



**Two threatened endemic fish species of the world: *Aphanius splendens* and *Aphanius transgrediens* Cyprinodontidae, from Turkey**

Salim Serkan GÜÇLÜ\*, Fahrettin KÜÇÜK

Süleyman Demirel University Eğirdir Fisheries Faculty, Inland Water Biology Department, Eğirdir/Isparta, Turkey

**Abstract**

Being an endemic and threatened fish species in Anatolia, *Aphanius splendens* restricted to Salda Lake in southwest Anatolia region, Turkey. The Gölcük Lake population is regarded as extinct and current population of *A.splendens* tends to decrease. The presence of this introduced species should be regarded as a serious threat to populations of *A. transgrediens* in the Acıgöl Lake. A detailed study is required for more information about population structure, biology, ecology and life history of these species for the threatened categories and conservation status..

**Key words:** Salda Lake, Acıgöl Lake, Killifish, Threatened fish, Conservation

**1. Introduction**

The Cyprinodontiform fish of the genus *Aphanius*, extant as well as fossil, are widely distributed along the late-period Tethys Sea coast lines. Fossil finds are known from many locations between southern Germany and Kirchisiah. Their present-day distribution has also been influenced by glacial and interglacial period differences in the Mediterranean Sea level (Wildekamp et al., 1999). The genus *Aphanius* consists of 9 species comprising two major clades that occur in Anatolia; *A.asquamatus*, *A.mento*, *A.fasciatus*, *A.danfordii*, *A.villwocki*, *A.anatoliae*, *A.splendens*, *A.transgrediens* and *A.sureyanus* (Wildekamp, 1993; Wildekamp et al., 1999; Hrbek and Meyer, 2003; Hrbek and Wildekamp, 2003). *Aphanius* is an important genus which reflect the effect on aquatic fauna of geological isolation in Anatolia. Genus of *Aphanius* are given important clues in the zoogeographical and bio-ecological studies.

Salda Lake is a closed-basin (endorrheic), alkaline-saline lake of 45 km<sup>2</sup> surface area at 1180 m above sea level. It is situated in a depression north of Mountain Eşeler in the Taurus tectonic belt. It is maximum water depth 104 m, but there are several local depressions with depths of 180–200 m (Kazancı et al., 2004). The mountainous surroundings of Salda Lake form a drainage basin of 147.6 km<sup>2</sup> comprising ultramafic and karstified carbonate rocks. Salda Lake is fed by the Değirmendere, Köpek, Kocakapak, Basbiden, Salda, Karakova and Çatlıklı streams, by Zafer spring and by numerous groundwater inflows, but there are no surface outlets. The water level fluctuates c. 51 cm annually due to the lake's hydraulic relationship with karstic aquifers, extensive evaporation during the hot and dry summer months and extensive irrigational use of the surrounding groundwater sources (Kazancı et al., 2004). Salda Lake in 1989, has been protected as a first-degree natural site areas and the wetland.

Acıgöl Lake is a tectonic lake loated within the borders of Afyonkarahisar and Denizli provinces. It has an area between 35-100 km<sup>2</sup>. It is 836 m above the sea level and maximum depth of 1.5-2 m. The lake is notable for its sodium sulfate reserves extensively used in the industry. Acıgöl Lake is Turkey's largest and world's second largest sodium sulfate reserve Acıgöl Lake, has been protected as the wetland (B class) and AKD021 coded Key Biodiversity Areas (Özdemir and Bahadır, 2009).

*Aphanius splendens* (Kosswig & Sözer 1945); *Common name*, Anadolu Yosun balığı (Turkish), Glänzender AnatolienKärpfling (Deutsch). *Conservation status and Identification*, Critically Endangered (CR) (A1ac, B1+2abce) (Kottelat, 1996; Küçük, 2006; Fricke et al., 2007); Anatolian endemic, LL 48-52, D I (II) 8-10, A I 9-11, Sc 32-38 and 40-46, chromosomes n=24. *A.splendens* is sexually dimorphic. Adult males show a coloration pattern characterized. The background body color is silver on which 8-11 irregular dark gray to almost black vertical bars are present. The dorsal fin is colorless at the base with a wide black border. The anal fin is white to pale yellow with a narrow black

\* Corresponding author / Haberleşmeden sorumlu yazar: Tel.: +902463133447/1409; Fax.: +902463133452; E-mail: salimguclu@sdu.edu.tr

border. The caudal fin is also colorless to white, usually with two black cross-bars. Females show, the sides have a beautiful silver sheen with large dark brown to almost black spots concentrated mainly along the mid-lateral line. All fins are colorless (Kosswig and Sözer, 1945; Wildekamp, 1993; Wildekamp et al., 1999). Males (total length<sub>max</sub>≤ 45-50 mm) are smaller overall than females (total length<sub>max</sub>≤60 mm) (Figure 1).



Figure 1. *Aphanius splendens* (male in left and female in right ) by R. Wildekamp (Wildekamp et al., 1999) *Aphanius transgrediens* (Ermin 1946); Common name, Anadolu Yosun balığı (Turkish), Acıgöl-

AnatolienKärpfling (Deutsch). Conservation status and Identification, Critically Endangered (CR) (B1+2bcd) (Kottelat, 1996; Küçük, 2006; Fricke et al., 2007). Anatolian endemic. LL 45-48, D 9-12, A 9-12, Sc 26-48, chromosomes n=24 (Villwock, 1964). This species is moderately slender and also shows an upturned angular lower jaw. Male coloration variable on the population level. Male; Light silver-gray on the body with dark gray to black vertical bars, usually irregular, and 8-11 in number. A series of dark gray spots is usually present on the back. The dorsal and anal fins are colorless at the base with a black border. During breeding this border broadens and the entire fin may become black. The caudal fin is colorless to pale gray with two dark vertical bars. Female, Silver with irregularly distributed dark Brown to gray spots on the back and sides. A concentration of spots usually appears on the mid-lateral line. All the fins are colorless (Wildekamp, 1993; Wildekamp et al., 1999). Max total length 40-50 mm (unsexed) (Wildekamp, 1993; Huber, 1996). (Figure 2).



Figure 2. *Aphanius transgrediens* (male in left and female in right) by R. Wildekamp (Wildekamp et al., 1999)

### 1.1. World Distribution

Type locality of *A.splendens* is Gölcük Lake, western Isparta (Sözer, 1942). From 1989 to 1996, the water levels of Gölcük Lake decreased dramatically. During surveys in since 1989, no specimens of *A.splendens* were obtained from Gölcük Lake. Presently, Gölcük Lake population is regarded as extinct. Extinction was caused most probably by the introduction of *Sander lucioperca* (Linnaeus 1758) (Pike-perch) and ongoing pollution. Nowadays, this species was only known from Salda Lake, western Burdur (Wildekamp et al. 1999). *A.transgrediens* is known only from a series of springs near of Acıgöl Lake, where in south central Turkey.

### 1.2. Habitat and ecology

*A.splendens*; Locality of *A.splendens*, Salda Lake is fed by springs and is abundant in planktonic fauna and the benthic fauna. Apart from some algae, submerged vegetation is lacking in Salda Lake. *A.splendens* lived in schools in the littoral zone with *Pseudophoxinus ninae* (Freyhof and Özüluğ, 2009). Kosswig and Sözer (1945) indicate that the development time of the eggs is about 12 days at 24 °C and that the fry become free-swimming after their yolk sacs have been absorbed. There isn't data related to reproduction in the natural habitat. *A.transgrediens*, inhabits springs near of Acıgöl Lake produce fresh to lightly brackish water. The fishes generally do not inhabit the lake itself because of the high salinity of the lake water and the periodic drying up during summer months to form a salt pan. In times of heavy rainfall the lake water may become fresh enough to allow populations from adjacent springs to migrate into the lake and mix with neighboring populations. There isn't data related to reproduction in the natural habitat (Wildekamp, 1993).

### 1.3. Threats

*A.splendens* is threatened by decreasing water levels, due to coastal regions dried loss of habitat, nearby of groundwater for irrigation purpose and sewage pollution. In view of the apparent serious degradation of the habitat of *A.splendens* and the introduction of Carp (*Cyprinus carpio* (Linnaeus 1758)) in Salda Lake, this species must be regarded as threatened (Wildekamp, 1993; Wildekamp et al., 1999). *A.transgrediens* is threatened by in the thenardite (sodium sulphate) factories around the lake to make over-production and therefore the water level falls, the increase of salinity, springs around Acıgöl Lake to dry, due to coastal regions dried loss of habitat and nearby of groundwater for irrigation purpose. The lake has started to be smaller day by day same 160 km<sup>2</sup> in the year of 1970 and about 50 km<sup>2</sup> in 2008 caused by drought and depletion of lake water. The role of the changes which appeared in the last 33 years (1975-2008), is important on this condition. Especially, extreme temperatures and increasing evaporation, decreases in precipitation, extreme consumption of water and the use of water in farming caused desertification in the basin where semi-arid climatic conditions are dominant. Salt, salt crystal and coastal dunes appear or form in the area where the lake level decreased. These formations are dragged along the east side of the basin by westerly blows and dust clouds are formed (Özdemir and Bahadır, 2009). In September 1992, in a spring at the southwestern end of Acıgöl Lake, the presence of the Poeciliid fish *Gambusia affinis* (Baird & Girard 1854) was observed together with *A.transgrediens*. *G.affinis*, introduced in various habitats for mosquito control, is known to be a threat to other fishes. It can thrive in the same environment as that occupied by *Aphanius* species, with the exception of hypersaline habitats, and may pose a threat to them by competitive exclusion and direct predation on fry. There is a strong possibility that *G.affinis* may spread to other springs during times of heavy rainfall when the water of Acıgöl Lake is sufficiently fresh to permit migration. The presence of this introduced species should be regarded as a serious threat to populations of *A.transgrediens* in the area (Wildekamp, 1993; Wildekamp et al., 1999).

## 2. Discussion

A detailed study of population structure, biology and ecology of *A.splendens* and *A.transgrediens* are required. Habitat loss by human activities should be prevented immediately. Fault and karst water sources feeding the lake, as the optimum use of agricultural irrigation and activities of sodium sulphate production facilities (in Acıgöl Lake) need to be minimized are required. However, future conservation efforts should include the protection of the species' natural habitat. Genus of *Aphanius* is a first genus that making the transition from sea to freshwater in Anatolia. In this respect, the *Aphanius* genus has an important role in distribution of fish in Anatolia (Kosswig 1965). *A.splendens* and *A.transgrediens* are highly endemic with restricted distribution.

## References

- Freyhof, J., Özüluğ, M. 2009. *Pseudophoxinus evliyaevi*, a new species of spring minnow from Western Anatolia with remarks on the distribution of *P. ninae* and the systematic position of *P. fahirae* (Teleostei: Cyprinidae). *Ichthyological Exploration of Freshwaters*, 20. 347-356.
- Fricke, R., Bilecenoglu, M., Sarı, H.M. 2007. Annotated checklist of fish and lamprey species (Gnathostoma and Petromyzontomorpha) of Turkey, including a Red List of threatened and declining species. *Stuttgarter Beitr. Naturk. Ser. A* 706. 1-172.
- Huber, J.H. 1996. Killi-Data 1996. Updated checklist of taxonomic names, collecting localities and bibliographic references of oviparous Cyprinodont fishes (Atherinomorpha, Pisces). *Société Française d'Ichtyologie Muséum National d'Histoire Naturelle* 399 p, Paris.
- Kazancı, N., Girgin, S., Dügel, M. 2004. On the limnology of Salda Lake, a large and deep soda lake in southwestern Turkey: future management proposals. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 14. 151-162.
- Kosswig, C. 1965. Zur Historischen Zoogeographie der Ichthyofauna im Süßwasser des südlichen Kleinasien. *Zool Jb Syst Bd*. 83-90 p. Hamburg.

- Kosswig, C., Sözer, F. 1945. Nouveaux Cyprinodontidés de l'Anatolie centrale. Revue de la Faculté des Sciences de l'Université d'Istanbul. Ser B. 10. 77-81.
- Kottelat, M. 1996. *Aphanius splendens*. In: IUCN 2011. IUCN Red List of threatened Species. version 2011.1. www.iucnredlist.org. Accessed 06 July 2011.
- Küçük, F. 2006. Türkiye'deki bazı endemik içsu balıklarının dünya Doğayı Koruma Birliği (IUCN) ölçütlerine göre değerlendirilmesi. I.Balıklandırma ve Rezarvuvar Yönetimi Sempozyumu Bildiri Kitabı. 151-159 p. Antalya.
- Özdemir, M.A., Bahadır, M. 2009. Çölleşme sürecinde Acıgöl (1970-2008) (Acıgöl in desertification process (1970-2008). İstanbul Üniversitesi Edebiyat Fakültesi Coğrafya Bölümü Coğrafya Dergisi. 18. 1-20.
- Sözer, F. 1942. Türkiye Cyprinodontid'leri hakkında. Contributions à la connaissance des Cyprinodontidés de la Turquie. Revue de la Faculté des Sciences de l'Université d'Istanbul. Ser. B, 7: 308–310.
- Villwock, W. 1964. Genetische Untersuchungen an altweltlichen Zahnkarpfen der Tribus Aphaniini (Pisces: Cyprinodontidae) nach Gesichtspunkten der neuen Systematik. Zeitschrift für Zoologische Systematik und Evolutionsforschung. 2. 267–382.
- Wildekamp, R.H. 1993. A world of killies, Atlas of the oviparous Cyprinodontiform fishes of the world. 1. 1-311. American Killifish Association, Mishawaka Indiana.
- Wildekamp, R.H., Küçük, F., Ünlüsayın, M., Neer, V.W. 1999. The Genus *Aphanius* Nordo, 1827 (Pisces: Cyprinodontidae) and its Species in Turkey With Remarks on Systematics. Journal of Turkish Zoology. 23. 23-44.

(Received for publication 10 March 2012; The date of publication 15 December 2012)