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Research Article:

Biodiversity and distribution of *Garra* species (Teleostei: Cyprinidae) in Iran

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Abstract

The genus *Garra*, a cyprinid fish with eleven confirmed species, is distributed in many Iranian rivers, from western to eastern and southern Iran. Materials for this study were from available published data, data bank provided by Isfahan University of Technology Ichthyological Museum (IUT-IM), and sampling during 2017-2018. Three species, *G. lorestanensis*, *G. typhlops* and *G. tashanensis* live in subterranean waters but other species, such as *G. amirhosseini*, *G. gymnothorax*, *G. mondica*, *G. nudiventris*, *G. persica*, *G. rossica*, *G. roseae* and *G. rufa* live in surface waters.

Keywords: Data bank, *Garra*, Subterranean, Iran

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Introduction

Fishes cannot move between unconnected aquatic systems and their distribution patterns can be influenced by physical and chemical factors of those systems (Watanabe, 1998) which makes zoogeographical pattern studies of this interesting group of animals attractive (Berra, 2001). In inland waters of Iran, there are more than 288 species of fish that mostly belong to three families: Cyprinidae, Nemacheilidae, and Cobitidae (Keivany *et al.*, 2016a; Esmaeili *et al.*, 2017). Members of the Cyprinid genus *Garra* Hamilton, 1822, are found across southwest Asia, Africa and southeastern Asia and are well adapted to life in swift-flowing waters, streams, rivers and lakes (Krupp and Schneider, 1989). This genus is widely distributed in freshwaters of Iran and more than 11 confirmed species are identified and introduced in ten Iranian basins (Esmaeili *et al.*, 2016; 2017). Despite widespread distribution, information on taxonomy, biology, reproduction, feeding and habitat requirements of members of this genus is very limited.

Type locality for Iranian species includes:

1. Hot spring garra or Amirhossein's garra, *G. amirhosseini* (Esmaeili *et al*., 2016) is Sartang-e-Bijar hot spring at Mehran, Tigris River basin;
2. Scaleless chest garra, *G. gymnothorax* (Berg, 1949) is Ziaret-Seid-Hasan, Mesopotamia (Tigris River), Iraq;
3. Blind cave garra, *G. lorestanensis* (Mousavi-Sabet and Eagderi, 2016) is Loven Cave, the Tigris River basin;
4. Mond garra, *G. mondica* (Sayyadzadeh *et al*., 2015) is Mond River drainage (Konar Siyah spring at Firouz Abad), Bushehr basin;
5. Lut garra, *G. nudiventris* (Berg, 1905) is Shivar, north-east Kerman;
6. Persian garra, *G. persica* (Berg, 1914) is Bampur River in Jaz-Murian basin;
7. hari garra, *G. rossica* (Nikolskii, 1900) is Hari River, Turkmenistan, Hari River basin;
8. the common or red garra, *G. rufa* (Heckel, 1843) is Aleppo in Syria, Euphrates basin;
9. tashan blind cave garra, *G. tashanensis* (Mousavi-Sabet *et al*., 2016) is the subterranean water of Tashan Cave, Tigris River basin;
10. Discless blind cave garra, *G. typhlops* (Bruun and Kaiser, 1944) is Loven Cave, the Tigris River basin (Esmaeili *et al.*, 2016, 2017).
11. Tang-e-Sarhe garra, *G. roseae* (Mousavi-Sabet *et al*., 2019) is stream Tang-e-Sarhe at near Siahangari, Makran Basin.

The present study aims to provide biodiversity and spatial distribution pattern of *Garra* species within Iranian freshwater basins.

Materials and methods

Distribution pattern of *Garra* species from the entire drainage basins of Iran was mapped. Materials for this study were result of (1) available published data, (2) Isfahan University of Technology Ichthyological Museum

(IUT-IM) fish collection with around 2288 specimens of different species of *Garra* captured from 203 stations and (3) Sampling done during 2017- 2018 by M. Zamani-Faradonbe using an electrofishing device, cast net and hand net that carried out in 30 stations and captured 682 specimens of different species of *Garra*. All specimens were identified following available descriptions and keys (Coad 2013; Esmaeili *et al.*, 2016; Keivany *et al.*, 2016a).

Results

The captured specimens were identified according to Coad (2013), Esmaeili *et al.* (2016), and Keivany *et al.* (2016a) based on the following morphological key characters:

Garra amirhosseini is distinguished from other Iranian species of *Garra* by having 7½ branched and three unbranched dorsal fin rays, 5½ branched and three unbranched anal fin rays, 9+8 principle caudal fin rays, 12-13 branched and one unbranched pectoral fin rays, 7-8 branched and one unbranched ventral fin ray, 33-36 lateral line scales, 3½- 4½ scales above the lateral line, 3½ scales between lateral line and pelvic-fin origin, 17-19 predorsal scales, 13-14 circumpeduncular scales, two pairs of barbells, 16-20 gill rakers on the first branchial arch and a mental disc. This species has limited distribution so that it is found only in some rivers in Tigris basin like Meymeh River and in Sartang-e-Bijar hot spring at Mehran city, Ilam Province, Iran (Figure 7).

Figure 1: *Garra amirhosseini*, Meyme River, Ilam Province, Iran, scale: 0.5 cm.

Garra gymnothorax is distinguished by having 7½-8½ branched and three unbranched dorsal fin rays, 5½ branched and three unbranched anal fin rays, 9+8 principle caudal fin rays, 12-13 branched and one unbranched pectoral fin rays, 7-8 branched and one unbranched ventral fin ray, 32-37 lateral line scales, 3½-4½ scales above the lateral line, 2½-3½ scales between lateral line and pelvic-fin origin, 10-12 predorsal scales, 12-13 circumpeduncular scales, two pairs of barbells, 17-23 gill rakers on the first branchial arch and a mental disc (Figure 2). This species is found in Karun River system in Bala River at Andimeshk, Sezar River in Karkheh drainage and Beshar River at Yasouj (Figure 7).

Figure 2: *Garra gymnothorax*, Balarud River, Khozestan Province, Iran, scale: 0.5 cm.

Garra lorestanensis is distinguished by having 7½-8½ branched and three unbranched dorsal fin rays, 5½ branched anal fin rays, 9+8 principle caudal fin rays, 13-14 branched and one unbranched pectoral fin rays, 6-7 branched and one unbranched ventral fin ray, naked body, two pairs of barbells, 10-12 gill rakers on the first branchial arch and a mental disc. *G. lorestanensis* can be found in an isolated subterranean habitat, Loven Cave (a well-like pool), the natural outlet of a subterranean limestone system of Zagros Mountains in Ab-e Sirum or Ab-e Serum Valley near Tang-e Haft railway station in Lorestan Province, south-west Iran (Figure 7).

Garra mondica is distinguished by having 7 branched and three unbranched dorsal fin rays, 5 branched and two unbranched anal fin rays, 9+8 principle caudal fin rays, 12-13 branched pectoral fin rays, 8 branched ventral fin rays, 31-34 lateral line scales, 4 scales above the lateral line, 3 scales between lateral line and pelvic-fin origin, no predorsal scales, 14-15 circumpeduncular scales, 2 pairs of barbells, 18-23 total gill rakers on the first branchial arch and a mental disc (Figure 3). This species is found in two small springs in Mond River drainage, Konar Siyah Spring, which is situated 20 km south-west of Firouzabad and the Tang-e-Mohr Spring, which is situated about 10 km south of Mohr and Firouzabad River, Mond drainage of Bushehr Basin and Shur River in Hormozgan Province (Figure 7).

Figure 3: *Garra mondica*, Firouzabad River, Bushehr Basin, Iran, scale: 0.5 cm.

Garra nudiventris is distinguished by having 7½ branched dorsal and three unbranched dorsal fin rays, 5½ branched and three unbranched anal fin rays, 9+8 principle caudal fin rays, 12-13 branched and one unbranched

pectoral fin ray, 7 branched ventral and one unbranched ventral fin rays, 36-39 lateral line scales, 6½-7½ scales above the lateral line, 5½-6½ scales between lateral line and pelvic-fin origin, naked predorsal, 16-18 circumpeduncular scales, one pair of barbells, 10-11 total gill rakers on the first branchial arch and a weak mental disc. This species has very limited distribution and is found only in Kalat-e-Baba Qanat at Birjand of Lut drainage basin, South Khorasan Province (Figure 7).

Garra persica has the following attributes: 6½-7½ branched and three unbranched dorsal fin rays, 5½ branched and three unbranched anal fin rays, 8+8 principle caudal fin rays, 12-13 branched and one unbranched pectoral fin ray, 7-8 branched and one unbranched ventral fin rays, 32-37 lateral line scales, 4½ scales above the lateral line, 4½ scales between lateral line and pelvic-fin origin, 14-17 predorsal scales, 14-16 circumpeduncular scales, two pairs of barbells, 17-19 gill rakers on the first branchial arch and a mental disc (Figure 4). This species is captured from different rivers in several basins, such as Kol, Ab Garm-e Genow Spring, Geru and Jegin Rivers in Hormuz basin, Firouzabad and Karzin tributaries of Mond River in Bushehr Basin and Rudan, Minab, and Karvandar rivers in Makran Basin (Figure 7).

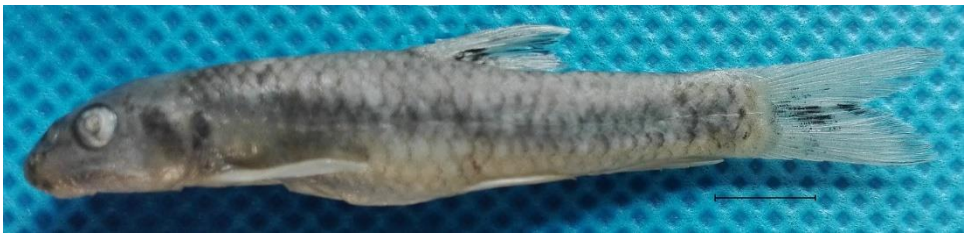

Figure 4: *Garra persica*, Minab River, Hormozgan Province, Iran, scale: 0.5 cm.

Garra rossica is distinguished by having 7½ branched and three unbranched dorsal fin rays, 5½ branched and three unbranched anal fin rays, 9+8 principle caudal fin rays, 12-13 branched and one unbranched pectoral fin rays, 7 branched and one unbranched ventral fin rays, 35-39 lateral line scales, 5½-6½ scales above the lateral line, 4½-5½ scales between lateral line and pelvic-fin origin, 13-17 predorsal scales, 15-18 circumpeduncular scales, 1-2 pairs of barbells, 11-15 total gill rakers on the first branchial arch and a weak mental disc (Figure 5). This species is distributed in streams west of Qaleh-ye Zaboli and Hamun-e Puzak of Sistan Basin, Bampur River of Jaz Murian Basin, Sarbaz, Ughin and Geh rivers of Makran Basin, Torogh and Kashafroud Rivers of Hari River Basin (Figure 7).

Garra rufa is distinguished by having 8½ branched and three unbranched dorsal fin rays, 5½ branched and three unbranched anal fin rays, 9+8 principle caudal fin rays, 12-13 branched and one unbranched pectoral fin rays, 7-8 branched and one unbranched ventral fin rays, 32-38

lateral line scales, 4½ scales above the lateral line, 3½ scales between lateral line and pelvic-fin origin, 11-14 predorsal scales, 13-16 scales in circumpeduncular, two pairs of barbells, 20-24 gill rakers on the first branchial arch and a mental disc (Figure 6). The habitats of this species are Beshar, Seymareh, Sirvan, Zohreh, Little Zab, Doirej, Fahlian, Armand, Mazoo, Kheirabad, Gamasiab, Maroon, Alvand, Godarkhosh, Kangir, Mimeh, Zimakan, Karkheh, Kakareza, Kashkan, Karun, Katola, Marbor, Sepidbarg rivers from Tigris Basin, Kor River from Persis Basin and Qarah Aqaj, Karzin, Mond, Shahpour, Sheldan, Dalaki from Bushehr Basin and Axe Rostam River from the Hormuz Basin (Figure 7).

Figure 5: *Garra rossica*, Bandan River, South Khorasan Province, Iran, scale: 0.5 cm.

Figure 6: *Garra rufa*, Kangir River, Kermanshah Province, Iran, scale: 0.5 cm.

Garra typhlops is distinguished by having 7½-8½ branched and three unbranched dorsal fin rays, 4-5 branched and three unbranched anal fin rays, 9+8 principle caudal fin rays, 14-17 branched and one unbranched pectoral fin rays, 5-7 branched and one unbranched ventral fin rays, all body is naked, two pairs of barbells, 10-13 total gill rakers on the first branchial arch and lack a mental disc. *G. typhlops* is a sympatric species with *G. lorestanensis* that distinguished from each other mainly based on presence/absence of mental disc. *G. typhlops* can be found in the isolated subterranean habitat of Loven Cave (Figure 7).

Garra tashanensis is distinguished by having 7½ branched and three unbranched dorsal fin rays, 5½ branched and three unbranched anal fin rays, 9+8 principle caudal fin rays, 12-14 branched and one unbranched pectoral fin rays, 6-7 branched and one unbranched ventral fin rays, reduced lateral line (3 scales), all body was

naked, two pairs of barbells. This species lives only in Tashan Cave of Tigris River basin, Khuzestan Province, Iran (Figure 7), and there is no information on the biology of this species.

Garra roseae is distinguished by having 7½ branched and three unbranched dorsal fin rays, 5½ branched and three unbranched anal fin rays, 9+8 principle caudal fin rays, 10-12 branched and one unbranched pectoral fin rays, 7-8 branched and one unbranched ventral fin rays, 42-58 lateral line scales, 7-9 scales above the lateral line, 6-7 scales between lateral line and pelvic-fin origin, 6 scales between lateral line and anal-fin origin, 24-30 predorsal scales, 20-24 circumpeduncular scales, lacking barbells, 11-13 total gill rakers on the first branchial arch and a small mental disc. This species is distributed in stream Tang-e-Sarhe, Makran Basin, near Siahangari, at km 465 on road from Zahedan to Chabahar, Sistan-va-Baluchistan province, Iran (Figure 7).

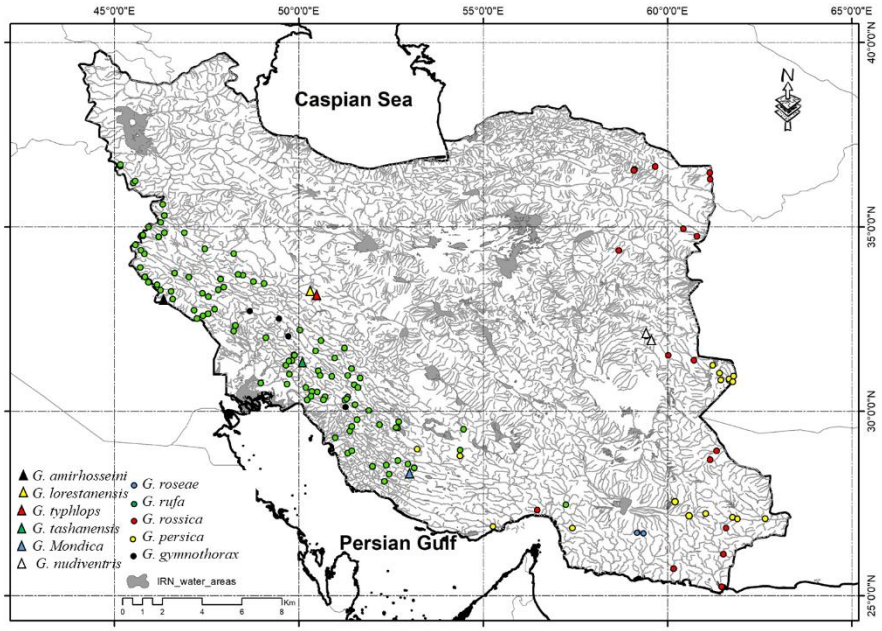

Figure 7: Geographic distribution of *Garra* species in Iran.

Discussion

Achieving a conservation program, determining diversity, interactions and integrity studies require having a thorough knowledge of diversity and species dispersal range. Therefore, such studies of distribution mapping can be useful and valuable. Little information is available on the Iranian freshwater fish. So, such studies can identify habitats and areas of separation and provide a basis for conservation programs. It seems that only *G. rufa* and *I. typhlops* (*G. lorestanensis* and *G. typhlops*) are studied and evaluated by IUCN so that *G. typhlops* is evaluated as vulnerable with D2 status in 1996 and *G. rufa* as least concern in 2014

(Freyhof, 2014).

The first report of *G. amirhosseini* was from Sartang-e-Bijar hot spring at Mehran, Tigris River basin by Esmaeili *et al.* (2016). As this species is introduced recently, little information is published on it but Zamani-Faradonbe *et al*. (2018) in Meymeh River, based on some traits using identification key of Esmaeili *et al.* (2016) presumed the presence of *G. amirhosseini* in this river. In this study, length-weight relationship was $W=0.0004L^{3.21}$, $r^2=0.93$ and condition factor was 1.03±0.14, also maximum total length and body weight was 68 mm and 4.3 g, respectively.

Also due to small population and limited habitat few studies are done on biology of *G. gymnothorax* and just Esmaeili *et al.* (2016), Kiani *et al*. (2017), and Hashemzadeh Segherloo *et al.* (2017; 2018) studied the phylogenetic status of this species using some samples of this species from Helayjan River at Izeh, Karun River system.

The population of *G. lorestanensis* that inhabit Loven Cave was first identified and introduced as the first Iranian cave-fish as Iranocypris typhlops [Persian name: Mahi-ye Kur-e ghar (E.W. Kaiser, 1937)] (Bruun and Kaiser, 1944). Bruun and Kaiser (1944) suggested *I. typhlops* to be related to genus *Barbus* Cuvier and Cloquet (1816), but Saadati (1977) rejected this suggestion. Sargeran *et al.* (2008) studied *I. typhlops* and found two taxa or forms based on the mental disc. Mahjoorazad and Coad (2009) reported a new locality for this species. Coad (2013) proposed that this species may be related to the genus *Garra* (Hamilton, 1822). Hashemzadeh Segherloo *et al.* (2012) provided the first molecular evidence of the species phylogeny based on the cytochrome c oxidase subunit I (COI) gene, which indicated that the species is phylogenetically close to the genus *Garra*. Farashi *et al.* (2014) re-evaluated the taxonomic position of *I. typhlops*. Hamidan *et al.* (2014) transferred this species from the monotypic genus *Iranocypris* to the genus *Garra*. Jalili and Eagderi (2014) described osteological structures of *G. typhlops*. Finally, Mousavi-Sabet and Eagderi (2016) described the new species, *G. lorestanensis* and distinguished this species from *G. typhlops* by a combination of characters, including lacking pigment and eyes, having a well-developed mental disc, two pairs of barbels, and naked body. Hashemzadeh Segherloo *et al.* (2018) studied genetic and morphology of these species to investigate the possible sympatric origin of *G. typhlops* and *G. lorestanensis*. Although *G. lorestanensis* was introduced from an isolated subterranean habitat, Loven Cave (a well-like pool, the natural outlet of a subterranean limestone system of the Zagros Mountains in the Ab-e Sirum or Ab-e Serum Valley near Tang-e Haft railway station in Lorestan Province, south-west Iran and it is

recently recorded from Simarreh River basin, 131 km away in a direct line, no information has been published on its biology, but Sargeran *et al.* (2008) investigated its morphometric and meristic characteristics.

G. mondica was introduced by Sayyadzadeh *et al.* (2015), however little information has been published on biology of this species. Zamani-Faradonbe *et al.* (2018) studied its length-weight relationship as $W=0.0002L^{2.87}$, $r^2=0.97$ and condition factor as 0.93±0.62. Esmaeili *et al.* (2016), Kiani *et al.* (2017), and Hashemzadeh Segherloo *et al.* (2017; 2018) studied the phylogenetic status of this species. Studies mentioned that it is found in two small springs, the Konar Siyah Spring, which is situated 20 km south-west of Firouz Abad and the Tang-e-Mohr spring, which is situated about 10 km south of Mohr and Firouz Abad River, Mond drainage of Bushehr Basin, Iran (Sayyadzadeh *et al.* 2015; Zamani-Faradonbe *et al.* 2018).

G. nudiventris is found only in Kalat-e-Baba Qanat at Birjand, Lut drainage basin of South Khorasan Province, thus there is no study on this fish but Esmaeili *et al.* (2016, 2017) which studied the phylogenetic status of this species.

Zamani-Faradonbe *et al.* (2018) reported length-weight relationship for *G. persica* in HajiAbad Stream of tributary of Kul River, Hormuz basin as $W=0.0006L^{3.04}$, $r^2=0.97$ and condition factor as 0.77±0.4, and in Rudan River of tributary of Minab River, Makran basin as $W=0.0006L^{2.94}$, $r^2=0.95$ and 0.58±0.08. Esmaeili *et al.* (2009) investigated the karyotype of *G. persica* from Rudan River and reported diploid chromosome number of this species as 2n=48, consisting 15 pairs of metacentric, eight pairs of submetacentric and one pair of subtelocentric chromosomes (15 m, 8 Sm, 1 St). Askari *et al.* (2017) studied genetic diversity of *G. persica* in Kohgiluyeh and Boyer-Ahmad Province using microsatellite markers. Therefore based on mentioned studies, it can be said that *G. persica* inhabit in Rasoul, Sarzeh, Gowdar Rivers in Hormuz basin, Bampur River and Qanat at Kahnuj in Jaz-Murian basin, Zaminbandan Stream in Mashkil basin.

Nowferesti *et al.* (2014) reported growth equation of *G. rossica* in Bakharz River as $W=0.0067L^{3.19}$, $r^2=0.97$. Zamani-Faradonbe *et al.* (2018) reported length-weight relationship for *G. rossica* in Torogh River as $W=0.0002L^{2.95}$, $r^2=0.99$, condition factor as 0.78±0.4, in Sarbaz River as $W=0.0006L^{2.96}$, $r^2=0.93$, condition factor as 0.79±0.10 and in Nehbandan River as $W=0.0004L^{2.59}$, $r^2=0.92$, condition factor as 0.92±0.17. Esmaeili *et al.* (2012) studied scale structure of *G. rossica* from Irandegan River using scanning electron microscope (SEM). Sayyadzadeh *et al.* (2015), Esmaeili *et al.* (2016), Mousavi-Sabet *et al.* (2016), and Hashemzadeh Segherloo *et al.* (2017) studied phylogenic status of this species, so present pattern of *G. rossica* in addition to the listed areas, are Nehbandan Qanat, a pool near Kuh-e

Khajeh, the Qanat near Khash and Tahlab River of Mashkil basin.

Due to presence of *G. rufa* in many rivers, many studies about biology of this species are available. Esmaeili and Ebrahimi (2006), Gerami *et al.* (2013), Hashemzadeh Segherloo *et al.* (2015), Keivany *et al.* (2016a), Keivany and Zamani-Faradonbe (2017) and Zamani-Faradonbe *et al.* (2018) studied Length–weight relationships parameters and condition factor of *G. rufa*. Ghalenoei *et al.* (2010) and Keivany *et al*. (2015) investigated morphological diversity of *G. rufa*. Teimori *et al*. (2011) studied micro-structure consideration of the adhesive organ of this species. Shabani *et al*. (2013) and Kolangi Miandare *et al*. (2016) reported genetic variations of *G. rufa*. Nezamoleslami *et al*. (2015) studied on karyology while Abedi *et al*. (2011) studied on reproductive biology and age determination of this species. Age structure and growth of *G. rufa* inhabiting Iranian inland waters is studied by Pazira *et al*. (2013). Also Farashi *et al*. (2014), Sayyadzadeh *et al*. (2015), Esmaeili *et al*. (2016), Mousavi-Sabet *et al*. (2016) and Hashemzadeh Segherloo *et al*. (2017) studied the phylogenic status of this species. The mentioned studies collected samples from many freshwater sources that some are mentioned before in the results section and others include SabzAb, Tange Haft, Palangan, Ghalate, Cheshme Gerdab, Chamgordalan, Chardavol, Cholvar, Kabkiyan, Berim, Sarab Bahram, Semirum, and Ali Kalleh from Tigris River basin, Spring Pirbanoo, stream at Saadi Tomb from the Persis basin and Koohmareh Sorkhi, Sefid, Ahram, Bahoosh, Darolmizan, Helle and Kavar from Bushehr basin.

It should be noted that there is no information on the biology of *G. typhlops*. Farashi *et al*. (2014), Sayyadzadeh *et al*. (2015), Esmaeili *et al*. (2016), Mousavi-Sabet *et al*. (2016), Hashemzadeh Segherloo *et al*. (2017; 2018) studied phylogenic status of *G. typhlops*. The Tashan cave fish, *G. tashanensis*, has been reported only from Tashan cave of Tigris River basin, Khuzestan Province, Iran, and there is no information on the biology of this species.

Almost all species of *Garra* have populations and representatives in all basins except Urmia, Caspian, Kerman and Namak lake basins. The distribution patterns of species can be affected by various ecological or historical factors. However, today there are events that affect natural distribution of many species that are mostly due to human activities such as aquaculture, trade of edible and ornamental fish and releasing some fish species for disease and aquatic vegetation control purposes. Distribution range of such fishes as common carp (*Cyprinus carpio*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*H. nobilis*), grass carp (*Ctenopharyngodon idella*), rainbow trout (*Oncorhynchus mykiss*), *Chelon auratus* and *Chelon saliens* has been modified by aquaculture activities.

Some species, such as *Alburnus hohenackeri*, *Pseudorasbora parva*, *Carassius auratus*, *Hemiculter leucisculus* and some ornamental fish like *Amatitlania nigrofasciata*, *Xiphophorus hellerii* and *Carassius gibelio* have been unwillingly and accidentally introduced. Some fishes such as *Gambusia holbrooki* are introduced in order to control malaria (Esmaeili *et al*., 2014; Mohammadian-Kalat *et al*., 2015; Esmaeili *et al*., 2017). The role of *G. rufa* in skin disease control is expected to lead to the release of some non-native populations in the rivers, especially near big cities. Therefore, preparation of a comprehensive distribution map is essential.

In order to obtain a suitable distribution map, we must first look at the ways of displacing freshwater fish populations. The displacement range of freshwater fish such as *Garra* spp. may be very limited. Although there has not been a report on the extent of displacement in a population of these fish in the rivers during their life history, it seems that links between freshwater sources are the only way for them to move among them. Considering the higher frequency of rivers in western Iran, western populations are expected to be much larger than the east, which is the case. This has led to the abundance and extent of some species, such as *G. rufa*, in many rivers of western to southern parts of Iran. Different geological events such as tectonics and formation of Zagros Mountains have led to formation of current hydrographic basins and changes in distribution patterns of Iranian freshwater fish. Therefore populations of *Garra* spp. in Iran can be grouped according to distribution range to several categories:

A) Species with very limited distribution range such as *G. lorestanensis*, *G. typhlops*, and *G. tashanensis*;

B) Species with low to moderate distribution range such as *G. amirhosseini*, *G. gymnothorax*, *G. mondica* and *G. nudiventris*;

C) Species with moderate to high distribution range such as *G. persica*, *G. rossica* and *G. rufa*.

This study can be considered as a base for understanding biodiversity, variation and distribution of Iranian *Garra* spp. which could complement the studies of Iranian freshwater fishes (Table 1).

Table 1: Summary of meristic traits of *Garra* spp.

Species	Disk	dorsal rays	anal rays	caudal	pectoral rays	ventral rays	L.L	Up	Down	Circum Peduncular scale	predorsal midlin scale	barbells	gill rakers
G. amirhosseini	Yes	III, $7_{1/2}$	III, $5_{1/2}$	9+8	I,12-13	I,7-8	33-36	$3_{1/2}$-$4_{1/2}$	$3_{1/2}$	13-14	17-19	2	16-20
G. gymnothorax	yes	III, 7½-$8_{1/2}$	III, 5½	9+8	I, 12-13	I, 7-8	32-37	3½-4½	2½ - 3½	12-13	10-12	2	17-23
G. lorestanensis	yes	III, 7½-$8_{1/2}$	5½	9+8	I, 13-14	I, 6-7	naked	naked	naked	naked	naked	2	10-12
G. mondica	yes	III, 7½	II, 5½	9+8	12-13	8	31-34	4	3	14-15	naked	2	18-23
G. nudiventris	weak	III, 7½	III, 5½	9+8	I, 12-13	I, 7	36-39	6½-7½	5½-6½	16-18	naked	1	10-11
G. rossica	weak	III, 7½	III, 5½	9+8	I, 12-13	I, 7	35-39	5½-6½	4½-5½	15-18	13-17	1-2	11-15
G. roseae	weak	III, 7½	III, 5½	9+8	I, 10-12	I, 7-8	42-58	7-9	6-7	20-24	24-30	0	11-13
G. rufa	yes	III-8½	III, 5½	9+8	I, 12-13	I, 7-8	32-38	4½	3½	13-16	11-14	2	20-24
G. persica	yes	III, 6½-7½	III, 5½	8+8	I, 12-13	I, 7-8	32-37	4½	4½	14-16	14-17	2	17-19
G. typhlops	No	III, 7½-$8_{1/2}$	III, 4-5	9+8	I, 14-17	I, 5-7	naked	naked	naked	naked	naked	2	10-13
G. tashanensis	yes	III, 7½	5½	9+8	I, 12-14	I, 6-7	Reduced (3)	Naked	Naked	Naked	Naked	2	-

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