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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. 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

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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.

TL: total length distance between snout tip and most upper caudal fin end S: standard length, distance between snout tip and most upper caudal fin end BOPDYD: body depth at an affin origin S58, 4 S52, 2 BOPDYD: body depth at affix dorsal-fin origin FOPD: candal-peduncle depth, from lateral line downwards) at and-fin origin RALFDA: half body depth (from lateral line downwards) at and-fin origin POPD: candal-peduncle width at position of CPD measurement 43, 3 CPDW: candal-peduncle width at position of CPD measurement 43, 3 CPDW: candal-peduncle width at position of CPD measurement 44, 3 READI: maximum head depth, vertical distance at ventral edge of operculum 46, 8 48, 3 READI: maximum head depth, distance between lower edge of orbit to ventral midline from the part of the	Character	MU013-1	MU013-2
BODYDA: body depth at affirst dorsal-fin origin BODYDA: body depth at anal-fin origin BODYDA: body depth at anal-fin origin BODYDA: body depth at anal-fin origin BODYDA: body depth (from lateral line downwards) at anal-fin origin BODYDA: body depth (from lateral line downwards) at anal-fin origin BODYDA: body depth at anal-fin at position of CDP measurement BODYDA: could-peduncle width at position of CDP measurement BODYDA: body depth at anal-fin at position of CDP measurement BEAD: head depth across a vertical midline through eye BODYDA: body at a substitution of the substitutio	TL: total length distance between snout tip and most upper caudal fin end	233.6	228.5
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HALFDA: half body depth (from lateral line downwards) at anal-fin origin CPDD: caudal-peduncle depth, minimum depth anterior to caudal dorsal origin CPDW: caudal-peduncle width at position of CPD measurement 43.3 42.3 HEAD: maximum head depth, errois a vertical distance at ventral edge of operulum 46.8 48.3 HEAD: maximum head depth, errois a vertical distance at ventral edge of orbit to ventral midline of head 47.7 SUBORB: suborbital depth-distance between lower edge of orbit to ventral midline of head 47.7 28.3 SUBORB: suborbital depth-distance between lower edge of orbit to ventral midline of head 47.7 28.3 HEAD: head length - distance between upper bow edges of orbits HEAD: head length - distance between snout tip to anterior margin of operculum 64.7 63.6 SUBORB: suborbital length, distance between snout tip to anterior margin of operculum 64.7 63.6 SUBORB: postorbital length, distance between posterior edge of orbit and posterior margin of operculum 20.5 22.9 ORBITI: orbit length, horizontal fleshy orbit diameter 12.5 10.9 UJAWI: upper-jaw length-distance between symphysis and posterior end of upper jaw 20.6 21.6 12.4 12.5 10.9 UJAWI: upper-jaw length-distance between symphysis in lower jaw and posterior end of upper jaw 20.6 21.6 12.8 SNOUTV: snout width-least distance between symphysis of lower jaw and posterior end of upper jaw 20.6 21.6 BARBI: barbel length BARBI: barbel length-distance between snout tip to origin of second dorsal fin 21.9 22.9 23.9 24.0 25.9 26.0 27.9 27.1 27.1 27.2 28.3 27.0 27.1 28.3 28.0		55.4	55.2
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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.

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Literature cited

Barman R.P., Mishra S.S. 2007. A review on the Goat fish family Mullidae in the Indian waters. Records of the Zoological Survey of India, Occ. Paper No. 258: 1-44. (Published by the Director, Zool. Surv. India, Kolkata).

- Eschmeyer W.N., Fong J.D. 2017. Species by family/subfamily. (http://researcharchive.calacademy.org/research/ichthyology/catalog/SpeciesByFamily.asp). Electronic version accessed December 2017. [Recalculated with each new version; based on current literature, this provides all available species names, valid species, and species described in the last 10 years by family/subfamily.]
- Eschmeyer W.N., Fricke R., van der Laan R. 2017. Catalog of fishes: genera, species, references. (http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp). Electronic version accessed December 2017. [This version was edited by Bill Eschmeyer.]
- Froese R., Pauly D. 2017. FishBase 2017, version (March, 2017). World Wide Web electronic publication Home page at: http://www.fishbase.org.
- Myers R.F. 1999. Micronesian reef fishes: a comprehensive guide to the coral reef fishes of Micronesia. Coral Graphics, Barrigada, Guam.
- Nelson J.S., Grande T.C., Wilson M.V. 2016. Fishes of the World. John Wiley & Sons. 752 p.
- Randall J.E., Heemstra E. 2009. Three new goatfishes of the genus *Parupeneus* from the western Indian Ocean, with resurrection of *P. seychellensis*. Smithiana, Publications in Aquatic Biodiversity, Smithiana Bulletin 10: 37-49.
- Randall, J.E. 1995. Coastal fishes of Oman. University of Hawaii Press, Honolulu, Hawaii.
- Randall J.E. 2001. Mullidae. Goatfishes (surmullets). In: K.E. Carpenter, V. Niem (Eds.). The living marine resources of the Western Central Pacific. Vol. 5. Bony fishes part 3 (Menidae to Pomacentridae), Food and Agricultural Organization of the United Nations, Rome. pp: 3175-3200.
- Rrandall J.E., King D.R. 2009. *Parupeneus fraserorum*, a new species of goat fish (Perciformes: Mullidae) from South Africa and Madagascar. Smithiana Bulletin 10: 31-35.
- Smith-Vaniz W.F., Williams I. 2016. *Parupeneus heptacanthus*. (errata version published in 2017) The IUCN Red List of Threatened Species 2016: e.T46086532A115393394. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T46 0865 32A46664724.en. Downloaded on December 2017.
- Uiblein F., Heemstra P. 2010. Ataxonomic review of the Western Indian Ocean goatfish of the genus Upeneus (Family Mullidae), with description of four new species. Smithiana Bulletin 11: 35-71
- Uiblein F., Heemstra P. 2011. Description of a new goatfish species, *Upeneus randalli* n. sp. (Mullidae), from the Persian Gulf, with remarks and identification keys for the genus Upeneus. Scientia Marin 75: 585-594.