Garra ranganensis, a new cyprinid fish (Teleostei: Cypriniformes) from Arunachal Pradesh, northeastern India

Lakpa Tamang¹, Bikramjit Sinha², Santoshkumar Abujam³*, Ram Kumar⁴

1. Department of Zoology, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh 791 112, India; Email: lakpatamang@rediffmail.com
2. Zoological Survey of India, Arunachal Pradesh Regional Centre, Senki Valley, Itanagar, Arunachal Pradesh 791 113, India; E-mail: sinhabj@rediffmail.com
3. Department of Zoology, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh 791 112, India; E-mail: santosh.abujam@gmail.com
4. Department of Zoology, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh 791 112, India; E-mail: ramkumar6681@gmail.com

*Corresponding author:
Santoshkumar Abujam,
Department of Zoology,
Rajiv Gandhi University,
Arunachal Pradesh, phone no. 9401479699;
E-mail: santosh.abujam@gmail.com

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ABSTRACT

*Garra ranganensis* is described from the Ranga River in the upper Brahmaputra River drainage in Arunachal Pradesh, northeastern India. *Garra ranganensis* is distinguished from its congeners belonging to Brahmaputra, Chindwin-Irrawaddy basins in north eastern India, from the Upper Irrawaddy basin, China and Southeast Asia (those bearing well developed transverse lobe and proboscis) in having a bilobed proboscis (except *G. birostris*, *G. bispinosa* and *G. cornigera*), with a large unicuspid acanthoid tubercle at the end of each lobe. Further, can be distinguished from its congeners in exception of *G. quadratrostris*, *G. rotundinasus*, and *G. minimus* in having more and fewer lateral line scales (36–37 vs. 32–35; 39–40 in *G. elongata*; 40–42 in *G. magnidiscus*). Other combinations of characters are detailed in discussion section.

**Key words:** Freshwater Labeoninae, upper Brahmaputra basin, new species.

1. INTRODUCTION

The cyprinid fishes of the genus *Garra* Hamilton, 1822 are primarily characterized by having a slender and sub-cylindrical body, a mental adhesive disc and horizontally extended paired fins. The members of the genus usually live in fast-flowing freshwater of mountain streams and rivers, where they commonly attach to the surface of rocky and gravelly substrate by the help of mental adhesive disc and extended paired fins (Li et al., 2008), but some species are also found in brackish waters (Getahun, 1999). Some species live in lakes (Stiassny & Getahun, 2007) whereas some are cave dwellers too (Banister, 1987).

In addition to *Garra substrictorostris* Roni & Vishwanath, 2018, *G. bilobarosiris* Roni & Vishwanath, 2017, *G. minimus*, *G. alticaputus*, *G. nigricauda*, *G. kimini* Arunachalam et al., 2013, the total number of species distributed in the drainages of north eastern India raised to 37. Of these, following 18 species are known to occur in the upper Brahmaputra basin in Arunachal Pradesh viz. *G. lamta* (Hamilton, 1822); *G. gotyla* (Gray, 1830); *G. lissorhynchus* McClelland, 1842; *G. annandalei* Hora, 1921; *G. naganensis* Hora, 1921; *G. kempfi* Hora, 1921 (Nath & Dey, 2000); *G. rupecula* McClelland, 1839; *G. arupi* Nebeshwar et al., 2009; *G. kalpangi* Nebeshwar et al., 2012; *G. magnidiscus* Tamang, 2013; *G. minimus*, *G. alticaputus*, *G. nigricauda*, *G. kimini* Arunachalam et al., 2013; *G. arunachalensis*, *G. quadratrostris*, *G. birostris* Nebeshwar & Vishwanath, 2013; and *G. tamangi* Gurumayum and Kosygin, 2016. The second and last four species bears well to moderate, while rest of the species lacks or possesses weakly developed transverse lobe and proboscis.

While conducting an ichthyological survey in Ranga River, a tributary of the Upper Brahmaputra River basin in Lower Subansiri district of Arunachal Pradesh, specimens of *Garrawere* obtained, whose bilobed proboscis with unicuspid acanthoid tubercle at the end of each lobe surprisingly shares with *G. cornigera* of Chindwin basin. Further comparisons and examination reveal edit to be an undescribed species, which is herein described as *Garra ranganensis*.

2. MATERIAL AND METHODS

*Garra ranganensis* was collected by using castnet with 7 mm meshes and a 3 m diameter, in shallow water (ca 40–80 cm) and preserved in 5% formalin and later in 70% alcohol. Measurements were made point to point with digital calipers and data recorded to tenths of a millimeter. Counts and measurements were made on the left side of specimens whenever possible except tubercles on lateral field, posterior margin of nares and lateral margin of proboscis which were counted left and right side respectively. Subunits of head are presented as proportions of head length (HL). Head length (including snout length, eye diameter and interorbital distance) and measurements of body parts are given as proportions of standard length (SL). Measurements and counts follow Nebeshwar & Vishwanath (2013).

Lateral line scales were counted from the anterior most scale in contact with the shoulder girdle to the last scale on the caudal fin. Fin rays and number of scales were counted under a stereo-zoom transmitted light microscope (LEICA EZ4). Scales not arranged in series, side scales were counted. Numbers in parentheses following meristic data indicate the number of specimens with that count and an asterisk is meant for data of holotype.

Terminology for oromandibular structures follow Zhang et al. (2002) and Zhang (2005): depressed rostral surface, rostral cap groove and sublabryhmal groove that follow Nebeshwar & Vishwanath (2013); lateral field of snout (a tuberculated region situated anteroventral to nostril) that follow Tamang (2013) and ventral preopercle groove refers to inclined line that runs directly from the...
preopercle to base of callous pad below mental adhesive disc (see Fig. 3). Abbreviations used: RGUMF, Rajiv Gandhi University Museum of Fishes, Itanagar; ZSI, Zoological Survey of India; APRC, Arunachal Pradesh Regional Centre, Itanagar.

3. *GARRA RANGANENSIS*, NEW SPECIES

**Holotype**

ZSI/APRC782, 122.1 mm SL; India: Arunachal Pradesh: Ranga River (Brahmaputra basin), about 5 km upstream from Yazali, Lower Subansiri District, 27° 25' 41.16"N, 93° 45' 47.58'E; 881 m asl; Sinha & party, 5 September 2012.

![Figure 1](image1.jpg)

**Figure 1** Lateral, dorsal and ventral views of *Garra ranganensis*, ZSI/APRC-782, holotype, 122.1 mm SL; India: Arunachal Pradesh: Lower Subansiri district: Ranga River.
Paratypes
ZSI/APRC1166(4) 101.2–111.4 mm SL; same data as holotype.

Diagnosis
Garra ranganensis is distinguished from its congeners (those bearing well developed transverse lobe and proboscis) in Brahmaputra, Chindwin-Irrawaddy in northeast India, from the Upper Irrawaddy basin, China and Southeast Asia in having a bilobed proboscis (except G. birostris, G. bispinosa and G. cornigera), with a moderate to large unicuspid acanthoid tubercle at the end of each lobe. Further can be distinguished from its congeners in exception of G. quadratirostris, G. rotundinasus, and G. minimus in having more and fewer lateral line scales (36–37 vs. 32–35 and 39–40 in G. elongata; 40–42 in G. magnidiscus). Additional unique differentiating combination of characters are: last branched ray of pelvic fin reaching to or exceeding posterior margin of anus, anus to anal-fin distance 36–37% of pelvic-anal distance, a transverse lobe with 14–21 conspicuous small to large unicuspid acanthoid tubercles; predorsal scales 11–12; transverse scale rows above the lateral line 3½.

Figure 2 Snout morphology of: a, Garra ranganensis, ZSI/APRC782, holotype, 122.1 mm SL; b, G. quadratirostris, ZSI/APRC1042, India; Arunachal Pradesh: West Kameng district: Tenga River; c, G. birostris, ZSI/APRC 1041, 127.3 mm SL, India: Arunachal Pradesh: Papum Pare district: Dikrong River; d, G. arunachalensis, ZSI/APRC1046, 151.1 mm SL; India: Arunachal Pradesh: West Siang district: Sinyot River near Payum (Brahmaputra basin).
NEW SPECIES

ARTICLE

Figure 3 *Garra ranganensis*, ZSI/APRC782, holotype, 122.1 mm SL, showing oromandibular structures

Description

General body shape as in Figure 1. Morphometric data are presented in Table 1. Dorsal profile rising evenly from base of proboscis to supraoccipital process and gently convex to dorsal-fin origin, thereafter gently decreasing to end of caudal-fin base. Ventral profile flat to pectoral-fin origin, then straight or slightly convex to pelvic-fin origin, thereafter straight to anal-fin origin, further, gently increasing to end of anal-fin base and then straight to caudal-fin base. Body elongate, depth (19.1–20.4% SL), cylindrical anteriorly, gently compressed upto dorsal-fin base and thereafter greatly decreasing to caudal-fin base, deepest at dorsal-fin origin, deeper than wide. Head moderate, more or less depressed, ventrally flat, slightly broader than body, lateral side gently decreasing towards snout tip when viewed ventrally, depth less than its length and width. Snout outline somewhat obtusely rounded. Transverse lobe with 14–21 small to large unicuspid acanthoid tubercles, roughly arranged in 3 rows, lobe isolated posteriorly by a deep to shallow transverse groove. Lateral field situated anteroventral to nostril, with 7–11 tubercles each side. Proboscis well developed, broader than longer and bilobed with a moderate to large unicuspid acanthoid tubercle, anteriorly directed at the end of each lobe, proboscis sharply delineated from depressed rostral surface by narrow transverse groove. Associated tubercles: usually 2 small tubercles present in between lobes (3), sometime 1 tubercle (1) or absent in holotype; 1–2 small tubercles on lateral margin (left) and 2 tubercles (right) posterior to each lobe; and patch of 2–4 small tubercles each on posterior margin of nares.
Sublachrymal groove short, shallow, and connected to rostral cap groove. Eye moderate, dorso-laterally situated, slightly closer to posterior extremity of opercle than to tip of snout, separated by a broad interorbital space, not visible in ventral view. Postorbital length slightly shorter than snout length.

Table 1 Morphometric data of Garra ranganensis sp. nov. (n=5)

<table>
<thead>
<tr>
<th></th>
<th>Holotype</th>
<th>Range</th>
<th>Mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard length (mm)</strong></td>
<td>122.1</td>
<td>101.2–122.1</td>
<td>111.2±7.4</td>
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<tr>
<td><strong>In % of standard length</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Body depth</td>
<td>19.6</td>
<td>19.1–20.4</td>
<td>19.6±0.5</td>
</tr>
<tr>
<td>Head length</td>
<td>26.7</td>
<td>24.9–28.9</td>
<td>26.8±1.7</td>
</tr>
<tr>
<td>Head depth at eye</td>
<td>13.3</td>
<td>13.3–15.5</td>
<td>13.9±0.9</td>
</tr>
<tr>
<td>Head width at opercle</td>
<td>18.5</td>
<td>18.1–21.7</td>
<td>19.6±1.5</td>
</tr>
<tr>
<td>Head width at nare</td>
<td>16.6</td>
<td>16.0–19.8</td>
<td>17.6±1.6</td>
</tr>
<tr>
<td>Body width at dorsal-fin origin</td>
<td>17.3</td>
<td>15.8–18.0</td>
<td>16.8±0.9</td>
</tr>
<tr>
<td>Body width at anal-fin origin</td>
<td>9.6</td>
<td>9.6–11.2</td>
<td>10.6±0.6</td>
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<tr>
<td>Caudal peduncle length</td>
<td>17.1</td>
<td>14.0–17.1</td>
<td>15.6±1.1</td>
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<tr>
<td>Caudal peduncle height</td>
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<td>11.6–12.0</td>
<td>11.8±0.2</td>
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<tr>
<td>Dorsal-fin length</td>
<td>23.9</td>
<td>22.2–25.8</td>
<td>24.3±1.5</td>
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<tr>
<td>Dorsal-fin base length</td>
<td>17.8</td>
<td>17.0–18.4</td>
<td>17.5±0.6</td>
</tr>
<tr>
<td>Pectoral-fin length</td>
<td>21.3</td>
<td>19.0–22.8</td>
<td>21.3±1.4</td>
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<tr>
<td>Pelvic-fin length</td>
<td>20.9</td>
<td>19.0–21.3</td>
<td>20.5±0.9</td>
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<tr>
<td>Anal-fin length</td>
<td>20.8</td>
<td>18.8–20.8</td>
<td>19.9±0.7</td>
</tr>
<tr>
<td>Anal-fin base length</td>
<td>7.4</td>
<td>7.4–8.2</td>
<td>7.8±0.3</td>
</tr>
<tr>
<td>Length of upper caudal-fin lobe</td>
<td>25.4</td>
<td>25.4–28.1</td>
<td>26.9±1.1</td>
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<tr>
<td>Length of lower caudal-fin lobe</td>
<td>27.6</td>
<td>26.6–29.2</td>
<td>28.2±1.1</td>
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<tr>
<td>Length of median caudal-fin rays</td>
<td>12.8</td>
<td>12.8–16.6</td>
<td>14.8±1.4</td>
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<td>Preanal length</td>
<td>79.1</td>
<td>77.0–80.5</td>
<td>79.1±1.3</td>
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<td>Preanus length</td>
<td>71.5</td>
<td>67.6–71.5</td>
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<td>Prepelvic length</td>
<td>55.4</td>
<td>53.3–56.5</td>
<td>55.0±1.4</td>
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<td>Predorsal length</td>
<td>51.4</td>
<td>47.5–51.4</td>
<td>49.9±1.7</td>
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<td>Prepectoral length</td>
<td>23.7</td>
<td>21.9–24.6</td>
<td>23.2±1.0</td>
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<tr>
<td>Pelvic-anal distance</td>
<td>25.2</td>
<td>24.6–25.9</td>
<td>25.1±0.5</td>
</tr>
<tr>
<td>Anus-anal length</td>
<td>9.5</td>
<td>8.9–9.8</td>
<td>9.4±0.4</td>
</tr>
<tr>
<td>Snout length</td>
<td>14.7</td>
<td>13.5–16.2</td>
<td>14.9±1.1</td>
</tr>
<tr>
<td>Eye diameter</td>
<td>4.8</td>
<td>3.9–4.8</td>
<td>4.3±0.4</td>
</tr>
<tr>
<td>Interorbital distance</td>
<td>11.9</td>
<td>11.0–12.5</td>
<td>11.8±0.5</td>
</tr>
</tbody>
</table>

**In % of pelvic-anal distance**

|                                |          |           |                  |
| Anus to anal fin distance      | 37.5     | 35.9–37.5 | 37.2±0.9         |

**In % of head length**

|                                |          |           |                  |
| Snout length                   | 55       | 54–56     | 55±0.8           |
| Eye diameter                   | 18       | 15–18     | 16±0.9           |
| Interorbital space             | 45       | 43–46     | 44±1.3           |
| Mental disc length             | 44       | 43–46     | 44±1.3           |
| Mental disc width              | 56       | 56–65     | 61±3.6           |
| Callous pad length             | 24       | 24–28     | 26±1.5           |
| Callous pad width              | 37       | 37–44     | 40±3.1           |
Barbels two pairs; rostral barbel located antero-laterally, greater than half of eye diameter; maxillary barbel rooted at corner of mouth, with broad base, and shorter than rostral barbel. Mouth inferior, transverse, and slightly arched. Upper lip smooth and greatly reduced. Rostral cap well developed, entirely covering upper lip, confluent with lower lip around corners of mouth, subdistal crescentic area densely covered by minute and round papillae, its ventral margin concave, well crenulated medially, weakly distally. Anteromedian fold transverse and slightly arched, densely covered by numerous small and round papillae, arched groove between anteromedian fold and central callous pad sparsely papillated. Mental disc well developed, wider than long (width 56–65 and length 43–46% HL), extending beyond the posterior margin of eye, but not reaching the level of pectoral-fin origin. Latero-posterior flap surrounding central callous pad densely covered and evenly distributed by round tubercles. Anterolateral lobe well developed, slightly elliptical, densely papillated, and about one-third part covered by rostral fold. Central callous pad elliptical, wider than long (width 37–44% HL and length 24–28) and wider than half of disc width. Gill opening moderate, origin posterior to eye, almost straight to superior margin of eye, and extending just below pectoral-fin origin, ventral preopercle groove, more inclined, and reaching callous pad base below mental disc. Nostril closer to anterior margin of eye than to tip of snout, nares separated by a large rounded membrane flap dividing it into two parts, posterior nare slightly larger than anterior.

Dorsal fin located at middle or slightly anterior of standard length with 3 unbranched, 8(3*) 9(2) branched rays. Anterior margin of dorsal fin straight except distal margin which is convex, length almost equal to prepectoral length and longer than pectoral and pelvic fins, but shorter than caudal fin.

Pectoral-fin rhomboidal, and horizontally extended with first 1 unbranched ray in all specimens, 13 branched and last 1 unbranched (1), 14 branched and last 2 unbranched (1*), 14 branched and last 3 unbranched (2), and 15 branched and last 1 unbranched (1) rays. Anterior margin of pectoral fin moderately convex, first four branched rays distally bifurcated and modified to form adhesive pad, conspicuously distinguished from other branched rays. Pelvic fin with first 1 unbranched ray in all specimens, 7 branched and last 2 unbranched (1), 8 branched (1*), 8 branched and 1 unbranched (3) rays; last unbranched rays closely set to each other; tip of fin extending to second or third preanal scale from anal-fin origin; anterior margin of pelvic fin gently convex, origin at vertical through anterior third of second to fourth base of branched dorsal-fin ray; axillary scale almost equal to or slightly extending beyond base of last ray, and base of last pelvic ray separated from anus by 4 (1*), 5(3), and 6(1) scales. Anus separated from anal-fin origin by 4–5 scales. Anterior margin of anal-fin straight with first 2 unbranched and 5½ branched rays, tip of adpressed fin reaching margin of hypural complex.

Lateral line complete, almost straight, with 36 (2*), 37 (3) perforated scales, scale size decreasing towards caudal-fin base except last 2 larger scales; first row of scales either side of lateral line almost similar to lateral line scales. Transverse scales above and below lateral line 3½ /2½–3/3½. Predorsal scales 11 (1), and 12 (4*). Circumpeduncular scales 12. Scales between last dorsal fin ray and first upper procurent ray of caudal fin 15 (1), 16(2), and 17 (2*), and scales between last anal fin ray and first lower procurent ray of caudal fin 6 (1*), 7 (2), 8 (1), and 9(1).

Anus closer to anal-fin origin than to pelvic-fin origin (distance from anus to anal-fin origin 36–37% of distance between pelvic- and anal-fin origins). Caudal fin deeply forked with i,9,8,i (5) principal rays, upper and lower procurent rays symmetrical with 3 rays each, lower lobe slightly broader and longer than upper. Chest and belly scaled and embedded in skin, scales on thorax more deeply embedded and smaller than belly scales, but smaller than flank scales.

**Coloration**

In preservative (70 % alcohol). Head and body grayish brown, head more grayish than body. Anterior portion of body darker than posterior; flanks with 6 brown stripes on posterior part, beyond base of pelvic fin, and 1 faint brown stripe each either side of vent between pelvic and anal fins, flank stripes more distinct on caudal peduncle. Abdominal region pigmented with light grayish brown. Distal margin of operculum creamy. A faint blackish spot anterior to upper angle of gill opening. Tubercles on transverse lobe and proboscis light pinkish brown. Dorsal fin grayish brown, with series of dark brown spots at the bases of each branched rays, distal half of radials light brown. Pectoral and pelvic fins grayish brown dorsally, former darker than latter, ventral surface grayish cream. Anal fin light grayish brown. Caudal fin overall grayish hyaline with dusky to brown streak on distal region of each lobe and on median rays; upper streak thinner than lower and median rays broader than both; other rays of caudal fin faint brown to dusky, but lower lobe much darker than upper. Eye pupil grayish brown.

**Etymology**

The species is named after the type locality, Ranga River. An adjective.
Distribution and habitat

*Garra ranganensis* is presently known only from the Ranga River, a tributary of the Brahmaputra River basin, about 5km upstream from Yazali town, Lower Subansiri district, Arunachal Pradesh, north eastern India (Fig. 4 & 5). The habitat consists of medium to large dark to grayish brown boulders along the river banks with heavy sand deposits. The river with cool and clear, fast to moderate running water and bed consists of flat boulders, pebbles, cobbles covered by slime algae, and somewhere heavy sand deposits. The river banks and uphill consist of small to large trees and shrubs. Other associated species collected at the type locality includes *Garra kalpaangi*, *Tor putitora*, *Neolissochilus hexagonolepis*, *Barilius bendelisis*, *Schizothorax richardsonii*, *Chagunius chagunio*, *Aborichthys cataracta*, *Psilorhynchus balitora*, and *Schistura* sp.

**Figure 4** Type locality of *Garra ranganensis*: Ranga River, Yazali, Lower Sunbansiri district, Arunachal Pradesh, India

4. DISCUSSION

The *Garra* are geographically widely distributed and diversified genus, ranging from the northern and central Africa to Southeast Asia through the Middle East, Southern China and South Asia (Menon, 1964; Zhang & Chen, 2002; Stiassny & Getahun, 2007), till date known to occur 140 recognized species in the world, thus it would be not wise to compare *G. ranganensis* with all congeners. Kottelat (1990, 2001) already remarked that most of the highly specialized rheophilic fish species in Southeast Asia have restricted distribution ranges. *Garra ranganensis* is compared only to its congeners along the base of the Himalaya in Brahmaputra, Chindwin-Irrawaddy basins in northeast India, from the Upper Irrawaddy basin, China and Southeast Asia, those having weakly to well developed transverse lobe and proboscis on snout.

Besides the *Garra* species viz *G. gotyla*, *G. arunachalensis*, *G. quadratirostris*, *G. birostris* and *G. tamangi* recognized in upper Brahmaputra river drainages in Arunachal Pradesh there are other *Garra* species viz. *G. substrictirostris*, *G. biloborostris*, *G. bimaculacauda*, *G. clavirostris*, *G. cornigera*, *G. elongata*, *G. koladynensis*, *G. litanensis*, *G. nasuta*, *G. parastenorhynchus*, and *G. trilobata* known from drainages of northeastern India that possesses transverse lobe and proboscis on the snout.

*Garra ranganensis* is distinguished simultaneously from *G. gotyla*, *G. arunachalensis*, *G. quadratirostris*, and *G. tamangi* in having bilobed (vs. quadrate; trilobed in *G. tamangi*); including *G. birostris* in having last branched ray of pelvic fin reaching or exceeding posterior margin of anus (vs. not reaching); anus to anal-fin distance (36–37% of pelvic to anal-fin distance vs. 22–28 in *G. gotyla*;
19–25 in G. arunachalensis; 21–30 in G. birostris; 37–44 in G. quadratiostris and 21–24 in G. tamangi); more lateral line scales (36–37 vs. 33–34 in G. gotyla, G. birostris, G. tamangi; 35 in G. arunachalensis; except in G. quadratiostris). Further: from G. gotyla, G. arunachalensis, G. birostris and G. tamangi by having more lateral line (36–37 vs. 33–35); fewer transverse scale rows between lateral line and dorsal-fin origin (3½ vs. 4–4½), and between lateral line and anal-fin origin (3½ vs. 4–4½); from G. arunachalensis, G. quadratiostris and G. birostris in having a shorter pectoral-fin (19.0–22.8% SL vs. 21.0–26.5), callous pad (24–28% HL vs. 28–38 except in G. birostris) and snout (54–56% HL vs. 55–63 except in G. quadratiostris); from G. gotyla in having a broader mental disc (56–65% HL vs. 51–57), a longer and broader callous pad (length 24–28% HL vs. 20–24 and width 37–44% HL vs. 30–37), a longer snout (54–56% HL vs. 48–55), a prominent and closely (vs. weak and distantly) set tubercles on transverse lobe with 14–21 (vs. 9–13) tubercles; and proboscis with 2 large (vs. patch of 3–9 small) acanthoid tubercles, the posterior margin of mental adhesive disc closer to (vs. far away from) the level of pectoral-fin origin, and ventral preopercle groove greatly (vs. moderately) inclined (compare Fig. 3 with Nebeshwar & Vishwanath, 2013: fig. 7); from G. arunachalensis in having two unicuspid acanthoid tubercles on each lobe (vs. corner margin) of proboscis, anteriorly (vs. laterally) projecting; from G. quadratiostris in having a prominent (vs. weak) unicuspid acanthoid tubercle on each lobe (vs. anterior margin) of proboscis; a shallower (11.6–12.0 % SL vs. 12.9–14.4) caudal peduncle, and a shorter anal fin (18.8–20.8% SL vs. 20.5–24.9) and pelvic fin (19.0–21.3% HL vs. 20.5–23.3); from G. birostris by the presence of unicuspid (vs. tri to tetracuspid) acanthoid tubercles, three medial tubercles on transverse lobe comparatively smaller (vs. larger) and moderately (vs. broadly) joined basally with adjacent tubercles (see Fig. 2 a & c), a shorter pelvic to anal distance (24.6–25.9% SL vs. 25.7–30.0), and a greater prepelvic distance (53.3–56.5% SL vs. 50.2–53.8).

**Figure 5** Map of Arunachal Pradesh, showing the type locality of *Garra ranganensis* (filled circle)

*Garra ranganensis* readily differs from other upper Brahmaputra congeners *G. arupi*, *G. kalpangi*, *G. magnidiscus*, *G. minimus*, *G. kimini*, *G. nigricauda* and *G. alticaputus* having awell (vs. weakly) developed transverse lobe with prominent (vs. weak) tubercles; further: from *G. arupi*,*G. kalpangi*, *G. kimini*, *G. nigricauda* and *G. alticaputus* in having more lateral line scales (36–37 vs. 35–36 in *G. arupi*; 32–33 in *G. kalpangi*; 33–34 in *G. kimini*; 34–36 in *G. nigricauda* and 33 in *G. alticaputus*); from *G. arupi* by the absence (vs. presence) of prominent submarginal black band on dorsal fin; from *G. kalpangi* in having posterior margin of mental adhesive disc closer to (vs. far away from) the level of the pectoral-fin origin (compare Fig. 3 with Nebeshwar *et al.*, 2012: fig. 2a); from *G. magnidiscus* in having fewer lateral line scales (36–37 vs. 40–42); from *G. alticaputus* in having more predorsal scales (11–12 vs. 10); and fewer circumpeduncular scales (12 vs. 16). *Garra ranganensis* can be further differentiated from *G. minimus* and *G. kimini* in
presence (vs. absence) of scales on chest; further from \textit{G. kimini} in having more predorsal scales (11–12 vs. 9–10), and lower number of circumpapiluncular scales (12 vs. 16); and from \textit{G. nigricauda} in having more predorsal scales (11–12 vs. 9–10).


\textit{Garra ranganensis} is distinguished from \textit{G. substrictorostris} and \textit{G. clavirostris} by having bilobed (vs. unilobed) proboscis. Further, from \textit{G. substrictorostris} by having unicusp (vs. multicuspid) tubercles on transverse lobe, 3½ (vs. 5½) transverse scales above lateral line, longer distance between anus and anal fin origin (35.9–37.5% pelvic-anal distance vs. 15 – 27). From \textit{G. clavirostris} by having bilobed (vs. unilobed) proboscis, transverse lobe with only unicusp (vs. uni- to multicuspid) tubercles, more lateral line scales 36–37 (vs. 33–34), more predorsal scales 11–12 (vs. 9–10).

From \textit{G. bimaculata} by having well developed (vs. weakly developed) transverse lobe and proboscis on snout, caudal fin without (vs. with) one distinct black mark on the distal region of each lobe, and in having more lateral line scales 36–37 (vs. 33–34). From \textit{G. elongata} by having prominent (vs. weakly developed) proboscis, with (vs. without) acanthoid tubercles and bilobed proboscis, and fewer lateral line scales 36–37 (vs. 39–40). From \textit{G. koladynensis} in having bilobed (vs. trilobed) proboscis, transverse lobe with unicusp only (vs. uni-, bi- to hexacuspid) tubercles, more lateral line scales 36–37 (vs. 33–34), and more predorsal scales 11–12 (vs. 9–10). From \textit{G. litanensis} in having more lateral line scales 36–37 (vs. 32–33) and predorsal scales 11–12 (vs. 9–10), bilobed (vs. squarish) proboscis on snout.

\textit{Garra ranganensis} also shares its transverse lobe and proboscis with \textit{G. nasuta} described by McClelland (1838) from the Kasya Mountains (Khasi hills). Sketch diagram of dorsal view of head (McClelland, 1838: pl. 55 figs. 2, 2a; also reproduced as fig. 9 in Nebeshwar & Vishwanath, 2013), clearly shows the presence of a pit between the nares, contrarily absent in \textit{G. ranganensis}. From \textit{G. parasteronoryynchus} by having bilobed (vs. club-shaped) proboscis on snout, more lateral line scales 36–37 (vs. 31-32), transverse lobe with unicusp (vs. multicuspid) tubercles.

In northeastern India, \textit{Garra ranganensis} is closely resembles with two species \textit{G. cornigera} described from Chindwin basin in Manipur and another species \textit{G. biloborostris} from Brahmaputra River basin in Assam in having bilobed proboscis and unicusp tubercles on transverse lobe of snout. However, \textit{Garra ranganensis} is distinguished from \textit{G. cornigera} on the following characters: more lateral scales (36–37 vs. 33), predorsal scales (11–12 vs. 9–11), and unicusp tubercles on transverse lobe of snout (14–21 vs. 8–13). \textit{Garra ranganensis} can be further differentiated by having a larger mental adhesive disc, posterior margin of which reaches close to level of pectoral-fin origin, that results ventral gill opening groove shorter and more inclined towards ventral mid-line whereas in \textit{G. cornigera} it is slope and ventral gill opening groove much longer from the pectoral fin origin (compare Fig. 1 with Shangningam & Vishwanath, 2015: fig.1b). Moverover, \textit{Garra ranganensis} can be distinguished from \textit{G. cornigera} by having shorter pectoral-fin (19.0–22.8% SL vs. 23.0–29.3) and pelvic fin (19.0–21.3% SL vs. 21.0–24.3), longer mental disc (43–46% HL vs. 34.0–42.0), broader callous pad (37–44% HL vs. 30–36). From \textit{Garra biloborostris} by having longer distance between anus and anal fin origin (35.9–37.5% pelvic-anal distance vs. 17.8 – 26.2). Further can be distinguished from \textit{G. biloborostris} by having proboscis without (vs. with) two separate arched-shaped groove below each lobe, and lobe moderately (vs. slightly) elevated (see Fig. 2a with Roni & Vishwanath, 2017: figs. 2 and 3), and by having more lateral line scale 36–37 (vs. 30–33).

Chindwin-Irrawaddy drainage harbors about 19 species of \textit{Garra}. Of these eight species \textit{G. litanensis} Vishwanath, 1993, \textit{G. elongata} Vishwanath & Kosygin, 2000, \textit{G. bispinosa} Zhang, 2005, \textit{G. qiaojiensis} Wu & Yao, 1977, \textit{G. rotundinasus} Zhang, 2006, \textit{G. gravelyi} (Annandale, 1919), \textit{G. cornigera} and \textit{G. trilobata} Shangningam & Vishwanath, 2015 possesses proboscis on snout. \textit{Garra ranganensis} is distinguished from \textit{G. litanensis} by the following characteristics: fewer transverse scale rows above the lateral line (3½ vs. 5½), more lateral line scales (36–37 vs. 32–33), more predorsal scales (11–12 vs. 9–10), a bilobed (vs. unilobed) proboscis (see fig. 2 c & d in Vishwanath, 1993); from \textit{G. elongata} by having a prominent (vs. poorly developed) proboscis and transverse lobe on snout, fewer lateral-line and predorsal scales (36–37 vs. 39–40 and 11–12 vs. 13), more posteriorly-situated anus (distance from anus to anal fin 36–37 % of pelvic-anal distance vs. 47–51), and absence (vs. presence) of a submarginal transverse black band on the dorsal fin; from \textit{G. bispinosa} in having a longer head (24.9–28.9% SL vs. 22.6–24.6), a longer prepelvic distance (53.3–56.5% SL vs. 48.2–53.2), more lateral line scales (36–37 vs. 34–35), a longer mental disc (43–46% SL vs. 38–43), lower number of circumpapiluncular scales (12 vs. 16), and fewer transverse scale rows above the lateral line (3½ vs. 4); from \textit{G. qiaojiensis} in having a bilobed (vs. quadrate) proboscis, a longer head (24.9–28.9% SL vs. 21.8–23.9) and a shorter mental adhesive disc (length 35–37% HL vs. 49–56). \textit{Garra ranganensis} shares with \textit{G. rotundinasus} the presence of 36–37 perforated lateral line scales. However, it can be distinguished by having a snout with prominent (vs. weakly developed), bilobed (vs. truncated) proboscis, a larger mental adhesive disc (width 56–65% HL vs. 69–82 and length 35–37% HL vs. 45–61), more transverse scales rows above lateral line (3½ vs. 2½), and anterior margin
of snout moderately (vs. broadly) rounded (see fig. 2A; Zhang, 2006); and from G. gravelyi in having a bilobed (vs. truncated) area in front of the nostrils, more lateral line and predorsal scales (36–37 vs. 32–34 and 11–12 vs. 8–9). Snout morphology of Garra ranganensis closely shares with G. cornigera in being a bilobed proboscis with large unicuspid acanthoid tubercles at the end of each lobe. G. ranganensis, however, can be differentiated from G. cornigera in having more (14–21 vs. 8–13) small to medium sized unicuspid acanthoid tubercles on transverse lobe; more lateral line scales (36–37 vs. 33); more number of scales (4–5 vs. 3) between anus and anal-fin origin; longer mental disc (43–46 vs. 34–42) and broader callous pad (37–44 vs. 30–36); and posterior margin of mental disc closer (vs. far away) from the pectoral fin origin (compare Fig. 3 with Shangningam & Vishwanath, 2015: fig. 1 b); and readily distinguished from G. trilobata in having bilobed (vs. trilobed) proboscis.


Following are the other species of Garra recognized from China and Southeast Asia associated with proboscis on snout (Hora, 1921; Menon, 1964; Zhang, 2005, 2006): G. gravelyi (Annandale, 1919), G. orientalis Nichols, 1925, G. bourreti (Pellegrin, 1928), G. salweenica Hora & Mukerji, 1934, G. fuliginosa Fowler, 1934, G. qiaojiensis Wu & Yao, 1977, G. cyrano Kottelat, 2000, G. bispinosa Zhang, 2005, G. rotundinasus Zhang, 2006. Garra gravelyi, G. qiaojiensis, G. bispinosa, and G. rotundinasus are already compared above. Garra ranganensis is easily distinguished from Garra orientalis, G. salweenica and G. fuliginosa by the presence of a bilobed (vs. trilobed) proboscis on snout. Further: from G. orientalis in having (vs. lacking) a series of black spots at the bases of the dorsal-fin rays, more lateral-line scales (36–37 vs. 32–34), and more predorsal scales (11–12 vs. 9–10); from G. bourreti in lacking (vs. having) slender proboscis pointing forwards; from G. salweenica by having a longer head (24.9–28.9% SL vs. 20.0–24.1), and more lateral-line scales (36–37 vs. 32–34). Garra fuliginosa was described by Fowler, 1934 based solely from holotype (178 mm TL) from the Chao Phraya basin. The topotype of G. fuliginosa, illustrated as fig. 8 in Kottelat, 2000, clearly indicates the presence of a dark blotch on the caudal peduncle, which is absent in Garra ranganensis and the posterior margin of mental adhesive disc is situated far away from the level of the pectoral-fin origin, while closer in G. ranganensis. Further, it can be differentiated in having (vs. lacking) dark brown spots at the base of the dorsal-fin rays. Garra ranganensis is immediately distinguished from G. cyrano in having a shorter (vs. longer and slender) proboscis, with a shallow (vs. deep) notch along the inferior side. Garra ranganensis can be further differentiated from G. orientalis, G. salweenica, G. cyrano in having more lateral-line scales (36–37 vs. 32–34), fewer scales above lateral line (3½ vs. 4–4½), fewer circumpeduncular scales (12 vs. 16), further from G. orientalis, and G. salweenica in having more forwardly-situated anus (distance from anus to anal fin 36–37% of pelvic-anal distance vs. 17–26 in G. orientalis and 19–25 in G. salweenica), and more preanal scales (4–5 vs. 3–4).

Palaeobiogeographic analyses of freshwater fishes can provide a link between the geological and biotic evolution of the Tibetan Plateau, because their dispersal depends on the formation of direct connections between drainages (Bermingham and Martin 1998; Lundberg 1993). During the Cretaceous period the Indian Plate collided with the Asian Plate that had resulted gradual uplift of the Himalayas, the formation of rivers, and changes in climate. This process had gradually led to the disconnection of ancestral Tsangpo-Irrawaddy River forming Tsangpo-Brahmaputra River system (Brookfield 1998). In this study we have observed that Garra ranganensis and G. tamangi of Brahmaputra drainage are very closely resembles with those of G. cornigera and G. trilobata of Chindwin basin in being bilobed and trilobed proboscis respectively. The existence of these sister groups in two different isolated River systems supports that they might have got separated after the Cretaceous period. This is further supported by the distribution of other proboscis bearing congeners G. bispinosa (bilobed) and G. orientalis, G. salweenica and G. fuliginosa (trilobed) in upper Salween and Irrawaddy River.

5. COMPARATIVE MATERIALS

Garra arunachalensis: ZSI/APRC1046, 5, 84.0–140.0 mm SL; India: Arunachal Pradesh: West Siang district: Sinyot River near Payum (Brahmaputra basin).

G. birostris: RGUMF 0080, 5, paratypes, 40.0–85.0 mm SL; India: Arunachal Pradesh: Papum Pare district: Pom River at Ramghat (Brahmaputra basin); ZSI/APRC 1041, 9, 52.2–127.3 mm SL: India: Arunachal Pradesh: Papum Pare district: Dikrong River at Midhpu (Brahmaputra basin).

G. quadratirostris: ZSI/APRC1042, 4, 99.3–151.0 mm SL; India: Arunachal Pradesh: West Kameng district: Tenga River at Tenga (Brahmaputra basin).

G. arupi: RGUMF 0184, holotype, 60.0 mm SL; RGUMF 0185, 15, 50.0–72.4 mm SL; India: Arunachal Pradesh: Deopani River at Roing, Lower Dibang Valley.
G. kalpangi: RGUMF 0006, holotype, 60.0 mm SL; RGUMF 0007, 9, 50.0–72.4 mm SL; India: Arunachal Pradesh: Kalpangi River at Yachuli, Lower Subansiri district.

G. magnidiscus: ZSI/V/APFS/P-622, holotype, 83.8 mm SL; ZSI/V/APFS/P-623, 12, paratypes, 52.7–82.7 mm; India: Arunachal Pradesh: Upper Siang district: a fast flowing tributary to Siang River, about 3 km from Bomdo village on main road to Tuting.

G. tamangi: ZSI/APRC/P-1175, holotype, 153.9 mm SL; ZSI/APRC/P-1176,3, paratypes, 67.9–153.9 mm SL; India: Arunachal Pradesh: Papum Pare district: Dikrong River at Hoj near NHPC Hydel complex, a tributary of Brahmaputra River basin.

Note
Catalogue number ZSI v/42 for G. arunachalensis used in Nebeshwar & Vishwanath, 2013 is now replaced by ZSI/APRC-1046, as former was unidentified registration number.

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Authors’ contributions
The first author contributed to the sample collection, writing of the manuscript and compilation of data. The 2nd author contributed to the sample collection. The 3rd and 4th authors also contributed equally to the compilation of data and revising the manuscript.

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The authors have declared that no potential conflicts of interests exist.

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