in irrigating agricultural lands (Table 1).

Table 1. Dardanelles major rivers and water catchment areas and installations

<table>
<thead>
<tr>
<th>Streams</th>
<th>Total Length (km)</th>
<th>River Basin (km²)</th>
<th>Dam Lakes (Established or Not)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karamenderes Stream</td>
<td>109</td>
<td>1586</td>
<td>Bayramic Dam Lake (Established)</td>
</tr>
<tr>
<td>Kavak Brook</td>
<td>50</td>
<td>210</td>
<td>Cokal Dam Lake (Established)</td>
</tr>
<tr>
<td>Umurbey Brook</td>
<td>22</td>
<td>279</td>
<td>Umurbey Dam Lake (Established)</td>
</tr>
<tr>
<td>Tuzla Brook</td>
<td>80</td>
<td>507</td>
<td>Calı Dam Lake (Established)</td>
</tr>
<tr>
<td>Sancay Stream</td>
<td>40</td>
<td>407</td>
<td>Atikhisar Dam Lake (Established)</td>
</tr>
<tr>
<td>Kocadere Brook</td>
<td>84</td>
<td>279,40</td>
<td>Tasoluk Dam Lake (Established)</td>
</tr>
<tr>
<td>Kocacay Brook</td>
<td>62</td>
<td>976</td>
<td>Bakacak Dam Lake (Established)</td>
</tr>
<tr>
<td>Tayfur Brook</td>
<td>19</td>
<td>-</td>
<td>Tayfur Dam Lake (Established)</td>
</tr>
<tr>
<td>Bayramdere Brook</td>
<td>11</td>
<td>-</td>
<td>Bayramdere Dam Lake (Established)</td>
</tr>
<tr>
<td>Buyuk Brook</td>
<td>10</td>
<td>-</td>
<td>Gokceada Dam Lake (Established)</td>
</tr>
<tr>
<td>Cınar Brook</td>
<td>28</td>
<td>-</td>
<td>Ayıtdere Dam Lake (Not established)</td>
</tr>
</tbody>
</table>

In the region there are no significant natural lakes. Simply a small portion of Ece Lake which was largely dried in previous years constitutes a natural back water particularly in winter months. City of Canakkale on the other hand has quite a rich potential in terms of artificial reservoir. Within the city borders, there are 7 dam lakes operating and 35 ponds in various sizes.

Canakkale Freshwater Fish Fauna

So far in studies directed to detecting freshwater fish species in small creeks, brooks and streams and artificial reservoirs constructed in front of them, 15 species of 5 familia have been recorded (Table 2).
Table 2. The fish fauna in Dardanelles

<table>
<thead>
<tr>
<th>Fish species</th>
<th>Reservoir</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Chub, <em>Squalius cephalus</em></td>
<td>Gonen Stream, Handere Brook, Kocacay Stream, Celebi Brook, Çakırköy Brook, Atikhisar Dam Lake, Sarı Brook, Yenice Irrigation Pond</td>
<td>Sarı et al., 2006; Akbulut et al., 2008; Berber et al., 2008</td>
</tr>
<tr>
<td>Salmo trutta macrostigma</td>
<td>Handere Brook, Celebi Brook</td>
<td>Sarı et al., 2006</td>
</tr>
<tr>
<td>Bitterling, <em>Rhodeus seriseus amarus</em></td>
<td>Kocacay Stream, Gonen Brook</td>
<td></td>
</tr>
<tr>
<td>Eurasian minnow, <em>Phoxinus phoxinus</em></td>
<td>Handere Brook, Celebi Brook</td>
<td></td>
</tr>
<tr>
<td>Vimba, <em>Vimba vimba</em></td>
<td>Çakırköy Brook</td>
<td></td>
</tr>
<tr>
<td>Danube bleak, <em>Chalcalburnus chalcoides</em></td>
<td>Çakırköy Brook, Kocacay Stream</td>
<td></td>
</tr>
<tr>
<td>European eel, <em>Anguilla anguilla</em></td>
<td>Mhli Brook</td>
<td></td>
</tr>
<tr>
<td><em>Cobitis fahirae</em></td>
<td>Çakırköy Brook, Kocacay Stream, Gonen Stream</td>
<td></td>
</tr>
<tr>
<td>Transcaucasian barb, <em>Capoeta capoeta bergamae</em></td>
<td>Kocacay Brook, Çınar Brook, Bakacak Brook, Harmanlı Brook</td>
<td></td>
</tr>
<tr>
<td>Crimean barbel, <em>Barbus tauricus escherichi</em></td>
<td>Gonen Stream, Celebi Brook, Kocacay Stream, Handere Brook, Tuzla Brook, Karamenderes Stream, Adacay Brook, Bakacak Brook, Harmanlı Brook</td>
<td>Sarı et al., 2006; Berber et al., 2008</td>
</tr>
<tr>
<td>Gudgeon, <em>Gobio gobio</em></td>
<td>Bakacak Brook, Bahçeli Barok, Yenice Irrigation Pond</td>
<td></td>
</tr>
<tr>
<td>Tench, <em>Tinca tinca</em></td>
<td>Yenice Irrigation Pond</td>
<td>Berber et al., 2008</td>
</tr>
<tr>
<td>Common carp, <em>Cyprinus carpio</em></td>
<td>Yenice Irrigation Pond</td>
<td></td>
</tr>
<tr>
<td>Big-scale sand smelt, <em>Atherina boyeri</em></td>
<td>Sarıcı Stream</td>
<td>Akbulut et al., 2008</td>
</tr>
<tr>
<td>Mosquitofish, <em>Gambusia affinis</em></td>
<td>Sarıcı Stream</td>
<td></td>
</tr>
</tbody>
</table>

**Fish Restocking Activities**

In Turkey fish restocking activities are legal executed by General Directorate of State Hydraulic Works (DSI) controlled by Ministry of Agriculture and Ministry of Environment and Forestry. Within this context, in several natural lakes, dam lakes and ponds between years 1995 and 2005, 62,000,000 offspring of common carp
were stocked by the institutions of Ministry of Agriculture. Until now, 273,000,000 fish
offspring, most of which are common carps have been stocked by breeding stations
of DSI. Common carp (\textit{Cyprinus carpio}) was the most important among the species
used for fish restocking (Table 3).

In Canakkale fish restocking activities were executed by Directorate of Ministry of
Agriculture. In the framework of above mentioned activities which gained impetus in
recent years, 425,000 mirror carp were left to 7 ponds in 2004, and 115,000 fish
offspring were dropped in 10 ponds in 2007. Up until now over 1,100,000 fish
restocking has been conducted in dam lakes and ponds within the city borders (Table
3).

Table 3. Restocking activities in Canakkale province (Anonymous, 2008c)

<table>
<thead>
<tr>
<th>Countyside</th>
<th>Location</th>
<th>Restocking (number)</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center</td>
<td>Aşagıokçular Lake (small)</td>
<td>20,000+100</td>
<td>\textit{C. carpio} (fingerling)+\textit{Esox lucius} (Broodstock)</td>
</tr>
<tr>
<td>Center</td>
<td>Akcapınar Lake (small)</td>
<td>20,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Center</td>
<td>Dumrek Lake (small)</td>
<td>30,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Ayvacık</td>
<td>Kosedere Lake (small)</td>
<td>80,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Bayramiç</td>
<td>Isikeli Lake (small)</td>
<td>80,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Bayramiç</td>
<td>Cirpılar Lake (small)</td>
<td>50,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Bayramiç</td>
<td>Koyluçay Lake (small)</td>
<td>20,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Ezine</td>
<td>Kemalli Lake (small)</td>
<td>110,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Ezine</td>
<td>Bahceli Lake (small)</td>
<td>30,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Ezine</td>
<td>Sapkoy Lake (small)</td>
<td>30,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Gelibolu</td>
<td>Kavak-Demircili Lake (small)</td>
<td>45,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Gökçeada</td>
<td>Sahinkaya Lake (small)</td>
<td>125,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Gökçeada</td>
<td>Derekoy Lake (small)</td>
<td>60,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Gökçeada</td>
<td>Urgulu Lake (small)</td>
<td>10,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Gökçeada</td>
<td>Aydınçi Lake (small)</td>
<td>45,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Lapseki</td>
<td>Nusrețiye Lake (small)</td>
<td>50,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Yenice</td>
<td>Karaköy Lake (small)</td>
<td>20,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Yenice</td>
<td>Davutkoy Lake (small)</td>
<td>30,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Yenice</td>
<td>Kalkım Lake (small)</td>
<td>30,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
<tr>
<td>Yenice</td>
<td>Cinarcık Lake (small)</td>
<td>10,000</td>
<td>\textit{C. carpio} (fingerling)</td>
</tr>
</tbody>
</table>
In the early years of fish restocking, sizes of common carp varied between 50 and 70 mm. In studies particularly conducted by DSI it was found out that use these sizes was not efficient enough so the decision was to increase the fish size to 100-120 mm.

Besides, the average total size of common carp offspring released in different reservoirs was determined to be 30.71 mm in Canakkale in 2007 (Table 4).

Table 4. Some morphometric characteristics of Restocking carp fish used for restocking in 2007 (N=107)

<table>
<thead>
<tr>
<th>Cyprinus carpio</th>
<th>TL ±SE (mm)</th>
<th>WT ±SE (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30.71±0.325</td>
<td>0.43±0.019</td>
</tr>
<tr>
<td>(min-max)</td>
<td>(24.19-44.81)</td>
<td>(0.23-1.52)</td>
</tr>
</tbody>
</table>

Discussions and Conclusion

Water resources—namely dam lakes and ponds which were built for energy generation, drinking water supply and irrigation purposes could be used for fish production and thus create an extra economical income, employment opportunities and produce the protein which is essential in human diet. Globally, fish production is about to reach the top level. Therefore it is a necessity to make the use of freshwater resources more efficient and rational. In this phase, fish restocking activities play a significant role in reservoirs (Marmulla, 2001).

In Turkey, the foremost handicap in fish restocking activities is lack of conducting periodical observations in water resources before and after fish restocking. In order to efficiently conduct economically and ecologically sound management, water resources need to be examined periodically in a physical, chemical and biological way (Sugunan, 2000).

Even though fish restocking in freshwater resources has been made to increase stock efficiency and biological fight, it is possible to encounter with undesired outcomes. Amongst them the most important one is that undesired fish species were also released to water resources. In Turkey, Pumpkinseed, *Lepomis gibbosus*, Stone moroko, *Pseudorasbora parva*, Gold Fish, *Carassius auratus*, Crucian carp,
Carassius carassius, Prussian carp, Carassius gibelio, and big-scale sand smelt, Atherina boyeri are examples of species which were spread by the means of human intervention (Table 5) (Sasi and Balik, 2003; Innal and Erkakan, 2006). It is known that due to their high competition skills they become dominant causing a decrease or even a total elimination in the number of native fish species. Even though several Carassius and Atherina species can be used economically in small portion, their introduction may lead to considerably higher economical loss in more precious species. In order to prevent this loss, the material to be used should be obtained from a specific source in a controlled manner and should be studied in detail.

Table 5. Restocking fish species of some reservoirs in Anatolia

<table>
<thead>
<tr>
<th>Fish species</th>
<th>Reservoirs</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mosquito fish, Gambusia affinis</td>
<td>Amik Lake, Many Freshwater Resources</td>
<td>Geldiay and Balık, 1996, Balık and Ustaoglu, 2006</td>
</tr>
<tr>
<td>Grass Carp, Ctenopharyngodon idella</td>
<td>Sakaryabası Fish Culture and Research Station</td>
<td>Erk’akan and Yerli, 1988</td>
</tr>
<tr>
<td>Common whitefish, Coregonus laveratus</td>
<td>Iznik Lake</td>
<td>Geldiay and Balık, 1996;</td>
</tr>
<tr>
<td>Coregon, Coregonus macrophthalmus</td>
<td>Sapanca Lake</td>
<td>Ozulug et al., 2005</td>
</tr>
<tr>
<td>Rainbow trout, Oncorhynchus mykiss</td>
<td>Many Freshwater Resources</td>
<td>Geldiay and Balık, 1996, Cetinkaya, 2006</td>
</tr>
<tr>
<td>Charr, Salvelinus alpinus</td>
<td>Erzurum,</td>
<td>Yani̇k et al., 2002</td>
</tr>
<tr>
<td>Brook trout, Salvelinus fontinalis</td>
<td>Dogu Karadeniz</td>
<td>Balık and Ustaoglu, 2006</td>
</tr>
<tr>
<td>White bass, Morone chrysops</td>
<td>Kemer Dam Lake</td>
<td>Welcomme, 1988,</td>
</tr>
<tr>
<td>Striped bass, Morone saxatilis</td>
<td>Many Freshwater Resources</td>
<td>Balık and Ustaoglu, 2006</td>
</tr>
<tr>
<td>Common carp, Cyprinus carpio</td>
<td>Many Freshwater Resources</td>
<td>Berber et al., 2008</td>
</tr>
<tr>
<td>Pike-perch, Sander lucioperca</td>
<td>Egirdir Lake, Marmara Lake</td>
<td>Balık and Ustaoğlu, 2006</td>
</tr>
<tr>
<td>European perch, Perca fluviatilis</td>
<td>Tahtalı Dam Lake,</td>
<td>Geldiay and Balık, 1996</td>
</tr>
</tbody>
</table>
In specific fish restocking studies, it has been seen that the introduced fish species may have irreversible negative outcomes. In Egirdir and Beysehir Lakes, introduction of pike-perch fish (*Sander lucioperca*) caused elimination of various fish species (6). Particularly in Egirdir Lake, 10 native fish species decreased in their number and merely 3 fish species could continue their existence. Therefore water resources where carnivore fish species will be introduced should be examined thoroughly. Their relation between native fish fauna and introduced species should be studied in detail. An integrated data base should be prepared for fish restocking activities. Legally a meaningful cooperation should be established between institutions in charge of fish restocking and universities. Fish restocking based on scientific methods and monitoring activities in later phases will contribute greatly to reach the main objective.

It has been detected that negative outcomes in fish restocking are related on the whole to fish introduction activities executed by local fishermen or people who are incompetent. In that respect lack of training is striking. The objective of fish
restocking, its principles and follow up controls and negative impacts should be explained. Thus unauthorized people can be kept away from actions which can cause great disasters in the end.

In making fish restocking plans, water level changes in freshwater resources should be taken into account. Excessive drought, especially making use of dam lakes and ponds for irrigation purposes can create fluctuations in water levels. In a research conducted during the year, an average 15 m depth was found in Yenice Central Irrigation Pond. Water level fluctuations related to time prevented vegetation zone formation in pond shores. Coastal vegetation is particularly important to keep water species alive; to enable their feeding, breeding and growing activities. Besides, excessive waves in water level can cause a decrease in the number of fish eggs and devastating effects in their existence (June 1970; Walburg 1976).

To use irrigation of dam lakes and ponds rented cooperatives or private individuals for breeding purposes may cause some troubles in practice. The foremost cause of poaching of these fishermen in ponds is related to knowing the fish and fauna existent in this resource. That is because nobody would care to invest to ambiguity. Therefore ponds or similar water resources for rent should absolutely be evaluated by the authorized institutions. The vital data for investor are the fish in water resources and their approximate amounts, water level and its fluctuations over time, the age and other physical qualities of reservoir and water quality values. Water resources evaluated in these terms will help the investor to have a pre-knowledge. Therefore both illegal hunting and even more importantly circulation of fishery materials which may be the cause of diseases in different water resources will be prevented.

There are some problems caused by renting the reservoirs for aquacultural work facilities. According to no 2/1 report regulating commercial aquacultural fishing, permissions for aquacultural fishing in freshwater resources are arranged by taking into account the breeding season, sexual maturity age and estimated population stock. In the rented water resources however since the topic is handled in terms of breeding, a continuous yield and marketing can be in question. That means that the species, even though it may be in breeding season, can be marketed for commercial benefits.

References


