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LEBETUS GUILLETI (TELEOSTEI: GOBIIDAE) IN THE NORTHERN ADRIATIC SEA: FIRST RECORD AND DETAILS ON THE SPECIES' MORPHOLOGY

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ABSTRACT

The occurrence of *Lebetus guilleleti* (Le Danois, 1913) is described for the first time from the northern Adriatic Sea, Croatian coastal waters. Eight females (SL 12.1-17.4 mm) and five males (SL 10.6-12.5 mm) were collected in the Kvarner region, south of Rijeka on sandy substrates at depths between 6 and 13 m in 1999 and 2001. A second small population was documented photographically along the western coast of Istria, near Rovinj in May 2002. The collected specimens were assigned to *L. guilleleti* (Le Danois, 1913) by the following features: small body size, specific body coloration, complete loss of the head lateral line canals, presence of suborbital row a, limited number of head sensory papillae with two interorbital rows, elongate dorsal fin rays and meristic values of D2 1/7-8, A 1/4-5, P 14-15, LL 24-26 and VC 25-26. This recent finding enables a more detailed description of the morphology of this little known species as given below. Morphometrics, meristic values, lateral line system, coloration and skeletal features as well as ecology are described and compared with related gobiid genera.

Key words: Gobiidae, *Lebetus guilleleti*, Mediterranean, northern Adriatic Sea

LEBETUS GUILLETI (TELEOSTEI: GOBIIDAE) IN ADRIATICO SETTENTRIONALE: PRIMA SEGNALAZIONE E DETTAGLI MORFOLOGICI

SINTESI

Gli autori segnalano per la prima volta la presenza di *Lebetus guilleleti* (Le Danois, 1913) nell'Adriatico settentrionale, in acque croate. Otto femmine (SL 12.1-17.4 mm) e 5 maschi (SL 10.6-12.5 mm) sono stati trovati nella regione kvarnerina a sud di Fiume, su substrati sabbiosi tra i 6 e i 13 metri di profondità. Un'altra popolazione è stata scoperta più a nord, vicino a Rovigno. Gli esemplari sono stati attribuiti alla specie *Lebetus guilleleti* (Le Danois, 1913) in base alle seguenti caratteristiche: piccole dimensioni corporee, colorazione corporea specifica, assenza completa di canali lineari laterali sul capo, presenza della fila suborbitale a, numero limitato di papille sensorie sul capo con due file interorbitali, raggi della pinna dorsale allungati e valori meristici di D2 1/7-8, A 1/4-5, P 14-15, LL 24-26 e VC 25-26. Tale recente scoperta permette di dare una descrizione più dettagliata della morfologia di questa poco nota specie. I valori morfometrici e meristici, il sistema lineare laterale, la colorazione e le caratteristiche scheletriche nonché l'ecologia vengono descritte e comparate con i correlati generi di gobiidi.

Parole chiave: Gobiidae, *Lebetus guilleleti*, Mediterraneo, Adriatico settentrionale

INTRODUCTION

The taxonomy within the genus *Lebetus* Winther, 1877 has been somewhat confusing since the two species *Gobius orca* and *G. scorpioides* were described by Collett (1874) and assigned to a new genus by Winther (1877). These two species, which were mainly distinguished by coloration, turned out to be females and males of a single species exhibiting specific sexual dichromatism (Miller, 1961, 1963). The valid name for this species was supposed to be *L. orca* initially, but had to be changed to *L. scorpioides* later (Miller, 1971). At that time it turned out that two different species actually exist, both found within the material of *L. scorpioides*, indistinguishable by coloration patterns but by different postlarval development and meristic characters of subadult specimens. The new species, described from specimens of *scorpioides*-material, was designated as *L. guilleti*, raising the subspecies *L. scorpioides guilleti* by Le Danois (1913) to species level (Miller, 1971). Both *L. scorpioides* (Collett, 1874) and *L. guilleti* (Le Danois, 1913) had previously been known only from the north-eastern Atlantic boreal region, especially around the British Isles, the western Channel and south-western Scandinavia, and some early records made near the Strait of Gibraltar were considered doubtful (Miller, 1963). The occurrence of the genus *Lebetus* in the Mediterranean Sea was reported first by Zander (1982), who found one specimen at Banyuls-sur-Mer/France in June 1979, which was assigned to *L. guilleti*. Now, two small populations of this species have been discovered in the northern Adriatic Sea along Croatian coast, one in the Kvarner region south of Rijeka and another along the western coast of Istria, close to Rovinj (Fig. 1), greatly extending the known distribution area within the Mediterranean Sea. These recently collected specimens exhibit distinct adult features and are therefore used to describe the morphology of this species. Morphometrics, meristic values, lateral line system, osteology and coloration as well as a short note on the ecology of *L. guilleti* are provided.

MATERIAL AND METHODS

Material: 1 specimen; northern Adriatic Sea, Croatia, Kvarner region, Klenovica, south of Rijeka, close to Selce: 1 ♀, 17.4 + 4.3 mm (PMR VP1022), 07.09.1999, leg. Kovačić. 12 specimens; northern Adriatic Sea, Croatia, Kvarner region, Selce, south of Rijeka: 1 ♀, 12.8 + 4.0 mm (CH 38:1) and 1 ♂, 12.6 + d mm (CH 38:2), 12.04.2001, leg. Herler; 4 ♀♀, 12.1 + 3.9 to 14.5 + 4.3 mm (CH 38:3, 5, 7, 8), 2 ♂♂, 11.3 + 4.0 mm (CH 38:6) and 11.9 + 3.9 mm (CH 38:4), 2 ♀♀, 12.6 + 4.3 mm and 13.1 + 4.1 mm, 2 ♂♂, 10.6 + 4.0 mm and 10.9 + 3.6 mm (NMW 94589-94592), 30.04.2001, leg. Herler.

Compared material: 1 specimen; western Mediterranean Sea, France, Banyuls-sur-Mer: 1 ♂, 12.9 + 4.6 mm (ZMH 7969), June 1979, leg. Zander.

The fish were collected with hand nets and photographed after anaesthetics (quinaldine diluted with ethanol 1:15) were dispersed from a squeeze bottle. The size of fish is given in SL+CI (d=damaged). For osteological descriptions, two specimens, 1 ♀ 12.8 + 4.0 mm (CH 38:1) and 1 ♂ 12.6 + d mm (CH 38:2), were cleared and stained with alcian-blue and alizarin-red. Near Rovinj, six specimens were observed during a single dive in May 2002; two were documented photographically, but no collection took place.

Morphometrics: Ab, anal fin base; Ad and Aw, body depth and width at anal fin origin; Cl, caudal fin length; CHd, cheek depth; CP and CPd, caudal peduncle length and depth; D1b and D2b, first and second dorsal fin bases; E, eye diameter; H and Hw, head length and width; I, interorbital width; Pl, pectoral fin length; PO, postorbital length; SL, standard length; SN, snout length; SN/A and SN/AN, snout to anal fin origin and anus; SN/D1 and SN/D2, snout to origin of first and second dorsal fins; SN/V, snout to pelvic disc origin; UJ, upper jaw length; V/AN, pelvic disc origin to anus; Vd, body depth at pelvic disc origin; Vl, pelvic disc length.

Meristics: A, anal fin; C, caudal fin; D1, D2, first and second dorsal fins; LL, scales in lateral series; P, pectoral fin; TR, scales in transverse series; V, pelvic disc; VC, number of vertebrae.

Collections: CH, collection Herler; NMW, Museum of Natural History Vienna; PMR, Museum of Natural History, Rijeka.

RESULTS

Morphology

Identification: The specimens were assigned to *Lebetus guilleti* (Le Danois, 1913) by meristic features D2 I/7-8, A I/4-5 and 25-26 vertebrae. The small body size, typical habitat choice and conspicuous brown and white body coloration also enables easy discrimination in the field. Slight differences in the coloration between *L. guilleti* and the congeneric *L. scorpioides* are given in Table 2.

General morphology: Body proportions are given in Table 1. Body small, laterally compressed with dorso-ventral symmetrical shape. Head relatively small and slightly depressed, with large eyes longer than snout. Eyes positioned dorsolateral resulting in narrow interorbital space. The mouth is oblique with short upper lip extending back only to below anterior edge of orbit. Anterior nostril a short tube without process from rim, posterior nostril with only slightly ascending rim. Branchiostegal membrane attached to side of isthmus at ventral origin of P, and membrane not fused across isthmus.

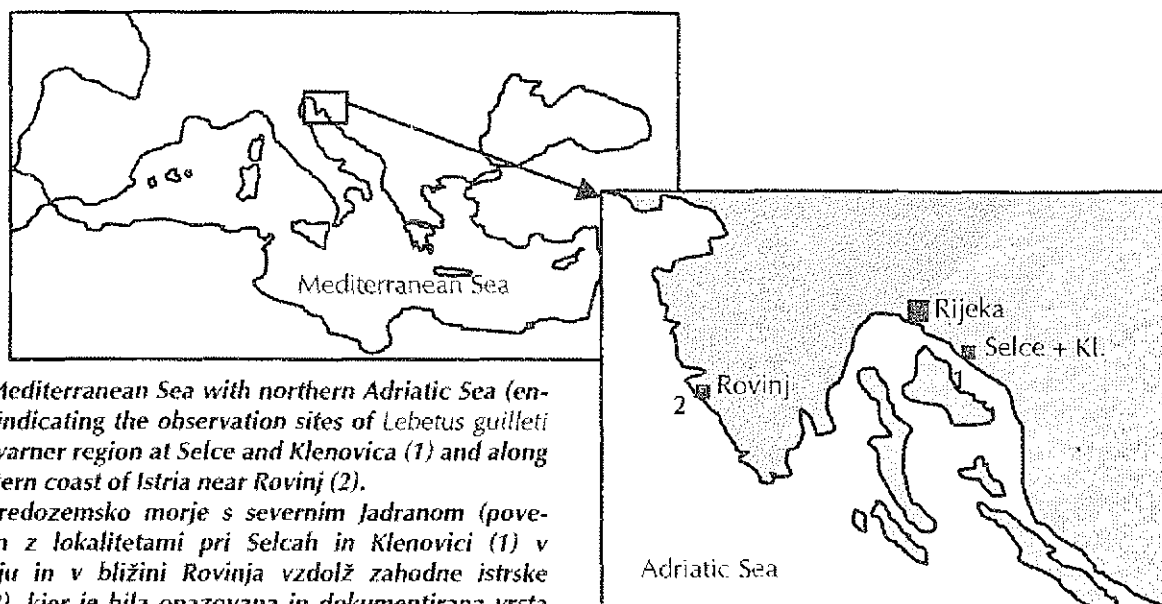


Fig. 1: Mediterranean Sea with northern Adriatic Sea (enlarged) indicating the observation sites of *Lebetus guilleti* in the Kvarner region at Selce and Klenovica (1) and along the western coast of Istria near Rovinj (2).

Sl. 1: Sredozemsko morje s severnim Jadranom (povečano) in z lokalitetami pri Selcah in Klenovici (1) v Kvarnerju in v bližini Rovinja vzdolž zahodne istrske obale (2), kjer je bila opazovana in dokumentirana vrsta *Lebetus guilleti*.

Tab. 1: Morphometric values in both sexes of the northern Adriatic *Lebetus guilleti*. n = number of specimens; s = standard deviation.

Tab. 1: Morfometrične vrednosti pri obeh spolih severnojadranske vrste *Lebetus guilleti*. n = število primerkov; s = standardni odklon.

		<i>Lebetus guilleti</i> (Le Danois, 1913)					
Sex		♂♂			♀♀		
SL		10.6 - 12.5 mm			12.1 - 17.4 mm		
n		5			8		
		range	mean	s	range	mean	s
%SL _L	H	29.8-30.6	30.1	0.3	29.9-32.5	30.9	0.8
	Hw	17.2-18.9	17.9	0.6	16.9-21.8	18.3	1.5
	SN/D1	36.7-38.7	37.8	0.8	36.9-39.4	37.9	1.0
	SN/D2	58.0-61.3	59.8	1.3	58.4-61.5	59.9	1.1
	SN/AN	52.3-58.3	55.9	2.0	56.3-60.6	58.5	1.5
	SN/A	58.9-62.8	61.4	1.4	61.9-66.7	64.7	1.5
	SN/V	30.5-34.5	32.6	1.7	30.4-34.4	32.3	1.4
	CP	22.7-24.5	23.6	0.7	21.8-26.8	23.4	1.5
	D1b	10.7-12.3	11.5	0.6	11.2-15.5	12.3	1.4
	D2b	21.4-25.5	23.6	1.4	21.5-25.3	23.0	1.3
	Ab	14.0-17.9	15.7	1.7	13.3-16.6	15.0	1.0
	Cl	32.9-37.7	34.9	1.9	24.7-34.0	31.3	2.8
	Pl	26.5-28.9	27.6	1.1	21.8-27.6	25.2	1.6
	Vl	28.2-33.1	31.1	1.7	27.6-32.4	30.4	1.5
	Vd	17.9-20.1	18.9	0.9	16.6-21.3	18.6	1.6
	Ad	15.3-19.6	17.3	1.5	14.6-18.0	16.6	1.1
	Aw	10.3-13.0	11.2	1.0	9.2-13.2	11.0	1.2
	CPd	10.4-12.2	11.1	0.7	9.6-11.5	10.4	0.6
	V/AN	23.9-26.2	25.0	0.7	26.3-30.0	28.5	1.3
	E	9.1-10.8	9.9	0.6	8.6-10.8	9.9	0.8
% CP _L	CPd	42.9-51.9	46.9	3.3	39.6-50.2	44.5	3.0
% H _L	SN	22.6-27.1	24.8	1.4	22.0-27.8	25.1	2.0
	E	30.0-35.3	32.9	2.0	28.8-35.2	32.1	2.1
	PO	44.8-48.3	47.1	1.3	44.7-48.8	46.5	1.4
	CHd	11.7-15.1	13.2	1.4	11.8-14.9	13.5	1.1
	Hw	56.8-61.8	59.4	1.9	54.4-73.1	59.3	5.6
	UJ	27.4-33.7	30.6	2.3	28.6-35.8	31.7	2.4
% E _L	I	18.2-23.2	20.2	1.7	11.3-18.5	14.8	2.8
% V/AN _L	VI	118.0-130.6	124.3	4.3	98.0-115.4	106.8	5.2

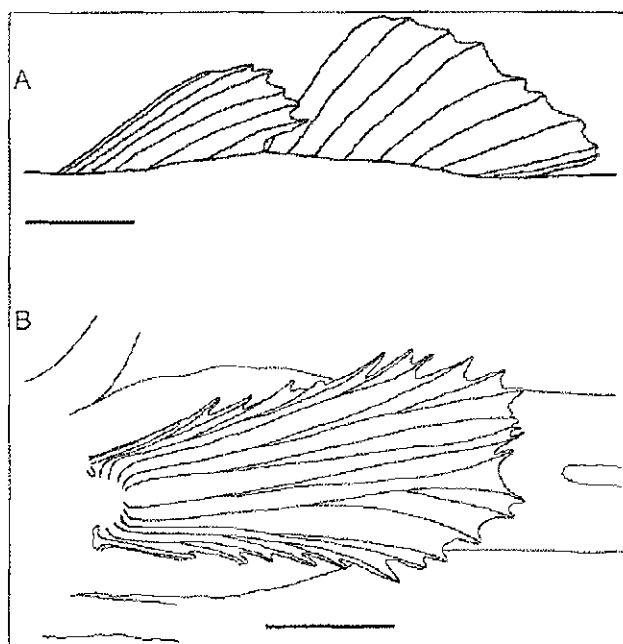


Fig. 2: Fin shapes in *Lebetus guilleli*. (A) D1 and D2, ♂, 10.6 + 4.0 mm; (B) ventral fin, ♂ 10.9 + 3.6 mm. Scale bar = 1 mm.

Sl. 2: *Oblike plavuti vrste Lebetus guilleli*. (A) D1 in D2, ♂, 10,6 + 4,0 mm; (B) trebušna plavut, ♂ 10,9 + 3,6 mm. Merilo = 1 mm.

Teeth in both jaws in three rows, enlarged in first of these, erect and caniniform. Sexual dimorphism, apart from sexual dichromatism described below, can be seen in some body proportions (Tab. 1). Females show a longer abdomen through higher values in SN/AN, SN/A and V/AN (all in % SL). The caudal and pectoral fins (C1

and P1 in % SL) are somewhat shorter in ♀♀. In interorbital width (I in % E) the ♀♀ are exceeded by the ♂♂.

Fins (Fig. 2): D1 VI; D2 I/7-8 (7:8, 8:5); A I/4-5 (4:4, 5:9); C (branched rays) 8-10 (8:3, 9:8, 10:1, d:1); P 14-15 (14:9, 15:4); V I/5+I/5. Rays of median fins D1, D2 and A elongated especially in males. In P, all rays are within membrane. V truncate, V4 and V5 usually of same length or latter slightly shorter, with no anterior membrane developed. C slightly rounded to truncate. Segmented fin rays branched only in C and V.

Scales: LL 24-26 (24:3, 25:4, 26:4, d:1). TR 7-8 (7:12, 8:1). Squamation occurs only on the trunk, while nape, predorsal area back to end of D1 base, opercle, breast and belly are naked. The scales on the trunk are ctenoid and are easily lost in preserved specimens.

Vertebrae: VC 25-26, including urostyle (10 precaudal + 15 caudal vertebrae and 11 + 15 respectively).

Lateral line system (Fig. 3): No head canals present and a low number of superficial neuromasts. Rows of papillae were lettered according to Miller (1963) as given for *L. scorpioides* (formerly *L. arca*) but adapted to a more recent nomenclature (Miller, 1986) in some rows. Number of papillae are given as the most frequent values in parentheses.

1.) Preorbital: Snout with only few papillae. Row *rs* (2-3) close to each other and to posterior nostril, row *s* (1) more distant on anterior edge of snout. Rows *c* with *c*² (1) near posterior nostril and *c*¹ (5) downward from anterior nostril.

2.) Suborbital: Row *a* (5) with longitudinal extension termed row *a*¹ (2) from posterior edge of orbit. 3 to 4 papillae irregularly distributed on upper cheek and therefore difficult to assign to row *b* or *c*. Row *d* (1-2) on posterior edge of lower jaw.

Tab. 2: Inter- and intraspecific comparison of morphological differences within the gobiid genus *Lebetus* from different geographical regions.

Tab. 2: Inter- in intraspecifična primerjava morfoloških razlik znotraj rodu *Lebetus* iz različnih geografskih regij.

Species	<i>L. scorpioides</i>	<i>L. guilleli</i>	<i>L. guilleli</i>
Location	north-eastern Atlantic	north-eastern Atlantic	northern Adriatic
Reference	Miller (1963, 1971)	Miller (1971)	this study
	n = 76	n = 6	n = 13
Features:			
D2 soft rays	9-10	7-9	7-8
A soft rays	7-8	5-6	4-5
Vertebrae	27-29	25-26	25-26
D1 shape (♂♂)	enlarged, rounded	?	smaller, triangular
D1 coloration (♂♂)	dusky yellow, white edged	?	grey, 2 yellow bands
D2 coloration (♂♂)	4 broad red bands	?	6 yellow bands
Postlarvae (5-6 mm):			
Ventral fin length	< 10% SL	> 10% SL	?
Melanophores (A base)	absent	present	?

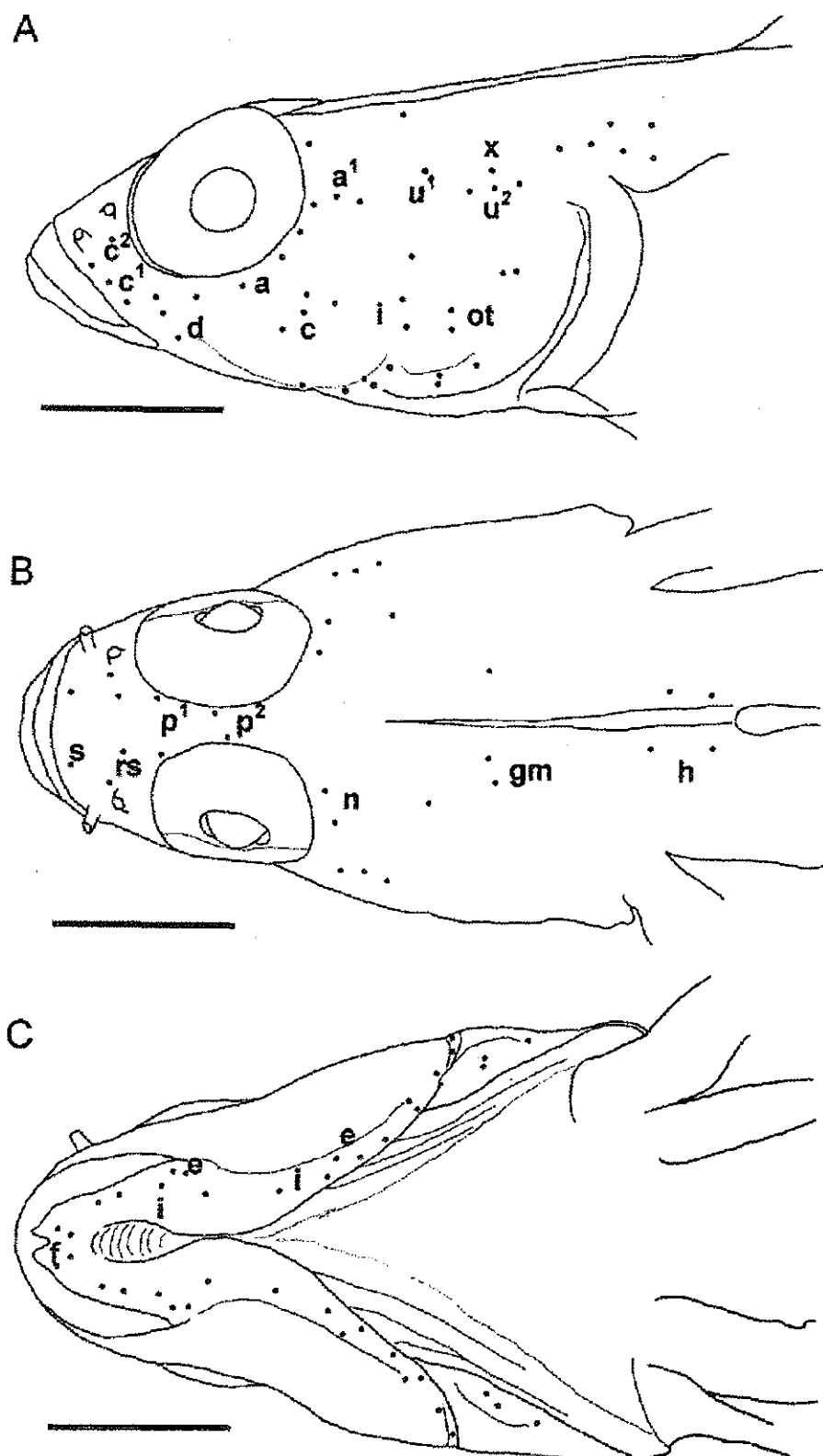


Fig. 3: Lateral line system of the northern Adriatic *Lebetus guilleti*; ♂, 10.9 + 3.6 mm. (A) lateral view, (B) dorsal view, (C) ventral view of head. Scale bar = 1 mm.

Sl. 3: Sistem pobočnice pri severnojadranskih primerkih vrste *Lebetus guilleti*; ♂, 10,9 + 3,6 mm. (A) glava s strani, (B) s hrbtne strani, (C) s trebušne strani. Merilo = 1 mm.

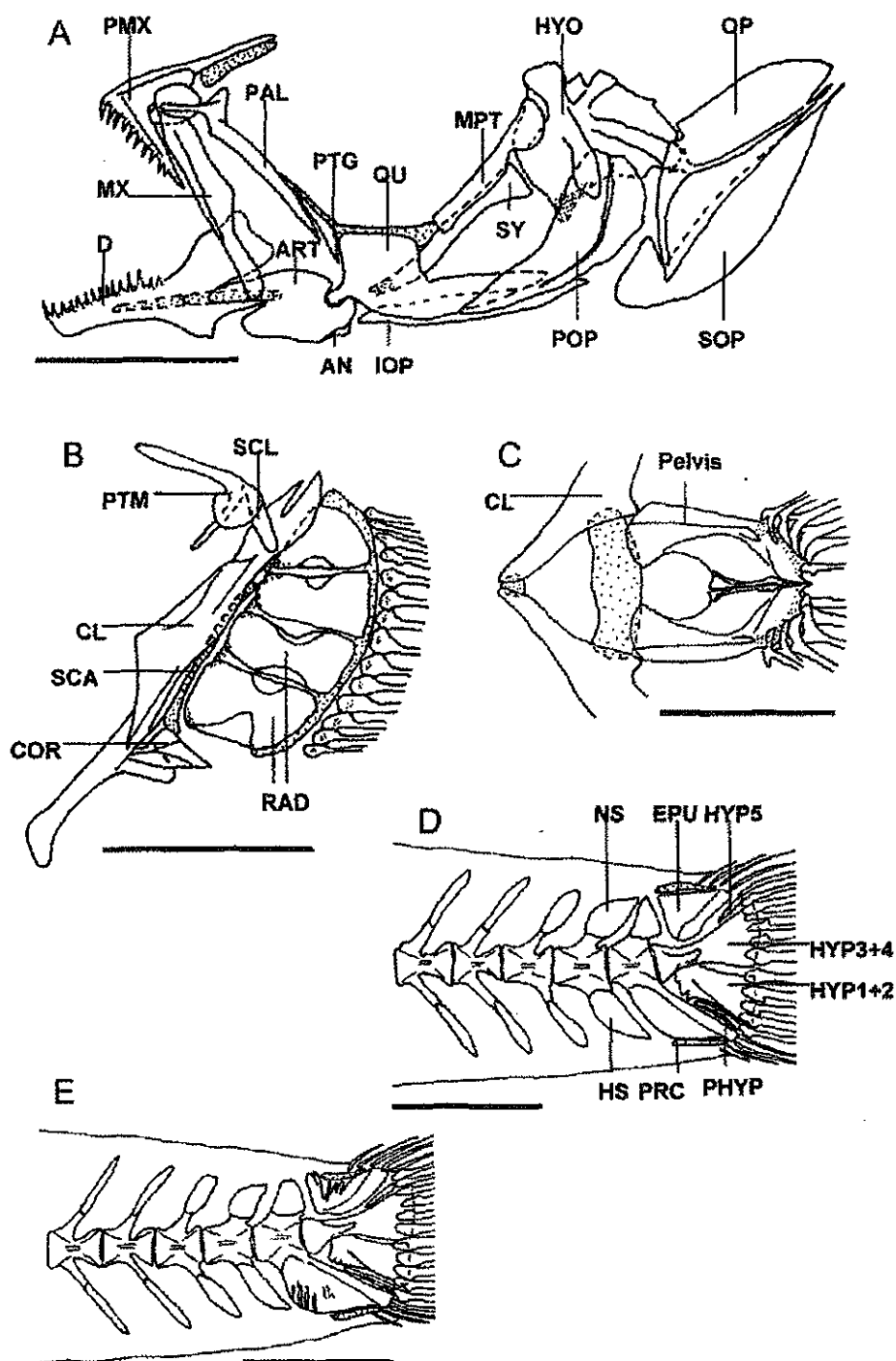


Fig. 4: Skeleton of the northern Adriatic *Lebetus guilleti*; ♀, 12.8 + 4.0 mm (A - D) and ♂, 12.6 + d mm (E). (A) Jaws, suspensorium and opercle series; (B) pectoral girdle; (C) pelvic girdle; (D, E) last vertebrae and caudal skeleton; all in lateral view. Bones white, cartilage stippled. Scale bar = 1 mm. AN, retroarticular; ART, anguloarticular; CL, cleithrum; COR, coracoid; D, dentary; EPU, epural plate; HS, hemal spine; HYO, hyomandibular; HYP, hypural; IOP, interopercle; MPT, metapterygoid; MX, maxilla; NS, neural spine; OP, opercle; PAL, palatine; PHYP, parhypural; PMX, premaxilla; POP, preopercle; PRC, procurent cartilage; PTG, ectopterygoid; PTM, post-temporal; QU, quadrate; RAD, radials; SCA, scapula; SCL, supracleithrum; SOP, subopercle; SY, symplectic.

Sl. 4: Sketel severnojadranskih primerkov vrste *Lebetus guilleti*; ♀, 12,8 + 4,0 mm (A - D) in ♂, 12,6 + d mm (E). (A) Čeljusti, oporni in operkularni nizi; (B) oplečje; (C) okolčje; (D, E) zadnja vretenca in obrepni skelet; vse s pogledom s strani. Kosti bele, hrustanec pikčast. Merilo = 1 mm.

3.) Preoperculo-mandibular: Papillae of posterior part of external row *e* (1-2) along preopercle, distant from each other, those of the anterior part (2) close to each other at posterior edge of lower jaw. Internal row *i* in three parts with superior section (2) along upper preopercle, posterior section (6) along lower preopercle, and anterior (4) section along lower jaw. Mental row *f* (2) in clear distance from rows *e* and *i*.

4.) Oculoscaphular: Row *u*¹ (1) in the middle of post-orbital region. Row *x* (1) more posterior, with row *u*² (3) below this. Row *xy* (1) above upper end of opercle. Row *z* (1) superior to superior section of row *i*. Axillary series represented by rows *as*¹ (2), *as*² (1), *as*³ (1), *la*¹ (1) and *la*² (1) clearly separated.

5.) Opercular: Transverse row *ot* divided into upper (2-3) and lower (1-2) section. Rows *os* (1-2) and *oi* (1-2) present.

6.) Anterior dorsal: Row *n* (3) with section of two papillae along posterior edge of orbit and one in distance from orbit. Rows *g* and *m* (1-3) together and difficult to assign, in most cases forming a triangle on each side. Row *h* (2-3) usually before origin of D1.

7.) Interorbital: Row *p*¹ (1) in anterior and *p*² (1) in middle part of interorbital space on each side close to orbit.

8.) Trunk: Dorsal series with *ld*¹ (1) near D1 origin, *ld*² (1-2) below posterior part of D1 and *ld*³ (2-3) on upper edge of caudal peduncle. Median rows *lm* in 7 to 10 short (1-3) transverse rows. Ventral series with *lv*¹ (2-3) between origins of P and V, *lv*² (2-3) in middle of abdomen and *lv*³ (2-3) above anus.

9.) Caudal: Three papillae in short transverse row at C origin. One median longitudinal row (2-4) originating from middle papillae of former row.

Osteology (Fig. 4): Both stained specimens well ossified. Apart from vertebrae and pterygiophores no major differences in the skeleton of the stained male and female were observed. Hyoid (not shown in Fig. 4): 5 branchiostegal rays, first thin and attached to slender anterior process of axe-shaped anterior ceratohyal. Rays 2, 3 and 4 on broad part of the latter. Fifth blade-like ray attached to posterior ceratohyal.

1.) Jaws, suspensorium and opercular series (Fig. 4a): Teeth present on premaxilla and dentary. Both elements with three rows of caniniform teeth at symphysis, decreasing to one row posterolaterally. Teeth in outer row enlarged. Premaxilla with long ascending and articular process, posterior part short, joining only the anterior half of maxilla. Postmaxillary process absent. Maxilla broad only in first two thirds, last third splint-like, overlapping dentary plate and dorsally anguloarticular when mouth opened. Palatine slender with thin process inserting in anterodorsal end of maxilla. Ectopterygoid as small bone between palatine and quadrate. Anguloarticular inserts in dentary with pointed anterior process,

while the ventral ramus is plate-like. Posterodorsal, anguloarticular articulates with quadrate. Retroarticular small, ventromedial at posterior end of anguloarticular. Metapterygoid small, laterally overlapping hyomandibular and anterodorsal half of symplectic. Latter attaching to quadrate medially. Posterior ramus of quadrate overlapped by anterior ramus of preopercle, latter dorsally fixed between plate and inferior process of hyomandibular.

2.) Pectoral girdle (Fig. 4b): Post-temporal with two processes and thin plate, which overlaps the articulation with supracleithrum. Cleithrum relatively straight in lateral view, strongly bifid at dorsal end and with ascending plate from middle part. In lower third bony plates, which join the pelvic intercleithral cartilage on both sides. Ventral intercleithral cartilage between ventrally joining left and right cleithrum. Coracoid inserting close to ventral bony plate of cleithrum. Scapula unossified, slender with dorsal foramen. Four large proximal radials surrounded by cartilaginous areas. The tiny distal radials are cartilaginous.

3.) Pelvic girdle (Fig. 4c): Pelvis joining large pelvic intercleithral cartilage anteriorly. Pelvic fin rays insert on cartilaginous posterior rim of pelvis. Medially rod-like bones project forward from posterior inner rims of pelvis.

4.) Axial skeleton and median fins: 25-26 vertebrae, including urostyle. Variation was found in number of precaudal vertebrae with 10 and 11, respectively. The number of caudal vertebrae was 15 in both stained specimens, with hernal arches closed. In lateral view, first five vertebral centra becoming progressively longer and less wide backwards. First two centra shorter than wide. The absence of one precaudal vertebra in the female specimen (CH 38:1) seems to impinge on the arrangement of the pterygiophores of D1 and D2. D1 shows the formula 3-2301 instead of 3-2211 as exhibited by the male (CH 38:2). Two free interneural spaces between pterygiophores of D1 and D2 and therefore three pterygiophores of D2 before the first caudal vertebra in the male, but only two in the female. In both specimens, the number of proximal pterygiophores in D2 resembles the count of all fin rays, that in A only the count of soft rays. Pleural ribs are found on third to last precaudal vertebrae, therefore 8 and 9 in number, attached to parapophyses of vertebrae. Epipleural ribs on second precaudal vertebra to fourth caudal vertebra (13 and 14). First epipleural rib attached to second vertebra, remaining precaudal attached to pleural ribs. First two caudal epipleural ribs attached to vertebrae, last two loose contact.

5.) Caudal skeleton (Figs. 4d, 4e): Neural spines and hemal spines of last three vertebrae enlarged, especially last hemal spine expanded, larger in male. Dorsal and ventral procurent cartilage slender, joining large epural

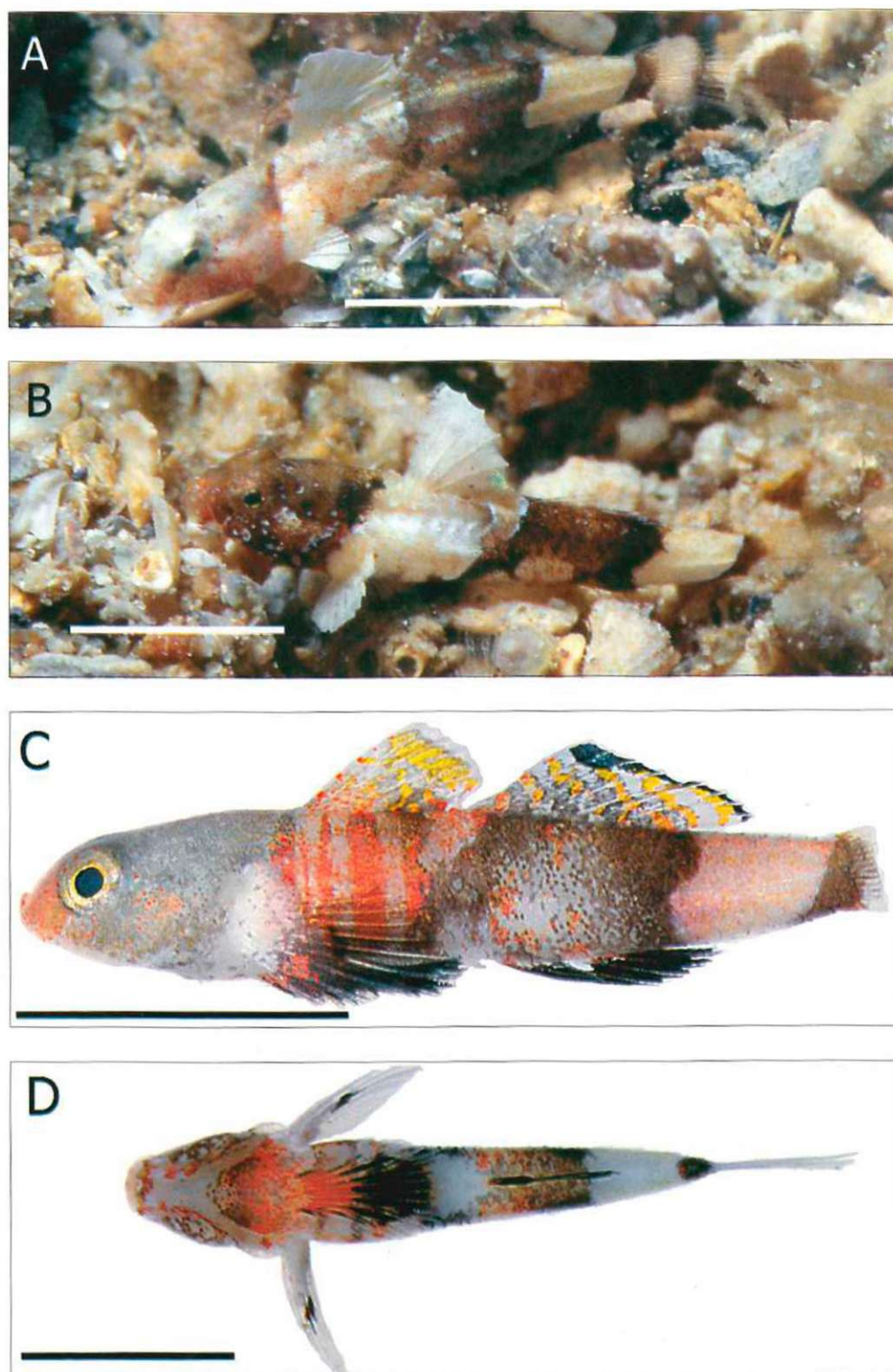


Fig. 5: Coloration of the northern Adriatic *Lebetus guilleti*. Male (A) and female (B) in the natural habitat. More colourful variations are shown after narcotisation and/or recent preservation in formaldehyde: (C) ♂, 12.6 + d mm, lateral view; (D) ♀, 13.1 + 4.1 mm, ventral view. Scale bar = 5 mm.

Fig. 5: Obarvanost severnojadranskih primerkov vrste *Lebetus guilleti*. Samec (A) in samica (B) v naravnem življenjskem prostoru. Bolj pisane barve se pokažejo po omamljenju in/ali po shranitvi primerka v formaldehidu: (C) ♂, 12,6 + d mm, pogled s strani; (D) ♀, 13,1 + 4,1 mm, pogled s trebušne strani. Merilo = 5 mm.

plate and last hemal spine, respectively. Ossification of former less in male, notched on dorsal rim. Parhypural and hypural 5 small splint-like bones. Two large hypural plates, hypural 3+4 and hypural 1+2, former fused with urostyle, latter inserting ventral to ural centrum. All fin rays associated with large hypural plates branched. One ray of both dorsal and ventral of those branched rays articulated, but not branched.

Coloration. Within the natural habitat, the body coloration is well adapted to the substrate (Figs. 5a, 5b). Basic coloration is a broad brown and white oblique transverse pattern. Head greyish in males, brownish in females, followed by a white interspace below D1 base. Anterior edge of following brown transverse bar oblique, running from D2 origin to ventral middle of belly. Large bright spot ventrally interrupts this bar in both sexes. Posterior edge at beginning of caudal peduncle curved. Caudal peduncle almost white. Before C origin narrow brown transverse band with oblique anterior edge from dorsal origin of caudal fin to ventral beginning of last quarter of caudal peduncle. Brown pattern dorsally slightly extending on to caudal fin. All brown vertical bars are well separated from white interspaces by dark margins. Proximal half of pectoral fin white, distal half transparent to dusky. C transparent. Sexual dimorphism especially shown in dorsal fin coloration.

Males (Fig. 5a): D1 greyish with yellow oblique bands, one narrow in lower third and one broad in upper third; edged white. D2 edged black, especially with large blotch in upper anterior corner. Six oblique narrow yellow bands below dark edge running across fin rays and separated from one another by dark edges and transparent interspaces. V and A usually dusky. Lips yellow to light orange.

Females (Fig. 5b): D1 white to light grey with a small green eye spot between fifth and sixth fin rays. D2, V and A transparent. Lips red, especially in posterior half.

A more colourful pattern in body coloration is shown when the fish are narcotised, kept in a photographic aquarium or recently preserved in formaldehyde (Figs. 5c, 5d).

Males: When captured, head becomes yellowish with some orange spots on cheek, snout and upper lip light orange. First bright interspace on trunk shows 4 narrow but conspicuous brown to orange-red vertical bands extending on to belly. Middle parts of following brown vertical bar with large red parts. Yellow bands in D1 and D2 and dark edge of D2 become more distinct. A, distal half of V and ventral part of P turn dark grey to black. Proximal half of V red.

Females: Head and broad brown trunk bar with dark red regions. Bands within first white interspace on trunk not distinct, somewhat irregular and coloured light brown with red dots. D1 turns dark grey with two to three slight red bands, eye spot still visible. D2 dusky with 4 red oblique bands. A and distal half of V black.

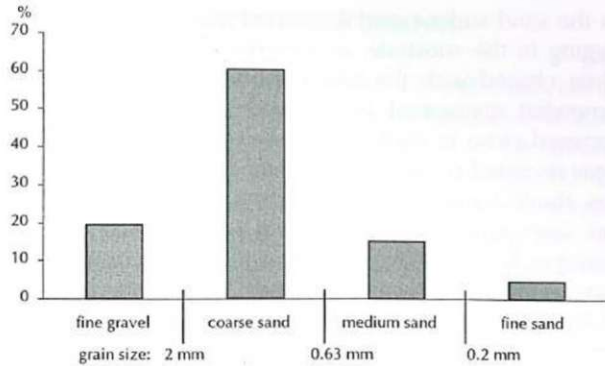


Fig. 6: Grain size distribution of the sediment in the habitat of *Lebetus guilleti* in the northern Adriatic Sea.

Sl. 6: Granulacija sedimenta v habitatu vrste *Lebetus guilleti* v severnem Jadranskem morju.

Breast, proximal half of V and base of A red. P bright with dark spot in centre.

After preservation in 70% ethanol, the specimens retain only brown and black coloration with white interspaces. Females exhibit darker mottling on head, breast and in first dorsal fin. Narrow red bands below D1 get lost or turn light brown. In both sexes, broad brown oblique bar on trunk brightened in centre, therefore mainly represented by dark margins. Brown band on caudal peduncle well visible. Black margin of D2 in males stays distinct. Distal half of V and A in both sexes black. P in males with ventral half dusky, in females with black spot in the centre.

Ecology

All specimens observed and collected were found on a bottom consisting of a highly biogenic coarsely structured sand as shown by the grain size distribution (Fig. 6). The fish were found within a depth range of 6 to 13 m. The shallowest discovery was near Klenovica, Kvarner region, where one specimen was collected at 6 m depth. At Selce, Kvarner region, the specimens occurred frequently at depths between 11 and 13 m, and between 7 and 10 m at Rovinj. The habitats investigated near Rovinj and in the Kvarner region show high similarities, characterised by sandy bottom, which is interrupted by bedrock areas at depths of about 5 to 9 m, dividing the sandy areas into small insular spots. The fish were found in both large areas and in small insular spots of sand bottom. The specimens were discovered accidentally when the anaesthetic was dispersed from a squeeze bottle over the sediment. The tiny fish exhibit a very cryptic behaviour with few movements and high colour adaptation, which makes them almost invisible. The fish can be discovered by a diver when moving one hand forward slowly and directly over the sand surface, which causes flight reactions. The fish appear to dwell

on the sand surface and it seemed quite unusual when digging in the substrate, as observed in one specimen, when chased with the anaesthetic. The distribution is somewhat aggregated, because most specimens usually occurred close to each other, while large neighbouring areas revealed no fish. The highest abundance observed was about 2 ind./m². Co-occurring epibenthic fish species were especially *Gobius roulei*, *Buenia affinis* and *Pomatoschistus bathi*, which dwell on the same substrate in high abundance. All collected specimens are adult and sex determination was possible from coloration, differences in fin shape and the typical sexual dimorphism of the urogenital papillae. Within the material collected only one size class, obviously the one year-class, occurs. The specimens collected in spring range from 10.6 to 14.5 mm SL. This includes the specimen collected in the western Mediterranean by Zander (1982) in June 1979 with 12.9 mm SL. The only collection made in autumn revealed a larger specimen of 17.4 mm SL. Collected at the same time, females are larger than males within this one size class.

DISCUSSION

Since Miller (1971, 1986) suggested two species within *Lebetus* Winther, 1877, due to different postlarval developments of pelvic fins and pigmentation and different meristic values of anal fin, second dorsal fin and vertebrae, the northern Adriatic specimens can be assigned to *L. guilleti* (Le Danois, 1913) (Tab. 2). Counts of fin rays and vertebrae are significantly higher in *L. scorpioides* than in *L. guilleti* and therefore enable identification also of subadult or adult benthic specimens (Miller, 1971). The western Mediterranean specimen found by Zander (1982) at Banyuls (France) exhibited the very typical coloration (Zander, *pers. comm.*) as described above for the northern Adriatic specimens and represents a male *L. guilleti*. The greater number of specimens investigated now increases the knowledge of the morphology of this species and indicates a wider anal fin ray count of 1/4-6 (Tab. 2).

Apart from meristics, there are differences between *L. guilleti* and *L. scorpioides* in some specific coloration patterns. In particular, the first dorsal fin in males of the former is less uniformly coloured. The second dorsal fin exhibits more but narrower oblique bands. The dorsal fins are also important for sex discrimination in both species (see also Miller, 1963). Body coloration seems to be more differentiated in *L. guilleti* with vertical bars occurring on the abdomen in both sexes but especially in males. Also the dark bar on the posterior caudal peduncle appears more evident, expanding more anteriorly on ventral side. Nevertheless, the basic coloration patterns of both species is very similar. In osteology, the main differences occur in the number of vertebrae, this being lower in *L. guilleti*. Other features show no major

differences. The cleithrum in *L. guilleti* appears straighter in lateral view and somewhat elongated on its bifid dorsal end. The caudal skeleton appears less strong, with the roots of the neural and hemal spine expanding over entire length of vertebral centra only in the last vertebra.

Similarities of the genus *Lebetus* with other Mediterranean gobies relate mainly to *Speleogobius trigloides* Zander and Jelinek, 1976. Although there is an anterior oculoscapular head canal developed in the latter, the arrangement of the superficial head sensory papillae is very similar (compare with Zander & Jelinek, 1976; Miller, 1986). Meristics of fin rays and scales are almost the same as those of *L. guilleti*. As predorsal scales are only present in *S. trigloides*, *Lebetus* may be regarded as more specialised by reduction of squamation. In both the anterior membrane of the ventral disc is lost. They also conform in small body size and in a conspicuous colourful body coloration, which can be suppressed by *Lebetus* due to substrate adaptation. These similarities suggest a close relationship and possible common ancestry for *Speleogobius* and *Lebetus*, with some features more generalised in the former.

Affinities of the genus *Lebetus* with different 'sand-goby' genera (*Pomatoschistus*, *Gobiusculus*, *Kri-powitschia* and *Economidichthys*) and related genera are described by Miller (1963) and McKay & Miller (1997). High similarities are exhibited with *Buenia* Ijij by the arrangement of head sensory papillae and meristic counts, although the latter being lower in *L. guilleti*. Both genera conform in a very limited number of head neuromasts basically arranged longitudinally and in dwelling sand bottom. *Buenia* is more generalised in possessing a complete head canal system. Further differences exist in the dorsal pterygiophore formula, being derived with 1221 in *Buenia*, and in higher variations in the counts of precaudal and caudal vertebrae in *Lebetus* (McKay & Miller, 1997).

Concerning the ecology of *L. guilleti* in the northern Adriatic Sea, several observations confirm the results of Zander (1982) and Miller (1971) in the western Mediterranean Sea and northern Atlantic. Both the habitat choice of rough biogenic sand bottom and the co-occurrence of *Pomatoschistus bathi* in high abundance correspond with Zander (1982). The substrate inhabited by the small population near Rovinj, where about six specimens were observed during one dive, resembles that off Selce. Highly biogenic coarse sand is interspersed with large rocky boulders. The habitat choice of coarse deposits and the occurrence in quite shallow waters were also described by Miller (1971) for the north-eastern Atlantic specimens. In contrast to *L. scorpioides* from the north-east Atlantic, which is supposed to mature in the second year of life (Miller, 1963), *L. guilleti* seems to attain sexual maturity within the first year of life in the Mediterranean. Since the one year

class, represented by only tiny specimens collected in the Mediterranean until now, appears to be the only size class, a semelparous reproductive strategy is possible. The very small size of this fish within the Mediterranean may explain why this species had not been found in that region for such a long time.

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LEBETUS GUILLETI (TELEOSTEI: GOBIIDAE): PRVI ZAPIS TE VRSTE IZ SEVERNEGA JADRANSKEGA MORJA IN PODATKI O NJENI MORFOLOGIJI

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POVZETEK

Avtorji članka poročajo o prvem opazovanju vrste *Lebetus guilleti* (Le Danois, 1913) iz družine glavačev v obalnih vodah severnega Jadrana. Leta 1999 in 2001 so v Kvarnerju južno od Reke dokumentirali osem samic (SL 12,1-17,4 mm) in pet samcev (SL 10,6-12,5 mm) na peščeni podlagi v globinah med 6 in 13 metri. Druga manjša populacija te vrste je bila fotografirana maja 2002 ob istrski obali v bližini Rovinja. Zbrani osebkii so pripadali vrsti *L. guilleti* (Le Danois, 1913), kar je bilo ugotovljeno po njihovih naslednjih značilnostih: majhno telo, specifična barva telesa, popolnoma brez bočnih naglavnih kanalov, obstoj podočesnega niza a, omejeno število naglavnih čutilnih papil z dvema medočesnima nizoma, podaljšani žarki hrbtne plavuti in meristične vrednosti D2 1/7-8, A 1/4-5, P 14-15, I.I. 24-26 in VC 25-26. Ta nedavna odkritja so omogočila natančnejši opis morfologije te malo znane vrste. Avtorji podajajo njene morfometrične podatke, meristične vrednosti, parametre v zvezi s pobočnico, obarvanost, skeletne značilnosti in ekologijo in *L. guilleti* primerjajo s sorodnimi rodovi glavačev.

Ključne besede: Gobiidae, *Lebetus guilleti*, Sredozemlje, severno Jadransko morje

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