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Scorpaena wellingtoni n. sp., a new scorpionfish from the Galápagos Islands (Scorpaeniformes: Scorpaenidae)

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Abstract

The new scorpionfish species *Scorpaena wellingtoni* is described from two specimens collected from Tagus Cove on Isla Isabela in the Galápagos Archipelago. The barcode COI mtDNA sequence for the holotype of the new species differs by 10.8–14.2% from other members of a set of small related New World scorpionfishes, including *S. russula* and *S. sonorae* in the eastern Pacific and *S. inermis*, *S. albifimbria*, and *S. calcarata* in the western Atlantic. The new species is very similar in appearance to the Atlantic Mushroom Scorpionfish, *S. inermis*, with similar markings, a reduced second preopercular spine, no supplemental preopercular spine, eight dorsal-fin soft rays, two spines on the suborbital ridge, a short snout, and a narrow shallow interorbital space. It shares the tabs extending down from the pigmented corneal drape over the pupil, however they are not mushroom-shaped as in *S. inermis*. The new species further differs from *S. inermis* by having a distinct occipital pit, more prominent head spines, and a cleithral spine. *S. wellingtoni* also resembles the Atlantic Coral Scorpionfish *S. albifimbria* in markings, a reduced second preopercular spine, a relatively deep body, a short snout, and the presence of the occipital pit and cleithral spines, but it does not share the supplemental preopercular spine or the nine dorsal-fin soft rays and three suborbital-ridge spines found on *S. albifimbria*. The two widespread eastern-Pacific congeners, *S. russula* and *S. sonorae*, also have reduced second preopercular spines, but both differ from the new species in markings and having flat or very shallow occipital pits and an additional dorsal-fin ray and suborbital-ridge spine (*S. calcarata* in the Atlantic differs in the same characters, except the last). A rare deepwater species from Cocos Island and the Galápagos Archipelago, *S. cocosensis*, shares most meristic characters but has a less arched upper body, a wider interorbital space with prominent interorbital ridges, and different color and markings. *S. wellingtoni* is apparently found only in the Galápagos Islands and is thus far the only endemic scorpionfish reported in the Archipelago.

Key words: Galápagos, fishes, scorpionfish, endemic, new species, *Scorpaena wellingtoni*, Scorpaenidae, barcode, DNA sequence, biogeography, species list, biodiversity

Introduction

The taxonomy of the scorpionfishes of the tropical eastern Pacific Ocean has been remarkably stable over the past century, with all descriptions of shallow-water species dating from the 19th century (Poss 1995, Robertson & Allen 2008). However, recent explorations of the deeper slopes in the region with submersibles have revealed

(or rediscovered) new species of scorpaenids of several genera from the Galápagos Islands, Cocos Island, and Ecuador, including *Scorpaena cocosensis* Motomura 2004, *Scorpaenodes rubrivinctus* Poss, McCosker, & Baldwin 2010, and *Trachyscorpia verai* Bearez & Motomura 2009 (Motomura & McCosker 2009, McCosker & Rosenblatt 2010; the *T. verai* obtained from fishermen). An additional new and apparently rare scorpionfish species was recently collected at normal scuba diving depths on a National Geographic Society/National Public Radio-sponsored expedition in May 1998 to the Galápagos Archipelago. The specimen closely resembles the Mushroom Scorpionfish of the Caribbean Sea, *Scorpaena inermis* Cuvier 1829. The mtDNA COI sequence reveals it to be an eastern Pacific representative of a group of small scorpionfishes found in the New World tropics. A review of museum specimens revealed a second and larger specimen at the California Academy of Sciences, collected by John McCosker from the same location in the Galápagos Archipelago, at Tagus Cove on Isla Isabela.

Materials and Methods

Type specimens of the new species are deposited in the Marine Vertebrate Collection of Scripps Institution of Oceanography (SIO) and the California Academy of Sciences Ichthyology Collection (CAS). The holotype was collected by hand and preserved in 90% ethanol. Ethanol-preserved specimens of other species of the genus *Scorpaena* were collected for DNA sequencing from the Pacific Ocean in Baja California, Panama, Guanacaste in Costa Rica, and from larval samples collected over the Galápagos Rift hydrothermal vents south of Cocos Island in 1985 (Victor 1987). Comparison species from the Atlantic were collected in Panama, Belize, Quintana Roo (Mexico), Dominica, and the U.S. Virgin Islands. Comparison tissues or sequences on the Barcode of Life Database (BOLD) were graciously provided by P. Hastings and H.J. Walker of the Marine Vertebrate Collection of Scripps Institution of Oceanography; D. Steinke of the Canadian Centre for DNA Barcoding, University of Guelph; A. Bentley of the Ichthyology Division, Biodiversity Institute, University of Kansas; J. Lowenstein of the American Museum of Natural History; L. Vásquez-Yeomans and M. Valdez-Moreno of ECOSUR, Unidad Chetumal, in Quintana Roo, Mexico (Valdez-Moreno *et al.* 2010); R. Imondi of Coastal Marine Biolabs; C. Nolan of the Marine Institute, Ireland; C. Baldwin and L. Weigt of the Smithsonian Institution's National Museum of Natural History; and D.R. Robertson of the Smithsonian Tropical Research Institute (Appendix 1).

DNA extractions were performed with the NucleoSpin96 (Machery-Nagel) kit according to manufacturer specifications under automation with a Biomek NX liquid-handling station (Beckman-Coulter) equipped with a filtration manifold. A 652-bp segment was amplified from the 5′ region of the mitochondrial COI gene using a variety of primers (Ivanova *et al.* 2007). PCR amplifications were performed in 12.5 µl volume including 6.25 µl of 10% trehalose, 2 µl of ultra pure water, 1.25 µl of 10× PCR buffer (10mM KCl, 10mM (NH4)2SO4, 20mM Tris-HCl (pH8.8), 2mM MgSO4, 0.1% Triton X-100), 0.625 µl of MgCl2 (50mM), 0.125 µl of each primer (0.01mM), 0.0625 µl of each dNTP (10mM), 0.0625 µl of *Taq* DNA polymerase (New England Biolabs), and 2 µl of template DNA. The PCR conditions consisted of 94°C for 2 min., 35 cycles of 94°C for 30 sec., 52°C for 40 sec., and 72°C for 1 min., with a final extension at 72°C for 10 min.

Specimen information and barcode sequence data from this study were compiled using the Barcode of Life Data Systems (BOLD, www.barcodinglife.org; Ratnasingham & Hebert 2007). The sequence data is publicly accessible on BOLD and GenBank. Sequence divergence was calculated using BOLD with the Kimura 2-parameter (K2P) model generating a mid-point rooted neighbor-joining (NJ) phenogram to provide a graphic representation of the species divergence.

Measurements mostly follow Eschmeyer (1965); all lengths, including the length of the snout and caudal peduncle, are horizontal spans, with the exception of the oblique measurements of the upper jaw, the pectoral fin length, and the lengths of spine and rays. Lengths for specimens are standard length (SL), the horizontal span from the front of the upper lip to the middle of the posterior margin of the hypural plate. Body depth is measured as the vertical span from the base of the third dorsal-fin spine to the origin of the pelvic-fin spine, body width is the greatest width side-to-side at the outside of the pectoral-fin bases. Head length (HL) is the horizontal span from the front of the upper lip to the posteriormost edge of the opercular membrane, snout length is the span from the front of the upper lip to the anteriormost bony edge of the orbit (not the oblique measurement). Orbit diameter is the greatest bony diameter (=horizontal span) and postorbital length is the span from the posteriormost bony

edge of the orbit to the posteriormost edge of the opercular membrane. Interorbital width is the least bony width, supraocular interorbital width is the width between the supraocular spine bases. Upper-jaw length is the oblique maximum length from the tip of the upper jaw to the farthest point of the maxilla, while upper jaw span is the horizontal span from the front of the upper lip to the posterior tip of the maxilla (Eschmeyer 1965 uses the latter). Predorsal, preanal, and prepelvic lengths are the spans from the front of the upper lip to the origins of the first dorsal spine, first anal spine and pelvic spine, respectively. Pectoral-fin length following Eschmeyer (1965) is not always a span, but the measurement from the origin of the uppermost ray to the posterior end of the fin, since the base of the longest pectoral-fin ray can be hard to discern in adult scorpionfishes. Caudal-fin length is from the middle of the posterior margin of the hypural plate to the posterior edge of the middle rays. Caudal-peduncle length is the span from the base of the last anal-fin ray to the posterior margin of the hypural plate and caudal-peduncle depth is the least depth.

Longitudinal scale rows are oblique scale rows from above the first pored lateral line scale to the caudal-fin base. Pored lateral-line scales are counted from just behind the supracleithral spine to the end of the hypural plate (not onto the fin). Gill-raker counts are of protruding rakers on the first arch on the upper and lower limb with the raker at the angle counted in the lower set (rudiments, which are undefined, are typically not included, but I include obvious protrusions as rakers). Spine terminology follows Eschmeyer (1969) and Motomura (2004). Vertebral counts include the urostylar centrum. The last two soft rays of the dorsal and anal fins are split to the base in scorpaenids and, to prevent the frequent confusion, we follow Poss *et al.* (2010) by adding ½ to the count to denote the split last ray (i.e. 8 rays with the last split as 8 ½). In addition, there is frequent uncertainty over which spines on the suborbital ridge are being reported, thus we count spines along the ridge plus the one at the end separately (as 2 plus 1, for example). Spines are defined as points that slightly catch the forceps (or finger) and not blunt nubs or bumps.

Scorpaena wellingtoni, n. sp.

Figures 1–4.

Holotype. SIO 13-2 (1) 28.0 mm SL, Ecuador, Galápagos Islands, Isla Isabela, Tagus Cove (-0.26°, -91.37°), B. Victor, G. Wellington, & C. Caldow, May 28, 1998.

Paratype. CAS 90378 (1) 59.7 mm SL, Ecuador, Galápagos Islands, Isla Isabela, Tagus Cove (-0.26°, -91.37°), J. McCosker, Nov. 12, 1995.

Diagnosis. A species of *Scorpaena* with the following combination of characters: dorsal fin XII,8½; anal fin III,5½; pectoral-fin rays 21, second through fifth ray branched; penultimate dorsal-fin spine more than half length

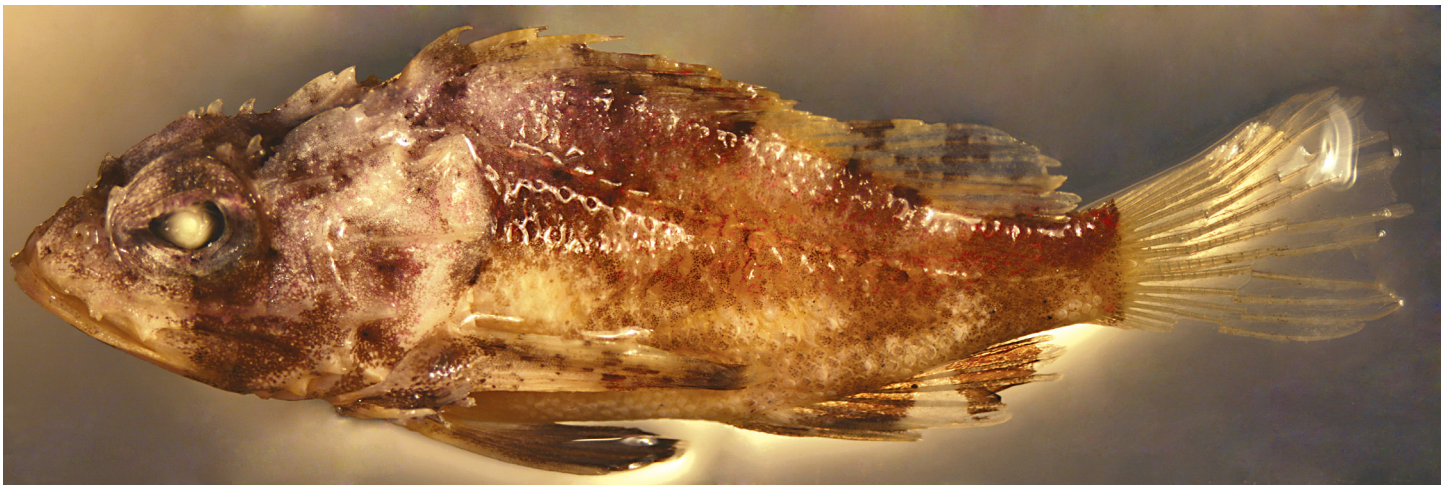

Figure 1. *Scorpaena wellingtoni*, holotype, SIO 13-2, 28 mm SL, Tagus Cove, Galápagos Islands.

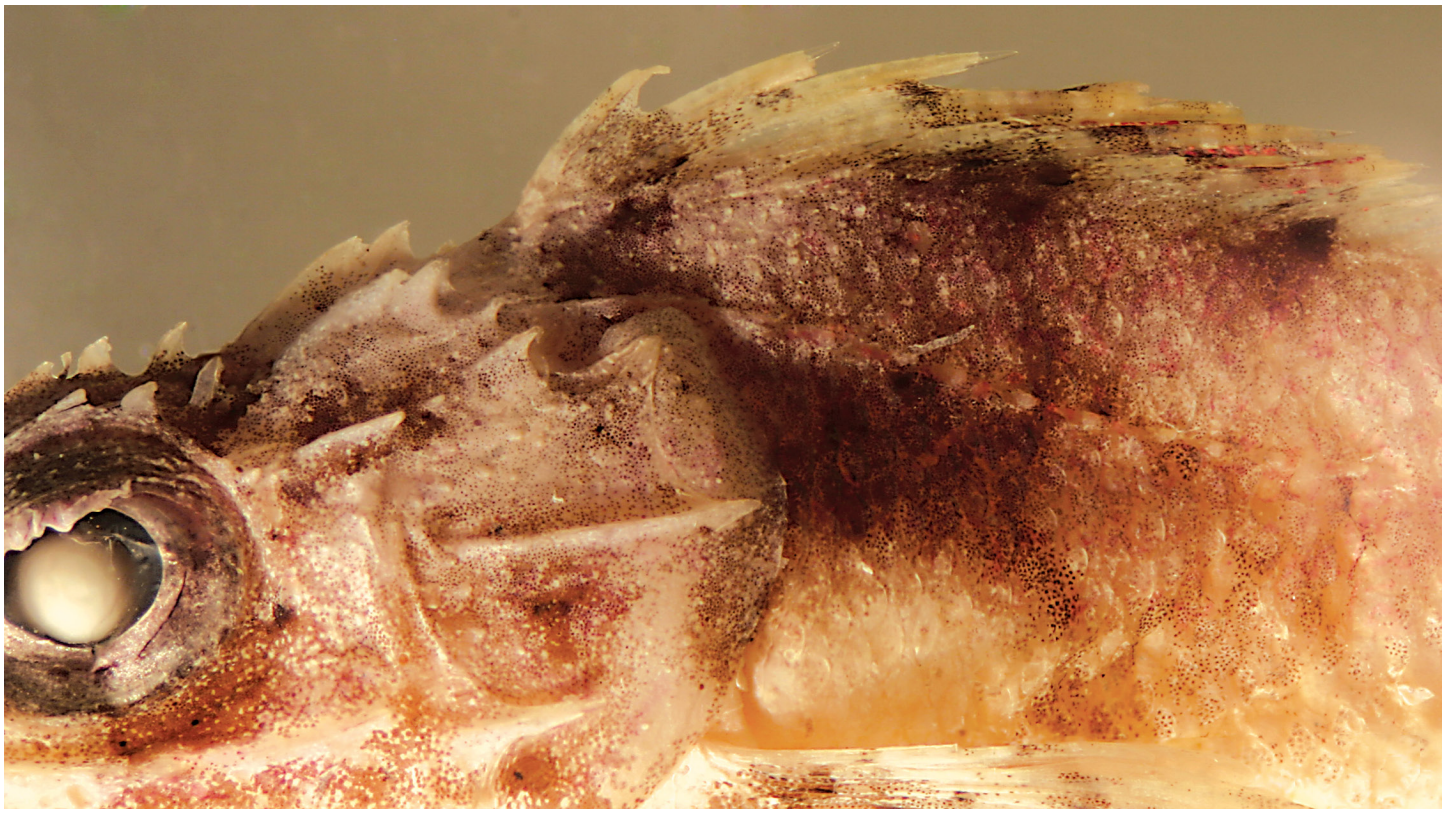

Figure 2. *Scorpaena wellingtoni*, holotype, SIO 13-2; arched back, prominent head spines.

of ultimate spine; 4 upper-limb gill rakers, 6–7 on lower limb; relatively deep body, depth 36.2–37% SL, upper body below spinous dorsal fin arched; large eye and short snout; moderate to shallow occipital pit, no significant suborbital pit; narrow and shallow interorbital space, interorbital width 3.2–5.2% SL, width between supraocular spines 4.3–6.3% SL, interorbital ridges not developed; suborbital ridge with two small spines, one at midpoint, one at end; two simple lacrimal spines, posterior spine oriented straight down; five preopercular spines, first spine reaching halfway across operculum with no supplemental preopercular spine, second spine much shorter than third; upper posttemporal spine directed obliquely upward; cleithral spine present; lower rim of upper corneal layer (= "corneal drape") of eye with rounded tabs associated with tentacles; 23 lateral line scales, some with tentacles; anterior mandibular pores paired; markings include dark bar on cheek below rear half of eye, dark blotches on operculum above and below first preopercular spine, indistinct dark blotch on anterior mid-body, series of dark spots and saddles along base of spinous and soft dorsal fins, dusky caudal peduncle, two dark bands on both soft dorsal and anal fins, clear caudal fin, dark base and tip of pectoral fin, and dark pelvic fins.

Description. (measurements presented as percent SL for holotype (paratype)). Body relatively deep, maximum body depth 37.0 (36.8)(Fig. 1); upper body below spinous dorsal fin moderately arched (Fig. 2); moderately compressed, body width 23.3 (20.5); predorsal length 34.1 (31.7); preanal length 66.7 (64.1); prepelvic length 37.8 (38.1). Head large, longer than body depth, head length 45.2 (43.4); snout length 10.0 (7.1); postorbital length 19.3 (21.0); eyes large, orbit diameter 15.9 (15.3), 2.8 into HL (2.8), orbit/snout ratio 1.59 (2.15)(Fig. 3), upper third covered with a wrinkled drape-like corneal layer with numerous wart-like cirri, the lower rim of the layer hanging over the pupil consisting of a series of rounded tabs, each with a fleshy tentacle, the longest on the middle tab (Fig. 4).

Occipital pit moderate (shallow in paratype) with several wart-like cirri, mostly in central area (Fig. 3). No significant suborbital pit. Interorbital space moderately depressed and narrow, interorbital ridges not well developed, interorbital width 5.2 (3.2) (or 3.1 (4.8) times into orbit diameter), narrowest interorbital distance forward of midline of eye; interorbital width between supraocular spine bases 6.3 (4.3). Anterior nostril with a tentacle longer than opening diameter. Nasal spine large with tentacle shorter than spine; lacrimal ridge over mid-maxilla with two prominent simple spines (preorbital spines), anterior spine directed down and slightly

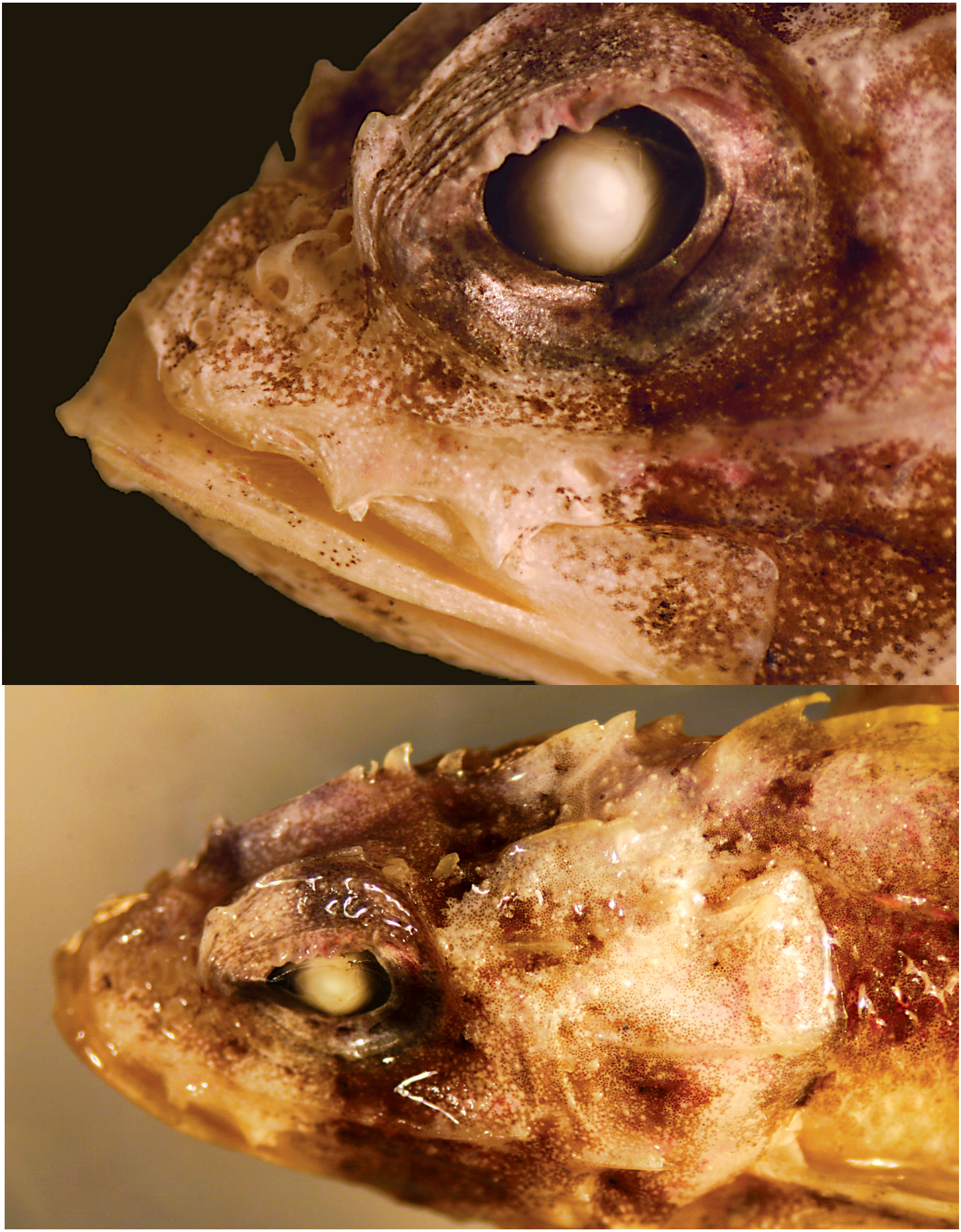

Figure 3. *Scorpaena wellingtoni*, holotype, SIO 13-2; short snout, lacrimal spines (above); moderate occipital pit (below).

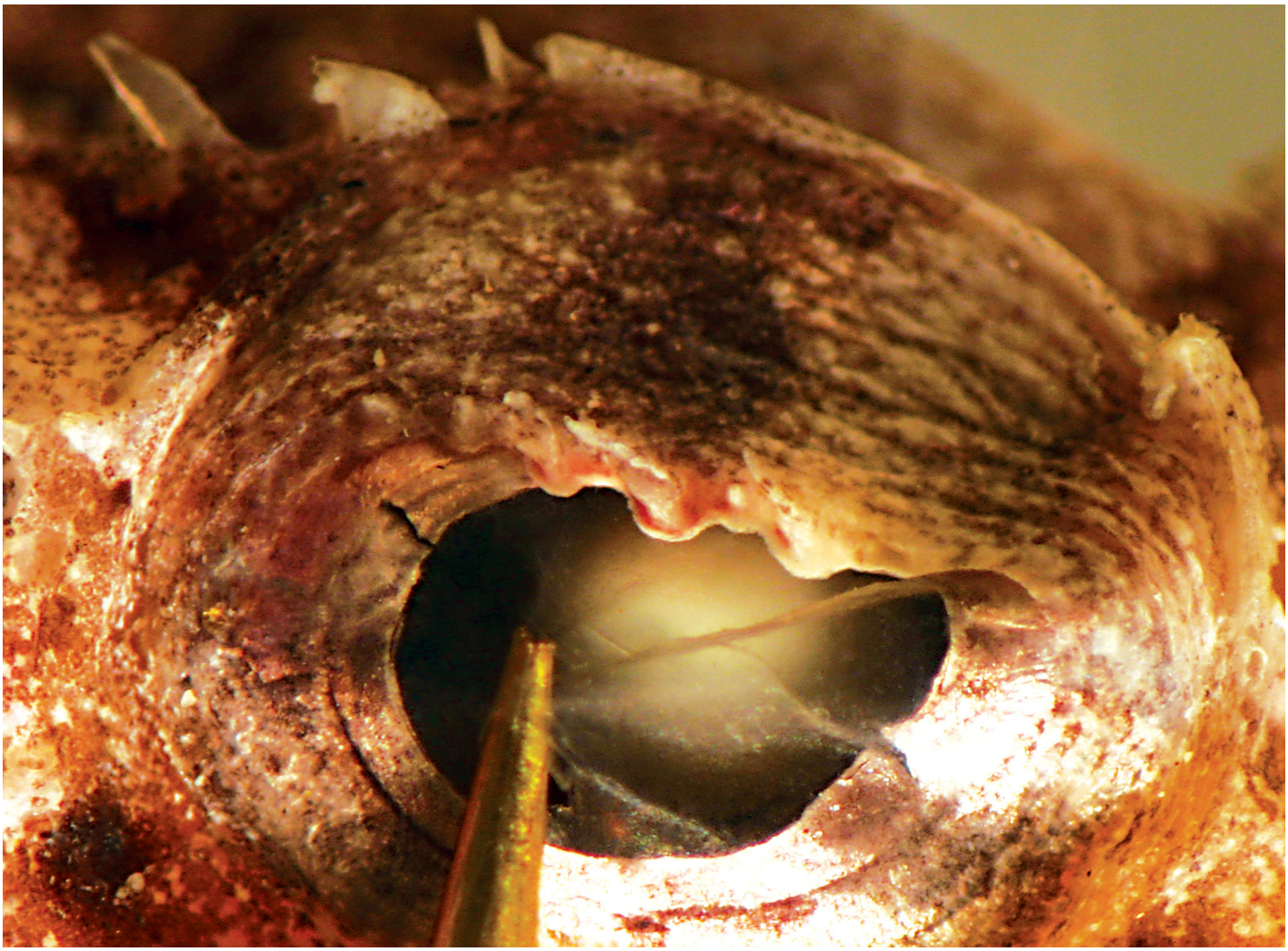

Figure 4. *Scorpaena wellingtoni*, holotype, SIO 13-2; corneal tabs with tentacles.

forward, posterior spine directly down, both associated with fleshy tabs of the same size as spines; suborbital ridge with one spine at mid-portion at the level of the rear edge of the pupil and nub at end of ridge (i.e. 1+1, or two suborbital spines counting end-spine); sub-suborbital tentacle below posterior portion of suborbital ridge; five preopercular spines, first reaching halfway across operculum, no supplemental spine at base of first, second much reduced, third larger, fourth and fifth rounded; two prominent opercular spines with long ridges; preocular spine prominent with tentacle twice spine length; supraocular spine small followed by long tentacle about 1 mm long; postocular and tympanic spines large and hooked; sphenotic small with two spines, pterotic a long low ridge with small spine; parietal spine large, long-based and elevated, followed by stouter and higher nuchal spine; upper posttemporal spine small and pointed posterodorsally, lower posttemporal spine larger, with tentacle about three times length; supracleithral spine small; cleithral spine small and flattened.

Mouth large, upper-jaw length 22.2 (23.1), upper jaw span 20 (22.2); posterior margin of maxilla reaching past level of posterior margin of pupil but not to orbital rim; lateral surface of maxilla smooth, without ridges; mandible with a small symphyseal knob; ventral aspect of dentary with three obvious pores on each side, questionable additional pores lateral to symphyseal knob; anterior mandibular pores, behind symphyseal knob, paired; underside of lower jaw without tentacles.

Gill rakers short and knob-like with serrations (on paratype each paired, side-by-side, with an inner and outer knob), 4 on upper limb, 6–7 on lower limb (including raker at angle). Branchiostegal rays 7. Vertebrae 24.

Dorsal fin XII, 8 ½ rays (½ denotes ray #8 split to base); anal fin III, 5 ½; pectoral fin 21 rays, second through fifth ray branched; pelvic fin I,5. Dorsal spines with incised membranes, first dorsal-fin spine length 7.4 (6.6), second 12.2 (12.2), third 17 (15.6), fourth 18.5 (16.8), fifth 19 (18.1), penultimate 8.1 (10.7); last 13 (15.3);

longest dorsal-fin soft ray (third) 20.7 (21.3); first anal-fin spine length 9.3 (8.5); second 16.7 (19); third 14.8 (16.4); longest anal-fin soft ray (third) 19.3 (20); pectoral-fin medium length, reaching to vertical through base of third anal-fin spine, length 32 (30.5); pelvic-fin spine length 20.4 (17.8); longest pelvic-fin ray (third) 28.5 (22.2); caudal fin truncate, length 29.6 (29.5); caudal-peduncle length 15.6 (14.9); caudal-peduncle depth 10.7 (11.1).

Cycloid scales covering body, slightly ctenoid on posterior upper body. Wart-like cirri on skin of head, more numerous dorsally. Pored lateral line scales before caudal-fin base 23–24, tentacles associated with some scales; about 44 longitudinal scale series in the row above the lateral line, small tags on some anterior scales above lateral line, about 6 scales between lateral line and last dorsal-fin spine.

Color in ethanol. Live colors are unknown. Ethanol-preserved holotype mottled, with a broad dark bar on the cheek below the rear half of eye, dark blotches on the operculum above and below the first preopercular spine, light over the rear operculum contrasting with a dark blotch over the anterior mid-body just below the lateral line, a series of concentrated dark spots and dusky saddles along base of spinous and soft dorsal fins followed by a dusky caudal peduncle, the spinous dorsal fin has a dark blotch at the front and broadly over the mid-fin, the soft dorsal and anal fins both have two dark bands, the caudal fin is clear, there are dark patches over the base and at the tip of the pectoral fins, and the pelvic fins are dusky. The paratype is less boldly marked, with the dark on the pelvic fins limited to the distal portion.

Barcode sequence. A 652-nucleotide sequence of the section of the mitochondrial COI gene used for barcoding by the BOLD informatics database (Ratnasingham & Hebert 2007) was obtained for the holotype (Genbank accession number KC616430). Following the database management recommendation of the BOLD the sequence of the holotype is presented here as well:

CCTTTATTTAGTATTTGGTGCCTGAGCTGGGATAGTGGGAACCGCCCTAAGCCTGCTAATTCGAGCG
GAATTAAGCCAGCCCGGAGCCCTTCTGGGAGACGATCAGATTTATAATGTAATCGTTACAGCTCATG
CTTTCGTAATGATTTTCTTTATAGTAATACCAATTATAATTGGTGGTTTTGGCAACTGACTAATTCCCC
TAATTCCCCTAATAATTGGGGCGCCTGACATGGCATTCCCTCGGATAAATAACATAAGCTTTTGGCTA
CTTCCCCCCTCTTTCTTACTTCTTCTAGCCTCATCAGCCGTTGAGGCTGGGGCTGGTACCGGGTGGA
CAGTATACCCACCTCTAGCCGGCAACCTTGCCCACGCTGGAGCTTCTGTAGACTTAACTATTTTCTC
TTTACATTTAGCGGGCATCTCGTCAATTCTAGGTGCCATTAACTTTATTACAACAATTATCAATATGAA
GCCACCAGCAATTTCTCAGTACCAGACACCCCTATTCGTATGGGCCGTCCTAATTACTGCTGTACTTC
TACTTCTTTCCCTACCAGTTCTTGCTGCAGGCATTACAATGCTGTTAACTGACCGTAACTTAAATACC
ACCTTCTTTGATCCAGCGGGGGGAGGGGATCCAATTCTCTATCAACACCTC

The neighbor-joining phenetic tree based on the COI mtDNA sequences of New World *Scorpaena* species, following the Kimura two-parameter model (K2P) generated by BOLD (Barcode of Life Database), shows deep divergences between species and only minimal differences within species (Fig. 5). The database contains most of the known species in the New World tropics, with the exception of three of the rarer or deeper W. Atlantic species and *Scorpaena afuerae* Hildebrand 1946 and *S. cocosensis* in the Pacific. Six small, mostly shallow-water species share a branch on the tree (top of Fig. 5) and comprise the new *S. wellingtoni* along with the Atlantic *S. inermis, Scorpaena albifimbria* Evermann & Marsh 1900, and *Scorpaena calcarata* Goode & Bean 1882, as well as two eastern Pacific congeners, *Scorpaena russula* Jordan & Bollman 1890 and *Scorpaena sonorae* Jenkins & Evermann 1889. Minimum interspecific distances among this group range from 10.8–18.7% (K2P distances; or 10.3–16.0% by pairwise distances). The most similar sequence to *S. wellingtoni* is that of Pacific *S. russula*, which is 10.8% (10.3% pairwise distance) different, however congeners from the Atlantic are only slightly more divergent from *S. wellingtoni*, e.g. 12.8% in the case of *S. albifimbria* (11.5% pairwise distance). The five members of the group differ from *S. wellingtoni* by 10.8–14.2% (K2P distances; or 10.3–12.6% pairwise distances).

Etymology. The new species is named for Gerard M. Wellington, a pioneer in research on the marine biology and conservation in the Galápagos Archipelago. He developed the first plan for the Parque Nacional Galápagos as a member of the Peace Corps in the 1970s and in subsequent decades conducted many expeditions and surveys, especially on the effect of the El Nino-Southern Oscillation and climate change on the fragile marine ecosystem of the Galápagos Archipelago.

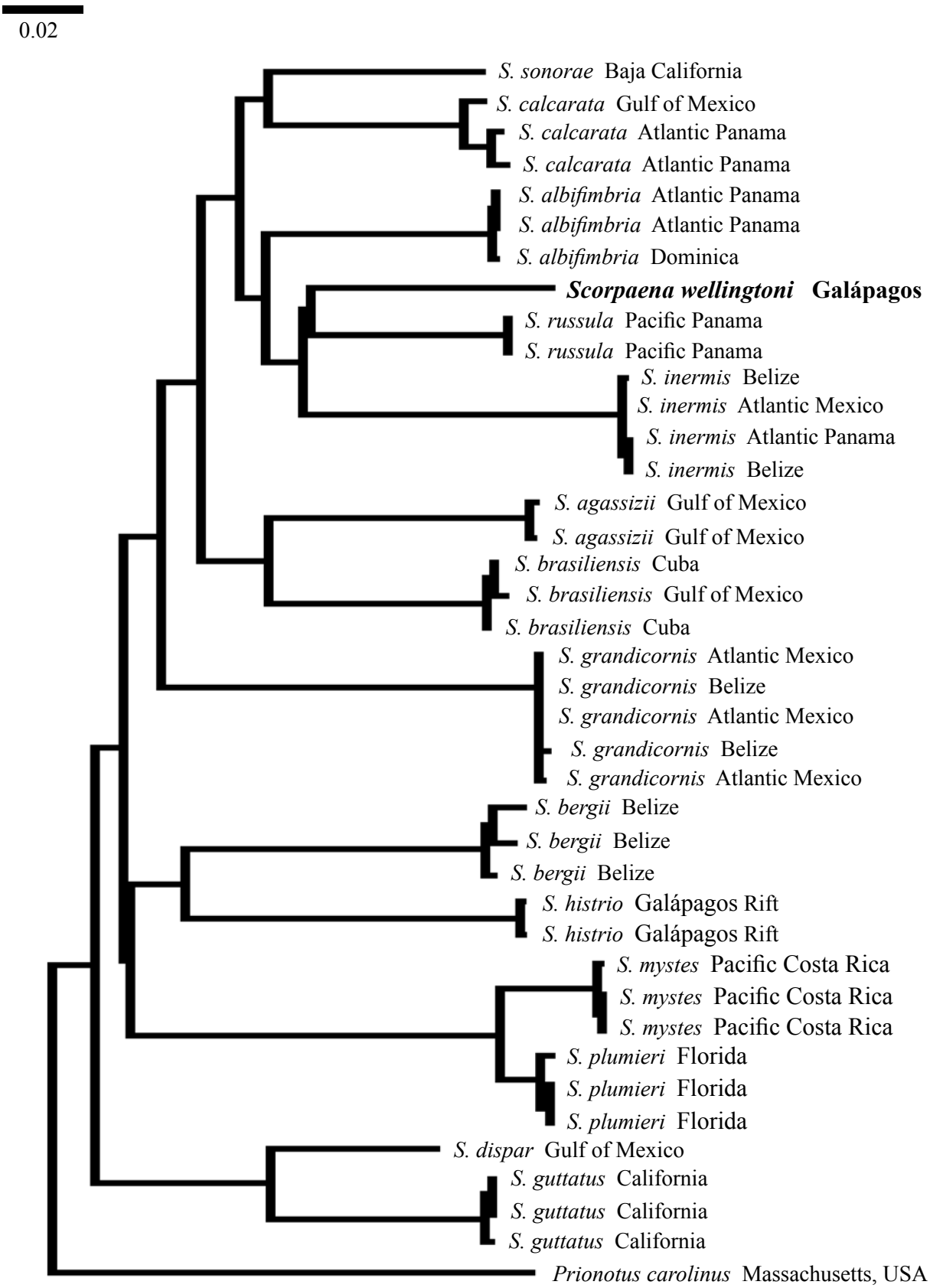

Figure 5. The neighbor-joining phenetic tree based on the COI mtDNA sequences of New World *Scorpaena*, following the Kimura two-parameter model (K2P) generated by BOLD (Barcode of Life Database). The scale bar at left represents a 2% sequence difference. Collection locations for specimens are indicated and the scorpaeniform *Prionotus carolinus* is used as an outgroup. GenBank accession numbers and collection data for the sequences in the tree are listed in Appendix 1.

Figure 6. *Scorpaena inermis*, underwater photograph, Cozumel. Atlantic Mexico (courtesy Jim Lyle)

Comparisons. *Scorpaena wellingtoni* has markings very similar to the Atlantic *S. inermis* and *S. albifimbria* (Fig. 6). An interesting similarity is the development of tabs on the skin-like corneal drape that extends over the upper pupil. *S. inermis* is known as the Mushroom Scorpionfish because of the distinctive inverted mushroom-shaped tabs that extend down over the pupil, making it unmistakable in underwater photographs (Fig. 6). *S. wellingtoni* displays quite similar tabs (at least in the ethanol-preserved holotype), although they are rounded and not mushroom-shaped. It has not been previously reported, but a close examination of fresh specimens of the Atlantic *S. calcarata* shows the same tabs (Fig. 7). *S. albifimbria* apparently has no tabs on the edge of the corneal

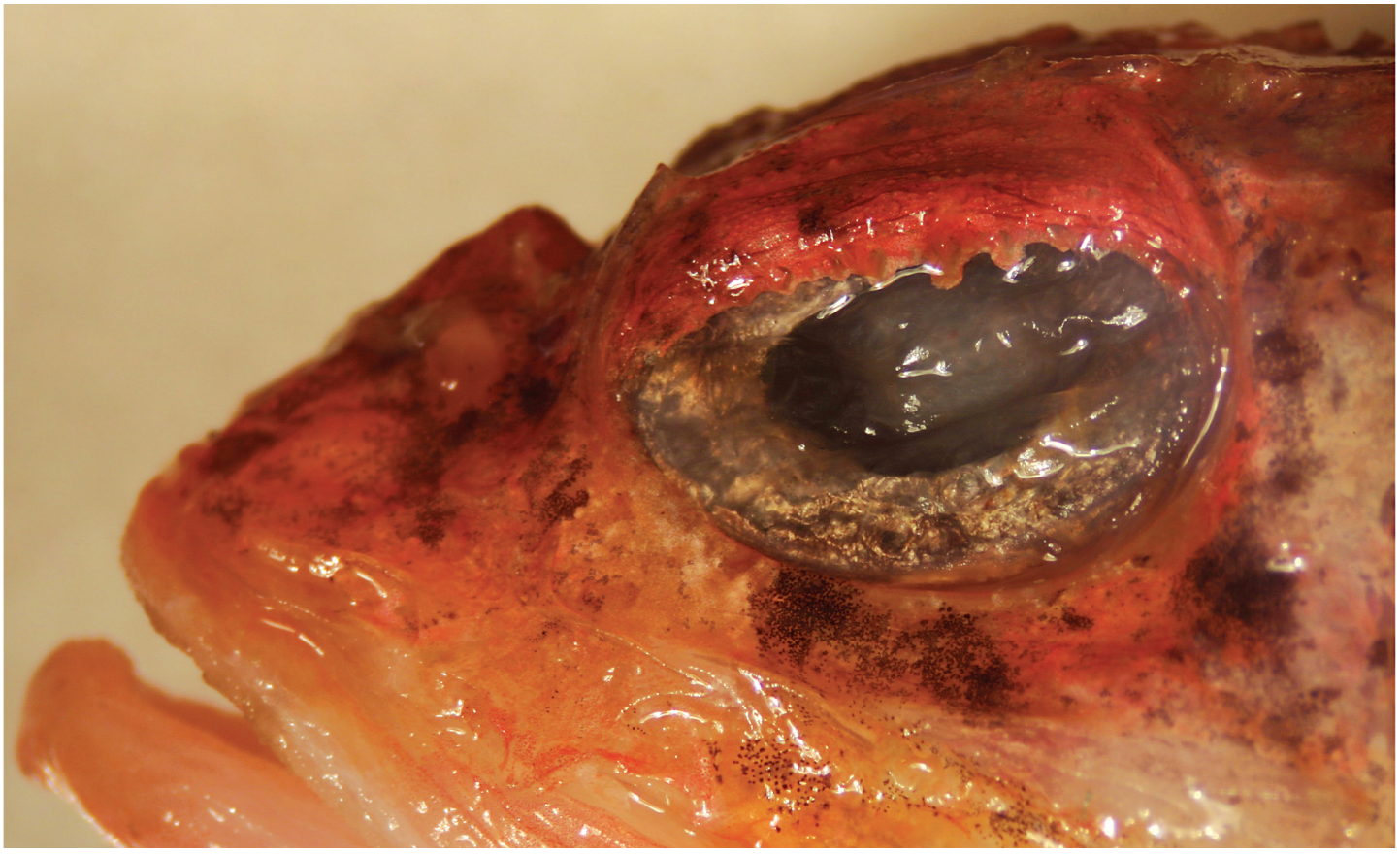

Figure 7. *Scorpaena calcarata*, Gulf of Mexico (specimen courtesy Brandi Noble)

drape, but shares the prominent fleshy tentacles and wart-like cirri on the corneal drape that is apparent on the eyes of all four of these species.

In addition to mostly similar meristics, other similarities to *S. inermis* include two spines on the suborbital ridge (one mid plus end), the absence of the supplemental preopercular spine, a reduced second preopercular spine, and a very narrow and shallow interorbital space. The surface appearance is almost the same: with the same scale patterns, similar arrangements of fleshy tags and tentacles arrayed on spine tips and on some lateral line scales, as well as similar arrays of wart-like cirri on the head. *S. wellingtoni* differs from *S. inermis* in having a deeper occipital pit, larger head spines at the same size, and a cleithral spine.

The similarities to *S. inermis* include the low soft dorsal fin-ray count; only *S. cocosensis* among the tropical eastern Pacific species and only *S. inermis* and *Scorpaena brachyptera* Eschmeyer 1965 among the fourteen known Atlantic species (reviewed in Eschmeyer (1965) Table 1) also have eight dorsal soft rays, although the other species with nine have the occasional variant with eight (typically from 5 to 10% of specimens; Eschmeyer (1965) and additional counts of mine). It should be noted that many counts in the older literature are presumably counting the last ray as two; for example, ten dorsal-fin soft rays in the descriptions of both *S. russula* and *S. sonorae*.

Both the markings and the pronounced arch of the upper body of *S. wellingtoni* resemble those of *S. albifimbria*. Differences from *S. albifimbria* include a lower dorsal soft-ray count, the absence of the supplemental preopercular spine, and one fewer spine on the suborbital ridge. The body depth of *S. wellingtoni*, 36–37% SL, falls between the two Atlantic species *S. inermis* and *S. albifimbria*: Eschmeyer's (1965) table of the frequency distribution of body depth proportions among Atlantic species has *S. inermis* with 31–37% SL and *S. albifimbria* with the deepest profile among the *Scorpaena* with 39–44% SL (range for all species combined is 31 to 44% SL). The remaining set of similar species have narrower bodies with distinctly less arched backs: *S. russula* and *S. sonorae* both have BD of 30–33% SL (Poss 1995), *S. cocosensis* has 30.9–33.7% SL (Motomura 2004, Motomura & McCosker 2009), and *S. calcarata* has 32–38% SL in Eschmeyer (1965), with adults below 35%. *S. calcarata* can be further distinguished by the absence of the occipital pit, an additional dorsal-fin soft ray, and different markings.

The remaining western Atlantic *Scorpaena* are more distant in COI sequence from *S. wellingtoni* and all differ by having a supplemental preopercular spine and many by not having the reduced second preopercular spine (along with a set of other specific characters; Eschmeyer 1965). Within the tropical eastern Pacific, three species of *Scorpaena* share the absence of the supplemental preopercular spine and a reduced second preopercular spine with *S. wellingtoni*. Two are found along the mainland coast: *S. sonorae* in the north from Baja California and the Sea of Cortez and *S. russula* from Baja California down to Peru (the two species have almost all the same meristics and are separated primarily by marking patterns). Both are particularly shallow-bodied species and further differ from *S. wellingtoni* by a flat or shallow occipital pit, one more dorsal-fin soft ray, and in markings: *S. sonorae* by having a prominent dark spot on the soft dorsal fin and *S. russula* by having pale pelvic fins.

The third eastern-Pacific relative is a recently described deepwater species, *S. cocosensis*, collected once on Cocos Island at 57–92m (62 mm SL) and once in the Galápagos at 93m (90.9 mm SL)(Motomura 2004, Motomura & McCosker 2009). It is a relatively shallow-bodied species with essentially no arch in the anterior upper body and a body depth of only 30.9–33.7% SL. The arch is so low that the origin of the first dorsal fin spine is barely above the horizontal level of the top of the orbit. However, the arch of the body can vary inversely with size of the fish in *Scorpaena* (Poss, pers. comm.) and only matched-size fish should be used for comparisons. Fortunately, the paratype of *S. wellingtoni* is the same size as the holotype of *S. cocosensis* and a useful metric for comparison is the ratio of the body depth at the first dorsal spine to the head length, i.e. 84.8% HL in the 59.7 mm SL *S. wellingtoni* vs. only 69.6% HL in the 62 mm SL *S. cocosensis*.

S. cocosensis further differs from *S. wellingtoni* by some adaptations to deep water, such as a much wider interorbital space with prominent interorbital ridges around a deep channel, mostly uniform red markings with black only on pectoral-fin edges, the absence of any fleshy tabs or tentacles on the head, body, or lateral line scales, along with an upward-pointing upper posttemporal spine (Motomura 2004, Motomura & McCosker 2009).

Biogeography. Although the Galápagos Archipelago has been documented to have 16 species of scorpionfishes, many are primarily deepwater species and the islands are relatively depauperate in the otherwise species-rich genus *Scorpaena* (McCosker & Rosenblatt 2010). Only *Scorpaena histrio* Jenyns 1840, *Scorpaena mystes*

Jordan & Starks 1895, and a single specimen of *S. cocosensis* have been reported thus far for the Galápagos (Grove & Lavenberg 1997, McCosker & Rosenblatt 2010, Tirado *et al.* 2013). *S. wellingtoni* adds another species to the list, and is apparently the only endemic scorpionfish in the Archipelago. Nothing is known of its ecology or distribution beyond Tagus Cove on the western island of Isabela. Whether they are more wide-ranging, within the Galápagos or elsewhere in the region, is unknown and there is the possibility that they may have been overlooked because *S. wellingtoni* is apparently a small species and could be confused easily with *S. russula* along the Central American coastline.

There is some precedent for species known specifically from the area around Tagus Cove in the Galápagos, including a small flatfish collected on the same expedition and recently described as *Citharichthys darwini* Victor & Wellington 2013. In addition, the goby *Chriolepis tagus* Ginsburg 1953 is known only from Tagus Cove. It is possible that this is because Tagus Cove is a well-known dive site on the itinerary of virtually every survey expedition, or it could be that the area represents a unique habitat with some exceptional residents. The Galápagos geological hotspot lies directly under the islands of Fernandina and Isabela, both with recently active volcanoes, and the area is exceptionally dry and characterized by seasonal upwelling of colder deep water (Glynn & Wellington 1983, Edgar *et al.* 2004). This leads to a relatively unusual combination of cold water and light sedimentation that may be responsible for creating a distinctive habitat for some fishes.

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Appendix 1. Specimen data and GenBank accession numbers for the mtDNA COI barcode sequences used in the phenogram in Fig. 5.

Genus	species	Collection site	Voucher	GenBank #	Collector/Source
Scorpaena	*sonorae*	Baja California Sur	SIO 11-75	KC616461	J. Snow/SIO
Scorpaena	*calcarata*	N. Carolina, USA	MCZ 167688	KC616439	NMFS/KUI Tissue
Scorpaena	*calcarata*	Panama, Portobelo	n761s190	KC616442	B. Victor
Scorpaena	*calcarata*	Panama, Portobelo	n761s350	KC616441	B. Victor
Scorpaena	*albifimbria*	Panama, Portobelo	n7530asa96	KC616434	B. Victor
Scorpaena	*albifimbria*	Panama, Portobelo	n7531bsa189	KC616435	B. Victor
Scorpaena	*albifimbria*	Dominica, Lesser Antilles	d11718sa260	KC616433	B. Victor
Scorpaena	*wellingtoni*	Isla Isabela, Galápagos	SIO 13-2	KC616430	B. Victor, G. Wellington
Scorpaena	*russula*	Panama, Pacific	pending	pending	D. R. Robertson/C. Baldwin
Scorpaena	*russula*	Panama, Pacific	pending	pending	D. R. Robertson/C. Baldwin
Scorpaena	*inermis*	Turneffe, Belize	cn11sc83	KC616457	C. Nolan/B. Victor
Scorpaena	*inermis*	Quintana Roo, Mexico	ECO-CH LP 3798	GU225033	L. Vásquez Yeomans
Scorpaena	*inermis*	Panama, Portobelo	n730bsi290	KC616452	B. Victor
Scorpaena	*inermis*	Turneffe, Belize	cn11sc67	KC616454	C. Nolan/B. Victor
Scorpaena	*agassizii*	NW Florida, GOM	gom281sa650	KC616432	B. Noble/B. Victor
Scorpaena	*agassizii*	NW Florida, GOM	gom281sa540	KC616431	B. Noble/B. Victor
Scorpaena	*brasiliensis*	Cuba	HLC 12049	FJ584091	D. Steinke
Scorpaena	*brasiliensis*	NW Florida, GOM	gom216sb1700	short seq	B. Noble/B. Victor
Scorpaena	*brasiliensis*	Cuba	HLC 12285	FJ584092	D. Steinke
Scorpaena	*grandicornis*	Quintana Roo, Mexico	ECO-CH LP 3623	GU224589	L. Vásquez Yeomans
Scorpaena	*grandicornis*	Turneffe, Belize	cn12sp64	KC616445	C. Nolan/B. Victor
Scorpaena	*grandicornis*	Quintana Roo, Mexico	ECO-CH-LP 5150	JN312319	L. Vásquez Yeomans
Scorpaena	*grandicornis*	Turneffe, Belize	cn111sc63	KC616444	C. Nolan/B. Victor
Scorpaena	*grandicornis*	Quintana Roo, Mexico	ECO-CH-LP 4112	HM389842	L. Vásquez Yeomans
Scorpaena	*bergii*	Turneffe, Belize	cn111sb95	KC616438	C. Nolan/B. Victor
Scorpaena	*bergii*	Turneffe, Belize	cn111sb88	KC616436	C. Nolan/B. Victor
Scorpaena	*bergii*	Turneffe, Belize	cn111sc86	KC616437	C. Nolan/B. Victor
Scorpaena	*histrio*	Galápagos Rift vents	gv85310sc70	KC616450	B. Victor
Scorpaena	*histrio*	Galápagos Rift vents	gv85310sc86	KC616446	B. Victor
Scorpaena	*mystes*	Guanacaste, Costa Rica	JHLOW00196	KC616460	J. Lowenstein
Scorpaena	*mystes*	Guanacaste, Costa Rica	JHLOW00317	KC616458	J. Lowenstein
Scorpaena	*mystes*	Guanacaste, Costa Rica	JHLOW00195	KC616459	J. Lowenstein
Scorpaena	*plumieri*	S. Florida	USNM SMS 7400	JQ842681	C. Baldwin *et al.*, USNM
Scorpaena	*plumieri*	S. Florida	USNM SMS 7402	JQ842682	C. Baldwin *et al.*, USNM
Scorpaena	*plumieri*	S. Florida	USNM SMS 7570	JQ842683	C. Baldwin *et al.*, USNM
Scorpaena	*dispar*	N. Gulf of Mexico	KU29684	KC616443	NMFS/KUI Tissue
Scorpaena	*guttata*	S. California	SIO 01-198	GU440516	P. Hastings, H.J. Walker
Scorpaena	*guttata*	S. California	CMB NH-15	JX295819	R. Imondi, CMB
Scorpaena	*guttata*	S. California	CMB NH-31	JX295842	R. Imondi, CMB
Prionotus	*carolinus*	Massachusetts, USA	DAL 07-097	KC015843	P. Chase, NOAA