

Endemic freshwater fishes of Iran: an updated species inventory and their conservation status

Golnaz Sayyadzadeh* 

Department of Biology, Faculty of Sciences, Lorestan University, 6815144316 Khorramabad, Iran

*Corresponding author ✉: sayadzadeh.g@lu.ac.ir

Citation: Sayyadzadeh, G. (2026). Endemic freshwater fishes of Iran: an updated species inventory and their conservation status. *Journal of Animal Diversity*, 8 (1): 9–17. <https://dx.doi.org/10.22034/JAD.2026.8.1.2>

Director-in-Charge: Dr. Ali Gholamifard

Editor-in-Chief: Professor Francesco M. Angelici

Associate Editor: Professor Christopher Tudge

Received: 10 January 2026

Revised: 14 February 2026

Accepted: 20 March 2026

Published online: 31 March 2026

Abstract

Iran, at the junction of the Palearctic, Saharo-Sindian and Irano-Anatolian regions, hosts a rich and highly endemic inland fish fauna shaped by the complex tectonics of the Zagros and Alborz mountains and numerous isolated endorheic basins. Based on the latest comprehensive checklist of Iran's freshwater fishes and subsequent taxonomic studies, an updated inventory of the country's endemic freshwater ichthyofauna is compiled. Of the 316 currently recognized species, 105 (33.2%) are endemic to Iran, belonging to 5 orders, 11 families and 29 genera. The order Cypriniformes is overwhelmingly dominant, comprising 82 species (78.1% of all endemics), followed distantly by Cyprinodontiformes (12 species, 11.4%), and Siluriformes, Gobiiformes and Cichliformes with fewer than five species each. At the family level, Cyprinidae (35 species, 33.3%) and Nemacheilidae (30 species, 28.6%) together accounted for almost two-thirds of the endemic fauna. Endemic species were unevenly distributed among the 19 recognized Iranian drainage basins, with the Tigris basin harboring the highest number (40 species, 38.1%), followed by the Persis, Hormuz, Caspian Sea, and Kor basins. According to the IUCN Red List, 76 endemic species (72.4%) remain Not Evaluated, whereas 29 species (27.6%) have been formally assessed. Among the assessed species, 14 are Endangered, seven are Critically Endangered, two are Vulnerable, four are Least Concern, one is Data Deficient, and one is Extinct in the Wild. These findings align with earlier national estimates of endemism and reaffirm Iran as a major center of freshwater fish endemism in the Middle East, highlighting the urgent need for systematic Red List assessments and basin-scale conservation planning for its mostly unevaluated endemic ichthyofauna.

Key words: Biogeography, drainage basin, endemism, ichthyofauna, IUCN

Introduction

Freshwater ecosystems cover less than 1% of the Earth's surface yet support a disproportionate share of global vertebrate diversity, and they are simultaneously among the most heavily degraded habitats worldwide (Dudgeon et al., 2006). Within this context, levels of endemism provide one of the most informative currencies for setting conservation

priorities, since narrow-range endemic species are typically more vulnerable to habitat loss, water abstraction and climatic change than widespread taxa (Myers et al., 2000).

Iran lies at the confluence of the Palearctic, Saharo-Sindian and Irano-Anatolian biogeographic realms and encompasses an unusually complex hydrographic template: the folded ranges of the Zagros and Alborz

mountains, together with numerous internally drained (endorheic) basins such as Namak, Kavir, Maharlou, Jazmurian and Esfahan, have repeatedly isolated aquatic populations over geological time. This combination of tectonic complexity and hydrological fragmentation is considered a principal driver of the exceptionally high rate of in-situ speciation documented in several freshwater fish lineages in Iran, including cichlids of the genus *Iranocichla* (Schwarzer et al., 2016) and toothcarps of the family Aphaniidae (Freyhof and Yöğurtçuoğlu, 2020).

Knowledge of the Iranian ichthyofauna has expanded considerably since the pioneering work of Heckel (1846–1849) and the subsequent studies of Coad (1995), who recognized 150 species. Successive checklists by Esmaili et al. (2010, 2017, 2018) and Eagderi et al. (2022) progressively raised this figure, culminating in the most recent reappraisal by Sayyadzadeh and Esmaili (2024), who recognized 300 species of freshwater lampreys and fishes in 110 genera, 38 families, 23 orders and three classes from Iranian basins. A substantial proportion of this increase reflects an ongoing wave of species descriptions based on integrative (morphological and molecular) taxonomy (Freyhof et al., 2014; Khaefi et al., 2016; Sayyadzadeh et al., 2019, 2022; Sayyadzadeh and Esmaili, 2020; Zamani-Faradonbe et al., 2021; Esmaili et al., 2022; Zarei et al., 2022; Jokar et al., 2023). Since the most recent checklist (Sayyadzadeh and Esmaili, 2024), however, some additional species have been formally described or newly recorded from Iranian waters (e.g., *Carasobarbus doadrioi*, *C. hajhosseini* and *C. saadatii*, Jouladeh-Roudbar et al., 2024; *Tariqilabeo iranicus*, Esmaili et al., 2025; three new species of *Turcinoemacheilus*, Jouladeh-Roudbar et al., 2023b), and further taxonomic revisions have changed the status of several previously recognized taxa.

Despite this progress, no recent publication has focused specifically on synthesizing the taxonomic composition, geographic distribution and conservation status of the strictly endemic component of the Iranian freshwater ichthyofauna. The present study addresses this gap by compiling an updated, taxonomically vetted checklist of the endemic freshwater fishes of Iran, summarizing their distribution among orders, families and major drainage basins, and evaluating the current state of their IUCN Red List assessment, in order to provide a baseline for future conservation prioritization.

Material and Methods

The taxonomic baseline for this study was the most recent comprehensive checklist of the freshwater lampreys and fishes of Iran and the Middle East (Sayyadzadeh and Esmaili, 2024; Çiçek et al., 2024), which was cross-checked and updated against taxonomic and systematic literature published subsequently (through early 2026) describing new species, revalidating taxa, or revising generic placement

(e.g., Jouladeh-Roudbar et al., 2023a, b, 2024; Esmaili et al., 2025; Freyhof et al., 2025).

Species delimitation and the resulting counts of total and endemic taxa can vary substantially depending on whether a “lumper” or “splitter” taxonomic philosophy is applied (e.g., Mayden, 1997; Padial et al., 2010). In the present checklist we follow an integrative taxonomic approach that combines morphological diagnoses with available molecular evidence, consistent with the most recent revisions and with the nomenclature adopted in Eschmeyer’s Catalog of Fishes (Fricke et al., 2026) and recent regional works (Esmaili et al., 2018; Jouladeh-Roudbar et al., 2020; Sayyadzadeh and Esmaili, 2024; Freyhof et al., 2025). This approach is currently preferred in Middle Eastern freshwater ichthyology because many formerly widespread nominal species have been shown to comprise multiple narrowly endemic lineages, especially within Cyprinidae, Nemacheilidae and Aphaniidae. Consequently, the number of endemic species recognized here is higher than in earlier, more conservative (lumper) checklists, reflecting improved taxonomic resolution rather than an artificial inflation of diversity.

A species was scored as endemic when its confirmed natural distribution is restricted entirely within the political boundaries of Iran, following the criterion applied in previous national checklists (Esmaili et al., 2010, 2017; Sayyadzadeh and Esmaili, 2024). Applying this criterion to the 316-species working list yielded 105 endemic species, which form the dataset analyzed here. Basin-level distribution follows the system of major Iranian drainage basins traditionally used in the national ichthyological literature (Esmaili et al., 2017). Species occurring in more than one drainage basin were counted in each respective basin; thus, basin-level totals are non-exclusive and may exceed the total number of endemic species (Fig. 1).

Conservation status was extracted from the IUCN Red List of Threatened Species (IUCN, 2025); taxa lacking a formal assessment were coded as Not Evaluated (NE). The number of endemic species was summarized by order (Table 1, Fig. 2), family (Table 2, Fig. 3), basin (Fig. 1) and IUCN category (Fig. 4), and the complete annotated checklist is provided in Table 3.

Results

Of the 316 freshwater fish species currently recognized from Iran, 105 (33.2%) satisfied the criterion of endemism applied here. These 105 endemic species are distributed among 5 orders, 11 families and 29 genera (Table 3).

Taxonomic composition

The order Cypriniformes was overwhelmingly dominant, comprising 82 of the 105 endemic species (78.1%), followed by Cyprinodontiformes (12 species, 11.4%), while Siluriformes and Gobiiformes each contributed 4 species (3.8%) and Cichliformes 3 species (2.9%) (Table 1; Fig. 2).

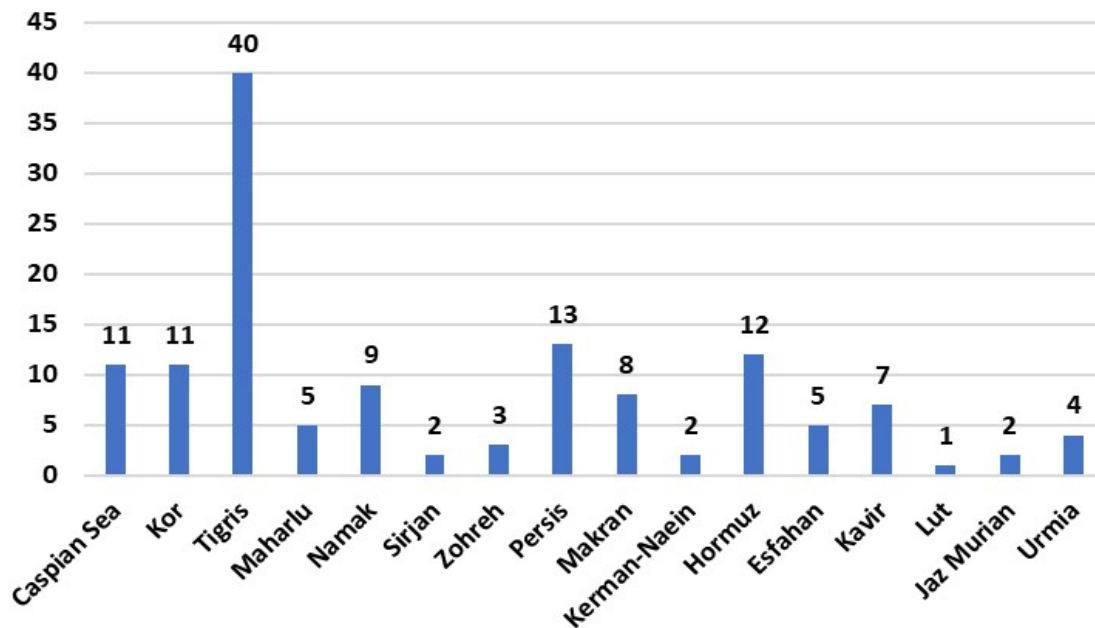


Figure 1: Number of endemic freshwater fish species recorded from each of the major Iranian drainage basins.

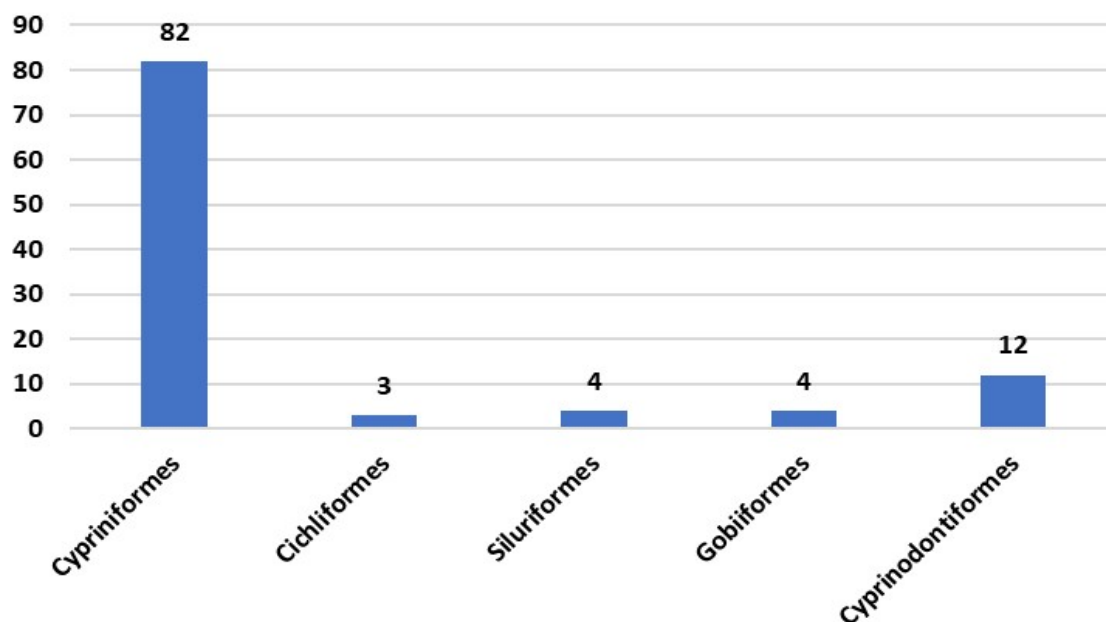


Figure 2: Number of endemic freshwater fish species per taxonomic order.

At the family level, Cyprinidae (35 species, 33.3%) and Nemacheilidae (30 species, 28.6%) together accounted for 61.9% of all endemics, followed by Leuciscidae (13 species, 12.4%) and Aphaniidae (12 species, 11.4%). The remaining seven families (Gobiidae, Sisoridae, Cichlidae, Cobitidae, Acheilognathidae, Gobionidae and Bagridae) collectively contributed only 15 species (14.3%), and three of them (Acheilognathidae, Gobionidae

and Bagridae) were represented by a single endemic species each (Table 2; Fig. 3).

At the generic level, the endemic fauna is concentrated in a relatively small number of species-rich genera, most notably *Capoeta* (13 species), *Garra* (12 species), *Paraschistura* (10 species) and *Esmaeilius* (9 species), followed by *Oxynoemacheilus*, *Paracobitis*, *Turcinoemacheilus* and *Alburnoides*, each with 6 species.

Geographic distribution

Endemic species were unevenly distributed among the 19 recognized Iranian drainage basins (Fig. 1). The Tigris basin (the Iranian portion of the Tigris-Euphrates/Persian Gulf drainage draining the western Zagros) harbored by far the highest number, with 40 endemic species (38.1% of the total), consistent with its complex network of karstic springs and montane tributaries. It was followed by the Persis basin (13 species), Hormuz basin (12) and by the Caspian Sea and Kor basins (11 species each). Several endorheic basins supported only one or two narrow-range endemics each (e.g., Lut with 1 species; Sirjan, Kerman-Naein and Jazmurian each with 2 species, all

recorded jointly with an adjacent basin), illustrating the prevalence of micro-endemism in the Iranian ichthyofauna.

Conservation status

According to the IUCN Red List, the conservation status of most of the endemic freshwater fishes of Iran remains formally unevaluated: 76 of the 105 species (72.4%) are currently listed as Not Evaluated. Of the 29 species that have been formally assessed, 14 (13.3%) are Endangered, 7 (6.7%) are Critically Endangered, 4 (3.8%) are Least Concern, 2 (1.9%) are Vulnerable, 1 (1.0%) is Data Deficient, and 1 (1.0%) is Extinct in the Wild (Fig. 4 and Table 3).

Table 1: Number and percentage of endemic freshwater fish species per order.

Order	No. of species	% of total
Cypriniformes	82	78.1
Cyprinodontiformes	12	11.4
Siluriformes	4	3.8
Gobiiformes	4	3.8
Cichliformes	3	2.9

Table 2: Number and percentage of endemic freshwater fish species per family.

Family	No. of species	% of total
Cyprinidae	35	33.3
Nemacheilidae	30	28.6
Leuciscidae	13	12.4
Aphaniidae	12	11.4
Gobiidae	4	3.8
Sisoridae	3	2.9
Cichlidae	3	2.9
Cobitidae	2	1.9
Acheilognathidae	1	1.0
Gobionidae	1	1.0
Bagridae	1	1.0

Table 3: Annotated checklist of the endemic freshwater fishes of Iran (n = 105), arranged by order and family. IUCN categories: DD = Data Deficient; LC = Least Concern; NE = Not Evaluated; VU = Vulnerable; CR = Critically Endangered; EN: Endangered; EW: Extinct in the Wild.

No.	Order	Family	Species	Basin(s)	IUCN
1	Cypriniformes	Cobitidae	<i>Cobitis faridpaki</i>	Caspian Sea	NE
2	Cypriniformes	Cobitidae	<i>Cobitis linea</i>	Kor	EN
3	Cypriniformes	Nemacheilidae	<i>Eidinemacheilus smithi</i>	Tigris	VU
4	Cypriniformes	Nemacheilidae	<i>Oxynoemacheilus karunensis</i>	Tigris	NE
5	Cypriniformes	Nemacheilidae	<i>Oxynoemacheilus kiabii</i>	Tigris	NE
6	Cypriniformes	Nemacheilidae	<i>Oxynoemacheilus marunensis</i>	Tigris	NE
7	Cypriniformes	Nemacheilidae	<i>Oxynoemacheilus parvinae</i>	Tigris	NE
8	Cypriniformes	Nemacheilidae	<i>Oxynoemacheilus persa</i>	Kor, Persis, Maharlou	NE
9	Cypriniformes	Nemacheilidae	<i>Oxynoemacheilus tongiorgii</i>	Kor	CR
10	Cypriniformes	Nemacheilidae	<i>Paracobitis abrishamchianorum</i>	Caspian Sea	NE
11	Cypriniformes	Nemacheilidae	<i>Paracobitis atrakensis</i>	Caspian Sea	NE
12	Cypriniformes	Nemacheilidae	<i>Paracobitis basharensis</i>	Tigris	NE
13	Cypriniformes	Nemacheilidae	<i>Paracobitis hircanica</i>	Caspian Sea	NE
14	Cypriniformes	Nemacheilidae	<i>Paracobitis malapterura</i>	Namak, Kavir	NE
15	Cypriniformes	Nemacheilidae	<i>Paracobitis persa</i>	Kor	EN
16	Cypriniformes	Nemacheilidae	<i>Paraschistura abdolii</i>	Hormuz, Jazmurian, Sirjan	NE
17	Cypriniformes	Nemacheilidae	<i>Paraschistura aredvii</i>	Tigris, Zohreh	NE
18	Cypriniformes	Nemacheilidae	<i>Paraschistura delvarii</i>	Persis	NE
19	Cypriniformes	Nemacheilidae	<i>Paraschistura hormuzensis</i>	Makran	EN
20	Cypriniformes	Nemacheilidae	<i>Paraschistura ilamensis</i>	Tigris	EN
21	Cypriniformes	Nemacheilidae	<i>Paraschistura kermanensis</i>	Kerman-Naein	CR
22	Cypriniformes	Nemacheilidae	<i>Paraschistura makranensis</i>	Makran	NE
23	Cypriniformes	Nemacheilidae	<i>Paraschistura naumanni</i>	Maharlou, Persis, Hormuz	NE
24	Cypriniformes	Nemacheilidae	<i>Paraschistura nielsenii</i>	Persis	NE
25	Cypriniformes	Nemacheilidae	<i>Paraschistura susiani</i>	Tigris	EN
26	Cypriniformes	Nemacheilidae	<i>Sasanidus kermanshahensis</i>	Tigris	NE
27	Cypriniformes	Nemacheilidae	<i>Turcinoemacheilus bahaii</i>	Esfahan	EN
28	Cypriniformes	Nemacheilidae	<i>Turcinoemacheilus hafezi</i>	Tigris	EN
29	Cypriniformes	Nemacheilidae	<i>Turcinoemacheilus saadii</i>	Tigris	NE
30	Cypriniformes	Nemacheilidae	<i>Turcinoemacheilus ansari</i>	Tigris	EN
31	Cypriniformes	Nemacheilidae	<i>Turcinoemacheilus christofferi</i>	Tigris	CR
32	Cypriniformes	Nemacheilidae	<i>Turcinoemacheilus moghbeli</i>	Tigris	NE

Table 3: (Continued).

No.	Order	Family	Species	Basin(s)	IUCN
33	Cypriniformes	Cyprinidae	<i>Barbus karunensis</i>	Tigris	NE
34	Cypriniformes	Cyprinidae	<i>Barbus milaris</i>	Namak, Kavir	NE
35	Cypriniformes	Cyprinidae	<i>Capoeta aculeata</i>	Namak, Kavir	NE
36	Cypriniformes	Cyprinidae	<i>Capoeta alborzensis</i>	Namak, Kavir	NE
37	Cypriniformes	Cyprinidae	<i>Capoeta birunii</i>	Esfahan	NE
38	Cypriniformes	Cyprinidae	<i>Capoeta buhsei</i>	Namak	LC
39	Cypriniformes	Cyprinidae	<i>Capoeta coadi</i>	Tigris	NE
40	Cypriniformes	Cyprinidae	<i>Capoeta ferdowsii</i>	Zohreh	NE
41	Cypriniformes	Cyprinidae	<i>Capoeta gracilis</i>	Esfahan	LC
42	Cypriniformes	Cyprinidae	<i>Capoeta macrolepis</i>	Kor	NE
43	Cypriniformes	Cyprinidae	<i>Capoeta pyragyi</i>	Tigris	NE
44	Cypriniformes	Cyprinidae	<i>Capoeta raghazensis</i>	Hormuz	NE
45	Cypriniformes	Cyprinidae	<i>Capoeta razii</i>	Caspian Sea, Kavir	NE
46	Cypriniformes	Cyprinidae	<i>Capoeta saadii</i>	Kor, Persis, Maharlu, Kerman-Naein, Hormuz	LC
47	Cypriniformes	Cyprinidae	<i>Capoeta shajarianii</i>	Tigris	NE
48	Cypriniformes	Cyprinidae	<i>Carasobarbus doadrioi</i>	Tigris	NE
49	Cypriniformes	Cyprinidae	<i>Carasobarbus hajhosseini</i>	Tigris	NE
50	Cypriniformes	Cyprinidae	<i>Carasobarbus saadatii</i>	Tigris	NE
51	Cypriniformes	Cyprinidae	<i>Carasobarbus sublimus</i>	Tigris, Zohreh	EN
52	Cypriniformes	Cyprinidae	<i>Cyprinion tenuiradius</i>	Persis	NE
53	Cypriniformes	Cyprinidae	<i>Garra amirhosseini</i>	Tigris	NE
54	Cypriniformes	Cyprinidae	<i>Garra gymnothorax</i>	Tigris	NE
55	Cypriniformes	Cyprinidae	<i>Garra hormuzensis</i>	Hormuz	NE
56	Cypriniformes	Cyprinidae	<i>Garra lorestanensis</i>	Tigris	NE
57	Cypriniformes	Cyprinidae	<i>Garra meymehensis</i>	Tigris	NE
58	Cypriniformes	Cyprinidae	<i>Garra monica</i>	Persis	NE
59	Cypriniformes	Cyprinidae	<i>Garra nudiventris</i>	Lut	NE
60	Cypriniformes	Cyprinidae	<i>Garra persica</i>	Hormuz, Makran, Jazmurian	LC
61	Cypriniformes	Cyprinidae	<i>Garra roseae</i>	Makran	EN
62	Cypriniformes	Cyprinidae	<i>Garra tashanensis</i>	Tigris	NE
63	Cypriniformes	Cyprinidae	<i>Garra tiam</i>	Tigris	EN
64	Cypriniformes	Cyprinidae	<i>Garra typhlops</i>	Tigris	VU
65	Cypriniformes	Cyprinidae	<i>Paracapoeta anamisensis</i>	Makran	NE
66	Cypriniformes	Cyprinidae	<i>Paracapoeta mandica</i>	Persis	NE
67	Cypriniformes	Cyprinidae	<i>Tarigilabeo iranicus</i>	Makran	NE
68	Cypriniformes	Acheilognathidae	<i>Rhodeus caspius</i>	Caspian Sea, Urmia, Tigris	NE
69	Cypriniformes	Gobionidae	<i>Romanogobio persus</i>	Urmia	EN
70	Cypriniformes	Leuciscidae	<i>Acanthobrama persidis</i>	Kor, Persis, Maharlu	NE
71	Cypriniformes	Leuciscidae	<i>Acanthobrama urmianus</i>	Urmia	DD
72	Cypriniformes	Leuciscidae	<i>Alburnoides damghani</i>	Kavir	NE
73	Cypriniformes	Leuciscidae	<i>Alburnoides idignensis</i>	Tigris	NE
74	Cypriniformes	Leuciscidae	<i>Alburnoides namaki</i>	Namak	NE
75	Cypriniformes	Leuciscidae	<i>Alburnoides nicolausi</i>	Tigris	NE
76	Cypriniformes	Leuciscidae	<i>Alburnoides qanati</i>	Kor, Sirjan	NE
77	Cypriniformes	Leuciscidae	<i>Alburnoides tabarestanensis</i>	Caspian Sea	NE
78	Cypriniformes	Leuciscidae	<i>Alburnus doriae</i>	Namak, Esfahan, Tigris	NE
79	Cypriniformes	Leuciscidae	<i>Chondrostoma esmaeilii</i>	Tigris	CR
80	Cypriniformes	Leuciscidae	<i>Chondrostoma orientale</i>	Kor	NE
81	Cypriniformes	Leuciscidae	<i>Petroleuciscus ulanus</i>	Urmia	CR
82	Cypriniformes	Leuciscidae	<i>Squalius namak</i>	Namak	NE
83	Siluriformes	Bagridae	<i>Mystus cyrusi</i>	Hormuz	NE
84	Siluriformes	Sisoridae	<i>Glyptothorax sardashtensis</i>	Tigris	NE
85	Siluriformes	Sisoridae	<i>Glyptothorax silviae</i>	Tigris, Persis	NE
86	Siluriformes	Sisoridae	<i>Glyptothorax vatandousti</i>	Tigris	NE
87	Gobiiformes	Gobiidae	<i>Benthophilus persicus</i>	Caspian Sea	NE
88	Gobiiformes	Gobiidae	<i>Ponticola hircaniaensis</i>	Caspian Sea	EN
89	Gobiiformes	Gobiidae	<i>Ponticola iranica</i>	Caspian Sea	NE
90	Gobiiformes	Gobiidae	<i>Ponticola patimari</i>	Caspian Sea	NE
91	Cichliformes	Cichlidae	<i>Iranocichla hormuzensis</i>	Hormuz	NE
92	Cichliformes	Cichlidae	<i>Iranocichla persa</i>	Makran	NE
93	Cichliformes	Cichlidae	<i>Iranocichla sp.*</i>	Hormuz	NE
94	Cyprinodontiformes	Aphaniidae	<i>Aphaniops furcatus</i>	Hormuz, Makran	NE
95	Cyprinodontiformes	Aphaniidae	<i>Aphaniops ginaonis</i>	Hormuz	CR
96	Cyprinodontiformes	Aphaniidae	<i>Aphaniops hormuzensis</i>	Hormuz	NE
97	Cyprinodontiformes	Aphaniidae	<i>Esmaeilus arakensis</i>	Namak	NE
98	Cyprinodontiformes	Aphaniidae	<i>Esmaeilus darabensis</i>	Hormuz	EN
99	Cyprinodontiformes	Aphaniidae	<i>Esmaeilus isfahanensis</i>	Esfahan	NE
100	Cyprinodontiformes	Aphaniidae	<i>Esmaeilus kavirensis</i>	Kavir	NE
101	Cyprinodontiformes	Aphaniidae	<i>Esmaeilus pluristriatus</i>	Persis	NE
102	Cyprinodontiformes	Aphaniidae	<i>Esmaeilus persicus</i>	Maharlu	EW
103	Cyprinodontiformes	Aphaniidae	<i>Esmaeilus shirini</i>	Kor, Persis	CR
104	Cyprinodontiformes	Aphaniidae	<i>Esmaeilus sophiae</i>	Kor, Tigris, Persis	NE
105	Cyprinodontiformes	Aphaniidae	<i>Esmaeilus vladkovi</i>	Tigris	NE

* *Iranocichla* sp. is an undescribed endemic taxon previously recognized in Iranian fish checklists and supported as a distinct taxonomic unit by genetic evidence; it is retained here following these previous treatments.

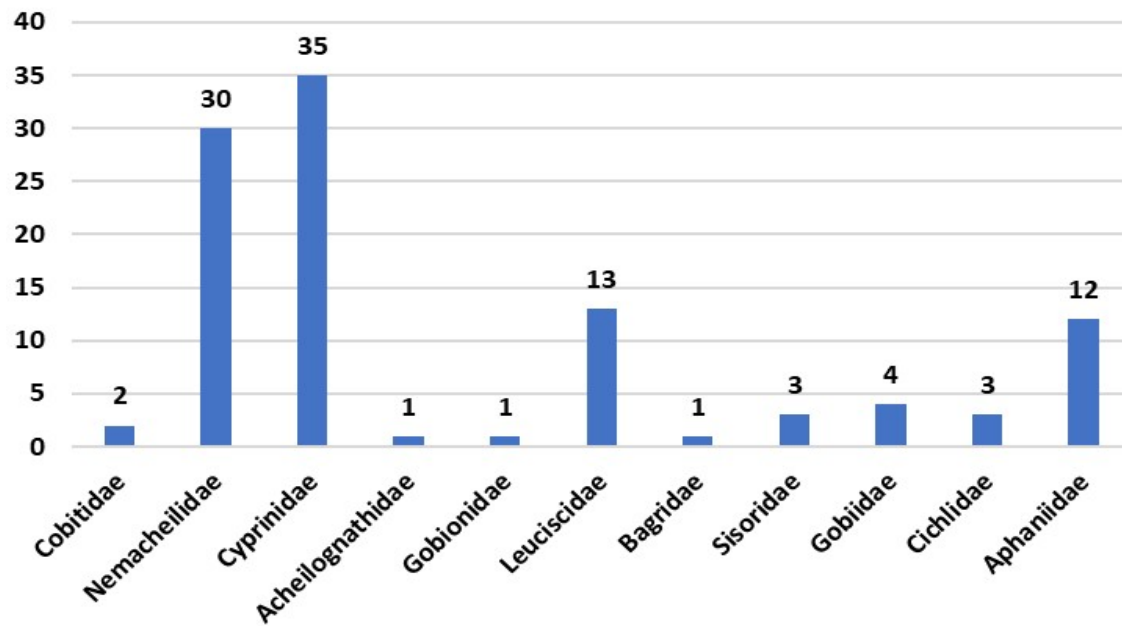


Figure 3: Number of endemic freshwater fish species per family.

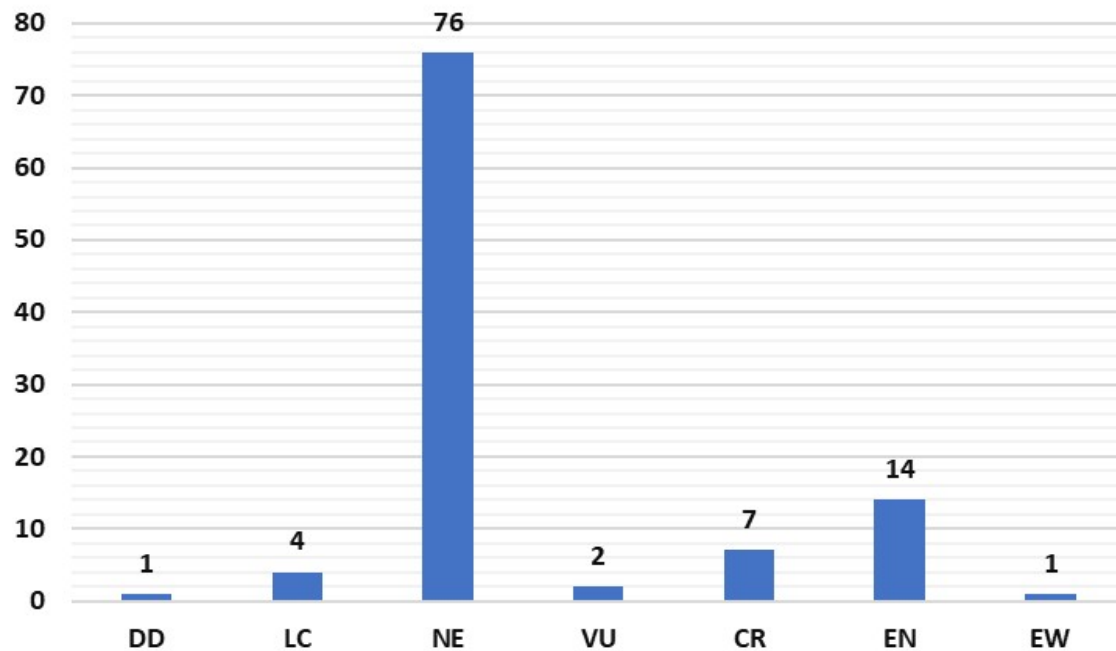


Figure 4: Number of endemic freshwater fish species per IUCN Red List category (DD = Data Deficient; LC = Least Concern; NE = Not Evaluated; VU = Vulnerable; CR: Critically Endangered; EN: Endangered; EW: Extinct in the Wild).

Discussion

The present analysis indicates that 33.2% of the fish species currently recognized from Iran (105 of 316) are endemic, a value that is broadly consistent with

previous national-scale estimates of endemism in the Iranian ichthyofauna (e.g., approximately 28-32% in Esmaeili et al., 2017; Jouladeh-Roudbar et al., 2020) and confirms Iran as one of the most important centers of freshwater fish endemism in the Middle East.

This overall level of endemism, however, is not distributed evenly across the fauna: it is heavily concentrated within a small number of strictly freshwater families, most notably Cyprinidae, Nemacheilidae and Aphaniidae, which together contribute over 70% of all endemic species. Cyprinids, nemacheilid loaches and toothcarps complete their entire life cycle in inland waters and are therefore intrinsically more prone to allopatric speciation within isolated basins than the euryhaline or migratory lineages (e.g., sturgeons, clupeids and most gobies) that make up a large share of the non-endemic component of the national checklist, which is consistent with the taxonomic pattern of endemism documented here (Sayyadzadeh and Esmaili, 2024).

The concentration of endemics within species-rich genera - *Capoeta*, *Garra*, *Paraschistura* and *Esmaeilius* together account for 42% of all endemic species - mirrors patterns described elsewhere in the region and is consistent with repeated, geologically recent radiations associated with the uplift of the Zagros and the isolation of endorheic lake basins such as Namak, Kavir, Maharlou and Esfahan (Schwarzer et al., 2016; Freyhof and Yöğurtçuoğlu, 2020). The exceptionally high number of endemic species in the Tigris basin (38.1% of all endemics) further supports the view that the dissected, spring-fed tributary system draining the western flank of the Zagros has acted as a particularly potent generator of allopatric diversification, a pattern also reflected in the disproportionate number of recently described, single-basin endemics in genera such as *Carasobarbus*, *Turcinoemacheilus*, *Oxyzomacheilus* and *Glyptothorax* (Sayyadzadeh et al., 2016, 2020, 2022; Jokar et al., 2023; Jouladeh-Roudbar et al., 2023a, b, 2024). The concentration of endemism in the Tigris drainage is consistent with its status, together with the wider Tigris-Euphrates system, as one of the Middle East's foremost freshwater biodiversity hotspots (Freyhof et al., 2021; Çiçek et al., 2023).

The rate at which new endemic species continue to be described indicates that the true diversity of the Iranian freshwater ichthyofauna, particularly in less thoroughly surveyed basins such as Makran, Hormuz and Jazmurian, is probably still underestimated. This ongoing taxonomic discovery has direct conservation consequences, since newly described species typically enter the literature with very restricted known ranges and, by definition, without a prior IUCN assessment.

The most striking result of this study is not only the persistence of a substantial assessment gap but the markedly elevated threat status revealed among species that have already been assessed: while 72.4% of Iran's endemic freshwater fishes remain Not Evaluated by the IUCN, 21 of the 29 formally assessed species (72% of assessed species, 20% of all endemics) are classified as Critically Endangered (7 species) or Endangered (14 species), and one species is now considered Extinct in

the Wild. This combination of a large assessment gap and a high proportion of already-threatened status among assessed species is of particular concern given that many of these species are restricted to single springs, qanats or short reaches of endorheic drainages that are already under severe anthropogenic pressure from groundwater over-extraction, damming and the well-documented desiccation of several Iranian lake basins (Sayyadzadeh and Esmaili 2024; Ahrari et al., 2024). Freshwater biodiversity in general is disproportionately threatened relative to terrestrial systems (Dudgeon et al., 2006), and the combination of high micro-endemism and an almost total lack of Red List coverage documented here suggests that a substantial number of Iranian endemic fishes may already qualify for a threatened category once assessed. We therefore recommend that Red List assessment be prioritized for genera with multiple narrow-range endemics, particularly *Esmaeilius*, *Paraschistura* and *Glyptothorax*, and that basin-level conservation planning give particular attention to the Tigris, Persis, Namak, Kavir and Hormuz basins identified here as areas with high numbers of endemic species.

Conclusion

This updated checklist confirms that Iran harbors 105 endemic freshwater fish species, representing 33.2% of its strictly freshwater ichthyofauna, distributed across 5 orders, 11 families and 29 genera, with pronounced concentration in Cypriniformes and in the Tigris drainage. The majority of these species (72.4%) remain unevaluated by the IUCN Red List, and a striking proportion of those already assessed (21 of 29 species, including one now Extinct in the Wild) are classified as Critically Endangered or Endangered, representing a substantial and urgent conservation data and threat-status gap. Given the ongoing rate of species discovery and the mounting hydrological pressures facing several of Iran's key endemic-rich basins, systematic Red List assessment and targeted basin-level conservation measures are urgently needed to safeguard this globally significant component of freshwater biodiversity.

Acknowledgments

I sincerely thank the anonymous reviewers for their constructive comments and suggestions, which helped improve the manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest

The author declares that there are no conflicting issues related to this research article.

References

- Ahrari, A., Sharifi, A. and Haghighi, A. T. (2024). Anthropogenic vs. climatic drivers: Dissecting Lake desiccation on the Iranian plateau. *Journal of Environmental Management*, 368: 122103. <https://doi.org/10.1016/j.jenvman.2024.122103>
- Çiçek, E., Esmaili, H. R., Sayyadzadeh, G., Saad, A., Sungur, S., Jawad, L., Eagderi, S., Çapar, O. B., Coad, B. W. and Fricke, R. (2024). Freshwater lampreys and fishes in the Middle East. *Taxa (Journal of Taxonomy and Systematics)*, 4: 1–429.
- Çiçek, E., Jawad, L., Sungur, S., Eagderi, S., Esmaili, H. R., Mouludi-Saleh, A. and Fricke, R. (2023). Freshwater fishes of Iraq: a revised and updated annotated checklist - 2023. *Zootaxa*, 5357 (1): 1–49. <https://doi.org/10.11646/zootaxa.5357.1.1>
- Coad, B. W. (1995). Freshwater fishes of Iran. *Acta Scientiarum Naturalium Academiae Scientiarum Bohemicae*, Brno, 29 (1): 1–64.
- Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z. I., Knowler, D. J., Lévêque, C., Naiman, R. J., Prieur-Richard, A. H., Soto, D., Stiassny, M. L. J. and Sullivan, C. A. (2006). Freshwater biodiversity: importance, threats, status and conservation challenges. *Biological Reviews*, 81 (2): 163–182. <https://doi.org/10.1017/S1464793105006950>
- Eagderi, S., Mouludi-Saleh, A., Esmaili, H. R., Sayyadzadeh, G. and Nasri, M. (2022). Freshwater lamprey and fishes of Iran; a revised and updated annotated checklist - 2022. *Turkish Journal of Zoology*, 46 (6): 500–522. <https://doi.org/10.55730/1300-0179.3104>
- Esmaili, 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. <https://doi.org/10.31610/zsr/2010.19.2.361>
- Esmaili, H. R., Mehraban, H., Abbasi, K., Keivany, Y. and Coad, B. W. (2017). Review and updated checklist of freshwater fishes of Iran: taxonomy, distribution and conservation status. *Iranian Journal of Ichthyology*, 4 (Suppl. 1): 1–114. <https://doi.org/10.22034/iji.v4iSuppl.1.220>
- Esmaili, H. R., Sayyadzadeh, G., Eagderi, S. and Abbasi, K. (2018). Checklist of freshwater fishes of Iran. *FishTaxa*, 3 (3): 1–95.
- Esmaili, H. R., Sayyadzadeh, G., Masoumi, A. H., Hashemi, S. H. and Echreshavi, S. (2025). *Tariqilabeo iranicus*, a new species of labeonine fish from the Makran basin in Iran (Teleostei: Cyprinidae). *Zootaxa*, 5620 (3): 437–450. <https://doi.org/10.11646/zootaxa.5620.3.3>
- Esmaili, H. R., Sayyadzadeh, G., Zarei, F., Eagderi, S. and Mousavi-Sabet, H. (2022). *Mystus cyrusi*, a new species of bagrid catfish (Teleostei: Bagridae) from Middle East. *Zootaxa*, 5099 (3): 325–343. <https://doi.org/10.11646/zootaxa.5099.3.2>
- Freyhof, J. and Yoğurtçuoğlu, B. (2020). A proposal for a new generic structure of the killifish family Aphanidiidae, with the description of *Aphaniops teimorii* (Teleostei: Cyprinodontiformes). *Zootaxa*, 4810 (3): 421–451. <https://doi.org/10.11646/zootaxa.4810.3.2>
- Freyhof, J., Esmaili, H. R., Sayyadzadeh, G. and Geiger, M. (2014). Review of the crested loaches of the genus *Paracobitis* from Iran and Iraq with the description of four new species (Teleostei: Nemacheilidae). *Ichthyological Exploration of Freshwaters*, 25 (1): 11–38.
- Freyhof, J., Kaya, C. and Ali, A. (2021). A critical checklist of the inland fishes native to the Euphrates and Tigris drainages. In: Jawad, L. A. (Ed.), *Tigris and Euphrates Rivers: Their Environment from Headwaters to Mouth*. Aquatic Ecology Series, Vol. 11. Springer, Cham. pp. 815–854. https://doi.org/10.1007/978-3-030-57570-0_35
- Freyhof, J., Segherloo, I. H., Vatandoust, S., Abdollahi-Mousavi, S. E., Normandeau, E., Geiger, M. F. and Yoğurtçuoğlu, B. (2025). Resolving a 182-year-old taxonomic puzzle: *Luciobarbus* in the Persian Gulf basin (Teleostei: Cyprinidae). *Zootaxa*, 5620 (1): 29–71. <https://doi.org/10.11646/zootaxa.5620.1.3>
- Fricke, R., Eschmeyer, W. N. and van der Laan, R. (editors) (2026). Eschmeyer's Catalog of Fishes: Genera, Species, References. Electronic version (Accessed 10 March 2026). <http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>
- Heckel, J. J. (1846–1849b). Anhang. Die Fische Persiens gesammelt von Theodor Kotschy, In: Russegger, J. (Ed.), *Reisen in Europa, Asien und Afrika, mit besonderer Rücksicht auf die naturwissenschaftlichen Verhältnisse der betreffenden Länder, unternommen in den Jahren 1835 bis 1841 von Joseph Russegger*. Schweitzerbart'sche Verlagsbuchhandlung, Stuttgart, 2 (3): 255–272.
- IUCN (2025). The IUCN Red List of Threatened Species. Version 2025-2. <https://www.iucnredlist.org> (Accessed 12 March 2026).
- Jokar, M., Kamangar, B. B., Ghaderi, E. and Freyhof, J. (2023). *Glyptothorax sardashtensis*, a new species of torrent catfish from the upper Lesser Zab drainage in Iran (Teleostei: Sisoridae). *Zootaxa*, 5254 (4): 476–492. <https://doi.org/10.11646/zootaxa.5254.4.2>

- Jouladeh-Roudbar, A., Ghanavi, H. R. and Doadrio, I. (2020). Ichthyofauna from Iranian freshwater: annotated checklist, diagnosis, taxonomy, distribution and conservation assessment. *Zoological Studies*, 59: 21.
<https://doi.org/10.6620/ZS.2020.59-21>
- Jouladeh-Roudbar, A., Ghanavi, H. R. and Freyhof, J. (2023a). *Glyptothorax vatandousti*, a new species of torrent catfish from the upper Karkheh drainage in Iran (Teleostei: Sisoridae). *Zootaxa*, 5315 (1): 37–58.
<https://doi.org/10.11646/zootaxa.5315.1.2>
- Jouladeh-Roudbar, A., Kaya, C., Vatandoust, S. and Ghanavi, H. R. (2024). New insights into the phylogeny of *Carasobarbus* Karaman, 1971 (Actinopterygii, Cyprinidae) with the description of three new species. *Scientific Reports*, 14: 21801.
<https://doi.org/10.1038/s41598-024-71463-7>
- Jouladeh-Roudbar, A., Vatandoust, S., Doadrio, I. and Ghanavi, H. R. (2023b). Integrative taxonomy of *Turcinoemacheilus* Bănărescu & Nalbant, 1964 in West Asia with the description of three new species (Teleostei: Nemacheilidae). *Diversity*, 15 (12): 1222.
<https://doi.org/10.3390/d15121222>
- Khaefi, R., Esmaili, H. R., Sayyadzadeh, G., Geiger, M. F. and Freyhof, J. (2016). *Squalius namak*, a new chub from Lake Namak basin in Iran (Teleostei: Cyprinidae). *Zootaxa*, 4169 (1): 145–159.
<https://doi.org/10.11646/zootaxa.4169.1.7>
- Mayden, R. L. (1997). A hierarchy of species concepts: the denouement in the saga of the species problem. In: Claridge, M. F., Dawah, H. A. and Wilson, M.R. (eds.), *Species: The Units of Biodiversity*. Chapman and Hall, London. pp. 381–424.
- Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B. and Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403: 853–858.
<https://doi.org/10.1038/35002501>
- Padial, J. M., Miralles, A., De la Riva, I. and Vences, M. (2010). The integrative future of taxonomy. *Frontiers in Zoology*, 7: 16.
<https://doi.org/10.1186/1742-9994-7-16>
- Sayyadzadeh, G. and Esmaili, H. R. (2024). Freshwater lamprey and fishes of Iran: reappraisal and updated checklist with a note on Eagderi et al. (2022). *Zootaxa*, 5402 (1): 1–99.
<https://doi.org/10.11646/zootaxa.5402.1.1>
- Sayyadzadeh, G. and Esmaili, H.R. (2020). *Oxynoemacheilus marunensis*, a new loach species from the Persian Gulf basin with remarks on *O. frenatus* (Teleostei: Nemacheilidae). *Zootaxa*, 4885 (2): 189–206.
<https://doi.org/10.11646/zootaxa.4885.2.2>
- Sayyadzadeh, G., Eagderi, S. and Esmaili, H. R. (2016). A new loach of the genus *Oxynoemacheilus* from the Tigris River drainage and its phylogenetic relationships among the nemacheilid fishes (Teleostei: Nemacheilidae) in the Middle East based on mtDNA COI sequences. *Iranian Journal of Ichthyology*, 3 (4): 236–250.
- Sayyadzadeh, G., Teimori, A. and Esmaili, H. R. (2019). *Paraschistura kermanensis*, a new stone loach species from southeastern Iran (Teleostei: Nemacheilidae). *Zootaxa*, 4638 (4): 571–583.
<https://doi.org/10.11646/zootaxa.4638.4.7>
- Sayyadzadeh, G., Zarei, F. and Esmaili, H. R. (2022). *Glyptothorax* (Teleostei: Sisoridae) from the Middle East: an integrated molecular and morphological insight into its taxonomic diversity. *Diversity*, 14: 884.
<https://doi.org/10.3390/d14100884>
- Schwarzer, J., Shabani, N., Esmaili, H. R., Mwaiko, S. and Seehausen, O. (2016). Allopatric speciation in the desert - diversification of cichlids at their geographical and ecological range limit in Iran. *Hydrobiologia*, 791: 193–207.
<https://doi.org/10.1007/s10750-016-2976-3>
- Zamani-Faradonbe, M., Zhang, E. and Keivany, Y. (2021). *Garra hormuzensis*, a new species from the upper Kol River drainage in the Persian Gulf basin (Teleostei: Cyprinidae). *Zootaxa*, 5052 (3): 380–394.
<https://doi.org/10.11646/zootaxa.5052.3.4>
- Zarei, F., Esmaili, H. R., Kovačić, M., Schliwen, U. K. and Abbasi, K. (2022). *Ponticola hircaniaensis* sp. nov., a new and critically endangered gobiid species (Teleostei: Gobiidae) from the southern Caspian Sea basin. *Zootaxa*, 5154 (4): 401–430.
<https://doi.org/10.11646/zootaxa.5154.4.1>