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A new loach species of the genus *Cobitis* in Croatia

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A b s t r a c t . A new spined loach species *Cobitis jadovaensis* is described from the Jadova River in Croatia. This species differs from its congeners in the Croatian Adriatic basin with a unique set of characters: a very short dorsal fin base; short anal fin base; narrow head; a single lamina circularis; a single small prominent dark inclined spot on the upper part of the caudal base; all four Gambetta zones well developed and reaching beyond the dorsal base; zones Z1 and Z3 with many irregular spots; zone Z1 narrower than Z2; zone Z2 as wide as Z3; zone Z2 with spots larger than a pupil size fuses with Z3 on caudal peduncle; zone Z4 wider than Z2 and Z3, with 11 – 14 roundish to oval blotches.

Key words: *Cobitis jadovaensis*, new species, Jadova River, description

Introduction

To date, four species of the genus *Cobitis* (Cobitidae) are known in the eastern Adriatic catchment: *C. bilineata* Canestrini, 1865 – from Italy to the Zrmanja River; *C. dalmatina* Karaman, 1928 – in the Cetina River, *C. narentana* Karaman, 1928 – in the Neretva River and its tributaries, and *C. illyrica* Freyhof et Stelbrink, 2007 – in Imotsko polje and the Matica River (M r a k o v č i ć et al. 2000, S c h n e i d e r et al. 2000, F r e y h o f & S t e l b r i n k 2007, B u j et al. 2008). During an investigation of the Jadova River in the Lika region of Croatia in 2005-2006, individuals of spined loaches of the same genus were found. Detailed morphological analyses of 14 individuals (8 males, 4 females, 2 juveniles) of varying size were conducted and the results compared with characteristics of aforementioned species. Significant differences were revealed. Based on these results, a new species of spined loaches is described in this study.

Material and Methods

Fish were collected by electrofishing in the Jadova River in the Lika region in Western Croatia. All specimens were fixed and preserved in 4% formaldehyde solution. Measurements were made in the laboratory using digital calipers (Mitutoyo CD-6˝ CS) with a precision of 0.1 mm. In addition to morphological characters used in descriptions of spined loach species, twenty four morphometric characters (measured according to B ă n ă r e s c u et al. 1972) and five meristic characters were considered: total length (TL), standard length (SL), lateral length of head (Lc), preanal distance (pA), pre-anus distance (pan), V-A distance (Van), preventral distance (pV), prepectoral distance (pP), length of caudal peduncle (lpC), length

of dorsal fin base (ID), length of anal fin base (lA), caudal fin length (lC), pectoral fin length (lP), ventral fin length (lV), head depth (at centre of eye) (hco), maximum body depth (H), minimum body depth (h), width of body (laco), width of head (lac), interoccular distance (io), eye diameter (Oh), preorbital distance (prO), postorbital length (poO) and predorsal distance (pD); the numbers of rays in dorsal, anal, pectoral, ventral, and caudal fins. Morphometric data were analyzed using the classic method and the truss network method modified from Strauss & Bookstein (1982), (Fig. 1).

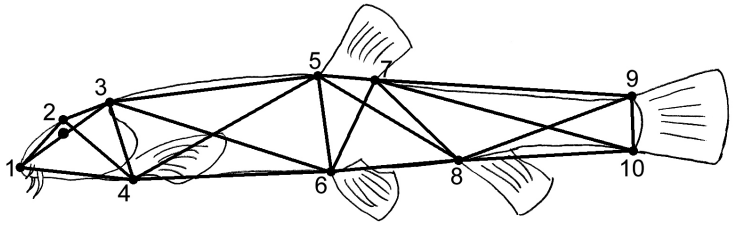

Fig. 1. Diagram of truss network measurements applied to Cobitidae (modified from Strauss & Bookstein 1982).

Data were standardized prior to statistical analysis. The Bray-Curtis equation was used for cluster analysis to find similarities between the processed morphometric data of the known species of the genus *Cobitis* in the Croatian Adriatic basin.

Results and Discussion

Cobitis jadovaensis Mustafić et Mrakovčić sp. nova (Fig. 2)
Holotype: PMR VP1654, 1 ex., male: 69.8 mm SL; from a small refuge pond remaining after the drying out of the Jadova River during the summer period; N 44°30´14.6˝, E

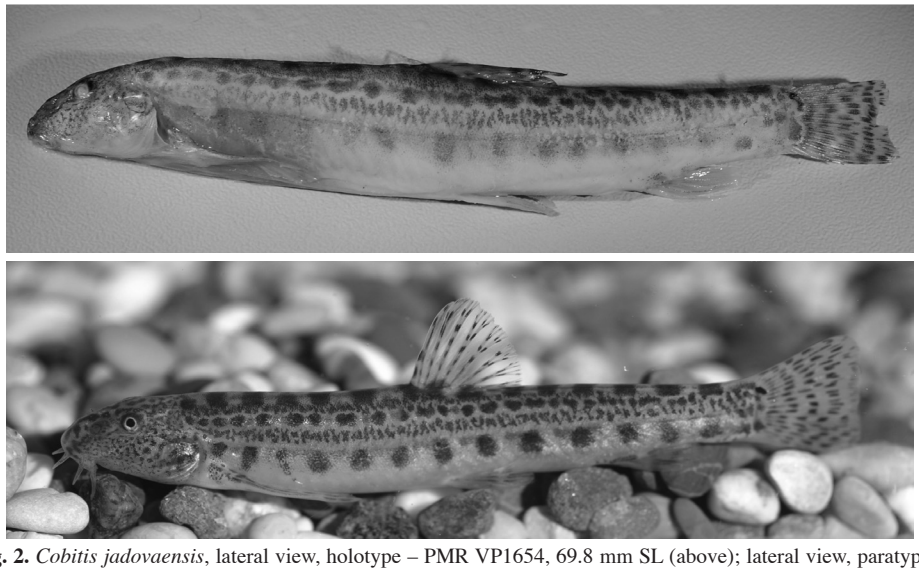

Fig. 2. *Cobitis jadovaensis*, lateral view, holotype – PMR VP1654, 69.8 mm SL (above); lateral view, paratype – PMF ZZ2171, 69.3 mm SL (below).

Table 1. Morphometric measurements of *Cobitis* species in the Adriatic basin in Croatia.

Species (River)	*C. jadovaensis* (Jadova)			*C. dalmatina* (Cetina)		*C. narentana* (Neretva)		*C. bilineata* (Zrmanja)	
	n=14			n=11		n=10		n=10	
	Holotype	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TL/SL	(1.17)	1.16	0.02	1.18	0.02	1.18	0.01	1.17	0.02
SL/Lc	(5.05)	5.02	0.26	4.92	0.27	4.77	0.23	4.92	0.16
SL/pD	(1,86)	1.97	0.09	1.92	0.04	1.96	0.05	1.99	0.05
SL/pan	(1.27)	1.32	0.03	1.32	0.02	1.31	0.02	1.35	0.02
SL/pA	(1.21)	1.26	0.04	1.27	0.02	1.25	0.02	1.29	0.01
SL/pV	(1.71)	1.83	0.08	1.85	0.05	1.84	0.05	1.91	0.04
SL/lpC	(8.13)	8.09	1.32	7.41	0.61	7.54	0.93	6.91	0.64
SL/lD	(13.69)	13.40	1.61	9.87	0.65	9.42	0.98	8.91	0.71
SL/lA	(15.34)	17.22	2.38	13.06	1.23	12.82	0.67	11.5	1.16
SL/lC	(6.07)	6.17	0.43	5.71	0.58	5.64	0.32	5.97	0.55
SL/lP	(5.22)	6.04	1.18	6.17	0.92	7	0.79	6.39	1.15
SL/lV	(7.84)	8.37	1.02	7.87	0.76	8.08	0.44	7.58	0.76
SL/Van	(4.83)	4.68	0.23	4.54	0.34	4.42	0.2	4.54	0.17
SL/hco	(10.04)	9.41	1.99	9.82	0.61	8.92	0.39	9.64	0.51
SL/H	(6.27)	7.18	1.45	6.42	0.51	6.36	0.4	7.3	0.74
SL/h	(11.99)	11.90	2.42	12.05	0.67	11.3	0.52	11.3	0.78
SL/laco	(9.12)	13.48	3.17	12.46	1.38	10.37	1.09	12.23	1.16
lpC/h	(1.48)	1.51	0.42	1.64	0.17	1.51	0.15	1.65	0.21
Van/lV	(1.62)	1.80	0.25	1.71	0.25	1.83	0.09	1.68	0.21
Lc/hco	(1.99)	1.89	0.44	2	0.13	1.87	0.07	1.96	0.11
Lc/lac	(3.80)	3.47	1.35	2.54	0.23	2.16	0.11	2.41	0.31
Lc/iO	(8.03)	7.16	1.66	8.94	1.86	8.26	0.98	9.14	1.39
Lc/Oh	(6.17)	7.66	1.43	5.38	0.53	5.49	0.32	4.93	0.42
Lc/prO	(2.63)	2.60	0.31	2.45	0.19	2.37	0.16	2.43	0.17
Lc/poO	(1.97)	2.10	0.14	2.5	0.18	2.56	0.2	2.63	0.21
Oh/iO	(1.30)	0.97	0.31	1.66	0.28	1.51	0.15	1.87	0.36

015°32´42.5˝; altitude 582 m; 25 July 2005; collected by P. Mustafić, M. Mrakovčić, D. Zanella, Z. Marčić and S. Vajdić.

P a r a t y p e s : PMR VP1655, 2 ex., 55.9 (male) and 82.4 (female) mm SL, data as for a holotype; PMF ZZ2171, 9 ex., 40.2 – 78.6 SL mm, locality as for holotype, 21 April 2006; PMF ZZ2172, 2 ex., 28.0 and 78.9 mm SL, locality as for holotype, 25 July 2005.

The holotype and 2 paratype specimens are deposited at the Natural History Museum Rijeka (PMR), while the remaining paratypes are deposited at the Department of Zoology, Faculty of Science, University of Zagreb (PMF).

D i a g n o s i s : a single broad axe-shaped lamina circularis in males; a single small prominent dark inclined spot on the upper part of the caudal base; all four Gambetta zones (G a m b e t t a 1934) well developed and reaching beyond the dorsal base; zones Z1 and Z3 with many irregular spots; zone Z1 narrower than Z2; zone Z2 as wide as Z3; zone Z2 with spots larger than a pupil fuses with Z3 on caudal peduncle; zone Z4 wider than Z2 and Z3, with 11 – 14 roundish to oval blotches; very short dorsal fin base fitting 11.2 – 16.7 (mean 13.4) times in SL; short anal fin base fitting 13.5 – 20.4 (mean 17.22) times in SL; a narrow head with head width fitting 3.5 times in head length.

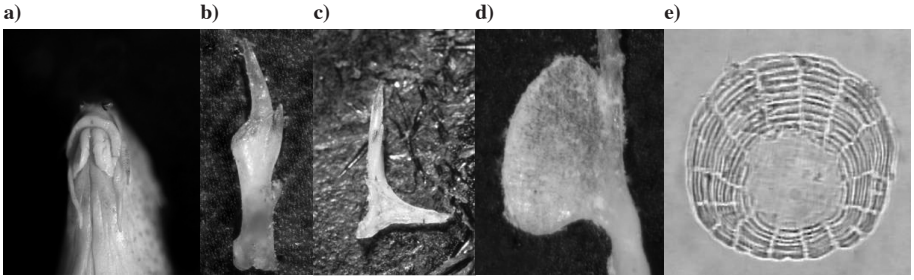

Fig. 3. a) mouth with barbels, b) and c) suborbital spine in two positions, d) lamina circularis, e) subdorsal scale.

Fig. 4. Sexual dimorphism based on the pectoral fin length (above – female 52.8 mm SL, below – male 55.6 mm SL).

Description: D II 7, A II 5 (6), V I 5-6, P I 8-9, C 16. Morphometric characters are presented in Table 1. Head short (head length fits more than 5 times (5.02) in SL), with eyes positioned closer to the snout (preorbital distance fits 2.6 times in head length, while postorbital distance fits 2.1 times). Mouth arched with three pairs of long barbels (Fig. 3a). Both lips furrowed. Mental lobes large and well developed. Suborbital spine is straight with mediolateral process (Figs. 3b & 3c). Scales rounded (Fig. 3e) with a large somewhat acentric focal zone.
Sexual dimorphism: well developed lamina circularis in males (Fig. 3d). Compared to females, males have much longer pectoral fin – length of pectoral fin in males fits 5.35 times in SL, while in females length of pectoral fin – fits 7.6 times in SL (Fig. 4).
Distribution: To date, *C. jadovaensis* has only been recorded in the Jadova River (Fig. 5), an isolated river in the karst region of Lika, Croatia. The river completely dries out

Fig. 5. Jadova River on 20 June 2006 (left) and 26 July 2006 (right).

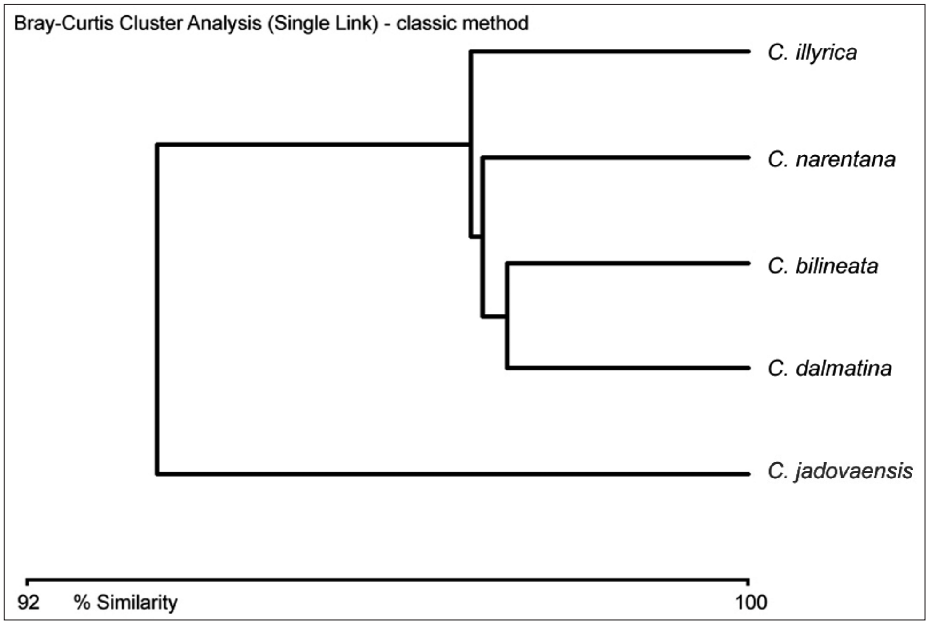

Fig. 6. Cluster analysis of morphometric measurements made by classic method.

during the summer period. We assume that the described species survives the drought period in underground waters and small refuge ponds.

E t y m o l o g y : The species name jadovaensis is derived from the name of the Jadova River where this species is found.

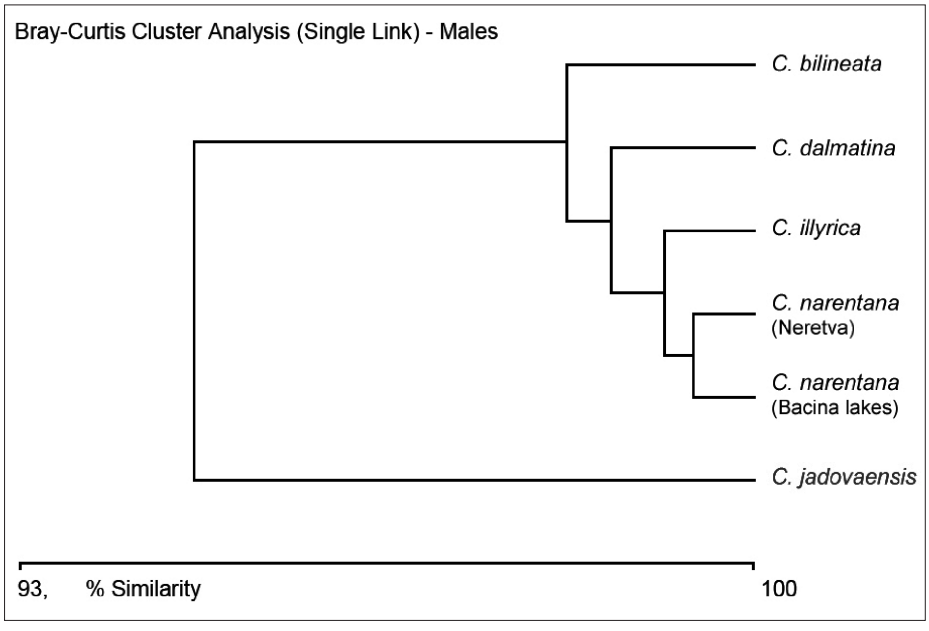

Fig. 7. Cluster analysis of morphometric measurements made by truss network method for males.

Comparative remarks: *C. jadovaensis* differs from most other *Cobitis* species distributed in Croatia due to its colour pattern (*C. bilineata* has two black spots at the caudal base, the only spot on the upper part of caudal base is inconspicuous or absent in both *C. dalmatina* and *C. illyrica*), it has a narrower and shorter head (head width 3.5 times in head length versus 2.2-2.5 times in other species, head length more than 5 times in SL versus 4.7-4.9 times in other species). With respect to colour pattern, *C. jadovaensis* is very similar to *C. narentana* but can be easily distinguished by the length of the anal fin base, which is very short in *C. jadovaensis* (fits 17.2 times in SL), while in *C. narentana* fits 12.8 times in SL. Differences in the lengths of dorsal fin and anal fin bases and some other morphometric characters between *C. jadovaensis* and *C. bilineata*, *C. dalmatina*, and *C. narentana* are presented in Table 1. Cluster analysis of morphometric characters by both classic (Bănărescu et al. 1972) (Fig. 6) and truss network (Strauss & Boockstein 1982) methods (Fig. 7) shows significant differences between the Jadova River population and all other *Cobitis* species in the Adriatic basin in Croatia. The comparative morphological analysis corresponds with mtDNA analysis of the Jadova River population and other Croatian spined loach species (Buj et al. 2008).

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