

Garra chebera, a new species of cyprinid fish from an isolated basin in Ethiopia (Teleostei: Cyprinidae)

R. Habteselassie^{*/**}, E. Mikschi^{***}, H. Ahnelt^{****} & H. Waidbacher^{**}

Abstract

Garra chebera, a new cyprinid species from Womba basin in south western Ethiopia, is described. It is unique among African *Garra* in possession of 2 simple and 13 branched rays on the pectoral fin and 1 simple and 8 branched rays on the pelvic fin. In addition, it is distinguished from African congeners by the following combination of features: distinct black spot at the speculum on the first lateral line scale; well-developed, large papillate disc; fully scaled predorsal region and scaled post pelvic region; unscaled chest and belly; vent located close to anal fin (vent distance 13.2–24.2 mm; mean 18% of the distance between anal and pelvic fin origins).

Key words: Cyprinidae, *Garra*, new species, Chebera-Churchura national park, Ethiopia.

Zusammenfassung

In der vorliegenden Arbeit wird *Garra chebera*, eine neue Cyprinidenart aus dem Womba-Becken, Südwest-Äthiopien, beschrieben. Sie unterscheidet sich durch den Besitz von zwei ungespaltenen und 13 gespaltenen Strahlen in den Brustflossen, sowie einem ungespaltenen und 8 gespaltenen Strahlen an der Afterflosse deutlich von anderen afrikanischen *Garra*-Arten. Weitere Merkmale zur Unterscheidung von Vertretern der Gattung sind: ein auffälliger schwarzer Punkt auf der ersten Schuppe der Seitenlinie; gut entwickelte, große Mundscheibe, vollständige Beschuppung im Prädorsalbereich, Beschuppung im Postpelvicbereich, unbeschuppte Brust- und Bauchregion; Analöffnung nahe der Afterflosse (13.2–24.2 mm; im Durchschnitt 18% der Distanz zwischen After- und Bauchflossenansatz).

Introduction

The cyprinid genus *Garra* HAMILTON, 1822 has a geographic distribution from Borneo, China and southern Asia, through the middle east, Arabian Peninsula and East Africa to West Africa (GETAHUN 1999). Species of the genus *Garra* inhabit a wide range of substrates (muddy, sandy and rocky bottoms) in streams, rivers, pools and lakes. They are primarily freshwater species but are also reported from brackish waters (GETAHUN 1999). Some members of the genus like *Garra congoensis* POLL, 1959 and *Garra ornata*

^{*/**} Dr. Redeat Habteselassie, National Fisheries and Living Aquatic Resources Research Centre, P.O. Box-64, Sebeta, Ethiopia – redeathabteselassie@gmail.com

Dr. Herwig Waidbacher, Institute of Hydrobiology and Aquatic Ecology Management, University of Natural Resources and Applied Life Sciences, Max-Emanuelstraße 17, 1180 Vienna, Austria – herwig.waidbacher@boku.ac.at

Dr. Ernst Mikschi, Natural History Museum of Vienna, Fischsammlung, Burgring 7, A-1010 Vienna, Austria – ernst.mikschi@nhm-wien.ac.at

^{****} Dr. Harald Ahnelt, Department of Theoretical Biology, Faculty of Life Sciences, University of Vienna, Althanstraße 14, 1090 Vienna, Austria – harald.ahnelt@univie.ac.at

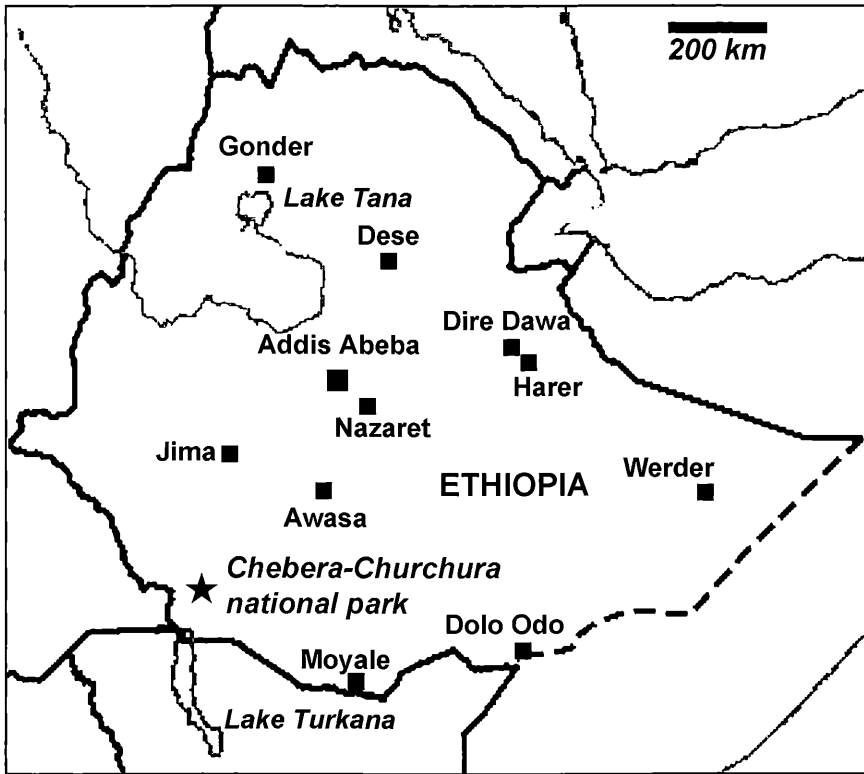


Fig. 1: Map of study area: south-western Ethiopia, Chebera Churchura national park.

(NICHOLS & GRISCOM 1917) are specialized for life in very fast flowing turbulent water (ROBERT & STEWART 1976) and also in rocky stretches with rapids and falls (LOWE-McCONNELL 1978). Some species (e.g. *Garra tana* STIASSNY & GETAHUN, 2007) are reported from lakes (STIASSNY & GETAHUN 2007). Other members of the genus (e.g. *Garra barreimiae* FOWLER & STEINITZ, 1956, *Garra dunsirei* BANISTER, 1987) are cave dwellers (BANISTER 1987) and some members of this group (e.g. *G. barreimiae*) are blind.

The Ethiopian highlands seem to be a centre of species diversity of the genus *Garra* on the African continent. Out of the seventeen species reported from Africa (STIASSNY & GETAHUN 2007) eleven occur in Ethiopia. Most studies so far conducted on the genus *Garra* in Ethiopia focused mainly on the major river basins, while small isolated basins are less explored. Our study on an isolated basin in south western Ethiopia revealed a previously undescribed species, herein described as *Garra chebera*.

Study area

The study was conducted in Chebera-Churchura national park, in south western Ethiopia. This national park is located in Southern Nations and Nationalities regional state and has an area of 121500 hectares. Sampling was conducted in the Dildil stream

which is a permanent tributary of Lake Womba. Lake Womba is an isolated lake which is fed, in addition to the Dildil stream, by a number of seasonal streams originating from adjacent hills. The catchment of lake Womba is bordered by catchments of the Gojeb river to the north and catchments of the Omo river to the east and to the south. The confluence of the Gojeb and Gibe rivers which occurs east of Womba catchment forms the Omo river and drains south in the rift valley to Lake Turkana (Fig. 1).

Materials and methods

Fish specimens were collected from the Dildil stream in Chebera-Churchura national park between 2006 and 2008 using a cast net and electrofishing gear. Specimens used in morphometric and meristic data analysis were preserved in 4% formalin solution in the field. Measurements were taken with digital callipers and data recorded to the nearest 0.1 mm. All measurements and counts were made on the left side of the fish. To facilitate comparison of measurements with previous works of similar nature, many of the characters and their definitions follow MENON (1964). Additional measurements, i.e. predorsal, prepectoral, prepelvic and pre anal length, are the body lengths measured from the tip of the snout to the dorsal-, pectoral-, pelvic- and anal-fin origins, respectively. The head length and measurements of other parts of the body are presented as proportions of the standard length unless otherwise stated. Measurements of other parts of the head are given as percentages of the head length. Rostal and maxillary barbel length are given as percentages of the orbit diameter. Other additional measurements are as follows: pelvic to anal distance is measured from the pelvic fin insertion to the anal fin origin; vent to anal distance is taken from the vent to anal fin origin and is expressed as percentage of the pelvic to anal distance; head depth is measured from a point on the occiput (behind the eye) vertically downward to the ventral contour of the chest; head width is distance through the head, taken at the extreme posterior end of the head between the two opercula when opercles are closed (normal position); caudal peduncle length is measured between the posterior end of the anal fin and the postero-ventral end of the caudal peduncle; caudal peduncle depth is measured between the dorsum and ventrum of the caudal peduncle at the narrowest part. The genus *Garra* possess a modified lower lip forming a mental adhesive disc. The terminology used for description of the disc follows STIASSNY & GETAHUN (2007). Type A is a weakly developed disk without free posterior or lateral margins, and often consisting only of a central cushion-like callus. Type C is well developed with free lateral and posterior margins; type C discs are heavily papillate with batteries of fleshy papillae arrayed around the periphery of the whole disc. Type B is intermediate in development, the disc may be conspicuous but usually has only partially free lateral margins and a narrow free posterior margin, and is lacking fields of conspicuous papillae around the periphery.

Fin ray counts were made using whole specimens, and cleared and stained specimens. Clearing and staining of specimens were made following DINGERKUS & UHLER (1977). Lateral line scale and fin ray counts follow HOLCIK & al. (1989). The last branched ray on the dorsal and anal fin, if split to the base, is counted as an individual branched ray.

Vertebral counts follow AHNELT & DUCHKOWITSCH (2004) from radiographs and cleared and stained specimens. The total number of vertebrae equals precaudal (abdominal) ver-

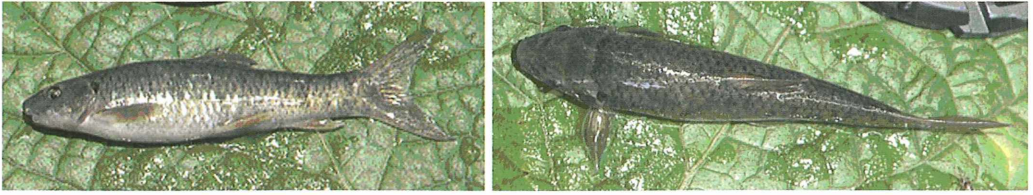


Fig. 2: *Garra chebera*, live specimen with fresh coloration from type locality, south western Ethiopia, Womba basin, 65.6 mm SL A) lateral view (note the dark spot behind operculum) B) dorsal view.

tebrae plus caudal vertebrae. Generally precaudal vertebrae are defined as vertebrae without closed haemal arches (ROJO 1991). But this definition is imprecise. The parhypophysis of the penultimate and/or ultimate vertebrae may be joined by a bony bridge which forms a narrow arch, but their ends not joined. This type of precaudal vertebra is termed “intermediate vertebra” by BOGUTSKAYA & KOMLEV (2001) and is characterised by a narrow canal surrounding the caudal artery but not the caudal vein (AHNELT & DUCHKOWITSCH 2004). We define the first caudal vertebra as a vertebra with closed hemal arch plus hemal spine. Additionally we also give the number of the predorsal vertebrae. In our vertebral formula we follow BOGUTSKAYA & KOMLEV (2001) who refer to the total number of vertebrae followed by the number of predorsal vertebrae (in parentheses), the total number of precaudal vertebrae, the number of intermediate vertebrae (in parentheses) plus the total number of caudal vertebrae.

Morphometric and meristic data used in the comparison of the new species described herein with five other *Garra* species is taken from STIASSNY & GETAHUN (2007). The characters used in the comparison are based on the main features which are used in the diagnosis of *Garra* species which include the type of sucking disk, squamation of chest, belly, post pelvic region and predorsal region, markings on body, vent distance and intestine length.

The specimens examined for the present study are deposited in the Ichthyological Collection of the Natural History Museum of Vienna, Austria. In addition, non-type materials are deposited in National Fish and Living Aquatic Resources Research Center, Sebeta, Ethiopia.

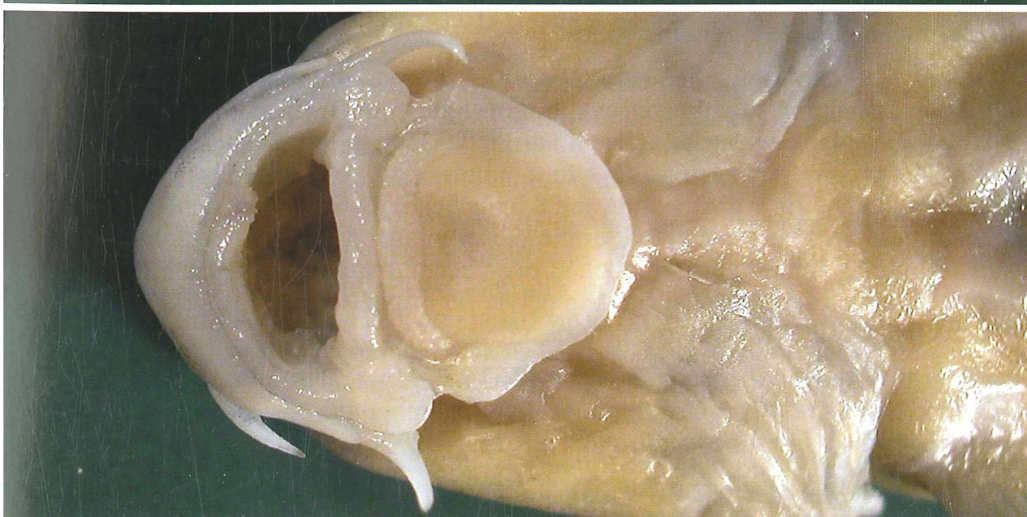
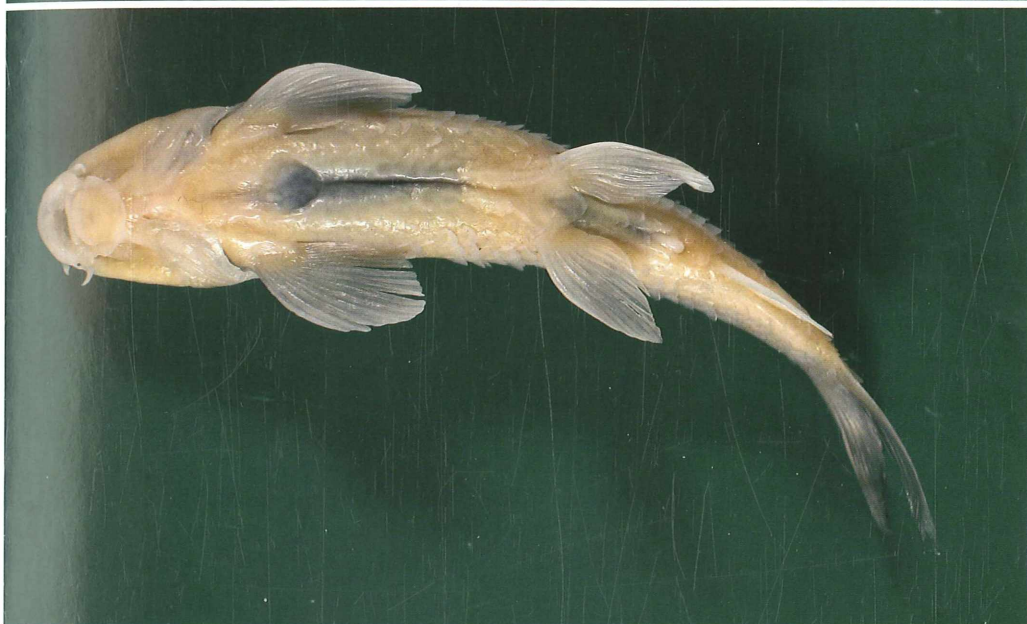
Abbreviations used: C & S, cleared and stained; HL, head length; Int. L, intestinal length; NMW, Natural History Museum of Vienna; SL, standard length.

Results

Garra chebera sp. n.

Type material. Holotype (NMW 95229): 68.9 mm SL; Dildil stream, tributary of Lake Womba, in Chebera-Churchura national park, some 12 kms south east of Genji village at 07°03' N and 36°48' E localities, ETHIOPIA; **Paratypes**: 16 specimens 39.6-74.8 mm SL (NMW 95230); two specimens C & S (NMW 95231), same data as holotype.

Fig. 3: *Garra chebera* A) Dorsal view (note the fully-scaled predorsal region), B) Ventral view, C) Ventral view of head (note the type C disc).



Diagnosis: Unique among African *Garra* in possession of 2 simple and 13 branched rays on the pectoral fin and 1 simple and 8 branched rays on the pelvic fin. In addition, it is distinguished from African congeners by the following combination of features: well-developed, large papillate type C disc; fully scaled predorsal region and scaled post pelvic region; unscaled chest and belly; vent located close to anal fin (vent distance 13.2–24.2; mean 18% of the distance between anal and pelvic fin origins) and intestine long (SL 28.4– 42% of intestine length).

Description: Morphometric and meristic data are presented in table 1. Maximum size 74.8 mm SL. Body relatively cylindrical (depth 21.0–24.4% of SL), greatest body depth located at levels of dorsal fin origin. Head moderately short (head length 22.1–26.1; mean 23.6% SL) and depressed; height less than width and width less than head length. Dorsal head profile rises steeply over snout, then more or less smoothly convex to dorsal fin origin. Rostral cap well developed, extending ventrally over upper jaw and with indented ventral margin.

Dorsal profile of body slightly convex from tip of supraoccipital process to dorsal fin origin. Dorsal-fin base almost straight, sloped posteroventrally. Profile from end of dorsal fin base to caudal fin ray straight or somewhat concave. Ventral profile of body gently rounded from pectoral- to pelvic-fin origin, and slightly concave from pelvic fin origin to caudal fin tip. Anal fin base nearly straight, posterodorsally inclined. Profile between posterior end of anal-fin base to caudal fin ray slightly concave. Eyes small, placed dorsolaterally, and anteriorly positioned (closer to tip of the snout than to the posterior margin of the operculum) and visible from top.

Well developed type C disk, with free posterior and lateral margins (Fig. 2C). Two pairs of minute barbels; rostral ones positioned at the anterior of the ventrally expanded rostral cap, shorter than eye diameter; maxillary ones at corner of mouth, shorter than eye diameter. Lateral line complete, directed backward medially along caudal peduncle with 34–36 scales. Longitudinal scale rows above lateral line 4–4.5 and below lateral line 4–4.5. Predorsal scales 14–15, smaller than flank scales. Chest and belly asquamate. Post pelvic region scaled with 4–6 scales. Vent placed closer to anal fin origin than to pelvic fin origin; vent distance 13.2–24.2; mean 18% of distance between the origin of the anal fin and the pelvic fin insertion.

Dorsal fin with 3 simple and 7 branched rays; third simple and first branched rays longest; distal margin slightly concave; origin slightly closer to snout tip than to caudal fin base; inserted in advance of pelvic fin origin; its length less than head length, slightly shorter than pectoral fin. Pectoral fin with 2 simple and 13 branched rays; third branched ray longest. Pelvic fin with 1 simple and 8 branched rays; second branched ray longest; its length less than head length; its origin closer to anal fin than to pectoral fin origin. Anal fin with 2 simple and 5 branched rays, second simple and first branched rays longest; origin closer to caudal fin than pelvic fin origin. Caudal fin forked, its longest rays less than 2 times as long as its shortest rays.

Pharyngeal teeth in three rows, 2.3.5–5.3.2. Total vertebral number 35; vertebral formula 35: (11)21(2)+14. Gas bladder two chambered, posterior chamber short (16.3–23.8% SL). Intestine length short (SL 28.4– 42% of intestine length).

Coloration: In live specimens (Fig. 2A & 2B) body dark dorsally, light coloured below

Table 1. Morphometric and meristic data for *Garra chebera* sp.n. Proportional measurements (mm) are given in either percentage standard length (SL), percentage head length (HL) or percentage orbit diameter (E). When there is a range of values, meristics of holotype are given in parenthesis.

Morphometrics and meristics	n	holotype	range	mean	SD
Standard length (SL)	18	68.9	39.6–74.8		
In % SL					
Body depth	18	21.6	20.8–26.8	23.4	1.92
Head Length	18	22.5	22.1–26.1	23.6	1.48
Predorsal length	18	46.6	46.5–50.0	48.1	1.15
Pectoral fin length	18	20.1	18.0–21.9	20.1	1.29
Caudal peduncle length	18	12.6	11.7–19.1	14.6	2.22
Caudal peduncle depth	18	11.2	10.3–13.2	12.0	0.95
Dorsal fin length	18	19.2	17.9–21.2	19.5	1.02
Anal fin length	18	14.2	13.0–17.1	15.2	1.28
Pelvic fin length	18	17.3	11.0–19.7	16.8	2.65
In % HL					
Head width	18	78.0	66.5–80.1	74.7	4.09
Head depth	18	67.9	61.3–68.9	65.0	2.4
Snout Length	18	40.3	30.9–40.3	36.1	3.19
Orbit diameter	18	21.7	18.5–32.0	24.5	3.99
Interorbital width	18	47.3	36.7–50.3	44.7	4.94
In % E					
Rostal barbel length	18	91.1	40.0–91.7	68.7	19.77
Maxillary barbel length	18	54.8	50.0–97.2	66.8	15.15
Dorsal fin rays		III + 7			
Anal fin rays		III + 5			
Pectoral fin rays		II + 13			
Pelvic fin rays		I + 8			
Lateral line scales		34–36 (34)			
Scale rows lateral line-dorsal fin		4–4.5 (4)			
Scale rows lateral line-pelvic fin		4–4.5 (4)			
Scale rows lateral line-anal fin		3–4 (4)			
Predorsal scales		14–15 (15)			

lateral line, fins dusky brown; faint submarginal band of black pigment in membrane between rays, flanks with slightly bluish coloration, three to five small black spots between rays in basal membrane of dorsal fin. Characteristically well-developed, distinct black spot present just behind operculum, on the first lateral line scale.

In preserved specimens (Fig. 3A, B & C), body dark dorsally, creamy yellow-brown below lateral line and ventrally. Head, snout, and most of cheek, and operculum: dark brown. Pale coloration extends postero-dorsally around eye. Distinct light dark spot on the first lateral line scale behind operculum. Dorsal fin membrane light dark, faint submarginal band of black pigment in membrane between rays. Anal fin pale creamy white. Pectoral fin uniformly pale creamy white with faint submarginal band of black pigment in membrane between rays. Pelvic fin pale creamy white.

Distribution and habitat: Currently known only from type locality. Type series was collected in slow flowing pools over sandy substrate, with dense woody river bank veg-

etation and complete shade at zenith. In this area the Dildil stream flows through dense natural forest with minimum human impact before draining into Lake Womba. During time of sampling the stretch had mean depth of 25 cm, water temperature of 18.3°C and flow rate of 1.3 m/s.

Etymology: *Chebera* in reference to Chebera-Churchura national park, the locality in which the type series was collected.

Remarks: *Garra chebera* possesses a characteristically well-developed, distinct black spot behind the operculum on the first scale of the lateral line, while the spot in other *Garra* species, if present, is red. It is our opinion that the presence or absence of a distinct spot on the upper corner of the opercula in live *Garra* specimens is an important character in diagnosis of species. The latest revision of the genus by STIASSNY & GETAHUN (2007) did not use the presence or absence of the spot as a criterion to identify *Garra* species. GOLUBTSOV & al. (2004), in their review of rift valley fishes of Ethiopia, suggested that two distinct taxa of *Garra* occur sympatrically in most regions of southern Ethiopia, the difference being mainly the presence or absence of a small gleaming red spot in the upper corner of the gill cover, which seemed to be formed by carotenoids that usually disappear after several months in preservation liquid.

Discussion

Comparison of similarities and differences of *G. chebera* with two species of *Garra* reported from the adjacent Gibe-Omo river basin (i.e. *Garra dembeensis* (RÜPPELL, 1836) and *Garra makiensis* (BOULENGER 1904)) and three species which have broad geographical distribution in Ethiopia (i.e. *Garra dembecha* STIASSNY & GETAHUN, 2007, *Garra blanfordii* BOULENGER, 1901 and *Garra quadrimaculata* RÜPPELL, 1836) is given as follows.

With the exception of *G. dembecha* which has weakly developed type-A disc, the presence of well developed type-C disc is a common character in *G. chebera*, *G. blanfordii*, *G. quadrimaculata*, *G. makiensis* and *G. dembeensis*. In addition to the similarity in disc morphology, *G. chebera*, *G. blanfordii*, *G. quadrimaculata*, and *G. makiensis* are similar in possessing fully scaled predorsal region. The presence of scaled post-pelvic region is also another character which is commonly shared by *G. chebera*, *G. quadrimaculata* and *G. makiensis* while the other three have no scales on the post-pelvic region.

Garra chebera is readily distinguished from *G. dembecha* by the possession of type-C disc, fully scaled predorsal region and scaled postpelvic region (versus type-A disc, partially scaled predorsal region and asquamate post-pelvic region in *G. dembecha*). *Garra dembecha* has wide geographical distribution and is reported from drainage basins in Eritrea, Ethiopia and Kenya.

Garra chebera differs from *G. dembeensis* by its scaled post-pelvic region and fully scaled predorsal region which has 15 scales (versus asquamet post-pelvic region and 0-4 predorsal scales in *G. dembeensis*). *Garra dembeensis* is one of the most widespread of African *Garra*, present in most drainage basins of Ethiopia, as well as in Cameroon, Nigeria, Tschad, Egypt, Kenya, and Tanzania (STIASSNY & GETAHUN 2007).

Garra chebera is readily distinguished from *G. blanfordii* in having scaled post-pelvic region and the presence of markings on head and membrane between rays of the dorsal fin (versus asquamate post-pelvic region and absence of markings on head and dorsal fin in *G. blanfordii*). The absence of markings on head, body, or fins is a character which distinguishes *G. blanfordii* not only with *G. chebera* but also with other African congeners.

Garra chebera is different from *G. quadrimaculata* and *G. makiensis* in chest and belly squamation. *Garra chebera* has asquamate chest and belly while *G. quadrimaculata* possess fully scaled chest and belly and *G. makiensis* possess few non-overlapping scales over chest and belly.

Vent is located close to anal fin in *G. chebera* (mean vent distance 18%) and very close in *G. quadrimaculata* and *G. makiensis* (mean vent distance is 12.3% and 13.6% respectively) while it is distant from anal fin in *G. dembecha*, *G. blanfordii*, *G. dembeensis* (mean vent distance is 32%, 28.5% and 26% respectively). *G. chebera* has moderately elongate intestine (SL 28.4–42% of intestine length) while *G. makiensis* and *G. quadrimaculata* have very long intestine (SL 15.9–18.1% of intestine length and SL 20.9–24.2% of intestine length, respectively). *G. dembeensis*, *G. dembecha* and *G. blanfordii* have relatively shorter intestine (SL 39–42%, SL 40–56% and SL 40–50% of intestine length, respectively).

Key to *Garra* species of Ethiopia (after STIASSNY & GETAHUN 2007, modified)

- 1 Two pairs of barbels (maxillary and rostral) 2
Single pair of barbels (maxillary) *Garra duobarbis* (Ethiopia)
- 2 Rostral fold ventrally expanded, covering upper jaw; mouth broad 3
Rostral fold not ventrally expanded, upper jaw exposed; mouth narrow
Garra regressus (Ethiopia, Lake Tana)
- 3 Mental disc moderately to well developed, lateral and posterior margins free 4
Mental disc reduced to a central callus, sometimes with a narrow free posterior margin, but entirely lacking free lateral margins and papillate periphery 12
- 4 Chest with either many or some scattered scales, lateral line scales 34–35; vent close to anal fin *Garra quadrimaculata* (Ethiopia, Eritrea, Somalia)
Chest asquamate 5
- 5 Post-pelvic region asquamate 6
Post-pelvic region scaled 10
- 6 Body either with distinct midlateral band, or darker dorsally than ventrally; black spots in basal membrane of dorsal fin; predorsal region only partially scaled; region between vent and anal fin scaled 7
Body uniformly pale; no markings in dorsal fin; predorsal region completely scaled; region between vent and anal fin asquamate
Garra blanfordii (Ethiopia, Eritrea, Sudan)
- 7 Predorsal region partly scaled or asquamate 8
Preorsal region completely scaled 9
- 8 Five to nine scales in predorsal region; body depth 14.9–16.8, m. 16.0% SL; intestine short (SL 95.0–102.0% Int.L *Garra geba* (Ethiopia)

- Zero to three scales in predorsal region; body depth 15.6–23.9, m. 20.4% SL; intestine moderately long (SL39.0–42.0% Int.L.).....
- Garra dembeensis* (Cameroon, Chad, Egypt, Ethiopia, Kenya, Nigeria, Tanzania)
- 9 Disc moderately developed (type B); dark ash-grey midlateral band to base of caudal peduncle; belly scaled; no tubercles on snout *Garra aethiopica* (Ethiopia)
Disc well developed (type C); body more-or-less uniformly dark on flanks; belly either asquamate or with only a few embedded scales 10
- 10 Some scales on belly; distance from vent to anal fin 10.3–16.9, m. 13.6%; pectoral fin IV+11; pelvic fin III+7; eye either median, or posterior in large specimens
Garra makiensis (Ethiopia)
Belly asquamate11
- 11 Distance from vent to anal fin 19.2–29.5, m. 18.2%; 10–12 predorsal scales; no dark spot behind opercle; pectoral fin IV+11–12; elvic fin II+7; eye median
Garra ignestii (Ethiopia)
Distance from vent to anal fin 13.2–24.2, m. 18%; 15 predorsal scales; dark spot behind opercle on first scale of lateral line; pectoral fin II+13; pelvic fin I+8; eye dorsolateral
Garra chebera sp. n. (Ethiopia)
- 12 Length of caudal peduncle 20.4–22.3, m. 20.2% SL; 39–40 scales in lateral line; intestine short (SL 62.7–79% Int.L.); spots in basal membrane of dorsal fin either absent or small and faint *Garra tana* (Ethiopia, Lake Tana)
Length of caudal peduncle 13.3–20.7, m. 16.8% SL; 37–38 scales in lateral line; intestine longer (SL 40–56% Int.L.); either four or five elongate black spots in basal membrane of dorsal fin *Garra dembecha* (Ethiopia, Eritrea, Kenya, Tanzania)

Acknowledgement

The Austrian government through the Austrian Academic Exchange Service (OEAD) and the Department of Water, Atmosphere and Environment, BOKU University, Vienna, Austria funded this study and the Ethiopian Institute of Agriculture Research provided logistic support. We thank Fitsum Wubeshet, Kebede Bereda, Hermann Moosberger and Michael Straif for field assistance. We thank the local administration of Konta-Leyu Woreda for granting permits to access the study area. We are most grateful to the staff of the Natural History Museum of Vienna for their technical assistance, with special thanks to Wellendorf Helmut for his assistance in taking professional pictures of the type series. We acknowledge and appreciate the assistance we received from the staff of British Natural History Museum, Department of fish, amphibian and reptiles, and the staff of University of Veterinary Medicine, Vienna, Austria, for their unreserved assistance in taking radiographs of fishes. Finally, we thank Adrian Craig, Grahamstown, South Africa, for helpful comments on the manuscript.

References

- AHNELT H. & DUCHKOWITSCH M., 2004: The postcranial skeleton of *Proterorhinus marmoratus* with remarks on the relationship of the genus *Proterorhinus* (Teleostei: Gobiidae). – *Journal of Natural History* 38: 913–924. Published online March 2003.
- BANISTER K.E., 1987: Two new species of *Garra* (Teleostie: Cyprinidae) from the Arabian Peninsula. – *Bulletin of the British Museum of Natural History* 52 /1: 59–70.
- BOGUTSKAYA N.G. & KOMLEV A.M., 2001: Some new data to morphology of *Rhodeus sericeus* (Cyprinidae, Acheilognathinae) and description of a new species, *Rhodeus colchicus*, from west Transcaucasica. – *Proceedings of the Zoological Institute of the Russian Academy of Sciences* 287: 81–97.

- DINGERKUS G. & UHLER L.D., 1977: Enzyme clearing of alcian blue stained whole small vertebrates for demonstration of cartilage. – *Stain Technology* 52: 229–232.
- GETAHUN A., 1999: Systematic studies of the African species of the genus *Garra* (Pisces: Cyprinidae). Unpublished Ph.D. thesis. The American Museum of Natural History.
- GOLUBTSOV A.S., DGEBUADZE Y.Y. & MINA M.V., 2002: Fishes of the Ethiopian rift valley. – In: TUDORANCEA C. & TAYLOR W.D. (eds), *Ethiopian Rift Valley Lakes*: 167–256. – Leiden: Backhuys Publishers.
- HOLCIK J., BANARESCU P. & EVANS D., 1989: General introduction to fishes. – In: HOLCIK J. (ed.): *The freshwater fishes of Europe*: 1–58. – Wiesbaden: AULA-Verlag.
- LOWE-McCONNEL R.H., 1978: *Ecological studies in tropical fish communities*. – 382 pp., Cambridge, United Kingdom: University Press.
- MENON A.G.K., 1964: Monograph of the Cyprinid fishes of the genus *Garra* Hamilton. – *Memoirs of the Indian Museum*, 14/4: 175–261.
- ROBERT T.R. & STEWART D.J., 1976: An ecological and systematic survey of fishes in the rapids of the lower Zaire or Congo River. – *Bulletin of the Museum of Comparative Zoology* 147: 239–317.
- STIASSNY M.L.J. & GETAHUN A., 2007: An overview of labeonin relationships and the phylogenetic placement of the Afro-Asian genus *Garra* Hamilton, 1922 (Teleostei: Cyprinidae), with the description of five new species of *Garra* from Ethiopia and a key to all African species. – *Zoological Journal of the Linnean Society* 150: 41–83.

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Annalen des Naturhistorischen Museums in Wien](#)

Jahr/Year: 2009

Band/Volume: [111B](#)

Autor(en)/Author(s): Habteselassie Redeat, Mikschi Ernst, Ahnelt Harald,
Waidbacher Herwig

Artikel/Article: [Garra chebera, a new species of cyprinid fish from an isolated basin in Ethiopia \(Teleostei: Cyprinidae\) 43-53](#)