ISSN 2319 – 5746 EISSN 2319 – 5754

Species

Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*

Arunachalam M[1], Nandagopal, S[1], Richard L Mayden[2]

1.Sri Paramakalyani Centre for Environmental Sciences, Manonmaniam Sundaranar University, Alwarkurichi - 627 412, Tamil Nadu, India; Email: arunacm@gmail.com (MA); bionanda.gopal1982@gmail.com (SN)

2.Department of Biology, Saint Louis University, St. Louis, Missouri 63103, USA; Email: cypriniformes@gmail.com (RLM)

Corresponding author: Richard L. Mayden; Department of Biology, Saint Louis University, St. Louis, Missouri 63103, USA ; Email: cypriniformes@gmail.com

Publication History

Received: 22 May 2014

Accepted: 04 July 2014

Published: 17 September 2014

Citation

Arunachalam M, Nandagopal S, Richard L Mayden. Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*. *Species*, 2014, 10(24), 58-78

ABSTRACT

Garra khawbungi sp. nov. is described from the Tuipui River, Khawbung Village, Mizoram, India. This species is closely related to *Garra nigricollis* but is distinguished by having more lateral-line scales, fewer predorsal scales, fewer branched caudal-fin rays, presence of a transverse groove on snout, and absence of a black band across the posterior margin of the head and between left and right side pectoral-fin bases. *Garra tyao* sp. nov., from the Tyao River, Tyao Village, Mizoram, India, is differentiated from *G. dampaensis* in having more branched dorsal-fin rays, more branched pelvic-fin rays, fewer branched caudal-fin rays, more lateral-line scales, fewer predorsal scales, fewer upper transverse scale rows; from *G. namyaensis* in having fewer predorsal scales; and from *G. lissorhynchus* by the position of the "W"- shaped dark band in the caudal fin and fewer lateral-line scales. *Garra tyao* is distinct from *G. nambulica* in having more branched pectoral and pelvic-fin rays and fewer predorsal scales and from *G. paralissorhynchus* by more pectoral-fin rays and fewer predorsal scales.

Keywords: *Garra,* Asia, Cyprinidae, Freshwater fishes, taxonomy, morphometrics, India

1. INTRODUCTION

The genus *Garra* (= Cyprinus) Hamilton (1822) contains 36 species (Talwar and Jhingran, 1991) from India, of which 12 species are from streams of the Western Ghats (Arunachalam *et al*., 2013). Of the 40 species, 28 species are/were reported from north and northeastern part of India (Table 1) and seven species had been reported from southern Myanmar (Kullander and Fang, 2004). There are two major revisions of *Garra*, one of Indian species (Menon, 1964) and the other of African species (Getahun, 2000).

Recently research surveys of streams from various locations draining into the Tyao River near the villages of Tyao and Khawbung, Champhai District, Mizoram, India, have resulted in many new samples for biodiversity studies. During these expeditions two new species of *Garra,* were collected and are described herein.

2. MATERIALS AND METHODS

Abbreviations include SL = standard length, HL = head length, ZSI/SRS = Zoological Survey of India/Southern Regional Station, F = Fish, FF = Freshwater Fish, MSUMNH = Manonmaniam Sundaranar University Museum of Natural History, Alwarkurichi, India, and CMA = Collection of M. Arunachalam. Methods for measurements and counts follow those of Hubbs and Lagler (1964). Additional characters such as: disc length, disc width, central-pad length, central-pad width, post-dorsal length (distance between origin of dorsal-fin and caudal-fin base) and body depth are from Kullander and Fang (2004). Distance between pectoral-fin origin and vent and distance between pelvic-fin origin and vent were also taken in the present study. Measurements were taken to the nearest 0.1 mm using digital calipers. Body measurements are expressed as percentages of Standard length (%SL) and head measurements as percentages of head length (%HL). Specimens of *Garra gravelyi* were examined at Calcutta Museum but were in poor condition for obtaining full data; thus, data for *Garra gravelyi* were obtained from Talwar and Jhingran (1991). Holotypes are deposited in ZSI/SRS, Chennai. Paratypes are deposited in MSUMNH, Alwarkurichi, India, and in CMA.

3. SPECIES DESCRIPTIONS

3.1. *Garra khawbungi* sp. nov.

(Figures 1, 3 and 4)

Holotype

ZSI/SRS F8625, male. 89.84 mm SL, Tuipui River, Khawbung Village - Champhai District, Mizoram, India (N 22^0 38’ 14.8’’ E 94^0 07’ 44.0’’), Collectors: M. Arunachalam, M. Raja, C. Vijayakumar and S. Nandagopal. 11 May 2012.

Paratypes

MSUMNH 63, 4 ex., 77.86-98.32 mm SL; CMA 21, 3 ex., 75.07-88.65 mm SL. All other details same as Holotype.

Diagnosis

A medium-sized species of *Garra* diagnosed by the following combination of characters: snout rounded in dorsal profile with weakly developed transverse groove; groove with pointed tubercles arranged irregularly but approximately in three rows across. Snout not elongated as proboscis. Two pairs of barbels, both rostral and maxillary. Lateral-line scale rows 36-37; circumpeduncular scale rows 16; transverse-scale rows 4.5/3.5/4.5. Well-developed scale rows present up to pectoral-fin insertion and embedded scale rows present after pectoral-fin insertion up to pelvic-fin insertion.

Description

Body cylindrical and elongate, not compressed posterior of dorsal-fin base (Table 2). Predorsal body depth not uniform, dorsal profile convex from nape to dorsal-fin origin. Dorsal-fin base not straight. Dorsal profile from dorsal-fin base to caudal-fin base straight; ventral profile of body from pectoral-fin origin to pelvic-fin origin slightly convex; profile from pelvic-fin origin to anal-fin origin straight. Head large and interorbital space convex. Head width 3½ times greater than head length. Snout not elongated as proboscis; rounded in dorsal view with weakly developed transverse groove; snout tubercles pointed and semi-irregularly arranged but appearing as three rows on each side.

Two pairs of barbels, rostral barbel located almost 1.58 times anterolaterally of eye diameter; maxillary barbel shorter than rostral barbel. Rostral cap well developed, curved ventrally and connected with lower lip at corner of mouth. Upper jaw entirely covered by rostral cap. Central-pad elliptical in shape; width greater than length.

Dorsal-fin rays iii, 8; dorsal fin origin slightly anterior to vertical to pelvic-fin insertion. Body depth greatest at dorsal-fin origin. First branched dorsal-fin ray slightly longer than other branched rays. Depressed pectoral-fin not reaching pelvic-fin insertion. Pectoral-fin rays i, 14-15; fin insertion close to gill opening and with slightly pointed

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

posterior margin; fourth branched ray of pectoral-fin longest; depressed pectoral-fin separated from pelvic-fin insertion by 4 scales. Pelvic-fin rays i, 8; fin insertion vertical to base of third branched ray of dorsal-fin. Posterior tip of depressed pelvic-fin covering anus but not reaching anal-fin origin. First and second branched pelvic-fin rays greatest in length. Anal-fin rays ii-iii, 5; posterior terminus of depressed anal-fin not reaching base of caudal-fin. Vent closer to anal-fin origin (5 scales) than to pelvic-fin insertion (7 scales). Caudal-fin forked, upper lobe equal to lower lobe; 9+8 branched fin rays. Lateral-line complete and with 36-37 scale rows; upper transverse scale rows 4.5; scale rows below lateral-line 3.5; scale rows between lateral-line to anal-fin origin 4.5; scale rows between vent and anal-fin base 4.5-5.0; circumpeduncular scales 16; predorsal scales 10 (Table 3). Well-developed scale rows present up to pectoral-fin insertion and embedded scale rows present after pectoral-fin insertion up to pelvic-fin origin.

Colour in Preservative

Dorsum of head and body pale greyish. All fins hyaline except a black band on one or two rays of lower lobe of caudal-fin. Venter yellowish around mouth, chest, anterior belly, and near origins of pectoral-fins.

Etymology

The name *khawbungi* is a noun in apposition in reference to the name of the village Khawbung in Champhai District, Mizoram, India, where the specimens were first collected.

3.2. *Garra tyao* sp. nov.

(Figures 2, 5 and 6)

Holotype

ZSI/SRS F8626, 1 ex. male. 64.31mm SL, Tyao River, Tyao Village, Champhai District, Mizoram, India (N 23^0 27’ 25.5’’ E 93^0 4’ 35.6’’), Collectors: M. Arunachalam, M. Raja, C. Vijayakumar and S. Nandagopal. 10 May 2012.

Paratypes

MSUMNH 64, 8 ex., 63.07-70.46 mm SL; CMA 22, 10 ex., 56.51-76.01 mm SL. All other details same as Holotype.

Diagnosis

A small species of *Garra* related to *G. namyaensis*, *G. lissorhynchus*, *G. paralissorhynchus* and *G. nambulica*. *Garra tyao* possesses a rounded snout in dorsal view; snout with minute tubercles. Rostral lobe well developed; tubercles not densely distributed or arranged in a regular pattern. The species differs from *G. dampaensis* in having more branched dorsal-fin rays, more branched pelvic-fin rays, fewer branched caudal-fin rays, more lateral-line scale rows, and fewer predorsal scale rows, fewer upper transverse scale rows. *Garra tyao* is distinguished from *G. lissorhynchus* by the position of a dark “W”-shaped band (posterior end of caudal-fin vs. middle of caudal-fin), fewer lateral-line scale rows (31 vs. 34) and fewer predorsal scales (8-10 vs. 13). *Garra tyao* is distinct from *G. nambulica* in having more branched pelvic-fin rays (8 vs. 6), more pectoral-fin rays (14-15 vs. 12), and fewer predorsal scale rows (8-10 vs. 24). *Garra tyao* is diagnosed from *G. paralissorhynchus* in having more pectoral-fin rays (14-15 vs. 11) and fewer predorsal scales (8-10 vs. 12).

Description

Body depressed; cylindrical anteriorly but gradually compressed posterior to dorsal-fin base (Table 4). Body depth not uniform; dorsal profile convex from occiput to dorsal-fin origin. Dorsal-fin base not straight; profile from dorsal-fin base to caudal-fin deeply concave. Ventral profile of body from pectoral-fin to pelvic-fin origins straight. Profile between pelvic-fin origin and anal-fin origin convex. Head moderately large; interorbital space convex. Head width greater than head length. Snout rounded in dorsal view and with minute tubercles. Rostral lobe well developed and tubercles not arranged in a regular pattern or densely distributed.

Two pairs of maxillary barbels, rostral barbels located anterolaterally and are almost half of eye diameter; maxillary barbel shorter than rostral barbel. Rostral cap well developed; curved ventrally and connected with lower lip at corner of mouth. Upper jaw entirely covered by rostral cap. Central-pad is semi-circular in shape; width greater than length.

Dorsal-fin rays ii-iii, 7; first branched ray slightly longer than other branched rays that are equal in length; fin inserted slightly anterior to pelvic-fin. Deepest point of the body at dorsal-fin origin. Pectoral and pelvic-fins extending horizontally. Pectoral-fin rays i, 14-15; fin origin close to gill opening. Pectoral-fin with slightly pointed posterior margin and fourth and fifth branched rays longest; when depressed fin not reaching pelvic-fin origin.

Pelvic-fin rays i, 8; fin origin vertical to third branched ray of dorsal-fin; first and second branched rays of depressed pelvic-fin longest, covering anus and nearly reaching anal-fin origin. Anal-fin rays ii-iii, 3-4; posterior end of

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*,
Species, 2014, 10(24), 58-78,

depressed anal-fin reaching caudal-fin base. Vent closer to anal-fin origin than to pelvic-fin origin, separated from anal-fin origin by 6 scales. Caudal-fin emarginated, upper lobe equal to lower lobe, and with 9+8 branched rays.

Lateral-line complete and with 31 scale rows; transverse scale rows 3-3.5 above lateral-line; 3-3.5 below lateral-line; 4-4.5 scale rows from lateral-line to anal-fin origin; circumpeduncular scale rows 15-16; predorsal scale rows 9-10; scale rows between vent and anal-fin base 2-3 (Table 5). Well-developed scale rows present up to pectoral-fin insertion and embedded scale rows present after pectoral-fin insertion up to pelvic-fin origin.

Colouration

In live specimens head, body, and dorsum grey with a blackish spot immediately posterior to dorsal gill opening. Yellowish colour extends from base of dorsal, pectoral and pelvic-fins to nearly half the distance distally of each fin. Margin of all unbranched and branched dorsal-fin rays with black stripes. Caudal-fin with indistinct "W"-shaped bands; bands unlike the "W"-shaped band present in *Garra lissorhynchus*, *Garra nambulica* and *Garra paralissorhynchus*. In preservation, dorsal, pectoral and pelvic-fin colours are not distinct.

Etymology

The name *tyao* refers to the Tyao River in Tyao village, Champhai District, Mizoram, India, where the species was first collected (Figure 7).

Comparisons

Garra khawbungi can be diagnosed from *G. lissorhynchus* by a greater number of dorsal-fin rays (iii, 8 vs. ii, 6), a greater number of lateral-line scale rows (36-37 vs. 34), fewer predorsal scales (10 vs. 13), a greater number of anal scale rows (4.5-5 vs. 3.5), and the absence of "W"- shaped band (vs. presence). *G. khawbungi* can be diagnosed from *G. nambulica* in having fewer predorsal scale rows (10 vs. 24), a greater number of lateral-line scale rows (36-37 vs. 34), a greater number of pectoral-fin rays (14-15 vs. 12), a greater number of lower transverse scale rows (4.5 vs. 3.5), presence of scales on chest and belly (vs. naked), and the lack of a "W"- shaped band on the caudal-fin (vs. presence). *G. khawbungi* can be diagnosed from *Garra annandalei* in having greater number of branched pectoral-fin rays (14-15 vs. 13), greater number of predorsal scales (10 vs. 9), and a greater number of lateral-line scale rows (36-37 vs. 34). *G. khawbungi* differs from *G. gotyla gotyla* in having a greater number of lateral-line scale rows (36-37 vs. 33), a greater number of anal scale rows (4.5-5.0 vs. 3), type of proboscis on snout (no proboscis vs. well-developed median proboscis), and a greater number of lower transverse scale rows (4.5 vs. 3.5). *G. khawbungi* is diagnosed from *G. elongata* in having a greater number of branched pectoral-fin rays (14-15 vs. 12), fewer lateral-line scale rows (36-37 vs. 39), a greater number of circumpeduncular scale rows (16 vs. 12), a greater number of preanus scales (16-20 vs. 13), and a greater number of transverse scale rows (4.5/3.5/4.5 vs. 3.5/2.5/3.0). *G. khawbungi* is diagnosed from *G. paralissorhynchus* in having a greater number of pectoral-fin rays (14-15 vs. 11), a greater number of lateral-line scale rows (36-37 vs. 31), fewer predorsal scales (10 vs. 12), a greater number of dorsal-fin rays (iii, 8 vs. ii, 6), a greater number of transverse scale rows (4.5/3.5/4.5 vs. 3.5/3.5/3.5), a greater number of anal scale rows (4.5-5.0 vs. 3.5), and the absence of "W"-shaped band on caudal-fin (vs. presence). *G. khawbungi* is distinct from *G. kempi* in having a greater number of pectoral-fin rays (14-15 vs. 12), fewer lateral-line scale rows (36-37 vs. 40), fewer predorsal scale rows (10 vs. 12), and a greater number of circumpeduncular scale rows (16 vs. 12). *G. khawbungi* can be diagnosed from *G. naganensis* in having a greater number of branched pectoral-fin rays (14-15 vs. 13), fewer lateral-line scale rows (36-37 vs. 39), fewer predorsal scale rows (10 vs. 12), and fewer anal scale rows (4.5-5.0 vs. 6). This new species differs from *G. kalpangi* in having a greater number of pectoral-fin rays (14-15 vs. 10-12), a greater number of lateral-line scale rows (36-37 vs. 32-33), a greater number of transverse scale rows (4.5/3.5/4.5 vs. 3.5/4.0/3.5), and a greater number of anal scale rows (4.5-5.0 vs. 3.0). *G. khawbungi* is diagnosed from *G. gravelyi* in having a greater number of lateral-line scale rows (36-37 vs. 32-34), and a greater number of predorsal scale rows (10 vs. 8-9). It is diagnosed from *G. arupi* in having a greater number of branched pectoral-fin rays (14-15 vs. 10-11), fewer anal scale rows (4.5-5.0 vs. 6-8) and fewer predorsal scale rows (10 vs. 11-12). It can be diagnosed from *G. manipurensis* in having a greater number of lateral-line scale rows (36-37 vs. 34) and a greater number of pectoral-fin rays (14-15 vs. 12). *G. khawbungi* is diagnosed from *G. compressus* in having fewer lateral-line scale rows (36-37 vs. 39), a greater number of pectoral-fin rays (14-15 vs. 11), fewer predorsal scale rows (10 vs. 12), a greater number of transverse scale rows (4.5/3.5/4.5 vs. 3.5/2.5/3.0) and the shape of suctorial disc (elliptical vs. pentagonal). It is diagnosed from *G. litanensis* in having a greater number of branched pectoral-fin rays (14-15 vs. 13), a greater number of lateral-line scale rows (36-37 vs. 32), and fewer lower transverse scale scale rows (4.5 vs. 3.5). *G. khawbungi* is diagnosed from *G. namyaensis* in having a greater number of lateral-line scale rows (36-37 vs. 31), fewer predorsal scale rows (10 vs. 13), a greater number of anal scale rows (4.5-5.0 vs. 3-4) and a greater number of pectoral-fin rays (14-15 vs. 12). *G. khawbungi* is diagnosed from *G. propulvinus* in having a greater number of lateral-line scale rows (36-37 vs. 31) and fewer branched caudal-fin rays (9/8 vs. 10/9). *G. khawbungi* is diagnosed from *G. vittatula* in having a greater number

of lateral-line scales (36-37 vs. 31), fewer predorsal scale rows (10 vs. 11-12), and fewer branched caudal-fin rays (9/8 vs. 10/9). It is further diagnosed from *G. spilota* in having a greater number of lateral-line scale rows (36-37 vs. 30-31), a greater number of pectoral-fin rays (14-15 vs. 13), and fewer branched caudal-fin rays (9/8 vs. 10/9). *G. khawbungi* is distinguished from *G. rakhinica* in having a greater number of lateral-line scales (36-37 vs. 28) and fewer branched caudal-fin rays (9/8 vs. 10/9). *G. khawbungi* is also differentiated from *G. flavatra* in having a greater number of lateral-line scale rows (36-37 vs. 27-29), a greater number of transverse scale rows (4.5/3.5/4.5 vs. 3.5/4.5/3.5), and fewer branched caudal-fin rays (9/8 vs.10/9). It is diagnosed from *G. poecilura* in having a greater number of lateral-line scales (36-37 vs. 29), fewer predorsal scales (10 vs. 11), fewer branched caudal-fin rays (9/8 vs. 10/9), and a greater number of pectoral-fin rays (14-15 vs. 12-13). *G. khawbungi* is further diagnosed from *G. nigricollis* in having a greater number of lateral-line scales (36-37 vs. 33), fewer predorsal scales (10 vs. 11) and fewer branched caudal-fin rays (9/8 vs. 10/9). It is diagnosed from *G. notata* in having a greater number of lateral-line scale rows (36-37 vs. 34), fewer predorsal scale rows (10 vs. 14-16), fewer upper transverse scale rows (4.5 vs. 5.0-5.5), fewer lateral-line to pelvic-fin scale rows (3.5 vs. 4.5), and scale rows on belly (present vs. naked). It is diagnosed from *G. nasuta* (McClelland) in having more lateral-line scale rows (36-37 vs. 33-34) and in lacking a proboscis (vs. prominent trilobed proboscis). *G. khawbungi* differs from *G. arunachalensis* in having more lateral-line scale rows (36-37 vs. 35), more anal scale rows (4.5-5 vs. 3-4), more circumpeduncular scale rows (16 vs. 12), more number of lower transverse scale rows (4.5 vs. 3.5), no proboscis (vs. prominent quadrate proboscis); from *G. quadratirostris* in having more transverse scale rows (4.5/3.5/4.5 vs. 3.5-4.0/2.5/3.5), more circumpeduncular scale rows (16 vs. 12), fewer anal scale rows (4.5-5.0 vs. 5-6), no proboscis (vs. prominent quadrate proboscis) and subcutaneous scales present on chest (vs. well developed); from *G. birostris* in having more lateral-line scales (36-37 vs. 33-34), more anal scale rows (4.5-5.0 vs. 3-4), no proboscis (vs. prominent quadrate proboscis) and subcutaneous scales present on chest (vs. well developed). The new species is diagnosed from *G. magnidiscus* in having more branched pectoral-fin rays (14-15 vs. 10-12), fewer predorsal scale rows (10 vs. 12-15), fewer lateral-line scale rows (36-37 vs. 40-42), and more circumpeduncular scale rows (16 vs. 12-14). It differs from *G. dampaensis* in having more branched dorsal-fin rays (8 vs. 6), more branched anal-fin rays (5 vs. 4), fewer branched caudal-fin rays (9/8 vs. 10/9), greater number of lateral-line scale rows (36-37 vs. 27-29), and absence of "W"-shaped dark band on posterior margin of caudal-fin (vs. present). *G. khawbungi* can be diagnosed from *G. minimus* by a greater number of unbranched dorsal-fin rays (iii vs. ii), more upper transverse scale rows (4.5 vs. 3.5), more number of scales between lateral-line to origin of pelvic-fin (3.5 vs. 2.5-3), more number of lower transverse scale rows (4.5 vs. 2.5-3), a greater number of circumpeduncular scales (16 vs. 12) and more preanal scales (22-23 vs. 18-20). *G. khawbungi* differs from *G. alticaputus* in having greater number of unbranched dorsal-fin rays (iii vs. ii), a greater number of lateral-line scale rows (36-37 vs. 33), more number of lower transverse scale rows (4.5 vs. 3.5) and more anal scale rows (4.5-5 vs. 3-3.5). *G. khawbungi* differs from *G. nigricauda* in having a greater number of lower transverse scale rows (4.5 vs. 3.5-4), more circumpeduncular scales (16 vs. 12), more number of anal scale rows (4.5-5.0 vs. 3-4) and less number of preanal scales (16-20 vs. 22-24). *G. khawbungi* can be diagnosed from *Garra kimini* in having a greater number of lateral-line scales (36-37 vs. 33-34), more number of lower transverse scale rows (4.5 vs. 3.5) and more anal scale rows (4.5-5 vs. 2.5-3).

G. tyao is diagnosed from *G. lissorhynchus* in having a dark "W"- shaped band on the posterior edge of the caudal fin (vs. middle of caudal fin), fewer lateral-line scale rows (31 vs. 34), fewer predorsal scale rows (8-10 vs. 13), and fewer transverse scale rows (3.5/3.5/4.5 vs. 4.5/3.5/3.5). *G. tyao* is distinct from *G. nambulica* in having a greater number of branched pelvic-fin rays (8 vs. 6), pectoral-fin rays (14-15 vs. 12), fewer predorsal scale rows (8-10 vs. 24), presence of scales on the chest and belly (vs. naked) and the presence of a "W"- shaped dark band along margin of caudal-fin (vs. middle of caudal fin). *G. tyao* is diagnosed from *G. annandalei* in having fewer lateral-line scale rows (31 vs. 34), a greater number of lateral transverse scale rows (4.5 vs. 3.5), and presence of "W"-shaped dark band along the margin of caudal fin (vs. absent). *G. tyao* differs from *G. gotyla gotyla* by the absence of proboscis on the snout (vs. well developed median proboscis), fewer lateral-line scale rows (31 vs. 33), and fewer transverse scale rows (3.5/3.5/4.5 vs. 4.5/3.5/3.5). From *G. elongata* the species differs in having fewer lateral-line scale rows (31 vs. 39), fewer predorsal scale rows (8-10 vs. 13), fewer anal scale rows (2-3 vs. 5.5), a greater number of branched pectoral-fin rays (14-15 vs. 12), fewer branched caudal-fin rays (9/8 vs. 10/9), a greater number of preanus scales (18-19 vs. 13), and the presence of "W"- shaped dark band on posterior margin of caudal-fin (vs. absent). From *G. paralissorhynchus*, this species differs in having in a greater number of pectoral-fin rays (14-15 vs. 11), fewer predorsal scales (8-10 vs. 12), fewer transverse scale rows (4.5 vs. 3.5), scale rows on chest and belly region (well developed vs. naked), presence of a "W"- shaped dark band on posterior margin of caudal fin (vs. middle of caudal fin), and subcutaneous scale rows on the chest region.

Garra tyao is diagnosed from *G. kempi* in having more pectoral-fin rays (14-15 vs. 12), fewer lateral-line scale rows (31 vs. 40), fewer predorsal scale rows (8-10 vs. 12), more circumpeduncular scale rows (16 vs. 12), presence of a "W"- shaped dark band on posterior margin of caudal-fin (vs. absent), subcutaneous scales present on chest and well developed scales on belly region (vs. chest often naked, belly scaled but reduced along midline. From *G.*

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

naganensis, *Garra tyao* is diagnosed in having fewer lateral-line scale rows (31 vs. 39), greater number of pectoral-fin rays (14-15 vs. 13), fewer predorsal scale rows (8-10 vs. 12), fewer anal scale rows (2.0-3.0 vs. 6), and the presence of a "W"- shaped dark band on posterior margin of caudal-fin (vs. absent).

Relative to other species of *Garra, Garra tyao* can be differentiated from *G. kalpangi* in having more pectoral-fin rays (14-15 vs. 10-12), fewer lateral-line scale rows (31 vs. 32-33), fewer predorsal scale rows (8-10 vs. 10-11), and the lack of a proboscis (vs. poorly developed). This species can also be distinguished from *G. gravelyi* in having fewer lateral-line scale rows (31 vs. 32-34) and the presence of a "W"- shaped dark band on posterior margin of caudal-fin (vs. absent). From *G. arupi, Garra tyao* is distinguished in having more branched pectoral-fin rays (14-15 vs. 10-11), fewer anal scale rows (2.0-3.0 vs. 6-8), fewer predorsal scale rows (8-10 vs. 11-12), and the presence of a "W"- shaped dark band on posterior margin of caudal-fin (vs. absent). The species differs from *G. manipurensis* in having fewer lateral-line scales (31 vs. 34), more pectoral-fin rays (14-15 vs. 12), fewer upper transverse scale rows (3.5 vs. 4.5), more number of lower transverse scale rows (4.5 vs. 3.5), fewer branched caudal-fin rays (9/8 vs. 10/9) and in having a "W"- shaped dark band on the posterior margin of caudal-fin (vs. absent); from *G. compressus* it is diagnosed by fewer lateral-line scale rows (31 vs. 39-40), more pectoral-fin rays (14-15 vs. 11), fewer predorsal scale rows (8-10 vs. 12-13), more transverse scale rows (3.5/3.5/4.5 vs. 3.5/2.5/3.0), shape of suctorial disc (semi-circular vs. pentagonal), and the presence of a "W"- shaped dark band on posterior margin of caudal-fin (vs. absent). This new species is distinct from *G. litanensis* in having more branched pectoral-fin rays (14-15 vs. 13), fewer lateral-line scale rows (31 vs. 32), fewer upper transverse scale rows (3.5 vs. 4.5), more number of lower transverse scale rows (4.5 vs. 3.5), and the presence of "W"- shaped dark band on posterior margin of the caudal fin (vs. absent). From *G. namyaensis*, it is diagnosed on the basis of more pectoral-fin rays (14-15 vs. 12), fewer branched caudal-fin rays (9/8 vs. 10/9), fewer predorsal scale rows (8-10 vs. 13) and more number of lower transverse scale rows (4.5 vs. 3.5).

Garra tyao is diagnosed from *G. propulvinus* in having fewer branched caudal-fin rays (9/8 vs. 10/9) and the presence of a "W"- shaped dark band on posterior margin of the caudal fin (vs. absent). From *G. vittatula*, it is diagnosed in having fewer predorsal scale rows (8-10 vs. 11-12), fewer branched caudal-fin rays (9/8 vs. 10/9), and by the presence of "W"- shaped dark band on posterior margin of the caudal fin (vs. absent). From *G. spilota*, this new species differs in having more pectoral-fin rays (14-15 vs. 13), fewer branched caudal-fin rays (9/8 vs. 10/9), and a "W"- shaped dark band on posterior margin of the caudal-fin (vs. absent). It is distinguished from *G. rakhinica* in having a greater number of lateral-line scale rows (31 vs. 28-29), fewer branched caudal-fin rays (9/8 vs. 10/9), and having the "W"- shaped dark band on posterior margin of caudal-fin (vs. absent). From *G. flavatra*, it is distinguished in having more lateral-line scale rows (31 vs. 27-29), fewer branched caudal-fin rays (9/8 vs. 10/9), and the presence of "W"- shaped dark band on the posterior margin of the caudal-fin (vs. absent).

Garra tyao is distinguished from *G. poecilura* in having more lateral-line scale rows (31 vs. 28-29), fewer predorsal scale rows (8-10 vs. 11), fewer branched caudal-fin rays (9/8 vs. 10/9), more pectoral-fin rays (14-15 vs. 12-13), and the presence of a "W"- shaped dark band on the posterior margin of caudal-fin (vs. absent). From *G. nigricollis*, it is diagnosed in having fewer lateral-line scale rows (31 vs. 33), fewer predorsal scale rows (8-10 vs. 11), fewer branched caudal-fin rays (9/8 vs. 10/9), and the presence of "W"- shaped dark band on posterior margin of caudal-fin (vs. absent). From *G. notata*, it can be diagnosed in having fewer lateral-line scale rows (31 vs. 34), fewer predorsal scale rows (8-10 vs. 14-16), fewer upper transverse scale rows (3.5 vs. 5.0-5.5), fewer lateral-line to pelvic-fin scale rows (3.5 vs. 4.5), scales on belly (present vs. naked), and the "W"- shaped dark band on posterior margin of caudal-fin (vs. absent). It can be distinguished *G. nasuta* (McClelland) in having fewer lateral-line scale rows (31 vs. 33-34), lack of a proboscis (vs. prominent and trilobed), fewer upper transverse scale rows (3.5 vs. 4.5), and the "W"- shaped dark band on posterior margin of caudal-fin (vs. absent).

G. tyao differs from *G. arunachalensis* in having fewer branched dorsal-fin rays (7 vs. 8.5), fewer branched anal-fin rays (3-4 vs. 5.5), fewer lateral-line scale rows (31 vs. 35), fewer predorsal scale rows (8-10 vs. 10-12), fewer upper transverse scale rows (3-3.5 vs. 4-4.5), more number of lower transverse scale rows (4-4.5 vs. 3.5), more circumpeduncular scale rows (16 vs. 12), fewer anal scale rows (2-3 vs. 3-4), and no proboscis (vs. prominent quadrate proboscis); from *G. quadratirostris* in having fewer branched dorsal-fin rays (7 vs. 8.5), fewer branched anal-fin rays (3-4 vs. 5.5), fewer lateral-line scale rows (31 vs. 37), fewer predorsal scale rows (8-10 vs. 10-11), more transverse scale rows (3-3.5/3-3.5/4-4.5 vs. 3.5-4.0/2.5/3.5), more circumpeduncular scale rows (16 vs. 12), fewer anal scale rows (2-3 vs. 5-6), no proboscis (vs. prominent quadrate proboscis) and subcutaneous scales present on chest (vs. well developed). It is distinguished from *G. birostris* in having fewer branched dorsal-fin rays (7 vs. 8.5), fewer branched anal-fin rays (3-4 vs. 5.5), more lateral-line scale rows (31 vs. 33-34), fewer predorsal scale rows (8-10 vs. 10-11), fewer anal scale rows (2-3 vs. 3-4), fewer upper transverse scale rows (3-3.5 vs. 4.5); no proboscis (vs. prominent bi-lobed proboscis) and subcutaneous scales present on chest (vs. well developed). It is diagnosable from *G. magnidiscus* in having fewer branched anal-fin rays (3-4 vs. 5.5), more branched pectoral-fin rays (14-15 vs. 10-12), fewer branched caudal-fin rays (9/8 vs. 10/9), fewer predorsal scale rows (8-10 vs. 12-15), fewer lateral-line scale rows (31 vs. 40-42), fewer upper transverse scale rows (3-3.5 vs. 4-4.5), more number of lower transverse scale rows

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*,
Species, 2014, 10(24), 58-78,

(4-4.5 vs. 3-3.5), and more circumpeduncular scale rows (15-16 vs. 12-14). It differs from *G. dampaensis* in having more branched dorsal-fin rays (7 vs. 6), more branched pelvic-fin rays (8 vs. 7), fewer branched caudal-fin rays (9/8 vs. 10/9), a greater number of lateral-line scale rows (31 vs. 27-29), fewer predorsal scale rows (8-10 vs. 10-11), and fewer upper transverse scale rows (3-3.5 vs. 3.5-4.5). *G. tyao* can be diagnosed from *G. minimus* by a less branched dorsal-fin rays (7 vs. 8), less branched anal-fin rays (3-4 vs. 5), less lateral-line scales (31 vs. 35-37), less predorsal scales (8-10 vs. 10-11), more number of scales between lateral-line to origin of pelvic-fin (3-3.5 vs. 2.5-3), more number of lower transverse scale rows (4-4.5 vs. 2.5-3), more circumpeduncular scales (15-16 vs. 12), less anal scale rows (2-3 vs. 4-6), presence of a "W"- shaped dark band along posterior margin of caudal-fin (vs. absent). *G. tyao* differs from *G. alticaputus* by a less branched dorsal-fin rays (7 vs. 8), less branched anal-fin rays (3-4 vs. 5), less lateral-line scales (31 vs. 33), less predorsal scales (8-10 vs. 10), less upper transverse scale rows (3-3.5 vs. 4.5), more number of lower transverse scale rows (4-4.5 vs. 3.5), less anal scale rows (2-3 vs. 3-3.5), less preanal scales 18-19 vs. 20-21) and presence of a "W"- shaped dark band along posterior margin of caudal-fin (vs. absent). *G. tyao* differs from *G. nigricauda* by a less branched dorsal-fin rays (7 vs. 8), less branched anal-fin rays (3-4 vs. 5), less lateral-line scales (31 vs. 35-36), less upper transverse scale rows (3-3.5 vs. 4.5), more number of lower transverse scale rows (4-4.5 vs. 3.5-4), more circumpeduncular scales (15-16 vs. 12), less anal scale rows (2-3 vs. 3-4), less preanal scales 18-19 vs. 22-24) and presence of a "W"- shaped dark band along posterior margin of caudal-fin (vs. absent). *G. tyao* differs from *G. kimini* by a less branched dorsal-fin rays (7 vs. 8), less branched anal-fin rays (3-4 vs. 5), less lateral-line scales (31 vs. 33-34), less upper transverse scale rows (3-3.5 vs. 4.5), more number lower transverse scale rows (4-4.5 vs. 3.5) and presence of a "W"- shaped dark band along posterior margin of caudal-fin (vs. absent).

Based on the absence of proboscis, *G. khawbungi* is proposed to belong to a species group lacking a proboscis (Table 6). Species of this group include *G. lamta*, *G. annandalei*, *G. naganensis*, *G. manipurensis*, *G. compressus*, *G. arupi*, *G. magnidiscus*, *G. propulvinus*, *G. vittatula*, *G. rakhinica*, *G. flavatra*, *G. nigricollis*, *G. spilota*, *G. poecilura* and among these *G. lissorhynchus*, *G. abhoyai*, *G. nambulica*, *G. paralissorhynchus*, *G. namyaensis* and *G. dampaensis* have "W"- shaped dark band on caudal-fin.

Species with a well-developed proboscis include *G. gotyla*, *G. nasuta* and *G. birostris;* species having a weakly developed proboscis include *G. gravelyi*, *G. litaensis*, *G. elongata*, *G. kalpangi*, *G. nigricauda*, *G. minimus*, *G. arunachalensis* and *G. quadratirostris*.

4. COMPARATIVE MATERIALS EXAMINED

Garra lissorhynchus (McClelland) Topotype: ZSI Calcutta, FF 8098/1; 73.05 mm SL; (Location: Museum Collection, Assam, India). Collected by: L. Kosygin. MSUMNH – C14: 14 ex., 35.81-66.61 mm SL, Ranga River at Betapul colony, Lower Subanshri District, Arunachal Pradesh. Collected by Dr. M. Arunachalam and team. 17 Jun. 2011. ***Garra nambulica*** (Viswanath) Paratype: ZSI Calcutta, 4139; 50.41 mm SL; Location: Irengloic (Stream flowing to Nambul River) Shingala Village, Imphal West District, Manipur, India. Date of collection: 03.02.2004. Type series examined from MUMF (Manipur University Museum of Fishes); Paratypes: 53.13 mm SL; same locality as above. Collected by: Dr. W. Viswanath. ***Garra annandalei*** (Hora) Holotype**:** ZSI Calcutta, F 6082/2-1; 60.17 mm SL; Kokha nallah, Koshi river, District: Barabakshetra. India. Date of collection: 30.01.1946. MSUMNH – C16: 4 ex., 61.41-79.28 mm SL, Kaljani River, Tabsiktha Village, West Bengal, Collected by Dr. M. Arunachalam and team. 08 Mar. 2013. ***Garra gotyla gotyla*** type**:** ZSI Calcutta, F 198/2; 121.92 mm SL; (Kumaon Hills survey – May to June 1948). Location: Kosi River (Kosi Village – Almorah). Date of collection: 07.06.1948. MSUMNH – C13: 10 ex., 66.6-99.5 mm SL, Old Sarawathi River, Punjab. Collected by Dr. M. Arunachalam and team. 06 Oct. 2011. ***Garra elongata*** **(**Viswanath & Kosygin) ZSI Calcutta, FF 4157; 81.28 mm SL; (Location: Hill stream near Tollai, Ukhrul district, Manipur, India). Date of collection: 12.11.1997. Collected by: L. Kosygin. ***Garra naganensis*** (Hora) ZSI Calcutta, F 9970/1; 89.93 mm SL; (Location: Senapathi Stream, Naga Hills, Assam, India). Collected by: L. Kosygin. Type series examined from MUMF (Manipur University Museum of Fishes); Paratypes: 109.5 mm SL. ***Garra paralissorhynchus*** (Viswanath & Santadevi) Paratype**:** ZSI Calcutta, 4158; 52.35mm SL; Location: Khuga River, Churachandrapur district, Manipur, India. Date of collection: 25.07.2000. Type series examined from MUMF (Manipur University Museum of Fishes); Paratypes: 47.28 mm SL; same locality as above. ***Garra kempi*** (Hora) Holotype: ZSI Calcutta, F 7716/1; 88.51 mm SL; Location: Sharjon River, below Damda, the Abor hills, India. Date of collection: 25.07.2000. Type series borrowed from MUMF (Manipur University Museum of Fishes); Paratypes: 67.1 mm SL; Abor and Naga Hills, Arunachal Pradesh. ***Garra abhoyai*** (Hora). Type series examined from MUMF (Manipur University Museum of Fishes); Paratypes: 57.46 mm SL. Collected by: Dr. W. Viswanath. ***Garra manipurensis*** (Viswanath and Sarojnalini). Type series examined from MUMF (Manipur University Museum of Fishes); Paratypes: 68.39 mm SL. Manipur River, Manipur, India. ***Garra compressus*** (Koshgin and Viswanath). Type series examined from MUMF (Manipur University Museum of Fishes); Paratypes: 83.59 mm SL; Wanze stream (Chindwin basin), Khamsom, Ukrul district, Manipur. ***Garra litanensis*** (Viswanath). Type series examined from MUMF (Manipur University Museum of Fishes). Paratypes: 97.78 mm SL; Litan Stream (Chindwin basin) near Litan, Manipur in

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

northeastern India. ***Garra namyaensis*** (Shangningam and Vishwanath). Type series examined from MUMF (Manipur University Museum of Fishes). Paratypes: 51.93 mm SL; Namya River, Ukhrul district, Manipur, India. ***Garra minimus*** Arunachalam *et al*: MSUMNH 59, 5 ex. 39.8-52.9 mm SL; tributary of Ranga River, Lower Subanshri District, Arunachal Pradesh, India. ***Garra alticaputus*** Arunachalam *et al*: MSUMNH 60, 3 ex. 57.6-61.6 mm SL; Dikrong River at Boorum Village (tributary of Ranga River), Lower Subanshri District, Arunachal Pradesh, India. ***Garra nigricauda*** Arunachalam *et al*: Siang River, near Pasighat, Arunachal Pradesh, India. ***Garra kimini*** Arunachalam *et al*: tributary of Ranga River, 7 km from Hola camp, Lower Subanshri District, Arunachal Pradesh, India. Data from Nebeshwar, K., K. Bagra and D.N. Das (2011) for the species of ***Garra kalpangi***. Data from Nebeshwar, K., W. Vishwanath and D.N. Das (2009) for the species of for ***Garra arupi***. Data from Kullander and Fang (2004) for the species ***G. propulvinus, G. vittatula, G. spilota, G. rakhinica, G. flavatra, G. poecilura*** and ***G. nigricollis***. Data from Lalronunga, Lalnuntluanga and Lalramliana (2013) for the species of for ***Garra dampaensis***. Data from Tamang (2013) for the species of ***Garra magnidiscus***. Data from Nebeshwar and Vishwanath (2013) for the species of ***Garra arunachalensis***, ***Garra birostris***, ***Garra quadratirostris***.

SUMMARY POINTS

1. The genus *Garra* of the family Cyprinidae is likely more diverse than current classification indicates, due to their diverse habitats, their nature of many being nearly cryptic species, and limited access to samples in museums and the field.
2. The species described herein and the review is the beginning of what is expected to be an increase in the discovered and descriptions of species following increased inventory efforts.
3. Efforts should be made for collaboration of the many researchers working on *Garra* to coordinate uniformity in methods and characters being used in descriptions to enhance the progress in the taxonomy and systematics of the group.

FUTURE ISSUES

1. The Genus *Garra* is predicted to be one of the most diverse groups of Asian freshwater fishes.
2. New species of *Garra* are being described as new inventories of streams typically inhabited by these species of *Garra* are being more accessible for collections voucher materials.
3. Increasing access to the types of habitats that species of this genus inhabit should yield several additional new species.
4. More exploratory efforts are needed to study the fishes in the state of Mizoram and also in the North Eastern part of India.
5. The discovery of two current species is a result of one exploratory study.

ACKNOWLEDGMENTS

This research was supported in part by the Sri Paramakalyani Centre for Environmental Sciences, (DST- Government of India-S/FST/ESI-101/2010), Manonmaniam Sundaranar University) and grants to Dr. Richard L. Mayden (National Science Foundation EF-0431326, DEB-1021840 and DBI-0956370). This work was initiated, intended and completed as part of collaborative international initiative to develop infrastructure in the taxonomy of Cypriniformes, likely the most diverse group of freshwater fishes in the world. The two initiatives Cypriniformes Tree of Life and All Cypriniformes Global Biodiversity Initiative (www.cypriniformes.org) have aided in this mission. We also thank Dr. W. Viswanath (Department of Life Sciences, Manipur University, Canchipur, Manipur, India) for loans of specimens from Northeastern India. We acknowledge the help of Mr. S. S. Mariappan, Drawing Master, Panchayat Union Middle School, Pothukudi, Tamil Nadu, India for line drawings. Special thanks to Dr. K. Venkataraman, Director, ZSI Kolkatta; Shri. K.C Gopi, Scientist E, ZSI Kolkatta; Dr. B.H.C Murthy, Scientist B, ZSI Kolkatta; Dr. K. Illango, Scientist D, Officer in Charge, ZSI/SRS [now it is ZSI SRC, (Southern Regional Centre)], Chennai; Dr. Jayasree Thilak, Scientist C, ZSI/SRS/SRC Chennai for access to the collection of fishes and examination of species of *Garra* for comparative purposes.

REFERENCES

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. *Journal of Fisheries and Aquaculture*, 2013, 4(3), 121–138
2. Arunachalam M, Raja M, Nandagopal S, Mayden RL. *Garra palaruvica*, A new cyprinid fish (cypriniformes: cyprinidae) from Kerala, Western Ghats, peninsular India. *International Journal of Zoology Research*, 2013, 3(1), 62–68
3. Chen Z, Zhao S, Yang J. A new species of the genus *Garra* from Nujiang River Basin, Yunnan, China (Teleostei: Cyprinidae). *Zoological Research*, 2009, 30(4), 438–444
4. Getahun. Systematic studies of the African species of the genus *Garra* (Pisces: Cyprinidae). Unpublished doctoral dissertation, City University of New York, 2000, 478pp
5. Hamilton F. An account of the fishes found in the river Ganges and its branches. Edinburgh & London, 1822, vii +405pp, Pls. 39.
6. 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
7. Hubbs CL, Lagler KF. Fishes of the Great lakes region. Ann Arbor: University of Michigan press. 1964, 213pp
8. Kosygin L, Viswanath W. A New Cyprinid Fish *Garra compressus* from Manipur, India. *J. Freshwater Biol*. 1998, 10(1-2), 45–48

9. Kullander SO, Fang F. Seven new species of *Garra* (Cyprinidae: Cyprininae) from the Rakhine Yoma, southern Myanmar. *Ichthyol. Explor. Freshwaters*, 2004, 15(3), 257–278
10. Li F, 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
11. McClelland M. Indian Cyprinidae. Asiatic research, Calcutta, 1839, 19, 217–465, Pls. XXXVII–LIV
12. Menon AGK. Monograph of the cyprinid fishes of the genus *Garra*, Hamilton. *Mem. Indian. Mus*. 1964, 14(4), 173–260
13. Nebeshwar K, Kenjum Bagra, Das DN. *Garra kalpangi*, a new cyprinid fish species (Pisces: Teleostei) from upper Brahmaputra basin in Arunachal Pradesh, India. *J. Threat. Taxa*, 2012, 4(2), 2353–2362
14. Nebeshwar K, Viswanath Wand Das DN. *Garra arupi*, a new cyprinid fish species (Pisces: Telosstei) from upper Brahmaputra basin in Arunachal Pradesh, India. *J. Threat. Taxa*, 2009, 1(4), 197–202
15. Nebeshwar, Vishwanath. Three new species of *Garra* (Pisces: Cyprinidae) from north-eastern India and redescription of *G. Gotyla*. *Ichthyol. Explor. Freshwaters*, 2013, 24(2), 97–120
16. Shangningam B, Vishwanath W. A New Species of the Genus *Garra* Hamilton, 1822 from the Chindwin Basin of Manipur, India (Teleostei: Cyprinidae: Labeoninae), *ISRN Zoology*, 2012, 1–6 pages
17. Viswanath W, Joyshree H. A new species of the genus *Garra* Hamilton-Buchanan (Teleostei: Cyprinidae) from Manipur, India. *Zoos. Print Journal*, 2005, 20(2), 1832–1834
18. Viswanath 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
19. Viswanath W, Sarojnalini C. A new cyprinid fish, *Garra manipurensis*, from Manipur, India. *Japan. J. Ichthyol*. 1988, 35(2), 124–126
20. Viswanath W, Shanta K. A new species of the genus *Garra* Hamilton-Buchanan (Cypriniformes: Cyprinidae) from Manipur, India. *J. Bombay Nat. Hist. Soc*. 2005, 102(1), 86–88
21. Viswanath W. On a Collection of Fishes of the Genus *Garra* Hamilton from Manipur, India, with Description of a New Species. *J. Freshwater Biol*. 1993, 5(1), 59–68
22. Zhang E, Chen YY. *Garra tengchongensis*, a new cyprinid species from the upper irrawady river basin in Yunnan, China (Pisces: Teleostei). *Raffles Bull. Zool*., 2002, 50(2), 459–464
23. Zhang E. *Garra bispinosa*, a new species of cyprinid fish (Teleostei: Cypriniformes) from Yunnan, Southwest China. *Raffles Bull. Zool.,* 2005, 50(2), 459–464
24. Zhang E. *Garra rotundinasus*, a new species of cyprinid fish (Pisces: Teleostei) from the upper irrawady River basin, China. *Raffles Bull. Zool*., 2006, 54(2), 447–453
25. Zhou W, Pan XF, Kottelat M. Species of *Garra* and *Discogobia* (Teleostei: Cyprinidae) in Yuanjiang (Upper Red River) drainage of Yunnan Province, China with description of a new species. *Zoological Studies*, 2005, 44, 445–453

Table 1

Species of *Garra* from Western Ghats, North and northeastern part of India and Myanmar

Species of *Garra* from North and northeastern part of India		
1	*G. lamta*	Hamilton-Buchanan, 1822
2	*G. gotyla*	Gray, 1832
3	*G. nasuta*	McClelland, 1839
4	*G. rupecula*	McClelland, 1839
5	*G. lissorhynchus*	McClelland, 1843
6	*G. gravelyi*	Annandale, 1919
7	*G. kempi*	Hora, 1921
8	*G. annandalei*	Hora, 1921
9	*G. naganensis*	Hora, 1921
10	*G. abhoyai*	Hora, 1921
11	*G. manipurensis*	Viswanath and Sarojnalini, 1988
12	*G. litanensis*	Viswanath, 1993
13	*G. compressus*	Koshgin and Viswanath, 1998
14	*G. elongata*	Viswanath and Kosygin, 2000
15	*G. nambulica*	Viswanath and Joyshree, 2005
16	*G. paralissorhynchus*	Viswanath and Shanta Devi, 2005
17	*G. arupi*	Nebeshwar *et al*., 2009
18	*G. kalpangi*	Nebeshwar *et al*., 2012
19	*G. namyaensis*	Shangningam and Vishwanath, 2012
20	*G. dampaensis*	Lalronunga *et al*., 2013
21	*G. magnidiscus*	Tamang, 2013
22	*G. arunachalensis*	Nebeshwar and Viswanath, 2013
23	*G. birostris*	Nebeshwar and Viswanath, 2013
24	*G. quadratirostris*	Nebeshwar and Viswanath, 2013
25	*G. minimus*	Arunachalam, Nandagopal and Richard L. Mayden, 2013
26	*G. alticaputus*	Arunachalam, Nandagopal and Richard L. Mayden, 2013
27	*G. nigricauda*	Arunachalam, Nandagopal and Richard L. Mayden, 2013
28	*G. kimini*	Arunachalam, Nandagopal and Richard L. Mayden, 2013
Species of *Garra* from Myanmar		
1	*Garra propulvinus*	Kullander and Fang, 2004
2	*Garra vittatula*	Kullander and Fang, 2004
3	*Garra rakhinica*	Kullander and Fang, 2004
4	*Garra flavatra*	Kullander and Fang, 2004
5	*Garra nigricollis*	Kullander and Fang, 2004
6	*Garra spilota*	Kullander and Fang, 2004
7	*Garra poecilura*	Kullander and Fang, 2004
Species of *Garra* from Western Ghats of India		
1	*Garra mullya*	Sykes, 1841
2	*Garra gotyla stenorhynchus*	Jerdon, 1849
3	*Garra mcclellandi*	Jerdon, 1849
4	*Garra bicornuta*	Rao, 1920
5	*Garra hughi*	Silas, 1955
6	*Garra menoni*	Rema Devi and Indra, 1984
7	*Garra kalakadensis*	Rema Devi, 1992
8	*Garra surendranathanii*	Shaji, Arun and Easa, 1996
9	*Garra periyarensis*	Gopi, 2000
10	*Garra emarginata*	Kurup and Radhakrishnan, 2010
11	*Garra mlapparensis*	Kurup and Radhakrishnan, 2010
12	*Garra palaruvica*	Arunachalam, Raja, Nandagopal, Richard L. Mayden, 2013

Table 2

Morphometric characters of *Garra khawbungi* from Tuipui River, Khawbung Village, Mizoram

No	Morphometric Characters	*Garra khawbungi* (N = 8, including Holotype)		
		Min.	Max.	Mean
1	Standard length	75.1	98.3	83.8
2	Snout to urocentrum	93.4	96.2	94.8
3	Pre anal length	71.1	77.4	75.1
4	Pre dorsal length	45.7	48.3	47.0
5	Pre pelvic length	48.2	52.5	50.5
6	Pre pectoral length	20.3	22.9	21.5
7	Pre occipital length	89.1	98.0	93.6
8	Snout to opercle	90.2	95.7	93.5
9	Upper jaw length	31.7	39.2	37.1
10	Snout length	49.2	59.8	55.9
11	Pre nasal length	32.8	37.7	35.2
12	Orbit width	23.8	31.8	27.0
13	Inter orbital width	42.8	47.5	45.0
14	Inter nasal width	28.6	32.0	29.8
15	Head width	71.1	76.9	73.7
16	Gape width	33.8	42.1	37.5
17	Lower jaw to isthmus	22.5	33.1	25.9
18	Peduncle length	10.4	18.3	13.3
19	Dorsal origin/Pelvic-fin insertion	22.8	25.4	23.6
20	Dorsal spinous height	24.1	27.0	25.9
21	Anal-fin height	18.8	22.4	20.7
22	Head depth at nostril	42.7	50.0	44.6
23	Head depth at pupil	56.4	62.0	59.5
24	Head depth at occiput	70.6	75.4	72.8
25	Peduncle depth	11.7	13.8	12.8
26	Caudal-fin length	29.5	32.5	31.1
27	Dorsal-fin height	25.8	28.1	26.9
28	Pectoral-fin length	21.9	25.0	23.8
29	Pelvic-fin length	19.5	21.9	20.8
30	Pelvic-fin auxiliary scale length	8.1	10.2	9.0
31	Maxillary barbel length	5.9	16.9	11.7
32	Rostral barbell length	13.7	19.9	17.0
33	Occiput to dorsal-fin origin	24.2	27.1	25.4
34	Occiput to Pectoral-fin insertion	16.9	18.8	17.9
35	Occiput to Pelvic-fin insertion	36.6	42.1	39.1
36	Dorsal-fin insertion/Pelvic-fin insertion	19.1	23.2	21.3
37	Dorsal-fin origin/Pectoral-fin insertion	26.3	29.5	27.7
38	Dorsal-fin origin/Anal-fin origin	36.8	40.2	38.4
39	Dorsal-fin insertion/Caudal-fin base	32.8	44.8	39.7
40	Dorsal-fin insertion/Anal-fin origin	23.4	25.4	24.2
41	Dorsal-fin insertion/Anal-fin insertion	26.3	29.8	27.7
42	Dorsal-fin base length	15.1	20.8	18.1
43	Anal-fin base length	6.5	10.0	8.5
44	Pectoral-fin insertion/Pelvic-fin insertion	25.2	30.5	28.2
45	Pectoral-fin insertion/Anal-fin origin	45.0	53.0	49.2
46	Pelvic-fin insertion/Anal-fin origin	19.0	23.1	21.5
47	Head length	18.6	23.4	20.5
48	Total length	92.9	121.6	104.0
49	Post-dorsal length	52.0	62.0	57.2

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

50	Body depth	21.7	25.2	23.6
51	Distance b/w pectoral-fin origin to vent	45.0	49.1	46.3
52	Distance b/w pelvic-fin origin to vent	15.9	18.2	17.1
53	Disc length	25.7	28.8	27.9
54	Disc width	37.8	46.0	41.3
55	Central pad length	13.6	19.4	16.6
56	Central pad width	24.4	31.0	28.6

Table 3

Meristic characters of *Garra khawbungi* from Tuipui River, Khawbung Village, Mizoram

S. No	Meristic counts	Min	Max	Mean
1	Unbranched dorsal-fin rays	3	3	3.0
2	Branched dorsal-fin rays	8	8	8.0
3	Unbranched anal-fin rays	2	3	2.5
4	Branched anal-fin rays	5	5	5.0
5	Unbranched pelvic-fin rays	1	1	1.0
6	Branched pelvic-fin rays	8	8	8.0
7	Unbranched pectoral-fin rays	1	1	1.0
8	Branched pectoral-fin rays	14	15	14.4
9	Caudal-fin upper lobe	9	9	9.0
10	Caudal-fin lower lobe	8	8	8.0
11	Lateral-line scales	36	37	36.1
12	Pre dorsal scales	10	10	10.0
13	Upper transverse scale rows	4.5	4.5	4.5
14	Lateral-line to pelvic-fin scales	3.5	3.5	3.5
15	Lower transverse scales (anus)	4.5	4.5	4.5
16	Circumpeduncular scales	16	16	16.0
17	Circumferential scales	22	23	22.1
18	Anal scale rows	4.5	5	4.6
19	Pre anus scales	16	20	17.8

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

Table 4

Morphometric characters of *Garra tyao* from Tyao River, Tyao village, Mizoram

No	Morphometric Characters	*Garra tyao* (N = 19, including Holotype)		
		Min.	Max.	Mean
1	Standard length	56.5	76.0	66.7
2	Snout to urocentrum	90.1	95.6	93.3
3	Pre anal length	73.0	80.0	76.4
4	Pre dorsal length	47.3	51.9	49.1
5	Pre pelvic length	51.5	58.4	55.2
6	Pre pectoral length	21.3	24.8	22.6
7	Pre occipital length	76.9	95.6	84.3
8	Snout to opercle	86.3	99.1	91.1
9	Upper jaw length	30.2	43.4	35.3
10	Snout length	44.1	54.2	48.4
11	Pre nasal length	31.7	39.7	34.5
12	Orbit width	20.3	27.5	24.1
13	Inter orbital width	39.6	48.0	44.7
14	Inter nasal width	28.8	37.3	33.0
15	Head width	73.7	86.7	80.1
16	Gape width	30.0	43.1	34.6
17	Lower jaw to isthmus	27.5	35.3	31.4
18	Peduncle length	10.6	15.6	13.0
19	Dorsal origin/Pelvic-fin insertion	23.8	28.0	25.6
20	Dorsal spinous height	11.5	15.7	13.7
21	Anal-fin height	18.9	23.7	21.3
22	Head depth at nostril	31.4	40.8	36.8
23	Head depth at pupil	49.2	59.6	54.1
24	Head depth at occiput	64.4	76.8	70.4
25	Peduncle depth	14.0	16.4	15.1
26	Caudal-fin length	23.8	29.4	25.8
27	Dorsal-fin height	24.5	29.7	27.0
28	Pectoral-fin length	21.9	26.2	24.1
29	Pelvic-fin length	20.4	23.3	21.8
30	Pelvic-fin auxiliary scale length	5.3	9.2	7.5
31	Maxillary barbel length	2.8	4.3	3.5
32	Rostral barbel length	7.1	14.4	10.4
33	Occiput to dorsal-fin origin	24.2	30.8	27.5
34	Occiput to Pectoral-fin insertion	17.3	22.0	20.0
35	Occiput to Pelvic-fin insertion	39.0	44.7	42.3
36	Dorsal-fin insertion/Pelvic-fin insertion	17.9	25.2	21.2
37	Dorsal-fin origin/Pectoral-fin insertion	27.1	35.0	29.8
38	Dorsal-fin origin/Anal-fin origin	32.1	41.8	37.0
39	Dorsal-fin insertion/Caudal-fin base	26.5	33.2	31.0
40	Dorsal-fin insertion/Anal-fin origin	22.3	27.1	25.2
41	Dorsal-fin insertion/Anal-fin insertion	25.3	29.2	27.5
42	Dorsal-fin base length	12.3	16.0	14.7
43	Anal-fin base length	5.1	9.2	6.5
44	Pectoral-fin insertion/Pelvic-fin insertion	27.1	36.3	32.5
45	Pectoral-fin insertion/Anal-fin origin	44.6	54.6	50.0
46	Pelvic-fin insertion/Anal-fin origin	12.4	18.6	16.4
47	Head length	15.6	20.0	17.6

48	Total length	69.2	94.1	81.0
49	Post-dorsal length	44.5	52.7	48.2
50	Body depth	21.2	29.6	24.9
51	Distance b/w pectoral-fin origin to vent	44.2	54.0	50.0
52	Distance b/w pelvic-fin origin to vent	14.4	19.9	16.7
53	Disc length	31.7	39.6	35.7
54	Disc width	48.6	57.0	53.3
55	Central pad length	22.8	28.9	25.9
56	Central pad width	36.0	42.3	38.9

Table 5

Meristic characters of *Garra tyao* from Tyao River, Tyao village, Mizoram

S. No	Meristic counts	Min	Max	Mean
1	Unbranched dorsal-fin rays	2	3	2.2
2	Branched dorsal-fin rays	7	7	7.0
3	Unbranched anal-fin rays	2	3	2.1
4	Branched anal-fin rays	3	4	4.0
5	Unbranched pelvic-fin rays	1	1	1.0
6	Branched pelvic-fin rays	8	8	8.0
7	Unbranched pectoral-fin rays	1	1	1.0
8	Branched pectoral-fin rays	14	15	14.3
9	Caudal-fin upper lobe	9	9	9.0
10	Caudal-fin lower lobe	8	8	8.0
11	Lateral-line scales	31	31	31.0
12	Pre dorsal scales	8	10	9.4
13	Upper transverse scale rows	3	3.5	3.5
14	Lateral-line to pelvic-fin scales	3	3.5	3.5
15	Lower transverse scales (anus)	4	4.5	4.5
16	Circumpeduncular scales	15	16	15.8
17	Circumferential scales	20	22	20.5
18	Anal scale rows	2	3	2.9
19	Pre anus scales	18	19	18.5

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

Table 6

Morphological differentiation of *Garra* species from India and Myanmar

Species	No proboscis	No proboscis with transverse groove	Weakly developed proboscis	Well developed proboscis	W-shaped band on caudal-fin
G. lamta	✔				
G. gotyla				✔	
G. nasuta				✔	
G. rupecula					✔
G. lissorhynchus					✔
G. gravelyi			✔		
G. kempi		✔			
G. annandalei	✔				
G. naganensis	✔				
G. abhoyai					✔
G. manipurensis	✔				
G. litanensis			✔		
G. compressus	✔				
G. elongata			✔		
G. nambulica					✔
G. paralissorhynchus					✔
G. arupi	✔				
G. kalpangi			✔		
G. namyaensis					✔
G. dampaensis					✔
G. magnidiscus	✔				
G. arunachalensis			✔		
G. birostris				✔	
G. quadratirostris			✔		
***G. khawbungi* sp. nov.**	✔				
***G. tyao* sp. nov.**					✔
G. propulvinus	✔				
G. vittatula	✔				
G. rakhinica	✔				
G. flavatra	✔				
G. nigricollis	✔				
G. spilota	✔				
G. poecilura	✔				
G. mullya	✔				
G. gotyla stenorhynchus				✔	
G. mcClellandi		✔			
G. bicornuta				✔	
G. hughi	✔				
G. menoni	✔				
G. kalakadensis	✔				
G. surendranathanii	✔				
G. periyarensis	✔				
G. emarginata	✔				

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

Figure 1

Type locality of the new species *Garra khawbungi* sp.nov. Tuipui River, Khawbung Village, Champhai district, India

Figure 2

Type locality of the new species *Garra tyao* sp.nov. Tyao River, Tyao village, Champhai district, India

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

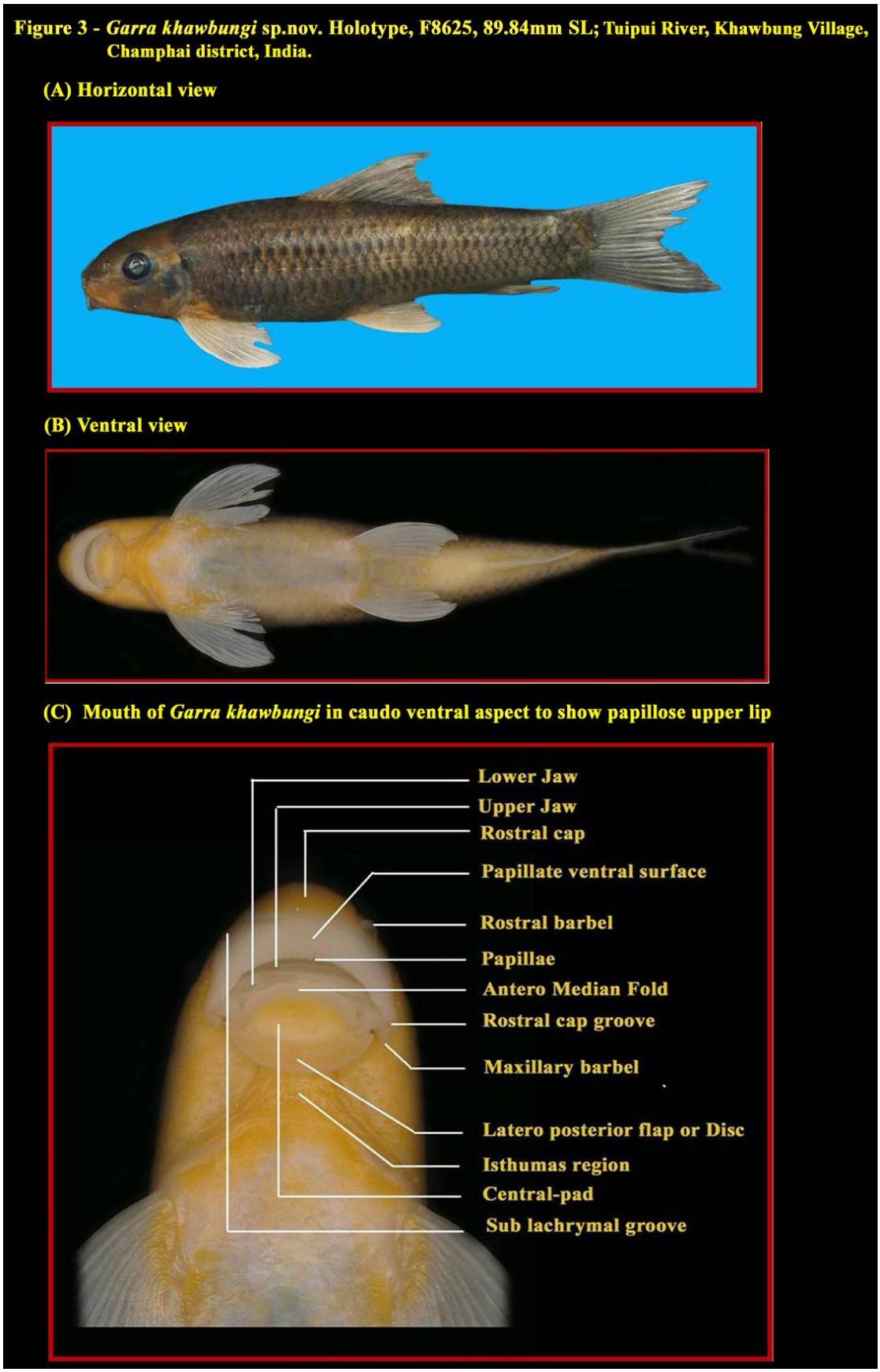

Figure 3

Garra khawbungi sp.nov. Holotype, F8625, 89.84mm SL, Tuipui River, Khawbung village, Champhai district, Mizoram, India

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

Figure 4 - Line drawings of ventral (a) and mouth (b) views of *Garra khawbungi* sp.nov. collected from Tuipui River, Khawbung village, Champhai district, Mizoram, India.

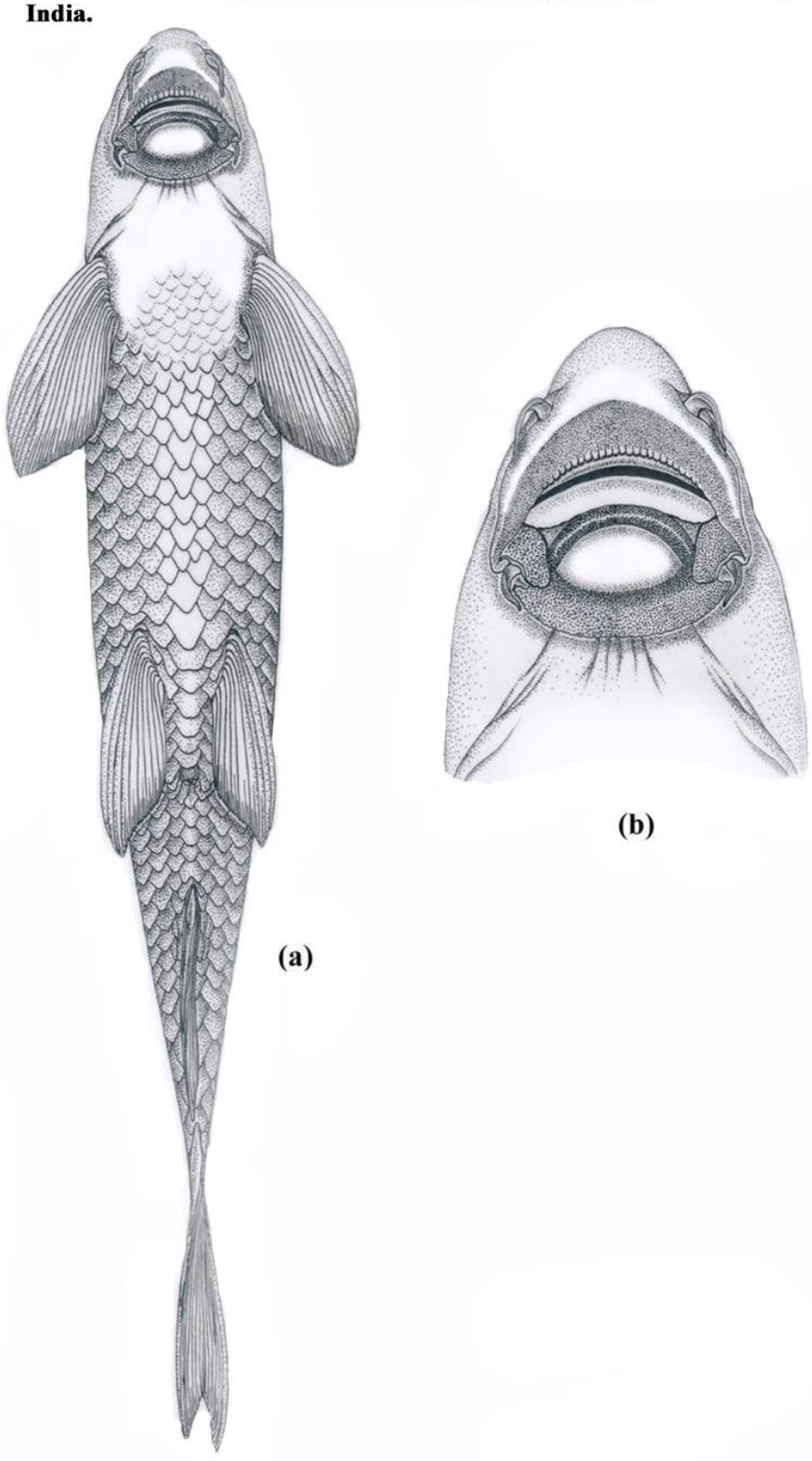

Figure 4

Line drawings of ventral (a) and mouth (b) views of *Garra khawbungi* sp.nov. collected from Tuipui River, Khawbung village, Champhai district, Mizoram, India

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

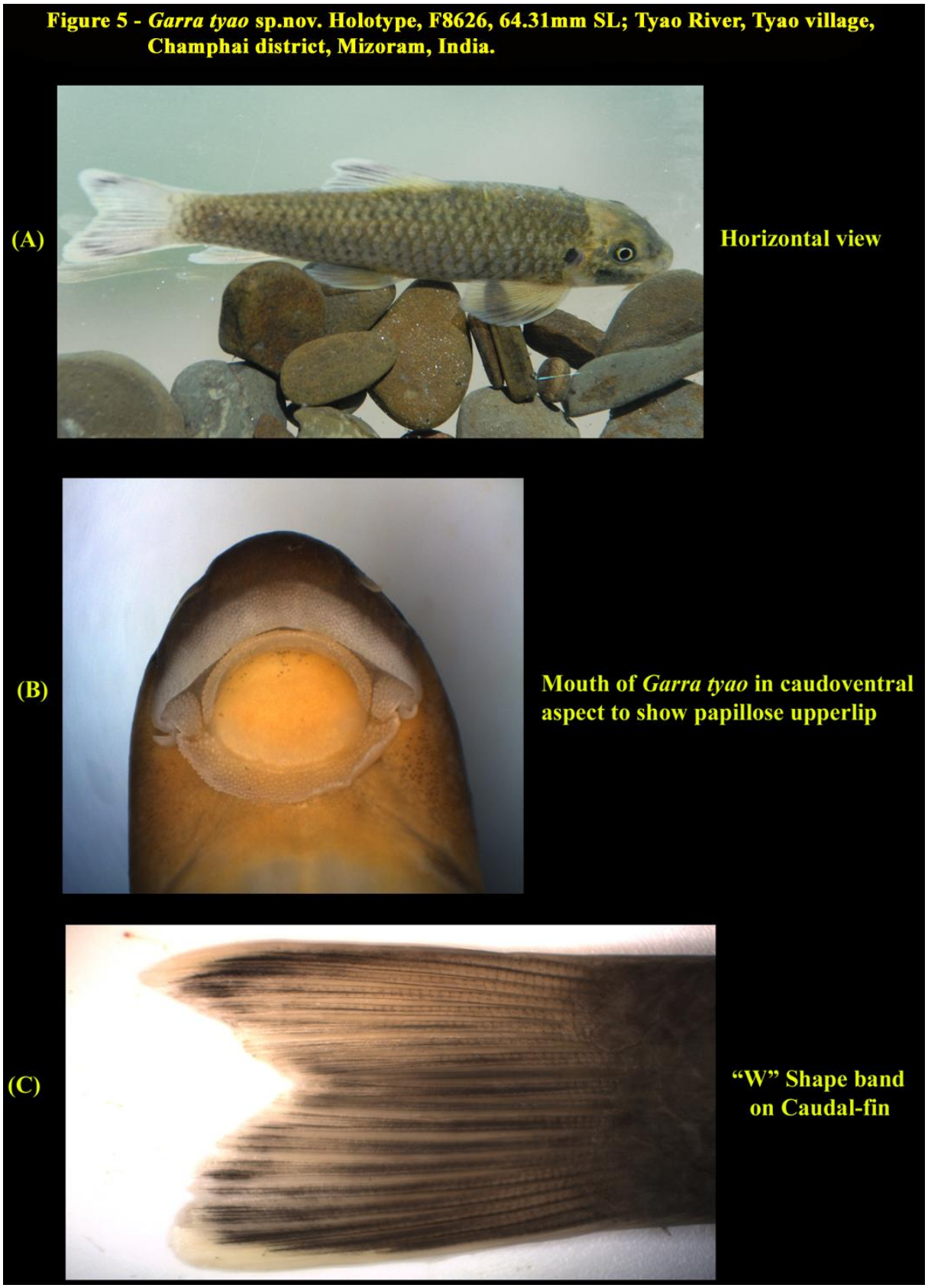

Figure 5

Garra tyao sp.nov. Holotype, F8626, 64.3mm SL, Tyao River, Tyao village, Champhai district, Mizoram, India

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

Figure 6 - Line drawings of ventral (a) and mouth (b) Caudal (c) views of *Garra tyao* sp.nov. collected from Tyao river, Tyao village, Champhai district, Mizoram, India.

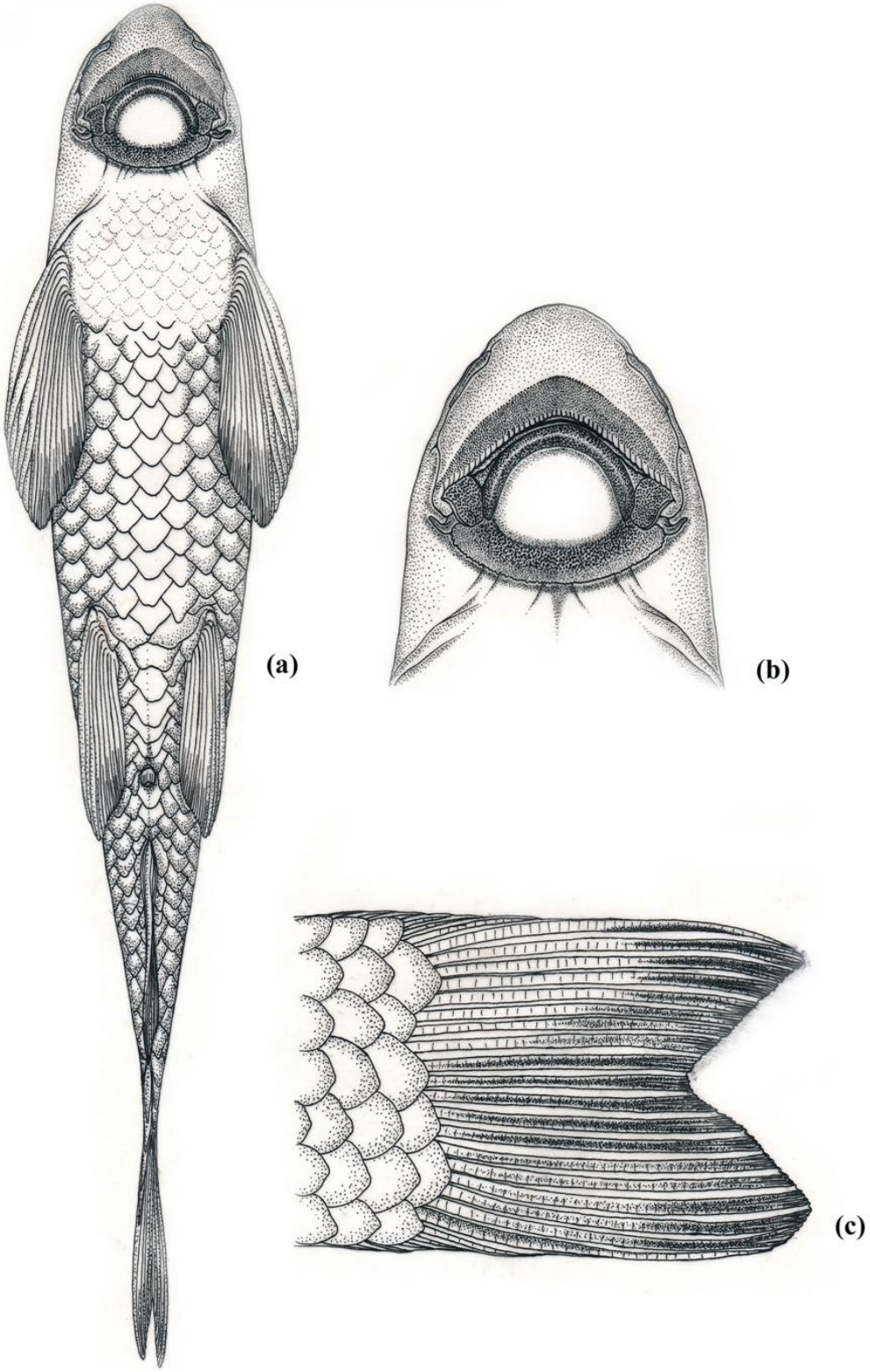

Figure 6

Line drawings of ventral (a) and mouth (b) and caudal (c) views of *Garra tyao* sp.nov. collected from Tyao river, Tyao village, Champhai district, Mizoram, India

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,

Figure 7

Map showing type locality of *Garra khawbungi* sp. nov. and *Garra tyao* sp. nov.

Arunachalam et al.
Two new Species of *Garra* from Mizoram, India (Cypriniformes: Cyprinidae) and A General Comparative Analyses of Indian *Garra*, Species, 2014, 10(24), 58-78,