

Gobiidae Fish Species Diversity in the Hoi Estuary of the Ma River, Thanh Hoa Province, Vietnam

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ABSTRACT

Fieldwork in the Hoi estuary area of the Ma River has collected 33 specimens in 2021 and 2022, and nine species of Gobiidae have been recorded. Three of these species are recorded for the first time in the study area, including *Acentrogobius caninus* (Valenciennes, 1837), *Glossogobius olivaceus* (Temminck & Schlegel, 1845), and *Oxyurichthys papuensis* (Valenciennes, 1837). This paper provides morphological characteristics of nine species collected in the study area, also update the list of Gobiid species in the Hoi estuary; it now includes 18 species, accounts for 11.61% of the total number of Gobies species currently known in Vietnam. This proves the diversity of fish species in the study area. This result contributes to the understanding of the Gobiid group as well as the fish fauna in the study area.

Keywords: Gobies; morphology characteristics; Ma river; north-central; Vietnam.

1. INTRODUCTION

Gobiidae is the second most diverse group of vertebrates, and is one of the most diverse families of fish. This family consists of more than 210 genera and over 1950 described species (i.e., nearly 10% of all fish species) [1]. Gobiidae includes species with a wide distribution, found in most tropical and subtropical regions. Worldwide, 2,000 species of 261 genera have been recorded [2]. In which, currently there are 92 species [3], and according to Froese and Pauly [4] Vietnam has 155 species of Gobiidae belonging to 64 genera. The Ma is a large river located in the territory of Laos and Vietnam. The family Gobiidae is the species-

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richest fish family in the Mediterranean [5]. The Ma river basin has an area of about 28,400 km², of which about 17,600 km² is within the territory of Vietnam [6]. Downstream, the Ma River flows into the sea in three estuaries: Sung, Lach Trung and Hoi estuaries; the Hoi estuary is the largest of the three and belongs to Hoang Hoa district and Sam Son city. During our fieldwork in the Hoi estuary in 2021 and 2022, we have collected 33 specimens of Gobies. We have identified nine species, among them, three species are newly recorded from the study area.

2. MATERIALS AND METHODS

Fieldwork was conducted from October to December 2021 and in May 2022 in the at 19°46'N; 105°52'E in Hoi estuary of the Ma River, Sam Son town, Thanh Hoa province, Vietnam. Thirty-three specimens were collected and examined (Table 1) [6]. Specimens collected from fishermen's boats fishing in the area. Specimens were preserved and deposited at the Animal Laboratory at Hong Duc University, Thanh Hoa, Vietnam.

Table 1. List of specimens and time of sampling species

Specimen	Species	Date
CH66	<i>Acentrogobius caninus</i>	20 October 2021
CH67	<i>Acentrogobius caninus</i>	20 October 2021
CH70	<i>Oxyurichthys papuensis</i>	20 October 2021
CH71	<i>Oxyurichthys papuensis</i>	20 October 2021
CH72	<i>Oxyurichthys papuensis</i>	20 October 2021
CH73	<i>Oxyurichthys papuensis</i>	20 October 2021
CH74	<i>Oxyurichthys papuensis</i>	20 October 2021
CH101	<i>Glossogobius olivaceus</i>	17 November 2021
CH102	<i>Glossogobius olivaceus</i>	17 November 2021
CH120	<i>Glossogobius giuris</i>	6 December 2021
CH121	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH122	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH123	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH124	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH125	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH126	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH127	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH128	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH129	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH130	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH131	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH132	<i>Glossogobius giuris</i>	6 December 2021
CH169	<i>Glossogobius olivaceus</i>	6 December 2021
CH170	<i>Glossogobius olivaceus</i>	6 December 2021
CH171	<i>Tridentiger trionocephalus</i>	6 December 2021
CH172	<i>Tridentiger trionocephalus</i>	6 December 2021
CH173	<i>Glossogobius giuris</i>	6 December 2021
CH174	<i>Acentrogobius viridipunctatus</i>	6 December 2021
CH175	<i>Acentrogobius chlosostigmatoides</i>	6 December 2021
CH176	<i>Chaeturichthys stigmatias</i>	6 December 2021
CH280	<i>Taenioides eruptionis</i>	21 May 2022
CH281	<i>Taenioides eruptionis</i>	21 May 2022
CH282	<i>Taenioides eruptionis</i>	21 May 2022

Technical terms and measurements follow Chen and Kottelat [7]. The characteristics analyzed include: standard length (SL), body depth, head length, predorsal length, preanal length, prepelvic length, caudal peduncle depth, caudal peduncle length, snout length, eye diameter, and interorbital width. CH: Abbreviation for specimens collected in Hoi estuary [6].

3. RESULTS

3.1 Species Identified

This study identified nine species belonging to six genera of Gobiidae, of which the genus *Acentrogobius* has three species and *Glossogobius* has two species. The genera *Chaeturichthys*, *Oxyurichthys*, *Tridentiger*, and *Taenioides* each have one species (Table 2) [6].

Table 2. List of species in the Gobiidae recorded in 2021, 2022 in the Hoi's estuarine area of Ma river, Thanh Hoa province, Vietnam

No.	Species	No. of specimens
1	<i>Acentrogobius caninus</i> (Valenciennes, 1837)	2
2	<i>Acentrogobius chlosostigmatoides</i> (Bleeker, 1849)	1
3	<i>Acentrogobius viridipunctatus</i> (Valenciennes, 1837)	12
4	<i>Chaeturichthys stigmatias</i> Richardson, 1844	1
5	<i>Glossogobius giuris</i> (Hamilton, 1822)	3
6	<i>Glossogobius olivaceus</i> (Temminck & Schlegel, 1845)	4
7	<i>Oxyurichthys papuensis</i> (Cuvier et Valenciennes, 1837)	5
8	<i>Tridentiger trigonocephalus</i> (Gill, 1858)	2
9	<i>Taenioides eruptionis</i> (Bleeker, 1849)	3

3.2 Morphological Characteristics

***Acentrogobius caninus* (Valenciennes, 1837)**

The morphological characteristics of this study was consistent with the description of Rainboth (1996) [8], Nguyen [3]. Morphometrics: SL 93.2–101.8 mm; 17–18 predorsal scale rows; 10–11 transverse scale rows; 25–26 scales in lateral series; first dorsal VI, second dorsal I,9; anal rays 9; pectoral rays 18–19.

Proportions as % SL: body depth 19.07 (17.98–20.17); head length 29.69 (29.67–29.72); predorsal length 33.72 (33.01–34.44); preanal length 60.37 (58.37–62.38); prepelvic length 30.40 (29.57–31.22); caudal peduncle depth 10.55 (8.45–12.66); caudal peduncle length 15.87 (15.42–16.31). Proportions as % HL: snout length 25.47 (23.47–27.48); eye diameter 20.46 (18.54–22.38); interorbital width 10.16 (9.39–10.93) [6].

Maxilla extending to anterior part of eye; naked cheek, upper part of opercles scaled. In preserved specimens (Fig. 1A): body light brown to gray, sides of head with many small dots; five large black streaks with five alternating spots along

middle of body; large black spot at base of caudal fin; a large black (blue when alive) spot above of pectoral-fin base [6].

***Acentrogobius chlosostigmatoides* (Bleeker, 1849)**

The morphological characteristics found in this study was consistent with the description of Rainboth (1996) [8], Nguyen [3]. Morphometrics: SL 118.5 mm; 22 predorsal scale rows; 7 transverse scale rows; 32 scales in lateral series; first dorsal VI, second dorsal I,10; anal rays I,9; pectoral rays 20.

Proportions as % SL: body depth 27.26; head length 31.73; predorsal length 36.42; preanal length 60.56; prepelvic length 32.85; caudal peduncle depth 14.86; caudal peduncle length 13.74. Proportions as % HL: snout length 29.23; eye diameter 18.66; interorbital width 24.30.

Maxilla extends to posterior part of eye; check naked, opercle scaled along upper margin. In preserved conditions: Body light brown, slightly gray. The dorsal, anal, and caudal fins are darker, with some small light black dots on the abdomen from behind the pectoral fin to before the anal fin (Fig. 1B).

***Acentrogobius viridipunctatus* (Valenciennes, 1837)**

The morphological characteristics of this study was consistent with the description of Kimura et al. [9]. Morphometrics: SL 102.5–143.1 mm; 25–28 predorsal scale rows; 16–18 transverse scale rows; 30–33 scales in lateral series; first dorsal VI, second dorsal I,9; anal rays I,9; pectoral rays 18.

Proportions as % SL: body depth 26.48 (24.64–27.10); head length 30.74 (29.66–31.11); predorsal length 38.33 (35.57–39.25); preanal length 64.17 (61.65–65.01); prepelvic length 31.56 (31.23–31.72); caudal peduncle depth 14.89 (13.98–15.19); caudal peduncle length 18.66 (17.98–19.00). Proportions as % HL: snout length 27.40 (25.39–28.40); eye diameter 22.05 (20.24–22.66); interorbital width 14.47 (14.11–14.84).

Body moderately elongate; head and body slightly compressed; gill opening extending anteriorly; pelvic fins united medially. Head and body grayish brown, with numerous bright blue spots (Fig. 1C).

***Chaeturichthys stigmatias* Richardson, 1844**

The morphological characteristics revealed by this study was consistent with the description reported by Nguyen [3], Shibukawa and Iwata [10]. Morphometrics: SL 225 mm; 23 predorsal scale rows; 17 transverse scale rows; 48 scales in lateral series; first dorsal VIII, second dorsal I,20; anal rays I,18; pectoral rays 21.

Proportions as % SL: body depth 14.50; head length 20.52; predorsal length 26.84; preanal length 48.86; prepelvic length 21.72; caudal peduncle depth 7.34; caudal

peduncle length 17.21. Proportions as % HL: snout length 36.95; eye diameter 13.20; interorbital width 22.29.



Fig. 1. Lateral view of *Acentrogobius caninus* (A), *A. chlosostigmatoides* (B), and *A. viridipunctatus* (C). Scale bar: 5 cm

Body long and flat; head relatively large; 3 pairs of short barbels on the chin. The mouth is very oblique, directed upwards, the lower jaw is longer than the upper jaw. Two separate dorsal fins, second dorsal fin and anal fin long; pectoral fins

wide, short; pelvic fins form a circular disc, shorter than pectoral fin; caudal fin is long and pointed, lanceolate-shaped. Head and body light brown; the end of first dorsal fin is black; anal fin pale black; caudal fin gray, lower edge black (Fig. 2A).

***Glossogobius giuris* (Hamilton, 1822)**

The studied specimens have morphological characteristics consistent with the description of Rainboth (1996) [8], Nguyen [3]: Morphometrics: SL 100.2–139.5 mm; 23–24 predorsal scale rows; 13–14 transverse scale rows; 31–32 scales in lateral series; first dorsal VI, second dorsal I,9; anal rays I,8; pectoral rays 19.

Proportions as % SL: body depth 18.12 (16.25–19.64); head length 34.37 (32.61–35.63); predorsal length 40.07 (37.96–41.29); preanal length 63.05 (60.76–65.93); prepelvic length 33.46 (30.96–34.74); caudal peduncle depth 12.34 (11.60–12.99); caudal peduncle length 19.89 (17.20–21.27). Proportions as % HL: snout length 32.95 (32.03–33.79); eye diameter 17.67 (14.71–19.92); interorbital width 10.25 (8.98–11.17).

Suborbital pit line with small posterior branch near eye; cheek pit organs in 5 longitudinal rows, the middle rows several papillae wide (Fig. 2B).

***Glossogobius olivaceus* (Temminck & Schlegel, 1845)**

The studied specimens have morphological characteristics revealed by this study was consistent with the description of Kwun [11]. Morphometrics: SL 98.7–120.2 mm; first dorsal VI, second dorsal I,9; anal I,8; pectoral rays 19–20; 30–32 scales in lateral series; 21–24 predorsal scale rows [6].

Proportions as % SL: body depth 20.03 (18.29–21.07); head length 31.97 (29.75–33.36); predorsal length 36.91 (33.76–40.73); preanal length 61.06 (58.87–63.02); prepelvic length 30.80 (29.30–33.11); caudal peduncle depth 10.61 (9.28–11.81); caudal peduncle length 16.06 (14.92–17.33). Proportions as % HL: snout length 32.73 (28.27–34.77); eye diameter 20.08 (18.75–21.19); interorbital width 17.42 (9.82–27.81).

In preserved ethanol: head and body darkish brown, abdominal region whitish, several small blackish dots on the nape; lateral region of body with four to five blackish blotches. Membranes of dorsal and caudal fin several small darkish dots; membranes of anal fin and pelvic disc with whitish margins (Fig. 2C).

***Oxyurichthys papuensis* (Cuvier et Valenciennes, 1837)**

The morphological characteristics of this study were consistent with the description of Pezold & Larson [12]. Morphometrics: SL 101.6–112.6 mm, first dorsal VI, second dorsal I,12; anal I,13; pectoral rays 21–24; caudal 13–15; lateral scales 56–60; predorsal scale rows 17–20 [6].

Proportions as % SL: body depth 17.95 (17.20–18.69); head length 24.69 (24.32–25.24); predorsal length 29.06 (27.71–29.67); preanal length 51.09 (50.18–52.60); prepelvic length 23.93 (21.85–25.22); caudal peduncle depth 10.64 (9.41–11.38); caudal peduncle length 10.85 (9.68–13.19). Proportions as % HL: snout length 32.67 (30.18–35.96); eye diameter 25.00 (23.38–26.97); interorbital width 7.36 (5.62–8.76).



Fig. 2. Lateral view of *Chaeturichthys stigmatias* (A), *Glossogobius giuris* (B), and *G. olivaceus* (C). Scale bar: 5 cm

Head and body light yellowish to brownish, with some grey or dark brown markings. Four rounded to oval, brown blotches along middle of body and a distinct, black to blackish, triangular blotch at caudal-fin base (brown in ethanol); eight or nine vertical brown to greyish-brown bars alongside of body (Fig. 3A) [6].



Fig. 3. Lateral view of *Oxyurichthys papuensis* (A), *Tridentiger trigonocephalus* (B), and *Taenioides eruptionis* (C). Scale bar: 5 cm

***Tridentiger trigonocephalus* (Gill, 1858)**

The morphological characteristics of this study were consistent with the description of Lindberg and Krasnyukova [13], Nguyen [3]. Morphometrics: SL 110.5–114.5 mm, first dorsal VI, second dorsal I,12; anal I,9; pectoral rays 17–18; caudal 16; lateral scales 47–48; predorsal scale rows 23–25.

Proportions as % SL: body depth 25.13 (24.88–25.37); head length 27.85 (27.80–27.90); predorsal length 38.44 (37.62–39.27); preanal length 71.34 (71.30–71.38); prepelvic length 31.21 (30.77–31.66); caudal peduncle depth 17.31 (16.71–17.91); caudal peduncle length 18.82 (18.46–19.17). Proportions as % HL: snout length 26.40 (25.63–27.16); eye diameter 22.04 (21.85–22.22); interorbital width 30.57 (27.73–33.33).

In preserved ethanol: Head and body are light brown, dark stripe in middle of body, from top of snout to base of caudal fin; another broader stripe above, along bases of dorsal fin to above of base caudal fin. The first dorsal fin pale brown, the upper half is black; second dorsal and anal fins brown, with white edging along margin (Fig. 3B).

***Taenioides eruptionis* (Bleeker, 1849)**

The morphological characteristics (Fig. 3C) of this study were consistent with the description of Nguyen [3]. Morphometrics: SL 192–230 mm, dorsal VI,47; anal 41; pectoral rays 15–16; caudal 16.

Proportions as % SL: body depth 8.15 (7.79–8.71); head length 11.94 (10.58–12.99); predorsal length 19.63 (17.46–21.29); preanal length 36.79 (33.33–38.96); prepelvic length 12.77 (12.43–12.99); caudal peduncle depth 3.22 (3.17–3.25). Proportions as % HL: snout length 27.98 (25.00–30.00); eye diameter 10.18 (10.00–10.53); interorbital width 18.14 (18.00–18.42).

The body is very long, flat on the sides, without scales. The snout is very short, 3 pairs of barbels on ventral surface of lower jaw; the anterior nostril is short tubular, close to the upper lip, the posterior nostril is also tubular but shorter, below the eye. Mouth almost vertical; lower jaw longer than upper jaw. Dorsal fin long, continuous; dorsal and anal fins are connected to the caudal fin. Pelvic fins are large, forming a suction disc. Tail fin pointed. In preserved ethanol: the body is light yellow brown; the caudal fin is light black (Fig. 3C).

4. DISCUSSION

Among the 156 species of Gobiidae in Vietnam, the genus *Acentrogobius* has three species, which include *A. caninus*, *A. chlorostigmatoides*, and *A. viridipunctatus*; there was another species in *Acentrogobius*, but it has now been transferred to *Yongeichthys* Whitley, 1932: this is *Y. nebulosus* (Forsskål, 1775) (according to Fricke et al. [2]). The genus *Glossogobius* has four species, including *G. aureus*, *G. giuris*, *G. olivaceus*, and *G. sparsipapillus*, and *Oxyurichthys* has

four species, including *O. microlepis*, *O. ophthalmonema*, *O. papuensis*, and *O. tentacularis* [6].

In the estuaries of Thanh Hoa province, several studies have been done: Duong Quang Ngoc [14] recorded 263 species belonging to 58 families (12 species of Gobiidae) in the Ma river basin, including the Hoi estuary, and Nguyen Xuan Huan et al. [15] recorded 14 species of Gobiidae studied in the Hoi estuary. Compared to these studies, our results found three additional species—*Acentrogobius caninus*, *Glossogobius olivaceus*, and *Oxyurichthys papuensis*—in the fish fauna of the Hoi estuary in particular and Thanh Hoa province in general. Thus, synthesizing the above studies and our results here, the number of gobiids in the Hoi estuary is updated to include 18 species belonging to 13 genera (Table 3) [6].

Table 3. Updated list of species in the Gobiidae in the Hoi estuary of Ma river

Species	This study	Nguyen et al. (2014)	Duong (2007)
<i>Acanthogobius flavimanus</i> (Temminck & Schlegel, 1845)		+	
<i>Acentrogobius caninus</i> (Valenciennes, 1837)	+		
<i>Acentrogobius chlosostigmatoides</i> (Bleeker, 1849)	+	+	+
<i>Acentrogobius viridipunctatus</i> (Valenciennes, 1837)	+	+	
<i>Aulopareia janetae</i> Smith, 1945		+	
<i>Chaeturichthys stigmatias</i> Richardson, 1844	+	+	+
<i>Favonigobius gymnauchen</i> (Bleeker, 1860)		+	+
<i>Glossogobius giuris</i> (Hamilton, 1822)	+	+	+
<i>Glossogobius olivaceus</i> (Temminck & Schlegel, 1845)	+		
<i>Glossogobius sparsipapillus</i> Akihito & Meguro, 1976		+	+
<i>Mugilogobius abei</i> (Jordan & Snyder, 1901)			+
<i>Odontamblyopus rubicundus</i> (Hamilton, 1822)		+	+
<i>Oligolepis acutipennis</i> (Valenciennes, 1837)		+	+
<i>Oxyurichthys papuensis</i> (Cuvier et Valenciennes, 1837)	+		
<i>Taenioides eruptionis</i> (Bleeker, 1849)	+	+	+
<i>Tridentiger barbatus</i> (Günther, 1861)		+	+
<i>Tridentiger trigonocephalus</i> (Gill, 1858)	+	+	+
<i>Trypauchen vagina</i> (Bloch & Schneider, 1801)		+	+
Total	9	14	12

Studies in estuaries and coastal areas of Vietnam have shown that *Acentrogobius caninus* has a fairly wide distribution and has been recorded in many locations (Fig. 4): Ba Lat estuary, Nam Dinh province [16]; Nhat Le estuary, Quang Binh province [17]; Bu Lu River, Thua Thien-Hue province [18]; Thu Bon River, Quang Nam province [19]; Quang Nam coastal wetlands [20]; Quang Ngai coastal [21]; Binh Cang-Nha Phu, Khanh Hoa province [22]; lower Sai Gon River [23]; Ca Mau coastal [24]; coastal area in Bac Lieu province [25]. According to Fishbase (2023), the distribution of this species is very large, among includes all coastal waters of Vietnam. However, this species has not been reported from Thanh Hoa province until now.

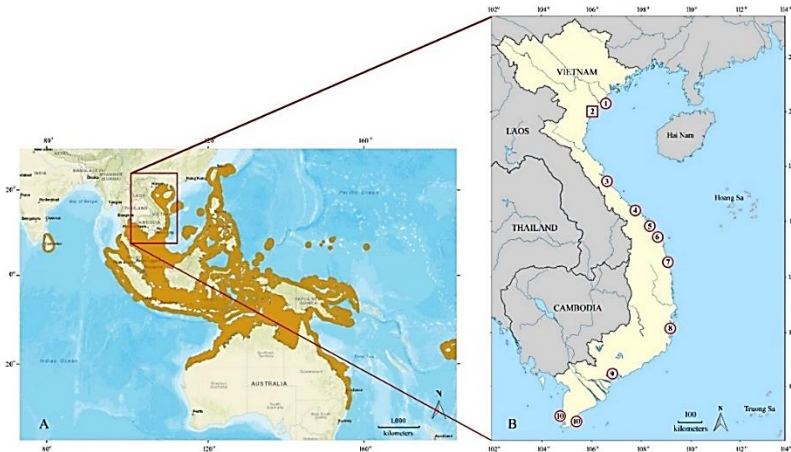


Fig. 4. Distribution of *Acentrogobius caninus*. A. In the worldwide (Source: edited from IUCN, [26]). B. In Vietnam (1. Ba Lat estuary area; 2. Hoi estuary, Sam Son town – new records location in Vietnam; 3. Nhat Le estuary; 4. Bu Lu River; 5. Thu Bon River; 6. Quang Nam coastal wetlands; 7. Quang Ngai coastal; 8. Binh Cang–Nha Phu; 9. Lower Sai Gon River; 10. Ca Mau coastal. Source: edited from Luu Ly, Uwe Derering)

Glossogobius olivaceus and *Oxyurichthys papuensis* are more narrowly distributed. *Glossogobius olivaceus* occurs across East Asia, including the Philippines, China, Taiwan, Japan, and Russia, as well as Africa, including South Africa and Madagascar, and Kwun [11] [6] confirmed its presence in Korea, in an estuarine region in Ulsan. In Vietnam, *G. olivaceus* has only been recorded in the Ba Lat estuary, Nam Dinh province [16]. Here, we expand the distribution of *G. olivaceus* to Southern Vietnam, about 86 km from Ba Lat estuary to the Hoi estuary (Fig. 5).

According to Pezold and Larson [12], *Oxyurichthys papuensis* occurs in New Caledonia, Papua New Guinea, Palau, Japan, Taiwan, Indonesia, Philippines, Seychelles, East Africa, and the Persian Gulf. In Vietnam, *O. papuensis* was recorded in the Thu Bon River, Quang Nam province [19] and coastal wetlands of Quang Nam province [20]. We expand the distribution of *O. papuensis* to Northern Vietnam by about 560 km from Quang Nam province to Hoi estuary (Fig. 6) [6].

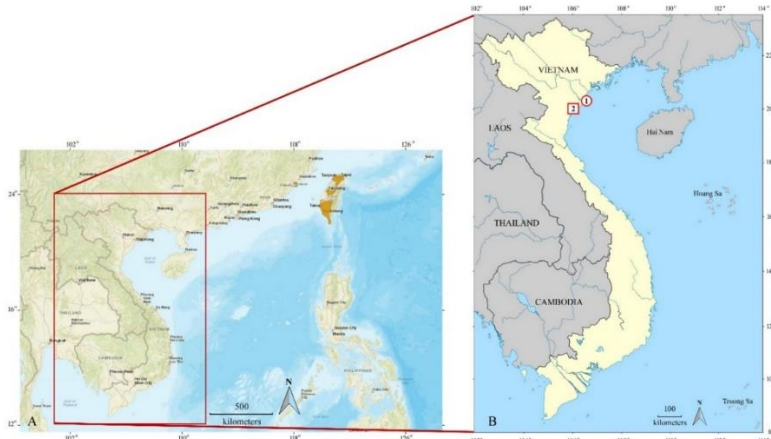


Fig. 5. Distribution of *Glossogobius olivaceus*. A. In the worldwide (Source: edited from IUCN, [26]). B. In Vietnam (1. Ba Lat estuary, Nam Dinh province; 2. Hoi estuary, Sam Son town – new records location in Vietnam. Source: edited from Luu Ly, Uwe Derering)

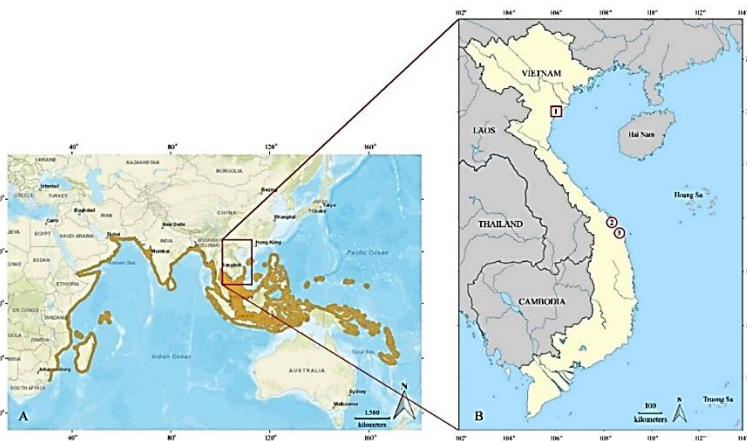


Fig. 6. Distribution of *Oxyurichthys papuensis*. A. In the worldwide (Source: edited from IUCN, [26]). B. In Vietnam (1. Hoi estuary, Sam Son town, Thanh Hoa province – new records location in Vietnam; 2. Coastal wetlands of Quang Nam province; 3. Lower Thu Bon River, Quang Nam province. Source: edited from Luu Ly, Uwe Derering)

5. CONCLUSION

Until now, the number of species in the Gobiidae in the Ma River estuary, Thanh Hoa province has been recorded as 18 species, accounting for 11.61% of the total 155 species of the Gobiidae in Vietnam. Among them, three species are newly recorded for the study area: *Acentrogobius caninus* (Valenciennes, 1837), *Glossogobius olivaceus* (Temminck & Schlegel, 1845), and *Oxyurichthys papuensis* (Valenciennes, 1837).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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