

***Scorpaena bulacephala*, a new species of scorpionfish (Scorpaeniformes: Scorpaenidae) from the northern Tasman Sea**

HIROYUKI MOTOMURA¹, PETER R. LAST² & GORDON K. YEARSLEY²

¹*Ichthyology, Australian Museum, 6 College Street, Sydney, New South Wales 2010, Australia (motomura@austrmus.gov.au)*

²*CSIRO Marine & Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia (PRL, peter.last@csiro.au; GKY, gordon.yearsley@csiro.au)*

Abstract

A new species of small-sized scorpionfish, *Scorpaena bulacephala*, is described on the basis of seven specimens collected from off Norfolk and Lord Howe Islands, northern Tasman Sea, southwestern Pacific Ocean, at depths of 86–113 m. The new species is closely related to a Hawaiian endemic species, *S. colorata*. The two species are distinguished from other Indo-Pacific species of *Scorpaena* by the following combination of characters: exposed cycloid scales covering the anteroventral surface of the body and pectoral-fin base, the lateral surface of the lacrimal without spines, and 17 pectoral-fin rays. The new species differs from *S. colorata* in having 39–44 longitudinal scales rows and relatively short fin spines and rays, especially short longest pectoral-fin ray (31.5–33.5% of standard length). Morphological changes with growth and sexual dimorphism of the new species are also discussed.

Key words: Scorpaenidae, *Scorpaena*, new species, Tasman Sea, southwestern Pacific Ocean

Introduction

In May–June 2003, the biodiversity of the northern Tasman Sea was surveyed by an international research team using the New Zealand FRV *Tangaroa*. This survey, known as NORFANZ, led to the collection of seven unidentified scorpionfish specimens from off Norfolk and Lord Howe Islands, at depths of 86–113 m. These specimens belong to the genus *Scorpaena* Linnaeus, 1758 whose Indo-Pacific species are characterized by 12 dorsal-fin spines, teeth on the palatines, an occipital pit, the posterior lacrimal spine directed posteroventrally, some pectoral-fin rays branched in adults, and the pored lateral-line scales continuing on to the caudal-fin base (e.g., Poss, 1999; Motomura et al., 2005),

although no definition of the genus on a worldwide basis is available (e.g., Eschmeyer, 1965; Motomura, 2004a).

These Tasman Sea specimens share two characters (i.e., absence of spines on the lateral surface of the lacrimal and presence of exposed scales on the anteroventral surface of the body and the pectoral-fin base) with only four species: *S. colorata* (Gilbert, 1905), *S. gibbifrons* Fowler, 1938, *S. papillosa* (Schneider & Forster in Bloch & Schneider, 1801) and *S. sumptuosa* Castelnau, 1875. However, the specimens differ from these three species in several aspects, including head spine, ridge and scale structures, meristics, and several proportional measurements. The specimens are therefore described herein in detail as a new species. Morphological changes with growth and sexual dimorphism of the species are also discussed.

Materials and Methods

Counts and measurements follow Motomura (2004a, b) with the following additions. Scales above the lateral line were counted obliquely from between the first dorsal-fin spine base and the first pored lateral-line scale. Scales below the lateral line were counted vertically from between the first anal-fin spine base and the lateral line. Scales were also counted vertically between the last dorsal-fin spine base and the lateral line. Predorsal scale rows were taken as the number of rows between the first dorsal-fin spine base and the posterior margin of the occipital pit. Suborbital space is the least distance between the ventral margin of the orbit and the suborbital ridge. Occipital pit length was measured from the anterior margin to the posterior margin of the occipital pit, and the occipital pit width between the lateral edges of the occipital pit. Post-occipital pit length was taken from the posterior margin of the occipital pit to the first dorsal-fin spine base. Head width is the straight-line distance between posterior ends of pterotic spine bases. Standard and head lengths are expressed as SL and HL, respectively.

Terminology of head spines follow Randall & Eschmeyer (2002) with the following additions: the spine occurring at the base of the uppermost preopercular spine is referred to as the supplemental preopercular spine (Eschmeyer, 1965); and the coronal and extra spines are figured in Chen (1981: fig. 1) and Motomura et al. (2004: fig. 14b). Institutional codes follow Leviton et al. (1985).

All Indo-Pacific species of *Scorpaena* currently regarded as valid were examined. Comparative data mentioned in this paper where no references are cited are based on the following specimens. *Scorpaena colorata*: BPBM 23928 (9 specimens), 50.9–73.2 mm SL, off Haleiwa (21°40'N, 158°07'W), Oahu Island, Hawaiian Islands, 95–110 m depth, shrimp trawl, coll. by T. Cromwell, 3 May 1968; BPBM 24109 (4 specimens), 47.3–94.7 mm SL, northwest side of Molokai (21°15'N, 157°08'W), Hawaiian Islands, 119 m depth, shrimp trawl, coll. by T. Cromwell, 12 Nov. 1968. *Scorpaena papillosa*: BMNH 1872.4.26.3, 159.0 mm SL, Wellington, New Zealand; CAS 13451 (2 specimens), 116.0–

117.2 mm SL, New Zealand; NMNZ P. 6828, 117.0 mm SL, north of Hoho Inlet (48°01.00'S, 166°35.00'E), 40 m depth, craypot, coll. by D. S. Horning, 9 Dec. 1974. *Scorpaena sumptuosa*: CAS 204410, 105.1 mm SL, off Geraldton, Western Australia, Australia, 1976; CAS 219504, 141.7 mm SL, Shark Bay, Western Australia, Australia, coll. by W. Poole, Aug. 1965; MNHN A. 710, 228.6 mm SL, Australia (precise locality unknown), coll. by F. L. Castelnau; MNHN A. 4409 (dried syntype), 241.2 mm SL, Fremantle (32°07'S, 115°43'E), Western Australia, Australia, coll. by F. L. Castelnau, 1875; MNHN B. 2570 (dried syntype), 229.1 mm SL, same data as MNHN A. 4409. Data for the holotype of *S. gibbifrons* are based on Fowler (1938), Poss (1999) and J. T. Williams (pers. comm.).

***Scorpaena bulacephala* new species**

New English name: Bullhead Scorpionfish

Figures 1–5

Holotype. CSIRO H 6009-05, female, 80.7 mm SL, south of Norfolk Island (28°54–55'S, 167°40–41'E), Norfolk Ridge, Tasman Sea, 111–113 m depth, coll. by FRV *Tangaroa*, 15 May 2003.

Paratypes. AMS I. 43470-001, 32.1 mm SL, southeast of Lord Howe Island (31°49'S, 159°20'E), Lord Howe Rise, Tasman Sea, 86–89 m depth, coll. by FRV *Tangaroa*, 22 May 2003; CSIRO H 6009-06, 87.5 mm SL, same data as holotype; CSIRO H 6028-03, 49.5 mm SL, same data as AMS I. 43470-001; CSIRO H 6028-07, 2 specimens, 34.3–44.8 mm SL, same data as AMS I. 43470-001; NMV A. 25132-005, 84.2 mm SL, Balls Pyramid (31°52'26–40"S, 159°14'26"–15°27"E), Lord Howe Rise, Tasman Sea, 76–81 m depth, benthic sled, coll. by FRV *Tangaroa*, 23 May 2003.

Diagnosis. A species of *Scorpaena* with the following combination of characters: Dorsal-fin soft rays 9; fourth dorsal-fin spine longest; pectoral-fin rays 17; longitudinal scales rows 39–44; pored lateral-line scales 23; ctenoid scales covering lateral surface of trunk; exposed cycloid scales covering anteroventral surface of body and pectoral-fin base; lateral surface of maxilla without a longitudinal ridge; lateral surface of lacrimal without spines; anterior lacrimal spine with 1–3 small spines on its posterior margin; posterior lacrimal spine simple, directed ventroposteriorly; median interorbital ridge and coronal spine absent; occipital pit and supplement preopercular spine present; relatively short fin spines and rays, especially short longest pectoral-fin ray (31.5–33.5% of SL); space between upper and lower opercular spines not covered by skin with sensory pores and canals; supraocular tentacle length less than or approximately equal to pupil diameter; lateral surface of trunk, except pored lateral-line scales, without tentacles.

Description. Proportional measurements of the specimens of *Scorpaena bulacephala* are given as percentages of SL and HL in Table 1. Data for the holotype are presented first, followed by paratype data (if different) in parentheses.

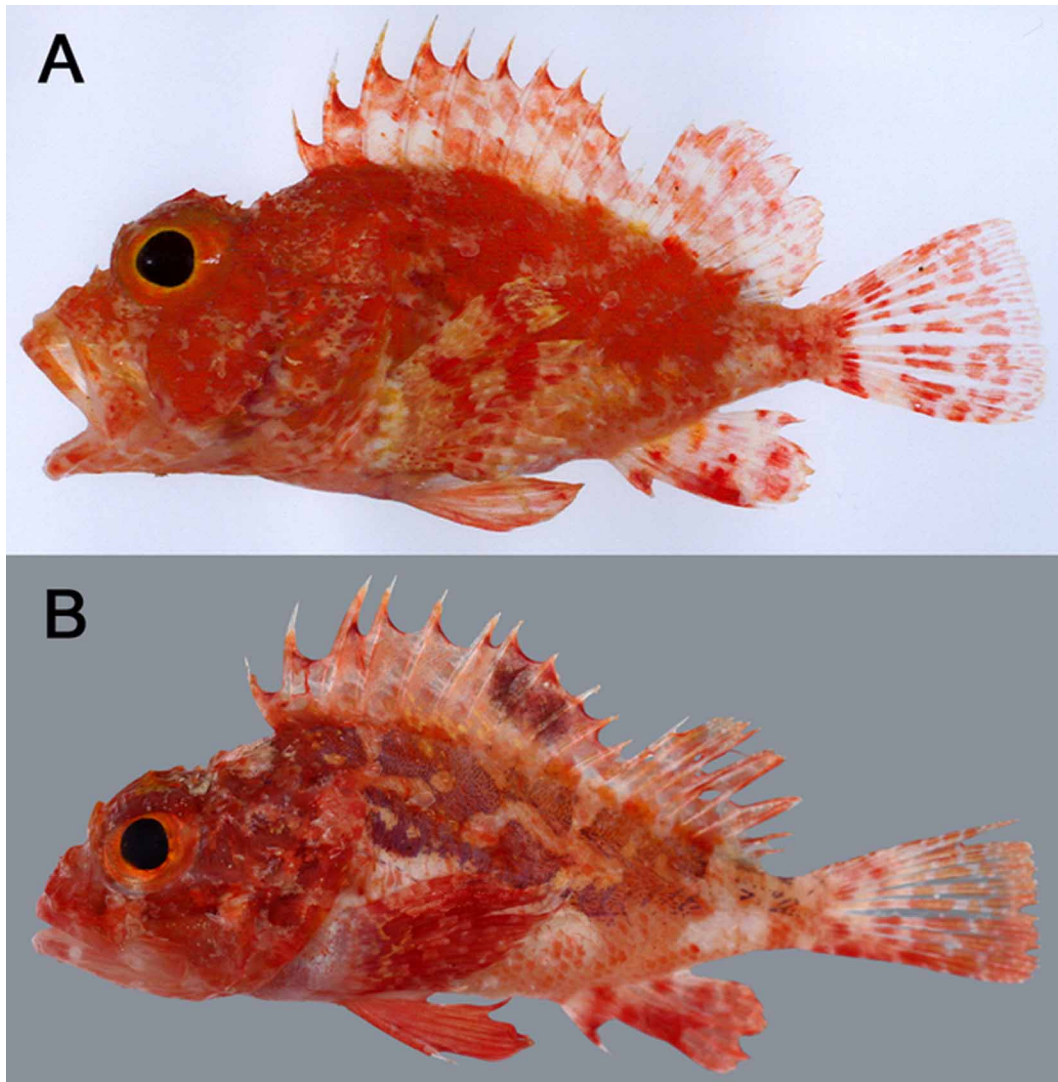


FIGURE 1. Color photographs of *Scorpaena bulacephala*. A, CSIRO H 6009-05, female, holotype, 80.7 mm SL, south of Norfolk Island; B, CSIRO H 6028-03, probable male, paratype, 49.5 mm SL, southeast of Lord Howe Island.

Dorsal fin with 12 spines and 9 soft rays; all soft rays branched; length of first spine 1.6 (1.6–2.0; mean 1.7) in second spine; fourth spine longest, its length slightly less than upper-jaw length; fourth to eleventh spines progressively shorter; length of eleventh spine 1.9 (1.5–1.9; mean 1.7) in last spine; membrane of spinous portion of dorsal fin moderately notched; second soft ray longest, approximately equal length with longest dorsal-fin spine; posterior branch of last soft ray joined by membrane to caudal peduncle for approximately one-third its length. Anal fin with 3 spines and 5 soft rays; all soft rays branched; first spine 2.4 (2.0–2.5; mean 2.4) in second spine, 1.8 (1.7–2.1; mean 1.9) in third spine; first soft ray longest; posterior branch of last soft ray joined by membrane to caudal pedun-

cle for less than one-sixth its length. Pectoral fin with 17 rays on each side of body, an uppermost ray and 11 lower rays unbranched, remaining rays branched (1 or 2 upper rays and 10–13 lower rays unbranched in larger paratypes over 49.5 mm SL; all rays unbranched in smaller paratypes less than 44.8 mm SL); ninth ray longest (tenth ray in smallest paratype), length less than head length; lower unbranched rays thickened; posterior margin of fin rounded. Pelvic fin with 1 spine and 5 soft rays, all soft rays branched; second soft ray longest, slightly longer than upper-jaw length; last soft ray joined by membrane to abdomen for more than two-thirds its length. Caudal fin with 17 (15–17) segmented rays, 11 (or 10) rays branched, remaining rays unbranched; posterior margin of fin slightly rounded. Caudal-peduncle depth 1.8 (1.7–1.9; mean 1.8) in caudal-peduncle length.

TABLE 1. Morphometric characters of *Scorpaena bulacephala*, expressed as percentages of standard and head lengths.

	Holotype	Paratypes						Mean
	CSIRO H 6009-05	CSIRO H 6009-06	NMV A 25132-005	CSIRO H 6028-03	CSIRO H 6028-07	CSIRO H 6028-07	AMS I 43470-001	
Standard length (mm)	80.7	87.5	84.2	49.5	44.8	34.3	32.1	
% of standard length								
Body depth	43.1	39.7	40.3	37.0	37.7	38.5	38.3	39.2
Body width	22.3	21.9	23.2	20.8	20.1	20.4	18.7	21.1
Head length	48.3	44.6	45.8	44.0	44.9	46.6	47.0	45.9
Snout length	12.8	12.7	13.2	12.3	10.9	10.8	11.5	12.0
Orbit diameter	16.9	14.7	13.1	15.4	16.1	15.5	16.2	15.4
Interorbital width ¹	6.7	5.8	5.8	5.7	6.0	6.4	5.3	6.0
Interorbital width ²	5.5	4.9	4.8	4.8	5.1	5.8	5.0	5.1
Head width	17.3	15.8	16.0	16.8	16.5	16.9	16.5	16.6
Upper-jaw length	22.7	21.7	23.6	22.0	21.9	22.4	22.4	22.4
Maxilla depth	7.1	6.7	7.8	7.1	6.7	7.3	7.2	7.1
Suborbital space	1.7	1.6	1.9	1.0	0.8	0.3	0.6	1.1
Postorbital length	21.9	19.7	22.3	21.0	19.4	20.4	20.6	20.8
Between tips of opercular spines	8.4	6.9	7.1	6.9	7.4	7.9	7.8	7.5
Occipital pit length	5.1	4.6	4.8	5.5	6.3	7.0	6.9	5.7
Occipital pit width	6.1	5.6	5.9	7.3	7.4	7.9	7.8	6.8
Post-occipital pit length	6.7	7.8	8.3	7.9	6.3	5.5	6.9	7.0
Predorsal-fin length	40.0	38.4	38.7	39.0	37.5	37.3	39.6	38.6
Preanal-fin length	74.0	72.0	72.9	67.3	70.3	72.0	70.7	71.3
Prepelvic-fin length	48.0	47.7	47.1	40.2	46.4	47.8	44.5	46.0
1st dorsal-spine length	10.0	8.3	8.9	9.3	10.5	9.3	7.5	9.1

.....continued on the next page

Table 1 (continued)

	Holotype			Paratypes				Mean
	CSIRO H 6009-05	CSIRO H 6009-06	NMV A 25132-005	CSIRO H 6028-03	CSIRO H 6028-07	CSIRO H 6028-07	AMS I 43470-001	
2nd dorsal-spine length	16.2	14.7	15.3	16.4	16.3	16.6	15.0	15.8
3rd dorsal-spine length	20.4	17.8	19.0	19.2	19.9	20.7	-	19.5
4th dorsal-spine length	20.7	18.6	19.6	20.8	21.9	21.0	-	20.4
5th dorsal-spine length	20.2	18.1	18.4	20.0	20.1	20.1	-	19.5
6th dorsal-spine length	20.2	17.8	17.9	19.0	-	-	-	18.7
7th dorsal-spine length	19.7	15.9	17.2	18.4	18.8	19.0	18.1	18.1
8th dorsal-spine length	18.2	16.1	16.3	16.2	-	18.4	-	17.0
9th dorsal-spine length	15.7	13.4	14.3	14.9	-	16.6	14.3	14.9
10th dorsal-spine length	12.8	9.5	11.9	12.7	-	14.0	13.1	12.3
11th dorsal-spine length	9.2	8.7	9.0	10.3	10.3	10.8	10.6	9.8
12th dorsal-spine length	17.0	16.1	13.5	16.6	-	17.2	16.5	16.2
Longest dorsal-ray length	20.1	20.6	20.2	19.6	20.3	22.2	20.6	20.5
1st anal-spine length	9.7	8.3	7.6	10.1	8.7	9.6	8.1	8.9
2nd anal-spine length	23.4	20.1	19.0	20.2	20.8	21.9	20.2	20.8
3rd anal-spine length	17.8	15.3	15.6	16.8	16.5	17.8	17.1	16.7
Longest anal-ray length	21.1	22.5	22.2	21.2	22.1	24.5	23.1	22.4
Pectoral-ray length	31.5	31.7	31.8	32.5	33.0	33.5	33.0	32.2
Pelvic-spine length	17.1	15.8	15.0	17.6	17.4	18.7	18.1	17.1
Longest pelvic-ray length	24.8	25.7	24.8	25.9	25.2	25.9	26.5	25.5
Caudal-fin length	30.4	30.1	30.8	30.5	30.4	31.8	32.4	30.9
Caudal-peduncle length	16.0	17.6	18.8	18.0	17.6	16.6	16.8	17.3
Caudal-peduncle depth	9.0	9.1	10.2	9.5	9.6	9.6	9.0	9.5
% of head length								
Snout length	26.4	28.5	28.8	28.0	24.4	23.1	24.5	26.2
Orbit diameter	34.9	33.1	28.5	34.9	35.8	33.1	34.4	33.5
Interorbital width ¹	13.8	13.1	12.7	12.8	13.4	13.8	11.3	13.0
Interorbital width ²	11.3	11.0	10.4	11.0	11.4	12.5	10.6	11.2
Head width	35.9	35.4	35.0	38.1	36.8	36.3	35.1	36.1
Upper-jaw length	46.9	48.7	51.6	50.0	48.8	48.1	47.7	48.8
Maxilla depth	14.6	15.1	17.1	16.1	14.9	15.6	15.2	15.5
Postorbital length	45.4	44.1	48.7	47.7	43.3	43.8	43.7	45.2
Between tips of opercular spines	17.4	15.4	15.5	15.6	16.4	16.9	16.6	16.3
Occipital pit length	10.5	10.3	10.4	12.4	13.9	15.0	14.6	12.4
Occipital pit width	12.6	12.6	13.0	16.5	16.4	16.9	16.6	14.9
Post-occipital pit length	13.8	17.4	18.1	17.9	13.9	11.9	14.6	15.4

¹at vertical midline of eye; ²at posterior end of preocular spine base; -indicates broken.

Longitudinal scale rows 42 (39–44). Pored lateral-line scales 23. Scales above lateral line 7 (5–7), below 16 (13–16). Scale rows between base of last dorsal-fin spine and lateral line 7 (6 in 4 paratypes). Predorsal scale rows 4 (5 in 2 paratypes). Gill rakers on upper limb 5 (6 in 3 paratypes), lower limb 12 (12–14), including 3 (4 in 2 paratypes) rakers on hypobranchial; total gill rakers 17 (17–20). Gill rakers relatively long and spinous, longest raker on first gill arch approximately equal length with gill filaments around angle of gill arch; fourth gill slit closed by membrane. Branchiostegal rays 7. Swimbladder absent.

Body moderately compressed anteriorly, progressively more compressed posteriorly. Nape and anterior body arched. Body depth relatively deep, slightly less than head length. Very few small papillae on head (small papillae scattered on upper half of head, especially dorsal surface of head, in most paratypes). A short, fleshy, slender tentacle, its length less than (or approximately equal to) pupil diameter, on posterior end of supraocular spine base; the tentacle extending beyond tip of tympanic spine when laid back (supraocular tentacle absent in left side of head in one small paratype); supraocular tentacle with several rounded branches along its lateral surface. A short, slender tentacle on posterior end of preocular spine base, its length less than one-third of supraocular tentacle length. No tentacles on outer margin of eye membrane (4 tentacles on upper margin in 2 large paratypes). Anterior lacrimal spine associated with a short, slender tentacle (absent in one small paratype), length of latter approximately equal to that of preocular tentacle. Posterior lacrimal spine associated with a short, fleshy tentacle, length of latter less than that of supraocular tentacle, and 2 (0–2) tiny tentacles occurring on posterior base of the large tentacle; posterior lacrimal spine tentacle linked posteriorly to head by skin. A short tentacle on posterior edge of low membranous tube associated with anterior nostril; the tentacle shorter than supraocular tentacle, but extending beyond posterior margin of posterior nostril when laid back. Five rounded, thin skin flaps (uppermost flap absent in left side of head of holotype; only 3 or 4 flaps in 4 small paratypes) along preopercular margin, each flap occurring near tip of each preocular spine; lengths of flaps less than that of posterior lacrimal spine tentacle. A short, thin tentacle on cheek (absent in 4 paratypes). No tentacles on posterior end of parietal spine base (one slender tentacle present on parietal in one paratype). No tentacles on occipital pit, midinterorbital space, snout, maxilla, lips, underside of lower jaw and opercle. No tentacles on fins and lateral surface of body, except on 9 (0–9) pored lateral-line scales each with a rounded, small, thin skin flap. Pectoral-fin axil without skin flaps.

Well-exposed ctenoid scales (cycloid scales in 4 paratypes less than 49.5 mm SL) covering an area surrounded by opercular margin and tips of upper and lower opercular spines, other parts of head not covered with exposed or embedded scales. Well-exposed ctenoid scales on lateral surface of body, scales becoming cycloid on abdomen. Body scales not extending on to rays or membranes of fins, except basal caudal fin. Exposed cycloid scales covering pectoral-fin base. Cycloid scales covering ventral surface of body, except between pelvic fins; some scales embedded by thin skin, but scales on anteroventral

surface of body well exposed. Lateral line strongly sloping downward at tip of opercle. Sensory pores of cephalic lateralis system prominent; 3 pores on cheek just below suborbital ridge, first pore largest, located just below posterior end of lacrimal bone, second pore below slightly posterior to first suborbital spine, third below between second and third suborbital spines. Numerous small sensory pores on upper half of head, including interorbital space and posterior to occipital pit, but not extending on to space between upper and lower opercular spines. Underside of dentary with 3 sensory pores on each side, first pore below anterior to tip of anterior lacrimal spine, second pore below and between tips of anterior and posterior lacrimal spines, third pore located on posterior margin of dentary. A pore behind symphyseal knob of lower jaw on each side; an indistinct pore each side of symphyseal knob.

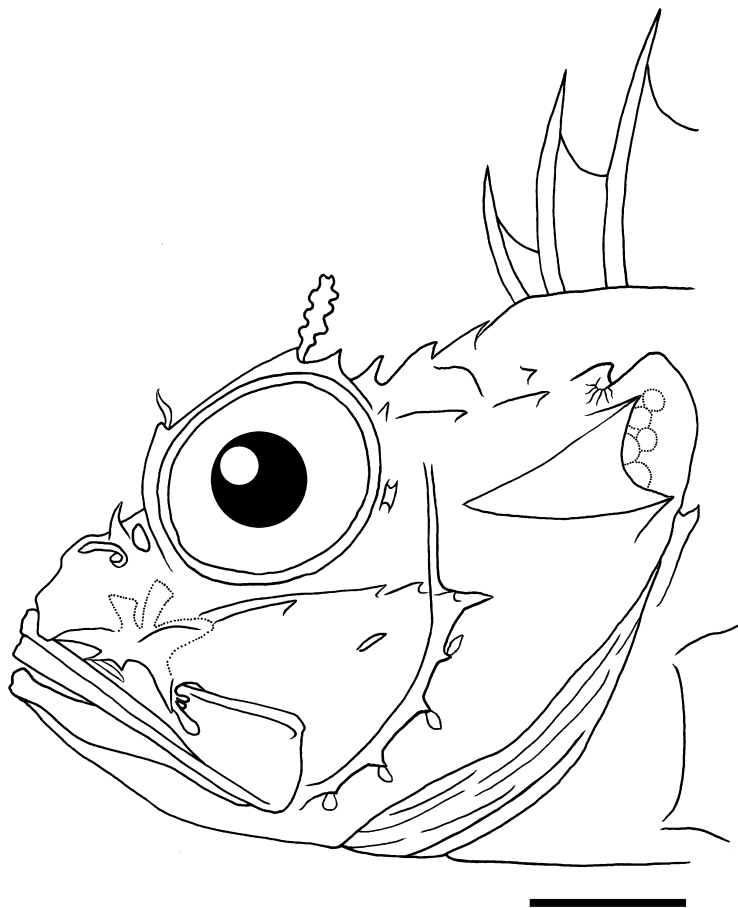


FIGURE 2. Lateral view of head of *Scorpaena bulacephala*. CSIRO H 6009-05, holotype, 80.7 mm SL. Numerous small papillae and sensory pores on head and scales on trunk not illustrated. Illustration of small spine occurring on posterior margin of anterior lacrimal spine based on spine of right side because left side one deformed (bump not spine). Scale bar indicates 10 mm.

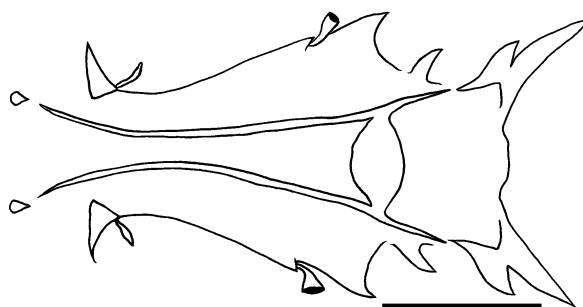


FIGURE 3. Dorsal view of interorbital space in *Scorpaena bulacephala*. CSIRO H 6009-05, holotype, 80.7 mm SL. Small papillae and sensory pores not illustrated. Anterior region situated to left. Scale bar indicates 5 mm.

Mouth large, slightly oblique, forming an angle of about 35 (20–35) degrees to horizontal axis of head and body. Posterior margin of maxilla just reaching the vertical at posterior margin of pupil (extending slightly beyond in 4 small paratypes, but not reaching posterior margin of orbit). Upper edge of posterior maxilla swollen laterally, forming a distinct ridge; central part of maxilla slightly convex (nearly flat in 4 small paratypes), but not forming a ridge. Lower jaw with a symphyseal knob. Width of symphyseal gap separating premaxillary teeth bands slightly greater than (or approximately equal to) width of each band. Upper jaw with a band of short, incurved, conical teeth, tips of teeth not strongly pointed. About 10 tooth rows at front of upper jaw, tooth band narrowing posteriorly. Tooth band of upper jaw wider than that of lower jaw. Lower jaw with a band of short, slightly curved, conical teeth; lengths of most teeth slightly shorter than those of upper jaw, but some teeth much longer than longest teeth on upper jaw. Four rows of small teeth at front of vomer, becoming 1 or 2 rows posteriorly, forming a V-shaped patch on vomer. Width of vomerine plate slightly less than (or approximately equal to) length of palatine plate. About 1 or 2 tooth rows on palatines. Underside of lower jaw smooth without ridges.

Dorsal profile of snout steep, forming an angle of about 50 (50–65) degrees to horizontal axis of head and body. Nasal spine simple, sharp, directed dorsally, its length much greater than anterior nostril diameter. Ascending process of premaxilla not intruding into interorbital space, its posterior margin just reaching level with posterior margin of posterior nostril in dorsal view. Median interorbital ridge absent. Interorbital ridges well developed, separated by a deep channel, beginning posterior to nasal spines and joining to low ridges surrounding occipital pit laterally (or joining to tympanic spine base); interorbital ridges branching at level with posterior end of postocular spine base and the branches conjoined to each other, forming a distinct broad ridge to anterior angular edge of occipital pit; interorbital ridges diverging anteriorly and posteriorly in dorsal view, distance between interorbital ridges narrowest at slightly anterior to the vertical midline through eye. Interorbital space moderately deep, about half (to one-third) of orbit extending above dorsal

profile of head. Preocular spine simple, directed dorsoposteriorly; tip of spine extending beyond level with upper margin of pupil in lateral view. Supraocular spine simple, its tip just reaching the vertical through posterior margin of pupil in lateral view; spine slightly shorter than preocular, postocular and tympanic spines. Postocular spines simple, strongly canted laterally, its base wider than tympanic spine base. Tympanic spine simple, strongly pointed, directed dorsally, with narrow base. Interorbital, coronal and extra spines absent. A transverse ridge, formed from branches of interorbital ridges, anterior to occipital pit slightly curved posteromedially in dorsal view. Occipital pit remarkably deep (pit becoming deeper and smaller in surface area with growth), centre of pit slightly convex; longitudinal length of pit less than width of pit. A distinct transverse ridge, formed from posterior bases of nuchal spines, in rear of occipital pit between bases of parietal and nuchal spines (the ridge becoming distinct with growth). Occipital pit surrounded laterally by interorbital ridges and parietal spines (or tympanic spines, low ridge between tympanic and parietal spines, and parietal spines if interorbital ridges joining to tympanic spines). Parietal spine simple, its base curving strongly into occipital pit. Nuchal spine simple; nuchal and parietal spines joined at base. Sphenotic with a small spine (or 2 spines). Postorbital without pointed spines. Pterotic spine simple, located below parietal and nuchal spines. An indistinct, oblique (or nearly horizontal) low ridge occurring in an area surrounded by parietal, nuchal, pterotic and lower posttemporal spines. Upper posttemporal spine simple, pointed, small, directed posteriorly (or dorsoposteriorly), its length slightly shorter than that of lower posttemporal spine. Lower posttemporal spine simple, its base length less than (approximately equal to) that of pterotic spine. Supracleithral spine simple, flattened, not strongly pointed. Cleithral spine flattened, pointed with a low median ridge.

Lateral surface of lacrimal with 6 ridges radiating from centre and lacking pointed spines; a backward ridge with a distinct median ridge, other ridges with a low median ridges; 2 downward ridges forming anterior and posterior lacrimal spines; anterior end of forward ridge embedded with skin; ends of 2 upward ridges with bumps. Anterior lacrimal spine pointed, directed forward, its tip just reaching dorsal margin of upper lip; a second short spine (left side of head with a bump in holotype; 1–3 spines in paratypes) occurring at near base of anterior lacrimal spine. Posterior lacrimal spine simple, directed ventroposteriorly, its tip not reaching upper lip (reaching in one small paratype); posterior lacrimal spine much greater than anterior spine. Suborbital ridge with 3 spines, first spine below between centre and posterior margin of pupil, tip of second spine just below posterior margin of orbit, third spine on end of suborbital ridge. Space between ventral margin of eye and suborbital ridge remarkably narrow. Suborbital pit absent. Preopercle with 5 spines; uppermost spine largest with a supplemental preopercular spine on its base; second to fifth spines without a distinct median ridge. Preopercle, between uppermost preopercular spine and upper end of preopercle, smooth without serrae or spines. Upper opercular spine simple with a low median ridge. Lower opercular spine simple with a distinct median ridge. Space between upper and lower opercular spines without ridges or scales and covered with

thin skin. Posterior tips of upper and lower opercular spines not reaching opercular margin.

Origin of first dorsal-fin spine above lower posttemporal spine. Posterior margin of opercular membrane reaching the vertical through fourth dorsal-fin spine base. Posterior tip of pectoral fin extending beyond the vertical through first anal-fin spine base. Origin of pelvic-fin spine slightly posterior to origin of pectoral fin. Posterior tip of depressed pelvic fin extending beyond anus, but not reaching (or reaching) first anal-fin spine base. Origin of first anal-fin spine slightly anterior to origin of last dorsal-fin spine.

Color when fresh. Based on colour photographs. Body strongly variegated, mainly brilliant red, suffused with irregular purplish, yellowish brown and white blotches. Female holotype with translucent unpaired fins, covered with reddish patches and spots; edge of first dorsal-fin membrane slightly darker reddish brown, remaining fin with irregular reddish blotches, no enlarged dark spots. Second dorsal fin pale edged with two broad, poorly defined reddish stripes. Caudal fin reddish basally, alternating irregular pale and reddish areas distally over fin rays, membranes translucent. Anal fin similar to dorsal fins, reddish areas most pronounced anteriorly. Pectoral fin similar to side of body. Pelvic fin weakly variegated. Pupil black, iris reddish with yellowish inner margin. Paratype (CSIRO H6028-003, probable male) similar to holotype, with irregular purplish patches along sides and back. Head, and pectoral and pelvic fins more uniformly reddish than holotype. Large, weak purplish oval spot between dorsal-fin spines 7 and 10.

Color of preserved specimens. Head and trunk yellowish-white, mottled with poorly-defined grey blotches dorsally; these blotches extending from dorsal surface of head to around ventral margin of orbit and from dorsal-fin base and upper caudal peduncle to below lateral line, but not reaching lower half of head and lower one-third of body. No distinct black spots on head or body. Lips, maxilla, underside of lower jaw and inside mouth uniformly whitish. Spines, rays and membranes of all fins uniformly translucent white (a dark grey blotch, its diameter less than orbit diameter, on distal margin of membrane between sixth and tenth dorsal-fin spines in males).

Distribution and habitats. Currently known only from off Norfolk Island on the Norfolk Ridge and off Lord Howe Island on the Lord Howe Rise, in the northern Tasman Sea. Collection data for the species indicated capture depths from 86–113 m. The substrate type was not specified.

Etymology. Derived from a combination of the Latin *bula* (bull) and *cephalus* (head) with reference to its head shape.

Discussion

Dissection of the abdomen on the right side of the holotype (80.7 mm SL) of *S. bulacephala*, which lacks a black spot on the membrane of the spinous portion of the dorsal fin, showed it to have an expanded gonad with relatively large-sized ova, indicating that it is a

small species. All other specimens (32.1–87.5 mm SL) of *S. bulacephala* have a dark grey spot on the membrane between the sixth and tenth dorsal-fin spines typical of the males of most species of *Scorpaena*.

There are slight morphological differences between the holotype (female) and paratypes (probable males). The holotype has very few small papillae on the head, whereas the paratypes have a large number of scattered small papillae on the upper half of the head, especially the dorsal surface. In addition, comparisons of the holotype (80.7 mm SL) with the similar sized paratypes (84.2–87.5 mm SL) showed that several morphometrics differ significantly between them: e.g., body depth (43.1% of SL vs. 39.7–40.3% of SL in the latter), head length (48.3% vs. 44.6–45.8%), orbit diameter (16.9% vs. 13.1–14.7%), interorbital width, head width, and lengths of some fin spines (see Table 1). These minor differences appear to represent sexual dimorphism (or secondary sexual characteristics), although their confirmation requires examination of more specimens.

Examination of a series of life stages between 32.1 and 87.5 mm SL (although there is a size gap between 49.5 and 80.7 mm SL) showed the following morphological changes with growth to be recognized. As well known in most members of the genus *Scorpaena*, the number of the branched pectoral-fin rays in *S. bulacephala* also increases with growth. All pectoral-fin rays of all specimens less than 44.8 mm SL were unbranched, 2 rays (third and fifth rays) becoming branched in a 49.5 mm specimen, and then 4–6 rays (second to seventh rays) branched in specimens exceeding 80.7 mm. Initially cycloid, the scales enclosed by the posterior tips of the upper and lower opercular spines and opercular margin, change to ctenoid with growth between 50 and 80 mm SL (cycloid in all specimens less than 49.5 mm SL and ctenoid in all specimens exceeding 80.7 mm SL). This change of the scales is also confirmed in a co-occurring congener, *S. onaria* (see Motomura *et al.*, 2005). The occipital pit structure also changes with growth. A transverse ridge, formed from the posterior bases of the nuchal spines, at the rear of the occipital pit becomes progressively more distinct (steeper) with growth. As a result, the pit becomes deeper. The posterior margin of the maxilla in specimens over 80.7 mm SL just reaches the vertical through the posterior margin of the pupil, whereas it extends slightly beyond (although not reaching the posterior margin of the orbit) in specimens less than 49.5 mm SL.

Analyses of 42 measurements found that several lengths of *S. bulacephala* decreased proportionally with growth (see Table 1). Some of most significant growth-related changes are demonstrated in Fig. 4. The pelvic-fin spine and occipital pit length and width become significantly less with growth (Fig. 4A–C). As a result of ontogenetic changes to the occipit (Fig. 4B–C), the pit becomes relatively smaller with growth. Such growth-related changes in the occipital pit demonstrated by morphometrics have never been reported in the Scorpaenidae. Other *Scorpaena* need to be carefully examined because growth-related changes may exist in this important taxonomic region in other species. The caudal-fin length of *S. bulacephala* also becomes significantly shorter with growth (Fig. 4D). However, unlike other growth-related changes (Fig. 4A–C), a significant proportional differ-

ence between 44.8 and 87.5 mm SL was not found although the caudal fin of specimens less than 34.3 mm SL was much longer proportionally (Fig. 4D). Perhaps this indicates that a long caudal fin is a juvenile character for this species.

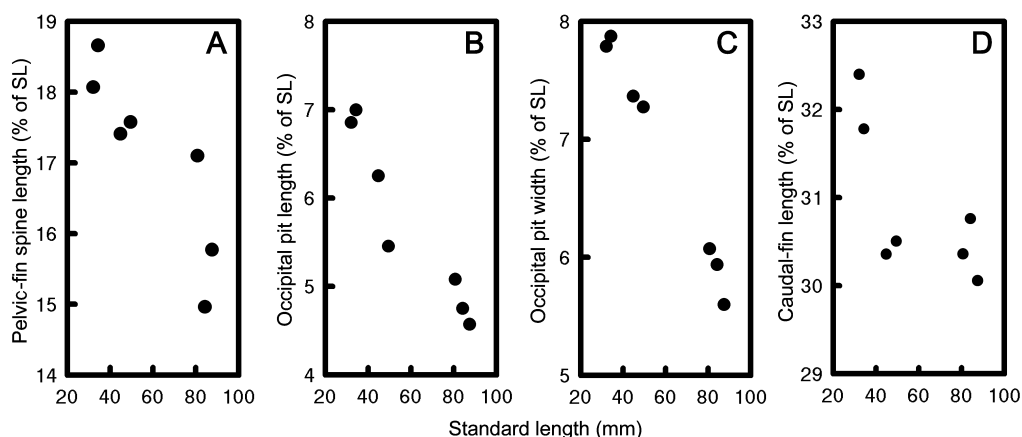


FIGURE 4. Relationships of A) pelvic spine length, B) occipital pit length, C) occipital pit width and D) caudal-fin length (all as % of standard length) to standard length in *Scorpaena bulacephala*.

Unlike most Indo-Pacific species of *Scorpaena*, *S. bulacephala* has the following combination of characters: absence of spines on the lateral surface of the lacrimal (Fig. 2) and presence of exposed scales covering the anteroventral surface of the body and the pectoral-fin base. Examination of all available nominal species belonging to the genus *Scorpaena* showed that only four species in the Indo-Pacific region shared these characters: *S. colorata*, *S. gibbifrons*, *S. papillosa* and *S. sumptuosa*. *Scorpaena bulacephala* can be readily distinguished from the latter three species by the absence of a median longitudinal ridge on the maxilla (present in *S. gibbifrons* and *S. sumptuosa*); the absence of upward pointed spines on the dorsal margin of the lacrimal and coronal spines (both present in *S. papillosa*); 9 soft dorsal-fin rays (10 in *S. papillosa*); and 17 pectoral-fin rays (usually 16 in *S. gibbifrons*, *S. sumptuosa* and *S. papillosa*).

Scorpaena bulacephala is most similar to a Hawaiian endemic species, *S. colorata*, in overall body appearance. In addition to the main characters (i.e., absence of spines on the lateral surface of the lacrimal and presence of exposed scales covering the anteroventral surface of the body and the pectoral-fin base), these species share all the characters (including most meristics and major head spine structures) given as diagnostic of *S. colorata* by Eschmeyer & Randall (1975: 326), suggesting a close relationship between them. However, careful comparison of *S. bulacephala* and *S. colorata* (13 specimens, 47.3–94.7 mm SL) during this study showed that there are several morphological differences between the species.

In meristic characters, *S. bulacephala* differs from *S. colorata* in having a lower count of longitudinal scale rows (39–44 vs. 44–49 in the latter; Table 2). There are no other significant differences in meristic counts between these species: i.e., *S. colorata* has 9 dorsal-fin soft rays, 17 (rarely 16 or 18) pectoral-fin rays, 23 pored lateral-line scales, 5–7 scales above the lateral line, 14–16 scales below the lateral line, 6 or 7 scale rows between the last dorsal-fin spine base and the lateral line, 4–7 predorsal scale rows, 5 or 6 gill rakers on the upper limb, 12–14 rakers on the lower limb, and 17–19 total gill rakers (data are based on 13 specimens examined, see Materials and Methods).

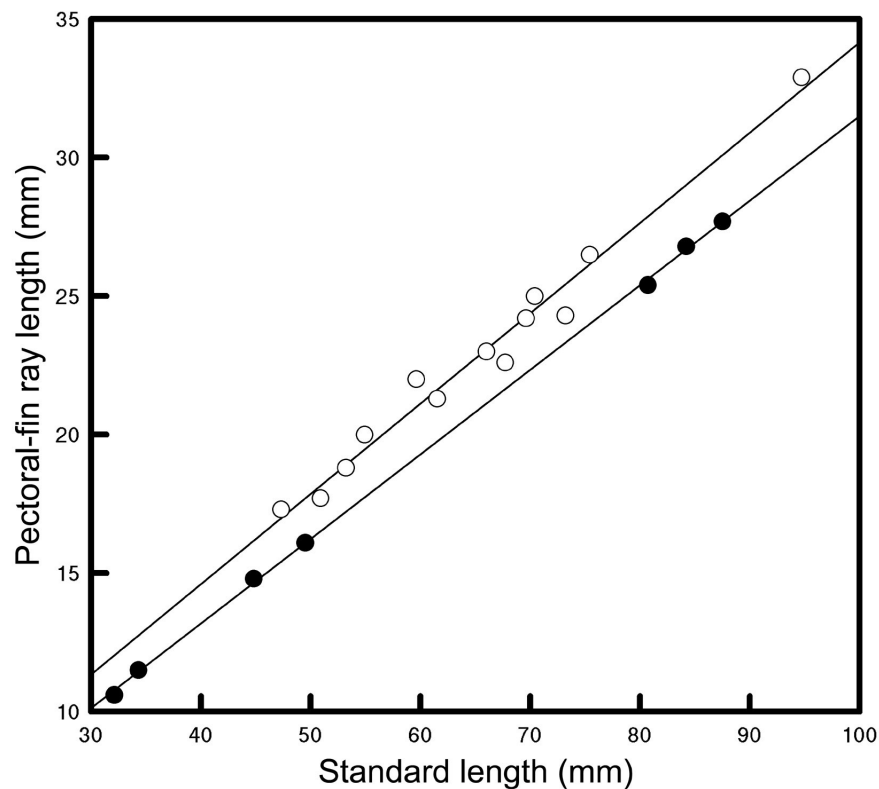


FIGURE 5. Relationships of longest (ninth) pectoral-fin ray length to standard length in *Scorpaena bulacephala* (closed circles) and *S. colorata* (open circles).

TABLE 2. Frequency distribution of longitudinal scale row counts in *Scorpaena bulacephala* and *S. colorata*.

	39	40	41	42	43	44	45	46	47	48	49
<i>S. bulacephala</i>	1		1	1	2	1					
<i>S. colorata</i>						1	1	3	4	3	1

In addition, *S. bulacephala* is distinguishable from *S. colorata* by the first anal-fin spine base located slightly anterior to the vertical through the last dorsal-fin spine base (vs. slightly posterior to the last dorsal-fin spine in the latter). In morphometric characters, all fin spines and rays of *S. bulacephala* are slightly shorter than those of *S. colorata*: e.g., first dorsal-fin spine length 7.5–10.5% of SL (mean 9.1%) in *S. bulacephala* vs. 9.6–13.9% (11.5%) in *S. colorata*; second pelvic-fin soft ray length 24.8–26.5% (25.5%) vs. 25.1–30.1% (27.2%); and first anal-fin spine length 7.6–10.1% (8.9%) vs. 8.6–12.1% (10.5%). Although these proportional measurements overlap between the two species, there is little or no overlap between them when the same range in SL are compared because the variation in some fin spine and ray lengths represent ontogenetic changes, as mentioned above. Most significant morphometric difference between them is in the length of the longest (ninth) pectoral-fin ray (31.5–33.5% of SL, mean 32.4% in *S. bulacephala* vs. 33.2–36.9%, 35.1% in *S. colorata*), which is shown in Figure 5.

The following characters of *S. bulacephala* appear to be diagnostic (examination of more specimens is needed): no tentacles on the lateral surface of the trunk, except on the pored lateral-line scales (vs. several distinct tentacles usually on the lateral surface of the trunk, especially on the anterodorsal surface in *S. colorata*; see Gilbert, 1905: fig. 243; Eschmeyer & Randall, 1975: 322, fig. 25b), a shorter supraocular tentacle (length less than or approximately equal to pupil diameter vs. variable, but usually greater than pupil diameter, sometimes greater than orbit diameter), thin skin without sensory pores and canals covering entire area between the upper and lower opercular spines (vs. relatively thick skin with numerous sensory pores and canals covering on the upper opercular spine and extending on to upper area between the spines) and interorbital ridges more strongly developed than those of *S. colorata*.

Acknowledgments

We are especially grateful to A. Graham and L. Conboy (CSIRO) for their kind curatorial assistance during this study. We thank J. MacLaine (BMNH), J. E. Randall, L. O'Hara and A. Suzumoto (BPBM), W. N. Eschmeyer, T. Iwamoto, D. Catania and J. Fong (CAS), P. Pruvost and N. Bailly (MNHN), C. Roberts, A. L. Stewart and C. D. Paulin (NMNZ), M. Gomon and D. Bray (NMV), H. Wellendorf and C. Prenner (NMW) and J. T. Williams (USNM) for opportunities to examine comparative material, provision data of specimens or specimen loans. The first author wishes to thank M. McGrouther, T. Trnski, A. Hay and all staff of the Fish Section, Australian Museum, Sydney for their generous support during the first author's stay in Australia and J. M. Leis (AMS), who kindly made the first author's scorpionfish study at AMS possible. The first author also thanks D. Yearsley (Rosny, Tasmania) for her kind hospitality during his stay in her house. Specimens collected during this project were obtained from the NORFANZ survey, which was supported by funds provided by the Australian and New Zealand governments through the National

Oceans Office (Hobart), Mfish (Wellington) and the expert efforts of NIWA Vessel Management and their field staff. The first author's stay at CSIRO was supported by the National Fish Bioregionalisation Project, which was funded by the National Oceans Office and CSIRO Marine Research. The first author's stay in AMS was supported by the Visiting Collection Fellowship grant from the Australian Museum (Sydney, Australia).

References

- Chen, L.-C. (1981) Scorpaenid fishes of Taiwan. *Quarterly Journal of the Taiwan Museum*, 34, 1–60.
- Eschmeyer, W.N. (1965) Western Atlantic scorpionfishes of the genus *Scorpaena*, including four new species. *Bulletin of Marine Science*, 15, 84–164.
- Eschmeyer, W.N. & Randall, J.E. (1975) The scorpaenid fishes of the Hawaiian Islands, including new species and new records (Pisces: Scorpaenidae). *Proceedings of the California Academy of Sciences (fourth series)*, 40, 265–334.
- Fowler, H.W. (1938) Descriptions of new fishes obtained by the United States Bureau of Fisheries steamer “Albatross”, chiefly in Philippine seas and adjacent waters. *Proceedings of the United States National Museum*, 85, 31–135.
- Gilbert, C. H. (1905) The aquatic resources of the Hawaiian Islands. Part II. Section II. The deep-sea fishes. *Bulletin of the United States Fish Commission*, 23, xi + 577–713.
- Leviton, A.E., Gibbs, Jr. R.H., Heal, E., & Dawson, C.E. (1985) Standards in herpetology and ichthyology. Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia*, 1985, 802–832.
- Motomura, H. (2004a) New species of scorpionfish, *Scorpaena cocosensis* (Scorpaeniformes: Scorpaenidae) from the Cocos Islands, Costa Rica, eastern Pacific Ocean. *Copeia*, 2004, 818–824.
- Motomura, H. (2004b) Revision of the scorpionfish genus *Neosebastes* (Scorpaeniformes: Neosebastidae), with descriptions of five new species. *Indo-Pacific Fishes*, 37, 1–76.
- Motomura, H., Paulin, C. D. & Stewart, A. L. (2005) First records of *Scorpaena onaria* (Scorpaeniformes: Scorpaenidae) from the southwestern Pacific Ocean, and comparisons with the Northern Hemisphere population. *New Zealand Journal of Marine and Freshwater Research*, 39, 865–880.
- Motomura, H., Yoshino, T., & Takamura, N. (2004) Review of the scorpionfish genus *Scorpaenopsis* (Scorpaeniformes: Scorpaenidae) in Japanese waters with three new records and an assessment of standard Japanese names. *Japanese Journal of Ichthyology*, 51, 89–115.
- Poss, S.G. (1999) Scorpaenidae. In: Carpenter, K.E. & Niem, V.H. (Eds) *FAO Species Identification Guide for Fishery Purposes. The Living Marine Resources of the Western Central Pacific. Vol. 4. Bony Fishes Part 2 (Mugilidae to Carangidae)*. FAO, Rome, 2291–2352.
- Randall, J.E. & Eschmeyer, W.N. (2002: dated 2001) Revision of the Indo-Pacific scorpionfish genus *Scorpaenopsis*, with descriptions of eight new species. *Indo-Pacific Fishes*, 34, 1–79.