

Short communication

First report of gobioid species *Oxyurichthys paulae* Pezold, 1998, from the east coast of India and *Yongeichthys audax* (Smith 1959) from the Odisha coast, India

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The present study reports two new records of Gobioid species: *Oxyurichthys paulae* from the east coast of India and *Yongeichthys audax* from the Odisha coast for the first time. These two species were collected from the Bahuda estuary, the southernmost estuary of the Odisha coast. The study also generates the COI gene data for the species *Yongeichthys audax* of the currently examined specimen from the Bahuda estuary.

[**Keywords:** Bahuda estuary, COI gene, Estuarine goby, Gobiidae, Phylogenetic analysis]

Introduction

The Indo-Pacific genus *Oxyurichthys* Bleeker 1857 belongs to the order Gobiiformes and family Oxudercidae and is distinguished from other genera of gobies with a combination of characters: a median membranous crest or ridge is present on the nape; the upper jaw typically bears a single row of teeth, with a few additional teeth occasionally present in an anterior inner row; tongue broadly rounded¹. There are 22 valid species of *Oxyurichthys* reported globally². The genus has reported with 16 valid species from Indian Ocean²⁻⁴ namely: *O. auchenolepis* Bleeker 1876, *O. limophilus* Pezold & Larson 2015, *O. lonchotus* (Jenkins 1903), *O. longicauda* (Steindachner 1893), *O. microlepis* (Bleeker 1849), *O. ophthalmonema* (Bleeker 1856), *O. papuensis* (Valenciennes 1837), *O. takagi* Pezold 1998, *O. tentacularis* (Valenciennes 1837), *O. keiensis* (Smith 1938), *O. notonema* (Weber 1909),

O. nuchalis (Barnard 1927), *O. omanensis* Zarei, Al Jufaili & Esmaeili 2022, *O. paulae* Pezold 1998, *O. petersii* (Klunzinger 1871), *O. zeta* Pezold & Larson 2015. Among these, five species have ocular cirri at the postero-dorsal position of the eye^{3,4} namely: *O. ophthalmonema*, *O. tentacularis*, *O. longicauda*, *O. omanensis*, and *O. paulae*. Altogether, five species of the genus *Oxyurichthys*, namely *O. ophthalmonema*, *O. tentacularis*, *O. microlepis*, *O. omanensis* and *O. papuensis* have been reported from India⁵⁻⁶. This study reports the presence of *Oxyurichthys paulae* Pezold 1998 from the east coast of India, i.e., from the Bahuda estuary, Odisha.

Yongeichthys Whitley, 1932 belonging to the order Gobiiformes and family Gobiidae found in the coastal waters all along the Atlantic coast of Africa, as well as the Indian Ocean and the western Pacific Ocean¹. The genus *Yongeichthys* comprises seven species: *Y. audax* (Smith 1959), *Y. nebulosus* (Forsskal 1775), *Y. signatus* (Peters 1855), *Y. griseus* (Day 1876), *Y. thomasi* (Boulenger 1916), *Y. tuticorinensis* (Fowler 1925), and *Y. viganensis* (Steindachner 1893), globally¹⁻². Among them, five species, namely *Y. audax*, *Y. nebulosus*, *Y. signatus*, *Y. griseus*, and *Y. tuticorinensis*, have been reported from the Indian Ocean^{1,2,7}. However, only two species, i.e., *Y. griseus* and *Y. tuticorinensis*, were reported from the Indian waters^{5,8,9}; and only one species, i.e., *Y. nebulosus*, was reported from Odisha¹⁰. The present study adds a second species, i.e., *Yongeichthys audax*, to the Odisha coast.

Materials and Methods

During a local survey of the Bahuda estuary (19°07'08.7" N; 84°47'25.4" E) in southern Odisha, India, the currently studied specimens were collected along with many other estuarine gobioid fishes. Both the species were collected in two different surveys. As *O. paulae* was directly preserved in the 10 % formalin, molecular analysis of the species was not possible. But *Yongeichthys audax* was taken to the lab in fresh condition. After collection, about 20 mg of tissue was isolated and stored at -20 °C for molecular analysis. The entire specimen was then preserved in 10 % formalin and sent to the laboratory for

taxonomic identification. This identification process followed published articles, such as Whitley¹¹, Talwar & Jhingran¹², Rema Devi¹³, & Larson¹. Morphological details were observed using a Leica S9i stereo microscope, and morphometric measurements were recorded in millimetres by using digital callipers with an accuracy of 0.01 mm. The identified fish sample was registered and deposited at the National Zoological Repository in the Estuarine Biology Regional Centre, Zoological Survey of India, Gopalpur-on-Sea, Ganjam, Odisha.

DNA extraction and PCR amplification

The genomic DNA was extracted using the HiPurA® Insect DNA Purification Kit, following the manufacturer's protocol. The obtained DNA concentration was approximately 38 ng/μL. Once isolated, the DNA sample was stored at -20 °C for future use. The COI gene amplification was performed using I Gene Labserve PCR machine by carrying a final volume of 25 μL [9μL of Nuclease free water, 12.5 μL of 2X Hi G9 Taq PCR Master Mix, 0.5 μL forward primer Fish F1 (5'TCAACCAACCACAAAGACATTGGCAC-3'), 0.5 μL of reverse primer Fish R1 (5'-TAGACTTCTGGGTGGCCAAAGAATCA-3')¹⁴, and 2.5 μL of extracted DNA Template] with thermo-cyclic conditions. For PCR, included an initial denaturation at 94 °C for 3 min, 35 cycles at 94 °C for 30 sec, annealing at 54 °C for 30 sec, and extension at 72 °C for 1 min, with a final extension at 72 °C for 10 min followed by an indefinite hold at 4 °C^(ref. 15). The resulting PCR product was sequenced using the Sanger sequencing method (HKP scientific). Sequence assembly was carried out using BioEdit version 7.2^(ref. 16). The COI gene sequence, consisting of 528 base pairs, was submitted to NCBI with the accession number PP729959. Multiple alignments of similar COI gene sequences were obtained from the NCBI database, and pair-wise evolutionary distances were calculated using the best substitution model. The maximum likelihood tree was constructed by using the best-fit model HKY+G+I^(ref. 17) in MEGA 11 software¹⁸. The colouration and necessary changes of the phylogenetic tree were performed by using Fig Tree 1.4.4 software¹⁹.

Abbreviations used

Standard Length - SL, Head Length - HL, first dorsal fin spines - D1, second dorsal spine - D2, pectoral fin rays - P, and maximum likelihood (ML).

Results

Systematics

Order: Gobiiformes Günther 1880

Family: Gobiidae Cuvier, 1816

Genus: *Oxyurichthys* Bleeker, 1857

Oxyurichthys paulae Pezold, 1998

Material examined: ZSI/EBRC/F15859; 01 specimen; 66.7 mm SL (Fig. 1); Bahuda estuary, Odisha; 27 June 2023.

Diagnostic Characters: D VI + I, 12 A I, 13; P 24; predorsal scales: 14; lateral line scales: 46; body compressed, 6.41 in SL. Forty-six lateral scale rows on body. Scales ctenoid on lateral sides of the body. Cycloid scales usually present on predorsal and prepelvic region, including anal and dorsal fin base. Slightly depressed head, 4.19 in SL. Cheek naked. Mouth oblique. Tongue tip round. Lower jaw slightly protruded with multiple rows of teeth, and upper jaw with single row of teeth. Maxilla reaches to the mid of the eye. Large orbit, 4.07 in HL. Dorsally a single ocular cirrus on posterior edge of each eye (Fig. 2). Rounded snout, 4.07 in HL with two pairs of pores. Two completely separated and parallel longitudinal rows of papillae on head with many small transverse papillae. Length of pelvic fin 4.17 in SL and length of pectoral fin 3.61 in SL. Two separated dorsal fins. First



Fig. 1 — Lateral view of *Oxyurichthys paulae* ZSI/EBRC/F15859 collected from Bahuda estuary (preserved)



Fig. 2 — Lateral view of head of *Oxyurichthys paulae* with ocular cirri and papilla pattern

Table 1 — Morphometric characters of the collected specimens of *Oxyurichthys paulae* and *Yongeichthys audax*

	<i>Oxyurichthys paulae</i> ZSI/EBRC/F15859		<i>Yongeichthys audax</i> ZSI/EBRC/F16499	
Total length (in mm)	—		57.4	
Standard length (in mm)	66.7		45.6	
	In SL		In SL	
Preanal length	2.0		1.7	
Pre-dorsal length (Before 1 st dorsal fin)	3.7		3.4	
Pre-dorsal length (Before 2 nd dorsal fin)	2.1		2.1	
Head Length (HL)	4.2	In HL	3.7	In HL
Eye diameter	17.1	0.9	18.2	4.9
Body depth	6.4	2.5	5.2	1.4
Anal fin base	2.2	7.1	4.6	1.2
1 st dorsal fin base	6.1	2.6	6.4	1.7
2 nd dorsal fin base	2.5	6.4	3.2	0.9
Pectoral fin length	3.6	4.4	4	1.1
Caudal peduncle length	10.6	1.5	5	1.4
Caudal peduncle depth	10.8	1.5	9.1	2.5
Lower jaw length	8.7	1.8	14.3	3.8
Upper jaw length	8.7	1.8	10.4	2.8
Pelvic fin length	4.2	3.8	4.8	1.3
Snout length	17.1	0.9	15.7	4.2

dorsal fin base 6.11 in SL and second dorsal fin base 2.47 in SL (Table 1).

Colouration: The fresh specimen yellowish in colour. Four vertical faint brown bars on lateral sides of the body. Ring of the orbit blackish. A greyish blotch on the base of caudal fin origin. Scales with blackish margin. Pale opercula and pectoral fin origin. Dorsal fin origin greyish. Pelvic fin blackish towards tip while whitish at its origin point. On preservation in formalin, the body and the bars becomes pale.

Distribution: The species was originally described by Pezold²⁰ from Cochin, Kerela, in the Arabian Sea; Collected by Day from Mumbai (Bombay) in 1885. Presently, the distributional status is restricted to the Arabian Sea, west coast of India. Current study records *O. paulae* for the first time from the east coast of India, possibly due to larval dispersion through monsoon-driven currents.

Habitat: The species is particularly found in the muddy area of the Bahuda estuary.

Genus: *Yongeichthys* Whitley 1932

Yongeichthys audax (Smith 1959)

Material examined: ZSI/EBRC/F16499; 01 specimen; 57.4 mm SL (Fig. 3); Bahuda estuary, Odisha; 29 Dec 2023.

Diagnostic Characters: D VI + I, 9 A I, 9; P; 16. Predorsal scales: 10, lateral line scales: 27; body



Fig. 3 — Lateral view of *Yongeichthys audax* (ZSI/EBRC/F16499) collected from Bahuda estuary (preserved)

compressed, 5.18 in SL. Scales ctenoid except for the scales of predorsal, prepelvic and prepectoral region. Slightly compressed naked head, 3.71 in SL. Mouth oblique. Tongue tip round. Both jaws with multiple rows of teeth. Large orbit, 4.92 in HL. Rounded snout, 4.24 in HL. Two completely separated longitudinal rows of papillae on head. Large gill opening and broad isthmus. Maxilla short. Pelvic frenum complete. Length of pelvic fin 4.82 in SL and length of pectoral fin 3.96 in SL. Two separated dorsal fins. First dorsal fin base 6.42 in SL and second dorsal fin base 3.23 in SL. Head width 1.9 in HL. Head height 1.5 in HL. Caudal fin length 1.1 in HL. Postdorsal length 0.3 in HL. Pectoral fin base 2.5 in HL. Body width 2.6 in HL (Table 1).

Colouration: The fresh specimen is light yellowish in colour. Three oblique and prominent black bars laterally on the head – the anteriormost bar extends from the eye and crosses the lower lip, the second one spreads on the cheek region, and the last, wider bar

lies on the dorsal half of the opercle and reaches to the posterior end of the cheek. Additionally, 4–5 blackish blotches on the lateral side. Head bar colour faded on preservation. Formalin-preserved samples with pale to tan body colour.

Distribution: The species was originally described by Smith²¹ from Ibo Island, Mozambique, in the western Indian Ocean as *Acentrogobius audax*. Presently it exhibits a distribution that extends from KwaZulu-Natal (South Africa), Mozambique to Seychelles, Madagascar, and even the Osumi Islands (Japan) in the northwestern Pacific¹. In Indian waters the species is distributed along the Tamil Nadu coast^{22,23}. The current study adds the distribution of *Y. audax* to the Odisha coast.

Habitat: The species is particularly found on the muddy bottoms of the Bahuda estuary.

Molecular analysis: According to the molecular analysis, the COI gene sequence from the examined specimen (PP729959) completely aligns with that of *Yongeichthys audax*, a species uploaded from Seychelles as *Acentrogobius audax*. The generated sequence also matches some previously uploaded sequences (JX193752–JX193755 and MZ606269) from India, named *Acentrogobius audax*, with

nucleotide distances ranging from 0 % to 0.9 %. Furthermore, in the phylogenetic analysis, the Indian specimen from the recent study clusters within the same clade as *Yongeichthys audax* in the Maximum Likelihood (ML) tree (Fig. 4). The ML tree includes *Eleotris fusca* (Forster, 1801) as the out-group. Consequently, the recent study provides clear evidence of the occurrence of the *Yongeichthys audax* species with matched genetic characters.

Discussion

From the east coast of India, hitherto only two *Oxyurichthys* species, i.e., *Oxyurichthys microlepis* (Bleeker, 1849) and *Oxyurichthys tentacularis* (Valenciennes, 1837), have been reported²⁴. While the current specimen could be confused with the *O. tentacularis* by the presence of tentacle in the posterior edge of the eye. However, they can be easily distinguished by the lateral scale count (46 in *O. paulae* vs. 54–66 in *O. tentacularis*), pectoral fin count (24 in *O. paulae* vs. 19–21 in *O. tentacularis*) and vertical bars on lateral sides of body (present in *O. paulae* vs. absent in *O. tentacularis*)³. The species *O. paulae* has been reported only from the Kerala coast from all over the west coast of India². This study

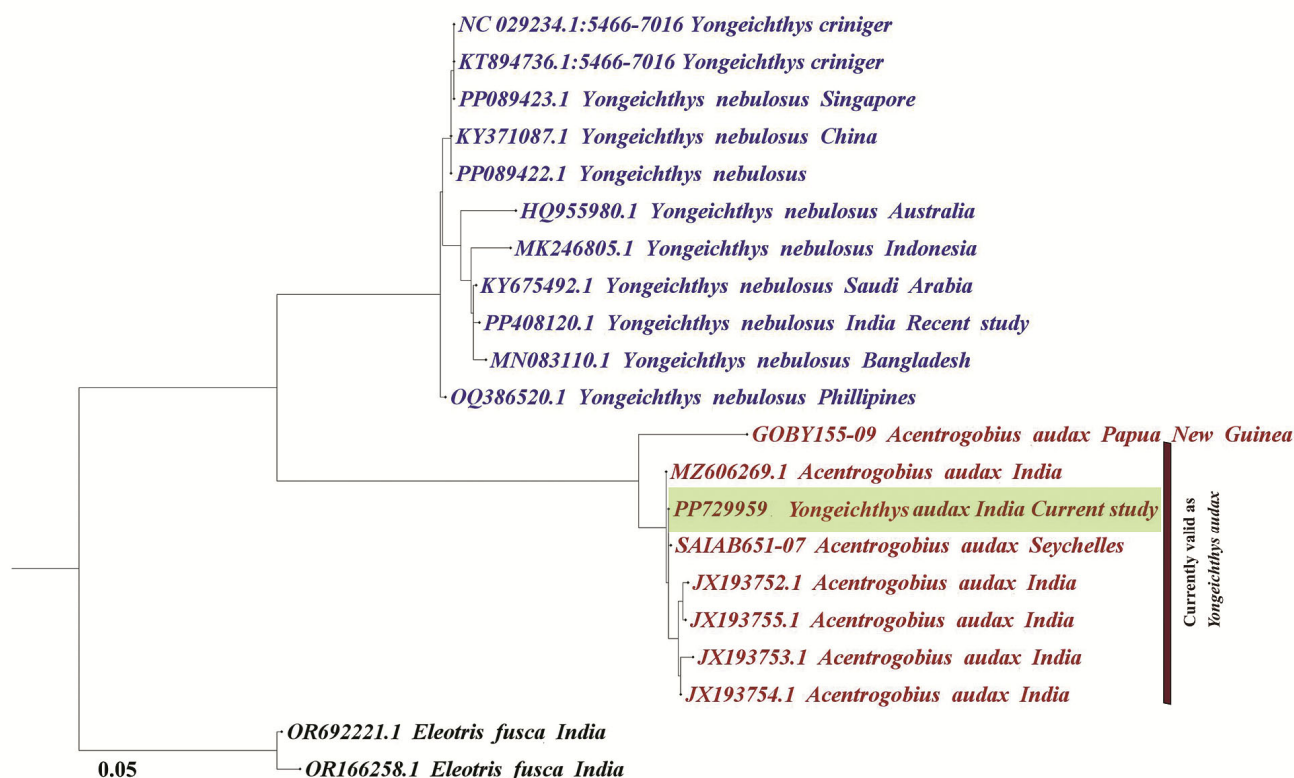


Fig. 4 — Phylogenetic tree of the species *Yongeichthys audax* collected from Bahuda estuary with other available sequences

reports the extended distribution of *O. paulae* towards the east coast of India. As the species was found only once during the three years of local surveys, this suggests its rare availability in the particular habitat.

The species *Yongeichthys audax* was first reported from the marine waters of Mozambique as *Acentrogobius audax* by Smith²¹. The study used the genus name *Acentrogobius* for several species that are nowadays included under the genera *Acentrogobius*, *Drombus*, *Exyrias*, *Favonigobius*, *Istigobius*, *Redigobius*, and *Yongeichthys*. In a recent publication by Larson¹, *A. audax* is referred to as *Yongeichthys audax*. Normally, individuals of *Acentrogobius* have a restricted gill opening and a medium isthmus²⁵. In contrast, the genus *Yongeichthys* has a laterally extended gill opening and a broad isthmus¹¹. Hence, *Acentrogobius audax*, with these characteristics, may be categorised under the genus *Yongeichthys*, in addition to having predorsal scales. However, the keys given by Talwar & Jhingran¹² and Rama Devi¹³ describe *Yongeichthys* as having a naked predorsal region. Following Larson¹, *Y. audax* is recognised as a valid species with a wider distribution. The species *Y. audax* differs from all five Indian Ocean species of the genus *Yongeichthys* by having a greater number of predorsal scales (9–12), extended along the dorsal midline up to the area above the preopercle vs. naked predorsal area, or else only 1 or 2 scales over the opercle and naked predorsal midline. While compiling the genetic data, it was observed that the sequences uploaded to BOLD from Papua New Guinea with the record number GOBY155-09, which were identified as *Acentrogobius audax*, might be a misinterpretation, as the nucleotide distance of that sequence varies by 8 % from the other sequences of *Yongeichthys audax*. Although five Indian COI gene sequences of the species *Yongeichthys audax* collected from Ashtamudi Lake, Kerala, are available in NCBI, no morphological data on those specimens or any other specimen of *Yongeichthys audax* have been published yet from the Indian coasts. According to Larson¹, *Y. audax* may be a junior synonym of *Y. viganensis*, which has not yet been reported in the Indian Ocean. As the genetic data for *Y. viganensis* or any synonymised specimen of this species are not available for comparison, the study refrain from commenting on the taxonomic status and report the presently studied specimen as *Y. audax*. Hence, the present study confirms the existence of *Yongeichthys*

audax along the Odisha coast, supported by clear morphological and molecular data.

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Conflict of Interest

All authors declare that they have no competing interests.

Ethical Statement

The species investigated in this study is not listed under any protected category of national or international wildlife conservation legislation. Specimens were collected in dead condition from the landing centre.

Author Contributions

SA: Identification, molecular analysis, and manuscript preparation; SP: Identification and compilation of data; AM, SA & RKB: Specimen collection and photography; AM, SSM, SP & KKB: Identification, overall designing and thorough review of the manuscript.

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