Journal of Anatolian Environmental and Animal Sciences
(Anadolu Çevre ve Hayvancılık Bilimleri Dergisi)
DOI: https://doi.org/10.35229/jaes.903810

JAES
Year: 8, No: 3, 2023 (568-575)
AÇEH
Yıl: 8, Sayı: 3, 2023 (568-575)

ARAŞTIRMA MAKALESİ RESEARCH PAPER

A New Trout Species from Southern Marmara Sea Drainages (Teleostei: Salmonidae)

http://zoobank.org/urn:lsid:zoobank.org:pub:9832CB94-8F6A-4CE4-A9B3-25B448B3A389

Davut TURAN[1*] **Sadi AKSU**[2]
[1*]*Recep Tayyip Erdogan University, Faculty of Fisheries, Rize, Turkey*
[2] *Vocational School of Health Services, Eskişehir Osmangazi University, Eskişehir, Turkey*

Geliş/Received: 26.03.2021 ***Kabul/Accepted: 14.05.2021*** ***Yayın/Published: 30.06.2023***

How to cite: **Turan, D. & Aksu, S. (2021).** A New Trout Species from Southern Marmara Sea Drainages (Teleostei: Salmonidae). *J. Anatolian Env. and Anim. Sciences,* ***8***(3), 568-575. https://doi.org/10.35229/jaes.903810
Atıf yapmak için: **Turan, D. & Aksu, S. (2021).** Marmara Denizi'nin Güney Drenajından Yeni Bir Alabalık Türü (Teleostei: Salmonidae). An*adolu Çev. ve Hay. Dergisi*, ***8***(3), 568-575. https://doi.org/10.35229/jaes.903810

*: https://orcid.org/0000-0002-9586-6223
: https://orcid.org/0000-0003-2770-561X

***Corresponding author's:**
Davut TURAN
Recep Tayyip Erdogan University, Faculty of Fisheries, Rize, Turkey
✉: dvtturan@yahoo.com

Abstract: *Salmo duhani*, sp. n., a new species, is described from the southern Marmara Sea drainages, Turkey. It differs from the other *Salmo* species in the neighboring basins by having a shorter maxillary (8-10% SL); a shorter head (24-28% SL); 115-121 lateral line scales; 26-29 scale rows between lateral line and dorsal-fin origin; 20-23 scale rows between lateral line and anal-fin origin; 15-17 scales between lateral line and adipose-fin insertion; 17-19 gill rakers on the outer side of first gill arch; 10-13 large and oblong parr marks along the lateral line in all individuals.

Keywords: Anatolia, biodiversity, freshwater fish, *Salmo*, taxonomy.

Marmara Denizi'nin Güney Drenajından Yeni Bir Alabalık Türü (Teleostei: Salmonidae)

***Sorumlu yazar:**
Davut TURAN
Recep Tayyip Erdoğan Üniversitesi, Su Ürünleri Fakültesi, Rize, Türkiye
✉: dvtturan@yahoo.com

Öz: Yeni bir tür olan *Salmo duhani* Türkiye'nin güney Marmara Denizi drenajından tanımlanmaktadır. Türün yakın havzalarda dağılım gösteren diğer *Salmo* türlerinden farkı: maksiller kısadır (% 8-10 SB); baş boyu kısadır (% 24-28 SB); ligne lateral pul sayısı 115-121; ligne lateral ile dorsal yüzgecin başlangıcı arasındaki pul sıra sayısı 26-29; ligne lateral ile anal yüzgecin başlangıcı arasındaki pul sıra sayısı 20-23; ligne lateral ile adipoz yüzgecin başlangıcı arasındaki pul sıra sayısı 15-17; birinci solungaç yayının dış tarafında bulunan solungaç dikeni sayısı 17-19; bütün bireylerde yanal çizgi boyunca büyük ve dikdörtgen şeklinde 10-13 par bulunmasıdır.

Anahtar kelimeler: Anadolu, biyolojik çeşitlilik, iç su balığı, *Salmo*, taksonomi.

INTRODUCTION

The genus *Salmo* is widespread in cold streams and lakes of Turkey. In the last decade, Turan *et al.*, (2010, 2011, 2012, 2014a, b, 2017, 2020) taxonomically evaluated native trouts in Turkey and recognized into fourteen species. Additionally, two established populations of the introduced *Salmo trutta* have been recently recorded in the upper Tigris River and drainages of Lake Van (Kaya, 2020).

The *Salmo* populations of northwestern Turkey had been previously reported as *Salmo* cf. *labrax* (Saç & Özuluğ, 2019) or *S. trutta macrostigma* (Geldiay & Balık, 1999; Sarı et al., 2006, 2019), however, *S. labrax* is restricted to Northern Black Sea drainages and *S. macrostigma* is to Algeria (Kottelat, 1997; Delling & Doadrio, 2005; Kottelat & Freyhof, 2007). The other peri-Mediterranean populations referred to *S. macrostigma* belong to several species (*S. cettii* [Italy], *S. farioides* [eastern Adriatic], *S. tigridis* [Tigris River], *S. okumusi*, *S.*

euphrataeus, *S. fahrettini* and *S. munzuricus* [Euphrates River], *S. chilo, S. kottelati*, *S. labecula, S. opimus* and *S. platycephalus* [streams and rivers flowing to the Mediterranean Sea]) (Delling, 2003, 2011; Delling and Doadrio, 2005; Turan *et al.*, 2011, 2012, 2014a, b, 2017, 2020).

After the European trouts summarized with recognition of 29 species by Kottelat & Freyhof (2007), in the last decade, many species were also described in Turkey (Turan et al., 2010, 2011, 2012, 2014a, b, 2017, 2020). However, there have always been controversial aspects about the taxonomy of the genus, and a group of geneticists has continued to negate this diversity within the genus *Salmo* (e.g. Tougard et al., 2018; Kalaycı et al., 2018).

Kalaycı et al., (2018) claimed that all *Salmo* species in Caspian and the Black Sea drainages in Turkey belong to *Salmo trutta*, based on their production of hybrid fertile individuals in the laboratory. On the other hand, Ninua et al., (2018) claimed that there is not a species level differentiation between a migratory population of Georgia and northeastern Turkey, and all belong to *Salmo labrax*. However, they did not examine or compare any specimens from the type locality of *S. labrax*.

Here, we examined some populations from the southern Marmara Sea basin, which have been formerly misidentified as *S. macrostigma*.

MATERIAL AND METHOD

Specimens are deposited in FFR, Zoology Museum of the Faculty of Fisheries, Recep Tayyip Erdogan University, Rize. Measurements and counts were all obtained on wild-caught specimens, well preserved, in a straight position. Specimens not fixed straight or damaged were excluded. All samples include both sexes, juveniles, and mature specimens. Most Salmo populations are small, geographically restricted and under great threat because of overfishing and habitat destruction, and it is not advisable to collect and preserve large series of individuals. Colour pattern and variation in shape were observed in the field on additional individuals, which were not preserved.

Measurements were taken with digital callipers (0.1 mm accuracy). Counts and measurements follow Turan et al. (2014a). Lateral line scale count includes scales on the base of the caudal fin. Sex was determined by examination of the gonads of at least 10 specimens. In the description of colour pattern, bands are the broad blackish vertical marks on the body, typically positioned behind the gill opening, below the dorsal-fin, above the anal-fin, and on the caudal peduncle. In some species, these bands are known in well-preserved specimens only, or in stressed individuals only, and in other species, they are visible in situ in undisturbed individuals. A spot is called ocellated when surrounded by a white or very palering.

Morphometric and meristic data for *S. abanticus, S. labrax, S. rizeensis, S. coruhensis, S. caspius, S. palegonicus, S. tigridis, S. okumusi, S. euphrataeus, S. platycephalus, S. labecula, S. opimus, S. chilo, S. okumusi, S. kottelati* and *S. munzuricus* are from Turan et al. (2010, 2011, 2012, 2014a-b, 2017).

RESULTS AND DISCUSSION

Ninua et al., (2018) considered *Salmo coruhensis* and *S. labrax* as conspecific, and used the priority name *S. labrax*. However, their study material lacked specimens of *S. labrax* from its type locality, and some of their *S. labrax* locations overlapped with *S. coruhensis* distribution range. Therefore, we concluded that Ninua et al., (2018) might have misidentified *S. coruhensis* as *S. labrax*, and we treated *S. coruhensis* as a valid name here.

Kalaycı et al., (2018) claimed that all *Salmo* species in Caspian and Black Sea drainages in Turkey belong to *Salmo trutta*, based on their reproduction of hybrid fertile individuals among *Salmo trutta abanticus*, *S.t. labrax*, *S.t. caspius* and *S.t. fario* in the laboratory. Firstly, it was reported that the subspecies category, which constitutes the simplified form of the systematic classification, couldn't actually be accepted (Kottelat, 1997). *Salmo fario* was described from rivers of Sweden and Switzerland; however, it is not a valid species anymore (e.g. Berg, 1948; Kottelat, 1997). *Salmo labrax* was described from Crimea (Ukraine), and distributed in northern and western tributaries of the Black Sea basin, which has not found in Turkey (Turan et al., 2010; Latiu et al., 2020). *Salmo caspius* was described from the Kura River near Bozhii in Azerbaijan as a migratory species, and may the Turkish resident population does not belong to this species. Moreover, the fish samples that fertile hybrids reproduced by Kalaycı et al., (2018) were not collected from type localities of the species, except for *S. abanticus*. Further, they did not take into account *S. coruhensis* and *S. rizeensis*, which were described a decade ago in the southeastern drainages of the Black Sea in Turkey. They collected *S.t. labrax* from Tektaş Stream and *S.t. fario* from Fırtına River. Tektaş Stream is inhabited by *Salmo coruhensis*, while the Fırtına River is inhabited by both sympatric *S. coruhensis* and *S. rizeensis*. It is likely that, these authors collected *S. coruhensis* instead of *S. rizeensis* in the Fırtına River. Therefore, it cannot be excluded that they only reproduced pure *S. coruhensis* individuals rather than hybrid individuals. Even if the correct species were used in the study, the study was limited to F1 and F2 offspring, and the species were produced under unnatural conditions. Thus, the results of the study are not reliable.

Apart from all these, there is another very important point: Kalaycı et al., (2018) claimed that all these mentioned species under the Danubian lineage are *Salmo trutta*, based on their results. However, *Salmo trutta* was described from Rhine River Germany, and it belongs to Atlantic linage. Even, the Danube River population is formed by *Salmo labrax*.

Recently, Latiu et al., (2020) have recorded *Salmo labrax* in Romanian waters. Their specimens (Latiu et al., 2020, Figure 2; 14) resemble morphologically very similar to the figure presented from Crimea, Ukraine (around the type locality of the species, Kottelat and Freyhof 2007; 428). The differences between *Salmo coruhensis* and *S. labrax* were clearly demonstrated in the original description, and morphologic appearances of both species were obviously very different (Turan et al., 2010; Figures 5b and 7; 343, 346, respectively).

The trout population in stream Ayazma (an upper drainage of stream Küçükmenderes, North Aegean basin) shares some morphological diagnostic features with *Salmo pelagonicus* and has recently recorded as *S. pelagonicus* by Turan and Bayçelebi, (2020) (Figure 1).

***Salmo duhani*, new species** (Figure 1): *Salmo trutta macrostigma* (non Duméril, 1858): Sarı et al., 2006: 37 (Çanakkale province; Yenice county; Stream Çelebi, a drainage of Gönen River).
http://zoobank.org/urn:lsid:zoobank.org:act:C050C743-3FE3-40AD-9A65-DF97DB09FFD8

Figure 1. *Salmo duhani*, from top: FFR 3183, holotype, 228 mm SL, male; FFR 03184, paratypes, 160 mm SL, female, and 92 mm SL, juvenile; Turkey: stream Zeytinli.

Holotype: FFR 3183, 228 mm SL, male; Turkey: Çanakkale Prov.: stream Zeytinli about 9 km east of Kazdağı National Park, 39.750N 27.017E, 28.11.2006.

Paratypes: FFR 3184, 15, 95-287 mm SL; same data as holotype. -FFR 3185, 14, 85-170 mm SL; Turkey: Çanakkale Prov.: stream Zeytinli, 39.749N 27.015E, 01.09.2014. —FFR 3186, 12, 108-160 mm SL; Turkey: Çanakkale Prov.: stream Zeytinli 39.759N 27.021E, 01.09.2014. —FFR 3194, 10, 62-122 mm SL; Turkey: Çanakkale Prov.: stream Kocaçayı, 12 km west of Kalkım, 39.804N 27.071E, 01.09.2014. —FFR 3195, 15, 93-275 mm SL; Turkey: Çanakkale Prov.: stream Kocaçayı at Yenice, 39.817N 27.099E, 28.11.2006. FFR 03188, 30, 85–200 mm SL; Turkey: Balıkesir-Çanakkale border: stream Ayazma (39°44' N 26°50' E); a drainage of Karamenderes River (a costal drainage). —FFR 03189, 7,75–190 mm SL; Turkey: Çanakkale Province: stream Adaçay (39°48' N 26°54' E); a drainage of Karamenderes River.

Diagnosis: *Salmo duhani* differs from all other species of *Salmo* in adjacent waters by having a slenderer caudal peduncle in males (depth 8-10% SL, vs. 10-13, except *S. abanticus*), the size of adipose-fin not sexually dimorphic (the adipose-fin of male is approximately equal to that of female, vs. markedly larger in male) and numerous black spots on back and flank in adult females (vs. few black spots on back and flank in females). *Salmo duhani* is further distinguished from *S. abanticus* by having red spots on the body in specimens larger than 200 mm SL (vs. absent), circular black spots on the flank (vs. polygonal), circular rings around the black spots (vs. polygonal) and black spots approximately equal size or smaller than pupil (vs. markedly larger than pupil). *Salmo duhani* is further distinguished from *S. labrax* by having a slenderer body in males (depth at dorsal-fin origin 20-23% SL, mean 21.3, vs. 23-27, mean 25) and a smaller adipose-fin in males (depth 4-6% SL, mean 5.1, vs. 7-9, mean 7.6). It further differs from *S. coruhensis* by the number of the red spots which does not increase with increasing size in males (vs. increasing with increasing size). *Salmo duhani* further differs from *S. rizeensis* by having grayish background color in life (vs. brownish or greenish). It is also distinguished from *S. rizeensis* by maxilla slightly reaching beyond eye in males and females (vs. reaching markedly beyond eye in males larger than approximately 200 mm SL) and the snout pointed (vs. slightly rounded).

Description: General appearance of *Salmo duhani* is shown in Figure 1, morphometric and meristic data are presented in Tables 1 and 2, respectively. Body slender, dorsal profile behind head slightly convex, ventral profile less arched than dorsal profile. Head short, its length not sexually dimorphic but its shape sexually dimorphic (the upper profile slightly convex in interorbital area and slightly concave at the level of nostrils in adult males, convex in the interorbital area and slightly convex on snout in females, markedly convex in juveniles). Mouth small, terminal or slightly subterminal in adult males, subterminal in females, and conspicuously subterminal in juveniles

(Figure 1). Upper jaw equal or slightly longer than lower jaw in adult males, but clearly projecting lower jaw in females and juveniles. Tip of lower jaw slightly curved upward in males longer than over 220 mm SL, not curved in females. Maxilla short in both sexes, reaching slightly beyond eye in specimens larger than about 100 mm SL, and not sexually dimorphic; upper edge convex below the eye in males and females, straight or slightly convex in juvenile. Snout pointed in males, slightly pointed in females, and rounded in juveniles. Adipose-fin small, not reaching the base of caudal-fin, its upper edge straight anteriorly and slightly convex posteriorly in males and females, and convex in juveniles.

Lateral line with 115-121 scales; 20-23 scale rows between lateral line and anal-fin origin; 26-29 scale rows between lateral line and dorsal-fin origin; 15-17 scales between lateral line and the adipose-fin insertion (Tab. 2). Pectoral fin with one simple and 11-12 branched rays, outer margin straight or slightly convex. Pelvic-fin with one simple and 8-9 branched rays, outer margin slightly convex. Anal-fin with three simple and 7½-8½ branched rays, outer margin convex anteriorly, concave posteriorly.

Dorsal-fin with 3-4 simple and 9½-10½ branched rays, outer margin straight or slightly convex. Caudal-fin forked and lobes pointed or slightly rounded in specimens smaller than approximately 180 mm SL, slightly forked and lobes rounded in specimens larger than about 190 mm SL. Gill rakers 6-7 + 11-12 = 17-19 on the outer side of first gill-arch.

Table 1. Morphometry of *Salmo duhani* (holotype, FFR 3183; paratypes FFR 3184, n=15; paratypes FFR 3195, n=15) and *Salmo trutta* from Rhine River, Germany. The calculations include the holotype.

	Holotype	Holotype & Paratypes				*Salmo trutta*			
Sex	male	male		female		male		female	
Number of specimens		n=15		n=15		n=7		n=3	
Standard length (mm)	228	95-184		97-287		111-149		125-156	
In percentage of standard length		Range (mean)	SD	Range (mean)	SD	Range (mean)	SD	Range (mean)	SD
Head length	27.5	24.4-27.7 (26.1)	1.1	24.9-27.7 (24.8)	0.7	28.4-31.2 (29.9)	1.1	27.3-29.6 (28.7)	1.0
Predorsal length	46.4	43.3-48.5 (46.3)	0.9	43.3-48.5 (44.1)	1.1	48.1-52.0 (50.5)	1.6	45.9-51.9 (49.5)	2.6
Prepelvic length	55.2	51.5-55.2 (53.6)	1.1	51.5-55.2 (50.9)	1.1	54.7-56.9 (55.7)	0.7	54.4-55.4 -(55.0)	0.4
Preanal length	75.7	72.3-75.9 (74.8)	0.7	72.3-76.6 (71.3)	1.0	74.3-77.7 (76.6)	1.2	75.6-77.2 (76.5)	0.7
Body depth at dorsal-fin origin	21.6	19.6-23.3 (21.3)	0.8	19.6-23.3 (20.2)	1.0	23.7-26.3 (25.4)	0.9	23.4-26.9 (25.4)	1.6
Body depth at anal-fin origin	17.0	14.8-17.9 (16.2)	0.7	15.0-17.9 (15.4)	0.8	16.1-18.9 (17.5)	1.2	17.1-19.8 (18.0)	1.3
Depth of caudal peduncle	9.5	7.9-9.9 (9.0)	0.5	8.3-9.9 (8.6)	0.4	9.7-11.1 (10.3)	0.5	9.5-11.0 (10.3)	0.6
Length of caudal peduncle	16.7	16.3-18.2 (17.4)	0.5	16.3-18.2 (16.3)	0.7	15.6-16.8 (16.3)	0.4	15.7-17.0 (16.2)	0.6
Distance between adipose- and caudal-fins	15.6	13.6-16.1 (14.9)	0.5	13.3-16.1 (14.0)	0.9	13.8-15.3 (14.7)	0.6	13.2-15.1 (14.5)	0.9
Body width at anal-fin origin	10.0	7.6-10.2 (9.0)	0.7	7.6-10.2 (8.6)	0.6	5.5-7.4 (6.7)	0.7	5.7-8.2 (6.9)	1.0
Length of dorsal-fin base	15.3	12.5-15.3 (13.7)	0.8	12.5-15.3 (13.0)	0.6	13.9-16.4 (14.7)	0.9	13.9-15.2 (14.5)	0.6
Depth of dorsal-fin	17.5	15.2-18.6 (17.3)	1.2	16.4-19.1 (16.7)	0.7	17.1-21.7 (19.3)	1.8	18.1-19.5 (18.9)	0.6
Length of pectoral-fin	17.9	16.7-20.9 (19.2)	1.2	17.4-20.9 (17.9)	0.8	18.4-20.2 (19.6)	0.7	17.8-20.1 (19.1)	1.0
Length of adipose-fin base	3.4	1.8-4.0 (3.0)	0.6	2.7-4.2 (3.1)	0.4	3.4-4.7 (4.0)	0.5	3.5-4.5 (4.0)	0.5
Depth of adipose-fin	6.2	4.2-6.2 (5.1)	0.5	4.2-6.3 (5.0)	0.6	6.3-7.3 (6.8)	0.4	5.5-7.6 (6.6)	0.9
Length of pelvic-fin	13.7	12.5-15.0 (13.6)	0.6	12.5-15.0 (13.0)	0.5	13.3-15.3 (14.3)	0.8	13.7-14.9 (14.3)	0.6
Depth of anal-fin	16.5	14.1-17.4 (15.7)	0.7	14.1-17.4 (14.8)	1.0	15.4-18.0 (16.8)	1.1	14.8-16.5 (16.0)	0.8
Length of anal-fin base	11.0	7.3-11.3 (9.5)	1.1	7.3-11.3 (8.9)	1.2	9.7-10.8 (10.1)	0.4	9.7-10.3 (9.9)	0.2
Length of upper caudal-fin lobe	14.4	14.4-20.0 (17.4)	1.4	16.1-20.0 (16.6)	1.2	19.2-21.1 (19.8)	0.7	18.3-19.9 (19.1)	0.9
Length of median caudal-fin rays	12.3	11.1-13.2 (12.1)	0.5	11.1-13.2 (11.4)	0.6	14.1-16.1 (15.0)	0.8	13.8-14.8 (14.2)	0.5
Length of lower caudal-fin lobe	16.0	14.5-20.0 (17.6)	1.5	16.0-20.0 (16.5)	0.9	19.4-20.6 (20.2)	0.6	19.2-20.4 (19.8)	0.6
Snout length	8.5	6.2-8.5 (7.1)	0.5	6.2-8.5 (6.7)	0.5	7.0-7.9 (7.5)	0.3	6.7-7.3 (7.0)	0.3
Distance between nasal openings	5.4	3.5-5.4 (4.6)	0.5	4.1-5.4 (4.4)	0.3	4.2-4.5 (4.3)	0.1	3.7-4.4 (4.1)	0.3
Eye diameter	5.3	4.7-6.6 (5.9)	0.6	5.2-7.0 (5.7)	0.5	7.2-8.2 (7.5)	0.4	6.8-7.7 (7.1)	0.4
Interorbital width	8.2	6.8-8.2 (7.5)	0.3	6.8-8.8 (7.2)	0.5	6.8-7.8 (7.4)	0.4	6.5-7.5 (7.1)	0.4
Head depth through eye	13.6	11.1-13.6 (12.3)	0.7	11.7-13.7 (11.9)	0.6	12.3-13.6 (13.0)	0.5	11.6-13.2 (12.5)	0.7
Head depth at nape	16.8	15.4-17.1 (16.1)	0.5	15.4-18.3 (15.5)	0.7	16.9-18.7 (18.0)	0.7	16.4-18.3 (17.5)	0.8
Length of maxilla	9.6	7.9-9.8 (9.0)	0.3	7.9-10.0 (8.6)	0.7	10.7-11.8 (11.1)	0.5	10.1-11.2 (10.7)	0.5
Maximum height of maxilla	2.5	2.1-2.7 (2.5)	0.4	2.3-3.4 (2.5)	0.4	2.5-3.1 (2.9)	0.2	2.8-3.3 (3.0)	0.2
Width of mouth gape	10.6	7.0-10.6 (8.8)	1.1	7.3-10.6 (8.3)	1.0	8.3-9.2 (8.7)	0.3	7.9-9.0 (8.5)	0.5
Length of mouth gape	14.3	11.0-14.3 (12.2)	0.9	11.0-14.3 (11.7)	0.6	14.2-16.2 (15.3)	0.8	13.2-15.5 (14.5)	0.9

Sexual dimorphism: In males, the mouth is terminal or slightly subterminal in adult specimens, the upper profile head is slightly convex in the interorbital area and slightly concave at the level of nostrils. In females, the mouth is subterminal, the upper profile head is convex in the interorbital area.

Coloration: General body color greyish in life. General color of freshly preserved specimens: dark grey on the back and greyish on flank, belly yellowish. One to 4 black spots behind the eye and on the cheek (usually larger than pupil) and 1-6 black spots on top of the head (smaller than pupil). Few, ocellated, medium to large (equal to or smaller than pupil) black spots scattered on the back and upper flank in males and females, smaller than about 160 mm SL, and back, the upper part of flank and middle part of the body in females larger than about 170 mm SL (Figure 1). The number of spots not increasing with sizes. Dorsal fin greyish, with 3-5 rows of black spots, and 3-4 rows of red spots posteriorly on the lower part. Caudal fin grey or dark grey. Anal, pectoral and pelvic fins yellowish. Adipose fin greyish, without any black and red spot along the distal margin. Ten to 13 parr marks distinct, vertically oblong, broad and large in all specimens examined.

Table 2. Frequency distribution of meristic features of five *Salmo* species from the Marmara Sea and adjacent basins.

Lateral line scales

	N	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	mean
S. duhani	33						3	8	9	5	3	3	2								117.4
S. abanticus	21				2	2		5	2	4	4		2								117.1
S. labrax	41	2	2	6	3	7	8	7	3	3											114.3
S. rizeensis	31					5	7	5	5	5	2	2									116.4
S. trutta	10								1	2			1		2	1		1	1	1	122.5

Transverse line scales

		Above lateral line										Below lateral line							
	N	26	27	28	29	30	31	32	33	34	mean	17	18	19	20	21	22	23	mean
S. duhani	33	5	12	9	7						27.5				7	8	11	7	21.6
S. abanticus	21	6	5	4	6						27.6		2	4	11	4			19.8
S. labrax	41		6	13	8	7	5	2			28.9			9	13	15	2	2	20.4
S. rizeensis	31	4	7	9	8	3					28.0		6	8	9	8			19.6
S. trutta	10					2	1	5	1	1	31.8	2	5	2	1				31.8

		Gill rakers								Scales between adipose-fin insertion and lateral line				
	N	14	15	16	17	18	19	20	mean	14	15	16	17	mean
S. duhani	33				5	13	15		18.4		7	21	5	15.9
S. abanticus	21					4	12	10	19.0		4	17		15.8
S. labrax	41				5	18	14	6	18.5		9	22	12	16.1
S. rizeensis	31			2	3	10	16		18.2	4	19	9	1	15.1
S. trutta	10	1	4	4	1				15.5		4	6		15.6

Distribution and habitat: *Salmo duhani* is known from the upper tributaries of streams Gönen in the southern Marmara Sea basin (Figure 2). It prefers clear and moderately swift flowing streams and rivers, with a substrate of pebbles and sand.

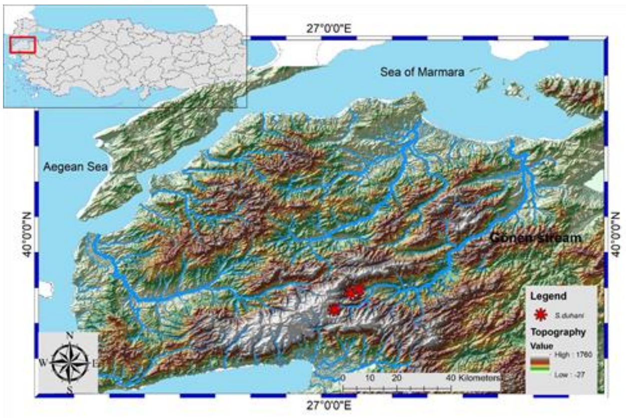

Figure 2. Distributions of *Salmo duhani.*

Etymology: *Salmo duhani* is named after Duhan Turan, son of the first author. A noun in genitive.

DISCUSSION

Trout biodiversity has long been an international debate particularly between morphologists and geneticists (Ferguson, 2004). Initially, phenotypic plasticity of species was not well-understood. Furthermore, several species concepts with no consensus decision has resulted in inflated taxonomic identifications (23 species according to IUCN, 2020; 30-35 species according to Kottelat & Freyhof, 2007; Sanz, 2018 and up to 60 species according to Behnke, 1986; Jonsson & Jonsson, 2011; Froese & Pauly, 2019). However, the most recent opinion paper by Guinand, Oral & Tougard, (2021), discussed thoroughly that phenotypic and genotypic diversity of brown trout is best explained in the concept of species complex and indicates multiple trout species.

Molecular studies demonstrated that the populations of previously recorded *S. trutta* form belongs to a number of distinct haplotype lineages, thus, several lineages were proposed by using mtDNA: North African, Atlantic, Adriatic, Mediterranean, Marbled, Danubian, Tigris, Dades, Duero (Bernatchez 2001; Bardakçı et al., 2006; Sušnik et al., 2005; Tougard et al., 2018). Later, many species have been described under these linages. However, there have always been researchers of the opposite view, and the diversity in the genus *Salmo* has been neglected (Tougard et al., 2018; Kalaycı et al., 2018). Even, interestingly, Tougard et al., (2018) listed all these linages under the *Salmo trutta*. Nevertheless, especially in studies conducted in the last decade, there are serious differences in diagnostically important features (e.g. head length, length and height of maxilla, scale counts, body color and pattern, length and height of adipose-fin) among several trout populations. Pure molecular studies conducted without considering these diagnostic differences have made some researchers mistakenly deny the diversity in trouts.

Besides the differences of the new species listed in the diagnosis section, it also differs from the other congeners listed below. *Salmo duhani* is distinguished from *S. pelagonicus* by having more par marks on the flank (10-13, vs. 9-10), a greyish body colour (vs. brownish), more red spots on the flank (vs. without or a few red spots on the flank), black spots scattered on the back and upper part of flank (vs. scattered on the flank, especially an anterior part of the body), a narrower ring around black and red spots (vs. very large ring), a smaller black spots (smaller than a pupil, vs. larger than pupil), the maxillary reaching to slightly beyond posterior margin of the eye (vs. markedly beyond posterior margin of the eye) and smaller adipose fin (small size, vs. medium size) (Figure 1).

Salmo duhani differs from all other *Salmo* species in Turkey by having a slenderer caudal peduncle in males (depth 8-10% SL, vs. 10-13), the size of adipose-fin not sexually dimorphic (the adipose-fin of males is approximately equal to that of females, vs. markedly larger, except *S. chilo*) and numerous black spots on flank and back in adult females (vs. few black spots on flank and back in females, except *S. labecula*).

Salmo duhani also distinguished from *S. trutta* by having slightly fewer lateral line scales (115-121, vs. 117-128), fewer scale rows between lateral line and dorsal-fin origin (26-29, vs. 30-34), more scale rows between lateral line and anal-fin origin (20-23, vs. 17-20), more gill rakers first gill arch (17-19, vs. 14-17), a shorter head in males (25-28% SL, vs. 28-31), a shorter prepelvic length (52-55% SL, vs. 55-57), a slenderer caudal peduncle (8-10% SL, vs. 10-11), a smaller adipose fin (adipose-fin depth 4-6% SL, vs. 6-8), a smaller maxilla (length of maxilla 8-10% SL, vs. 10-12) and a smaller mouth gape in males (length of mouth gape 11-14% SL, vs. 14-16).

In this study, *Salmo coruhensis* is recorded for the first time from the streams Hisardere, drainage of the Lake İznik, and Sultaniye eastern drainage of İzmit bay, Marmara Sea basin. These records are the westernmost known distribution range of the species. There are record of resident *Salmo rizeensis* in Evrenye creek, Kastamonu (41.943N 33.893E) (Yoğurtçuoğlu et al., 2020), however, we could not find any *Salmo coruhensis* in the western Black Sea coasts of Turkey. The fact that there are many industrial factories that cause pollution in rivers may be the reason for this migratory species that cannot be found in the area.

Despite conservation status of some of the Salmonid species in Turkey were evaluated against IUCN criteria, there are still serious gaps about the ecology, threats, and exact number of independent populations of the species (IUCN, 2020). Kaya et al., (2019) reported several suggestions on the five species in the Turkish Mediterranean basin. They suggested that: *Salmo labecula* and *S. kottelati* should be evaluated as Critically Endangered because of their poorly known populations and invaded habitats by *Oncorhynchus mykiss*; *S. opimus* should be evaluated as Near Threatened because of its inhabits at least five different locations with intensive populations; both *S. chilo* and *S. platycephalus* should be evaluated as Endangered as each of them known to distribute only at a single location, even though their populations are intensive.

Material used in morphologic comparison: See Turan et al., (2010, 2017). The other material examined is listed below:

S. trutta: Germany, 7, 111-156; Rhine River, Plesibach Stream at Niederpleiss.

ACKNOWLEDGMENTS

We thank Dr. Utku Avcı for improving the language. We also thank to Maurice Kottelat for allowing us to use pictures of *Salmo pelagonicus* and *S. macedonicus* and Jörg Freyhof for allowing us to examine his materials. This work was supported by The Scientific and Technical Research Council of Turkey (Project No. TOVAG-106 O 259).

REFERENCES

Bardakci, F., Degerli, N., Ozdemir, O. & Basibuyuk, H.H. (2006). Phylogeography of the Turkish brown trout Salmo trutta L.: mitochondrial DNA PCR-RFLP variation. *Journal of Fish Biology*, ***68***(A), 36-55.

Behnke, R.J. (1986). Brown trout. *Trout*, ***27***, 42-47.

Berg, L.S. (1948). Ryby presnych vod SSSR i sopredelnych stan. [Freshwater fishes of the U.S. S. R. and adjacent countries.] 4th ed. vol. 1. Opredeliteli po faune SSSR. [Guide to the fauna of the U.S.S.R.], Moskva. *Freshwater Fishes of the U.S.S.R. and Adjacent Countries*, ***27***, 1-466.

Bernatchez, L. (2001). The evolutionary history of brown trout (*Salmo trutta* L.) inferred from phylogeographic, nested clade, and mismatch analyses of mitochondrial DNA variation. *Evolution*, ***55***(2), 351-379.

Delling, B. & Doadrio, I. (2005). Systematics of the trouts endemic to Moroccan lakes, with description of a new species (Teleostei: Salmonidae). *Ichthyological Exploration of Freshwaters*, ***16***, 49-64.

Delling, B. (2003). *Species diversity and phylogeny of Salmo with emphasis on southern trouts (Teleostei, Salmonidae)* (Doctoral thesis, Stockholm University, Department of Zoology, Sweden). Retrieved fromhttps://www.divaportal.org/smash/record.jsf?pid=diva2%3A1067465&dswid=8326

Delling, B. (2011). Diversity of western and southern Balkan trouts, with the description of a new species from the Louros River, Greece (Teleostei: Salmonidae). *Ichthyological Exploration of Freshwaters*, ***21***, 331-344.

Ferguson, A. (2004). The importance of identifying conservation units: Brown Trout and pollan biodiversity in Ireland. *Proceedings of the Royal Irish Academy Section B* ***104***(3), 33-41.

Froese, R. & Pauly, D. (2019). *FishBase*. World Wide Web electronic publication. Available at: www.fishbase.org (last accessed 20 November 2020).

Geldiay, R. & Balık, S. (1999). *Freshwater fishes of Turkey*. Ege Üniversitesi Su Ürunleri Fakültesi

Yayınları, No: 46, Ders Kitabı Dizini, No:16, Izmir, 519 pp. [in Turkish].

Guinand, B., Oral, M. & Tougard, C. (2021). Brown trout phylogenetics: a persistent mirage towards (too) many species. *Journal of Fish Biology*. (in press). DOI: 10.1111/jfb.14686

IUCN [International Union for the Conservation of Nature]. (2020). *IUCN Red List of threatened species*. Version 2014.3. http://www.iucnredlist.org [last accessed 20 November 2020].

Jonsson, B. & Jonsson, N. (2011). *Ecology of Atlantic Salmon and Brown trout: Habitat as a Template for Life Histories*. Heidelberg: Springer-Verlag

Kalayci, G., Özturk, R. C., Capkin, E. & Altinok, I. (2018). Genetic and molecular evidence that brown trout *Salmo trutta* belonging to the Danubian lineage are a single biological species. *Journal of Fish Biology*, ***93***, 792-804. DOI: 10.1111/jfb.13777

Kaya, C. (2020). The first record and origin of *Salmo trutta* populations established in the upper Tigris River and Lake Van Basin (Teleostei: Salmonidae). *Journal of Anatolian Environmental and Animal Sciences*, ***5***, 366-372. DOI: 10.35229/jaes.777575

Kaya, C., Bayçelebi, E., Oral, M. & Turan, D. (2019). Re-assessment of conservation status of native trout species in Turkish Mediterranean drainages (Pisces: Salmonidae). *Mediterranean biodiversity: from systematics to conservation*, p. 36. Retrieved from https://arts.units.it/retrieve/handle/11368/2951260/284569/extended_abstract_book.pdf

Kottelat, M. & Freyhof, J. (2007). *Handbook of European freshwater fishes*. Kottelat, Cornol & Freyhof, Berlin, 660 pp.

Kottelat, M. (1997). European freshwater fishes. An heuristic checklist of the freshwater fishes of Europe (exlusive of former USSR), with an introduction for non-systematisms and comments on nomenclature and conservation. *Biologia*, ***52***(Suppl. 5), 271pp. DOI: 10.1023/A:1007452304138

Kuljanishvili, T., Epitashvili, G., Freyhof, J., Japoshvili, B., Kalous, L., Levin, B., Mustafayev, N., Ibrahimov, S., Pipoyan, S. & Mumladze, L. (2020). Checklist of the freshwater fishes of Armenia, Azerbaijan and Georgia. *Journal of Applied Ichthyology*, ***36***, 501-514. DOI: 10.1111/jai.14038

Lațiu, C., Cocan, D., Uiuiu, P., Ihuț, A., Nicula, S. A., Constantinescu, R., & Mireșan, V. (2020). The Black Sea Trout, *Salmo labrax* Pallas, 1814 (Pisces: Salmonidae) in Romanian Waters. *Bulletin UASVM Animal Science and Biotechnologies*, ***77***(2), 9-19. DOI: 10.15835/buasvmcn-asb: 2020.0017

Ninua, L., Tarkhnishvili, D. & Gvazava, E. (2018). Phylogeography and taxonomic status of trout and salmon from the Ponto-Caspian drainages, with inferences on European Brown Trout evolution and taxonomy. *Ecology and Evolution*, ***8***, 2645-2658. DOI: 10.1002/ece3.3884

Saç, G. & Özuluğ, M. (2019). Freshwater fish fauna of İstanbul Province (Turkey). *Turkish Journal of Bioscience and Collections*, ***3***, 19-36. DOI: 10.26650/tjbc.201930004

Sanz, N. (2018). Phylogeography history of brown trout: A review. In J. Lobón-Cerviá & N. Sanz (Eds.), *Brown trout - Biology, ecology and management* (pp. 17-63). Hoboken, NJ: Wiley. DOI: 10.1002/9781119268352.ch2

Sarı, H.M., Balık, S., Ustaoğlu, R. & İlhan, A. (2006). Distribution and Ecology of Freshwater Ichthyofauna of the Biga Peninsula, North-western Anatolia, Turkey. *Turkish Journal of Zoology*, ***30***, 35-45.

Sarı, H.M., İlhan, A, Saç, G. & Özuluğ, M. (2019). Fish fauna of Yıldız Mountains (Northeast Thrace, Turkey). *Su Ürünleri Dergisi*, ***36***, 65-73. DOI: 10.12714/egejfas.2019.36.1.08

Sušnik, S., Knizhin, I., Snoj, A. & Weiss, S. (2006). Genetic and morphological characterization of a Lake Ohrid endemic, *Salmo* (*Acantholingua*) *ohridanus* with a comparison to sympatric *Salmo trutta*. *Journal of Fish Biology*, ***68***, 2-23.

Tougard, C., Justy, F., Guinand, B., Douzery, E.J.P. & Berrebi, P. (2018). *Salmo macrostigma (Teleostei, Salmonidae): nothing more than a brown trout (S. trutta) lineage?. Journal of Fish Biology*, ***93,*** 302-310.

Turan, D. & Bayçelebi, E. (2020). First Record of *Salmo pelagonicus* Karaman, 1938 (Teleostei: Salmonidae) in the Karamenderes River, Turkey. *Journal of Anatolian Environmental and Animal Sciences*, ***5***, 551-555.

Turan, D., Doğan, E., Kaya, C. & Kanyılmaz, M. (2014b). *Salmo kottelati*, a new species of trout from Alakır Stream, draining to the Mediterranean in southern Anatolia, Turkey (Teleostei, Salmonidae). *Zookeys*, ***462***, 135-151.

Turan, D., Kalayci, G., Bektaş, Y., Kaya C. & Bayçelebi, E. (2020). A new species of trout from the northern drainages of Euphrates River, Turkey

(Salmoniformes: Salmonidae). *Journal of Fish Biology*, ***96***, 1454-1462. DOI: 10.1111/jfb.14321

Turan, D., Kottelat M. & Engin, S. (2010). *Two new species of trouts, resident and migratory, sympatric in streams of northern Anatolia (Salmoniformes: Salmonidae). Ichthyological Exploration of Freshwaters,* ***20***(2009 [2010]), 289-384.

Turan, D., Kottelat M. & Engin, S. (2012). The trouts of the Mediterranean drainages of southern Anatolia, Turkey, with description of three new species (Teleostei: Salmonidae). *Ichthyological Exploration of Freshwaters,* ***23***, 219-236.

Turan, D., Kottelat M. & Engin, S. *(2014a).* Two new species of trouts from the Euphrates drainage, Turkey (Teleostei: Salmonidae). *Ichthyological Exploration of Freshwaters,* ***24***, 275-287.

Turan, D., Kottelat, M. & Bektaş, Y. (2011). *Salmo tigridis*, a new species of trout from Tigris River, Turkey (Teleostei: Salmonidae). *Zootaxa,* ***2993***, 23-33.

Turan, D., Kottelat, M. & Kaya, C. (2017). *Salmo munzuricus*, a new species of trout from the Euphrates River drainage, Turkey (Teleostei: Salmonidae). *Ichthyological Exploration of Freshwaters,* ***28***, 55-63.

Yoğurtçuoğlu, B., Kaya, C. & Freyhof, J. (2020). Freshwater fishes of the Anatolian Midwestern Black Sea basin. *Ichthyological Exploration of Freshwaters,* ***30***(2), 111-30.