A NORTHERN ADRIATIC POPULATION OF *BUENIA AFFINIS* (GOBIIDAE)

by

Marcelo KOVAČIĆ (1)

ABSTRACT. - Specimens of the gobiid *Buenia affinis* Iljin, 1930 were collected during scuba-diving in the Kvarner area, northern Adriatic Sea. Specimens were found on a sandy bottom, at depths of 3-25 m. Standard lengths of the 16 specimens collected were from 23.9-33.3 mm. The present finding is the first positive record in the Adriatic Sea and provides data on morphology (morphometrics, meristics, papillae counts, coloration) and ecology (habitat, biocenosis, fish assemblage) of the Adriatic specimens.

RÉSUMÉ. - Une population de *Buenia affinis* (Gobiidae) du nord de la mer Adriatique.

Des spécimens du gobie *Buenia affinis* Iljin, 1930 ont été collectés en plongée dans la région de Quarnero au nord de la mer Adriatique. Les spécimens ont été trouvés sur un fond sableux, à des profondeurs de 3 à 25 m. La longueur standard des 16 spécimens était comprise entre 23,9 à 33,3 mm. Cette capture est la première authentique de cette espèce dans la mer Adriatique. Des données sont apportées sur la morphologie (morphométrie, méristique, nombre de papilles, coloration) et sur l'écologie (habitat, biocénose et peuplement de poissons) des spécimens de la mer Adriatique.

Key words. - Gobiidae - *Buenia affinis* - MED - North-Eastern Adriatic - Morphology - Ecology.

Buenia affinis Iljin, 1930 is a Mediterranean gobiid species known only from a few published records (Miller, 1973, 1986). Miller (1972) discovered that Kolombatović's (1891) syntypes of *Gobius affinis* deposited in the Naturhistorishes Musem, Vienna, belong to another gobiid species, *Pomatoschistus pictus* (Malm, 1865). Therefore, the only published records of *B. affinis* remained those of Sanzo (1911) and Fage (1918). These papers provided only data on the lateral-line system in specimens received from Stazione Zoologica di Napoli (Sanzo, 1911) and on morphology of postlarvae and meristics of anal and dorsal fins of postlarval specimens from the Aegean (Fage, 1918). However, even Fage was not completely sure about species identification of these postlarvae and Miller (1986) mentioned this record as doubtful. Miller (1972,1986) considered *B. affinis* as valid species correctly placed in *Buenia* Iljin, 1930, based on Sanzo's description of the lateral-line system. Miller (1986) added to the data on *B. affinis* a third locality approximately between Nice and Genoa, and a count of 36 scales in lateral series without any additional explanation or cited reference. Since the data on the meristics of anal fin, second dorsal fin and scales in lateral series are not completely certain to belong to *B. affinis*, the only positive morphological character remains the lateral-line system. The specimens collected since 1996 in the Kvarner area (Fig. 1) show the same arrangement of sensory papillae as Sanzo's (1911) description and illustrations, and were therefore identified as *B. affinis*. One of the collected specimens was examined and the identification confirmed by P.J. Miller (University Bristol).

MATERIAL AND METHODS

Material

All specimens were collected by the author in the Kvarner area, Croatia, they are deposited and registered at the Prirodoslovni muzej Rijeka (PMR). Male, 31.7+6 mm, PMR VP976, Oštro, 16 Apr. 1996; male, 28.8+5.5 mm, PMR VP454, Malinska, 17 Apr. 1996; male, 28+5.2 mm, PMR VP455, Oštro, 9 May 1996; two females, 33.3+5.5, 31.0+5.9 mm, PMR VP983, Oštro, 16 May 1996; two females, 30.3+6.2, 25.7+4.8 mm, PMR VP982, Grgur, 12. Jun 1996; female, 30.7+5.5 mm, PMR VP980, Oštro, 29. Aug 1996; male, 29.8+5.5 mm, PMR VP977, Oštro, 10 Feb 1997; male, 29.5+5.4 mm, PMR VP978, Oštro, 19 Feb. 1997; three females, 32+5.7, 31.1+4.7, 27.3+5.1 mm, PMR VP981, Oštro, 7 Mar. 1997; three males, 27.7+4.9, 25.1+4.9, 23.9+4.9 mm, PMR VP979, Oštro, 25 Jun. 1997. Material for osteological examination: five females, 29.1+6.2, 27.6+5.5, 26.4+4.4, 25.7+4.5, 23.3+5.1 mm, PMR VP984, and four males 24.7+4.5, 24.5+5.0, 24.3+4.4, 23.6+4.9 mm, PMR VP985, Oštro, 27 May 1996.

Methods

Morphometric and meristic methods as in Miller (1988).

(1) Prirodoslovni muzej Rijeka. Lorenzov prolaz 1, HR-51000 Rijeka, CROATIA. [Marcelo.Kovacic@public.srce.hr]

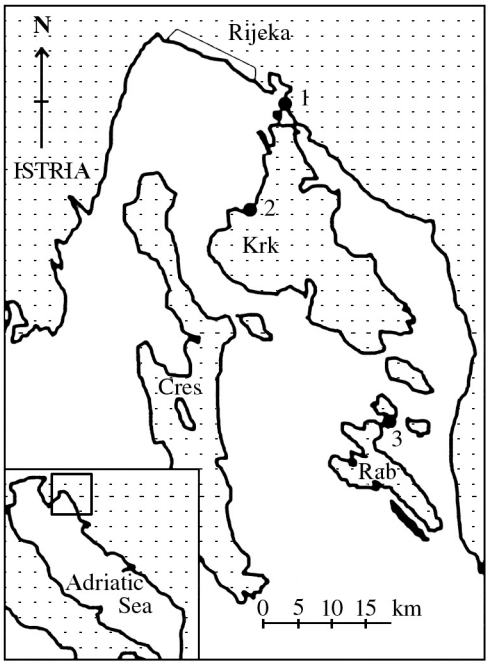

Figure 1. - The Kvarner area, Croatia. Collecting sites: (1) Oštro, (2) Malinska and (3) Grgur.

Fin abbreviations. - A: anal fin; C: caudal fin; D1, D2: first and second dorsal fins; P: pectoral fin; V: pelvic disc. *Morphometric abbreviations*. - Ab: anal fin base; Ad and Aw: body depth and width at anal fin origin; Cl: caudal fin length; CHd: cheek depth; CP, CPw and CPd: caudal peduncle length, width and depth, CPw measured with CPd, at minimum caudal peduncle depth; D1b and D2b: first and second dorsal fin base; 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, distance from snout to vertical of anal fin origin and anus; SN/D1 and SN/D2: distance from snout to origin of first and second dorsal fins; SN/V: distance from snout to vertical of pelvic fin origin; V/AN: distance from pelvic fin origin to anus; Vd: body depth at pelvic fin origin; Vl: pelvic fin length.

The terminology of lateral-line system follows Sanzo (1911) and Miller (1963) for *Buenia jeffreysii*. Poorly visible papillae in preorbital, oculoscapular and anterior-dorsal rows were checked on three males (specimens from Oštro, Kvarner area, Croatia, June 25, 1997) by the De Buen (1923) staining method and on three females (Oštro, March 7, 1997) by the Iljin (1930) staining method. Vertebral counts and dorsal pterygiophore sequences were examined from cleared and stained specimens (Dingerkus and Uhler, 1977). The benthic communities were classified according to Pérès and Gamulin-Brida (1973). Sediments were sampled at the locality of Oštro within the depth range of *B. affinis* (at depths 5, 7.5, 10, 12.5, 15 and 20 m) and granulometric analyses were done using standard laboratory tests (Anonymous, 1990). Sediment types were classified according to standard sedimentologic tables (Bell, 1993; Tišljar, 1994).

RESULTS

Generic and species identification

The genera *Buenia*, *Deltentosteus* Gill, *Lebetus* Winther, *Lesueurigobius* Whitley and *Speleogobius* Zander & Jelinek share a unique characteristic among eastern Atlantic and Mediterranean gobies in having no transverse *a* and *c* rows. The genus *Buenia* is delimited from other genera of paraphyletic DLBS group (McKay and Miller, 1997) and from *Lesueurigobius* by the following combination of characters: (1) anterior and posterior oculoscapular, and preopercular head canals present and normally developed, without numerous extra pores; (2) pelvic disc with anterior transverse membrane; (3) predorsal area and head naked. *B. affinis* may be distinguished from the other *Buenia* species, *B. jeffreysii* (Günther, 1867) by (1) lower P fin ray count (P 15-16 against P 18 in *B. jeffreysii*), (2) lower count of sensory papillae in row *c* below eye (5, ending before *cp*, against 8, ending above *cp*), (3) higher count of sensory papillae in row *b* (*b* 4-6 against *b* 3), (4) D1 rays, including D1 II not distinctly elongate in both sexes (D1 II elongate in males of *B. jeffreysii*) and (5) lower vertebral count (11+17 against 12+18). Data for *B. jeffreysii* are from Miller (1963, 1986) and McKay and Miller (1997), including counts of sensory papillae from illustrations (fig. 21 in Miller, 1963 and p. 1027 in Miller, 1986).

Morphology

Body proportions (Tab. I). - Body subcylindrical, laterally compressed towards caudal fin (Fig. 2). Head fairly long. Snout moderately large, sharp (snout angle about 55°) with somewhat sloping profile. Anterior nostril short, tubular, lacking process from rim. Eyes large, close together. Mouth oblique, jaws subequal, posterior angle of jaws below ante-

Figure 2. - *Buenia affinis*, female, 33.3 + 5.5 mm, Oštro, Kvarner area, Croatia, May 16, 1996.

Table I. - Body proportions of *Buenia affinis*. Values for females and males are range, and, in parentheses, mean and standard deviation. Ab: anal fin base; Ad and Aw: body depth and width at anal fin origin; Cl: caudal fin length; CHd: cheek depth; CP, CPw and CPd: caudal peduncle length, width and depth, CPw measured with CPd, at minimum caudal peduncle depth; D1b and D2b: first and second dorsal fin base; 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: distance from snout to vertical of anal fin origin and anus; SN/D1 and SN/D2: distance from snout to origin of first and second dorsal fins; SN/V: distance from snout to vertical of pelvic fin origin; V/AN: distance from pelvic fin origin to anus; Vd: body depth at pelvic fin origin; Vl: pelvic fin length.

Sex	Males	Females
n	8	8
SL (mm)	23.9-31.7	25.7-33.3
%SL, H	27.5-30.7 (29.4±1.3)	27.9-30.0 (28.9±0.7)
Hw	18.6-21.8 (20.1±1.2)	18.8-21.3 (19.9±1.0)
SN/D1	34.6-38.3 (36.4±1.3)	34.5-40.1 (37.5±1.5)
SN/D2	51.8-56.5 (54.2±1.7)	51.5-57.1 (55.5±1.9)
SN/AN	46.8-51.4 (48.8±1.7)	48.1-50.5 (49.4±0.8)
SN/A	52.8-58.2 (55.5±1.9)	53.5-58.5 (56.4±1.8)
SN/V	28.5-32.3 (30.3±1.3)	28.4-33.0 (30.2±1.6)
CP	25.1-29.9 (27.0±1.6)	24.4-29.6 (27.6±1.6)
D1b	12.9-15.6 (14.4±0.9)	13.4-15.0 (14.1±0.6)
D2b	17.8-23.3 (20.6±1.9)	17.0-21.3 (19.5±1.4)
Ab	15.9-20.8 (17.6±1.6)	14.0-17.7 (16.0±1.4)
Cl	17.7-20.5 (18.9±0.9)	16.5-20.5 (18.4±1.1)
Pl	19.1-23.6 (21.5±1.7)	18.3-23.7 (20.6±1.9)
Vl	21.5-25.2 (23.6±1.2)	21.8-25.3 (23.5±1.3)
Vd	13.6-17.6 (16.2±1.3)	15.2-20.3 (17.3±1.6)
Ad	13.0-14.8 (13.9±0.6)	13.2-14.8 (14.2±0.5)
Aw	11.9-13.0 (12.5±0.4)	11.3-13.9 (12.5±0.7)
CPd	7.4-8.5 (7.9±0.4)	6.8-8.1 (7.3±0.4)
CPw	3.8-5.0 (4.4±0.4)	4.6-5.6 (5.1±0.4)
V/AN	16.9-19.9 (18.4±1.1)	18.3-21.8 (19.7±1.1)
%CP, CPd	24.7-31.8 (29.2±2.2)	24.7-30.3 (26.6±1.0)
%H, SN	23.3-28.4 (25.9±2.0)	25.8-28.6 (26.7±1.9)
E	23.3-30.1 (26.8±2.2)	23.6-28.6 (26.0±1.4)
PO	42.5-53.5 (47.3±3.9)	42.9-50.6 (47.3±2.2)
CHd	12.1-16.4 (14.6±1.6)	12.4-17.1 (14.6±1.6)
Hw	64.8-71.2 (68.4±2.3)	64.0-75.0 (68.7±3.4)
%E, I	8.3-14.3 (10.3±2.3)	9.1+15.0 (12.8±1.7)
%V/AN, Vl	113.3-142.0 (128.5±11.1)	106.1+136.2(119.7±9.4)

rior border of pupil. Branchiostegal membrane attached along entire lateral margin of isthmus from immediately anterior to pectoral margin.

Fins. - D1 VI; D2 I/8 (8:16); A I/7 (7:16); C 12 branched rays (11:4; 12:10, 13:1, and the specimen 31.1+5.8 mm from Oštro, Kvarner area, Croatia, May 16, 1996 with damaged C); P 15-16 (left and right side: 14 and 14: 1, 15 and 15: 6, 15 and 16: 5, 16 and 16: 4). Fin-bases and lengths in proportion to standard body length given in Table I. D1 rays not elongate. P uppermost rays within membrane. V rounded, anterior membrane 1/3-1/2 length of spinous ray in midline depth, with straight rear end. C rounded.

Scales. - Body covered with ctenoid scales. Predorsal area, including nape, opercle and cheek naked. Breast scaled. Scales in lateral series 26-29 (16 specimens, left and right side: 26: 12, 27: 6, 28: 12, 29: 2), in transverse series 6 (16 specimens, left and right side: 6: 32).

Coloration. - In life (from observations noted in the habitat): body is transparent, with partially pigmented skin (dark brown, yellowish sandy and whitish blue colours) and colours from internal organs: red gills and silvery peritoneum. Eyes dark, with dark green pupil. The pattern of skin pigmentation is the same as in freshly collected specimens and it is here described in detail for the latter. Freshly preserved specimens (from slides): transparency lost, and body became opaque. Upper part of body fawn, with pale saddles at nape, origin of D1, origin of D2, end of D2, on caudal peduncle and on the origin of C. Reticulate pattern, formed by dark markings along the scale margins, between saddles. Below saddles four vertical irregular black to grey marks along lateral midline and longitudinal T-shaped mark on caudal origin, with two to three vertical light brown lines between marks (visible only in adults). Underside, including breast and belly, whitish. Head fawn, with dark brown band on preopercle, larger dark brown area on cheek and dark brown stripe from eye to upper lip in adults, smaller specimens without stripe from eye to upper lip. Eyes bright, pupil dark. D1 and D2 with three light brown to grey bands, D1 also with dark blotch on membrane around D1 VI. C transparent. A yellow, with grey band along tip. P transparent, with two oval marks, one at base of first upper ray, and the second on bottom of third and fourth rays. V dark grey in adults, transparent in smaller specimens. Coloration became paler in the weeks following fixation, so the final colour of preserved specimens is fawn, with uniformly brown markings, patterned as in freshly collected specimens. No distinct sexual dimorphism is evident.

Vertebrae and dorsal pterygiophores. - Number of vertebrae 11+16 - 11+17 (11+17: 8, 11+16: 1), including urostyle. Dorsal pterygiophore formula 3-122100 (3-122100: 9).

Lateral line system (Fig. 3). - Head with anterior and posterior oculoscapular, and preopercular canals, carrying pores σ, λ, κ, ω, α, ρ, ρ^1, ρ^2 and γ, δ, ε respectively. Rows and number of sensory papillae as follows: (1) *preorbital* (n = 6): snout with three rows in median preorbital series, superior row *r* close to pore σ (1-2), inferior row *s* with two sections, s^1 (1-2) close to nostrils, s^2 (1-2) more medially. Lateral series *c* in two parts: anterior upper c^2 (1-2) and

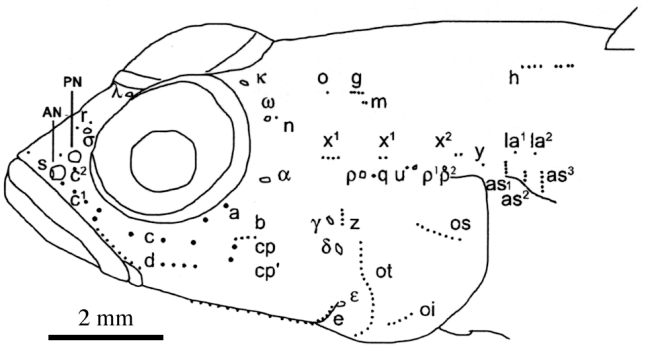

Figure 3. - *Buenia affinis*, head lateral-line sensory papillae and canal pores, male, 27.7+4.9 mm, Oštro, Kvarner area, Croatia, June 25, 1997. AN, PN, anterior and posterior nostrils; see other terminology in the text.

posterior lower c^1 (3). (2) *suborbital* (n = 16): rows *a* and *c*, including *cp*, without transverse proliferation; *a* below rear part of eye (2); *c* below eye (5), anteriorly beginning with two papillae below front border of eye, posteriorly ending before *cp* and *a* rows*; cp'* approximately below *cp*. Longitudinal row *b* short (2-6), anteriorly beginning below rear border of eye. Longitudinal row *d* with separated supralabial (6-12) and horizontal part (4-7). (3) *preoperculo-mandibular* (n = 16): external row *e* and internal row *i* divided into anterior (*e*: 15-23, *i*: 8-16), and posterior sections (*e*: 17-26, *i*: 10-13); row *f* (2) joined with row *i* in some specimens. (4) *oculoscapular* (n = 6): anterior longitudinal row x^1 divided in anterior section (2-5) above row *z* and posterior section (2-5) above row *q*, posterior longitudinal row x^2 (2-3) above and behind pore ρ^2; row *z* (4-5) behind pore γ, row *q* (0-2) and u (1) between pores ρ and ρ^1, row *y* (1) behind pore ρ^2. Axillary rows as^1 (3-4), as^2 (3-7), as^3 (2-7), la^1 (1-2) and la^2 (1-3) present. (5) *opercular* (n = 16): transverse row *ot* (13-19); superior longitudinal row *os* (5-11); and interior longitudinal row *oi* (4-7). (6) *anterior dorsal* (n = 6): row *n* (0-1), row *g* (3-5), row *o* (1-3), row *m* (1-3) and row *h* (6-12) present.

Ecology

B. affinis was observed at depths of 3 to 25 m, but occurred most frequently from 5 to 20 m. Specimens were present exclusively on the sandy sediments at all localities in the Kvarner area where it was recorded. These sandy bottoms were mostly clear, although at places scarcely covered with cobbles (6-20 cm) and boulders (> 20 cm). The average particle size of sand at the *B. affinis* habitat at Oštro showed that the species occurred on coarse sands (D_{50} 0.7-0.8 mm, depths 5, 7.5 and 12.5 m) and medium sands (D_{50} 0.2-0.4 mm, depths 10, 15 and 20 m). The sediments investigated consist mostly of coarse biogenous fragments (calcite skeleton remains) mixed with finer lithogenous material (fragments originated from the desintegrations and weathering of rocks). The characteristic invertebrate macrofauna of *B. affinis* habitat studied at Oštro belongs to the biocenosis of the well sorted fine sands (*Aiptasia mutabilis*, *Cerianthus membranaceus*, *Condylactis aurantiaca*, *Acanthocardia aculeata*, *A. spinosa*, *Callista chione*, *Ensis ensis*, *Psammobia depressa*, *Tellina tenuis*, *Venus casina*, *Eunice aphroditios*, *Hermonia hystrix*, *Sabella pavonina*, *Sabella spallanzanii*, *Astropecten auranciacus*, *Echinaster sepositus*, *Holothuria forskali*, *H. tubulosa*, *Phallusia mammillata*) and to the biocenosis of rough sands and fine gravels under the influence of bottom currents (*Branchiostoma lanceolatum*, *Dosinia exoleta*).The most common syntopic fish species with *B. affinis* were the epibenthic *Gobius roulei* and hyperbenthic *Coris julis*. During divings another four hyperbenthic (*Serranus hepatus*, *Spicara flexuosa*, *Symphodus cinereus*, *S. ocellatus*), seven epibenthic (*Gobius bucchichi*, *G. couchi*, *G. geniporus*, *G. niger*, *G. vittatus*, *Parablennius tentacularis*, *Trachinus draco*) and one cryptobenthic species (*Chromogobius zebratus*) were also observed with *B. affinis*.

DISCUSSION

The genus *Buenia* is represented by two species, *B. affinis* and *B. jeffreysii*. *B. jeffreysii* is well documented along the eastern Atlantic coast (Miller, 1963, 1973, 1986). On the other hand, *B. affinis*, despite being listed as a valid species (Tortonese, 1975; Ševčić, 1977; Jardas, 1996 for the Adriatic Sea, and Miller, 1973, 1986 for the Mediterranean) or junior synonym (De Buen, 1923; Ninni, 1938; Šoljan, 1948; Cavinato, 1952; Bini, 1969), has only a few, mostly doubtful records (Sanzo, 1911; Fage, 1918; Miller, 1986; Costa *et al*., 1996). Used as junior synonym (De Buen, 1923; Ninni, 1938; Šoljan, 1948; Cavinato, 1952; Bini, 1969), *B. affinis* was confused with *Pomatoschistus marmoratus* (Risso, 1810) (used synonyms: *G. marmoratus*, *G. affinis*, *G. reticulatus* Valenciennes, 1837, *G. rhodopterus* Günther, 1861).

The lateral line system published by Sanzo (1911) matches well the present data. The only comparable morphological characters for adults from Fage's (1918) postlarvae are meristics of D2 and A, and they clearly differ from the presently collected specimens. There have been no published records of *B. affinis* since Sanzo (1911) and Fage (1918) except for the third location in the map by Miller (1986) and a doubtful record published by Costa *et al*. (1996). However, the origin and the data for the third record in Miller (1986) remained unknown. Morphological characters of specimens from Sicily published in Costa *et al*. (1996) are scarce. Nevertheless, body and head shape, presence of postmaxillary process of the premaxilla, meristics ("D2 = 12; A = II-10; C = 22") and coloration pattern clearly disagree

with the presently collected specimens and all the other sand gobies. The specimens from Sicily resemble mostly on *Millerigobius macrocephalus* or *Zebrus zebrus*.

The presented data show that only two positive records for *B. affinis* are known: the western Mediterranean from Naples, Italy (Sanzo, 1911) and the Adriatic from the Kvarner area, Croatia (recent data) (Fig. 1). However, I share the opinion expressed by P.J. Miller (personal communication) based on the illustration of lateral line system that it is more likely that specimens shortly described in Zander (1982) from Banyuls, France, are *B. affinis* than *B. jeffreysii*, so two possible records remain in the western Mediterranean: Banyuls (Zander, 1982) and locality approximately between Nice and Genoa (Miller, 1986). Therefore, the two *Buenia* species could be clearly geographically separated on Mediterranean species *B. affinis* and the eastern Atlantic *B. jeffreysii*.

Acknowledgments. - Diving assistence was provided by M. Arko Pijevac, I. Bilopavlović and M. Kirinčić. I thank P.J. Miller for checking of the species identification and for suggestions and criticism of this paper, M. Arko-Pijevac for the help with biocenological data, Č. Benac for help with the sedimentological data.

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Reçu le 12 décembre 2001.
Accepté pour publication le 25 mars 2002.