

## First Record of the Sand Smelt *Atherina boyeri* Risso, 1810 in the Süreyyabey Dam Lake, Yeşilirmak Basin, Turkey

Semra Benzer\*

Department of Science Education, Gazi Faculty of Education, Gazi University, Ankara, Turkey

\* Corresponding author: Semra Benzer, Department of Science Education, Gazi Faculty of Education, Gazi University, Ankara, Turkey,

Tel: +90-312-2021608; E-mail: [sbenzer@gazi.edu.tr](mailto:sbenzer@gazi.edu.tr)

### ABSTRACT

*Atherina boyeri* is a translocated and invasive fish species that is known to pose problems to the native fish fauna and other. In this study, twenty three morphometric properties of the sand smelt, *A. boyeri* population in Süreyyabey Dam Lake was investigated for the first time. Twenty three morphometric characters of samples were measured and evaluated. These characteristics were standard length, fork length, total length, body weight, pre orbital distance, eye diameter, inter orbital distance, head length, head width, dorsal fin I nose point distance, dorsal fin II nose point distance, pre anal distance, pre pectoral distance, pre ventral distance, dorsal fin I base length, dorsal fin II base length, anal fin base length, pectoral fin base length, ventral fin base length, maximum body height, caudal peduncle height, body width, caudal peduncle width. The fork length of individuals which were caught (FL) were between 5.30 and 7.30 cm, and their weight (W) were ranged between 1.12 and 3.57 g. This paper reports the first occurrence of *A. boyeri* from Süreyyabey Dam Lake in Yeşilirmak Basin.

**Keywords:** *Atherina boyeri*; Sand smelt; Morphometric properties; Süreyyabey Dam Lake

### INTRODUCTION

Turkey has the richest freshwater ichthyofauna in the Mediterranean Region with approximately 380 species [1]. Turkey also has rich fish diversity and has ratio of endemism [2]. *Atherina boyeri* Risso, 1810 is both a native and translocated fish in Turkish waters, in terms of distribution [3]. Translocated or invasive fish species may cause problems to the native fish fauna and other species and may lead to the introduction of exotic diseases and parasites [3,4].

The sand smelt, *A. boyeri*, is a kind of Atherinid fish that generally occupies coastal and estuarine waters, including coastal lagoons, over a wide range of salinities from freshwater to hyper saline conditions [5]. As a carnivores or opportunistic predator species, it feeds on zooplankton and benthic organisms [6].

It is an euryhaline that mostly reside in coastal and shallow brackish waters including coastal lagoons, salt marshes and inland waters [6- 13]. In recent years, *A. boyeri*, a marine species, has been expanding its distribution area to inland waters [3,14-26]. In recent years, the distribution of this species in inland waters has been expanding because of accidental or intentional grounds and the increasing demand in the international market have made the species more popular among fishermen [25].

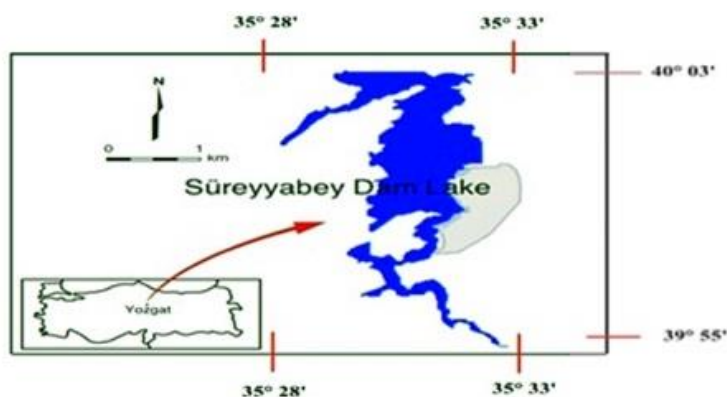
Sand smelt, *A. boyeri* has large adaptation talent and exhibits regional differentiation for its morphological and biological characteristic [23]. Since it easily adapts to new environments and form large populations in various salinities, *A. boyeri* has succeeded in colonizing again in water systems [24].

Fish morphology means a range of anatomical design among fish species. Body architecture can be analyzed in characteristic depth, predation style, other swimming specializations required for the survival success of a given species. For example, the type, size and arrangement of a fish's fins are completely in line with its ecological niche [27]. Morphometric assessment is also used in the identification of the differences in fish population [28,29].

In this study, the first occurrence of *A. boyeri* from Süreyyabey Dam Lake in the Yeşilirmak Basin was reported. This research describes the area where these were found and document the morphometric data of the population.

## MATERIALS AND METHODS

Süreyyabey Dam Lake is located approximately 82 km northeast of Yozgat (35° 28' N and 35° 33' N latitudes and 39° 55' E and 40° 03' E longitudes) (**Figure 1**). Süreyyabey Dam, Yozgat province on the Çekerek Creek, was constructed for irrigation, energy and flood control. The area of lake is 41,34 km<sup>2</sup> with a rock body fill type dam. The Çekerek River, one of the most important branches of Yeşilirmak, is located between the Deveci Mountains (1892 m) and Dagni Mountain (1755 m) [30].



**Figure 1:** Map of Süreyyabey Dam Lake.

The samples (*A. boyeri*) were collected from Süreyyabey Dam Lake. During the study, 46 fish specimens were caught in 2016 (**Figure 2**). The samples were preserved in 4% formaldehyde solution and measured weight to the nearest 0.01 g and total, fork and standard length to the nearest 0.01 mm. Measurements for twenty three morphometric characteristics were recorded in **Table 1**.



**Figure 2:** Photo of *A. boyeri*.

The total length and weight (min-max) of the fish were 5.80 – 7.80 cm and 0.12 – 3.57 g, respectively. A sample sand smelt (n= 46; males= 28; females=18) was collected from Süreyyabey Dam Lake. Twenty three mensural characteristics including standart length (SL), fork lenght (FL) and total length (TL), and body weight were measured.

## RESULTS

*A. boyeri* shows twenty three differences in terms of morphometric and meristics characteristics. However, these differences are at the population level in the Mediterranean Basin and there is no major distinction between these populations. The pre maxillary and colour differences, along with the shape of the vertebrae and scales, are the most significant distinguishing aspects between their populations [31]. *A. boyeri* is capable of adaptation and usually occupies at the changeable conditions of seas, lagoons and lakes such as temperature, salinity, turbidity, and currents [6,32].

**Table 1:** Morphometric characteristics of *A. boyeri* specimens.

PARAMETERS		min	Max	Average	SD	CI	margin of error	upper bound	lower bound
<b>FEMALE</b>									
1	Standard Length	4.90	6.80	5.817	0.577	0.267	0.036	5.550	6.083
2	Fork Length	5.30	7.30	6.211	0.579	0.267	0.036	5.944	6.479
3	Total Length	5.80	7.80	6.722	0.630	0.291	0.043	6.431	7.013
4	Body Weight	1.12	3.57	2.079	0.676	0.312	0.050	1.766	2.391
5	Preorbital distance	0.20	0.60	0.411	0.108	0.050	0.001	0.361	0.461
6	Eye diameter	0.30	0.60	0.444	0.086	0.040	0.001	0.405	0.484
7	Interorbital distance	0.30	0.70	0.372	0.102	0.047	0.001	0.325	0.419
8	Head length	0.90	1.60	1.211	0.225	0.104	0.005	1.107	1.315
9	Head width	0.40	0.80	0.600	0.119	0.055	0.002	0.545	0.655
10	Dorsal fin I nose point distance	1.50	3.10	2.633	0.409	0.189	0.018	2.445	2.822
11	Dorsal fin II nose point distance	3.10	4.40	3.906	0.418	0.193	0.019	3.712	4.099
12	Preanal distance	3.10	4.90	3.806	0.480	0.222	0.025	3.584	4.027
13	Prepectoral distance	0.80	1.70	1.344	0.262	0.121	0.007	1.224	1.465
14	Preventral distance	1.90	2.70	2.344	0.236	0.109	0.006	2.236	2.453
15	Porsal fin I base length	0.10	0.60	0.272	0.149	0.069	0.002	0.204	0.341
16	Dorsal fin II base length	0.20	0.90	0.556	0.243	0.112	0.006	0.443	0.668
17	Anal fin base length	0.30	1.10	0.756	0.250	0.116	0.007	0.640	0.871
18	Pectoral fin base length	0.10	0.80	0.450	0.209	0.097	0.005	0.353	0.547
19	Ventral fin base length	0.10	0.20	0.128	0.046	0.021	0.000	0.106	0.149
20	Maximum body height	0.80	1.50	1.094	0.189	0.087	0.004	1.007	1.182
21	Caudal peduncle height	0.20	0.50	0.333	0.091	0.042	0.001	0.291	0.375
22	Body width	0.40	1.00	0.650	0.162	0.075	0.003	0.575	0.725
23	Caudal peduncle width	0.10	0.30	0.178	0.065	0.030	0.000	0.148	0.208
<b>MALE</b>									
1	Standard Length	4.10	6.30	5.614	0.528	0.195	0.019	5.419	5.810
2	Fork Length	4.90	6.80	5.971	0.488	0.181	0.017	5.791	6.152
3	Total Length	5.90	7.40	6.554	0.487	0.180	0.017	6.373	6.734
4	Body Weight	0.90	3.29	1.878	0.556	0.206	0.022	1.672	2.084
5	Preorbital distance	0.20	0.50	0.368	0.072	0.027	0.000	0.341	0.395
6	Eye diameter	0.30	0.50	0.439	0.057	0.021	0.000	0.418	0.460
7	Interorbital distance	0.30	0.50	0.368	0.067	0.025	0.000	0.343	0.393
8	Head length	0.80	1.50	1.175	0.219	0.081	0.003	1.094	1.256
9	Head width	0.30	0.80	0.596	0.135	0.050	0.001	0.547	0.646
10	Dorsal fin I nose point distance	2.10	2.90	2.557	0.210	0.078	0.003	2.479	2.635
11	Dorsal fin II nose point distance	3.20	4.30	3.796	0.305	0.113	0.007	3.684	3.909
12	Preanal distance	3.10	4.20	3.686	0.324	0.120	0.007	3.566	3.806
13	Prepectoral distance	0.80	1.70	1.282	0.244	0.090	0.004	1.192	1.372
14	Preventral distance	1.40	2.50	2.214	0.245	0.091	0.004	2.124	2.305
15	Porsal fin I base length	0.10	0.50	0.275	0.117	0.044	0.001	0.231	0.319
16	Dorsal fin II base length	0.20	0.70	0.511	0.126	0.047	0.001	0.464	0.557
17	Anal fin base length	0.10	1.80	0.779	0.321	0.119	0.007	0.660	0.898
18	Pectoral fin base length	0.10	2.50	0.493	0.445	0.165	0.014	0.328	0.658
19	Ventral fin base length	0.10	0.40	0.132	0.067	0.025	0.000	0.107	0.157
20	Maximum body height	0.80	1.30	1.093	0.178	0.066	0.002	1.027	1.159
21	Caudal peduncle height	0.20	0.40	0.296	0.058	0.021	0.000	0.275	0.318
22	Body width	0.30	0.90	0.668	0.250	0.092	0.004	0.575	0.760
23	Caudal peduncle width	0.10	0.40	0.189	0.096	0.035	0.001	0.154	0.225

**SD:** Std Deviation; **CI:** Confidence Interval

Many morphometric characters of *A. boyeri* from the Süreyyabey Dam Lake show difference when compared to those in the Iznik Lake population [31] and Devegeçidi Dam Lake population [23], Izmir Basin population [18]. Such differences between populations could be possibly explained by the changing morphometries of this polymorphic species with respect to physical and chemical variables characteristic of different environments [33] or errors by different researchers taking the measurements [34].

It is reported that morphometric characters may change not only in populations but also in regions [35]. There are differences in the morphological characteristics of the population at the regional level as well as the morphometric diversity [36].

The studies on the *A. boyeri* populations which are spread widely in the inland waters of Turkey are very limited. There have not been many studies of these biometric features in Turkey.

Bartulovic et al. [6] in Mala Neretva River, Croatia (TL= 3.1 - 11.6 cm); Özeren [17] in İznik Lake (TL= 3.0 - 11.5 cm, W= 0.1- 11.0 g); Çetinkaya et al. [32] in İznik Lake (FL= 2.0 -10.6 cm, W= 0.06 - 10.5 g); İlhan and Sarı [22] in Marmara Lake (TL= 3.70 - 8.70 cm, W= 0.40 - 5.40 g); Apaydın and Yağcı et al. [37] in Eğirdir Lake (TL= 1.6 - 9.8 cm, W= 0.15 - 9.42 g); Saç et al. [24] in Büyükçekmece Reservoir (SB= 3.1 - 6.1 cm, W= 0.295 - 2.360 g); Gençoğlu and Ekmekçi [25] in Hirfanlı Dam Lake (TL= 29.20 - 88.92 mm, W= 0.12 - 10.48 g); Ünlü et al. [23] in Devegeçidi Dam Lake (TL= 43.3 - 59.9 mm, W= 0.7 - 8.0 g) are reported in the literature.

This paper reports the first occurrence of *A. boyeri* from Süreyyabey Dam Lake in Yeşilirmak Basin. This paper describes the area where this fish were found and its morphometric data of the population was recorded. Findings obtained in this study are very important because the previous studies about the morphometric properties of *A. boyeri* have not been investigated in this region. It is considered that the data obtained in this study will also contribute to future studies.

## REFERENCES

- [1] Froese, R., et al., 2017. FishBase 2017, version (March, 2017). World Wide Web electronic publication Home page at: <http://www.fishbase.org>.
- [2] Fricke, R., et al., 2007. Annotated checklist of fish and lamprey species (Gnathostomata and Petromyzontomorphi) of Turkey, including a Red List of threatened and declining species. Staatliches Museum für Naturkunde.
- [3] Innal, D., et al., 2006. Effects of exotic and translocated fish species in the inland waters of Turkey. *Reviews in Fish Biology and Fisheries*, 16(1), pp.39-50.
- [4] Tarkan, A.S., et al., 2014. Risk screening of non-native freshwater fishes at the frontier between Asia and Europe: first application in Turkey of the fish invasiveness screening kit. *Journal of Applied Ichthyology*, 30(2), pp.392-398.
- [5] Henderson, P., et al., 1987. On the reproductive biology of the sand smelt *Atherina boyeri* Risso (Pisces: Atherinidae) and its evolutionary potential. *Biological Journal of the Linnean Society*, 32, pp.395-415.
- [6] Bartulovic, V., et al., 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). *J. Appl. Ichthyol.*, 20, pp.427-430.
- [7] Leonardos, I., et al., 2000. Age, growth and mortality of *Atherina boyeri* Risso, 1810 (Pisces: Atherinidae) in the Mesolongi and Etolikon lagoons (W. Greece). *Fisheries Research*, 45(1), pp.81-91.
- [8] Pallaoro, A., et al., 2002. Age, growth and mortality of big scale sand smelt, *Atherina (Hepsetia) boyeri* Risso, 1810 in the Pantana Lagoon, Croatia. *Periodicum Biologorum*, 104 (2), pp.175-183.
- [9] Andreu-Soler, A., et al., 2003. Age and growth of the sand smelt, *Atherina boyeri* Risso, 1810, in the Mar Menor coastal lagoon (SE Iberian Peninsula). *J Appl Ichthyol* 19, pp.202-208.
- [10] Koutrakis, E.T., et al., 2004. Age, growth and mortality of a semi-isolated lagoon population of sand smelt, *Atherina boyeri* (Risso, 1810) (Pisces: Atherinidae) in an estuarine system of Northern Greece. *J. Appl. Ichthyol.*, 20, pp.382-388.
- [11] Kottelat, M., et al., 2007. Handbook of European Freshwater Fishes. Norwich, UK: Steven Simpson. pp.646.
- [12] Boudinar, A.S., et al., 2015. Habitat discrimination of big-scale sand smelt *Atherina boyeri* Risso, 1810 (Atheriniformes: Atherinidae) in eastern Algeria using somatic morphology and otolith shape. *Italian Journal of Zoology*, 82(3), pp.446-453.
- [13] Vasil'eva, E.D. 2017. Diagnostic features and taxonomy of the Mediterranean species of the big-scale sand smelts belonging to *Atherina boyeri* group (Atherinidae). *Journal of Ichthyology*, 57(6), pp.791-802.
- [14] Altun, Ö. 1991. Küçükçekmece Baraj Gölü'nde yaşayan gümüşbalığı (*Atherina boyeri* Risso, 1810)'nın morfolojisi. *Turkish Journal of Zoology*, 15, pp.64-75.
- [15] Küçük, F., et al., 2006. Eğirdir Gölü'ne sonradan giren gümüşbalığı (*Atherina boyeri* Risso, 1810)'nın göl ekosistemine ve balıkçılığa etkisi. In: 1. Ulusal Balıklandırma ve Rezervuar Yönetimi Sempozyumu; 7-9 February 2006; Antalya, Turkey.
- [16] Tarkan, S., et al., 2007. Variations in growth and life history traits of sand smelt, *Atherina boyeri*, populations from different water bodies of Turkey: influence of environmental factors. *Rapp Comm Int Mer Médit*, 38, pp.611.
- [17] Özeren, S.C. 2009. Age, Growth and Reproductive Biology of the Sand Smelt *Atherina boyeri*, Risso 1810 (Pisces: Atherinidae) in Lake İznik, Turkey. *J. Int. Fisheries*, 4, pp.34-39.
- [18] Taskavak, E., et al., 2012. Biometric properties of the sand smelt *Atherina boyeri* Risso, 1810 from the Izmir Bay (Aegean Sea). *Journal of Fisheries Sciences*, 6(1), pp.18.
- [19] Kucuk, F., et al., 2012. Reproductive features of big scale sand smelt, *Atherina boyeri* (Risso, 1810), an exotic fish in Lake Eğirdir (Isparta-Turkey). *Turk. J. Fish. Aquat. Sci.*, 12, pp.731-735.
- [20] Ekmekçi, F.G., et al., 2013. Türkiye içsularındaki istilacı balıkların güncel durumu ve istilanın etkilerinin değerlendirilmesi. *İstanbul Uni Su Ürünleri Derg.* 28(1), pp.105-140.

- [21] Kırankaya, S.G., et al., 2014. Condition, length–weight and length–length relationships for five species from Hirfanlı Reservoir, Turkey. *Journal of Fisheries Sciences*, 8, pp.208–213.
- [22] İlhan, A., et al., 2015. Length weight relationships of fish species in Marmara Lake West Anatolia, Turkey. *Croatian Journal of Fisheries*, 73, pp.30-32.
- [23] Ünlü, E., et al., 2017. New record and range extension of the big-scale sand smelt *Atherina boyeri* Risso, 1810 (Atherinidae) in the Devegeçidi Dam Lake, Tigris River basin, Turkey. *J. Appl. Ichthyol.*, 33(1), pp.63-68.
- [24] Saç, G., et al., 2016. Resettlement of *Atherina boyeri* Risso, 1810 in Büyükçekmece Reservoir (İstanbul, Turkey). *FishTaxa*, 1(1), pp.27-28.
- [25] Gençoğlu, L., et al., 2016. Growth and reproduction of a marine fish, *Atherina boyeri* Risso 1810, in a freshwater ecosystem. *Turk J Zool*, 40, pp.534-542.
- [26] Benzer, S., et al., 2017. Comparative growth models of big-scale sand smelt (*Atherina boyeri* Risso, 1810) sampled from Hirfanlı Dam Lake, Kırşehir, Ankara, Turkey. *Computational Ecology and Software*, 7(2), pp.82-90.
- [27] Hogan, Z., et al., 2007. Long distance migration and marine habitation in the tropical Asian catfish, *Pangasius krempfi*. *Journal of Fish Biology*, 71(3), pp.818-832.
- [28] Tzeng, T.D. 2004. Morphological variation between populations of spotted mackerel (*Scomber australasicus*) off Taiwan. *Fish. Res.*, 68(1-3), pp.45-55.
- [29] Buj, I., et al., 2008. Morphological and genetic diversity of *Sabanejewia balcanica* in Croatia. *Folia Zool.*, 57(1-2), pp.100-10.
- [30] Anonymous, 1970. Yeşilirmak Havzası Toprakları, Köy İşleri Bakanlığı, Toprak Su Genel Müdürlüğü, Havza nu: 14, Raporlar Serisi: 29. Ankara. 1970.
- [31] Altun, Ö. 1999. Gümüşbalığı (*Atherina boyeri* Risso, 1810) Populasyonlarında Gözlemlenen Morfolojik Varyasyonlar, *Turkish Journal of Zoology*, 23, pp.911-918.
- [32] Çetinkaya, S., et al., 2011. The growth characteristics of sand smelt (*Atherina boyeri*, Risso 1810) in Lake İznik (Türkiye). *Turkish Journal of Fisheries and Aquatic Sciences*, 11(4), pp.641-648.
- [33] Antonucci, F., et al., 2012. External shape analyses in *Atherina boyeri* (Risso, 1810) from different environments. *Italian journal of Zoology*, 79(1), pp.60-68.
- [34] Palmer, C.J., et al., 1979. A further occurrence of *Atherina boyeri* Risso 1810 in North- Eastern Atlantic waters. *Environmental Biology of Fishes* 4.1 (1979), pp.71-75.
- [35] Chan, M.D. 2001. Fish ecomorphology: predicting habitat preference of stream fishes from their body shape, Doctor of Philosophy Thesis, Virginia Polytechnic Institute and State University, pp.252.
- [36] Francisco, S.M., et al., 2006. Contrast in genetic structure and historical demography of marine and riverine populations *Atherina* at similar geographical scales, Estuarine, *Coastal and Shelf Science*, 69, pp.655-661.
- [37] Apaydın Yağcı, M., et al., 2015. Growth and reproduction of sand smelt *Atherina boyeri* Risso, 1810 in Lake Eğirdir, Isparta, Turkey. *Indian Journal of Fisheries Sciences*, 6 (1), pp.1-5.