




First Record of Invasive Nile Tilapia *Oreochromis niloticus* (Linnaeus, 1758) (Family: Cichlidae) in Akgöl (Mersin, Türkiye)

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Abstract

Tilapias are one of the world's most productive and internationally traded foods. It was brought to tropical and subtropical regions for aquaculture purposes to it that spread quickly. The aquaculture sector in Turkey as well as in the rest of the world, it is one of the most important reasons for the spread of invasive species. Three specimens, was collected via gill net during a survey carried out in Akgöl (Mersin) on summer of 2021. The fish samples were 12.4 cm, 20.0 and 21.4 cm in total length (TL) and 36.0 g, 120.0 and 212.0 g total weight (TW), respectively. In this study, *Oreochromis niloticus* were recorded for the first time in Akgöl (Mersin). It is though that this species was brought to Akgöl (Mersin) for aquaculture and later adapted here.

Keywords:

Oreochromis niloticus, *tilapia*, *invasive species*, *göksu delta*, *northeastern Mediterranean*

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Introduction

Nile tilapia *Oreochromis niloticus* (Linnaeus, 1758) is a tropical freshwater species in the Perciformes order within the Cichlidae family. Habitats of this species are mainly located in tropical and subtropical regions of America and Africa, as well as Madagascar, India, and Sri Lanka (Salzburger & Meyer, 2004; Maan & Sefc, 2013; Arslan et al., 2021). All tilapiine fishes are the

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most cultured species in the world. In addition, these species have been introduced in many countries due to their commercial value. Because of its rapid growth, age, and size at maturity, this species has become successful invaders outside of its native range.

The Nile tilapia is considered to be an invasive fish species in Turkish inland waters in the IUCN Red List (Diallo et al., 2020). *O. niloticus* was reported for Turkey in the freshwater fish review list by Çiçek et al. (2015; 2020). In addition, this species were reported from Asi River (Gürlek, 2004), Köyceğiz Lake (Yılmaz, 2009), Damsa Dam Lake (Mert & Çiçek, 2010), Sakarya River basin (Emiroğlu, 2011), from Pınarbaşı Creek (Burdur) (Innal & Sungur, 2019), and other geographical distribution areas in Turkey (Arslan et al., 2021).

In Akgöl are lived four fish species. Two of these are salinity-tolerant migratory fish species; European eel *Anguilla anguilla* (Linnaeus, 1758) and Flathead grey mullet *Mugil cephalus* Linnaeus, 1758 cross into the Paradeniz Lagoon. In addition, two freshwater species Common carp *Cyprinus carpio* Linnaeus, 1758 and North African catfish *Clarias gariepinus* (Burchell, 1822) lay their eggs in this lake. Eel and catfish are mostly caught for export, while other species are consumed in the region (TVKGM, 2022).

The aim of this study is to provide a new record of *O. niloticus* in Akgöl freshwaters. This species is probably stocked in the Akgöl (Mersin) for aquaculture and adapted to this habitat. So, this work was to document the first record of *O. niloticus* in freshwater fishes in Turkey.

Material and Methods

The Göksu Delta is located in the Mediterranean Sea region of the southeastern part of Turkey. There are two large lakes in Delta (Paradeniz Lake (492 ha) and Akgöl (820 ha)). Both lakes are quite shallow, the depth of Akgöl is maximum 1 m and is a very salty lake (Figure 1). Moreover, this lake is the irrigation drainage water flows from the channels (Gülçiçek, 2018). The annual summer months (June-August) maximum temperature is 32°C in the lake. The coldest month of lake on January, that is an average temperature of 11.8°C. *O. niloticus* was accidentally caught in Akgöl (36.302147, 33.944958) in the summer of 2021 in study.



Figure 1. Akgöl Area (<https://tvk.csb.gov.tr/goksu-deltasi-i-393>)

Fish samples were sampled using gill nets of various mesh sizes (23 and 30 mm). After, the captured *O. niloticus* specimens were kept in 4% formaldehyde until they were brought to the Fisheries Laboratory of Mersin University. The Nile tilapia fish specimen photograph was given in Figure 2.



Figure 2. Nile tilapia, *Oreochromis niloticus* caught in the Akgöl (foto by Deniz Ayas)

Results

Identification

Total length ranged from 12.4-21.4 cm, eye distance ranged from 0.7-1.0 and head lengths 5.9-3.4 cm (Table 1). Some morphometric characters of *O. niloticus* are given in Table 1.

The morphological features are as follows: The scales are cycloid; gill rakers are short; teeth are wide; the caudal fin is scaly. The caudal fin is soft and different numerous dark vertical stripes; the anal fin is faintly barred; the pectoral fin is pointed. Dorsal spines 16-18; Dorsal soft rays 11-13; Anal spines: 3-3; Anal soft rays: 10-11. First gill arch contains 25 to 31 gill rakers. The upper lateral line contains 20-23 scales; the lower has 14-18 scales.

Color (Fresh specimen)

O. niloticus has margin of dorsal fin grey or black with vertical bars in caudal fin. The body is greyish, relatively dark (in adults). The belly whitish, upper lip is pale green or white and lower lip white. The dorsal and anal fin is grayish or blackish. The pectoral and caudal fins are reddish.

Table 1. The morphometric characteristics of *O. niloticus* from Akgöl for three specimens. W: Total Weight; POL: Pre orbital length; CPH: Caudal peduncle height; CPL: Caudal peduncle height; BW: Body weight; BH: Body height; PvL: Pelvic fin length; PAL: Pre anal length; AFB: anal fin base; PDL: Pre dorsal length; DFB: Dorsal fin base; POL: Pre orbital length; IOD: Inter orbital distance; ED: Eye distance; HL: Head length; SL: Standard length; TL: Total length

Morphometric measurements (cm)			
Characters	Number of Samples		
	(1)	(2)	(3)
TL	12.4	20.0	22.4
SL	9.4	15.7	17.7
HL	3.4	5.60	5.9
ED	0.7	1.0	1.0
IOD	1.3	2.1	2.4
POL	1.1	2.0	2.3
DFB	5.7	9.5	10.5
PDL	4.0	6.0	6.5
AFB	1.7	3.3	3.4
PAL	7.4	11.2	12.3
PvL	3.4	5.2	6.3
BH	4.2	6.4	7.6
BW	3.3	2.0	2.4
CPL	1.1	2.0	2.0
CPH	1.4	2.4	2.7
W (g)	36.0	120.00	212.0

Discussion

Oreochromis species, which are also used for weed control, were brought to the region for aquaculture in Göksu Wetland and Çukurova region. These species were detected in 18 systems in Mersin and Adana regions (Arslan et. al., 2021). *O. niloticus* is exotic fish species that was recorded for the first time in Akgöl Lake.

Oreochromis niloticus has been introduced to more than 90 countries worldwide and is one of the most important introduced fish species in the world (Fitzsimmons, 2001; Picker & Griffiths 2011; Hasan & Tamam, 2019).

Global climate change is believed to be a factor in some non-native species becoming invasive. In addition, it is reported that both native and non-native species increase the pressure of spreading in their commercial and recreational activities (Hellmann et. al., 2008; Rahel & Olden 2008; Kuljanishvili et. al., 2021).

As it is known, in case of the emergence of alien species, native species in the environment may disappear. This is one of the main reasons of the decrease in biodiversity (Davies et al., 2010; Houde et al., 2015). In addition to adversely affecting native species, effects such as competitive interactions, predation, parasitism, and hybridization are biotic effects caused by invasive species (Blanchet et al., 2007; Carey & Wahl, 2010; Houde et al., 2015). Successful invaders in fish communities often outperform native species by factors that ensure their survival, such as habitat selection and food choices (Blanchet et al., 2007; Martin et al., 2010; Gu et al., 2015; Raymond et al., 2015). It is thought that such a situation may arise for *O. niloticus* species in the Akgöl, which can cause the extinction of native and endemic species with its negative effects.

We speculate that *O. niloticus* was released into Akgöl by unknown local fishermen. But this view is still not entirely clear. This invasive species, *O. niloticus* may alter the evolutionary pathway of native species by competitive exclusion, niche displacement, predation and other ecological and genetic mechanisms (Mooney & Cleland, 2001). Therefore, the reproduction of this fish species should be monitored especially since the effect of successful breeding strategies in forming strong populations is known.

Consequently, the presence of three specimens suggests the possibility that this species could form a population in Akgöl. Therefore, it is recommended to investigate whether this invasive species will be a threat to this region with monitoring studies in the near future.

Author Contributions

SAE: Designed the study, wrote the first version of manuscript and checked the final version of manuscript. DE: Designed the study, checked the first and final version of manuscript. DA: Provided data. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

- Arslan, P., İnnal D., & Özeren S. C. (2021). Notes on the Distribution of the Genus *Oreochromis* in the East Mediterranean Region of Turkey. *Commagene Journal of Biology*, 5(1), 18-23. <https://doi.org/10.31594/commagene.824644>.
- Blanchet, S, Loot, G., Grenouillet, G., & Brosse, S. (2007). Competitive Interactions Between Native and Exotic Salmonids: A Combined Field and Laboratory Demonstration. *Ecology of Freshwater Fish*, 1,; 133-143. <https://doi.org/10.1111/j.1600-0633.2006.00205.x>.
- Carey, M.P., & Wahl, D.H. (2010). Native Fish Diversity Alters the Effects of An Invasive Species on Food Webs. *Ecology*, 91(10), 2965-2974. <https://doi.org/10.1890/09-1213.1>.

- Çiçek, E., Birecikligil S. S., & Fricke, R. (2015). Freshwater Fishes of Turkey: A Revised and Updated Annotated Checklist. *Biharean Biologist*, 9, 141-157.
- Çiçek, E., Birecikligil S. S. & Fricke, R. (2020). Freshwater Lampreys and Fishes of Turkey: A Revised and Updated Annotated Checklist 2020. 4809, 241-270. *Zootaxa*, <https://doi.org/10.11646/ZOOTAXA.4809.2.2>.
- Davies, K.F., Cavender-Bares J. & Deacon N. (2010). Native Communities determine the identity of exotic invaders even at scales at which communities are unsaturated. *Diversity and Distributions*, 17, 35-42. <https://doi.org/10.1111/j.1472-4642.2010.00721.x>.
- Diallo, I., Snoeks, J., Freyhof, J., Geelhand, D., & Hughes, A. (2020). *Oreochromis niloticus* The IUCN Red List of Threatened Species 2020: e.T166975A134879289. <https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T166975A134879289.en>. Accessed on 01 September 2022.
- Emiroğlu, Ö. (2011). Alien Fish Species in Upper Sakarya River and Their Distribution. *African Journal of Biotechnology*, 10, 16674-16681. <https://doi.org/10.5897/AJB11.2502>.
- Fitzsimmons, K. (2001). *Environmental and Conservation Issues in Tilapia Aquaculture*, pp. 128-131. In: R. Subasinghe and T. Singh (eds.), *Tilapia: Production, Marketing, and Technological Developments*. FAO Infofish, Kuala Lumpur, Malaysia.
- Froese, R., & Pauly, D. (2022). Fishbase. Worldwide Web Electronic Publication. www.fishbase.org, Version (10/2022).
- Gu, D.A., Ma G.M., Zhu Y.J., Xu M., Luo D., Li Y.Y., Wei H., Mu X.D., Luo J.R., & Hu Y.C. (2015). The Impacts of Invasive Nile Tilapia (*Oreochromis niloticus*) on the Fisheries in the Main Rivers of Guangdong Province, China. *Biochemical Systematics and Ecology*, 59, 1-7. <https://doi.org/10.1016/j.bse.2015.01.004>.
- Gülçiçek, O. (2018). Investigation of Water Quality of Akgöl Lake in the Göksu Delta. *Advances in Ecological and Environmental Research*, 3, 173-179.
- Gürlek, M. (2004). Genetic and Morphologic Identification of Tilapia (Tilapia) Species Found in Çukurova and Hatay Regions and Determination of Key Characters for Species Identification, *Msc Thesis*, University of Mustafa Kemal, Hatay, Turkey.
- Hasan, V., & Tamam, M.B. (2019). First Record of the Invasive Nile Tilapia, *Oreochromis niloticus* (Linnaeus, 1758) (Perciformes, Cichlidae), on Bawean Island, Indonesia. *Check List*, 15(1), 225-227. <https://doi.org/10.15560/15.1.225>.

- Hellmann, J. J., Byers, J. E., Bierwagen, B.G., & Dukes, J. S. (2008). Five Potential Consequences of Climate Change for Invasive Species. *Conservation Biology*, 22: 534-543. <http://dx.doi.org/10.1111/j.1523-1739.2008.00951.x>.
- Houde, A.L.S., Wilson, C.C., & Neff B.D. (2015). Competitive Interactions among Multiple Non-native Salmonids and Two Populations of Atlantic salmon. *Ecology of Freshwater Fish*, 24, 44-45. <https://doi.org/10.1111/eff.12123>.
- Innal, D. & Sungur, S. (2019). First record of non-indigenous fish *Hemichromis letourneuxi* (Cichlidae) from Pınarbaşı Creek (Burdur, Turkey). *The Journal of Graduate School of Natural and Applied Sciences of Mehmet Akif Ersoy University*, 10(1): 90-94. <https://doi.org/10.29048/makufebed.562523>.
- Kottelat, M., & Freyhof, J. (2007). *Handbook of European Freshwater Fishes*. Publications Kottelat, Cornol and Freyhof, Berlin.
- Kuljanishvili, T., Epitashvili, G., Japoshvili, B., Patoka, J., & Kalous, L. (2021). Finding of Nile tilapia *Oreochromis niloticus* (Cichliformes: Cichlidae) in Georgia, the South Caucasus. *Earth and Environmental Science*, 744, 012036. <https://doi.org/10.1088/1755-1315/744/1/012036>.
- Maan, M.E., & Sefc, K.M. (2013). Colour variation in cichlid fish: Developmental mechanisms, selective pressures and evolutionary consequences. *Seminars in Cell and Developmental Biology*, 24(6-7): 516- 528. <https://doi.org/10.1016/j.semcdb.2013.05.003>.
- Martin, C.W., Valentine M.M., & Valentine, J.F. (2010). Competitive Interactions Between Invasive Nile Tilapia and Native Fish: The Potential for Altered Trophic Exchange and Modification of Food Webs. *PLoS One*, 5(12), e14395. <https://doi.org/10.1371/journal.pone.0014395>.
- Mert, R., & Cicek, E. (2010). Range Expansion of Introduced Tilapia Species (*Oreochromis niloticus*, L. 1758, Cichlidae) in Turkey. *Journal of Animal and Veterinary Advances*, 9, 1753-1756. <https://doi.org/10.3923/javaa.2010.1753.1756>.
- Mooney, H.A., & Cleland, E.E. (2001). The Evolutionary Impact of Invasive Species. *Proceedings of the National Academy Sciences USA*, 98(10), 5446-5451. <https://doi.org/10.1073/pnas.091093398>.
- Picker, M.D., & Griffiths, C.L. (2011). *Alien and Invasive Animals: A South African Perspective*. Randomhouse/Struik, Cape Town.

- Rahel, F.J., & Olden, J.D. (2008). Assessing the Effects of Climate Change on Aquatic Invasive Species. *Conservation Biology*, 22, 521-533. <http://dx.doi.org/10.1111/j.1523-1739.2008.00950.x>.
- Raymond, W.W., Albins, M.A., & Pusack, T.J. (2015). Competitive interactions for shelter between invasive Pacific red lionfish and native Nassau grouper. *Environmental Biology of Fishes*, 98(1), 57-65. <https://doi.org/10.1007/s10641-014-0236-9>.
- Salzburger, W., & Meyer, A. (2004). The Species Flocks of East African Cichlid Fishes: Recent Advances in Molecular Phylogenetics and Population Genetics. *The Science of Nature Naturwissenschaften*, 91(6), 277-290. <https://doi.org/10.1007/s00114-004-0528-6>.
- TKVGM. (2022). General Directorate for Protection of Natural Assets. Available at: (<https://tvk.csb.gov.tr/goksu-deltasi-i-393>).
- Yılmaz, F. (2009). The Comparison of Heavy Metal Concentrations (Cd, Cu, Mn, Pb, and Zn) in Tissues of Three Economically Important Fish (*Anguilla anguilla*, *Mugil cephalus* and *Oreochromis niloticus*) Inhabiting Köycegiz Lake-Muğla (Turkey). *Turkish Journal of Science and Technology*, 4(1), 7-15.