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Validity of the Poorly Known Scorpionfish, *Rhinopias eschmeyeri*, with Redescriptions of *R. frondosa* and *R. aphanes* (Scorpaeniformes: Scorpaenidae)

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The validity of the scorpionfish, *Rhinopias eschmeyeri*, known only from the holotype from Mauritius, is confirmed, and the species is redescribed in detail on the basis of ten specimens from the Indo-West Pacific Ocean (Mascarene Islands to Japan and Australia). Additionally, *R. frondosa* and *R. aphanes* are redescribed. These three species are characterized by having one or two small dense black spots in the soft dorsal fin; the opercle without scales between the tips of the upper and lower opercular spines and the opercular margin; and 16 (rarely 15 or 17) pectoral-fin rays. *Rhinopias eschmeyeri* differs from the latter two species in aspects of form, location, and number of tentacles on the head and body; form of dorsal-fin margins and caudal-fin ray tips; shape of penultimate dorsal-fin spine; degree of development in lacrimal and suborbital ridge; and coloration.

THE Indo-Pacific scorpionfish genus *Rhinopias* Gill, 1905 is characterized by 12 dorsal-fin spines, three anal-fin spines, 15–18 pectoral-fin rays (lower rays thickened), dorsal-, anal-, and upper pectoral-fin soft rays branched in adults, head and body strongly compressed (head width less than body width), body extremely deep (38–54% of standard length; range from Poss, 1999), body covered with small cycloid scales; palatine teeth, interorbital ridges and tympanic spines absent; and upper post-temporal spines present (Motomura and Senou, 2005; this study). The genus was reviewed by Eschmeyer et al. (1973), who recognized four valid species: *R. aphanes* Eschmeyer, 1973, described from a single specimen collected from off Nouméa, New Caledonia; *R. argoliba* Eschmeyer, Hirosaki, and Abe, 1973, described from a single specimen collected from off Izu Ocean Park, Sagami Bay, Japan; *R. frondosa* (Günther, 1892), described from a single specimen from Mauritius; and *R. xenops* (Gilbert, 1905), described from a single specimen from Avau Channel, between Maui and Lanai Islands, Hawaii. Subsequently, *R. eschmeyeri* Condé, 1977 and *R. cea* Randall and DiSalvo, 1997 were described from Machébourg, Mauritius and Motu Iti, Easter Island, respectively.

Specimens of *Rhinopias* are very rare in museum collections (Eschmeyer et al., 1973), although many underwater photographs have been taken owing to the striking appearance of living individuals. With the exception of *R. frondosa*, which is relatively common (although rarer than other inshore scorpionfishes) and widely distributed in the Indo-West Pacific, specimens of *Rhinopias* available for taxonomic studies are limited, e.g., only two specimens of *R. argoliba* have been reported (Eschmeyer et al., 1973; Mandrytsa, 2002) and two for *R. cea* (Randall and DiSalvo, 1997; Randall, 2001). *Rhinopias eschmeyeri* has not been reported on the basis of collected specimens since its original description by Condé (1977).

During revisionary studies of *Rhinopias* and related genera (e.g., Motomura and Senou, 2005), the first author noticed that specimens collected from a wide range in the Indo-West Pacific and previously identified as *R. frondosa* (or *Rhinopias* sp.), were found to exhibit two morphotypes. These were initially believed to represent sexual dimorphism, because of their completely overlapping distributional ranges. However, expanded gonads full of well-developed ova were confirmed in specimens of each morphotype. In addition, each morphotype had several unique characters consistent with those of the holotypes of *R. eschmeyeri* and *R. frondosa*, respectively. Accordingly, we regard them as separate species, the validity of *R. eschmeyeri* being confirmed.

The holotype of *R. eschmeyeri* and nine specimens identified during this study are described in detail. Corrections to the diagnostic characters given in Condé's original description, with additional characters separating *R. eschmeyeri* and *R. frondosa*, are included. Of the ten specimens of *R. eschmeyeri* examined, four represent the first confirmed records of the species from the Pacific Ocean (Japan, Vietnam, and Australia) on the basis of specimens. Similarities in several morphological features among *R. aphanes*, *R. eschmeyeri*, and *R. frondosa* are noted and a redescription of each species is provided.

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Materials and Methods

Measurements follow Motomura (2004a, b). Standard and head lengths are expressed as SL and HL, respectively. The last two soft rays of the dorsal and anal fins are counted as single rays, each pair being associated with a single pterygiophore. Pectoral-fin ray counts begin with the uppermost element. Longitudinal scale rows include the vertical scale rows above the lateral line, taken from above the first pored lateral-line scale to the caudal-fin base (scale rows are irregular and difficult to count; scales were stained and examined under a dissecting microscope). Pored lateral-line scales that have an external median tube are counted from the first pored scale near the upper end of the gill opening to the pored scale on the posterior margin of the hypural plate. Gill-raker counts are made on the first arch, with the upper count given first (lower counts include rakers at angle and hypobranchial). Mean values related to meristics are rounded off to whole numbers. Terminology of the head spines follow Randall and Eschmeyer (2002). Osteological characters were confirmed from radiographs. Institutional codes follow Leviton et al. (1985), with the addition of Kanagawa Prefectural Museum of Natural History, Odawara, Japan (KPM); Muséum-Aquarium de Nancy, Nancy, France (MAN, formerly Musée Zoologie de l'Université et de la Ville de Nancy); and Museum of Tropical Queensland, Townsville, Australia (MTQ).

Rhinopias eschmeyeri Condé, 1977

Eschmeyer's Scorpionfish
Houseki-kasago
Figures 1, 2, 3A, 4A, B, 5A, 6A; Tables 1–3

Rhinopias eschmeyeri Condé, 1977:19, figs. 1–3 (type locality: Mahébourg, Mauritius).

Holotype.—MAN 10475, 148.1 mm SL, Mauritius, Mahébourg, 3 m depth, 24 Sept. 1976, L. P. Jauffret.

Non-type material.—9 specimens, 100.6–166.3 mm SL. BPBM 35771, 2 (159.5–166.3 mm SL), Mauritius, 1993, D. Pelicier; FAKU 62339, 137.0 mm SL, Japan, Wakayama, off Sakai, 22 Feb. 1974, C. Araga; MAN 11879, 161.2 mm SL, Mauritius, Mahébourg, 30–35 m, 1 May 1982, L. P. Jauffret; MNHN 1965-264, 123.1 mm SL, Vietnam, Nhatrang, 12°15′N, 109°10′E, 1963, P. Fourmanoir; MNHN 1966-855, 126.2 mm SL, Réunion, 20°45'S, 53°15'E, P. Guézé; MNHN 1982-67, mature female, 125.5 mm SL, Seychelles, 04°25′S, 54°53′E, RV Coriolis, 55 m, trawl, 10 Sept. 1980; MTQ I. 24065, mature female, 134.8 mm SL, Australia, Queensland, 40 km northwest of Holbourne Island, ca. 19°25′S, 148°13′E, 47.5 m, bottom trawl, 4 Sept. 1990, R. Betteridge; QM I. 34364, 100.6 mm SL, Australia, Queensland, off Burnett Heads, 24°45′S, 152°30′E, 30 m, trawl, 1 Jan. 2003, T. Adams. The following specimen was also examined (but counts and measurements were not

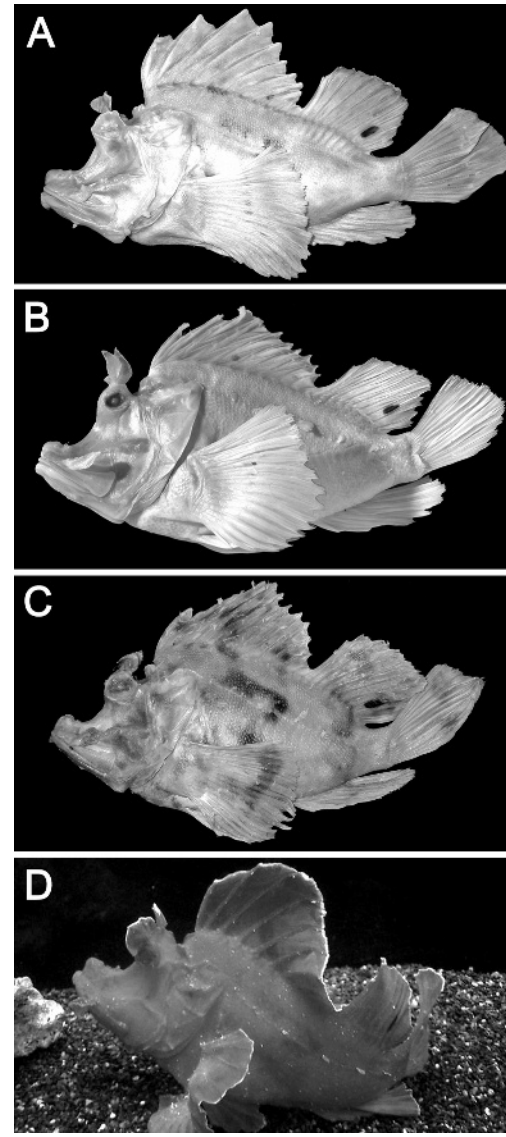

Fig. 1. *Rhinopias eschmeyeri.* (A) MAN 10475, holotype, 148.1 mm SL, Mauritius (H. Motomura); (B) MTQ I. 24065, 134.8 mm SL, Queensland, Australia (C. Bento); (C) MNHN 1966-855, 126.2 mm SL, Réunion (H. Motomura); (D) an aquarium individual (pink color), ca. 18 cm total length, collected from the Philippines (M. Oshima).

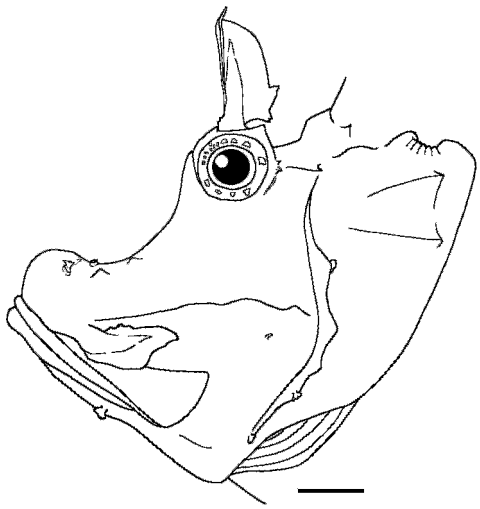

Fig. 2. Lateral view of head of *Rhinopias eschmeyeri*. MTQ I. 24065, 134.8 mm SL, Queensland, Australia. Scale bar = 10 mm.

taken): WAM-P. 32472-001, 160 mm SL, Australia, Western Australia, Karratha, ca. 20°30′S, 117°E, trawl, Jan. 2004, G. Carter.

Diagnosis.—*Rhinopias eschmeyeri* is distinguished from *R. argoliba*, *R. cea*, and *R. xenops* by the presence of one small black spot, slightly greater than pupil diameter, in the middle of the membrane between the seventh and eighth dorsal-fin soft rays (vs. spot absent in the latter three species), the absence of scales on the opercle between the tips of the upper and lower opercular spines and the opercular margin (vs. scales present), and 16 pectoral-fin rays (vs. 18 rays). It differs from *R. aphanes* and *R. frondosa* in having two tentacles on the underside of the lower jaw (vs. 12–18 tentacles in *R. aphanes* and 9–24 in *R. frondosa*), lacking tentacles on the frontal below the eyes in anterior view (vs. 2–4 tentacles present in the two species), lacking distinct tentacles on the lateral surface of the body above the lateral line (vs. present), having short tentacles, without distinct branches along distal margins, on the supraocular and posterior lacrimal spines (vs. long tentacles, with distinct branches), having the distal margin of the spinous portion of the dorsal fin without notches or very weakly notched (vs. strongly notched), having the penultimate dorsal-fin spine usually curved posteriorly (vs. usually not curved), and having head, body, fins, and tentacles usually without distinct pigmentation or markings (vs. with elongate black-margined white markings each with a central region of yellow, green, or brown in *R. aphanes* and with numerous distinct circular dark-margined spots in *R. frondosa*). It also differs from *R. aphanes* in having membrane of the spinous portion of the dorsal fin notably fleshy (vs. not fleshy in the latter), the distal margins of the soft-rayed portions of the dorsal, pelvic, anal, and caudal fins without notches or very weakly notched (vs. strongly notched), tips of each caudal-fin ray divided into four branches (vs. two branches in adults and unbranched in juveniles), dorsal-fin spines relatively soft and tips bending easily under the slight pressure (vs. firm with strongly pointed tips), the lateral surface of the lacrimal usually smooth or with a bump (vs. usually with a pointed spine), the suborbital ridge usually with three bumps (vs. usually with three pointed spines), and the soft-rayed portion of the dorsal fin with a single black spot, usually smaller than orbit diameter (vs. with double spots, usually much larger than orbit diameter).

Description.—Proportional measurements as percentages of SL and HL of the specimens of *Rhinopias eschmeyeri* are given in Table 1. Dorsal fin XII, 9 (8 in one specimen); anal fin III, 5; pectoral-fin rays 16 on each side of body; pelvic fin I, 5; longitudinal scale rows ca. 67–79 (71 in holotype); pored lateral-line scales 22–24 (mode 23; 22 in holotype); scale rows between base of last dorsal spine and lateral line 11–14 (mode 13; 14 in holotype); gill rakers on upper limb 5 or 6 (mode 5; 5 in holotype), lower limb 13–15 (mode 14; 13 in holotype), including 3 or 4 (mode 4; 3 in holotype) rakers on hypobranchial, total 18–21 (mode 19; 18 in holotype); branchiostegal rays 7; vertebrae 24.

All soft rays of dorsal fin branched; dorsal-fin first spine length 1.3–1.6 (mean 1.4; 1.5 in holotype) in second spine length; third spine longest (fourth longest in two specimens), length greater than upper-jaw length; fourth to eleventh spines progressively shorter; eleventh spine shortest, usually strongly curved posteriorly, its length 2.4–3.4 (mean 2.9; 3.4 in holotype) in last spine length; interspinous membranes of adjacent dorsal-fin spines reaching tips, or near tips, of posterior spines, except second, third, and twelfth spines; fourth or fifth soft rays longest; fifth to ninth soft rays progressively shorter; intersoft-rayed membrane reaching tips of posterior rays; posterior branch of last soft ray joined by membrane to caudal peduncle for less than one-eighth its length; membrane of spinous portion of dorsal fin somewhat fleshy. All soft rays of anal fin branched; anal-fin first spine length 1.5–2.1 (mean 1.8; 1.8 in holotype) in second spine length and 1.8–2.4 (mean 2.0; 2.0 in holotype) in third spine length; third spine longest; second or third soft ray longest, its

TABLE 1. MORPHOMETRIC CHARACTERS OF *Rhinopias eschmeyeri*, *R. frondosa*, AND *R. aphanes*, EXPRESSED AS PERCENTAGES OF STANDARD AND HEAD LENGTHS. Mean values include holotype data. [1]at vertical midline of eye; [2]at posterior end of preocular spine base.

	R. eschmeyeri			*R. frondosa*			*R. aphanes*		
	Holotype	Non-types	Mean	Holotype	Non-types	Mean	Holotype	Non-types	Mean
	MAN 10475	$n = 9$		BMNH 1891.4.30.3	$n = 13$		AMS IB. 7079	$n = 5$	
Standard length (mm)	148.1	100.6–166.3		146.2	92.5–152.6		177.7	56.6–167.5	
% of standard length									
Body depth	47.5	45.7–53.2	48.4	48.1	43.2–51.1	47.2	45.9	43.0–47.0	45.1
Body width	21.6	17.1–24.4	19.9	20.6	14.4–20.5	18.4	18.5	14.7–20.5	18.2
Head length	47.7	44.7–50.9	47.1	45.6	44.6–47.8	46.4	49.1	45.4–48.9	47.3
Snout length	19.7	19.7–21.6	20.6	20.0	19.1–21.3	20.2	22.2	20.1–21.4	21.1
Orbit diameter	7.8	6.9–8.9	8.0	8.4	7.4–8.9	8.1	7.4	7.3–9.5	8.0
Interorbital width[1]	7.6	5.8–9.0	6.6	6.8	5.4–8.0	6.6	6.5	5.1–7.8	6.4
Interorbital width[2]	6.8	5.5–8.7	6.3	6.4	5.0–7.8	6.2	5.4	4.3–6.9	5.6
Upper-jaw length	21.9	20.1–23.3	21.8	21.5	20.3–22.5	21.1	23.9	21.7–23.9	23.3
Depth of posterior margin of maxilla	7.8	6.9–8.6	7.5	7.3	6.8–7.9	7.4	7.8	6.9–8.4	7.6
Postorbital length	21.2	18.8–22.7	20.2	19.9	17.9–21.1	19.8	20.7	19.2–20.5	20.0
Predorsal-fin length	37.3	36.1–40.8	38.0	39.7	34.8–39.1	37.3	41.1	39.4–42.8	41.2
Preanal-fin length	78.7	70.0–78.7	74.5	73.7	70.2–77.3	73.2	77.8	73.7–78.6	76.8
Prepelvic-fin length	49.1	43.9–48.9	46.1	44.4	42.5–51.6	45.2	46.3	46.3–49.6	47.6
1st dorsal-spine length	17.2	14.2–18.5	16.4	19.6	14.4–21.4	18.5	12.0	14.1–16.6	14.8
2nd dorsal-spine length	23.1	21.7–26.9	23.7	27.4	19.8–27.9	24.8	19.2	18.8–24.2	21.1
3rd dorsal-spine length	26.2	24.4–32.9	28.1	30.4	26.5–33.3	29.2	22.8	22.0–29.5	25.1
4th dorsal-spine length	26.1	22.6–31.0	27.1	30.6	26.2–34.6	30.7	22.7	20.3–27.9	24.4
5th dorsal-spine length	23.4	20.5–26.3	23.7	26.7	21.6–28.7	25.1	18.7	20.5–24.7	21.8
6th dorsal-spine length	20.0	17.2–24.2	20.1	23.0	18.7–24.3	21.7	16.4	17.9–23.0	19.6
7th dorsal-spine length	16.1	15.1–20.8	17.8	20.2	13.8–21.9	19.1	16.2	17.6–20.1	18.3
8th dorsal-spine length	14.1	12.9–18.5	15.9	17.6	14.5–20.7	17.5	14.9	17.0–19.8	17.7
9th dorsal-spine length	10.4	11.9–15.4	12.8	12.2	11.3–17.0	14.1	13.7	14.9–17.3	15.7
10th dorsal-spine length	5.2	7.2–10.2	8.4	7.0	7.1–13.4	9.2	8.3	9.6–12.7	10.8
11th dorsal-spine length	4.8	3.9–6.0	5.0	5.4	4.8–6.7	5.7	5.0	5.9–8.0	6.4
12th dorsal-spine length	12.8	12.9–16.3	14.3	12.2	11.5–16.5	14.4	13.0	12.8–19.8	14.3
Longest dorsal-ray length	22.2	19.6–26.7	23.7	26.2	23.0–29.2	26.0	24.6	26.4–31.8	27.6
1st anal-spine length	5.8	7.4–9.6	7.9	7.4	6.1–10.4	7.8	8.3	7.4–11.7	8.8
2nd anal-spine length	12.3	13.1–15.4	14.2	13.1	11.1–17.3	13.9	12.4	11.8–19.8	14.8
3rd anal-spine length	14.0	14.3–17.3	15.5	15.0	13.1–17.5	15.3	13.2	10.8–18.9	14.7
Longest anal-ray length	23.3	23.4–27.2	24.9	27.1	22.5–29.0	26.0	23.8	22.9–32.7	27.2

TABLE 1. CONTINUED.

	R. eschmeyeri			*R. frondosa*			*R. aphanes*		
	Holotype	Non-types	Mean	Holotype	Non-types	Mean	Holotype	Non-types	Mean
	MAN 10475	$n = 9$		BMNH 1891.4.30.3	$n = 13$		AMS IB. 7079	$n = 5$	
Pectoral-ray length	36.5	33.5–39.3	36.8	36.3	32.3–40.6	37.7	36.9	35.1–44.0	38.5
Pelvic-spine length	12.8	12.2–15.2	13.6	12.3	11.3–17.5	13.5	11.2	11.9–17.3	13.3
Longest pelvic-ray length	23.4	21.3–26.2	24.0	26.0	23.0–28.2	25.7	25.4	25.0–30.2	27.1
Caudal-fin length	32.3	32.6–36.8	34.2	32.8	28.6–36.4	32.9	29.7	28.9–34.5	31.9
Caudal-peduncle length	12.7	11.9–14.4	13.2	14.4	12.0–18.1	14.5	15.3	14.5–16.5	15.3
Caudal-peduncle depth	11.5	11.7–13.9	12.3	13.0	11.1–13.0	12.3	11.5	11.3–12.5	11.9
% of head length									
Snout length	41.4	42.4–46.1	43.8	44.0	41.4–46.1	43.4	45.2	43.0–46.1	44.7
Orbit diameter	16.3	15.5–19.3	17.0	18.5	16.1–19.3	17.5	15.1	16.1–19.5	16.9
Interorbital width[1]	15.9	12.3–18.6	14.0	14.9	11.8–17.3	14.3	13.2	11.3–15.9	13.5
Interorbital width[2]	14.3	11.9–17.9	13.5	14.0	11.0–17.0	13.3	11.0	9.4–14.1	11.9
Upper-jaw length	45.9	44.9–48.2	46.3	47.1	43.8–48.9	45.4	48.6	44.4–51.5	49.3
Depth of posterior margin of maxilla	16.9	14.5–16.9	16.0	15.9	14.3–17.2	15.8	15.9	14.1–17.3	16.1
Postorbital length	44.5	40.9–44.6	42.9	43.7	39.6–45.0	42.6	42.2	41.2–43.0	42.2

length slightly longer than longest dorsal-fin soft ray; third to fifth soft rays progressively shorter; posterior branch of last soft ray joined by membrane to caudal peduncle for less than one-fourth its length; membranes between rays weakly notched. Uppermost ray of pectoral fin usually unbranched (rarely branched), lower 5–8 (7 in holotype) rays unbranched and fleshy, remaining rays branched; eighth to tenth (tenth in holotype) ray longest, its length greater than longest dorsal spine length; membranes between branched rays reaching tip of each ray; membranes between fleshy unbranched rays notched. All soft rays of pelvic fin branched; second (rarely third) soft ray longest, slightly longer than upper-jaw length; posterior branch of last soft ray joined by membrane to abdomen for more than two-thirds its length. Caudal fin with 14 segmented rays, 12 of the 14 rays branched; seventh or eighth ray longest, slightly greater than longest dorsal spine length; posterior margin of fin double truncated; 4 or 5 dorsal and 4 or 5 ventral series of caudal procurrent rays. Tip of each soft ray in all fins, except lower unbranched pectoral-fin rays, divided into 4 branches.

Gill rakers short and spinous, longest raker on first gill arch less than one-fourth length of longest gill filament; fourth gill slit closed by membrane. Dorsal pterygiophores broad, thin, with a strong lateral ridge on each side; first dorsal pterygiophore broadest and associated with first and second dorsal spines; ventral margin of first dorsal pterygiophore strongly notched, and first and second neural spines inserting into the notch; other pterygiophores not notched; third neural spine inserting between second and third dorsal pterygiophores, remaining neural spines inserting to each space between dorsal pterygiophores. Swimbladder absent.

Numerous small papillae on entire head, including interorbital space, lateral surface of maxilla and ventral surface of lower jaw. A large, broad, fleshy tentacle on supraocular spine, its length much greater than (rarely approximately equal to) orbit diameter; tentacle without distinct branches. A large tentacle, similar to supraocular tentacle in shape and size, on posterior lacrimal spine; posterior tip of tentacle not reaching posterior margin of maxilla; posterior of tentacle not linked to head by skin. Three (rarely two) small, rounded tentacles along preopercular margin, uppermost tentacle at uppermost preopercular spine, second tentacle at fourth preopercular spine and third tentacle at lower end of preopercle. A tiny tentacle on cheek (rarely absent). Six to 12 (6 in holotype) small, rounded, fleshy tentacles on upper part of outer margin of

eye, 5–9 (5 in holotype) on lower part. No tentacles on frontal below eyes in anterior view. One or two tiny tentacles (occasionally absent) along anteroventral margin of lacrimal (difficult to see with naked eye). A pair of tentacles on underside of mandible, located midway between second and third sensory pores (not counting a pore behind symphyseal knob) on each side; tentacle length variable from rudiment to greater than orbit diameter; tentacles simple, fleshy without distinct branches. Two to six (two in holotype) large tentacles (usually shorter than orbit diameter) and several tiny tentacles associated with pored lateral-line scales. Pectoral-fin axil without a skin flap. No distinct tentacles on lateral surface of body, except pored lateral line. Usually no tentacles on fin membranes and rays; if present, tentacles tiny, rounded, and very few in number.

Entire head, including opercle, without scales. Cycloid scales (some scales rarely with very few tiny cteni) covering entire lateral surface of body, but not extending onto rays or membranes of fins, except caudal-fin base. Cycloid scales covering ventral surface of body between pelvic-fin origin and first anal-fin spine base, but scales absent between pelvic fins; these scales usually covered by thin skin. Embedded cycloid scales covering anteroventral surface of body and pectoral-fin base; scales on pectoral-fin base usually covered by thin skin (scales exposed in one specimen, BPBM 35771, 159.5 mm SL; very few scales on anteroventral surface of body and pectoral-fin base in one specimen, FAKU 62339, 137.0 mm SL). Lateral line sloping steeply downward above posterior margin of upper opercle.

Body and head strongly compressed, head width narrower than greatest body width (at pectoral-fin bases). Body deep, deepest at origin of fourth or fifth dorsal-fin spine; body depth 2.0–2.7 (mean 2.4; 2.7 in holotype) in body width. Head moderate, its length less than body depth. Mouth oblique, forming an angle of about 30 degrees to horizontal axis of head and body. Posterior margin of maxilla not reaching a vertical from posterior margin of orbit. Lateral surface of maxilla without ridges and scales. Lower jaw with thickened symphyseal portion fitting into shallow median depression of upper jaw when mouth closed. Width of symphyseal gap separating premaxillary teeth bands much less than width of each band. Upper and lower jaws with a band of villiform teeth, bands narrowing posteriorly; width of tooth band of upper jaw greater than that of lower jaw; most teeth of upper jaw approximately same length as teeth of lower jaw. Patch of villiform teeth on each side of vomer. No teeth on palatine.

Dorsal profile of snout curved sinuously, initially convex, then deeply concave; dorsal profile midway between nasal spine and tip of preocular spine forming an angle of about 50–60° to horizontal axis of head and body. Nasal spine simple, directed posterodorsally, its length less than anterior nostril diameter; nasal spine embedded basally, only tip exposed. Posterior margin of ascending process of premaxilla not reaching level of anterior margin of posterior nostril. A bump (rarely indistinct) projecting from lateral surface of frontal located about midway between nasal spine and preocular spine base. Interorbital ridges absent. Interorbital space deep, forming V-shape in anterior view; about half or more of orbit extending above dorsal profile of head. Preocular spine simple, directed dorsally, tip not reaching or just reaching a horizontal line through upper margin of pupil in lateral view. Supraocular spine simple, located considerably anterior to vertical midline of eye. Postocular spines simple, triangular in lateral view, greater than supraocular spine. Tympanic, coronal, and extra spines absent. Occipital pit moderately deep, without transverse ridge in front of pit; occipital pit smoothly connected with interorbital space; a distinct transverse ridge at rear of occipital pit between bases of parietal spines; occipital pit surrounded laterally by low ridges forming out of anterior bases of parietal spines. Parietal and nuchal spines well-developed, both spines fused together (both are outwardly a single spine). Sphenotic with 1–3 small spines, located posterior to eye at a horizontal line through middle of pupil in lateral view. Postorbital smooth (rarely serrated). Pterotic spine simple, located just posterior to sphenotic spines. Upper posttemporal spine simple, strongly pointed, small, directed dorsoposteriorly, located about midway between posterior ends of nuchal and lower posttemporal spines. Lower posttemporal spine usually without spiny points, forming a smooth low ridge. Supracleithral spine simple, flattened, not strongly pointed. Cleithral spine flattened, pointed posteromedially.

Lacrimal with five embedded low ridges radiating from center; uppermost end of dorsally-directed ridge with a bump posteroventral to posterior nostril; other ridges without bumps on their ends. Lateral surface of lacrimal usually smooth, without spines (sometimes with an indistinct spine or a bump). Suborbital ridge very low, with three indistinct bumps, lacking pointed spines. Very broad space between ventral margin of orbit and suborbital ridge. Suborbital pit shallow, front rimmed by an oblique or vertical indistinct lacrimal ridge. Preopercle with

four blunt spines; upper two spines equally largest; lower two spines indistinct; all spines lacking a median ridge. Supplemental preopercular spine absent. Upper and lower opercular spines simple with a median ridge.

Origin of first dorsal spine anterior to, or just above, posterior end of nuchal spine base. Posterior margin of opercular membrane and upper end of pectoral-fin base reaching a vertical near fifth dorsal spine base. Posterior tip of longest pectoral-fin ray extending beyond a vertical from base of first anal-fin soft ray. Origin of pelvic fin slightly posterior to pectoral-fin base; posterior tip of depressed pelvic fin just reaching or extending beyond anus. Origin of first anal spine below that of last dorsal spine.

Coloration in life.—Aquarium photographs provided by M. Oshima and underwater photographs registered at KPM (KPM-NR 32982; KPM-NR 84735) showed that ground color of *R. eschmeyeri* varies considerably between individuals (white, beige, reddish-brown, brown, pink, orange, and bright red individuals were confirmed). Notwithstanding this, except for the black spot on the dorsal fin, each individual was a single uniform color (sometimes with small white spots scattered on the head and fin membranes, with white narrow band along fin margins [Fig. 1D] and with two broadly oblique, irregular pale brown bands on body [Fig. 1A, C]; see preserved color description). A black spot on the membrane of the soft-rayed portion of the dorsal fin was usually distinct, although sometimes faint in pale (white and beige) individuals. According to T. Okawa (pers. comm.), the body coloration of several aquarium-held individuals of *R. eschmeyeri* was slightly changeable, being influenced by their surroundings. Figure 1D shows a pink individual (ca. 18 cm total length) collected from the Philippines. Color in life of the holotype was illustrated in Condé (1977: figs. 1–3).

Coloration when fresh.—Based on a color transparency of whitish specimen (MTQ I. 24065, female, 134.8 mm SL, Queensland, Australia; Fig. 1B) taken by P. W. Arnold. Head (including supraocular and lacrimal tentacles), body (including all tentacles), and fins (including spines, soft rays, and membranes) white. Tentacles on outer margin of eye membrane pale brown. A distinct black blotch, slightly greater than pupil diameter, on membrane between seventh and eighth dorsal-fin soft rays.

Coloration of preserved specimens.—Two major color forms were apparent, a uniformly white (or yellowish-white) form and a yellowish-white form with pale brown blotches on the body and dorsal fin. Uniformly white form (Fig. 1B): Entire head, body and fins (except black spot on dorsal fin) white or yellowish-white. A dense black spot, less than orbit diameter, on membrane between seventh and eighth dorsal-fin soft rays. One to four small faint dusky or pale brown blotches, less than orbit diameter, sometimes scattered on dorsal- and caudal-fin membranes. Four tiny black spots along anterior margin of supraocular tentacles in one specimen (MTQ I. 24065, 134.8 mm SL), absent in other specimens. Yellowish-white with pale brown blotches form (Fig. 1A, C): Two broadly oblique irregular pale brown bands, one from middle of spinous dorsal-fin base to lateral surface of abdomen above or anterior to first anal-spine base, the other from middle of soft-rayed dorsal-fin base to posterior end of anal-fin base. Remaining color features, including small faint dusky spots scattered on dorsal- and caudal-fin membranes and a dense black spot on soft-rayed portion of dorsal fin, similar to uniformly-white form.

Distribution.—On the basis of collected specimens only, *Rhinopias eschmeyeri* is currently known from the western Indian (Seychelles, Mauritius, and Réunion), the eastern Indian (Western Australia) and the western Pacific Oceans (Japan, Vietnam, and Queensland, Australia). Many unpublished aquarium photographs of individuals collected from the Philippines and Indonesia were also examined by the first author (e.g., Fig. 1D). Masuda et al. (1984:pl. 281, fig. E) reported a figure specimen as *R. frondosa* (locality unknown), and Kuiter and Tonozuka (2001:132, figs. A–B) reported underwater photographs, taken in Lembeh Strait, Sulawesi, Indonesia at depths from 35–37 m, also as *R. frondosa.* The individuals photographed, however, were undoubtedly *R. eschmeyeri.* Further underwater photographs of the species, registered as KPM-NR 32982 and KPM-NR 84735, were taken off Cape Shionomisaki, Kii Peninsula, Japan at a depth of 18 m and Puerto Galera, north end of Mindoro Island, Philippines at a depth of 30 m, respectively. We are confident that the species is widely distributed in the Indo-West Pacific region. Collection data indicated capture depths from 30–55 m (18–37 m based on underwater photographs).

Remarks.—*Rhinopias eschmeyeri* was described by Condé (1977) from a single specimen (MAN 10475, 148.1 mm SL) from Mahébourg, Mauritius. Subsequently, only Dinesen and Nash (1982), Randall and DiSalvo (1997), Fricke

TABLE 2. FREQUENCY DISTRIBUTION OF SELECTED MERISTIC CHARACTERS IN *Rhinopias eschmeyeri*, *R. frondosa*, and *R. aphanes*. [1] includes one specimen that lacks a left pectoral fin; [H] includes holotype.

	Pectoral-fin rays (one side/other side)				Pored lateral-line scales			Scales between last dorsal-spine base and lateral line			
	15/16	16/16	16/17	17/17	22	23	24	11	12	13	14
R. eschmeyeri		10^{1H}			2^{H}	5	3	1	1	5	3^{H}
R. frondosa	2	12^{H}			3	9^{H}	2		10^{H}	3	1
R. aphanes		2^{H}	2	1	1	3^{H}	1	1	3^{H}	1	

	Gill rakers												
	Upper limb			Lower limb				Total					
	5	6	7	13	14	15	16	18	19	20	21	22	23
R. eschmeyeri	7^{H}	3		2^{H}	7	1		2^{H}	5	2	1		
R. frondosa	3	5^{H}	6		7^{H}	4	3		2	4^{H}	2	5	1
R. aphanes	1	4^{H}			3^{H}	2				4^{H}	1		

(1999), and Randall (2001) have referred to Condé's description, regarding *R. eschmeyeri* as a valid species known only from Mauritius. At no time has the species been reported on the basis of collected specimens since the original description. Condé (1977) described the holotype as having 15 pectoral-fin rays, thereby distinguished from *R. frondosa*, which has 16 (rarely 15) pectoral-fin rays. However, re-examination of the holotype revealed it to have 16 pectoral-fin rays on each side of the body. In fact, *R. eschmeyeri* and related species, *R. aphanes* and *R. frondosa*, are now known to usually have 16 pectoral-fin rays (rarely 15 or 17; see Table 2).

Randall and DiSalvo (1997) quoted Condé's (1977) description of *R. eschmeyeri* as ''It is unique in having a large, round, fleshy flap above each eye.'' However, our examinations of *R. eschmeyeri* and *R. frondosa* showed the character to be somewhat variable. Although the supraocular tentacles of *R. frondosa* were usually much longer (although more slender) than those of *R. eschmeyeri*, being fleshy in both species, the former were sometimes rounded. In fact, the size and shape of the tentacles varied individually. However, the presence or absence of distinct branches occurring along the lateral margin of the supraocular tentacle distinguishes the two species (see Comparisons).

Presence of a pair of tentacles on the underside of the lower jaw is the most important diagnostic character for *R. eschmeyeri* (see Comparisons). Although the number of the tentacles is not variable within this species, lengths of the tentacles vary individually (see Fig. 4A, B): e.g., the tentacles in FAKU 62339 specimen are rudimentary, and those in MAN 11879 specimen are very long, being 52.1% of upper-jaw length.

Our examination of ten specimens of *R. eschmeyeri* showed variations in scale condition on the anteroventral surface of the body and pectoral-fin base: one specimen (BPBM 35771, 159.5 mm SL) had a large number of well exposed scales, one (FAKU 62339, 137.0 mm SL) had a very small number of scattered embedded scales, and the remainder had a large number of embedded scales. One specimen (BPBM 35771, 166.3 mm SL) with embedded scales was collected concurrently from the same locality as one (BPBM 35771, 159.5 mm SL) with well exposed scales, and the size (159.5 mm SL) of the latter specimen falls within the size range (100.6–166.3 mm SL) of specimens with embedded scales, indicating that scale condition in *R. eschmeyeri* does not reflect geographical variation or growth-related changes, simply individual variation. Scale variation as in *R. eschmeyeri* were also found in specimens of *R. frondosa*.

Eschmeyer et al. (1973) discussed the shedding of 'skin' (= cuticle) in the genus *Rhinopias*, including *R. aphanes*, *R. argoliba*, *R. frondosa*, and *R. xenops*, and Motomura and Senou (2005) reported the shedding of cuticle in a closely-related genus *Hipposcorpaena*. Cuticle in the process of shedding from the body surface was also found in most specimens of *R. eschmeyeri*.

Counting of longitudinal scale rows in *Rhinopias* is difficult owing to the irregularity of the rows and indistinct scale contours, which may be related to the epidermal structure associated with shedding. *Rhinopias eschmeyeri*, *R. frondosa*, and *R. aphanes* have 67–79, 68–83, and 65–82 longitudinal scale rows, respectively. The ranges of scale row numbers in these species are relatively greater than in other members of Scorpaenidae, although they do not appear to reflect geographical variation or growth-related changes.

Rhinopias eschmeyeri and *R. frondosa* are currently popular aquarium fishes. Many individuals collected from Southeast Asian waters have

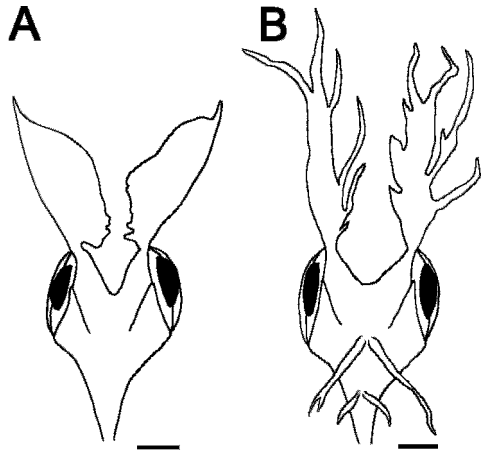

Fig. 3. Anterior view of frontal region in (A) *Rhinopias eschmeyeri* and (B) *R. frondosa*. (A) MTQ I. 24065, 134.8 mm SL, Queensland, Australia; (B) BMNH 1891.4.30.3, holotype, 146.2 mm SL, Mauritius. Scale bars = 5 mm.

recently been imported to Japan, where they are traded separately as different morphotypes (M. Oshima and T. Okawa, pers. comm.).

***Rhinopias frondosa* (Günther, 1892)**
Weedy Scorpionfish
Figures 3B, 4C, 5B, 7; Tables 1–3

Scorpaena frondosa Günther, 1892:482, pl. 39 (type locality: Mauritius).

Holotype.—BMNH 1891.4.30.3, 146.2 mm SL, Mauritius, M. Robillard (collection date unknown, but before Aug. 1891).

Non-type material.—13 specimens, 92.5–152.6 mm SL. BMNH 1934.8.16.2, 92.5 mm SL, Sri Lanka, dredge, donated from Colombo Museum, 4 April 1933; BPBM 22538, 152.6 mm SL, west coast of Mauritius, off Flic en Flac, 1978, D. Pelicier; FAKU 62483, 143.7 mm SL, Japan, Wakayama, Hidaka, off Iwashiro, 18 April 1959, H. Toyama; FAKU 62484, 122.2 mm SL, Japan, Wakayama, Hidaka, off Minabe, Ozaki, 17 Jan. 1959; FAKU 62485, 120.9 mm SL, Japan, Wakayama, Susami, off Satano, 9 April 1972, C. Araga; FRLM 24457, 142.2 mm SL, Japan, Mie, Shima, Wagu, gill net, 31 Oct. 1999, I. Taniyama; FRLM 26527, 133.4 mm SL, same locality as FRLM 24457, gill net, 22 Oct. 2000, T. Sado and K. Fujita; FRLM 26678, 148.5 mm SL, same data as FRLM 26527; MNHN 1967-550, 79.4 mm SL, Réunion, 21°00′S, 54°30′E, 100 m, P. Guézé; MNHN 1992-492, 2:107.7–142.8 mm SL, Madagascar, 20°00′S, 42°30′E, Mauge, 1971; OMNH-P 8688, 141.8 mm SL, Japan, Wakayama, Hidaka, Minabe, Sakai Fishing Port, gill net, 3 Feb. 1996, K. Hatooka; QM I. 33272, 121.8 mm SL, Australia, Queensland, east of Point Cartwright, 26°44′S, 153°24′E, 54 m, trawl, 11 Oct. 2001.

Diagnosis.—*Rhinopias frondosa* is distinguished from *R. argoliba*, *R. cea*, and *R. xenops* by the presence of one or two small black spots, usually less than orbit diameter, in the middle of the membrane between the sixth and ninth dorsal-fin soft rays (vs. spots absent in the latter three species), the absence of scales on the opercle between the tips of the upper and lower opercular spines and the opercular margin (vs. scales present), and 16 (rarely asymmetrically 15 and 16) pectoral-fin rays (vs. 18 rays). It differs from *R. aphanes* in having fleshy tentacles on the supraocular and posterior lacrimal spines (vs. not fleshy), the distal margins of the soft-rayed portions of the dorsal, pelvic, anal, and caudal fins without notches or very weakly notched (vs. strongly notched in the latter), tips of each caudal-fin ray divided into four branches (vs. two branches in adults and unbranched in juveniles), dorsal-fin spines relatively soft and tips bending easily under the slight pressure (vs. firm with strongly pointed tips), the lateral surface of the lacrimal usually smooth or with a bump (vs. usually with a pointed spine), the suborbital ridge usually with three bumps (vs. usually with three pointed spines), and the soft-rayed portion of the dorsal fin with one or two black spots, usually smaller than orbit diameter (vs. with two spots usually much larger than orbit diameter). It differs from *R. eschmeyeri* in having 9–24 tentacles on the underside of the lower jaw (vs. two in the latter), 2–4 tentacles on the frontal below the eyes in anterior view (tentacles absent), numerous distinct tentacles on the lateral surface of the body above the lateral line (vs. distinct tentacles absent), long tentacles, with distinct branches along distal margins, on the supraocular and posterior lacrimal spines (vs. short tentacles, without distinct branches), the distal margin of the spinous portion of the dorsal fin strongly notched (vs. without notches or very weakly notched), and the penultimate dorsal-fin spine usually not curved posteriorly (vs. usually curved posteriorly). It also differs from *R. aphanes* and *R. eschmeyeri* in having head and body with numerous distinct circular dark-margined spots (vs. with elongate black-margined white markings each with a central region of yellow, green, or brown in *R. aphanes* and without distinct pigmentation or markings in *R. eschmeyeri*).

Distribution.—This species is widely distributed in the Indo-West Pacific, from South Africa (off

Durban) east to southern Japan, the Caroline Islands (Eschmeyer et al., 1973; Eschmeyer, 1986), and eastern Australia (this study). An Australian specimen (QM I. 33272, 121.8 mm SL, 26°44′S, Queensland) represents the first record of the species from Australia as well as the southernmost record of the species in the Pacific Ocean. *Rhinopias frondosa* has not been recorded from the Red Sea, Persian Gulf, or New Caledonia, being replaced in the last-mentioned locality by the related species, *R. aphanes*.

Remarks.—Proportional measurements (as percentages of SL and HL) of *Rhinopias frondosa* are given in Table 1, frequency distributions of meristic characters and tentacle numbers being shown in Tables 2 and 3, respectively. *Scorpaena frondosa* Günther, 1891 was originally described from Mauritius on the basis of a single specimen (BMNH 1891.4.30.3, 146.2 mm SL; Fig. 7A). Subsequently, Gill (1905) proposed a new genus, *Rhinopias*, for Günther's *S. frondosa*. *Peloropsis*, proposed by Gilbert (1905) for *Peloropsis xenops* Gilbert, 1905, is a junior synonym of *Rhinopias*, the latter having about six months priority (Eschmeyer et al., 1973). Since the original description, *R. frondosa* (sometimes as *Peloropsis frondosa*) has been widely regarded as a valid species (e.g., Eschmeyer et al., 1973; Shinohara et al., 2001; Manilo and Bogorodsky, 2003), no synonyms being known. Previous reports of the species were detailed by Eschmeyer et al. (1973). However, some records of *R. frondosa* have been based on *R. eschmeyeri* (e.g., Masuda et al., 1984; Kuiter and Tonozuka, 2001), the two species being confused due to their morphological similarity. We confirmed that the westernmost (South Africa) and easternmost (Caroline Islands) records of *R. frondosa*, reported by Eschmeyer (1986:fig. 149.20) and Eschmeyer et al. (1973:fig. 7), respectively, were based on correct identifications, judging from their specimen figures.

***Rhinopias aphanes* Eschmeyer, 1973**
Lacy Scorpionfish
Figures 6B, 8; Tables 1–3

Rhinopias aphanes Eschmeyer in Eschmeyer et al., 1973:300, fig. 8 (type locality: off Nouméa, New Caledonia).

Holotype.—AMS IB. 7079, 177.7 mm SL, New Caledonia, off Nouméa, 30 m depth, collection date unknown, Y. Merlet and M. R. Catala-Stucki.

Non-type material.—5 specimens, 56.6–167.2 mm SL. AMS I. 22659-001, 2 (56.6–158.5 mm SL), Australia, Queensland, Great Barrier Reef, Big Broadhurst Reef, 8 m, 15 Feb. 1981, G. Bull and C. Wallace; AMS I. 22660-001, 128.7 mm SL, Australia, Queensland, central Great Barrier Reef, Davies Reef, 18°51′S, 147°38′E, 11 m, 19 Dec. 1980, W. J. Nash and Z. D. Dinesen; AMS I. 22661-001, 162.5 mm SL, Papua New Guinea, Port Moresby, Aug. 1980, N. Coleman and B. Halstead; AMS I. 33752-001, 167.2 mm SL, Australia, Queensland, Portlock Reef, 09°34′27″S, 144°46′18″E, 15 m, spear, 29 Jan. 1993, M. McGrouther. The following specimens were also examined (but counts and measurements were not taken): MNHN 1980-380, 11.1 mm SL, New Caledonia, 22°10′S, 166°30′E, P. Fourmanoir; USNM 356589, 175 mm SL, Vanuatu, Shepherd Islands, Tongoa Island, Judy Reef, 16°52′30″S, 168°31′30″E, MV Lewia, 22.9–32.9 m, 9 June 1996, J. T. Williams et al.; WAM-P 29625-010, 176 mm SL, Papua New Guinea, Bootless Inlet, 9°35′S, 147°15′E, 5–30 m, spear, 1985, P. Colin.

Diagnosis.—*Rhinopias aphanes* is distinguished from *R. argoliba*, *R. cea*, and *R. xenops* by the presence of two black spots in the middle of the membrane between the sixth and eighth dorsal-fin soft rays (vs. spots absent in the latter three species), the absence of scales on the opercle between the tips of the upper and lower opercular spines and the opercular margin (vs. scales present), and 16 or 17 pectoral-fin rays (vs. 18 rays). It differs from *R. eschmeyeri* and *R. frondosa* in having the membrane of the spinous portion of the dorsal fin not fleshy (vs. fleshy in the latter two species), the distal margins of the soft-rayed portions of the dorsal, pelvic, anal, and caudal fins strongly notched (vs. without notches or very weakly notched), tips of each caudal-fin ray divided into two branches in adults and unbranched in juveniles (vs. four branches), dorsal-fin spines firm with strongly pointed tips (vs. spines relatively soft and tips bending easily under the slight pressure), the lateral surface of the lacrimal usually with a pointed spine (vs. usually smooth or with a bump), the suborbital ridge usually with three pointed spines (vs. usually with three bumps), the soft-rayed portion of the dorsal fin with two black spots, usually greater than orbit diameter (vs. one or two spots, usually smaller than orbit diameter), and head and body with elongate black-margined white markings each with a central region of yellow, green, or brown (rarely purplish) in life (vs. without distinct pigmentation or markings in *R. eschmeyeri* and with numerous distinct circular dark-margined spots in *R. frondosa*). It also differs from *R. eschmeyeri* in having 12–18 tentacles on

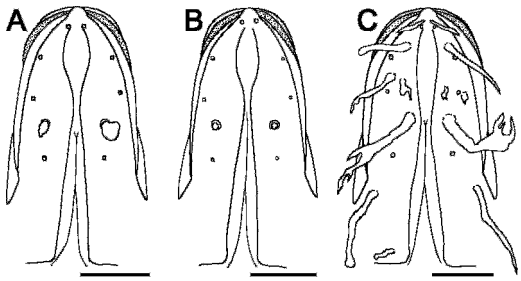

Fig. 4. Ventral view of mandible in (A–B) *Rhinopias eschmeyeri* and (C) *R. frondosa*. (A) MTQ I. 24065, 134.8 mm SL, Queensland, Australia; (B) FAKU 62339, 137.0 mm SL, Japan; (C) BMNH 1891.4.30.3, holotype, 146.2 mm SL, Mauritius. Scale bars = 10 mm.

the underside of the lower jaw (vs. two tentacles in the latter), 2–4 tentacles on the frontal below the eyes in anterior view (vs. tentacles absent), numerous distinct tentacles on the lateral surface of the body above the lateral line (vs. absent), long tentacles, with distinct branches along distal margins, on the supraocular and posterior lacrimal spines (vs. short tentacles, without distinct branches), and the penultimate dorsal-fin spine usually not curved posteriorly (vs. usually curved posteriorly).

Distribution.—This species is distributed only in the Coral Sea and adjacent waters, specimens having been collected from Papua New Guinea (this study), New Caledonia (Eschmeyer et al., 1973; this study), Vanuatu (J. T. Williams, pers. comm.; the specimen confirmed in this study), and northeastern Australia (Dinesen and Nash, 1982; this study). The southern limit of the species has been determined from an underwater photograph taken at Lady Elliot Island (ca. 24°07′S, 152°43′E), Queensland (Randall, 2001:fig. 1). Allen (in Randall et al., 1990) summarized the distribution of the species as ''Northeastern Australia, New Caledonia, New Guinea and north to Japan'', being followed by subsequent authors (e.g., Poss, 1999; Randall, 2001). However, we could find neither confirmed records nor specimens of *R. aphanes* from north of Papua New Guinea. The Japanese record reported by Randall et al. (1990) is in error (G. R. Allen, pers. comm.).

Remarks.—Proportional measurements (as percentages of SL and HL) of *Rhinopias aphanes* are given in Table 1, frequency distributions of meristic characters and tentacle numbers being shown in Tables 2 and 3, respectively. *Rhinopias aphanes* was originally described by Eschmeyer (*in* Eschmeyer et al., 1973) on the basis of a single specimen (AMS IB. 7079, 177.7 mm SL) collected off Nouméa, New Caledonia. Subsequently, Fourmanoir and Laboute (1976) included a figure of the holotype, taken in life. Dinesen and Nash (1982) reported three specimens of *R. aphanes* as first records from Australia and gave detailed color descriptions of the species, including individual variation and changes in hue according to the surroundings. A larva of the species was reported by Fourmanoir (1976) from New Caledonia (MNHN 1980-380, 11.1 mm SL). No juveniles and larvae of *R. eschmeyeri* and *R. frondosa* have been reported.

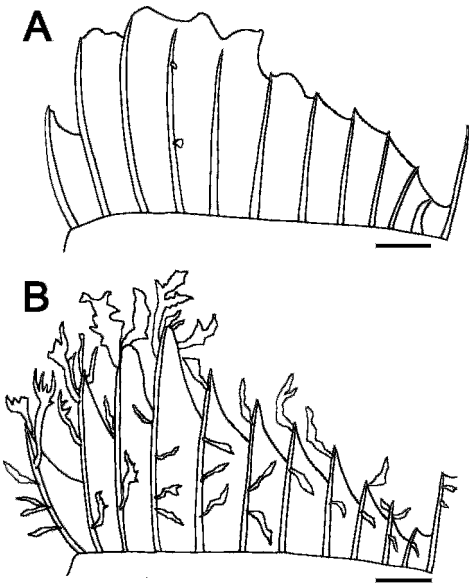

Fig. 5. Spinous portion of the dorsal fins in (A) *Rhinopias eschmeyeri* and (B) *R. frondosa*. (A) FAKU 62339, 137.0 mm SL, Japan (anterior part of dorsal fin was based on MTQ I. 24065, 134.8 mm SL because of broken spines in the former); (B) FRLM 26527, 133.4 mm SL, Japan. Anterior to left. Scale bars = 20 mm.

All soft rays of the two smallest specimens examined during this study (AMS I. 22659-001, 56.6 mm SL and MNHN 1980-380, 11.1 mm SL) are unbranched, whereas those of all larger specimens are branched, indicating that the soft rays (except lower pectoral-fin rays) become branched with growth in *R. aphanes*. Such ontogenetic changes should be expected in the other species.

Kuiter and Tonozuka (2001:132, fig. B) reported an underwater photograph, taken at Papua New Guinea at a depth of 10 m, as *R. aphanes*; however, it appears to be *R. frondosa*. Although many underwater photographs of *R. aphanes* have been reported (e.g., Laboute and

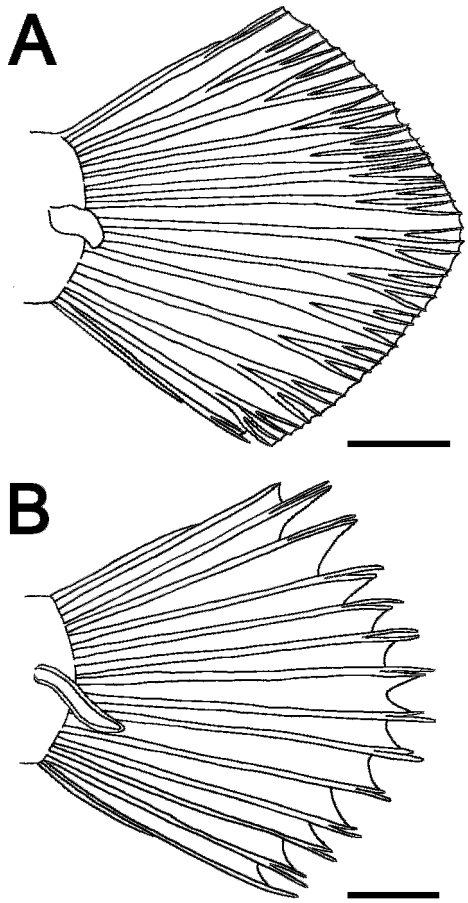

Fig. 6. Caudal fins in (A) *Rhinopias eschmeyeri* and (B) *R. aphanes*. (A) MTQ I. 24065, 134.8 mm SL, Queensland, Australia; (B) AMS I. 22661-001, 162.5 mm SL, Papua New Guinea. Small tentacles scattered on the caudal-fin rays are not illustrated. Scale bars = 10 mm.

Grandperrin, 2000:166; Kuiter and Tonozuka, 2001:132, fig. A; Randall, 2001:fig. 1), the number of museum specimens is very limited. According to published photographs, color descriptions by Dinesen and Nash (1982) and a photograph of a specimen (AMS I. 33752-001, 167.2 mm SL) taken by S. Reader before preservation, the extent of individual color variations in *R. aphanes* is much less than in *R. frondosa* and *R. eschmeyeri*. Randall (2001) noted an inconsistent use of English names for *R. aphanes* and proposed ''Lacy Scorpionfish'' for the species instead of ''Weedy Scorpionfish'' or ''Merlet's Scorpionfish.''

Comparisons.—Three species of *Rhinopias*, *R. eschmeyeri*, *R. frondosa*, and *R. aphanes*, reviewed in this paper are similar to each other in overall body appearance, and most of their morphometric (Table 1) and meristic (Table 2) characters overlap. In addition, they share the following characters: one or two small dense black spots, approximately equal in size with pupil diameter, in the middle of the membrane between the sixth and ninth dorsal soft rays (Figs. 1, 7–8); the opercle, between the tips of the upper and lower opercular spines and the opercular margin, not covered with scales (Fig. 2); and a lower pectoral-fin ray count (usually 16 rays, rarely 15 or 17; Table 2). Other currently known species of *Rhinopias*, *R. argoliba*, *R. cea*, and *R. xenops*, are distinguished from the three species by the absence of black spots in the soft-rayed portion of the dorsal fin, the opercular margin covered with scales, and a higher pectoral-fin ray count (18 rays).

The condition of tentacles on the head and body is one of the most useful characters for separating these species. *Rhinopias eschmeyeri* can easily be distinguished from *R. frondosa* and *R. aphanes* by the lack of tentacles on the frontal below the eyes in anterior view (vs. usually two pairs of tentacles in *R. frondosa* and one or two pairs of tentacles in *R. aphanes*; Table 3, Fig. 3), lacking distinct tentacles on the lateral surface of the body (vs. present in the latter two species; Figs. 1, 7–8), having a pair of two tentacles on the underside of the lower jaw (9–24 in *R. frondosa* and 12–18 in *R. aphanes*; Table 3, Fig. 4), and having short tentacles, without distinct branches, on the supraocular and posterior lacrimal spines (vs. long tentacles, with distinct branches occurring along distal margins, in the latter two

TABLE 3. FREQUENCY DISTRIBUTION OF NUMBERS OF TENTACLES (INCLUDING RUDIMENTS) ANTERIOR TO EYE AND ON UNDERSIDE OF LOWER JAW IN *Rhinopias eschmeyeri*, *R. frondosa*, AND *R. aphanes*. [1] and [2] locations of tentacles were shown in Figs. 3 and 4, respectively; [H] includes holotype.

	Tentacles anterior to eye[1]					Tentacles on underside of lower jaw (except on lower lip)[2]															
	0	1	2	3	4	2	—	9	10	11	12	13	14	15	16	17	18	19	20	—	24
R. eschmeyeri	10^{H}					10^{H}															
R. frondosa			1		13^{H}			1	2		2	3^{H}	1		2	1			1		1
R. aphanes			3	2	1^{H}						2	1		1^{H}			2				

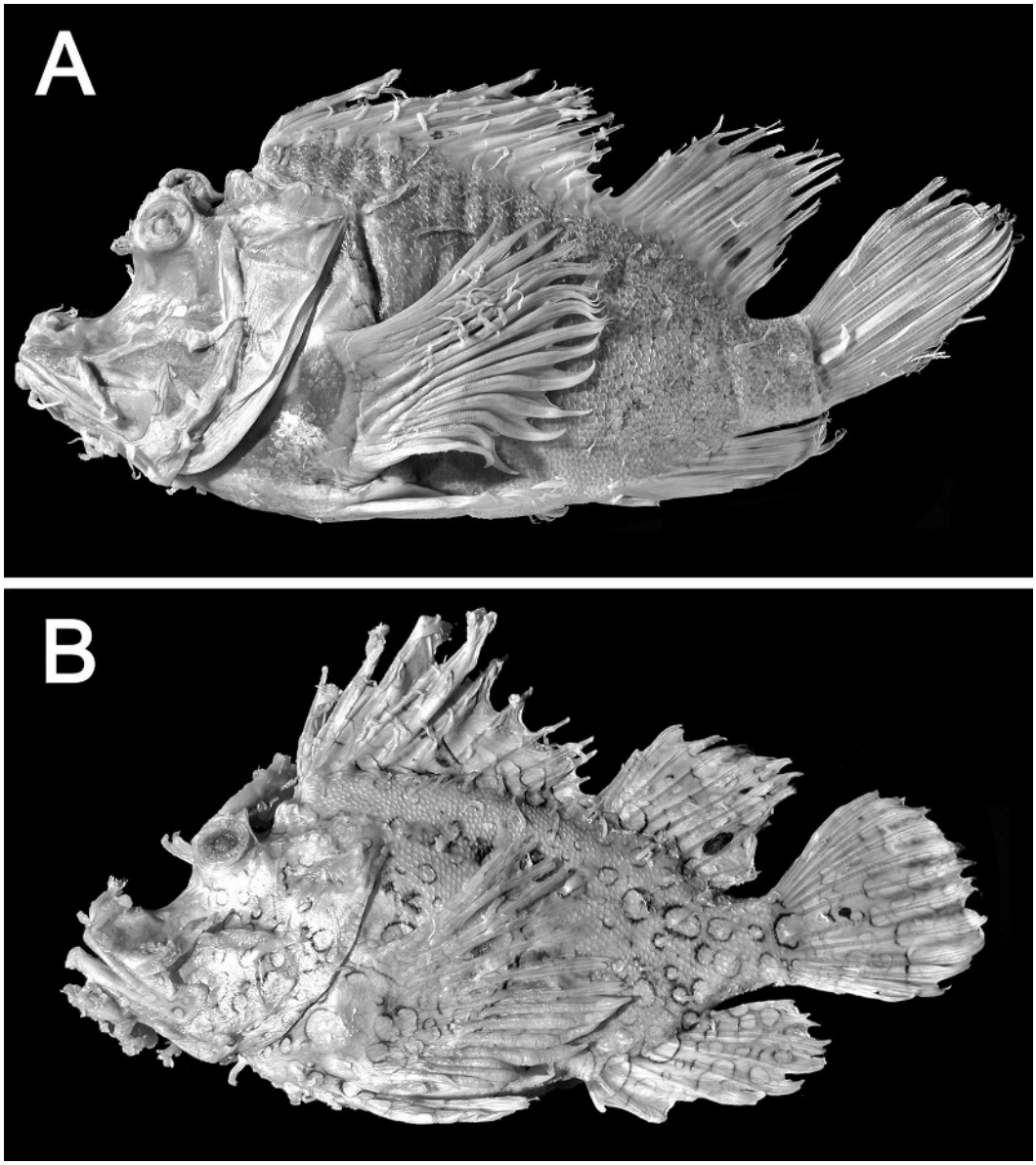

Fig. 7. *Rhinopias frondosa*. (A) BMNH 1891.4.30.3, holotype of *Scorpaena frondosa*, 146.2 mm SL, Mauritius (C. Bento); (B) FRLM 26527, 133.4 mm SL, Japan (H. Motomura).

species; Figs. 1–3, 7–8). In addition, tentacles on the head and body in *R. eschmeyeri* and *R. frondosa* are fleshy and thickened, whereas those in *R. aphanes* are not.

The condition of the fin membranes also separate these three species. The distal margin of the spinous portion of the dorsal fin in *R. eschmeyeri* lacks notches, or is notched very weakly (Fig. 5A), whereas in *R. frondosa* it is strongly notched, e.g., membrane anterior to the fourth dorsal-fin spine extending up to 59–76% (mean 65%) of the spine length (Fig. 5B), and that in *R. aphanes* is even more strongly notched, i.e., 48–65% (mean 57%). The distal margins of other fins (soft-rayed portion of dorsal, pelvic, anal, and caudal fins) in *R. eschmeyeri* and *R. frondosa* lack notches, or are weakly notched, whereas those in only *R. aphanes* are strongly notched. The caudal fins of *R. eschmeyeri* and *R. aphanes* are shown in Figure 6. In addition, membrane of the spinous portion of the dorsal fin in *R. eschmeyeri* is notably fleshy, whereas in *R. aphanes* it is not

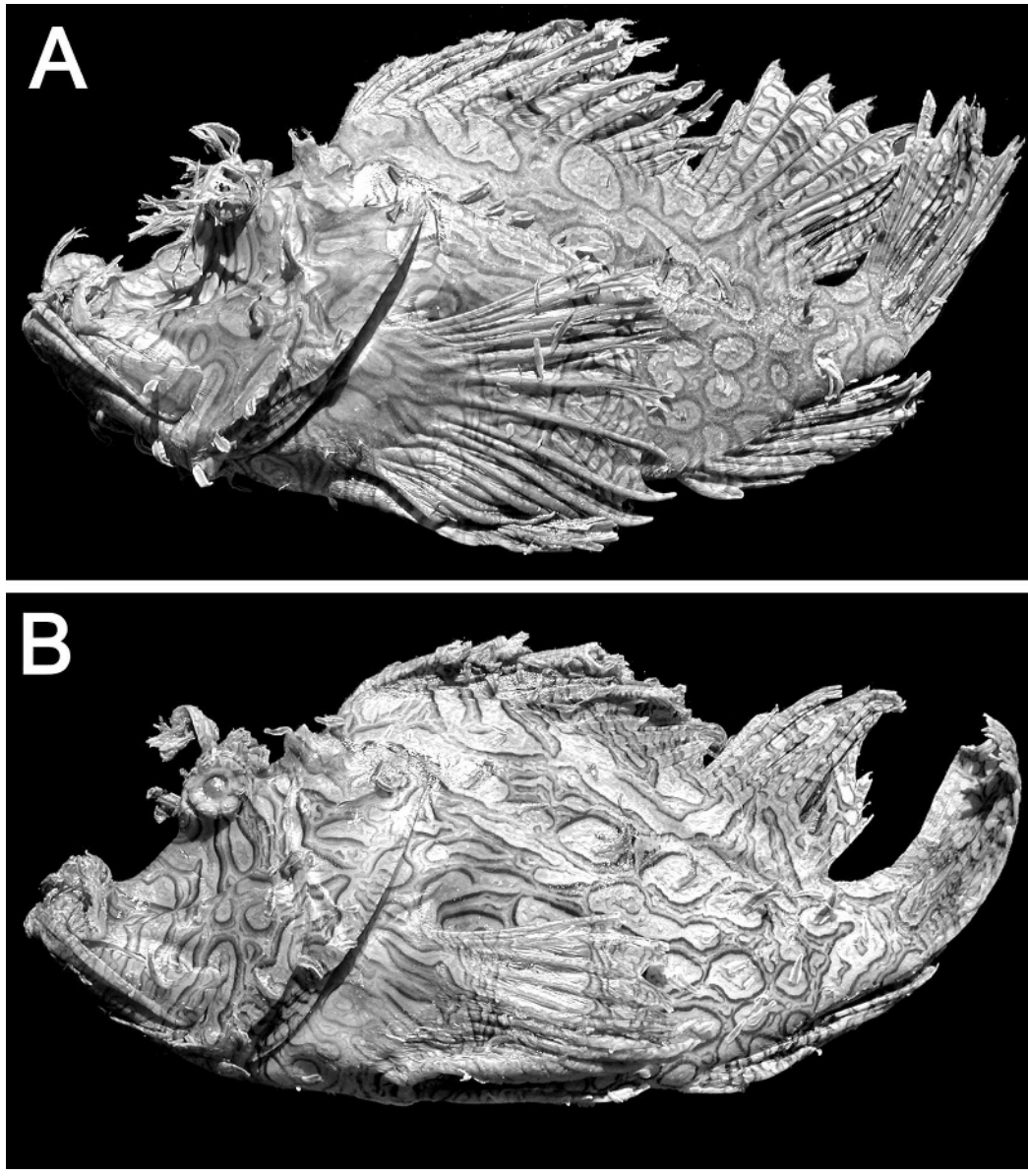

Fig. 8. *Rhinopias aphanes*. (A) AMS IB. 7079, holotype, 177.7 mm SL, New Caledonia (H. Motomura); (B) AMS I. 33752-001, 167.2 mm SL, Queensland, Australia (H. Motomura).

(being similar to other scorpaenids), and in *R. frondosa* it is intermediate between those of *R. eschmeyeri* and *R. aphanes*.

Comparisons of the dorsal-fin spine and soft ray structures among the three species also show differences. *Rhinopias eschmeyeri* and *R. frondosa* have spines which are relatively soft, tips of the spines easily bending under the slight pressure. In contrast, *R. aphanes* has spines typical of most scorpaenids, which are firm, with strongly pointed tips. The penultimate dorsal-fin spine of *R. eschmeyeri* is usually curved posteriorly (Fig. 5A), whereas that of *R. frondosa* and *R. aphanes* is usually not curved (Fig. 5B). Tips of each caudal-fin ray in *R. eschmeyeri* and *R. frondosa* are divided into four branches (Fig. 6A), whereas those in *R. aphanes* are divided into only two branches (Fig. 6B); those in juveniles of the latter are unbranched (see Remarks for *R. aphanes*).

Head spine and ridge structures of these three species are very similar (see Fig. 2). However, *R. eschmeyeri* and *R. frondosa* differ from *R. aphanes* in

lacking strongly pointed spines (spines usually forming bumps) on the lateral surface of the lacrimal and the suborbital ridge (vs. usually having pointed spines in the latter). No significant spine and ridge differences between *R. eschmeyeri* and *R. frondosa* were found during this study.

There are no significant differences in scale and gill-raker counts among the three species (Table 2). Some counts, e.g., scales between the last dorsal-fin spine and lateral line, and total gill rakers, appear to show modal differences between *R. eschmeyeri* and the other two species (see Table 2); however, their confirmation requires examination of more specimens.

In addition to the above mentioned morphological characters, the three species can be distinguished by their coloration. Live coloration of *R. eschmeyeri* shows considerable variation among individuals (see color description), however the entire head (including eyes and tentacles), body, and fins (except black spot on dorsal fin) of each individual is a single uniform color. Although *R. eschmeyeri* sometimes has a few indistinct irregular markings on the body (Fig. 1A, C) and a narrow white band along fin margins (Fig. 1D), it lacks, without exception, distinct large circular or elongate spots found in *R. frondosa* and *R. aphanes* (Figs. 7–8). Live coloration of *R. frondosa* is also variable (see Masuda et al., 1984:pl. 281, fig. C; Kuiter and Tonozuka, 2001:132, figs. C–D; Randall, 2001:figs. 4–6). It has numerous distinct circular dark-margined spots on the head and body, the central region of these spots being the same color as the ground color on the body (black-margined white circular spots in preserved specimens). On the other hand, live coloration of *R. aphanes* is quite distinct, relative to *R. eschmeyeri* and *R. frondosa*. *Rhinopias aphanes* is usually yellowish (rarely purplish) with elongate black-margined white markings, each with a central region of yellow, green, or brown (rarely purplish) on the head and with elongate or circular markings on the body. Furthermore, tentacles on the head and body in *R. aphanes* are blackish with yellowish margins in life (brown with white margins in preservative), whereas those in *R. eschmeyeri* and *R. frondosa* are uniform, but varies among individuals, without alternate coloration on the margins (uniformly white in preservative). Moreover, *R. aphanes* has two black spots on the soft-rayed portion of the dorsal fin, whereas *R. eschmeyeri* and *R. frondosa* usually have only one spot (of the specimens of the latter two species examined during this study, only a single specimen, holotype of *Scorpaena frondosa*, has two spots).

Material Examined

Rhinopias argoliba: ZIN 49340, 110 mm SL, Coral Sea, 25°13′S, 159°46′E, RV Akademik Oparin, 65–70 m depth, 6 Sept. 1988. *Rhinopias cea*: BPBM 31701, 148.0 mm SL, French Polynesia, Austral Islands, Rapa Island, May 1990, F. Reveil. *Rhinopias xenops*: BPBM 33504, 147.8 mm SL, Hawaiian Islands, Oahu, off Waikiki, 73 m depth, otter trawl, 9 Feb. 1974, P. S. Lobel on board RV Machias.

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