

The ichthyofauna of Kor and Helleh River Basins in southwest of Iran with reference to taxonomic and zoogeographic features of native fishes

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This study was conducted to determine taxonomic and zoogeographic features of fishes from the Kor and Helleh River basins in southwestern Iran. The specimens were collected from 2004 to 2007. Twenty four species belonging to 20 genera, 9 families, and 6 orders from the Kor River basin and 21 species belonging to 19 genera, 8 families, and 6 orders from Helleh basin were identified. Ichthyofauna of Helleh basin included some species not present in the Kor basin: *Luciobarbus barbulus*, *Tor grypus*, *Carasobarbus luteus*, *Garra rufa*, *Mastacembelus mastacembelus*, *Glyptothorax silviae*, and *Cyprinion* cf. *macrostomum*. The Helleh basin ichthyofauna is a combination of western (Ethiopian) and eastern (Oriental) fauna. The cyprinid genera, *Barbus*, *Alburnus*, *Capoeta*, and *Chondrostoma* should be revised using both molecular and morphological data.

Key words: Endemic fishes, Exotic fishes, Fish diversity, Iran

INTRODUCTION

Iran is a mountainous country, and much of it is desert. Thousands of small springs and streams exist with no present or recent connection to other water bodies. Based on field work, maps, fish distribution, previous research (Sadati, 1977; Armantrout, 1980; Coad, 2010), and hydrography, 19 major drainage basins have been recognized in Iran (Coad, 2010). There are two main types of basins in Iran, exorheic, with the rivers and lakes draining to the sea and endorheic, in which rivers have no connection to the sea, but drain into an internal body of water such as a lake or are lost in the desert. Iran has approximately 202 fish species distributed throughout these basins (Esmaeili et al., 2010). The inland water ichthyofauna of Iran is dominated by the family Cyprinidae. Among the drainage systems, the Caspian Sea basin shows the greatest fish species diversity, followed by the Tigris, Karoun, and Persian Gulf basins.

The Kor basin comprises 26,440 km² northeast of Shiraz. Its lowest area (c. 1525 m asl) is occupied by a chloride lake, the third largest lake in Iran, composed of two parts, a northern basin known as Tashk and a southern basin known as Neyriz or Bakhtegan (Houtum-Schindler, 1891).

The Helleh basin comprises rivers that drain the southern Zagros Mountains into the north of the Persian Gulf. At its northern edge, the Zohreh River flows across the Khuzestan plains near Tigris River tributaries. Other major rivers in this basin are the Helleh, which drains into the Persian Gulf

north of Bushehr (28°59'N, 50°50'E), and the Mond, or Qarah Aqaj, which, with its tributaries, drains much of Fars Province into the Persian Gulf in south of Bushehr. The Helleh River receives the Dalaki and Shapur Rivers which drain the lower Zagros ranges west of Shiraz (Fig. 1). The area of this basin is estimated to be 20,300 km² and includes Lake Famur (Coad, 2010). The delta of the Helleh River consists of brackish and freshwater marshes and lagoons with a maximum depth of 3.5 m. It is the largest freshwater marsh system on the Persian Gulf coast in southern Iran. Lake Famur, or Parishan, (29°31'N, 51°48'E), near Kazeroun, is a particular feature of the Persian Gulf basin (Helleh), with an area of 42 km² at about 820 m asl. It is fed by about 80 fresh and brackish springs with a combined discharge of approximately 800 l sec⁻¹ and supports fish populations near the springs.

The two basins (Helleh and Kor) are in proximity to each other but have no connection. They contain important ichthyofauna of southern Iran. This study presents a comparative updated list of freshwater fishes of the Kor and Helleh basins, including endemics, exotics, and transplanted species, with notes on their taxonomy.

MATERIAL AND METHODS

This study was carried out from 2004 to 2007. The fish specimens were collected using an electroshock, dip nets, and cast nets at various stations in the two basins (Fig. 1). The samples were fixed and preserved in 10% formalin. Identification of specimens was based on Abdoli (2000) and Coad (2010). The specimens have been deposited in the Collection of the Biology Department, Shiraz University (ZM-CBSU).

RESULTS

Twenty-four species belonging to 20 genera, 9 families, and 6 orders were identified from the Kor River basin (Tables 1, 3), and 21 species belonging to 19 genera, 8 families, and 6 orders were identified from the Helleh River basin (Tables 2, 4). The fish fauna of both basins were dominated by cyprinids. Ichthyofauna of the Helleh basin included several species not found in the Kor basin including *Luciobarbus barbulus*, *Tor gypus*, *Carasobarbus luteus*, *Garra rufa*, *Mastacembelus mastacembelus*, *Glyptothorax silviae*, and *Cyprinion* cf. *macrostomum*. Endemic, exotic, and transplanted species were found in both basins. However the percentage of endemic populations in the Kor basin was higher than in the Helleh basin (Tables 3, 4).

DISCUSSION

Systematic studies of the fishes of Iran at the population, species, and subspecies, levels are not yet completed, and many genera and species systematics are not well understood (Coad, 1985, 2010; Esmaeili et al., 2010). In genera including *Barbus*, *Cyprinion*, *Capoeta*, and also members of Gobiidae, Cyprinodontidae (Tooth-Carps), and Nemacheilidae (formerly Balitoridae for Iranian species) there are major systematic problems. Populations of *Barbus* complex group are few in the Helleh basin, and their taxonomic status should be revised. Although *Luciobarbus pectoralis* is recorded from the Kor and Helleh River Basins (Abdoli, 2000; Coad, 2010), in the present study no specimen was found in the Kor River basin. It may be that this species was misidentified and mistakenly reported in this basin. Several species were found in the Helleh basin that were absent from the Kor basin. The Helleh basin ichthyofauna is a combination of western (Ethiopian) and eastern (Oriental) fauna. The members of Nemacheilidae have more systematic problems in Iran, causing taxonomic confusion and a revision is highly recommended.

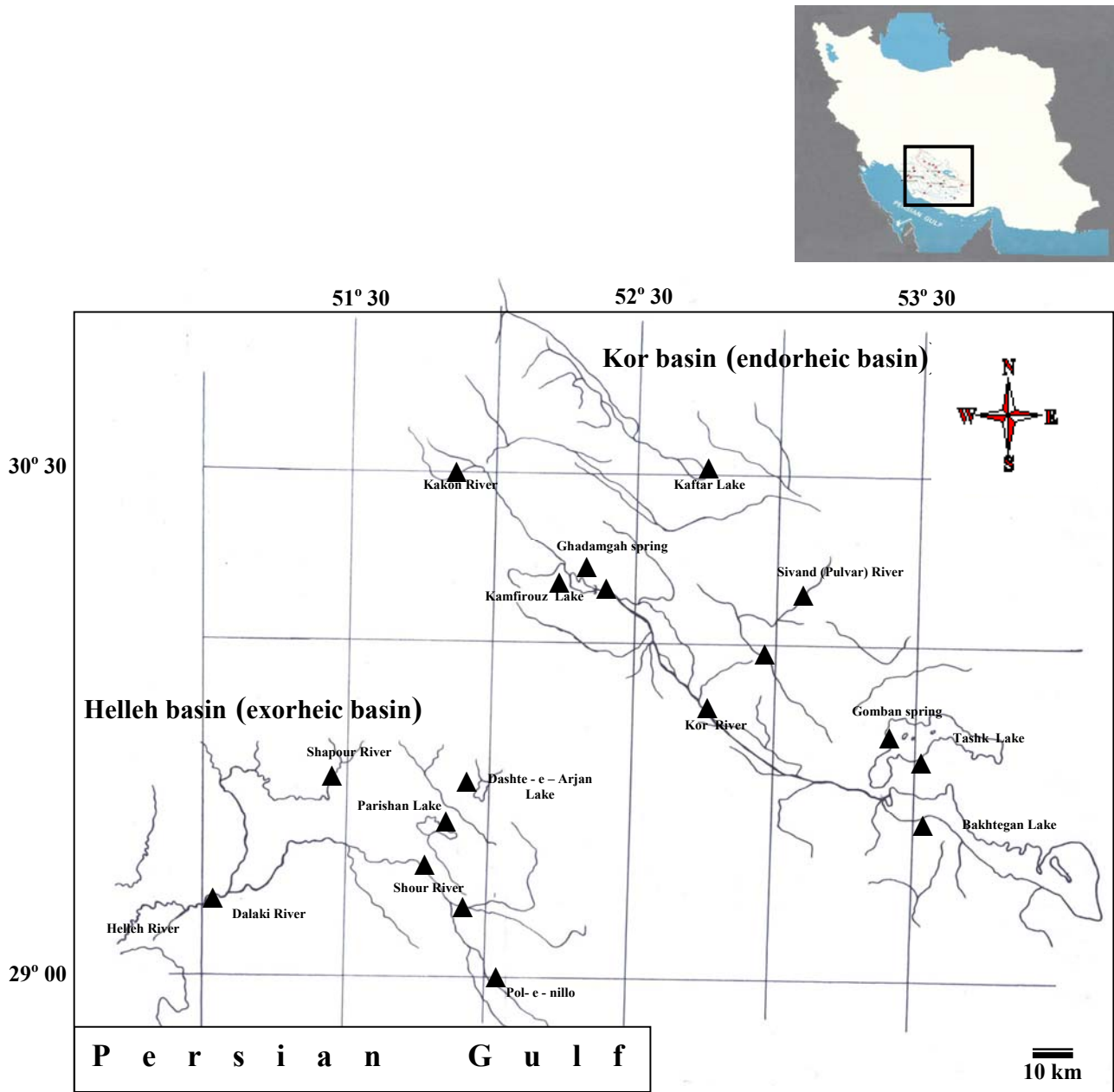


FIG. 1.- Sampling stations in Kor River and Helleh River basins.

ZOOGEOGRAPHY

Iran occupies a significant portion of the Middle East, in terms of land and water area and in terms of zoogeography. The country contains elements of both Ethiopian and Oriental ichthyofauna, although it is predominantly a part of the Palearctic Realm (Coad, 1985). Southern Iran is the main route for movement of animals, especially fish, between the Oriental and Ethiopian biogeographical regions; therefore southern ichthyofauna of Iran is a combination of the Oriental and the Ethiopian. Some genera, for example, *Glyptothorax* (Sisoridae), *Mastacembelus* (Mastacembelidae), *Mystus* (Bagridae), and *Cyprinion* (Cyprinidae) that are found in Persian Gulf basin belong to Oriental and others, such as *Barbus* complex group (Cyprinidae) belong to the Ethiopian region.

TABLE 1. - Orders and families of fishes of the Kor basin in Iran and the number of genera and species. * introduced or translocated species.

Order	Family	No. of genera	%	No. of species	%
Acipenseriformes	Acipenseridae *	2	10	3	12.5
	Cyprinidae	10	50	12	50
Cypriniformes	Cobitidae	1	5	1	4.166
	Nemacheilidae	2	10	3	12.5
Perciformes	Percidae *	1	5	1	4.166
Salmoniformes	Salmonidae *	1	5	1	4.166
Cyprinodontiformes	Cyprinodontidae	1	5	1	4.166
	Poeciliidae *	1	5	1	4.166
Mugiliformes	Mugilidae *	1	5	1	4.166
Total	9	20	100	24	100

TABLE 2. - Orders and families of fishes of the Helleh basin in Iran and the number of genera and species. (*) introduced or translocated species.

Order	Family	Genera n (%)	No. of species
Cypriniformes	Cyprinidae	12 (63.2)	14 (66.7)
	Nemacheilidae	1 (5.3)	1 (4.8)
Siluriformes	Sisoridae	1 (5.3)	1 (4.8)
Mugiliformes	Mugilidae *	1 (5.3)	1 (4.8)
Salmoniformes	Salmonidae *	1 (5.3)	1 (4.8)
Cyprinodontiformes	Cyprinodontidae	1 (5.3)	1 (4.8)
	Poeciliidae *	1 (5.3)	1 (4.8)
Synbranchiformes	Mastacembelidae	1 (5.3)	1 (4.8)
Total	8	19 (100)	21 (100)

KOR RIVER BASIN

The Kor is an endorheic basin in southern Iran. It is a speciation center for several native fish species. Many of the Tigris River basin species are also found in the Kor River basin (Coad, 1985). Two possible routes can be suggested. One is by previous common headwater capture through the Zagros Mountains to the northwest, and the other involves the geological history of the Persian Gulf. As recently as 18000 years ago, the Tigris-Euphrates basin debouched into the mouth of the Pleistocene (Coad, 1985). Rivers of the Gulf and Hormuz basins would then be tributaries to the Tigris-Euphrates basin and could have derived fauna directly from this source (Coad, 1985). This connection can be seen in species such as *Mastacembelus mastacembelus* and *Barilius mesopotamicus* (Coad, 1985).

TABLE 3. - Distribution of Kor River fishes in different water bodies in Southern Iran. A: Gardan-e-pol spring; B: Band-e-Amir spring; C: Ghadamgah spring-stream system; D: Gomban spring; E: Kaftar lake; F: Kakon River; G: Kamfirouz lake; H: Kor River; I: Sivand River; J: Sarab spring; K: Moshkan stream. (T = Translocated fish, En = Endemic fish)

Family	Species	Native /Exotic	A	B	C	D	E	F	G	H	I	J	K
Acipenseridae	<i>Acipenser persicus</i>	T											
	<i>Acipenser stellatus</i>	T											
	<i>Husu huso</i>	T											
Cyprinidae	<i>Alburnoides qanati</i>	Native, En			•		•			•			•
	<i>Alburnus mossulensis</i>	Native			•	•	•		•	•	•		
	<i>Capoeta damascina</i>	Native			•	•	•			•	•		
	<i>Capoeta aculeata</i>	Native, En		•	•	•	•			•			
	<i>Carassius auratus</i>	Exotic					•		•				
	<i>Ctenopharyngedon idella</i>	Exotic											
	<i>Cyprinus carpio</i>	Exotic					•		•				
	<i>Hypophthalmichthys molitrix</i>	Exotic							•				
	<i>Hypophthalmichthys nobilis</i>	Exotic					•						
	<i>Mesopotamichthys sharpeyi</i>	T								•			
	<i>Petroleuciscus persidis</i>	Native, En			•		•			•			
<i>Pseudorasbora parva</i>	Exotic												
Cobitidae	<i>Cobitis linea</i>	Native, En			•							•	
Nemacheilidae	<i>Oxynoemacheilus farsicus</i>	Native, En			•	•						•	•
	<i>Oxynoemacheilus persus</i>	Native, En											
	<i>Seminemacheilus tongiorgii</i>	Native, En			•								
Percidae	<i>Sander lucioperca</i>	T											
Mugilidae	<i>Liza abu</i>	T							•				
Salmonidae	<i>Oncorhynchus mykiss</i>	Exotic											
Cyprinodontidae	<i>Aphanius sophiae</i>	Native, En	•	•	•	•						•	•
Poeciliidae	<i>Gambusia holbrooki</i>	Exotic		•		•	•						

Several species reported in the Kor River basin, *Cyprinion tenuiradius*, *L. pectoralis*, *L. barbatus*, *Carasobarbus luteus*, *Garra rufa*, and *Mastacembelus mastacembelus* (Abdoli, 2000) were not collected there in this study. This may be a case of misidentification or a mistake in earlier reports. These species are found in the Persian Gulf basin. The Kor basin contains species which are not found in the Persian Gulf basin, including *Alburnoides qanati* (formerly *A. bipunctatus*), *Capoeta aculeata*, *Petroleuciscus persidis*, *Oxynoemacheilus farsicus*, *Seminemacheilus tongiorgii*, and *Cobitis linea*. *Alburnoides qanati* is a newly described species in the Kor basin (Coad and Bogutskaya, 2009). The taxonomic status of *A. bipunctatus*

TABLE 4. - Distribution of Helleh basin fishes. A: Dalaki River; B: Dadina spring; C: Dasht-e-Arjan lake; D: Kohmarreh sorkhi River; E: Parishan lake; F: Pol-e- nilo; G: Shapur River; H: Jereh River; I: Shur River. (T = translocated species, En = endemic species)

Family	Species	Native /Exotic	A	B	C	D	E	F	G	H	I
Cyprinidae	<i>Alburnus mossulensis</i>	Native	•	•		•			•	•	
	<i>Carasobarbus luteus</i>	Native	•	•			•		•	•	
	<i>Capoeta damascina</i>	Native	•	•	•	•	•	•	•	•	
	<i>Capoeta barroisi</i>	Native	•			•					•
	<i>Carassius auratus</i>	Exotic					•				
	<i>Ctenopharyngodon idella</i>	Exotic					•				
	<i>Cyprinion cf. macrostomum</i>	Native							•		
	<i>Cyprinus carpio</i>	Exotic					•				
	<i>Garra rufa</i>	Native									
	<i>Hypophthalmichthys molitrix</i>	Exotic					•				
	<i>Hypophthalmichthys nobilis</i>	Exotic					•				
	<i>Lucioarbus barbulus</i>	Native	•			•					
	<i>Pseudorasbora parva</i>	Exotic			•						
	<i>Tor grypus</i>	Native					•				
Nemacheilidae	<i>Oxynoemacheilus persus</i>	Native, En				•			•	•	
Sisoridae	<i>Glyptothorax silviae</i>	Native, En				•					
Mugilidae	<i>Liza abu</i>	T					•				
Salmonidae	<i>Oncorhynchus mykiss</i>	Exotic				•					
Cyprinodontidae	<i>Aphanius cf. sophiae</i>	Native, En			•						
Poeciliidae	<i>Gambusia holbrooki</i>	Exotic		•	•		•				
Mastacembelidae	<i>Mastacembelus mastacembelus</i>	Native	•	•			•				•

complex group in Iran was recently revised, and 5 new Iranian species were described (Bogutskaya and Coad, 2009; Coad and Bogutskaya, 2009). *Petroleuciscus persidis* is a cyprinid fish first described by Coad (1981) from a spring near Darab City in southern Iran. This species is now found in the Maharlu and Kor River basins. Its nearest relative in Iran is *Petroleuciscus ulana*, which was reported in Urmia basin (Abdoli, 2000). *Petroleuciscus borysthenicus* has been recorded in Turkey (Onaran et al., 2006). *Chondrostoma regium* is a cyprinid species found in the Kor River basin. Its taxonomic and zoogeographic status in this area is unclear. Recently the Kor population has been considered as distinct species, *C. orientale* (Esmacili et al., 2010). Presumably the population in the Kor basin originated from the Karoun and Tigris basins where it also occurs. Apparently the origin of this genus is the Iberian Peninsula (Coad, 2010). These areas can be considered true centers for its speciation. Several species of this genus are dominant in the Iberian Peninsula; including 11 endemic species (Zardoya and Doadrio, 1998; Doadrio and Caramona, 2003), and more await formal description (Caramona et al., 2000). However the taxonomy of populations of *Chondrostoma* in the Kor River and other basins should be revised using both molecular and morphological data (Esmacili et al., 2010). *Seminemacheilus tongiorgii* is an endemic loach that is restricted to southern Iran in the Kor River basin. The closest relative of this species is *Seminemacheilus cf. ispartensis*, which is found in Turkey (Kucuk et al., 2007). Taxonomy of this genus needs further work in Iran and other

geographical areas. The cyprinid genus, *Alburnus*, from both Kor and Helleh basins should also be revised using both molecular and morphological data (Esmacili et al., 2010).

HELLEH RIVER BASIN

The Helleh River is one of the important branches of the Persian Gulf basin. As stated, the Helleh basin is located in the proximity of Kor basin, but its ichthyofauna is different from Kor basin in some aspects. The Helleh basin ichthyofauna is a combination of western (Ethiopian) and eastern (Oriental) fauna. Some taxa have several species of Oriental origin, including *Cyprinion* (5 species), *Glyptothorax* (about 30 species), *Garra* (20 species) and *Mastacembelus* (6 species) (Talwar and Jhingran, 1991). All these genera are found in the Helleh basin. *Mastacembelus mastacembelus* and *G. silviae* are not found in southeastern basins of Iran, but their relatives are found in southern and southwestern Iran and Oriental (Talwar and Jhingran, 1991; Abdoli, 2000; Coad, 2010). Therefore, alternatively, the Helleh basin may have received these elements from Oriental. The Helleh basin received elements from the Tigris basin including *Barbus* groups (*L. barbulus*, *L. kersin*, *L. pectoralis*, *Carasobarbus luteus* and *T. grypus*). In this study no specimens of *L. kersin* and *L. pectoralis* were collected.

THREATS

The decrease of water volume due to pump wells usage and diversion canals; drainage rehabilitation which changes the structure of the system; water pollution from domestic and agricultural sources; droughts; and the development of an intensive aquaculture industry with exotic species that may colonize water bodies are major threats to ichthyofauna of the region (Esmacili et al., 2007, 2008, 2009).

Data from the present study indicate that the ichthyofauna of Helleh basin differs from that of the Kor basin, taxonomy of some taxa should be revised, and some fishes are under threat, hence conservation programs are highly recommended.

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LITERATURE CITED

- ABDOLI, A. 2000. The Inland Freshwater Fishes of Iran (In Farsi). *Iranian Museum of Nature and Wildlife*, Tehran, 378 pp.
- ARMANTROUT, N. B. 1980. The freshwater fishes of Iran. Ph.D. Thesis, Oregon State University, Corvallis, Oregon. xx + 472 pp.
- BOGUTSKAYA, N. G. AND COAD, B. W. 2009. A review of vertebral and fin-ray counts in the genus *Alburnoides* (Teleostei: Cyprinidae) with a description of six new species. *Zoosystematica Rossica*, 18(1):126-173.
- CARAMONA, J. A., DOMINGUEZ J. AND AOADRIO, I. 2000. Congruence between allozymes and cytochrome b gene sequence in assessing genetic differentiation within the endemic *Chondrostoma lemmingii* (Pisces: Cyprinidae). *Heredity*, 84: 721-732.
- COAD, B. W. 1981. *Pseudophoxinus persidis*, a new Cyprinid species from Southern Iran. *Canadian Journal of Zoology*, 59 (11): 2058-2063.

- COAD, B. W. 1985. *Alburnus doriae* De Filippi, 1864 a synonym of *Leuciscus lepidus* (Heckel, 1843) (Osteichthyes: Cyprinidae). *Matsya*, 9-10 (1983-1984):173-175.
- COAD, B. W. 2010. *Freshwater Fishes of Iran*. at www.briancoad.com, maintained by Brian W. Coad and Nicholas P. Coad, Pure Throttle Technologies Inc., Ottawa, Ontario.
- COAD, B. W. AND BOGUTSKAYA, N. G. 2009. *Alburnoides qanati*, a new species of cyprinid fish from southern Iran (Actinopterygii, Cyprinidae). *ZooKeys*, 13:67-77.
- DOADRIO, I. AND CARAMONA, J. A. 2003. A new species of the genus *Chondrostoma* Agasiz, 1832 (Actinopterygii, Cyprinidae) from the Iberian Peninsula. *Graellsia*, 59 (1): 29-36.
- ESMAEILI, H. R., TEIMORY, A., COAD, B. W. AND GHOLAMI Z. 2008. Threatened fishes of the world: *Cobitis linea* (Heckel, 1849) (Cobitidae). *Journal of Environmental Biology of Fishes*, 83 (4), pp. 407-408.
- ESMAEILI, H. R., TEIMORY, A., COAD, B. W. AND GHOLAMI Z. 2009. Threatened fishes of the world: *Seminemacheilus tongjiorgii* (Balitoridae). *Journal of Environmental Biology of Fishes*, 84. P.375.
- ESMAEILI, H. R., COAD, B. W., GHOLAMIFARD A., NAZARI N., AND TEIMORY, A. 2010. Annotated checklist of the freshwater fishes of Iran. *Zoosystematica Rossica*19: 361- 386.
- ESMAEILI, H.R., TEIMORY, A. AND KHOSRAVI, A. 2007. A note on the biodiversity of Ghadamghah spring –stream system in Fras Province, Southwest Iran. *Journal of Animal Biosystematics*. 3, 15-22.”
- HECKEL, J. J. 1849. Die Fische Persiens gesammelt von Theodor Kotschy. Schweitzerbart'sche Verlagsbuchhandlung. *Stuttgart*, 2(3): 255-272.
- HOUTUM-SCHINDLER, A. 1891. Note on the Kur River in Fârs, its sources and dams, and the districts it irrigates. *Proceedings of the Royal Geographical Society*, 13: 287-291.
- KUCUK, F., GUMUS, E., GULLE I. AND GUCLU, S. S. 2007. The fish fauna of the Goksa River (Turkiye): Taxonomic and zoogeographic features. *Turkish journal of Fisheries and aquatic Sciences*, 7: 53-63.
- ONARAN, M. A., OZDEMIR, N. AND YILMAZ, F. 2006. The fish fauna of Esen Stream (Fethiye-Mugla). *International Journal of Science and Technology*, 1 (1): 35-41.
- SAADATI, M. A. G. 1977. Taxonomy and distribution of the freshwater fishes of Iran. M.S. Thesis, Colorado State University, Fort Collins. xiii + 212 pp.
- TALWAR, P. K. AND JHINGRAN, A. G. 1991. Inland Fishes of India and Adjacent Courtiers. *New Delhi*, Vol: 1. xvi+1158.
- ZARDOYA, R. AND DOADRIO, L. 1998. Phylogenetic Relationships of Iberian Cyprinids: Systematic and Biogeographical Implications. *Biological Science*, 265 (1403): 1365-1372.