

Review of the genus *Garra* Hamilton, 1822 in Iran with description of a new species: a morpho-molecular approach (Teleostei: Cyprinidae)

Hamid Reza ESMAEILI^{1*}, Golnaz SAYYADZADEH¹, Brian W. COAD², Soheil EAGDERI³

¹*Ichthyology and Molecular Systematics Research Lab., Department of Biology, College of Sciences, Shiraz University, Shiraz, Iran.*

²*Canadian Museum of Nature, Ottawa, Ontario, K1P 6P4, Canada.*

³*Department of Fisheries, Faculty of Natural Resources, University of Tehran, Karaj, Alborz Province, Iran.
Email: hresmaeili@shirazu.ac.ir

Abstract: The Iranian species of the genus *Garra* are reviewed, and diagnoses are presented for all recognized species. *Garra gymnothorax*, *G. lorestanensis*, *G. mondica*, *G. nudiventris*, *G. persica*, *G. rossica*, *G. rufa*, *G. typhlops* and *G. variabilis* are considered valid. *Discognathus crenulatus* Heckel, 1847 is considered as a synonym of *G. rufa*. One new species is described, *Garra amirhosseini*, from the Tigris River drainage in Iran distinguished from its congeners by having 7½ branched dorsal-fin rays, breast and belly with very small scales which are fully covered by a thick epidermal layer, and 9+8 branched caudal-fin rays. *Garra amirhosseini* is also distinguished from all other of congeners in the Persian Gulf basin except a species without a mental disc, *G. elegans*, by having two fixed, diagnostic nucleotide substitutions in the mtDNA COI barcode region. Maximum Likelihood based estimation of the phylogenetic relationships placed the sequenced fishes into 16 groups which showed between 0.62% (*Garra amirhosseini* vs. *Garra elegans*) and 17.6% (*Garra variabilis* vs. *Garra barreimiae*) K2P sequence divergence in their COI barcode region.

Keywords: *Garra amirhosseini* sp. n., Barcode region, Phylogenetic relationships, Middle East, Persian Gulf.

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Introduction

With 126 valid species, the genus *Garra* Hamilton, 1822 is one of the most diverse genera of the Labeoninae, and has a widespread distribution ranging from East Asia to Africa (Froese & Pauly 2016; Sayyadzadeh et al. 2015; Mousavi-Sabet & Eagderi 2016). In the western Palearctic, there are three *Garra* species groups, *G. variabilis* group, *G. tibanica* group and *G. rufa* group (Hamidan et al. 2014). The first group comprises *Garra variabilis* and *G. kalati* which are distributed in the Mediterranean and Persian Gulf basins with no record of *G. kalati*

from Iran. The second group comprises *G. tibanica*, *G. smarti*, *G. buettikeri* and *G. dunsirei* from the Arabian Peninsula with no Iranian records. The *Garra rufa* group includes very diverse species distributed in the great Persian Gulf basin (Euphrates, Tigris, Persis, and Hormuz) and endorheic Lake Maharlu which once was connected to the Persian Gulf basin through the Paleo-Kor River (see Esmaeili et al. 2010, 2015a, b). Since the first revision of the genus *Garra* by Menon (1964), more than 10 new species have been described of which some were based on the squamation pattern, including *Garra mondica* in

the *Garra rufa* group described from the Mond River drainage in Iran (Sayyadzadeh et al. 2015). In this study, all *Garra* populations in Iran were analyzed for their morphological characters, squamation pattern, and sequenced for COI barcode region. We describe another new species in the *Garra rufa* group based on squamation pattern and some other morphological and molecular characters from a hot spring in the Tigris River drainage of Iran. A key to identification of species of the genus *Garra* is given.

Material and Methods

After anesthesia, fishes were fixed in 5% formaldehyde and later stored in 70% ethanol. Measurements were made with digital calipers and recorded to the nearest 0.1 mm. All measurements are made point to point, never by projections. Methods for counts and measurements follow Kottelat and Freyhof (2007). The terminology of the snout morphology and the oromandibular structures follow Stiassny & Getahun (2007) and Nebeshwar & Vishwanath (2013). Standard length (SL) is measured from the tip of the snout to the end of the last scales on the body in lateral line. The length of the caudal peduncle is measured from the insertion of the last anal-fin ray to the end of the hypural complex, at mid-height of the caudal-fin base. The last two branched rays articulating on a single pterygiophore in the dorsal and anal fins are counted as "1½". The holotype is included in the calculation of means and SD.

Abbreviations: SL, standard length; HL, lateral head length; K2P, Kimura 2-parameter. Collection codes: CMNFI, Canadian Museum of Nature, Ottawa; FSJF, Fischsammlung J. Freyhof, Berlin; NMW, Naturhistorisches Museum Wien, Vienna; ZIN, Laboratory of Ichthyology, Zoological Institute, Russian Academy of Sciences, St. Petersburg; ZM-CBSU, Zoological Museum of Shiraz University, Collection of Biology Department, Shiraz; ZMUC, Zoological Museum, University of Copenhagen.

DNA extraction and PCR: Genomic DNA was extracted using Macherey and Nagel NucleoSpin®

Tissue kits following the manufacturer's protocol on an Eppendorf EpMotion® pipetting-roboter with vacuum manifold. The standard vertebrate DNA barcode region of the COI (cytochrome c oxidase subunit 1) was amplified using a M13 tailed primer cocktail including FishF2_t1 (5'TGTAAAAC GACGGCCAGTCGACTAATCATAAAGATATC GCAC), FishR2_t1 (5'CAGGAAACAGCTATGAC ACTTCAGGGTGACCGAAGAATCAGAA), VF2_t1 (5'TGTAAAACGACGGCCAGTCAACCAACC ACAAAGACATTGGCAC) and FR1d_t1 (5'CAGG AAACAGCTATGACACCTCAGGGTGTCCGAA RAAYCARAA) (Ivanova et al. 2007). Sequencing of the ExoSAP-IT (USB) purified PCR product in both directions was conducted at Macrogen Europe Laboratories with forward sequencing primer M13F (5'GTAAAACGACGGCCAGT) and reverse sequencing primer M13R-pUC (5'CAGGAAACAGCTA TGAC).

Molecular data analysis: Data processing and sequence assembly was done in Geneious Biomatters (2013) and the ClustalW algorithm (Higgins & Sharp 1988) was used to create a DNA sequence alignment. Modeltest (Posada & Crandall 1998), implemented in the MEGA 6 software (Tamura et al. 2011), was used to determine the most appropriate sequence evolution model for the given data, treating gaps and missing data with the partial deletion option under 95% site coverage cutoff. We generated maximum likelihood phylogenetic trees with 10,000 bootstrap replicates in RaxML software 7.2.5 (Stamatakis 2006) under the GTR+G+I model of nucleotide substitution, with CAT approximation of rate heterogeneity and fast bootstrap to explore species phylogenetic affinities. Bayesian analyses of nucleotide sequences were run with the parallel version of MrBayes 3.1.2 (Ronquist & Huelsenbeck 2003) on a Linux cluster with one processor assigned to each Markov chain under the most generalizing model (GTR+G+I) because overparametrization apparently does not negatively affect Bayesian analyses (Huelsenbeck & Ranala 2004). Each Bayesian analysis comprised two simultaneous runs of four Metropolis-coupled

Markov-chains at the default temperature (0.2). Analyses were terminated after the chains converged significantly, as indicated by the average standard deviation of split frequencies <0.01. We used the sequences of Iranian populations of *G. rufa* and all individuals of *G. persica*, *G. rossica*, *G. cf. gymnothorax* and *G. mondica* given in Sayyadzadeh et al. (2015) and also *G. amirhosseini* (in this study). In order to better understand the phylogenetic position of the studied species, we include records from the NCBI Genbank for *G. barreimiae*, *G. cf. longipinnis*, *G. jordanica*, *G. ghorensis*, *G. rufa*, *G. typhlops*, *G. variabilis* and *G. widdowsoni*.

Screening for diagnostic nucleotide substitutions was performed manually from the resulting sequence alignment. Estimates of evolutionary divergence over sequence pairs between species were conducted in Mega6 (Tamura et al. 2013). Analyses were conducted using the Kimura 2-parameter model (Kimura 1980). The rate variation among sites was modelled with a gamma distribution (shape parameter=1). Codon positions included were 1st+2nd+3rd+Noncoding. All positions containing gaps and missing data were eliminated.

Results

We included COI barcode sequences for a total of 94 *Garra* individuals. Maximum Likelihood estimation of phylogenetic relationships based on mitochondrial COI barcode region place the sequenced fishes into 16 groups (Fig. 1), which show between 0.62% (*G. elegans* vs. *G. amirhosseini*) and 17.6% (*G. variabilis* vs. *G. barreimiae*) K2P sequence divergence in their COI barcode region. *Garra nudiventris*, *G. rossica* and *G. variabilis* are related and form a group well-separated from the other analysed species. *Garra amirhosseini*, *G. elegans*, *G. mondica*, *G. persica*, *G. rufa* and *G. widdowsoni*, form a separate monophyletic group. Table 1 lists the diagnostic nucleotide substitutions found in the 647 base pairs long mtDNA COI barcode region. Table 2 lists the average estimates of the evolutionary

divergence between the *Garra* species recognized here as number of base substitutions per site.

Key to species of *Garra* in Iran:

- 1a – Subterranean species, body whitish or pink; eye absent 2
- 1b – Epigeal species, body brown or grey, usually mottled; eye fully developed..... 3
- 2a – Mental disc absent; body naked *G. typhlops*
- 2b – Mental disc present; body naked or scaled 4
- 3a – Mental disc absent *G. elegans*
- 3b – Mental disc present 5
- 4a – Body naked *G. lorestanensis*
- 4b – Body fully covered by scales or scales restricted to lateral midline *G. widdowsoni*
- 5a – One (two short in some populations) pair of barbels 6
- 5b – Two pairs of barbels 7
- 6a – Predorsal mid-line region, breast and belly naked *G. nudiventris*
- 6b – Predorsal mid-line region, breast and belly fully covered by scales or embedded scales 8
- 7a – 8+8 branched caudal-fin rays *G. persica*
- 7b – 9+8 branched caudal-fin rays 9
- 8a – Head length shorter than caudal peduncle length and pectoral fin length *G. variabilis*
- 8b – Head length longer than caudal peduncle length and pectoral fin length *G. rossica*
- 9a – 7½ branched dorsal-fin rays, breast and belly naked or with very small scales covered by a thickish epidermal layer 10
- 9b – Mostly 8½ branched dorsal-fin rays, breast naked or covered by both embedded and fully scales, belly usually covered by scales 11
- 10a – Mid-dorsal area in front of the dorsal-fin origin naked; breast, anterior belly naked *G. mondica*
- 10b – Mid-dorsal area in front of the dorsal-fin origin always covered by embedded scales; breast and belly with very small scales covered by a thick epidermal layer *G. amirhosseini*
- 11a – Breast naked (in Bashar population with hidden scales) *G. gymnothorax*
- 11b – Breast partly covered by scales *G. rufa*

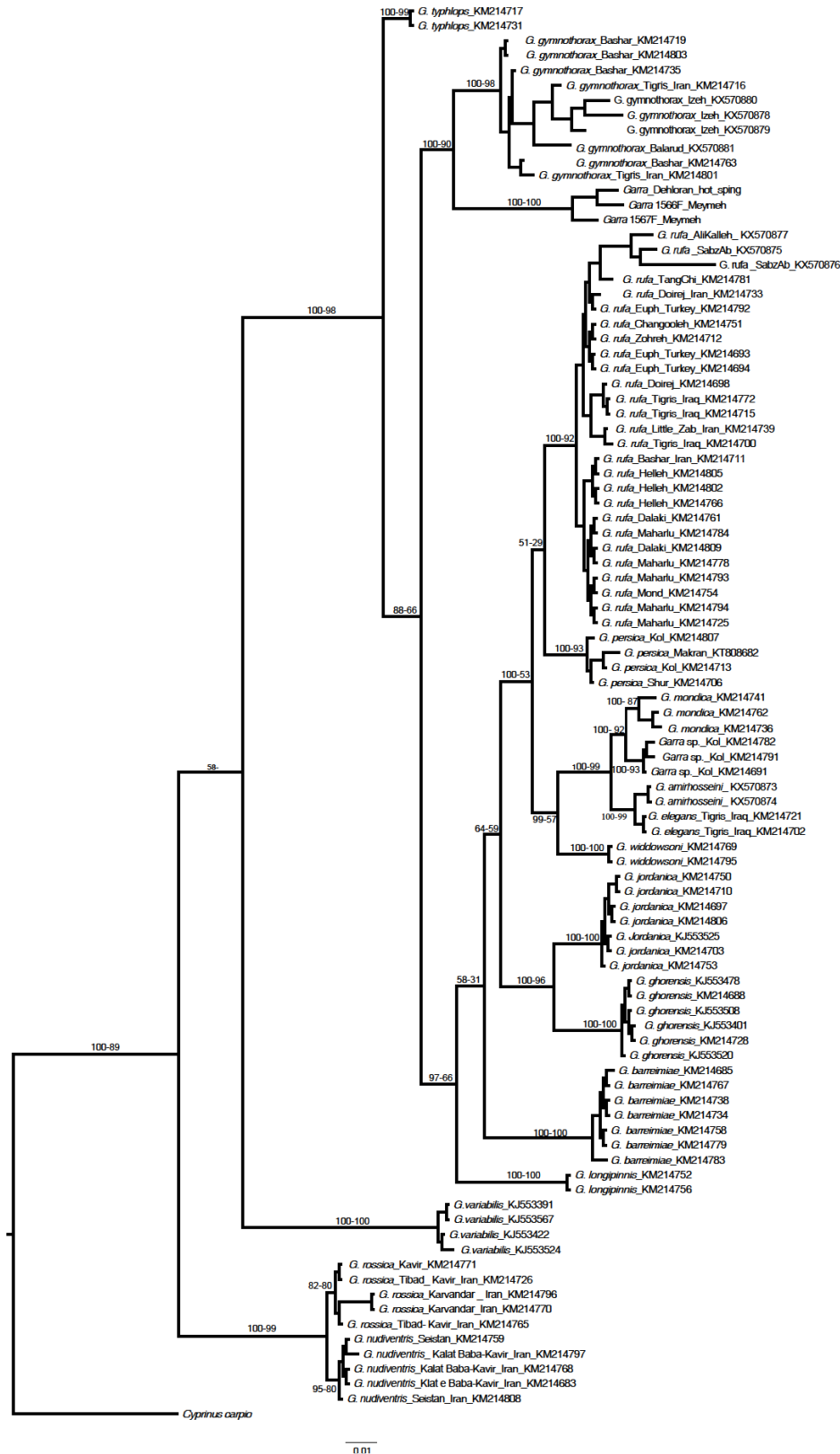


Fig.1. Maximum Likelihood (ML) estimation of the phylogenetic relationships based on the mitochondrial COI barcode region. Nucleotide positions with less than 95% site coverage were eliminated before analysis. Numbers of major nodes indicate bootstrap values from the Maximum Likelihood-, from 1000 pseudo-replicates followed by Bayesian posterior probabilities.

Table 1. Diagnostic nucleotide substitutions found in mtDNA COI barcode region of *Garra* species.

Nucleotide position relative to <i>Oryzias latipes</i> complete mitochondrial genome (AP004421)																						
Nucleotide position	N	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5		
		6	6	6	6	7	7	7	7	7	7	7	7	8	8	8	8	8	8	8		
		0	2	4	7	0	0	2	2	6	7	7	8	2	2	2	2	3	4	5		
		1	8	0	3	0	9	1	4	9	5	9	2	0	3	6	9	6	7	1		
<i>G. amirhosseini</i>	2	T	T	T	T	T	A	C	A	A	A	T	C	C	A	G	A	G	C	G	T	A
<i>G. barreimiae</i>	7	C	T	T	C	T	G	C	G	A	A	T	C	T	A	C	G	G	T	G	T	T
<i>G. elegans</i>	2	T	T	T	T	T	A	C	A	A	A	T	C	C	A	G	A	G	C	G	T	A
<i>G. ghorensis</i>	6	T	T	T	T	T	A	C	A	A	G	T	T	C	A	G	A	G	C	G	T	A
<i>G. gymnothorax</i>	10	T	T	T	T	T	A	C	A	A	A	T	C	C	A	G	A	G	C	T	C	A
<i>G. jordanica</i>	7	T	T	T	T	T	A	C	A	A	G	T	C	C	A	G	A	G	C	G	T	A
<i>G. longipinnis</i>	2	T	T	T	T	A	A	C	A	A	A	T	C	C	G	A	C	G	C	G	T	A
<i>G. mondica</i>	3	T	T	T	T	T	A	C	A	A	A	T	C	C	A	G	A	G	C	G	T	A
<i>G. nudiventris</i>	5	T	T	T	T	C	A	C	C	A	A	T	C	C	A	G	G	G	C	G	T	A
<i>G. persica</i>	4	T	T	T	T	T	A	C	A	A	A	T	C	C	A	G	A	G	C	G	T	A
<i>G. rossica</i>	5	T	T	T	T	C	A	C	C	A	A	T	C	C	A	G	G	G	C	G	T	A
<i>G. rufa</i>	27	T	T	T	T	T	A	C	A	G	A	T	C	C	A	G	A	G	C	G	T	A
<i>G. typhlops</i>	2	T	T	T	T	T	A	C	A	A	A	T	C	C	A	G	G	G	C	G	T	A
<i>G. variabilis</i>	4	T	A	C	T	C	A	C	C	A	G	C	C	C	A	A	A	G	C	G	T	A
<i>G. widdowsoni</i>	2	T	T	T	T	T	A	T	A	A	A	T	C	C	A	G	A	A	C	G	T	A
<i>Garra</i> sp. Kol	3	T	T	T	T	T	A	C	A	A	C	T	C	C	A	G	A	G	C	G	T	A

Nucleotide position	N	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6
		8	8	9	9	9	9	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0
		8	8	0	0	1	2	2	3	4	7	7	0	0	0	3	3	4	5	6	7	7
		3	9	2	4	8	2	8	4	6	3	9	3	6	9	4	6	0	4	0	5	5
<i>G. amirhosseini</i>	2	A	A	C	A	T	A	T	G	T	C	C	C	C	A	C	A	C	A	A	A	A
<i>G. barreimiae</i>	7	A	A	C	A	T	G	T	A	T	C	C	C	C	G	C	A	C	A	A	A	A
<i>G. elegans</i>	2	A	A	C	A	T	A	T	G	T	C	C	C	C	G	C	A	C	A	A	A	A
<i>G. ghorensis</i>	6	A	A	C	G	T	A	T	G	T	C	C	A	C	G	C	A	C	G	A	A	A
<i>G. gymnothorax</i>	10	G	A	C	A	T	A	T	G	T	C	C	C	C	G	C	G	C	A	A	A	A
<i>G. jordanica</i>	7	A	A	T	A	T	A	T	G	T	C	C	C	C	A	C	A	C	A	A	A	A
<i>G. longipinnis</i>	2	A	A	C	A	T	A	T	G	T	C	C	C	C	G	T	A	T	A	G	A	A
<i>G. mondica</i>	3	A	A	C	A	T	A	T	G	T	C	C	C	C	G	C	A	C	A	A	A	A
<i>G. nudiventris</i>	5	A	A	C	A	T	A	T	G	T	C	C	T	C	A	C	A	C	C	A	A	A
<i>G. persica</i>	4	A	A	C	A	T	A	T	G	T	C	C	C	C	A	C	A	C	A	A	A	A
<i>G. rossica</i>	5	A	A	C	A	T	A	T	G	T	C	C	T	C	A	C	A	C	C	A	A	A
<i>G. rufa</i>	27	A	A	C	A	T	A	T	G	T	C	C	C	C	G	C	A	C	A	A	A	A
<i>G. typhlops</i>	2	A	A	C	A	T	A	T	G	T	C	C	C	C	G	C	A	C	T	A	A	A
<i>G. variabilis</i>	4	A	G	C	A	T	A	T	G	C	T	T	T	T	T	C	A	C	C	A	A	A
<i>G. widdowsoni</i>	2	A	A	C	A	C	A	C	G	T	C	C	C	C	G	C	A	C	A	A	G	A
<i>Garra</i> sp. Kol	3	A	A	C	A	T	A	T	G	T	C	C	C	C	G	C	A	C	A	A	A	A

Genus *Garra* Hamilton, 1822

Type species: *Cyprinus (Garra) lamta* Hamilton, 1822 by subsequent designation of Bleeker (1863: 192).

Type locality: Behar Province and Rapti River, Gorakhpur District, Uttar Pradesh, India.

Diagnosis: Among cyprinids *Garra* is phylogenetic-

ally diagnosed by the following combination of apomorphic features: lower lip expanded posteriorly to form either an ovoid or circular callous pad or suction disc; vomero-palatine organ either vestigial or fully regressed; pectoral fins with the first two or more rays prominent and often unbranched; supraethmoid wider than long in dorsal aspect; and

Table 2. Estimates of evolutionary divergence (%) over sequence pairs between species found in the COI barcode region of *Garra* species studied.

	N	<i>G. amirhosseini</i>	<i>G. barreimiae</i>	<i>G. elegans</i>	<i>G. ghorensis</i>	<i>G. gymnothorax</i>	<i>G. jordanica</i>	<i>G. longipinnis</i>	<i>G. mondica</i>	<i>G. nudiventris</i>	<i>G. persica</i>	<i>G. rossica</i>	<i>G. rufa</i>	<i>G. typhlops</i>	<i>G. variabilis</i>	<i>G. widdowsoni</i>	<i>Garra</i> sp. Kol
<i>G. amirhosseini</i>	2																
<i>G. barreimiae</i>	7	8.54															
<i>G. elegans</i>	2	0.62	8.3														
<i>G. ghorensis</i>	6	7.55	9.01	7.31													
<i>G. gymnothorax</i>	10	6.25	8.06	5.55	8.09												
<i>G. jordanica</i>	7	6.55	7.64	6.45	4.37	6.36											
<i>G. longipinnis</i>	2	7.3	8.26	7.06	7.76	7.45	7.85										
<i>G. mondica</i>	3	1.68	7.57	1.33	6.76	5.17	6.21	6.4									
<i>G. nudiventris</i>	5	13.2	14.7	14	13.4	13.5	14.4	13	13.2								
<i>G. persica</i>	4	3.86	6.62	4.09	6.13	5.69	5.16	6.4	3.86	12.1							
<i>G. rossica</i>	5	13.3	15.3	14.1	13.7	13.8	14.5	13	13.3	0.75	12.2						
<i>G. rufa</i>	27	4.22	6.98	4	5.63	5.67	3.94	7	3.77	12.7	2.45	12.8					
<i>G. typhlops</i>	2	6.6	8.04	6.84	6.83	4.81	6.67	6.1	6.6	10.1	4.76	10.4	5.15				
<i>G. variabilis</i>	4	15.7	17.6	16.3	14.2	14.3	14.4	15	16	11.9	12.5	12.3	13.7	11.5			
<i>G. widdowsoni</i>	2	4.31	7.57	4.09	7.08	6.72	6.21	7.8	3.86	13.7	3.42	13.8	2.96	7.08	14.9		
<i>Garra</i> sp. Kol	3	1.68	8.04	1.46	6.83	5.77	5.97	6.3	0.83	13.1	3.86	13.3	3.77	6.59	15.1	3.86	

cleithrum narrow and anteriorly elongate. In addition, the following combination of features distinguish *Garra* from other members of the labeonin subtribe Garraina: pharyngeal teeth in three rows, 2,4,5–5,4,2; dorsal fin with either 10 or 11 branched rays, inserted slightly in advance of pelvic fins; anal fin with 8-9 branched rays, situated well behind pelvic fins; diploid chromosome number 50 (see Stiassny & Getahun 2007).

Garra amirhosseini sp. n.

(Figs. 2-10)

Holotype: ZM-CBSU H1216, 67.3mm SL; Iran: Ilam prov.: Sartang-e-Bijar hot spring at Mehran, Tigris River drainage, 33°46'16.3"N 45°56'17.2"E; G. Sayyadzadeh and A. Mansouri, 26 Oct 2015.

Paratypes: All from Iran. ZM-CBSU H1217, 6, 46-66mm SL; same data as holotype; ZM-CBSU J2791, 22, 40-60mm SL; Iran: Ilam prov.: Sartang-e-Bijar hot spring at Mehran, Tigris River drainage, 33°46'19.1"N 45°56'19.0"E; H.R. Esmaili and

M. Masoudi, 13 Sep. 2012.

Material for molecular analysis: ZM-CBSU M747-M748; Ilam prov.: Sartang-e-Bijar hot spring at Ilam, Tigris River drainage, 33°46'19.1"N 45°56'19.0"E, GenBank accession numbers: KX570873, KX570874.

Diagnosis: *Garra amirhosseini* sp. n. is distinguished from all other species of *Garra* in the rivers flowing to the Persian Gulf by having the breast and belly with very small scales which are fully covered by a thick epidermal layer (vs. naked breast in *G. gymnothorax*, naked breast and belly in *G. mondica* or vs. fully covered by normal scales without any covering layer). *Garra amirhosseini* is further distinguished from *G. mondica* by having a predorsal mid-line which is fully covered by scales or embedded scales (vs. naked or with 2-4 embedded scales at front of dorsal fin origin in a few individuals). *Garra amirhosseini* is further distinguished from *G. rufa* and *G. gymnothorax* by having usually 7½ branched dorsal-fin rays (vs.



Fig.2. *Garra amirhosseini*, ZM-CBSU H1216, holotype, 67.3mm SL; Iran: hot Spring Sartang-e Bijar.

usually $8\frac{1}{2}$). *Garra amirhosseini* is distinguished from all the congeners included in this study except a species without mental disc *G. elegans* (vs. having mental disc in *G. amirhosseini*) by two fixed, diagnostic nucleotide substitutions, and a K2P nearest-neighbor distance of 0.62% to *G. elegans*.

Beside the breast and belly with very small scales fully covered by a thick epidermal layer, *Garra amirhosseini* is also distinguished from *G. persica* by having usually 9+8 caudal-fin rays (vs. usually 8+8). *Garra amirhosseini* is distinguished from *G. rossica* by having a fully developed mental disc (vs. reduced) and 16-20 total gill rakers on the first branchial arch (vs. 13-15), from *G. variabilis* by having a fully developed mental disc (vs. reduced) and two pairs of

barbels (vs. one) and from *G. typhlops* and *G. widdowsoni* by having well-developed eyes and a brown and silvery colour pattern (vs. absence).

Description: General appearance of body is shown in Figures 2-10, and morphometric data are given in Table 3. Body elongated, moderately compressed laterally, more compressed in region of caudal peduncle. Dorsal head profile rising gently, flat or slightly convex, more or less continuous with dorsal body profile to nape or about middle between nape and dorsal-fin origin. Ventral profile more or less straight to anal-fin origin. Head moderately large and depressed, with slightly convex or flat interorbital distance; height at nape less than head length; width at nape greater or about equal to depth at nape. Snout



Fig.3. *Garra amirhosseini*, ZM-CBSU H1217, H1219, H1220, paratypes, a, 66.4mm SL, b, 58.9mm SL, and c, 54.9mm SL; Iran: hot Spring Sartang-e Bijar.

roundish; transverse lobe with 6-18 tubercles, demarcated posteriorly by a slightly shallow transverse groove in some individuals, no transverse groove in others. Proboscis covered with small or medium sized tubercles, largest on anterior margin of proboscis. Proboscis not, or only slightly, elevated from depressed rostral surface. Lateral surface of snout covered by small-sized tubercles reaching to anterior eye margin in some individuals, or to posterior nostril in others. Depressed rostral surface always without tubercles, anterior arm of depressed rostral surface not reaching to base of rostral barbel, clearly separating transverse lobe from lateral surface in large specimens. No groove between transverse lobe and lateral surface in some individuals. No head

tubercles in juveniles and in a few adults. Eye placed dorso-laterally in anterior half or about mid-region of head. Barbels in two pairs; rostral barbel antero-laterally located, shorter or about equal to eye diameter; maxillary barbel at corner of mouth, shorter than rostral barbel. Well-developed disc with free lateral and posterior margins; which is heavily papillate with batteries of fleshy papillae arrayed around the periphery of the whole disc. Rostral cap well-developed, fimbriate, papillate on ventral surface. Upper lip present as a thin band of papillae arranged in two ridges. Upper jaw almost or completely covered by rostral cap. Disc elliptical, shorter than wide and narrower than head width through base of maxillary barbel; papillae on anterior

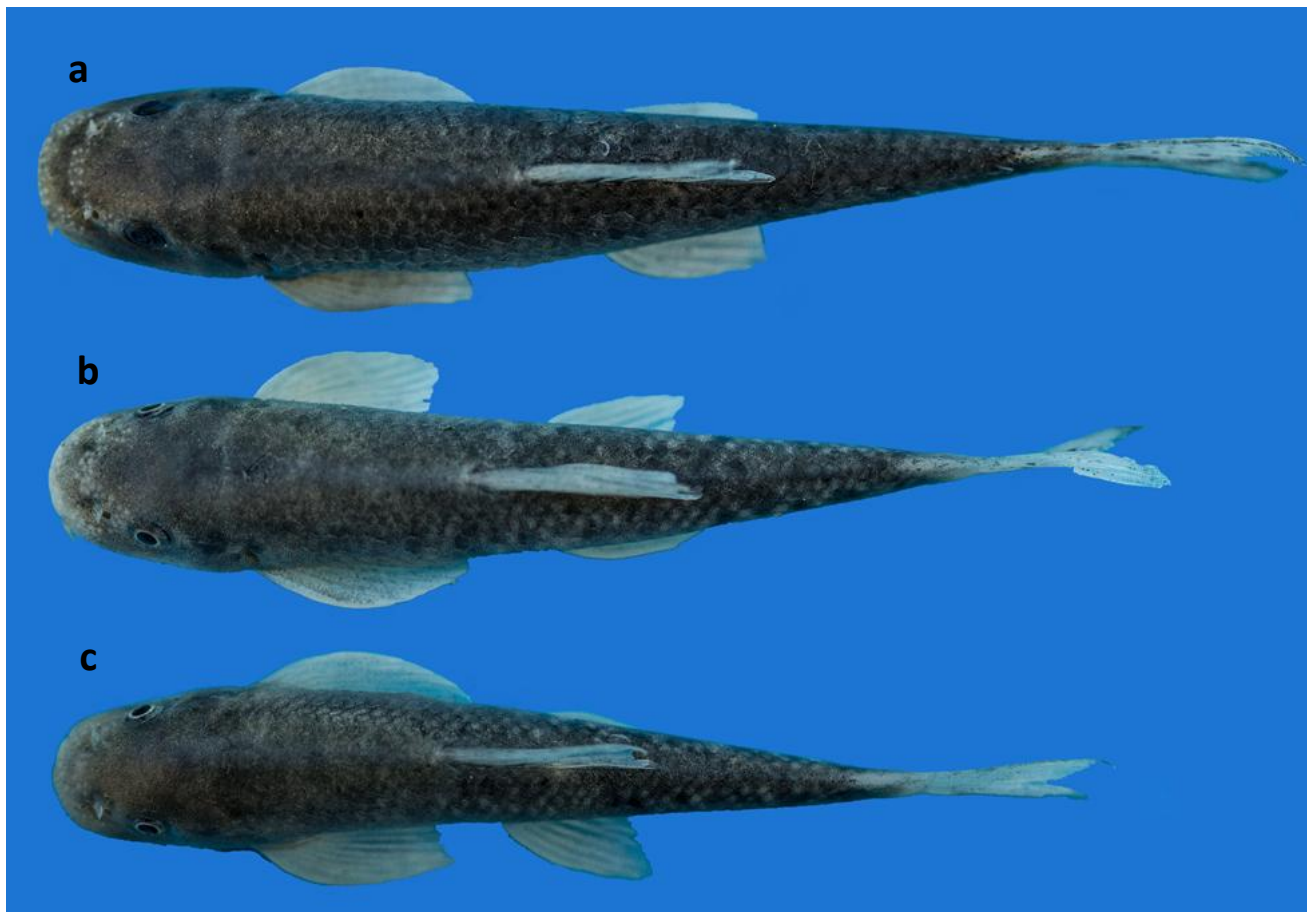


Fig.4. *Garra amirhosseini*, ZM-CBSU H1217, H1219, H1220, paratypes, a, 66.4mm SL, b, 58.9mm SL, and c, 54.9mm SL; Iran: hot Spring Sartang-e Bijar.

fold of same size, regularly arranged; groove between antero-median fold and central callous-pad narrow and deep, papillae on inner half of whole length of latero-posterior flap coarsely arranged; anterior marginal surface of central callous pad without or with sparsely arranged small papillae; posterior margin of latero-posterior flap extending vertical to middle of eye (Figs. 6-7).

Dorsal fin with 3 simple and 7½ branched rays, last simple ray slightly shorter than head length; distal margin concave; origin closer to snout tip than to caudal-fin base; inserted anterior to vertical from pelvic-fin origin; first branched ray longest, tip of last branched ray reaching vertical to anus. Pectoral fin with 1 simple and 12-13 branched rays, reaching to a point 3-4 scales anterior to pelvic-fin origin, length shorter or slightly equal to head length. Pelvic fin with 1 simple and 7-8 branched rays, reaching to

anus, origin closer to anal-fin origin than to pectoral-fin origin, inserted below second or third branched dorsal-fin ray. Anal fin short, with 3 simple and 5½ branched rays; first branched ray longest; distal margin straight or slightly concave; origin closer to pelvic-fin origin than to caudal-fin base. Anus 2-3 scales in front of anal-fin origin. Caudal fin forked with 9+8 branched rays; tip of lobes pointed. Total gill rakers on the first branchial arch 16-20 [16(5), 17(7), 18(2), 19(-), 20(1)]. Lateral line complete, with 33-36 [33(4), 34(3), 35(4), 36(4)] scales on body and 2-3 scales on caudal-fin base. Transverse scale rows above lateral line 3½-4½; between lateral line and pelvic-fin origin 3½ and between lateral line and anal-fin origin 3½. Circumpeduncular scale rows 13-14. Usually, 17-19 scales on predorsal midline between dorsal-fin origin and nape which are deeply embedded in many individuals and are uncountable.



Fig.5. *Garra amirhosseini*, ZM-CBSU H1217, H1219, H1220, paratypes, a, 66.4mm SL, b, 58.9mm SL, and c, 54.9mm SL; Iran: hot Spring Sartang-e Bijar.

Scales on flank regularly arranged. Chest and belly with very small scales which are fully covered by a thick epidermal layer. One short axillary scale at base of pelvic fin in some individuals, and 5-7, usually 5, scales between posteriormost pelvic-fin base and anus, embedded in skin in some individuals.

Coloration: In ethanol: Head, dorsum and flank dark gray. Single or groups of dark scales on flank. A very faint, irregularly-shaped mid-lateral stripe restricted to posterior flank or absent in some individuals. Mouth, chest and abdomen yellowish white. A wide black or dark brown bar at posteriormost caudal peduncle, faded in some individuals, bold, and 2-3 scales wide in others. Bar reaching dorsal midline in most individuals, not reaching ventral midline. A small black blotch at anteriormost lateral line. Lateral line pores cream whitish. Fins hyaline with irregularly set black spots on rays, darker and

numerous in dorsal and caudal fins, or rays partly dusty grey or black. Base of last 2-6 branched dorsal-fin rays with a black spot more prominent in rays 3-5, hyaline in others. In life: Fins hyaline with black spots. Head grey. Flank scales dark grey with individual or groups of pale grey scales forming a mottled pattern; whitish or pale grey on ventral flank and belly. Iris silvery orange. A pale blue dot at anteriormost lateral line, forming a faded patch reaching down to upper pectoral-fin base in some individuals.

Distribution: *Garra amirhosseini* was found in a hot spring in the Tigris River drainage in Iran, the Sartang-e-Bijar Spring (Figs. 11, 31), which is situated about 70km north-west of Ilam.

Etymology: The species is named for Amirhossein son of the first author.

Remarks: *Garra amirhosseini* occurs in the Tigris



Fig.6. *Garra amirhosseini*, ZM-CBSU H1216, holotype, 67.3mm SL; Iran: hot Spring Sartang-e Bijar.

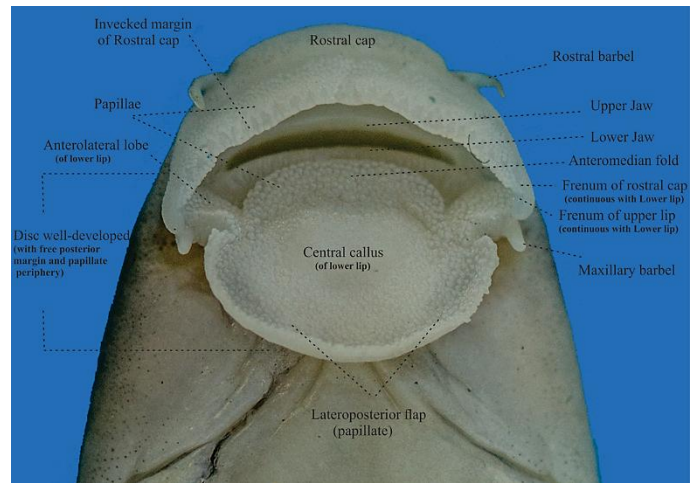


Fig.7. *Garra amirhosseini*, ZM-CBSU H1216, holotype, 67.3mm SL; Iran: hot Spring Sartang-e Bijar showing ventral part of head.

(1949) described *G. rufa gymnothorax* from the Iranian Karun drainage, a tributary of the lowermost Tigris, distinguishing *G. r. gymnothorax* from *G. r. rufa* by its naked breast (vs. scaled). Alexander Naseka (Dolsko) examined syntypes (ZIN 13214–15) of this nominal species for us (Fig. 12), and these fishes have indeed a naked breast as described by Berg (1949). Coad (1991) treated *G. r. gymnothorax* as a synonym of *G. rufa*. Our molecular data suggest that fishes from the Karun River drainage might represent a distinct species, as they form a separate molecular group, well differentiated from *G. rufa* (Fig. 1: *G. gymnothorax*). Within the Tigris River drainage in Iran, *Garra amirhosseini* is distinguished from the other two species by having the breast and belly with very small scales which are fully covered by a thick epidermal layer (vs. fully covered by normal scales without any covering layer in *G. rufa* or naked breast in *G. gymnothorax*) and by usually 7½ branched dorsal-fin rays (vs. 8½). In our molecular tree, the nearest group to *Garra amirhosseini*, is *G. elegans* which is also known from the Tigris River drainage. *Garra amirhosseini* is distinguished from *G. elegans* by having mental disc (vs. mental disc absent). *Garra amirhosseini*, is distinguished from *G. mondica* by having breast and belly covered with small scales (vs. naked), a predorsal midline which is fully covered by scales or

River drainage in Iran with *G. rufa* and *G. gymnothorax*, while *G. rufa* is widespread, it has not been found in sympatry with *G. amirhosseini* which has been recorded from a hot spring only. Berg



Fig.8. Live specimen of *Garra amirhosseini* ZM-CBSU H1216, holotype, 67.3mm SL; Iran: hot Spring Sartang-e Bijar.



Fig.9. Live specimen of *Garra amirhosseini*, ZM-CBSU H1216, holotype, 67.3mm SL; Iran: hot Spring Sartang-e Bijar.

embedded scales (vs. naked or with 2-4 embedded scales at front of dorsal fin origin in few individuals). *Garra amirhosseini* differs from all the subterranean members of the genus *Garra* (*G. lorestanensis*, *G. typhlops* and *G. widdowsoni*) by presence of eyes and pigment (vs. lacking pigment and eyes).

***Garra gymnothorax* (Berg, 1949)**

(Figs. 12-13)

Material examined: The syntypes of *Garra rufa gymnothorax* are in the Zoological Institute, St. Petersburg (ZIN 13214), there being 6 fish in the

catalogue and 6 in the jar although Berg (1949) lists 7 in his description. They measure 30.5-44.9mm standard length. The date in Berg (1949) is 6.VI.1904 while in the catalogue it is 4.III.1904 and in the jar 24.III.1904, variations not accountable by old and new styles of dating (13 days apart). A further collection listed by Berg (1949), (ZIN 24435), is not listed as type material in the text nor in the jar but the catalogue suggests that they are (Eschmeyer et al. (2016) list these 10 fish as syntypes). ZIN 24354 is from "Ziaret-Seid-Hasan, Mesopotamiya". The type series may be only ZIN 13214 as in the text.



Fig.10. Live specimen of *Garra amirhosseini*, ZM-CBSU H1216, holotype, 67.3mm SL; Iran: hot Spring Sartang-e Bijar.



Fig.11. Hot Spring Sartang-e Bijar, type locality of *Garra amirhosseini*.

Table 3. Morphometric data of *Garra amirhosseini*, holotype ZM-CBSU H1216, paratypes, ZM-CBSU H1217-H1219, ZM-CBSU J2791-J2805, n=19).

	Holotype	Range	Mean	SD
Standard length (mm)	67.3	40.4-67.3	51.0	
In percent of standard length				
Head length	25.40	23.0-25.7	24.4	0.8
Body depth at dorsal-fin origin	20.97	17.5-23.5	21.2	1.9
Predorsal length	48.56	45.3-48.9	47.0	1.0
Postdorsal length	40.63	38.7-42.7	40.8	0.9
Preanal length	75.00	70.2-76.8	74.2	1.6
Prepelvic length	53.12	51.2-56.3	53.9	1.4
Distance between pectoral and pelvic-fins	32.19	29.1-34.2	31.7	1.3
Distance between pelvic and anal-fins	21.42	17.6-21.4	19.8	1.1
Depth of caudal peduncle	11.16	9.8-11.2	10.3	0.4
Length of caudal peduncle	19.44	17.2-20.6	19.1	1.0
Dorsal-fin base length	14.72	11.9-14.7	13.2	0.8
Anal-fin base length	7.25	5.7-7.7	6.6	0.5
Pectoral-fin length	22.96	21.4-24.9	23.1	0.9
Pelvic-fin length	18.75	17.0-19.5	18.4	0.8
In percent of head length				
Head depth	65.0	59-70	64.6	2.4
Snout length	52.0	37-52	41.5	3.4
Postorbital distance	43.3	39-46	42.8	1.8
Interorbital width	41.2	39-49	44.8	2.5
Eye diameter	15.6	13-19	15.2	1.9
Maximum head width	77.9	70-81	75.6	2.4
Rostral barbel	15.4	13-16	14.3	1.1
Maxillary barbel	11.2	4-12	9.5	2.0

Eschmeyer et al. (1996) list ZIN 13215, 17 fish, and ZIN 24436, 3 fish, as syntypes. Eschmeyer et al. (2016) give syntypes as ZIN 13214-15 (6, 6+), 24429 (1), 24435-36 (10, 3). ZM-CBSU H1225, 11, 45-72 mm SL; Iran: Khuzestan prov.: Helayjan River at Izeh, Tigris River drainage, 31°47'04.8"N 49°47'36.2"E; G. Sayyadzadeh and M. Razbanian, 21 Dec 2015. ZM-CBSU B962, 1, 89mm SL; B964, 1, 79, mm SL; Iran: Khuzestan prov.: Balarud River at Andimeshk to Pol-e-Dokhtar road, Tigris River drainage, 32°35'11.6"N 48°17'01.0"E; H.R. Esmaili, 07 Oct 2008. ZM-CBSU H1514, 12, 45-75mm SL; Iran: Kohkiloye and Boyerahmad prov.: Bashar River at Lema village, Yasouj city, Tigris River drainage, 31°02'25.7"N 51°13'03.6"E; R. Khaefi, 10 Jul 2010.

Diagnosis: *Garra gymnothorax* is distinguished from all other species of *Garra* in Iran by a combination of characters, none of them unique. The breast is naked or with embedded scales in one population (vs. covered by scales in *G. rufa*), belly and predorsal mid-dorsal line covered by scales (vs. naked in *G. mondica*), eye placed in posterior half of head (vs. slightly in anterior half in *G. amirhosseini*), usually 8½ branched dorsal-fin rays (vs. 7½ in *G. amirhosseini* and *G. mondica*) and usually 9+8 caudal-fin rays (vs. usually 8+8 in *G. persica*). *Garra gymnothorax* is distinguished from *G. rossica* by having a fully developed mental disc (vs. weak-developed) and 17-23 total gill rakers on the first branchial arch (vs. 13-15), from *G. variabilis* by having a fully developed mental disc (vs. weak-



Fig.12. *Garra rufa gymnothorax*. ZIN 13214, syntypes, 29.4–ca. 45mm SL.

developed) and two pairs of barbels (vs. one) and from *G. typhlops* and *G. widdowsoni* by having well-developed eyes and a brown and silvery colour pattern (vs. absence).

It is distinguished from all the congeners included in this study by four fixed, diagnostic nucleotide substitutions, and a K2P nearest-neighbor distance of 4.81% to *G. typhlops*.

Description: General appearance of body is shown in Figures 12-13, and morphometric data are given in Table 4. Body elongated, moderately compressed laterally, more compressed in region of caudal peduncle. Dorsal head profile rising gently, flat or slightly convex, more or less continuous with dorsal body profile to nape or about middle between nape and dorsal-fin origin. Ventral profile more or less



Fig.13. Live specimen of *Garra gymnothorax*, ZM-CBSU H1224, 65.4mm SL; Iran: Helayjan River.

Table 4. Morphometric data of *Garra gymnothorax*, ZM-CBSU H1223-H1235, B962, B964, (n=15); *Garra rufa*, ZM-CBSU H1526-H1529, J101, J104, J107, J122, (n=8).

	<i>G. gymnothorax</i>				<i>G. rufa</i>			
	Min	Max	Mean	SD	Min	Max	Mean	SD
Standard length (mm)	44.6	88.6	56.7		71.5	106	86.2	
In percent of standard length								
Head length	23.7	26.2	25.1	1.0	21.3	24.8	23.1	1.4
Body depth at dorsal-fin origin	21.2	23.2	22.1	0.6	18.8	24.8	22.0	2.1
Predorsal length	45.8	50.3	47.46	1.2	44.9	47.8	46.5	1.1
Preanal length	73.3	77.1	74.8	1.3	71.6	75.7	73.3	1.4
Prepelvic length	50.2	53.4	51.9	0.8	49.2	51.4	50.3	0.1
Distance between pectoral and pelvic-fins	27.3	32.0	29.4	1.1	28.4	32.3	30.1	1.1
Distance between pelvic and anal-fins	21.9	24.1	22.8	0.7	21.7	24.8	23.3	0.1
Depth of caudal peduncle	11.3	13.5	12.4	0.6	11.4	12.6	12.2	0.4
Length of caudal peduncle	17.6	21.8	19.9	1.1	18.8	28.5	23.3	4.2
Dorsal-fin base length	15.0	18.9	16.7	1.0	14.8	18.7	16.9	1.5
Anal-fin base length	7.0	8.7	7.6	0.5	6.9	8.3	7.4	0.4
Pectoral-fin length	22.1	26.3	23.9	1.3	18.5	24.5	21.4	2.8
Pelvic-fin length	18.9	21.4	19.9	0.8	15.3	23.0	18.6	2.6
In percent of head length								
Head depth	64.5	71.7	69.2	2.0	61.5	68.4	65.7	2.5
Snout length	42.2	51.8	46.7	2.8	44.1	51.9	48.9	3.3
Postorbital distance	34.7	41.2	37.6	1.9	33.9	39.7	36.8	1.9
Interorbital width	43.3	47.6	45.6	1.2	39.9	50.4	44.1	3.6
Eye diameter	17.0	22.9	20.3	1.8	15.9	18.4	17.3	0.1
Maximum head width	68.5	75.1	71.9	1.7	68.1	86.1	75.8	5.8
Rostral barbel	13.7	19.1	16.0	1.6	7.4	19.1	14.6	4.3
Maxillary barbel	6.3	14.8	10.7	1.9	6.5	14.5	9.8	2.5



Fig.14. Natural habitat of *G. gymnothorax*, Iran: Helayjan River.

straight to anal-fin origin. Head moderately large and depressed, with slightly convex or flat interorbital distance; height at nape less than head length; width at nape greater or about equal to depth at nape. Eye placed dorso-laterally in posterior half of head. Barbels in two pairs; rostral barbel antero-laterally located, shorter or about equal to eye diameter; maxillary barbel at corner of mouth, shorter than rostral barbel. Well-developed disc with free lateral and posterior margins; which is heavily papillate with batteries of fleshy papillae arrayed around the periphery of the whole disc. Rostral cap well-developed, fimbriate, papillate on ventral surface. Upper lip present, as a thin band of papillae arranged in two ridges. Upper jaw almost or completely covered by rostral cap. Disc elliptical, shorter than wide and narrower than head width through base of maxillary barbel.

Dorsal fin with 3 simple and $7\frac{1}{2}$ - $8\frac{1}{2}$ [$7\frac{1}{2}$ (5), $8\frac{1}{2}$ (38)] branched rays, distal margin concave; origin

closer to snout tip than to caudal-fin base; inserted anterior to vertical from pelvic-fin origin; first branched ray longest, tip of last branched ray reaching vertical to anus. Pectoral fin with 1 simple and 12-13 branched rays, reaching to a point 3-4 scales anterior to pelvic-fin origin, length shorter or slightly equal to head length. Pelvic fin with 1 simple and 7-8 branched rays, reaching to anus, origin closer to anal-fin origin than to pectoral-fin origin, inserted below second or third branched dorsal-fin ray. Anal fin short, with 3 simple and $5\frac{1}{2}$ branched rays; first branched ray longest; distal margin straight or slightly concave; origin closer to pelvic-fin origin than to caudal-fin base. Anus 3-4 scales in front of anal-fin origin. Caudal fin forked with 9+8 branched rays; tip of lobes pointed. Total gill rakers on the first branchial arch 17-23 [17(4), 18(11), 19(10), 20(8), 21(3), 22(1), 23(4)]. Lateral line complete, with 32-37 [32(6), 33(7), 34(8), 35(3), 36(3), 37(8)] scales with 2-3 of them situated on caudal fin base.

Transverse scale rows above lateral line $3\frac{1}{2}$ - $4\frac{1}{2}$; between lateral line and pelvic-fin origin $2\frac{1}{2}$ - $3\frac{1}{2}$. Circumpeduncular scale rows 12-13. Usually, 10-12 scales on predorsal midline at front of dorsal-fin origin. Scales on flank regularly arranged. Chest naked and in one population with hidden scales, belly covered by scales. One short axillary scale at base of pelvic fin in some individuals, and 4-7, usually 5, scales between posteriormost pelvic-fin base and anus.

Distribution: *Garra gymnothorax* is known from Karun River system in the Helayjan River at Izeh, Balarud River at Andimeshk and Bashar River at Yasouj (Figs. 14, 31).

Remark: See *G. amirhosseini*.

***Garra lorestanensis* Mousavi-Sabet & Eagderi, 2016**
(Fig. 15)

Material examined: Listed in Mousavi-Sabet & Eagderi (2016).

Diagnosis: *Garra lorestanensis* is distinguished from its congeners by lacking pigment and eyes (vs. presence in all epigeal species), having mental disc (vs. absence in *G. typhlops*) and naked body (body fully covered by scales or scales restricted to lateral midline in *G. widdowsoni*).

Description: See Figure 15 for general appearance, Table 1 page 48 for morphometric data of holotype and 5 paratypes (see Mousavi-Sabet & Eagderi 2016). Relatively stout species with wide head, moderately compressed laterally, more compressed posteriorly especially in caudal peduncle region. Body deepest at or slightly in front of dorsal-fin base, depth decreasing towards caudal-fin base. Greatest body width at or slightly behind of pectoral-fin base, body almost equally wide until dorsal-fin origin. Head relatively large, and deeply depressed. Dorsal head profile rising gently from the tip of snout, slightly convex, sharply continuous with dorsal body profile from about middle between tip of snout and nape to about middle between nape and dorsal-fin origin. Ventral profile slightly concave in pectoral-pelvic contour, and more or less straight from pelvic

to anal-fin origin. Caudal peduncle relatively shallow (caudal peduncle depth 9.5-11.5% SL). Caudal peduncle length 1.4-1.8 times longer than its depth. Lateral line complete, with 28-35 pores. Body naked. Pharyngeal teeth in three rows with a formula of 3,4,5-5,4,3 in three studied specimens. 10-12 total gill rakers on the first branchial arch, in five studied specimens. Snout roundish; transverse lobe with sparsely small tubercles, shallow transverse groove between transverse lobe and proboscis in larger specimens, no obvious transverse groove in small individuals. Proboscis with sparsely small sized tubercles. Proboscis not (commonly in small individuals) or only slightly (in larger specimens) elevated from depressed rostral surface. Scattered small-sized tubercles on lateral surface of snout reaching to posterior nostril in larger specimens. Depressed rostral surface normally without tubercles, anterior arm of depressed rostral surface not reaching to base of rostral barbel, separating transverse lobe from lateral surface. Commonly no obvious groove between transverse lobe and lateral surface. No obvious head tubercles in small individuals. Mouth surrounded by two pairs of barbels; rostral barbel antero-laterally located, maxillary barbel at corner of mouth, shorter than rostral barbel. Rostral cap poorly developed, fimbriate, papillate on ventral surface. Upper lip present, upper jaw almost covered by rostral cap. Disc elliptical, longer than wide and narrower than head width through roots of maxillary barbel; papillae on antero-median fold; well-developed groove between antero-median fold and central callous-pad narrow and deep, scattered small sized papillae on latero-posterior flap; surface of central callous pad with sparsely arranged small papillae. Dorsal fin with 3 simple and $7\frac{1}{2}$ (4) or $8\frac{1}{2}$ (2) branched rays. Anterior dorsal-fin origin located mid dorsum, or slightly posterior. Pelvic fin with 1 simple and 6-7 branched rays. Pelvic-fin origin behind a vertical of dorsal-fin origin, about a vertical of mid dorsal-fin base. Pectoral fin with 1 simple and 13-14 branched rays. Pectoral fin reaching approximately 55-60% of distance from pectoral-fin



Fig.15. *Garra lorestanensis*, VMFC GL-H, holotype, 55mm SL; Iran: Loven Cave (Photo by Mousavi-Sabet).



Fig.16. Loven Cave, natural habitat of *Garra lorestanensis*.

origin to pelvic-fin origin. Anal fin with $5\frac{1}{2}$ branched rays. Margin of dorsal and anal fins straight or slightly concave. Caudal fin with $9+8$ branched rays. Caudal fin distinctly forked; tip of lobes pointed (see Mousavi-Sabet & Eagderi 2016).

Distribution: *Garra lorestanensis* is known from the Loven Cave, 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, the Tigris River drainage, the Persian Gulf basin, Lorestan Province, southwestern Iran (Figs. 16, 31).

Remark: See page 51 in Mousavi-Sabet & Eagderi 2016.



Fig.17. Live specimen of *Garra mondica*, ZM-CBSU H1030, paratype, 62.9mm SL; Iran: Spring Konar Siyah.

***Garra mondica* Sayyadzadeh, Esmaeili & Freyhof 2015**

(Fig. 17)

Materials examined: Listed in Sayyadzadeh et al. (2015).

Diagnosis: *Garra mondica* is distinguished from all other species of *Garra* in the rivers flowing to the Persian Gulf south of the Tigris by having a naked breast and anterior belly (vs. fully covered by scales) and a naked mid-dorsal area in front of the dorsal-fin origin or dorsal midline with only few, usually embedded scales. The naked mid-dorsal area seems to be a unique character state of this species within its comparison group including the species of the Euphrates and Tigris drainages. A naked breast and anterior belly is also found in some populations of *G. rufa*. *Garra mondica* is further distinguished from *G. rufa* by having usually 7½ branched dorsal-fin rays (vs. usually 8½). *Garra mondica* is distinguished from all the congeners included in this study by 2 fixed, diagnostic nucleotide substitutions and a K2P nearest-neighbor distance of 3.9% to *G. rufa* (Table 2). Besides the naked breast, anterior belly and predorsal back, *G. mondica* is also distinguished from *G. persica* by having usually 9+8 caudal-fin rays (vs. usually 8+8). *Garra mondica* is distinguished from *G. rossica* by having a fully-developed mental disc (vs. reduced) and 18-23 total gill rakers on the first branchial arch (vs. 11-15), from

G. variabilis by having a fully developed mental disc (vs. reduced) and two pairs of barbels (vs. one) and from *G. lorestanensis*, *G. typhlops* and *G. widdowsoni* by having well-developed eyes and a brown or grey, usually mottled colour pattern (vs. absence of colour pattern).

Description: See Figure 17 for general appearance. Body elongated, moderately compressed laterally, more compressed in region of caudal peduncle. Dorsal head profile rising gently, slightly convex, more or less continuous with dorsal body profile to nape or about middle between nape and dorsal-fin origin. Ventral profile more or less straight to anal-fin origin. Head moderately large and depressed, with slightly convex or flat interorbital space; height at nape less than head length; width at nape greater or about equal to depth at nape. Snout roundish; transverse lobe with 11-21 tubercles, demarcated posteriorly by a shallow transverse groove in some individuals, no transverse groove in others. Proboscis covered with small or medium sized tubercles, largest on anterior margin of proboscis. Proboscis not or only slightly elevated from depressed rostral surface. Lateral surface of snout covered by small to medium sized tubercles reaching to anterior eye margin in some individuals, or to posterior nostril in others. Depressed rostral surface always without tubercles (Figs. 18, 29).

Distribution: *Garra mondica* is found in two small



Fig.18. Spring Konar Siyah, type locality of *G. mondica*.

springs in the Mond River drainage in Iran, the Konar Siyah Spring (Figs. 18, 31), which is situated 20km south-west of Firouzabad and the Tang-e-Mohr Spring, which is situated about 10km south of Mohr.

Remarks: See Sayyadzadeh et al. (2015).

***Garra nudiventris* (Berg, 1905)**

(Fig. 19)

Material examined: The types for the var. *nudiventris* are in ZIN 11113, listed by Berg (1905) as 2 fish from Schivar (see Eschmeyer et al. 2016), by Berg (1949) as being 4 fish, not numbered in the ZIN catalogue and with 5 fish in the jar (45.6-66.2mm SL;). ZIN 11113 appears to have been renumbered in part as 11703 and 11708 according to Berg (1949). ZIN 11708 is listed in Berg (1949) as 13 specimens and 11703 seems to be also 13 specimens. The type localities for var. *nudiventris* are for ZIN 11113 "Shivar, north of Nikh (Nekh), north-east Kerman, basin of L. Hamun, 23 VI 1896, N. Zarudnyi", for ZIN 11708 "Podaghi, north-north-east of Bazman, eastern Kerman, 6 VII 1898, N. Zarudnyi" and 11703 is probably "Neizar in Seistan, N. Zarudnyi" according to Berg (1949) (the catalogue number

11703 does not appear under the description of materials in Berg (1949), possibly omitted in error, and it is deduced here that it should have preceded the locality cited). ZM-CBSU H1500, 6, 40-54mm SL; Iran: Khorasan prov.: Kalat-e-Baba Qanat at Birjand, Lut drainage basin, 32°49'33.7"N 59°15'29.2"E. H.R. Esmaeili, G. Sayyadzadeh, A. Gholamifard, R. Zamanian Nejad, S. Mirghyasi, S. Ghasemian and B. Parsi, 30 Aug 2011.

Diagnosis: *Garra nudiventris* is distinguished from all other species of *Garra* in Iran except *G. mondica* by having the predorsal mid-line region and belly naked (vs. fully covered by scales). It is distinguished from all other species of *Garra* in Iran except some populations of *G. rossica* by having one pair of barbels (vs. two pairs) and the lowest total gill rakers on the first arch (10-11 vs. 13-24). It is also distinguished from *G. gymnothorax* and *G. rufa* by having 7½ branched dorsal-fin rays (vs. usually 8½ branched dorsal-fin rays). It is distinguished from *G. persica* by having usually 9+8 caudal-fin rays (vs. usually 8+8), and from *G. typhlops* and *G. widdowsoni* by having well-developed eyes and a brown and silvery colour pattern (vs. absence).



Fig.19. Live specimen of *Garra nudiventris*, ZM-CBSU H1500, 54.5mm SL; Iran: Kalat e Baba Qanat.

Table 5. Morphometric data of *Garra nudiventris*, ZM-CBSU H1500, n=6, *Garra rossica*, ZM-CBSU J2967, n=7).

	<i>G. nudiventris</i>				<i>G. rossica</i>			
	Min	Max	Mean	SD	Min	Max	Mean	SD
Standard length (mm)	39.8	54.5	44.9		49.2	84.7	61.3	
In percent of standard length								
Head length	25.5	26.5	26.1	0.3	23.4	25.3	24.3	0.6
Body depth at dorsal-fin origin	17.4	19.8	18.2	0.9	18.6	22.2	20.3	1.3
Predorsal length	51.4	53.6	52.4	1.1	50.1	53.1	51.4	0.9
Preanal length	74.6	79.1	77.7	1.6	74.5	76.2	75.1	0.5
Prepelvic length	56.0	59.3	58.0	1.1	53.3	56.1	54.5	1.0
Distance between pectoral and pelvic-fins	31.2	33.7	32.7	0.9	31.4	34.0	32.6	0.8
Distance between pelvic and anal-fins	18.5	20.3	19.4	0.8	19.1	22.2	20.3	0.9
Depth of caudal peduncle	10.5	11.8	10.9	0.5	11.2	13.0	11.8	0.6
Length of caudal peduncle	16.3	18.0	16.7	0.6	18.2	20.1	19.1	0.7
Dorsal-fin base length	9.4	11.2	10.6	0.7	9.3	12.7	11.0	1.0
Anal-fin base length	6.2	8.0	6.7	0.7	6.0	7.6	6.6	0.5
Pectoral-fin length	21.5	22.4	22.0	0.3	20.6	22.5	21.7	0.6
Pelvic-fin length	16.8	17.8	17.3	0.4	17.6	18.9	18.0	0.5
In percent of head length								
Head depth	58.9	66.1	60.9	2.6	56.4	63.0	59.3	2.5
Snout length	31.8	32.2	32.0	0.1	36.3	42.8	39.4	2.7
Postorbital distance	44.6	49.7	46.5	2.4	39.7	45.2	42.4	2.0
Interorbital width	39.4	43.1	41.4	1.3	40.5	47.0	44.3	2.4
Eye diameter	17.5	21.2	19.7	1.5	17.4	20.0	18.5	0.9
Maximum head width	24.2	30.3	26.8	2.1	29.9	34.1	31.9	1.5
Rostral barbel					5.0	13.4	9.2	3.0
Maxillary barbl	6.4	7.7	7.0	0.5	4.4	11.5	9.1	2.4

It is distinguished from all the congeners included in this study except *G. rossica* by 11 fixed, diagnostic nucleotide substitutions, and a K2P nearest-neighbor distance of 0.75% to *G. rossica*.

Description: General appearance of body is shown in Figure 19 and morphometric data are given in Table 5. Body elongated, moderately compressed laterally, more compressed in region of caudal peduncle.



Fig.20. Habitat of *Garra nudiventris* Iran: Kalat e Baba Qanat.

Dorsal head profile rising gently, flat or slightly convex, more or less continuous with dorsal body profile to nape or about middle between nape and dorsal-fin origin. Ventral profile more or less straight to anal-fin origin. Head moderately large and depressed, with slightly convex or flat interorbital distance; height at nape less than head length; width at nape greater or about equal to depth at nape. Eye placed dorso-laterally in anterior half of head. Barbels in one maxillary pair. Disc weak-developed with free lateral and posterior margins, slightly papillate. Rostral cap developed, fimbriate, papillate on ventral surface. Upper jaw almost or completely covered by rostral cap. Disc triangular, shorter than wide and narrower than head width through base of maxillary barbel.

Dorsal fin with 3 simple and $7\frac{1}{2}$ branched rays, distal margin straight, in some specimens slightly concave; origin slightly closer to caudal-fin base than to snout tip or equal from both ends; inserted anterior

to vertical from pelvic-fin origin; first branched ray longest, tip of last branched ray not reaching vertical to anus. Pectoral fin with 1 simple and 12-13 branched rays, reaching to a point 9-11 scales anterior to pelvic-fin origin, length shorter than head length. Pelvic fin with 1 simple and 7 branched rays, reaching to anus, origin closer to anal-fin origin than to pectoral-fin origin, inserted below second or third branched dorsal-fin ray. Anal fin short, with 3 simple and $5\frac{1}{2}$ branched rays; first branched ray longest; distal margin straight or slightly concave; origin closer to pelvic-fin origin than to caudal-fin base. Anus 3-4 scales in front of anal-fin origin. Caudal fin forked with 9+8 branched rays; tip of lobes pointed. Total gill rakers on the first branchial arch 10-11. Lateral line complete, with 36-39 scales which 2-3 of them situated on caudal fin base. Transverse scale rows above lateral line $6\frac{1}{2}$ - $7\frac{1}{2}$; between lateral line and pelvic-fin origin $5\frac{1}{2}$ - $6\frac{1}{2}$. Circumpeduncular scale rows 16-18. Predorsal midline at front of

dorsal-fin origin naked. Scales on flank regularly arranged. Chest and belly naked. One very short axillary scale at base of pelvic fin in some individuals, and 9-11 scales between posteriormost pelvic-fin base and anus that in some specimens are embedded and uncountable. There is a lateral dark strip on lateral line of body.

Distribution: *Garra nudiventris* is known from Lut drainage basin at Kalat-e-Baba Qanat (Figs. 20, 31).

Remarks: *Discognathus rossicus* var. *nudiventris* Berg, 1905 was described from "Schiwar" in Iran for specimens with a naked abdomen, thoracic region and groove on the back anteriorly. The distribution of these specimens overlaps with that of the type in Southern Iran (from Sistan) and Southern Baluchistan. Berg (1949) later placed them as an infraspecies.

Garra rossica (Nikol'skii, 1900)

(Fig. 21)

Material examined: The syntypes of *Discognathus rossicus* are in the Zoological Institute, St. Petersburg (ZIN 10365), the type locality in Latin on page 239 being "Flum. Tedschent in prov. Transcasp. Zarudnyi. 1892 (4)" while on p. 240 are the localities "Habitat in flumine Tedshent in provincia Transcaspensi, nec noc in Persia orientale ad Kirmanum orientale" (Nikol'skii 1900), and confirmed by BWC. However, there were 3 fish in the jar (45.0-54.5mm SL) although 4 are listed in the

catalogue and in the type description. Berg (1905) lists 3 fish but in Berg (1949) lists only 2. Other materials listed by Nikol'skii (1900) from eastern Iran and Kerman (ZIN 11113, 11703, 11704, 11705, 11708) are apparently not types of *rossicus* although Berg (1949) indicates that 11704 ("Neizar in Seistano") and 11705 ("Ljabeab in Seistano") are part of the type series from Iran. Eschmeyer et al. (2016) also list ZIN 10665 (4) as part of the type series, perhaps a misprint for ZIN 10365. Eschmeyer et al. (2016) list ZIN 10365 [not 10665] (4, now 3), 11113 (6), 11703-05 (6+, 6, 6), 11708 (6) as syntypes. ZM-CBSU J2762, 12, 49-85mm SL; Iran: Sistan and Baluchistan prov.: Irandegan River at Irandegan, 27°53'22.9"N 61°05'35.9"E; F. Irandegani, 27 Dec 2011. ZM-CBSU H1506, 8, 31-52mm SL; Iran: Khorasan e Razavi prov.: Khiaban Qanat at Taibad, Bejestan drainage basin, 34°44'10.1"N 60°34'29.7"E; H. R. Esmaeili, G. Sayyadzadeh, A. Gholamifard, R. Zamanian Nejad, S. Mirghyasi, S. Ghasemian and B. Parsi, 28 Aug 2011.

Diagnosis: *Garra rossica* is distinguished from all other species of *Garra* in Iran except *G. nudiventris* by having the weak developed mental disc (vs. well-developed), one or two short barbels (vs. two large) and low total gill rakers (11-15 vs. 17-24). It is distinguished from *G. nudiventris* by having predorsal mid-line region and belly fully covered by scales (vs. naked). It is also distinguished from *G. gymnothorax* and *G. rufa* by having 7½ branched



Fig.21. Live specimen of *Garra rossica*, ZM-CBSU N168, 41.9mm SL; Iran: Irandegan River.



Fig.22. Natural habitat of *Garra rossica*, Iran: Irandegan River.

dorsal-fin rays (vs. usually $8\frac{1}{2}$). It is distinguished from *G. persica* by having usually 9+8 caudal-fin rays (vs. usually 8+8), and from *G. typhlops* and *G. widdowsoni* by having well-developed eyes and a brown and silvery colour pattern (vs. absence).

It is distinguished from all the congeners included in this study except *G. nudiventris* by 11 fixed, diagnostic nucleotide substitutions, and a K2P nearest-neighbor distance of 0.75% to *G. nudiventris*.

Description: General appearance of body is shown in Figure 21, and morphometric data are given in Table 5. Body elongated, moderately compressed laterally, more compressed in region of caudal peduncle. Dorsal head profile rising gently, flat or slightly convex, more or less continuous with dorsal body profile to nape. Ventral profile more or less straight to anal-fin origin. Head moderately large and depressed, with flat or slightly convex interorbital

distance; height at nape less than head length; width at nape greater or about equal to depth at nape. Eye placed dorso-laterally in slightly anterior half of head. Barbels in two short pairs and in one population in one maxillary pair. Disc weak-developed with free lateral and posterior margins; slightly papillate. Rostral cap developed, fimbriate, papillate on ventral surface. Upper jaw almost or completely covered by rostral cap. Disc elliptical, slightly shorter than wide and narrower than head width through base of maxillary barbel.

Dorsal fin with 3 simple and $7\frac{1}{2}$ branched rays, distal margin straight, in some specimens slightly concave; origin slightly closer to snout tip than to caudal-fin base ends; inserted anterior to vertical from pelvic-fin origin; first branched ray longest, tip of last branched ray reaching vertical to anus. Pectoral fin with 1 simple and 12-13 branched rays,

reaching to a point 5-8 scales anterior to pelvic-fin origin, length shorter than head length. Pelvic fin with 1 simple and 7 branched rays, reaching to anus, origin closer to anal-fin origin than to pectoral-fin origin, inserted below second or third branched dorsal-fin ray. Anal fin short, with 3 simple and 5½ branched rays; first branched ray longest; distal margin straight or slightly concave; origin closer to pelvic-fin origin than to caudal-fin base. Anus 2-3 scales in front of anal-fin origin. Caudal fin forked with 9+8 branched rays; tip of lobes pointed. Total gill rakers on the first branchial arch 11-15. Lateral line complete, with 35-39 scales which 2-3 of them situated on caudal fin base. Transverse scale rows above lateral line 5½-6½; between lateral line and pelvic-fin origin 4½-5½. Circumpeduncular scale rows 15-18. Usually, 13-17 scales on predorsal midline at front of dorsal-fin origin. Scales on flank regularly arranged. Chest and midline of belly covered by embedded scales. One very short axillary scale at base of pelvic fin in some individuals, and 5-9, scales between posteriormost pelvic-fin base and anus.

Distribution: *Garra rossica* is known from Jaz-Murian and Kavir drainage basin (Figs. 22, 31).

Remarks: See material examined and diagnosis.

Garra rufa (Heckel, 1843)

(Fig. 23)

Material examined: The types of *Discognathus rufus* are from "Aleppo" according to Heckel (1843). The syntypes of *Discognathus rufus* (Fig. 24) according to Krupp (1985c) are in the Naturhistorisches Museum Wien under NMW 53240, 8 specimens, 59-108mm SL; from Aleppo and 1 syntype is in the Senckenberg Museum Frankfurt under SMF 553 (formerly NMW), 103mm SL; and also from Aleppo. The catalogue in Vienna lists 6 specimens. One specimen from NMW 53240, 112.3mm SL; was designated as the lectotype and 7 fish, 60.2-97.5mm SL; as paralectotypes by F. Krupp, 29 October 1984, and published in Krupp and Schneider (1989). ZM-CBSU J101, 22, 41-106mm SL; Iran: Kohgiluyeh

and Booyerahmad prov.: Khersan River at Pataveh, Tigris River drainage, 30°55'04.14"N 51°17'16.14"E; G. Sayyadzadeh, R. Zamanian Nejad, S. Mirghiyasi and S. Ghasemian, 04 March 2011. ZM-CBSU H1526, 20, 54.7-84.7mm SL; Iran: Illam prov.: Doirej River at Abdanan, Tigris River drainage, 32°39'13.0"N 47°32'37.7"E; H.R. Esmaeili and S. Vatandoust, 11 Sep 2012.

Diagnosis: *Garra rufa* is distinguished from all other species of *Garra* in Iran except *Garra gymnothorax* by having usually 8½ branched dorsal-fin rays (vs. 7½). It is distinguished from *G. gymnothorax* by the breast fully covered by scales or embedded in some populations (vs. naked). Belly and predorsal mid-dorsal line covered by scales (vs. naked in *G. mondica*), eye placed in posterior half of head (vs. slightly in anterior half in *G. amirhosseini*), usually 9+8 caudal-fin rays (vs. usually 8+8 in *G. persica*), a fully developed mental disc and two pairs of barbels (vs. weak-developed and one pair in *G. rossica*, *G. nudiventris* and *G. variabilis*), 20-24 total gill rakers on the first branchial arch (vs. 10-15 in *G. rossica* and *G. nudiventris*). It is distinguished from *G. typhlops* and *G. widdowsoni* by having well-developed eyes and a brown and silvery colour pattern (vs. absence).

It is distinguished from all the congeners included in this study by one fixed, diagnostic nucleotide substitutions, and a K2P nearest-neighbor distance of 2.45% to *G. rufa*.

Description: General appearance of body is shown in Figure 23, and morphometric data are given in Table 4. Body elongated, moderately compressed laterally, more compressed in region of caudal peduncle. Dorsal head profile rising gently, flat or slightly convex, more or less continuous with dorsal body profile to nape or about middle between nape and dorsal-fin origin. Ventral profile more or less straight to anal-fin origin. Head moderately large and depressed, with slightly convex or flat interorbital distance; height at nape less than head length; width at nape greater or about equal to depth at nape. Eye placed dorso-laterally in posterior half of head.



Fig.23. Live specimen of *Garra rufa*, ZM-CBSU J724, 91mm SL; Iran: Bashar (Beshar) River.

Barbels in two pairs; rostral barbel antero-laterally located, shorter or about equal to eye diameter; maxillary barbel at corner of mouth, shorter than rostral barbel. Well-developed disc with free lateral and posterior margins; which is heavily papillate with batteries of fleshy papillae arrayed around the periphery of the whole disc. Rostral cap well-developed, fimbriate, papillate on ventral surface. Upper lip present, as a thin band of papillae arranged in two ridges. Upper jaw almost or completely covered by rostral cap. Disc elliptical, shorter than wide and narrower than head width through base of maxillary barbel.

Dorsal fin with 3 simple and usually $8\frac{1}{2}$ branched rays, distal margin concave; origin closer to snout tip than to caudal-fin base; inserted anterior to vertical from pelvic-fin origin; first branched ray longest, tip of last branched ray reaching vertical to anus. Pectoral fin with 1 simple and 12-13 branched rays, reaching to a point 4-5 scales anterior to pelvic-fin origin, length shorter or slightly equal to head length. Pelvic fin with 1 simple and 7-8 branched rays, reaching to anus, origin closer to anal-fin origin than to pectoral-fin origin, inserted below second or third branched dorsal-fin ray. Anal fin short, with 3 simple and $5\frac{1}{2}$ branched rays; first branched ray longest; distal margin straight or slightly concave; origin closer to pelvic-fin origin than to caudal-fin

base. Anus 3-4 scales in front of anal-fin origin. Caudal fin forked with 9+8 branched rays; tip of lobes pointed. Total gill rakers on the first branchial arch 20-24. Lateral line complete, with 32-38 scales which 2-3 of them situated on caudal fin base. Transverse scale rows above lateral line $4\frac{1}{2}$; between lateral line and pelvic-fin origin $3\frac{1}{2}$. Circumpeduncular scale rows 13-16. Usually, 11-14 scales on predorsal midline at front of dorsal-fin origin. Scales on flank regularly arranged. Chest with embedded scales, belly covered by scales. One short axillary scale at base of pelvic fin in some individuals, and 4-7, scales between posteriormost pelvic-fin base and anus.

Distribution: *Garra rufa* is known from Tigris River, Maharlou and Persis drainage basins (Fig. 25, 31).

Remarks: The syntypes of *Discognathus crenulatus* Heckel, 1847, a synonym of *G. rufa*, are in the Naturhistorisches Museum Wien under NMW 53236 (14 specimens) from the Qarah Aqaj River and 53237 (6) from Sa'di's tomb measuring 33-79mm SL; (Kähsbauer, 1964). The 14 specimens under NMW 53236 measure 24.0-75.9mm SL; and 7 (not 6) specimens under NMW 53237 measure 35.4-56.6mm SL;. Neither the record of Kähsbauer (1964) nor data from jars on the shelves accord with the catalogue in Vienna which gives 10 or 8 and 6 or 5 specimens respectively for these two syntype localities.



Fig.24. *Discoghathus crenulatus* NMW-53327_Syntypes_1-7_WEB.



Fig.25. Natural habitat of *Garra rufa*, Iran: Bashar River.

***Garra persica* Berg, 1913**

(Fig. 26)

Material examined: The syntype specimens are in the Zoological Institute, St. Petersburg under catalogue numbers ZISP 11707 (6 specimens from the "River Bampur in Eastern Persia. N. Zarudnyi 1898, 15-27.VII") and 11706 (1 specimen from "Kiabad in Zirkuh (Eastern Khorassan). N. Zarudnyi 1898, 3.V") according to Berg (1914) where the original description is founded on these fish, implying all are types. The latter is also given as "settlement Kiabad between Zirkuh Province and Sistan" in the catalogue (this locality may be at or near Kuh-e Ziri at 32°48'N, 59°50'E according to Coad (1981c)). These dates are old style and corrected to new in Berg (1949) (27.VII-8.VIII and 15.V, respectively). In St. Petersburg under ZISP 11707 there are 10 fish 24.0-46.5mm SL; and ZISP 11706 is not listed as a type in the catalogue nor in Berg (1949). Berg (1949) lists 10 fish in 11707 too. These specimens were formerly

identified as *Discognathus lamta* by Nikol'skii (1899) who lists 1 fish in 11706 and 6 in 11707. Three syntypes are in the Zoological Survey of India, Calcutta (ZSI F11101/1) listed under *Garra rufa obtusa* and received from the Zoological Institute, St. Petersburg, Russia on exchange (Menon & Yazdani 1968). There are more apparent types available than those listed by Berg (1914). ZM-CBSU 10200, 30, 34-56mm SL; Iran: Fars prov.: Rasoul River at Goud e Gaz, Kol River drainage, 27°17'28.8"N 54°29'20.7"E; H.R. Esmaili and A. Teimori, 27 Jan 2008.

Diagnosis: *Garra persica* is distinguished from all other species of *Garra* in Iran by having usually 8+8 caudal-fin rays (vs. usually 9+8). It is distinguished from *G. rufa* and *G. gymnothorax* by having usually 6½-7½ branched dorsal-fin rays (vs. 8½), from *G. rossica*, *G. nudiventris* and *G. variabilis* by having a fully developed mental disc and two pairs of barbels (vs. weak-developed and one pair), from *G. mondica*



Fig.26. Live specimen of *Garra persica*, ZM-CBSU H1546, 46.7 mm SL; Iran: Shur River.

by having belly and predorsal mid-dorsal line covered by scales (vs. naked). It is also distinguished from *G. typhlops* and *G. widdowsoni* by having well-developed eyes and a brown and silvery colour pattern (vs. absence).

It is distinguished from all the congeners included in this study except a blind species *G. typhlops* (vs. well-developed eye in *G. persica*) by one fixed, diagnostic nucleotide substitutions, and a K2P nearest-neighbor distance of 2.45% to *G. rufa*.

Description: General appearance of body is shown in Figure 26. Body elongated, moderately compressed laterally, more compressed in region of caudal peduncle. Dorsal head profile rising gently, flat or slightly convex, more or less continuous with dorsal body profile to nape or about middle between nape and dorsal-fin origin. Ventral profile more or less straight to anal-fin origin. Head moderately large and depressed, with slightly convex or flat interorbital distance; height at nape less than head length; width at nape greater or about equal to depth at nape. Eye placed dorso-laterally in posterior half of head. Barbels in two pairs; rostral barbel antero-laterally located, shorter or about equal to eye diameter; maxillary barbel at corner of mouth, shorter than rostral barbel. Well-developed disc with free lateral and posterior margins; heavily papillate with batteries of fleshy papillae arrayed around the periphery of the whole disc. Disc elliptical, shorter than wide and narrower than head width through base

of maxillary barbel. Rostral cap well-developed, fimbriate, papillate on ventral surface. Upper lip present, as a thin band of papillae arranged in two ridges. Upper jaw almost or completely covered by rostral cap.

Dorsal fin with 3 simple and $6\frac{1}{2}$ - $7\frac{1}{2}$ branched rays, distal margin concave; origin closer to snout tip than to caudal-fin base or equal between two ends in some specimens; inserted anterior to vertical from pelvic-fin origin; first branched ray longest, tip of last branched ray reaching vertical to anus. Pectoral fin with 1 simple and 12-13 branched rays, reaching to a point 5-7 scales anterior to pelvic-fin origin, length shorter than head length. Pelvic fin with 1 simple and 7-8 branched rays, reaching to anus, origin closer to anal-fin origin than to pectoral-fin origin, inserted below second or third branched dorsal-fin ray. Anal fin short, with 3 simple and $5\frac{1}{2}$ branched rays; first branched ray longest; distal margin straight or slightly concave; origin closer to pelvic-fin origin than to caudal-fin base. Anus 2-3 scales in front of anal-fin origin. Caudal fin forked with 8+8 branched rays; tip of lobes pointed. Total gill rakers on the first branchial arch 17-19. Lateral line complete, with 32-37 scales which 2-3 of them situated on caudal fin base. Transverse scale rows above lateral line $4\frac{1}{2}$; between lateral line and pelvic-fin origin $4\frac{1}{2}$. Circumpeduncular scale rows 14-16. Usually, 14-17 scales on predorsal midline at front of dorsal-fin origin. Scales on flank regularly arranged. Chest with



Fig.27. Natural habitat of *Garra persica*, Iran: Rudan River.

embedded scales, belly covered by scales. One short axillary scale at base of pelvic fin in some individuals, and 5-7, scales between posteriormost pelvic-fin base and anus.

Distribution: *Garra persica* is known from Rudan and Kol River drainage basins and also Shour, Bampour and Karvandar Rivers (Figs. 27, 31).

Remark: See material examined and diagnosis.

***Garra typhlops* (Bruun & Kaiser, 1944)**

(Fig. 28)

Material examined: Holotype. ZMUC P 26475, 46.5 mm TL and 38.5mm SL; Iran: Lorestan prov.: from a flood resurgence at Kaaje-Ru, valley of Ab-i-Serum, a tributary of Dez River, Karun River drainage, 33°04'39"N 48°35'33"E. Paratypes. ZMUC P 26476, 26477, 26478, 26480 measure 19.5-42.0mm total length and 16.5-34.5mm SL; according

to Bruun & Kaiser (1948). CMNFI 2007-0124, 6, 27.3-42.2mm SL; type locality as above. CMNFI 2008-0177, 1, 30.4mm SL; type locality as above.

Diagnosis: *Garra typhlops* is one of two subterranean species in Iran, distinguished from all other *Garra* species in Iran except *G. lorestanensis* by absence of eyes and a depigmented body. It is also distinguished from *G. lorestanensis* by absence of mental disc (vs. having mental disc).

Description: General appearance of body is shown in Figure 28. The body is compressed and the head somewhat flattened. Body deepest in front of dorsal-fin base, depth decreasing towards caudal-fin base. Greatest body width at or slightly behind of pectoral-fin base, body almost equally wide until dorsal-fin origin. Dorsal head profile rising gently from the tip of snout, slightly convex, sharply continuous with dorsal body profile from about middle between tip of



Fig.28. *Garra typhlops*, VMFC GT01, 41mm SL; Iran: Loven Cave (photo by Mousavi_Sabet).

snout and nape to about middle between nape and dorsal-fin origin. Ventral profile slightly concave in pectoral-pelvic contour, and more or less straight from pelvic to anal-fin origin. Caudal peduncle relatively shallow. There are two pairs of barbels, one pair at the mouth corners and one about half way along the upper lip. The upper lip has a feebly crenulated edge. The mouth is subterminal and horseshoe-shaped. Mental disc is absent. There is no visible trace of eyes in most fish. The skin has a few rows of scales behind the pectoral fin base, although some individuals may have more flank scales. There are about 32 myomeres along the flank. A lateral line is present. The dorsal fin with 3 simple and 7-8 branched rays, the anal fin 3 simple and 4-5 branched rays, the pectoral fin 14-17 branched rays and the pelvic fin 5-7 branched rays. Pharyngeal teeth in 3 rows, 1 to 3 in the outer row, 3 to 4 in the middle row and 3-5 in the inner row. Gill rakers very short, not reaching the adjacent raker when appressed and numbering 10-13 in total. Total vertebrae 34-36 (commonly 34). Gut s-shaped. Preorbital bones that enclose the infraorbital canal absent, the posterior pharyngeal process of the basioccipital is broad and directed vertically with lateral ridges, haemal spine of the fourth fused vertebra of the Weberian apparatus narrow, well-developed PU2 of the caudal skeleton with a long neural spine,

Distribution: The Iranian cave barb's original locality is a water cave, the natural outlet of a subterranean limestone system in the Zagros Mountains. The

stream below the cave locality is the 'Ab-e Sirum', a tributary of the Dez River, in Lorestan province. The Dez flows into the Karun River which drains to the head of the Persian Gulf. The cave is located at 33°04' 39"N and 48°35'33"E. (Figs. 29, 31).

Remarks: It was described in the genus *Iranocypris* Bruun & Kaiser, 1944. The species was suggested to be related to the genus *Barbus* by Bruun & Kaiser (1944), a view that was subsequently rejected by Saadati (1977). Coad (2011) proposed that the 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*. More recently, Farashi et al. (2014) examined phylogenetic relationships of the cave fish with other species of the family Cyprinidae based on the mitochondrial cytochrome b gene. Their results show that *I. typhlops* is monophyletic and is sister taxon of a cluster formed by *Garra rufa* (Heckel, 1843) and *Garra barreimiae* (Fowler & Steinitz 1956) within a clade that includes other species of the genus *Garra* and recommended that *I. typhlops* should be transferred to the genus *Garra* Hamilton, 1822. Sayyadzadeh et al. (2015) approved the view of Farashi et al. (2014) and transferred *Iranocypris* to the genus *Garra*. Two sympatric forms were reported within the *I. typhlops* group (Sargeran et al. 2008). They are morphologically distinguished by the



Fig.29. Natural habitat of *Garra typhlops*. Iran: Loven Cave and Stream.



Fig.30. *Paracobitis smithi*, VMFC PS1410, 44mm SL; Iran: Loven Cave. Iran: Loven Cave (photo by Mousavi-Sabet).

presence/absence of a mental disc on the ventral surface of the head, considering as *G. lorestanensis* and *G. typhlops* by Mousavi-Sabet & Eagderi (2016), respectively. *Garra typhlops* is distinguished from the subterranean *G. lorestanensis* (Figs.15, 28) which is sympatrically found in the same locality, by absence of mental disc (vs. presence of mental disc; Figs. 15, 28), smaller intestine, and bipartite swimbladder (vs. longer intestine and either a single chambered or bipartite swimbladder in *G. lorestanensis*), which

was previously reported too by Sargeran et al. (2008). *Garra typhlops* can be osteologically distinguished from *G. lorestanensis* by absent of preorbital bones that enclose the infraorbital canal (vs. reduced in *G. lorestanensis*); the posterior pharyngeal process of the basioccipital is directed vertically with lateral ridges (vs. broad directing horizontally with a vertical ridge on its ventral face in *G. lorestanensis*), commonly 34 vertebrae in *G. typhlops* (vs. commonly 35 vertebra in *G. lorestanensis*), narrow

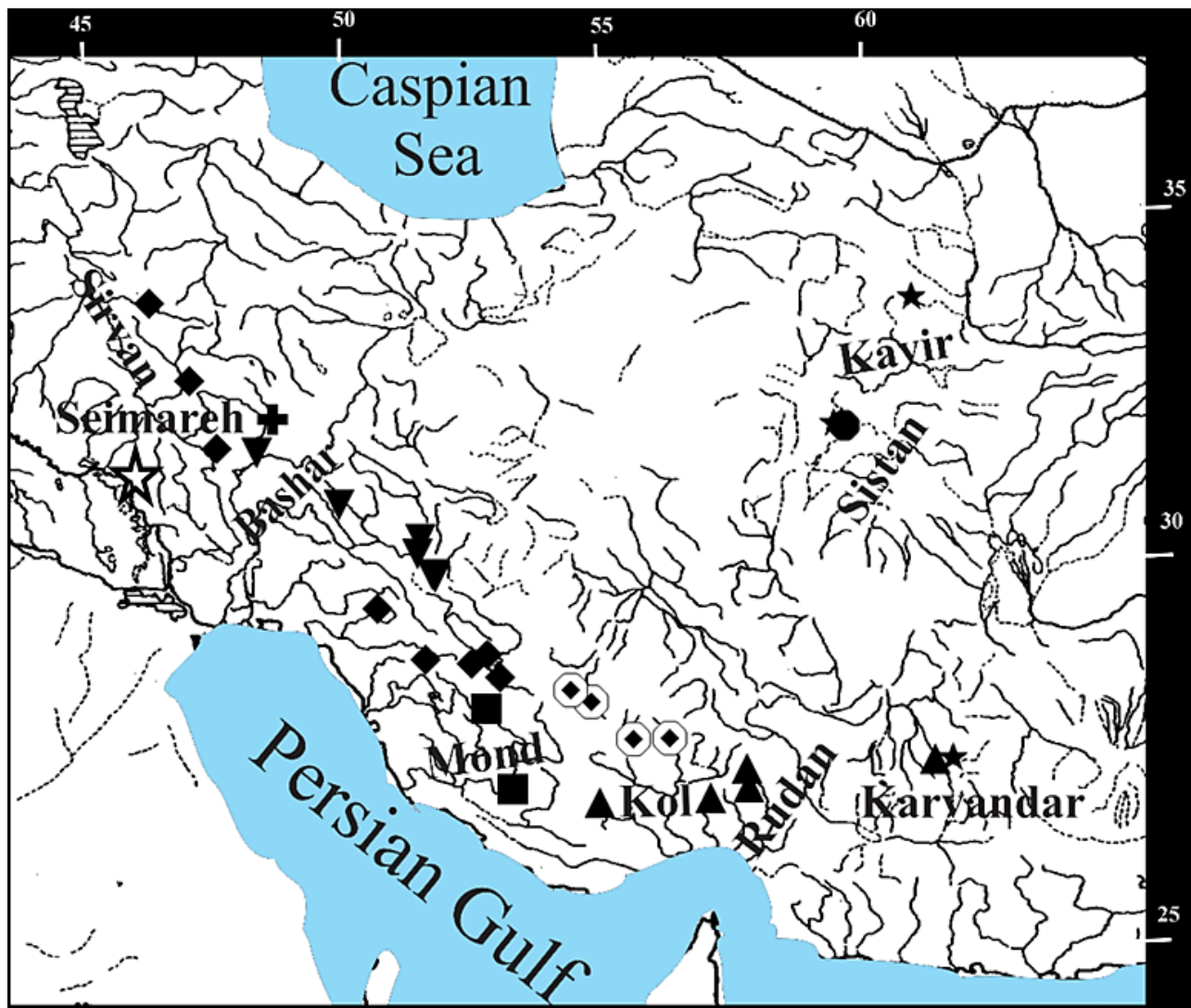


Fig.31. Fig. 31. Records of Iranian *Garra* species. ▼, *G. gymnothorax*; ■, *G. mondica*; ▲, *G. persica*; ★, *G. rossica*; ◆, *G. rufa*; ⊙, *G. sp. Kol*; +, *G. lorestanensis* and *G. typhlops*; ☆, *G. amirhosseini*, and ●, *G. nudiventris*

haemal spine of the fourth fused vertebra of the weberian apparatus in *G. typhlops* (vs. wide in *G. lorestanensis*); PU2 of the caudal skeleton is well-developed with a long neural spine (vs. small PU2 with a short neural spine in *G. lorestanensis*).

Garra typhlops is easily distinguished from its sympatric subterranean loach, *Paracobitis smithi* (Fig. 30) by having two pairs of barbels (vs. three pairs), and absence of adipose keel (vs. presence of a weak adipose keel).

Comparative materials: *Garra gymnothorax*: ZIN 13214, 7 syntypes, 39-57mm SL; Iran: Kulikhan, Karun River system, H. Zarudnyy, 6 June 1904.

Garra cf. gymnothorax: FSJF 2198, 19, 40-94mm SL; Iran: Kohkeloyeh va Boyrahmad prov.: Beshar River 20km northeast of Yasooj, 30°44'9.12"N 51°29'31.32"E. FSJF 2209, 9, 66-129mm SL; Iran: Chaharmahal Bakhtiari prov.: Stream Sangan at Sangan, 31°15'41.52"N 51°17'9.00"E.

Garra lorestanensis CMNFI 2007-0124, 2, 27.0-31.6 mm SL; type locality.

Garra nudiventris: CMNFI 2007-0025, 8, 36.6-47.1mm SL; Khorasan, qanat south of Birjand, ca. 32°24'N, ca. 59°49'E. – CMNFI 2007-0026, 19, 36.3-62.9mm SL; Khorasan, qanat at Shusf, 31°48'N, 60°01'E. CMNFI 2007-0027, 13, 31.4-60.7mm SL;

Khorasan, qanat at Khvansharaf, 31°34'N, 60°06'E. CMNFI 2007-0028, 13, 36.3-58.9mm SL; Khorasan, qanat at Khunik-e Pa'in, 31°28'N, 60°06'E. CMNFI 2008-0197, 1, 73.6mm SL; South Khorasan, Birjand qanats, 32°52'N, 59°12'E. CMNFI 2008-0199, 1, 73.1mm SL; South Khorasan, Birjand qanats, 32°52'N, 59°12'E. CMNFI 2008-0200, 1, 70.7mm SL; South Khorasan, Birjand qanats, 32°52'N, 59°12'E.

Garra persica: FSJF 2218, 20, 50-83mm SL; Iran: Hormuzgan prov.: River Rodan about 6 km northeast of Rodan, 27°28'53.70"N 57°15'53.70"E. FSJF 397, 20, 35-50mm SL; Iran: Sistan & Baluchestan prov.: Karvander River at bridge north of Karvander, 27°51'18"N 60°46'03"E. ZM-CBSU 10200, 30, 34-56mm SL; Iran: Fars prov.: Rasool River at God e Gaz village, 27°17'28.8"N 54°29'20.7"E. CMNFI 1979-0138, 1, 25.7mm SL; Fars-Hormozgan border, stream in Rasul River drainage (ca. 27°32'N, ca. 54°58'30"E). CMNFI 1979-0139, 1, 30.6mm SL; Fars-Hormozgan border, stream in Rasul River drainage (ca. 27°25'30"N, ca. 54°59'E); CMNFI 1979-0144, 1, 27.3mm SL; Hormozgan, Minab River at Minab (27°09'30"N, 57°04'E). CMNFI 1979-0145, 4, 14.8-25.4mm SL; Hormozgan, Geru River south of Minab (26°55'N, 57°01'30"E). CMNFI 1979-0149, 7, 29.0-49.4mm SL; Hormozgan, stream north of Bandar Abbas (27°36'N, 56°14'E). CMNFI 1979-0152, 1, 62.2mm SL; Hormozgan, Shur River drainage (28°09'N, 55°43'E). CMNFI 1979-0178, 23, 25.1-66.9mm SL; Hormozgan, Sarzeh River drainage (27°36'N, 56°15'E). CMNFI 1979-0180, 1, 42.7mm SL; Hormozgan, stream 3km east of Essin (27°19'N, 56°17'30"E). CMNFI 1979-0181, 1, 44.0mm SL; Hormozgan, Kul River (27°17'30"N, 56°03'30"E). CMNFI 1979-0186, 8, 30.2-64.6mm SL; Hormozgan, stream and pools at Sar Khun (ca. 27°24'30"N, ca. 56°25'E). CMNFI 1979-0187, 9, 32.1-57.9mm SL; Hormozgan, stream and pools at Sar Khun (27°23'30"N, 56°26'E). CMNFI 1979-0312, 10, 26.6-35.6mm SL; Baluchestan, dam on Bampur River (27°11'N, 60°36'E). CMNFI 1979-

0315, 1, 23.8mm SL; Baluchestan, Bampur River 2km north of Karvandar (27°51'N, 60°46'E). CMNFI 1979-0324, 1, 29.6mm SL; Baluchestan, Bampur River at Sa'idabad (27°11'N, 60°22'E). CMNFI 1979-0329, 2, 25.4-30.8mm SL; Baluchestan, stream at Zaminbandan (27°02'N, 61°20'E). CMNFI 1979-0411, 1, 60.4mm SL; Hormozgan, Minab River (27°24'N, 57°12'E). CMNFI 1979-0412, 9, 22.9-39.3mm SL; Hormozgan, spring at Saras (27°30'N, 57°34'E). CMNFI 1979-0416, 39, 15.1-46.8mm SL; Hormozgan, Ab Garm-e Ganow (ca. 27°26'N, ca. 56°20'E); CMNFI 2007-0051, 10, 29.5-43.7mm SL; Hormozgan, upper Kol River basin (28°19'N, 55°55'E). CMNFI 2007-0055, 5, 30.9-44.6mm SL; Hormozgan, Minab River basin (27°47'N, 57°12'E); CMNFI 2007-0056, 2, 32.1-54.2mm SL; Kerman, qanat at Kahnuj (27°58'N, 57°45'E). CMNFI 2007-0058, 7, 36.7-51.7mm SL; Fars, headwaters of Gowdar River (ca. 27°24'N, ca. 54°16'E). CMNFI 2008-0142, 1, ?mm SL; Hormozgan, Jaghin River (27°12'N, 57°25'E).

Garra rufa: Qweik drainage: NMW 53240, lectotype (101mm SL) and 7 paralectotypes of *D. rufus*, 59-101mm SL; Syria: Aleppo; T. Kotschy, 1842. NMW 53238, syntypes of *D. obtusus*, 2, 43-134mm SL; Syria: Aleppo; T. Kotschy, 1842. Euphrates and Tigris drainage: NMW 53257, 6 syntypes of *D. obtusus*, 31-104mm SL; Iraq: Mossul; T. Kotschy, 1842. NMW 53236-37, syntypes of *D. crenulatus*, 4, 56-74mm SL; Iran: Qarah Aqaj River. FSJF 2238, 22, 55-101mm SL; Iran: Fars prov.: Spring Pirbanoo about 10km south of Shiraz, 29°31'8.10"N 52°27'55.98"E. FSJF 2549, 8, 43-82mm SL; Turkey: Adiyaman prov.: stream Egri south of Adiyaman, a tributary to Atatürk reservoir, 37°44'30.00"N 38°20'6.48"E. FSJF 2588, 5, 58-65mm SL; Turkey: Adiyaman prov.: steam Çakal, 13km west of Adiyaman, tributary to Atatürk reservoir, 37°43'20.53"N 38° 9'55.27"E. FSJF 2621, 2, 60-67mm SL; Turkey: Diyarbakır prov.: Tigris south of Diyarbakır, 37°53'13.80"N 40°13'47.28"E. FSJF 2849, 7, 71-105mm SL; Turkey: Diyarbakır prov.: stream Ambar at road to Silvan, 25km east of

Diyarbakır, 37°59'24.72"N 40°22'56.64"E. FSJF 2864, 3, 98-129mm SL; Turkey: Batman prov.: Tigris 5km west of Hasankeyf, 37°43'25.68"N 41°21'37.80"E. FSJF 2909, 1, 91mm SL; Turkey: Sivas prov.: stream Kangal under railway bridge at Çetinkaya, 39°15'5.76"N 37°37'8.04"E. FSJF 2955, 1, 62mm SL; Turkey: Diyarbakır prov.: stream Savur between Bayındır and Ahmetli east of Tepe, 37°45'49.32"N 40°53'2.04"E. FSJF 2999, 5, 60-94mm SL; Turkey: Gaziantep prov.: stream Merziman south of Yavuzeli, 37°17'32.64"N 37°43'23.16"E. FSJF 3371, 2, 92-100mm SL; Iraq: stream Suraw near Suraw village, 35°45'45.60"N 45°59'5.40"E. FSJF 3368, 18, 52-103mm SL; Iraq: Nalparez River, 35°34'14.40"N 45°51'46.80"E. ZM-CBSU J 2083, 25, 61-135mm SL; Iran: Illam prov.: Seimareh River, 33°39'40.3 "N 47°03'29.2 "E. ZM-CBSU J 2006, 10, 44-78mm SL; Iran: Kermanshah prov.: Sirvan River, 34°49'37.9 "N 46°21'30 "E. ZM-CBSU J 1051, 12, 60-92mm SL; Iran: Khuzestan prov.: Zohreh River, 30°13'58.56 "N 50°26'50.52 "E.

Garra rossica: CMNFI 1979-0091, 5, 24.6-58.3mm SL; Khorasan, qanat at Nehbandan, 31°32'N, 60°02'E. CMNFI 1979-0226, 5, 37.2-49.0mm SL; Sistan, pool near Kuh-e Khajeh, 30°57'N, 61°17'E. CMNFI 1979-0227, 6, 48.1-61.1mm SL; Sistan, neizar at Kuh-e Khajeh, 30°57'N, 61°16'E. CMNFI 1979-0230, 2, 29.2-43.4 mmSL; Sistan, Hamun-e Puzak, ca. 31°15'N, ca. 61°42'E. CMNFI 1979-0236, 7, 18.3-47.3mm SL; Sistan, ditch 27km from Zabol, ca. 30°52'N, ca. 61°22'E. CMNFI 1979-0238, 11, 15.3-29.2mm SL; Sistan, ditch 11km south of Zabol, 30°57'N, 61°27'30"E. CMNFI 1979-0315, 2, 24.9-50.3mm SL; Baluchestan, Bampur River 2km north of Karvandar, 27°51'N, 60°46'E. CMNFI 1979-0316, 9, 35.7-53.4mm SL; Baluchestan, stream in Sarbaz River drainage, 26°48'N, 61°02'E. CMNFI 1979-0326, 1, 39.0mm SL; Baluchestan, Ughin River south of Pip, ca. 26°35'N, ca. 60°02'E. CMNFI 1979-0327, 5, 37.3-46.7mm SL; Baluchestan, stream in Geh River drainage, 26°32'N, 59°57'E. CMNFI 1979-0330, 68, 14.7-65.1mm SL; Baluchestan, stream 22km west of

Qaleh-ye Zaboli, 27°02'30"N, 61°26'E. CMNFI 1979-0336, 30, 22.4-31.6mm SL; Baluchestan, qanat 7km from Khash, 28°10'N, 61°15'E. CMNFI 1979-0339, 3, 40.6-51.0mm SL; Baluchestan, Tahlab River drainage 16km from Mirjaveh, 28°56'30"N, 61°21'E.

Garra typhlops: CMNFI 2007-0124, 6, 27.3-42.2mm SL; type locality. CMNFI 2008-0176, 1, 31.2mm SL; type locality. CMNFI 2008-0177, 1, 30.4mm SL; type locality.

Material used for molecular study: *Garra barreimiae*: FSJF DNA-2488; UAE: Wadi Shawkah, in Emirate of Ras Al-Khaimah, 25°05'54"N 56°06'33"E (GenBank accession numbers: KM214685, KM214738, KM214758, KM214779). FSJF DNA-2489; UAE: Wadi Wurayah in Emirate of Al-Fujaira, 25°23'54"N 56°16'10"E (GenBank accession numbers: KM214734, KM214767, KM214783).

Garra cf. gymnothorax: ZM-CBSU M845, M846, M848; Iran: Bashar River, 31°02'25.7"N 51°13'03.6"E (GenBank accession numbers: KM214803, KM214735, KM214763). ZM-CBSU M837; Iran: Bashar River, 30°40'50.94"N 51°32'20.72"E (GenBank accession number: KM373234). ZM-CBSU M1570, M1571, M1572; Iran: Helayjan River, Tigris River drainage, 31°47'04.8"N 49°47'36.2"E (GenBank accession numbers: KX570878, KX570879, KX570880). ZM-CBSU M1553; Iran: Balarud River, Tigris River drainage, 32°35'11.6"N 48°17'01.0"E (GenBank accession number: KX570881).

Garra cf. longipinnis: FSJF DNA-2493; Oman: Al-Saiq Platue at Jabal al Akhdar, 23°02'00"N 57°28'00"E (GenBank accession numbers: KM214752, KM214756).

Garra ghorensis: FSJF DNA-1193; Jordan: Spring at Ghor al Hadithah, 31°17'47"N 35°32'33"E (GenBank accession numbers: KJ553478, KJ553508, KJ553520). – FSJF DNA-1225; Jordan: stream below Afra hot spring, 30°57'56"N 35°40'56"E (GenBank accession number: KJ553401). FSJF DNA-2495; Jordan: Wadi Burbaita at the upper part of Wadi Al-Hassa, 30°59'01"N 35°40'11"E (GenBank accession numbers:

KM214688, KM214728, KM214788). FSJF DNA-2496; Jordan: Wadi Fifa in Southern Ghor, 30°55'52"N 35° 28'52"E (GenBank accession number: KM214722). FSJF DNA-2497; Jordan: Wadi Ibn-Hammad in Al-Karak Province, 31°18'05"N 35°37'47"E (GenBank accession number: KM214798).

Garra jordanica: FSJF DNA-1186; Jordan: Spring in Suweyma, 31°46'14"N 35°36'10"E (GenBank accession numbers: KM214710, KM214750). FSJF DNA-1206; Syria: River Yarmuk at in Wadi Jallayn, 32°44'21"N 35°58'56"E (GenBank accession number: KJ553525). FSJF DNA-2498; Jordan: lower most Mujib River, 31°27'22"N 35°35'08"E (GenBank accession numbers: KM214697, KM214703, KM214753, KM214806).

Garra mondana: ZM-CBSU M699; Fars prov.: Tang-e-Mohr spring at Lamerd, 27°31'36"N, 52°51'47"E, GenBank accession number: KM214741. ZM-CBSU M793–M794; Fars prov.: Konar Siyah spring at Firuzabd, 28°43'40"N 52°25'20"E, GenBank accession numbers: KM214762, KM214736.

Garra persica: ZM-CBSU M1135, M995; Iran: Rudan River, 27°45'49.4"N 57°14'32.8"E (GenBank accession number: KT808682, KM373235). ZM-CBSU M700; Iran: Shur River, 27°19'40.58"N 56°33'10.79"E (GenBank accession number: KM214706). ZM-CBSU M701; Iran: Kol River, 27°17'28.8"N 54°29'20.7"E (GenBank accession number: KM214807).

Garra rossica: ZM-CBSU M318; Iran: Sistan basin, 34°44'10.1"N 60°34'29.7"E (GenBank accession number: KM214771). ZM-CBSU M792, M298; Iran: Karvandar River, 27°51'17.97"N 60°46'2.99"E (GenBank accession numbers: KM214796, KM214770). ZM-CBSU M367; Iran: Kavir basin, 32°52'46.74"N 59° 3'17.39"E (GenBank accession number: KM214759).

Garra rufa: FSJF DNA-2414; Turkey: Balıklı kaplıca 10 km northeast of Kangal, 39°18'49.07"N 37°28'10.06"E (GenBank accession numbers:

KM214792-KM214794). FSJF DNA-923; Turkey: stream Çakal, 13km west of Adıyaman, tributary to Atatürk reservoir, 37°43'20.36"N 38°9'55.34"E (GenBank accession numbers: KM214692, KM214695, KM214800). FSJF DNA-2234; Iraq: Tabin river south of Zarbi, 35°48'19.20"N 45°1'12.00"E. FSJF DNA-2480; Iraq: Shatt al-Arab at Basrah, 30°32'22"N 47°49"E (GenBank accession number: KM214777). FSJF DNA-918; Turkey: River Tigris south of Diyarbakır, 37°53'13.80"N 40°13'47.40"E (GenBank accession number: KM214684). ZM-CBSU M849, M850; Iran: Dalaki River, 29°28'15.40"N 51°18'14.60"E (GenBank accession: KT808680, KT808681). ZM-CBSU M704, M836; Iran: Koohmareh Sorkhi River at Helleh, 29°23'39.80"N 52°9'40.20"E (GenBank accession numbers: KM214760, KM214810). ZM-CBSU M844; Iran: Little Zab River, 36° 28'36.3"N 45°19'54.0"E (GenBank accession number: KM214739). ZM-CBSU M847; Iran: Bashar River at Yasouj, 31°2'25.68"N 51°13'3.60"E (GenBank accession number: KM214711). ZM-CBSU M745; Iran: Doirej River at Ilam, 32°39'13.13"N 47°32'36.97"E (GenBank accession number: KM214733). ZM-CBSU M713; Iran: Kavar River at Mond, 29°10'54.60"N 52°41'28.20"E (GenBank accession number: KM373232). ZM-CBSU M842; Iran: stream at Saadi Tomb, 29°37'20.77"N 52°34'55.59"E (GenBank accession number: KM214714). ZM-CBSU M711; Iran: Fahlian River, 30°11'4.40"N 51°31'25.57"E (GenBank accession number: KM214709). ZM-CBSU M1568, M1569; Iran; SabzAb River, Tigris River drainage, 32°20'01.2"N 48°17'06.3"E (GenBank accession numbers: KX570875, KX570876). ZM-CBSU M1557; Iran; Ali Kalleh River, Tigris River drainage, 32°24'27.1"N 48°24'43.3"E (GenBank accession numbers: KX570877).

Garra typhlops: FSJF DNA-2169; Iran: Well at Kaaje-Ru, 33°04'39"N 48°35'33"E (GenBank accession numbers: KM214717, KM214731).

Garra variabilis: FSJF DNA-1159; Syria: Nahr al Barid at Nahr al Barid, 35°18'08"N 36°20'43"E

(GenBank accession numbers: KJ553391, KJ553567) FSJF DNA-1168; Syria: Orontes at Shayzar, 35°16'18"N 36°33'46"E (GenBank accession numbers: KJ553422, KJ553524).

Garra widdowsoni: FSJF DNA-2301; Iraq: cavern 25 feet below ground, 6 miles north of Haditha, 34°4'0.00"N 42°23'60.00"E (GenBank accession numbers: KM214769, KM214795).

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References

Berg, L.S. 1905. Die Fische von Turkestan [Рыбы Туркестана]. Scientific Results of the Aral Expedition. Izvestii Turkestanskago otdiela Russkago geograficheskago obschestva v. 4: i-xvi + 1-261, Pls. 1-6. [Text in Russian, title in German and Russian. [Also as v. 4 in Mitt. Türk. Abteil. Kaiserl. Russ. Geogr. Gesell.].

Berg, L.S. 1914. Description of a new species of *Garra* (= *Discognathus*) from eastern Persia. Ezhegodnik. Zoologicheskogo Muzeya Akademii Nauk SSSR 18(1913): 61.

Berg, L.S. 1949. Presnovodnye ryby Irana i sopredel'nykh stran [Freshwater fishes of Iran and adjacent countries]. Trudy Zoologicheskogo Instituta Akademii Nauk SSSR 8: 783-858.

Biomatters. 2013. Geneious Pro. Available: <http://www.geneious.com> (accessed 2015).

Bruun, A.F. & Kaiser, E.W. 1944. *Iranocypris typhlops* n. g., n. sp., the first true cave-fish from Asia. Danish Scientific Investigations in Iran (Copenhagen) Part 4: 1-8, Pl. 1. [Possibly published in 1948.]

Coad, B.W. 1991. Fishes of the Tigris-Euphrates basin: a critical checklist. Syllogeus 68: 1-49.

Coad, B.W. 2011. Freshwater Fishes of Iran. Available at <http://www.briancoad.com/contents.htm>.

Eschmeyer, W.N.; Fricke, R. & van der Laan, R. 2016. Catalog of fishes: Genera, Species, References. (<http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>). Electronic version accessed 09 March 2016.

Esmaili, H.R.; Coad, B.W.; Gholamifard, A.; Nazari, N. & Teimori, A. 2010. Annotated checklist of the freshwater fishes of Iran. Zoosystematica Rossica 19: 361-386.

Esmaili, H.R.; Khajehpanah, A.; Mehraban, H.R.; Elmi, A.; Malekzahi, H. & Pazira, A. 2015a. Fishes of the Mashkid and Makran basins of Iran: an updated checklist and ichthyogeography. Iranian Journal of Ichthyology 2: 113-132.

Esmaili, H.R.; Babai, S.; Gholamifard, A.; Pazira, A.; Gholamhosseini, A. & Coad, B.W. 2015b. Fishes of the Persis region of Iran: an updated checklist and ichthyogeography. Iranian Journal of Ichthyology 3: 201-223.

Farashi A.; Kaboli, M.; Rezaei, H.R.; Naghavi, M.R.; Rahimian, H. & Coad, B.W. 2014. Reassessment of the taxonomic position of *Iranocypris typhlops* Bruun & Kaiser, 1944 (Actinopterygii, Cyprinidae). ZooKeys 374: 69-77.

Froese, R. & Pauly, D. 2016. FishBase. www.fishbase.org. version (06/2016). World Wide Web Electronic Publication.

Hamidan, N. A.; Geiger, M.F. & Freyhof, J. 2014. *Garra jordanica*, a new species from the Dead Sea basin with remarks on the relationship of *G. ghorensis*, *G. tibanica* and *G. rufa* (Teleostei: Cyprinidae). Ichthyological Exploration of Freshwaters 25: 223-236.

- Hashemzadeh Segherloo I.; Bernatchez, L.; Golzarianpour, K.; Abdoli, A.; Primmer, C.R. & Bakhtiary, M. 2012. Genetic differentiation between two sympatric morphs of the blind Iran cave barb *Iranocypris typhlops*. *Journal of Fish Biology* 81: 1747-53.
- Heckel, J.J. 1843. Abbildungen und Beschreibungen der Fische Syriens nebst einer neuen Classification und Charakteristik sämmtlicher Gattungen der Cyprinien. Stuttgart, 109 p.
- Higgins, D.G. & Sharp, P.M. 1988. CLUSTAL: a package for performing multiple sequence alignment on a microcomputer. *Gene* 73: 237-244.
- Huelsenbeck, J.P. & Ranala, B. 2004. Frequentist properties of Bayesian posterior probabilities of phylogenetic trees under simple and complex substitution models. *Systematic Biology* 53: 904-913.
- Ivanova, N.V.; Zemlak, T.S.; Hanner, R.H. & Hebert, P.D.N. 2007. Universal primer cocktails for fish DNA barcoding. *Molecular Ecology Notes* 7: 544-548.
- Kimura, M. 1980. A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences. *Journal of Molecular Evolution* 16: 111-120.
- Kottelat, M. & Freyhof, J. 2007. Handbook of European freshwater fishes. Kottelat, Cornol & Freyhof, Berlin.
- Menon, A.G.K. 1964. Monograph of the Cyprinid fishes of the genus *Garra* Hamilton. *Memoirs of the Indian Museum* 14: 173-260.
- Nebeshwar, K. & Vishwanath, W. 2013. Three new species of *Garra* (Pisces: Cyprinidae) from north-eastern India and redescription of *G. gotyla*. *Ichthyological Exploration of Freshwaters* 24: 97-120.
- Nelson, J.S. 2006. *Fishes of the World*. Fourth Edition. John Wiley & Sons, New York.
- Nikol'skii, A.M. 1900. Novyi vid *Discognathus* iz Rossii (Pisces, Cyprinidae) [A new species of *Discognathus* from Russia]. *Ezhegodnik Zoologicheskago Muzeya Imperatorskoi Akademii Nauk, St. Petersburg* 5: 239-241. (In: Latin and Russian)
- Posada, D. & Crandall, K.A. 1998. MODELTEST: testing the model of DNA substitution. *Bioinformatics* 14: 817-818.
- Ronquist, F. & Huelsenbeck, J.P. 2003. MRBAYES 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* 19: 1572-1574.
- Sargeran, P.; Bakhtiyari, M.; Abdoli, A.; Coad, B.W.; Sarvi, K.; Rahmati Lishi, M. & Hajimoradloo, A. 2008. The endemic Iranian Cave-fish, *Iranocypris typhlops*: two taxa or two forms based on the mental disc?. *Zoology in the Middle East* 44: 67-74.
- Sayyadzadeh, G.; Esmaeili, H.R. & Freyhof, J. 2015. *Garra mondica*, a new species from the Mond River drainage with remarks on the genus *Garra* from the Persian Gulf basin in Iran (Teleostei: Cyprinidae). *Zootaxa* 4048: 075-089.
- Stamatakis, A. 2006. RAxML-VI-HPC: maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. *Bioinformatics* 22: 2688-2690.
- Stiassny, M.L.J. & Getahun, A. 2007. An overview of labeonin relationships and the phylogenetic placement of the Afro-Asian genus *Garra* Hamilton, 1922 (Teleostei: Cyprinidae), with the description of five new species of *Garra* from Ethiopia, and a key to all African species. *Zoological Journal of the Linnean Society* 150: 41-83.
- Tamura, K.; Peterson, D.; Peterson, N.; Stecher, G.; Nei, M. & Kumar, S. 2011. MEGA5: Molecular Evolutionary Genetics Analysis using maximum likelihood, evolutionary distance, and maximum parsimony methods. *Molecular Biology and Evolution* 28: 2731-2739.
- Tamura, K.; Stecher, G.; Peterson, D.; Filipiński, A. & Kumar, S. 2013. MEGA6: Molecular Evolutionary Genetics Analysis version 6.0. *Molecular Biology and Evolution* 30: 2725-2729.
- Yang, L.; Arunachalam, M.; Sado, T.; Levin, B.A.; Golubtsov, A.S.; Freyhof, J.; Friel, J.P.; Chen, W.J.; Vincent, M.; Manickam, R.; Agnew, M.K.; Simons, A.M.; Saitoh, K.; Miya, M.; Mayden, R.L. & He, S.P. 2012. Molecular phylogeny of the cyprinid tribe Labeonini (Teleostei: Cypriniformes). *Molecular Phylogenetics and Evolution* 65: 362-379.

بازنگری جنس *Garra Hamilton, 1822* در ایران، همراه با توصیف یک گونه جدید: رویکرد ریختی-مولکولی (ماهیان استخوانی عالی: کپور ماهیان)

حمید رضا اسماعیلی^{۱*}، گلناز صیادزاده^۱، برایان کد^۲، سهیل ایگدری^۳

^۱آزمایشگاه تحقیقاتی ماهی‌شناسی و سیستماتیک مولکولی، بخش زیست‌شناسی، دانشکده علوم، دانشگاه شیراز، شیراز، ایران.

^۲موزه تاریخ طبیعی کانادا، اوتاوا، کانادا.

^۳گروه شیلات، دانشکده منابع طبیعی، دانشگاه تهران، کرج، ایران.

چکیده: گونه‌های مختلف جنس *Garra* در ایران مورد بازبینی قرار گرفته و برای تمامی گونه‌های مشخص شده ویژگی تشخیصی ارائه شده است. *G. rufa*, *G. persica*, *G. nudiventris*, *G. mondica*, *G. lorestanensis*, *Garra gymnothorax*, *G. variabilis* و *typhlops* گونه‌های معتبر می‌باشند. *Discognathus crenulatus* Heckel, 1847 هم نام گونه *G. rufa* در نظر گرفته شد. *Garra amirhosseini* به‌عنوان یک گونه جدید از حوضه آبریز تیگریس در ایران توصیف شد. این گونه از دیگر گونه‌های هم جنس خود در داشتن ویژگی‌های زیر قابل تشخیص می‌باشد: تعداد ۷ شعاع نرم در باله پشتی، فلس‌های بسیار ریز در ناحیه سینه و شکم که به‌طور کامل توسط یک لایه ضخیم اپیدرمی پوشانده می‌شوند و تعداد ۹+۸ شعاع نرم در باله دم. *Garra amirhosseini* همچنین از تمامی گونه‌های هم جنس خود در حوضه خلیج فارس، به‌جز یک گونه فاقد دیسک، *G. elegans* در داشتن تعداد دو جابجائی نوکلئوتیدی تشخیصی در ژن سیتوکروم اکسیداز میتوکندریایی متمایز می‌باشد. برآورد بیشترین درست‌نمایی روابط فیلوژنتیکی، توالی‌های مورد نظر را در ۱۶ گروه مشخص جای داد که کمترین فاصله ژنتیکی ۰/۶۲ درصد (*Garra amirhosseini* vs. *Garra elegans*) و بیشترین آن ۱۷/۶ درصد (*Garra variabilis* vs. *Garra barreimiae*) محاسبه گردید.

کلمات کلیدی: *Garra amirhosseini*، ناحیه بارکدینگ، روابط فیلوژنتیکی، خاورمیانه، خلیج فارس.