



Original Article

Fishes of the Dasht-e Kavir basin of Iran: an updated checklist

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Abstract: This study provide a new and updated checklist of the freshwater fishes of the Dasht-e Kavir basin of Iran. The list is based on historical literature records and taxon occurrence data obtained as a result of extensive field expeditions, examination of ichthyological collections and literature review. The total confirmed freshwater fish species of the Dasht-e Kavir basin comprise 22 species in 17 genera, 6 families, 4 orders and one class. The most diverse order is the Cypriniformes with 18 species (81.82%) followed by Cyprinodontiformes (2 species, 9.09%), Salmoniformes and Gasterosteiformes each with 1 species (1 species, 4.55%). The most diverse family is the Cyprinidae with 18 species (72.73%), Nemacheilidae (2 species, 9.09%) followed by Salmonidae, Cyprinodontidae, Poeciliidae and Gasterosteidae each with only one species (4.55%). New species are supposed to be discovered, the taxonomic status of some species has been changed, some are being resurrected from synonymy, and some taxonomic problems remain and are commented on briefly. Four endemic species (18.18%) in 4 genera and 2 families; and 12 exotic species (54.55%) in 10 genera and 4 families are listed here.

Article history:

Received 2 May 2015

Accepted 7 July 2015

Available online 25 August 2015

Keywords:

Checklist

Biodiversity

Freshwater fishes

Dasht-e Kavir basin

Introduction

The Iran is located in the Palearctic region bordering the Oriental and African zones (Coad and Vilenkin, 2004) and its north-west, west and south-west are parts of Irano-Anatolian hot spot with high biodiversity especially freshwater fish (Esmaili et al., 2010, 2014a, b). Iran is divided into Nineteen drainage basins (Fig. 1) both exorheic where the rivers and lakes drain to the sea and endorheic, where rivers drain to an internal basin such as a lake, or are lost in the desert, and have no connection with the sea (Coad, 2015; Esmaili et al., 2015). Dasht-e Kavir is a large desert lying in the middle of the Iranian plateau and is one of the endorheic basins of Iran that occupies about 230,400 sq km in the rain shadow of the Alborz Mountains (Fig. 2) (Afshin, 1994; Coad, 2015).

The main streams entering this basin, drain the Alborz Mountains and their eastern extensions in

Khorasan. Intermittent streams drain to several Kavirs viz the Damghan Kavir in the north, the Sabzevar or Kalshur Kavir in the north-east and the Great Kavir which are grouped together under Dasht-e Kavir basin. The Great Kavir is the largest one that its rivers except Hableh (Fig. 3) and Golrudbar Rivers, are temporary streams (Afshin, 1994). The Great Kavir also receive waters exiting from other kavirs (Afshin, 1994; Coad, 2015). The Damghan Kavir receives two major streams including the Damghan and Hasanabad Rivers, and other streams dry up in early summer. The Sabzevar Kavir has numerous small and temporary streams which feed it as well as two major streams, the Mureh and Kalshur Rivers. The Kalshur drains the Kuh-e Binalud and flows west to meet the south flowing Mureh. In addition, qanats support fishes in this area (Fig. 4). Qanat discharges in this area were 20-50 l/sec (Coad, 2015). Mahdavi and Anderson

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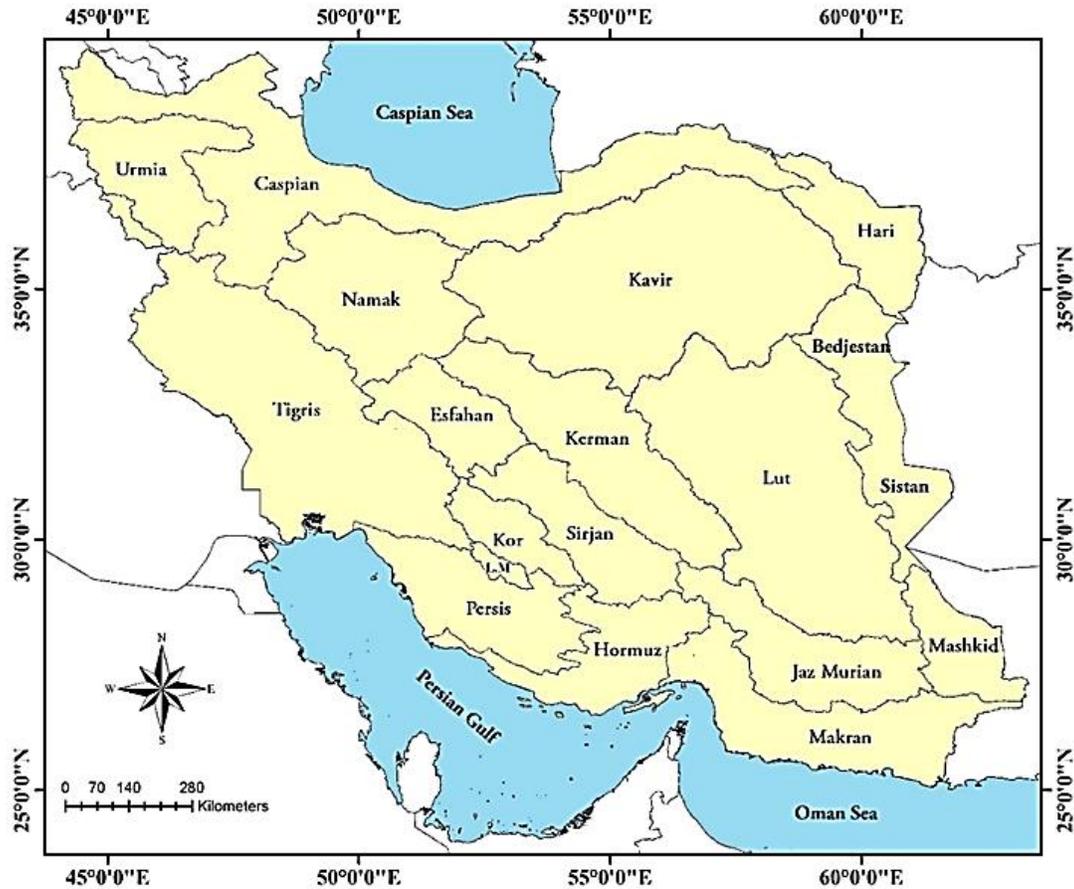


Figure 1. Map of Iran showing different drainage basins of Iran (L.M: Lake Maharlu basin).

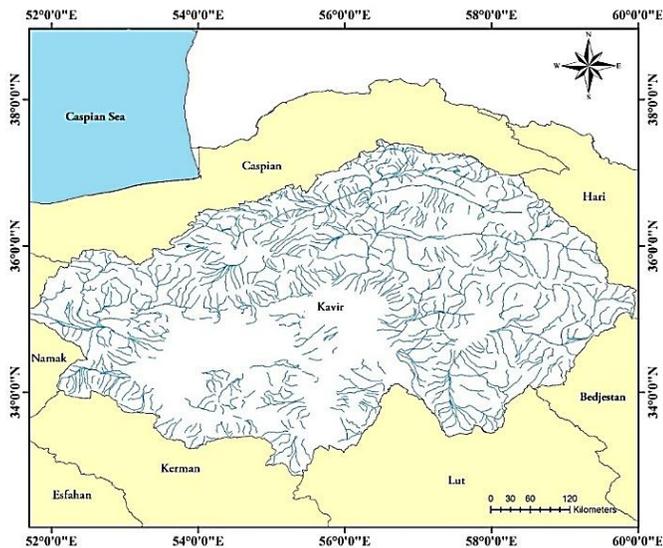


Figure 2. Map of the Dasht-e Kavir basin of Iran.

(1983) detailed the qanat water supply of the margins of this basin.

It can be expected that endorheic and exorheic basins of Iran represent the higher diversity of freshwater

fish species i.e. approximately 222 species or more (Esmaili et al., 2014a, b). Therefore, the present study provides an updated checklist including natives, endemics, exotics and transplanted fish species, from the Dasht-e Kavir basin which is considerably higher than that given in the last checklist provided by Coad (1998) and Esmaili et al. (2010).

Materials and Methods

This checklist has been resulted from the works listed in the references (see the references) and also by examination or accessing available data in ichthyological collections in Iran (e.g., ZM-CBSU, Zoological Museum of Shiraz University, Collection of Biology Department, Shiraz; CMNFI, Canadian Museum of Nature, Ottawa, Canada; BMNH, Natural History Museum, London, UK; personal fish collection of Soheil Eagderi, Fisheries Department, University of Tehran) and extensive



Figure 3. Nam River, a tributary of Hableh River, Kavir basin, Iran.



Figure 4. Qanat Pir salman (Qanats are important habitat for fishes of the Dasht-e kavir basin)

field expeditions till June 2015 from different river systems of the Dasht-e Kavir basin of Iran (Fig. 2).

Results

The total fish species of the Dasht-e Kavir basin comprise 22 species in 18 genera, 6 families, 4 orders and one class. The most diverse order is the Cypriniformes with 18 species (81.82%) followed by Cyprinodontiformes (2 species, 9.09%), Salmoniformes and Gasterosteiformes each with one species (1 species, 4.55%). The most diverse family is the Cyprinidae with 18 species (72.73%), Nemacheilidae (2 species, 9.09%) followed by Salmonidae, Cyprinodontidae, Poeciliidae and Gasterosteidae each with only one species (4.55%). The Dasht-e Kavir basin comprises four confirmed endemic (18.18%) and 12 exotic species (54.55%) (Table 1).

Checklist

* = endemic to Iran, ** = exotic.

Class Actinopterygii

Order Cypriniformes (2 families, 14 genera and 18 species)

Family Cyprinidae (12 genera and, 16 species)

Genus *Alburnoides* Jettelles, 1861

1. *Alburnoides* sp. *

Comment: The members of the genus *Alburnoides* is under revision in Iran. The recent studies suggest that the members of this genus from the Dasht-e Kavir is



Figure 5. *Alburnoides* sp.

different from that of *A. namaki* in terms of molecular and morphological characteristics and probably belongs to a separate taxa (Fig. 5).

Genus *Alburnus* Rafinesque, 1820

2. *Alburnus hohenackeri* Kessler, 1877 **

Comments: *Alburnus hohenackeri* was originally described from Karabakh, Azerbaijan, on the Kura River. Previously the wide-ranging species *Alburnus alburnus* (Linnaeus, 1758) was identified as the taxon in Iran. *Alburnus charusini* Herzenstein, 1889 is a synonym. Introduced to the Dasht-e Kavir basin.

Genus *Barbus* Cuvier, 1816

3. *Barbus* sp. *



Figure 6. *Barbus* sp.

Comments: *Barbus miliaris* De Filippi, 1863 was described from a "fiumicelli presso Teheran" (= a stream near Tehran). Karaman (1971) considers *Barbus miliaris* from the Namak Lake basin of Iran

Table 1. List of fish taxa of Dasht-e Kavir basin in different ecological group.

Family	Species	Ecological group
	<i>Alburnoides</i> sp.	fluvial
	<i>Alburnus hohenackeri</i>	fluvial
	<i>Barbus</i> sp.	fluvial
	<i>Capoeta aculeata</i>	fluvial
	<i>Capoeta buhsei</i>	fluvial
	<i>Capoeta fusca</i>	fluvial
	<i>Carassius auratus</i>	fluvial
	<i>Carassius gibelio</i>	fluvial
Cyprinidae	<i>Ctenopharyngodon idella</i>	fluvial
	<i>Cyprinus carpio</i>	fluvial-semi
	<i>Hemiculter leucisculus</i>	fluvial
	<i>Hypophthalmichthys molitrix</i>	fluvial
	<i>Hypophthalmichthys nobilis</i>	fluvial
	<i>Pseudorasbora parva</i>	fluvial
	<i>Schizothorax pelzami</i>	fluvial
	<i>Squalius</i> cf. <i>orientalis</i>	fluvial
Nemacheilidae	<i>Paracobitis malapterura</i>	fluvial
	<i>Paraschistura turcmenica</i>	fluvial
Salmonidae	<i>Oncorhynchus mykiss</i>	fluvial
Cyprinodontidae	<i>Aphanius kavirensis</i>	fluvial?
Poeciliidae	<i>Gambusia holbrooki</i>	fluvial
Gasterosteidae	<i>Gasterosteus aculeatus</i>	Fluvial

to be a subspecies of the Caspian Sea basin type subspecies, differentiated by larger scales (78-92 versus 85-103 of *Luciobarbus mursa*), less fleshy lips, an undeveloped lower lip lobe, feebly ossified last dorsal fin spine, and shorter pectoral fins. Berg (1948-1949) recognised *miliaris* as distinct from *mursa* on the basis of a shorter snout, somewhat larger scales, fewer scale rows above the lateral line, smaller dimensions and different colour. According to our morphological studied, it seems that population of *Barbus* in the Dasht-e Kavir basin belongs to *Barbus miliaris*, but more studies are required (Fig. 6).

Genus *Capoeta* Valenciennes, 1842

4. *Capoeta aculeata* (Valenciennes, 1844)



Figure 7. *Capoeta aculeata*.

Comment: *Chondrostoma aculeatum* was originally described from "eaux douces de la Perse" (=Iran

freshwater). *Scaphiodon macrolepis* Heckel, 1847 was described from probably the Pulvar (= Sivan) River, Fars near Persepolis and *Varicorhinus bergi* Derzhavin, 1929 was described from Karaj River near Tehran. However, both now are synonyms (Fig. 7).

5. *Capoeta buhsei* Kessler, 1877 *



Figure 8. *Capoeta buhsei*.

Comment: Type locality is not clear, probably Karaj River near Tehran, Iran. *Varicorhinus nikolskii* Derzhavin, 1929 was described in Latin from the "Keredsh flumen" (= Karaj River near Tehran) is a synonym (Fig. 8).

6. *Capoeta fusca* Nikol'skii, 1897

Comment: Type locality is Mondechi and Kuss, Iran. *Capoeta nudiventris* Nikol'skii, 1897 is a synonym (Fig. 9).

Genus *Carassius* Jarocki, 1822

7. *Carassius auratus* (Linnaeus, 1758) **

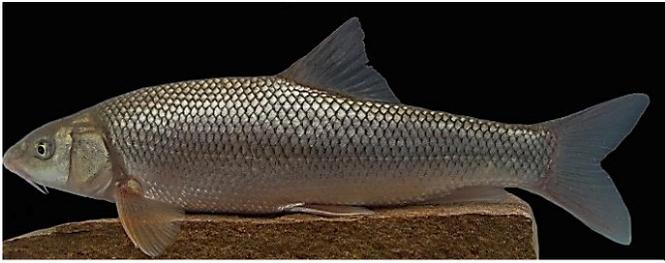


Figure 9. *Capoeta fusca*.

Comment: *Cyprinus auratus* was originally described from China and Japanese rivers. Introduced to the Caspian Sea and Sistan basins.

8. *Carassius gibelio* (Bloch, 1782) **

Comment: *Cyprinus gibelio* was originally described from Odra River system, Silesia, Czech Republic. Kottelat and Freyhof (2007); Bogutskaya et al. (2008, with question); Esmaeili et al. (2010); Kalous et al. (2012) considered it as distinct species.

Genus *Ctenopharyngodon* Steindachner, 1866

9. *Ctenopharyngodon idella* (Valenciennes, 1844) **

Comment: Type locality in China. No types known.

Genus *Cyprinus* Linnaeus, 1758

10. *Cyprinus carpio* Linnaeus, 1758 **

Comment: Type locality in Europe. Native populations in the Caspian Sea basin; also introduced to the Dasht-e Kavir basin and elsewhere in Iran.

Cyprinion Cypris Heckel, 1843 is a synonym.

Genus *Hemiculter* Bleeker, 1859

11. *Hemiculter leucisculus* (Basilewsky, 1855) **

Comment: *Culter leucisculus* was originally described from Peking, China. *Hemiculter eigenmanni* (Jordan and Metz, 1913) is a synonym.

Introduced to the Dasht-e Kavir basin.

Genus *Hypophthalmichthys* Bleeker, 1859

12. *Hypophthalmichthys molitrix* (Valenciennes, 1844) **

Comment: Introduced to the Dasht-e Kavir basin. *Leuciscus molitrix* was originally described from China.

13. *Hypophthalmichthys nobilis* (Richardson, 1844) **

Comment: Introduced to the Dasht-e Kavir basin. *Leuciscus nobilis* was originally described from Canton, China.

Genus *Pseudorasbora* Bleeker, 1859

14. *Pseudorasbora parva* (Temminck and Schlegel, 1846) **

Comment: Introduced to the Dasht-e Kavir basin. *Leuciscus parvus* Temminck and Schlegel, 1846 was originally described from Japan.

Genus *Schizothorax* Heckel, 1838

15. *Schizothorax pelzami* Kessler, 1870



Figure 10. *Schizothorax pelzami*.

Comment: Type locality is Cabul River at Jullalabad. Tarnuck River in the Indus River basin.

Schizothorax schumacheri Fowler and Steinitz, 1956 is an Iranian synonym (Fig. 10)

Genus *Squalius* Bonaparte, 1837

16. *Squalius cf. orientalis* (Nordmann, 1840)



Figure 11. *Squalius cf. orientalis*.

Comment: *Leuciscus orientalis* was originally described from Abkhazia Georgia, No types known. It has been considered as valid species (Doadrio and Carmona, 2004; Bogutskaya and Zupančič, 2010; Turan et al., 2009; Perea et al., 2010; Esmaeili et al., 2014a) (Fig. 11).

Family Nemacheilidae (1 genus and 1 species)

Comment: Formerly included in the family Cobitidae or the family was named Balitoridae (see Tang et al. (2006) and Kottelat and Freyhof (2007)). This species were placed in the genera *Nemacheilus*, *Adiposia*, *Barbatula*, *Orthrias* and *Schistura* in earlier literature.

Genus *Paracobitis* Bleeker, 1863

17. *Paracobitis malapterura* (Valenciennes, 1846)

Comment: *Cobitis malapterura* was described from the Namak Lake basin of Iran (Freyhof et al., 2015). Based on Vatandoust et al. (2014) and Freyhof et al. (2015), the mitochondrial gene tree showed the



Figure 12. *Paracoptis malapterura*.

Dasht-e Kavir basin population belongs to *P. malapterura* (Fig. 12).

18. *Paraschistura turcmenica* (Berg, 1932)

Comment: *Nemachilus turcmenicus* was originally described from Keltechinar River [Cherokh River] near Gyaurs (37°47'N, 58°44'E), Turkmenistan.

Order Salmoniformes (1 family, 1 genus and 1 species)

Family Salmonidae (1 genus and 1 species)

Genus *Oncorhynchus* Suckley, 1861

19. *Oncorhynchus mykiss* (Walbaum, 1792) **

Comment: *Salmo mykiss* was originally described from Kamchatka, Russia. Introduced to the Dasht-e Kavir basin.

Order Cyprinodontiformes (1 families, 1 genus and 1 species)

Family Cyprinodontidae (1 genus and 1 species)

Genus *Aphanius* Nardo, 1827

20. *Aphanius kavirensis* Esmaili, Teimori, Gholami and Reichenbacher, 2014 *



Figure 13. Female (above) and male (below) of *Aphanius kavirensis*.

Comment: Type locality in Semnan, Damghan, Cheshmeh Ali Spring, Kavir Basin, 36°16'45.6"N, 54°05'01.6"E, Iran, altitude 1569 meters. Holotype: ZM-CBSU 9587a (Figs. 13-14).



Figure 14. Cheshmeh Ali Spring at Damghan city (Dasht-e Kavir basin), natural habitat of *Aphanius kavirensis*.

Family Poeciliidae (1 genus and 1 species)

Genus *Gambusia* Poey, 1854

21. *Gambusia holbrooki* Girard, 1859 **

Comment: Type locality in Palatka, eastern Florida; Charleston, South Carolina, U.S.A. Introduced to the Dasht-e Kavir basin.

Order Gasterosteiformes (1 families, 1 genus and 1 species)

Family Gasterosteidae (1 genus and 1 species)

Genus *Gasterosteus* Linnaeus, 1758

22. *Gasterosteus aculeatus* Linnaeus, 1758 **

Comment: *Gasterosteus aculeatus* was originally described from Europe. Introduced to the Dasht-e Kavir basin.

Discussion

Anthropogenic activities have played a significant role in changing distribution pattern of Iranian freshwater fishes especially in the past few decades (Esmaili et al., 2010a, 2012, 2015) which can be well-understood regarding the Dasht-e Kavir basin due to presence of 12 exotic species (54.55%). *Ctenopharyngodon idella*, *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *H. nobilis* and *Ocorynchus mykiss* are commercially valuable exotic species recorded from this basin and probably introduced to the natural aquatic ecosystems of the Dasht-e Kavir basin by fish farmers. In addition, *A. hohenackeri*, *C. auratus*, *C. gibelio*, *H. leucisculus*, *P. parva*, and *G. aculeatus* have been

probably introduced to this basin along with commercially important cyprinds from the Caspian Sea basin as accidental introduction. Furthermore, *G. holbrooki* has been released as a control agent for *Anopheles* controlling (malaria) (Tabibzadeh et al., 1970). Some of them (e.g., *Cyprinus carpio*, *Carassius auratus*, *Pseudorasbora parva* and *Gambusia holbrooki*) have been established in natural water bodies acting as invasion species. The introduction of a non-native species in an ecosystem is likely present an ecological risk if the species is able to integrate itself successfully into the ecosystem (Gozlan and Newton, 2009), resulting in possible detrimental interactions with native species or even on ecosystem functioning (Gozlan et al., 2010).

Freshwater fishes provide relatively conservative system for examining zoogeographical patterns. Since, they are limited to drainage systems and cannot disperse without connections of the freshwater systems (Berra, 2001). Iran occupies a significant portion of the Middle East and its freshwater fish fauna stands out from its neighboring counterpart in terms of species richness and level of endemism (see Esmaeili et al., 2010, 2014a-b; Coad, 2015). Geographical isolation, together with the climatic conditions and watershed fragmentation experienced by Iranian plateau over geological time, has led to differentiation of the freshwater ichthyofauna into several independent and isolated populations promoting speciation. Iran contains elements of both Ethiopian and Oriental ichthyofauna, although it is predominantly a part of the Palearctic Realm. This zoogeographical situation, coupled with the past geological history, vicariance events and recent anthropogenic effects have played a significant role on the ichthyodiversity of Iran (Coad, 1982; Kosswig, 1951; Naseka, 2010). Iranian current inland basins were present since the early Tertiary (about 70 mya) before entrance of fish species. From the Pliocene period (about 6 to 2 mya) along with originating of the Middle East ichthyofauna, the inland basins of Iran had arid climate that prevents permanent settlement of the

ichthyofauna due to lacking proper habitats (Por, 1975; Coad 1995). A vast desert belt is extended from the west of Africa toward Saudi Arabia, Syria, Iran and India possessing almost similar animal fauna that climatic features is considered as main factor operating in their distribution. Across this belt, there were higher speciation events of fishes with a basic ichthyofauna formed by the members of the families, including Cyprinidae, Nemacheilidae, Mastacembelidae, Cyprinodontidae and Cichlidae that characterised by a relatively high resistance to salt waters. Hence, they can find from Africa to India across this belt and the migrations could be occurred along this belt toward the East and vice versa (Berra, 1981). The Dasht-e kavir basin, a part of this desert belt has arid climate characterised by less than 200 mm annual rainfall. Therefore, its native limited freshwater fish species, including *Capoeta*, *Schizothorax* and some members of the family Nemacheilidae have an origin of this desert belt. The diversity of ichthyofauna in India, Southeast Asia and West Africa is much more than that of its center i.e. the Middle East despite having opportunities to produce a higher diversity that may limited due to arid climate (Por, 1975; Coad, 1995).

North of this desert belt along the Middle East is confined by the Taurus Mountains in Turkey, Alborz Mountains in Iran and Hindu Kush-Himalayan Mountains in Afghanistan and India. These mountain chains are topographic barrier to reach precipitation from the north and create drought conditions in the southern regions (Abell et al., 2008). In addition, these mountain chains have separated the fish fauna of the southern drought regions from Palearctic fish fauna acting as a filter because some exchanges have occurred between them particularly at the western parts of this high mountains in Iran and Turkey, where the mountain barrier is not continuous (Gleick, 1993). In some regions, the rivers including Hari and Murghab Rivers (in east of Iran), Sefid River (in north of Iran) and Aras River (in West of Iran and east of Turkey) cross the mountains and therefore provide the passages for exchanges (Abell et al., 2008; Coad,

2015).

Three taxa of freshwater fishes with the origin of the desert belt, including *Capoeta*, *Barbus* and members of the family Nemacheilidae are found in the north of above mentioned mountains i.e. the Palearctic ecozone (Nümann, 1966). Furthermore, some members of the subfamily Leuciscinae such as *Alburnus* and *Squalius* with the origin from the Palearctic are found in the southern part of this mountains (Naseka, 2010). These distribution patterns of fish species in both sides of the mountain chains shows the occurrence of exchange between them that have provides opportunity for further movement of some Palearctic fish species toward south. The occurrence of the genera *Alburnoides*, *Alburnus* and *Squalius* in the Dasht-e Kavir basin could be as result of such an exchange (Coad, 2015). Ichthyofauna of Iran except remains of marine species e.g. *A. kavirensis*, could not reached Iranian inland water until the Pliocene and Pleistocene periods that main exchange occurred (Frenkel, 1995). After to the Pliocene and Pleistocene periods, the most of Iranian freshwater fishes were settled except *Cyprinion* and some other isolated genera (Menon, 1964; Karaman, 1971). Most of Iranian fishes except the genus *Cyprinion* and some isolated genera are not endemic and have arisen and settled as result of the exchanges (Naseka, 2010; Coad, 2015). The Dasht-e Kavir basin similar to many basins of the above mentioned desert belt has arid climate possessing a composition of exotic, exchanged and endemic fish species that have ability to withstand harsh conditions of the arid climate and inhabit springs and qanats that are isolated from main rivers and each other.

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چکیده فارسی

فهرست به روز شده ماهیان حوضه آبریز دشت کویر ایران

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چکیده:

مطالعه حاضر فهرست جدید و به روز شده ماهیان آب شیرین حوضه آبریز دشت کویر ایران را ارائه می‌نماید. این فهرست بر اساس مطالعات پیشین، مشاهدات میدانی، نمونه برداری‌های گسترده، بررسی نمونه‌های موزه‌ای و مرور منابع تهیه شده است. در مجموع ۲۲ گونه ماهی متعلق به ۱۷ جنس، ۶ خانواده، ۴ راسته و ۱ رده از حوضه آبریز دشت کویر تایید و گزارش گردید. فراوان‌ترین راسته مربوط به کپورماهی شکلان Cypriniformes با ۱۸ گونه (۸۱/۸۲ درصد) و به دنبال آن راسته کپورماهیان دندان‌دار Cyprinodontiformes با ۲ گونه (۹/۰۹ درصد)، راسته آزادماهی شکلان Salmoniformes و سه‌خاره‌ماهی شکلان Gasterosteiformes هر کدام با ۱ گونه (۱ گونه، ۴/۵۵ درصد) قرار داشتند. فراوان‌ترین خانواده مربوط به کپورماهیان با ۱۸ گونه (۷۲/۷۳ درصد)، سگ‌ماهیان جویباری (۲ گونه، ۹/۰۹ درصد) و به دنبال آن خانواده‌های آزادماهیان Salmonidae، کپورماهیان دندان‌دار Cyprinodontidae، پشه ماهیان Poeciliidae و سه‌خاره ماهیان Gasterosteidae هر کدام با یک گونه (۱ گونه، ۴/۵۵ درصد) بودند. در این حوضه آبریز احتمال کشف گونه‌های جدید وجود داد، وضعیت آرایه‌شناختی برخی گونه‌ها تغییر کرده، برخی گونه‌های معتبر شده و همچنین برخی مشکلات آرایه‌شناختی هنوز وجود دارد که به صورت توضیح کوتاه بیان شده‌اند. چهار گونه بومزاد (۱۸/۱۸ درصد) مشتمل بر ۴ جنس و ۲ خانواده و ۱۲ گونه مهاجم (۵۴/۵۵ درصد) مشتمل بر ۱۰ جنس و ۴ خانواده در این مقاله فهرست می‌گردد.

کلمات کلیدی: فهرست، تنوع زیستی، ماهیان آب شیرین، حوضه آبریز دشت کویر.