Morphometric features of topmouth gudgeon *Pseudorasbora parva* (Temminck & Schlegel, 1846) in the Hirfanlı Reservoir, Turkey

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Abstract

The aim of this study was to some morphometric characteristics of *Pseudorasbora parva* from Hirfanlı Reservoir, Turkey. A morphological analysis of 29 morphometric characters were performed. These characteristics head length; preorbital distance; eye diameter; postorbital distance; head depth; predorsal distance; prepelvic distance; preanal distance; pectoral fin–pelvic fin (P-V) distance; pelvic fin–anal fin (V-A) distance; body depth (18 perpendicular); dorsal fin (anterior end)-anal fin distance (Da-A); dorsal fin (posterior end)–anal fin distance (Dp-A); postdorsal distance; postanal distance; caudal (C) peduncle length (dorsal); caudal peduncle length (ventral); caudal peduncle depth; dorsal fin (D) base length; anal fin (A) base fin length; pectoral fin (P) length; pelvic (V) fin length; caudal upper lobe length; caudal fork length; caudal lower lobe length; dorsal fin length; anal fin length; gape. The samples were measured weight to the nearest 0.01g and total, fork and standard length to the nearest 0.01 mm. The length; caudal upper lobe length; caudal fork length; caudal lower lobe length; dorsal fin length; anal fin length; gape. The samples were measured weight to the nearest 0.01g and total, fork and standard length to the nearest 0.01 mm. The total length (TL) ranged from 4.10 cm to 9.30 cm and body weight ranged from 0.600 to 7.137 g.

Keywords: *Pseudorasbora parva*; topmouth gudgeon; morphometric properties; Hirfanlı Reservoir

1. Introduction

Morphometric measurements are widely used to identify differences between fish populations (Cheng et al., 2005). Fish morphology means anatomical design among fish species. Body architecture can be discussed in terms of the characteristic depth, predation style and other swimming specializations required for the survival success of a given species (Hogan, 2007).

The topmouth gudgeon *Pseudorasbora parva* is a small cyprinid in the freshwaters of Japan, China, Korea and the River Amur. It was described originally from Nagasaki Japan, holotype (Eschemeyer, 2003). Topmouth gudgeon, *P. parva* (Temmick & Schlegel, 1842) is a highly invasive species in Europe (Gozlan et al., 2002). It has environmental tolerance to low oxygen, organic pollution, and even concentrations of pesticides that are lethal to other fish species (Allen et al., 2006). The life story flexibility of successful invaders may be also be associated with their potential for great morphological plasticity (Zahorska et al., 2009, Novomeska et al., 2013). *P. parva* have negative impact on the negative fish fauna via competition spawning area, food and other resources (Ekmekçi et al., 2013).

There are many studies on various features of *P. parva* at national and international (Erk'akan, 1984, Wildekamp et al., 1997, Cakic et al., 2004, Ekmekçi & Kirankaya, 2006; Britton et al., 2007; Boltachev, 2006; Karabanov et al., 2010; Wang et al., 2012; Patimar & Baensaf, 2012; Huo et al., 2012; Tarkan et al., 2014; Kirankaya et al., 2014; Kapusta et al., 2014; Tarkan et al., 2015; İlhan & Sari 2015; Carosi et al., 2016; Benzer et al., 2016; Bakać et al., 2017; Benzer 2018; Benzer & Benzer 2019) in the different locations. This paper describes the area where this fish was found and recorded morphometric data of the population in Hirfanlı Reservoir.

2. Materials and methods

2.1. Study area

The study was carried out in Hirfanlı Reservoir (Fig. 1), which was constructed in 1959, on river Kızılirmak, 70 km far from the south of Kırıkkale. It is located at 856 m altitude with a capacity of 7.63 x 109 m³ and an area of 320 km². The depth, length and width of the lake are 58 m, 90 and 15 km, respectively. It is 24 km far from Ankara Kirşehir Highway and 30 km from Ankara-Adana highway (DSI, 1968).

2.2. Methodology

Fish specimens were captured by commercial fisherman from Hirfanlı Reservoir in 2016. The samples were preserved in 4% formaldehyde solution and transported to the laboratory; weight was measured to the nearest 0.001g and total and standard length to the nearest 0.1 mm.
Fishermen who hunted for commercial purposes to hunt *Atherina boyeri* have also been found to hunt *Aphanis marassantensis* and *P. parva* species in Hirfanlı Reservoir.

3. Result and discussion

In this research, some morphometric characters were examined and the minimum, maximum, mean, standard deviation values are given in Table 1. Measurements and counts of the 25 specimens are given Table 1. Total lengths and body weights of the examined specimens ranged 4.10 and 9.30 cm; 0.600 and 7.137 g respectively.

It appear that both the adult phenotype and the pattern of development in introduced *P. parva* can, in general, be highly influenced by local conditions because the morphology and the ecology presented by an organism have been shown to be directly or indirectly under the influence of the environmental conditions that the organism experiences and its heritable composition (Norton et al., 1995).

In this study were found difference even between population from the other water systems (Table 2). The topmouth gudgeon is considered to be a species with great morphological variability (Kotusz & Witkowski, 1998, Zhorska et al., 2013). Some of the research work related to *P. parva* in Turkey and in the world include (TL 27.8 to 58.1 mm, 0.4 to 3.2 g in Kuchki Pond (Boltatchev et al., 2006); TL 4.58-5.70 cm Iran (Esmaili & Ebrahimi, 2006); SL 23.42-59.71 mm Slovakia (Zahorska & Kovac, 2009); SL 18.16 - 67.57 mm, Sur Pond (Zahorska et al., 2010); TL 5.4-8.3 cm Lake Doirani, Lake Mikri Prespa and Lake Volvi (Bobori et al., 2010); TL 3.0-7.2 cm Sirwan River (Hasankhani et al., 2014); TL 18.02-96.24 mm Hirfanlı Reservoir (Kranckaya et al., 2014); TL 5.20-11.0 Marmara Lake (Ilhan & Sar, 2015); TL 4.6-7.5 Tajan River (Aazami et al., 2015); TL 4.2-9.2 cm Mogan Lake (Benzer et al., 2016); TL 56.75-76.10 mm Gökçeada Dam Lake (Bakaç et al., 2017); TL 4.10-6.80 cm Süreyyabay Dam Lake (Benzer, 2018); TL 2.7-9.2 Hirfanlı Dam Lake (Benzer & Benzer, 2019).

The difference may be caused by differences in morphological features of the species and habitats. In general, topmouth gudgeon populations show considerable variation in external morphology, which is not only evident in European populations but also in its native range (Gozlan et al., 2010). It appears that both adult phenotype and/or habitats show significant morphological variability, but differences were also found between populations from the same region (Zahorska et al., 2009). This variability can be expressed not only in the formation of different adult phenotypes but also in the manner with which the phenotypes are achieved. In general, the temperature regime has a considerable influence on life histories and extreme temperatures are known to affect various traits, from morphology (Sumer et al., 2005).

*P. parva* individuals prefers wide, varied environments with abundant food sources, in shallow regions and regions with dense vegetation (Kapusta et al., 2008). It was reported that *P. parva* transmits fatal diseases to native fish fauna, limits the reproduction of the endangered native fish species (Ekmekçi & Kirnkaya, 2006).

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**Table 1.**

| Character                   | Minimum | Maximum | Mean   | Standard Deviation |
|-----------------------------|---------|---------|--------|--------------------|
| Body weight (g)             |         |         |        |                    |
| Total length (mm)           |         |         |        |                    |
| Standard length (SL)        |         |         |        |                    |
| Hirfanlı Reservoir (2019)   | 4.10    | 9.30    | 6.70   | 1.67               |
| Mogan Lake (2016)           | 18.16   | 59.71   | 42.84  | 9.54               |
| Marmara Lake (2015)         | 5.20    | 11.0    | 7.60   | 1.60               |
| Lake Doirani, Lake Mikri Prespa and Lake Volvi (2010) | 4.6-7.5 | 5.4-8.3 | 6.3-7.1 | 0.5-1.0 |

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**Figure 1.** Hirfanlı Reservoir

**Figure 2.** *Pseudorasbora parva*

**Figure 3.** Morphometric characters for distance-based measurements (Záhorská et al., 2013)
### Table 1

Morphometric characteristics of *Pseudorasora parva* specimens

| Parameters                          | This Study | Benzer (2018) | Barka et al. (2017) | Zahosska et al. (2013) |
|-------------------------------------|------------|---------------|---------------------|------------------------|
|                                     | (Hirfanli Reservoir) | (Süreyyabey Dam Lake) | (Gökeçada Dam Lake (Dam Entrance)) | (Lake Lichieszki) |
|                                     | Mean±SD    | Mean±SD       | Mean±SD             | Mean±SD               |
| Standard length (cm)                | 6.50±1.02  | 3.4-7.2       | 4.388±0.47          | 3.50-5.50             |
| Fork length (cm)                    | 7.30±1.09  | 3.9-8.2       | 4.794±0.53          | 3.80-6.10             |
| Total length (cm)                   | 8.17±1.22  | 4.2-9.2       | 5.322±0.52          | -                      |
| Body weight (g)                     | 5.41±1.74  | 0.6-7.13      | 1.612±0.56          | 1.0-3.46              |
| In % of SL                          |            |               |                     |                       |
| Head length                         | 23.07±1.72 | 13.8-32.30    | 23.25±1.19          | 20.51-34.18           |
| Preorbital distance                 | 8.12±2.20  | 3.0-15.38     | 9.68±10.11          | 5.56-79.76            |
| Eye diameter                         | 9.91±1.23  | 3.0-7.69      | 6.930±9.8           | 4.56-9.12             |
| Postorbital distance                | 11.57±2.92 | 6.1-21.53     | 10.96±16.2          | 6.84-15.95            |
| Head depth                          | 15.50±2.88 | 9.3-18.26     | 19.64±3.35          | 13.67-29.63           |
| Predorsal distance                  | 51.06±577 | 29.2-58.84    | 53.69±553           | 29.63-84.32           |
| Prepelvic distance                  | 50.76±7.5  | 27.68-54.4    | 53.05±58.52         | 48.11±146             |
| Preanal distance                     | 71.85±9.8  | 38.45-88.4    | 72.31±81.71         | 50.14±97.9            |
| Pectoral fin - pelvic fin distance  | 25.10±4.10 | 13.8-30.76    | 25.34±14.4          | 15.95-34.18           |
| Pelvic fin - anal fin distance       | 23.50±4.15 | 10.77-29.22   | 21.60±7.31          | 13.67-29.63           |
| Body depth                          | 25.65±4.89 | 10.77-30.76   | 26.09±5.54          | 20.51-43.30           |
| Dorsal fin (anterior end) - anal fin distance | 33.71±5.98 | 18.46-38.45 | 31.65±9.0           | 18.23-47.83           |
| Dorsal fin (posterior end) - anal fin distance | 26.02±6.74 | 12.30-43.06  | 23.85±24            | 15.95-38.47           |
| Postdorsal distance                 | 42.33±6.40 | 23.07-49.22   | 38.61±91            | 20.51-52.4             |
| Postanal distance                   | 24.36±5.1 | 17.77-34.5    | 23.31±13.6          | 15.95-29.63           |
| Caudal peduncle length (dorsal)     | 38.94±6.29 | 26.15-47.68   | 35.48±27.5          | 15.95-50.14           |
| Caudal peduncle length (ventral)    | 21.65±9.22 | 10.77-26.17   | 20.74±31            | 2.73-34.18             |
| Caudal peduncle depth,              | 13.23±2.92 | 4.1-19.99     | 10.55±22            | 3.65-15.95            |
| Caudal fin base                      | 14.51±0.1 | 4.61±14.86    | 12.42±32.4          | 4.56±27.35            |
| Anal fin base                        | 9.66±2.65  | 6.1-13.84     | 8.04±26.2           | 2.28-13.67            |
| Pectoral fin distance                | 15.26±2.94 | 7.9-18.46     | 15.29±6.32          | 7.84-22.79            |
| Pelvic fin                            | 16.79±3.9  | 7.69-23.07    | 14.43±19.9          | 9.12-22.79            |
| Caudal upper lobe length             | 25.58±3.29 | 15.38-29.22   | 23.29±24.4          | 13.67-31.91           |
| Caudal lower lobe length             | 14.23±2.8  | 7.69-21.53    | 13.35±10.9          | 9.12-25.07            |
| Dorsal fin                            | 25.16±15   | 12.30-30.76   | 23.43±6.8           | 15.95-39.11           |
| Anal fin length                       | 15.63±3.12 | 7.69-20.37    | 14.40±6.04          | 4.56-25.07            |
| Gape                                 | 5.16±2.26  | 3.08-10.77    | 6.42±53.2           | 2.28-13.67            |

### Table 2

Morphometric measurements of *Pseudorasora parva* in literature

| Parameters            | Mean±SD    | Range          | Mean±SD    | Range          |
|-----------------------|------------|----------------|------------|----------------|
| Standard length (cm)  | 6.50±1.02  | 3.4-7.2        | 4.388±0.47 | 3.50-5.50      |
| Fork length (cm)      | 7.30±1.09  | 3.9-8.2        | 4.794±0.53 | 3.80-6.10      |
| Total length (cm)     | 8.17±1.22  | 4.2-9.2        | 5.322±0.52 | -              |
| Body weight (g)       | 5.41±1.74  | 0.6-7.13       | 1.612±0.56 | 1.0-3.46       |

### Table 3

Measurements of *Pseudorasora parva* in Lake Lichieszki

| Parameters             | Mean±SD    | Range          | Mean±SD    | Range          |
|------------------------|------------|----------------|------------|----------------|
4. Conclusion

This paper describes the area where this fish was found and recorded morphometric data of the population. Findings obtained in this study are very important because the previous studies about the morphometric properties of *P. parva* have not been found. It is considered that the data obtained in this study will also contribute to future studies.

Bibliography

Aazami, J., Esmaill-Sari, A., Abdoli, A., Sohrabi, H. & Van Den Brink, P.J., 2015. Length-weight relationships of 14 fish species from Tajan River, Southern Caspian Sea basin, Iran. Iranian Journal of Ichthyology, 2(4): 299-301.

Allen, Y., Kirby, S., Copp, G.H. & Brazier, M., 2006. Toxicity of rotenone to topmouth gudgeon *Pseudorasbora parva* for eradication of this non-native species from a tarn in Cumbria, England. Fish Manag Ecol 13: 337–340. doi: 10.1111/j.1365-2400.2006.00499.x

Bakaç, i., Yalçın Özdele, Ş. & Ekmekçi, F.G., 2017. First record for invasive Topmouth gudgeon *Pseudorasbora parva* (Temminck and Schlegel, 1846) from Gökçeada (Çanakkale). Ege Journal of Fisheries and Aquatic Sciences, 34(4): 459-462. doi: 10.12714/egefas.2017.34.4.14

Benzer, S., 2018. First Record of Topmouth Gudgeon *Pseudorasbora parva* (Temminck and Schlegel, 1846) in the Süreyyabey Dam Lake, Yeşilirmak Basin, Turkey. Annals of Biological Sciences, 2018, 6 (2):26-29

Benzer, S. & Benzer, R., 2019. Growth and length–weight relationships of *Pseudorasbora parva* (Temminck & Schlegel, 1846) in Hirfanli Dam Lake: Comparison with traditional and artificial neural networks approaches. *Iranian Journal of Fisheries Sciences*. DOI:10.22092/ijfs.2018.119889.

Benzer, S., Benzer, R. & Gül, A., 2016. Artificial neural networks application for biological systems: the case study of *Pseudorasbora parva*. St. Kliment Ohrdski University Press Sofia. Developments in Science and Engineering, Chapter, 49-59.

Bobori, D.C., Moutopoulos, D.K., Bekri, M., Salvarina, I. & Munoz, A.I.P., 2010. Length-weight relationships for freshwater fishes caught in three Greek lakes. Journal of Biological ResearchThessaloniki, 14: 219-224.

Boltachev, A. R., Danilyuk, O. N., Pakhorukov, N. P. & Bondarev, V. A., 2006. Distribution and certain features of the morphology and biology of the stone moroco *Pseudorasbora parva* (Cypriniformes, Cyprinidae) in the waters of Crimea. Journal of Ichthyology, 46(1): 58-63.

Britton, J. R., Davies, G. D., Brazier, M. & Pinder, A.C., 2007. A case study on the population ecology of a topmouth gudgeon (*Pseudorasbora parva*) population in the UK and the implications for native fish communities. Aquatic Conservation: Marine and Freshwater Ecosystems, 17(7): 749-759.

Cakic, P., Lenthard, M., Kolarevic, J., Mikovic, B. & Hegedis, A., 2004. Distribution of the Asiatic Cyprinid *Pseudorasbora parva* in Serbia and Montenegro. *J Fish Biol*. 65: 1431-1434. doi:10.1111/j.1095-8649.2004.00525.x

Carosi, A., Ghetti, L. & Lorenzoni, M., 2016. Status of *Pseudorasbora parva* in the Tiber river basin (Umbria, central Italy) 20 years after its introduction. Knowledge and Management of Aquatic Ecosystem, 417(22): 11. DOI:10.1051/kmae/2016009

Cheng, Q. Q., Lu, D. R. & Ma, L., 2005. Morphological differences between close populations discernible by multivariate analysis: a case study of genus Coilia (Teleostei: Clupeiformes). *Aquatic Living Resources*, 18(2): 187-192.

DSI, 1968. Limnological survey report of Hirfanli Dam Lake, Ankara, Turkey

Ekmekçi, F.G., Kirankaya, Ş.G., Gençoğlu, L. & Yoğurtçuoğlu, B., 2013. Present Status of Invasive Fishes In Inland Waters of Turkey and Assessment Of The Effects Of Invasion. Istanbul Uni. Journal of Fisheries & Aquatic Sciences. 28(1): 105-140.

Ekmekçi, F.G. & Kirankaya, S.G., 2006. Distribution of an invasive fish species, *Pseudorasbora parva* (Temminck & Schlegel, 1846) in Turkey. Turkish Journal of Zoology, 30: 329–334.

Erik’akan, F., 1984. Trakya Bölgesinden Türkiye için Yeni Kayıt Olan Bir Balık Türü *Pseudorasbora parva* (Pisces Cyprinidae). Doğa Bilim Dergisi, 8(3): 350-356. (in Turkish)

Eschemeyer, W.N., 2003. The catalog of FishesOn-Line. California Academy of Sciences, USA :http://www.calacademy.org/research/ichthyology/catalog/

Esmaeili, H.R. & Ebrahimi, M., 2006. Length–weight relationships of some freshwater fishes of Iran. Journal of Applied Ichthyology, 22(4): 328–329. DOI: 10.1111/j.1439-0426.2006.00653.x

Gozlan, R. E., Pinder, A. C. & Shelley, J., 2002. Occurrence of the Asiatic cyprinid *Pseudorasbora parva* in England. Journal of Fish Biology, 61(1): 298-300.

Hasankhani, M., Keivany, Y., Daliri, M., Pouladi, M. & Soofiani, N.M., 2014. Length–weight and length–length relationships of four species (*Barbus lacerta*, *Pseudorasbora parva*, *Squalius lepidus* and *Oxynoemacheilus angorae*) from the Sirwan River, western Iran. Journal of Applied Ichthyology, 30(1): 206-207. DOI: 10.1111/jai.12319

Hogan C.M., 2007. Fish morphology. In: Cleveland C.J. (ed.), Encyclopedia of Earth, Washington DC.

Huo, T.B., Jiang, Z.F., Karjan, A., Wang, Z.C., Tang, F.J. & Yu, H.X., 2012. Length–weight relationships of 16 fish species from the Tarim River, China. Journal of Applied Ichthyology, 28: 152–153. DOI: 10.1111/j.1439-0426.2011.01899.x
İlhan A., San H. M., 2015. Length-weight relationships of fish species in Marmara Lake, West Anatolia, Turkey. Croatian Journal of Fisheries, 73 (1): 30-32.

Kapusta A., Kutsokon Y., Bogacka-Kapusta E., 2014. Comparisons of morphometrics recently established population of topmouth gudgeon (Pseudorasbora parva) from a heated lakes in Poland – Acta Universitatis Prešoviensis, Folia Oecologica 6: 4-8.

Kapusta, A., Bogacka-Kapusta, E., & Czarnecki, B., 2008. The significance of stone moroko, Pseudorasbora parva (Temminck and Schlegel), in the small-sized fish assemblages in the littoral zone of the heated Lake Licheński. Archives of Polish Fisheries, 16(1), 49-62.

Karabanov, D. P., Kodukhova, Y. V., & Kutsokon, Y. K., 2010. Expansion of stone moroko Pseudorasbora parva (Cypriniformes, Cyprinidae) to waters of Eurasia. Vestn. Zool., 44(2): 115-124.

Kirankaya, Ş.G., Ekmeçki, F.G., Yalgün Özdemir, Ş., Yoğurtçuoğlu, B. & Gençoğlu, B., 2014. Condition, lengthweight and length-length relationships for five fish species from Hırfanlı Reservoir, Turkey. Journal of Fisheries Sciences, 8(3): 208-213. DOI: 10.3153/jfsc.201421426

Kotusz, J., & Wittkowski, A., 1998. Morphometrics of Pseudorasbora parva [Schlegel, 1842] [Cyprinidae: Gobioninae], a species introduced into the Polish waters. Acta Ichthyologica et Piscatoria, 2(28): 3-14.

Norton, S. F., Luczkovich, J. J., & Motta, P. J., 1995. The role of ecomorphological studies in the comparative biology of fishes. In Ecomorphology of fishes (pp. 287-304). Springer, Dordrecht.

Novomeská A., Katina S., Copp G.H., Pedicillo G., Lorenzoni M., Pompei L., Cucherousset J., & Kováč, 2013. Morphological variability of black bullhead Ameiurus melas in four non-native European populations. Journal of Fish Biology. 82: 1103-1118.

Patimar, R., & Baensaf, S., 2012. Morphology, growth and reproduction of the non-indigenous topmouth gudgeon Pseudorasbora parva (Temminck et Schlegel, 1846) in the wetland of Alma-Gol, northern Iran. Russian Journal of Biological Invasions, 3(1): 71-75.

Sumer, S., Kovac, V., Povz, M. & Slatner, M., 2005. External morphology of Slovenian population of pumpkinseed Lepomis gibbosus (L) from a habitat with extreme thermal conditions. J Appl Ichthyol 21: 306-311.

Tarkan, A.S., Ekmeçki, F.G., Vilizzi, L. & Copp, G. H., 2014. Risk screening of nonnative freshwater fishes at the frontier between Asia and Europe: first application in Turkey of the fish invasiveness screening kit. Journal of Applied Ichthyology, 30: 392-398.

Tarkan, A.S., Marr, S.M. & Ekmeçki F.G., 2015. Non-native and translocated freshwater fish species in Turkey. Fishmed 2015.003: 1-28.

Wang, T., Wang, H.S., Sun, G.W., Huang, D. & Shen, J.H., 2012. Length-weight and length-length relationships for some

Yangtze River fishes in Tian-e-zou Oxbow, China. Journal of Applied Ichthyology, 28: 660-662. DOI:10.1111/j.1439-0426.2012.01971.x

Wildekamp R.H., Van Neer, W., Küçük, F. & Ünlüsayın M., 1997. First record of the Asiatic gobinid fish Pseudorasbora parva from the Asiatic part of Turkey, Journal of Fish Biology 51: 858-861.

Záhorská, E., Kováč, V., 2009. Reproductive parameters of invasive Stone moroko Pseudorasbora parva (Temminck and Schlegel, 1846) from Slovakia. J App Ichthyol 25: 466-469.

Záhorská, E., Kováč, V. & Katina, S., 2010. Age and growth in a newly established invasive population of topmouth gudgeon. Central European Journal of Biology, 5(2): 256-261. DOI:10.2478/s11535-010-0002-8

Záhorská, E., Kováč, V., Falka, I., Beyer, K., Katina, S., Copp, G. H., & Gozlan, R. E., 2009. Morphological variability of the Asiatic cyprinid, topmouth gudgeon Pseudorasbora parva, in its introduced European range. Journal of Fish Biology, 74(1): 167-185.

Záhorská, E., Balážová, M., & Šúrová, M., 2013. Morphology, sexual dimorphism and size at maturation in topmouth gudgeon (Pseudorasbora parva) from the heated Lake Licherskie (Poland). Knowledge and Management of Aquatic Ecosystems, 411(7).