

# Journal of Aquaculture Engineering and Fisheries Research

E-ISSN 2149-0236

ORIGINAL ARTICLE/ORIJİNAL ÇALIŞMA

SHORT COMMUNICATION

KISA MAKALE

## REOCCURRENCE OF A COMMERCIAL EURYHALINE FISH SPECIES, *Atherina boyeri* Risso, 1810 (Atherinidae) IN BÜYÜKÇEKMECE RESERVOIR (İSTANBUL, TURKEY)

Gülşah SAÇ<sup>1</sup>, Özcan GAYGUSUZ<sup>2</sup>, Ali Serhan TARKAN<sup>3</sup><sup>1</sup> Istanbul University, Natural and Applied Sciences Institute, Vezneciler, Eminönü-Istanbul, Turkey<sup>2</sup> Istanbul University, Faculty of Fisheries, Laleli, Istanbul, Turkey<sup>3</sup> Muğla Sıtkı Koçman University, Faculty of Fisheries, Muğla, Turkey

Received: 19.11.2014

Accepted: 24.04.2015

Published online: 26.08.2015

Corresponding author:

Gülşah SAÇ, Istanbul University, Natural and Applied Sciences Institute, Bozdoğan Kemerli Street, No:6, 34134, Vezneciler, Eminönü-Istanbul, Turkey

E-mail: [gulsahsac@gmail.com](mailto:gulsahsac@gmail.com)

### Abstract:

The big-scale sand smelt, *Atherina boyeri* Risso, 1810 was recorded for the first time from Büyükçekmece Reservoir (İstanbul, Turkey) in 1982. However, recent studies on the fish fauna of Büyükçekmece Reservoir indicated that *A. boyeri* did not exist in the reservoir. In the present study, which was originally planned for determining biological features of perch, *Perca fluviatilis* Linnaeus, 1758 in the reservoir, existence of *A. boyeri* was determined in the stomach contents of two *P. fluviatilis* individuals captured in October and November 2009. Possible reasons for reappearance of the species are discussed.

**Keywords:** Big-scale sand smelt, Stomach content, Temperature, Reappearance

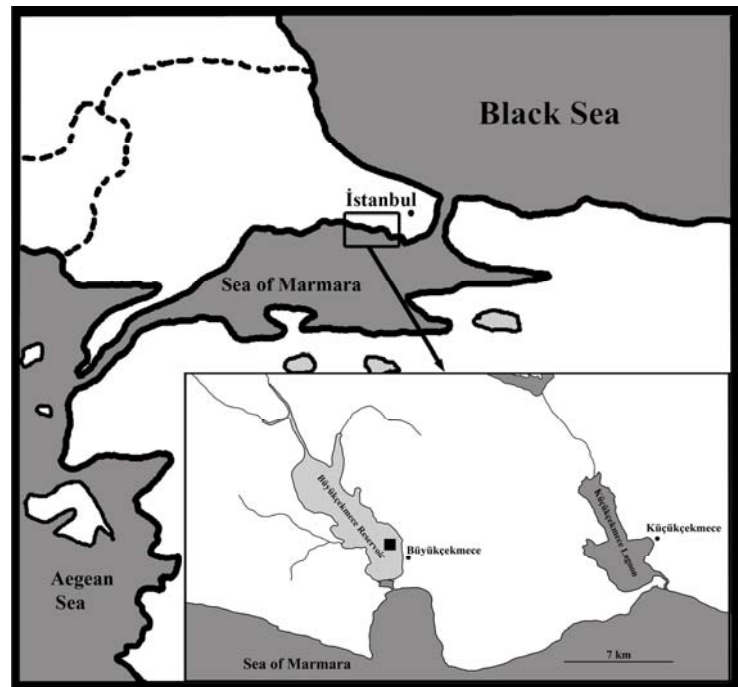
## Introduction

The big-scale sand smelt, *Atherina boyeri* Risso, 1810 is a euryhaline fish species, which migrates to sea in autumn and enters the lagoons in spring for reproduction. It has ecological and commercial relevance, and highly diffused in the most Mediterranean coastal lagoons, salt marshes and, more rarely, inland waters where it is accidentally or consciously introduced and characterized by high morphological variability among populations (Congiu et al., 2002; Andreu-Soler et al., 2003). It is also found in the northeast Atlantic, from the Azores to the northwest coast of Scotland (Bartulović et al., 2004). The natural distribution area of the fish in Turkey is Akyatan and Tuzla lakes (Adana), Bafa Lake (Aydın), Köyceğiz Lake (Muğla), Gediz Stream (İzmir), Büyükçekmece Reservoir and Küçükçekmece Lagoon (İstanbul), Peso Lake (Edirne), Sapanca Lake (Sakarya) and some estuaries in the East Black Sea Region such as Yeşilirmak (Samsun), Karadere (Kastamonu) (Altun, 1991; Kuru et al., 2001; Özuluğ et al. 2005a). *A. boyeri* is one of the most important fisheries resources in inland waters of Turkey with approximately 6500 tons production per year (Harlioğlu, 2011).

Büyükçekmece was a lagoon located in the mouth of Karasu Stream emptying into the Sea of Marmara (Figure 1). The sea connection of the lagoon was blocked by a dam to provide drinking and usage water for İstanbul in 1985 and the lake became freshwater lake in due time. The surface of the reservoir is 28.5 km<sup>2</sup> with approximately 7 m water depth (Meriç, 1992; Aktan et al., 2006). The reservoir is a shallow lake, which has a dynamical structure due to climatic changes and it provides the city of İstanbul with ≈14% of its drinking water (mean = 100×10<sup>6</sup> m<sup>3</sup>/year). The reservoir has progressively become mesotrophic because of industrial and domestic waste water inputs, which arrived through streams (mainly Karasu, Keşliçiftliği and Çekmece streams) emptying into the reservoir (Aktan et al., 2006; Şahin, 2006; Özuluğ, 1999).

Although several studies on the fish fauna of Turkish inland waters had not stated the presence of *A. boyeri* in Büyükçekmece Reservoir until

1950s (Ninni, 1923; Kosswig and Battalgil, 1942; Deveciyan, 1926), it was recorded for the first time from Büyükçekmece Reservoir in 1982 by Balık (1985). After then, Meriç (1986) reported this fish species in a study carried out to determine fish fauna of the reservoir. According to results of these studies, mostly marine species such as *Pomatomus saltatrix* (Linnaeus, 1766), *Mugil cephalus* Linnaeus, 1758, *Sardina pilchardus* (Walbaum, 1792), *Engraulis encrasicolus* (Linnaeus, 1758) with some freshwater fish species such as *Tinca tinca* (Linnaeus, 1758), *Rutilus rutilus* (Linnaeus, 1758), and catadromous fish species *Anguilla anguilla* (Linnaeus, 1758) existed in the reservoir. After building of the dam, freshwater species took over the marine species due to decrease in salinity down to 0.2‰ (Saç, 2010) and 23 freshwater fishes were then recorded (Özuluğ 1999). However, Meriç (1992) noted that *A. boyeri* was not present in the reservoir due to low water temperatures. In addition to this, Özuluğ (1999) also did not list *A. boyeri* in the taxonomic study of the fish fauna of the reservoir.



**Figure 1.** Map of Büyükçekmece Reservoir and Küçükçekmece Lagoon.

## Materials and Methods

The present study was originally initiated with the aim of understanding food habits of perch, *Perca fluviatilis* Linnaeus, 1758 in the reservoir and fish samples were collected between March 2009 and April 2010. A total of 428 perch was captured by using gillnets having different mesh sizes (10×10 mm, 20×20 mm, 30×30 mm, 40×40 mm and 50×50 mm). The gastrointestinal tracts of 81 *P. fluviatilis* specimens were examined to determine the dietary components. Unexpectedly, two *A. boyeri* specimens were found in stomach contents of two different *P. fluviatilis* specimens captured in October and November 2009. The perch specimens were 13.8 cm total length (38.62 g) and 25.4 cm total length (268.00 g), while *A. boyeri* specimens were 8.6 cm total length (2.12 g) and 6.1 cm length (because this sample was digested to some extent, only current length was given) (1.75 g), respectively (Figure 2).



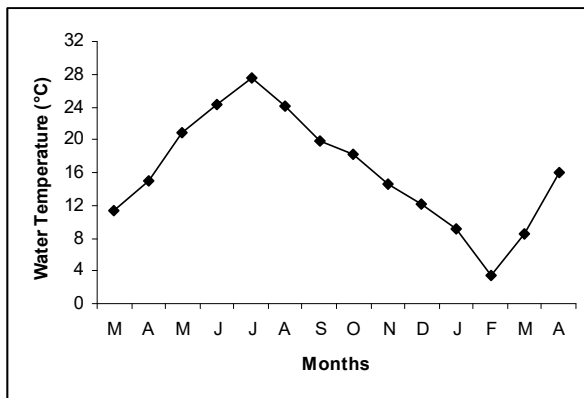
**Figure 2.** *A. boyeri* specimens found in stomach content of *P. fluviatilis*. Lower case indicates almost an intact *A. boyeri* specimen, probably just shortly before captured by the predator while the specimen in upper case was in a slightly advanced state of digestion.

## Results and Discussion

Recent studies on the fish fauna of the reservoir showed that *A. boyeri* has disappeared in the reservoir (Meriç, 1992; Özuluğ, 1999). However, present study had undeniably proved the existence of *A. boyeri* in the reservoir. There may be three ways for the fish to present in the reservoir: (1) the fish was re-introduced to the reservoir by stocking, (2) the fish has always been in the reservoir but could not captured in the previous studies or, (3) the fish entered into the reservoir by opening of dam shutters after heavy rains. Personal communications with the authorized persons revealed that the dam shutters left open during 3 – 4 days after flood disaster in September 9, 2009. It is known that the species has been living in the Sea of Marmara and is able to swim upstream. In light of this information, the most plausible explanation was that the species might have entered to the reservoir after the dam shutters had opened. This explanation is likely, as *A. boyeri* is abundant in a lagoon-type lake, Küçükçekmece Lagoon (personal communication, Reşit Özdilek, fisherman), which has very similar character and close proximity to Büyükçekmece Reservoir (Figure 1). As sea connection is constant and maximum depth is around 20 m in Küçükçekmece Lagoon, it is expected that *A. boyeri* population has never crashed in this lagoon unlike Büyükçekmece Reservoir.

Meriç (1992) reported that connection of Büyükçekmece Lagoon with the Sea of Marmara was blocked by a barrier (11.4 m in height) in order to meet the need for fresh water in city of İstanbul and that some ecological changes have occurred making the lagoon a freshwater lake by decreasing salinity to average 0.2‰ (Saç, 2010) from ≈25‰ (Acara and Gözenalp, 1959). Meriç (1992) also concluded that disappearance of *A. boyeri* can be attributed to harsh winters in Büyükçekmece Reservoir, as the most important ecological condition might be water temperature because feeding of *A. boyeri* ceases when water temperature is lower than 8°C and, water temperature lower than 4°C is fatal for this species. According to Henderson et al. (1988), the reason of migration of *A. boyeri* from coast (spawning area) to sea was protecting itself from low winter temperature of shallow waters in England. Büyükçekmece is a shallow reservoir and has average 2–3 m depth. Meriç (1992) recorded 3.2°C at 6.5 m depth and 3.0°C at surface water in a

station having 7.15 m maximum depth in Büyükçekmece Reservoir. According to Aktan et al. (2006), surface temperature was 3.8°C in February, 2004 while Şahin (2006) was reported 2°C at 2.5 m depth in February, 2005 in the reservoir. At the present study, minimum water surface temperature was measured as 3.5 °C on February, 2010 (Figure 3). It is highly remarkable for *A. boyeri* to attain Büyükçekmece Reservoir despite fatal water temperatures for the species in the winter. However, as only two specimens encountered in the stomach contents of a predator species for almost three decades (since 1986), it is obvious that this species has low abundance and a restricted distribution in this reservoir. This fact would support the idea that it can enter the reservoir through sea connection when it opens periodically. Notwithstanding a couple of general faunal studies did not report *A. boyeri* in Büyükçekmece Reservoir before 1980s, these studies were superficial (i.e. not in detail) and high abundance of *A. boyeri* was confirmed by personal communication with a researcher (Nurettin Meriç) who worked in the lake in 1970s. He has also admitted that *A. boyeri* was not commercially caught however it was one of the dominant fish species in Büyükçekmece Lagoon. Given this species was present in the coastal areas of the Sea of Marmara in 1940s (Erazi, 1942) and migrates to lagoons in spawning time, it should be one of the abundant natural fish species in Büyükçekmece Lake before the dam construction.



**Figure 3.** Surface water temperature values of Büyükçekmece Reservoir during study period.

## Conclusion

*A. boyeri* is a commercialized fish species for Turkish inland waters. For this purpose, it has been translocated to some fresh water bodies in Turkey such as İznik, Eğirdir lakes and Kara-

caören-I, Kesikköprü and Ömerli reservoirs, adapted successfully and became the dominant fish species of these ecosystems (Özuluğ et al., 2005b; İnnal and Erk'akan, 2006; Altındağ and Ahıska, 2006; Gülle et al., 2008; Özvarol and Karabacak, 2011).

These water bodies are deeper than Büyükçekmece Reservoir and *A. boyeri* can migrate from coastal or surface areas to deep for protecting itself from cold fatal water temperatures. This difference between Büyükçekmece Reservoir and other water bodies may explain higher colonization success of *A. boyeri* in other water bodies. Reappearance of *A. boyeri* in Büyükçekmece Reservoir is most likely because of opening the sea connection of the reservoir. Unfavorable environmental conditions for *A. boyeri* in the reservoir seem to continue and this might prevent increase the abundance of the species but sea connection of the reservoir may still provide its regular entrance to the reservoir. Reoccurrence of *A. boyeri* in the reservoir can be considered as a very important phenomenon in terms of ecological and commercial perspectives especially when the population size reaches considerably high levels. However, Büyükçekmece Reservoir should continuously be monitored and more detailed comparable field works should be conducted to get more solid results on this hypothesis.

## Acknowledgements

We are greatly indebted to Nurettin Meriç and Müfit Özuluğ, who kindly helped the manuscript. We also would like to thank Arif Paşa, who helped us in the field sampling.

## References

- Acara, A., Gözenalp, F. (1959): The northern lagoons of the Sea of Marmara. *Proc. General Fisheries Council for the Mediterranean*, 5: 235-239.
- Aktan, Y., Aykulu, G., Albay, M., Okgerman H., Akçaalan, R., Gürevin, C., Dorak, Z. (2006): Büyükçekmece Gölü'nde aşırı artış gösteren fitoplankterlerin gelişimini kontrol eden faktörlerin araştırılması. Tübitak Projesi; ÇAYDAG-103Y127,112.
- Altındağ, A., Ahıska, S. (2006): The fisheries problems in the Kesikköprü Dam Lake (Ankara) 1. Balıklandırma ve Rezervuar Yönetimi Sempozyumu, 07-09 Şubat, Antalya.



- Altun, Ö. (1991): Küçükçekmece Gölü'nde yaşayan gümüşbalığı (*Atherina boyeri* Risso, 1810)'nın morfolojisi. *Doğa-Turkish Journal of Zoology*, 15: 64-75
- Andreu-Soler, A., Oliva-Paterna, F.J., Fernandez-Delgado, C., Torralva, M. (2003): Age and growth of the sand smelt, *Atherina boyeri* (Risso 1810), in the Mar Menor coastal lagoon (SE Iberian Peninsula). *Journal of Applied Ichthyology*, 19: 202-208.
- Balık, S. (1985): Trakya Bölgesi içsu balıklarının bugünkü durumu ve taksonomik revizyonu. *Doğa Bilim Dergisi A2*, 9(2): 147-160.
- Bartulovic, V., Glamuzina, B., Conides, A., Dulcic, D., Njire, D., Kozul, V. (2004): Age, growth, mortality and sex ratio of sand smelt, *Atherina boyeri* Risso, 1810 (Pisces: Atherinidae) in the estuary of the Mala Neretva River (middle-eastern Adriatic, Croatia). *Journal of Applied Ichthyology*, 20: 427-430.
- Congiu, L., Rossi, R., Colombo, G. (2002): Population analysis of the sand smelt *Atherina boyeri* (Teleostei Atherinidae), from Italian coastal lagoons by random amplified polymorphic DNA. *Marine Ecology Progress Series*, 229: 279-289.
- Deveciyan, K., (1926). Türkiye'de Balık ve Balıkçılık. İstanbul, Osmanlı Düyun-u Umumiye İdaresi Matbaası.
- Erazi, R.A.R., (1942). Marine fishes found in the Sea of Marmara and in the Bosphorus, İstanbul Üniversitesi Fen Fakültesi Mecmuası B, 7(1-2): 103-115.
- Gülle, İ., Zeki Yıldırım, M., Küçük, F. (2008): Limnological history of Lake Eğirdir (Turkey): from 1950's to the present. *Natura Montenegrina, Podgorica*, 7(2): 115-128.
- Harlıoğlu, A.G. (2011): Present status of fisheries in Turkey. *Reviews in Fish Biology and Fisheries*, 21: 667-680.
- Henderson, P.A., Holmes, R.H.A., Bamber, R.N. (1988): Size-selective over-wintering mortality in the sand smelt, *Atherina boyeri* Risso, and its role in population regulation. *Journal of Fish Biology*, 33: 221-233.
- İnnal, D., Erk'Akan, F. (2006): Effects of exotic and translocated fish species in the inland waters of Turkey, *Reviews in Fish Biology and Fisheries*, 16: 39-50.
- Kosswig, C., Battalgil, F. (1942): Zoogeographie der Türkischen Süßwasserfische. *İstanbul Üniversitesi Fen Fakültesi Mecmuası B*, 7(3): 145-165.
- Kuru, M., Balık, S., Ustaoglu, M.R., Ünlü, E., Taşkavak, E., Gül, A., Yılmaz, M., Sarı, H. M., Küçük, F., Kutrup, B., Hamalosmanoğlu, M. (2001): Türkiye'de bulunan sulak alanların Ramsar Sözleşmesi balık kriterlerine göre değerlendirilmesi projesi. T.C. Çev. Bak. Çevre Kor. Gen. Müd. ve Gazi Üniv. Vakfı, Kesin Raporu., Ankara.
- Meriç, N. (1986): Fishes encountered in Büyükçekmece Lake, İstanbul. *İstanbul Üniversitesi Fen Fakültesi Mecmuası B*, 51: 41-46.
- Meriç, N. (1992): Büyükçekmece Baraj Gölü balıkları üzerine bir ön çalışma. Fırat Üniv. XI. Ulusal Biyoloji Kongresi, Hidrobiyoloji, Elazığ, 167-174.
- Ninni, E. (1923): Primo contributo allo studio dei pesci e della pesca nelle acque dell'Impero Ottomano, 5, Premiate Officine Grafiche Carlo Ferrari, Venezia.
- Özuluğ, M. (1999): A taxonomic study on the fish in the basin of Büyükçekmece Dam Lake. *Tr. J. of Zoology* 23: 439-451.
- Özuluğ, M., Altun, Ö., Meriç, N. (2005a): On the Fish Fauna of Lake İznik (Turkey). *Turkish Journal of Zoology*, 29: 371-375.
- Özuluğ, M., Acıpinar, H., Gaygusuz, Ö., Gürsoy, Ç., Tarkan, A.S. (2005b): Effects of human factor on the fish fauna in a drinking-water resource (Ömerli Dam Lake-İstanbul, Turkey). *Research Journal of Agriculture and Biological Sciences*, 1(1): 50-55.
- Özvarol, Z.A.B., Karabacak, G.S. (2011): Changes in the population structure of pikeperch (*Sander lucioperca* Linnaeus, 1758) Karacaören-I Dam Lake, Turkey. *Journal of Animal and Veterinary Advances*, 10(2): 224-228.
- Saç, G., (2010). Büyükçekmece Baraj Gölü'ndeki İsrail Sazanı *Carassius gibelio* (Bloch, 1782)'nın Büyümesi ve Üremesi, Yüksek Lisans Tezi, İstanbul Üniversitesi Fen Bilimleri Enstitüsü, İstanbul, 69.

Şahin, S.K. (2006): Büyükçekmece Gölü (İstanbul) bentik makroorganizmalarının nitel ve nicel dağılımları, Yüksek Lisans Tezi, İs-

tanbul Üniversitesi Fen Bilimleri Enstitüsü, İstanbul, 73.