NEW SPECIES

Vol. 20, 2019

ISSN
2319–5746
EISSN
2319–5754

Species

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

Lakpa Tamang[1], **Bikramjit Sinha**[2], **Santoshkumar Abujam**[3]✉, **Ram Kumar**[4]

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, India; phone no. 9401479699;
E-mail: santosh.abujam@gmail.com

Article History
Received: 30 October 2018
Accepted: 27 December 2018
Published: February 2019

Citation
Lakpa Tamang, Bikramjit Sinha, Santoshkumar Abujam, Ram Kumar. *Garra ranganensis*, a new cyprinid fish (Teleostei: Cypriniformes) from Arunachal Pradesh, northeastern India. *Species*, 2019, 20, 59-71

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. quadratirostris, 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.biloborostris* 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. kempi* 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. quadratirostris*, *G. birostris* Nebeshwar & Vishwanath, 2013; and *G. tamangi* Gurumayum and Kosygin, 2016. The second and last four species bears well to moderate, whilerest 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 *Garra*were 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 3m 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 sublachrymal 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 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.

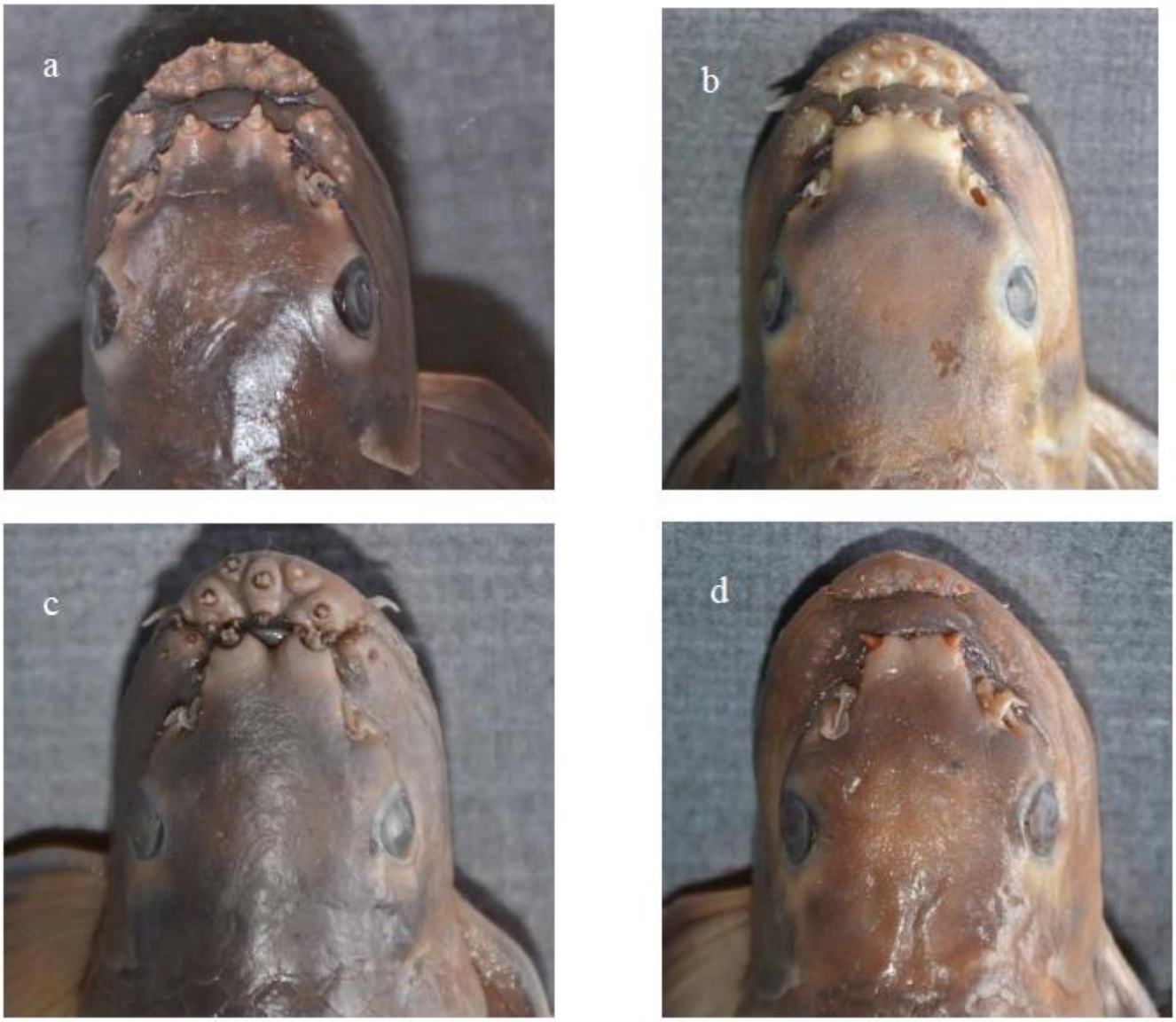

Figure 2 Snout morphology of: **a,** *Garra ranganensis*, ZSI/APRC782, holotype, 122.1 mm SL; **b,** *G. quadratirostris*, ZSI/APRC1042, India; Arunachal Pradesh: West Kameng district: Tenga River; **c,** *G. birostris*, ZSI/APRC 1041, 127.3 mm SL, India: Arunachal Pradesh: Papum Pare district: Dikrong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

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 14–21small 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 amoderate 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)

	Holotype	Range	Mean±SD
Standard length (mm)	122.1	101.2–122.1	111.2±7.4
In % of standard length			
Body depth	19.6	19.1–20.4	19.6±0.5
Head length	26.7	24.9–28.9	26.8±1.7
Head depth at eye	13.3	13.3–15.5	13.9±0.9
Head width at opercle	18.5	18.1–21.7	19.6±1.5
Head width at nare	16.6	16.0–19.8	17.6±1.6
Body width at dorsal-fin origin	17.3	15.8–18.0	16.8±0.9
Body width at anal-fin origin	9.6	9.6–11.2	10.6±0.6
Caudal peduncle length	17.1	14.0–17.1	15.6±1.1
Caudal peduncle height	11.7	11.6–12.0	11.8±0.2
Dorsal-fin length	23.9	22.2–25.8	24.3±1.5
Dorsal-fin base length	17.8	17.0–18.4	17.5±0.6
Pectoral-fin length	21.3	19.0–22.8	21.3±1.4
Pelvic-fin length	20.9	19.0–21.3	20.5±0.9
Anal-fin length	20.8	18.8–20.8	19.9±0.7
Anal-fin base length	7.4	7.4–8.2	7.8±0.3
Length of upper caudal-fin lobe	25.4	25.4–28.1	26.9±1.1
Length of lower caudal-fin lobe	27.6	26.6–29.2	28.2±1.1
Length of median caudal-fin rays	12.8	12.8–16.6	14.8±1.4
Preanal length	79.1	77.0–80.5	79.1±1.3
Preanus length	71.5	67.6–71.5	70.0±1.8
Prepelvic length	55.4	53.3–56.5	55.0±1.4
Predorsal length	51.4	47.5–51.4	49.9±1.7
Prepectoral length	23.7	21.9–24.6	23.2±1.0
Pelvic-anal distance	25.2	24.6–25.9	25.1±0.5
Anus-anal length	9.5	8.9–9.8	9.4±0.4
Snout length	14.7	13.5–16.2	14.9±1.1
Eye diameter	4.8	3.9–4.8	4.3±0.4
Interorbital distance	11.9	11.0–12.5	11.8±0.5
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 1unbranched (1), 14 branched and last 2 unbranched (1*), 14 branched and last 3 unbranched (2), and 15 branched and last1 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. Pelvicfin withfirst 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 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-fin 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 5**½** 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 line3**½** /2½–3/3½. Predorsal scales 11 (1), and 12 (4*). Circumpeduncular scales 12. Scales between last dorsal fin ray and first upper procurrent ray of caudal fin 15 (1), 16(2), and 17 (2*), and scales between last anal fin ray and first lower procurrent 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 procurrent 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, and1 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 spotanterior 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 speciescollected at the type locality includes *Garra kalpangi*, *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 develop 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. substrictorostris*, *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. quadratirostris* 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. quadratirostris*). 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. quadratirostris* 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. quadratirostris*); 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. quadratirostris* 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).

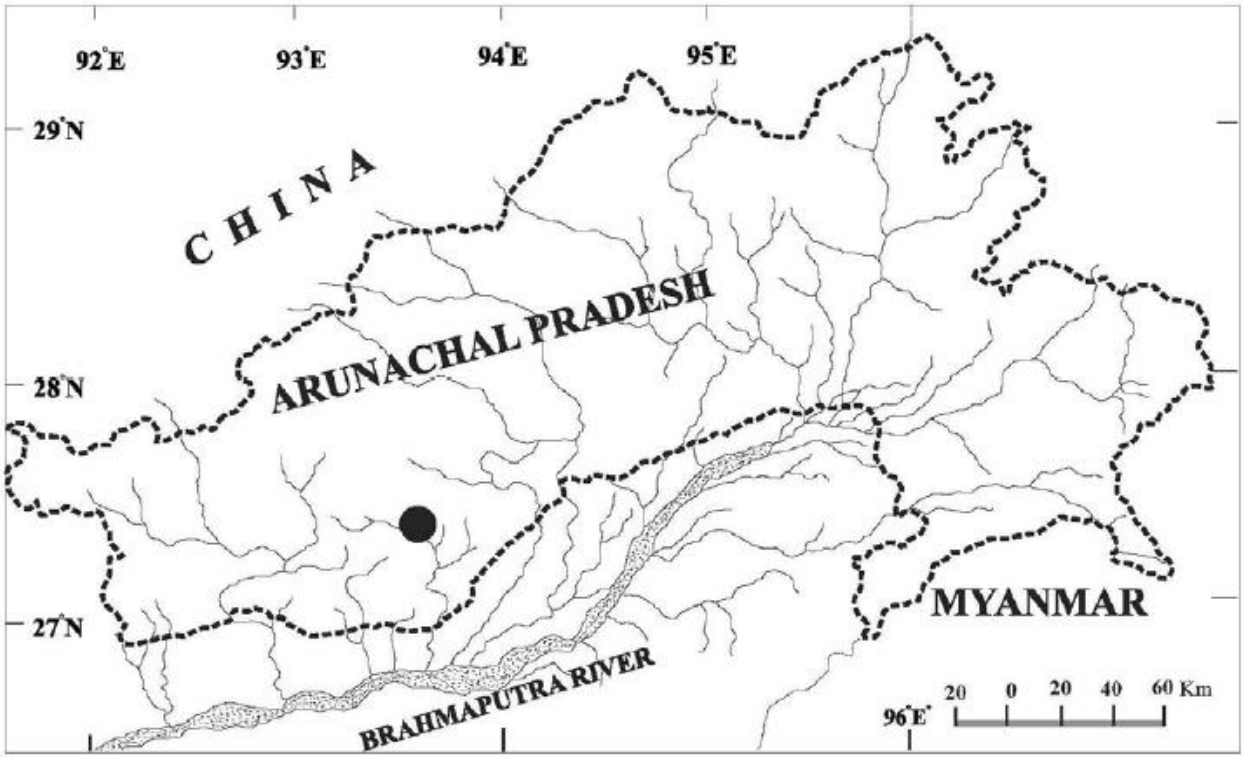

Figure 5 Map of Arunachal Pradesh, showing the type locality of *Garra ranganensis* (filled circle)

Garra ranganensis readily differs from other upper Brahmaputra congeners *G. arupi*, *G. kalpangi*, *G. magnidiscus, G. minimus, G. kimini, G. nigricauda* and *G. alticaputus*in 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 *G. kiminii*in having more predorsal scales (11–12 vs. 9–10), and lower number of circumpeduncular scales (12 vs. 16);and from *G. nigricauda* in having more predorsal scales (11–12 vs. 9–10).

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. substrictorostris*, *G. clavirostris, G. bimaculacauda, G.elongata, G. koladynensis, G. litanensis, G. nasuta, G. parastenorhynchus, G. trilobata*. *G.cornigera* and *G.biloborostris* known from drainages of northeastern India that possesses transverse lobe and proboscis on the snout.

Garra ranganensis is distinguished from *G. substrictorostris* and G. *clavirostris*by having bilobed (vs. unilobed) proboscis. Further, from *G. substrictorostris* by having unicuspid (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 *G. clavirostris* by having bilobed (vs. unilobed) proboscis, transverse lobe with only unicuspid (vs. uni- to multicuspid) tubercles, more lateral line scales 36-37 (vs. 33-34), more predorsal scales 11-12 (vs. 9-10).

From *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 *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 *G. koladynensis* in having bilobed (vs. trilobed) proboscis, transverse lobe with unicuspid only (vs. uni-, bi- to hexacuspid) tubercles, more lateral line scales 36-37 (vs. 33-34), and morepredorsal scales 11-12 (vs. 9-10). From *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.

Garra ranganensis also shares its transverse lobe and proboscis with *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 *G. ranganensis*. From *G. parastenorhynchus* by having bilobed (vs. club-shaped) proboscis on snout, more lateral line scales 36-37 (vs. 31-32), transverse lobe with unicuspid (vs. multicuspid) tubercles.

In northeastern India, *Garra ranganensis* is closely resembles with two species *G. cornigera* described from Chindwin basin in Manipur and another species *G. biloborostris* from Brahmaputra River basin in Assam in having bilobed proboscis and unicuspid tubercles on transverse lobe of snout. However, *Garra ranganensis* is distinguished from *G. cornigera* on the following characters: more lateral scales (36–37 vs. 33), predorsal scales (11-12 vs. 9-11), and unicuspid tubercles on transverse lobe of snout (14–21 vs. 8-13). *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 *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, *Garra ranganensis* can be distinguished from G. *cornigera* by having shorter pectoral-fin (19.0–22.8% SL vs. 23.-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 *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 *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 *Garra*. Of these eight species*G. litanensis* Vishwanath, 1993, *G. elongata* Vishwanath & Kosygin, 2000, *G. bispinosa* Zhang, 2005, *G. qiaojiensis* Wu & Yao, 1977, *G. rotundinasus* Zhang, 2006, *G. gravelyi* (Annandale, 1919), *G. cornigera* and *G. trilobata* Shangningam & Vishwanath, 2015 possesses proboscis on snout. *Garra ranganensis* is distinguished from *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 *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 *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 vs. 38–43), lower number of circumpeduncular scales (12 vs. 16), and fewer transverse scale rows above the lateral line (3½ vs. 4); from *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). *Garra ranganensis* shares with *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 (14–21vs. 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.

Garra species with a proboscis presently recognized from China and Southeast Asia include *G. bispinosa, G. cyrano, G. fuliginosa, G. gravelyi , G. longchuanensis , G. orientalis, G. qiaojiensis , G. salweenica,* and *G. rotundinasus* (Nebeshwar & Vishwanath 2013; Yu et al. 2016).

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 ancentral 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 tribobled 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: Poma 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.

Data for: *G. litanensis* and *G. gravelyi*from Vishwanath (1993); *G. elongata* fromVishwanath & Kosygin (2000); *G. minimus*, *G. alticaputus*, *G. nigricauda*, and *G. kimini* from Arunachalam *et al*., 2013; *G. rotundinasus* from Zhang (2006); and *G. orientalis, G. salweenica,G. qiaojiensis, G. cyrano,G. fuliginosa* and *G. bispinosa* from Zhang (2005) and Kottelat (2000); *G. bourreti*, *G. cornigera* and *G. trilobata* from Kottelat (2000) and Shangningam & Vishwanath (2015).

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.

Acknowledgements

First author is thankful to DBT, New Delhi for financial assistance through field job under RGU-CU-KU Twinning program in Department of Zoology, RGU. We are grateful to Kailash Chandra, Director Incharge, Zoological Survey of India, Kolkata for providing infrastructure facilities. Thanks to D. N. Das, Rajiv Gandhi University, Arunachal Pradesh, India for access to the materials under his care.

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.

Disclosures about potential conflict of interests

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

Further information (e.g., funding, conference presentation)

This work has been supported by DBT, New Delhi, through field survey work under RGU-CU-KU Twinning program in Department of Zoology, Rajiv Gandhi University as fellowship to the first author. However, no fund has been allotted for publication under the mentioned schemes. So far, the present work has not been presented at any conferences and Seminars.

REFERENCE

1. Arunachalam M, Nandagopal S, Mayden RL. Morphological diagnoses of *Garra* (Cypriniformes: Cyprinidae) from north-eastern India with four new species description from Brahmaputra River. *J fish and Aquacult*, 2013: 4(3): 121–138.
2. Banister KE. Two new species of *Garra* (Teleostei-Cyprinidae) from the Arabian peninsula. *Bull British Mus (Natural History) Zool*, 1987: 52: 59–70.
3. Bermingham E, Martin AP. Comparative mtDNA phylogeography of neotropical freshwater fishes: testing shared history to infer the evolutionary landscape of lower Central America. *Mol Ecol,* 1998: 7: 499–517.
4. Brookfield ME. The evolution of the great river systems of southern Asia during the cenozoic India-Asia collision: rivers draining southwards, *Geomorphol*, 1998: 22: 285–312.
5. Fowler HW. Descriptions of new fishes obtained 1907 to 1910, chiefly in the Philippine Islands and adjacent seas. Proc Acad Nat Sci Philadelphia 1934: 85: 233–367.
6. Getahun A. Systematic studies o f the African species of the genus *Garra* (Pisces: Cyprinidae). Unpublished Ph.D. thesis. *The American Museum of Natural History*, 1999.
7. Gurumayum SD, Kosygin L. *Garra tamangi*, a new species of cyprinid fish (Teleostei: Cypriniformes) from Arunachal Pradesh, northeastern India, *Species*, 2016: 17(55): 84–93.
8. Hora SL. Indian cyprinoid fishes belonging to the genus *Garra*, with notes on related species from other countries. *Rec Indian Mus*, 1921: 22: 633–687.
9. Kottelat M. Indochinese nemacheilines – A revision of nemacheiline loaches (Pisces: Cypriniformes) of Thailand,

Burma, Laos, Cambodia and Southern Vietnam. *Verlag, Dr. Friedrich Pfeil, München*, 1990: 262 pp.

10. Diagnosis of a new genus and 64 new species of fishes from Laos (Teleostei: Cyprinidae, Balitoridae, Bagridae, Syngnathidae, Chauduriidae and Tetradontidae). *J South Asian Nat Hist*, 2000: 5: 37–82.
11. Fishes of Laos. *Wildlife Heritage Trust*, Colombo, 2001: 198 pp.
12. Li FL, Zhou W, Fu Q. *Garra findolabium*, a new species of cyprinid fish (Teleostei: Cypriniformes) from the Red River drainage in Yunnan, China, *Zootaxa*, 2008: 1743: 62–68.
13. Lundberg JG. African-South American freshwater fish clades and continental drift: problems with a paradigm. In: Goldblatt P (ed) Biological relationships between Africa and South America. *Yale University Press*, New Haven, 1993: 156–199.
14. McClelland M. Observations on six new species of Cyprinidae with an outline of a new classification of the family. *J Asiatic Soc Bengal*, Calcutta, 1838:7: 941–948.
15. Menon AGK. Monograph of the cyprinid fishes of the genus *Garra* Hamilton. *Memoirs of the Indian Mus*, 1964:14: 173–260.ZAzxzaz
16. Nath P, and Dey SC. Fish and fisheries of North Eastern India (Arunachal Pradesh*). Narendra Publishing House*, New Delhi, 2000: 217.
17. Nebeshwar K. Vishwanath W. Three new species of *Garra* (Pisces: Cyprinidae) from north-eastern India and redescription of *G. gotyla*. *Ichthyol Explor Freshwaters*, 2013: 24: 97–120.
18. Nebeshwar K, Bagra K, Das, DN. *Garra kalpangi*, a new cyprinid fish species (Pisces: Teleostei) from Upper Brahmaputra basin in Arunachal Pradesh, India. *J Threatened Taxa*, 2012: 4: 2353–2362.
19. Nebeshwar K, Vishwanath V, Das DN. *Garra arupi*, a new cyprinid fish species (Cypriniformes: Cyprinidae) from upper Brahmaputra basin in Arunachal Pradesh, India. *J Threatened Taxa*, 2009: 1: 197–202.http://dx.doi.org/10.11609/jott.o 1842.197–202.
20. Roni N, Vishwanath W. *Garra biloborostris*, a new labeonine species from north-eastern India (Teleostei: Cyprinidae) Vertebrate Zool, 2017: 67 (2): 133 –137
21. Shangningam B, Vishwanath W. Two new species of *Garra* from the Chindwin basin, India (Teloestei: Cyprinidae). *Ichthyol Explor Freshwaters*, 2015: 26(3), 262–272.
22. Stiassny MLJ, Getahun A. An overview of labeonin relationships and the phylogenetic placement of the Afro-Asian genus *Garra* Hamilton, 1922 [sic, 1822] (Teleostei: Cyprinidae), with the description of five new species of *Garra* from Ethiopia, and a key to all African species. *Zool J Linnean Soc*, 2007: 150: 41–83.
23. Tamang L. *Garra magnidiscus*, a new species of cyprinid fish (Teleostei: Cypriniformes) from Arunachal Pradesh, northeastern India, *Ichthyol Explor Freshwaters*, 2013: 24(1): 31–40.
24. Yu Q, Wang X, Xiong H, He S. *Garra longchuanensis*, a new cyprinid (Teleostei: Cypriniformes) from southern China. Zootaxa, 2016: 4126: 295-300.
25. Vishwanath W, Kosygin L. *Garra elongata*, a new species of the subfamily Garrinae from Manipur, India (Cyprinidae, Cypriniformes). *J Bombay Nat Hist Soc*, 2000: 97: 408–414.
26. Vishwanath, W. On a collection of fishes of the genus *Garra* Hamilton from Manipur, India, with a description of a new species. *J Freshwater Biol*, 1993: 5: 59–68.
27. Zhang E. *Garra bispinosa*, a new species of cyprinid fish (Teleostei: Cypriniformes) from Yunnan, Southwest China. *The raffles Bull Zool*, Supplement, 2005: 13: 9–15.
28. Zhang E. *Garra rotundinasus*, a new species of cyprinid fish (Pisces: Teleostei) from the upper Irrawaddy River basin, China. *The Raffles Bull Zool*, 2006: 54: 447–453.
29. Zhang E, He SP, Chen YY. Revision of the cyprinid genus *Placocheilus* Wu, 1977 in China, with description of a new species from Yunnan. *Hydrobiologia,* 2002: 487: 207–217.
30. Zhang E, Yue PQ, Chen, JX. Labeoninae. In Yue, P.Q. et al. (Ed.), Fauna Sinica (Osteichthyes: Cypriniformes III. *Science Press*, Beijing, 2000: 172–272.