Mugla Journal of Science and Technology

DISTRIBUTION AND TAXONOMIC STATUS OF FRESHWATER FISHES OF MUĞLA (SOUTH-WEST TÜRKİYE): UPDATED CHECKLIST

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Received: 23.01.2023, Accepted: 16.05.2023
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Research Article
DOI: 10.22531/muglajsci.1241162

Abstract

This study was carried out in the inland waters of Muğla Basin between 2018-2019. As a result of field studies and literature, it was determined that there were 36 species of fish belonging to 17 families (Anguillidae, Atherinidae, Cobitidae, Leuciscidae, Cyprinidae, Gobionidae, Nemacheilidae, Aphaniidae, Poeciliidae, Blenniidae, Centrarchidae, Cichlidae, Gobiidae, Moronidae, Mugilidae, Salmonidae, Siluridae). While 11 of the species in Muğla region are of marine origin, 8 of them are endemic (Cobitis doradeмiri, Cobitis fahirae, Capoeta aydinensis, Luciobarbus kottelati, Vimba mirabilis, Petroleuciscus smyrnaeus, Squalius fellowesii, Ladigesocypris irideus). In addition, seven species are exotic species (Carassius auratus, Carassius gibelio, Pseudorasbora parva, Gambusia holbrooki, Lepomis gibbosus, Coptodon zilli, Oncorhynchus mykiss). Fish fauna has been studied for the first time for Akyol Creek, Mazı Creek, Maden Creek, Gökçay Creek, Yanıklar Stream, and Bayir Reservoir.

Keywords: Inland water fish, taxonomy, Muğla

MUĞLA (GÜNEY-BATI TÜRKİYE) TATLI SU BALIKLARININ DAĞILIMI VE TAKSONOMİK DURUMU: GÜNCEL SON LİSTE

Özet

Bu çalışma 2018-2019 yılları arasında Muğla bölgesi iç sularında gerçekleştirilmiştir. Muğla ili iç su bölgelerinde yapılan saha ve literatür çalışmaları sonucunda 17 familyaya (Anguillidae, Atherinidae, Cobitidae, Leuciscidae, Cyprinidae, Gobionidae, Nemacheilidae, Aphaniidae, Poeciliidae, Blenniidae, Centrarchidae, Cichlidae, Gobiidae, Moronidae, Mugilidae, Salmonidae, Siluridae) ait 36 tür tespit edilmiştir. Muğla yöresindeki türlerin 11'i deniz kökenli iken, sekizi endemiktir (Cobitis doradeмiri, Cobitis fahirae, Capoeta aydinensis, Luciobarbus kottelati, Vimba mirabilis, Petroleuciscus smyrnaeus, Squalius fellowesii, Ladigesocypris irideus). Ayrıca yedi tür istilacıdır (Carassius auratus, Carassius gibelio, Pseudorasbora parva, Gambusia holbrooki, Lepomis gibbosus, Coptodon zilli, Oncorhynchus mykiss). Akyol Deresi, Mazı Çayı, Maden Çayı, Gökçay Çayı, Yanıklar Deresi ve Bayır Barajı için balık türleri ilk kez rapor edilmiştir.

Anahtar Kelimeler: İç su balıkları, taksonomi, Muğla

Cite

Genç, T. O., Yılmaz, F., (2023). "Distribution and taxonomic status of freshwater fishes of Muğla (south-west Türkiye): updated checklist", Mugla Journal of Science and Technology, 9(1), 71-79.

1. Introduction

Previous research on freshwater fish in Muğla has focused only on the basic biological characteristics of some fish species or some streams. Until the 1990s, there was only a few literatures available on the biodiversity of freshwater fish in Muğla. Muğla, located between 36° 17`and 37° 33` Northern latitude and 27° 13`and 29° 46` Eastern longitude, has 13 328 km^2 surface area and very rough terrain. The province is located in the basins of Büyük Menderes, Dalaman, and Eşen Rivers and is surrounded by the Mediterranean Sea in the South and by the Aegean Sea in the West [1]. Çiçek et al. [2] reported 384 fish species belonging to 20 orders and 34 families in the inland waters of Turkey in their study in 2020. Fricke et al. [3] published a checklist of marine and freshwater fish species of Turkey. Kuru et al. [4] updated the number of fish species living in Turkey's freshwaters as 371 in their publication. Kuru [5] reported the number of fish species 236 in a previous study. Özdemir et al. [6] explored the fish communities of Muğla rivers and listed 7 fish species and 19 non-native fish species. Yılmaz et al. [7] published an article on the hazard status and protection of *Squalus irideus*, which is endemic to the region, living in small rivers located in the Marmaris-Dalaman borders of Muğla. Yilmaz et al. [8] found 8 taxa in the study of fish fauna in the Akçay River, which forms the border of Muğla Denizli, and Özcan and Balık [9] identified 15 fish species in the Akçay River and Kemer Reservoir. Onaran et al. [10], have made a systematic study on Eşen Stream fishes

and determined a total of 13 fish species and gave 11 of these species as new records from the region. Balık et al. [11] investigated the fish fauna of Yuvarlakçay Stream. Barlas and Dirican [12] conducted comprehensive research on the fish fauna of Dipsiz-Çine Creek and reported 14 taxa including 10 species, and 4 subspecies. Barlas et al. [13] reported an exotic species of *Lepomis gibbosus* from Sarıçay and Dipsiz-Çine River as a new record. Erkakan et al. [14] identified four new species of the genus *Cobitis*, *Cobitis fahirae*, specific to the Aegean region. Buhan [15] published a detailed study on the mullet species and lagoon management in Köyceğiz Lagoon system. Balık [16] assessed of endemic fish living in Anatolia and gave detailed information about the important species in the study area. Balık [17] made a thesis on the taxonomy and ecological characteristics of freshwater fish in Western Anatolia and gave detailed information on 41 species belonging to 15 families with diagnostic keys. Yılmaz et al. [1] have done a detailed study on the freshwater fish fauna of Muğla and reported that there are 26 species and six subspecies of 15 families. New morphological and molecular studies in fish systematics have changed the names of many fish species. This study aims to reveal the freshwater fish fauna of Muğla Province by combining the previous literature and new field studies.

2. Material - Methods

Fish sampling were made by two expert researchers with an electroshock device with 650 W output power, which can work with at least 12 Volt DC and 5-60 Amps battery, by ethical rules and in a way that would cause minimal harm to fish. Sampling locations were selected to be as representative as possible each study site, which was visited throughout the entire sampling period. Notably, samples from reservoirs were taken from the outlet to ensure consistency with the lotic characteristics of the stream sampling sites. Each sampling site was visited once. The coordinates of the fish sampling areas and identified species were recorded using GPS. The samples were fixed by the 4% formaldehyde solution in the field and were carried to the Muğla University Hydrobiology Research Laboratory. Sampling studies were carried out between 2018-2019. Field studies were carried out in approximately 35 freshwater regions. The study areas are shown in Figure 1. The coordinates and station numbers of the freshwater regions where the study was conducted are shown in Table 1.

Table 1. The coordinates and station numbers of the sampling points.

Region	Station No and Name	Sampling point coordinates
Milas-Bodrum Region	1- Sarıçay Stream	35 S 564585.50 4133271.49
	2- Mumcular Reservoir	35 S 558520.84 4107891.25
	3- Göltürkbükü Pond	35 S 535517.92 4107701.12
	4- Mazı Stream	35 S 553925.10 4114688.21
	5- Akyol Stream	35 S 560704.06 4120396.35
	6- Geyik Reservoir	35 S 577891.06 4139314.98
Yatağan Region	7- Pınarbaşı Stream	35 S 599956.05 4128417.75
	8- Dipsiz-Çine Stream	35 S 600806.06 4142738.76
	9- Gökçay Creek	35 S 618010.51 4150308.13
	10- Madenler Creek	35 S 605756.67 4133744.74
	11- Kazan Pond	35 S 608122.20 4128405.40
	12- Bayır Reservoir	35 S 611384.60 4127834.15
	13- Kamışdere Stream	35 S 598629.68 4132322.75
Muğla-Marmaris Region	14- Ula Pond	35 S 623528.15 4110494.07
	15- Akçapınar Stream	35 S 621301.00 4098642.36
	16- Çetibeli Stream	35 S 615416.10 4094655.15
	17- Marmaris-Beldibi Stream	35 S 613285.06 4079395.66
	18- Hisarönü Stream	35 S 600787.91 4074333.98
Köyceğiz-Dalaman Region	19- Namnam River	35 S 644439.12 4087674.23
	20- Balıklı Stream	35 S 637857.19 4096834.87
	21- Yuvarlakçay River	35 S 650477.91 408365.39
	22- Köyceğiz Lake	35 S 647979.50 4086502.92
	23- Dalyan Channel	35 S 645985.84 4077509.20
	24- İztuzu Stream	35 S 644322.90 4073569.81
	25- Dalaman River	35 S 660796.79 4075891.06
	26- Tersakan River	35 S 663278.93 4073159.35
	27- Arıcılar Stream	35 S 641720.14 4107852.73
	28- Kükürtlü Lake	35 S 663556.02 4060480.98
Fethiye Region	29- Yanıklar Stream	35 S 683052.54 4064098.34
	30- Ören River	35 S 711393.80 4067248.56
	31- Seydikemer Stream	35 S 711508.35 4058712.67
	32- Eşen Stream	35 S 709976.89 4035285.21
	33- Seki Stream	35 S 727147.29 4078648.16
Akçay Region	34- Akçay Stream	35 S 653847.64 4128903.13
	35- Çamoluk Stream	35 S 641495.10 4147619.48

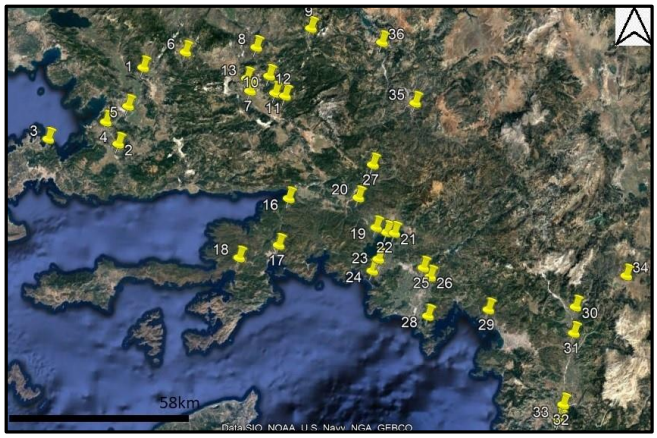

Fig 1. Freshwater fish sampling points in Muğla Province [18].

3. Results and Discussion

In order to understand the distribution of fish species, the Muğla region was divided into six main unconnected regions by the authors. Before this study was conducted, studies were carried out by different researchers at different times in six main regions. In this study, thirty-five field studies were carried out to cover six regions. In addition, fish species for the new six aquatic regions (Akyol Stream, Mazı Stream, Maden Stream, Gökçay Stream, Yanıklar Stream, and Bayır Reservoir) were mentioned for the first time in this study. The fish species caught in this study were combined with those previously mentioned in the literature, and the total number of fish species living in the inland waters of the Muğla Region was explained. The systematic categories of species are shown below [2, 4]:

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Ordo: Anguilliformes
Fam: Anguillidae
Sp: *Anguilla anguilla* (Linnaeus, 1758)
Ordo: Atheriniformes
Fam: Atherinidae
Sp: *Atherina boyeri* (Risso 1810)
Ordo: Cypriniformes
Fam: Cobitidae
Sp: *Cobitis dorademiri* Erk'akan, Özdemir & Özeren, 2017
Sp: *Cobitis fahirae* Erk'akan, Atalay-Ekmekçi & Nalbant, 1998
Fam: Leuciscidae
Sp: *Alburnoides smyrnae* Pellegrin 1927
Sp: *Petroleuciscus smyrnaeus* (Boulenger, 1896)
Sp: *Squalius fellowesii* (Günther, 1868)
Sp: *Ladigesocypris irideus* (Ladiges, 1960)
Sp: *Vimba mirabilis* (Ladiges, 1960)
Sp: *Vimba vimba* (Linnaeus, 1758)
Fam: Cyprinidae
Sp: *Barbus xanthos* Güçlü, Kalayci, Küçük & Turan 2020
Sp: *Capoeta aydinensis* Turan, Küçük, Kaya, Güçlü & Bektaş, 2017
Sp: *Carassius auratus* (Linnaeus, 1758)
Sp: *Carassius gibelio* (Bloch, 1782)
Sp: *Cyprinus carpio* Linnaeus, 1758
Sp: *Luciobarbus kottelati* Turan, Ekmekçi, Ilhan & Engin, 2008
Fam: Gobionidae
Sp: *Pseudorasbora parva* (Temminck & Schlegel, 1846)
Fam: Nemacheilidae
Sp: *Oxynoemacheilus anatolicus* Erk'akan, Özeren & Nalbant 2008
Ordo: Cyprinodontiformes
Fam: Aphaniidae
Sp: *Aphanius fasciatus* (Valenciennes, 1821)
Fam: Poeciliidae
Sp: *Gambusia holbrooki* Girard, 1859
Ordo: Blenniiformes
Fam: Blenniidae
Sp: *Salaria fluviatilis* (Asso, 1801)
Ordo: Centrarchiformes
Fam: Centrarchidae
Sp: *Lepomis gibbosus* (Linnaeus, 1758)
Ordo: Cichliformes
Fam: Cichlidae
Sp: *Coptodon zillii* (Gervais, 1848)
Ordo: Gobiiformes
Fam: Gobiidae
Sp: *Knipowitschia byblisia* Ahnelt, 2011
Sp: *Knipowitschia caunosi* Ahnelt, 2011
Sp: *Gobius ophiocephalus* Pallas, 1814
Ordo: Eupercaria
Fam: Moronidae
Sp: *Dicentrarchus labrax* (Linnaeus, 1758)
Ordo: Mugiliformes
Fam: Mugilidae
Sp: *Chelon labrosus* (Risso, 1827)
Sp: *Chelon auratus* (Risso, 1810)
Sp: *Oedalechilus labeo* (Cuvier, 1829)
Sp: *Chelon ramada* (Risso, 1827)
Sp: *Chelon saliens* (Risso, 1810)
Sp: *Mugil cephalus* Linnaeus, 1758
Ordo: Salmoniformes
Fam: Salmonidae
Sp: *Oncorhynchus mykiss* (Walbaum, 1792)
Sp: *Salmo trutta macrostigma* (Duméril, 1858)
Ordo: Siluriformes
Fam: Siluridae
Sp: *Silurus glanis* Linnaeus, 1758

1. Milas-Bodrum Region

The most important river source in the region has attracted attention as Sarıçay Stream. It is a stream fed by Geyik Reservoir and pours into Güllük Lagoon. Sarıçay river is polluted by domestic wastes, agricultural wastes, olive oil enterprises wastes, and irrigation water originating from the Milas district [19]. In previous studies, 10 fish species from Sarıçay, three from Mumcular Reservoir, and three from Geyik have been reported. Exotic species such as *Lepomis gibbosus, Pseudorasbora parva* and *Carrasius gibelio* are noteworthy. Fish names in old studies were written as the authors indicated, but both new names and synonyms are clearly shown in Table 2 in order to have the opportunity to compare the old names with the new names.

Yılmaz et al. [1] determined that 11 fish species live in this region. These species are; *Anguilla anguilla, Leuciscus cephalus, Leuciscus smyrnaeus, Barbus plebejus escherichi, Cyprinus carpio, Pseudorasbora parva, Cobitis taenia, Orthrias angorae, Gambusia affinis, Lepomis gibbosus, Carassius carassius*.

In the field studies, *Gambusia holbrooki* and *Petroleuciscus smyrnaeus* were caught from Sarıçay, *Squalius fellowesii* from Mumcular Dam, Akyol Creek, Mazı Creek and Göltürkbükü lake. *Carassius gibelio*

species live in the Mumcular Reservoir and *Salaria fluviatilis* species live in Akyol Creek. Fish species records were reported for the first time in Akyol and Mazı Creek.

2. Yatağan Region

The most important river source in the region is known as Dipsiz-Çine Stream and it is connected to the Büyük Menderes basin. Çine Reservoir was built on the river and was put into operation in 2010. The absence of a fish passes over the Reservoiris a major problem for fish in the river. The Dipsiz stream is important for agricultural irrigation and cooling water to Yatağan Thermal Power Plant. Around the Dipsiz-Çine river, there are many industrial enterprises such as marble factories, olive oil factories, and milk factories.

The Dipsiz Stream is used for drinking water for the Yatağan region and its environment. By using these rivers, a large part of the agricultural land located in Yatağan Plain and Çine Plain is irrigated. 1600 m^3 of water is taken from the bottomless water source to Yatağan Thermal Power Plant and the water taken is treated with various chemicals before being used for cooling and then discharged back to the river [20]. In this study, five species (*Luciobarbus kottelati, Capoeta aydinensis, Barbus xanthos, Alburnoides smyrnae, Squalius fellowesii*) were detected in Dipsiz-Çine stream. Barlas and Dirican have identified 10 species in the Dipsiz- Çine river while Yilmaz et al. [1] reported 14 species. It is known that there are 10 (*Anguilla anguilla, Leuciscus cephalus, Leuciscus smyrnaeus, Alburnoides bipunctatus, Alburnus orontis, Pseudorasbora parva, Cobitis simplicispinna, Orthrias angorae, Gambussia affinis ve Lepomis gibbosus*) species and four (*Barbus plebejus escherichi, Barbus capito pectoralis, Capoeta capoeta bergamae* ve *Vimba vimba tenella*) subspecies belonging to five families [12]. The reason for the determination of different numbers of taxa in the studies is that they conducted research to cover a narrow area or the whole of the river.

Petroleuciscus symrnaeus is a very important species living in the limited habitats in the rivers between İzmir and Muğla and endemic to Southwest Anatolia. Pınarbaşı stream is an important region for this species. In our study, many of fish were caught in this stream.

Kazan Pond was made for irrigation water purposes. Four species have been previously reported in the pond [6]. Among these species *Carassiuis gibelio* and *Squalius fellowesii* were also detected during our study.

The Bayir Reservoir was constructed for drinking and irrigation water, but no scientific studies have been found on fish species. *Cyprinus carpio* (mirror and scaly form) and *Gambusia holbrooki* species have been reported for the first time from this dam lake in our field studies. These species are found here by aquaculture method. Madenler and Gökçay Creek are small rivers connected to Dipsiz-Çine Stream. The fish (*Barbus xanthos, Squalius fellowesii, Capoeta aydinensis*) caught from these creeks were reported for the first time from this area.

3. Muğla-Marmaris Region

The rivers in this region are small rivers close to the sea and are generally under the marine influence. *Ladigesocypris irideus*, which is widespread in the rivers in this region and is endemic to Muğla. In addition, *Squalius fellowesii* is also endemic in southwestern Anatolia and is found extensively in streams that share the same habitats with *L. irideus*. These species live in Hisarönü creek, which is the only fresh water source in the Datça peninsula, as well as in Çetibeli Stream and Akçapınar Stream. Three species in Çetibeli (*Ladigesocypris irideus, Squalius fellowesii, Anguilla anguilla*) and Marmaris streams (*Anguilla anguilla, Liza aurata, Salaria fluviatilis*) and one sample in Akçapınar (*Salaria fluviatilis*) stream were determined. Ula Pond is very close to the Ula district center, and it is a small pond for irrigation purposes, and six fish species have been reported in previous studies [21]. Four species (*Carassius auratus, Carassius gibellio, Cyprinus carpio, Gambusia holbrooki*) previously reported from the Ula Pond were not found in this study, but only *L. irideus* and *S. fellowesii* were identified during the field study. Species caught from Balıklı stream are *Ladigesocypris irideus*, *Barbus pergamonensis*, *Squalius fellowesii* and *Knipowitschia byblisia*.

4. Köyceğiz-Dalaman Region

This study area is the largest region of Muğla province in terms of species diversity and the size of the watershed area. There are many literature studies related to the field. In itself; the Namnam River, Yuvarlakçay River, Dalaman River, Tersakan River, Köyceğiz Lake, and Lagoon Basin can be divided into sub-regions.

Namnam River: The water collection basin of the river forms 550 km^2 and half of the Köyceğiz Lake basin (1052 km^2). The 30 km long river basin forms the border of Ula and Köyceğiz districts. It is one of the important water springs pouring into Köyceğiz Lake [22]. Intensive agricultural activities around the river have harmful effects on water quality. In summer, the already decreasing waters due to seasonal effects are used extensively in agricultural irrigation. Namnam Hydroelectric power plant (HPP) and Kavakçalı (HPP) were established to generate electricity on the Namnam River. These structures put pressure on the stream water source. In addition, the riverbed dries in an important area between the source region and Köyceğiz lake in summer and continues as bottom water. Previous studies have reported that six species live on the river [1, 6]. *Barbus xanthos, Capoeta aydinensis, Squalius fellowesii, Oncorhynchus mykiss, Vimba vimba* species were found in our field studies.

Yuvarlakçay River, which is approximately 30 km long, is one of the important sources feeding Köyceğiz Lake. In the stream, There is Turkey's largest capacity trout

production facility. There are also several restaurants around the river for tourist purposes. A total of 13 taxa, 4 of which are subspecies, have been identified in nine families in the studies conducted to determine the diversity of fish species of Yuvarlakçay (*Anguilla anguilla, Leuciscus cephalus, Barbus plebejus escherichi, Capoeta capoeta angorae, Leuciscus borysthenicus, Ladigesocypris ghigii ghigii, Cobitis vardarensis, Gambusia affinis, Mugil cephalus, Atherina boyeri, Tilapia zillii, Blennius fluviatilis, Knipowithschia caucasica*) [1, 6, 11]. In the field studies we conducted, it was observed that *Tilapia* became extremely dominant in the river outfall and put great pressure on native species. The species identified in this river: *Coptodon zillii, Cobitis fahirae, Anguilla anguilla, Capoeta aydinensis, Squalius fellowesii*.

Köyceğiz Lake has an area of 5400 hectares. The Dalyan canal system connecting the lake to the sea is 14 km long and covers an area of 150 hectares. The canal that connects the lake to the sea is 5–70 m wide and 1 -6 m deep [15]. Between the wide delta formed at the junction of the channel and the sea, there is a beach area of approximately 4-5 km with an average width of 100 m. Köyceğiz Lake Lagoon System is among the most important wetlands of our country. It was declared a Special Environmental Protection Area in 1988 due to its natural beauty and ecological features [23]. There are many economic fish species living in the lake and it is a highly developed sector in commercial fishing. Species belonging to the *Mugilidae* family of marine origin, especially in the lagoon system, live on average of 600 tons of harvest each year by the local fishing cooperative. Excessive proliferation of *Tilapia*, which is an exotic species in this region and subsequently introduced into the lake, has harmful effects on both the indigenous species living in the lake and the Dalyan fisheries. It is known that at least 20 fish species live in many studies in the lake and some of them are marine species. *Liza aurata, Barbus xanthos, Capoeta aydinensis, Cyprinus carpio, Squalius fellowesii, Coptodon zillii, Mugil cephalus* species were found in our field studies.

Dalaman River; Born on the northern foothills of the Yeşilgöl Mountains to the south of the Gölhisar district of Burdur province, it is an important river in the region with a length of 229 km. It draws a border between Ortaca and Dalaman districts and flows from Sarısu Mevkii to the Mediterranean Sea. The study area has a surface area of 38 hectares, in addition to providing shelter for fishing and birds, it can also be used for recreational, commercial, tourism and sport fishing purposes in Dalaman, and Ortaca districts with a population of around 40 thousand. The Akgedik Reservoir was completed on the river in 2009 and put into service. There are also many HPP. The lack of fish passages on these structures poses a great danger in terms of the integrity of stream fish fauna. In a study conducted in Dalaman Stream; *Capoeta capoeta bergamae, Leuciscus cephalus, Anguilla anguilla, Barbus plebejus escherichi, Cyprinus carpio, Mugil cephalus* and *Mugil aurata* species have been reported to live [1, 24]. *Ladigesocypris irideus, Alburnoides smyrnae,, Salaria fluviatilis, Squalius fellowesii* species were found in our field studies.

In the Tersakan River basin, intensive citrus and pomegranate cultivation are carried out intensively (four seasons), and chemical fertilization and pesticides are applied to make this agricultural production more efficient. The part of these fertilization and sprayings that cannot be taken by the soil is first carried to the Tersakan Stream by surface waters and then to the sea by this river. Eight fish species (*Anguilla anguilla*, *Leuciscus cephalus*, *Cobitis simplicispinna*, *Gambusia affinis*, *Blennius fluviatilis*, *Gobius ophiocephalus*, *Mugil cephalus* and *Mugil ramada*) belonging to 7 families and 3 subspecies (*Barbus plebejus escherichi*, *Capoeta capoeta bergamae* and *Ladigesocypris ghigii ghigii* live in Tersakan Stream [1, 25]. *Squalius fellowesii, Capoeta aydinensis* species were found in our field studies.

5. Fethiye Region

Eşen Stream is the river that forms the Muğla-Antalya border. It takes its source from Akdağlar, passes Seki Plateau, feeds on strong resources in Ören, first it joins Akçay and then Karaçay and reaches the sea. Although it is very important that the natural trout species live in the Ören region, overhunting and HPP constructions have been putting great pressure on this species in recent years. In addition, the trout farms in the Ören region create serious pollution pressure on the river. Other threats to the river include water intake, sand pits, and domestic and agricultural pollution.

In the studies carried out so far, 10 species (*Anguilla anguilla, Leuciscus cephalus, Petroleuciscus borysthenicus, Blennius fluviatilis, Mugil cephalus, Oedalechilus labeo, Mugil ramado, Liza saliens, Carassius carassius* and *Atherina boyeri*) and three subspecies (*Salmo trutta macrostigma, Barbus plebejus escherichi* ve *Capoeta capoeta bergamae*) belonging to 6 families (*Anguillidae, Salmonidae, Cyprinidae, Mugilidae, Atherinidae and Blennidae*), were determined on Eşen River [1, 6, 10]. It was the first time that a scientific study was conducted in Yaniklar stream and the species obtained are: *Anguilla anguilla, Barbus xanthos, Salaria fluviatilis, Squalius fellowesii*. The species obtained in the region in our field studies are: *Anguilla anguilla, Barbus xanthos, Salaria fluviatilis, Squalius fellowesii, Oncorhynchus mykiss*.

6. Akçay Region

Akçay stream is born from the borders of Beyağaç District of Denizli Province and is fed with strong arms and poured into Kemer Reservoir as a high-flow river. Kemer Reservoir, which was established in 1954-1958 for protecting from irrigation floods and generating electrical energy, is located on Akçay Stream. There is no significant industrial waste mixed with the river. Domestic wastes belonging to the settlements and some small tar enterprises waste sometimes cause pollution

problems in the stream. In addition, the HPP on the river and irrigation water taken in the summer months create great pressure on the fish living in the river.

Özcan and Balık [9] reported 14 species (*Barbus plebejus*, *Barbus pectoralis, Capoeta bergamae, Carassius gibelio, Cyprinus carpio, Petroleuciscus smyrnaeus, Leuciscus cephalus, Lepomis gibbosus, Oncorhynchus mykiss, Acanthobrama mirabilis, Alburnoides bipunctaıus, Chondrostoma meandrense, Nemacheilus angorae, Morone chrysops*) on streams and related streams in their study. In this study, *Barbus xanthos, Squalius fellowesii, Luciobarbus kottelati* species were caught from the Akçay region. The species mentioned in previous studies and the species detected in this study are shown in Table 2.

Table 2. Fish species living in inland waters of Muğla Regions.

No	Species	Synonyms	English name	Red list categories IUCN	Endemism	Station Numbers Where Fish are Caught in this study	Station Numbers Where Fish are Caught in literature
1	*Anguilla anguilla*	*Muraena anguilla* Linnaeus, 1758	European eel	CR	-	16, 17, 18, 21, 24, 32	1, 8, 19, 20, 21, 22, 25, 26, 32
2	*Atherina boyerii*	-	Big-scale sand smelt	LC	-	-	21, 22, 32
3	*Cobitis dorademiri*	-	-	NE	Endemic	27	20, 22
4	*Cobitis fahirae*	-	Aegean spined loach	LC	Endemic	21	8
5	*Alburnoides smyrnae*	*Alburnoides bipunctatus* Bloch, 1782	Schneider	NE	-	8, 25	8, 34
6	*Barbus xanthos*	-	-	LC	-	7, 8, 9, 10, 19, 20, 22, 27, 29, 33, 35	1, 8, 19, 20, 21, 22, 25, 26, 32, 34
7	*Capoeta aydinensis*	-	-	NE	Endemic	7, 8, 9, 10, 19, 21, 22, 24, 26, 27	8, 19, 20, 21, 22, 25, 26, 32, 34
8	*Carassius auratus*	*Cyprinus auratus* Linnaeus, 1758	Goldfish	LC	-	-	2, 14, 32, 34
9	*Carassius gibelio*	*Cyprinus gibelio* Bloch, 1782	Prussian carp	NE	-	2, 11, 28	11, 14, 26, 34
10	*Cyprinus carpio*	-	Common carp	VU	-	6, 12, 22	1, 2, 6, 11, 14, 22, 25, 26, 34
11	*Luciobarbus kottelati*	-	Menderes barbel	VU	Endemic	8, 13, 35	
12	*Petroleuciscus smyrnaeus*	*Leuciscus smyrnaeus* Boulenger, 1896	Izmir chub	LC	Endemic	1, 7	1, 8, 19, 34
13	*Pseudorasbora parva*	*Leuciscus parvus* Temminck & Schlegel, 1846	Stone moroko	LC	-	-	1,8
14	*Squalius fellowesii*	-	Aegean chub	LC	Endemic	2, 3, 4, 5, 6, 8, 9, 10,11, 14, 16, 19, 22, 25, 27, 29, 30, 31, 32, 33, 34, 35	1, 2, 8, 11, 14, 17, 19, 20, 21, 25, 26, 32, 34
15	*Ladigesocypris irideus*	-	Anatolian ghizani	NT	Endemic	14, 16, 18, 20, 25, 27	14, 19, 20, 21, 22, 26
16	*Vimba mirabilis*	*Acanthobrama mirabilis* Ladiges, 1960	Menderes bream	LC	Endemic	-	34
17	*Vimba vimba*	*Cyprinus vimba* Linnaeus, 1758	Vimba bream	LC	-	19	8
18	*Oxynoemacheilus anatolicus*	-	-	LC	-	-	1, 8, 22, 25, 32, 34
19	*Aphanius fasciatus*	-	Mediterranean banded killifish	LC	-	-	22
20	*Gambusia holbrooki*	-	Eastern mosquitofish	LC	-	1, 12, 18	1, 8, 11, 14, 21, 22, 26,
21	*Salaria fluviatilis*	*Blennius fluviatilis* Asso, 1801	Freshwater blenny	LC	-	5, 15, 17, 18, 25, 29, 31	17, 21, 25, 26, 32
22	*Lepomis gibbosus*	-	Pumpkinseed	LC	-	-	1, 6, 8, 34
23	*Coptodon zillii*	-	Redbelly tilapia	NE	-	21, 22, 24, 28	21, 22
24	*Knipowitschia byblisia*	-	Byblis Goby	LC	-	20	22
25	*Knipowitschia caunosi*	-	Caunos Goby	LC	-	-	21
26	*Gobius ophiocephalus*	*Gobius filamentosus* Risso, 1827	Grass goby	LC	-	-	21, 26
27	*Dicentrarchus labrax*	*Perca labrax* Linnaeus, 1758	European seabass	LC	-	-	22
28	*Chelon labrosus*	-	Thicklip grey mullet	LC	-	-	22, 25
29	*Chelon auratus*	*Mugil auratus* Risso, 1810	Golden grey mullet	LC	-	17, 18, 23, 24,	22
30	*Oedalechilus labeo*		Boxlip mullet	NE	-	-	22, 32
31	*Chelon ramada*	*Mugil ramada* Risso, 1827	Thinlip grey mullet	LC	-	-	21, 22, 26, 32
32	*Chelon saliens*	*Mugil saliens* Risso, 1810	Leaping mullet	LC	-	-	22, 32
33	*Mugil cephalus*	-	Flathead grey mullet	LC	-	24	21, 22, 25, 26, 32

34	*Oncorhynchus mykiss*	*Salmo gairdnerii* Richardson, 1836	Rainbow trout	NE	-	19, 27, 30	25, 32, 34
35	*Salmo trutta macrostigma*	-	Brown trout	DD	-	-	2, 32
36	*Silurus glanis*	-	Wels catfish	LC	-	-	22, 34

4. Conclusion

In this study, 35 freshwater regions in six main regions were visited in Muğla Basin. In this respect, it is more comprehensive than other studies in Muğla. In order to learn the total number of fish species, the fish species in the literature are listed together with the field studies. There are 36 fish species, eight of which are endemic (*Cobitis doradamiri, Cobitis fahirae, Capoeta aydinensis, Luciobarbus kottelati, Vimba mirabilis, Petroleuciscus smyrnaeus, Squalius fellowesii, Ladigesocypris irideus)* and seven of which are invasive (*Carassius auratus, Carassius gibelio, Pseudorasbora parva, Gambusia holbrooki, Lepomis gibbosus, Coptodon zilli, Oncorhynchus mykiss*), belonging to 17 families in the inland waters of Muğla Basin. In addition, a new list was needed due to the identification of new species and the renaming of many species. An important aspect of this study is that many of species (*Oxynoemacheilus anatolicus*, *Salaria fluviatilis, Coptodon zillii, Dicentrarchus labrax, Chelon labrosus, Chelon auratus, Chelon ramada, Chelon saliens Alburnoides smyrnae, Cobitis doradamiri, Barbus xanthos, Capoeta aydinensis, Luciobarbus kottelati, Squalius fellowesii, Ladigesocypris irideus*) were revised and included in the list with their new names. Fish species were reported for the first time for Akyol Stream, Mazı Stream, Maden Stream, Gökçay Stream, Yanıklar Stream and Bayır Dam that were not visited before. There are many reasons (year and season differences, natural destruction, study area of the river) for determining different numbers of species in studies. *Leuciscus cephalus* was described *Squalius cephalus* and then *Squalius fellowesii* and was included in the endemic fish of Muğla [26,27]. In their study, Erkakan et al. [28] defined *C. doradamiri* as a new species for Köyceğiz Basin and Balıklı Stream. It is known that *C. fahirae* lives in the Menderes Basin, but a detailed study is needed that this species lives in the inland waters of the Muğla Basin. *Barbus xanthos*, a new species, is described from the Eşen, Dalaman, Tersakan and Büyük Menderes rivers in south-western Anatolia [29]. Turan et al. [30] described the species, which was previously identified as *Barbus capito pectaralis*, to *Luciobarbus kottelati*. In addition, the species known as *Capoeta bergamae* in the Muğla region was defined *Capoeta aydinensis* in the study of Turan et al. [31] in 2017. Although *Petroleuciscus borysthenicus* has been reported in previous studies, it is doubtful that it lived in the Muğla region. In the study conducted in Büyük Menderes River drainage *Petroleuciscus smyrnaeus* species was specified as *Petroleuciscus ninae* [32]. The status of this species is uncertain as no evaluation has been made in other river branches connected to the Menderes region. The situation of the species belonging to the genus *Petroleuciscus* in Sarıçay and Dipsiz River should be examined. In addition, *Ladigesocypris ghigi ghigi* species was given as *Squalus irideus* in previous studies. However, the new name of the species is *Ladigesocypris irideus*. Although it was stated that *Alburnus orontis and Alburnus demiri* were detected in old studies, it is known that this species is not found in Muğla inland waters. The name of the *Alburnoides bipunctatus* species was changed to *Alburnoides smyrnae* as a result of the study conducted by Turan et al. [33] in 2013. Although not caught in this study, Yoğurtçuoğlu et al. [32] determined that the *Oxynoemacheilus anatolicus* species lived on the Dalaman River. Two new species of the genus Knipowitschia, *Knipowitschia byblisia* and *Knipowitschia caunosi* were described from the coastal Lake Köycegiz, southwest Turkey [35]. Freyhof et al. [36] reported that *Cobitis doradamiri* is endemic to the Lake Köyceğiz basin and the lower Dalaman River drainage. *Cobitis fahireae* were reported in the upper Dalaman drainage. As a result of the studies carried out in recent years, the number of trout has increased to 14. The trout species living in the Muğla region needs to be re-examined.

Acknowledgments

This study was supported and financed by the Ministry of Agriculture and Forestry of the Republic of Türkiye within the scope of the project titled "National Biodiversity Inventory and Monitoring Project".

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