

Taxonomic and distribution status of Margaretha's goatfish, *Upeneus margarethae* Uiblein and Heemstra, 2010 (Perciformes: Mullidae) from Thondi coast, east coast of India

Abstract

Goatfishes are tropical marine fishes that belong to the family Mullidae. Goatfishes are recognized by their bright color with strips and the presence of two long unbranched barbells on the chin. In the last decade, the number of goatfish species has increased noticeably (20 new species) owing to the interest of researchers in coastal fish diversity. Five specimens of *Upeneus margarethae* were reported for the first time from the Bay of Bengal region. The species has expanded its distribution range to the Thondi and Chennai coast of the Bay of Bengal. Five *Upeneus margarethae* were collected using commercial trawlers from August 2019 to January 2020. This species is characterized by having VIII dorsal spines, 13-14 pectoral fin rays, Lateral line 28-29, Gill rakers 20-21; 4 bars on both upper and lower caudal-fin, which was partly visible, and orange lateral mid-body stripe passing from eye to base of the caudal-fin. The detailed morphometric and meristic characters with a fresh color pattern representing images for the first time from the Palk Strait, Southeast coast of India, agree with the holotype specimen and comparable records from other areas of the world.

Keywords: Bay of Bengal, geographical, goat fish, mesh size, trawlers

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Introduction

Goatfishes are tropical marine fishes belonging to the family of Mullidae, comprising six genera and 101 species.^{1,2} Mullidae is ecologically and commercially important fishes. Its inhabitants of shallow habitats are strongly associated with the coral reefs.³ Goatfishes are recognized by their bright color with strips and the presence of two long unbranched barbells on the chin, which are the main key characters for the taxonomical identification of the Mullidae family. In the last decade, 20 new goatfish species have been described owing to the developing taxonomic works and researchers' interest in coastal fish diversity.^{2,4-6} *Upeneus* is one of the most prominent genera of the Mullidae family, with 47 species. The size range is 72-280 mm standard lengths (S.L.).⁶ They are characterized by 7-8 dorsal fin spines, chin barbels, small-sized teeth on palatines, vomer, jaws in multiserial and villiform teeth on jaws, the adult specimen length of barbels 4-7 and length of the snout 7-11 times in S.L.¹

According to Uiblein and Heemstra,⁴ the complex of *Upeneus* species is divided into four groups viz., japonicus, tragula, moluccensis, and vittatus based on morphological and meristics (Body-color patterns and bars on the caudal fin) characters. The Vittatus group was split into two groups: the stenopsis group established by Uiblein and Causse,⁷ and the Suahelicus group.¹ Further, the tragula group was split into another *margarethae* group comprising six species, *U. margarethae*, *U. randalli*, *U. mouthami*, *U. caudofaciatus*, *U. gubal* and *U. heterospinus*.^{1,8} Currently, out of 47 species from *Upeneus*, 42 are classified into six groups viz., margarethae, japonicus, tragula,

moluccensis, suahelicus, stenopsis, and the remaining five species are considered ungrouped.^{6,8}

The newly reported species *U. margarethae* is commonly called Margaretha's Goatfish, which comes under the margarethae group. The type locality of *U. margarethae* is from off Beira, Mozambic, in the Western Indian Ocean, and additional distribution ranges with a detailed morphometric comparison with known specimens.⁴ However, for the first time, the present study documented the occurrence of *U. margarethae* from the Thondi coast, Southeast coast of India, with taxonomic characters compared with known specimens, and current distribution ranges extensions were discussed.

Materials and methods

Using commercial trawlers, five specimens of *U. margarethae* were collected from Thondi and Chennai coasts from August 2021 - January 2022. The specimens were photographed, and fishes were brought to the laboratory. The morphometric dimensions were documented using a Vernier caliper to the nearest 0.1 mm. Meristic characters, including fin ray counts, lateral series scales, and gill raker, were performed and identified based on the original description and other key characters by Uiblein and Heemstra.⁴ For comparative study, morphometric dimensions were converted into percentages of standard length. The current sample location-based distribution map with topographic features is created to envisage the distribution along the Indian coast (Figure 1).

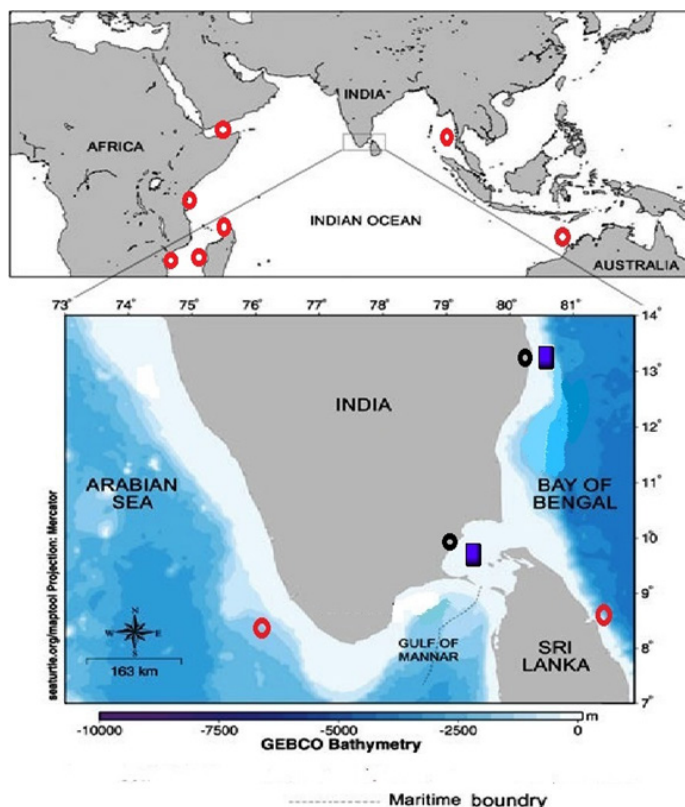


Figure 1 Global distribution of *Upeneus margarethae*, the red circle indicating previous known sites and the black circle indicating the present sampling location of (capture at [black square]) the Bay of Bengal.

Results

Taxonomic classification

Phylum	Chordata
Class	Actinopterygii
Order	Perciformes
Family	Mullidae Rafinesque, 1815
Genus	<i>Upeneus</i> Cuvier, 1829
Species	<i>Upeneus margarethae</i> (Figure 2) ⁴

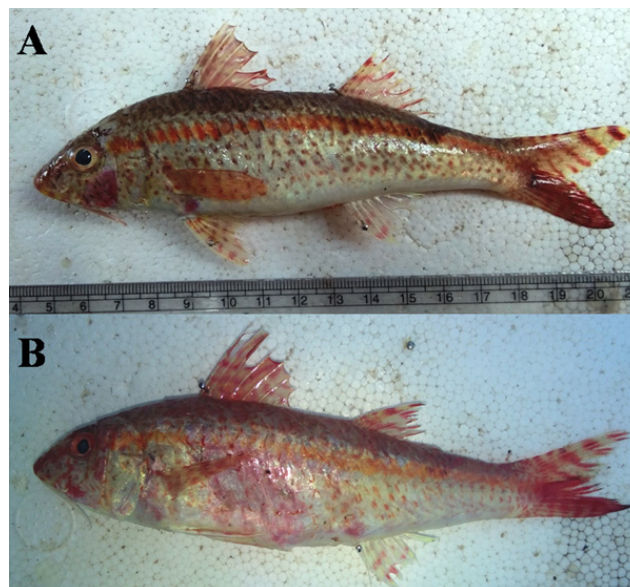


Figure 2 *Upeneus margarethae* (A and B) from the Southeast coast of India, Bay of Bengal.

Material examined

The total length of five specimens ranges from 120.52 to 158.30 mm. The total length of two specimens collected from the Chennai coast on 09th August 2021 are 120.52 and 128.60 mm, whereas the three samples collected from the Thondi coast on 13th January 2022 are 122.10, 155.12, and 158.30 mm. The specimens were compared with other known *Upeneus margarethae*.

Diagnosis

The body is slightly compressed and oblong, with two barbels below the chin. Dorsal fins VIII spine and nine rays; branched pectoral-fin rays 13-14; upper (4) and lower gill rakers 16-17(20-21); scales of the lateral-line 28-29 (Table 2); Standard length in % in (S.L.); I dorsal fin body depth 24.6-25.9; body depth at anal 21.50-22.80; depth of caudal peduncle 10.7-10.9; width of caudal peduncle 5.14-5.58; head length 28.50-29.64; orbit length 6.80-6.90; upper jaw length 10.17-10.39; barbel length 17.84- 18.00; caudal peduncle length 27.60-27.90; anal-fin base 10.74-11.12; the height of II dorsal-fin 18.19-18.65; length of pelvic fin 21.82-22.47; length of pectoral fin 21.03-21.46; width of pectoral fin 4.95-5.21 (Table 1).

Table 1 Morphometric comparison of *Upeneus margarethae* (in % S.L.) off the Bay of Bengal, with earlier records

Morphometric measurements % in S.L.	Present study (n=5)	Uiblein and Heemstra (2010)			
	Max - Min	Holotype	North Australia	Sri Lanka (n=2)	Red Sea (n=2)
Standard Length (S.L.) mm	95.51 - 132.38	82	95	78 - 80	78-94
Body depth at first dorsal (BODYDD)	24.60 - 25.90	26	25	23 - 25	25
Body depth at anal (BODYDA)	21.50 - 22.80	24	21	20	23
Caudal-peduncle depth (CPDD)	10.70 - 10.90	11	11	11-Oct	11
Caudal-peduncle width (CPDW)	5.41 - 5.58	4.8	3.7	3.6-4.1	4.3
Inter-orbital length (INTORB)	7.52 - 7.65	8.2	8.7	7.6-8.4	8.4-8.9
Head length (HEADL)	28.50 - 29.64	30	27	28 - 31	28-30
Snout length (SNOUTL)	10.83 - 11.00	12	11	12-Nov	11
Postorbital length (PORBL)	11.64 - 11.87	12	11	12-Nov	12
Orbit length (ORBITL)	6.80 - 6.90	8.7	6.9	7.3-7.4	7.7-8.1
Upper-jaw length (UJAWL)	10.17 - 10.39	11	11	11	11-Oct

Table Continued..

Morphometric measurements % in S.L.	Present study (n=5)	Uiblein and Heemstra (2010)			
	Max - Min	Holotype	North Australia	Sri Lanka (n=2)	Red Sea (n=2)
Barbel length (BARBL)	17.84 - 18.00	17	16	18 -19	16-18
First pre-dorsal length (SD1)	34.61 - 36.11	40	37	37-38	35-37
Second pre-dorsal length (SD2)	62.19 - 64.92	67	62	62-65	62-63
Inter dorsal distance (D1D2)	16.15 - 16.32	15	14	13-15	14-Dec
Caudal-peduncle length (CPDL)	27.6 - 27.90	23	25	24	22-25
Pre-anal length (SANL)	62.77 - 63.73	66	65	64-66	67-70
Pre-pelvic length (SPEL)	31.66 - 32.15	29	33	33-34	34-34
Pre-pectoral length (SPEC)	28.61 - 29.02	31	30	30-33	31-33
Length of first dorsal-fin base (D1B)	14.42 - 14.82	15	15	14-15	14-16
Length of second dorsal-fin base (D2B)	14.70 - 14.90	15	13	13	14
Length of anal-fin base (ANALB)	10.74 - 11.12	12	11	11	12-Nov
Pelvic fin length (PELVL)	21.82 - 22.47	23	20	21-22	23-23
Pectoral fin length (PECTL)	21.03 - 21.46	23	21	21-22	21-23
Pectoral fin width (PECTW)	4.97 - 5.21	4.8	4.4	4.9-5.2	4.8-5.6
First dorsal-fin height (D1H)	20.58 - 21.87	21	20	20-22	20-22
Second dorsal-fin height (D2H)	18.19 - 18.65	18	16	16-16	17-18

Table 2 Meristic characters of *Upeneus margarethae* and comparisons with Holotype, other known samples

Meristic Characters	Present study (n=5)	Uiblein and Heemstra (2010)			
		Holotype	North Australia	Sri Lanka (n=2)	Red Sea (n=2)
Pectoral-fin rays (PECR)	13-14	14	14	14	14
Rudimentary gill rakers on upper limb (GrUud)	3	3	3	3	2
Developed gill rakers on upper limb (GrUd)	3	3	3	3	3-Feb
Total gill rakers on upper limb (GrU)	6	6	6	6	5-Apr
Developed gill rakers on lower limb (GrLd)	11	12	12	13-Nov	13
Rudimentary gill rakers on lower limb (GrLud)	4	5	5	5	4
Gill rakers on lower limb(GrL)	16-17	17	17	16-18	17
Total gill rakers (TGr)	20-21	23	23	22-24	21-22
Lateral line scales (Llscal)	28-29	28	29	30	29-30

Color

The body and head have irregular red markings with a white base, dorsal fin with two red horizontal stripes; barbells are pale white; irregular brown blotches are present beneath the lateral line of the body, ventral side of the head and belly is white; pectoral fins hyaline, pelvic fins dull white with brown scatted blotches between the rays; upper and lower caudal lobe with four red bars partly visible, the origin of orange stripe from eye to caudal-fin base of the body (Figure 2).

Distribution

The type locality of Mozambic in Western India, Madagascar, Persian Gulf, Red Sea, Australia Western Pacific, off Kerala, off Sri Lanka, and the distribution range extension to Thondi and Chennai coast, Bay of Bengal (Figure 1).

Discussion

Still, information on taxonomic status is lacking with perceptible diagnostic morphometric meristic characters of Mullidae at the species level. Especially the pectoral-fin rays, dorsal-fin spines, gill rakers, lateral line scale count, and body color patterns play a significant role in species differentiation of this family. Twenty new species were added in the last decade, possibly due to researchers' developing taxonomic efforts and interest in exploring coastal fish

diversity ecosystems. Twenty four species belonging to only three genera [Mullidichthys (1), Parupeneus (11), and Upeneus- 12)] of the Mullidae family are known from the Indian waters.^{9,10} The genus *Upeneus* possessing teeth can be easily distinguished from the similar genera, Mullidichthys and Parupeneus, having no teeth on the vomer and palatines.^{9,11-12} The present specimens belonged to the genus *Upeneus* by the presence of teeth patterns, and morphometric and meristic characters were identified as *Upeneus margarethae*, which agreed well with those from North Australia and Holotype specimens and previous descriptions.⁴

Morphometric characters (in % S.L.) observed in the current specimens were matched with the holotype and North Australia specimens measurements, followed by Sri Lanka and Red Sea specimens.⁴ But, slight range deviation was observed in the characters like Inter-orbital length (INTORB), Orbit length (ORBITL), First pre-dorsal length (SD1)Inter dorsal distance (D1D2), Caudal-peduncle width (CPDW), Caudal-peduncle length (CPDL and Pre-anal length (SANL) due to the ecological impact that may influence the inter-specific changes within the species. However, the meristic characters were similar to all the known specimens from Holotype, North Australia, Sri Lanka, and Red sea specimens except for gill raker counts.⁴ In some cases, morphological variation among populations from close-by ecological characters may influence the existing morphological variation, which may reflect phenotypic plasticity.¹³

Conclusion

The lack of detailed taxonomy studies of goat fishes, especially the *Upeneus* genus from Indian waters, needs a detailed study. Further, molecular studies are required to resolve the complexity of identifying species and understand the status of *Upeneus* diversity. The present study brings new insight and inference for the researchers and conservation of the species from the Southeast Coast of India.

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Conflicts of interest

The authors declare there are no conflicts of interest.

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