

## Description of a new species of *Periophthalmus* (Teleostei: Gobiidae) from the Lesser Sunda Islands

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**Abstract.** We describe *Periophthalmus pusing* sp. nov., a mudskipper species from the Lesser Sunda Islands. This species closely resembles, and was previously identified as, its congener *Periophthalmus gracilis* Eggert, 1935. A black spot on the posterior portion of the first dorsal fin, a diagnostic character for *P. gracilis*, is also present in the new species, and thus led to the earlier confusion. Adults of *Periophthalmus pusing* sp. nov. (> 30 mm SL) differ from those of *Periophthalmus gracilis* in having XI–XV spines in the first dorsal-fin (vs. VI–XII in *P. gracilis*), first dorsal fin taller than depth of body at anus (first dorsal fin shorter than depth of body at anus in *Periophthalmus gracilis*), interdorsal distance less than half the length of the first dorsal-fin spine (interdorsal distance more than half the length of the first dorsal-fin spine in *Periophthalmus gracilis*).

**Key words.** Oxudercinae, mudskipper, cryptic species, ichthyofauna, Sumba Island.

### INTRODUCTION

Oxudercine gobies (Teleostei: Gobiidae) are a group of amphibious fishes distributed along tidally influenced soft-bottomed coastlines within tropical and sub-tropical Indo-Pacific and Eastern Atlantic Oceans (Murdy, 1989). Commonly referred to as ‘mudskippers’, forty-one species in 10 genera are described (Polgar et al., 2013; Jaafar & Larson, 2008; Murdy, 1989). The most speciose genus, *Periophthalmus* Bloch & Schneider, 1801—with 18 species—includes almost half of all oxudercine fish diversity (Jaafar & Larson, 2008).

Members of the genus *Periophthalmus* (henceforth abbreviated to ‘*P.*’) are easily identified because of their distinct morphology and behaviour. The eyes of all *Periophthalmus* species are situated dorsally, and bulge above the dorsal head profile. These fishes have modified pectoral fins to facilitate locomotion while out of water (Pace & Gibb, 2009). They can be readily observed foraging in mangrove forests or on exposed mudflats during the ebb tide (Polgar & Bartolino, 2010). Species discrimination within *Periophthalmus*, however, remains challenging. The body

plan of members of the genus *Periophthalmus* is conservative and resultantly, few taxonomic characters are available to distinguish between species. Characters used for delimitation are primarily based on shape and structure of the pelvic fins. Shape, structure, pattern, and colour of the first dorsal fin are also used; this is unsurprising as the first dorsal fin is involved in conspecific signalling when territorial boundaries are reinforced, and courtship displays are performed (e.g., Brillet, 1983). Morphometric measurements have been found to be non-discrete within and between species (Murdy, 1989), or have limited applicability (Jaafar & Larson, 2008; Larson & Takita, 2004).

We discovered this new species while surveying oxudercine goby diversity within the Lesser Sunda Islands in Indonesia. A small black spot near the posterior margin of the first dorsal fin, a diagnostic character for *Periophthalmus gracilis* Eggert, 1935, is also present in this new cryptic species. For this reason, we initially identified it as *P. gracilis* but upon closer examination, this species is considered distinct, and herein described.

### MATERIAL AND METHODS

Morphometric measurements were made on the holotype (Table 1). Counts were made on all type specimens, and results are presented in a frequency table (Table 2). Fin ray counts distinguished between segmented and un-segmented rays. The last two rays of the second dorsal and anal fins share the ultimate pterygiophore and were counted as a single ray. Predorsal scales were counted in a straight line, beginning immediately anterior to the first dorsal-fin origin, anteriorly, and terminating just posterior of the interorbital region. Scales in a longitudinal series were counted on the left side, beginning at the dorsoposterior attachment of the operculum, in a posteroventral direction until the dorsal

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Table 1. Measurements and counts of the holotype of *Periophthalmus pusing* sp. nov. (MZB 23015). Measurements are presented as percentages of the standard length (% SL) and head length (% HL).

Species	<i>Periophthalmus pusing</i> sp. nov. HOLOTYPE MZB 23015		
Standard Length	35.3 mm (female)		
MEASUREMENTS		COUNTS	
% SL			
Head Length (HL)	26.6	Fin Elements	
Predorsal Length	24.1		
First Dorsal-fin Base Length	21.5	First Dorsal Fin	XIV
Second Dorsal-fin Base Length	23.8	Second Dorsal Fin	I, 11
Anal-fin Base Length	22.1	Anal Fin	I, 11
Pelvic-fin Base Length	11.3	Pelvic Fin	I, 5
Caudal-fin Length	24.4	Left Pectoral Fin	12
Pectoral-fin Length	26.3	Right Pectoral Fin	12
Pectoral-fin Height	7.1	Caudal Fin (Segmented)	17
Body Width at Anus	4.2		
Body Depth at Anus	9.9	Scale Counts	
% HL			
Head Width	54.3	Longitudinal Series	47
Head Depth	58.5	Transverse - Backwards	10
Snout Length	30.9	Transverse - Forwards	12
Eye Diameter	19.1	Predorsal Midline	19
Jaw Length	28.7		

attachment of the pectoral fin, and continued on a straight line along the midline of the body, and terminating at the hypural crease (see Murdy, 1989). Measurements were made with vernier calipers to the nearest 0.1 mm on the left side of the body. Body proportions were found to be similar between congeners, thus only measurements (as a percentage of standard length [SL] or head length [HL]) of the holotype specimen are presented (Table 1). Specimens used in this study are deposited in the following institutions: Australian Museum, Sydney, Australia (AMS); Lee Kong Chian Natural History Museum, Singapore (ZRC); Museum Zoologicum Bogoriense, Bogor, Indonesia (MZB); Naturalis, Leiden, The Netherlands (RMNH); and National Museum of Natural History, Smithsonian Institution, Washington D.C., USA (USNM).

## SYSTEMATICS

### *Periophthalmus pusing* sp. nov.

(Figs 1, 2, Tables 1, 2)

**Materials examined.** Holotype: MZB 23015, female, 35.3 mm SL, Indonesia, Sumba, Waingapu, Kawangu,

collected by Jaafar Z. and Zamroni Y., 10 November 2012. Paratypes (n=14): AMS I.46780-001, male (32.8 mm SL) and 2 females (33.2–36.6 mm SL), collection data same as holotype; RMNH.PISC.38420, male (29.7 mm SL), 2 females (30.1–32.8 mm SL), collection data same as holotype; USNM 432497, male (29.6 mm SL), 3 females (29.6–36.6 mm SL), collection data same as holotype; ZRC 54416, 2 males (33.0–36.8 mm SL), 2 females (33.8–37.2 mm SL), collection data same as holotype.

**Diagnosis.** Adult *Periophthalmus pusing* sp. nov. are distinguished from all congeners with the following suite of characters: pelvic frenum absent; pelvic fins separate for the entire length; a black spot posteriorly on first dorsal fin, spot usually between ninth and the ultimate spine; first dorsal fin taller than second dorsal fin; interdorsal distance less than half the length of the first dorsal-fin spine. First dorsal-fin elements XI–XV; second dorsal-fin elements I, 10–I, 12; anal-fin elements I, 10–I, 12; pectoral-fin elements 10–12; longitudinal scale rows 42–54; predorsal midline 14–19.

**Description.** Table 1 shows the morphometric and meristic data for the holotype (MZB 23015). A frequency table with

Table 2. Frequency table showing variation in fin element and scale counts in *Periophthalmus pusing* sp. nov. (n=15) and *P. gracilis* (n=27, \*=presence of damaged specimens so that total sample size is not 27).

VARIATION IN MERISTIC COUNTS								
	First Dorsal-fin Elements							
Range	VIII	IX	X	XI	XII	XIII	XIV	XV
<i>Periophthalmus pusing</i> sp. nov.	–	–	–	3	4	4	2	2
<i>Periophthalmus gracilis</i>	4	10	8	4	1	–	–	–
	Second Dorsal-fin Elements							
Range	I, 10	I, 11	I, 12					
<i>Periophthalmus pusing</i> sp. nov.	1	12	2					
<i>Periophthalmus gracilis</i>	17	10	–					
	Anal-fin Elements							
Range	I, 9	I, 10	I, 11	I, 12				
<i>Periophthalmus pusing</i> sp. nov.	–	1	12	2				
<i>Periophthalmus gracilis</i> *	1	12	6	7				
	Left Pectoral-fin Elements							
Range	10	11	12					
<i>Periophthalmus pusing</i> sp. nov.	1	6	8					
<i>Periophthalmus gracilis</i> *	–	7	18					
	Longitudinal Scale Rows							
Range	35–40	41–45	46–50	51–55	56–60			
<i>Periophthalmus pusing</i> sp. nov.	–	8	4	3	–			
<i>Periophthalmus gracilis</i>	8	6	3	6	4			
	Predorsal Midline							
Range	10–15	16–20	21–25					
<i>Periophthalmus pusing</i> sp. nov.	3	12	–					
<i>Periophthalmus gracilis</i> *	1	19	6					



Fig. 1. Holotype of *Periophthalmus pusing* sp. nov. MZB 23015, female, 35.3 mm SL, collected in Sumba Island, Indonesia (Photograph by: Sandra Raredon).



Fig. 2. Live specimen of *Periophthalmus pusing* sp. nov., approximately 35 mm SL, collected in Sumba Island, Indonesia.

meristic counts for *Periophthalmus pusing* sp. nov. and *P. gracilis* is presented in Table 2. The holotype was fixed in formalin and maintained in ethanol (see Fig. 1). Fig. 2 is a photograph of a live specimen of *Periophthalmus pusing* sp. nov. while Fig. 3 is a photograph of a live specimen of *P. gracilis*. The descriptions below provide details of adult specimens over 30 mm SL. As with other congeners, juvenile specimens, especially those equal or less than 25 mm SL, are difficult to discern to species.

**General description:** A slender-bodied *Periophthalmus* with compressed trunk and large, cylindrical head. One row of teeth in both upper and lower jaws; teeth caninoid, evenly spaced; no recurved canine teeth internal to lower jaw symphysis; tongue adnate. Trunk fully covered with scales, scales increase in size posteriorly; opercle and dorsal portion of preopercle with small embedded scales; scales absent on interorbital, isthmus, and snout. First dorsal fin tall, and somewhat rounded; first dorsal fin taller than second dorsal fin, up to two times the height of the second dorsal fin; first dorsal-fin elements almost reaching the second dorsal fin when adpressed; first and second dorsal fins closely set, distance between fins less than half the first spine length of the first dorsal fin. Pelvic frenal absent, pelvic fins separate throughout their length, no basal membrane joining innermost pelvic-fin rays; pelvic fins opaque beige, with light brown scattered pigment on the dorsal area.

**Live colouration:** Ground colour of live specimens greenish-brown to tan-brown dorsally, silvery white to light beige ventrally. Multiple silvery-white vertical lines on the trunk from the pectoral-fin base to the caudal peduncle; lines more prominent ventrally, almost indiscernible dorsally. Seven to eight dark brown saddle-like bars crossing dorsum as described below. First dorsal fin with distal silvery-white to hyaline band; a broad, submarginal dark brown or black band, posterior section intense brown to black, and appears as a spot; black spot aligns with third saddle-like bar on trunk (Fig. 2); proximal to submarginal band with variable colouration, from greenish yellow anteriorly and reddish-orange posteriorly, with two or three rows of bright yellow

elongate to circular spots, to entirely reddish orange with one to two rows of hyaline spots. Second dorsal fin with distal hyaline band, with a broad submarginal reddish-orange and, another hyaline band, and a basal dusky reddish-brown band proximally; basal band with one to two rows of small circular dull yellow to hyaline spots. Anal fin hyaline; pectoral-fin membranes hyaline and dusky light green to brown along fin elements; caudal fin hyaline with aligned series of dark brown spots on interradian membranes, appearing as irregular seven to nine dull yellow-brown thin vertical bars; pelvic fins beige, with light subtle light yellow pigmentation on the dorsal area.

**Colour in preservative:** Ground colour of body beige to dusky brown, creamy beige ventrally; colour most intense anteriorly, dark brown around eyes and on snout. Seven to eight dark brown irregular saddle-like bars crossing dorsum; bars course anteroventrally in the following anterior to posterior pattern: immediately anterior to first dorsal fin, at mid-base of first dorsal fin, just anterior to first dorsal-fin terminus, immediately posterior to origin of second dorsal fin, mid-base of second dorsal fin, immediately posterior to the second dorsal fin, mid-caudal peduncle, posteriormost reach of caudal peduncle. First dorsal fin with thin, distal hyaline band; a broad, submarginal dark brown or black band, posterior section of the band intense brown to black, especially between the ultimate 4-5 spines that appears as a spot in the posterior portion of the first dorsal fin; spot aligns with third saddle-like bar on trunk; proximal to submarginal band, light to dusky brown anteriorly and white to hyaline posteriorly; white elongate spots in two to three rows on spines, especially anteriorly. Second dorsal fin with thin, distal hyaline band, with a broad submarginal brown band and another hyaline band, and a basal dusky brown band proximally; basal band with one to two rows of small circular spots especially on fin elements. Anal fin hyaline; pectoral-fin membranes hyaline and dusky light brown along fin elements; caudal fin hyaline with aligned series of dark brown speckles on interradian membranes, appearing as seven to nine irregular dusky brown thin vertical bars.



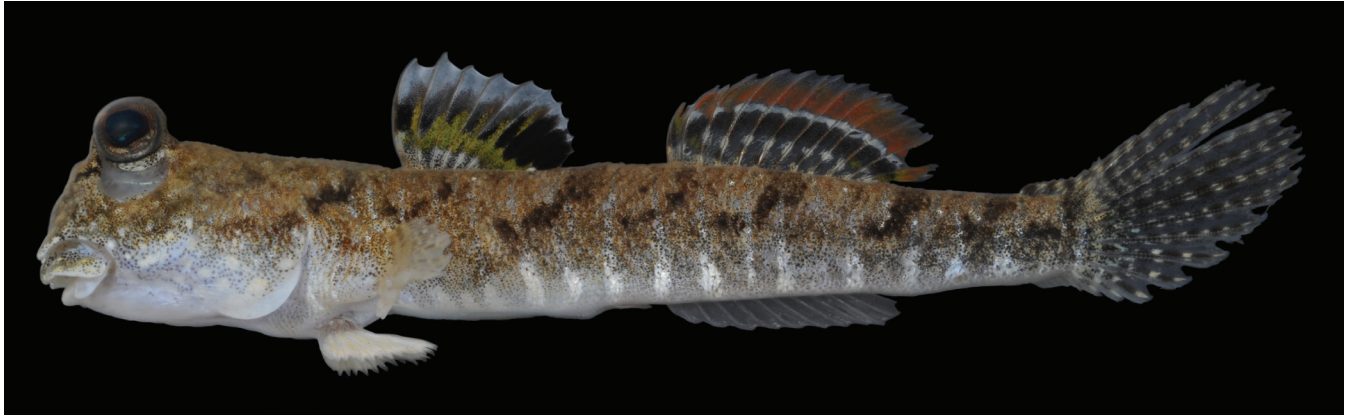


Fig. 3. Live specimen of *Periophthalmus gracilis*, approximately 48 mm SL, collected in Vietnam (Photograph by: Tran Dac Dinh).

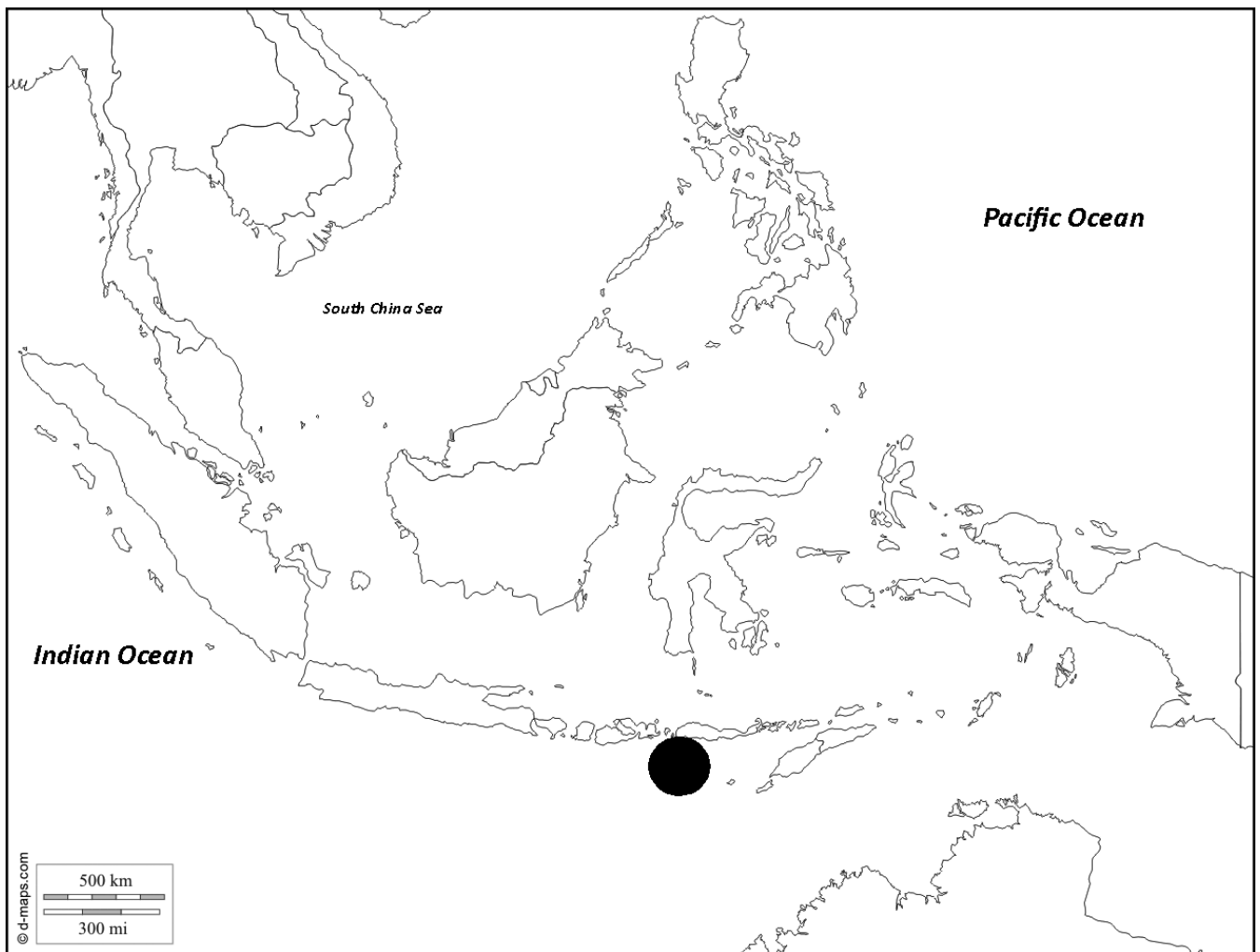


Fig. 4. Occurrence of *Periophthalmus pusing* represented by a black circle—Sumba Island, Indonesia. The base map is courtesy of d-maps.com.

**Etymology.** The specific epithet ‘pusing’, meaning ‘giddy’ in Indonesian, is the common name used by the coastal people of the Lesser Sunda Islands to refer to *Periophthalmus* mudskippers. These fishes are known as ‘Ikan Pusing’ (Indonesian: ikan=fish, pusing=giddy), as it is believed that consuming these fishes causes headaches and giddiness.

**Distribution.** Presently known to occur only on the island of Sumba, Indonesia (Fig. 4).

**Field notes:** The general locality in which this mudskipper was found—Kawangu—is a tide-dominated coastal system with relatively low wave action. Within the mangrove forest, *P. pusing* sp. nov. was found in a variety of microhabitat types in seaward and higher mangrove areas as well as within, and on sloping banks of tidal creeks. This species was syntopic with two congeners: *Periophthalmus argenteolineatus* and *Periophthalmus malaccensis*.

**Remarks.** Adult *Periophthalmus pusing* sp. nov. differ from all other congeners, except *P. gracilis*, in the absence of the pelvic frenum, pelvic fin not unified, and the presence of a black spot on the posterior first dorsal fin. Adult *Periophthalmus pusing* sp. nov. can be differentiated from adult *P. gracilis* in having XI–XV spines in the first dorsal fin (vs. VI–XII in *P. gracilis*), first dorsal fin taller than second dorsal fin (first dorsal fin shorter or equal in height to second dorsal fin in *P. gracilis*), interdorsal distance less than half the length of the first dorsal-fin spine (interdorsal distance approximates the length of the first dorsal-fin spine in *P. gracilis*). Whereas juvenile specimens (approx. 25–30 mm SL) of *Periophthalmus pusing* sp. nov. and those of *P. gracilis* are superficially similar, differences are apparent upon scrutiny. For specimens of the same size, the first dorsal fin in *Periophthalmus pusing* sp. nov. has more spines, is taller, and has a shorter interdorsal-fin distance. It is extremely difficult to identify the species of most *Periophthalmus* specimens below 25 mm SL.

**Comparative material.** *Periophthalmus gracilis*: USNM 278295, Vanikoro, Solomon Islands, female (42.1 mm SL); USNM 341322, Solomon Islands, male (36.3 mm SL); USNM 278473, Marieveles, Philippines, male (35.8 mm SL), female (35.5 mm SL); AMS I.22700–014, Daintree River mouth, Australia, 2 females (38.3–40.6 mm SL); AMS I.26333–003, Queensland, Australia, male (39.3 mm SL), 3 females (33.1–39.6 mm SL); AMS I.19355–022, Balikpapan, East Kalimantan, Indonesia, 2 males (20.4–33.0 mm SL), female (33.1 mm SL); ZRC 50771, Tritih, Cilacap, Java, Indonesia, 3 females (39.4–46.0 mm SL); USNM 366711, Temburong River, Brunei, 3 males (32.4–34.4 mm SL), female (35.0 mm SL), juvenile (26.7 mm SL); ZRC 27057, St. John’s Island, Singapore, 2 males (34.1–34.3 mm SL); ZRC 53201, Pandan Mangroves, Singapore, male (34.1 mm SL), 2 females (32.9–35.8 mm SL); ZRC 37792, Sarawak, East Malaysia, male (34.5 mm SL), 6 females (33.2–38.3 mm SL); ZRC 47563, Pantai Batu Hitam, Pahang, Peninsular Malaysia, female (39.8 mm SL).

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