FishTaxa (2017) 2(4): 195-200
E-ISSN: 2458-942X
Journal homepage: www.fishtaxa.com

A note on the cinnabar goatfish, *Parupeneus heptacanthus* (Lacepède, 1802) from northern parts of the Persian Gulf and the Makran Sea (Teleostei: Mullidae)

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Abstract

The cinnabar goatfish, *Parupeneus heptacanthus* (Lacepède, 1802), is a species of mullid fish distributed in the Red Sea, Indo-West Pacific: East Africa, Madagascar and Mascarenes east to Marshall Islands, Samoa and Tonga, north to southern Japan, south to Australia, Lord Howe Island and New Caledonia. It has been mainly reported from the southern part of the Persian Gulf and Makran Sea. Here, the morphological features especially live color pattern of *P. heptacanthus* from the northern area of Persian Gulf and Makran Sea are described and discussed. It is the first record of life color pattern of this species from the northern Persian Gulf.

Keywords: Mullid fish, Geographical range, Morphological characteristics, Coloration.
Zoobank: urn:lsid:zoobank.org:pub:A7E49629-94D1-46FD-8FFD-E21AD846C9D4

Introduction

The Mullidae (goatfishes) comprises 6 genera and about 91 species (Nelson et al. 2016; Eschmeyer and Fong 2017) of almost small (up to 60 cm) marine or rarely brackish water fishes. They are distributed worldwide and are found in the Red Sea, Indo-West Pacific: East Africa, Madagascar and Mascarenes east to Marshall Islands, Samoa and Tonga, north to southern Japan, south to Australia, Lord Howe Island and New Caledonia (see Eschmeyer and Fong 2017) generally occurring in open mud or sand bottoms or in the vicinity of reefs (Randall 1995). The goatfishes can be easily distinguished from all other perciforms by their unique long hyoid barbels acting as chemosensory organ, used in trophic foraging and locating preys such as crustaceans, polychaetes and small bivalves (Randall 1994; Randall1 and King 2009; Randall1 and Heemstra 2009; Nelson et al. 2016).

The species of *Parupeneus* Bleeker, 1863 are known only from the Indo-Pacific region. The genus *Parupeneus* comprises about 32 valid species (Froese and Pauly 2017) that is confined to the Indo-Pacific region (Randall1 and King 2009), including the Persian Gulf and Makran Sea. Till date, 9 species, *P. bifasciatus* (Lacepede, 1801), *P. barberinus* (Lacepede, 1801), *P. cyclostomus* (Lacepede, 1801), *P. heptacanthus* (Lacepède, 1802), *P. indicus* (Shaw, 1803), *P. macronemus* (Lacépède, 1801), *P. margaritatus* Randall & Guézé, 1984, *P. pleurostigma* (Bennett, 1831) and *P. rubescens* (Lacepède, 1801), have been reported from Makran (Oman) Sea (Al-Jufaili et al. 2010) but mainly *P. rubescens* and rarely *P. heptacanthus* are being reported from the Iranian part of Persian Gulf and Makran Sea. Here, the morphological features especially live color pattern of *P. heptacanthus* from the northern area of Persian Gulf and Makran Sea are described and discussed. It is the first record of life color pattern of this species from the northern Persian Gulf.

Material and Methods

Two specimens, ZM-CBSU Mu013-1, ZM-CBSU Mu013-2 of *P. heptacanthus* with total lengths (TL) of 228.5-233.6 mm and standard lengths (SL) of 184.1-191.4 mm were collected from, Pozm, Chabahar, Sistan and Baluchestan Province, Iran; 25°26'12.29"N, 60°28' 36.60"E, (Fig. 1); 24 November 2017 (A. Baloch) using gill

Accepted: 30 December 2017; Published: 31 December 2017

Figure 1. Sampling sites of *Parupeneus heptacanthus* from the Persian Gulf and Makran Sea.

net. One more individual, was photographed (Fig. 2) from Kish Island, Hormozgan Province, Iran; 26˚30′30.98″N, 54˚02′53.43″E, Summer 2010 (R.K) (Fig. 1). After anesthesia, the collected specimens were fixed in 10% formaldehyde and later stored in 70% ethanol. The specimens are deposited in the Zoological Museum of Shiraz University, Collection of Biology Department, Shiraz (ZM-CBSU). Morphometric measurements (Table 1) were taken to the nearest 0.1 mm using digital calipers. A stereomicroscope was used for the meristic characters. Morphometric methods followed Uiblein & Heemstra (2010, 2011).

Results

Parupeneus Bleeker, 1863

Identification: The genus *Parupeneus* Bleeker, 1863 is diagnosed primarily by dentition. The teeth in the jaws are bluntly conical, moderately large and well-spaced in a single row, and there are no teeth on the vomer or palatines. Body elongate. Mouth small. Two long barbels on chin. All the species of *Parupeneus* share the following meristic data: dorsal fins VIII+9; anal-fin rays 7; principal caudal fin rays 15; pelvic-fin rays I,5; 8 to 9 vertical rows of scales along upper side of caudal peduncle, 2 to 3 vertical rows of scales in space between the two dorsal fins, and lateral-line scales 27 or 28 (26-31, Barman and Mishra 2007). The variation in the lateral-line scale count is attributed to the decision of the observer where to end the scale count at the base of the caudal fin (two or three pored scales are on the caudal-fin base) (see Barman and Mishra 2007; Randall and King 2009).

Parupeneus heptacanthus (Lacepède, 1802)

(Figs. 2-4).

English name: Cinnabar Goatfish, Bighead goatfish, Blackspot goatfish, Goatfish, Opalescent goatfish, Redspot goatfish, Small-spot goatfish, Spotted golden goatfish

Synonym. *Sciaena heptacantha* Lacepède, 1802

Holotype: (unique): MNHN A-5438 (dry) (Eschmeyer et al. 2017)

Type locality: No locality stated (probably Indonesia) (Eschmeyer et al. 2017)

IUCN status: Least Concern ver 3.1 (Smith-Vaniz and Williams 2017)

Diagnosis: *Parupeneus heptacanthus* is distinguished from other species of goatfishes by the presence of a single row of well-spaced stout conical teeth in jaws, no teeth on the roof of the mouth, 3 vertical rows of scales in the

Figure 2. Live specimen of *Parupeneus heptacanthus* from Kish Island, Hormozgan Province, Iran (photographed by R. Ketabi).

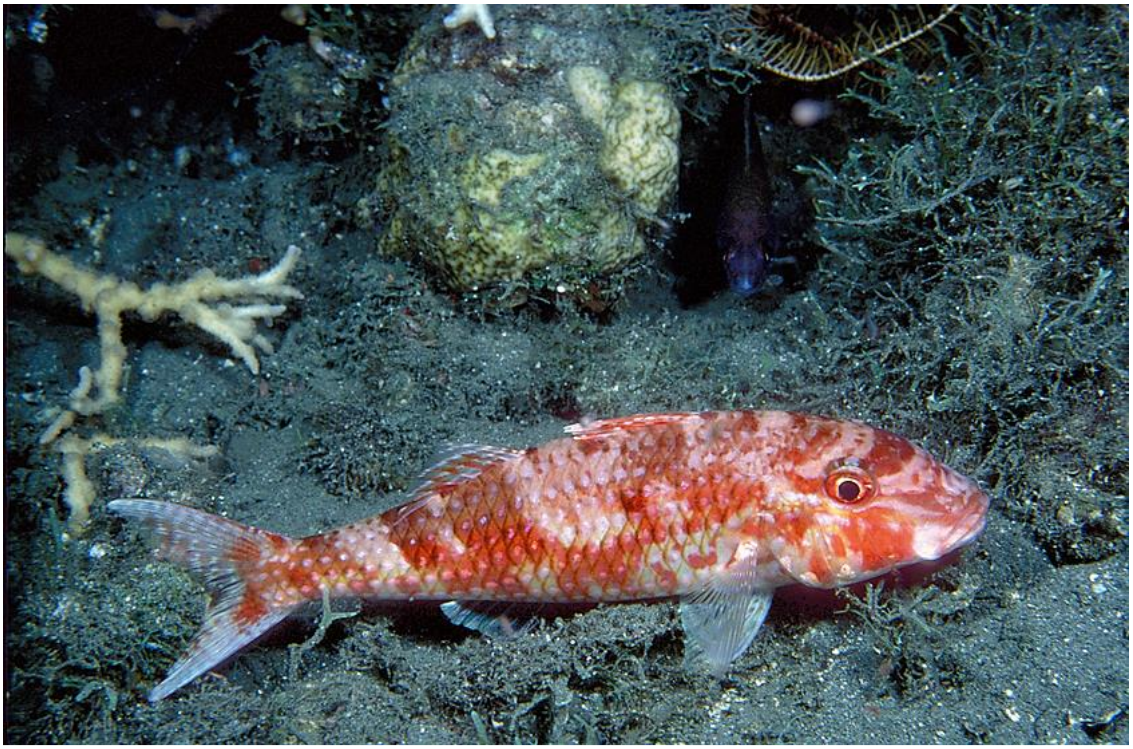

Figure 3. Live specimen of *Parupeneus heptacanthus* from Red Sea (photographed by R. Randall).

space between the dorsal fins, 9 vertical rows of scales along the upper part of caudal peduncle and usually a pale reddish spot just below seventh and eighth lateral line scales (Figs. 2, 3).

Description: Dorsal fins VIII+9; anal-fin rays 7; pelvic-fin rays I, 5; pectoral-fin ray 16; principal caudal fin rays 15; lateral-line scales 27-28, 3 vertical rows of scales in the space between dorsal fins; 9 vertical rows of scales along the upper part of caudal peduncle; scales above lateral line to dorsal-fin origin 2; scales below lateral line to anal-fin origin 5; lower-limb gill rakers 21-23 in general (gill rakers 6-7 + 22 in specimens from northern Persian Gulf and Makran Sea; 6-7 + 20-23 from Oman, see Randall 1995).

Body rather deep, upper profile forming a characteristic regular arch; interorbital space convex. Mouth ventral and small, maxilla extending almost 2/3 distance to front margin of eye, snout short and steep. Chin with 2 moderately long barbels, extending to rear border of preopercle. A small spine on upper third of opercular margin. Teeth in both jaws in a single row, none on vomer and palatines (roof of mouth). Three vertical rows of

Table 1. Morphometric characters of two specimens of *Parupeneus heptacanthus* (ZM-CBSU MU013-1, ZM-CBSU MU013-2) collected from Makran Sea.

Character	MU013-1	MU013-2
TL: total length distance between snout tip and most upper caudal fin end	233.6	228.5
SL: standard length, distance between snout tip and caudal fin base at mid-body	191.4	184.1
BODYDD: body depth at first dorsal-fin origin	55.4	55.2
BODYDA: body depth at anal-fin origin	50.8	51.2
HALFDA: half body depth (from lateral line downwards) at anal-fin origin	17.8	18.0
CPDD: caudal-peduncle depth, minimum depth anterior to caudal dorsal origin	27.3	23.1
CPDW: caudal-peduncle width at position of CPD measurement	43.3	42.3
HEAD1: maximum head depth, vertical distance at ventral edge of operculum	46.8	48.3
HEAD2: head depth across a vertical midline through eye	38.1	37.6
SUBORB: suborbital depth–distance between lower edge of orbit to ventral midline of head	24.7	25.3
INTORB: interorbital length–least distance between upper bony edges of orbits	17,3	16.9
HEADL: head length - distance between snout tip to posteriormost margin of operculum	64.7	63.6
SNOUTL: snout length -distance between snout tip to anterior margin of orbit	35.1	35.3
PORBL: postorbital length, distance between posterior edge of orbit and posterior margin of operculum	20.5	22.9
ORBITL: orbit length, horizontal fleshy orbit diameter	12.5	10.9
ORBITD: orbit depth, vertical fleshy orbit diameter	10.5	10.9
UJAWL: upper-jaw length–distance between symphysis and posterior end of upper jaw	20.6	21.6
LJAWL: lower-jaw length–distance between symphysis of lower jaw and posterior end of upper jaw	14.8	13.2
SNOUTW: snout width–least distance between hinder margins of upper jaw, with closed mouth	18.9	19.2
BARBL: barbel length	44.4	41.6
BARBW: maximum barbel width, horizontal width measured at base of soft part of barbel	4.9	5.0
SD1: first pre-dorsal length–distance between snout tip to origin of first dorsal fin	79.9	74.0
SD2: second pre-dorsal length–distance between snout tip to origin of second dorsal fin	123.1	123.9
D1D2: interdorsal distance - distance between last spine of first dorsal and first ray of second dorsal fin	21.9	15.6
CPD: L caudal-peduncle length–distance between last anal ray and ventral origin of caudal fin	39.5	42.0
SANL: pre-anal length–distance between snout tip to origin of anal fin	120.7	117.3
SPEL: pre-pelvic length–distance between snout tip to origin of pelvic fin	68.6	66.4
SPEC: pre-pectoral length–distance between snout tip to dorsal origin of pectoral fin	64.6	64.6
D2ANL: second dorsal-fin depth–distance between origin of second dorsal fin to origin of anal fin	50.5	51.3
D1PELVC: pelvic-fin depth–distance between origin of first dorsal fin to origin of pelvic fin	53.1	55.6
D1PEC: pectoral-fin depth–distance between origin of first dorsal fin to dorsal origin of pectoral fin	34.9	36.0
D1B: length of first dorsal-fin base	35.7	36.8
D2B: length of second dorsal-fin base	29.6	33.7
CAUH: caudal-fin length–distance between dorsal caudal-fin origin and upper caudal-lobe tip	22.9	48.0
ANALB: length of anal-fin base	12.5	221.6
ANALH: anal-fin height–distance between anal-fin origin and anal-fin anterior tip (to tip of first long anal ray)	27.0	29.4
PELVL: pelvic-fin length–distance between pelvic-fin origin and pelvic-fin tip	42.2	40.3
PECTL: distance between pectoral-fin dorsal origin and pectoral-fin tip	41.6	39.3
PECTW: Width of pectoral-fin base	12.5	12.0
D1H, first dorsal-fin height - distance between first dorsal-fin origin and first dorsal-fin anterior tip (= to tip of first long dorsal-fin spine)	44.7	48.9
D2H: Second dorsal-fin height - distance between second dorsal-fin origin and second dorsal-fin anterior tip (= to tip of second dorsal-fin ray)	28.2	29.1
P: pectoral-fin rays	15	13
GrUud: rudimentary (= width larger than its depth) gill rakers on upper limb	6	3
GrUd: developed gill rakers on upper limb	5	6
GrLd: developed gill rakers on lower limb (including gill raker in corner)	15	16
GrLud: rudimentary gill rakers on lower limb	6	5
GrU: total gill rakers on upper limb	11	9
GrL: total gill rakers on lower limb	21	21
Gr: total gill rakers	32	30
Llscal: scales along lateral line to caudal-fin base (excluding scales on caudal fin)	27	26

scales along the space between dorsal fins; 9 vertical rows of scales along upper part of caudal peduncle. Two widely separated dorsal fins, first with 8 spines, first spine very short; third spine longest, 1st dorsal fin higher than 2nd, origin of dorsal fin over third lateral-line scale, pectoral fins longer than pelvic fins, extending to distance between two dorsal fins, pelvic fin short not reaching to anal fin, anal-fin origin at about one eye diameter behind a vertical of second dorsal-fin origin, caudal fin forked.

Colour: Live fish very colourful (Figs. 2, 3), with blue reflections on back. Body brownish yellow to red shading to silvery white ventrally. Scale margins darker with a blue to pearly spot centrally on the back. Scales on back and sides with light circular central spots, forming about 5 horizontal lines to caudal peduncle, more clear in the mid body specially bellow dorsal fins. 2nd dorsal fin with horizontal pink or violet stripes, but no stripes on 1st dorsal; anal fin with yellow stripes. Caudal fin with vertical pink or violet stripes. A small reddish spot on the 7th and 8th lateral line scales in adults. This spot is often faded on old museum specimens of *P. heptacanthus*. Cheek, snout and interorbital space with a few inconspicuous iridescent blue lines-diagonally placed. Faint narrow pale blue bands on second dorsal and anal fins.

Range distribution: *Parupeneus heptacanthus* occurs throughout the Indo-West Pacific from the eastern coast of Africa at 34°S to the Red Sea, the Persian Gulf, Makran Sea and Andaman Sea, east to Samoa and the Marshall Islands, Caroline Islands and Fiji (Randall 1995; Randall and Heemstra 2009), north to southern Japan and south to Australia, from the Northern Territory to Queensland, and Lord Howe Island (Randall 2001; Smith-Vaniz and Williams 2017). It is reportedly found at depths ranging from 12 to 350 m (Myers 1999); however, it is more common to find individuals at 60 m (Myers 1991; Smith-Vaniz and Williams 2017).

Discussion

The cinnabar goatfish, *P. heptacanthus* is widely distributed in the Indo-West Pacific region. Recent fish examinations and expeditions in this region have revealed that, some of the *P. heptacanthus* populations have been misidentified and represent distinct species (see Randall and King 2009; Randall and Heemstra 2009). It seems that all of the species of *Parupeneus* have the same number of rays of the median and the same number of lateral-line scales (Randall and Heemstra 2009) and these characters could not be used in correct fish distinction. The counts of pectoral-fin rays are modally 15 or 16, except one species with 17. The gill-raker counts proved to be helpful to differentiate the species, but these counts are broadly overlapping for all species (Randall and Heemstra 2009). According to Randall and Heemstra (2009), the most useful proportional measurements are body depth, head length, snout length, cheek depth, barbel length and the length of the paired fins. Life colour pattern seems to be another useful character to distinguish closely related species. *Parupeneus heptacanthus* remains a common species throughout the Indian Ocean, including the Red Sea, Persian Gulf, and Andaman Sea, east in the Pacific to the Caroline Islands and Fiji (Randall and Heemstra 2009). However, using molecular markers (both nuclear and mitochondrial) are highly recommended.

Acknowledgments

We thank Dr. J.E. Randall for providing live photo of *Parupeneus heptacanthus* from the Red Sea, R. Sadeghi and H. Hashemi (Environment Department of Hormozgan Province) for their helps and supports in the fieldwork. The research work was funded by Shiraz University and was approved by the Ethics Committee of Biology Department (SU-9531462).

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