

REVIEW ARTICLE



On the definition, status of research, diversity and prospect of exploration of the Genus *Garra* (Cypriniformes: Cyprinidae) from Mizoram, Northeast India

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The cyprinid genus *Garra* includes small to medium-sized, benthic fish species that are usually found in fast-flowing rivers and streams. Fish of this genus have a modified lower lip forming a mental adhesive disc and horizontally placed pectoral and pelvic fins with a flat ventral profile. The genus *Garra* is vast and wide with each species exhibiting various differences at the morphological and molecular level. Reports on the exploration and investigation of the genus in Mizoram are few and those that are reported need certain validation and clarifications. Recollection and elaborated review of this genus are obligatory. Therefore, meticulous analysis of these freshwater fish using morphological as well as molecular methods is required to validate previous findings. Furthermore, the review paper will shed a light on the diagnosis of the fish, status of research, and research prospects in Mizoram.

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Introduction

Mizoram lies in the northeastern part of India sandwiched between Bangladesh and Myanmar on the Southern end. The state is situated between 21° 56' to 24°31'N latitudes and 92°16' to 93°26'E longitudes, with 21,087 km² of geographical area. Mizoram has three major rivers drainage system viz., Barak (Ganga–Brahmaputra basin), Karnaphuli and Kolodyne basin.¹ The northerly flowing river drains into the Barak basin and the southerly flowing rivers drains into the Kolodyne basins while in the west, rivers drains into the Karnaphuli. These rivers serve as a habitat for many fauna, thus providing Mizoram with rich ichthyological diversity.²

The genus *Garra* is a group of ray-finned freshwater fishes that belong to the Family

Cyprinidae. They are characterized by an inferior mouth and the oromandibular region is specially modified into a disc-like apparatus that is used for adhering to rock surfaces.³⁻⁷ The members of this genus are usually found in fast-flowing rivers or streams and some species were found to occur in brackish waters, lakes and aquatic bodies inside caves.⁸ Studies have shown that freshwater fishes differ based on the particular river basin that they are distributed and it was also concluded that such high variability among the distributed forms have proved the species to be distinct, often not even closely related species.⁹ The genus *Garra* is very widespread and exhibit great diversity with many morphological variations and coloration. There are

more than 170 nominal species of the genus *Garra* that are widely distributed from Southern China, across Southeast Asia, India, and the Middle East to northern and central Africa. In northeastern India, 38 species of *Garra* are so far recorded.¹⁰⁻¹⁴

Systematic Classification

Phylum	Chordata
Subphylum	Vertebrata
Superclass	Gnathostomata
Class	Actinopterygii
Order	Cypriniformes
Super Family	Cyprinoidea
Family	Cyprinidae
Sub Family	Labeoninae
Genus	<i>Garra</i>

Diagnosis/Definition of the genus

The genus *Garra* are benthic fishes that are found in fast flowing rivers and streams, characterized by a having a slender and sub-cylindrical body and a horizontally extended paired fins.¹⁵ The genus *Garra* is also characterized by a slightly arch body at the dorsal region and a flat ventral region extending from the snout to the anus.¹⁶ But the most distinguishing feature of this genus is the presence of a specialized transverse and semicircular inferior mouth with the lower lip modified into a disc-like apparatus that enable the fish to adhere to surfaces of rocks and the substratum.^{17,18} The snout of species of *Garra* shows different variations. It may be smooth in Arunkumar & Moyon, 2019¹⁹ *Garra ngatangkha*, Zhang & Chen, 2002²⁰ *G. tengchongensis*, Vishwanath & Sarojnalini, 1988²¹ *G. manipurensis* or with transverse lobe at the tip of the snout in species such as Hora, 1921²² *G. kempfi*, Tamang, 2013²³ *G. magnidiscus*, Vishwanath & Kosygin, 2000²⁴ *G. elongata*. The snout may have a proboscis with transverse lobe in species such as Nebeshwar & Vishwanath 2013²⁵ *G. arunachalensis*, *G. quadrairostris*, McClelland, 1838²⁶ *G. nasuta* and some species exhibits the presence of a rostral flap such as in Vishwanath & Shanta, 2005²⁸ *G. paralissorhynchus*, McClelland 1842²⁸ *G. lissorhynchus*.

Menon in his monograph stated that Hamilton Buchanan, in 1822 describe the first species of the genus *Garra* from the river Ganges. The monograph also provided useful tools and technique for identification of fish of this genus and divided the genus *Garra* into 4 different groups and 9 complexes based on their morphological features:²⁹

The *variabilis* group

The *variabilis* complex, in which the adhesive apparatus is little differentiated and the free

posterior margins of the adhesive disc are absent. The ventral surface is less flattened and the vent/anal opening is almost immediately in front of the anal fin.

The *tibanica* group

The *tibanica* complex, in which there is a row of fine prominent dark spots at the base of the branched dorsal fin rays and a broad dark band from behind the gill openings to the base of the caudal fin. Snout is smooth.

The *rufa* complex: This complex closely resembles the *tibanica* complex and differs from the former with increased number of gill-raker count, increased intensity of dark pigmentation along the mid-lateral band and a more pointed or conical snout marked off with a shallow transverse groove.

The *lamta* complex: Members of these complexes have a lesser number of scales along the lateral line and a dark mid-lateral band above and below along the lateral line and reduced towards the posterior end. Rows of dark spots at the base of the dorsal fins are also absent.

The *lissorhynchus* complex: Members of these groups can be easily identified by the presence of a broad black W-shaped band on the caudal fin. And also, the presence of a dark streak near the free end margin of the dorsal fin.

The *taeniata* complex: The *taeniata* complex shares similar features with the *lissorhynchus* complex and both may have descended from a common ancestral stock. They are characterized by a dark lateral band and a brownish streak in the upper and lower caudal fins.

The *yunnanensis* complex: Species of this complex has greater number of lateral line scales and the position of the vent is immediately in front of the anal fin.

The *imberbis* complex: Species of this complex are distributed in Myanmar, South China and Indo-china. They are characterized by an increased number of lateral line scales, larger distance between the vent and the anal fin and increased number of gill raker and the general disappearance of barbels.

The *gotyla* group

The *gotyla* complex: The species of this complex are characterized by a well-developed proboscis on the top of the snout. Species of doubtful relationships.^{30,31}

Status of Research

The genus *Garra* is a complex group showing a wide range of diversity and taxonomic instability and requires extensive research in morphological, taxonomical and phylogenetic studies⁵. Several

descriptions, re-descriptions and revisions on the ichthyofaunal diversity of Northeast India have been done by many authors in the last few. But there are only few researches that have been done on the genus *Garra* in Mizoram. A study conducted by Lalronunga *et al.*³² showed that a new species of the genus of the lissorhynchus complex, *G. dampensis* was described from Seling river, which is a tributary of the Karnaphuli River. A study led by Arunachalam *et al.*³³ resulted in the description of two new species of *Garra*- *G. khawbungi* from Tupui River near Khawbung village and *G. tyao* from Tyao River, Tyao Village. Nebeshwar and Vishwanath, 2017³⁴ describe two new species of *Garra* - *G. kolodynensis* of the gotyla complex from the Kolodyne River basin and *G. matensis* of the lissorhynchus complex from the river Mat, which is a tributary of the Kolodyne River. Beihrosa *et al.*³⁵ in 2018 reported the occurrence of seven species of the genus *Garra* from the Kolodyne river and its tributaries viz. *G. flavatra*, *G. cf. kolodynensis*, *G. cf. matensis*, *G. nigricollis*, *G. rakhinica*, *G. manipurensis* and *G. khawbungi*.

Diversity

Fish constitutes the largest group among the vertebrates with an estimated 27,977 valid species under 62 orders, 515 families and 4,494 genera. Freshwater fishes are important zoogeographically because they are confined to drainage systems which are bordered by saltwater barriers.³⁶⁻³⁸ The wide distribution of the genus *Garra* in many regions of Asia may be attributed to its affinity for swift waters, which are abundant in the foothills of the Himalayas.¹⁸ Based on the research performed by Denis³⁹ between 2010-2016, 11 species of *Garra* are recorded from the Mizoram river basins. In addition, Nebeshwar and Vishwanath reported two new species from the Kolodyne drainage viz. *G. matensis* and *G. kolodynensis*.³⁴ Thus, the total number of

Garra species in Mizoram sums up to 13. The diversity of species of the genus *Garra* in Mizoram is shown in Table 1, with their respective distribution.

Prospects for Research

Ichthyofaunal exploration in Mizoram has not advanced very much due to the limited availability of native researchers working on fish and also due to the lack of extensive survey works. The problem can be mainly attributed to the difficult terrains and difficult topography of the land. Language barrier is another problem that resulted in less exploration from outside the state. Mizoram has three major rivers, the Kolodyne River, which flows towards the south, the Barak River that flows towards the North and the Karnaphuli River on the west. Each of these rivers has many tributaries that are rich in flora and fauna. Most of the rivers are fast flowing and serves as an excellent habitat for the genus *Garra*.³⁸ The diversity of *Garra* in Mizoram is highly underestimated suggesting that more probing into the diversity of the fish fauna is required.

Moreover, the validity of some of the species recorded by earlier workers was doubted by subsequent authors, and this has likely urge for a more extensive study on the diversity of the genus *Garra*.³⁹ This is because decisions in fish taxonomy of earlier data were often based on poorly preserved specimens and authors often observe variability with very limited resources.⁹ The scanty study on the genus *Garra* in Mizoram has become a challenge to further expand the study of the fish resources and this also suggested that there may be a number of species waiting to be discovered.

Conclusion

The amount of contributions in the distribution and taxonomy of the genus *Garra* in Mizoram is very

Table 1 | List of species of the genus *Garra* with their distribution.³⁹

Sl. No	Species	Barak	Kolodyne	Karnaphuli
1	<i>Garra dampensis</i>	-	-	+
2	<i>Garra flavatra</i>	-	+	-
3	<i>Garra cf. gotyla</i>	+	+	-
4	<i>Garra khawbungi</i>	-	+	-
5	<i>Garra lissorhynchus</i>	+	-	-
6	<i>Garra manipurensis</i>	+	-	+
7	<i>Garra aff. naganensis</i>	+	-	-
8	<i>Garra nigricollis</i>	-	+	+
9	<i>Garra rakhinica</i>	-	+	-
10	<i>Garra cf. vittatula</i>	-	+	-
11	<i>Garra tyao</i>	-	+	-
12	<i>Garra matensis</i>	-	+	-
13	<i>Garra kolodynensis</i>	-	+	-

few. Description of species from rivers of Mizoram is far from complete. Thus an in-depth survey of the genus *Garra* diversity in rivers from Mizoram is required. It is worth mentioning that several species of fishes has ornamental values. Also, the documentation of these species can improve the process of conservation.

Conflict of interest

The author declared no conflict of interest.

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