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Taxonomic revision of the genus *Carasobarbus* Karaman, 1971 (Actinopterygii, Cyprinidae)

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Abstract

Representatives of the fish genus *Carasobarbus* Karaman, 1971 (Actinopterygii: Cyprinidae) from the Middle East and North Africa were previously placed in 14 different genus-group taxa (*Barbellion*, *Barbus*, *Barynotus*, *Capoeta*, *Carasobarbus*, *Cyclocheilichthys*, *Kosswigobarbus*, *Labeobarbus*, *Luciobarbus*, *Pseudotor*, *Puntius*, *Systomus*, *Tor* and *Varicorhinus*). The generic assignment of several species changed frequently, necessitating a re-evaluation of their taxonomic status. In this study, the genus *Carasobarbus* is revised based on comparative morphological examinations of about 1300 preserved specimens from collections of several museums and freshly collected material. The species *Carasobarbus apoensis*, *C. canis*, *C. chantrei*, *C. exulatus*, *C. fritschii*, *C. harterti*, *C. kosswigi*, *C. luteus* and *C. sublimus* form a monophyletic group that shares the following combination of characters: medium-sized barbels with a smooth last unbranched dorsal-fin ray, nine or 10 branched dorsal-fin rays and six branched anal fin-rays; scales large, shield-shaped, with many parallel radii; the lateral line containing 25 to 39 scales; the pharyngeal teeth hooked, 2.3.5-5.3.2 or 2.3.4-4.3.2; one or two pairs of barbels. The species are described in detail, their taxonomic status is re-evaluated and an identification key is provided. A lectotype of *Systomus luteus* Heckel, 1843 is designated. *Carasobarbus* Karaman, 1971, *Kosswigobarbus* Karaman, 1971, and *Pseudotor* Karaman, 1971 are subjective synonyms, and acting as First Reviser we gave precedence to the name *Carasobarbus*.

Keywords

Cyprinidae, SW Asia, NW Africa, taxonomy

Introduction

The species of the cyprinid genus *Carasobarbus* Karaman, 1971 are distributed across SW Asia and NW Africa. They occur in all major river systems of the Levant, Mesopotamia, southern Iran, the western and south-western Arabian Peninsula and in northern Morocco. *Carasobarbus* species are an important element of the ichthyofaunas of these areas.

Research about the Mesopotamian and Levantine representatives of *Carasobarbus* began as early as the middle of the 19th century. Important ichthyologists of that era, such as A. Valenciennes and J. J. Heckel, were the first to study these fish. One of the most prominent biological collections from the Middle East of this time was made by T. Kotschy from 1836 to 1840. It is stored at the Museum of Natural History of Vienna and encompasses the type specimens of many zoological and botanical taxa (Kähsbauer 1963). The Moroccan ichthyofauna was described towards the end of the 19th century and the start of the 20th century by A. Günther and G. A. Boulenger. An expedition lead by C. du Gast in 1912 was one of the first systematic sampling efforts in this area (Pellegrin 1912). The Arabian representatives were reported only about 35 years ago by K. E. Banister and M. A. Clarke. In 1971, M.S. Karaman established the monotypic genus *Carasobarbus* for *Systomus luteus* Heckel, 1843 characterised by a laterally compressed and high-backed body, a narrow and high head, a single pair of barbels, pharyngeal bones with three rows of spoon-shaped teeth, a pharyngeal teeth count 2.3.5-5.3.2, a subterminal to terminal mouth, weakly developed lips that run along the jaws as a thin band, no median lobe on the lower lip, infraorbital bones of normal size, a short and broad first infraorbital (lacrimal) bone that is shorter than the eye diameter, a dorsal fin that is moderately long and has 10 branched rays, the origin of the dorsal fin being above the ventral fins, the last unbranched ray of the dorsal fin being well ossified and smooth, the anal fin with six branched rays, and large scales with numerous parallel radii. We revised and expanded Karaman's (1971) diagnosis of the genus that now contains the nine following species: *Carasobarbus apoensis* (Banister et Clarke, 1977), *C. canis* (Valenciennes in Cuvier and Valenciennes 1842), *C. chantrei* (Sauvage, 1882), *C. exulatus* (Banister & Clarke, 1977), *C. fritschii* (Günther, 1874), *C. harterti* (Günther, 1901), *C. kosswigi* (Ladiges, 1960), *C. luteus* (Heckel, 1843), and *C. sublimus* (Coad & Najafpour, 1997). Members of this genus were listed in 14 different genera and subgenera in the past: *Barbellion* Whitley, 1931, *Barbus* Cuvier, 1816, *Barynotus* Günther, 1868, *Capoeta* Valenciennes in Cuvier and Valenciennes 1842, *Carasobarbus* Karaman, 1971, *Cyclocheilichthys* Bleeker, 1859, *Kosswigobarbus* Karaman, 1971, *Labeobarbus* Rüppell, 1835, *Luciobarbus* Heckel, 1843, *Pseudotor* Karaman, 1971, *Puntius* Hamilton, 1822, *Systomus* McClelland, 1839, *Tor* Gray, 1834, and *Varicorhinus* Rüppell, 1835.

The objectives of the current study are to (1) define a monophyletic genus that is based on synapomorphic characters, (2) provide a conclusive diagnosis of the genus *Carasobarbus*, (3) give a detailed re-description of all species based on a sample of specimens large enough to show the intraspecific variability, (4) map the range of each species based on records confirmed by voucher specimens, (5) summarise information on biology, habitat and conservation status of each species, (6) discuss the taxonomic history and current status of each species, (7) provide an identification key. This will form a baseline for a molecular phylogenetic and zoogeographic analysis of *Carasobarbus* and related genera that is currently in preparation and will be published separately by the first author.

Methods

Abbreviations for ichthyological collections follow Sabaj-Pérez (2010) and Fricke and Eschmeyer (2013).

Nomenclature of geographic names follows the spelling recommended by the "United States Board on Geographic Names" (http://geonames.usgs.gov/), even though the transcriptions/transliterations of these toponyms are sometimes inconsistent. Wādī or Oued refer to a temporary stream. Nahr, Naẖal, Nehri, Rūdkhāneh or Rūd refer to a permanent river or stream. Buḩayratt, Göl or Daryācheh refer to a lake. ʻAyn or Aïn refer to a spring. Geographical coordinates in parentheses are original coordinates, given by a publication, the collector or a collection database. Coordinates determined ex post are marked by brackets. Most of these are from the National Geospatial-Intelligence Agency gazetteer (http://geonames.nga.mil/ggmagaz/) and as a consequence, do not refer to the actual site of collection, but to the geographic feature itself. For some of the well known waterbodies and cities the conventional name is used: Euphrates (Nahr al Furāt / Fırat Nehri), Jordan River (HaYarden / Nahr al Urdan), Lake Homs (Buḩayratt Qaţţīnah), Lake Tiberias (Yam Kinneret / Buḩhayratt Ţabarīyā), Orontes (Nahr al ʻĀşī / Asi Nehri), Tigris (Dicle Nehri / Nahr Dijlah), Aleppo (Ḩalab), Damascus (Dimashq), Mosul (Al Mawşil).

Twenty morphometric measurements were taken from specimens straightened whenever necessary; severely damaged and bent specimens were not used. There are some differences in the way of taking measurements (e.g. Hubbs and Lagler 1958 vs. Banister and Clarke 1977, Krupp 1983a). In this study, seven measurements were done over projections to the body axis. They are as follows: total length (the distance between projections of the tip of the snout and the posterior margin of the longest lobe of the caudal fin, with the caudal fin spread to its natural maximum), standard length (SL) (the distance between projections of the tip of the snout and the end of the hypural plate), preanal length (the distance between projections of the tip of the snout and the origin of the anal fin), predorsal length (the distance between projections of the tip of the snout and the origin of the dorsal fin), preventral length (the distance between projections of the tip of the snout and the origin of the ventral fin), head length (HL) (the distance between projections of the tip of the snout and the posterior margin of the bony opercle), and length of the caudal peduncle (the distance between projections of the insertion of the anal-fin base and the end of the hypural plate). The other measurements were done point-to-point: body depth (BD) as the maximum depth of the body (without dorsal fin) taken orthogonal to body axis; depth (minimum) of the caudal peduncle as the smallest depth of the caudal peduncle; length of the dorsal and anal fins as length of the last unbranched ray in the dorsal and anal fins, respectively; lengths of the pectoral and ventral fins as the distance from the fin base to the tip of the pectoral and ventral fins, respectively; length of the dorsal-fin base and the anal-fin base as a distance

Table 1. Comparison of morphometric characters of specimens between 50 mm SL and 150 mm SL. All measurements expressed as percentage of SL.

		total length	preanal length	predorsal length	preventral length	head length	caudal peduncle length	body depth	caudal peduncle depth	dorsal fin length	pectoral fin length	ventral fin length	anal fin length	dorsal-fin base length	anal-fin base length	anterior barbel length	posterior barbel length	eye diameter	mouth width	interorbital distance
C. apoensis	max	130.5	81.0	55.8	57.9	31.2	18.1	32.6	12.3	24.5	22.6	20.0	21.3	19.4	10.8	0.0	6.6	8.1	9.0	10.5
	min	121.0	76.3	48.5	51.3	26.5	11.8	25.4	10.2	16.7	18.1	16.9	16.8	15.1	7.2	0.0	2.4	5.5	5.7	8.1
	med	126.0	78.8	53.1	53.9	28.8	14.2	29.1	11.1	21.1	20.2	18.1	18.8	17.3	8.8	0.0	4.8	6.3	7.4	9.5
	n	41	43	44	44	44	44	44	44	42	44	44	43	44	44	0	44	44	44	44
C. canis	max	132.6	82.1	56.4	58.0	32.4	17.2	31.2	12.6	30.7	24.4	21.9	22.3	20.5	10.1	3.9	6.3	9.0	8.8	9.6
	min	121.2	75.0	47.8	50.9	26.2	12.5	26.7	9.9	18.0	18.4	16.1	14.9	16.8	7.0	0.7	2.3	5.4	6.2	7.1
	med	126.3	78.4	51.6	54.3	29.1	14.8	28.9	11.9	21.5	20.5	18.0	18.7	18.6	8.6	2.3	4.8	6.6	7.1	8.6
	n	54	56	56	56	56	56	56	56	46	56	56	56	56	56	52	55	56	54	56
C. chantrei	max	134.8	82.3	53.9	55.3	30.0	17.1	35.8	14.0	27.5	24.4	21.8	23.8	21.2	10.2	2.5	4.7	8.9	8.1	10.3
	min	121.9	72.8	47.7	50.6	22.2	11.7	26.4	11.0	18.8	17.6	16.4	16.3	17.2	7.0	0.5	2.2	5.0	5.8	7.7
	med	129.7	77.9	50.6	53.0	26.1	14.5	30.8	12.6	24.6	21.7	19.8	20.4	19.2	8.8	1.1	3.4	6.9	6.9	9.2
	n	81	84	84	84	84	84	84	84	76	82	84	83	84	84	68	84	84	81	84
C. exulatus	max	134.8	82.3	53.9	55.3	30.0	17.1	35.8	14.0	27.5	24.4	21.8	23.8	21.2	10.2	2.5	4.7	8.9	8.1	10.3
	min	121.9	72.8	47.7	50.6	22.2	11.7	26.4	11.0	18.8	17.6	16.4	16.3	17.2	7.0	0.5	2.2	5.0	5.8	7.7
	med	129.7	77.9	50.6	53.0	26.1	14.5	30.8	12.6	24.6	21.7	19.8	20.4	19.2	8.8	1.1	3.4	6.9	6.9	9.2
	n	81	84	84	84	84	84	84	84	76	82	84	83	84	84	68	84	84	81	84
C. fritschii	max	137.5	82.9	53.7	55.3	26.8	18.8	34.3	13.6	28.0	25.2	23.8	31.3	20.6	11.9	5.6	8.3	8.8	9.8	10.7
	min	121.1	73.6	44.9	47.0	18.8	10.7	24.8	10.6	19.6	19.3	15.8	18.1	15.0	6.6	1.4	2.8	4.7	5.4	6.3
	med	129.8	77.1	49.3	50.7	23.0	15.0	29.2	11.9	23.6	22.2	20.5	22.4	17.4	9.1	3.1	4.7	6.6	7.1	9.1
	n	229	243	244	243	244	244	244	243	196	244	244	242	243	243	242	244	244	244	244
C. harterti	max	140.9	78.0	53.7	55.8	27.5	18.4	31.6	13.3	31.8	25.5	24.8	24.1	19.0	10.3	9.1	9.6	9.5	7.1	9.6
	min	122.6	70.9	46.5	48.5	21.2	12.3	26.8	11.8	25.8	21.5	20.4	18.9	16.5	8.4	4.5	5.5	5.9	5.2	7.4
	med	131.8	75.0	49.8	51.1	24.4	16.0	29.2	12.8	28.9	23.5	22.8	21.1	18.0	9.3	6.6	7.8	7.4	6.2	8.4
	n	19	24	24	24	24	24	24	24	11	24	23	23	24	24	24	24	24	24	24
C. kosswigi	max	133.9	79.7	53.4	51.9	25.3	16.0	32.8	12.9	35.5	23.8	21.8	26.4	21.8	11.1	5.5	7.4	8.1	5.9	8.5
	min	127.1	75.4	47.0	48.7	22.8	11.9	26.2	10.4	26.1	20.1	19.1	20.0	18.1	8.8	2.8	3.6	4.8	3.7	7.3
	med	130.4	77.7	49.7	50.8	24.5	14.5	31.1	11.9	28.8	22.1	20.8	22.6	19.9	10.0	4.3	5.1	5.9	4.6	7.9
	n	14	15	15	15	15	15	15	15	14	15	15	15	15	15	15	15	15	15	15
C. luteus	max	134.1	84.0	56.3	57.9	33.1	15.8	40.1	14.3	31.9	24.6	22.7	23.7	22.6	10.7	3.2	7.1	10.1	10.7	11.3
	min	120.4	74.7	47.3	48.6	21.7	8.6	26.2	11.0	17.6	17.9	16.8	15.8	14.9	6.6	0.6	2.8	0.0	5.1	7.4
	med	127.5	79.1	52.2	53.4	27.3	13.2	33.6	12.8	24.9	21.4	19.8	19.9	19.2	9.0	1.7	4.4	7.2	7.1	9.6
	n	257	264	268	265	267	266	268	268	241	267	268	266	267	267	41	266	265	233	268
C. sublimus	max	137.9	81.4	57.0	56.8	30.1	14.8	33.4	13.8	29.9	25.5	23.8	28.4	22.1	11.5	7.0	9.7	10.0	7.6	9.0
	min	131.9	76.5	49.1	49.6	25.2	10.3	27.9	11.8	19.7	22.9	21.0	21.9	19.4	8.7	4.1	5.1	5.6	3.6	6.8
	med	134.4	77.9	52.5	54.2	27.7	13.0	30.6	12.8	28.3	24.3	22.2	23.9	20.7	10.2	5.4	8.0	8.9	6.4	8.4
	n	16	18	18	18	18	18	18	18	14	18	18	18	18	18	18	18	18	18	18

between the origin and the insertion of the fin; length of the anterior and posterior barbels as distance from the barbel base to the tip of the barbel when straightened; horizontal diameter of the eye as a distance between the anterior and the posterior bony margins of the eye cavity; width of the mouth as a distance between the two posterior ends of the lower jaw; interorbital distance as a distance between the upper margins of the eye cavities across the head. For comparison between species, all measurements are expressed as percentage of SL. To attenuate effects of allometric growth, only specimens in the size range between 50 mm SL and 150 mm SL were used for the box-plots and the data given in Table 1.

In addition, seven meristic characters were analysed. The last branched anal- and dorsal-fin rays were counted as one when lying directly adjacent to each other without an interspace. Scales in the lateral line were counted from the first scale with a pore to the last scale on the caudal peduncle (some authors only count to the end of the hypural plate). Scales above the lateral line were counted between the origin of the dorsal fin and the lateral line; the lateral line was not included and a scale on the mid-line of the back was counted as 0.5. Scales below the lateral line were counted between origin of the anal fin to the lateral line; the lateral line was not included and a scale on the mid-line of the belly was counted as 0.5. Scales around the least circumference of the caudal peduncle were counted as one circle of scales around the least circumference of the caudal peduncle. Number of pairs of barbels was counted as two when anterior and posterior pairs are present, counted as one if only posterior pair is present and counted as 1.5 if posterior pair and one single anterior barbel is present.

For counting the number of pharyngeal teeth, the pharyngeal bones were extracted in a subsample of specimens and the pharyngeal teeth counted sometimes only on one side. Lost teeth were counted when the point of insertion was clearly visible. Scales were extracted in the anterior part of the body, above the lateral line.

We did not differentiate between male and female specimens because sex determination was not possible without dissection.

Results

Genus *Carasobarbus* Karaman, 1971

http://species-id.net/wiki/Carasobarbus

Carasobarbus Karaman 1971: 230; type species: *Systomus luteus* Heckel, 1843, by original designation, also by monotypy.

Kosswigobarbus Karaman 1971: 239; type species: *Cyclocheilichthys kosswigi* Ladiges, 1960, by original designation, also by monotypy.

Pseudotor Karaman 1971: 229; type species: *Barbus fritschii* Günther, 1874, by original designation.

Diagnosis. Medium-sized cyprinids with an ossified, smooth last unbranched dorsal-fin ray; 9 or 10 branched dorsal-fin rays and 6 branched anal-fin rays; large, shield-shaped scales with numerous parallel radii; the lateral line with 25 to 39 scales; the pharyngeal teeth hooked at their tips, their count being 2.3.5-5.3.2 or 2.3.4-4.3.2; 1 or 2 pairs of barbels present.

Carasobarbus species are evolutionarily hexaploid (Machordom and Doadrio 2001, Gorshkova et al. 2002, Leggatt and Iwama 2003, Tsigenopoulos et al. 2010).

Remarks and discussion. '*Barbus*' *grypus*, *Mesopotamichthys sharpeyi* and '*Barbus*' *reinii* from the Middle East have five branched rays in the anal fin. The hexaploid species from Africa (*Labeobarbus* and *Varicorhinus*), which are the sister group to *Carasobarbus* and the other species from the Middle East (Tsigenopoulos et al. 2010, KB unpublished), have five branched rays in the anal fin. The Asian species (*Tor* and *Neolissochilus*) are sister group to the species from Africa and the Middle East (Tsigenopoulos et al. 2010, KB unpublished) and have five branched rays in the anal fin. By application of the parsimony principle the possession of six branched anal-fin rays is a synapomorphy of the genus *Carasobarbus*. The possession of nine to 10 branched rays in the dorsal fin is synapomorphic for *Carasobarbus*, because the closely related Middle-Eastern species '*Barbus*' *grypus*, *Mesopotamichthys sharpeyi* and '*Barbus*' *reinii* as well as many African hexaploids have the plesiomorphic state of eight branched rays in the dorsal fin. However, in some African species the number of branched dorsal-fin rays is increased convergently. These two synapomorphies establish *Carasobarbus* as a monophyletic group. Analyses of the mitochondrial cytochrome *b* gene confirm the monophyly of this genus (Durand et al. 2002, Tsigenopoulos et al. 2010, KB unpublished data). Colli et al. (2009) found *Carasobarbus* to be monophyletic in their maximum likelihood analysis but not in their neighbour joining analysis. '*Barbus*' *grypus* Heckel, 1843 is the sister taxon of the genus *Carasobarbus* (Tsigenopoulos et al. 2010).

Out of the generic names *Barbellion*, *Barbus, Barynotus*, *Capoeta*, *Carasobarbus*, *Cyclocheilichthys*, *Kosswigobarbus*, *Labeobarbus*, *Luciobarbus*, *Pseudotor*, *Puntius*, *Systomus*, *Tor,* and *Varicorhinus* that were used for this taxon – or its parts – by previous authors, only *Carasobarbus*, *Kosswigobarbus* and *Pseudotor* are available for the genus in question. All other generic names have not been considered, because their type species are not closely related to the species under discussion here (Durand et al. 2002, Tsigenopoulos et al. 2010, KB unpublished data) or do not share the characters mentioned above. *Carasobarbus*, *Kosswigobarbus* and *Pseudotor* are subjective synonyms. They all were established in the same publication (Karaman 1971) and thus none of them has priority. We, acting as First Reviser, select *Carasobarbus* to have priority in accordance with article 24.2 of the International Code for Zoological Nomenclature (ICZN 2012). Thus *Carasobarbus* is the valid name for this genus.

Within the genus, several species share characters that are potentially synapomorph and elucidate sister group relations. *Carasobarbus fritschii* and *C. harterti* both have pharyngeal bones with four teeth in the medial row. This character is probably synapomorph, because all other congeners have five teeth in the medial row. This group corresponds to *Pseudotor*. *Carasobarbus kosswigi* and *C. sublimus* share the possession of a spatulate lower jaw and a median lobe on the lower lip. The spatulate lower jaw is synapomorph, because no congener and no other closely related species shares this character. The close phylogenetic relationship between *C. kosswigi* and *C. sublimus* is confirmed by genetic analysis (Borkenhagen et al. 2011). These two species correspond to *Kosswigobarbus*.

Carasobarbus apoensis (Banister & Clarke, 1977)

http://species-id.net/wiki/Carasobarbus_apoensis

Barbus apoensis Banister and Clarke 1977: 113.

Material. Type material. Holotype of *Barbus apoensis*: BMNH 1976.4.7:166, Saudi Arabia, permanent stream near Khamīs Mushayt (N18°17', E42°34'), F. Tippler, 12 Dec 1968.

Paratypes of *Barbus apoensis*: BMNH 1976.4.7:167-171, 5, same data as holotype. - BMNH 1976.4.7:172-175, 4, Saudi Arabia, upper Wādī Turabah near Aṭ Ṭā'if (N22°56', E40°54'), G. Popov. - BMNH 1971.2.11:1-2, 2, Saudi Arabia, intermittent watercourse in Wādī Adamah (N19°53', E41°57'), J. P. Mandaville, 27 Oct 1969.

Non-type material. Endorheic darinages. BMNH 1980.7.1:15, 1, Saudi Arabia, Wādī Habayaba between Aṭ Ṭā'if and Ash Shafā [N21°11', E 40°24'], A. Farag, 1980. - SMF 30167, 3; SMF 30170, 10 Saudi Arabia, Wādī Būwah (N20°45', E41°8'), F. Krupp and W. Schneider, 21 Mar 1990. - SMF 30169, 6; SMF 33147, 4, Saudi Arabia, Wādī Būwah (N20°44', E41°7'), F. Krupp and W. Schneider, 21 Mar 1990. - SMF 30168, 6; SMF 30171, 9, Saudi Arabia, Wādī Turabah (N20°32', E41°17'), F. Krupp and W. Schneider, 20 Mar 1990.

Streams draining towards the Red Sea. CMNFI 87-0135, 1; CMNFI 87-0137, 4, Saudi Arabia, Wādī Hadīyah (N25°34', E38°41'). - SMF 33149, 1, Saudi Arabia, Wādī Ḩaqqaq (N22°49', E39°22'), W. Büttiker, 5/6 May 1983. - SMF 33148, 2, Saudi Arabia, Wādī 'Ilyab (N20°5', E40°54'), H. Felemban and J. Gasparetti, 28 Oct 1983. - SMF 33539, 3, Saudi Arabia, Wādī 'Ilyab (N20°7', E40°57), W. Büttiker, 10–11 Nov 1983.

Unknown drainage system. SMF 33146, 4, Saudi Arabia, Al Ḩijāz, W. Büttiker.

Diagnosis. One pair of barbels, usually 10 branched rays in the dorsal fin, 27 to 32 scales in the lateral line, usually 12 scales around the least circumference of the caudal peduncle, last unbranched ray of dorsal fin shorter than head.

Description. The body depth is comparatively low and a nuchal hump is present in adults but not developed in juveniles. The height of the caudal peduncle is relatively low (Table 1). The dorsal and ventral fins are usually positioned behind the middle of the body. The head is elongate with a straight or slightly concave dorsal profile. The ventral profile of the head is slightly convex. (Figs 1, 2). The head length is about equal to the body depth. The mouth is broad and terminal or slightly sub-terminal with one pair of barbels (Fig. 3, Table 2). Only one out of 65 specimens had two pairs of barbels and in one specimen a single anterior barbel was present. The eyes are in the anterior half of the head and slightly protuberant. The morphometric characters are summarised in Table 1.

Figure 1. *Carasobarbus apoensis*, holotype (BMNH 1976.4.7:166) from a permanent stream near Khamīs Mushayt, © The Natural History Museum, London.

Figure 2. *Carasobarbus apoensis*, live specimen from Wādī Turabah.

The dorsal fin and its base are rather short. It usually has four unbranched and 10 branched rays (Table 3). The last unbranched ray is considerably shorter than the head (Fig. 4), weakly ossified, and its distal part is flexible. The anal fin has three unbranched and six branched rays (Table 4). Pectoral and ventral fins are relatively short (Table 1).

Carasobarbus apoensis has 27 to 32 scales in the lateral line (Table 5), usually 4.5 scales above the lateral line (Table 6), 3.5 or 4.5 scales below the lateral line (Table 7) and 12 scales around the least circumference of the caudal peduncle (Table 8). The scales are shown in Fig. 5.

The pharyngeal teeth count is 2.3.5- in 12 specimens, -5.3.2 in two specimens and 1.3.5- in one specimen. The pharyngeal teeth are hooked at their tips (Fig. 6).

Live colouration is golden with olive fins. The upper side is darker than the belly (Fig. 2). In ethanol-preserved specimens the upper side is dark, the belly yellow and the fins are grey or yellow (Fig. 1). Juveniles have a dark lateral spot on the caudal peduncle.

The maximum length observed in the material examined is 288 mm SL.

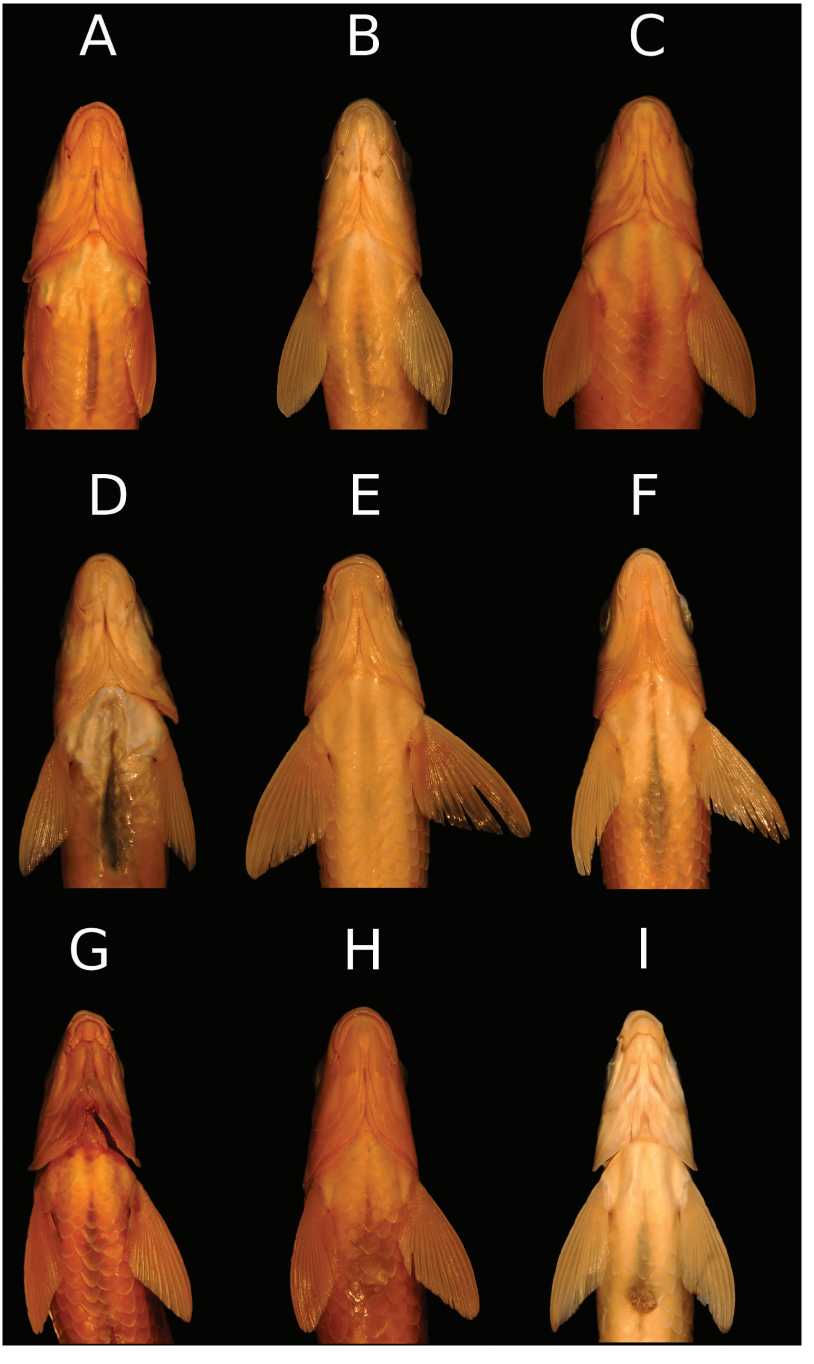

Figure 3. Ventral view of the head and chest. **A** *C. apoensis* (SMF 30167, 108.6 mm SL) **B** *C. canis* (SMF 33135, 108.3 mm SL) **C** *C. chantrei* (SMF 33133, 122.9 mm SL) **D** *C. exulatus* (SMF 33109, 103.7 mm SL) **E** *C. fritschii* (SMF 33446, 89.6 mm SL) **F** *C. harterti* (SMF 33368, 93.6 mm SL) **G** *C. kosswigi* (SMF 30173, 107.1 mm SL) **H** *C. luteus* (SMF 30176, 120.7 mm SL) **I** *C. sublimus* (SMF 33118, 80.2 mm SL), pictures resized to facilitate comparison.

Table 2. Number of pairs of barbels.

	n	1	1,5	2
C. apoensis	65	63	1	1
C. canis	89	4	1	84
C. chantrei	157	5	6	146
C. exulatus	83			83
C. fritschii	299	2		297
C. harterti	30			30
C. kosswigi	23			23
C. luteus	421	365	9	47
Naband population	10			10
C. sublimus	18			18

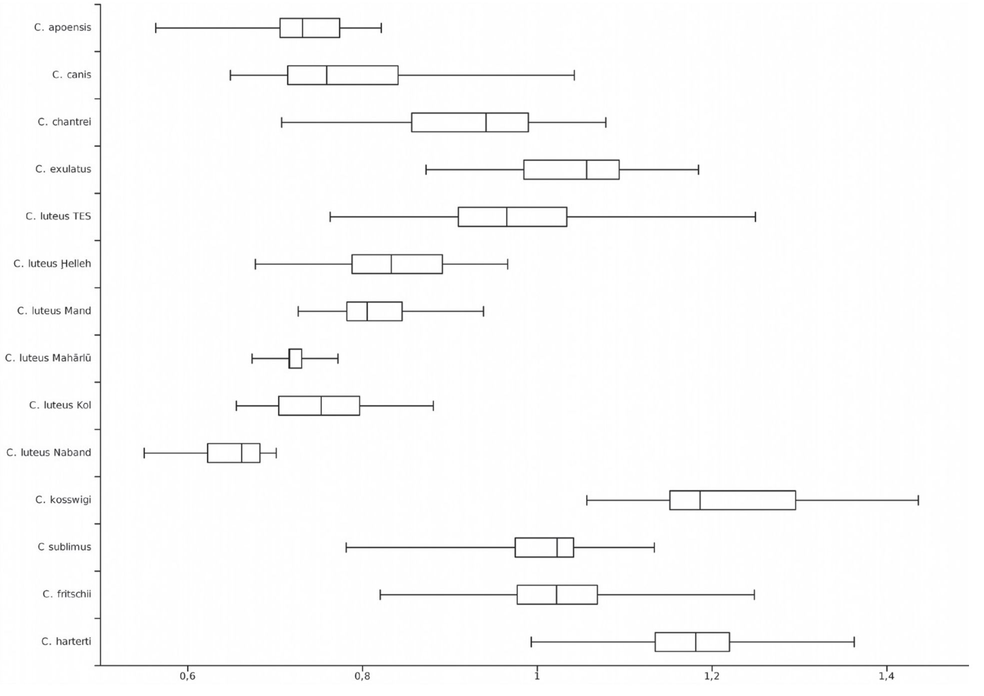

Figure 4. Last unbranched dorsal-fin ray length / head length; TES = Tigris-Euphrates system.

Carasobarbus apoensis differs from all congeners, except *C. luteus*, by having one rather than two pairs of barbels. For a comparison with *C. luteus* populations see below.

Distribution. *Carasobarbus apoensis* occurs in the Al Ḩijāz mountain range in wadis draining either inland or towards the Red Sea (Fig. 7). It is endemic to Saudi Arabia.

Habitats and biology. This species inhabits the upper courses of wadis, which are characterised by strong seasonal fluctuations in water levels, temperature and other physiochemical parameters.

Table 3. Number of branched dorsal-fin rays.

	n	7	8	9	10	11
C. apoensis	66			2	63	1
C. canis	90			5	85	
C. chantrei	196			21	164	11
C. exulatus	110		8	99	3	
C. fritschii	297	1	23	268	5	
C. harterti	30			30		
C. kosswigi	23			3	20	
C. luteus	441		1	23	411	6
Naband population	10			1	9	
C. sublimus	18			2	16	

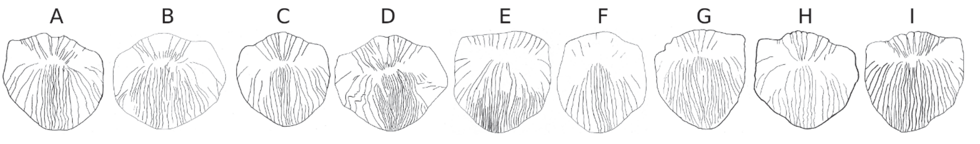

Figure 5. Striation pattern of scales taken from anteriour part of the boby above lateral line. **A** *C. apoensis* **B** *C. canis* **C** *C. chantrei* **D** *C. exulatus* **E** *C. fritschii* **F** *C. harterti* **G** *C. kosswigi* **H** *C. luteus* **I** *C. sublimus*.

Conservation status. *Carasobarbus apoensis* is rated Least Concern and still occurs in large numbers, but abstraction of large specimens by recreational fishing, water abstraction and habitat loss might become problematic for this species (BCEAW 2002).

Remarks and discussion. *Carasobarbus apoensis* was originally described from Khamīs Mushayt, Wādī Turabah and Wādī Adamah as a member of the genus *Barbus* (Banister and Clarke 1977). It was later transferred to the genus *Carasobarbus* (Ekmekçi and Banarescu 1998). Alkahem and Behnke (1983) reported an unknown *Barbus* and tentatively considered these specimens to be atypical *C. apoensis*. We did not find any evidence of an undescribed *Carasobarbus* species that occurs sympatrically with *C. apoensis*, thus we agree with their conclusion.

Carasobarbus apoensis is very closely related to *C. luteus* (KB unpublished data).

Carasobarbus canis (Valenciennes in Cuvier and Valenciennes 1842)

http://species-id.net/wiki/Carasobarbus_canis

Barbus canis Valenciennes in Cuvier and Valenciennes 1842: 186.
Barbus beddomii Günther 1868: 110.

Material. Type material. Lectotype of *Barbus canis*: MNHN 0000-1413, 1, Jordan River [N31°46', E35°33'], Bové, 1833 (designated by Krupp and Schneider 1989).

Paralectotype of *Barbus canis*: MNHN 0000-3944, 1, same data as lectotype.

Table 4. Number of branched anal-fin rays.

	n	5	6	7
C. apoensis	65		65	
C. canis	90	2	88	
C. chantrei	197	3	194	
C. exulatus	109	3	106	
C. fritschii	296	3	293	
C. harterti	30		29	1
C. kosswigi	23		23	
C. luteus	439	3	435	1
Naband population	10		10	
C. sublimus	18		18	

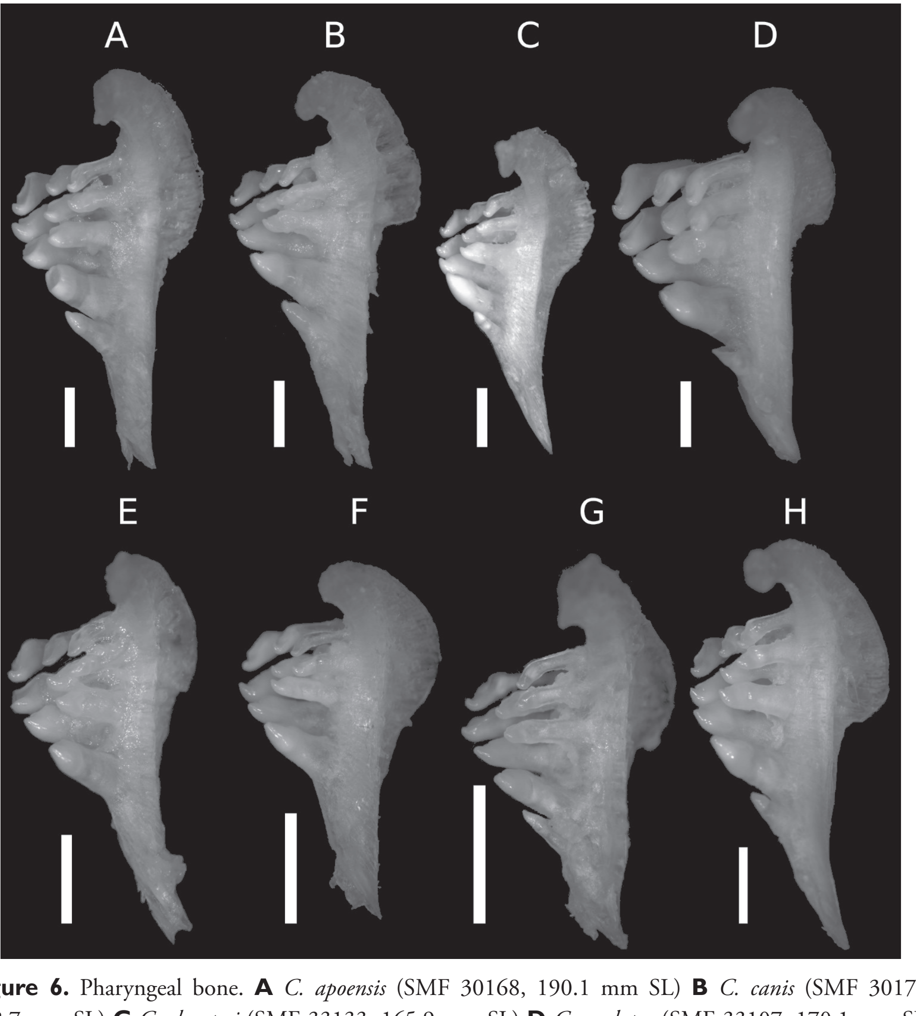

Figure 6. Pharyngeal bone. **A** *C. apoensis* (SMF 30168, 190.1 mm SL) **B** *C. canis* (SMF 30175, 168.7 mm SL) **C** *C. chantrei* (SMF 33133, 165.9 mm SL) **D** *C. exulatus* (SMF 33107, 170.1 mm SL) **E** *C. fritschii* (SMF 33405, 147.2 mm SL) **F** *C. harterti* (SMF 33396, 105.9 mm SL) **G** *C. kosswigi* (SMF 30174, 141.5 mm SL) **H** *C. luteus* (SMF 30179, 143.4 mm SL). Scale bar = 3 mm.

Holotype of *Barbus beddomii*: BMNH 1863.11.3:5, 1, Lake Tiberias [N32°48', E35°35'], T. W. Beddome.

Non-type material. Jordan River Drainage. SMF 14075, 2, Lake Tiberias (N32°48', E35°35'), M. Goren, 15 Mar 1968. - SMF 33134, 16, Syria, Nahr al Yarmūk near Jallayn (N32°44'21", E35°58'56"), N. Alwan et al., 16 Oct 2008. - SMF 24464, 1, Jordan, Nahr al Yarmūk near Maqārin (N32°43', E35°53'), F. Krupp and W. Schneider, 23 Sep 1985. - SMF 30175, 11, Syria, Lake Muzayrīb [N32°42'40", E36°1'39"], F. Krupp and W. Schneider, 12 Apr 1989. - SMF 33135, 17, Jordan, Wadi al-'Arab near the dam (N32°37'6", E35°37'46"), N. Alwan et al., 25 Oct 2008. - SMF 17123, 16, Wādī al Yābis (N32°24', E35°36'), F. Krupp and W. Schneider, 23 Jul 1980. - ZMH H 2343, 3, Jordan, Wādī Kufrinjah (N32°16'25", E35°33'42"). - SMF 24344, 3; SMF 24345, 17, Jordan, Nahr az Zarqā' (N32°12', E35°50'), F. Krupp and W. Schneider, 22 Jul 1980. - SMF 24339, 3, Jordan, Nahr az Zarqā' (N32°10', E35°37'), F. Krupp and W. Schneider, 21 Jul 1980. - SMF 24340, 1, Jordan, Nahr az Zarqā' near Sadd al Malik Talal (N32°10', E35°49'), F. Krupp and W. Schneider, 22 Jul 1980. - SMF 24331, 7; SMF 24346, 3, Jordan, Nahr al Yarmūk channel (N32°08', E35°36'), F. Krupp and W. Schneider, 21 Jul 1980. - NMW 53961, 1, Jordan River [N31°46', E35°33'], Cenoni, Dec 1898.

Azraq Oasis. BMNH 1956.2.24:15-16, 2; BMNH 1965.11.24:2, 1, Jordan, wetland near Azraq ash Shīshān [N31°50', E36°49'].

Coastal rivers of the Mediterranean Sea. BMNH 1949.9.16:124, 1, Israel, Naẖal Na'aman [N32°54'42", E35°4'50"]. - NMW 22367, 1, Israel, Naẖal Na'aman [N32°54'42", E35°4'50"], H. Steinitz, 21 Oct 1955. - SMF 9229, 1, Israel, Naẖal Yarqon [N32°6'7", E34°46'32"].

Diagnosis. Two pairs of barbels, 29 to 35 scales in the lateral line and usually 12 scales around the least circumference of the caudal peduncle, last unbranched ray of dorsal fin shorter than head.

Description. The body is low. A nuchal hump is present in adults but absent in juveniles. The largest body depth is at the origin of the dorsal fin. The head is long, rather low and fairly narrow with straight dorsal and convex ventral profile (Figs 8, 9). The head length approximately equals the body depth. The mouth is terminal or slightly subterminal. Two pairs of barbels are present (Table 2). The lips are smooth and thin (Fig. 3). The eyes are at the end of the anterior half of the head. The morphometric characters are summarised in Table 1.

Pectoral, ventral, dorsal and anal fins are comparatively short (Table 1). The dorsal fin usually has four unbranched and 10 branched rays (Table 3). The last unbranched ray is ossified and its distal part is flexible. It is usually markedly shorter than the head (Fig. 4). The anal fin usually has three unbranched and six branched fin rays (Table 4).

There are 29 to 35 scales in the lateral line (Table 5), usually 4.5 or 5.5 scales above the lateral line (Table 6), usually 4.5 scales below the lateral line (Table 7) and usually 12 scales around the least circumference of the caudal peduncle (Table 8). The scales are shown in Fig. 5.

Table 5. Lateral line scale count.

	n	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
C. apoensis	60			1	9	15	20	14	1							
C. canis	74					1	3	16	19	12	13	10				
C. chantrei	168							5	11	31	48	36	29	7	1	
C. exulatus	79		1	3	17	18	24	13	3							
C. fritschii	264						1	12	21	39	75	58	36	15	4	3
C. harterti	24							1		5	9	4	4		1	
C. kosswigi	19								1	7	2	3	5		1	
C. luteus	390	11	52	79	120	84	29	9	5	1						
Naband population	8				1	3	3	1								
C. sublimus	11			4	3	4										

The pharyngeal teeth count is 2.3.5-5.3.2 in 23 specimens, 2.3.3-5.3.2 in one specimen, 2.3.5- in one specimen and -5.3.2 in one specimen. The pharyngeal teeth are hooked at their tips (Fig. 6).

Live specimens are silvery to bronze coloured. The posterior third of the body and the fins are distinctly yellow in many specimens (Fig. 9). Ethanol-preserved specimens are brownish yellow and the back is only slightly darker than the rest of the body (Fig. 8). The fins are brownish yellow. Juveniles have a dark lateral spot on the caudal peduncle.

Carasobarbus canis differs from *C. apoensis* and *C. luteus* in having two pairs of barbels vs. one, from *C. kosswigi* and *C. sublimus* in having a crescent-shaped lower lip without median lobe vs. a spatulate lower lip with median lobe, from *C. exulatus* in modally having 10 branched dorsal-fin rays vs. nine and from *C. chantrei*, *C. fritschii* and *C. harterti* in modally having 10 scales around the least circumference of the caudal peduncle vs. 14 or 16.

Distribution. *Carasobarbus canis* occurs in the Jordan River system (Fig. 7). There are only few records from coastal rivers of the Mediterranean Sea (Naẖal Na'aman and Naẖal Yarqon). A recent treatment of the inland water fish communities of Israel does not report *C. canis* from coastal rivers (Goren and Ortal 1999). The population in the Azraq Oasis was introduced by humans (Krupp and Schneider 1989). Since the year 2000 this species was not found in Azraq (Hamidan 2004) and the population may have disappeared due to drought. Records from the Tigris-Euphrates system (Banister 1980) are based on misidentifications.

Habitats and biology. *Carasobarbus canis* inhabits a wide range of rivers, lakes and ponds (Goren 1974) with clean as well as polluted water (Mir 1990). Adults reach a length of about 40 cm (max. 66 cm) and are of economic importance locally (annual catch in Israel 1970-85 about 50 t, Fishelson et al. 1996). It feeds on fish, aquatic invertebrates, algae and detritus (Ben-Tuvia 1978, Spataru and Gophen 1985, Krupp and Schneider 1989). The relative proportion of fish in the diet increases with body length and small cyprinids of the genus *Mirogrex* are their most important prey (Spataru and Gophen 1985). The spawning grounds are (among others) at the shore of Lake Tiberias where the spawn-

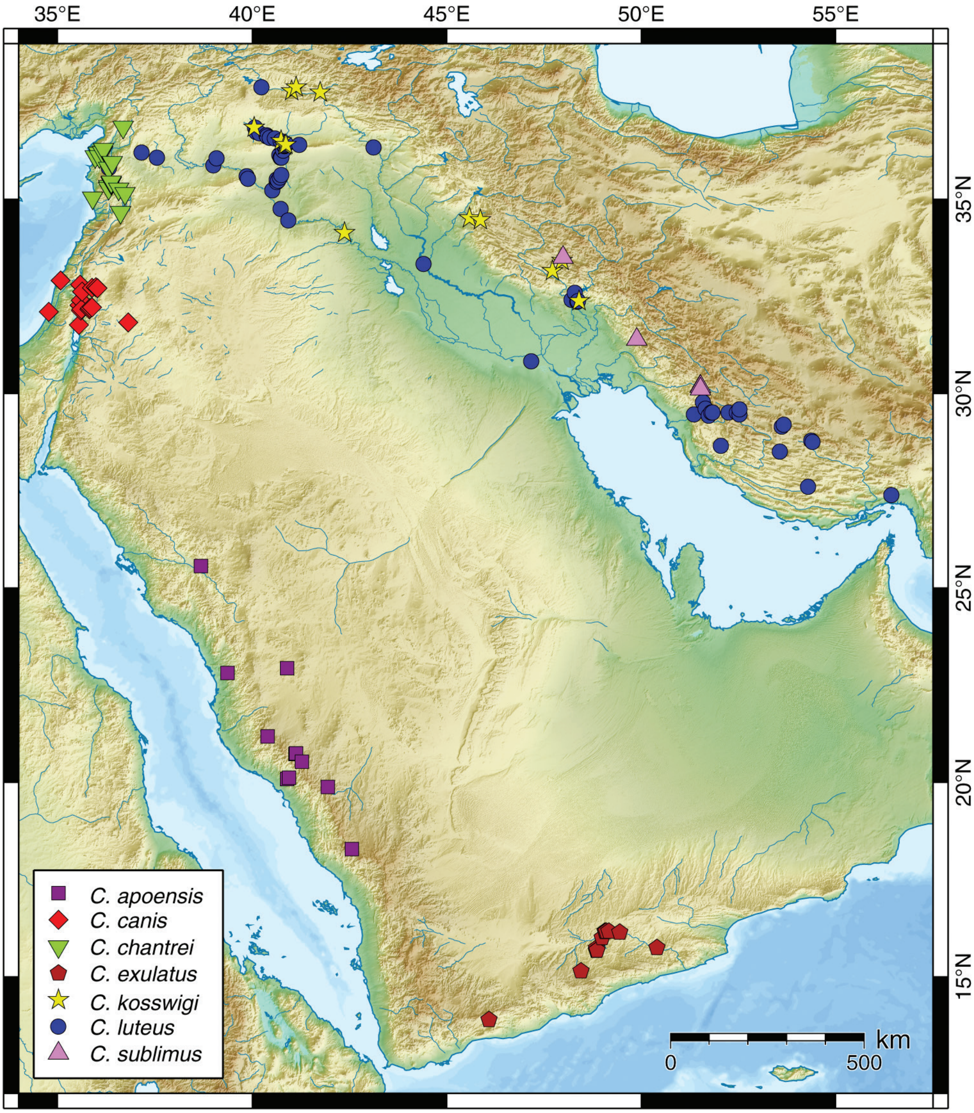

Figure 7. Map of the distribution of *C. apoensis*, *C. canis*, *C. chantrei*, *C. exulatus*, *C. kosswigi*, *C. luteus*, and *C. sublimus.*

ing occurs in shallow water over hard bottom in December and January, one month after the start of the rainy season (Fishelson et al. 1996). The sticky eggs attach to the substrate. Winter spawning is seen as evidence for an origin in cooler areas (Fishelson et al. 1996).

Conservation status. Catches in Lake Tiberias are declining (Fishelson et al. 1996). The species is rated Least Concern by the IUCN (Crivelli 2006a). The population in Lake Tiberias does not face serious threats; the riverine populations are declining and threatened by pollution, water extraction, drought and fragmentation due to damming (Crivelli 2006a).

Table 6. Number of scales above the lateral line.

	n	3,5	4	4,5	5	5,5	6	6,5	7
C. apoensis	60		2	45	7	6			
C. canis	82			48	11	20	3		
C. chantrei	171			4	1	147	6	13	
C. exulatus	79		3	70	5	1			
C. fritschii	276			15		226		35	
C. harterti	28					4		24	
C. kosswigi	21					8	5	7	1
C. luteus	389	6	2	315	19	46	1		
Naband population	8			8					
C. sublimus	17			16		1			

Figure 8. *Carasobarbus canis*, lectotype (MNHN 1413) from Jordan River.

Figure 9. *Carasobarbus canis*, live specimen from Wadi al-'Arab.

Remarks and discussion. *Carasobarbus canis* was described from the Jordan River as a member of the genus *Barbus* (Cuvier and Valenciennes 1842). Later it was assigned to *Luciobarbus* (Heckel 1843), and *Labeobarbus* (Günther 1864). Subsequently it was transfered back to *Barbus* (Günther 1868) and then placed in *Tor* (Karaman 1971, Banarescu 1977), *Barbus* (Banister and Clarke 1977, Krupp 1983a), *Carasobar-*

Table 7. Number of scales below the lateral line.

	n	3	3,5	4	4,5	5	5,5	6	6,5
C. apoensis	57		14		41		2		
C. canis	80		2	3	65	1	9		
C. chantrei	173			1	84	3	84	1	
C. exulatus	79		24	1	51	3			
C. fritschii	286		7	3	151	5	117	1	2
C. harterti	29		1		10		18		
C. kosswigi	23				4	3	15		1
C. luteus	384	2	125	16	231	9	1		
Naband population	8				8				
C. sublimus	17		1		13	1	2		

bus (Ekmekçi and Banarescu 1998) and *Barbus* subgenus *Carasobarbus* (Tsigenopoulos et al. 2010). MNHN 0000-1413 was designated as lectotype (Krupp and Schneider 1989). *Barbus beddomii* is considered to be a junior synonym of *C. canis* (Berg 1949, Karaman 1971, Krupp and Schneider 1989).

Carasobarbus chantrei (Sauvage, 1882)

http://species-id.net/wiki/Carasobarbus_chantrei

Labeobarbus chantrei Sauvage 1882: 165.
Barynotus verhoeffi Battalgil 1942: 292.

Material. Type material. Lectotype of *Labeobarbus chantrei*: MNHN A-3866, Turkey, Amik Gölü [N36°12'24", E36°9'26"], H. Chantre, 1881 (designated by Krupp 1985a).

Paralectotypes of *Labeobarbus chantrei*: MNHN A-3937, 1, same data as lectotype. - MNHN A-3938, 2; MNHN A-3939, 3; MNHN A-3940, 1, Syria, Ḩamāh [N35°9'0", E36°43'59"], H. Chantre, 1881.

Non-type material. Orontes River drainage. MNHN B-2977, 1, Syria, Orontes, A. Gruvel, 1829. - BMNH 1934.1.25:4, 1, Syria, Orontes. - FSJF 2311, 11, Turkey, Karasu Çayı below dam of Tahtaköprü Barajı (N36°51'7", E36°41'10"), M. Özulug and J. Freyhof, 7 Nov 2007. - SMF 17115, 8, Turkey, Orontes, 8 km E of Hatay (N36°17', E36°11'), J. Winkler and B. Koster, 20 Sep 1982. - CMNFI 88-0019, 1, Turkey, 8 km southwest of Hatay (N36°11', E36°3'). - SMF 17110, 4, Turkey, tributary to Orontes (N36°11', E36°3'), F. Krupp, 23 Aug 1978. - SMF 17122, 2, Turkey, 2 km southeast of Samandağı (N36°6', E35°58'), F. Krupp, 23 Aug 1978. - FSJF uncatalogued, 16, Turkey, at Sinanlı (N36°5'51", E36°4'43"), M. Özulug and J. Freyhof, 8 Nov 2007. - SMF 33130, 40, Syria, near Mashra'a el Būz (N35°57'3", E36°23'45"), N. Alwan et al., 8 Oct 2008. - SMF 33131, 58, Syria, 'Ayn az Zarqa (N35°56'40", E36°24'9"), N. Alwan et al., 8 Oct 2008. - SMF 17107, 1, Syria, Jisr ash Shughūr (N35°48', E36°19'), F. Krupp, 20 Aug 1980. - SMF 17109, 2, Syria, main bridge at

Table 8. Number of scales around the least circumference of the caudal peduncle.

	n	10	11	12	13	14	15	16	17	18	19	20
C. apoensis	60			58	2							
C. canis	85			80	1	4						
C. chantrei	168			4	7	110	27	20				
C. exulatus	87	1	6	80								
C. fritschii	253					3	12	212	26	23		1
C. harterti	28				2	4	3	18	1			
C. kosswigi	21			1	2	10	3	5				
C. luteus	408	3	2	399	4							
Naband population	9			8	1							
C. sublimus	17			17								

Jisr ash Shughūr (N35°48', E36°19'), F. Krupp, 19 Aug 1978. - CMNFI 88-0018, 4, Syria, ‘Ayn Zaqa (N35°27', E36°23'). - SMF 17114, 1; SMF 17121, 7, Syria, ‘Ayn Zaqa (N35°27', E36°23'), F. Krupp, 25–27 Mar 1979. - BMNH 1968.12.13:188-190, 3, Syria, spring lake at Qal‘at al Maḍīq [N35°25', E36°23']. - SMF 17120, 7, Syria, aquaculture pond near Qal‘at al Maḍīq (N35°25', E36°23'), F. Krupp, 8 Aug 1978. - SMF 33132, 5, Syria, stream at Qal‘at al Jarras (N35°19'49", E36°18'38"), N. Alwan et al., 12 Oct 2008. - SMF 17111, 6, Syria, ‘Ašārna (N35°17', E36°19'), F. Krupp, 11 Aug 1978. - SMF 17117, 5, Syria, near Shayzar (N35°16', E36°34'), F. Krupp, 27 Mar 1979. - SMF 24349, 3, Syria, Shayzar (N35°16', E36°34'), F. Krupp and W. Schneider, 17 Aug 1980. - SMF 17118, 1, Syria, 200 m below western outlet of Lake Homs (N34°40', E36°37'), F. Krupp and W. Schneider, 3 Aug 1978. - SMF 17119, 5, Syria, western outlet of Lake Homs (N34°40', E36°37'), F. Krupp and W. Schneider, 3 Aug 1978. - SMF 33133, 24, Syria, Lake Homs at Qaṭṭīnah (N34°39'43", E36°37'6"), N. Alwan et al., 13 Oct 2008.

Mediterranean coastal rivers. SMF 31669, 1; SMF 31670, 1, Syria, Nahr Marqīyah (N35°1'50", E35°54'18"), N. Alwan et al., 10 Oct 2008.

Tigris-Euphrates system. SMF 12966, 1, Turkey, Balıklıgöl at Şanlıurfa [N37°8'52", E38°47'4"], L. Lortet, 1884.

Diagnosis. Two pairs of barbels, 31 to 38 scales in the lateral line and usually 14 to 16 scales around the least circumference of the caudal peduncle, last unbranched dorsal-fin ray equal to or shorter than head.

Description. The body is comparatively high-backed and laterally compressed in mid-sized specimens but low-backed and almost cylindrical in large specimens. In large specimens a pronounced nuchal hump is present, in smaller specimens it is only weakly developed or absent. The maximum body depth is at the origin of the dorsal fin. The head is short and blunt with a convex ventral profile and a slightly convex to straight dorsal profile (Figs 10, 11). The mouth is terminal or slightly sub-terminal with two pairs of short barbels (Table 2).The body depth is usually greater than the head length (Fig. 12).The eyes are slightly protuberant and lie at the end of the anterior half of the head. The morphometric characters are summarised in Table 1.

Figure 10. *Carasobarbus chantrei*, paralectotype (MNHN A-3939) from Orontes at Ḩamāh.

Figure 11. *Carasobarbus chantrei*, live specimen from Buḩayratt Qaţţīnah.

The dorsal fin usually has four unbranched and nine to 11 branched rays (Table 3). The last unbranched ray is ossified but not very thick and flexible in its distal part. It is usually shorter than the head (Fig. 4). The anal fin usually has three unbranched and five or six branched rays (Table 4).

There are 31 to 38 scales in the lateral line (Table 5), 4.5 to 6.5 scales above the lateral line (Table 6), four to six scales below the lateral line (Table 7) and 12 to 16 scales around the least circumference of the caudal peduncle (Table 8). The scales are shown in Fig. 5.

The pharyngeal teeth count is 2.3.5-5.3.2 in two specimens, 2.3.5- in 11 specimens, -5.3.2 in two specimens and 1.3.5- in one specimen. The pharyngeal teeth are hooked at their tips (Fig. 6).

Small live specimens are silvery; larger specimens are silvery or bronze coloured and sometimes have yellow pectoral and ventral fins (Fig. 11). Small ethanol-preserved specimens are silvery with a somewhat darker back and a salmon pink hue. Juveniles have a dark lateral spot on the caudal peduncle. Ethanol-preserved adults are yellow-brown and the back is only slightly darker than the rest of the body (Fig. 10).

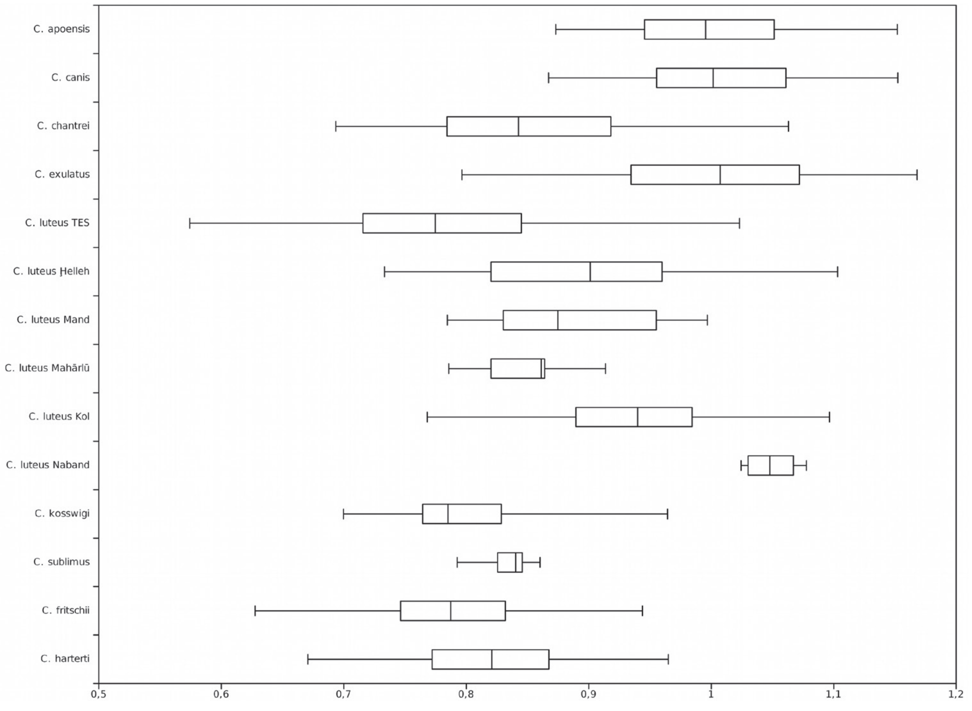

Figure 12. Head length / body depth; TES = Tigris-Euphrates system.

The maximum length observed in the material examined is 385 mm SL.

Carasobarbus chantrei differs from *C. apoensis*, *C. canis*, *C. exulatus*, *C. luteus* and *C. sublimus* in having 31 to 38 scales in the lateral line vs. 27 to 32, 29 to 35, 26 to 32, 25 to 33 and 27 to 29 respectively and modally 14 scales around the least circumference of the caudal peduncle vs. 12. It differs from *C. kosswigi* and *C. sublimus* in having a crescent-shaped lower lip without median lobe vs. a spatulate lower lip with median lobe and from *C. exulatus*, *C. fritschii* and *C. harterti* in modally having 10 branched dorsal-fin rays vs. nine.

Distribution. *Carasobarbus chantrei* occurs in the Orontes river drainage system (Fig. 7). Two juvenile specimens where collected in Nahr Marqīyah, a coastal river in Syria. This species had never before been reported from this location (Krupp 1985a) and it has most likely been introduced by humans. Two potential records from Nahr Quwayq (MNHN A-3861, MGHN 3554) are discussed in Krupp (1985a, c). Locality data for MHNL 3554 are ambiguous (Krupp 1985a). The locality for MNHN A-3861 is given as "Syria, Aleppo" in Krupp (1985a) and considered to be from Nahr Quwayq. The collection database of the MNHN gives "Origine: Syrie, localité: Alep, Milieu: Continent, Bassin hydrologique: Asi, Cours d'eau: Asi" as locality. As these data are contradictory, it is likely that the specimens do not come from the Nahr Quwayq, but from the Orontes (=Asi) and *C. chantrei* does probably not occur in the Nahr Quwayq. A record from the Ceyhan Nehri (Krupp 1985c) is not backed by specimens. Records from the

Tigris-Euphrates basin are misidentified *C. luteus* (Krupp 1985a, Krupp and Schneider 1991) and the specimen from Balıklıgöl at Şanlıurfa in Turkey (SMF 12966) is probably mislabelled or was introduced there (Krupp 1985a). It is not included in the map.

Habitats and biology. *Carasobarbus chantrei* occurs in a wide range of habitats stretching from stagnant waters of lakes to rapidly flowing river courses.

Conservation status. *Carasobarbus chantrei* is utilised as food fish locally but is increasingly replaced by carp (Krupp 1985a). During a field survey in Syria in 2008, the species was still abundant in parts of the Orontes. However, large stretches of this river, especially in the Al Ghāb area, suffer heavily from water abstraction and pollution by sewage and domestic waste and are devoid of fish. The species is rated "Endangered B1ab(ii,iii)" by the IUCN (Crivelli 2006b). The main threat is habitat degradation due to water extraction, pollution and drought (Crivelli 2006b).

Remarks and discussion. *Carasobarbus chantrei* was described from the Orontes and placed in *Labeobarbus* by Sauvage (1882). He transferred it to *Barbus* two years later (Sauvage 1884). In 1942 *Barynotus verhoeffi* was described from Amik Gölü, Turkey (Battalgil 1942). Ladiges (1960) erroneously synonymised *B. verhoeffi* with *C. canis*. Karaman (1971) synonymised *C. chantrei* with *C. canis* and thus transferred it to the genus *Tor* (sensu Karaman 1971). Fowler (1976) transferred *Barynotus verhoeffi* to the genus *Barbellion*. In 1985 Krupp redescribed *C. chantrei* as a valid species and provisionally placed it into the genus *Barbus* sensu lato. He found the type series to be inhomogeneous (MNHN B-2889 are *'Barbus' grypus*) and designated MNHN A-3866 as lectotype of *C. chantrei* (Krupp 1985a). The 'Catalog of Fishes' does not list MNHN B-2889 as types for *C. chantrei* (Eschmeyer 2011). Ekmekçi and Banarescu (1998) transferred the species to the genus *Carasobarbus*. Tsigenopoulos et al. (2010) used *Barbus* subgenus *Carasobarbus*.

Carasobarbus exulatus (Banister & Clarke, 1977)

http://species-id.net/wiki/Carasobarbus_exulatus

Barbus exulatus Banister and Clarke 1977: 116.

Material. Type material. Holotype of *Barbus exulatus*: BMNH 1976.4.7:299, Yemen, Wādī Ḩaḑramawt at Qasam (N16°10', E49°4'), W. A. King-Webster.

Paratypes of *Barbus exulatus*: BMNH 1976.4.7:308, 1; BMNH 1976.4.7:300-307, 8, same data as holotype. - BMNH 1976.4.7:328-329, 2; BMNH 1976.4.7:330-331, 2, Yemen, Wādī 'Idim/Wādī Ḩaḑramawt at Ghuraf (N16°0', E49°0'), W. A. King-Webster. - BMNH 1976.4.7:309, 1; BMNH 1976.4.7:310-318, 9; BMNH 1976.4.7:319-327, 9, Yemen, Wādī Ḩaḑramawt at Ghayl 'Umar (N15°44', E48°51'), W. A. King-Webster. - BMNH 1976.4.7:332-333 probably Wādī Marrān in Wādī Aḩwar system [N13°53'51", E46°05'14"], G. Popov, 2 Aug 1962.

Non-type material. Wādī Ḩaḑramawt/al Masīlah drainage. BMNH 1976.5.17:9-10, 2, Yemen, Wādī al Khūn (N16°10', E49°10'). - SMF 33108, 10, Yemen, Wādī al

Khūn (N16°9'51", E49°6'2"), F. Krupp et al., 3 Jun 2005. - SMF 33109, 17, Yemen, Wādī al Khūn (N16°9'45", E49°4'46"), F. Krupp et al., 3 Jun 2005. - SMF 33110, 14, Yemen, Wādī al Masīlah near Fughmah (N16°8'36", E49°27'7"), F. Krupp et al., 4 Jun 2005. - SMF 33111, 1, Yemen, Wādī al Masīlah at al Hind (N15°44'53", E50°24'32"), F. Krupp et al., 5 Jun 2005. - SMF 33106, 8, Yemen, Wādī ‘Idim at Ghayl ‘Umar near Arḍ ar Raydah (N15°40'51", E48°51'59"), F. Krupp et al., 2 Jun 2005. - SMF 33107, 11, Yemen, Wādī ‘Idim near Ghayl ‘Umar (N15°40'10", E48°51'4"), F. Krupp et al., 2 Jun 2005. -SMF 33105, 13, Yemen, Wādī Mara in Wādī Daw‘an system (N15°8'36", E48°26'58"), F. Krupp et al., 31 May 2005.

Diagnosis. Dorsal fin with 9 branched rays in most specimens; last unbranched ray of dorsal fin as long as or longer than head; 2 pairs of barbels; 26 to 32 scales in the lateral line and usually 12 scales around the least circumference of the caudal peduncle.

Description. The body is not particularly high backed and the maximum body depth is at the origin of the dorsal fin or slightly in front of it (Fig. 13). A nuchal hump is present in adult specimens (Fig. 14) but absent in juveniles (Fig. 15). The caudal peduncle is slender. The head profile is convex ventrally and straight dorsally. The body depth is about the same as the head length (Fig. 12). In specimens below 100 mm SL, the head is rather narrow, in larger specimens it becomes wider. The mouth is subterminal and comparatively narrow. Two pairs of barbels are present (Table 2), the posterior one is rather long. The eyes are at the end of the anterior half of the head and slightly protuberant. The morphometric characters are summarised in Table 1.

The dorsal fin is long and usually has four unbranched and eight to 10 branched rays (Table 3). The last unbranched ray is strongly ossified and only the tip is flexible. Its length is about the same as the head length (Fig. 4). The anal fin is long, usually has three unbranched and five or six branched rays (Table 4).

There are 26 to 32 scales in the lateral line (Table 5), 4 to 5.5 scales above the lateral line (Table 6), 3.5 to five scales below the lateral line (Table 7) and 10 to 12 scales around the least circumference of the caudal peduncle (Table 8). The scales are shown in Fig. 5.

The pharyngeal teeth count is 2.3.5-5.3.2 in one specimen, 2.3.5- in 16 specimens, -5.3.2 in one specimen and 2.3.4- in one specimen. The pharyngeal teeth are hooked at their tips (Fig. 6).

In live specimens and freshly preserved specimens the back and the sides are grey to golden, the belly is yellowish white and the fins are sometimes golden to orange (Fig. 15). Preserved specimens have a dark back and a lighter belly, the fins are whitish or greyish. Juveniles have a dark spot on the sides of the caudal peduncle.

The maximum length observed in the material available is 288 mm SL.

Carasobarbus exulatus differs from all congeners, except *C. fritschii* and *C. harterti* in modally having nine instead of 10 branched dorsal-fin rays. It differs from *C. fritschii* and *C. harterti* in modally having 12 scales around the least circumference of the caudal peduncle vs. 16 and in having 26 to 32 scales the lateral line vs. 30 to 39 and 31 to 38 respectively.

Figure 13. *Carasobarbus exulatus*, holotype (BMNH 1976.4.7:299) from Wādī Ḥaḍramawt at Qasam, © The Natural History Museum, London, photo P. Hurst.

Figure 14. Adult *Carasobarbus exulatus*, live specimen from Wādī al Khūn.

Figure 15. Juvenile *Carasobarbus exulatus*, live specimen from Wādī al Khūn.

Distribution. This species is endemic to Yemen and occurs in Wādī Ḩaḑramawt / Wādī al Masīlah and its pleistocene tributaries (Banister and Clarke 1977, Krupp 1983a, Fig. 7). It is also known from Sadd Ma'rib (Al-Safadi 1995), a dam lake at N15°23'46", E45°14'37" and Wādī Ḩajr (N14°02'42", E48°40'27"), where they are "found throughout the whole year and are distributed all over the stream" (Attaala and Rubaia 2005).

Locality data for BMNH 1976.4.7:332-333 is given as "Wadi Maran, E. Yemen" (Banister and Clarke 1977), which is most likely Wādī Marrān [N13°53'51", E46°05'14"], representing the westernmost record of this species that is backed by specimens.

Habitats and biology. The biology of this species is mostly unknown.

Conservation status. During a field expedition in 2005 one of the authors saw large, continuous water bodies in the Wādī Ḩaḑramawt / Wādī al Masīlah area. The species is rated as "Endangered B1a, b; B2a, b" and water extraction is identified as the main threat (BCEAW 2002).

Discussion. *Carasobarbus exulatus* was described from Wādī Ḩaḑramawt and Wādī Maran in Yemen and placed in *Barbus* (Banister and Clarke 1977). Later it was transferred to *Carasobarbus* (Ekmekçi and Banarescu 1998).

***Carasobarbus fritschii* (Günther, 1874) comb. n.**

http://species-id.net/wiki/Carasobarbus_fritschii

Barbus fritschii Günther 1874: 231.
Barbus rothschildi Günther 1901: 368.
Barbus riggenbachi Günther 1902: 447.
Capoeta atlantica Boulenger 1902: 124.
Capoeta waldoi Boulenger 1902: 124.
Barbus paytonii Boulenger 1911: 82.

Material. Type material. Syntypes of *Barbus fritschii*: BMNH 1874.1.30:27-31, 5, Morocco, Oued Ksob in Oued Igrounzar drainage [N31°28'59", W9°46'3"], K. v. Fritsch and J. Rein, 1872.

Syntypes of *Barbus paytonii*: BMNH 1903.10.29:17-20, 7, Morocco, Oued Oum er Rbia [N33°19'40", W8°20'2"], F. W. Riggenbach.

Syntypes *Barbus riggenbachi*: BMNH 1902.7.28:20-21, 2, Morocco, Oued Oum er Rbia [N33°19'40", W8°20'2"], F. W. Riggenbach. - BMNH 1902.7.28:19, 1, Morocco, Oued Talmest [N31°52'15", W9°18'31"], F. W. Riggenbach.

Syntypes *Barbus rothschildi*: BMNH 1901.7.26:6-7, 2, Morocco, Oued Oum er Rbia [N33°19'40", W8°20'2"], E. Hartert.

Syntypes of *Capoeta atlantica*: BMNH 1902.1.4:18-19, 2, Morocco, Oued Nfis at Trigadir-el-hor (Tagadirt n'Bour?) [N31°9'21", W8°6'2"], E. G. B. Meade-Waldo.

Syntypes of *Capoeta waldoi*: BMNH 1902.1.4:16-17, 2, Morocco, Oued Nfis at Trigadir-el-hor (Tagadirt n'Bour?) [N31°9'21", W8°6'2"], E. G. B. Meade-Waldo.

Non-type material. Oued al Maleh drainage. SMF 33412, 5; SMF 33510, 1; SMF 33511, 1; SMF 33512, 1, Morocco, Oued al Maleh above the dam (N33°33'53", W7°22'3"), K. Borkenhagen and J. Freyhof, 19 Apr 2011. - MNHN 1919-0365, 1; MNHN 1919-0366, 1, Morocco, Oued Bou Asseïla near Chaouia [N33°19'34", W7°16'46"], H. Millet, 1919.

Oued Bou Regreg drainage. MNHN 1939-0124, 1, Morocco, Oued Akrech [N33°56'7", W6°47'41"], J. M. Pérès, 1939. - SMF 33411, 10; SMF 33503, 1; SMF 33504, 1; SMF 33505, 1, Morocco, Oued Korifla above the dam lake (N33°44'0", W6°43'43"), K. Borkenhagen and J. Freyhof, 18 Apr 2011.

Oued Igrounzar drainage. BMNH 1889.7.19:9, 1, Morocco, near Essaouira [N31°30'45", W9°46'12"], C. Payton. - SMF 636, 4; SMF 952, 6, Morocco, Oued Ksob [N31°28'59", W9°46'3"], K. v. Fritsch and J. Rein, 1872. - SMF 33405, 19; SMF 33446, 1; SMF 33450, 1; SMF 33451, 1, Morocco, Oued Ksob near Essaouira (N31°28'0", W9°45'32"), A. Azeroual et al., 11 Apr 2011. - SMF 33388, 1; SMF 33389, 1; SMF 33390, 1; SMF 33404, 20, Oued Igrounzar between Ounara and El Ghazouane (N31°27'21", W9°41'4"), A. Azeroual et al., 10 Apr 2011. - SMF 33406, 2, Oued Igrounzar near El Khemis des Meskala (N31°21'31", W9°24'20"), A. Azeroual et al., 11 Apr 2011.

Oued Iqem drainage. SMF 33509, 1, Morocco, Oued Iqem near Skhirat (N33°53'22", W6°59'56"), K. Borkenhagen and J. Freyhof, 19 Apr 2011.

Oued Kiss drainge. MNHN 1924-0174, 1, Algeria, Oued Kiss at Marsa Ben Mehid (N35°4'59", W2°10'1"), C. A. Alluaud, 1924.

Oued Moulouya drainage. SMF 33407, 8; SMF 33408, 4; SMF 33479, 1; SMF 33481, 1; SMF 33484, 1, Morocco, Oued Za near Guefaït (N34°13'36", W2°23'34"), K. Borkenhagen and J. Freyhof, 15 Apr 2011. - MNHN 1926-0070, 1, Morocco, Oued Melloulou near Guercif [N34°13'32", W3°21'13"], P. M. Pallary, 1926. - NMW 19533, 1, Morocco, Ras el Aïn near Aïn Beni Mathar (=Berguent) [N34°0'41", W2°1'47"], F. Werner. - NMW 19532, 1, Morocco, Oued Za [N32°57'0", W5°12'0"], F. Werner.

Oued Oum er Rbia drainage. BMNH 1902.7.28:22-26, 5, Morocco, Oued Oum er Rbia [N33°19'40", W8°20'2"], F. Riggenbach. - BMNH 1903.7.1:8, 2, Morocco, El Jadida [N33°15'18", W8°30'22"], F. Riggenbach. - MNHN 1927-0099, 1; MNHN 1927-0100, 1; MNHN 1989-0535, 1, Morocco, Oued Oum er Rbia near Khenifra [N32°56'21", W5°40'7"], A. Gruvel and R. Dollfus, 1927. - MNHN 1928-0054, 1; MNHN 1928-0055, 1, Morocco, Oued Oum er Rbia near Khenifra [N32°56'21", W5°40'7"], P. Pallary, 1928. - SMF 33513, 1; SMF 33514, 1; SMF 33515, 1, Morocco, Oued Oum er Rbia near Boulaouane (N32°51'33", W8°2'41"), K. Borkenhagen and J. Freyhof, 20 Apr 2011. - SMF 33344, 1; SMF 33345, 1; SMF 33346, 1; SMF 33394, 12, Morocco, Oued Srou at bridge between Tighassaline and Khenifra (N32°49'51", W5°36'36"), A. Azeroual et al., 7 Apr 2011. - SMF 33360, 1; SMF 33361, 1; SMF 33362, 1; SMF 33395, 17, Morocco, Oued Derra near Oulad Yaïch (N32°26'23", W6°19'24"), A. Azeroual et al., 9 Apr 2011. - SMF 33363, 1; SMF 33364, 1; SMF 33365, 1; SMF 33397, 22, Morocco, Oued Oum er Rbia (N32°18'53", W6°54'33"), A. Azeroual et al., 9 Apr 2011.

Oued Sebou drainage. SMF 33410, 9; SMF 33494, 1; SMF 33495, 1; SMF 33496, 1, Morocco, Oued Ouergha between Sidi Qacem and Ouazzane (N34°27'52", W5°30'39"), K. Borkenhagen and J. Freyhof, 17 Apr 2011. - MNHN 1939-0125, 1; MNHN 1939-0126, 1; MNHN 1939-0127, 1, Morocco, El Gharb [N34°25', W6°20'], J. M. Pérès, 1939. - MNHN 1939-0122, 2; MNHN 1939-0123, 2; MNHN 1939-0145, 1, Morocco, Oued Sebou [N34°15'53", W6°41'5"], J. M. Pérès, 1939. - SMF 33409, 15; SMF 33489, 1; SMF 33491, 1; SMF 33493, 1, Morocco, Oued Lahdar near Taza (N34°14'35", W4°3'55"), K. Borkenhagen and J. Freyhof, 16 Apr 2011. - MNHN 1924-0191, 3, Morocco, Oued Beth near Dar Bel Hamri [N34°11'14", W5°57'54"], C. A. Alluaud, 1924. - MNHN 1920-0061, 1; MNHN 1920-0062, 1, Morocco, Oued Bou Hellou [N34°9'19", W4°25'33"], P. M. Pallary, 1920. - MNHN 1922-0065, 1, Morocco, Moulay Yacoub [N34°5'17", W5°10'54"], C. A. Alluaud, 1922. - MNHN 1920-0202, 1, Morocco, Faraoun near Volubilis [N34°4'25", W5°33'25"], C. A. Alluaud, 1920. - MNHN 1939-0128, 1; MNHN 1939-0129, 1, El Mabbabat [?], J. M. Pérès, 1939.

Oued Tennsift drainage. BMNH 1904.11.28:60, 1; BMNH 1905.11.28:60-63 and BMNH 1904.11.28:57-58, 6, Morocco, Oued Chichaoua [N31°43'48", W8°49'48"], F. Riggenbach. - MNHN 1919-0379, 1; MNHN 1919-0380, 1; MNHN 1919-0381, 1; MNHN 1919-0382, 1, Morocco, Oued Nfis near Dar Goundafi [N31°43'41", W8°21'1"], P. M. Pallary, 1919. - MNHN 1988-1146, 4, Morocco, Oued Nfis [N31°43'41", W8°21'1"], Goubier, VI.1988. - MNHN 1922-0066, 1; MNHN 1922-0067, 1; MNHN 1922-0068, 1, Morocco, Oued Chichaoua near Chichaoua [N31°32'37", W8°45'46"], C. A. Alluaud, 1922. - SMF 33371, 1; SMF 33372, 1; SMF 33373, 1; SMF 33374, 1; SMF 33398, 3, Morocco, Oued Nfis near Tameslouht (N31°27'2", W8°8'22"), A. Azeroual et al., 10 Apr 2011. - SMF 33378, 1; SMF 33379, 1; SMF 33380, 1; SMF 33399, 14; SMF 33403, 22, Morocco, Oued Nfis near Ouirgane (N31°13'24", W8°6'50"), A. Azeroual et al., 10 Apr 2011. - MNHN 1925-0371, 1, Morocco, Oued Nfis near Ouirgane [N31°10'40", W8°4'24"], J. Pellegrin, 1925.

Diagnosis. Two pairs of barbels, 30 to 39 scales in the lateral line and 14 to 20 scales around the least circumference of the caudal peduncle; dorsal fin usually shorter than anal fin and more than 15 % of its last unbranched ray flexible, dorsal profile of the head convex.

Description. The body is of moderate height and sometimes has a small nuchal hump in larger specimens. The head is round with a convex dorsal profile and convex or straight ventral profile (Figs 16, 17). The head length is shorter than the body depth (Fig. 12), the mouth is inferior with two pairs of barbels (Table 2). The lower lip is crescent shaped and sometimes weakly keratinised. The eyes are in the anterior half of the head. The morphometric characters are summarised in Table 1.

The dorsal fin is short and weakly ossified and more than 15 % of the length of its last unbranched ray is flexible. Its last unbranched ray is about as long as the head (Fig. 4). It usually has four unbranched and seven to 10 branched rays (Table 3). The anal fin usually has three unbranched and five or six branched rays (Table 4). Its length is rather variable in adult specimens. It reaches the base of the caudal fin in some specimens.

Figure 16. *Carasobarbus fritschii*, syntype (BMNH 1874.1.30:27-31) from Oued Ksob, © The Natural History Museum, London.

Figure 17. *Carasobarbus fritschii*, from Oued Ksob.

Carasobarbus fritschii has 30 to 39 scales in the lateral line (Table 5), usually 5.5 scales above the lateral line (Table 6), usually 4.5 or 5.5 scales below the lateral line (Table 7), and 14 to 20 scales around the least circumference of the caudal peduncle (Table 8). The scales are shown in Fig. 5.

The pharyngeal teeth count is 2.3.4-4.3.2 in two specimens, 2.3.4- in one specimen and -4.3.2 in eight specimens. Pharyngeal teeth are hooked at their tips (Fig. 6).

Live specimens are silvery and usually have a dark longitudinal band above the lateral line. Fins are hyaline to slightly orange (Fig. 17). Ethanol-preserved specimens are yellow-brown, the back is usually distinctly darker than the belly and flanks.

The maximum length observed in the material available is 180 mm SL.

Carasobarbus fritschii differs from all congeners except *C. exulatus* and *C. harterti* in having nine instead of 10 branched dorsal-fin rays. It differs from *C. exulatus* in having 30 to 39 scales in the lateral line vs. 26 to 32 and modally 16 scales around the least circumference of the caudal peduncle vs. 12. It differs from *C. harterti* in having a convex dorsal head profile and a last unbranched dorsal-fin ray that is weakly ossified and flexible for more than 15 % of its length vs. a straight dorsal head profile and a strongly ossified last unbranched dorsal-fin ray that is flexible in less than 15 % of its length.

Distribution. *Carasobarbus fritschii* is widespread and abundant in Northern and Central Morocco (Fig. 18). It occurs in the Oued al Maleh, Oued Bou Regreg, Oued Igrounzar, Oued Moulouya, Oued Oum er Rbia, Oued Sebou and Oued Tennsift drainage systems, and in numerous small coastal rivers. Most records are from Morocco, but one specimen is from the Oued Kiss in Algeria.

Habitats and biology. *Carasobarbus fritschii* occurs in a wide range of running water courses and dam lakes.

Conservation status. *Carasobarbus fritschii* is a hardy species and occurs in near-natural as well as heavily modified habitats. It is tolerant against pollution, damming and the presence of several exotic species (KB pers. obs.). The IUCN rates *C. fritschii* as "Least Concern" and *Barbus paytonii* (which is treated as a junior synonym in this study) as "Vulnerable B2ab(iii)" (Crivelli 2006c, Crivelli 2006e). According to the latter assessment the population in the lower Oued Oum er Rbia is adversely affected by agricultural pollution (Crivelli 2006e).

Discussion. *Carasobarbus fritschii* was described from the Oued Ksob as a member of the genus *Barbus* (Günther 1874). The same author described *Barbus rothschildi* from the Oued Oum er Rbia (Günther 1901). It is a junior synonym of *C. fritschii*. One year later Günther (1902) described *Barbus riggenbachii* from Oued Oum er Rbia and Oued Talmest. It is a junior synonym of *C. fritschii*. In the same year *Capoeta atlantica* and *Capoeta waldoi* were described from Oued Nfis (Boulenger 1902). These two species were placed into *Capoeta*, based on the keratinised lower lip that occurs in some specimens of *C. fritschii*. Both are junior synonyms of *C. fritschii*. *Barbus paytonii* was described from Oued Oum er Rbia (Boulenger 1911). It is a junior synonym of *C. fritschii*. In the same publication Boulenger transferred *C. waldoi* to the genus *Barbus*. The junior synonyms listed above were described, based on slight differences in mouth and lower lip shape or the degree of ossification of dorsal-fin rays. Sample sizes were usually very small. The examination of a large number of specimens revealed high variability and a continuous distribution of these characters. Boulenger (1919) transferred all species to the genus *Barbus* subgenus *Labeobarbus*, based on the possession of scales with parallel radii and an unserrated last unbranched dorsal-fin ray. Pellegrin (1919) listed the species in the genus *Barbus* but later (Pellegrin 1921, 1939) accepted the subgenus *Labeobarbus*. Pellegrin (1939) synonymised B. *riggenbachi* with *B. rothschildi* and did not list *C. atlantica*. Karaman (1971) created the genus *Pseudotor* and synonymised *C. atlantica* and *C. waldoi* with *Pseudotor fritschii fritschii*. Fowler (1976) accepted all previously described species and transferred *C. atlantica* and *C. waldoi* to the genus *Varicorhinus*. Berrebi (1981) used the genus *Barbus* subgenus *Labeobarbus* and found no relevant differences between *B. fritschii* and *B. paytonii* in his morphometric and biochemical analysis. El Gharbi et al. (1993) highlighted the African distribution of the subgenus *Labeobarbus*. Doadrio (1994) and Tsigenopoulos et al. (2010) used *Labeobarbus*. Subsequent authors used the genus *Barbus* (Azeroual et al.

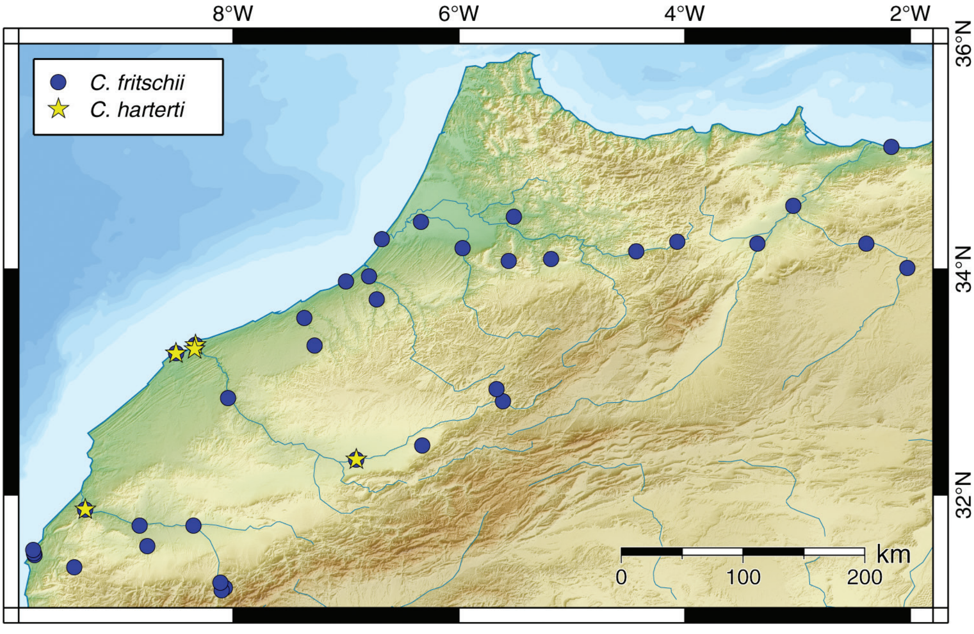

Figure 18. Map of the distribution of *C. fritschii* and *C. harterti.*

2000, Machordom and Doadrio 2001, Leggatt and Iwama 2003, Colli et al. 2009) or the provisional genus '*Barbus*' (Borkenhagen et al. 2011). We transfer this species to the genus *Carasobarbus*, based on the possession of a smooth last unbranched dorsal-fin ray, modally nine branched dorsal-fin rays, six branched rays in the anal fin and shield-shaped scales with numerous parallel radii. Analysis of molecular genetic characters (Durand et al. 2002, Tsigenopoulos et al. 2010, KB unpublished data) support this decision.

The name of this species is frequently misspelled "*Barbus fritschi*".

The 'Catalog of Fishes' lists SMF 636 and SMF 952 as types for *C. fritschii* (Eschmeyer 2011). Both lots where collected by K. v. Fritsch and J. Rein in Oued Ksob in 1872, together with the types of '*Barbus*' *reinii* Günther, 1874, *Luciobarbus nasus* (Günther, 1874) and the syntypes of *C. fritschii*. SMF 636 contains seven specimens: one *Luciobarbus nasus*, one *Luciobarbus ksibi (*Boulenger, 1905), one '*Barbus*' *reinii* and four *C. fritschii*. SMF 952 contains eight specimens: two '*Barbus*' *reinii* and six *C. fritschii*. In the original description Günther (1874) did not state the number of type specimens on which he based the description of *C. fritschii*, but in the same paper he described *Luciobarbus nasus* (as *Barbus nasus*), based on two specimens and '*Barbus*' *reinii*, based on three specimens. It is likely that Günther never saw the lots SMF 636 and SMF 952, because all syntypes of *Luciobarbus nasus* and '*Barbus*' *reinii* are in the BMNH. The collectors, K. v. Fritsch and J. Rein probably deposited these samples immediately in the SMF and we conclude that SMF 636 and SMF 952 are not part of the type series of *C. fritschii*.

Carasobarbus harterti **(Günther, 1901), comb. n.**
http://species-id.net/wiki/Carasobarbus_harterti

Barbus harterti Günther 1901: 367.

Material. Type material. Syntypes: BMNH 1901.7.26:4-5, 2, Morocco, Oued Oum er Rbia [N33°19'40", W8°20'2"], E. Hartert.

Non-type material. Oued Oum er Rbia drainage. BMNH 1902.7.28:27-33, 7; BMNH 1903.10.29:11-15, 8, Morocco, Oued Oum er Rbia [N33°19'40", W8°20'2"], F. Riggenbach. - BMNH 1903.7.1:5-7, 3, Morocco, Oued Oum er Rbia near El Jadida [N33°15'18", W8°30'22"], F. Riggenbach. - MNHN 1912-0089, 1; MNHN 1912-0090, 1; MNHN 1912-0091, 1; MNHN 1912-0092, 1; MNHN 1912-0093, 1, Morocco, Oued Oum er Rbia near Azemmour [N33°17'22", W8°20'33"], C. du Gast, 1912. - SMF 33366, 1; SMF 33368, 1; SMF 33370, 1, Morocco, Oued Oum er Rbia (N32°18'53", W6°54'33"), A. Azeroual et al., 9 Apr 2011.

Oued Tennsift drainage. BMNH 1902.7.28:34, 1, Morocco, Oued Talmest [N31°52'15", W9°18'31"], F. Riggenbach.

Diagnosis. Two pairs of long barbels; 31 to 38 scales in the lateral line and 13 to 17 scales around the least circumference of the caudal peduncle; dorsal fin longer than anal fin and less than 15 % of the length of its last unbranched ray is flexible, dorsal profile of the head straight.

Description. The body is of moderate height and without a nuchal hump. The head is triangular with almost straight dorsal and ventral profile (Figs 19, 20). The head length is shorter than the body depth (Fig. 12). The mouth is subterminal with two pairs of long barbels (Table 2). The eyes are in the anterior half of the head and relatively big. The morphometric characters are summarised in Table 1.

The dorsal fin is long and strongly ossified and less than 15 % of the length of its last unbranched ray is flexible. Its last unbranched ray is as long as or longer than the head (Fig. 4). It usually has four unbranched and nine branched rays (Table 3). The anal fin usually has three unbranched and six or seven branched rays (Table 4). It does not reach the caudal fin origin.

Carasobarbus harterti has 31 to 38 scales in the lateral line (Table 5), usually 5.5 or 6.5 scales above the lateral line (Table 6), 4.5 to 6.5 scales below the lateral line (Table 7) and 13 to 17 scales around the least circumference of the caudal peduncle (Table 8). The scales are shown in Fig. 5.

The pharyngeal teeth count is -4.3.2 in four specimens examined. The pharyngeal teeth are hooked at their tips (Fig. 6).

Live specimens are silvery with an olive tinge and orange fins (Fig. 20). Ethanol-preserved specimens are yellow-brown, the back is darker than the belly and flanks.

The maximum length observed in the material examined is 250 mm SL.

Carasobarbus harterti differs from all congeners except *C. exulatus* and *C. fritschii* in having nine rather than 10 branched dorsal-fin rays. It differs from *C. exulatus* in having 31 to 38 scales in the lateral line vs 26 to 32 and modally 16 scales around the

Figure 19. *Carasobarbus harterti*, syntype (BMNH 1901.7.26:4-5) from Oued Oum er Rbia, © The Natural History Museum, London.

Figure 20. *Carasobarbus harterti*, live specimen from Oued Oum er Rbia.

least circumference of the caudal peduncle vs. 12. It differs from *C. fritschii* in having a straight dorsal head profile and a last unbranched dorsal-fin ray that is strongly ossified and flexible for less than 15 % of its length vs. a convex dorsal head profile and a last unbranched dorsal-fin ray that is weakly ossified and flexible for more than 15 % of its length.

Distribution. *Carasobarbus harterti* occurs in the rivers of the Oued Oum er Rbia and Tennsift drainage systems in Morocco (Fig. 18).

Habitats and biology. *Carasobarbus harterti* is less common than *C. fritschii* and inhabits only the lower and middle course of big rivers.

Conservation status. The IUCN rates this species as "Vulnerable A2ace" (Crivelli 2006d). The population has declined more than 30 % in the time from 1996 to 2006 due to urban, agricultural and industrial pollution (Crivelli 2006d).

Discussion. *Carasobarbus harterti* was described from Oued Oum er Rbia as *Barbus harterti* (Günther 1901). Some authors placed this species in the genus *Barbus* subgenus *Labeobarbus* (Boulenger 1919, Pellegrin 1921) while others continued using the genus *Barbus* (Pellegrin 1919, 1939). Karaman (1971) synonymised it with *C. fritschii*, but regarded it as a distinct subspecies. He incorrectly synonymised *B. rothschildi*, *B. riggenbachi* and *B. paytonii* with this subspecies and placed it in his newly erected genus *Pseudotor*. Subsequent authors did not accept Karaman's proposal and continued using *Barbus* (Fowler 1976, El Gharbi et al. 1993, Azeroual et al. 2000, Leggatt and Iwama 2003, Colli et al. 2009, Borkenhagen et al. 2011) or proposed using *Labeobarbus* (Doadrio 1994, Tsigenopoulos et al. 2010). We transfer this species to the genus *Carasobarbus*, based on the possession of a smooth last unbranched dorsal-fin ray, nine branched dorsal-fin rays, six branched rays in the anal fin and shield-shaped scales with numerous parallel radii. Analysis of molecular genetic characters (Durand et al. 2002, Tsigenopoulos et al. 2010, KB unpublished data) support this decision.

Carasobarbus kosswigi **(Ladiges, 1960)**

http://species-id.net/wiki/Carasobarbus_kosswigi

Cyclocheilichthys kosswigi Ladiges 1960: 135.

Material. Type material. Holotype of *Cyclocheilichthys kosswigi*: ZMH H 1148, Turkey, Batman Çayı [N37°47'16", E41°0'51"], C. Kosswig, IV.1939.

Non-type material. Tigris-Euphrates system. NMW 90369, 1, Turkey, Batman Çayı near Baschkaja [N37°53'15", E41°7'56"], V. Pietschmann, 15 Jul 1914. - NMW 90805, 1, Turkey, Gökçesu Çayı (N37°45', E41°45'), 26 Sep 1985. - ZMH 9548, 2, Turkey, Ceylanpınar [N36°50'50", E40°3'0"]. - SMF 33119, 1, Syria, Nahr al Khābūr at Al Ḩasakah [N36°30'9", E40°44'52"], F. Krupp. - SMF 30172, 1, Syria, Nahr al Khābūr near Tall Budayrī (N36°24', E40°52'), F. Krupp, 2–4 Nov 1986. - SMF 30173, 1, Syria, Nahr al Khābūr near Nahāb (N36°23', E40°50'), F. Krupp, 23–27 May 1989. - SMF 30174, 1, Syria, Nahr al Khābūr near Nahāb (N36°23', E40°50'), F. Krupp, 28 Sep–8 Oct 1988. - CMNFI 79-0290, 2, Iran, Qaşr-e Shīrīn (N34°31', E45°35'). - CMNFI 79-0289, 1, Iran, 25–30 km from Qaşr-e Shīrīn (N34°28', E45°52'). - BMNH 1974.2.22:1292-1296, 4; BMNH 1974.2.22:1281, 1, Iraq, Euphrates at Ḩadīthah [N34°8'23", E42°22'41"], 19 Oct 1953. - CMNFI 79-0275, 1, Iran, Rūdkhāneh-ye Kashgān, 2 km from Ma'mūlān (N33°25', E47°58'). - SMF 33129, 3, Iran, Rūdkhāneh-ye Karkheh at Pol-e Dokhtar (N33°9'36", E47°43'12"), N. Alwan et al., 3 Mar 2008. - ZM-CBSU 4153, 1; ZM-CBSU 4154, 1, Iran, Rūdkhāneh-ye Dez at Dezfūl [N32°22'57", E48°24'7"], F. Bossaghzadeh, 8 Jun 2005.

Diagnosis. Two pairs of barbels; 32 to 38 scales in the lateral line, usually 14 to 16 scales around the least circumference of the caudal peduncle; last unbranched dorsal-fin ray markedly longer than head; mouth narrow, lower lip spatulate and median lobe present.

Description. Body moderately high, laterally compressed and without a nuchal hump. The greatest body depth is at the point of the origin of the dorsal fin. The ventral profile of the head is straight, its dorsal profile has a slight to pronounced hump

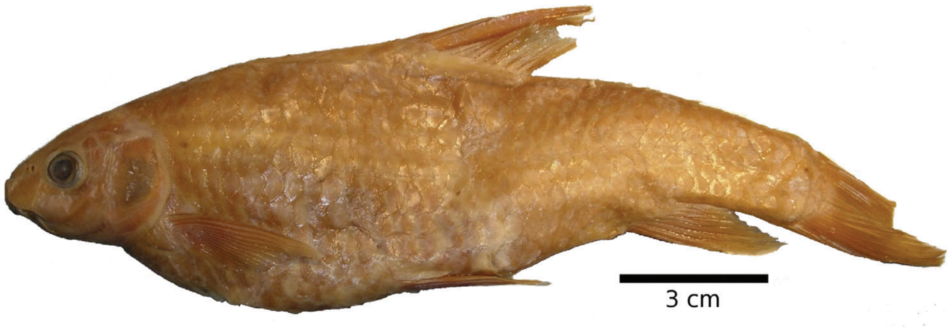

Figure 21. *Carasobarbus kosswigi*, holotype (ZMH 1148) from Batman Çayı.

Figure 22. *Carasobarbus kosswigi*, live specimen from Rūdkhāneh-ye Karkheh.

near the nostrils (Figs 21, 22). The head is short and narrow. The mouth is inferior. The maximum body depth is bigger than the head length (Fig. 12). The lips are comparatively thick and the lower jaw is narrow with a sharp horny sheath and a median lobe. The two pairs of barbels (Table 2) are stout and the anterior pair is quite long. The eyes are rather high in the middle of the head and rather small. The morphometric characters are summarised in Table 1.

The dorsal fin is long and usually has four unbranched and nine or 10 branched rays (Table 3). The last unbranched ray is long and well ossified; only the tip is flexible. It is considerably longer than the head (Fig. 4). The anal fin usually has three unbranched rays and six branched rays (Table 4). Its base is long. The bases of the dorsal and anal fin have a sheath of scales.

There are 32 to 38 scales in the lateral line (Table 5), 5.5 to seven scales above the lateral line (Table 6), 4.5 to 6.5 scales below the lateral line (Table 7) and (12) 14 to 16 scales around the least circumference of the caudal peduncle (Table 8). The scales are shown in Fig. 5.

The pharyngeal teeth count is 2.3.5-5.3.2 in seven specimens, 2.3.5- in one specimen and -4.3.2 in one specimen. The pharyngeal teeth are hooked at their tips (Fig. 6).

Live specimens are silvery. The back is darker than the belly, which is almost white (Fig. 22). Fixed specimens are yellow-brown and some have a darker back.

Carasobarbus kosswigi differs from all congeners, except *C. sublimus*, by having a spatulate lower jaw with a median lobe on the lower lip vs. a crescent-shaped lower jaw and a lower lip without median lobe. It differs from *C. sublimus* by having 32 to 38 scales in the lateral line vs. 27 to 29 and modally 14 scales around the least circumference of the caudal peduncle vs. 12 and by having a longer and more ossified last unbranched ray in the dorsal fin.

Distribution. *Carasobarbus kosswigi* occurs in the Euphrates-Tigris system (Fig. 7).

Habitats and biology. *Carasobarbus kosswigi* is rare, inhabits fast-flowing reaches of rivers and feeds on small animals (Krupp and Schneider 2008). The maximum length is about 150 mm SL and this species has no economic importance (Krupp and Schneider 2008).

Conservation status. Little information is available, but because this species is dependent on fast-flowing water, it is probably impacted by the construction of dams.

Discussion. *Carasobarbus kosswigi* was described from the Batman Çayı and placed in the genus *Cyclocheilichthys* (Ladiges 1960). Karaman erected the new genus *Kosswigobarbus* for this species (Karaman 1971). Coad gave a detailed re-description of this species and transferred it to the genus *Barbus* (Coad 1982). *Kosswigobarbus* was revalidated (Ekmekçi and Banarescu 1998) and sometimes used as a subgenus of *Barbus* (Tsigenopoulos et al. 2010). Later the species was placed in *Carasobarbus* (Borkenhagen et al. 2011).

Carasobarbus kosswigi is paraphyletic with respect to *C. sublimus* (Borkenhagen et al. 2011).

Carasobarbus luteus (Heckel, 1843)

http://species-id.net/wiki/Carasobarbus_luteus

Systomus luteus Heckel 1843: 1161.
Systomus albus Heckel 1843: 1163.
Systomus albus var. *alpina* Heckel 1847: 257.
Barbus parieschanica Wossughi et al. 1983: 34.

Material. Type material. Nahr Quwayq basin. Paralectotypes of *Systomus luteus*: NMW 54248, 1; NMW 54250:1-2, 2; NMW 54254:1-3, 3; SMF 6784, 1, Syria, Nahr Quwayq near Aleppo [N36°12'10", E37°9'31"], T. Kotschy, 17 May 1842.

Syntypes of *Systomus albus*: NMW 53674-53677, 4; NMW 53680, 1; SMF 812, 1, Syria, Nahr Quwayq near Aleppo [N36°12'10", E37°9'31"], T. Kotschy, 18 May 1842.

Rūd-e Mand basin. Syntypes of *Systomus albus alpina*: NMW 53678, 5; NMW 53679:1-2, 2; NMW 53681:1-2, 2, Iran, Rūdkhāneh-ye Qarah Āghāj near Shīrāz [N29°31'3", E52°15'0"], 2 Jan 1844.

Rūdkhāneh-ye Ḩelleh basin. Syntypes of *Systomus albus alpina*: NMW 53682:1-2, 2, Iran, Daryācheh-ye Parīshān [N29°31'7", E51°47'47"].

Tigris-Euphrates system. Lectotype of *Systomus luteus* (by present designation): NMW 54253:2, Iraq, Tigris near Mosul [N36°20'6", E43°7'8"], T Kotschy, 10 Apr 1843.

Paralectotypes of *Systomus luteus*: NMW 54247:1-2, 2; NMW 54249, 1; NMW 54253:1, 1; NMW 54255:1-2, 2; NMW 80043, 2 same data as lectotype.

Syntype of *Systomus albus*: NMW 91400, 1, Iraq, Tigris near Mosul [N36°20'6", E43°7'8"], 11 Apr 1843.

Unknown drainage system. Paralectotype of *Systomus luteus*: NMW 10827, 1, Syria, "Damascus", T. Kotschy, 1837.

Non-type material. Daryācheh-ye Mahārlū basin. CMNFI 79-0047, 1, Iran, source of Ab-e Paravan marshes 19.9 km from Shīrāz University [N29°36', E52°32']. - FSJF 2232, 2, Iran, Pirbano spring about 10 km south of Shīrāz (N29°31'8", E52°27'56"), A. Abdoli and J. Freyhof, 21 Apr 2007. - ZM-CBSU 3439, 1; ZM-CBSU 3449, 1; ZM-CBSU uncatalogued, 1, Iran, Pol-e Berenji, southwest of Shīrāz [N29°27'30", E52°32'0"], H. R. Esmaeili et al. - CMNFI 79-0347, 1, Iran, Solṭānābād marshes near Pol-e Berenji (N29°27'30", E52°32'0").

Orontes basin. MNHN 1977-0255, 1, Syria, Orontes, Gruvel, 1929, only one of two specimen examined. - MNHN 1977-0257, 1, Syria, Orontes, Gruvel, 1930. - SMF 24341, 1, Syria, Orontes at Jisr ash Shughūr (N35°48', E36°19'), F. Krupp, 21 Mar 1979 (aberrant specimen).

Rūd-e Mand basin. CMNFI 79-0206, 1, Iran, Qanat 41 km from Estahbān on road to Kharāmeh (N29°12', E53°40'). - CMNFI 79-0160, 1, Iran, cement pool near spring along road to Neyrīz (N29°9', E53°37'). - ZM-CBSU 4934-4942, 9, Iran, Dareh Daarveshan between Rudbal and Simakan (N28°39'10", E52°2'27"), H. R. Esmaeili et al. - ZM-CBSU 101-103, 3; ZM-CBSU 110, 1; ZM-CBSU uncatalogued, 1, Iran, Rūdkhāneh-ye Sīmakān near Jahrom [N28°30'0", E53°33'38"], H. R. Esmaeili et al.

Rūdkhāneh-ye Ḩelleh basin. CMNFI 79-0026, 1, Iran, Rūdkhāneh-ye Shāhpūr near Shahr-e Tārīkhī-ye Neyshābūr (N29°47', E51°35'). - ZM-CBSU 5180-5190, 10; ZM-CBSU 5192, 1, Iran, Kāzerūn, Sarab Dokhtar [N29°37'10", E51°39'15"], H. R. Esmaeili et al. - ZM-CBSU 6508-6517, 10; ZM-CBSU 6574, 1; ZM-CBSU 6602-6607, 6; ZM-CBSU 6610, 1; ZM-CBSU 6614+6615+6617-6619, 5; ZM-CBSU uncatalogued, 12, Iran, Daryācheh-ye Parīshān [N29°31'7", E51°47'47"], H. R. Esmaeili et al. - CMNFI 79-0240, 2; CMNFI 79-0304, 3, Iran, Daryācheh-ye Parīshān (N29°31', E51°50'). - CMNFI 79-0125, 1, Iran, Rūdkhāneh-ye Dālakī near Dālakī (N29°28', E51°21'). - ZM-CBSU 2650-2651, 2; ZM-CBSU 2654-2655, 2, Iran, spring at Palangī Dādīn, near Kāzerūn, Rūdkhāneh-ye Dālakī [N29°25'20", E51°43'54"], H. R. Esmaeili et al.

Rūdkhāneh-ye Kol basin. ZM-CBSU 3219-3229, 11; ZM-CBSU 3252-3260, 9, Iran, Golabi spring north of Dārāb [N28°47'15", E54°22'19"], H. R. Esmaeili et al. - FSJF 2253, 6, Iran, Golabi spring 35 km north of Dārāb (N28°47'15", E54°22'19"), A. Abdoli and J. Freyhof, 21 Apr 2007. - CMNFI 79-0155, 1, Iran, spring at Gavanoo, east of Ḩasanābād [N28°47', E54°22']. - CMNFI 79-0154, 2, Iran, Korsia village on Dārāb-Fasā road (N28°45'30", E54°24'0"). - ZM-CBSU 5622-5626, 5, Iran, Tang-e Khūr near Lār [N27°36', E54°17'], H. R. Esmaeili et al.

Rūdkhāneh-ye Naband basin. CMNFI 79-0187, 10, Iran, stream and pools at Sarkhūn, Rūdkhāneh-ye Sarzeh (N27°23'30", E56°26'0").

Tigris-Euphrates system. SMF 30208, 1, Turkey, Tigris at Diyarbakır (N37°53', E40°14'), R. Kinzelbach, 1982. - SMF 30176, 11, Syria, Nahr al Khābūr at Ra's al 'Ayn (N36°51', E40°4'), F. Krupp, 24–26 May 1989. - SMF 30186, 12, Syria, 'Ayn Sālūba and 'Ayn Hamza near Ra's al 'Ayn (N36°51', E40°4'), F. Krupp, 3 Oct 1988. - SMF 30200, 2, Syria, 'Ayn Sālūba at Ra's al 'Ayn (N36°51', E40°4'), F. Krupp, 3 Oct 1988. - SMF 30190, 7, Syria, Nahr al Khābūr 2 km East of Tall Junaydīyah (N36°44', E40°6'), F. Krupp, 26 May 1989. - SMF 30197, 2, Syria, Nahr al Khābūr 2 km East of Tall Junaydīyah (N36°44', E40°6'), F. Krupp, 5 Oct 1988. - SMF 30179, 3, Syria, Nahr al Khābūr at Tall ʿAtaš (N36°42', E40°11'), F. Krupp, 26 May 1989. - SMF 30188, 3, Syria, Nahr al Khābūr at Tall ʿAtaš (N36°42', E40°11'), F. Krupp, 6 Oct 1988. - SMF 31317, 1; SMF 33139, 7, Syria, Nahr al Khābūr at Tall Tamr (N36°39'7", E40°21'51"), N. Alwan et al., 29 Oct 2008. - SMF 30199, 1, Syria, Nahr al Khābūr at Tall Naşrī (N36°37', E40°23'), F. Krupp, 6–7 Oct 1988. - SMF 30178, 1; SMF 30202, 10, Syria, Nahr al Khābūr near Tall Bāz (N36°35', E40°27'), F. Krupp, 7 Oct 1988. - SMF 30184, 1; SMF 30193, 3, Syria, Nahr al Khābūr at Tall Bāz (N36°35', E40°27'), F. Krupp, 26 May 1989. - SMF 30181, 1; SMF 30192, 3, Syria, Nahr al Khābūr at Tall Umm al Māʿaz (N36°34', E40°35'), F. Krupp, 27 May 1989. - SMF 30183, 3, Syria, Nahr al Khābūr at Umm al-Māʿaz (N36°34', E40°35'), F. Krupp, 7 Oct 1988. - SMF 30182, 2, Syria, Nahr al Khābūr at Al Ḩasakah (N36°30', E40°44'), F. Krupp, 27 May 1989. - SMF 30195, 1, Syria, Nahr al Khābūr at Al Ḩasakah (N36°30', E40°44'), F. Krupp, 7 Oct 1988. - SMF 30185, 1; SMF 30213, 6, Syria, Nahr al Khābūr and Wādī Furātī at Tall Tayyiğ (N36°26', E40°52'), F. Krupp, 8 Oct 1988. - SMF 30189, 4, Syria, Nahr al Khābūr at Baḩrat Khātūnīyah (N36°24', E41°13'), F. Krupp, 23–24 May 1989. - SMF 30214, 5, Syria, Nahr al Khābūr at Tall Budayrī (N36°24', E40°49'), F. Krupp, 26 Sep–8 Oct 1988. - SMF 30206, 7, Syria, Nahr al Khābūr at Tall Budayrī (N36°24', E40°52'), F. Krupp, 2–4 Nov 1986. - SMF 30177, 3, Syria, Nahr al Khābūr at Nahāb (N36°23', E40°50'), F. Krupp, 28 Sep–8 Oct 1988. - SMF 30201, 23, Syria, Nahr al Khābūr at 'Ayn Ţābān (N36°22', E40°50'), F. Krupp, 28 Sep 1988. - SMF 30191, 2, Syria, Nahr al Khābūr at mouth of Wādī ar Raml (N36°15', E40°48'), F. Krupp, 8 Oct 1988. - SMF 30196, 1, Syria, Nahr al Khābūr at Umm Rukaybah (N36°8', E40°42'), F. Krupp, 8 Oct 1988. - SMF 30194, 3, Syria, Nahr al Khābūr at Ash Shaddādah (N36°4', E40°44'), F. Krupp, 9 Oct 1988. - SMF 31316, 1; SMF 33138, 2, Syria, Nahr al Khābūr at Ash Shaddādah (N36°3'46", E40°44'30"), N. Alwan et al., 28 Oct 2008. - SMF 33152, 6, Syria, Jisr Shānīn (N36°3'4", E39°5'10"), F. Krupp and W. Schneider, 19 Aug 1980. - SMF 31308, 1, Syria, Mamlaḩat al Jabbūl (N36°3'36", E37°33'1"), N. Hamidan, 23 Jun 2008. - SMF 28707, 18, Syria, Euphrates down stream Buḩayratt al Asad (N35°51'48", E39°0'34"), R. Beck, Jun 1998. - SMF 30198, 2, Syria, Nahr al Khābūr at Tall ash Shaykh Ḩamad (N35°37', E40°45'), F. Krupp, 21 Sep–14 Oct 1988. - SMF 30204, 1; SMF 30205, 4, Syria, Nahr al Khābūr at Tall ash Shaykh Ḩamad

(N35°37', E40°45'), F. Krupp, 20 Oct–9 Nov 1986. - SMF 33140, 1; SMF 33141, 37, Syria, Euphrates at Harmūshīyah (N35°35'52", E39°51'25"), N. Alwan et al., 31 Oct 2008. - SMF 30203, 2, Syria, Nahr al Khābūr 8 km South of Tall ash Shaykh Ḩamad (N35°33', E40°43'), F. Krupp, 24 Oct 1986. - SMF 28737, 5, Syria, Euphrates between Ḩalabīyah-Zalābīyah and Dayr az Zawr, R. Beck, Jun 1998. - SMF 28630, 3, Syria, Euphrates upstream Dayr az Zawr (N35°31', E39°54'), R. Beck, 23 May 1998. - SMF 28674, 41, Syria, Euphrates upstream Dayr az Zawr [N35°31', E39°54'], R. Beck, 30 May 1998. - SMF 33153, 1, Syria, Nahr al Khābūr at Aş Şuwar (N35°30', E40°38'), F. Krupp, 15 Mar 1979. - SMF 31315, 1; SMF 33137, 1, Syria, Nahr al Khābūr at Ghawat (N35°28'51", E40°39'54"), N. Alwan et al., 28 Oct 2008. - SMF 30187, 2, Syria, Nahr al Khābūr near Ḩarījīyah (N35°27', E40°38'), F. Krupp, 10 Oct 1988. - SMF 30180, 5, Syria, Nahr al Khābūr at Mashikh (N35°14', E40°31'), F. Krupp, 10 Oct 1988. - SMF 28663, 6, Syria, Euphrates at Qalʿat aş Şāliḩīyah (Dura Europos) [N34°45'0", E40°43'30"], R. Beck, 28 May 1998. - SMF 28758, 2, Syria, Euphrates at Abū Kamāl at mouth of Wādī Ratqah [N34°26'45", E40°56'0"], R. Beck, 9 Jul 1998. - NMW 93019:1-2, 2, Iraq, Tigris at Baghdād [N33°20'26", E44°24'3"], V. Pietschmann, Aug 1910. - SMF 33127, 4, Iran, Rūdkhāneh-ye Bālārūd (N32°35'19", E48°17'11"), N. Alwan et al., 3 Mar 2008. - BMNH 1980.8.28:6, 1, Iran, Rūdkhāneh-ye Dez at Dezfūl [N32°25', E48°13']. - SMF 33125, 1, Iran, Rūdkhāneh-ye Dez at Dezfūl (N32°22'40", E48°22'58"), N. Alwan et al., 2 Mar 2008. - SMF 33121, 5, Iran, Rūdkhāneh-ye Dez at Dezfūl (N32°21'49", E48°21'28"), K. Borkenhagen et al., 3 Nov 2006. - SMF 17303, 1, Iraq, Hawr al Ḩammār (N30°50', E47°10'), L. A. J. Al-Hassan, 1986. - SMF 30211, 1, Iraq, ʻAyn Zālah 50 km west of Mosul, Z. Rahemo, 1990.

Unknown drainage system. SMF 33120, 2, Syria, fish market in Damascus (reported to be from Buḩayratt Ar Rastan [N34°56', E36°44'] in Orontes drainage), F. Krupp. - CMNFI 79-0687, 4, Iran, Shīrāz bazar (probably from Rūd-e Mand basin or Daryācheh-ye Mahārlū basin).

The lectotype (NMW 54253:2) is a specimen of 211 mm SL, collected in the Tigris near Mosul on 10 Apr 1843 by T. Kotschy (Fig. 23). It has four unbranched and 10 branched rays in the dorsal fin, three unbranched and six branched rays in the anal fin, 27 scales in the lateral line and one pair of barbels. A bigger specimen (216 mm SL) from the same lot (NMW 54253:1) was not selected as lectotype, because it is atypical in having 11 branched rays in the dorsal fin and two pairs of barbels. The designation of a lectotype became necessary to fix the type locality of *S. luteus* (see Discussion).

Diagnosis. One pair of barbels; 25 to 33 scales in the lateral line, and typically 12 scales around the least circumference of the caudal peduncle; last unbranched ray of the dorsal fin about as long as the head or slightly shorter.

Description. Specimens from Rūdkhāneh-ye Naband basin were excluded from this species description (see below).

The dorsal profile is convex up to the origin of the dorsal fin and a nuchal hump is present in specimens longer than about 100 mm SL. This species has a high back and caudal peduncle (Figs 23, 24). The ventral profile of the head is convex, its dorsal pro-

Figure 23. *Carasobarbus luteus*, lectotype (NMW 54253:2) from Tigris near Mosul, © Naturhistorisches Museum Wien, photo E. Lavergne.

Figure 24. *Carasobarbus luteus*, live specimen from Nahr al Khābūr.

file is almost straight to convex and has a hump near the nostrils in juvenile specimens. The mouth is sub-terminal. The barbels are short and stout. The maximum body depth is usually greater than the head length (Fig. 12). Usually one pair of barbels is present, but about 10 % of the specimens have two pairs of barbels (Table 2). The eyes are at the back of the anterior half of the head. They are big and slightly protuberant. The morphometric characters are summarised in Table 1.

The dorsal fin usually has four unbranched and eight to 11 branched rays (Table 3). In specimens from the Tigris-Euphrates drainage system the last unbranched ray of the dorsal fin is strong with only the tip being flexible and it is about as long as the head. It is shorter and less ossified in Iranian populations (Fig. 4). The anal fin usually has three unbranched rays and five to seven branched rays (Table 4).

There are 25 to 33 scales in the lateral line (Table 5), 3.5 to 6 scales above the lateral line (Table 6), 3 to 5.5 scales below the lateral line (Table 7) and 10 to 13 scales around the least circumference of the caudal peduncle (Table 8). The scales are shown in Fig. 5.

The pharyngeal teeth count is 2.3.5-5.3.2 in 26 specimens, 2.3.4-5.3.2 in two specimens, 2.3.5-4.3.2 in one specimen, 2.3.5-5.3.3 in one specimen, 1.3.5-5.3.2 in one specimen, 2.3.5- in one specimen and 2.3.4- in one specimen. The pharyngeal teeth are hooked at their tips (Fig. 6).

Live specimens are silvery to olive and sometimes have yellowish fins (Fig. 24). Ethanol-preserved specimens are light yellowish brown to grey. In most cases the back is darker than the rest of the body. Some of the lighter coloured specimens have a salmon hue, others are silvery. The fins are yellowish brown to grey. Juveniles have a dark spot on the sides of the caudal peduncle.

Carasobarbus luteus from Ḩelleh, Kol, Mahārlū and Mand populations: The last unbranched ray of the dorsal fin is shorter and less well ossified. It is pronouncedly shorter than the head (Fig. 4). The mouth is wider and the body is not as high-backed as in specimens from the Tigris-Euphrates system (Fig. 12).

Carasobarbus luteus from Rūdkhāneh-ye Naband basin: In this population all specimens examined had two pairs of barbels (Table 2). The anterior pair is longer than in specimens from Tigris-Euphrates system with two pairs. The last unbranched ray in the dorsal fin is considerably shorter than the head (Fig. 4) and comparatively weak. Compared with specimens from Tigris-Euphrates system, the dorsal and ventral fins tend to be slightly further away from the head. The head is longer and the body not as high backed as in specimens from Tigris-Euphrates system (Fig. 12). The general body shape (Fig. 25) resembles that of *C. apoensis* and *C. canis*. Some of the gill rakers are y-shaped in the largest specimen examined.

Carasobarbus luteus, except the population from Rūdkhāneh-ye Naband, differs from all congeners, except *C. apoensis*, in having one instead of two pairs of barbels. It differs from *C. apoensis*, *C. canis*, *C. chantrei*, *C. fritschii*, *C. harterti* and *C. kosswigi* in modally having 28 scales in the lateral line vs. 30, 32, 34, 34, 34 and 33 respectively. It differs from *C. kosswigi* and *C. sublimus* in having a crescent-shaped lower lip without median lobe vs. a spatulate lower lip with median lobe and from *C. exulatus*, *C. fritschii* and *C. harterti* in modally having 10 rather than nine branched dorsal-fin rays. All populations, except the one from Rūdkhāneh-ye Naband differ from *C. apoensis* in having a shorter head and a higher back. The population from Rūdkhāneh-ye Naband is very similar to *C. apoensis* in body shape, but differs in having two as compared to one pair of barbels.

Distribution. *Carasobarbus luteus* has a much greater range than any of its congeners and its distribution area is fragmented, resulting in several isolated populations. It is widespread all over the Tigris-Euphrates drainage system, and occurs in the rivers of south-western Iran (Fig. 7). The Nahr al Quwayq population, from one of the sites of the type locality, is probably extirpated due to drought and pollution (Krupp 1980, Krupp 1983b). There are only few, mostly older, records from the Orontes (Krupp 1985c, Krupp 1987). During recent fieldwork *C. luteus* was not found there. Because *C. chantrei* is still widespread and abundant in many parts of the Orontes, it is unlikely

Figure 25. *Carasobarbus luteus*, specimen (CMNFI 79-0187) from Rūdkhāneh-ye Sarzeh.

that *C. luteus* disappeared due to habitat degradation. It might have been driven out by competition with *C. chantrei* or records were based on misidentifications or mislabelled specimens. One specimen (NMW 10827) is reported from Damascus. Because *C. luteus* does not occur in the Damascus basin and it is highly unlikely that it ever occurred there, the origin of this specimen is unclear.

Habitats and biology. *Carasobarbus luteus* is mainly herbivorous. It feeds on algae, aquatic plants, detritus and small invertebrates, the main feeding period is at noon, but food is also taken at night (Naama and Muhsen 1986). The intestine is long (Ali 1986). The maximum size is 38 cm total length and 750 g, but normally they are smaller than 35 cm and weight less than 500 g (Ahmed 1982). They reach maturity at the age of one or two years and at a size of about 14 cm; the spawning period is June and July in the Tigris-Euphrates system, the eggs are spawned among reeds, roots or other aquatic vegetation and fecundity is high (Al Hazzaa and Hussein 2003a).

This species can tolerate saline waters to some degree (Al-Hassan and Muhsin 1986, Mohamed et al. 1993) and is of commercial importance due to its size and abundance (Ahmed 1982, Barak and Mohamed 1983, Krupp and Schneider 2008).

There are attempts on aquaculture of this species. The stickiness of the eggs can be lowered by several chemical treatments for this purpose (Al Hazzaa and Hussein 2003b). During spawning males get reddish brown in the anterior part of the body and greenish at the caudal peduncle while females are less colourful (Al Hazzaa and Hussein 2003a). Males can produce series of sharp clicking noises which do not seem to be associated with aggressive behaviour (Al Hazzaa and Hussein 2003a).

Larvae hatch at 64 degree-days in well oxygenated water and the eyes are still without pigments at this stage. The development is similar to that of other cyprinids (Al Hazzaa and Hussein 2003a). Ahmed et al. (1984) studied the reproductive biology of *C. luteus*.

Conservation status. *Carasobarbus luteus* is widespread and abundant in the Tigris-Euphrates system. Peripheral populations, like those in smaller Iranian rivers and the Nahr al Quwayq in Syria are more threatened or have already been extirpated (see above).

Discussion. *Carasobarbus luteus* was described as *Systomus luteus* by Heckel (1843). Heckel (1843) listed Orontes, Tigris, Aleppo and Mosul as type localities. As all but one of the type specimens are either from the Tigris-Euphrates system or from the Nahr al Quwayq and Aleppo is located on the Nahr al Quwayq and not on the Orontes, Heckel may have confused these two rivers. One of the type specimens (NMW 10827) is from "Damascus" and can not be attributed to any of the relevant drainage systems. By designating NMW 54253:2 as lectotype we fix the Tigris near Mosul as type locality for *S. luteus*. The same confusion exists for the type localities of *Systomus albus*, which was also described from Tigris and Orontes in the same publication. A few years later *Systomus albus* var. *alpina* was described from the Daryācheh-ye Parīshān (Heckel 1847). These three taxa where later synomymised and placed in the genus *Barbus* (Günther 1868). Sauvage (1882, 1884) accepted *C. luteus* and *C. albus* as valid species and transferred them to the genus *Barynotus*. Later, both species where synonymised again and transferred to the genus *Barbus*, subgenus *Puntius* (Misra 1947) or the genus *Puntius* (Menon 1956). Ladiges (1960) synonymised both species under the name *Barynotus albus*. Because Günther (1868) had previously selected *luteus* as the valid species name, he is to be considered the first revising author and Ladiges' action is not valid. Kähsbauer (1963) lists the species under two different generic names: *Barbus* (as *B. luteus*) and *Systomus* (as *S. albus* var. *alpina*). Karaman (1971) erected the new genus *Carasobarbus* for this species. This met mixed acceptance. While some authors accepted the new taxonomic position (e.g. Wossughi 1978, Bianco and Banarescu 1982, Ahmed et al. 1984, Naama and Muhsen 1986), others did not embrace it (e.g. Banister and Clarke 1977, Krupp 1985a, c, Coad 1995, Coad 1996) until the revision by Ekmekçi and Banarescu (1998). Fowler (1976) placed *C. luteus* in the genus *Barbellion*. Tsigenopoulos et al. (2010) used *Barbus* subgenus *Carasobarbus. Barbus parieschanica* was described from Daryācheh-ye Parīshān (Wossughi et al. 1983). In the same publication the species name is also spelled *B. parschanica*, but *B. parieschanica* is probably the intended spelling (Coad 1995). Coad (1995) as the first revising author fixed *B. parieschanica* as the correct original spelling. *Barbus parieschanica* is a synonym of *C. luteus*. The 'Catalog of Fishes' lists RMNH 2463 as possible syntype of *S. luteus* and RMNH 2464 of *S. albus* var. *alpina* (Eschmeyer 2011). We did not examine these specimens.

We do not think that the population at Rūdkhāneh-ye Naband should be elevated to specific rank, because the number of specimens available is too low. We provisionally consider it an atypical population of *C. luteus* that might have been affected by bottleneck effects and accelerated morphological change, due to the restricted size and extreme conditions (high salinity and temperature) of its habitat. It would be very interesting to collect more samples for morphological studies and molecular sequence analysis.

In spite of some morphometric differences, *C. luteus* populations of Tigris-Euphrates system and Iran belong to the same species (Borkenhagen et al. 2011); specimens from Rūdkhāneh-ye Naband were not included in that study.

Carasobarbus luteus and *C. apoensis* are closely related to each other (KB, unpublished data) and *C. apoensis* might be the ecologically specialised sister species of *C. luteus*, that is adapted to the environmental conditions of the wadi ecosystems of the Al Ḩijāz mountains.

Carasobarbus sublimus (Coad & Najafpour, 1997)

http://species-id.net/wiki/Carasobarbus_sublimus

Barbus sublimus Coad and Najafpour 1997: 274.

Material. Type material. Holotype of *Barbus sublimus*: CMNFI 1995-0009, Iran, Rūdkhāneh-ye A'lā near Pol-e Tīghen (N31°23'30", E49°53'0"), B. W. Coad et al., 20 Sep 1995, not examined.

Paratypes of *Barbus sublimus*: CMNFI 95-0009a, 1, same data as holotype. - CMNFI 95-0010, 1, same data as holotype, not examined. - CMNFI 95-0011, 3, Iran, Rūdkhāneh-ye A'lā near Pol-e Tīghen (N31°23'30", E49°53'0"), G. Eskanderi, Dec 1994, only one specimen examined.

Non-type material. Rūdkhāneh-ye Kashgān. CMNFI 79-0277, 1, Iran, Rūdkhāneh-ye Kashgān at Harpul Kashkow, 50 km from Khorramābād (N33°30'0", E47°59'30"), K. Evans and H. Assadi, 5 Jul 1977.

Rūdkhāneh-ye Zohreh drainage. ZM-CBSU 5781-5786, 6, Iran, Rūdkhāneh-ye Fahlīān at Nūrābād [N30°6'51", E51°31'18"], H. R. Esmaeili et al. - SMF 33117, 3, Iran, Rūdkhāneh-ye Fahlīān (N30°11'10", E51°31'14"), K. Borkenhagen et al., 29 Nov 2007. - SMF 33118, 6, Iran, Rūdkhāneh-ye Fahlīān (N30°11'9", E51°31'15"), N. Alwan et al., 29 Feb 2008.

Diagnosis. Two pairs of barbels; 27 to 29 scales in the lateral line, 12 scales around the least circumference of the caudal peduncle; last unbranched dorsal-fin ray about as long as the head; mouth narrow, lower jaw spatulate and median lobe present on lower lip.

Description. A nuchal hump is not developed. The maximum body depth is at the anterior end of the dorsal fin base. The ventral profile of the head is almost straight; the dorsal profile is convex and evenly curved (Figs 26, 27). The maximum body depth is greater than the head length (Fig. 12). The mouth is inferior, narrow, the lips are thick and the lower jaw is spatulate with a horny sheath and a median lobe on the lower lip. The two pairs of barbels (Table 2) are well developed. The eyes are at the posterior end of the anterior half of the head. Some morphometric characters are summarised in Table 1.

The dorsal fin usually has four unbranched and nine or 10 branched rays (Table 3). The last unbranched ray of the dorsal fin is weakly ossified and about as long as the head (Fig. 4). The anal fin usually has three unbranched and six branched rays (Table 4) and its base is surrounded by a sheath of scales. Pectoral, ventral and anal fins are longer than in all other *Carasobarbus* species (Table 1).

There are 27 to 29 scales in the lateral line (Table 5), 4.5 or 5.5 scales above the lateral line (Table 6), 3.5 to 5.5 scales below the lateral line (Table 7) and 12 scales around the least circumference of the caudal peduncle (Table 8). The scales are shown in Fig. 5.

The pharyngeal teeth count is 2.3.4-5.3.2, 2.3.4-5.3.1 or 3.3.4-4.3.3 (Coad and Najafpour 1997). The pharyngeal bones available were too small for photography but are very similar to those of *C. kosswigi* (Fig. 6).

Live specimens from Rūdkhāneh-ye Fahlīān are silvery with hyaline fins (Fig. 27). Live specimens from Rūdkhāneh-ye A'lā are silvery with a slightly darker back, the

Figure 26. *Carasobarbus sublimus*, paratype (CMNFI 95-0011) from Rūdkhāneh-ye A'lā, photo S. Tränkner.

Figure 27. *Carasobarbus sublimus*, live specimen from Rūdkhāneh-ye Fahlīān.

scales have dark pigments on their hind margin; pectoral, ventral and anal fins have a yellow to orange hue, which is most obvious with fins folded back; dorsal and caudal fins are grey or hyaline (Coad and Najafpour 1997). Ethanol-preserved specimens are yellowish brown with a somewhat darker back and juveniles have a dark spot on the sides of the caudal peduncle.

Carasobarbus sublimus differs from all congeners, except *C. kosswigi*, by having a spatulate lower jaw with a median lobe on the lower lip vs. a crescent shaped lower jaw and a lower lip without median lobe. It differs from *C. kosswigi* by having 27 to 29 scales in the lateral line vs. 32 to 38 and modally 12 scales around the least circumference of the caudal peduncle vs. 14 and by having a shorter and less ossified unbranched last dorsal-fin ray.

Distribution. This species is known from Rūdkhāneh-ye A'lā, Rūdkhāneh-ye Fahlīān and possibly Rūdkhāneh-ye Kashgān (see discussion) in south-western Iran (Fig. 7).

Habitats and biology. *Carasobarbus sublimus* is adapted to streams with fast currents with water flowing over hard substrate (Coad and Najafpour 1997). The biggest specimen known has a SL of 115 mm (Coad and Najafpour 1997).

Conservation status. Little is known about the conservation status of *C. sublimus*, but because this species is dependent on fast-flowing water, it is probably impacted by the construction of dams.

Discussion. *Carasobarbus sublimus* was described in the genus *Barbus* and aligned with *C. apoensis*, *C. canis*, *C. chantrei*, *C. exulatus*, *C. kosswigi* and *C. luteus* in the original description (Coad and Najafpour 1997). Coad recommends the use of the genus *Kosswigobarbus* for this species (Coad 2011). It was transferred to *Carasobarbus*, based on morphological characters and close genetic relationship (Borkenhagen et al. 2011).

Locality data for CMNFI 79-0277 is not beyond doubt, because this lot was mentioned as *C. kosswigi* in the original description of *C. sublimus* (Coad and Najafpour 1997). According to morphometric and meristic characters (scales in lateral line, above lateral line and around the least circumference of the caudal peduncle; length of dorsal, pectoral, ventral and anal fin) this specimen is within the range of *C. sublimus* and outside the range of *C. kosswigi*. It might be an aberrant specimen or it might have been accidentally swaped with CMNFI 1995-0010 (a specimen of similar size from the same locality as the types of *C. sublimus*). We had no opportunity to examine CMNFI 1995-0010. Though we think it is unlikely that *C. kosswigi* and *C. sublimus* occur sympatrically, for the time being we consider it to be a possible record of *C. sublimus* from the Rūdkhāneh-ye Kashgān.

Hybrids

Two putative intergeneric hybrids of *C. canis* with other cyprinids are known, one with *Capoeta damascina* (Valenciennes in Cuvier and Valenciennes 1842) and one with *Luciobarbus longiceps* (Valenciennes in Cuvier and Valenciennes 1842).

Carasobarbus canis × *Capoeta damascina*

The hybrids are intermediate in many morphometric and meristic characters (Mir et al. 1988). The head resembles that of *Capoeta damascina*, the mouth is more inferior than in *C. canis* and the lips are thicker. The scales are larger than in *Capoeta damascina* and smaller than in *C. canis* (Mir et al. 1988, Fig. 28). Oogonia and spermatogonia coexist in the gonads of both sexes and the development of the gametes is disturbed, thus the hybrids are sterile (Fishelson et al. 1996).

Carasobarbus canis × *Luciobarbus longiceps*

These hybrids are intermediate in many morphometric and meristic characters (Krupp 1985b, Fig. 29). The lateral line scale count matches that of *C. canis*. Heterologous

Figure 28. *Carasobarbus canis* x *Capoeta damascina*, aquarium photograph of SMF 17184, originally from Nahr az Zarqā'.

Figure 29. Holotype of *Barbus continii* = *Carasobarbus canis* x *Barbus longiceps* preserved specimen (SL=165 mm), Lake Tiberias (MCSN 22300).

cells are present in the gonads of this hybrid but the gametes mature normally (Fishelson et al. 1996). This hybrid was described as *Barbus continii* Vinciguerra, 1926 from a single specimen (Krupp 1985b).

Key to the *Carasobarbus* species

1	Branched dorsal-fin rays 9, Yemen and NW Africa	**2**
–	Branched dorsal fin rays 10	**4**
2	Scales around least circumference of the caudal peduncle 10–12, Yemen	***C. exulatus***
–	Scales around least circumference of the caudal peduncle 13–20, Morocco	**3**
3	Dorsal profile of head convex, more than 15 % of the last unbranched dorsal-fin ray flexible	***C. fritschii***
–	Dorsal profile of head straight, less than 15 % of the last unbranched dorsal-fin ray flexible	***C. harterti***
4	Lower jaw spatulate and lower lip with a median lobe	**5**
–	Lower jaw u-shaped or crescent shaped and lower lip without median lobe	**6**

5 Scales around the least circumference of the caudal peduncle 12, 27–29 scales in the lateral line, head about as long as dorsal fin .... ***C. sublimus***
– Scales around the least circumference of the caudal peduncle 12–16, 32–38 scales in the lateral line, dorsal fin longer than the head .... ***C. kosswigi***
6 Modally 14 (12–16) scales around the least circumference of the caudal peduncle .... ***C. chantrei***
– Modally 12 (10–14) scales around the least circumference of the caudal peduncle **7**
7 Usually two pairs of barbels, Jordan River and adjacent waterbodies .... ***C. canis***
– Usually one pair of barbels, Mesopotamia, southern Iran and Arabia **8**
8 Head about as long as body depth, dorsal fin markedly shorter than head, modally 30 scales in the lateral line, Western Arabian Peninsula........ ***C. apoensis***
– Head shorter than body depth, dorsal fin about as long as head (except in Iranian populations), modally 28 scales in lateral line, Mesopotamia and southern Iran.. ***C. luteus***

Authors contribution

KB and FK developed the concept for this study and conducted field research independent of each other. KB collected, analysed and interpreted the data presented in this study and prepared the manuscript. FK reviewed the manuscript.

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References

Ahmed HA (1982) Crowth [sic] of the cyprinid fish, *Barbus luteus* (Heckel) in Tharthar Reservoir, Iraq. Bulletin of Basrah Natural History Museum 5: 3–15.

Ahmed HA, Al-Hammar MA, Al-Adhub AHY (1984) The reproductive biology of *Carasobarbus luteus* (Pisces, Cyprinidae) in Al-Hammar Marsh, Iraq. Cybium 8 (4): 69–80.

Al Hazzaa R, Hussein A (2003a) Initial observations in himri (*Barbus luteus*, Heckel) propagation. Turkish Journal of Fisheries and Aquatic Sciences 3: 41–45.

Al Hazzaa R, Hussein A (2003b) Stickiness elimination of himri barbel (*Barbus lutes*, Heckel) eggs. Turkish Journal of Fisheries and Aquatic Sciences 3: 47–50.

Al-Hassan LAJ, Muhsin KA (1986) The presence of *Barbus luteus* and *Heteropneustes fossilis* in the Khor al Zubair, in the North-West of the Arabian Gulf. Zoology in the Middle East 1: 116–119. doi: 10.1080/09397140.1986.10637531

Ali AM (1986) Morphometric characteristics of the khimri, *Barbus luteus* (Cyprinidae), from Tartar Reservoir and the Tigris River (Iraq). Journal of Ichthyology 25 (5): 168–171.

Alkahem AF, Behnke RJ (1983) Freshwater fishes of Saudi Arabia. Fauna of Saudi Arabia 5: 545–567.

Al-Safadi MM (1995) A pilot study of lake Ma'rib, Yemen. Hydrobiologia 315 (3): 203–209. doi: 10.1007/BF00051950

Attaala AM, Rubaia BS (2005) First record of the eel *Anguilla bengalensis* from Arabia with notes on freshwater fishes from Hadramout, Yemen. Zoology in the Middle East 34: 35–44. doi: 10.1080/09397140.2005.10638080

Azeroual A, Crivelli AJ, Yahyaoui A, Dakki M (2000) L'ichtyofaune des eaux continentals du Maroc. Cybium 23 (3): 17–22.

Banarescu P (1977) Position zoogéographique de l'ichthyofaune d'eau douces d'Asie occidentale. Cybium 2: 35–55.

Banister KE (1980) The fishes of the Tigris and Euphrates rivers. In: Rzóska J, Talling JF (Eds) Euphrates and Tigris, Mesopotamien Ecology and Destiny. Junk, The Hague, 95–106. doi: 10.1007/978-94-009-9171-2_9

Banister KE, Clarke MA (1977) The freshwater fishes of the Arabian Peninsula. Journal of Oman Studies (Special Report): 111–154.

Barak NAA, Mohamed AM (1983) Biological study of the cyprinid fish, *Barbus luteus* (Heckel) in Garma Marshes. Journal of Biological Sciences. Research Baghdad 14(2): 53–70.

Battalgil F (1942) Türkiye tatlısu balıkları hakkında. Contribution à la connaissance des poissons des eaux douces de la Turquie. Revue de la Faculté des Sciences de l'Université d'Instanbul, Série B: Sciences Naturelles 7(4): 287–306.

Ben-Tuvia A (1978) Fishes. In: Serruya C (Ed) Lake Kinneret, 407–430.

Berg LS (1949) Presnovodnye ryby Irana i sopredel'nykh stran [Freshwater fishes of Iran and adjacent countries]. Trudy Zoologicheskogo Instituta Akademii Nauk SSSR 8: 783–858.

Berrebi P (1981) Contribution a l'etude du sous-genre *Labeobarbus*. Bulletin de l'Institut Scientifique, Rabat 5: 59–72.

Bianco PG, Banarescu P (1982) A contribution to the knowledge of the Cyprinidae of Iran (Pisces, Cypriniformes). Cybium 6(2): 75–96.

Bleeker P (1859) Negende bijdrage tot de kennis der vischfauna van Banka. Natuurkundig Tijdschrift voor Nederlandsch Indië 18: 359–378.

Borkenhagen K, Esmaeili HR, Mohsenzadeh S, Shahryari FGA (2011) The molecular systematics of the *Carasobarbus* species from Iran and adjacent areas, with comments on *Carasobarbus albus* (Heckel, 1843). Environmental Biology of Fishes 91(3): 327–335. doi: 10.1007/s10641-011-9787-1

Boulenger GA (1902) Description of two new cyprinid fishes from Morocco. Annals and Magazine of Natural History (Series 7) 9(50): 124–125.

Boulenger GA (1905) Another new *Barbus* from Morocco. Novitates Zoologicae. A Journal of Zoology in Connection with the Tring Museum 12: 505.

Boulenger GA (1911) Catalogue of the fresh-water fishes of Africa in the British Museum (Natural History). London.

Boulenger GA (1919) La distribution en Afrique des Barbeaux du sous-genre *Labeobarbus*. Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 169: 1016–1018.

BCEAW (2002) Conservation Assessment and Management Plan (CAMP) for the Threatened Fauna of Arabia's Mountain Habitat. Final Report. The Breeding Centre for Endangered Arabian Wildlife, Sharjah; UAE.

Coad BW (1982) A re-description and generic re-assignment of *Kosswigobarbus kosswigi* (Ladiges, 1960), a cyprinid fish from Turkey and Iran. Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut 79: 263–265.

Coad BW (1995) Freshwater fishes of Iran. Acta Scientiarum Naturalium, Brno 29(1): 1–64.

Coad BW (1996) Zoogeography of the fishes of the Tigris-Euphrates Basin. Zoology in the Middle East 13: 51–70. doi: 10.1080/09397140.1996.10637706

Coad BW (2011) Freshwater Fishes of Iran. http://www.briancoad.com

Coad BW, Najafpour N (1997) *Barbus sublimus*, a new species of cyprinid fish from Khuzestan Province, Iran. Ichthyological Exploration of Freshwaters 7(3): 273–278.

Colli L, Paglianti A, Berti R, Gandolfi G, Tagliavini J (2009) Molecular phylogeny of the blind cavefish *Phreatichthys andruzzii* and *Garra barreimiae* within the family Cyprinidae. Environmental Biology of Fishes 84(1): 95–107. doi: 10.1007/s10641-008-9393-z

Crivelli AJ (2006a) *Barbus canis*. In: IUCN (2012) IUCN Red List of Threatened Species. Version 2012.2. http://www.iucnredlist.org

Crivelli AJ (2006b) *Barbus chantrei*. In: IUCN (2012) IUCN Red List of Threatened Species. Version 2012.2. http://www.iucnredlist.org

Crivelli AJ (2006c) *Barbus fritschii*. In: IUCN (2012) IUCN Red List of Threatened Species. Version 2012.2. http://www.iucnredlist.org

Crivelli AJ (2006d) *Barbus harterti*. In: IUCN (2012) IUCN Red List of Threatened Species. Version 2012.2. http://www.iucnredlist.org

Crivelli AJ (2006e) *Barbus paytonii*. In: IUCN (2012) IUCN Red List of Threatened Species. Version 2012.2. http://www.iucnredlist.org

Cuvier G, Cloquet H (1816) Le règne animal distribué d'après son organisation pour servir de base à l'histoire naturelle des animaux et d'introduction à l'anatomie comparée. Les reptiles, les poissons, les mollusques et les annélides, 532 pp.

Cuvier G, Valenciennes A (1842) Histoire naturelle des poissons. Volume 16, 472 pp.

Doadrio I (1994) Freshwater fish fauna of North Africa and its biogeography. Annales du Musee royale de l'Afrique Centrale, Zoologie 275: 21–34.

Durand JD, Tsigenopoulos CS, Ünlü E, Berrebi P (2002) Phylogeny and biogeography of the family Cyprinidae in the Middle East inferred from cytochrome *b* DNA - Evolutionary significance of this region. Molecular Phylogenetics and Evolution 22(1): 91–100. doi: 10.1006/mpev.2001.1040

Ekmekçi FG, Banarescu P (1998) A revision of the generic position of *Barynotus* (*Systomus*) *verhoeffi*, and the validity of the genera *Carasobarbus*, *Kosswigobarbus* and *Mesopotamichthys* (Pisces, Cyprinidae). Folia Zoologica 47 (Suppl. 1): 87–96.

El Gharbi S, Lambert A, Berrebi P (1993) Le genre *Barbus* (sous-genres *Barbus* et *Labeobarbus*) au Maroc. Génétique et parasitologie. Cahiers d'éthologie 13(2): 223–226.

Eschmeyer WN (Ed) (2011) Catalog of Fishes. California Academy of Sciences. Electronic version http://research.calacademy.org/research/ichthyology/catalog/fishcatmain.asp [14 July 2011]

Fishelson L, Goren M, Vuren J van, Manelis R (1996) Some aspects of the reproductive biology of *Barbus* spp., *Capoeta damascina* and their hybrids (Cyprinidae, Teleostei) in Israel. Hydrobiologia 317 (1): 79–88. doi: 10.1007/BF00013728

Fowler HW (1976) A Catalog of World Fishes (XXV). Quarterly Journal of the Taiwan Museum 29 (3&4): 277–396.

Fricke R, Eschmeyer WN (2013) Guide to Fish Collections. California Academy of Sciences. Electronic version. http://research.calacademy.org/research/ichthyology/catalog/collections.asp [accessed 15 May 2013]

Goren M (1974) The freshwater fishes of Israel. Israel Journal of Zoology 23: 67–118.

Goren M, Ortal R (1999) Biogeography, diversity and conservation of the inland water fish communities in Israel. Biological Conservation 89 (1): 1–9. doi: 10.1016/S0006-3207(98)00127-X

Gorshkova G, Gorshkov S, Golani D (2002) Karyotypes of *Barbus canis* and *Capoeta damascina* (Pisces, Cyprinidae) from the Middle East. Italian Journal of Zoology 69(3): 191–194. doi: 10.1080/11250000209356459

Gray JE (1830-35) Illustrations of Indian zoology; chiefly selected from the collection of Major-General Hardwicke, F.R.S. 20 parts in 2 vols.

Günther A (1864) Report on a collection of reptiles and fishes from Palestine. Proceedings of the Zoological Society of London 1864.

Günther A (1868) Catalogue of the fishes in the British Museum. Catalogue of the Physostomi, containing the families Heteropygii, Cyprinidae, Gonorhynchidae, Hyodontidae, Osteoglossidae, Clupeidae, Chirocentridae, Alepocephalidae, Notopteridae, Halosauridae, in the collection of the British Museum.

Günther A (1874) Notice of some new species of fishes from Morocco. Annals and Magazine of Natural History 13(75): 230–232. doi: 10.1080/00222937408680848

Günther A (1901) Second notice of new species of fishes from Morocco. Novitates Zoologicae. A Journal of Zoology in Connection with the Tring Museum 8: 367–368.

Günther A (1902) Third notice of new species of fishes from Morocco. Novitates Zoologicae. A Journal of Zoology in Connection with the Tring Museum 9: 446–448.

Hamidan N (2004) The freshwater fish fauna of Jordan. Denisia 14: 385–394.

Hamilton F (1822) An account of the fishes found in the river Ganges and its branches. Printed for A. Constable and company [etc., etc.]. Edinburgh, 426 pp.

Heckel JJ (1843) Ichthyologie. In: Russegger J von (Ed) Reisen in Griechenland, Unteregypten, im nördlichen Syrien und südöstlichen Kleinasien mit besonderer Rücksicht auf die naturwissenschaftlichen Verhältnisse der betreffenden Länder, unternommen in dem Jahre 1836, Stuttgart.

Heckel JJ (1847) Die Fische Persiens, gesammelt von Theodor Kotschy. In: Russegger J von (Ed) Reisen in Europa, Asien und Africa unternommen in den Jahren 1835 bis 1841.

Hubbs CL, Lagler KF (1958) Fishes of the Great Lakes Region. The University of Michigan Press. Ann Arbor, 213 pp.

ICZN (2012) International Commission on Zoological Nomenclature. Fourth Edition. The International Trust for Zoological Nomenclature. http://www.nhm.ac.uk/hosted-sites/iczn/code/

Kähsbauer (1963) Zur Kenntnis der Ichthyofauna von Iran. Annalen des Naturhistorischen Museums in Wien 66: 317–355.

Karaman MS (1971) Süßwasserfische der Türkei. 8. Teil: Revision der Barben Europas, Vorderasiens und Nordafrikas. Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut 67: 175–254.

Krupp F (1980) Die Verbreitung syrischer Süßwasserfische unter dem Einfluß des Menschen. Natur und Museum 110 (6): 157–164.

Krupp F (1983a) Freshwater fishes of Saudi Arabia and adjacent regions of the Arabian Peninsula. Fauna of Saudi Arabia 5: 568–636.

Krupp F (1983b) Recent changes in the distribution of Syrian freshwater fishes. Roczniki Nauk Rolniczych HT 100 (3): 79–88.

Krupp F (1985a) *Barbus chantrei* (Sauvage 1882), a valid species of cyprinid fish from the northern Levant. Senckenbergiana Biologica 66 (1/3): 17–25.

Krupp F (1985b) *Barbus continii* Vinciguerra 1926, a possible natural hybrid of *Barbus canis* and *Barbus longiceps* (Pisces: Osteichthyes: Cyprinidae). Senckenbergiana Biologica 66 (1/3): 9–15.

Krupp F (1985c) Systematik und Zoogeographie der Süßwasserfische des levantinischen Grabenbruchsystems und der Ostküste des Mittelmeeres. PhD thesis, University of Mainz, Mainz, Germany, VII+215+169 pp.

Krupp F (1987) Freshwater ichthyography of the Levant. In: Krupp F, Schneider W, Kinzelbach R (Eds) Proceedings of the Symposium on the Fauna and Zoogeography of the Middle East, Mainz 1985. Beihefte zum Tübinger Atlas des Vorderen Orients, Wiesbaden, A 28: 229–237.

Krupp F, Schneider W (1989) The fishes of the Jordan River drainage basin and Azraq Oasis. Fauna of Saudi Arabia 10: 347–416.

Krupp F, Schneider W (1991) Bestandserfassung der rezenten Fauna im Bereich des Nahr al-Ḫābūr. In: Kühne H (Ed) Die rezente Umwelt von Tall Šēḫ Ḥamad und Daten zur Umweltrekonstruktion der assyrischen Stadt Dūr-Katlimmu 1, Berlin, 69-85.

Krupp F, Schneider W (2008) Die Fischfauna des Nahr al-Ḫābūr, Nordost-Syrien. In: Kühne H (Ed) Umwelt und Subsistenz der assyrischen Stadt Dūr-Katlimmu am unteren Ḫābūr 8, Harrassowitz-Verlag, Wiesbaden, 41–51.

Ladiges W (1960) Süsswasserfische der Türkei. I. Teil Cyprinidae. Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut 58: 105–150.

Leggatt RA, Iwama GK (2003) Occurrence of polyploidy in the fishes. Reviews in Fish Biology and Fisheries 13(3): 237–246. doi: 10.1023/B:RFBF.0000033049.00668.fe

Machordom A, Doadrio I (2001) Evolutionary history and speciation modes in the cyprinid genus *Barbus*. Proceedings of the Royal Society of London Series B - Biological Sciences 268(1473): 1297–1306. doi: 10.1098/rspb.2001.1654

McClelland J (1839) Indian Cyprinidae. Asiatic Researches 19(2): 217–471.

Menon MAS (1956) On a third collection of fish from Iraq. Records of the Indian Museum 54: 139–157.

Mir S (1990) Taxonomical studies and the geographical distribution of freshwater fishes of Jordan. Bangladesh Journal of Zoology 18(2): 157–175.

Mir S, Al-Absy A, Krupp F (1988) A new natural intergeneric cyprinid hybrid from the Jordan River drainage, with a key to the large cyprinids of the southern Levant. Journal of Fish Biology 32(6): 931–936. doi: 10.1111/j.1095-8649.1988.tb05436.x

Misra KS (1947) On a second collection of fish from Iraq. Records of the Indian Museum 45: 115–127.

Mohamed ARM, Al-Hassan LAJ, Ali TS (1993) The presence of a cyprinid fish, *Barbus luteus* in marine waters of Iraq. Arquivos do Museu Bocage, Nova Serie 2(25): 415–416.

Naama AK, Muhsen KA (1986) Feeding periodicites of the mugilid *Liza abu* (Heckel) and Cyprinid *Carasobarbus luteus* (Heckel) from Al-Hammar Marsh, Southern Iraq. Indian Journal of Fisheries 33(3): 347–350.

Pellegrin J (1912) Reptiles, Batraciens et Poissons du Maroc (mission de Mme Camille du Gast). Bulletin de la Société Zoologique de France 37: 255–262.

Pellegrin J (1921) Les poissons des eaux douces de l'Afrique du Nord française Maroc: Algérie, Tunisie, Sahara. Mémoires de la Société des Sciences Naturelles du Maroc 1 (2).

Pellegrin J (1939) Les barbeaux de l'Afrique du nord Française: description d'une espèce nouvelle. Bulletin de la Société des sciences naturelles du Maroc 19: 1–10.

Pellegrin JM (1919) Sur la faune ichthyologique des eaux douces du Maroc. Comptes rendus hebdomadaires des séances de l'Académie des sciences 169: 809–811.

Rüppell E (1835) Neuer Nachtrag von Beschreibungen und Abbildungen neuer Fische, im Nil entdeckt. Museum Senckenbergianum 2(1): 1–28.

Sabaj-Pérez M (2010) Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology. http://www.asih.org/files/Coll_Abbr_v2.0_SabajPerez_8Nov2010.pdf

Sauvage HE (1882) Catalogue des poissons recueillis par M. E. Chantre pendant son voyage en Syrie, Haute-Mésopotamie, Kurdistan et Caucase. Bulletin de la Société philomathique de Paris 6: 163–168.

Sauvage HE (1884) Notice sur la faune ichthyologique de l'oust de l'Asie et plus particulièrement sur les poissons recueillis par M. Chantre pendant son voyage dans cette région. Nouvelles Archives du Muséum d'Histoire Naturelle, Paris (Ser. 2) 7: 1–41.

Spataru P, Gophen M (1985) Food composition of the barbel *Tor canis* (Cyprinidae) and its role in the Lake Kinneret ecosystem. Environmental Biology of Fishes 14(4): 295–301. doi: 10.1007/BF00002634

Tsigenopoulos CS, Kasapidis P, Berrebi P (2010) Phylogenetic relationships of hexaploid large-sized barbs (genus *Labeobarbus*, Cyprinidae) based on mtDNA data. Molecular Phylogenetics and Evolution 56(2): 851–856. doi: 10.1016/j.ympev.2010.02.006

Vinciguerra D (1926) Sopra una collezione di pesci della Palestina. Annali del Museo Civico di Storia Naturale Giacomo Doria 52: 210–226.

Whitley GP (1931) New names for Australian fishes. Australian Zoologist 6(4): 310–334.

Wossughi G (1978) Beitrag zur Systematik und Zoogeographie der Cyprinidae (Pisces: Teleostei) des Mittleren Ostens, unter besonderer Berücksichtigung des Irans. PhD thesis, University of Hamburg, Hamburg, Germany, 89 pp.

Wossughi GH, Khoshzahmat A, Etemadfar A (1983) Recognition of fresh-water fishes in the area between Noorabad of Mamasany, Kazeron and Dashtestan. Journal of Veterinary Faculty, University of Tehran 38(2-4): 21–44.

Appendix

Table of localities for all lots examined. (doi: 10.3897/zookeys.339.4903.app) File format: OpenDocument spreadsheet (ods).

Explanation note: Table of localities for all specimens examined as a spreadsheet to make them more easily available for use in biodiversity databases and geospatial investigations.

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RESEARCH ARTICLE

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New species of oribatid mites of the genera *Lepidozetes* and *Scutozetes* (Acari, Oribatida, Tegoribatidae) from Nepal

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§ *http://zoobank.org/905DB7C2-26A0-45FA-8EFA-9BDB3A20B96B*

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Abstract

Two new species of oribatid mites, *Lepidozetes acutirostrum* **sp. n.** and *Scutozetes clavatosensillus* **sp. n.**, are described from Nepal. The genera *Lepidozetes* and *Scutozetes* are recorded for the first time for the Oriental region. The identification keys to the known species of these genera are provided.

Keywords

Oribatida, new species, description, *Lepidozetes*, *Scutozetes*, key, Nepal

Introduction

In the course of taxonomic identification of Nepalese oribatid mites[1] (Acari: Oribatida) we found two new species of the family Tegoribatidae, belonging to the genera *Lepidozetes* Berlese, 1910 and *Scutozetes* Hammer, 1952. The purpose of this paper is

[1] Results of the Himalaya Expeditions of Dr. Jochen Martens.

to describe and illustrate these species under the names *Lepidozetes acutirostrum* sp. n. and *Scutozetes clavatosensillus* sp. n.

Lepidozetes is a small genus that was proposed by Berlese (1910) with *Lepidozetes singularis* Berlese, 1910 as the type species. Currently, the genus comprises four[2] species, which distributed in the Holarctic region (Subías 2004, online version 2013). Hence, the genus *Lepidozetes* is recorded in the Oriental region for the first time. The main generic characters of the genus were summarized by Bayartogtokh and Aoki (1999) and Weigmann (2006).

Scutozetes is a small genus that was proposed by Hammer (1952) with *Scutozetes lanceolatus* Hammer, 1952 as the type species. Currently, the genus comprises two species, which distributed in the Holarctic and Neotropical regions (Subías 2004, online version 2013). Hence, the genus *Scutozetes* is recorded in the Oriental region for the first time. The main generic characters of the genus were presented by Hammer (1952) and summarized by Bayartogtokh and Aoki (1999).

The identification keys to the known species of *Lepidozetes* and *Scutozetes* are provided below.

Material and methods

Specimens of *Lepidozetes acutirostrum* sp. n. (holotype: female; six paratypes: four females, two males) and *Scutozetes clavatosensillus* sp. n. (holotype: female; five paratypes: three females, two males) were collected by J. Martens and A. Ausobsky from Nepal: Mustang District, Purano Marpha above the village of Marpha, eastern Dhaulagiri massif, 3200–3600 m a.s.l., forest (prevailed *Pinus wallichiana*, *Cupressus torulosa*, *Abies spectabilis*) slightly north of the Himalayan main range, soil litter, 22.IV.1980.

All specimens were studied in lactic acid, mounted in temporary cavity slides for the duration of the study, and then stored in 70% ethanol in vials. Body measurements are presented in micrometers. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral width refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect. Formulae for leg setation are given in parentheses according to the sequence of trochanter–femur–genu–tibia–tarsus (famulus included). Formulae for leg solenidia are given in square brackets according to the sequence of genu–tibia–tarsus. Terminology used in this paper mostly follows that of Norton and Behan-Pelletier (2009).

[2] Subías (2004, online version 2013) includes the genus *Onazetes* Bugrov, 1991 with the type species, *Onazetes umbellatus* Bugrov, 1991 (see Bugrov 1991), in *Lepidozetes*. However, *O. umbellatus* has an additional pair of porose areas close to notogastral setae *c* (it absent in all *Lepidozetes* species) and five pairs of genital setae (six pairs in all *Lepidozetes*-species). Further research is needed to establish the taxonomical position of *Onazetes*.

Descriptions of new species

Lepidozetes acutirostrum **Ermilov, Martens & Tolstikov, sp. n.**
http://zoobank.org/A2C12F54-D6D3-4624-9C5F-B944E4C1F09F
http://species-id.net/wiki/Lepidozetes_acutirostrum
Figs 1–16

Diagnosis. Body size 647–697 × 431–481. Body surface microfoveolate. Rostrum pointed. Anterior margin of lamellae concave medially. Interlamellar setae longer than rostral and lamellar setae. Sensilli with lanceolate head. Tutoria with one strong tooth. Notogastral setae of medium size, weakly thickened, barbed. Pedotecta I pointed anteriorly. Adanal setae ad_1, ad_2 longer than other anogenital setae.

Description. *Measurements*. Body length 697 (holotype: female), 647–697 (six paratypes: four females and two males); body width 481 (holotype), 431–481 (six paratypes).

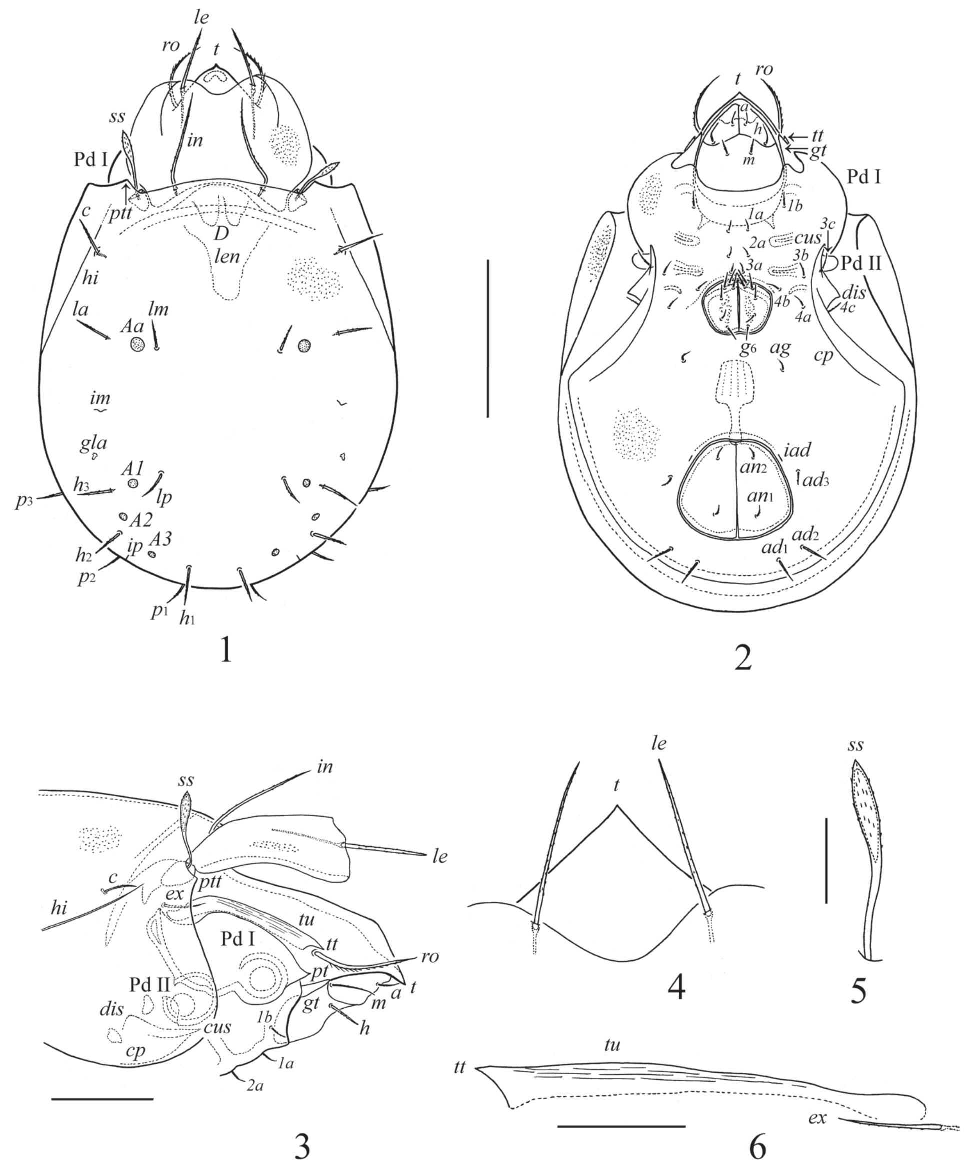
Integument. Body color brown. Body surface distinctly microfoveolate; foveolae rounded (diameter up to 1) or elongated. Dorsal sides of lamellae with longitudinal striae.

Prodorsum. Rostrum pointed (*t*). Lamellae long and broad, covering the prodorsum completely, except rostrum and parts of pedotecta I (Pd I). Anterior margin of lamellae concave medially. Rostral setae (*ro*, 94–106) setiform, ciliate, directed anterio-mediad, inserted laterally on prodorsum. Lamellar setae (*le*, 77–86) thickened, straight, barbed, directed forward, inserted dorso-anteriorly on lamellae. Interlamellar setae (*in*, 131–130) setiform, barbed, directed upwards and forwards, inserted on posterior part of lamellae; basal parts of these setae covered by the anterior margin of notogaster. Sensilli (*ss*, 82–94) with long stalk and elongate, lanceolate, barbed head. Tutoria (*tu*) long, of medium width, with one strong tooth anteriorly. Exobothridial setae (*ex*, 32–94) setiform, thin, slightly barbed, inserted posteriorly to tutoria.

Notogaster. Pteromorphs broadly rounded laterally. Anterior margins of pteromorphs with pointed tooth (*ptt*). Dorsophragmata (*D*) located close to each other. Postero-median part of hinges (*hi*) distinct, anterior part unvisible. Lenticulus (*len*) present, triangular, with amorphic borders. Four pairs of porose areas rounded: *Aa* (16–20), *A1* (12–16), *A2* and *A3* (both pairs, 8–12). Ten pairs of notogastral setae weakly thickened, barbed: posterior setae p_1, p_2, p_3 (32–41) shorter than other setae (53–61). Lyrifissures *ia*, *im*, *ip*, *ih* and *ips* and opisthonotal gland openings (*gla*) located typically for the genus.

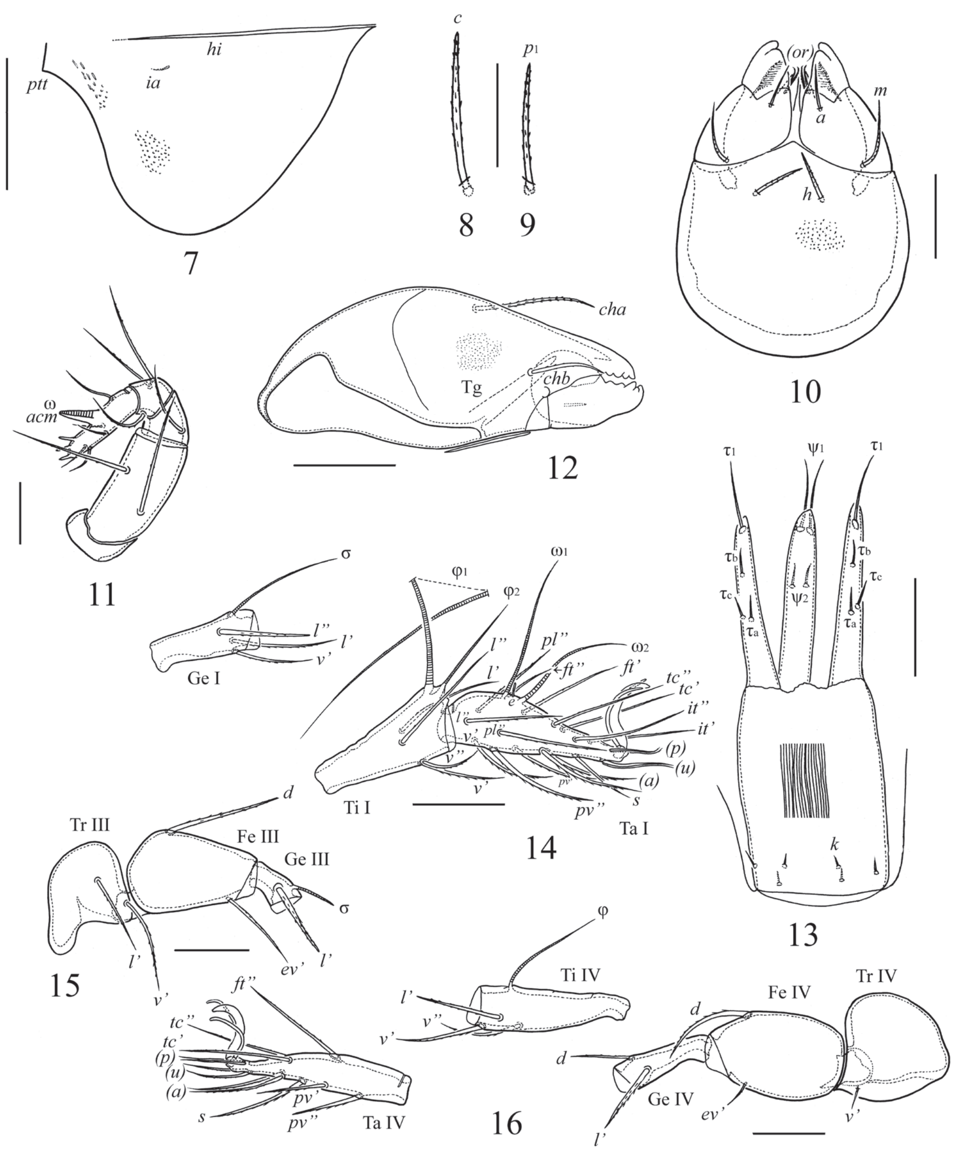
Gnathosoma. Subcapitulum longer than wide (151 × 110). Subcapitular setae *h* (28–32) thickened, straight, barbed; *a* (18–21) and *m* (41–45) thinner, slightly barbed. Two pairs of adoral setae (or_1, or_2, 12–14) setiform, hook-like distally, barbed. Palps (length 90–94) with setation 0–2–1–3–9(+ω). Solenidion weakly thickened, straight, blunt-ended, attached with eupathidium (*acm*). Chelicerae (length 151) with two barbed setae; *cha* (45–49) longer than *chb* (28–32). Trägårdh's organ (Tg) long, conical.

Lateral podosomal and epimeral regions. Genal teeth (*gt*) narrowly triangular. Pedotecta I large, pointed (*pt*) anteriorly. Pedotecta II (Pd II) small, scale-like. Apodemes 1, 2, 3 and sejugal distinctly developed, not fused medially. Epimeral setal formula



Figures 1–6. *Lepidozetes acutirostrum* sp. n., adult: **1** dorsal view **2** ventral view (legs not illustrated) **3** anterior part of body, lateral view (legs not illustrated) **4** rostrum, anterior margin of lamellae, lamellar setae, dorso-anterior view **5** sensillus **6** tutorium and exobothridial seta. Scale bar (**1, 2**) 200 µm, (**3**) 100 µm, (**4–6**) 40 µm.

2–1–3–3; setae (16–24) setiform, slightly barbed. Setae *1c* and their alveoli absent. Custodia (*cus*) with thin, free, blunted tips, directed anteriorly to the pedotecta II. Discidia (*dis*) pointed. Circumpedal carinae (*cp*) distinct.



Figures 7–16. *Lepidozetes acutirostrum* sp. n., adult: **7** pteromorph, lateral view **8** notogastral seta *c* **9** notogastral seta p_1 **10** subcapitulum, ventral view **11** palp **12** chelicera **13** ovipositor **14** genu (Ge), tibia (Ti) and tarsus (Ta) of leg I, right, antiaxial view **15** trochanter (Tr), femur (Fe) and genu of leg III, left, antiaxial view **16** leg IV, right, antiaxial view. Scale bar (7) 100 µm, (**8–10, 12, 14–16**) 40 µm, (**11**) 20 µm, (**13**) 50 µm.

Anogenital region. Six pairs of genital (g_1–g_6, 20), one pair of aggenital (*ag*, 20), two pairs of anal (an_1, an_2, 24) and three pairs of adanal (ad_1, ad_2, 36–41; ad_3, 28–32) setae setiform, barbed. Lyrifissures *iad* located in paraanal position. Ovipositor elongate, narrow (192 × 61); length of lobes 86, length of cylindrical distal part 106. Lobes with 12 thin, smooth setae: $\psi_1 \approx \tau_1$ (36) longer than $\psi_2 \approx \tau_a \approx \tau_b \approx \tau_c$ (16). Coronal setae *k* simple, short (8).

Table 1. Leg setation and solenidia of adult *Lepidozetes acutirostrum* sp. n. (same data for *Scutozetes clavatosensillus* sp. n.).

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	*v'*	*d*, *(l)*, *v"*, *bv"*	*(l)*, *v'*, σ	*(l)*, *(v)*, φ_1, φ_2	*(ft)*, *(tc)*, *(it)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*, *v'*, *(pl)*, *l"*, *e*, ω_1, ω_2
II	*v'*	*d*, *(l)*, *v"*, *bv"*	*(l)*, *v'*, σ	*(l)*, *(v)*, φ	*(ft)*, *(tc)*, *(it)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*, ω_1, ω_2
III	*l'*, *v'*	*d*, *ev'*	*l'*, σ	*l'*, *(v)*, φ	*(ft)*, *(tc)*, *(it)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*
IV	*v'*	*d*, *ev'*	*d*, *l'*	*l'*, *(v)*, φ	*ft"*, *(tc)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*

Roman letters refer to normal setae (*e* to famulus), Greek letters to solenidia. Single prime (') marks setae on anterior and double prime (") setae on posterior side of the given leg segment. Parentheses refer to a pseudosymmetrical pair of setae.

Legs. Medial claw thicker than two lateral claws; all smooth. Generally, morphology of leg segments, setae and solenidia typical for the genus (Bayartogtokh and Aoki 1999). Formulae of leg setation and solenidia: I (1–5–3–4–20) [1–2–2], II (1–5–3–4–15) [1–1–2], III (2–2–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Femora III with two setae. Famulus (*e*) short, straight, weakly blunt-ended, inserted between solenidia.

Type deposition. The holotype and one paratype are deposited in the collection of the Senckenberg Institution, Frankfurt, Germany; two paratypes are deposited in the collection of the Siberian Zoological Museum, Novosibirsk, Russia; three paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Etymology. The specific name "*acutirostrum*" refers to the pointed rostrum.

Comparison. *Lepidozetes acutirostrum* sp. n. can be distinguished from all known species of the genus *Lepidozetes* using the key, which is presented below.

Key to known species of the genus *Lepidozetes*

1 Sensilli clavate, with head rounded distally; interlamellar setae clearly shorter than sensilli **2**

– Sensilli lanceolate, with head pointed distally or disk-like; interlamellar setae clearly longer than sensilli **3**

2 Lamellae rounded anteriorly; leg tarsi with three claws; larger body size: 373–442 × 248–391 .... ***Lepidozetes singularis* Berlese, 1910 (=*L. conjunctus* Schweizer, 1922; =*L. chernovi* Ryabinin, 1974)** (see Berlese 1910; Schweizer 1922; Hammer 1952; Krivolutsky and Ryabinin 1974; Mahunka 1993; Bayartogtokh and Aoki 1999) (Distribution: Holarctic region)

– Lamellae concave anteriorly; leg tarsi with one claw; smaller body size: 300 × 229.... ***Lepidozetes trifolius* Fujikawa, 1972** (see Fujikawa 1972) (Distribution: Holarctic region)

3 Lamellae rounded anteriorly; sensilli with disk-like head; body size: 400 × 300... ***Lepidozetes latipilosus*** **Hammer, 1952** (see Hammer 1952) (Distribution: Holarctic region)

– Lamellae concave anteriorly; sensilli with lanceolate head **4**

4 Rostrum pointed; larger body size: 647–697 × 431–481............................... .... ***Lepidozetes acutirostrum*** **sp. n.** (Distribution: northern Nepal)

– Rostrum rounded; smaller body size: 500–568 × 348–424 .... ***Lepidozetes dashidorzsi*** **Balogh et Mahunka, 1965** (see Balogh and Mahunka 1965; Fujikawa 1972; Bayartogtokh and Aoki 1999) (Distribution: south-eastern Palearctic region)

Scutozetes clavatosensillus **Ermilov, Martens & Tolstikov, sp. n.**
http://zoobank.org/1D0CFEF9-4751-4A75-A5C5-0E55D418468A
http://species-id.net/wiki/Scutozetes_clavatosensillus
Figs 17–27

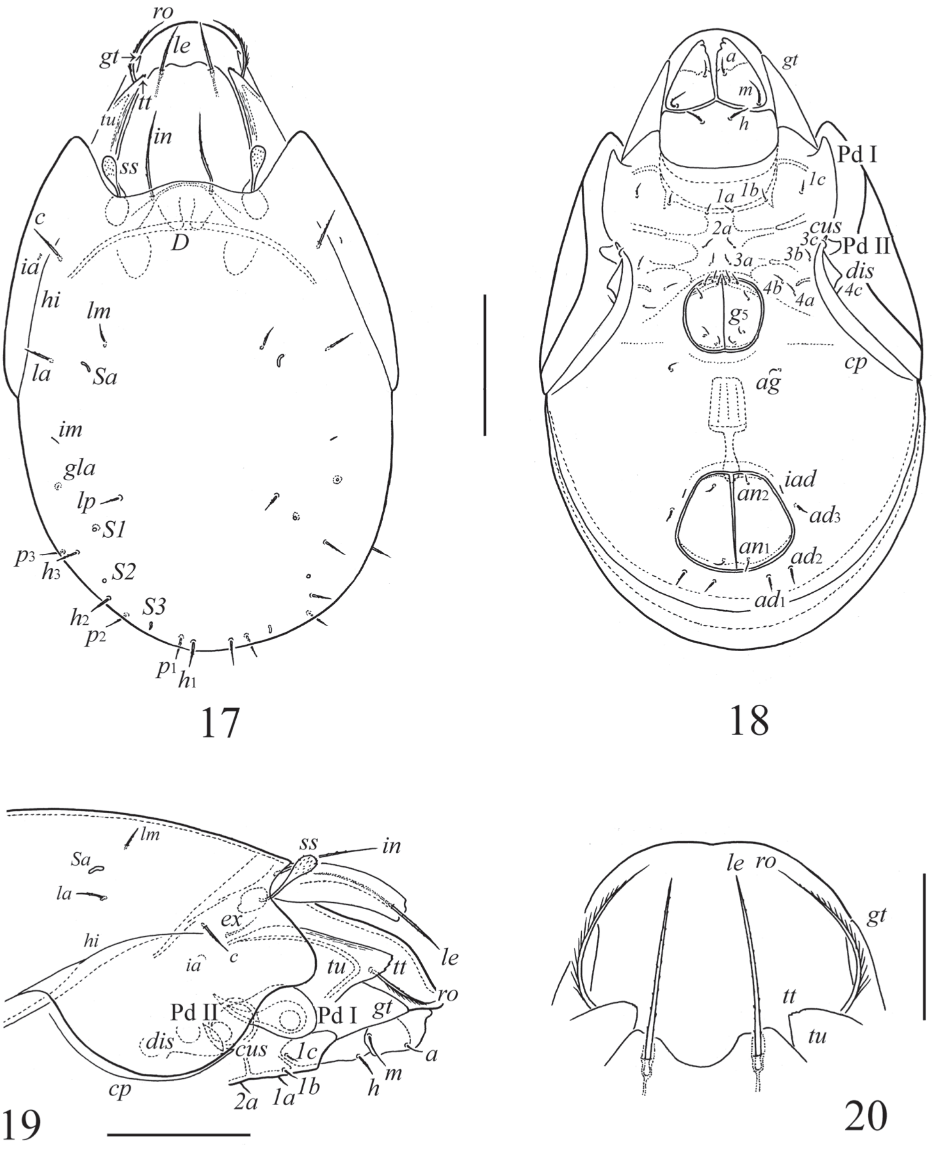
Diagnosis. Body size 415–448 × 265–273. Rostrum broadly rounded. Lamellae not covering rostrum and lateral sides of prodorsum. Anterior margin of lamellae weakly concave medially. Interlamellar setae longer than rostral and lamellar setae. Sensilli clavate. Tutoria triangular distally, with two to five small teeth anteriorly. Anterior margins of pteromorphs triangular. Notogastral setae of medium size, weakly thickened, barbed. Genal teeth broadly triangular. Adanal setae ad_1, ad_2 longer than other anogenital setae.

Description. *Measurements*. Body length 431 (holotype: female), 415–448 (five paratypes: three females and two males); body width 265 (holotype), 265–273 (five paratypes).

Integument. Body color light brown. Body surface microfoveolate (diameter of foveolae up to 1), but visible only under high magnification (× 1000) in dissected specimens. Dorsal sides of lamellae with longitudinal striae.

Prodorsum. Rostrum broadly rounded. Lamellae of medium size, not covering rostrum and lateral sides of prodorsum. Anterior margin of lamellae weakly concave medially. Rostral setae (57–65) setiform, ciliate, directed anterio-mediad, inserted laterally on prodorsum; their basal parts covered by the tutoria. Lamellar setae (41–49) straight, slightly barbed, directed forward, inserted dorso-anteriorly on lamellae. Interlamellar setae (73–82) setiform, slightly barbed, directed upwards and forwards, inserted on posterior part of lamellae; basal parts of these setae covered by the anterior margin of notogaster. Sensilli (45–53) clavate, with long stalk and oval head rounded or weakly truncated distally. Tutoria long, of medium width, triangular distally, with two to five small teeth anteriorly. Exobothridial setae (24) setiform, thin, slightly barbed, inserted dorso-posteriorly to tutoria.

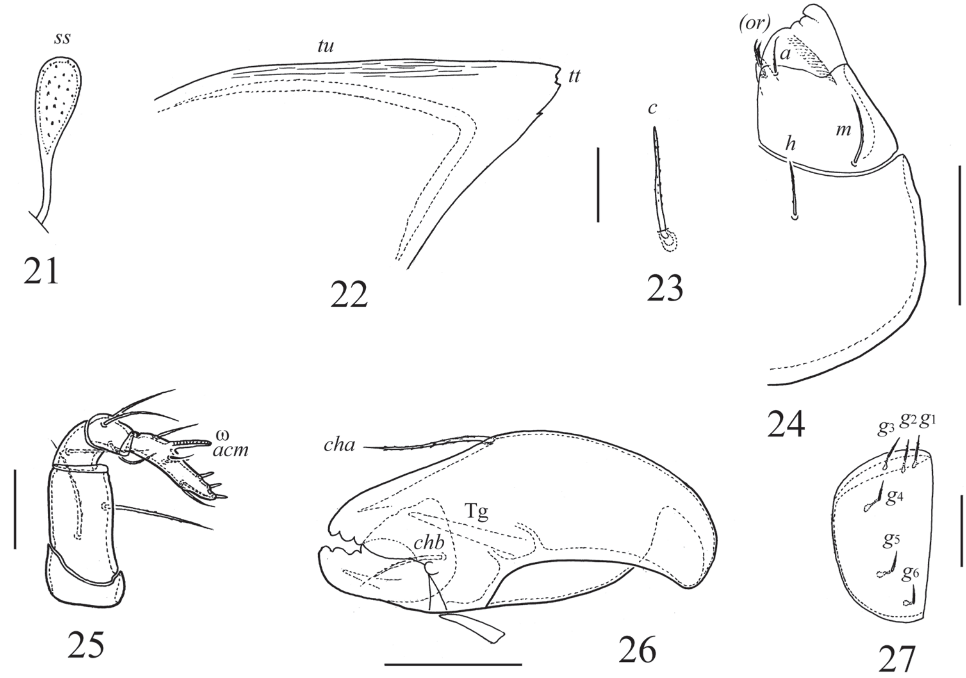
Notogaster. Pteromorphs concave laterally. Anterior margins of pteromorphs triangular, longer than length of sensilli. Dorsophragmata located close to each other. Postero-median part of hinges distinct, anterior part unvisible. Lenticulus indistinctive. Four



Figures 17–20. *Scutozetes clavatosensillus* sp. n., adult: **17** dorsal view **18** ventral view (legs not illustrated) **19** anterior part of body, lateral view (legs not illustrated) **20** rostrum, anterior margin of lamellae and tutoria, rostral and lamellar setae, dorso-anterior view. Scale bar (**17–19**) 100 µm, (**20**) 40 µm.

pairs of sacculli (*Sa*, *S1*, *S2*, *S3*) developed. Ten pairs of notogastral setae weakly thickened, barbed: setae *c* and *la* (both 28–32) longer than other setae (16–24). Lyrifissures *ia*, *im*, *ip*, *ih* and *ips* and opisthonotal gland openings located typically for the genus.

Gnathosoma. Subcapitulum longer than wide (110–114 × 86–90). Subcapitular setae *h* (16–20) thickened, straight, barbed; *a* (12–16) and *m* (24–28) little thinner,



Figures 21–27. *Scutozetes clavatosensillus* sp. n., adult: **21** sensillus **22** tutorium **23** notogastral seta *c* **24** left half of subcapitulum, ventral view **25** palp **26** chelicera **27** right genital plate. Scale bar (**21–23, 25, 27**) 20 μm, (**24, 26**) 40 μm.

slightly barbed. Two pairs of adoral setae (10–12) setiform, hook-like distally, barbed. Palps (length 69–77) with setation 0–2–1–3–9(+ω). Solenidion weakly thickened, straight, blunt-ended, attached with eupathidium. Chelicerae (length 114) with two barbed setae; *cha* (36) longer than *chb* (24). Trägårdh's organ long, conical.

Lateral podosomal and epimeral regions. Genal teeth broadly triangular. Pedotecta I of medium size, rounded anteriorly. Pedotecta II small, scale-like. Apodemes 1, 2, 3 and sejugal distinctly developed, not fused medially. Epimeral setal formula 3–1–3–3; setae (10–12) setiform, slightly barbed. Custodia with thin, free, blunted tips, directed anteriorly to the pedotecta II. Discidia pointed. Circumpedal carinae distinct.

Anogenital region. Six pairs of genital (8–12), one pair of aggenital (8–12), two pairs of anal (8–12) and three pairs of adanal (ad_1, ad_2, 14–16; ad_3, 10–12) setae setiform, barbed. Lyrifissures *iad* located in paraanal position.

Legs. Similar to *Lepidozetes acutirostrum* sp. n.

Type deposition. The holotype and one paratype are deposited in the collection of the Senckenberg Institution, Frankfurt, Germany; two paratypes are deposited in the collection of the Siberian Zoological Museum, Novosibirsk, Russia; two paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Etymology. The specific name "*clavatosensillus*" refers to the clavate sensilli.

Comparison. *Scutozetes clavatosensillus* sp. n. can be distinguished from all known species of the genus *Scutozetes* by the key, which is presented below.

Key to known species of the genus *Scutozetes*

1 Sensilli lanceolate, with head pointed distally; anterior margins of pteromorphs slightly projecting forward; body size: 437–484 × 320–390 .... ***Scutozetes lanceolatus* Hammer, 1952** (see Hammer 1952; Fujikawa 1972; Mahunka 1993) (Distribution: Holarctic and Neotropical regions, Surinam)

– Sensilli clavate, with head rounded distally; anterior margins of pteromorphs strongly projecting forward, triangular-form **2**

2 Lamellae large, covering lateral side of prodorsum, broadly rounded anteriorly; interlamellar setae reach the insertions of lamellar setae; body length: 420..................... ***Scutozetes ovalis* (Hammer, 1977)** (see Hammer 1977) (Distribution: Pakistan, Korea)

– Lamellae of medium size, not covering lateral side of prodorsum, concave anteriorly; interlamellar setae do not reach the insertions of lamellar setae; body size: 415–448 × 265–273... ....***Scutozetes clavatosensillus* sp. n.** (Distribution: North Nepal)

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References

Balogh J, Mahunka S (1965) Ergebnisse der zoologischen Forschungen von Dr. Z. Kaszab in der Mongolei 34. Acarina: Oribatei. Ann. Hist.-Nat. Mus. Nat. Hung. 57: 451–465.

Bayartogtokh B, Aoki J (1999) Oribatid mites of the family Tegoribatidae (Acari: Oribatida) from Mongolia. Acta Arachnol. 48(2): 107–125. doi: 10.2476/asjaa.48.107

Berlese A (1910) Brevi diagnosi di generi e species nuovi di Acari. Redia 6: 346–388.

Bugrov SA (1991) A new genus and species of oribatid mites (Acariformes, Oribatei) from the family Tegoribatidae. Zool. Zh. 70(9): 137–139.

Fujikawa T (1972) A contribution to the knowledge of the oribatid fauna of Hokkaido (Acari: Oribatei). Insecta Matsumurana, Journ. Faculty Agr. Hokkaido Univ. 35(3): 127–183.

Hammer M (1952) The microfauna of northern Canada. Part 1. Oribatidae. Acta Arctica 4: 1–108.

Hammer M (1977) Investigations on the oribatid fauna of North-West Pakistan. Det Kong. Dansk. Vidensk. Selsk. Biol. Skr. 21(4): 1–71.

Krivolutsky DA, Ryabinin DA (1974) New species of oribatid mites from Siberia and the Far East. Zool. Zh. 53(8): 1169–1177.

Mahunka S (1993) Beitrag zur Kenntnis der Höhlen-Oribatiden der Schweiz. Rev. Suisse Zool. 100(2): 225–233.

Norton RA, Behan-Pelletier VM (2009) Oribatida. Chapter 15. In: Krantz GW, Walter DE (Eds) A Manual of Acarology, 3rd edition. Texas Tech Univ. Press, Lubbock, 430–564.

Schweizer J (1922) Beiträge zur Kenntnis der terrestrischen Milbenfauna der Schweiz. Verh. Naturf. Ges. Basel 33: 23–112.

Subías LS (2004) Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes: Oribatida) del mundo (excepto fósiles). Graellsia, 60 (número extraordinario): 3–305. Actualized electronic version in May 2013, 570 pp.

Weigmann G (2006) Hornmilben (Oribatida). Die Tierwelt Deutschlands. Teil 76. Goecke and Evers, Keltern, 520 pp.

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RESEARCH ARTICLE

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Revision of the Australian Ceratocanthinae (Coleoptera, Scarabaeoidea, Hybosoridae)

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Abstract

The Australian fauna of Ceratocanthinae (Coleoptera, Scarabaeoidea, Hybosoridae) is revised. Two genera are present, both shared with Asia, with a total of seven species, all localized in eastern Queensland and all except one, endemic to Australia. *Cyphopisthes* is comprised of three species, two of them new (*Cyphopisthes yorkensis* **sp. n.** and *C. monteithi* **sp. n.**, the latter, together with *C. descarpentriesi* Paulian, 1977 displaying an unusual ecology, with occurrence in the southern Queensland dry rainforest/scrub habitats), and *Pterorthochaetes* is comprised of four species, two of them new (*Pterorthochaetes danielsi* **sp. n.** and *P. storeyi* **sp. n.**). Descriptions, distribution, ecological remarks and a key to species are provided.

Keywords

Queensland, *Pterorthochaetes*, *Cyphopisthes*, *Mastotermes*, taxonomy, identification key

Introduction

Australia has a very small fauna of Ceratocanthinae (Coleoptera, Scarabaeoidea, Hybosoridae). Only two genera have been recorded thus far: *Cyphopisthes* Gestro, 1899 and *Pterorthochaetes* Gestro, 1899, both genera being mainly distributed in the Oriental region, extending eastwards to the Australasian region, where *Pterorthochaetes* reaches Vanuatu and *Cyphopisthes* reaches New Guinea. In Australia both genera are restricted to eastern Queensland.

The first species described from Australia was the supposedly endemic *Pterorthochaetes simplex* Gestro, 1899. Almost eighty years passed before the description of a second endemic species: *Cyphopisthes descarpentriesi* Paulian, 1977, was published in a revision of the Australian fauna, where a third species, the New Guinean *Pterorthochaetes cribricollis* Gestro, 1899, wasrecorded from Australia and a key to genera and species was provided. The same information was repeated in a subsequent revision of the Oriental and Australasian Ceratocanthinae (Paulian, 1978). Subsequently Cassis and Weir (1992, 2002) listed the three known species, Grebennikov et al. (2002) described the larva and pupa of *C. descarpentriesi* and Hawkeswood (2006) summarized published data on the subfamily, mainly under the biological point of view. Generic records of unidentified Ceratocanthinae are also reported in ecological studies on canopy beetles from two sites within the rainforests of the Australian Wet Tropics published by Stork and Grimbacher (2006) and Grimbacher and Stork (2007). I was unable however to examine the three specimens quoted in the two aforementioned papers.

Re-evaluation of Paulian's type series of *C. descarpentriesi* revealed the presence of two new species among the paratypes, and examination of further material from the major Australian collections yielded two more species of *Pterorthochaetes*. The aim of this paper is therefore to provide an updated revision of the Australian Ceratocanthinae and to describe the aforementioned four new species.

The Australian Ceratocanthinae do not display a great diversity: the faunal composition falls within the Indo-Malayan element (*sensu* Matthews 2000), with endemism only at species level, suggesting a recent colonization of Australia from Asia via New Guinea. Most species occur in the rainforests of Cape York Peninsula and of the Queensland Wet Tropics, as defined by Adam (1992), however there are two species, *Cyphopisthes descarpentriesi* and *Cyphopisthes monteithi* sp. n., occurring in a completely different and drier habitat, i.e. open eucalypt woodlands and softwood and brigalow scrubs and this is very unusual, since all other Oriental and Australasian Ceratocanthinae seem to occur only in rainforests.

As a final remark it must be stressed that this revision is based on the examination of less than 50 specimens, all that the author was able to gather from museums and university collections. This shortage of available material demonstrates that a great deal of further research needs to be done in order to have a more satisfactory view of the distribution and diversity of these elusive beetles in Australia.

Methods and acronyms

I refer to Ballerio et al. (2011) and references quoted therein for methods and terminological conventions. In the same paper a definition of the most common types of punctation was provided. Here some more remarks on the two most common types are added. Horseshoe-shaped punctation: in most cases the branches of the horseshoe are more or less parallel, however sometimes the branches tend to be convergent, so that the opening of the horseshoe is small. In these cases the horseshoe looks more or less like an ocellate puncture, but with an opening. Comma-shaped punctation: sometimes resembling commas, sometimes short horseshoes, i.e. a horseshoe with short branches, more or less like a parenthesis.

Label data are provided verbatim only for holotypes, with a slash to separate labels. In giving collecting data the author's comments are in square brackets, while depository collection acronyms (and the accession number, when available) are in parenthesis.

Habitus photographs were taken with a Canon EOS D5 MII with a macro lens MP 65 mm, while genitalia photos were taken with a Mitutoyo M Plan APO 10x microscope objective on bellows. Serial photos were then combined with the Zerene Stacker software and cleaned and unmasked using photo processing software.

Abbreviations

EL	maximum elytral length
EW	maximum total elytral width
FIT	flight intercept trap
HL	maximum head length
HW	maximum head width
L	length
PL	maximum pronotal length at middle
PW	maximum pronotal width at middle
W	width
ABCB	Alberto Ballerio Collection, Brescia, Italy.
ANIC	Australian National Insect Collection (CSIRO), Canberra, Australia
MNHN	Muséum National d'Histoire Naturelle Collection, Paris, France
QM	Queensland Museum Collection, Brisbane, Australia (includes also the University of Queensland Insect Collection).
QPIM	Queensland Department of Primary Industries Collection, Mareeba, Australia
RMNH	Naturalis Collection, Leiden, The Netherlands

Systematics

Genus *Cyphopisthes* Gestro, 1899

The genus is in need of a revision and, after the re-definition made by Ballerio (2000), is currently comprised of a dozen morphologically very close species (with the sole exception of *Cyphopisthes inexpectatus* Paulian, 1981, which is actually a member of the "*Perignamptus* genus group", as defined by Ballerio 2009), ranging from India to New Guinea and Queensland (the record from New Caledonia by Paulian (1991) is doubtful). Members of the genus *Cyphopisthes* are rainforest dwellers (some Australian species are an exception), often found in termite nests or by sifting leaf litter.

Diagnosis of Australian species only: 4.5–5.0 mm in length. Reddish-brown to dark brown. Volant. Enrollment coaptations perfect, with all parts matching perfectly. Dorsum glabrous (setation is not visible at 30× magnification). Base of scutellum without a smooth raised transverse area. Elytra somewhat flattened dorsally and forming a distinct pseudepipleuron laterally. Antennae 10-segmented, with strongly securiform scape. Labrum subtruncate. Mandibles with long pointed apicalis. Head with a large dorsal ocular area, genal canthus complete (fused with or almost reaching occipital area). Protibiae sexually dimorphic (female with two outer apical teeth, male with only one outer apical tooth). Mesotibiae: apical spur of males curved inwards, in females apical spur is straight. Metatibiae with two straight apical spurs. Aedeagus with parameres weakly sclerotized, short, dorsally flattened and almost symmetrical (species specific differences usually not appreciable). Genital segment with a long manubrium (longer than or almost as long as basal triangle).

Cyphopisthes descarpentriesi **Paulian, 1977**

http://species-id.net/wiki/Cyphopisthes_descarpentriesi

Figs 1A–D, 5B, 6

Cyphopisthes descarpentriesi Paulian, 1977: 263 (description, distribution, biology); Paulian 1978 (key, distribution); Cassis and Weir 1992 (catalogue); Grebennikov et al. 2002 (description of larva and pupa); Grebennikov et al. 2004 (key to larva); Hawkeswood 2006 (summary of published data); Ocampo and Ballerio 2006 (cheklist).

Material examined. Holotype, sex undetermined, (ANIC) [enrolled specimen, glued on a point]: Queensland, 19.40S, 146.51E, Lansdown Station, Woodstock, 3 July 1974, #54, J.A.L. Watson in gallery of *Mastotermes* nest / Holotype / Holotype / *Cyphopisthes descarpentriesi* sp. n. R. Paulian det. / ANIC Database no. 25 062056. Examined paratypes: 2 exx., Lansdown Station, via Woodstock, 10 July 1979, R. A. Barrett, with *Mastotermes darwiniensis* (ANIC); 2 exx., Queensland, Pallarenda. Townsville, 1.VII.1974, J. A. L. Watson, in galleries of *Mastotermes* (MNHN, ANIC).

Description. Size: HL = 0.98 mm; HW = 1.54 mm; PL = 1.63 mm; PW = 2.63 mm; EL = 2.87 mm; EW = 2.63 mm. Overall morphology as in generic description. Reddish-brown, shiny, glabrous (very fine short yellowish setation visible at 50x magnification), sternum, tarsi and antennae reddish-brown.

Head: interocular distance about six times maximum width of dorsal ocular area, punctation dense and impressed, disc with very short transverse comma shaped punctures, each one having a simple small puncture at its interior side, sides of disc with large comma-shaped punctures centrifugally oriented, with opening facing internally, each one having a simple fine puncture internally, anterior portion of clypeus with three to four irregular anastomosing transverse lines.

Pronotum: margin completely bordered, anterior angles angulate, completely covered by large, almost closed, horseshoe-shaped punctures, on disc with a small opening

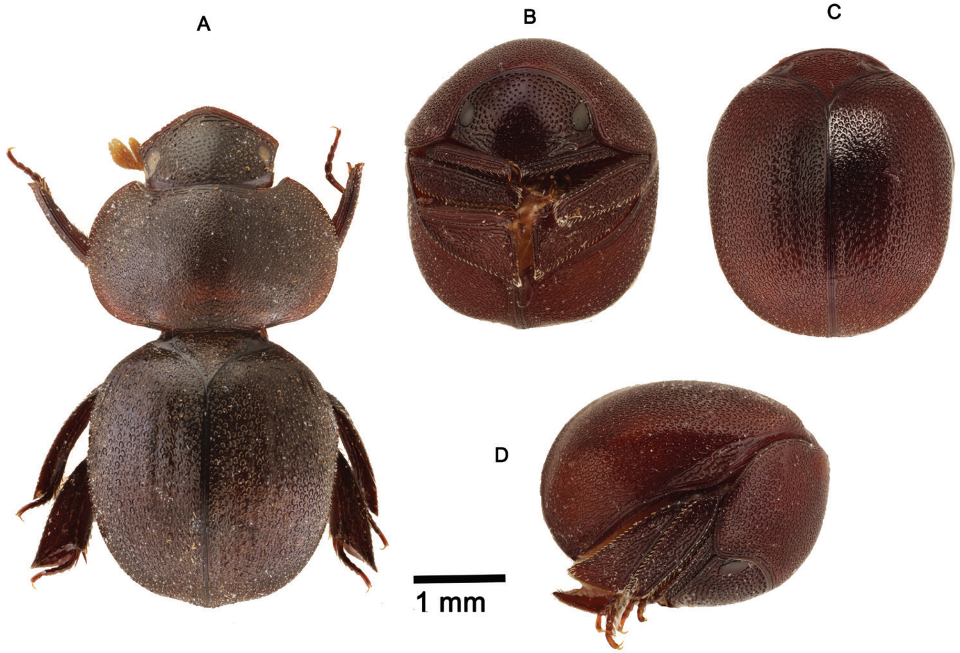

Figure 1. *Cyphopisthes descarpentriesi* Paulian, 1977. **A** Extended Paratype, dorsal view **B** enrolled Paratype, ventral view **C** enrolled Paratype, dorsal view **D** enrolled Paratype, lateral view.

directed anteriad, at sides punctures larger than on disc, with a small opening directed laterad, each puncture having inside a small setigerous pore. Punctation dense: interpunctural distance being less than puncture diameter.

Scutellum: covered by dense horseshoe-shaped punctures with posterior openings.

Elytra: W/L: 0,93. Humeral callus indistinct, two short longitudinal lines starting at humerus and occupying proximal third, sutural interstria indistinct, completely and uniformly covered by impressed large horseshoe-shaped punctures with a small posterior openings, each one bearing a setigerous pore in the middle. Pseudepipleura with longitudinally oriented anastomosing horseshoe-shaped punctures mixed with comma-shaped punctures.

Diagnosis. *C. descarpentriesi* is unique among all other known Australian *Cyphopisthes* in having the pronotum and the elytra completely covered by such large and dense uniform horseshoe-shaped punctures with small posterior openings. All other known members of the genus have remarkably finer punctation and elytral punctation differs from the pronotal one.

Etymology. Dedicated to André Descarpentries (1919–1998) of MNHN.

Distribution and habitat. Known from north eastern Queensland coast. All specimens have been collected in open eucalypt woodland, in nests of *Mastotermes* (Isoptera). Termitophily has already been reported for *Cyphopisthes* (Ballerio and Maruyama 2010). In the same nests larvae and pupae were collected, subsequently described by Grebennikov et al. (2002). Open eucalypt woodland is a very unusual habitat for a *Cyphopisthes*, since most species are rainforest dwellers.

Remarks. The type series contained three different species (two of them new to science and described below). Among paratypes of true *C. descarpentriesi* in ANIC one specimen had the genal canthus shortened, leaving a distinct gap between its tip and the occipital area.

Paulian (1978) identified as *C. descarpentriesi* also an old specimen in RMNH, ex coll. Pascoe, labelled “Mus. Godeffroy, Peak Down, Austr./10791/*Synarmostes acromialis* Pascoe”. Probably the correct locality name should be “Peak Downs” (22°15'S, 148°11'E) in Central Queensland (Federica Turco, pers. comm.). I examined two photographs of that specimen, kindly provided by Hans Huijbregts (RMNH): it is certainly not a *C. descarpentriesi*, and probably represents a specimen of *C. monteithi* sp. n. or another species very close to it.

Cyphopisthes monteithi sp. n.

http://zoobank.org/41532D13-A9FE-45DA-BB27-20A403215A64
http://species-id.net/wiki/Cyphopisthes_monteithi
Figs 2A–D, 3A–B, 5C, 6, 11C

Type locality. Amphitheatre scrub, Expedition Range National Park, Queensland, Australia.

Type material. Holotype, male (QM, accession number: T189552) [extended specimen, glued on a card; genitalia mounted in DMHF resin on a separate card under the beetle]: Queensland, 25.13S, 148.59E, Expedition Range NP, 5063, Amphitheatre scrub, 520 m, 25 Sep–17 Dec 1997, Cook & Monteith, Vine for. Intercept; Paratype: 1 male, QLD, 24.48S, 149.45E, Brigalow Res. Stn., site 5, 16 Dec. 2000–28 Mar. 2001, D Cook & G Monteith, FIT softwood scrub 10020 (QM, accession number: T189553).

Further material examined (excluded from the type series). 1 male: Mt. Coot-tha, Brisbane, Queensland, 13–20.III.1971, G. B. Monteith, ex leaf litter (QM) [included in the type series of *C. descarpentriesi* by Paulian]. 1 female, QLD, 27.58S, 152.39E, Kalbar 3 km SE, 120m, 2 Dec 2000–7 May 2001, C.J. Burwell, 10161, Brigalow scrub FIT (QM).

Description. Size: HL = 0.84 mm; HW = 1.11 mm; PL = 1.22 mm; PW = 2.02 mm; EL = 2.36 mm; EW = 2.11 mm. Overall morphology as in generic description. Dark brown, shiny, glabrous (very fine short yellowish setation visible at 90×), sternum, tarsi and antennae reddish-brown.

Head: interocular distance about five times maximum width of dorsal ocular area, punctation relatively dense and impressed, disc with some impressed short transverse comma-shaped punctures, each one having a simple small puncture at its interior side, sides of disc with large comma-shaped punctures centrifugally oriented, with opening facing internally, each one having a simple fine puncture internally, anterior portion of clypeus with three-four irregular anastomosing transverse lines.

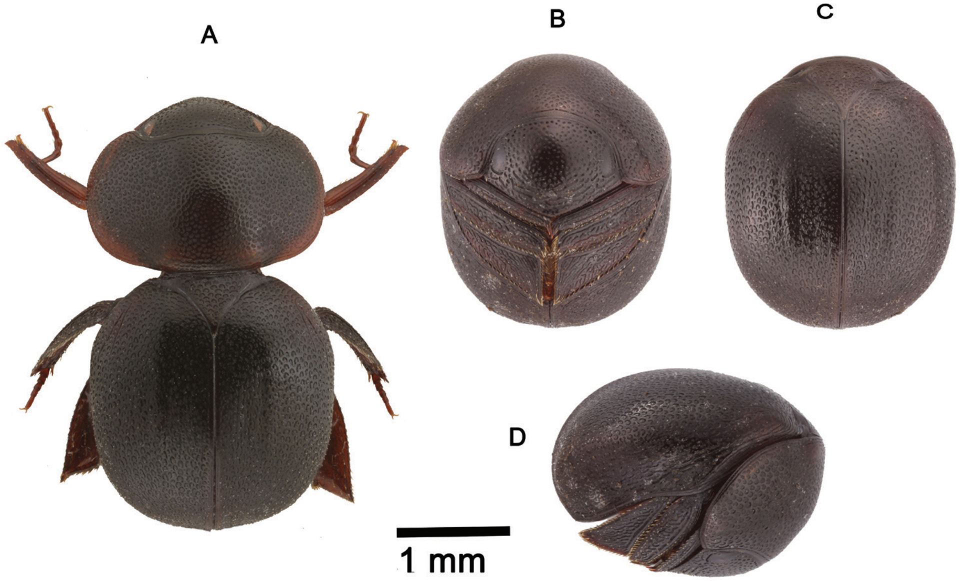

Figure 2. *Cyphopisthes monteithi* sp. n. **A** Extended Holotype, dorsal view **B** enrolled Holotype, ventral view **C** enrolled Holotype, dorsal view **D** enrolled Holotype, lateral view.

Pronotum: margin completely bordered, anterior angles angulate, completely covered by medium sized horseshoe-shaped punctures, on disc with an opening directed anteriad, punctures at sides larger than on disc, with an opening directed laterad, each puncture having inside it a small setigerous pore. Punctation dense: interpunctural distance being less than their diameter.

Scutellum: covered by dense horseshoe-shaped punctures with posterior openings.

Elytra: W/L: 0,93). Humeral callus indistinct, two short longitudinal lines starting at humerus and occupying proximal third, sutural interstria indistinct, disc with longitudinally oriented comma-shaped punctures, each one having a simple small puncture at its left side, sides of disc with medium horseshoe-shaped punctures with small posterior openings, each one bearing a setigerous pore in the middle. Interpunctural distance subequal to puncture width. Pseudepileura with longitudinally oriented anastomosing horseshoe-shaped punctures mixed with comma-shaped punctures.

Genital segment: Fig. 11C. Aedeagus: Fig. 3A, B.

Dignosis. Very close to *C. yorkensis* sp. n., but can be easily distinguished from it by the presence of denser and larger punctation on head disc.

Etymology. Noun in the genitive case. Dedicated to Dr. Geoff Monteith, former curator at Queensland Museum.

Distribution and habitat. Known from southern Queensland, where all specimens have been found in dry rainforest type of vegetation, i.e. softwood and brigalow scrub, in flight intercept traps (one specimen excluded from type series was collected by leaf litter sifting).

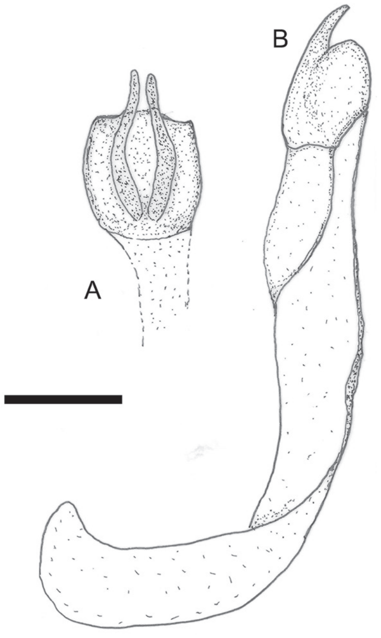

Figure 3. *Cyphopisthes monteithi* sp. n., aedeagus **A** dorsal view of parameres **B** lateral view of aedeagus. Scale bar: 0,1 mm.

Remarks. This new species and *C. descarpentriesi* are the most remarkable species among the Australian Ceratocanthinae since they occur south of the Queensland Wet Tropics, in environments completely different from the environment where most other *Cyphopisthes* occur, i.e. rainforests. The vegetation type in the areas where *C. monteithi* has been collected is characterized by drier, lower and sparser woodland, with patches off denser forest ("dry rainforest").

I excluded from the type series the specimen from Mount Coot-tha which differs from the holotype because of the more extended comma-shaped punctation on the disc and the presence of transverse lines in the pseudepipleura and the specimen from Kalbar, which has much sparser punctation on the head. This circumstance, together with the fact that they occur some 480 km Southeast of the type locality of *C. monteithi*, suggests prudence before assigning them to the new species. The same applies to the above mentioned specimen from Peak Downs (see under *C. descarpentriesi*).

***Cyphopisthes yorkensis* sp. n.**
http://zoobank.org/9046ACE0-1DCA-4D1C-B7AF-DA70F9949875
http://species-id.net/wiki/Cyphopisthes_yorkensis
Figs 4A–D, 5A, 6

Type locality. Iron Range, Cape York Peninsula, Queensland, Australia.

Figure 4. *Cyphopisthes yorkensis* sp. n. **A** Extended Holotype, dorsal view **B** enrolled Holotype, ventral view **C** enrolled Holotype, dorsal view **D** enrolled Holotype, lateral view.

Type material. Holotype, female (QM, accession number: T189554): North Queensland, Iron Range, Cape York Pen., 1–9 June 1971, G. B. Monteith [extended specimen, glued on a card]. Paratypes: 1 ex., sex undetermined, same data as holotype (MNHN); 1 ex., sex undetermined: 12.44S, 143.14 E, 3km ENE of Mt. Tozer, QLD, 28 Jun–4 Jul. 1986, T. Weir & A. Calder (ANIC).

Description. Size: HL = 0.80 mm; HW = 1.28 mm; PL = 1.24 mm; PW = 2.22 mm; EL = 2.42 mm; EW = 2.33 mm. Overall morphology as in generic description. Dark reddish-brown, shiny, glabrous (very fine short yellowish setation visible at 50×), sternum, tarsi and antennae reddish-brown.

Head: four to five anastomosing irregular transverse lines at anterior portion of clypeus, clypeal disc almost smooth, with only a few sparse fine simple punctures, sides of disc and frons with denser, bigger short comma-shaped punctures. Interocular distance about seven times the maximum width of dorsal ocular area.

Pronotum: margin completely bordered, anterior margin thicker than lateral and basal margin, anterior angles angulate. Punctation: on disc small horseshoe-shaped punctures with an opening directed anteriad, each one containing a fine simple puncture in middle, at sides punctures larger (about twice the size of discal punctures) than on disc, with an opening directed laterad, each puncture having inside it a small setigerous pore. Base with smaller comma-shaped punctures with openings directed anteriad. Punctation dense: interpunctural distance being shorter than, to equal to, puncture diameter.

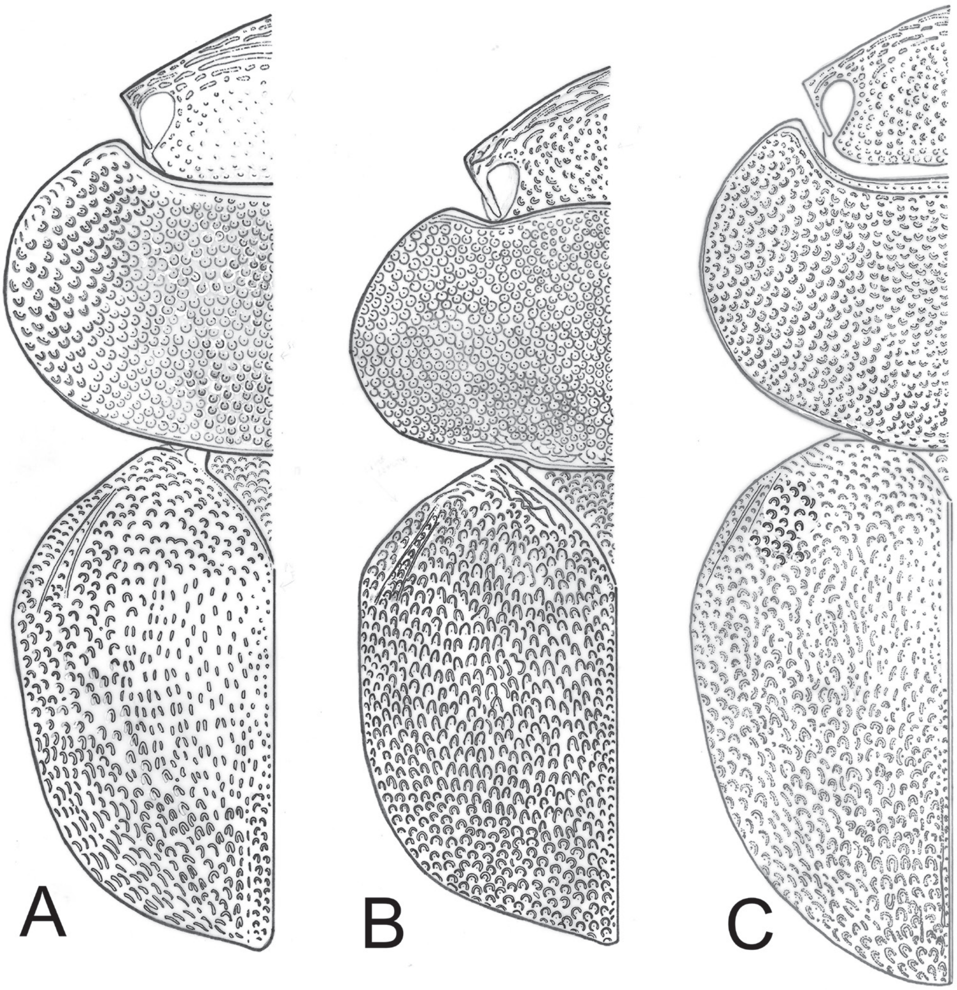

Figure 5. Outline of punctation pattern in **A** *Cyphopisthes yorkensis* sp. n. **B** *Cyphopisthes descarpentriesi* Paulian, 1977 **C** *Cyphopisthes monteithi* sp. n. (drawings by Mario Toledo).

Scutellum: covered by dense horseshoe-shaped punctures with posterior openings.

Elytra: (W/L: 0,93). Humeral callus indistinct, two short longitudinal lines (the inner being slightly shorter than the outer) starting at humerus and occupying the proximal third, sutural interstria indistinct, disc with longitudinally oriented comma-shaped punctures, each one having a simple small puncture at its internal side, humeral punctation made of short transverse comma-shaped punctures becoming horseshoe-shaped towards disc, with posterior openings, sides of elytral dorsum with longitudinally oriented long comma-shaped punctures opening laterad and a simple fine puncture at their outer side, punctation dense: interpunctural distance being shorter than their width. Pseudepileura with longitudinally oriented comma-shaped punctures.

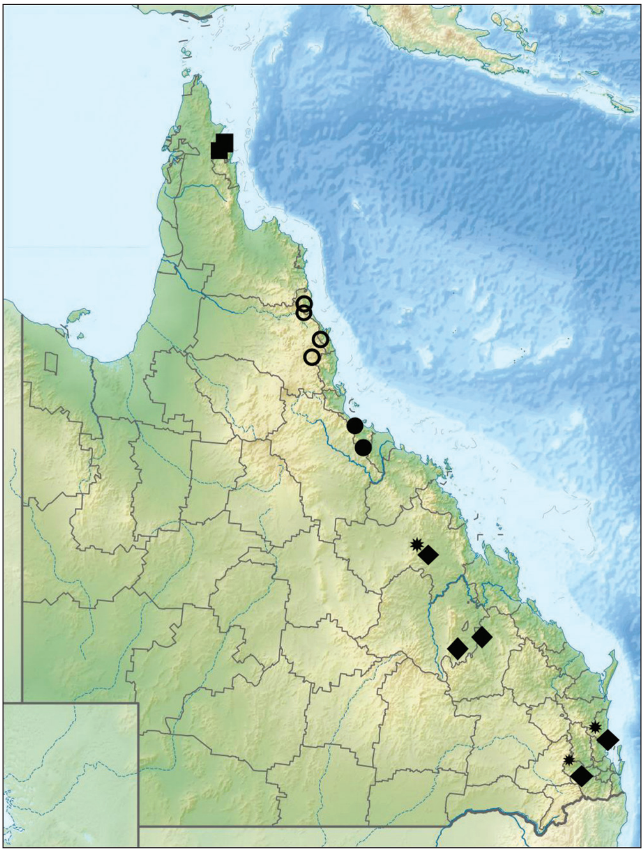

Figure 6. map of Queensland showing distribution of *Pterorthochaetes danielsi* sp. n., *Pterorthochaetes cribricollis* Gestro, 1899 and *Cyphopisthes yorkensis* sp. n. (black squares); *Pterorthochaetes storeyi* sp. n. (empty circles); *Cyphopisthes descarpentriesi* Paulian, 1977 (black circles); *Cyphopishtes monteithi* sp. n. (black rhombuses); *Cyphopisthes cf. monteithi* (black rhombuses with asterisk).

Diagnosis. Very close to the New Guinean *Cyphopisthes amphicyllis* (Sharp, 1875), because of the sparse fine punctation on the disc of head. The new species differs from it because of the more impressed punctation of the elytra, which is also slightly sparser than in *C. amphicyllis* and has many more comma-shaped punctures, whereas in *C. amphicyllis* the dominant type of punctation is horseshoe-shaped. Among Australian species it can be easily distinguished because of the sparse and fine punctation of clypeal disc and the more extended comma-shaped punctation on elytral disc.

Etymology. Latin adjective in the nominative singular, meaning "from York". Named after the type locality.

Distribution and habitat. Known from the Cape York Peninsula only (northern Queensland), where it occurs in the lowland rainforests of Iron Range and Mount Tozer.

Remarks. Holotype and the paratype in MNHN were part of the type series of *C. descarpentriesi*.

Genus *Pterorthochaetes* Gestro, 1899

About 25 species are ascribed to the genus, but a revision in progress will probably more than double the number of species (Ballerio, in prep.). The distribution ranges from India and Sri Lanka to Vanuatu. Members of the genus *Pterorthochaetes* are rainforest dwellers, often found under the bark of dead logs, sometimes in association with Passalidae (Kon et al. 2010, Ballerio and Maruyama 2010), by sifting leaf litter or in termite nests. The morphology is relatively uniform and the most useful characters for species recognition are found in the male genitalia (shape of parameres and sclerotisations of the internal sac) and female genitalia (bursal sclerites) (see Ballerio 1999).

Diagnosis for Australian species only: 6 to 8 mm in length. Dark brown to black. Volant. Enrollment coaptations perfect, with all parts matching perfectly. Dorsum setose (setae short and thick). Elytra regularly convex, without any distinct pseudepipleuron. Base of scutellum with a smooth raised transverse area (very reduced in *P. cribricollis*). Antennae 9-segmented, scape clavate. Mandibles with short pointed apices. Labrum not truncate, somewhat depressed distally. Head with a medium sized ocular area, genal canthus almost complete (not fused with the occipital area). Mesotibiae: with only one apical spur, in males the inner apical mesotibial angle is acutely expanded (false spur). Male metatibiae with one twisted apical spur and one straight apical spur. Aedeagus with parameres fairly sclerotized and asymmetrical. Genital segment with short manubrium. Female genitalia with bursa copulatrix with two paired symmetrical/asymmetrical sclerites (bursal sclerites).

Pterorthochaetes cribricollis Gestro, 1899

http://species-id.net/wiki/Pterorthochaetes_cribricollis

Figs 6, 7A–D, 11D, 12A, 13A–C, 14C

Pterorthochaetes cribricollis Gestro, 1899: 37 (description, distribution, key); Paulian 1978 (key, distribution); Cassis and Weir 1992 (catalogue); Ocampo and Ballerio 2006 (checklist)

Material examined. 10 specimens [two males and two females dissected]: 4 males and 2 females, Iron Range, Cape York Pen., N. Qld. 28 Apr.–5 May 1968. G. Monteith (QM); 1 female, Iron Range, Cape York Pen., N. Qld. 11–17 May 1968. G. Monteith (QM); 1 female, Iron Range, Cape York Pen., N. Qld. 26 May–2 June 1971 B. K. Cantrell (QM); 1 female, QLD: 12.710°S, 143.291°E, Cooks Hut, Iron Range, 5 m, 15 Dec 2010, Monteith, Escalona & Will, hand and at HV light 34817 (QM).

Description. Size: HL = 0.90 mm; HW = 1.30 mm; PL = 1.32 mm; PW = 2.20 mm; EL = 2.25 mm; EW = 2.15 mm. Overall morphology as in generic description. Dark brown, shiny, setation yellowish, sternum, tarsi and antennae reddish-brown.

Head: completely and uniformly covered by impressed comma-shaped punctures with posterior openings, spaced out by a distance of about half their diameter. Anterior

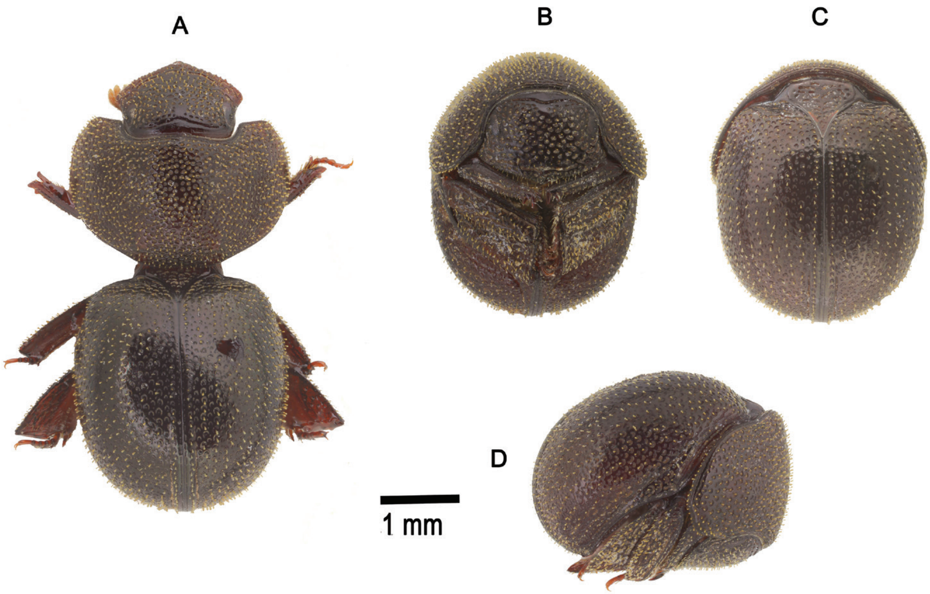

Figure 7. *Pterorthochaetes cribricollis* Gestro, 1899 **A** Extended specimen, dorsal view **B** enrolled specimen, ventral view **C** enrolled specimen, dorsal view **D** enrolled specimen, lateral view.

portion of clypeus with one or two irregular transverse anastomosing lines. Interocular distance about 9 times the maximum width of dorsal ocular area.

Pronotum: margins completely bordered, lateral margins with a row of erect thick yellowish slightly clavate setae, about as long as the distance between them. Pronotal setation made of thick medium sized clavate yellowish setae, punctation as follows: disc covered by impressed short transverse comma-shaped punctures, with posterior openings and containing a small fine setigerous pore, sides with a few larger more curved comma-shaped punctures opening backwards.

Scutellum: basally with two longitudinal irregular rows of horseshoe-shaped punctures, uniting towards apex.

Elytra: humeral callus poorly pronounced, sutural stria occupying medial and distal third. Elytral punctation as follows: uniformly covered by irregular longitudinal rows of mixed simple impressed small punctures and medium-sized horseshoe-shaped punctures opening backwards, larger on sides and apical third. Interpunctural distance subequal to puncturelength.

Aedeagus: basal piece about three times as long as parameres. Parameres slightly asymmetrical, internal sac distally with some irregular weak sclerotisations (Fig. 12A, Fig. 13A–C).

Male genital segment: as in Fig. 11D.

Bursal sclerites: slightly asymmetrical, as in Fig. 14C.

Diagnosis. Easily distinguished from all other Australian *Pterorthochaetes* because of the combination of smaller size, the pattern of punctation of pronotum and elytra, which on pronotum is only made of short impressed transverse comma-shaped punctures, whereas all other Australian species have, at least partly, horse-shoe shaped punctures, often with a very small posterior openings, while on elytra is made of a much smaller punctation compared to *P. danielsi* sp. n. and much denser compared to *P. storeyi* sp. n. and *P. simplex* Gestro, 1899.

Etymology. From Latin *cribratus* (profusely perforated) and *collis* (pronotum), due to the dense and impressed punctation.

Distribution and habitat. In Australia known from the lowland rainforests of Iron Range (Northern Queensland). This species occurs also in New Guinea (type locality: Papua New Guinea, Central Province, lower Kemp Welch River, Ighibirei).

Remaks. identification was made by comparison with the holotype from New Guinea in Museo Civico di Storia Naturale "G. Doria", Genova.

***Pterorthochaetes danielsi* sp. n.**
http://zoobank.org/D3EAF3F7-6DE8-4093-9ABB-8E8D9F69327D
http://species-id.net/wiki/Pterorthochaetes_danielsi
Figs 6, 8A–D, 11B, 12C, 13D–F, 14D

Type locality. West Claudie River, Iron Range, Queensland, Australia.

Type material. Holotype, male (QM, accession number: T189544): Australia: Queensland: NE: West Claudie R., Iron Range, 3 Dec. 1985, G. Monteith / QM Berlesate no. 690 12.45S, 143.14E Rainanteriorst 50m Stick brushing. [extended specimen, glued on a card, dissected, genitalia mounted in DMHF resin on a separate card, same pin]. Allotype: 1 female [dissected], Iron Range, Cape York Pen., N. Qld. 28 Apr.–5 May 1968. G. Monteith (QM, accession number: T189548). Paratypes [all dissected]: 1 male, same data as holotype (ABCB); 1 male, West Claudie R., Iron Range, N. Qld., 3–10 Dec. 1985, G. Monteith & D. Cook, Pyrethrum knockdown/ RF (QM, accession number: T189551); 1 male, Iron Range, Cape York Pen., N. Qld. 5–10 May 1968. G. Monteith (MNHN); 2 males, Iron Range, Cape York Pen., N. Qld. 28 Apr.–5 May 1968. G. Monteith (QM, accession numbers: T189555 and T189556); 1 female, QLD:12.714°S, 143.287°E, East Claudie River, 15 m, 9 Dec 2010 34778, G. Monteith, Bark spray (QM, accession number: T189773).

Description. HL = 0.75 mm; HW = 1.60 mm; PL = 1.75 mm; PW = 2.55 mm; EL = 3.00 mm; EW = 2.60 mm. Overall morphology as in generic description. Dark brown, shiny, setation yellowish, sternum, tarsi and antennae reddish-brown.

Head: completely and uniformly covered by impressed coarse horseshoe-shaped punctures, anastomosing on disc. Anterior portion of clypeus with irregular transverse anastomosing lines. Interocular distance about 11 times maximum width of dorsal ocular area.

Pronotum: margins completely bordered, lateral margins with a row of erect thick yellowish simple setae, about as long as the distance between them. Pronotal setation made of thick medium sized clavate yellowish setae, punctation as follows: disc cov-

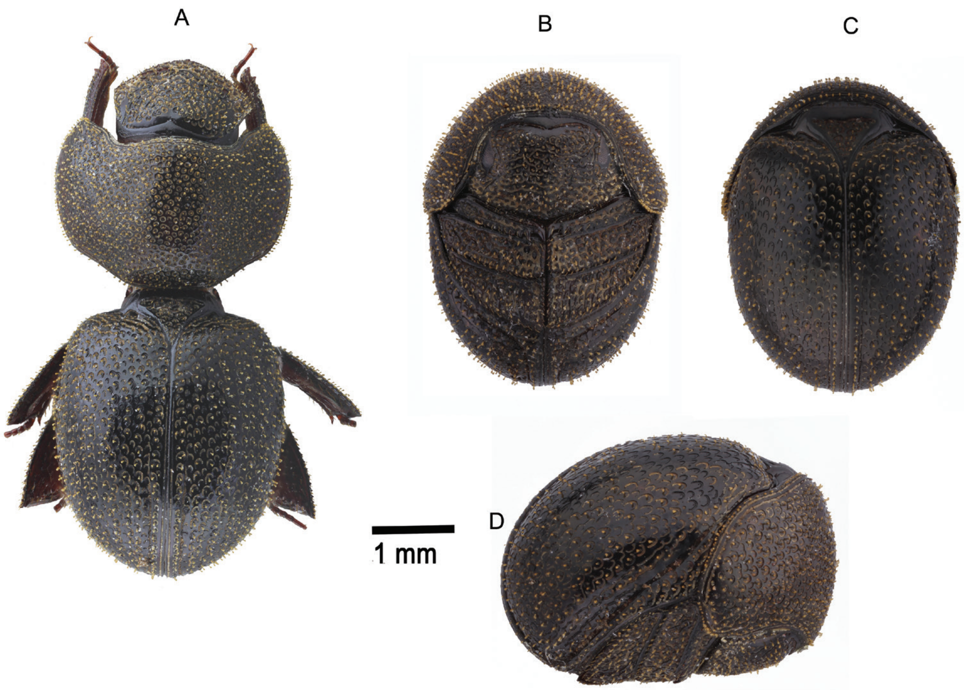

Figure 8. *Pterorthochaetes danielsi* sp. n. **A** Extended Holotype dorsal view **B** enrolled Paratype, ventral view **C** enrolled Paratype, dorsal view **D** enrolled Paratype, lateral view.

ered by impressed transverse small horseshoe-shaped punctures, with posterior openings and containing a small fine setigerous pore, sides of disc with a few large ocellate punctures and sides of pronotum with larger horseshoe-shaped punctures with opening laterad. Anterior angles having six longitudinal irregular lines. Distance between punctures distinctly less than their diameter.

Scutellum: basally with two longitudinal irregular rows of horseshoe-shaped punctures, uniting towards apex.

Elytra: humeral callus poorly pronounced, sutural stria occupying the medial and distal third. Elytral punctation as follows: uniformly covered by large horseshoe-shaped punctures, some punctures becoming ocellate at apical third and at sides of elytra. Each horseshoe-shaped and ocellate puncture enclosing a small fine simple puncture bearing a clavate yellowish seta. Interpunctural distance on elytra distinctly less than puncture diameter.

Aedeagus: basal piece about twice length of parameres. Parameres slightly asymmetrical, internal sac distally with some irregular weak sclerotisations (Fig. 13D–F, Fig. 12C).

Male genital segment: as in Fig. 11B.

Bursal sclerites: slightly asymmetrical, as in Fig. 14D, subject to some variability.

Diagnosis. Very close to the New Guinean *Pterorthochaetes brevis* (Sharp, 1875), from which differs mainly by the punctation of pronotal disc, which in *P. brevis* is sparser and of elytra, which in *P. brevis* is shallower and sparser. Among the other

Australian species it can be easily distinguished by having the elytral punctation in the form of dense, large horseshoe-shaped punctures, almost without isolated simple punctures. The shape of the bursal sclerites, while very similar to those of *P. brevis*, is unique within the Australian *Pterorthochaetes*.

Etymology. Noun in the genitive case. Dedicated to Gregory Daniels, former collections manager at University of Queensland Insect Collection, Brisbane.

Distribution and habitat. Known from the Cape York Peninsula only (Northern Queensland), where it occurs in the lowland rainforests of Iron Range.

Pterorthochaetes simplex Gestro, 1899

http://species-id.net/wiki/Pterorthochaetes_simplex
Figs 6, 9A–B, 14B

Pterorthochaetes simplex: Gestro, 1899: 36 (description, distribution, key); Paulian 1978 (key, distribution); Cassis and Weir 1992 (catalogue); Ocampo and Ballerio 2006 (checklist)

Material examined. Holotype, female (MNHN): Australie, Queensland / Typus / dr. Gestro vidit / holotype / *Pterorthochaetes simplex*, Typus ! Gestro. [extended, glued on a card, in good condition, dissected by the present author with bursal sclerites mounted in DMHF resin on a separate card under the specimen].

Description. Size: HL = 0.70 mm; HW = 1.30 mm; PL = 1.36 mm; PW = 2.30 mm; EL = 2.36 mm; EW = 2.00 mm. Overall morphology as in generic description. Dark brown, shiny, setation yellowish, sternum, tarsi and antennae reddish-brown.

Head: completely and uniformly covered by comma-shaped punctures, anastomosing on disc. Anterior portion of clypeus with three irregular transverse anastomosing lines. Interocular distance about 13 times the maximum width of dorsal ocular area.

Pronotum: margins completely bordered, lateral margins with a row of erect thick yellowish simple setae. Pronotal setation made of fine short simple yellowish setae, punctation as follows: disc covered by shallow sparse ocellate punctures, containing a small fine setigerous pore, sides with sparse shallow ocellate punctures larger than on disc mixed with a few large horseshoe-shaped punctures with small posterior openings. Anterior angles having six longitudinal irregular lines. Distance between punctures distinctly less than their diameter.

Scutellum: basally with two longitudinal irregular rows of horseshoe-shaped punctures, uniting towards apex.

Elytra: humeral callus poorly pronounced, sutural stria occupying medial and distal third. Elytral punctation as follows: uniformly covered by large shallow sparse horseshoe-shaped punctures mixed with very fine simple punctures, interpunctural distance being equal to their diameter.

Bursal sclerites: slightly asymmetrical, as in Fig. 14B.

Male unknown.

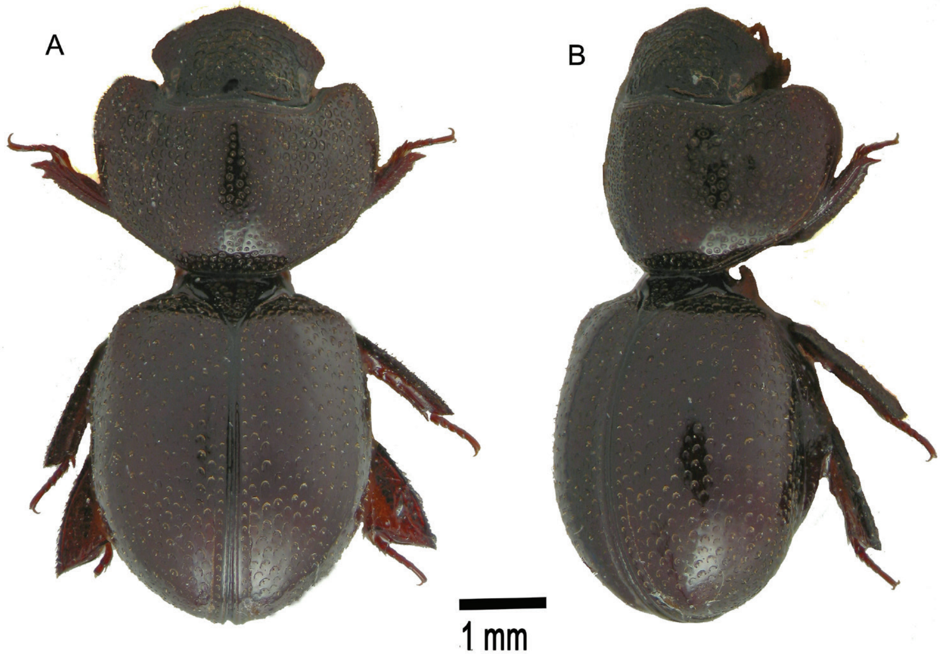

Figure 9. *Pterorthochaetes simplex* Gestro, 1899 **A** Extended Holotype, dorsal view **B** extended Holotype lateral view.

Diagnosis. Due to the large, shallow sparse punctation this species can be easily identified among all other Australian *Pterorthochaetes*. In particular the pronotal punctation is unique, being shallow, large and almost ocellate, while the elytral punctation is sparser than in *P. danielsi* sp. n. and larger and shallower than in *P. storeyi* sp. n.. The shape of the bursal sclerites is also very distinctive.

Etymology. Latin *simplex* (simple), probably due to the punctation of dorsum, shallower and sparser than in most other *Pterorthochaetes*.

Distribution and habitat. Unknown. The holotype bears a generic label indicating "Queensland". Paulian (1977) cites further specimens from Queensland in the museums of Canberra and Brisbane, but I was unable to locate specimens belonging to this species in the aforementioned museums. All the specimens bearing an identification label as *P. simplex* by Paulian belonged to the two new species herein described or, in the case of the specimen from New Guinea listed by Paulian, to a further new species not occurring in Australia. I was unable to locate the two specimens from "Churchill Creek (16.34°S, 145.19°E)" and "Mt Lewis road, via Julatten", both localities, however, fall within the range of *P. storeyi* sp. n. The records of *P. simplex* from Daintree by Grove (2000) actually refer to *P. storeyi* sp. n. (see below).

Remarks. As correctly stated in Paulian (1977) the holotype is kept in Paris (ex coll. Oberthür) and not in Genoa, as mistakenly reported in Paulian (1978).

Pterorthochaetes storeyi **sp. n.**
http://zoobank.org/D5822479-72B5-409C-A567-D9432241C361
http://species-id.net/wiki/Pterorthochaetes_storeyi
Fig. 6, 10A–D, 11A, 12B, 13G, H, I, 13A, E, F

Type locality. Thompson Creek, Daintree, Queensland, Australia.

Type material. Holotype, male (QM, registration number QMT93436): Daintree, NE Queensland: Thompson Creek, 16.06.31S, 145.26.25E, 140 m, Trunk FIT #16, 09/11/98-19/12/98, leg. Simon Grove. [extended specimen, glued on a card, dissected, genitalia mounted in DMHF resin on a separate card, same pin]. Allotype: 1 female [dissected], 1 female, Daintree, NE QLD: Thompson Creek, 16°06.31S, 145°26.25E, 140 m, Trunk FIT #24, 19/12/98–26/01/99, leg. Simon Grove (QPIM). Paratypes [6 males and 5 females dissected]: 1 male, Daintree, NE QLD: Thompson Creek, 16°06.31S, 145°26.25E, 140 m, Trunk FIT #01, 09/11/98-19/12/98, leg. Simon Grove (ABCB); 1 female, Daintree, NE QLD: Thompson Creek, 16°06.31S, 145°26.25E, 140 m, Trunk FIT #9, 19/12/98–26/01/99, leg. Simon Grove (QPIM); 1 female, Daintree, NE QLD: Thompson Creek, 16°06.31S, 145°26.25E, 140 m, 04/02/99, Night hand colln. #E9, leg. Simon Grove (QPIM); 1 male, Australia, N. Qld., Tully Falls S. F. 730 m, 18 km SSW Ravenshoe, 18.I.1988, Storey & Dickinson (QPIM); 1 male, Australia, N. Qld., Danbulla S. F., 1 km NE of Yungaburra, 13.II–6.III.1987, Storey & De Faveri (QPIM); 1 male, Worgabel S. F. via Atherton, 26.XII.1988, R. I. Storey at light (QPIM); 1 male, NEQ: 16.26S, 145.20E, O'Donoghue's Falls, 15–16 May 1995, 150 m, leg. Monteith, Ford & Slaney (QM, accession number T189543); 1 female, Daintree, NE QLD: Thompson Creek, 16°06.31S, 145°26.25E, 140 m, Trunk FIT #14, 09/12/98-26/01/99, leg. Simon Grove (QM, accession number: T189774); 1 male, Daintree, NE QLD: Thompson Creek, 16°06.31S, 145°26.25E, 140 m, 05/02/99, Trunk Knockdown #24, leg. Simon Grove (QM, accession number: T189775); 1 male, Daintree, NE QLD: Thompson Creek, 16°06.31S, 145°26.25E, 140 m, Trunk FIT #8, 09/12/98–26/01/99, leg. Simon Grove (QM, accession number: T189776); 1 male, QLD: 17.221°S, 145.761°E, Goldsborough Rd. 12.5 km past bridge, 16–17 Sept 2010, G. Monteith RF Barkspray 34575 (QM, accession number: T189777); 1 female, QLD: 16.202°S, 145.409°E, Lync-Haven Daintree Area, 2 Dec 2012, F. Turco, rainforest, 35 m, barkspray on logs, 18742 (ABCB).

Description. Size: HL = 0.70 mm; HW = 1.44 mm; PL = 1.50 mm; PW = 2.40 mm; EL = 2.66 mm; EW = 2.29 mm. Overall morphology as in generic description. Black, shiny, setation yellowish, sternum, tarsi and antennae reddish-brown.

Head: completely and uniformly covered by impressed coarse punctation, punctures transverse, comma shaped on disc, horseshoe-shaped (with opening towards internal side) at sides of disc and on frons. Anterior portion of clypeus with irregular transverse anastomosing lines. Interocular distance about 11 times the maximum width of dorsal ocular area.

Pronotum: margins completely bordered, lateral margins with a row of erect thick yellowish simple setae, longer than their distance. Pronotal setation made of thick medium

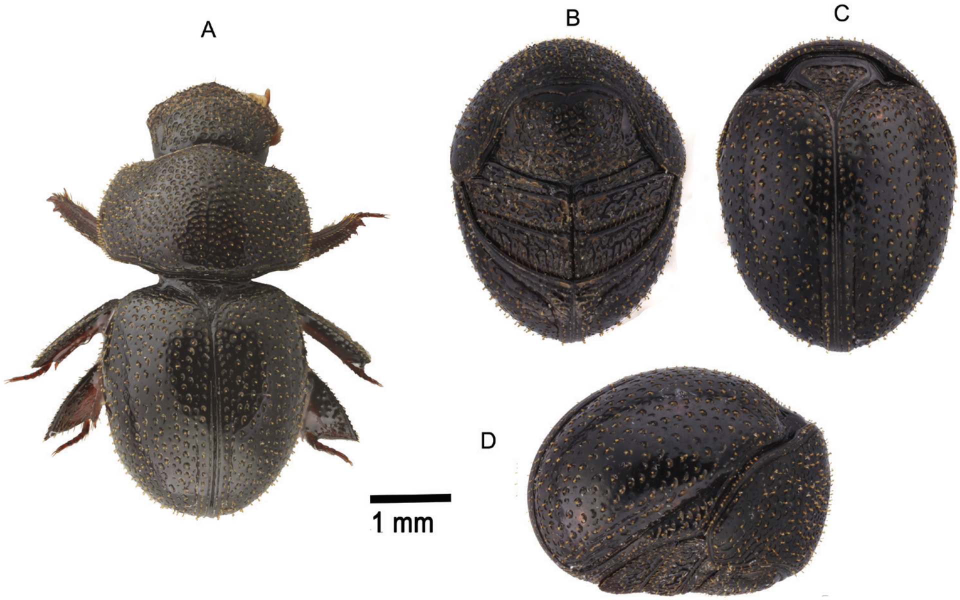

Figure 10. *Pterorthochaetes storeyi* sp. n. **A** Extended Paratype, dorsal view **B** enrolled Paratype, ventral view **C** enrolled Paratype, dorsal view **D** enrolled Paratype, lateral view.

sized clavate yellowish setae. Punctation as follows: disc covered by impressed transverse comma shaped punctures, with posterior openings and having a small fine setigerous pore near inferior side, sides of disc with a few ocellate punctures and sides of pronotum with larger horseshoe-shaped punctures with opening directed laterad. Anterior angles having six longitudinal irregular lines. Distance between punctures subequal to their diameter.

Scutellum: basally with two longitudinal irregular rows of horseshoe-shaped punctures, uniting towards apex.

Elytra: humeral callus poorly pronounced, sutural stria occupying the medial and distal third. Elytral punctation as follows: mixed simple fine punctures and longitudinal comma-shaped punctures with opening laterad, becoming horseshoe-shaped at apical third and at sides of elytra. Each comma-shaped and horseshoe-shaped puncture bearing bearing a clavate yellowish seta. Apical third of elytra with a few ocellate punctures. Interpunctural distance on elytra being larger than the diameter of punctures.

Aedeagus: basal piece about two times as long as parameres. Parameres slightly asymmetrical, internal sac with distally some irregular weak sclerotisations (Fig. 12B, Fig. 13G–I).

Male genital segment: as in Fig. 11A.

Bursal sclerites: strongly asymmetrical, as in Fig. 14A, E, F and subject to strong variability.

Diagnosis. *Pterorthochaetes storeyi* sp. n. can be easily identified among the other Australian *Pterorthochaetes* because of the distinctive punctation pattern of elytra, with punctures sparser and shorter than in *P. danielsi* sp. n. (usually with long comma-

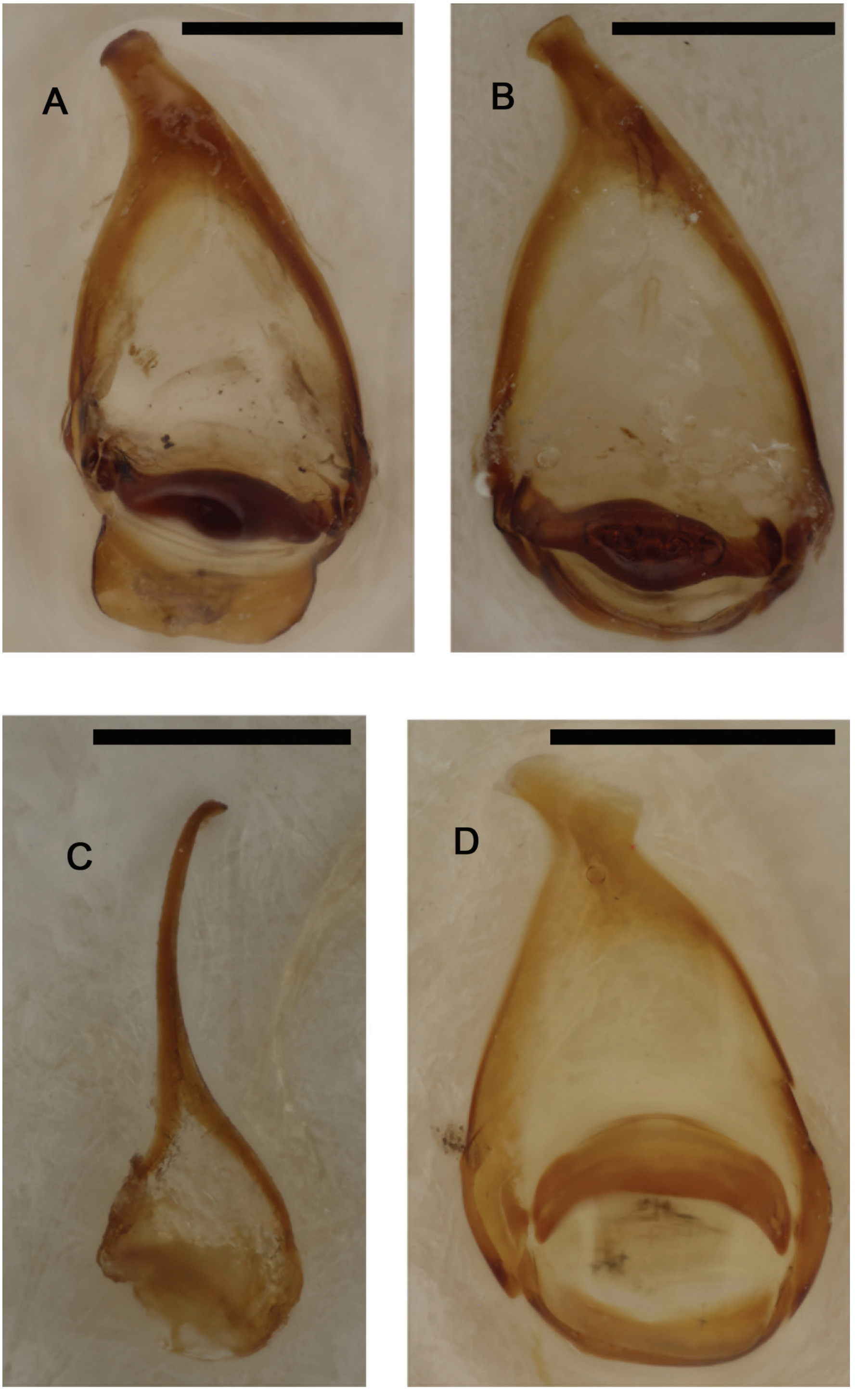

Figure 11. Genital segments of: **A** *Pterorthochaetes storeyi* sp. n. **B** *Pterorthochaetes danielsi* sp. n. **C** *Cyphopisthes monteithi* sp. n. **D** *Pterorthochaetes cribricollis* Gestro, 1899. Scale bar: 0,25 mm.

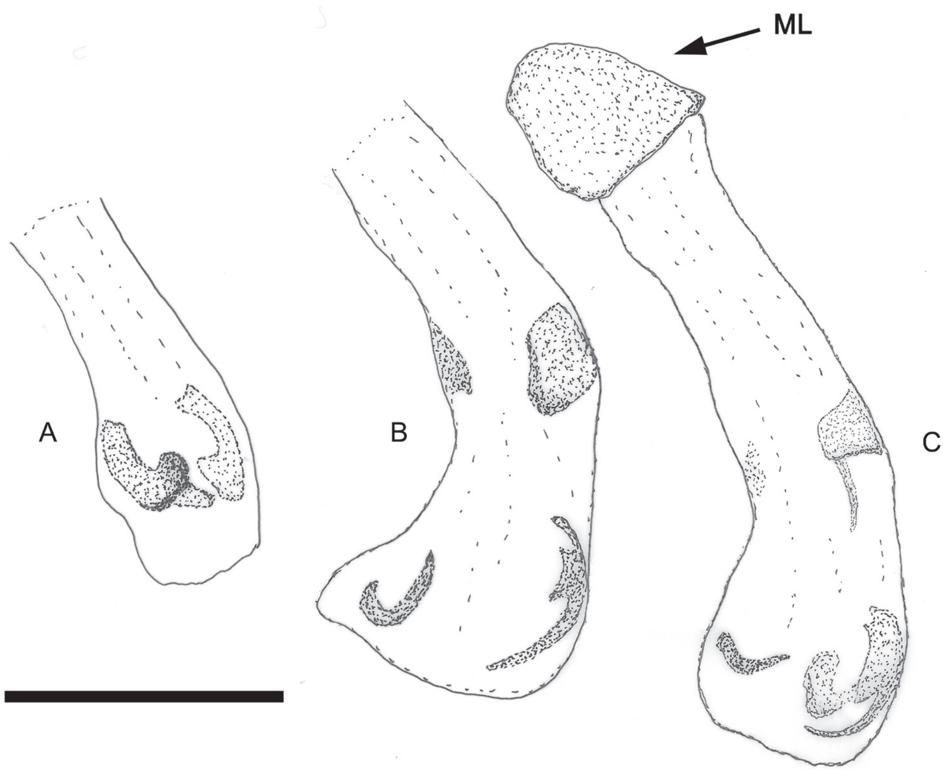

Figure 12. Internal sac of A *Pterorthochaetes cribricollis* Gestro, 1899 (distal portion only) **B** *Pterorthochaetes storeyi* sp. n. **C** *Pterorthochaetes danielsi* sp. n. (ML= median lobe). Scale bar: 0,5 mm.

shaped punctures, rather than true horseshoe-shaped punctures as in *P. danielsi*), smaller, shorter and more impressed than in *P. simplex*. The shape of bursal sclerites is also very distinctive and unique within the Australian *Pterorthochaetes*.

Etymology. Dedicated to Ross Storey (1949–2008), former technician at Queensland Department of Primary Industries, Mareeba. Noun in the genitive case.

Distribution and habitat. Known from the Queensland Wet Tropics (sensu Adam 1992), where it occurs in lowland rainforest areas. Adults were collected mainly with flight intercept traps or at light. The *P. simplex* quoted by Grove (2000) are actually specimens of *P. storeyi* sp. n.

Key to the genera and species of Australian Ceratocanthinae

1 Antennae 10-segmented, labrum subtruncate, elytra with a distinct pseudepipleuron .... ***Cyphopisthes* Gestro, 1899, 2**

– Antennae 9-segmented, labrum not truncate, somewhat depressed distally, elytra without a distinct pseudepipleuron ..... ***Pterorthochaetes* Gestro, 1899, 4**

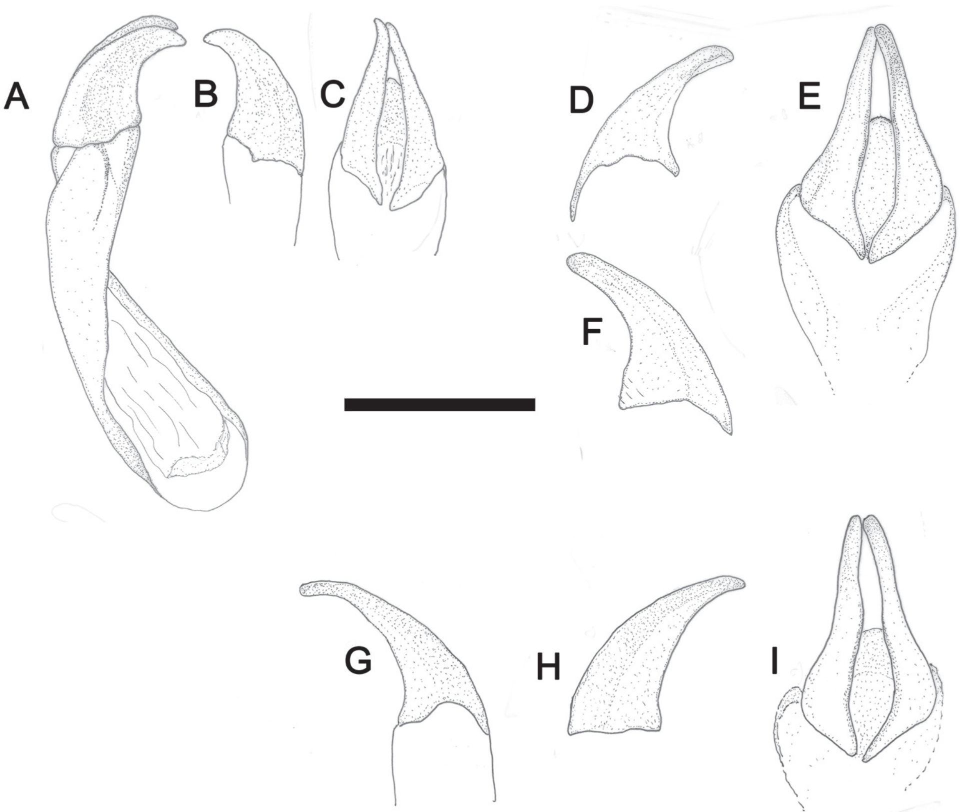

Figure 13. Aedeagus of: *Pterorthochaetes cribricollis* Gestro, 1899 **A** (aedeagus in lateral view) **B** (left paramere in lateral view) **C** (parameres in dorsal view); *Pterorthochaetes danielsi* sp. n. **D** (right paramere in lateral view) **E** (parameres in dorsal view) **F** (left paramere in lateral view); *Pterorthochaetes storeyi* sp. n. **G** (left paramere in lateral view) **H** (right paramere in lateral view) **I** (parameres in dorsal view). Scale bar: 0,5 mm.

2 Pronotum and elytra with uniform sculpturing consisting of dense large uniform horseshoe-shaped punctures .... ***C. descarpentriesi*** **Paulian, 1977**

– Pronotum and elytra with smaller punctation, elytral disc mainly with longitudinal comma-shaped punctures mixed with simple punctures **3**

3 Head with disc having relatively dense punctation, made of impressed very short comma-shaped punctures each one next to a very fine simple puncture .... ***C. monteithi*** **sp. n.**

– Head disc having very sparse punctation, made of very fine simple punctures.. ***C. yorkensis*** **sp. n.**

4 Pronotum and elytra with transverse comma-shaped and transverse short horseshoe-shaped punctation only .... ***P. cribricollis*** **Gestro, 1899**

– Pronotum and elytra with horseshoe-shaped or ocellate punctation, sometimes mixed with comma-shaped punctures.. **5**

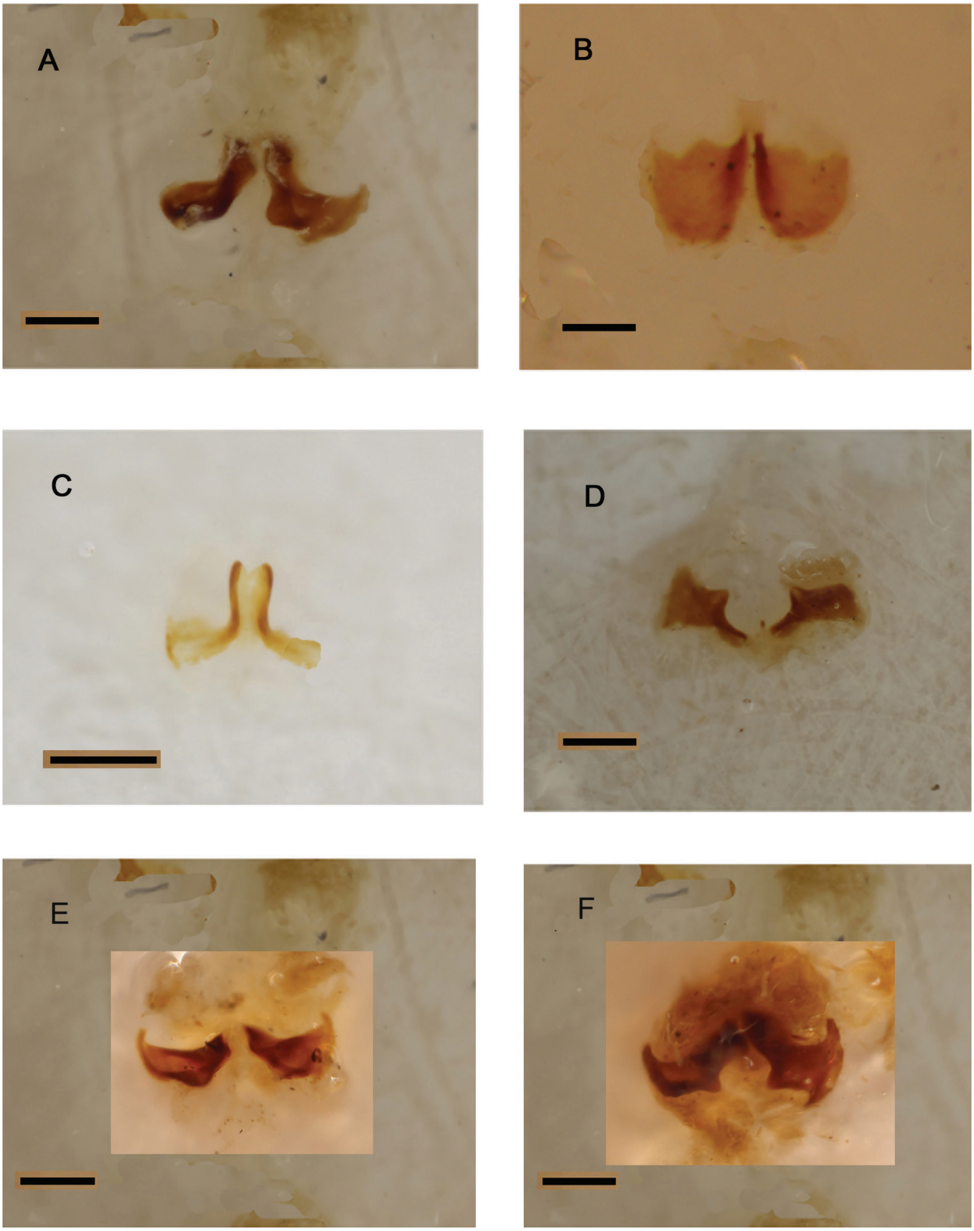

Figure 14. Bursal sclerites of: **A** *Pterorthochaetes storeyi* sp. n. **B** *Pterorthochaetes simplex* Gestro, 1899 **C** *Pterorthochaetes cribricollis* Gestro, 1899 **D** *Pterorthochaetes danielsi* sp. n. **E** *Pterorthochaetes storeyi* sp. n. **F** *Pterorthochaeres storeyi* sp. n. Scale bar: 0,2 mm.

5 Sides of pronotum mainly with shallow large ocellate punctures .... ***P. simplex*** **Gestro, 1899**
– Sides of pronotum mainly with horseshoe-shaped punctures **6**

6 Pronotal disc mainly with short horseshoe-shaped punctures, medial and proximal third of elytra with dense short horseshoe-shaped punctures, only very rare simple punctures .... ***P. danielsi*** **sp. n.**

– Pronotal disc mainly with transverse comma-shaped punctures,medial and proximal third of elytra with sparse short longitudinal comma-shaped punctures mixed with simple punctures...................................... ***P. storeyi*** **sp. n.**

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References

Adam P (1992) Australian rainforests. Oxford Biogeography Series 6. OUP pp. 308.

Ballerio A (1999) Revision of the genus *Pterorthochaetes*, first contribution (Coleoptera: Scarabaeoidea: Ceratocanthidae). Folia Heyrovskiana 7: 221–228.

Ballerio A (2000 [1999]) A new genus of Ceratocanthidae from the Oriental Region (Coleoptera: Scarabaeoidea). Elytron 13: 149–164.

Ballerio A (2009) Unusual morphology in a new genus and species of Ceratocanthinae from New Guinea (Coleoptera: Scarabaeoidea: Hybosoridae). The Coleopterists Bulletin 63(1): 44–53. doi: 10.1649/0010-065X-63.1.44

Ballerio A, Gill BD, Grebennikov V (2011) Illustrated overview and identification key to Cameroonian Ceratocanthinae beetles (Coleoptera: Scarabaeoidea: Hybosoridae) with description of four new species. Zootaxa 2892: 1–24.

Ballerio A, Maruyama M (2010) The Ceratocanthinae of Ulu Gombak: high species richness at a single site, with descriptions of three new species and an annotated checklist of the Ceratocanthinae of Western Malaysia and Singapore (Coleoptera, Scarabaeoidea, Hybosoridae). In: Ratcliffe B, Krell F-T (Eds) Current advances in Scarabaeoidea research. ZooKeys 34: 77–104. doi: 10.3897/zookeys.34.268

Cassis G, Weir TA (1992) Ceratocanthidae. In: Houston WWK (Ed) Zoological catalogue of Australia. Coleoptera: Scarabaeoidea. Canberra, AGPS Vol. 9, XII+ 65–66.

Cassis G, Weir TA (2002) Ceratocanthidae. Australian Faunal Directory, Australian Biological Resources Study, Canberra. http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/Ceratocanthidae [accessed 15 June 2013]

Gestro R (1899) Sopra alcune forme di Acanthocerini. Annali del Museo Civico di Storia Naturale di Genova 39: 450–498.

Grebennikov VV, Ballerio A, Scholtz CH (2002) Larva and pupa of *Cyphopisthes descarpentriesi* Paulian (Coleoptera: Scarabaeoidea: Ceratocanthidae) and their phylogenetic implications. Australian Journal of Entomology 41: 367–374. doi: 10.1046/j.1440-6055.2002.00307.x

Grebennikov VV, Ballerio A, Ocampo FC, Scholtz CH (2004) Larvae of Ceratocanthidae and Hybosoridae (Coleoptera: Scarabaeoidea): study of morphology, phylogenetic analysis and evidence of paraphyly of Hybosoridae. Systematic Entomology 29: 524–543. doi: 10.1111/j.0307-6970.2004.00257.x

Grimbacher PS, Stork NE (2007) Vertical stratification of feeding guilds and body size in beetle assemblages from an Australian tropical rainforest. Austral Ecology 32: 77–85. doi: 10.1111/j.1442-9993.2007.01735.x

Grove SJ (2000) Impacts of forest management on saproxylic beetles in the Australian lowland tropics and the development of appropriate indicators of sustainable forest management. Thesis. James Cook University, 378 pp.

Hawkeswood TJ (2006) Review of literature and the biology of the Australian Ceratocanthidae (Insecta: Coleoptera). Calodema 7: 8–11.

Kon M, Johki Y, Ballerio A (2010) The ceratocanthid beetle *Pterorthochaetes haroldi* (Coleoptera, Ceratocanthidae), collected from a gallery of the passalid beetle, *Leptaulax planus* (Coleoptera, Passalidae) in Sabah, Malaysia. Kogane 11: 93–95.

Matthews E (2000) Origins of Australian arid-zone tenebrionid beetles. Invertebrate Taxonomy 14: 941–951. doi: 10.1071/IT00021

Ocampo FC, Ballerio A (2006) Phylogenetic analysis of the scarab family Hybosoridae and monographic revision of the New World subfamily Anaidinae (Coleoptera: Scarabaeoidea). 4. Catalog of the subfamilies Anaidinae, Ceratocanthinae, Hybosorinae, Liparochrinae, and Pachyplectrinae (Scarabaeoidea: Hybosoridae). Bulletin of the University of Nebraska State Museum 19: 178–209.

Paulian R (1977) The Australian Ceratocanthidae (Coleoptera: Scarabaeoidea). Journal of the Australian Entomological Society 16: 261–265. doi: 10.1111/j.1440-6055.1977.tb00099.x

Paulian R (1978) Révision des Ceratocanthidae [Col. Scarabaeoidea] II - Les espèces orientales et australiennes. Annales de la Societé Entomologique de France (N.S.) 14: 479–514.

Paulian R (1991) Les Coléoptères Scarabaeoidea de Nouvelle-Calédonie. ORSTOM, Collection Faune Tropicale XXIX, 164 pp.

Stork NE, Grimbacher PS (2006) Beetle assemblages from an Australian tropical rainforest show that the canopy and the ground strata contribute equally to biodiversity. Proceedings of the Royal Society (B) 273: 1969–1975. doi: 10.1098/rspb.2006.3521

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RESEARCH ARTICLE

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Lethrus (*Lethrus*) *schneideri* sp. n. (Coleoptera, Geotrupidae) from Greece

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Abstract

Lethrus (*Lethrus*) *schneideri* Král & Hillert, **sp. n.** from Thrace, Greece, is described. The new species is morphologically most similar and probably closely related to *L.* (*L.*) *apterus* (Laxmann, 1770) and *L.* (*L.*) *ares* Král, Rejsek & Schneider, 2001. Diagnostic characters (shape of mandibles, ventral mandible processes, pronotum and parameres) are illustrated. Character matrix for separation of males of the *Lethrus* species closely related to *L. schneideri* Král & Hillert, **sp. n.** and geographic ranges for all species studied are mapped.

Keywords

Lethrus, new species, Geotrupidae, Lethrinae, Mediterranean, Palaearctic region

Introduction

The genus *Lethrus* Scopoli, 1777, is a Palaearctic geotrupid genus that has a wide distribution range and occurs from central and south-eastern Europe, including the Balkan Peninsula and western part of Turkey in the west, to Mongolia and the Ninxia province of China in the south-east (cf. e.g., Král and Nikolajev 2006, Král et al. 2001, Nikolajev 2003, Král and Hillert 2013). About 120 species are currently known, all flightless and with coalescent elytra. Most of them exhibit strictly allopatric distribution ranges restricted commonly to relatively small areas (cf. e.g., Král and Hillert 2013, Nikolajev 2003). So far, investigations of this genus in the Balkan Peninsula are relatively scanty. The first three species, *L.* (*L.*) *elephas*, *L.* (*L.*) *raymondi* and *L.* (*L.*) *schaumii*, have been described by Reitter as late as 1890. The next species, *L.* (*L.*) *fallax*, has been discovered and described 85 years later by Nikolajev in 1975. Recently, based on systematic investigations by the present authors and by the Italian coleopterist Riccardo Pittino, five additional species have been recognized and described: *L.* (*L.*) *ares* Král, Rejsek & Schneider, 2001; *L.* (*L.*) *liviae* Pittino, 2011 and *L.* (*L.*) *halkidikiensis* Král & Hillert, 2013; *L.* (*L.*) *perun* Král & Hillert, 2013 and *L.* (*L.*) *strymonensis* Král & Hillert, 2013. *Lethrus* specimens collected from the Balkan Peninsula were also studied in parallel by standard molecular analysis methods and results obtained indicate significant differences between populations meriting for at least several of them having the "species status" (Drožová et al. in prep.).

A new and morphologically clearly different species was found in the material obtained mostly by the present authors during their expeditions to Greece between 2009 and 2012. The species was named *Lethrus* (*Lethrus*) *schneideri* and described below.

Material and methods

The following abbreviations identify the collections housing the material examined (curators are given in parentheses).

DKCP David Král's collection, Praha, Czech Republic, deposited in NMPC
JSCP Jan Schneider's collection, Praha, Czech Republic
OHCB Oliver Hillert's collection, Schöneiche bei Berlin, Germany
MNHN Muséum national d'Histoire naturelle, Paris, France (Olivier Montreuil)
NMPC National Museum, Praha, Czech Republic (Jiří Hájek)
PTCL Pavel Turek's collection, Lanškroun, Czech Republic
ZSCK Zdeno Lucbauer's collection, Kettering, United Kingdom

Genitalia of three males of the new species were dissected for examination. The material was examined with an Olympus SZ61 stereo microscope; measurements were taken with an ocular grid. Photographs were taken using a Canon 550D digital camera equipped with a Canon MP-E 65/2.8 MACRO lens with 5:1 optical magnification. Final images were composed from multiple partially focused images using Zerene Stacker (Zerene Systems LLC, Richland, WA, USA). Specimens of the presently described species are provided with one red printed label: "Lethrus (Lethrus) schneideri sp. nov., HOLOTYPUS, ALLOTYPUS or PARATYPUS, David Král & Oliver Hillert det. 2013". The exact label data are cited for the material; individual lines of each label are separated by a single slash (/), [p] – preceding data within quotation marks are printed. The authors' remarks and additional comments are enclosed in brackets.

The material was obtained mainly during the following expeditions to Greece (participants in parentheses): Greece, April 2009 (Dana Drožová, David Král, Hana Podskalská-Šípková, Petr Šípek and Aneta Venderová-Fuchsová) and Greece, April 2011 (Stephan Gottwald and Oliver Hillert).

The nomenclature used to describe morphological structures is that proposed by Pittino (2011) and Král and Hillert (2013).

Taxonomy

***Lethrus* (*Lethrus*) *schneideri* Král & Hillert, sp. n.**
http://zoobank.org/C68F5659-F842-4D35-9CB9-565948451E57
http://species-id.net/wiki/Lethrus_schneideri
Figures 1C, F; 2C, F; 3C, 4C, F; 5C–E; 7; 8A–B

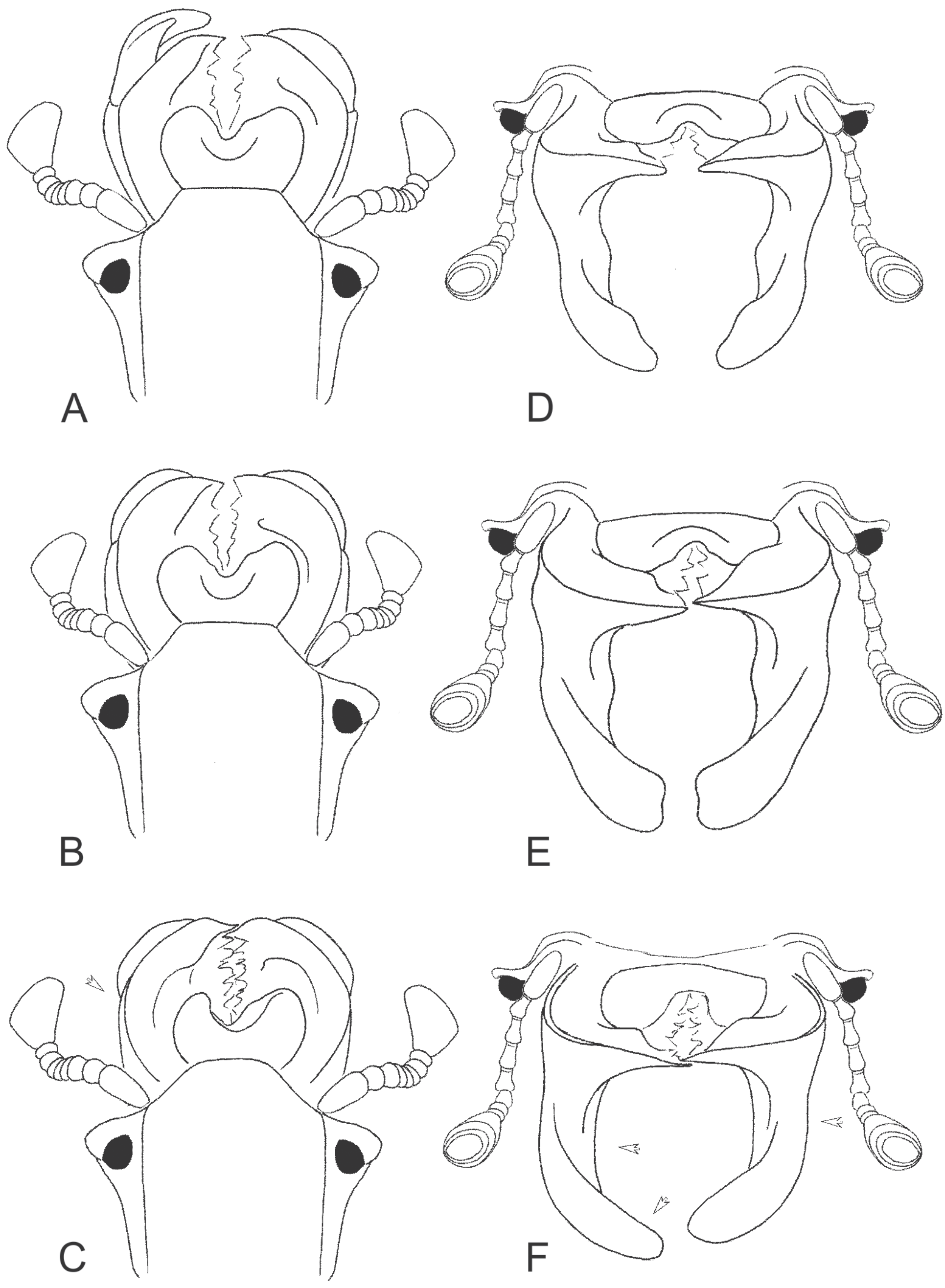
Type locality. Greece, E Macedonia & Thrace province, Rhodope district, Komotiní environment, Karydia, approx. 120 m a.s.l., 41°06.10'N, 25°24.58'E (Fig. 8B).

Type material (169 specimens). **Greece**: Holotype ♂, allotype ♀ (DKCP), "GR, E Macedonia & Thrace, 19.iv. / Rodopi dist., Komotiní env., / **KARYDIA**, 41°06.10'N, 25°24.58'E / D. Král, D. Drožová, H. Podskalská, P. Šípek & A. Venderová lgt., 2009 [p] ". Paratypes: 5 ♂♂, 10 ♀♀ (DKCP), 3 ♂♂, 3 ♀♀ (JSCP), same data; 47 ♂♂, 20 ♀♀ (OHCB), 4 ♂♂, 2 ♀♀ (DKCP), 2 ♂♂, 2 ♀♀ (JSCP), "Greece, (Thrace), / N of Komotini, military area / 10.04.2011, leg. O. HILLERT [p]"; 29 ♂♂, 10 ♀♀ (PTCL) 1 ♂, 1 ♀ (JSCP), "Greece, Thracie / Komotini, 2,1 km SZ Karydia / 41.155846, 25.422836 / 29.4.2012, leg. Pavel Turek [p]"; 14 ♂♂, 22 ♀♀ (ZLCK) 1 ♂ 1 ♀ (JSCP), "Greece, Komotini / 2,1 Km SZ Karydia / 41°8'59.19"N, 25°25'31.14"E / 29.4.2012, leg. Z. Lucbauer [p]".

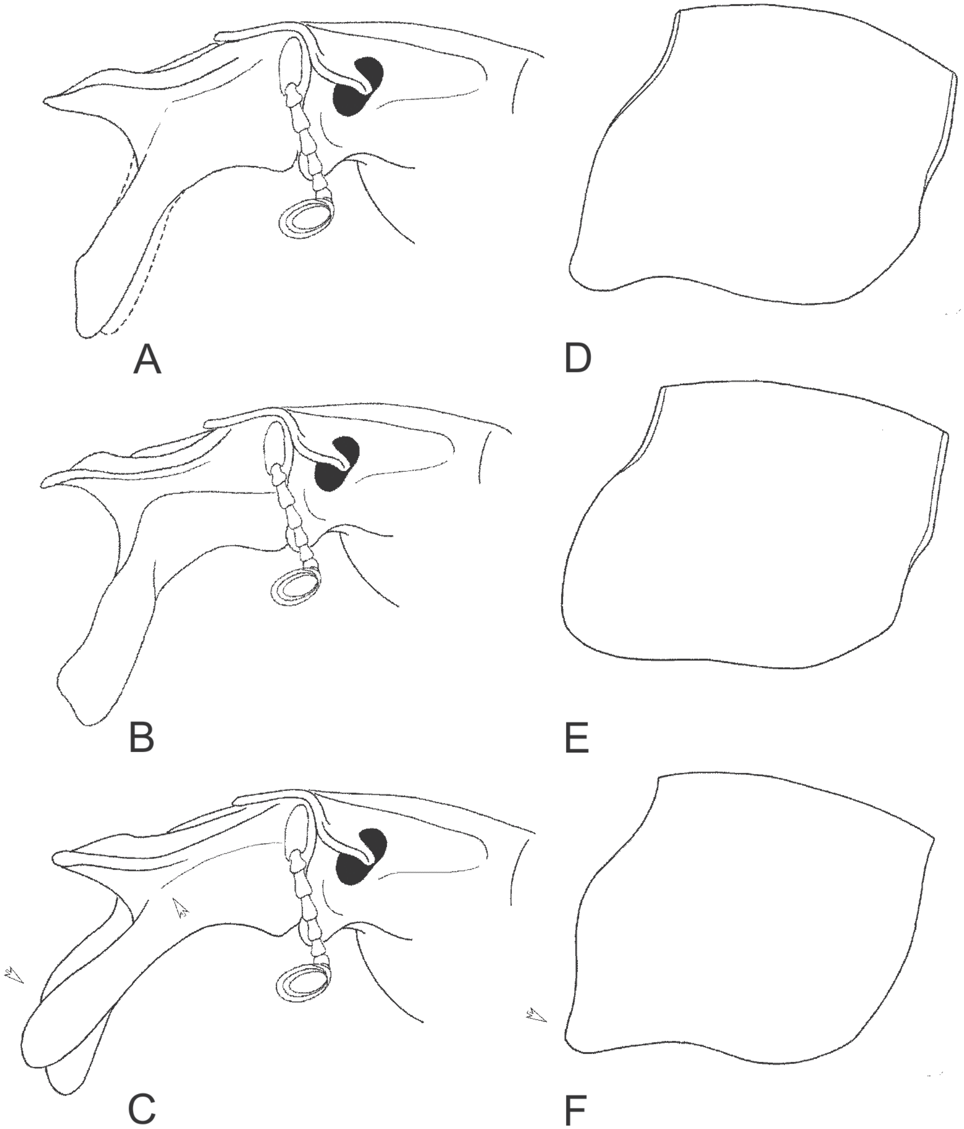
Additional material examined. 6 specimens). **Greece**: 1 ♂, 2 ♀♀ (NMPC), 1 ♂, 1 ♀ (OHCB), "Xanthi, Gr. / 14.v.1937 / coll. Barton [p]"; 1 ♂ (MNHN), "Grèce [p]".

Description of holotype. Maximally developed male with well developed ventral mandible processes (Figs 4C, F; 5C). Total body length 29 mm. Oblong, strongly convex; dorsal surface black, moderately shiny, except almost alutaceous pronotum; ventral surface black with fine blue tinge, moderately shiny, claws black-brown; macrosetation black.

Head (Figs 1C, F; 2C; 4C, F; 5C). Labrum bilobed, asymmetrical, right lobe remarkably more developed; surface rugosely and coarsely, shallowly and sparsely punctate, each puncture bearing short recumbent macroseta; anterior margin with dense row of long macrosetae. Clypeus transverse, trapezoidal with anterior angles round. Frontal impressions vague, frontal tubercles indistinct. Frontoclypeal suture present only laterally; keels separating eye canthus from frons only slightly developed

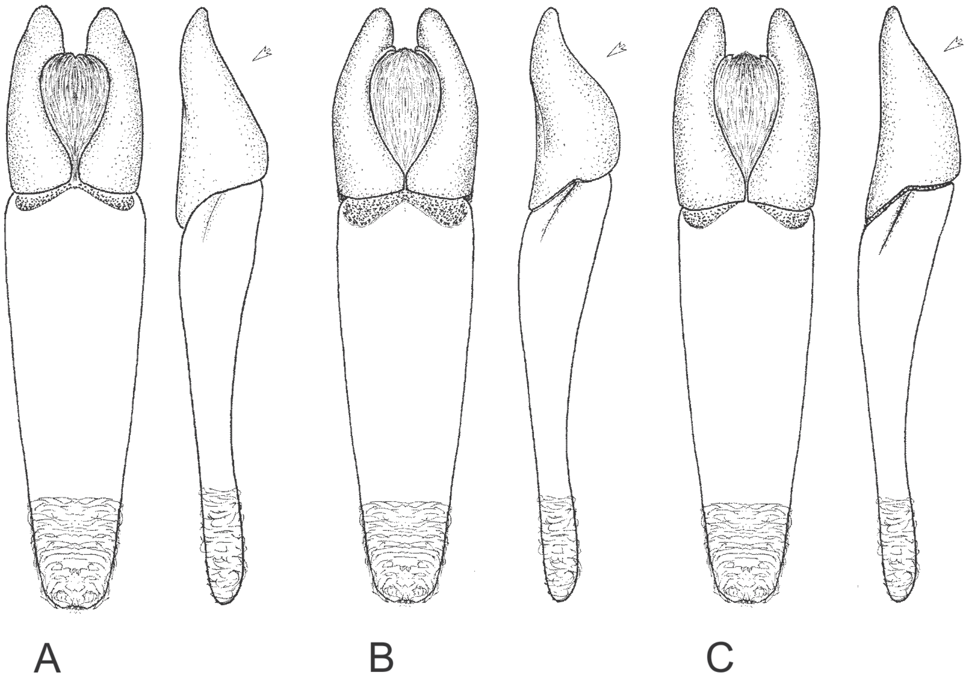


Figures 1. Maximally developed males: **A, D** *Lethrus* (*L.*) *apterus* (Slovakia, Kamenica nad Hronom, DKCP) **B, E** *L.* (*L.*) *ares* (Greece, Evros dist., Polía, holotype, NMPC) **C, F** *L.* (*L.*) *schneideri* sp. n. (holotype). **A–C** head in dorsal aspect **D–F** head in frontal aspect. Differential characters shown by arrow. Schematically, not to scale.



Figures 2. Maximally developed males: **A, D** *Lethrus* (*L.*) *apterus* (Slovakia, Kamenica nad Hronom, DKCP) **B, E** *L.* (*L.*) *ares* (Greece, Evros dist., Polía, holotype, NMPC) **C, F** *L.* (*L.*) *schneideri* sp. n. (holotype). **A–C** head in left lateral aspect **D–F** pronotum in left lateral aspect. Differential characters shown by arrow. Schematically, not to scale.

but distinct, slightly divergent posteriad. Eye canthus exceeding eyes, projecting anterolaterad, almost rectangular, lateral margins divergent posteriad, anterolateral angle round, oblique keel above eyes absent. Pleurostomal process evenly arcuate, hardly exceeding ventrolateral mandible outline. Punctation of frons double, consisting of

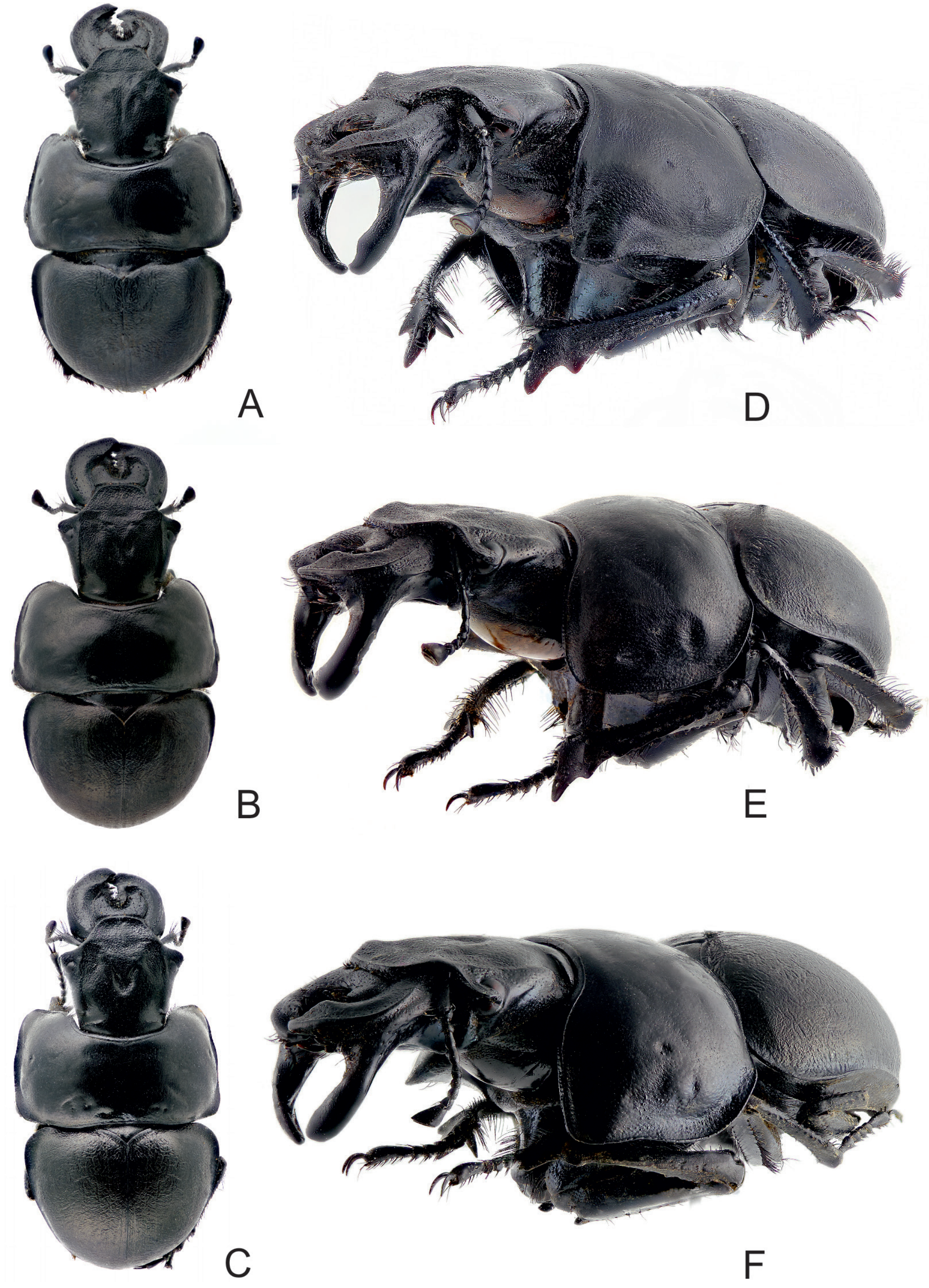


Figures 3. Aedeagi in dorsal and lateral aspect: **A** *Lethrus* (*L.*) *apterus* (Slovakia, Kamenica nad Hronom, DKCP) **B** *L.* (*L.*) *ares* (Greece, Evros dist., Polía, holotype, NMPC) **C** *L.* (*L.*) *schneideri* sp. n. (holotype). Differential characters shown by arrow. Schematically, not to scale.

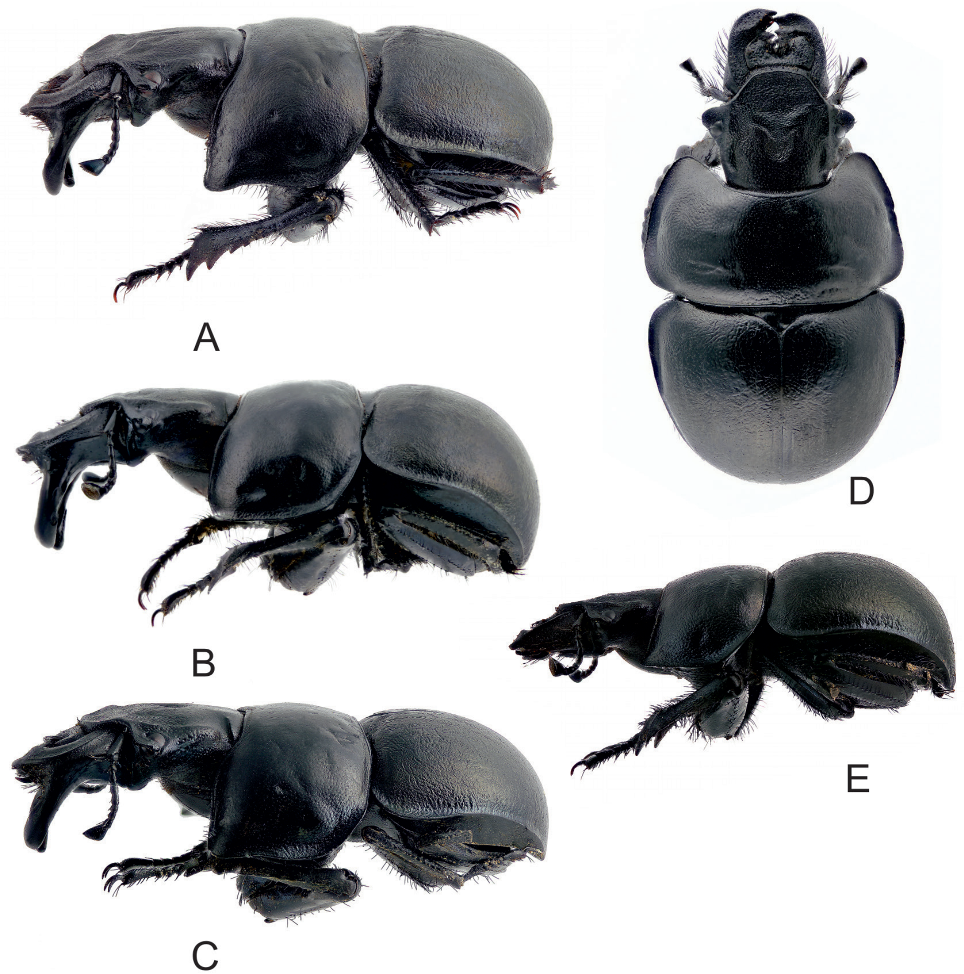
coarse, transversally rugose, regularly and densely distributed punctures, intermixed with fine, irregularly distributed ones; coarse punctures separated by approximately less than their diameter, punctation becoming distinctly sparser posteriad and on occiput; clypeus and eye canthus distinctly rugose.

Mandibles symmetrical, external outline almost semicircular, pointed subapically in dorsal aspect (Figs 1C, 4C) with maximum width approximately at middle of mandibles length.

Ventral mandible processes (Figs 1F, 2C, 4F, 5C) weakly asymmetrical, right process slightly more developed than left one and with different angle in lateral aspect. Both processes distinctly longer than length of mandible; base thickened, not exceeding lateral mandibular outline in dorsal aspect, with slightly concave external outline in basal half in frontal aspect; longitudinal keel on base laterally present, straight and distinctly subparallel to lateral mandibular outline, approximately as broad as maximum width of mandibles outline basally; in lateral aspect weakly arcuate, approximately subparallel to lateral mandibular outline, slightly divergent gradually basad approximately from middle of its length. Inferiobasal tooth absent; both processes bent inward approximately in middle of mandibles length in frontal view; anterior subapical tooth absent; apical emargination absent; apical tooth round.



Figures 4. Habitus of maximally developed males: **A, D** *Lethrus* (*L.*) *apterus* (Slovakia, Kamenica nad Hronom, body length: 27 mm, DKCP) **B, E** *L.* (*L.*) *ares* (Greece, Evros dist., Polía, body length: 28 mm, holotype, NMPC) **C, F** *L.* (*L.*) *schneideri* sp. n. (holotype). **A–C** dorsal aspect **D–F** left fronto-lateral aspect.



Figures 5. Habitus: **A** *Lethrus* (*L.*) *apterus* (Slovakia, Kamenica nad Hronom, body length: 27 mm, male, DKCP) **B** *L.* (*L.*) *ares* (Greece, Evros dist., Polía, body length: 28 mm, male holotype, NMPC) **C** *L.* (*L.*) *schneideri* sp. n. (male holotype), **D–E** the same but female allotype. **A–C, E** left lateral aspect **D** dorsal aspect.

Pronotum (Figs 2F; 4C, F; 5C) transverse, distinctly broader than base of elytra, broadest just behind middle; margin entirely bordered, slightly crenulate in anterior parts. Anterior angles weakly but distinctly projecting anterolaterad, with angulate outline; lateral margin approximately weakly emarginate anteriorly, then straight to round posterior angle; basal margin straight. Punctation of dorsal surface simple, consisting of deep, sparsely and irregularly distributed punctures; punctures separated by approximately two to four their diameters discally, surface near lateral margins considerably shagreened and alutaceous.

Scutellar shield widely triangular, finely shagreened.

Figure 6. Sketch map of eastern and south-eastern part of Europe with known distribution of *Lethrus* (*L.*) *apterus*. Compiled from the following sources: Baraud (1992) – overall range; Burakovski et al. (1983) – Poland; Endrődi (1957) – Carpathian basin; Guéourguiev and Bunalski (2004) – Bulgaria; Horion (1958) – Austria; Juřena et al. (2008) – Czech Republic, Slovakia; Mikšić (1970) – Serbia; Nikolajev (2003) – overall range; Panin (1957) – Romania; Semenov-Tian-Shanskij and Medvedev (1936) – overall range. Base map source: http://www.naturalearthdata.com/downloads/10m-raster-data/.

Elytra almost semicircular, apices not prominent, each apex forming independent arc. Epipleuron strongly narrowed apicad, epipleural keel not reaching elytral apex. Whole surface alutaceous, finely transversally rugose; striae not indicated, entirely vanishing in rugosities.

Legs. Profemur not armed, protibia with row of eight gradually proximad diminishing external denticles, and with row of tubercles on ventromedial edge.

Aedeagus as in Fig. 3C.

Variability in males. Body length 19–30 mm. Mandible processes in medium developed and underdeveloped (hypothelic) males short, more or less straight with simply rounded to almost acute apically.

Females (body length 18–24 mm, allotype 24 mm – Figs 5D, E) differ from males as follows: external outline of mandibles almost straight, in apical quarter round in dorsal aspect (Fig. 5D; ventral mandibular process absent (Fig. 5E); protibia broader, row of tubercles on ventromedial edge less pronounced.

Differential diagnosis. Among the species distributed in the Balkan Peninsula, the new species is most similar and probably closely related to *Lethrus* (*L.*) *ares* Král, Rejsek & Schneider, 2001 and *L.* (*L.*) *apterus* (Laxmann, 1770). Distinguishing features are: absence of anterior subbasal tooth of ventral mandibular processes (*L.* (*L.*) *schaumii* Reitter, 1890 and *L.* (*L.*) *elephas* Reitter, 1890 have distinct anterior sub-

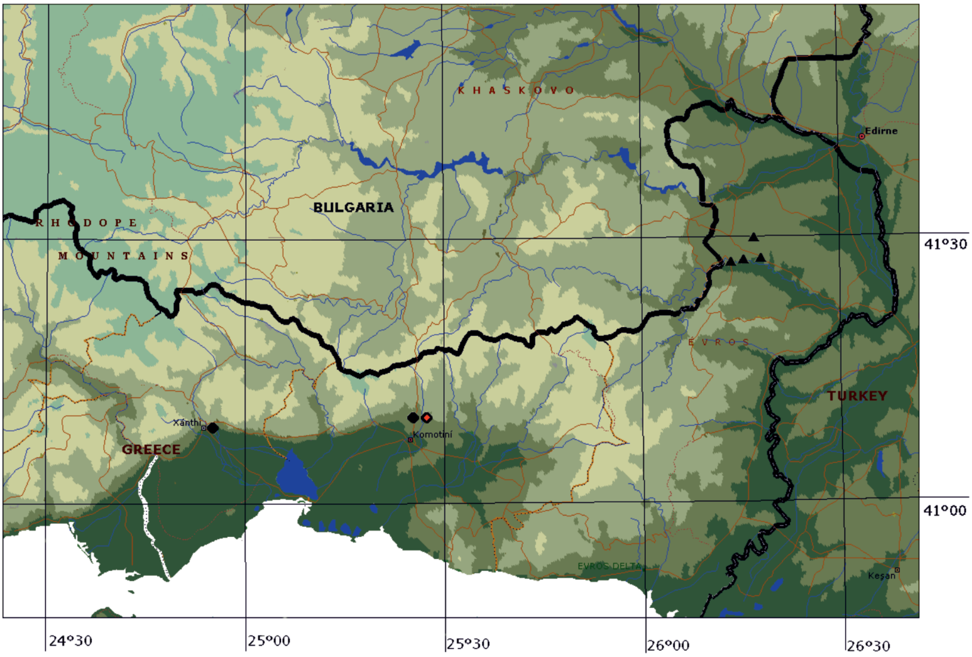


Figure 7. Sketch map of north-eastern part of Greece with marked distribution of *Lethrus* (*L.*) *ares* – triangles, compiled from Král et al. (2001) and *L.* (*L.*) *schneideri* sp. n. – circles, red circle represents the type locality.

basal tooth); absence of anterior subapical tooth of ventral mandibular processes (*L.* (*L.*) *halkidikiensis* Hillert & Král, 2013, *L.* (*L.*) *perun* Hillert & Král, 2013, *L.* (*L.*) *raymondi* Reitter, 1890 and *L.* (*L.*) *strymonensis* Hillert & Král, 2013 have distinct anterior subapical tooth); presence of approximately symmetrical ventral mandibular processes and regularly round or obtuse-angular anterior pronotal angles (*L.* (*L.*) *fallax* Nikolajev, 1975 and *L.* (*L.*) *liviae* Pittino, 2011 have remarkably asymmetrical ventral mandibular processes and strongly produced acute-angular anterior pronotal angle). For characters to separate *L.* (*L.*) *apterus*, *L.* (*L.*) *ares*, and *L.* (*L.*) *schneideri* sp. n. see the character matrix (Table 1). Additionally, *L.* (*L.*) *schneideri* sp. n. is probably an endemic species of the southernmost slopes of the Rhodope Mountains approximately between the towns of Xánthi and Komotiní, while *L.* (*L.*) *ares* is known so far only from four spots all situated in the Eridropótamos river basin (Fig. 7) and *L.* (*L.*) *apterus* is a widely distributed Pannonian species known from Burgenland (Austria), Moravia (Czech Republic) and Serbia in the west to the Don river basin in the east (Fig. 6). The geographic range of the latter is separated from that of the new species by the Thracian lowlands in Bulgaria inhabited by *L.* (*L.*) *schaumii*, and by the Rhodope Mountains.

Figures 8. A Collecting habitat of *Lethrus* (*L.*) *schneideri* sp. n., Greece: Thrace distr., N of Komotiní, April 2011 (photo by Oliver Hillert) **B** Type locality of *L.* (*L.*) *schneideri* sp. n., Greece: Thrace distr., Karydia, April 2009 (left PŠ, right DK) (photo by Hana Podskalská-Šípková).

Table 1. Character matrix for separation of males of *Lethrus* (*L.*) *apterus*, *L.* (*L.*) *ares* and *L.* (*L.*) *schneideri* sp. n.

Species character	***Lethrus* (*L.*) *apterus***	***Lethrus* (*L.*) *ares***	***Lethrus* (*L.*) *schneideri* sp. n.**
lateral longitudinal keel on base of ventral mandible process in dorsal aspect	straight and approximately parallel to lateral mandibular outline, distinctly broader as maximum width of mandibles outline basally (Fig. 1A)	straight and distinctly subparallel to lateral mandibular outline, approximately as broad as maximum width of mandibles outline basally (Fig. 1B)	straight and distinctly subparallel to lateral mandibular outline, approximately as broad as maximum width of mandibles outline basally (Fig. 1C)
lateral longitudinal keel on base of ventral mandible process in lateral aspect	weakly arcuate, approximately parallel to lateral mandibular outline, divergent gradually basad approximately from middle of its length (Figs 2A, 4D, 5A)	almost straight, distinctly subparallel to lateral mandibular outline, distinctly divergent gradually basad approximately from middle of its length (Figs 2B, 4E, 5B)	weakly arcuate, approximately subparallel to lateral mandibular outline, slightly divergent gradually basad approximately from middle of its length (Figs 2C, 4F, 5C)
mandibular processes	both processes symmetrical (Figs 1D, 2A)	both processes symmetrical (Figs 1E, 2B)	weakly asymmetrical, right process slightly more developed than left one and with different angle in lateral aspect (Figs 1F, 2C)
shape of left ventral mandible process in lateral aspect	anterior subapical tooth present, round; apical tooth not projected apically (Figs 2A, 4D, 5A)	anterior subapical tooth present, broadened distad, angulate; apical tooth projected apically (Figs 2B, 4E, 5B)	anterior subapical tooth absent, apical tooth not projected apically (Figs 2C, 4F, 5C)
shape of ventral mandible process in frontal aspect	external outline concave basally, inferiobasal tooth present, round; subapical tooth distinct, apical emargination present, remarkably deep (Fig. 1D)	external outline strongly concave basally, inferiobasal tooth present, round; subapical tooth distinct, apical emargination present, shallow (Fig. 1E)	external outline concave basally, inferiobasal tooth absent; subapical tooth absent, apical emargination absent (Fig. 1F)
shape of anterior pronotal angle	projected anterolaterad, angulate (Figs 2D; 4A, D; 5A)	not projected anterolaterad, broadly round (Figs 2E; 4B, E; 5B)	projected anterolaterad, angulate (Figs 2F; 4C, F; 5C)
shape of parameres in lateral aspect	shallowly sinuate distally (Fig. 3A)	distinctly sinuate distally (Fig. 3B)	shallowly sinuate distally (Fig. 3C)
distribution pattern	widely distributed from Austria (Burgenland), Czech Republic (Moravia) and Serbia to approximately right bank of the Don river in the eastern Ukraine, suthernmost to the northern foothills of the Stara planina Mts in Bulgaria (Fig. 6)	restricted only to south-easternmost foothills of the Rhodope Mts (Eridropótamos river basin region in Greece) (Fig. 7)	restricted only to southernmost foothills of the Rhodope Mts (Komotiní and Xánthi regions in Greece) (Fig. 7)

Collecting circumstances. The type series was collected from uncultivated fields on moderately steep, approximately SE oriented slope consisting of loess soil (Figs 8A–B) in a millitary area.

Distribution. Greece: Thrace, southernmost foothills of the Rhodope (Ροδόπη) Mountains. (Fig. 7), the regional units of Rhodope and Xánthi.

Name derivation. Patronymic, named in honour of our longtime friend, entomologist Jan Schneider (Praha, Czech Republic), an excellent Geotrupidae and Silphidae specialist.

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References

Baraud J (1992) Coléoptères Scarabaeoidea d'Europe. Faune de France. Volume 78. Fédération Française des Sociétés de Sciences Naturelles & Société Linnéenne de Lyon, Paris & Lyon, 856 pp.

Burakovski B, Mroczkowski M, Stefańska J (1983) Chrąszcze – Coleoptera (Scarabaeoidea, Dasciloidea, Byrrhoidea, Parnoidea). Katalog Fauny Polski. Część 23, Tom 9 [Beetles – Coleoptera (Scarabaeoidea, Dasciloidea, Byrrhoidea, Parnoidea). Catalogue of the fauna of Poland. Issue 23, Volume 9]. Państwowe wydawnictwo naukowe, Warszawa, 294 pp. [in Polish]

Drožová D, Janšta P, Šípek P, Král D (in prep.) Phylogeography of the earth-boring dung beetles of the genus Lethrus (Coleoptera: Geotrupidae) in the Eastern Mediterranean region.

Endrődi S (1957) A lemezecsápú bogarak (Lamellicornia) kárpátmedencei lelőhelyadatai [Lamellicorn beetles (Coleoptera) of the Carpathian basin]. Rovartani Kőzlemények (Series Nova) 10: 145–226. [in Hungarian]

Guéourguiev B, Bunalski M (2004) Critical review of the families Glaresidae, Lucanidae, Trogidae, Bolboceratidae, Geotrupidae, Hybosoridae and Ochodaeidae in Bulgaria (Coleoptera: Scarabaeoidea). Acta Zoologica Bulgarica 56: 253–275.

Horion A (1958) Faunistik der mitteleuropäischen Käfer. Band VI: Lamellicornia (Scarabaeidae - Lucanidae). August Feyel Verlag, Überlingen-Bodensee, xxiv + 343 pp.

Juřena D, Týr V, Bezděk A (2008) Příspěvek k faunistickému výzkumu listorohých brouků (Coleoptera: Scarabaeoidea) na území České republiky a Slovenska). Contribution to the faunistic research on Scarabaeoidea (Coleoptera) in the Czech Republic and Slovakia. Klapalekiana 44 (Supplementum): 17–176. [in Czech with English summary]

Král D, Nikolajev GV (2006) Geotrupidae: Lethrinae. In: Löbl I, Smetana A (Eds) Catalogue of Palaearctic Coleoptera, Vol. 3. Scarabaeoidea – Scirtoidea – Dasciloidea – Buprestoidea – Byrrhoidea. Apollo Books, Stenstrup, 93–95.

Král D, Hillert O (2013) Three new *Lethrus* species close to *L. raymondi* (Coleoptera: Geotrupidae) from the Balkan Peninsula. Acta Entomologica Musei Nationalis Pragae 53: 219–244.

Král D, Rejsek J, Schneider J (2001) *Lethrus* (*Lethrus*) *ares* sp. n. (Coleoptera: Geotrupidae) from Greece. Klapalekiana 37: 253–260.

Mikšić R (1970) Katalog der Lamellicornia Jugoslawiens. Institut za šumarstvo, Sarajevo, 71 pp.

Nikolajev GV (1975) Neue und wenig bekannte Scarabaeiden-Arten aus dem palearktischen Faunenegebiet (Coleoptera). Annales Historico-Naturales Musei Nationalis Hungarici 67: 147–149.

Nikolajev GV (2003) Zhuki-kravchiki (Scarabaeidae, Geotrupinae, Lethrini): biologiya, sistematika, rasprostraneniye, opredelitel' [Coleoptera, Scarabaeidae, Geotrupinae, Lethrini: biology, taxonomy, distribution, key]. Kazak universiteti, Almaty, 254 pp. [in Russian].

Panin S (1957) Fauna Republicii Populare Romîne, Insecta. Volumul 10, Fascicula 4. Coleoptera Familia Scarabaeidae (Subfamiliile: 1 Coprinae, 2 Geotrupinae, 3 Aphodiinae, 4 Aegialiinae, 5 Hybosorinae, 6, Ochodaeinae, 7 Orphninae, 8 Troginae, 9 Glaphyrinae, 10 Sericinae, 13 Hopliinae, 14 Dynastinae, 15 Valginae, 16 Trichiinae și 17 Cetoniinae). [Fauna of the Peoples's Republic of Romania, Insecta, volume 10, fascicle 4. Coleoptera family Scarabaeidae (subfamilies 1 Coprinae, 2 Geotrupinae, 3 Aphodiinae, 4 Aegialiinae, 5 Hybosorinae, 6, Ochodaeinae, 7 Orphninae, 8 Troginae, 9 Glaphyrinae, 10 Sericinae, 13 Hopliinae, 14 Dynastinae, 15 Valginae, 16 Trichiinae and 17 Cetoniinae]. Editura Academiei Republicii Populare Romîne, București, 316 pp + 36 pls. [in Romanian]

Pittino R (2011) *Lethrus* (*Lethrus*) *liviae* n. sp. from European Turkey (Coleoptera Geotrupidae). Giornale Italiano di Entomologia 12: 381–394.

Reitter E (1890) Analytische Uebersicht der bekannten Lethrus-Arten. Deutsche Entomologische Zeitschrift 1890: 289–295.

Sémenov-Tian-Shanskij A, Medvedev SI (1936) Opredelitel zhukov-kravchikov (triba Lethrini sem. Scarabaeidae). (Synopsis des genres et espèces de la tribu Lethrini (fam. Scarabaeidae)). Opredeliteli po faune SSSR, izdavaemiye zoologicheskim institutom akademii nauk 18. [Keys to identification of the USSR fauna, published by the Institute of Zoology of the Academy of Sciences 18]. Izdatelstvo Akademii Nauk SSSR, Moskva-Leningrad, 104 pp. [in Russian, French title]