

Exotic ornamental fishes in Iranian inland water basins: an updated checklist

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Abstract

The number of exotic freshwater ornamental fish species released from the aquarium trade in Iran has been increasing in recent years. All recorded exotic aquarium fishes are listed here, including 8 species in 7 genera, 5 families, and 5 orders. The introduced species belong to the Neotropical, Nearctic and Palearctic fish elements. Their distribution ranges within Iranian freshwater ecosystems are given, and the presence of Koi (ornamental *Cyprinus carpio*) are recorded for the first time from Iranian inland waters. Eradication programs need to be accompanied by a public awareness campaign to ensure that the aquarium trade and hobbyists do not release these pet fishes into natural habitats.

Received: 30 March 2019

Accepted: 13 July 2019

Published online: 30 September 2019

Key words: Aquarium trade, exotic fish, alien species, Neotropical, Nearctic, Palearctic

Introduction

The introduction of nonnative fish species to Iran has increased considerably within recent decades (Jouladeh-Roudbar et al., 2015), reaching 29 confirmed species belonging to eleven families for Iran (Esmaeili et al., 2018). Development of the aquarium trade industry, increasing transport capacity and economic globalization have accelerated the rate of introductions of alien species throughout the world. Therefore, one of the important pathways for the introduction of non-indigenous species is the aquarium fish trade (Copp et al., 2005; Rixon et al., 2005; Nunes et al., 2015), and several freshwater ornamental fish species have been reported within the last few years in Iran (Esmaeili et al., 2013; Mousavi-Sabet and Eagderi, 2014; 2016; Esmaeili et al., 2017). Introductions of fish species into Iranian water bodies dates back a long time, but were most prominent in the 1920s when the mosquitofish, *Gambusia holbrooki* Girard, 1859 (Poeciliidae) was introduced as an anti-malarial agent (Esmaeili et al., 2010; Jouladeh-Roudbar et al., 2015). Since then, about 9.76% of the Iranian ichthyofauna has comprised of introduced fishes (Esmaeili et al., 2018). Aquaculture, the aquarium trade, sport fishing, control of malaria, research and accidental introductions have been the main reasons for these introductions in the country (Coad, 1996; Esmaeili et al., 2007; Radkhah et al., 2016).

In this paper, the exotic ornamental fishes within Iranian freshwater ecosystems are listed, their distributions are given, and approaches to future research and management strategies are suggested.

Material and Methods

The current checklist is based on information collected from extensive searches of databases including the Zoological Record, Catalog of Fishes, Fishbase, Biological Abstracts, Helminthological Abstracts, Web of Knowledge, Google Scholar, Aquatic Sciences and Fisheries Abstracts Bibliography, and extensive field expeditions since 2008 throughout Iran. The fishes were collected from different water bodies, using different equipment, such as hand-net, gillnet, and electrofishing equipment. After anaesthesia, fishes were fixed in 5% formaldehyde and stored in 70% ethanol or directly fixed in 99% ethanol. The collected specimens were deposited in the Vatandoust and Mousavi-Sabet Fish Collection, Tehran (VMFC). The presented map is prepared based on available records of the exotic ornamental fishes throughout Iranian water basins.

Results

The exotic ornamental fish species introduced to Iranian inland water basins are listed below and their distribution map is given in Figure 1. The alien fishes introduced to Iran due aquarium trade, comprise 8 species in 7 genera, 5 families, and 5 orders as follows:

Taxonomic Account

Order Characiformes Regan, 1911

Family Serrasalminae Bleeker, 1859

Genus *Piaractus* Eigenmann, 1903

Piaractus brachipomus Cuvier, 1818 - Pirapitinga

Type locality: Brazil

Distribution in Iranian water basins: ehT Tigris River drainage, the Persian Gulf basin (Esmaeili et al., 2017) and also likely in the Hari River basin (Mousavi-Sabet et al., 2018).

Order Cichliformes Betancur-R et al., 2013

Family Cichlidae Bonaparte, 1835

Genus *Amatitlania* Schmitter-Soto, 2007

Amatitlania nigrofasciata (Günther, 1867) - Convict Cichlid (Fig. 2)

Type locality: Lake Amatitlán, Guatemala.

Distribution in Iranian water basins: Reported from headwater of the Kol River, Hormuz basin (Esmaeili et al., 2017) and the Soleymaniyeh spring, Namak Lake basin (Mousavi-Sabet and Eagderi, 2016).

Order Cypriniformes Bleeker, 1859

Family Cyprinidae Rafinesque, 1815

Genus *Carassius* Jarocki, 1822

Carassius auratus (Linnaeus, 1758) - Goldfish (Fig. 3)

Type locality: *Cyprinus auratus* Linnaeus, 1758 was originally described from China and Japanese rivers.

Distribution in Iranian water basins: Introduced to several basins in Iran.

Genus *Cyprinus* Linnaeus, 1758

Cyprinus carpio Linnaeus, 1758 - Koi (Fig. 4)

Type locality: Europe (for wild *Cyprinus carpio*).

Distribution in Iranian water basins: Introduced to the Sarcheshme Spring (33°55'42.74" N, 50°26'59.57" E), Mahalat City, Markazi Province, Namak Lake basin.

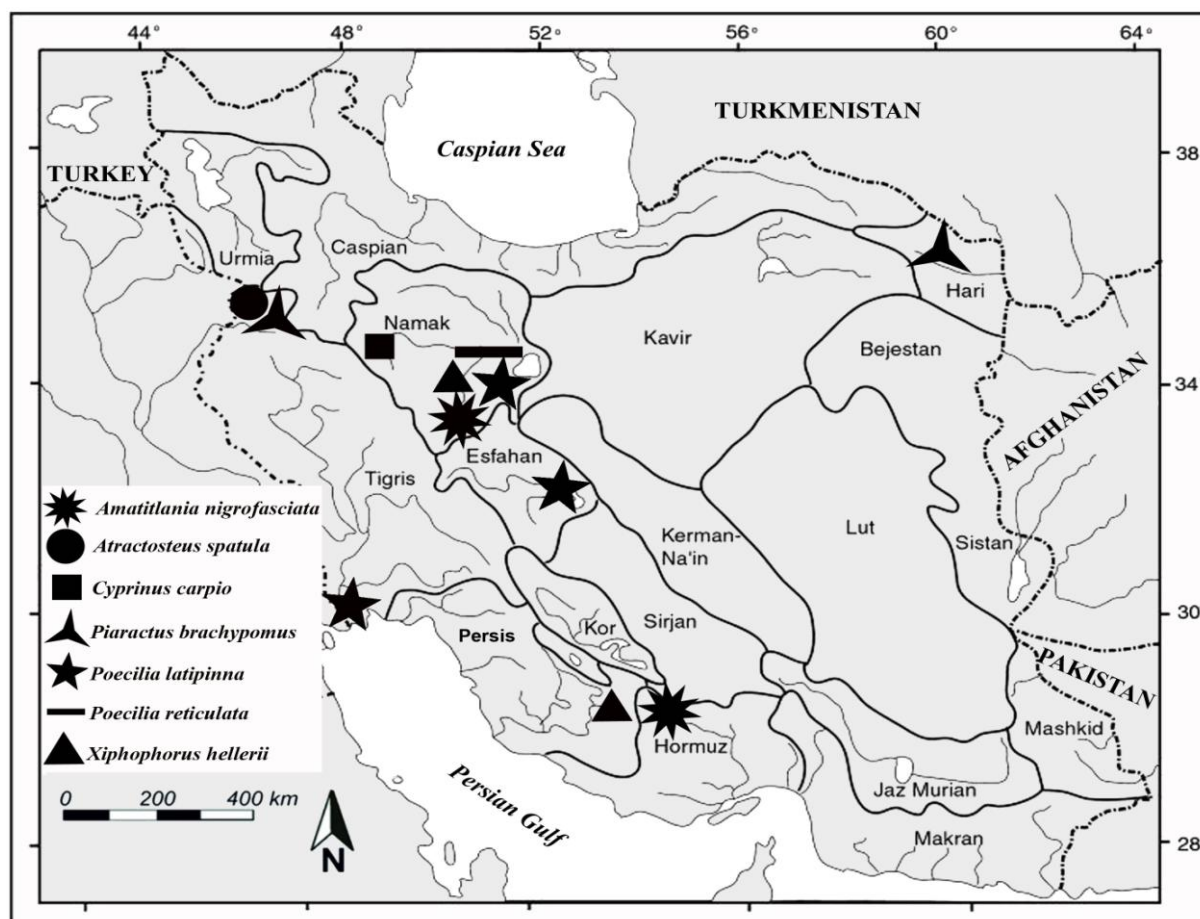


Figure 1: Map of the Iranian water basins, showing the distribution of 7 exotic ornamental fishes. The Goldfish, *Carassius auratus*, is ignored on the map, based on its wide distribution throughout Iran.



Figure 2: *Amatitlania nigrofasciata*: female, from the Namak Lake basin, Iran.



Figure 3: *Carassius auratus*, from the Tigris River basin, Iran.



Figure 4: *Cyprinus carpio*, from the Namak Lake basin, Iran.

Order Cyprinodontiformes Berg, 1940

Family Poeciliidae Garman, 1895

Genus *Poecilia* Bloch and Schneider, 1801

Poecilia latipinna (Lesueur, 1821) - Sailfin Molly (Fig. 5)

Type locality: Freshwater ponds in the vicinity of New Orleans, Louisiana, USA.

Distribution in Iranian water basins: The Esfahan, Namak Lake and the Tigris River (Persian Gulf basin) basins (Esmaeili et al., 2017; Mousavi-Sabet, 2018).

Poecilia reticulata Peters, 1859 - Guppy (Fig. 6)

Type locality: The Guayre River, Caracas, Venezuela.

Distribution in Iranian water basins: The Namak Lake basin (Mousavi-Sabet and Eagderi, 2014).

Genus *Xiphophorus* Heckel, 1848

Xiphophorus hellerii Heckel, 1848 - Green Swordtail (Fig. 7)

Type locality: Orizaba, Mexico [Atlantic].

Distribution in Iranian water basins: The Namak Lake and Persis basins.

Order Lepisosteiformes Hay, 1929

Family Lepisosteidae Cuvier, 1825

Genus *Atractosteus* Rafinesque, 1820

Atractosteus spatula (Lacepède, 1803) - Alligator gar

Type locality: North America.

Distribution in Iranian water basins: A single specimen of *Atractosteus spatula* was reported from the Marivan (Zarivar) Lake, in the Tigris River drainage, the Persian Gulf basin (Esmaeili et al., 2017).

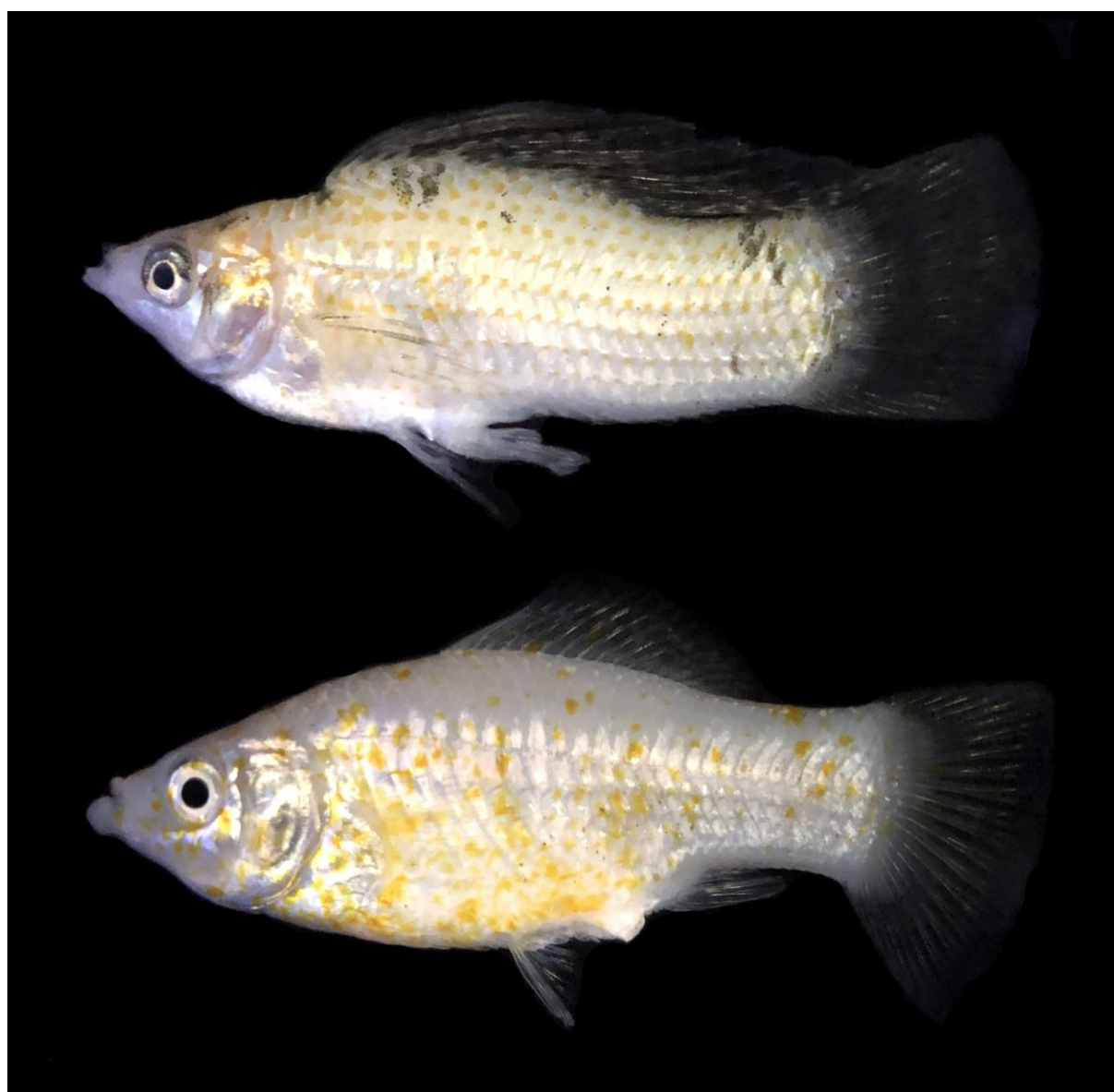


Figure 5: *Poecilia latipinna*: male (above) and female (below), from the Namak Lake basin, Iran.

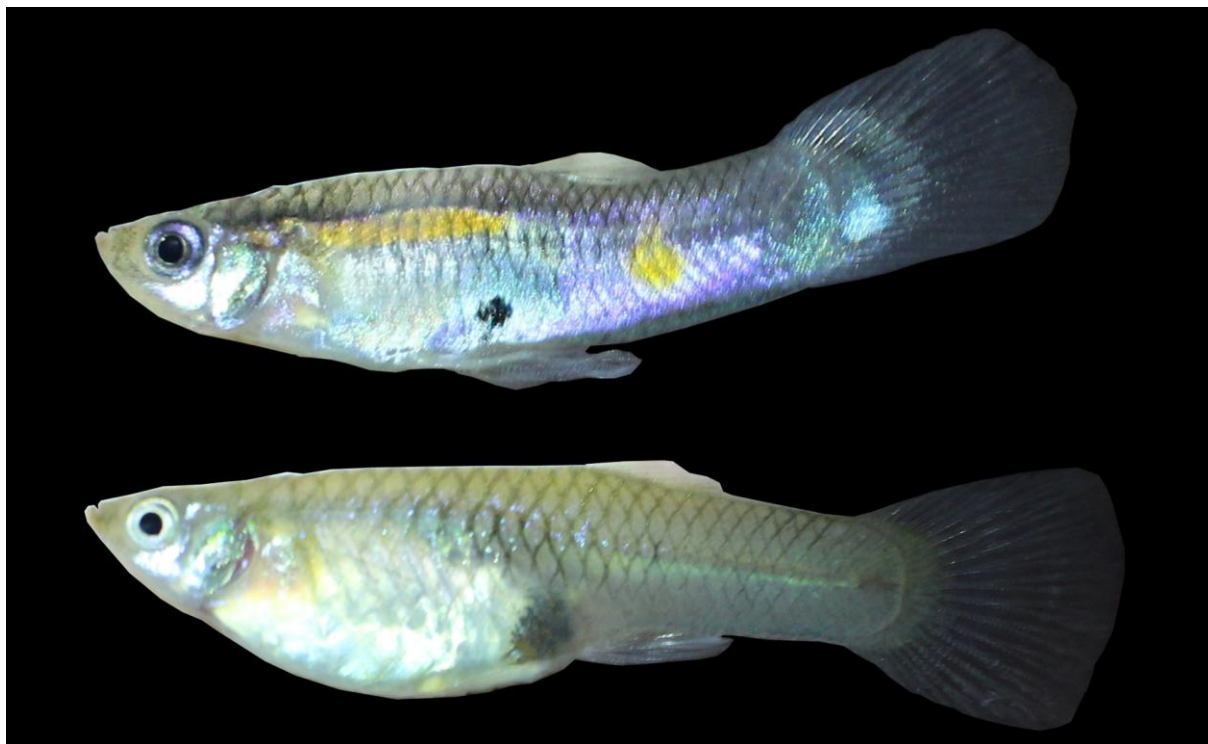


Figure 6: *Poecilia reticulata*: male (above) and female (below), from the Namak Lake basin, Iran.



Figure 7: *Xiphophorus hellerii*: male (above) and female (below), from the Namak Lake basin, Iran.

Discussion

Iran has been considered as one of the freshwater fish biodiversity hotspots in the Middle East with more than 268 native (including 95 endemic) fish species (Esmaeili et al., 2018). Similar to other world regions, the number of exotic fish species introduced in Iran is increasing in recent decades, reaching 29 confirmed species comprising about 9.76% of the total confirmed freshwater fishes in this country (Esmaeili et al., 2018). Aquaculture, the aquarium trade, sport fishing, control of malaria, research activities, demonstration in national fairs and accidental introduction are the main reasons for these introductions (Mousavi-Sabet and Eagderi, 2014; Mousavi-Sabet and Eagderi, 2016; Esmaeili et al., 2017; Mousavi-Sabet, 2018).

As listed above, the most diverse exotic species introduced to the Iranian water basins due to aquarium trade are members of the family Poeciliidae with three confirmed species. Livebearers are an important group of relatively small and often colorful aquarium fishes. Poeciliids are popular ornamental fishes in Iran and are also important as research models, being recently studied for ontogeny, growth, and sex reversal (Mousavi-Sabet and Ghasemnezhad, 2013; Faghani-Langroudi et al., 2014; Mousavi-Sabet et al., 2012, 2013, 2014, 2015; Moshayedi et al., 2015a; Moshayedi et al., 2015b; Khiabani et al., 2016). The family Poeciliidae (37 genera and about 304 species) includes live-bearing fishes of small size (< 200 mm length) having the diverse morphology and coloration, with distribution in the freshwater and brackish environments of the eastern United States, South America, and Africa, including Madagascar (Moyle, 2002; Nelson, 2006). A myriad of poeciliids have been widely and deliberately introduced worldwide for mosquito control or the aquarium trade due to their short generation time, colorfulness, hardiness, and readiness to breed in captivity (Moyle, 2002).

The family Cyprinidae with two popular ornamental fishes is the second diverse family in the present checklist. The goldfish, *Carassius auratus*, is widely distributed throughout Iran due to its relationship to important Iranian traditions. The fish is one of the main symbols in the Nowruz ceremony (Persian new year), and millions of the fish are bought for the Nowruz ceremony every year, and thousands of them released to natural water bodies by local people. Therefore, goldfish can be considered as the most distributed ornamental species in Iran. Despite the extended release, it is clear that goldfish cannot colonize in natural water bodies, as it is easy prey for predators. In addition, the mentioned variant of goldfish (related to Nowruz) is generally excluded from the aquarium trade, as no aquarist keeps the fish in aquaria and it is just a special ornamental fish for a single celebration (once a year). There are many other goldfish varieties in the aquarium trade in Iran, which are different from the “Nowruz goldfish”.

The second exotic ornamental cyprinid in Iran, which is reported here for the first time, is the Koi (*Cyprinus carpio*). The presence of Koi in Iranian waters is observed for the first time in the Sarcheshme Spring, Sarcheshme Park, in Mahalat City, Markazi Province, where it was introduced by the Mahalat municipality for tourism purposes.

The families Lepisosteidae, Serrasalminae and Cichlidae, each have only one member in the present checklist. It seems *Atractosteus spatula* and *Piaractus brachypomus* cannot sustain established populations in Iranian water basins yet because they seem to arrive episodically, and in few numbers. In contrast, *Amatitlania nigrofasciata* already produces established breeding populations.

It is well known that ornamental fishes are sold in pet shops and kept in aquaria all over the world, including Iran. It is also known that aquarists frequently get rid of unwanted/oversize

fish by releasing them into natural water bodies. Ornamental species, like the other introduced species, may cause harm to native fishes. As the introduction of exotic fishes may affect populations of native fishes through predation, competition, habitat changes, genetic changes, and introduction of parasites and diseases, special care should be taken to prevent such introductions. Therefore, these exotic species may have a negative impact on native fish populations in Iran through competition, habitat changes, and introduction of parasites and diseases (Esmaeili et al., 2010; 2014; 2017).

It can be concluded that ornamental fishes cannot be considered as one of the main challenges for native ichthyodiversity in Iran, because of their limited introductions and limited suitable habitats. As discussed though, some livebearers and a cichlid have produced established populations in some limited areas. Any eradication programs of exotic fishes have to be accompanied by public awareness campaigns to ensure that the aquarium trade and hobbyists do not release these pet fishes into natural habitats.

Acknowledgment

I thank the anonymous reviewers for their careful reading of my manuscript and their valuable comments and suggestions.

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