

Chondrostoma esmaeili, a new cyprinid species from the Tigris river drainage in Iran (Teleostei: Cyprinidae)

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Abstract

A new species of *Chondrostoma* is described from Iranian part of the Tigris river drainage. This species differs from other species of the genus *Chondrostoma* in Iran and Euphrates-Tigris river drainage by a combination of characters, including lack of a horny blade on lower jaw; arched mouth; 8 branched dorsal-fin rays (9 in holotype), and 10 branched anal-fin rays; 51–58 lateral line scales, 8–9 scales above the lateral line, 5–6 scales below the lateral line and short, 14–16 circum-peduncular scales, and 15–17 gill rakers along the entire gill arch.

Key words

Cyprinidae, Freshwater fish, Biodiversity, Morphology.

Introduction

The genus *Chondrostoma* AGASSIZ, 1832 is composed of small to medium-sized cyprinid fishes distributed in the northern Mediterranean drainages across Europe, western Asia and the Middle East (GANTE *et al.*, 2007), with records from the Caspian Sea, Esfahan, Tigris-Euphrates and Kor River basins in Iran (ESMAEILI *et al.*, 2014; MAHBOOBI SOOFIANI *et al.*, 2014; JOULADEH-ROUDBAR *et al.*, 2015; COAD, 2017). This genus has 20 confirmed species (ROBALO *et al.*, 2007; KÜÇÜK *et al.*, 2017) and three of them, the Kura nase, *Chondrostoma cyri* KESSLER, 1877, the King nase, *C. regium* (HECKEL, 1843) and the Oriental nase, *C. orientale* BIANCO & BANARESCU, 1982 are found in Iranian inland waters. Basic information on the general biology, taxonomy, karyology and morphology of these species are available from the pertinent literature (e.g. ESMAEILI *et al.*, 2010a, b; JOULADEH-ROUDBAR *et al.*, 2014, 2015; COAD, 2017).

The genus *Chondrostoma* is characterised by a somewhat compressed body shape, a subterminal mouth with transverse or arched slit, without barbel, with the upper jaw forming a muzzle well-arched, with very hard oral lips with sharp borders (DURAND *et al.*, 2003; GANTE *et al.*, 2007), high vertebral counts (42–49 vertebrae), four unbranched rays in the dorsal fin, scales of moderate to small size (44–106 in the lateral line; ROBALO *et al.*, 2007), scales squarish with radii in the anterior and posterior fields and a subcentral anterior focus, pharyngeal teeth knife-like and in one row with a high count (5, 6 or 7, the same number on each arch or one more on the left), gill rakers short and moderately numerous (up to 40), short dorsal fin without a thickened ray, 7–10 dorsal-fin branched rays, a moderately elongate anal-fin with 8–12 branched rays, deeply forked caudal fin and usually concaved dorsal and anal fins, a pelvic axillary



Fig. 1. *Chondrostoma esmaeilii* sp. nov., IMNRF-UT 1045-1, Holotype, Female, 136 mm SL; Iran: Sarab-e Ravansar Stream.

process always present, a black peritoneum, and a long, coiled gut (COAD, 2017).

We examined the collated specimens of the genus *Chondrostoma* from Sarab-e Ravansar Stream, the Tigris River drainage. Examination of this material revealed some morphological features of these specimens differing from other species of this genus in Iranian inland waters as well as those of the Tigris-Euphrates river drainage from Turkey. Hence, they are described as a new species herein.

Materials and Methods

Measurements were performed using digital calipers to the nearest 0.1 mm based on KOTTELAT & FREYHOF (2007). Total length and standard length were measured from the tip of the upper jaw to the end of the longest caudal-fin lobe and from the tip of the upper jaw to the end of the hypural complex, respectively. Head length and interorbital width were measured to their bony margins. Fin-ray counts separate unbranched and branched rays. The last two branched rays articulated on a single pterygiophore in the dorsal and anal-fins are noted as “1½”. Mean and standard deviation were calculated without the “½”. Lateral-line scales count includes pierced scales, from the first one just behind the supracleithrum to the posteriormost one at the base of the caudal-fin rays (i.e. posterior margin of the hypurals) excluding 1 or 2 scales located on the bases of the caudal-fin rays.

For osteological examination, 3 specimens of *Chondrostoma* (11.2–12.0 mm SL) collected from the Sarab-e Ravansar Stream, were cleared and stained with alizarin red S and alcian blue according to TAYLOR & VAN DYKE (1972). Then, the cleared and stained specimens were studied using a stereoscopic microscope (Leica MC5) and their skeletal elements were scanned by a scanner equipped with a glycerol bath (Epson V600). The scanned images were illustrated by CorelDrawX6 software.

Abbreviations used

TL, total length; SL, standard length; HL, lateral head length; K2P, Kimura 2-parameter; IMNRFI-UT, Ichthyological Museum of Natural Resources Faculty – University of Tehran. ZM-CBSU, Zoological Museum of Shiraz University, Collection of Biology Department, Shiraz. CMNFI, Canadian Museum of Nature, Ottawa. NHVUIC, Ichthyology Collections of Nevşehir Hacı Bektaş Veli University, Nevşehir, Turkey.

Results

Chondrostoma esmaeilii sp. nov.

Figs. 1–4, Tables 1, 3–8

Holotype: IMNRF-UT 1045-1, Female, 136.4 mm SL; Iran; Kermanshah Prov.: Ravansar, Sarab-e Ravansar Stream, 34°42'38"N 46°39'14"E, S. Eagderi & A. Jouladeh-Roudbar, July 2016.

Paratypes: IMNRF-UT 1045, 10, 91.0–120.3 mm SL; data same as holotype.

Diagnosis: *Chondrostoma esmaeilii*, sp. nov. is distinguished from the other species of the genus *Chondrostoma* in Iran and the Tigris-Euphrates river drainage by a combination of characters, including lacking a horny blade on lower jaw; arched mouth; 8 branched dorsal-fin rays (9 in holotype), and 10 branched anal-fin rays; lower number of lateral line scales (mean, range: 53.8, 51–58), lower number of scales above lateral line (8.25, 8–9), lower number of scales below lateral line (5.11, 5–6), and short and few gill rakers (16.3, 15–17) along the entire gill arch.

Description: See Figs. 1–2 for general appearance and Tables 1, 3–8 for morphometric and meristic data. Body deep and compressed laterally with a marked nuchal hump. Dorsal profile of head straight and dorsal profile



Fig. 2. *Chondrostoma esmaeilii* sp. nov., IMNRF-UT 1045-2, Paratype, Male, 104 mm SL; Iran: Sarab-e Ravansar Stream.

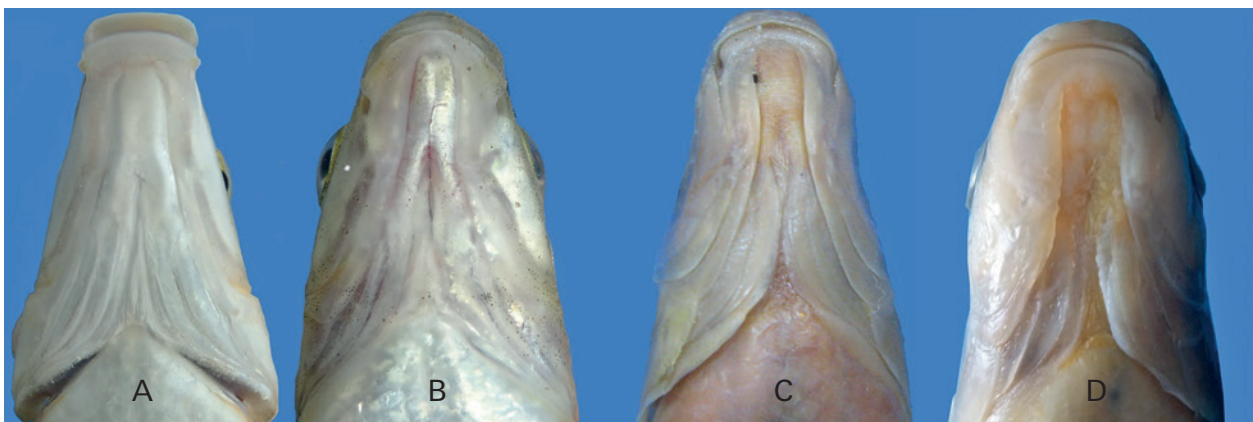


Fig. 3. Ventral view of head in *Chondrostoma*, A: *C. regium*, 221 mm SL, B: *C. esmaeilii*, 125 mm SL, C: *C. orientale*, 152 mm SL, D: *C. cyri*, 207 mm SL.

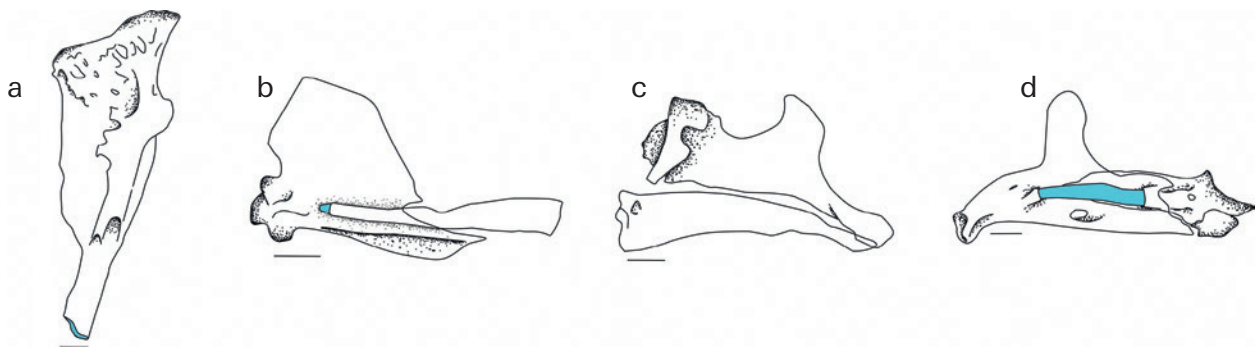


Fig. 4. (a) Hyomandibular, (b) quadrate, (c) medial views of the maxilla (above) and premaxilla (underneath), and (d) medial view of lower jaw in *Chondrostoma esmaeilii* sp. nov. (Scale bar = 1 mm).

of body convex. Snout rounded, mouth subterminal, arched without a horny blade (edge) in lower lip (Fig. 3). Presence of a triangular pelvic axillary scale. Dorsal fin with 3 unbranched and $8\frac{1}{2}$ – $9\frac{1}{2}$ branched rays, outer margin of dorsal-fin straight. Pelvic fins inserted under anterior third of dorsal-fin base. Caudal fin shallowly forked with rounded lobes. Complete lateral line without any strong spots or dark outline, with 51–58 scales, 8–9 between dorsal-fin origin and lateral line and 5–6 between anal-fin origin and lateral line. Pectoral fin with

15–17 branched rays. Pelvic fin with 1 unbranched and 8 branched rays. Anal fin with 3 unbranched and 9–10 branched rays, outer margin concave. Gill rakers 15–17 on first branchial arch. Circum-peduncular scales 14–16. Pharyngeal teeth 6–6. Total vertebrae 43. Hyomandibular broad dorsally, and narrow in ventral part directed antero-ventrally, and its anterior margin straight. Quadrate with a pointed, short posterior process with straight antero-dorsal margin. Maxillary short with posteriorly oriented dorsal process. Premaxilla shallow,



Fig. 5. Sarab-e Ravansar Stream, type locality of *Chondrostoma esmaeilii* sp. nov.

Table 1. Morphometric characteristics of *Chondrostoma esmaeilii* sp. nov. (Holotype, IMNRF-UT 1045-1; paratypes, IMNRF-UT 1045).

Characters	holo-type	Paratypes (n=10)			
		min	max	mean	SD
Standard length (mm)	136.4	91.0	120.3		
In percent of standard length					
Body depth maximal	27.4	24.3	28.2	26.3	1.2
Caudal peduncle depth	11.5	10.3	11.5	11.0	0.4
Predorsal length	49.8	51.3	56.3	53.3	1.4
Postdorsal length	49.8	46.1	51.8	48.9	1.6
Prepelvic length	51.1	52.5	56.8	54.5	1.5
Preanal length	68.9	71.9	75.2	73.0	1.0
Caudal peduncle length	20.6	16.8	20.6	19.5	1.2
Dorsal-fin base length	10.9	9.2	11.6	10.5	0.9
Dorsal-fin depth	14.7	15.3	18.5	17.1	1.1
Anal-fin base length	9.7	8.6	10.9	9.7	0.8
Anal-fin depth	11.5	11.5	13.6	12.4	0.6
Pectoral-fin length	14.8	15.3	17.9	16.8	1.0
Pelvic-fin length	13.3	12.2	15.9	13.6	1.2
Pectoral-pelvic-fin origin distance	30.8	26.8	34.0	30.8	2.0
Pelvic-anal-fin origin distance	20.4	18.2	22.0	20.2	1.1
Caudal-fin length	18.2	12.8	17.3	15.2	1.4
Body width	6.8	4.6	7.6	5.7	0.9
Caudal peduncle width	17.3	14.7	19.2	17.1	1.4
Head length	20.5	19.8	26.4	23.0	2.1
In percent of head length					
Snout length	20.5	17.1	20.8	18.4	1.1
Eye horizontal diameter	21.9	19.5	27.7	22.8	2.6
Postorbital distance	57.6	53.2	62.1	57.4	3.1
Head depth at nape	87.6	74.4	91.6	82.2	5.6
Head depth through eye	52.4	48.7	58.3	52.7	2.8
Head length at the nape	83.9	77.9	86.7	83.0	2.7
Head width	60.7	45.5	63.8	53.0	5.5
Inter orbital	35.7	27.5	40.1	33.2	4.1
Inter nasal	17.4	11.6	20.1	14.7	2.5
Mouth width	26.0	20.1	28.3	24.0	3.1

tapering anteriorly. Anterior end of the dentary bent ventrally and its coronoid process finger-like directed vertically (Fig. 4).

Coloration: In live specimens, dorsum is olive-brown with greyish tinges, flanks and belly are silvery-white. The dorsal, pectoral, pelvic and anal fins are orange with hyaline posterior margin, caudal-fin is bold orange with black posterior margin, and in some specimens, the dorsal fin has a black margin.

Distribution and Habitat: *Chondrostoma esmaeilii* sp. nov. inhabits the Sarab-e Ravansar Stream, Tigris River drainage, Iran (Fig. 5). At the Sarab-e Ravansar Stream (type locality), the current was slow to medium, width 3–10 m, maximum depth up to 0.8 m, bed muddy and in some parts sandy, and with dense vegetation. *Oxynoemacheilus kiabii*, *Carassius auratus*, *Alburnoides idignensis* and *Gambusia holbrooki* co-exist with *C. esmaeilii*.

Etymology: The species is dedicated to Professor Dr. Hamid Reza Esmaeili, for his long and outstanding contributions in biology and systematic studies on Iranian freshwater fishes.

Remarks: The type materials of *C. regium* were collected in 1842 from the Quwik River basin (near Aleppo) and in 1843 from the Mosul (Tigris River drainage) by T. Kotschy (COAD, 2017). Twelve syntypes of *C. regium* are in the Naturhistorisches Museum Wien that 7 fish (NMW 52532–52535) from the Quwik River and 5 from Mosul (NMW 52536–52538) (Fig. 6). A previous study by JOULADEH-ROUDBAR (2014) revealed that *Chondrostoma esmaeilii*, sp. nov. has 2.8% and 1.5% K2P sequence divergence in their Cyt b gene with specimens from the Tigris and Euphrates river drainages, respectively.

Chondrostoma esmaeilii is distinguished from *C. regium* (also based on data from KÜÇÜK *et al.*, 2017) by lacking a horny blade on the lower jaw and arched mouth (*vs.* presence of horny blade and straight mouth); shallowly forked caudal fin with rounded lobes (*vs.* deeply forked caudal fin with pointed lobes), short snout markedly rounded (17.1–20.8 *vs.* 28.1–32.3 % HL), deeper

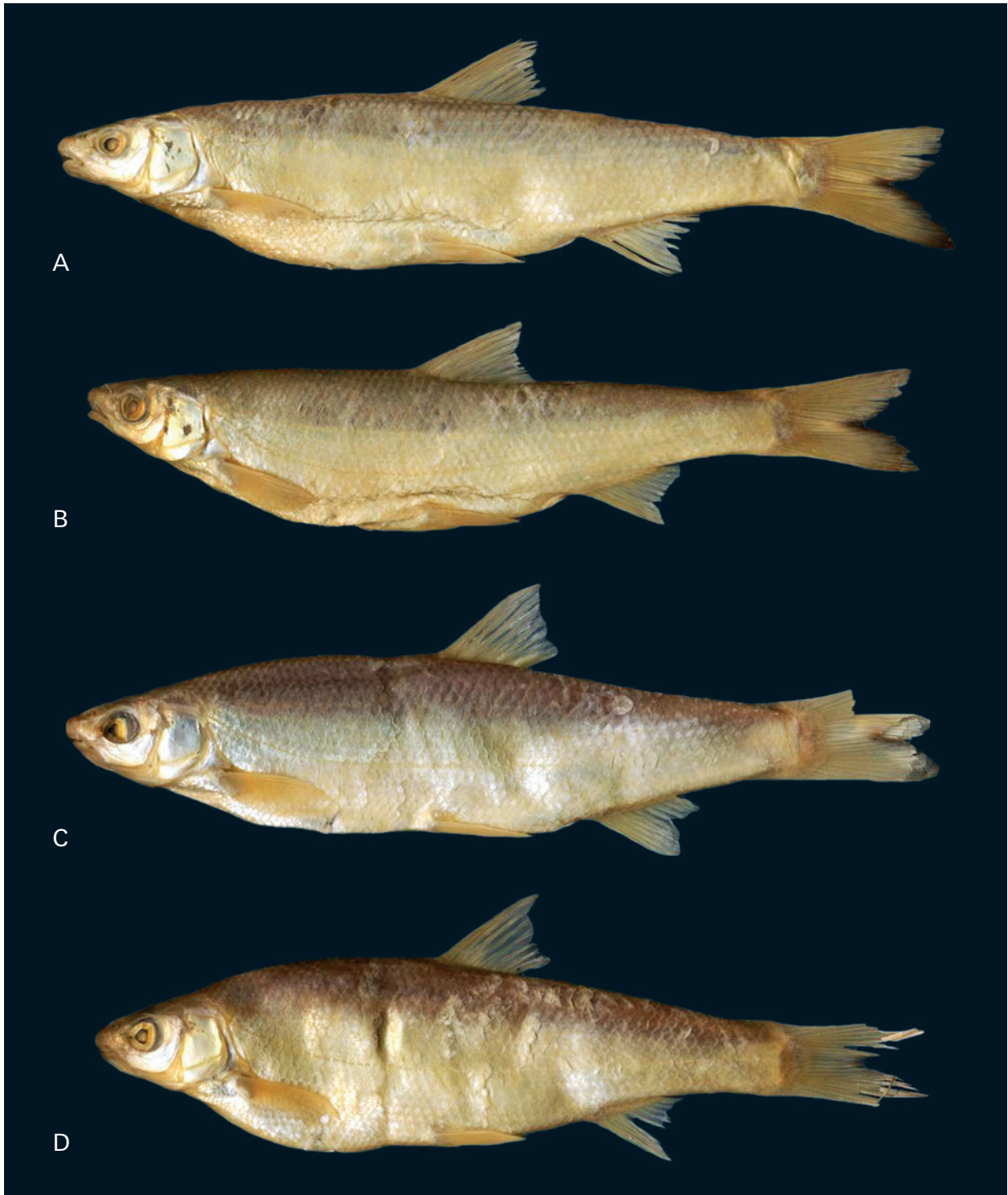


Fig. 6. *Chondrostoma regium*, paratypes; **A:** NMW 52538-1, 227 SL, **B:** NMW 52538-2, 208 SL, Kueik, River at Aleppo, Syria; **C:** NMW 52532-1, 146 SL, **D:** NMW 52532-2, 135 SL, Tigris River at Mossul, Iraq.

body (24.3–28.2 vs. 19.8–21.6 % SL), deeper caudal peduncle (10.3–11.5 vs. 8.8–9.6 % SL), lower number of lateral line scales (51–58 vs. 62–73), lower number of scales between lateral line and dorsal-fin origin (8–9, mode 8 vs. 9–11, mode 10), and lower number of gill rakers (15–17 vs. 25–32).

Chondrostoma esmaeilii is distinguished from *C. cyri* by lacking a horny blade on the lower jaw (vs. thin horny

layer), caudal fin with rounded lobes (vs. pointed lobes), short snout (17.1–20.8 vs. 27.7–31.8 % HL), deeper body (24.3–28.2 vs. 19.4–21.0 % SL), lower number of lateral line scale (51–58 vs. 56–64), and lower number of gill rakers (15–17 vs. 21–30) (Fig. 7).

Chondrostoma esmaeilii differs from *C. orientale* by having an arched mouth (vs. straight or slightly arched), shallowly forked caudal fin with rounded lobes (vs.



Fig. 7. *Chondrostoma cyri*, NHVUIC 2014-1-6, 207 mm SL; Turkey, Aras River.



Fig. 8. *Chondrostoma orientale*, ZM-CBSU 5792, 152 mm SL; Iran: Kor River.

forked caudal fin and pointed lobes), longer postdorsal length (41.6–51.8 vs. 37.4–41.7 % SL), longer postorbital length (53.2–62.1 vs. 42.4–52.8 % SL), deeper head at nape (74.4–91.6 vs. 46.4–75.6 % HL), short dorsal-fin base (9.2–11.9 vs. 11.6–14.2 % SL), short anal-fin base (8.6–10.9 vs. 11.4–13.4 % SL), short snout length (17.1–20.8 vs. 25.5–33.0 % SL), short head width (45.5–63.8 vs. 54.8–64.5 % HL), and lower number of gill rakers (15–17 vs. 25–34) (Fig. 8).

Comparative materials: *Chondrostoma orientale*: — CMNFI 1979–0025, 9, 79–119 mm SL; Iran, Fars prov.: Kor River at Marv Dasht, 29°51'N, 52°46'30"E. — CMNFI 1979–0028, 10, 108–139 mm SL; Iran, Fars prov.: Kor River drainage (no other locality data). — CMNFI 1979–0059, 1, 72 mm SL; Iran, Fars prov.: Pulvar River, 30°01'30"N, 52°57'E. — CMNFI 1979–0061, 4, 53–56 mm SL; Iran, Fars prov.: stream tributary to Pulvar River, 30°04'N, 53°01'E. — CMNFI 1979–0500, 7, 94–110 mm SL; Iran, Fars prov.: Pulvar River at Naqsh-e Rostam, 29°59'N, 52°54'E. *Chondrostoma cyri*: — NHVUIC 2014–1–6, 6, 199–246 mm SL; Turkey, Kars prov.: Çıldır Lake, Aras River drainage, 41°05'45"N, 43°16'48"E. *Chondrostoma regium*: — NHVUIC 2014–11–50, 2, 190–122 mm SL; Turkey, Adiyaman prov.: Keysun Stream at Besni, Euphrates River drainage, 37°37'10"N, 37°57'50"E.

Table 2. Morphometric characteristics of *Chondrostoma orientale* (CMNFI 1979-0500; CMNFI 1979-0028; CMNFI 1979-0025; CMNFI 1979-0059; CMNFI 1979-0061) and *C. cyri* (NHVUIC 2014-1-6-6).

Characters	<i>Chondrostoma orientale</i> (Kor River basin)			<i>Chondrostoma cyri</i> (Caspian Sea basin)		
	range	mean	SD	range	mean	SD
Standard length (mm)	79–139			199–246		
In percent of standard length						
Body depth maximal	22.4–30.9	27.5	1.5	19.3–22.6	21.0	1.3
Caudal peduncle depth	9.3–12	10.8	0.6	8.6–9.8	9.2	0.5
Predorsal length	49.7–53.4	51.3	1.0	45.8–49.5	47.9	1.3
Postdorsal length	37.4–41.7	39.8	1.1	40.1–42.6	41.7	0.9
Prepelvic length				44.9–49.0	46.5	1.5
Preanal length				61.9–67.8	66.1	2.4
Caudal peduncle length				20.1–21.8	21.3	0.7
Dorsal-fin base length	11.6–14.2	13.0	0.7	9.4–13.4	11.5	1.5
Dorsal-fin depth	16.8–20	18.2	0.8	15.8–19.0	17.3	1.3
Anal-fin base length	11.4–13.4	12.2	0.6	9.7–10.8	10.2	0.5
Anal-fin depth	11.2–15	12.8	0.7	12.6–15.0	13.6	0.8
Pectoral fin length	16.2–19	17.7	0.7	13.7–16.7	15.0	1.1
Pelvic fin length	14.6–18.8	16.6	1.1	11.6–15.4	13.2	1.3
Pectoral-pelvic-fin origin distance	27.6–31.9	29.3	1.3	25.8–29.3	27.4	1.4
Pelvic-anal-fin origin distance	17.8–21.3	19.8	0.8	17.9–21.6	20.1	1.4
Caudal-fin length	18.1–21	19.8	0.8	15.7–18.3	17.0	1.0
Body width				12.1–14.0	12.9	0.7
Caudal peduncle width				4.1–5.2	4.7	0.5
Head length (HL)	20.8–27.3	22.9	1.1	18.6–20.2	19.4	0.6
In percent of head length						
Snout length	25.5–33	29.5	1.8	27.7–31.8	29.8	1.6
Eye horizontal diameter	19.5–30.4	26.3	2.0	18.1–20.6	19.3	1.0
Postorbital distance	42.4–52.8	48.6	2.2	48.3–56.4	53.0	3.4
Head depth at nape	46.4–75.6	69.8	4.8	76.5–87.5	82.1	3.6
Head depth through eye				41.2–47.6	44.0	2.4
Head length at the nape				56.0–65.3	59.4	3.2
Head width	54.8–64.5	59.2	2.6	42.3–49.2	44.8	2.6
Inter orbital	30.5–40.3	36.5	1.8	33.6–36.1	34.8	0.9
Inter nasal				16.2–18.9	17.6	1.1
Mouth width	20.2–29.4	26.5	1.5	22.2–27.8	24.5	1.9

Table 3. Number of the lateral line scales in *Chondrostoma esmaeilii* sp. nov., *C. orientale* (CMNFI 1979–0500, CMNFI 1979–0028; CMNFI 1979–0025; CMNFI 1979–0059; CMNFI 1979–0061), *C. cyri* (NHVUIC 2014–1–6–6) and *C. regium* populations from the Tigris and Euphrates rivers (data from KÜÇÜK *et al.* 2017 and NHVUIC 2014–11–50, respectively).

Total lateral line scale	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	mode	mean	SD	
<i>C. esmaeilii</i>			1	2	3	1	3			1																53,55	53.7	2.0	
<i>C. cyri</i>							1	1		1				2		1											62	60.4	3.3
<i>C. regium</i> (Tigris)															2	5	1	1		2	1						64	65.2	2.1
<i>C. regium</i> (Euphrates)														1		1	1		1	3	2				1	68	67.3	3.1	
<i>C. orientale</i>	1	2	3	8	3	7	3		4																	52	53.2	2.1	

Table 4. Number of scales between lateral line and dorsal-fin origin in the examined *Chondrostoma* species.

Scales between lateral line and dorsal-fin origin	8	9	10	11	mode	mean	SD
<i>Chondrostoma esmaeilii</i>	7	4			8	8.3	2.5
<i>Chondrostoma cyri</i>	6				8	8.0	0
<i>Chondrostoma regium</i> (Tigris)		3	16	2	10	9.9	0.5
<i>Chondrostoma regium</i> (Euphrates)			8	4	10	10.3	0.5
<i>Chondrostoma orientale</i>	9	19	3		9	8.8	0.6

Table 5. Number of the scales between lateral line and anal-fin origin in the examined *Chondrostoma* species.

Scales between lateral line and anal-fin origin	4	5	6	7	mode	mean	SD
<i>Chondrostoma esmaeilii</i>		9	2		5	5.2	0.4
<i>Chondrostoma cyri</i>		6			5	5.0	0
<i>Chondrostoma regium</i> (Tigris)	1	15	5		5	5.2	0.5
<i>Chondrostoma regium</i> (Euphrates)	7	3	2		4	4.6	0.8
<i>Chondrostoma orientale</i>		22	8	1	5	5.3	0.5

Table 6. Number of the branched rays in the dorsal-fin of examined *Chondrostoma* species.

Dorsal-fin branched rays	7	8	9	10	11	mode	mean	SD
<i>Chondrostoma esmaeili</i>		10	1			8	8.1	0.3
<i>Chondrostoma cyri</i>		1	4	1		9	9.0	0.7
<i>Chondrostoma orientale</i>	1	30				8	8.0	0.3
<i>Chondrostoma regium</i> (Euphrates)				2		10	10	0.0

Table 7. Number of the branched rays in the anal-fin of the examined *Chondrostoma* species.

Dorsal-fin branched rays	9	10	11	12	mode	mean	SD
<i>Chondrostoma esmaeili</i>	3	8			10	9.7	0.5
<i>Chondrostoma cyri</i>	1	5			10	9.8	0.4
<i>Chondrostoma orientale</i>	23	8			9	9.3	0.4
<i>Chondrostoma regium</i> (Euphrates)				2	12	12	0.0

Table 8. Number of the gill rakers in the examined *Chondrostoma* species.

Gill rakers	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	mode	mean	SD
<i>C. esmaeili</i>	3	2	6																		17	16.3	0.9
<i>C. cyri</i>							1									6					30	30	0.0
<i>C. regium</i> (Tigris)										1	3	1	3	2	1			1			26.28	27.8	2.0
<i>C. regium</i> (Euphrates)												1	1	1	2						30	28.8	1.3
<i>C. orientale</i>										1		1	6	6	6	4	1	1	1		28–30	29.5	1.9

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