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Newly Recognized Diagnostic Characters of the Poorly Known Lionfish *Pterois brevipectoralis* (Scorpaenidae: Pteroinae), with Notes on Fresh Coloration

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Pterois brevipectoralis (Mandrytsa, 2002), previously known only from the holotype and two paratypes collected from the Saya de Malha Bank (western Indian Ocean), in depths of 57–90 m, is redescribed on the basis of 10 additional specimens collected from the type locality and the Cargados Carajos Shoals, Mascarene Islands. The species is characterized by the presence of usually XIII, 10 dorsal-fin rays, usually 16 pectoral-fin rays, a relatively low number (6–10) of dark blotches on the pectoral-fin membrane, a relatively short pectoral fin [longest ray 44.5–66.4 (mean 53.4)% SL; not extending beyond the level of the posterior end of the dorsal-fin base in specimens over 91.3 mm SL], ctenoid scales covering the head and dorsolateral body, and the posterior portion of the pectoral-fin rays (not associated with fin membrane) with several bands. In addition, extremely large (greater than orbit diameter), fan-like skin flaps on the tip of the posterior lacrimal spine and the posterior margin of the preopercle in large adults are recognized herein as diagnostic characters for the species. The first report of fresh coloration, based on a specimen from the Saya de Malha Bank, is included, and ontogenetic changes in various features are described in detail.

Key Words: *Pterois brevipectoralis*, *Pteropterus*, diagnosis, distribution, Cargados Carajos Shoals, Mascarene Islands, Saya de Malha Bank, Indian Ocean.

Introduction

The Indo-Pacific scorpaenid genus *Pterois* Oken, 1817 has been characterized within the subfamily Pteroinae as having three anal-fin spines, all pectoral-fin rays unbranched, the parietal spine of males not elongated, and no spine or ridge on the mandible (Eschmeyer and Randall 1975; Poss 1999). Smith (1957) and Mandrytsa (2001, 2002) regarded *Pteropterus* Swainson, 1839 as valid, being distinguished from *Pterois* by having more than 15 pectoral-fin rays (*vs* fewer than 15 in *Pterois*), the head and dorsolateral body covered with ctenoid scales (*vs* all scales cycloid), less than 65 scale rows in the longitudinal series (*vs* fewer than 65), and the ventral margin of the orbit close to the suborbital ridge (*vs* greatly separated). In his phylogenetic analysis of the Scorpaenoidei, based on morphological characters, Mandrytsa (2001) included the following five species in *Pteropterus*: *Scorpaena antennata* Bloch, 1787, *Pterois radiata* Cuvier in Cuvier and Valenciennes, 1829, *Pterois sphex* Jordan and Evermann, 1903, *Pteropterus mombasae* Smith, 1957, and *Pteropterus brevipectoralis* Mandrytsa, 2002 (as *Pteropterus* sp.). However, most recent studies have treated *Pteropterus* as a junior synonym of *Pterois* (*e.g.*, Herre 1952; Eschmeyer and Randall 1975; Poss 1999). In addition, Kochzius *et al.* (2003) suggested *Dendrochirus* Swainson, 1839 to also be a junior synonym of *Pterois* on the basis of a molecular phylogenetic analysis. Although *Dendrochirus* had previously been considered distinguished from *Pterois* by a single pectoral fin character, *i.e.*, several rays branched in adults, compared with all rays unbranched throughout life in *Pterois* (Smith 1957; Poss 1999; Mandrytsa 2001), such separation of the two genera was questioned by Eschmeyer and Randall (1975). However, a comprehensive phylogenetic study of Pteroinae has yet to be made, and the relationships between *Pterois*, *Pteropterus*, and *Dendrochirus* remain unclear. Accordingly, we tentatively follow the widespread practice of regarding *Pteropterus* as a junior synonym of *Pterois*, as previously done by Matsunuma and Motomura (2011).

Pterois brevipectoralis (Mandrytsa, 2002) was originally described as *Pteropterus brevipectoralis* on the basis of three specimens (65.5–147 mm SL) collected from the Saya de Malha Bank, western Indian Ocean, in depths of 57–90 m (Mandrytsa, 2002). The species has not been reported since. Because Mandrytsa's (2002) detailed description of the species was based solely on preserved specimens, it lacked any description of fresh coloration. The recent location of several additional specimens (49.2–117.9 mm SL), collected from the Saya de Malha Bank and the Mascarene Islands, representing first records from the latter locality, and the

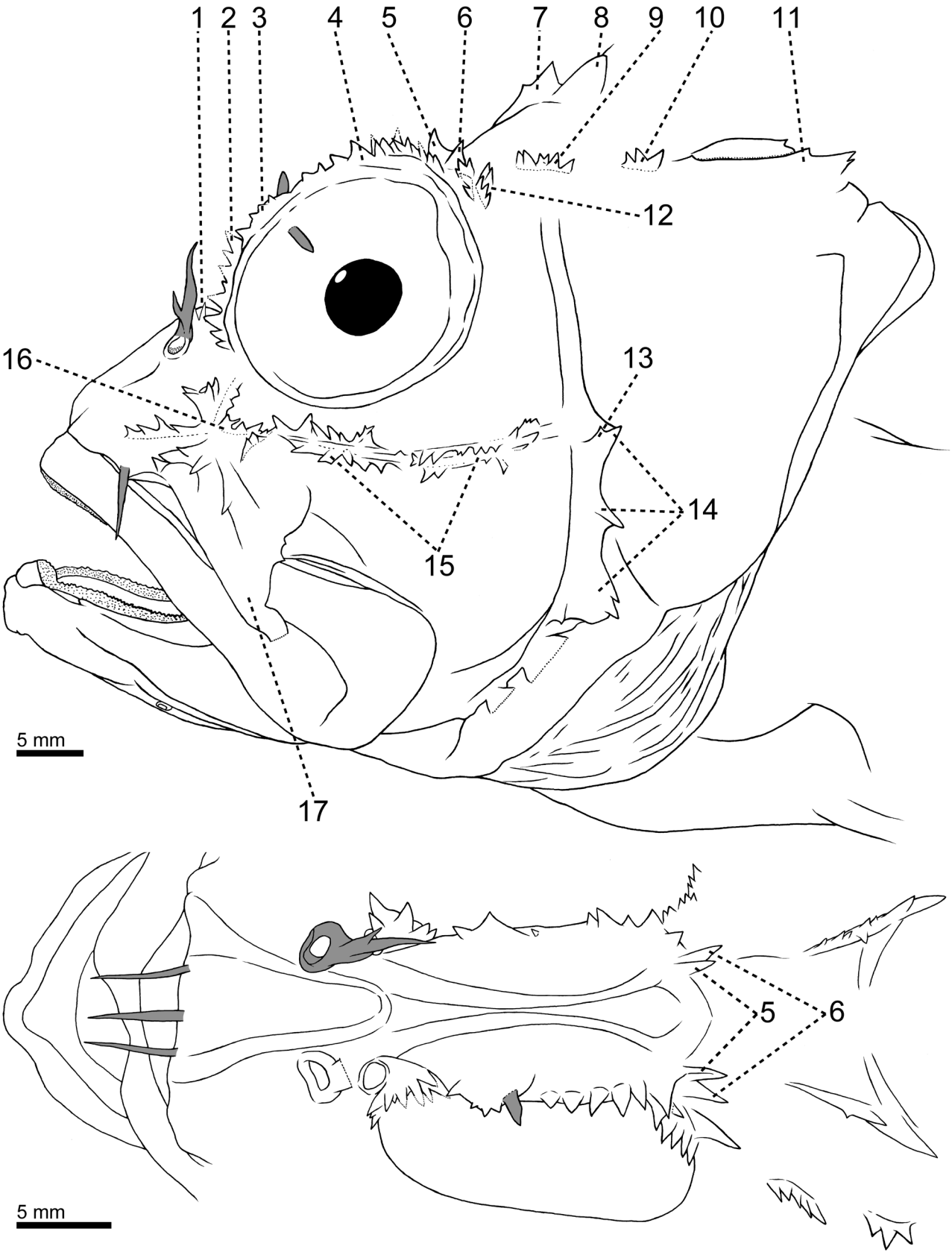

Fig. 1. Lateral (top) and dorsal (bottom) views of head of *Pterois brevipectoralis*, HUMZ 73848, 125.7 mm SL. Shaded areas indicate skin flaps. 1, nasal spine; 2, preocular spine; 3, supraocular spine; 4, postocular spine; 5, coronal spine; 6, tympanic spine; 7, parietal spine; 8, nuchal spine; 9, pterotic spine; 10, lower posttemporal spine; 11, supracleithral spine; 12, sphenotic spine; 13, supplemental preopercular spine; 14, preopercular spine; 15, suborbital ridge/spine; 16, lateral lacrimal ridge/spine; 17, posterior lacrimal spine. Barbel on anteroventral lacrimal based on right side in lateral view; nasal spines and right supraocular skin flap not illustrated in dorsal view.

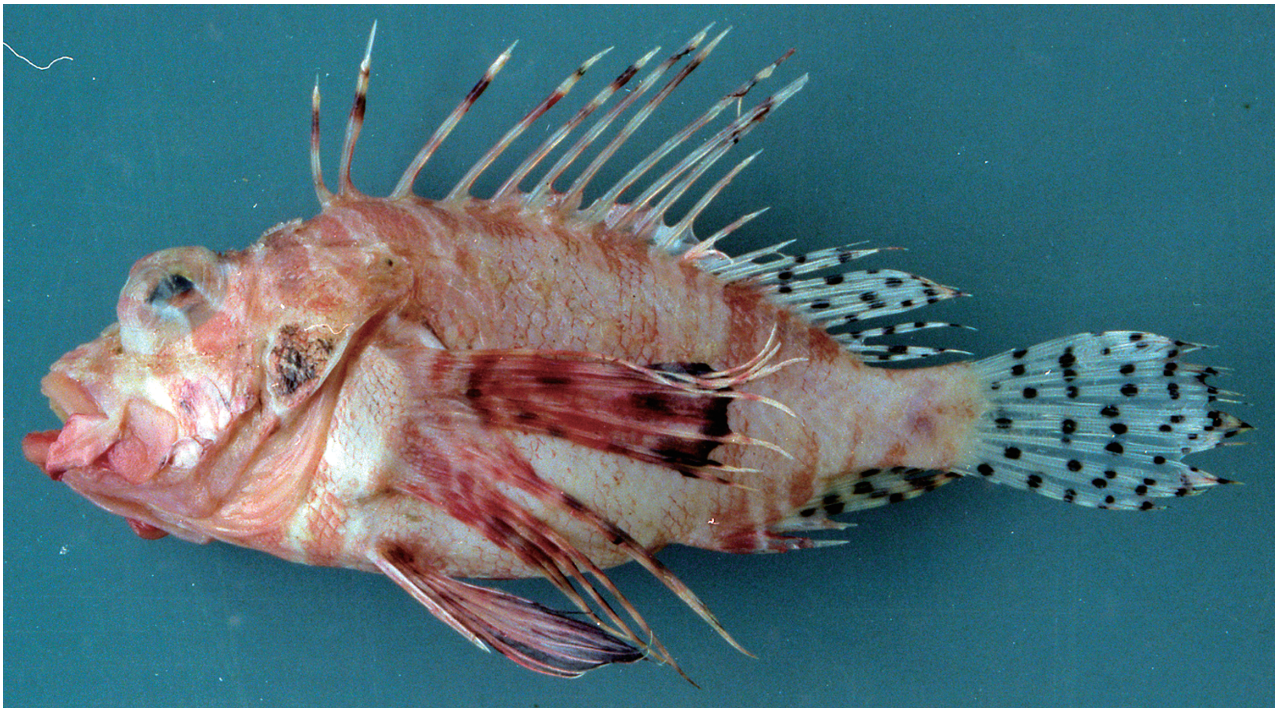

Fig. 2. Fresh specimen of *Pterois brevipectoralis*, HUMZ 73846, 115.8 mm SL, Saya de Malha Bank. Photo: HUMZ.

recognition of additional diagnostic features and ontogenetic changes, has led to the redescription of *Pterois brevipectoralis* given herein. Furthermore, a photograph of a specimen from the Saya de Malha Bank, taken prior to preservation, has enabled a description of the fresh coloration of the species.

Materials and Methods

Measurements generally follow Motomura (2004b, c), with head width and maxillary depth following Motomura *et al.* (2005b, 2006a) and Motomura *et al.* (2006b), respectively. The following additional measurements are given: body depth at anal-fin origin—body depth at level of first anal-fin spine base; 1st–9th pectoral-fin ray length—distance from the uppermost pectoral-fin ray origin to each ray tip. Lengths of skin flaps on the tips of supraocular and posterior lacrimal spines were measured as the distance between the flap base and the extreme end of the flap. Counts generally follow Motomura *et al.* (2005a–c) and Motomura and Johnson (2006), with predorsal scale counts following Motomura *et al.* (2006b). The following additional count is given: scales above lateral line—vertical scale rows between the first pored lateral-line scale and the dorsal-fin base. The last two soft rays of the dorsal and anal fins were counted as single rays, each pair being associated with a single pterygiophore. Counts and measurements were made on the left side wherever possible, except that pectoral-fin rays were counted on both sides.

Head spine terminology (shown in Fig. 1) generally follows Randall and Eschmeyer (2002: fig. 1) and Motomura (2004c: fig. 1), with the following additions: the spine at the base of the uppermost preopercular spine is termed the supplemental preopercular spine (Eschmeyer 1965) and that on the lateral surface of the lacrimal bone is called the lateral lacrimal spine (Motomura and Senou 2008: fig. 2; Motomura *et al.* 2011: fig. 1). Standard length is abbreviated as SL. Institutional codes followed Sabaj Pérez (2012).

Pterois brevipectoralis (Mandrytsa, 2002)
(Figs 1–6; Tables 1–2)

Pteropterus sp.: Mandrytsa 2001: 16 (phylogenetic material; key).

Pteropterus brevipectoralis Mandrytsa 2002: 129, unnumbered fig. on p. 129 (type locality: Saya de Malha Bank).

Examined specimens (10 specimens, 49.2–117.9 mm SL)**. MASCARENE ISLANDS:** USNM 392069, 49.2 mm SL, lagoon on west side of Frigate Island, Cargados Carajos Shoals, Mauritius (16.6°S, 59.5°E), 0–1 m, V. Springer *et al.*, 1 April 1976; USNM 400514, 2 specimens, 59.2–69.3 mm SL, *ca.* 2 miles (*i.e.*, *ca.* 3.2 km) east of Raphael Island, Cargados Carajos Shoals, Mauritius (16°S, 59°31′E), 0.2–1.1 m, V. Springer *et al.*, 3 April 1976. **SAYA DE MALHA BANK:** HUMZ 73841, 110.1 mm SL, HUMZ 73843, 111.7 mm SL, HUMZ 73844, 91.3 mm SL, HUMZ 73845, 101.0 mm SL, HUMZ 73846, 115.8 mm SL, HUMZ 73847, 117.9 mm SL, HUMZ 73848, 125.7 mm SL, 10°30′S, 61°32′E, 95 m, 3 September 1977.

Diagnosis. A species of *Pterois* with the following combination of characters: dorsal-fin rays usually XIII, 10; anal-fin soft rays 6; pectoral-fin rays usually 16 (rarely 15); scale rows in longitudinal series 46–51; pectoral-fin rays relatively short, not extending beyond level of posterior

end of dorsal-fin base in large specimens of >91.3 mm SL, longest ray length 44.5–66.4% (mean 53.4%) SL; large, fan-like skin flaps (length greater than half of orbit diameter in large specimens of >91.3 mm SL) on tip of posterior lacrimal spine and posterior margin of preopercular, relative size increasing with growth; head and dorsolateral parts of body covered with ctenoid scales; 6–10 large, black blotches on pectoral-fin membrane; posterior parts of pectoral-fin rays, not associated with fin membrane, with several reddish (dark in preserved specimens) bands.

Description. Characters included in specific diagnosis not repeated here. Morphometrics and selected meristics as shown in Tables 1–2; in particular, anal fin with 3 spines, pelvic fin with 1 spine and 5 soft rays, scales below lateral line 11, branchiostegal rays 7.

Body oblong, moderately compressed posteriorly; depth moderate, greater than length of longest dorsal-fin spine. Three barbels on snout tip, their length subequal to or slightly longer than nasal tentacle length. Short tentacle (simple in juveniles, with a lateral branch in large adults) on posterior edge of low, membranous tube associated with anterior nostril, its tip extending beyond posterior margin of posterior nostril when depressed posteriorly. Supraocular with long tentacle with 2–4 lateral branches in juveniles, low skin flap in large adults. Anteroventral part of lacrimal with short tentacle, its length subequal to barbels on snout tip. Large fan-like skin flap on tip of posterior lacrimal spine, becoming larger with growth, tip of flap extending beyond margin of preopercle when laid along maxilla in adults of >91.3 mm SL (not reaching margin in juveniles of <69.3 mm SL). Two relatively large (but smaller than posterior lacrimal spine flap) fan-like flaps on margin of preopercle, their tips extending beyond posterior margin of interopercle when laid flat. Usually also a large, fan-like flap present on ventral portion of third preopercular spine. Small skin flap present on anterodorsal portion of orbit surface, its length less than diameter of posterior nasal pore. No other skin flaps on head or body.

Ctenoid scales covering head and anterodorsal surface of body; remainder of body with cycloid scales. Basal scales absent on dorsal and anal fins. Relatively small cycloid scales extending onto bases of pectoral and caudal fins. Occipital area entirely covered with ctenoid scales. Dorsal surface of postocular covered with weakly ctenoid scales, mostly possessing 1 or 2 spines. Cheek with ctenoid scales, but suborbital pit lacking scales. Preopercle generally covered with cycloid scales, several larger scales being weakly ctenoid. Basal part of posterior lacrimal spine partly covered with small, weakly ctenoid scales, most possessing a single spine. Dorsal surfaces of supraocular and postocular, and posterior portion of interorbital area partly covered with relatively small, weakly ctenoid scales with usually 1 but up to 3 spines. Central and anterior portions of interorbital area lacking scales. Interopercle lacking scales. Opercle with mostly cycloid and some large, weakly ctenoid scales.

Mouth moderately large, slightly oblique, forming angle of *ca.* 30–40° to horizontal axis of head and body; upper edge of posterior maxilla swollen laterally, forming low

Table 1. Morphometrics, expressed as percentages of standard length, of *Pterois brevipectoralis*.

Locality	Mascarene Islands (n=3)	Saya de Malha Bank (n=7)	Means
SL (mm)	49.2–69.3	91.3–125.7	
Body D (% SL)	36.6–40.4	38.3–41.7	39.4
Body D[1]	30.7–31.9	26.6–31.0	29.5
Body W	24.2–26.5	24.5–28.9	26.1
Head L	39.6–43.6	40.9–45.1	43.5
Head W	13.6–15.3	15.3–17.0	15.8
Snout L	9.6–11.3	10.5–11.8	11.0
Orbit diameter	13.6–15.2	10.5–11.8	14.8
Interorbital W[2]	7.7–9.1	7.2–9.2	8.4
Interorbital W[3]	7.5–8.1	6.4–8.6	7.5
Upper-jaw L	18.5–20.3	21.6–23.4	21.6
Maxillary D	7.3–8.3	6.4–8.6	8.4
Suborbital D	0.8	0.9–1.7	1.1
Postorbital L	18.9–19.9	19.6–20.6	19.9
Pre-dorsal-fin L	33.5–36.8	34.9–37.0	36.0
Pre-anal-fin L	69.4–73.7	70.2–75.1	72.6
Pre-pelvic-fin L	35.6–40.3	39.2–42.8	40.4
1st DS L	17.1	—	17.1
2nd DS L	24.8–28.7	—	26.8
3rd DS L	28.2–28.9	26.0	27.7
4th DS L	32.9–34.9	—	33.9
5th DS L	—	—	—
6th DS L	38.2–40.3	—	39.2
7th DS L	36.0–43.0	—	40.1
8th DS L	35.6–42.1	—	39.8
9th DS L	34.3–39.0	37.7	37.0
10th DS L	30.3–36.9	34.4–36.1	34.4
11th DS L	—	17.5–30.2	24.0
12th DS L	11.2–18.2	13.1–15.3	14.6
13th DS L	17.7–18.8	11.5–15.8	15.0
1st DSR L	23.8–25.7	19.4–21.4	21.9
Longest DSR L	26.1–28.5	25.8–26.0	26.5
1st AS L	10.2–10.6	8.2–10.3	9.9
2nd AS L	17.6–19.3	14.2–18.1	16.7
3rd AS L	19.1–23.6	15.8–18.4	19.5
1st ASR L	28.7–31.6	22.9–26.6	26.5
Longest ASR L	32.2–34.5	27.2–28.5	29.4
1st P1 L	51.7–65.4	31.7–41.7	44.4
2nd P1 L	61.0–71.6	38.4–49.4	51.0
3rd P1 L	64.5–72.6	44.4–50.7	54.3
4th P1 L	66.4	41.0–52.2	50.7
5th P1 L	66.1–68.9	44.5–56.0	52.8
6th P1 L	62.5–64.4	43.7–55.5	51.4
7th P1 L	61.7	40.1–50.0	48.5
8th P1 L	56.6	40.5–46.8	46.4
9th P1 L	38.7–52.0	38.6–54.9	45.1
Longest P1 L	63.0–66.4	44.5–46.8	53.4
P2S L	23.4–25.7	17.9–19.8	21.5
Longest P2SR L	43.4–47.3	35.8–40.2	39.7
Caudal-fin L	35.0–38.3	34.8–36.2	36.0
Caudal-peduncle L	16.6–17.3	14.5–16.8	15.8
Caudal-peduncle D	11.3–11.7	10.4–11.2	11.0
Membrane above 6th P1 extending up to	85.9–93.0% of 6th P1 L	76.7–91.2% of 6th P1 L	86.1% of 6th P1 L

AS: anal-fin spine; ASR: anal-fin soft ray; D: depth; DS: dorsal-fin spine; DSR: dorsal-fin soft ray; L: length; P1: pectoral-fin ray; P2S: pelvic-fin spine; P2SR: pelvic-fin soft ray, W: width.
[1] at anal-fin origin; [2] at vertical midline of eye; [3] at posterior end of preocular spine base.

Table 2. Number of specimens of *Pterois brevipectoralis* displaying selected meristics.

Pectoral fin rays (one/other sides)			Dorsal fin soft rays		Pored LL scales		
15/15	15/16	16/16	9	10	24	25	26
1	3	6	1	9	1	1	1
SR in longitudinal series						Scales above LL	
46	47	48	49	50	51	7	8
1	1	1	1	1	1	4	5
SR between LL and last DSB			SR between LL and 6th DSB			Predorsal-fin SR	
6	7	8	5	6	7	5	6	7
2	6	2	5	4	1	5	4	1
Upper gill rakers			Lower gill rakers			Total gill rakers		
4	5	10	11	12	14	15	16	17
3	7	5	3	2	2	3	4	1

DSB: dorsal-fin spine base, LL: lateral line, SR: scale rows.

ridge; posterior margin of maxilla extending beyond mid-orbit level, but not reaching level of posterior orbit margin. Symphyseal gap separating premaxillary teeth bands distinctly wider than width of each band; upper jaw with band of small, slender conical teeth; about 9 tooth rows at front of upper jaw; about 4–6 tooth rows at front of lower jaw; small teeth in 4–5 rows forming blunt V-shaped patch on vomer; no palatine teeth. Three sensory pores on underside of each dentary, and one small pore on each side of symphysial knob.

Dorsal profile of snout relatively steep, forming angle of *ca.* 40–50° to horizontal axis of head and body. Nasal spine with 1–3 spinous points. Preocular spine with 2–10 spinous points. Supraocular with 0–3 small spines. Postocular with 4–15 small spines. Interorbital ridge moderately developed, reduced posteriorly. Coronal spine with single point (rarely 2 points in large adults). Tympanic spine with a single point (rarely 2 points in large adults). Anterior margin of occipital area sloped transversely from between bases of coronal spines, curved posteriorly in dorsal view. Parietal spine with 1–7 spinous points, its base relatively long, diverging posteriorly. Nuchal spine with 1–2 spinous points, its base completely conjoined with that of parietal spine. Postorbital spine absent. Sphenotic with 2–14 small spines. Pterotic with 1–8 small spines. Lower posttemporal spine with 1–4 spinous points. Cleithrum with upper and lower ridges; upper ridge with 1 flattened spine posteriorly (rarely 2 spines in large adults); lower ridge with 1–4 spines.

Lateral lacrimal spine with 1–4 spinous points; all lacrimal ridges strongly spinous in adults. Suborbital with upper main and lower supplemental ridges; upper ridge with 4–19 spines; lower ridge with 4–12 spines. Anterior lacrimal spine absent. Posterior lacrimal spine broad, plate-like, with 1–4 spinous points on distal margin. Preopercle with 3 spines, all of similar length; uppermost spine directed posterodorsally, other 2 directed posteriorly to posteroventrally; bases of uppermost and middle spine with 1–3 and 0–2 supplemental spines, respectively; lowermost spine broad, plate-like, with 2–4 spinous points on distal margin. Exposed opercular spine absent.

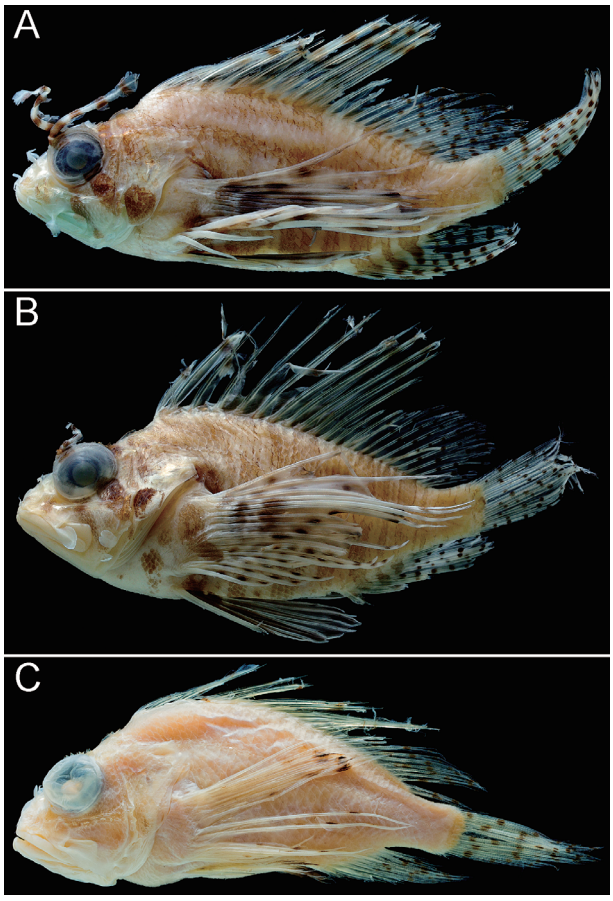

Fig. 3. Preserved specimens of *Pterois brevipectoralis*. A, USNM 392069, 49.2 mm SL, Frigate Island, Cargados Carajos Shoals, Mascarene Islands; B, USNM 400514, 1 of 2 specimens, 69.3 mm SL, Raphael Island, Cargados Carajos Shoals, Mascarene Islands; C, HUMZ 73844, 91.3 mm SL, Saya de Malha Bank.

Origin of first dorsal-fin spine above lower posttemporal spine; bases of first and second dorsal-fin spines closer than those of subsequent adjacent spines; seventh or eighth spine longest; twelfth spine usually shortest, its length 49–84%

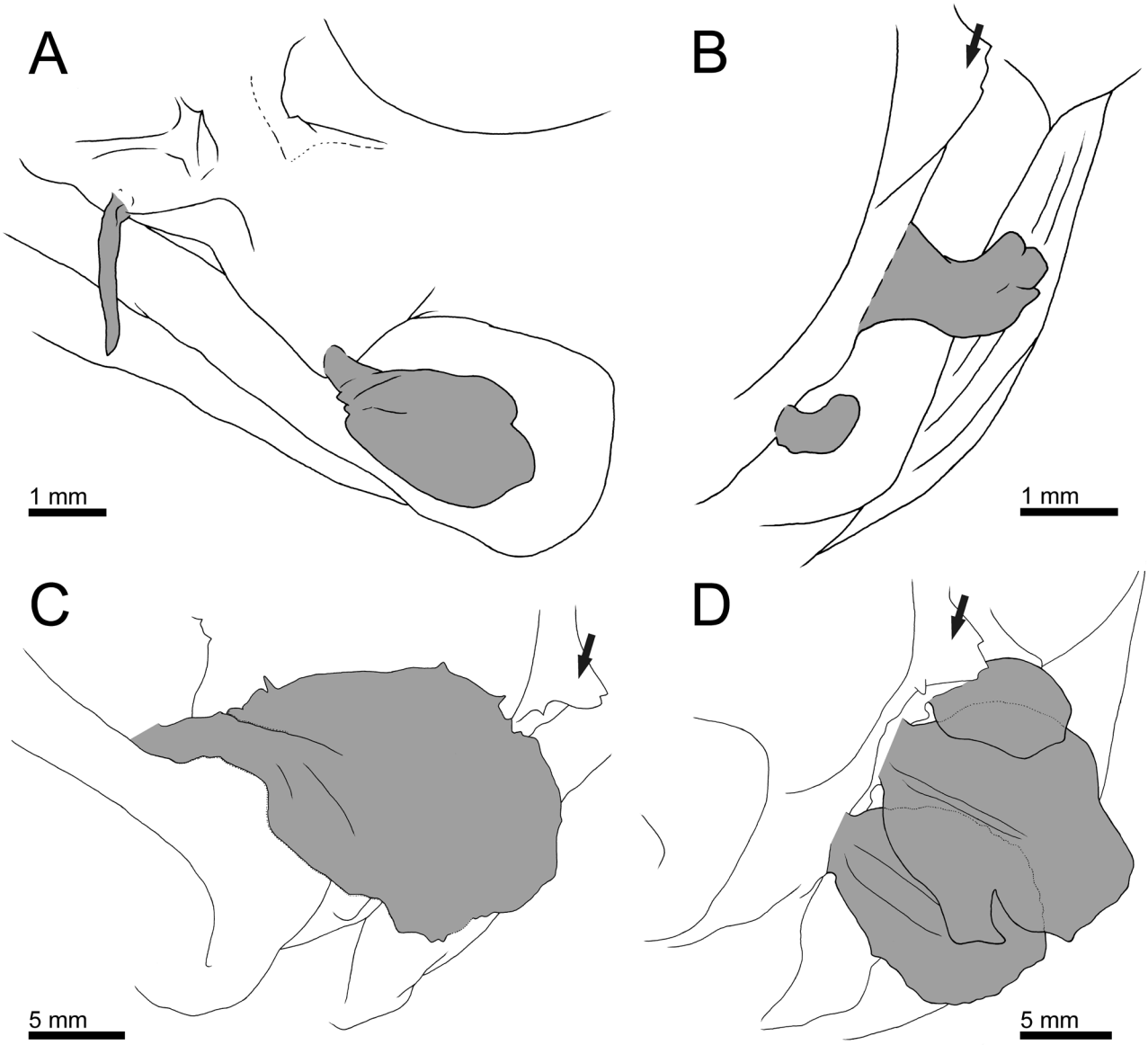

Fig. 4. Skin flaps on lacrimal (A and C) and preopercle (B and D) of *Pterois brevipectoralis* at different growth stages. A, B, USNM 392069, 49.2 mm SL; C, D, HUMZ 73848, 125.7 mm SL. Arrows indicate third preopercular spine.

and 90–114% of that of antepenultimate and posteriormost spines, respectively; membrane of spinous portion of dorsal fin strongly incised. Dorsal-fin soft rays all branched; fourth ray longest, but distinctly shorter than longest dorsal-fin spine; posteriormost ray not joined by membrane to caudal peduncle. Origin of first anal-fin spine just below posteriormost dorsal-fin spine base; third spine longest; length of first spine 53–70% and 45–65% of that of second and third spines, respectively. Anal-fin soft rays all branched; second or third ray longest, its length slightly greater than that of longest dorsal-fin soft ray; posteriormost ray not joined by membrane to caudal peduncle. Pectoral fin relatively long, tip of longest ray extending beyond vertical drawn through first anal-fin spine base in all juvenile/adult stages, and just reaching or extending beyond caudal-fin base in juveniles of $<$69.3 mm SL, just reaching or not reaching vertical drawn through posteriormost dorsal-fin soft ray base in large adults of $>$91.3 mm SL; all rays unbranched, lower rays weakly thickened. First pelvic-fin spine base below third dorsal-fin spine base; all pelvic-fin soft rays branched; usually second (rarely third) soft ray longest, its tip extending beyond first anal-fin spine base when depressed, but not reaching posteriormost anal-fin soft ray base; posteriormost soft ray joined by membrane to abdomen for less than about one-fifth to one-fourth of ray length. Caudal fin usually with 4 procurrent rays, 2 segmented unbranched rays, and 5 segmented branched rays in dorsal and ventral series (rarely 3, 2 and 5 rays, respectively, in each or either series); profile of posterior margin of fin moderately rounded. Caudal peduncle moderately short, deep, its depth 65–74% of caudal-peduncle length.

Color of fresh specimen. Based on color photograph of HUMZ 73846, taken before preservation (Fig. 2). Ground color of head and body white, somewhat pinkish dorsally. Jaws and skin flap on posterior lacrimal spine tip pinkish. Reddish band crossing eye, reaching posterodorsal corner

of preopercle. Large blackish blotch on ventral corner of opercle. Broad reddish band saddling nape at level of parietal spine, numerous narrow reddish bands on body sides. Dorsal-fin membrane translucent; 2–3 reddish bands on each dorsal-fin spine; *ca.* 25 small black spots on soft rays altogether. Anal-fin membrane translucent; *ca.* 11 small black spots on soft rays altogether. Pectoral fin dark red, with several relatively large black blotches on membrane and narrow black band on distal margin; free portion of rays creamy-white with 1–3 reddish bands. Pelvic fin dark red; strongly blackish marginally. Caudal-fin membrane translucent with *ca.* 50 small black spots on rays altogether. Eye yellowish; iris black.

Color of preserved specimens (based mostly on Mascarene Islands specimens, the coloration of Saya de Malha Bank specimens having disappeared almost completely, except for black markings) (Fig. 3). Head and body creamy-white. Five brown bands on head; anteriormost band on snout reaching from anteroventral margin of orbit to anteroventral margin of lacrimal; second band extending from below eye (from ventral margin) across posterodorsal corner of maxilla to ventral corner of preopercle; third band relatively broad from supraocular spine (supraocular tentacle base), obliquely crossing eye and reaching subopercle; fourth band just behind eye, saddling nape at level of coronal spine; fifth band saddling nape at level of parietal spine, reaching opercle. Large brown blotch on subopercle, numerous brown bands on lateral body, including caudal peduncle. Dorsal-fin membrane translucent; 1–3 brown bands on each dorsal-fin spine; 21–40 small black spots on soft rays altogether. Anal-fin membrane translucent; 16–32 small black spots on soft rays altogether. Pectoral-fin membrane translucent, blackish marginally, with 1–10 relatively large black blotches on membrane, numerous small, black spots on border between posterior rays and membrane; free portion of rays creamy-white with 1–4 brown bands. Pelvic-fin membrane blackish, rays creamy-white. Caudal-fin membrane translucent with 49–62 small black spots on rays altogether. Supraocular tentacle with 2–4 brown bands (based on USNM 392069, USNM 400514; Fig. 3A, B).

Remarks. Although the holotype of *P. brevipectoralis* was not available for this study, the present specimens (91.3–125.7 mm SL) collected from the Saya de Malha Bank agreed with the description of *Pteropterus brevipectoralis* (=*Pterois brevipectoralis*) given by Mandrytsa (2002), with the exception of the longitudinal series scale row counts [46–50 in the present specimens *vs* 53–55 in Mandrytsa (2002) as "scale vertical rows"]. This difference is likely due to different counting techniques, for although Mandrytsa (2002) stated that his counts generally followed Eschmeyer (1969), the longitudinal series scale rows thus being those above the lateral line from the row over the posterior end of the supracleithral spine base to the row at the end of the hypural (as in the present study), he may have included several scale rows behind the hypural plate, thereby resulting in higher numbers. Although Mandrytsa (2002) provided a drawing of the holotype of *P. brevipectoralis*, an accurate count of longitudinal series scale rows based on this drawing is not possible due to an apparent inaccuracy in the number of scale rows depicted. Although the drawing indicates at least 29 pored lateral line scales, despite the lateral line being partly hidden by the pectoral fin, Mandrytsa (2002) described the type series of *P. brevipectoralis* as having 25–26 pored lateral line scales. Moreover, the present specimens have 23–26 pored lateral line scales. In addition, the drawing indicates *ca.* 45 scale rows in the longitudinal series, including a row above the first pored lateral line scale, to the posteriormost row, but this is fewer than the figures of 53–55 given by Mandrytsa (2002) in his description. Minor differences in morphometrics, regarded here as intraspecific variation, were found between the present specimens and the original description, including a slightly shorter head length (39.6–45.1% of SL *vs* 42.3–44.9% of SL in the original description), slightly longer upper-jaw length (18.5–23.4% of SL *vs* 17.6–20.2% of SL), and slightly deeper caudal-peduncle depth (10.4–11.7% of SL *vs* 9.5–10.2% of SL). Although Mandrytsa (2002) wrote that the species has a single nasal spine, the present specimens had 1–3 spines,

Fig. 5. Supraocular tentacle of *Pterois brevipectoralis*, USNM 392069, 49.2 mm SL.

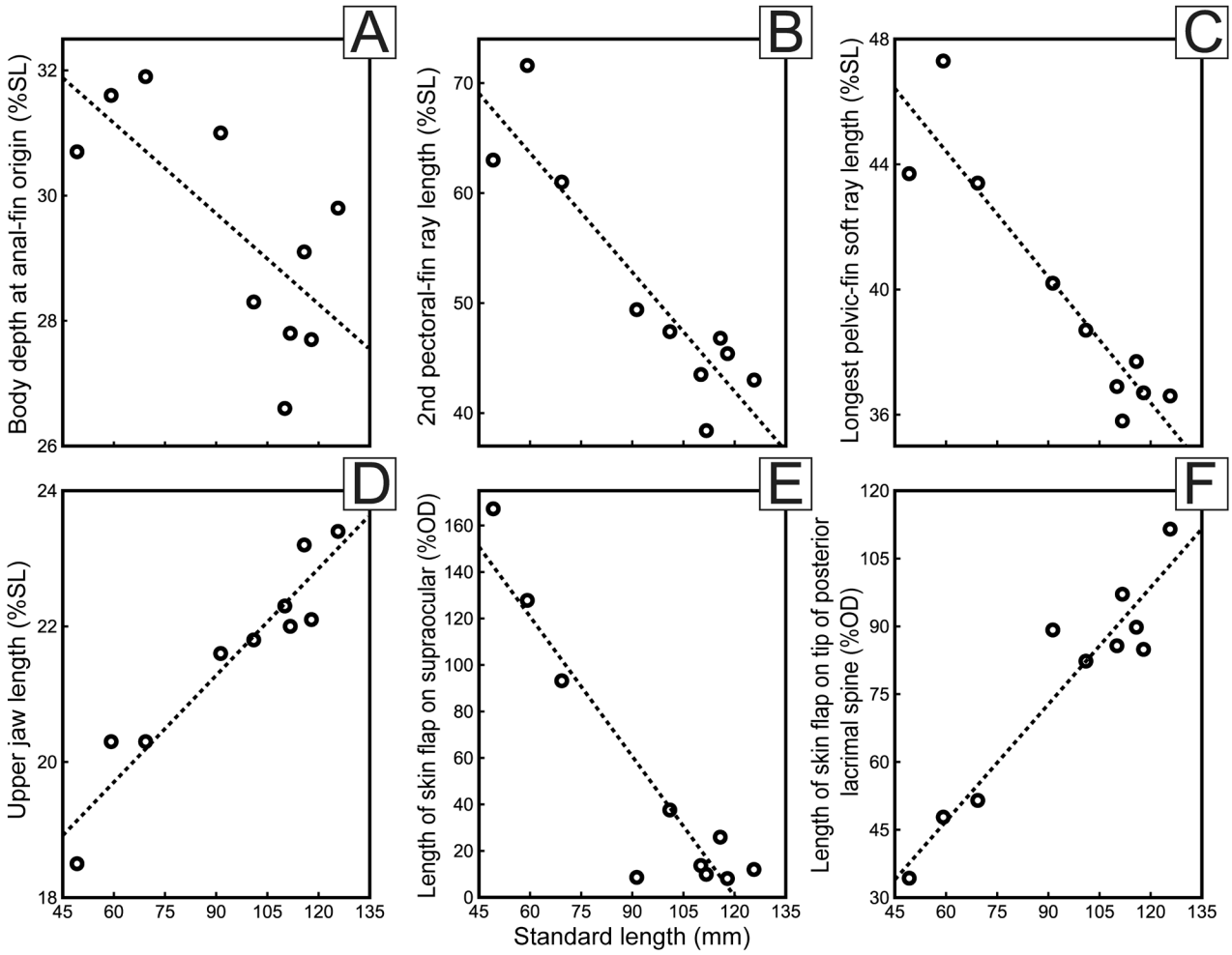

Fig. 6. Relationships of (A) body depth at anal-fin origin, (B) second pectoral-fin ray length, (C) longest pelvic-fin soft ray length, and (D) upper jaw length (as % of standard length), and (E) length of skin flap on supraocular and (F) length of skin flap on posterior lacrimal spine tip [as % of orbit diameter (OD)] to standard length in *Pterois brevipectoralis*.

with the number of spines tending to increase with growth (see "Morphological changes with growth" below). The present specimens (49.2–69.3 mm SL) collected from the Mascarene Islands also conformed to the diagnosis of *P. brevipectoralis*. Morphological differences apparent between the Mascarene Islands and Saya de Malha Bank specimens, including head spine condition and relative lengths of body parts, are regarded here as intraspecific ontogenetic changes (see "Morphological changes with growth" below). The Mascarene Islands specimens represent the first records for the species from that region, although they are relatively smaller (49.2–69.3 mm SL) and from a shallower depth (<1.1 m in the Cargados Carajos Shoals) than the three type specimens (65.5–147 mm SL) collected at 57–90 m depth from the Saya de Malha Bank (Mandrytsa 2002).

Morphological changes with growth. The number of head spines increases with growth in *P. brevipectoralis*. Whereas juvenile and young specimens of less than 91.3 mm SL have a simple nasal spine with a spinous point, large adults of more than 101.0 mm SL usually have 2 (rarely 3) points, as in *Parapterois* (Scorpaenidae: Pteroinae) (Motomura 2004a).

Growth-related changes in the relative lengths of some body parts are well documented for several members of the Scorpaenidae (*e.g.*, Motomura *et al.* 2005b, c, 2006b, 2011). Analyses of 51 measurements in *P. brevipectoralis* indicates that body depth at the anal-fin origin, caudal-peduncle length and depth, and the lengths of almost all fin rays tend to decrease as a percentage of SL with growth (Fig. 6A–C). In addition, the relative length of the upper jaw and the head width both become significantly greater with body size (Fig. 6D). Notably, the relative lengths of the 1st to 8th pectoral-fin rays all become markedly shorter with growth (Figs 6B, 7; Table 1), small specimens (49.2–69.3 mm SL) having relatively long pectoral-fin rays, with the tip of the longest ray just reaching or extending slightly beyond the caudal-fin base (Fig. 3A, B), and large adults (>91.3 mm SL) having relatively short pectoral-fin rays, with the tip of the longest ray not reaching the caudal-fin base (Figs 2, 3C).

In contrast, the skin flap on the tip of the posterior lacrimal spine becomes larger with growth (Figs 4A, C, 6E). The smallest specimen (49.2 mm SL) examined has a small skin flap on the spine tip, with the posterior tip of the flap not reaching the posterior margin of the maxilla when depressed posteriorly (Fig. 4A). In contrast, large adults (>91.3 mm SL) have a large, fan-like skin flap on the spine

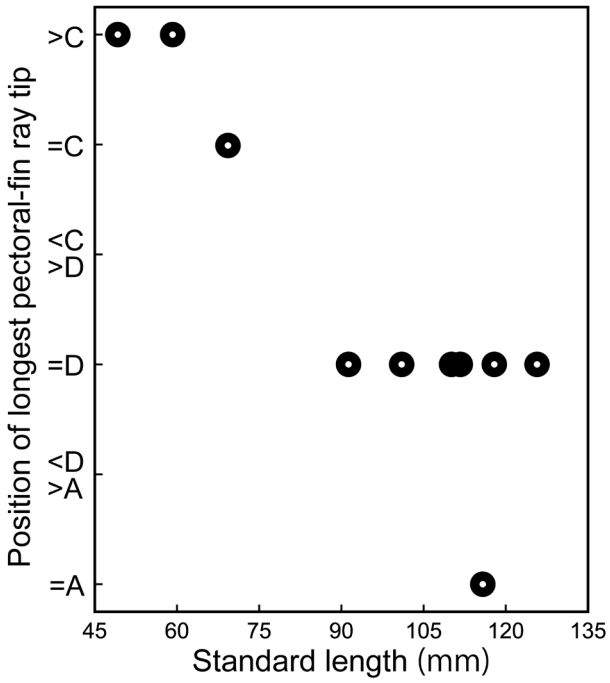

Fig. 7. Relationship of position of longest pectoral-fin ray tip to standard length (mm) in *Pterois brevipectoralis*. A, D, and C represent the anal-fin base end, the dorsal-fin base end, and the caudal-fin base, respectively; =, >, < indicate just reaching or extending slightly beyond, extending distinctly beyond, and not reaching, respectively.

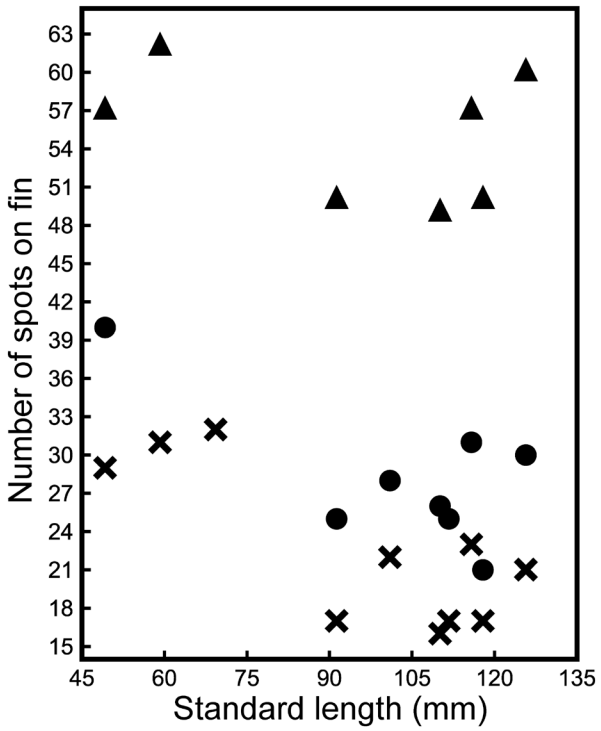

Fig. 8. Relationships of number of spots on dorsal (circles), anal (crosses), and caudal fins (triangles) to standard length in *Pterois brevipectoralis*.

tip, extending considerably beyond the posterior margin of the maxilla when depressed (Fig. 4C). The skin flaps on the posterior margin of the preopercle also tend to become larger with growth (Fig. 4B, D), small specimens (<59.2 mm SL) having 2 small skin flaps on the margin below the third preopercular spine (Fig. 4B) whereas large specimens (>69.3 mm SL) usually have 2 large, fan-like skin flaps in the same region and an additional large, fan-like flap on the ventral part of the third preopercular spine (Fig. 4D). Skin flap lengths in the largest specimen examined (125.7 mm SL) exceed the orbit diameter (111.5% of orbit diameter).

The skin flap on the supraocular becomes reduced with body growth (Figs 3, 6D). The smallest specimen (49.2 mm SL) has a long supraocular tentacle (167% of orbit diameter) with three pairs of lateral branches (Fig. 5) whereas large specimens of >91.3 mm SL have a small skin flap (length 9–38% of orbit diameter) (Fig. 1). In addition, large adults have a lateral branch on the anterior nasal flap (Fig. 1) whereas juveniles have a simple flap (Fig. 5). No other significant growth-related change in head skin flaps was found.

The numbers of dark spots on the median fins tend to decrease with body growth in *P. brevipectoralis* (Figs 2–3, 8). A juvenile specimen (49.2 mm SL) has a total of 40, 29, and 57 spots on the dorsal, anal, and caudal fins, respectively, whereas a large specimen (117.9 mm SL) has 21, 17, and 50 spots, respectively. Such changes are most apparent on the dorsal and anal fins.

Species comparisons. Mandrytsa (2002) stated that *P. brevipectoralis* could be distinguished from a related congener, *Pterois sphex* Jordan and Evermann, 1903 (as *Pteropterus sphex*), which shares similar dorsal and pectoral fin ray counts, by having relatively short pectoral fins (not extending beyond a vertical through the end of the dorsal-fin base in the former *vs* extending farther in *P. sphex*); however, as mentioned above, relative lengths of the pectoral-fin rays change significantly with growth in *P. brevipectoralis* (Fig. 7). This character, therefore, is available for species discrimination only in large adults. Mandrytsa (2002) also stated that *P. brevipectoralis* differs from *P. sphex* in having relatively shallower notches of the pectoral-fin membrane, the depth of the notch between the fifth and sixth rays not exceeding one-fifth of those ray lengths (*vs* over two-fifths in *P. sphex*). This character was confirmed as diagnostic by our examination of nine present specimens (49.2–125.7 mm SL) of *P. brevipectoralis* and two specimens (55.8–102.6 mm SL) of *P. sphex*. The membrane above the sixth pectoral-fin ray extends to up to 76.7–93.0% (mean 86.1%) of the ray length in *P. brevipectoralis* (Table 1) but only 55.6–70.5% in *P. sphex*. In addition, *P. brevipectoralis* is easily distinguished from *P. sphex* in the coloration of the pectoral fin, which has 6–10 large blotches in *P. brevipectoralis*, but 3–13 narrow vertical bands in *P. sphex* (Eschmeyer and Randall 1975: fig. 2; this study).

Pterois brevipectoralis is also similar to *Pterois mombasae* (Smith, 1957), occurring sympatrically in the western Indian Ocean, in overall body appearance. Both species have XIII, 10 dorsal-fin rays, a relatively short dorsal-fin spine and pectoral-fin rays, dark blotches on the pectoral-fin membrane, and bands on the posterior portions of the

pectoral-fin rays (not associated with fin membrane). *Pterois brevipectoralis* differs from *P. mombasae* in having fewer pectoral-fin rays [15–16 (mode 16) *vs* 17–20 (18) in *P. mombasae*], generally fewer blotches on the pectoral fin (6–10 *vs* 6–24), and shorter pectoral-fin rays [longest ray length 44.5–66.4 (mean 53.4)% SL *vs* 64.9–84.5 (75.2)% SL] (Smith 1957; Matsunuma and Motomura 2011; this study). Moreover, *P. brevipectoralis* is uniquely characterized by having extremely large (greater than half the orbit diameter), fan-like skin flaps on the tip of the posterior lacrimal spine and the posterior margin of the preopercle in large adults, such flaps becoming extremely large with growth. In contrast, similar flaps in *P. mombasae* are relatively small (less than half the orbit diameter) in large adults and become reduced with growth (this study).

Comparative material. *Pterois mombasae* (Smith, 1957): BSKU 61061, 84.2 mm SL, BSKU 61062, 90.2 mm SL, Kashiwa-jima island, Kochi, Japan; BSKU 72569, 79.3 mm SL, BSKU 86402, 59.4 mm SL, BSKU 86404, 56.3 mm SL, Tosa Bay, Kochi, Japan; BSKU 100149, 23.2 mm SL, Oki-no-shima island, Kochi, Japan; CAS 75355, 136.5 mm SL, off east coast of Sri Lanka; CAS 75358, 102.0 mm SL, Trincomalee, Sri Lanka; CMNH–ZF 15450, 30.9 mm SL, Yaku-shima island, Osumi Group, Japan; KAUM–I. 6582, 83.4 mm SL, KAUM–I. 6588, 106.9 mm SL, KAUM–I. 28824, 52.3 mm SL, Okinawa-jima island, Ryukyu Islands, Japan; KPM-NI 26919 (formerly IOP 1103), 26.2 mm SL, KPM-NI 26930 (formerly IOP 3120), 49.5 mm SL, Izu, Shizuoka, Japan; MNHN 1995–737, 98.4 mm SL, Futuna Island, Wallis and Futuna; NSMT-P 54352, 38.3 mm SL, Susaki, Chiba, Japan; NSMT-P 110789 (formerly KSHS 22471), 112.1 mm SL, NSMT-P 110789 (formerly KSHS 22473), 83.6 mm SL, Kashiwa-jima island, Kochi, Japan; PMBC (uncat.), 2 specimens, 70.3–75.0 mm SL, Phuket, Thailand; SAIAB (formerly RUSI) 117, 128.8 mm SL, holotype of *Pteropterus mombasae*, Mombasa, Kenya; URM-P 4264, 136.9 mm SL, URM-P 4265, 103.5 mm SL, URM-P 4266, 92.3 mm SL, URM-P 4267, 92.7 mm SL, URM-P 4268, 85.0 mm SL, URM-P 4269, 63.3 mm SL, Sesoko-jima island, Ryukyu Islands, Japan; URM-P 41467, 75.1 mm SL, Okinawa-jima island, Ryukyu Islands; USNM 265918, 54.9 mm SL, Macclesfield Bank; USNM 382904, 67.3 mm SL, Santa Cruz Island, Solomon Islands. *Pterois sphex*: AMS I.16203-001, 42.9 mm SL, Waimea Bay, Oahu Island, Hawaiian Islands; AMS I.16205-001, 102.6 mm SL, Makua, Oahu Island, Hawaiian Islands; LACM 37099-4, 40.6 mm SL, Kahe Point, Oahu Island, Hawaiian Islands; LACM 37100-5, 2 specimens, 50.6–55.8 mm SL, Kahe Point, Oahu Island, Hawaiian Islands; USNM 50650, 111.7 mm SL, holotype of *Pterois sphex*, Honolulu, Oahu Island, Hawaiian Islands.

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