Biogeography **18.**
23–28. Sep. 20, 2016

First records of the deepwater scorpionfish, *Lioscorpius trifasciatus* (Setarchidae), from outside Australian waters

Hiroyuki Motomura[1*], Romain Causse[2] and Carl D. Struthers[3]

[1] The Kagoshima University Museum, 1-21-30 Korimoto, Kagoshima 890-0065, Japan
[2] UMR 7208, Département "Milieux et peuplements aquatiques",
Muséum national d'Histoire naturelle, 43 rue Cuvier, 75231 Paris cedex 05, France
[3] Museum of New Zealand Te Papa Tongarewa, P. O. Box 467, Wellington, New Zealand

Abstract. *Lioscorpius trifasciatus*, originally described from 16 specimens taken from Australian territory in the Tasman and Coral seas, is now reported from New Caledonia, Vanuatu and Fiji with 224 additional specimens. A revised species' diagnosis is provided based on these new specimens, along with fresh colour photographs.

Key words: Setarchidae, *Lioscorpius*, distribution, southwestern Pacific.

Introduction

Lioscorpius trifasciatus was originally described by Last *et al.* (2005) as a second species of *Lioscorpius* Günther, 1880 from off eastern Australia in the Tasman and Coral seas, based on 16 specimens (holotype, 12 paratypes and 3 non-types). This species is easily distinguished from *L. longiceps* Günther, 1880 by having three spines and five soft rays in the anal fin, versus two spines and six rays in *L. longiceps* (Last *et al.*, 2005).

During reviews of scorpionfish specimens deposited at the Muséum national d'Histoire naturelle in Paris (Motomura *et al.*, 2011a) and Museum of New Zealand Te Papa Tongarewa in Wellington (Motomura *et al.*, 2011b), we found 224 additional specimens of *L. trifasciatus* which were collected from New Caledonia, Vanuatu and Fiji in the southwestern Pacific Ocean. These specimens represent the first records from outside Australian waters. This paper presents a revised diagnosis to *L. trifasciatus* after further examination of colouration (based on four fresh specimens) and morphometrics (based on 35 specimens) from recently collected specimens.

*Corresponding author: motomura@kaum.kagoshima-u.ac.jp

Material and methods

Counts and measurements followed Motomura (2004) and Last *et al.* (2005), with the exception of gill-raker counts which included rudiments. The last two soft rays of the dorsal and anal fins are counted as single rays, each pair being associated with a single pterygiophore. Standard length is expressed as SL. Full counts and measurements of 35 specimens of *Lioscorpius trifasciatus* in good condition were taken (Table 1), for the remaining 189 specimens identifications were confirmed, but data was not included in the diagnosis.

Institutional codes used in this paper are as follows: CSIRO (Australian National Fish Collection at the Commonwealth Scientific and Industrial Research Organisation's Marine and Atmospheric

Research laboratories in Hobart, Australia), KAUM (Kagoshima University Museum, Kagoshima, Japan), MNHN (Muséum national d'Histoire naturelle, Paris, France), and NMNZ (Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand). The following specimens of *Lioscorpius longiceps* (116 specimens, 26.4–138.5 mm SL) were examined for comparative purposes: **PHILIPPINES:** MNHN 2005-0529, 4, 53.3–53.8 mm SL; MNHN 2005-0569, 104.8 mm SL; MNHN 2005-0602, 8, 47.0–55.2 mm SL; MNHN 2005-0642, 10, 43.2–58.5 mm SL; MNHN 2005-0664, 3, 63.4–72.0 mm SL; MNHN 2005-0692, 3, 45.0–64.2 mm SL; MNHN 2005-0699, 2, 41.8–49.9 mm SL; MNHN 2005-0706, 4, 48.8–61.3 mm SL. **SOLOMON ISLANDS:** MNHN 2005-2513, 122.1 mm SL; MNHN 2005-3468, 62.2 mm SL; MNHN 2006-0070, 7, 92.7–138.5 mm SL; MNHN 2006-0084, 8, 55.6–113.6 mm SL; MNHN 2006-0238, 5, 70.7–101.9 mm SL; MNHN 2006-0291, 52.6 mm SL; MNHN 2006-0504, 39.1 mm SL; MNHN 2006-0515, 109.6 mm SL; MNHN 2006-0574, 4, 45.9-62.9 mm SL; MNHN 2006-0625, 2, 93.4-99.9 mm SL; MNHN 2006-0708, 2, 100.4–108.4 mm SL; MNHN 2006-0736, 45, 38.5–107.5 mm SL. **FIJI:** MNHN 2002-3080, 2, 27.5–29.4 mm SL. **VANUATU:** MNHN 2010-0652, 26.4 mm SL.

Lioscorpius trifasciatus Last, Yearsley & Motomura, 2005
[English name: Tripleband Scorpionfish]
(Figs. 1–2, Table 1)

Lioscorpius trifasciatus Last, Yearsley & Motomura, 2005: 13, fig. 1 (type locality: south of Saumarez Reef, Coral Sea, 22°34–35′S, 153°37–40′E).

Material examined. 35 specimens (61.6–124.5 mm SL) (counts and measurements: Table 1) — **NEW CALEDONIA:** KAUM–I. 47112, 119.4 mm SL, 23°00′07″S, 168°22′01″E, 372–393 m, RV *Alis*, 3 Nov. 2003; MNHN 2011-0091, 9, 75.6–103.5 mm SL, 22°13′01″S, 167°13′59″E, 500–510 m, RV *Vauban*, 2 Oct. 1985. **VANUATU:** KAUM–I. 47110, 74.3 mm SL, KAUM–I. 47111, 79.8 mm SL, 15°33′47″S, 167°19′30″E, 167–367 m, RV *Alis*, 14 Sept. 2006; KAUM–I. 47116, 78.0 mm SL, KAUM–I. 47115, 82.1 mm SL, KAUM–I. 47117, 81.2 mm SL, KAUM–I. 47118, 72.9 mm SL, KAUM–I. 47119, 74.6 mm SL, KAUM–I. 47120, 74.2 mm SL, KAUM–I. 47121, 77.7 mm SL, KAUM–I. 47122, 112.7 mm SL, KAUM–I. 47123, 110.4 mm

Fig. 1. Preserved specimen of *Lioscorpius trifasciatus* from Vanuatu (MNHN 1998-0023, 113.3 mm SL).

Table 1. Counts and measurements of *Lioscorpius trifasciatus*. Modes for counts and means (including data for smaller specimens) for measurements are in parentheses. Morphometric characters are expressed as percentages of standard length.

	New Caledonia, Vanuatu and Fiji		Australia (Last *et al*., 2005)	
	Non-types		Holotype	Paratypes
	n = 20	*n* = 15	CSIRO H 601-18	*n* =5
Standard length (mm)	61.6–88.5	90.7–124.5	111.8	96.5–115.2
Dorsal-fin rays	XII, 9–10 (10)		XII, 10	XII, 10
Anal-fin rays	III, 5		III, 5	III, 5
Pectoral-fin rays	21–25 (23)		23	23–24
Pelvic-fin rays	I, 5		I, 5	I, 5
Lateral-line scales	24–25 (25)		24	24-25
Gill rakers (upper)[1]	5–6 (6)		3	3
Gill rakers (lower)[1]	9–13 (11)		10	10
Gill rakers (total)[1]	15–19 (17)		13	13
Body depth	22.6–27.3	22.4–28.0 (25.1)	22.2	20.6–22.8
Body width	15.1–18.4	15.8–20.4 (17.1)	16.7	15.1–18.7
Head length	40.5–44.3	40.3–42.9 (41.9)	41.8	38.7–42.3
Head width	11.5–13.9	10.9–12.5 (12.1)	—	—
Snout length	11.4–13.2	12.0–14.1 (12.7)	13.1	12.4–13.2
Orbit diameter	9.0–11.2	8.0–9.8 (9.6)	8.0	7.4–8.2
Interorbital width[2]	5.3–6.4	5.4–6.7 (5.9)	5.5	5.3–5.9
Interorbital width[3]	6.6–8.0	6.9–8.0 (7.4)	—	—
Upper-jaw length	20.3–23.5	20.1–21.7 (21.5)	20.7	19.1–20.1
Maxilla depth	6.3–7.1	5.8–6.5 (6.5)	5.9	5.3–6.1
Between tips of opercular spines	4.2–5.3	4.2–5.2 (4.7)	—	—
Between ventral margin of orbit and suborbital ridge	0.9–1.8	1.3–1.9 (1.5)	—	—
Postorbital length	19.5–21.5	19.3–21.7 (20.4)	20.8	19.1–21.0
Predorsal-fin length	34.3–41.4	37.2–40.0 (38.6)	38.8	36.2–37.9
Preanal-fin length	67.2–72.6	64.4–74.3 (70.3)	71.6	69.9–72.8
Prepelvic-fin length	35.7–39.2	35.2–42.6 (37.7)	35.4	35.5–41.7
1st dorsal-fin spine length	6.3–7.5	7.2–8.8 (7.2)	7.6	6.6–8.4
2nd dorsal-fin spine length	9.9–12.0	10.1–13.5 (11.3)	10.2	10.2–11.5
3rd dorsal-fin spine length	15.4–18.3	15.7–18.0 (16.8)	15.2	14.2–16.7
4th dorsal-fin spine length	16.8–20.6	18.2–21.0 (19.0)	16.6	16.3–17.5
5th dorsal-fin spine length	15.3–19.1	16.1–20.3 (17.8)	20.6	15.0–18.2
11th dorsal-fin spine length	1.4–2.3	1.7–2.0 (1.9)	—	—
12th dorsal-fin spine length	10.7–13.9	8.6–13.6 (12.0)	9.7	8.6–10.0
Longest dorsal-fin soft ray length	17.4–19.3	17.4–19.3 (18.5)	16.8	16.1–16.8
1st anal-fin spine length	4.7–6.6	5.2–6.3 (5.8)	5.6	5.0–6.6
2nd anal-fin spine length	12.3–16.4	10.9–15.0 (13.7)	12.1	10.4–12.7
3rd anal-fin spine length	14.5–17.9	12.2–17.3 (15.4)	13.1	11.5–13.2
Longest anal-fin soft ray length	16.4–18.8	15.3–18.1 (17.4)	16.5	14.0–15.2
Pectoral-fin length	32.0–37.5	32.6–40.5 (35.8)	34.1	35.2–36.0
Pelvic-fin spine length	13.4–16.0	11.2–15.9 (14.2)	12.5	12.0–14.4
Longest pelvic-fin soft ray length	18.5–21.5	18.7–22.5 (20.4)	18.6	18.7–19.8
Caudal-fin length	24.9–29.2	24.0–27.9 (26.6)	20.9	22.2–23.6
Caudal-peduncle length	18.4–20.8	17.6–20.8 (19.6)	18.9	19.0–19.7
Caudal-peduncle depth	7.2–9.1	7.2–8.9 (8.1)	6.9	7.1–7.4

[1]Rudiments on gill arches are not counted in type series (Last et al., 2005); [2]at vertical midline of eye; [3]at posterior end of preocular spine base.

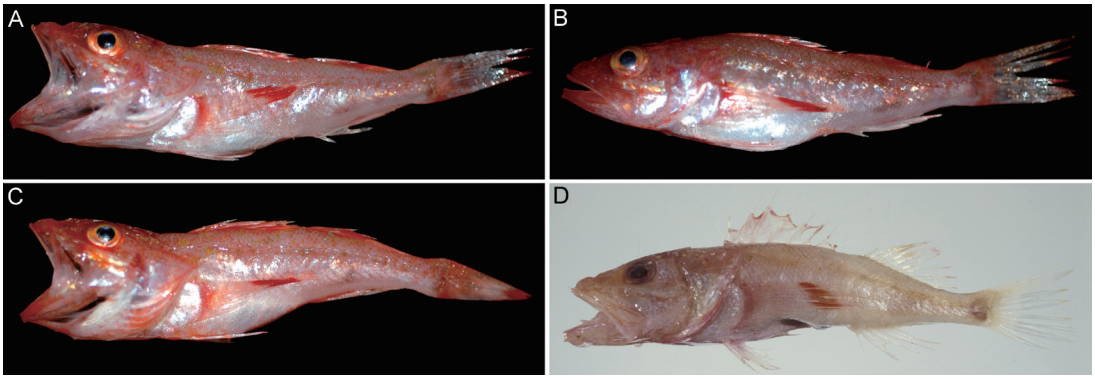

Fig. 2. Fresh specimens of *Lioscorpius trifasciatus* from the southwestern Pacific Ocean. A, MNHN 2008-1291, 64.8 mm SL, Vanuatu; B, MNHN 2008-1242, 72.7 mm SL, Vanuatu; C, MNHN 2008-1290, 76.4 mm SL, Vanuatu; D, NMNZ P. 035358, 88.5 mm SL, Fiji (defrosted specimen).

SL, 15°07′59″S, 167°16′59″E, 470–502 m, RV *Alis*, 6 Oct. 1994; MNHN 1998-0023, 11, 61.6–113.3 mm SL, same data as KAUM–I. 47116; KAUM–I. 47113, 114.5 mm SL, KAUM–I. 47114, 124.5 mm SL, 19°21′00″S, 169°28′01″E, 492-520 m, RV *Alis*, 22 Sept. 1994. **FIJI:** NMNZ P.035358, 88.5 mm SL, 16°34′48–54″S, 178°20′24–29′24″E, 350 m, B. Water, FV *Seafire*, 23 Jan. 1998.

Additional material. 189 specimens (31.1–133.6 mm SL) — **NEW CALEDONIA:** MNHN 2004-2623, 129.1 mm SL, 23°00′54″S, 168°22′01″E, 396–405 m, RV *Alis*, 3 Nov. 2003; MNHN 2004-2782, 2, 64.8–71.6 mm SL, same data as KAUM–I. 47112; MNHN 2004-2853, 2, 92.8–109.8 mm SL, 23°22′08″S, 168°00′00″E, 383–393 m, RV *Alis*, 1 Nov. 2003. **VANUATU:** MNHN 1998-0072, 3, 39.6–53.7 mm SL, 15°52′59″S, 167°27′00″E, 944–956 m, RV *Alis*, 4 Oct. 1994; MNHN 1998-0021, 3, 90.9–99.3 mm SL, 19°21′00″S, 169°27′00″E, 460–480 m, RV *Alis*, 22 Sept. 1994; MNHN 1998-0022, 40, 64.6–136.6 mm SL, 15°07′59″S, 167°16′59″E, 494–516 m, RV *Alis*, 6 Oct. 1994; MNHN 1998-0023, 11, 65.5–118.6 mm SL, 15°07′59″S, 167°16′59″E, 470–502 m, RV *Alis*, 6 Oct. 1994; MNHN 1998-0025, 91.0 mm SL, 17°49′01″S, 168°39′00″E, 385–410 m, RV *Alis*, 28 Sept. 1994; MNHN 1998-0026, 2, 100.4–109.1 mm SL, 19°21′00″S, 169°27′00″E, 475–480 m, RV *Alis*, 23 Sept. 1994; MNHN 1998-0027, 91.7 mm SL, 19°21′S, 169°25′E, 433–450m, RV *Alis*, 22 Sept. 1994; MNHN 1998-0028, 10, 59.9–130.2 mm SL, 15°40′01″S, 167°01′01″E, 398–400 m, RV *Alis*, 11 Oct. 1994; MNHN 1998-0030, 3, 97.6–133.7 mm SL, same data as KAUM–I. 47113; MNHN 1998-0031, 3, 93.2–113.4 mm SL, 15°06′00″S, 166°52′59″E, 315–360 m, RV *Alis*, 9 Oct. 1994; MNHN 1998-0032, 3, 107.0–111.2 mm SL, 17°52′59″S, 168°39′00″E, 550–571 m, RV *Alis*, 28 Sept. 1994; MNHN 1998-0033, 113.9 mm SL, 15°01′01″S, 166°55′59″E, 532–599 m, RV *Alis*, 9 Oct. 1994; MNHN 1998-0073, 10, 106.3–119.3 mm SL, 16°39′00″S, 168°01′59″E, 469–525 m, RV *Alis*, 1 Oct. 1994; MNHN 1998-0074, 16, 36.3–65.6 mm SL, 15°10′01″S, 167°13′59″E, 394–421 m, RV *Alis*, 6 Oct. 1994; MNHN 1998-0075, 8, 31.1–42.1 mm SL, 15°10′01″S, 167°13′01″E, 344–350 m, RV *Alis*, 6 Oct. 1994; MNHN 1998-0076, 10, 84.0–117.9 mm SL, 15°07′01″S, 166°52′59″E, 282–321 m, RV *Alis*, 9 Oct. 1994; MNHN 1998-0077, 7, 57.6–77.4 mm SL, 15°40′59″S, 167°01′59″E, 360–371 m, RV *Alis*, 11 Oct. 1994; MNHN 2005-3350, 7, 47.8–82.9 mm SL, 15°06′04″S, 166°55′01″E, 215–300 m, RV *Alis*, 16 Nov. 2004; MNHN 2005-3364, 4, 73.2–76.9 mm SL, MNHN 2005-3395, 81.5 mm SL, 15°05′10″S, 166°55′01″E, 190–333 m, RV *Alis*, 16 Nov. 2004;

MNHN 2008-1242, 72.7 mm SL, 15°33′47″S, 167°19′30″E, 167–367 m, RV *Alis*, 14 Sept. 2006; MNHN 2008-1290, 76.4 mm SL, MNHN 2008-1291, 64.8 mm SL, 15°40′30″S, 167°01′30″E, 366–389 m, RV *Alis*, 17 Sept. 2006; MNHN 2008-1611, 13, 67.9–82.9 mm SL, 15°39′S, 167°01′E, 275–290 m, RV *Alis*, 19 Oct. 2006; MNHN 2009-0128, 105.1 mm SL, 15°03′36″S, 166°52′12″E, 323–397 m, RV *Alis*, 8 Sept. 2005; MNHN 2009-1484, 43.3 mm SL, , RV *Alis*, 5 Sept. 2005; MNHN 2009-1513, 99.7 mm SL, 15°04′34″S, 166°53′28″E, 350–400 m, RV *Alis*, 6 Sept. 2005; MNHN 2010-0549, 20, 46.5–72.4 mm SL, same data as KAUM–I. 47110; MNHN 2010-0945, 66.3 mm SL, 15°04′59″S, 167°15′00″E, 397–402 m, RV *Alis*, 7 Oct. 1994.

Diagnosis. A species of *Lioscorpius* with the following combination of characters: anal fin with 3 spines and 5 rays; 1–3 diagonal red bands on pectoral fin; and red caudal-fin margin; relatively small head [38.7–44.3% (mean 41.9%) of SL], orbit [7.4–11.2% (9.6%) of SL], upper jaw [19.1–23.5% (21.5%) of SL], and maxilla depth [5.3–7.1% (6.5%) of SL]; short predorsal-fin distance [34.3–41.4% (38.6%) of SL]; and long second pelvic-fin ray [18.5–22.5% (20.4%) of SL], and anal-fin spines [first spine 4.7–6.6% (5.8%) of SL, second 10.4–16.4% (13.7%) of SL].

Remarks. The present specimens from the southwestern Pacific Ocean are identified as *L. trifasciatus* in having three spines and five soft rays in the anal fin. The only other congener, *L. longiceps*, has two spines and six soft rays (Last *et al*., 2005; this study). In addition to the number of anal-fin elements, Last *et al.* (2005) distinguished *L. trifasciatus* from *L. longiceps* by having three red bands on the pectoral fin, instead of one red band in the latter. However, colour photographs of four fresh specimens identified as *L. trifasciatus* in this study show that they have only one red band on the pectoral fin (Fig. 2). The pectoral-fin colour pattern of *L. trifasciatus* is most likely to vary within the species, or is able to change in response to biotic or abiotic factors, a trait well known in scorpionfishes (e.g., Motomura *et al*., 2010). The colour differences may represent species or population level characteristics, but we found no morphological differences between specimens with one or three bands. Molecular analysis of the dichromatism is required once genetic material is made available. According to Last *et al.* (2005), *L. trifasciatus* is also characterized by having a strongly contrasted reddish caudal-fin margin (vs. a faint or indistinct margin in *L. longiceps*). Validity of this character was confirmed in three of the four fresh specimen photographs (Fig. 2A–C). The remaining photograph (Fig. 2D) based on a defrosted specimen showed a pale reddish margin, indicating that the colour might fade or bleach with freezing. The state of these two characters in the other 220 reported specimens is unknown as no fresh colour notes were recorded at the time of capture and also due to colour not persisting after preservation.

Lioscorpius trifasciatus has been known only from 16 specimens from Australian territory of the Tasman and Coral seas (Last *et al*., 2005). During this study, 224 additional specimens (31.1–133.6 mm SL) of the species collected from New Caledonia, Vanuatu and Fiji in depths of 167–956 m were found in museum collections. The additional material reported here demonstrates that *L. trifasciatus* is common at a range of localities in the southwestern Pacific and indicates that the species may have a somewhat wider distribution in the region. At least off Vanuatu and Fiji, *L. longiceps* appears to be sympatric with *L. trifasciatus*.

Acknowledgements

The first author is especially grateful to P. Béarez, P. Pruvost, C. Ferrara, Z. Gabsi and all staff of MNHN and C. Roberts, A. Stewart, L. Moore and

all staff of the Fish Section of NMNZ for their assistance during his stay at their museums. We thank M. Matsunuma (KAUM) for helping to take data for the specimens. This study was supported in part by Grants-in-Aid for Scientific Research (A: 26241027, B: 24370041 and C: 23580259 and 26450265) from the Japan Society for the Promotion of Science, Tokyo, Japan (JSPS); the JSPS Core-to-Core Program, "Research and Education Network on Southeast Asian Coastal Ecosystems"; the "Coastal Area Capability Enhancement in Southeast Asia Project" of the Research Institute for Humanity and Nature, Kyoto, Japan; the "Biological Properties of Biodiversity Hotspots in Japan" project of the National Museum of Nature and Science, Tsukuba, Japan; "Establishment of Research and Education Network on Biodiversity and Its Conservation in the Satsunan Islands" project of Kagoshima University adopted by the Ministry of Education, Culture, Sports, Science and Technology, Japan; and by the NZ National Institute of Water and Atmospheric Research Ltd (NIWA) Core Funded Coasts & Oceans Programme 2: Biological Resources subcontract for fundamental knowledge of marine fish biodiversity with the Museum of New Zealand Te Papa Tongarewa, previously NIWA's FORST contract: C01X0502. The first author's visits to Paris for nine months in 2010–2016 and Wellington for two weeks in 2011 were supported by the Muséum national d'histoire naturelle and Museum of New Zealand Te Papa Tongarewa, respectively.

References

Last, P. R., Yearsley, G. K. & Motomura, H. 2005. *Lioscorpius trifasciatus*, a new scorpionfish (Scorpaeniformes: Setarchidae) from the South-West Pacific Ocean. *Zootaxa*, **1038**: 11–22.

Motomura, H. 2004. Revision of the scorpionfish genus *Neosebastes* (Scorpaeniformes: Neosebastidae), with descriptions of five new species. *Indo-Pac. Fish*., **37**: 1–76.

Motomura, H., Arbsuwan, S. & Musikasinthorn, P. 2010. *Thysanichthys evides* Jordan and Thompson, 1914, a senior synonym of *Sebastella littoralis* Tanaka, 1917, and a valid species of *Scorpaenodes* (Actinopterygii: Scorpaenidae). *Spec. Diversity*, **15**: 71–81.

Motomura, H., Béarez, P. & Causse, R. 2011a. Review of Indo-Pacific specimens of the subfamily Scorpaeninae (Scorpaenidae), deposited in the Museum national d'Histoire naturelle, Paris, with description of a new species of *Neomerinthe*. *Cybium*, **35**: 55–73.

Motomura, H., Struthers, C. D., McGrouther, M. A. & Stewart, A. L. 2011b. Validity of *Scorpaena jacksoniensis* and a redescription of *S. cardinalis*, a senior synonym of *S. cookii* (Scorpaeniformes: Scorpaenidae). *Ichthyol. Res*., **58**: 315–332.

(Received June 1, 2016; Accepted August 18, 2016)