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Endemic fishes in transboundary river basins in Turkey

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Abstract: Transboundary rivers flow between two or more countries. Turkey is located between two continents, Asia, and Europe. Five of Turkey's 25 river basins are transboundary named Maritsa, Orontes, Euphrates-Tigris, Kura-Araks and Coruh and spanning two continents and eight countries. All information on fish species distributed in the transboundary river basins in Turkey were gathered and presented in this study using published sources. 184 fish species in 25 families identified in transboundary river basins and 30 of them (16%) are endemic. The highest and lowest rate of endemism were found in Euphrates-Tigris and Maritsa basin, respectively. Most fish species in the area are threatened by human induced changes especially dams and habitat loss.

Keywords: Endemic fish species, transboundary river, Turkey

Türkiye'de sınıraşan nehir havzalarındaki endemik balıklar

Özet: Sınıraşan nehirler iki veya daha fazla ülke arasında akan nehirlerdir. Türkiye Asya ve Avrupa kıtaları arasında bulunmaktadır. Türkiye'nin 25 akarsu havzasının beşi; Meriç, Asi, Fırat-Dicle, Kura-Aras ve Çoruh iki kıta ve sekiz ülkeyi kapsamaktadır. Türkiye'de sınıraşan nehirlerde dağılım gösteren balık türleri ile ilgili bilgiler yayınlanmış kaynaklar kullanılarak sağlanmış ve bu çalışmada sunulmuştur. Sınıraşan nehir havzalarında tespit edilen 25 familyaya ait 184 balık türünden 30'u (%16) endemiktir. En yüksek ve en düşük endemizm oranı sırasıyla Fırat-Dicle ve Meriç havzalarında tespit edilmiştir. Bölgedeki balıkların çoğu özellikle baraj ve habitat kaybı gibi insan kaynaklı değişikliklerden dolayı tehdit altındadır.

Anahtar kelimeler: Endemik balık türü, sınıraşan nehir, Türkiye

1. Introduction

Turkey is located between Europe and Asia and divided into two main regions, Thrace, and Anatolia. Turkey has 25 river basins **(**DSI 2016) and each river basins shows different characteristic and have different flow regimes. Transboundary rivers are defined as waters that rise within the borders of a country and pass to another country's territory and flow between two or more countries. Five basins out of 25 river basins in Turkey are transboundary river basins as Maritsa (riparian states; Turkey, Bulgaria, Greece), Orontes (Turkey, Syria, Lebanon), Euphrates-Tigris (Turkey, Syria, Iraq), Kura-Araks (Turkey, Georgia, Iran, Azerbaijan, Armenia) and Coruh (Turkey, Georgia) (Fig. 1). Transboundary rivers constitute 36% of Turkey's current water potential **(**DSI 2016).

The freshwater fish of Turkey has been studied for more than a century. The first taxonomic study on freshwater fish in Turkey was carried out by Abbot (1835). There are several researches on Turkish freshwater fishes' checklist (Kuru 2004; Geldiay and Balik 2007; Fricke et al. 2007; Kuru et al. 2014; Cicek et al. 2015). However, a nation-wide inventory of endemic fish occurrences by all transboundary river basins has never been published. The purpose of this study is to identify endemic fish species living in transboundary river basins in Turkey and provide information about their current biological status.

Fig. 1. River basins in Turkey

2. Materials and Method

All available published sources were collected under the scope of this work in order to assess the current composition and characteristics of the endemic fish fauna of transboundary rivers in Turkey (Fricke et al. 2007; Geldiay and Balık 2007; Kuru et al. 2014; Cicek et al. 2015 and 2018). The further published studies related to transboundary basins and new fish records were also added to the scope of this study (Breil and Bohlen 2001; Bogutskaya et al. 2006; Turan et al. 2006 a-b; Erk'akan et al. 2007; Innal and Erk'akan 2006; Erk'akan et al. 2008; Van Neer et al. 2008; Turan et al. 2009; Birecikligil and Cicek 2010; Turan et al. 2011; Freyhof and Ozulug 2014; Kucuk et al. 2014; Turan et al. 2014a-b; Elp et al. 2015; Baycelebi et al. 2015; Cicek and Birecikligil 2016). Since there was limited information on Turkish part of Maritsa river, the study conducted by Economou et al. (2007) in Maritsa river, Greece as neighboring country was evaluated and used in this study. Valid names and authorities used by the authors were checked with the Fishbase (Froese and Pauly 2016). Fish species are grouped under their family names which are presented in taxonomical order follows Nelson (2006), species alphabetically within each family.

2.1. Study area

2.1.1. Maritsa (Meriç) Basin

The Maritsa River, whose catchment is shared by Bulgaria, Turkey, and Greece, is the longest river in the Balkan Peninsula forming a natural frontier of 240 km between Greece and Turkey. It rises in Bulgaria and flows along the Turkish-Greek border into the Aegean Sea. Having major tributaries named Arda and Tundja that mainly flow in Bulgaria, the river Erithropotamos flows in Bulgaria and Greece and the river Ergene that flows entirely in Turkish territory (UNECE 2007; Nikolaou et al. 2008).

2.1.2. Orontes (Asi) Basin

The Orontes River rises in the eastern part of the Beqaa Valley in Lebanon and flows into the Mediterranean Sea just south of Samandag, Turkey. The Orontes River is 556 km long, with 366 km in Syria, 98 km in Turkey and 40 km in Lebanon (Yildirim 2017). It is a northward-flowing river in the region and has two major tributaries, Afrin and Karasu join in former Amik Lake drained out for agriculture in the 1980s.

2.1.3. Euphrates-Tigris (Fırat-Dicle) Basin

The Euphrates River originates in the eastern highlands of Turkey, between Lake Van and the Black Sea, and is formed by two major tributaries, the Murat and the Karasu. There are numerous small tributaries of the Euphrates river basin in the mountains of Turkey, especially the Peri Suyu, Goksu and Tohma River. The Euphrates River is 3,000 km long (1,263 km in Turkey), divided between Turkey, Syria, and Iraq.

The Tigris River, also originating in eastern Turkey, flows through the east part of Turkey up to the border city of Cizre. It forms the border between Turkey and Syria, and Iraq and Syria. Its two major tributaries are the Great Zab and Lesser Zab and the following the Karasu, Kurucay, Batman, Botan, Garzan, Hezil, and Yenice Stream etc. The Tigris River is 1,850 km long, with 523 km in Turkey, 32 km on the border between Turkey and Syria and 1,418 km in Iraq.

2.1.4. Kura-Araks (Kura-Aras) Basin

The Kura River originates in the Kızılgedik Mountains in Ardahan province in northeast of Turkey and the Araks River originates in Erzurum province in eastern Turkey and has three major tributaries named as Arpacay, Karasu and Sarısu. The Kura-Araks basin is located in the South Caucasus with five separate countries named as Turkey, Iran, Armenia, Georgia, and Azerbaijan contributing area to the watershed. Kura and Araks both merge in Azerbaijan before entering the Caspian Sea.

2.1.5. Coruh (Çoruh) Basin

The Coruh River is located in north-east Turkey and shared by Turkey and Georgia. 91% basin area is located in Turkey while Georgia shares its 9%. The river originates in the western part of the Mescit mountains at Erzurum-Kars Plateau and flows to the Black Sea. The main tributaries of the Coruh River are the Tortum and Oltu rivers in Turkey. Coruh River is the fastest flowing river and is one of basins being exposed to the most erosion in Turkey (Akpinar et al. 2011; Sume et al. 2017).

3. Results and Discussion

184 fish species in 25 families occurred in five transboundary river basins in Turkey. A total of 30 species (16% of total fish species) was endemic in transboundary river basins in Turkey. Endemism rate and endemic fish species of each basin were shown in Fig. 2 and Table 1. The greatest number of endemic species was belonging to Cyprinidae family (13 species), followed by the Nemacheilidae (eight species), Salmonidae (six species) and Cobitidae (two species). Euphrates-Tigris basin had the highest endemism rate (18 species) following Orontes (four species), Coruh (four species) and Kura-Araks (three species) basins. Maritsa does not have any endemic fish species. *Crossocheilus caudomaculatus* is extinct in Orontes basin. Moreover, Büyük Menderes has the highest rate of endemism with 29 species among 25 river basins in Turkey following by Konya endorheic with 25 species. (Cicek et al. 2018).

Recent studies show that transboundary river basins in Turkey are under risk due to dam construction, habitat degradation and introduction of nonnative fish species (Fricke et al. 2007, Freyhof et al. 2014). Dam construction might cause habitat loss for some fishes because of disrupting habitat structure of rivers and force fishes living in lotic water to adapt to slower moving water. Dams especially multi-dam projects seriously block the movements of migratory fishes. Local economies might also negatively affect by dams due to river alterations and the presence of non-native fish species since, fishing is a livelihood for many residents along the transboundary river basin areas in Turkey. 15 fish species were determined as non-native in the transboundary river basins in Turkey and their risk to river basins increases due to direct and indirect negative effects on aquatic ecosystems (Fricke et al. 2007, Tarkan et al. 2015, Ablak-Gurbuz and Bonner 2020). Endemic fish species are very important part of a country's biodiversity. Endemic species are naturally found only in a certain region on the earth, so they are unique, and their distribution is limited. Therefore, threats to endemic fish species carry more risk of extinction than common species.

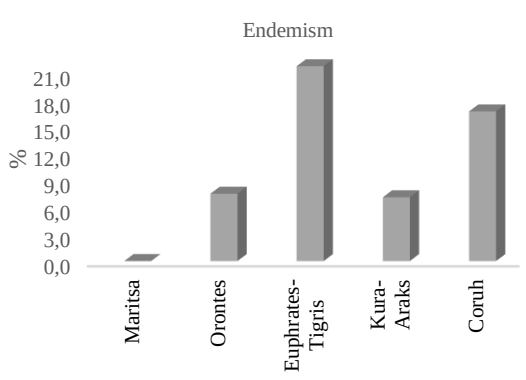

Fig. 2. Endemism of fish species in transboundary river basins

5. Conclusion

The species diversity in Turkey are quite high based on some factors for instance its geological and climatic characteristics and topographic structure. Transboundary river basins provide habitats for almost 50% of Turkey fishes. Fishes living in transboundary rivers can move forth and back between riverine countries, and any events that occurs in upstream country may affect downstream users. Most fishes such as lotic/non-guarders species and especially migrant fishes living in Turkey are threatened (Fricke et al. 2007; Freyhof et al. 2014) by several effects such as construction of dams and Hydroelectric Power Plants (HEPP), dewatering, habitat loss, pollution, destruction of fish spawning ground, introduction of foreign species, poaching while similar effects are happening in neighboring countries as well (Bobori and Economidis 2006; Economou et al. 2007; Coad 2010; Kibaroglu et al. 2011). To manage these valuable biodiversity, especially endemic, migrant, and lotic fishes should be monitored for, they are more prone to human-induced changes. It is essential to provide adequate flow to support aquatic life downstream of the dams and to design science-based management strategies for providing fish communities' continued survival. Endemism rate of fish species is a significant factor for river health.

Table 1. Endemic fish species in each transboundary river basin (*Sources are given in parentheses as numbers)

Orontes	Euphrates-Tigris	Kura-Araks	Coruh
Acanthobrama orontis (1,2,3)	*Alburnoides diclensis* (28)	*Squalius turcicus* (1,18)	*Capoeta banarescui* (4,6,19,20)
Barbus lorteti (4, 6,7)	*Alburnoides emineae* (9)	*Oxynoemacheilus cyri* (4,6,7,18)	*Capoeta ekmekciae* (4,6,7,20,21)
‡*Crossocheilus caudomaculatus* (4, 6)	*Alburnoides velioglui* (9)	*Oxynoemacheilus veyseli* (1)	*Salmo coruhensis* (20,22)
Oxynoemacheilus namiri (4, 5)	*Alburnus heckeli* (1,4,6,7,10)		*Salmo rizeensis* (20,22)
Pseudophoxinus turani (1, 24)	*Alburnus kurui* (1,4,6,7,10,23)		
	Pseudophoxinus firati (12)		
	Cobitis elazigensis (11,1)		
	Cobitis kellei (1,4,6,7,10)		
	Oxynoemacheilus erdali (13)		
	Oxynoemacheilus hazarensis (26)		
	Oxynoemacheilus kaynaki (14)		
	Paraschistura chrysicristinae (6, 29)		
	Turcinoemacheilus kosswigi (4,6,7,15)		
	Salmo euphrataeus (16)		
	Salmo munzuricus (27)		
	Salmo okumusi (16)		
	Salmo tigridis (17)		
	Squalius semae (25)		

*Sources: 1. Cicek et al. 2018; 2. Freyhof and Ozulug 2014; 3. Kucuk et al. 2014; 4. Cicek et al. 2015; 5. Birecikligil and Cicek 2010; 6. Fricke et al. 2007; 7. Kuru et al. 2014; 8. Van Neer et al. 2008; 9. Turan et al. 2014a; 10. Geldiay and Balik 2007; 11. Coad and Sarieyyüpoğlu 1988; 12. Bogutskaya et al. 2006; 13. Erk'akan et al. 2007; 14. Erk'akan et al. 2008; 15. Breil and Bohlen 2001; 16. Turan et al. 2014b; 17. Turan et al. 2011; 18. Cicek and Birecikligil 2016; 19. Turan et al. 2006 b; 20. Baycelebi et al. 2015; 21. Turan et al 2006a; 22. Turan et al. 2009; 23. Freyhof et al. 2018; 24. Kucuk and Guclu 2014; 25. Turan et al. 2017a; 26. Freyhof and Ozulug 2017; 27. Turan et al. 2017b; 28. Turan et al. 2016; 29. Kottelat 2012)

‡: Extinct species

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Conflict of interest disclosure:

There is no conflict of interest.

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