

Effects of Human Factor on the Fish Fauna in a Drinking-water Resource (Ömerli Dam Lake-Istanbul, Turkey)

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Abstract: The fish fauna of Ömerli Dam Lake Basin was monitored between November 2002 and June 2004. Monthly samplings were carried out during the study period. Totally, 17 fish species have been described from the dam lake basin. The dam lake has become polluted by domestic and industrial waste waters for fifteen years. Some alien fish species were unconsciously introduced into the dam lake from surroundings lakes by local fishermen. *Carassius gibelio* (Bloch, 1782), which was one of the introduced fishes into the dam lake, has become dominant fish species in 6 years. The fish fauna inhabiting Ömerli Dam Lake, which is using as important drinking water, fisheries and recreation, should be continuously monitored.

Key words: Ömerli Dam Lake, pollution, monitoring, invasive species, alien species.

INTRODUCTION

Negative effects of human on the living resources have been increased by industrial development. Some of these effects are environmental pollution, damaging the habitats and introducing alien fish species. Besides, some species are in danger of extinct in the fauna due to human disturbances.

Some invasive species such as *Carassius gibelio* (Bloch, 1872) was unintentionally or deliberately introduced into inland waters of Turkey^[1,2]. This species has become dominant in the Büyükçekmece Dam Lake, Turkey recently^[2]. Another invasive species, *Cyprinus carpio* Linnaeus, 1758, which has shown a similar situation in Australia might threaten indigenous species in the ecosystems as suggested by Koehn^[3]. To prevent these detrimental impacts, sustainable fish monitoring program put into effect in various water body in several lakes and reservoirs^[4,5]

Ömerli Dam, which was built in 1972, one of the reservoirs supplying drinking water to most of Istanbul, suffers from eutrophication. In the last few decades, Ömerli reservoir has become heavily polluted by sewage, industrial wastewater and soil run-off which have promoted the formation of toxic cyanobacterial (blue-green algae) blooms from late summer to mid autumn. Recently, several thousand of fish (mainly

Cyprinus carpio Linnaeus, 1758) died when the cyanotoxin (microcystin) was detected in the reservoir. After this phenomenon, the Istanbul Water Authority (ISKI) decided to apply algicide (copper sulphate) to control the blue-green algal biomass at specific sites in the reservoir^[6]. During the spring, summer and early autumn (April 2000 - September 2000), approximately 25 tons of algicide were added to the surface water. Cyanobacterial toxins were not detected during the treatment. Total nitrogen is too high (average 1.8 mg l⁻¹) in the reservoir. 411.5 tons of nitrogen is reaching the lake water via five main streams^[7]. Adding algicide to the reservoir is being continued by ISKI with same manner at present. Buraket^[8] reported that Chrome and Zinc concentrations were also high in the reservoir.

In Ömerli reservoir which has continuously pollution problems to threaten the living organisms, there have been a few studies on water quality^[9,10], on phytoplankton^[6,7] on zooplankton^[11] and on ostracod fauna^[12]. However, there has been no detailed study on the fish fauna of the reservoir. Selçuk and Ongan^[13] reported that nine fish species (*Cyprinus carpio* Linnaeus, 1758, *Rutilus rutilus* (Linnaeus, 1758), *Scardinius erythrophthalmus* (Linnaeus, 1758), *Leuciscus cephalus* (Linnaeus, 1758), *Silurus glanis* Linnaeus, 1758, *Esox lucius* Linnaeus, 1758, *Mugil cephalus* Linnaeus, 1758, *Anguilla anguilla* Linnaeus,

1758 and *Atherina boyeri* Risso, 1810) was present in Riva Stream where is discharge water of the reservoir and General Directorate of State Hydraulic Works (DSI) reported only three species with their common names (Pike, Chub and Sand Smelt) from the reservoir^[14].

The present research aims to describe the latest situation and alterations of the fish fauna of in a drinking-water resource, Ömerli Dam Lake basin, which is seriously affected by human effects.

MATERIALS AND METHODS

Specimens of fish captured from 6 stations between 15 November 2002 and 21 June 2004 can be seen on the map on Figure 1. Sampling stations from different areas of the reservoir were combined and named as station 6. Different sizes of gill nets, trammel nets were employed for capturing specimens besides, a long handled scoop net and a portable electroshock device (Elektracatch, WFC911). Specimens were fixed in 5% formaldehyde solution and preserved in 75% ethyl alcohol. Measurements were taken using a millimetric scale board and a digital compass. Meristic counts were made under binocular dissection microscope. Latitude and longitude were recorded with a geographical positioning system unit. Voucher specimens are deposited in the Hydrobiology Museum, Department of Biology, Faculty of Science, Istanbul University. The specimens were identified according to Berg^[15] and Banarescu^[16].

Study Area: Ömerli Dam Lake is the biggest reservoir in Istanbul and is located in northeast (approximately 30 km) of the city. The reservoir provides approximately 48% of the city's drinking water and average of 872000 m³ per day water is discharged from the reservoir. Morphometrically, the reservoir has a surface area of 23.5 km² and a volume of 2.2 x 10⁶ m³^[6]. Its maximum depth is 62 m as reported by ISKI. It was established after a high dam wall was built on Riva Stream in 1972 by DSI to provide drinking water for the city. The Riva Stream was then located between the reservoir and Black Sea as a discharge water system for the reservoir. There are four main streams which are feeding the reservoir at present, namely; the Ozan, the Göçbeyli, the Ballıca and the Kömürlük. The fifth stream named Paşaköy which was feeding the reservoir until 2004 has been connected to the Riva Stream via a tunnel (3 m diameter and 6 km length) by ISKI in order to prevent domestic and industrial wastewater inputs into the reservoir (Figure 1). Due to input of domestic and industrial wastewater, coming mainly via small streams, the whole water system is mesotrophic^[7].

Furthermore, two bivalv (*Dreissenia polymorpha* (Pallas, 1771) and *Anodonta* sp.) and crustacean species (*Astacus leptodactylus* (Eschscholtz, 1823) and *Potamon potamios* (Olivier, 1804)) were obtained from the Dam basin.

RESULTS AND DISCUSSIONS

After the examination of specimens captured from 6 stations in Ömerli Dam Lake Basin 17 fish species from 6 families were determined. This list includes the scientific name, collection site, date, number of specimens and total length (TL in mm).

Familia: CYPRINIDAE:

***Barbus tauricus escherichii* Steindachner, 1897:** Material examined: Ömerli Dam Lake, 12 April 2003, 1, 230 mm; – Göçbeyli Stream, 13 September 2003, 1, 55 mm; – Kömürlük Stream, 19 July 2003, 3, 68-93 mm; 13 September 2003, 1, 50 mm; – Ozan Stream, 19 July 2003, 2, 68-92 mm; 13 September 2003, 5, 66-98 mm.

***Carassius gibelio* (Bloch, 1872):** Material examined: Ömerli Dam Lake, 8 March 2003, 7, 190-257 mm; – Ballıca Stream, 19 July 2003, 4, 27-64 mm; 13 September 2003, 15, 40-73 mm.

***Alburnus chalcoides* (Güldenstädt, 1772):** Material examined: Ömerli Dam Lake, 8 March 2003, 6, 244-295 mm; 3 May 2003, 6, 112-117 mm; – Ozan Stream, 13 September 2003, 2, 43-60 mm.

***Cyprinus carpio* Linnaeus, 1758:** Material examined: Ömerli Dam Lake, 1 March 2003, 1, 252 mm; 21 June 2004, 1, 576 mm.

***Gobio gobio* (Linnaeus, 1758):** Material examined: Kömürlük Stream, 19 July 2003, 14, 56-89 mm; 13 September 2003, 16, 38-105 mm.

***Petrolevciscus borysthenicus* (Kessler, 1859):** Material examined: Ömerli Dam Lake, 20 March 2003, 4, 93-131 mm; 3 May 2003, 5, 91-160 mm; 19 July 2003, 1, 33 mm; – Ballıca Stream, 13 September 2003, 11, 60-96 mm; – Kömürlük Stream, 13 September 2003, 2, 105-110 mm; – Ozan Stream, 19 July 2003, 27, 59-117 mm; 13 September 2003, 38, 44-116 mm.

***Leuciscus cephalus* (Linnaeus, 1758):** Material examined: Ömerli Dam Lake, 13 December 2002, 1, 245 mm; 17 February 2003, 1, 335 mm; 3 May 2003, 2, 115-127 mm; – Göçbeyli Stream, 13 September 2003, 52, 46-125 mm; – Kömürlük Stream, 19 July 2003, 4, 48-93 mm; 13 September

2003, 18, 47-120 mm; – Ozan Stream, 19 July 2003, 5, 85-104 mm; 3 September 2003, 17, 48-88 mm.

Rhodeus amarus (Bloch, 1758): Material examined: Ömerli Dam Lake, 26 April 2003, 6, 68-82 mm; 3 May 2003, 12, 74-82 mm; 19 July 2003, 1, 60 mm; – Ballıca Stream, 19 July 2003, 7, 41-61 mm; 13 September 2003, 30, 21-38 mm; – Kömürlük Stream, 19 July 2003, 1, 52 mm; 13 September 2003, 53, 32-76 mm; – Ozan Stream, 13 September 2003, 6, 59-76 mm.

Scardinius erythrophthalmus (Linnaeus, 1758): Material examined: Ömerli Dam Lake, 8 March 2003, 9, 214-237 mm; 3 May 2003, 5, 110-128 mm.

Vimba vimba (Linnaeus, 1758): Material examined: Ömerli Dam Lake, 8 March 2003, 11, 221-252 mm; 3 May 2003, 20, 90-156 mm.

Familia: COBITIDAE:

Cobitis vardarensis Karaman, 1928: Material examined: Ömerli Dam Lake, 19 July 2003, 1, 98 mm; – Paşaköy Stream, 19 July 2003, 13, 75-92 mm; – Ballıca Stream, 19 July 2003, 2, 74-77 mm; 13 September 2003, 6, 60-73 mm; – Göçbeyli Stream, 13 September 2003, 9, 41-75 mm; – Kömürlük Stream, 19 July 2003, 5, 58-90 mm; – Ozan Stream, 19 July 2003, 4, 60-91 mm; 13 September 2003, 11, 58-88 mm.

Familia: SILURIDAE:

Silurus glanis Linnaeus, 1758: Material examined: Ömerli Dam Lake, 21 June 2004, 1, 485 mm.

Familia: ATHERINIDAE:

Atherina boyeri Risso, 1810: Material examined: Ömerli Dam Lake, 15 November 2002, 1, 98 mm; 26 April 2003, 1, 78 mm; 3 May 2003, 1, 104 mm; 16 August 2003, 10, 87-107 mm.

Familia: POECILIIDAE:

Gambusia holbrooki Girard, 1859: Material examined: Ömerli Dam Lake, 19 July 2003, 20, 20-44 mm; 13 September 2003, 30, 21-31 mm; – Ballıca Stream, 19 July 2003, 1, 29 mm; 13 September 2003, 35, 20-34 mm.

Familia: GOBIIDAE:

Neogobius gymnotrachelus (Kessler, 1857): Material examined: Ömerli Dam Lake, 13 December 2002, 3, 42-47 mm; 26 April 2003, 2, 99-124 mm; 19 July 2003, 3, 29-74 mm; 13 September 2003, 19, 34-62 mm; – Ballıca Stream, 19 July 2003, 2, 36-66 mm; – Ozan Stream, 19 July 2003, 10, 49-83 mm; 13 September 2003, 19, 36-78 mm.

Neogobius melanostomus (Pallas, 1814): Material examined: Ömerli Dam Lake, 13 December 2002, 1, 114 mm; 20 March 2003, 8, 108-131 mm; 26 April 2003, 6, 67-86 mm; 3 May 2003, 4, 104-109 mm; 19 July 2003, 1, 28 mm; – Ballıca Stream, 19 July 2003, 2, 59-60 mm; 13 September 2003, 5, 48-60 mm; – Ozan Stream, 19 July 2003, 2, 53-82 mm; 13 September 2003, 1, 65 mm.

Proterorhinus marmoratus (Pallas, 1814): Material examined: Ömerli Dam Lake, 13 December 2002, 1, 57 mm; – Ballıca Stream, 13 September 2003, 2, 37-41 mm; – Ozan Stream, 19 July 2003, 1, 52 mm; 13 September 2003, 3, 38-51 mm.

Conclusions: In the present study, the fish fauna of Ömerli reservoir has been monthly monitored for two years. Various types of fishing gear besides interviews with local fishermen were used during the study. All fish samples and a subset of the samples were morphologically examined from the streams and the reservoir, respectively.

The previous fish records between 1978 and 1980 in Ömerli reservoir were given by DSI^[14]. This study reported the composition of three fish species with only their common names and the other fish species which were living in the reservoir as following; Pike (60%), Sand Smelt (20%), Chub (10%) and the other fishes (10%). DSI also mentioned that approximately 120 000 *C. carpio* fry was introduced into the reservoir in 1981-1982^[14]. *C. carpio* is now one of the objects of commercial fisheries in the reservoir.

Approximately 500-600 *C. gibelio* was intentionally introduced into from Kayal Dam Lake (K2rklareli-Thrace) to the reservoir by a fisherman in 1998 (personal communication). As mentioned before, this species can be a powerful invader when they are introduced into new ecosystems. Analogously, Özulu–*et al.*^[2] has stated that this species has invaded some freshwater resources in Thrace recently. It was also found that *C. gibelio* has become dominant after its introduction to Ömerli reservoir. In the first year of the present study, numbers of most common fish species obtained from the reservoir were; 541 (*S. erythrophthalmus*), 291 (*V. vimba*), 230 (*C. gibelio*). However, in the second year of the study, under the same circumstances (same place, fisheries effort, times of the year and fishing gear), numbers of the considered species have changed as following; *S. erythrophthalmus* (305, 44% reduced), *V. vimba* (139, 52% reduced) and *C. gibelio* (794, 245% increased). After two years data was compared, it has been revealed that numbers of *C. gibelio* has gradually increased and it has become dominant fish species in the reservoir. A similar situation was reported by Özulu–*et al.*^[2] from Büyükçekmece Dam Lake.

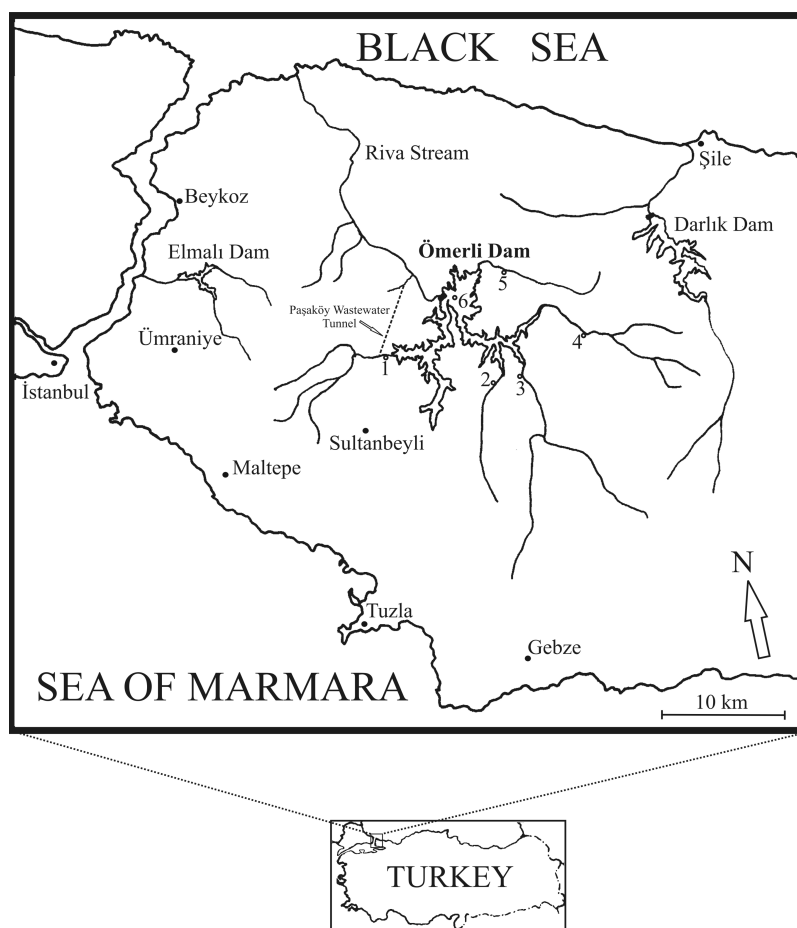


Fig. 1: Sampling stations at Ömerli Dam Lake Basin: 1. Paşaköy Stream (41°00'57''N, 29°17'00''E), 2. Ballıca Stream (41°00'02''N, 29°25'07''E), 3. Göçbeyli Stream (41°00'09''N, 29°26'04''E), 4. Ozan Stream (41°03'05''N, 29°28'09''E), 5. Kömürlük Stream (41°05'05''N, 29°25'19''E), 6. Ömerli Dam Lake.

Atherina boyeri is a euryhaline teleost fish which inhabits coastal and estuarine waters, as well as lagoons, salt marshes, shallow brackish water ecosystems, and inland waters. Having arrived through the riverlines and channels of the Riva Stream from the Black Sea before building of the reservoir dam wall in 1972, *A. boyeri* is now found in the Ömerli reservoir where it acclimatized and expanded, occupying the ecological niche of pelagic planctophagous fish. *A. boyeri* is now abundant fish species in the reservoir. This species also occurs in Lake İznik and Sapanca which are in the same region (Marmara Region) and similar depths (75 and 55 m, respectively) with Ömerli reservoir.

DSI report also depicted that percentage of Pike was 60% of the total fish biomass in the reservoir between 1978 and 1980^[14]. Our communication with local fishermen has confirmed this finding. However, they have mentioned that this species sharply declined after 1990s

and it has seldom been caught in the reservoir for last ten years. Furthermore, according to Selçuk and Ongan^[13], *E. lucius* which has not been obtained from the reservoir in the present study, occurred in the Riva Stream. This species is still being caught by local fishermen in the stream.

In the present study, a single *S. glanis* specimen has been found in the reservoir. Selçuk and Ongan^[13] reported *S. glanis* from Riva Stream. Although local fishermen admitted during the conversation that this species has been abundantly caught in the stream, it has not been obtained by fishermen and there has been no record from the reservoir until the present study.

It is thought that three gobiid species *N. melanostomus*, *N. gymnotrachelus*, *P. marmoratus* obtained in the present study might have come to the reservoir from the Black Sea before the dam wall construction.

R. rutilus was also reported by Selçuk and Ongan^[13] from the Riva Stream. However, we did not find this species in the reservoir throughout the study period.

Pa°aköy Stream, which was emptying into Ömerli reservoir, has become heavily polluted because of domestic and industrial waste waters coming from vicinity of the reservoir^[17]. At Pa°aköy Stream, only *C. vardarensis* species has been found on 19 July 2003 whereas no fish species has been encountered at the same place on 13 September 2003. The stream water which could not allow surviving even a pollution-tolerated fish species *C. vardarensis*, has been discharging into the Black Sea since February 2004 via a tunnel connected to the Riva Stream. Input of pollutants to Ömerli reservoir has thus been hindered by changing the course of the stream (Figure 1).

According to our observations for two studied years, abundance of fish species commercially caught as following order; *C. gibelio*, *S. erythrophthalmus*, *V. vimba* and *C. carpio*.

Local fishermen are deliberately introducing alien species into the reservoir at present. Uncontrolled attempts like this may cause very dangerous effects on the fish fauna of the reservoir. A local fisherman admitted that he introduced some specimens belonging to wells catfish, carp bream and tench to the reservoir. However, these specimens could not have been caught by him so far.

To conclude, Ömerli reservoir is one of the considerable evidences that human-induced detrimental effects on the nature has considerably increased. The reservoir has been polluted by domestic and industrial wastes for fifteen years. Many rehabilitation operations have been carried out to solve the pollution problem in the Ömerli Dam Lake Basin. Preventing the pollution, improving water quality and introducing of alien fish species by the fishermen have affected fish fauna of the reservoir basin.

It is necessary to continuously monitor the ecological balance of water resources such as Ömerli reservoir, which is important for drinking water, fisheries and recreation facilities. From this point of view, to describe of the fish fauna and monitor its variation in the time of this kind of water resources is required.

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