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Taxonomic Status of Endemic Fish Species in Lake Beyşehir Basin (Turkey)

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Research Article

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Abstract

The surveys were conducted between 2005-2019 to assess endemic fish species in the Lake Beyşehir that have special importance in terms of endemism. A total of 12 endemic freshwater fish species (*Aphanius* cf. *iconii, Capoeta mauricii, Chondrostoma beysehirense, Garra kemali, Gobio microlepidotus, Pseudophoxinus anatolicus, Pseudophoxinus battalgilae, Pseudophoxinus hittitorum, Squalius anatolicus, Cobitis battalgilae, C. bilseli* and *Oxynoemacheilus atili*) belonging to 6 families (Aphaniidae, Cyprinidae, Gobionidae, Leuciscidae, Cobitidae and Nemachelidae) were observed.

Key words: Konya Endorheic Basin, endemic fish, exotic fish, ichthyofauna.

Beyşehir Gölü Havzası'ndaki (Türkiye) Endemik Balık Türlerinin Taksonomik Durumu

Özet

Bu çalışmada endemizim açısından büyük öneme sahip olan Beyşehir Gölü Havzasında 2005-2019 tarihleri arasında yapılmış olan çalışmaların sonuçlarına yer verilmiştir. Çalışma sonucunda 6 familyaya mensup (Aphaniidae, Cyprinidae, Gobionidae, Leuciscidae, Cobitidae ve Nemachelidae) 12 endemik tatlı su balığı türüne (*Aphanius* cf. *iconii, Capoeta mauricii, Chondrostoma beysehirense, Garra kemali, Gobio microlepidotus, Pseudophoxinus anatolicus, Pseudophoxinus battalgilae, Pseudophoxinus hittitorum, Squalius anatolicus, Cobitis battalgilae, C. bilseli* ve *Oxynoemacheilus atili*) rastlanmıştır.

Anahtar Kelimeler: Konya Kapalı Havzası, endemik balık, egzotik balık, ihtiyofauna.

INTRODUCTION

Lake Beyşehir is the largest freshwater lake in Turkey, located in Konya and Isparta provinces. In terms of biodiversity and endemic fishes, it has a great importance but its significance has not been understood yet..

Anatolia has a stable structure lasting for millions of years, and it has given many species a permanent shelter. The Lake Beyşehir basin is one of the best examples for this permanent shelter, therefore there are many endemic species in the lake basin (Tavşanoğlu, 2016). Pollution and uncontrolled water withdrawal for irrigation have reduced the water level of the lake, so disrupted the natural structure of the water.

In the early 1980s, *Sander lucioperca* was introduced and became the dominant invasive species in the lake. Then, *Tinca tinca, Carassius gibelio, Atherina boyeri* were introduced to the lake and they rapidly proliferated (Küçük, 2012).

Up to date thirteen endemic fish species (*Alburnus akili, Aphanius* cf. *iconii, Capoeta mauricii, Chondrostoma beysehirense, Cobitis battalgilae, C. bilseli, Garra kemali, Gobio microlepidotus, Oxynoemacheilus atili, Pseudophoxinus anatolicus, P. battalgilae, P. hittitorum, Squalius anatolicus*) and four translocated (*Alburnus escherichii, Atherina boyeri, Tinca tinca,* and *Sander lucioperca*), five exotic (*Carassius gibelio, Cyprinus carpio, Gambusia holbrooki, Knipowitschia caucasica* and

Pseudorasbora parva) fish species reported in the Lake Beyşehir (Erk'akan et al., 1999; Geldiay and Balık, 2009; Küçük, 2012; Özuluğ et al., 2013).

In this study, distribution, recent taxonomic status, and conservation status of fishes in the Lake Beyşehir have been revealed.

MATERIALS and METHODS

Lake Beyşehir has an altitude of 1125 meters and with an overall surface area is 88750 hectares. The length of the lake is 45 kilometers and the widest part is 26 kilometers and has been declared as a national park in 1993 (Işıldar, 2010). Fish samples were caught at 9 different sampling sites in Lake Beyşehir and tributaries during May 2005 and June 2019 (Figure 1). Tricaine Methanesulfonate (MS-222) was used to minimize pain when fish were fixed in 4% formaldehyde. Meristic counts and measurements follow Kottelat and Freyhof (2007). Family names were given taxonomically according to Stout et al. (2016) and Van der Laan (2017). The valid names of species were taken from Fishbase (Froese and Pauly, 2019) or Catalog of fishes (Fricke et al., 2019). Conservation status of species provided from the IUCN Red List (2019).

Abbreviations: FFR, Zoology Museum of the Faculty of Fisheries, Recep Tayyip Erdogan University, Rize, Turkey. IFC–ESUF, Isparta University of Applied Sciences, Egirdir Fisheries and Aquatic Sciences. IUCN, International Union for Conservation of Nature and Natural Resources. SL, Standart Length.

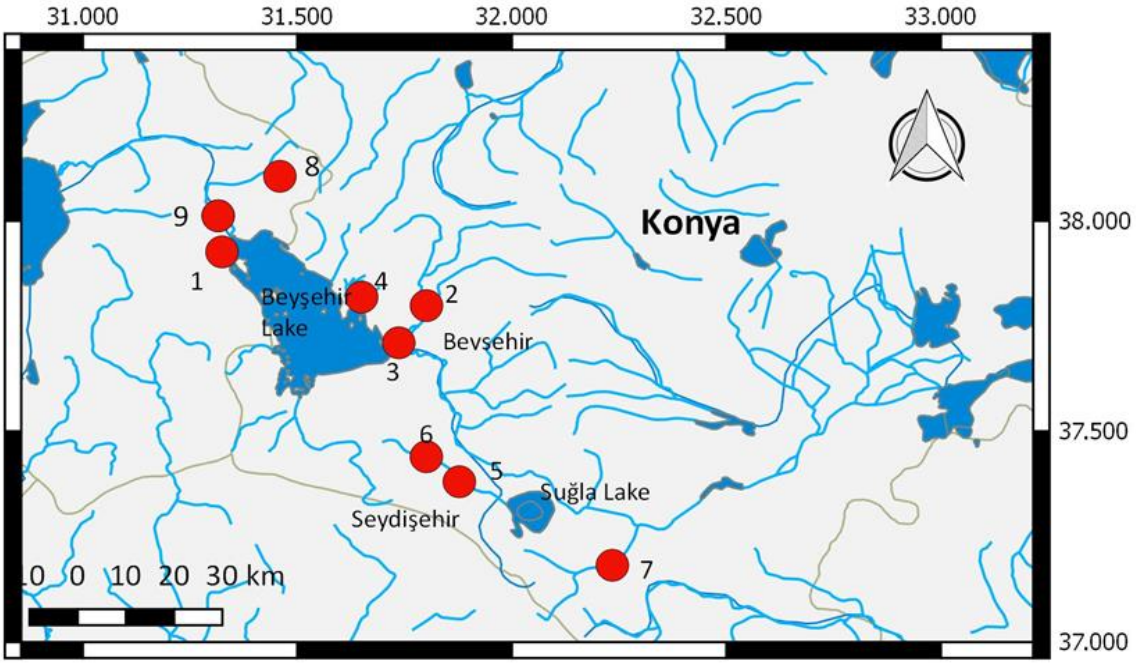

Figure 1. Sampling sites in the Lake Beyşehir and its tributaries.

RESULTS

This study was carried out between 2005 and 2019 in Lake Beyşehir and tributaries. During the surveys, a total of 12 endemic species belonging to 6 families were observed at the family level, the Leuciscidae comprises the greatest number of species (5 species), followed by Cyprinidae and Cobitidae (2), Nemacheilidae, Gobionidae, and Aphaniidae (1).

Family: LEUCISCIDAE

Chondrostoma beysehirense Bogutskaya, 1997 (Figure 2)

Common names: Beyşehir nase; Beyşehir kababurun balığı (Turkish).

Material Examined: FFR02019, 1, 110 mm SL, 06.06.2007; Beyşehir, Stream Sarıöz. — FFR02068, 1, 101 mm SL, 07.06.2015; Seydişehir, Stream Kuğulu. — IFC-ESUF 03-1505, 16, 155.70–250.79 mm SL, 26.06.2012, Beyşehir, Lake Beyşehir.

Conservation: Endangered (EN).

Distribution: Lake Beyşehir basin

Threats: The predominant threat for the population of Lake Beyşehir is the predator pressure of *Sander lucioperca*, unregulated fishing methods, pollution of canals and small rivers due to domestic and agricultural wastes and loss of habitat (water shortage in summer).

Figure 2. *Chondrostoma beysehirense*; Beyşehir, Lake Beyşehir, 209.2 mm SL.

Squalius anatolicus (Bogutskaya, 1997) (Figure 3)

Common names: Beyşehir dace; Chub; Beyşehir tatlısu kefali, akbalık (Turkish).

Material Examined: FFR00514, 9, 138-232 mm SL, 06.06.2007; Beyşehir. —FRR03810, 14, 127–240 mm SL; 06.06.2007; Beyşehir, Stream Sarıöz. —FFR06239, 10, 123–266 mm SL, 07.06.2015; Seydişehir, Stream Akçay. —FFR06242, 23, 98-223 mm SL, 07.06.2015; Seydişehir, Stream Kuğulu. —FFR06287, 1, 134 mm SB, 13.11.2018; Beyşehir, Stream Eylikler.

Conservation: Least Concern (LC).

Distribution: Beysehir, Tuz, and Ilgın Lake basins and Manavgat River (Özuluğ and Freyhof, 2011).

Threats: The predator pressure of *Sander lucioperca* may be effective in part for the population of Lake Beyşehir. There is no significant threat in other distribution areas.

Figure 3. *Squalius anatolicus*; Seydişehir, Stream Akçay, 220 mm SL.

Pseudophoxinus anatolicus (Hanko 1924) (Figure 4)

Common names: Anatolian minnow; Anadolu yağbalığı (Turkish).

Material Examined: IFC–ESUF 03–1014, 208.5 mm SL; 26.06.2012; Beyşehir, Lake Beyşehir.

Conservation: Endangered (EN).

Distribution: Beyşehir, Suğla and Akgöl Lake basins (Küçük et al., 2016).

Threats: It has a very rare (or rare) population density in Beyşehir and Suğla lakes. *Sander lucioperca* is the predator pressure in both populations.

Figure 4. *Pseudophoxinus anatolicus*; Beyşehir, Lake Beyşehir, 208 mm SL.

Pseudophoxinus battalgilae Bogutskaya, 1997 (Figure 5)

Common names: Beyşehir minnow; Beyşehir otbalığı (Turkish).

Material Examined: IFC-ESUF 03-0965, 62 mm SL; 19.05.2005; Seydişehir; Stream Bozkır, Lake Suğla drainage.

Conservation: Least Concern (LC).

Distribution: *P. battalgilae* is known from Lake Suğla area, Manavgat River basin, Akgöl Swamp, Lake Çavuşcu and Niğde environs (Kızılca and Gümüşler) (Freyhof and Özuluğ, 2010, Küçük et al., 2016).

Threats: No individuals were found in Lake Beyşehir, which is the type locality. Canals flowing to Lake Suğla and the Stream Bozkır populations are under pressure from pollution due to domestic wastes. There is no significant threat in the Manavgat River basin.

Figure 5. *Pseudophoxinus battalgilae*; Seydişehir, Stream Bozkır, 62 mm SL.

Pseudophoxinus hittitorum Freyhof & Özuluğ, 2010 (Figure 6)

Common names: Hittitic spring minnow; Hitit otbalığı (Turkish).

Material Examined: FFR03292, 10, 69–100 mm SL, 17.10.2009; Beyşehir, Stream Eflatunpınarı.

Conservation: Endangered (EN).

Distribution: Lake Beyşehir basin (streams Eflatunpınar, Bakaran and Deliktaş spring near Yeşildağ) (Küçük et al., 2009a).

Threats: The most important threat is the drying and pollution of the resources because it prefers very cold and clean spring waters.

Figure 6. *Pseudophoxinus hittitorum*; Beyşehir, Stream Eflatunpınarı, 100 mm SL.

Family: CYPRINIDAE

Capoeta mauricii Küçük, Turan, Şahin & Gülle, 2009 (Figure 7)

Common names: Long snout scraper; Uzun burun siraz (Turkish).

Material Examined: FFR 03801, 14, 114–238 mm SL, 06.06.2007; Beyşehir, Stream Sarıöz. — FFR 01928, 3, 127–144 mm SL, 07.06.2015; Beyşehir, Stream Eylikler.

Conservation: Endangered (EN).

Distribution: Sarıöz, Bakaran, Eflatun Pınarı, Sarıçay streams, a tributary of the southern of Lake Beyşehir basin (Küçük et al., 2009b).

Threats: *Capoeta mauricii* is endemic to Lake Beyşehir and populations of the species declining according to our in situ observations. Water abstraction is the main threat to the species.

Figure 7. *Capoeta mauricii*; Beyşehir; Stream Eylikler, 205 mm SL.

Garra kemali (Hankó, 1925) (Figure 8)

Common names: Ereğli minnow; Ereğli golyan balığı (Turkish).

Material Examined: FFR04030, 1, 65 mm SL, 07.06.2019 Beyşehir, Stream Eflatunpınarı. — FFR02479, 12, 35–45 mm SL, 19.05.2005 Beyşehir, Stream Kuğulu.

Conservation: Endangered (EN).

Distribution: The species was known from Lake Beyşehir basin, stream Köprüçay (Mediterranean Sea basin). It has been recently recorded from Hirfanlı reservoir (Black Sea basin) (Yoğurtçuoğlu et al., 2018).

Threats: Even though the species from the three independent water sources are known, the populations are generally very poor. Therefore, the species to be at threat. The major threats are potential invasive species and water abstraction.

Figure 8. *Garra kemali*; Beyşehir, Stream Eflatunpınarı, 32 mm SL.

Family: GOBIONIDAE

Gobio microlepidotus Battalgil, 1942 (Figure 9)

Common names: Beyşehir gudgeon; Beyşehir Derekayası, Yağlıca (Turkish).

Material Examined: FFR05944, 30, 49–138 mm SL, 07.06.2015; Seydişehir, Stream Akçay. —FFR05945, 5, 94–124 mm SL, 07.06.2015; Beyşehir, Stream Eylikler. —FFR05947, 3, 107-126 mm SL, 07.06.2015; Seydişehir, Stream Kuğulu.

Conservation: Vulnerable (VU).

Distribution: The species was known from Lake Beyşehir basin (Turan et al., 2016). It has been recently recorded from the Göksu River and Stream Limon (Mediterranean Sea basin) (Turan and Bayçelebi, 2019).

Threats: Even though the species from the three independent water sources are known. However, these populations are generally poor. *Gobio microlepidotus* is the only species in head water of the Göksu River and Stream Limon. Pollution and water abstraction are major threats.

Figure 9. *Gobio microlepidotus*; Seydişehir, Stream Kuğulu, 137 mm SL.

Family: APHANIIDAE

Aphanius* cf. *iconii (Figure 10)

Common names: Beyşehir killifish; Beyşehir dişli sazancığı.

Material Examined: FFR08658, 3, 40-55 mm SL, 07.06.2019 Beyşehir, Stream Eflatunpınarı. —IFC-ESUF 04-0013, 30, 20-42 mm SL, 15.04.2000 Beyşehir, Soğuksu Bridge

Distribution: Lakes Beyşehir and Eğirdir basins and Stream Köprüçay.

Threats: The threat to the populations of the springs feeding the Beyşehir and Eğirdir lakes is drought and pollution.

Figure 10. *Aphanius* cf. *iconii*; Beyşehir, Soğuksu Bridge, 41.2 mm SL ♀- 38.2 mm SL ♂.

Family: COBITIDAE

Cobitis battalgilae Bănarescu, 1962 (Figure 11)

Common names: Battalgil spined loach; Battalgil dikenli çöpçübalığı (Turkish)

Material Examined: IFC-ESUF uncat., 121 mm SL; 07.06.2006; Beyşehir; Stream Eflatunpınarı.

Conservation: Endangered (EN).

Distribution: *C. battalgilae* is known from Beyşehir and Lake Suğla basins, Manavgat River basin (Freyhof et al., 2018) and below the Apa Reservoir (Percides et al., 2018).

Threats: They live mostly in canals and small streams. The threat to the Manavgat River population is currently unknown.

Figure 11. *Cobitis battalgilae*; Beyşehir, Stream Eflatunpınarı, 121 mm SL.

Cobitis bilseli Battalgil, 1942 (Figure 12)

Common names: Beyşehir spined loach; Koca taşyiyen balığı (Turkish)

Material Examined: —FFR05523, 1, 120 mm SL, 06.06.2007; Beyşehir, Stream Sarıöz. —FFR05542, 1, 160 mm SL, 07.06.2015; Seydişehir, Stream Akçay. —FFR05544, 3, 92-185 mm SL, 07.06.2015; Seydişehir, Stream Kuğulu.

Conservation: Endangered (EN).

Distribution: Lake Beyşehir basin (Freyhof et al., 2018).

Threats: Domestic and agricultural pollution and habitat losses are also a threat to the Manavgat River population.

Figure 12. *Cobitis bilseli*; Gökçehüyük, Stream Akçay, 120 mm SL.

Family: NEMACHEILIDAE

Oxynoemacheilus atili Erk'akan, 2012 (Figure 13)

Common names: Lake Beyşehir loach; Çöpçü balığı (Turkish).

Material Examined: FFR01375, 12, 50-65 mm SL, 06.06.2007; Beyşehir, Stream Sarıöz. —FFR01534, 1, 47-56 mm SL, 07.06.2015; Seydişehir, Stream Kuğulu. —FFR01535, 1, 59 mm SL, 07.06.2015; Beyşehir, Stream Eylikler.

Conservation: Near Threatened (NT).

Distribution: Stream Eflatunpınarı, Lake Beyşehir basin (Erk'akan, 2012).

Threats: Domestic and agricultural pollution and habitat losses are also a threat to the Manavgat River population.

Figure 13. *Oxynoemacheilus atili*; Seydişehir, Stream Kuğulu, 55 mm SL.

DISCUSSION and CONCLUSION

Anatolia has numerous river systems and closed watersheds. This reveals very rich biodiversity, especially on water-dependent living creatures such as fish. The fishes of the Lake Beyşehir are one of the best examples of this rich diversity by hosting 12 native species and more than one species belong to the same genus. For instance, *Pseudophoxinus* represented by three (*P. anatolicus, P. battalgilae, P. hittitorum*) species in Lake Beyşehir and *Cobitis* two (*C. bilseli* and *C. battalgilae*).

Acanthorutilus anatolicus caralis Battalgil, 1942 was described from Lake Beyşehir. In the late 20th century, there was some argument about the validity of this species (Bogutskaya, 1992, 1997). Even though it was evaluated to species level as *Pseudophoxinus caralis* (Freyhof and Özuluğ, 2010; Bogutskaya et al., 2006). According to the last study, *P. caralis* is not distinguish from *P. anatolicus* morphologically (Geiger et al., 2014). The killifish samples found in Lake Beyşehir basin exhibited similar morphologic characters with *A. iconii*. However, the female samples have 3-4 regular rows of black spots on the flank (vs. spots are irregularly scattered on the flank). Therefore, we treat the Beyşehir as *A.* cf. *iconii* because of the insufficient material to assess its exact taxonomic position.

Some of the previously reported species were not caught. *Alburnus akili* population rapidly decreased after the introduction of *S. lucioperca*, which is the most dangerous invasive species of Lake

Beyşehir (Erk'akan et al., 1999). Küçük (2012) claimed that *A. akili* has already extinct. Recently, *Gobio battalgilae* have treated this as a synonym of *G. microlepidotus* (Turan et al., 2018).

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