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THE FISH FAUNA OF THE LESSER ZAB RIVER (TIGRIS RIVER SYSTEM) WITH FIVE FIRST RECORDS, AND NOTE ON CLIMATE CHANGE AND ANTHROPOGENIC EFFECTS ON FISH DIVERSITY IN ZAB RIVER BASIN (PYRANSAHER, IRAN)

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KEYWORDS: fish, alien fish, endemic fish, Iran.

ABSTRACT

The aim of this study is to describe the biodiversity and current status of ichthyofauna in the Lesser Zab River. Through the examination of more than 1,500 samples collected from various river stations between May and August 2014 and June and August 2016, 35 fish species belonging to six families have been identified. The fish identified belong to the orders Cypriniformes, Siluriformes, and Synbranchiformes, which include Cyprinidae, Balitoridae, Sisoridae, and Mastasembelidae. Both meristic and morphological analyses were conducted on the specimens. Some of these species are reported for the first time in this part of the Zab River. Additionally, the study mentions the effects of anthropogenic and climate changes on fish biodiversity in this basin.

RÉSUMÉ: Faune piscicole du la rivière Petit Zab (système fluvial du Tigre) avec cinq premières observations et note sur le changement climatique et les effets anthropiques sur la biodiversité piscicole du bassin du Zab (Pyranshaher, Iran).

L'objectif de cette étude est de décrire la biodiversité et l'état actuel de l'ichtyofaune dans la rivière Petit Zab. À travers l'examen de plus de 1.500 échantillons collectés dans différentes stations fluviales entre mai et août 2014 et entre juin et août 2016, nous avons identifié 35 espèces de poissons appartenant à six familles. Les poissons identifiés appartiennent aux ordres Cypriniformes, Siluriformes et Synbranchiformes, qui comprennent Cyprinidae, Balitoridae, Sisoridae et Mastacembelidae. Des analyses méristiques et morphologiques ont été menées sur les spécimens. Certaines de ces espèces sont signalées pour la première fois dans cette partie de la rivière Zab. De plus, l'impact des changements anthropiques et climatiques sur la biodiversité des poissons dans ce bassin a également été mentionné.

REZUMAT: Fauna piscicolă a râului Zab Mic cu cinci prime înregistrări, și notă asupra schimbărilor climatice și efectele antropogenice asupra diversității peștilor din bazinul râului Zab (Pyransaher, Iran).

Obiectivul acestui studiu este de a descrie biodiversitatea și starea actuală a ihtiofaunei din râul Lesser Zab. Prin examinarea a peste 1.500 de probe colectate din diferite stații ale râului între mai și august 2014 și între iunie și august 2016, am identificat 35 de specii de pești aparținând la șase familii. Peștii identificați aparțin ordinelor Cypriniformes, Siluriformes și Synbranchiformes, care includ Cyprinidae, Balitoridae, Sisoridae și Mastasembelidae. Au fost realizate analize meristice și morfologice asupra specimenelor. Unele dintre aceste specii sunt raportate pentru prima dată în această parte a râului Zab. În plus, a fost menționat și impactul schimbărilor antropice și climatice asupra biodiversității peștilor din acest bazin.

INTRODUCTION

Understanding the fish community structure in aquatic ecosystems in general and in rivers' basin is crucial for effective fisheries management and river basin conservation (Bănăduc and Curtean-Bănăduc, 2015; Çiçek et al., 2015; Sanguila and Hansel, 2015; Ruchimat et al., 2012). The Fish Index of Biotic Integrity (IBI) uses fish assemblages to assess the overall health of a stream ecosystem (Grabarkiewicz and Davis, 2008). Fish are valuable indicators of long-term environmental disturbances because, they are long-lived, their assemblages represent several trophic levels, they occupy top positions in aquatic food chains, and they are relatively easy to collect and identify (Pinna et al., 2023; Whitfield and Elliot, 2005; Froese and Torres, 1999). Beyond being a significant food source, fish serve for ornamental, hygienic, and industrial purposes and are crucial to the drug industry (Cassol et al., 2024). Despite their economic importance, freshwater fish are among the most threatened aquatic vertebrates (Valiallahi, 2015). The situation will worsen as the demand for food increases and conflicts over freshwater usage escalate, driven by climate change and drought (Valiallahi and Shakiba, 2015). It was estimated that 20% of the world's freshwater fish fauna are either extinct or in danger of extinction (Moyle and Leidy, 1989; Moyle et al., 1988).

The freshwater fish fauna of Iran and Iraq face challenges, mostly due to habitat changes caused by humans (Zare-Shahraki et al., 2022, 2023; Khoshnood et al., 2014, 2015; Jawad, 2012). Many species have such restricted distributions that even minor disturbances can lead to extinction. This study goal is to identify the fish in the Lesser Zab River and evaluate the current status of both endemic and exotic fish in this ecosystem. (Jawad, 2012)

The fish species of the Lesser Zab River is a significant topic because they have not been studied extensively, and there are no reliable historical records documenting the biodiversity of this river basin. Native fish populations are under stress and face numerous potential threats. The most recent reliable studies on freshwater fish in the area of Iran, Turkey, and Iraq were conducted by Coad (2017), Çiçek et al. (2015), and Jawad (2012), respectively. The findings of these studies were used as references in this paper.

Literature review on the fish fauna of the Zab River and Tigris Basin

Between December 1986 and April 1987, Rashid, Othman, and Nsayf collected a total of 88 fish to study the parasitology of fish in the Lesser Zab River at Alton Kupri in Northeast Iraq. The identified species included *Barbus grypus, Luciobarbus esocinus, Cyprinion macrostomus,* and *Acanthobrama marmid* (Rashid et al., 1989). In 2000-2001, Yahyazadeh Mir Yusof identified 19 fish species in the Aras and Zangbar Rivers as part of his project on the native fish species in northwestern Azerbaijan (Tab. 1.)

Table 1: The fish from the northern basin in western Azerbaijan (Yahyazadeh Mir Yusof, 2018).

Carassius carassius (Linnaeus, 1758)	*Alburnoides* sp.
Carassius auratus (Linnaeus, 1758)	*Rutilus rutilus* (Linnaeus, 1758)
Barbus mursa (Güldenstädt, 1773)	*Capoeta capoeta* (Güldenstädt, 1773)
Barbus lacerta Heckel, 1843	*Barbus capito* (Güldenstädt, 1773)
Ctenopharyngoden idella (Valenciennes, 1844)	*Oxynoemacheilus bergianus* (Derjavin, 1934)
Aristichthys nobilis (Richardson, 1845)	*Neogobius cephalarges* (Pallas, 1814)
Hypophthalmichthys molitrix (Valenciennes, 1844)	*Gambusia holbrooki* Girard, 1859
Cyprinus carpio Linnaeus, 1758	*Stizostedion luciuperca* (Linnaeus, 1758)
Aspius aspius (Linnaeus, 1758)	*Silurus glanis* Linnaeus, 1758
Abramis brama (Linnaeus, 1758)	

The Dukan Dam, situated in the upper Tigris River basin, is one of the upper branches of the Zab River. Data collected from this dam area in 2007-2008 by Ararat et al. (2009) identified 21 species of fish (Tab. 2).

Table 2: The fishes of the Dukan Dam area (Ararat et al. 2009).

Alburnus caeruleus Heckel, 1843	*Carassius auratus* (Linnaeus, 1758)
Alburnus mossulensis Heckel, 1843	*Cyprinus carpio* Linnaeus, 1758
Acanthobrama marmid Heckel, 1843	*Hypophthalmichthys molitrix* (Valenciennes, 1842)
Luciobarbus subquincunciatus (Günther, 1868)	*Heteropneustes fossilis* (Bloch, 1794)
Luciobarbus esocinus Heckel, 1843	*Aristichthys nobilis* (Richardson, 1845)
Luciobarbus xanthopterus Heckel, 1843	*Gambusia holbrooki* Girard, 1859
Squalius cephalus (Linnaeus, 1758)	*Mastacembelus mast.* (Banks & Solander, 1794)
Barbus grypus (Heckel, 1843)	*Mystus pelusius* (Solander, 1794)
Barbus lacerta Heckel, 1843	*Silurus triostegus* Heckel, 1843
Cyprinion macrostomum Heckel, 1843	*Squalius lepidus* Heckel, 1843
Capoeta damascina (Valenciennes, 1842)	

MATERIAL AND METHODS

Study area

The Tigris River, one of the largest in Asia, spans 1,850 km, originating in Turkey and flowing through Iran and Iraq before joining the Euphrates River to form the Shatt al-Arab, finally draining into the Persian Gulf. The Lesser Zab River is part of this system. It originates in Iran, where two small streams merge to form the Chami Kalveh in the Azarbayjan-e-Gharbi Region, flowing southeast before entering Iraq near Mawat and finally joins the Tigris north of Bayji. The total Lesser Zab basin area is approximately 22,250 km^2 (Fig. 1). (Jafari, 2022)

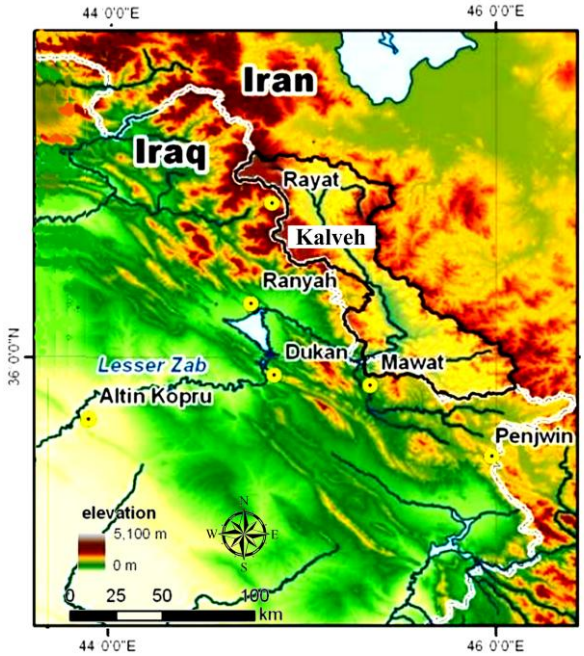

Figure 1: Digital elevation of the lower Zab River and the upper part of the Tigris River.

Water utilization by the Lesser Zab upstream of Dukan Dam started marking the hydrological regime of the river after 1991, when medium- to small-sized agricultural projects were implemented in Iraq and Iran (IUCN Action Plan, 2013).

The upper basin of the Lesser Zab lies within the mountainous region with elevations ranging from 3,591 m to 659 m. The longest flow path of the Lesser Zab inside Iran is estimated to be 165 km long. (Jafari, 2022)

The political division of the Lesser Zab River basin includes Pyranshaher and Sardashet in western Azerbaijan, Iran, and part of Baneh City in Kurdestan Province. The northern part of the Zab Basin is at Oshnaveh and Naghadeh. The eastern part of the Zab Basin is at Mahabad, Bokan, and Saghez, and on the west side, it reaches the international boarder of Iraq. The northeastern part of the Zab Basin includes the Berineh River, which includes Zevika, Gerdeh Sor, Mashkan, and Slevah villages; the Pyranshaher and southern parts include the Gakeah and Harzaneh districts, respectively; and the main drainage region of the Zab Basin in the Sardasht District is the Zab River, which has different branch names, such as Glass, Chamtit, Zeh, Badin Abad, Clevah, and Lavin (Figs. 1 and 2). (Jafari, 2022)

Table 3: Sampling sites at the Lesser Zab River, where fish samples have been caught for this study.

Station name	Latitude	Longitude
Sliva	36°47’58.044’’N	45°6’1.579’’E
Gardeh sor	36°49’55.865’’N	45°5’5.468’’E
Kani eshkot	36°34’2.555’’N	45°13’10.456’’E
Pyran	36°34’45.453’’N	45°10’54.261’’E
Kasagaran	36°36’52.103’’N	45°13’59.799’’E
Soghanlo	36°37’0.760’’N	45°12’54.866’’E
Gardeh shovan	36°39’52.046’’N	45°13’30.417’’E
Zedan	36°40’15.424’’N	45°11’37.941’’E
Gardeh govan	36°40’37.158’’N	45°13’3.211’’E
Hables	36°42’11.053’’N	45°11’7.306’’E
Razgari	36°44’28.011’’N	45°9’44.031’’E
Gardeh shnan	36°32’35.848’’N	45°20’31.253’’E
Shaykhan	36°31’14.633’’N	45°19’48.243’’E
Bavelah olya	36°30’48.593’’N	45°18’2.293’’E

The fish samples examined in this research were collected from various locations along the upper branches of the Lesser Zab River, including Peranshaer and parts of Sardashet, between May and August 2014, as well as June and August 2015. The sampling stations were selected at 50-meter intervals. The fish were captured using various methods, such as an electroshocker and different types of nets. Gill nets with mesh sizes ranging from 18-55 mm, cast nets (12-22 mm), and electrofishing were used to catch the fish. The fishing activities took place along the main branch of the river, where fishes were collected using a 500 W portable generator-powered electrofishing device. A metric ruler was used to measure some physical characteristics of the fish samples.

The collected materials were stored at the Faculty of Science, Srttu, Iran (in the Srttu Collection).

Fish species identification was conducted following the methods outlined by Coad (www.briancoad.com), based on the key characteristics of the species found at the site. The color features of the fresh specimens were examined, and specific characteristics like fin rays, lateral line scales, gill rakers, and pharyngeal teeth were analyzed in the laboratory to determine the genus, species, and subspecies of the sampled biologic material. Measurements of total length (TL), standard length (SL), fork length (FL), head length (HL), and interorbital distance (ID) were taken, along with counting the number of fin rays, scales on the lateral line, and pharyngeal teeth. Relevant literature on the ichthyofauna in the Zab River in Iran and Iraq was reviewed and assesed.

Figure 2: Localization of the Zab River
in western Iran.

Fishing efforts were conducted at over 10 stations from 2014 to 2015.

The sampling station names correspond to the local names of the main branches of the Lesser Zab River, such as Gadah, Dolah-Rash, Soghanlo, the Selevah River, and Gradshaytan.

In our preliminary study, we identified approximately 35 species of fish in this basin, primarily belonging to Osteichthyes. These include Cypriniformes, Siluriformes, and Synbranchiformes, which encompass Cyprinidae, Balitoridae, Sisoridae, and Mastacembelidae (Tab. 3).

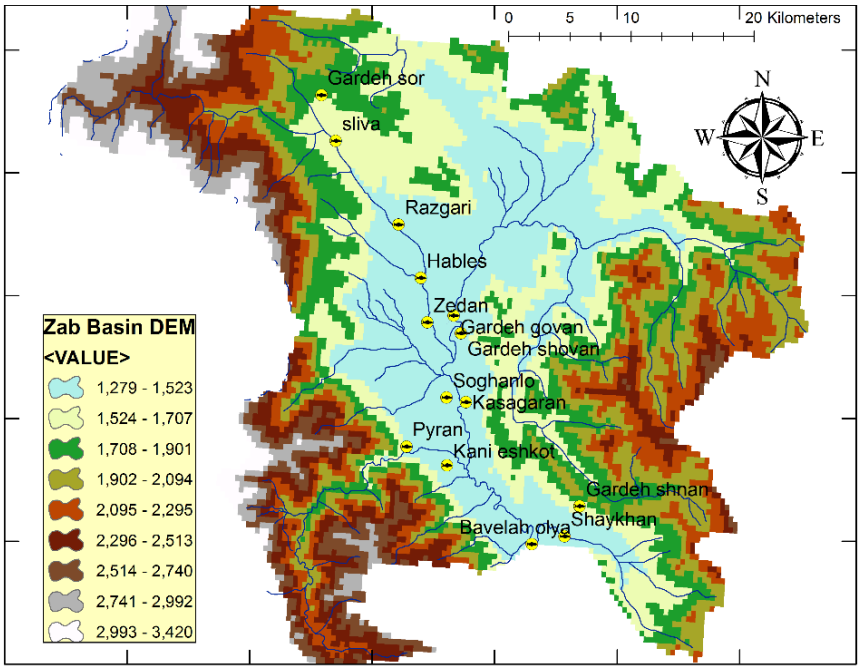

Figure 3: Digital elevation model of the lesser Zab Basin and the nearest villages to the sampling stations.

Table 4: Checklist of lesser Zab River fishes; * = endemic; E = exotic species; A = undescribed or alien species.

Cyprinidae	*Ctenopharyngodon idella* (E)
Acantobrama marmaid Heckel, 1843	*Garra persica* Berg, 1913
Alburnus chalcoides (Güldenstaedt, 1772)	*Garra* sp.
Alburnus filippi Kessler, 1877	*Hypophthalmichthys molitrix* (E)
Alburnus mossulensis Heckel, 1843	*Aristichthys nobilis* (E)
Alburnus zagrosensis Coad, 2009 *	*Squalius cephalus* (Linnaeus, 1758)
Barbus lacerta Heckel, 1843	*Squalius lepidus*
Barbus plebejus Bonaparte, 1839	**Cobitidae**
Luciobarbus mursa (Güldenstaedt, 1773)	*Cobitis linea* (Heckel, 1847) *
Luciobarbus scheich (Heckel 1843)	*Cobitis* sp.
Luciobarbus barbulus (Heckel, 1847)	**Nemacheilidae**
Capoeta damascina (Valenciennes, 1842)	*Oxynoemacheilus* sp. *
Capoeta capoeta (Güldenstädt, 1773)	*Paracobitis* sp.
Capoeta trutta (Heckel, 1843)	**Sisoridae**
Carassius carassius (Linnaeus, 1758)	*Glyptothorax kurdistanicus* (Berg, 1931)
Carassius auratus (Linnaeus, 1758)	**Salmonidae**
Chondrostoma regium (Heckel, 1843)	*Oncorhynchus mykiss* (Walbaum, 1792) (E)
Chondrostoma sp.	**Poeciliidae**
Cyprinion macrostomum Heckel, 1843	*Gambusia holbrooki* Girard, 1859 (E)
Cyprinion sp.	**Mastacembelidae**
Cyprinus carpio Linnaeus, 1758	*Mastacembelus mastacembelus*

The identification of fish species is crucial for future studies using modern tools, such as DNA analysis. Without accurate species identification, further research may be compromised.

In this study, 35 fish species were identified from the Lesser Zab River basin, primarily from the orders Cypriniformes, Siluriformes, and Synbranchiformes (Tab. 4). Five species were reported for the first time in this project: *Alburnus zagrosensis*, *Barbus plebejus*, *Luciobarbus mursa*, *Luciobarbus scheich*, and *Luciobarbus barbulus*.

Five exotic and translocated species, such as *Onchorynchus mykiss*, were recorded in the basin. *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis*, and *Gambusia holbrooki* were also present. Additionally, three endemic fish species were found in the area: *Cobitis linea*, *Alburnus zagrosensis*, and *Oxynoemacheilus* sp.

All the sampled fish were caught in the Lesser Zab River during 2014-2015, and all the images (Figs. 4-nn) were taken from fresh specimens by Shkiba M. and Valiallahi J.

Figure 4: *Acantobrama marmaid* Heckel, 1843.

A fleshy keel between the base of the pelvic fins and the vent, the last unbranched dorsal fin ray is thickened, spine-like and smooth, and the anal fin is long (9-14 branched rays).

Figure 5: *Alburnus chalcoides* (Güldenstaedt, 1772).

The short, naked ventral keel, eight branched dorsal fin rays. Lateral line scales 58-72. The dorsal and ventral scale margins are parallel or rounded and the anterior margin is wavy or has a pronounced central protuberance.

Figure 6: *Alburnus filippii* Kessler, 1877.

This fish is distinguished from its relative (*A. chalcoides*, also with a long, naked ventral keel by having modally seven branched dorsal fin rays and generally lower anal fin ray counts although these do overlap (10-21, usually 12-16 in Iran for *alburnus*, 9-13, usually 10-12, for *filippii*). Anal fin ray counts 12. Lower lateral line scales 58-68. (Coad, 2017)

Figure 7: *Alburnus mossulensis* Heckel, 1843.

The short, naked ventral keel, eight branched dorsal fin rays. With dark line at upper part of dorsal fin.

Figure 8: *Alburnus zagrosensis* Coad, 2009.

Seven branched dorsal fin rays, seven branched pelvic fin rays, absence of a prominent mid-flank stripe.

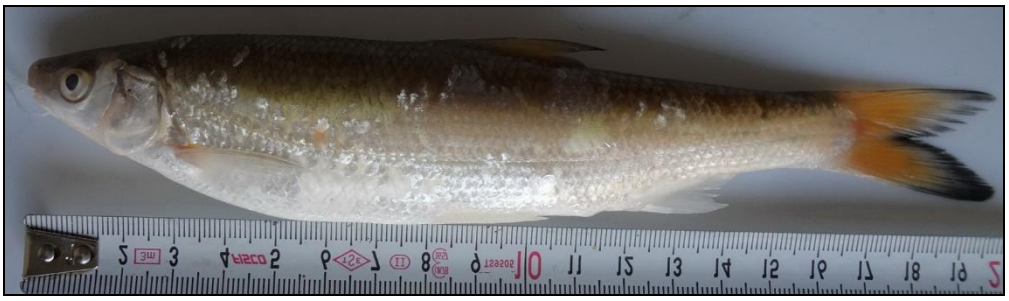

Figure 9: *Condrostoma regium* (Heckel, 1843)

Head and nose patern is characteristic for this genus.

Figure 10: *Barbus lacerta* Heckel, 1843.

Figure 11: *Barbus plebejus* Bonaparte, 1839.

At the Canadian museum of Nature there are six samples of this species the catalogue number of these specimens are: 1-CMN129(229), 79 mm TL. 66 mm SL. Kordestan Qezel Ozon River near Bijar 35°54”N, 47°20”E, MMTT, 1976; 2-CMN 139(239), 83 mm TL. 67 mm SL. Kermanshah, Gamasiab River near Sahneh, 34°24”N 47°40”E, 1976 MMTT, 1976; 3-CMN 126(226), 86 mm TL. 71 mm SL. Kordestan south of Saqqez, Zareneh River, Saqqez 36°12” N, 46°18” E, MMTT, 1976, 4-CMN 93-0125,102 mm TL. 84 mm SL. PT: 3,3,2- 2,3,4. Kermanshah, 25 km of Kermanshah to Kozaran road, Sarab nelofar 1993; 5-CMN uncat, TN: 67-G-Amleh, 163 mm TL.143 mm SL. Kermanshah, Gamasiab and Qareh so river territory, near Amleh Village. Valiallahi et al. 1998; 6-CMN 93-0126, 182 mm TL. 160 mm SL. PT: 4,3-4,3,2 Kermanshah, road to Ravansar, Sarab Yavari1993. (Valiallahi, 2006)

Figure 12: *Luciobarbus mursa* (Güldenstaedt, 1773).

An s shape body, high scale counts a fleshy three-lobed lower lip. Dorsal fin unbranched rays three, followed by eight branched rays, anal fin with three unbranched rays and five branched rays. Pectoral fin branched rays 17 and pelvic fin branched rays seven. Lateral line scales 82 or more.

Figure 13: *Luciobarbus scheich* (Heckel 1843).

L. scheich in comparing with *L. mystacus* has the shorter, more narrow head, the complete absence of a median lobe in the lower lip, the trunk, which adjoins the occiput with a gradual moderate rise is higher and in particular, toward the origin of the dorsal fin, where it tapers in almost edge-like fashion-more compressed than in the case of *L. mystaceus* also in *L. scheich* the scales are more delegates and thinner than scales in *L. mstaceus,* which have more coarse and ticker scales (Valiallahi, 2000a, b, 2015).

Figure 14: *Luciobarbus barbelus* Heckel, 1843.

Lociobarbus barbulus at Laser ZAB in Iran, Perdanan Station, Newly caught specimen by Mohamad Shakiba, 2015, name of this species at Peranshaher, Mahabad, is PollKey Lout Kover,meaning curved head and snout.

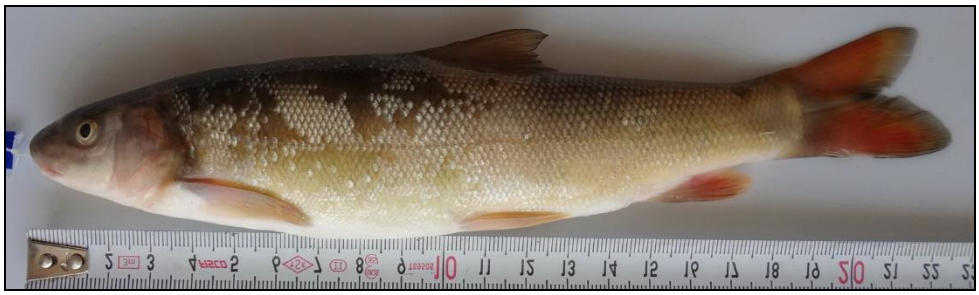

Figure 15: *Capoeta capoeta* (Güldenstädt, 1773).

It may have two subspecies, Berg (1948-1949) separate *C. c. capoeta* from *C. capoeta gracilis*, both of which may occur in Iran, by the following key:

1(2). Dorsal fin emarginated above; lateral line scales usually 55-59, dorsal fin spine strong with numerous denticles, back behind occiput and particularly in front of the dorsal fin strongly compressed *C. c. capoeta*.

2(1). Dorsal fin truncated in adults, lateral line scales usually 47-58, dorsal fin weak, back behind occiput not or only weakly compressed; radii on scales with minute recesses *C. c. gracilis* (Coad, 2014).

Figure 16: *Capoeta damascina* (Valencinnes, 1842).

The mode of nine dorsal fin rays, small scales, and the presence of large black blotches often distinguish this species from other *Capoeta* in Iran (Coad, 2014).

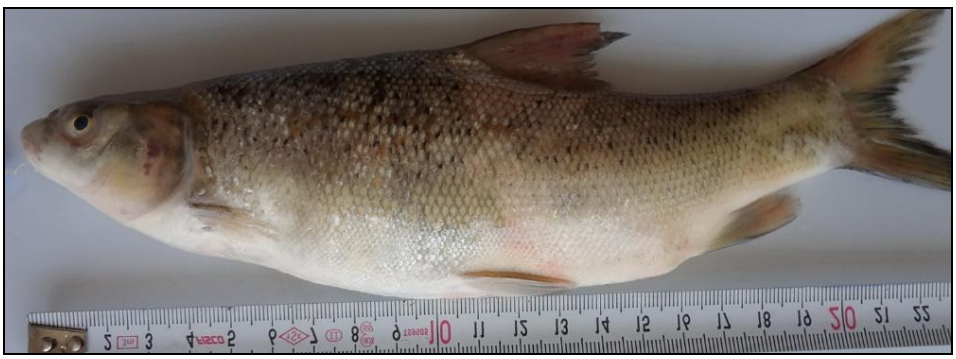

Figure 17: *Capoeta trutta* (Heckel, 1843).

One pair of barbell and dorsal fin spine strong, long with numerous denticles.

Figure 18: *Ctenopharyngodon idella* (Valenciennes, 1844).

The eyes being low on the side of the head, the anal fin is far back on the body close to the caudal fin, and pharyngeal teeth have large, parallel grooves on the grinding surface (Coad, 2016).

Figure 19: *Carassius carassius* (Linnaeus, 1758).

Figure 20: *Carassius* sp.

A kind of hybrid between *Carassius auratus* (Linnaeus, 1758) and probably *Carasobarbus luteus* (Heckel, 1843).

Figure 21: *Cyprinion macrostomum* Heckel, 1843.

Dorsal fin with four unbranched and 15 branched rays, anal fin with three unbranched and seven branched rays. The dorsal fin has the last unbranched developed as a spine with strong teeth except at the extreme tip which is thin and flexible. Pectoral fin with 17 branched rays, and pelvic fin with eight branched rays. Lateral line with 42 scales. The belly is scaled. There is a well-developed pelvic axillary scale.

Figure 22: *Squalius cephalus* (Linnaeus, 1758).

The relatively large scales give this fish a distinctive appearance and, combined with large body size, fin ray counts, rounded belly and the absence of barbels, separates it from other Iranian cyprinids (Coad, 2017).

The nominal Iranian subspecies, *L. c. orientalis*, differs from the European subspecies, *L. c. cephalus*, by having a more elongate body, a dark stripe behind the operculum and on average fewer scales and anal fin branched rays (Berg 1948-1949, 1949).

Figure 23: *Squalius* sp.

Differ from above fish by having different patern of snout in lower profile, the transverse lobe, shallow transversal groove between transverse lobe and proboscis.

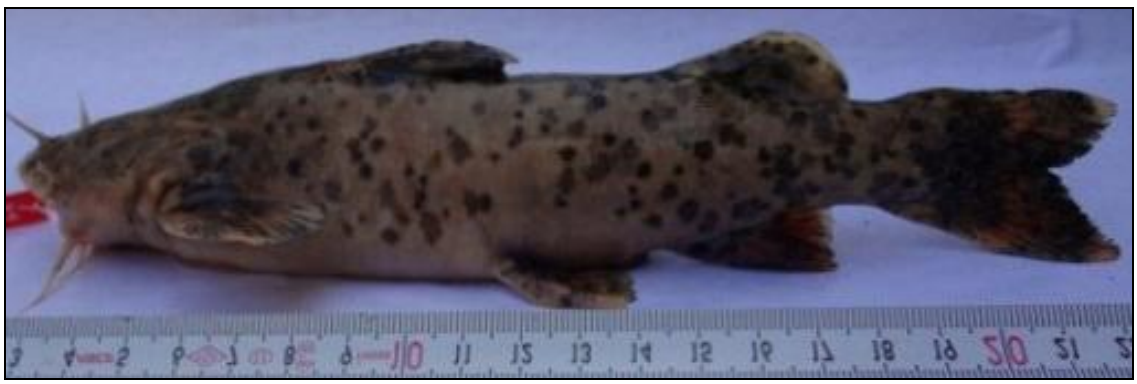

Figure 24: *Glyptothorax kurdistanicus* (Berg, 1931).

Figure 25: *Garra persica* Berg, 1913.

Two pairs of barbels are present, the adhesive disc is well developed with a free posterior margin, the dorsal fin has seven branched rays, and the caudal fin modally 16 branched rays.

Figure 26: *Oxyneomachilus frenata* (Heckel, 1843).

Straight edges of caudal peduncle, having modally 12 branched caudal fin rays, large dark spots along the flank, and above them speckles which do not tend to form a stripe.

Figure 27: *Oxynoemacheilus persa* (Heckel, 1847).

A short and deep body, and a deep and long caudal peduncle. Scales and other characters matches with *Oxynoemacheilus persa* (Heckel, 1847).

Figure 28: *Mastacembelus mastacembelus* (Banks and Solander, 1794).

Interviews were conducted with local fishermen, about *Luciobarbus barbulus* and other large *Barbus*, to gather information on the fish species in the Lesser Zab. According to their statements, the stocks of this species and other large *Barbus* fish decreased drastically during the last decade.

In this study, the authors could not detect the following species in the Lesser Zab River: *Barbus subquincunciatus, Luciobarbus mystaceus, Luciobarbus xanthopterus, Luciobarbus esocinus, Carasobarbus luteus,* and *Mystus pelusius.*

The Tigris-Euphrates system is an endemic center for fishes and is one of the main spawning and nursery grounds of seven large *Barbus* species in Iran. According to Dagli et al. (2009), 46 fish species and subspecies have been found in the Tigris-Euphrates basin of Turkey. These genera belong to 10 families. Many of these species are nonmigratory, but land-locked anadromous and catadromous taxa are also present due to the presence of numerous dams in Syria and Iraq (Dagli et al., 2009). Nearly half of the more than 30 fish species in the Euphrates River are economically important (Kuru, 2004).

Effects of anthropogenic and climate change on fish fauna of Zab River

The freshwater fish of the Lesser Zab River are part of the ichthyofauna of Iran, Iraq, and Turkey. Freshwater fishes in these countries are facing the same general types of ecological problems that exist throughout the world, and these problems are likely to worsen due to social and local issues. In addition to climate change, global warming, drought, water shortages, water retention, social problems resulting from war in and around these countries, such as demand for food and shelter, conflicts over the use of freshwater, etc.

Industrialization, population growth, hydropower use, dam construction, urban, industrial, and agricultural sewage, pesticide and chemical fertilizer flow into these rivers without any control, and overfishing have led to serious damage to the fish fauna of these countries, making the future of native fish more uncertain. The use of water from the Zab River System for irrigation and the use of dams on this river, which supplies drinking water for growing populations in this district, will adversely affect the current species of fish, especially some species in the IUCN Red List category that are at risk of extinction.

Most of the fish fauna of western Iran are migratory species, and the upper Euphrates and Tigris rivers are nursery grounds for the species migrating to montane streams for breeding. The construction of dams is considered to be more related to reductions in fish stocks than to environmental changes. Reservoirs are complex and dynamic ecosystems that differ from rivers primarily in terms of the presence of thermal stratification and changes in water quality parameters and sedimentation. However, it is known that fewer species will occur in reservoirs than in rivers due to the loss of habitat diversity and homogenization. The

loss of spawning grounds is the main reason for the proportional decrease in lotic species such as *Luciobarbus barbulus*, *Luciobarbus esosinus*, and *Arabibarbus grypus*, which have high oxygen requirements and need clean shallow gravel beds. The number of grass-eating lentic species is expected to decrease due to the loss of aquatic vegetation. Other long-term effects, such as the splitting of populations with dams and fluctuations in water levels and nutritive composition, will also negatively affect populations.

Pollution is a problem of concern in the Tigris River, but it may also start to develop in the Euphrates due to emerging industrialization. Exotic and transplanted fishes endanger local populations in the region due to competition, predatory habits, transmission of diseases and parasites, habitat destruction, aggressive behaviors, genetic swamping, and venomous capabilities. (Coad, 1991)

The introductions may either be accidental or purposeful (for fish farming as a controlling agent). *Cyprinus carpio*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, and *Aristichthys nobilis* in the warm and moderate parts and *Oncorhynchus mykiss* in the mountainous and cold parts of Iran are the most common transplanted fish species in dam systems in Iran. They are known to compete with native *Barbus* species, which are highly tolerant to environmental changes, fluctuations in salinity, decreased levels of oxygen due to increased BOD, and increased temperature. The escape fries of various alien exotic species have also been recorded in the Iraqi sector of the Euphrates (Coad, 1996). *Gambusia holbrooki* (introduced for controlling mosquitos) is now established and widespread in neighboring countries. (Coad, 1996, 1991)

Competition with present and future introduced taxa may be an important risk for populations of native species (Ararat et al., 2009).

CONCLUSIONS

The Cyprinidae family is a large family with 27 species out of a total of 35 species. *Squalius cephalus* is listed as LR/Ic on the 2007 IUCN Red List of Threatened Species (IUCN, 2017). According to Fricke et al. (2007) *Cyprinion macrostomus* is endangered, *Mastacembelus mastacembelus* is critically endangered, and *Alburnoides bipunctatus* is vulnerable in Turkey. The Tigris-Euphrates system is an endemic center for many fish species, but industrialization, dam construction, and climate change are threatening their populations. Pollution, overfishing, and habitat destruction are additional factors exacerbating the decline of native fish species.

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