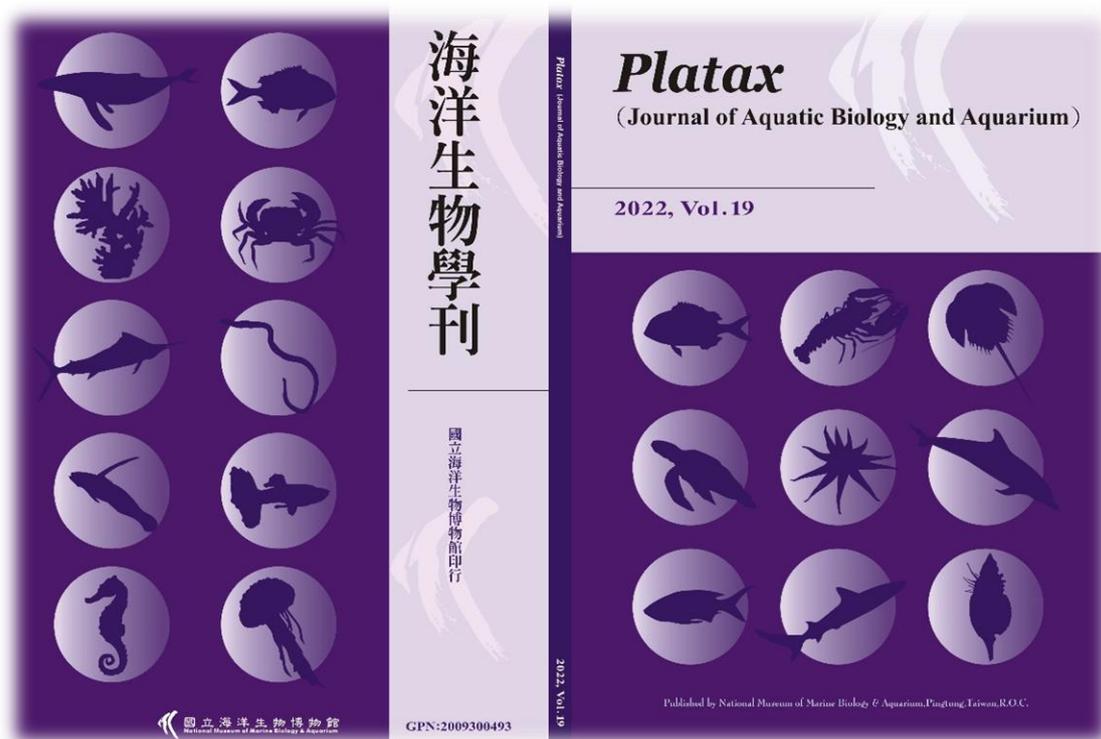


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## A new record of a rare frogfish *Nudiantennarius subteres* (Smith & Radcliffe, in Radcliffe, 1912) from southwestern Taiwan

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### Abstract

A rare frogfish, *Nudiantennarius subteres*, was recently collected off of southwestern Taiwan, representing the northern-most specimen-based record of this species. It can be distinguished from other antennariids in its reduced dermal spines, which are most evident in the head region, and second and third dorsal-fin spines; esca and illicium are both well-developed and distinct; the number of fin-ray counts.

**Keywords:** biodiversity, frogfish, ichthyology Lophiiformes, new record, taxonomy.

### Introduction

The frogfish family Antennariidae is a group of small (<20 cm) anglerfishes found at depths <300 m (Pietsch and Grobecker, 1987; Pietsch, 1999). They are characterized by having three dorsal-fin spines that are separated from the soft dorsal fin, and the first fin spine almost always bears a well-developed esca; a short and rather compressed body; gill openings small, forming individual pores at each pectoral-fin base (Pietsch, 1999). Six genera with 32 total species were recognized in the latest classification (Fricke et al., 2022; Hart et al., 2022).

Among these species, *Nudiantennarius subteres* (Smith & Radcliffe, in Radcliffe, 1912) is the only member of the genus *Nudiantennarius* Schultz, 1957 and is known only from specimens collected from Ambon and Lembeh, Indonesia, and Luzon, the Philippines (Pietsch and Arnold, 2017); although there is a record from southern Japan (Lindberg et al., 1997), no voucher specimen or subsequent record supports it.

Recently, two specimens of a bizarre-looking frogfish were collected off Ke-Tzu-Liao fishing port (southwestern Taiwan) by bottom trawl. These specimens

were later identified as *N. subteres* by the unique combination of characters, making this the first record of this genus and species in Taiwan. Detailed descriptions of these two specimens are provided herein, with the results compared to those of other known specimens.

### Methods and materials

Specimens were fixed in 10% formaldehyde and subsequently transferred to 70% ethanol or 50% isopropanol mixed by tap water. Methodology and terminology follow Pietsch and Grobecker (1987), except for the following: head length (HL) was measured from the symphysis of the upper jaw to the posterior margin of the neurocranium; upper-jaw length was measured from the symphysis of the upper jaw to the posterior end of the maxilla; lower-jaw length was measured from the tip of the lower jaw to the posterior end of the angular; caudal-fin length was measured from the posterior margin of the hypural plate to the tip of the caudal fin. Measurements were taken using digital calipers, rounded to the nearest 0.1 mm. Morphometric data are presented as % standard length (SL) and/or % HL, except when indicated otherwise. Paired-fin characters are presented as left/right. Counts of vertebrae and dorsal-and anal-fin rays were determined by X-radiograph (X-ray). Specimens were deposited at the Pisces collection of the National Museum

of Marine Biology and Aquarium, Taiwan (NMMB-P).

### Results

Family Antennariidae

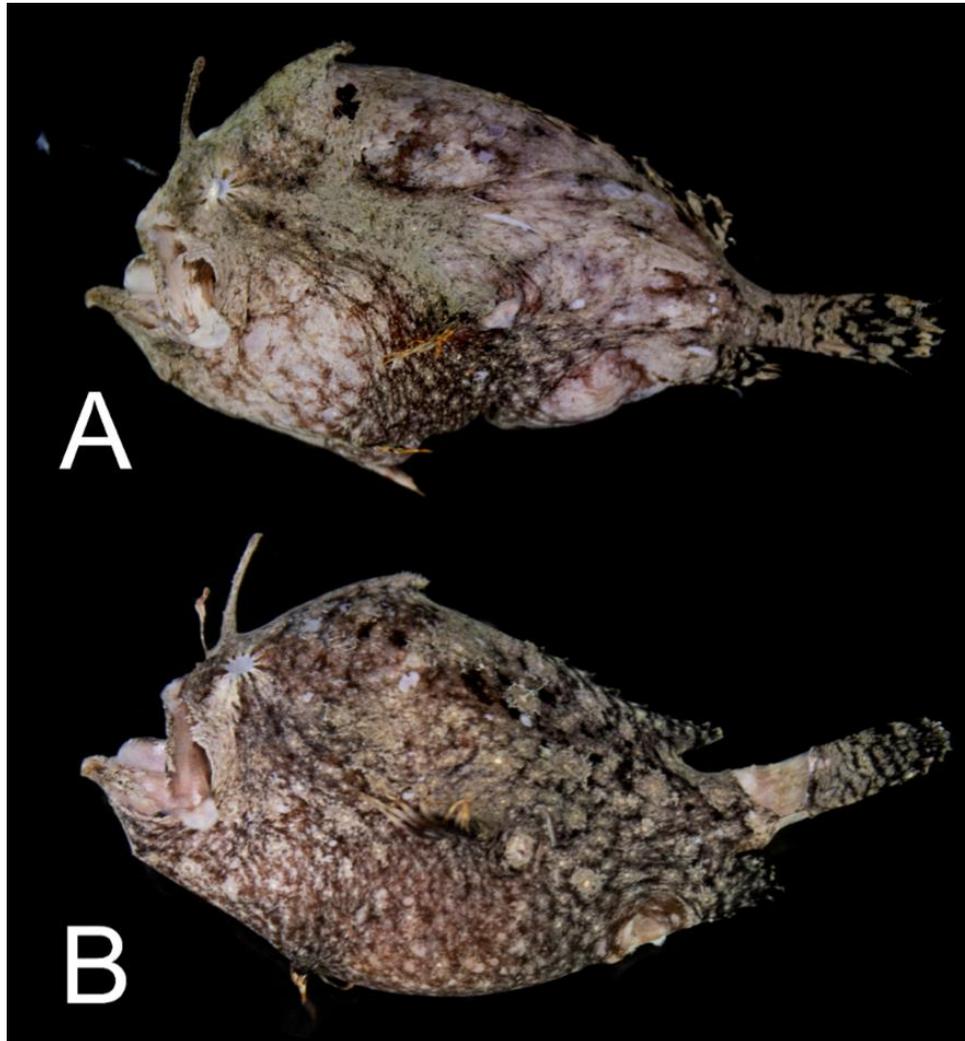
*Nudiantennarius subteres* (Smith & Radcliffe, in Radcliffe, 1912)

黑紋裸身躑魚

Figs. 1–4; Table 1

*Antennarius subteres* Smith & Radcliffe, in Radcliffe, 1912:205, pl 17, fig. 1 (Type locality: Lingayen Gulf, western coast of Luzon Island, 16°30'36"N, 120°11'06"E, Philippines, depth 45 fathoms; holotype: USNM 70268)

*Nudiantennarius subteres* (Smith & Radcliffe, in Radcliffe, 1912): Schultz, 1957:66, pl. 1, fig. D (new genus; after Smith & Radcliffe, in Radcliffe, 1912). Pietsch, 1984:36 (genera of frogfishes). Pietsch and Grobecker, 1987:184, figs. 16C, 75–77, 129 (description, distribution, relationships, and new records from Luzon and Ambon). Lindberg et al., 1997:213 (Southern Japan). Pietsch, 1999:2015 (western central Pacific, in key). Pietsch, 2000:597 (South China Sea). Allen and Adrim, 2003:25 (Moluccas; misidentified). Allen and Erdmann, 2012:155 (Indonesia). Arnold and Pietsch, 2012:128, fig. 1E (molecular phylogeny). Pietsch and Arnold 2020:170 (Ambon and Lembeh, Indonesia). Hart et al., 2022:7 (molecular phylogeny).



**Fig. 1.** Fresh condition of *Nudiantennarius subteres* (Smith & Radcliffe, in Radcliffe, 1912). A. NMMB-P36998, 44.3 mm SL. B. NMMB-P37063, 41.7 mm SL.

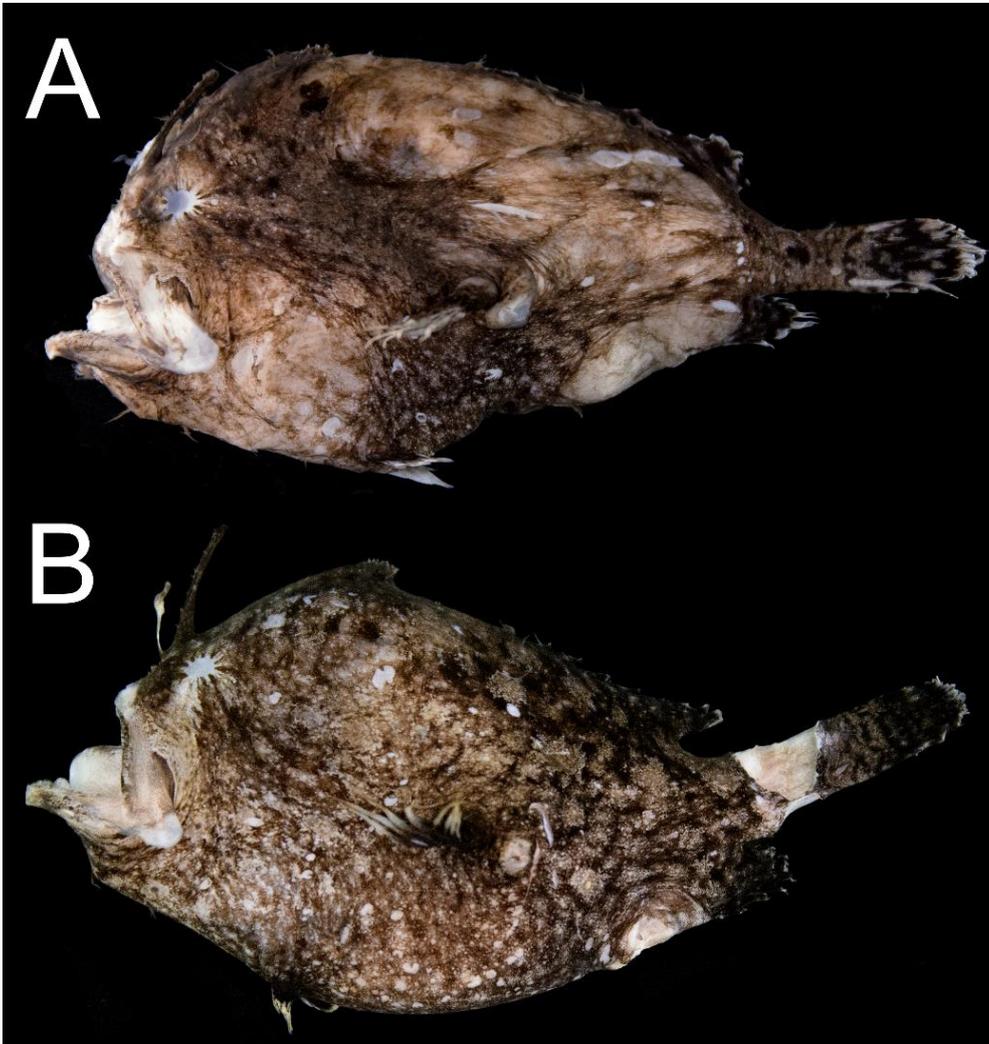
*Antennarius* sp.: Allen et al., 2003:363 (Lembeh Strait, Sulawesi).

**Materials examined.** NMMB-P36998, 44.3 mm SL, off Ke-Tzu-Liao (ca.22°42'53"N, 120°13'12"E), Kaohsiung, southwestern Taiwan, 6 May 2022, coll. Y.-C. Chen. NMMB-P37063, 41.7 mm SL, off Ke-Tzu-Liao, Kaohsiung,

southwestern Taiwan, 20 April 2022, coll. Y.-C. Chen.

**Description of Taiwanese specimens.** Morphometric and meristic data are provided in Table1.

Dorsal-fin rays III, 12, all rays simple except for three posteriormost rays bifurcate; pectoral-fin rays 9/9, all simple;

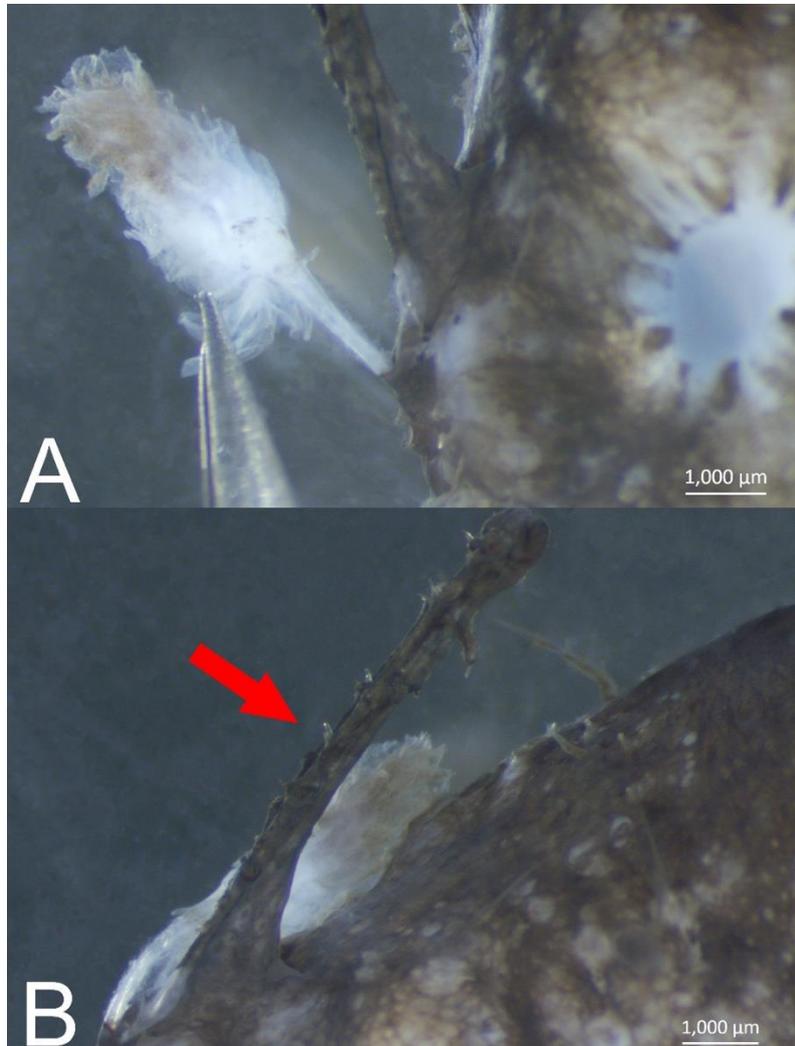


**Fig. 2.** Preserved condition of *Nudiantennarius subteres* (Smith & Radcliffe, in Radcliffe, 1912). A. NMMB-P36998, 44.3 mm SL. B. NMMB-P37063, 41.7 mm SL.

pelvic-fin rays 5/5, all simple; anal-fin rays 7, all bifurcate; vertebrae 11 (prehaemal)+8 (caudal)=19.

Body oval, somewhat compressed. Illicium thin, its length 0.9–1.0 in eye diameter, and about one-third length of second dorsal-fin spine. Esca oval, bearing numerous short filaments (Fig. 3A), its tip

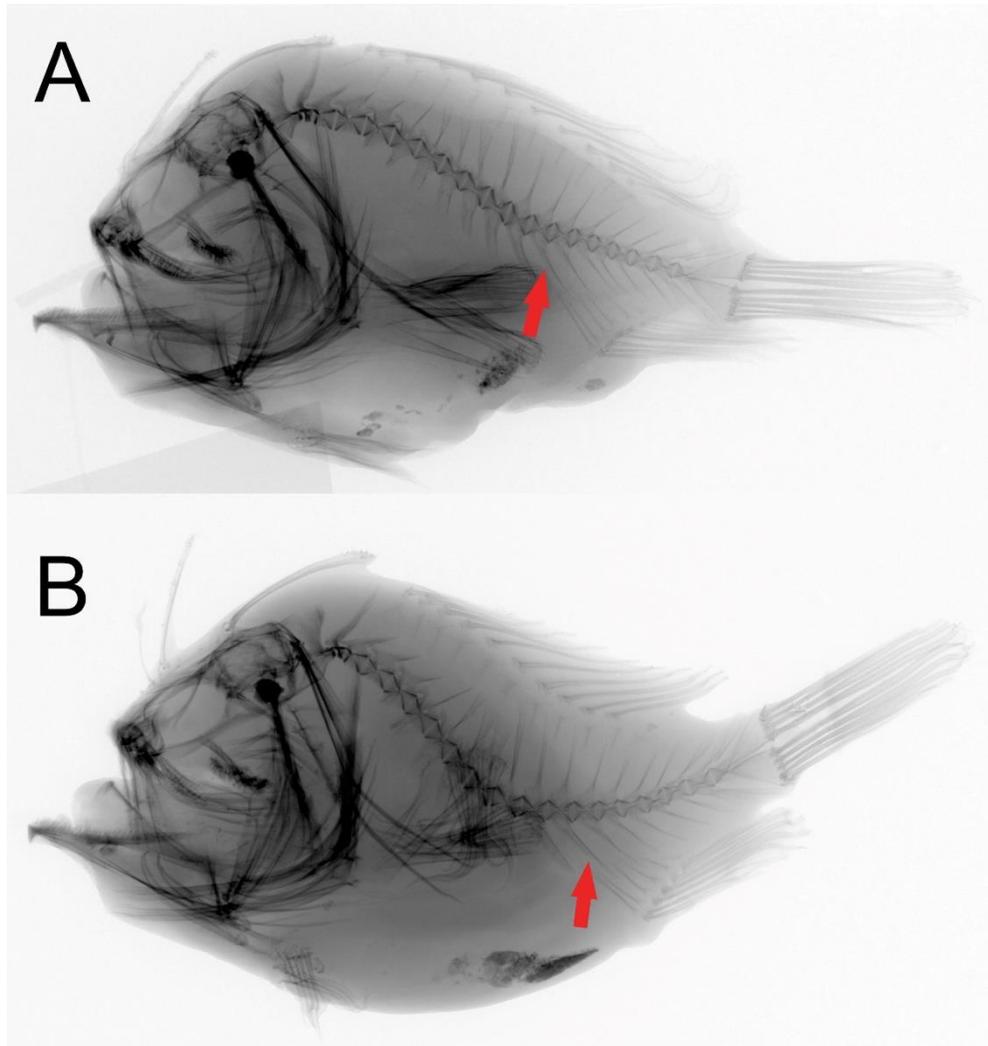
rather pointed, length 1.0 in eye diameter. Second dorsal-fin spine rod-shaped, its length 3.9–4.9 in SL. Third dorsal-fin spine rod-shaped, curved posteriorly, slightly longer than second spine, length 3.5–4.3 in SL, most of its surface embedded in skin. Gap between second and third dorsal-fin spine clearly larger



**Fig. 3.** Close-up images of *Nudiantennarius subteres* (Smith & Radcliffe, in Radcliffe, 1912), NMMB-P36998, 44.3 mm SL, preserved. A. Esca and illicium. B. Second dorsal-fin spine coated in small spinules (denoted by red arrow). Anterior to left.

than gap between illicium and second dorsal-fin spine. Most dorsal-fin rays embedded in skin. Distal portion of anal-fin rays exposed, while others embedded in skin. Distal one-third of pectoral-fin rays free, not embedded in skin and unconnected by membranes. Caudal fin

long, length 1.1–1.3 in HL, covered by skin. Caudal peduncle absent, posterior ends of dorsal and anal fins connected to caudal-fin base. Dermal spinules reduced, only present on surface of head region, second and third dorsal-fin spines (Fig. 3B), and chin, body naked elsewhere. Eyes



**Fig. 4.** X-radiograph of *Nudiantennarius subteres* (Smith & Radcliffe, in Radcliffe, 1912).  
A. NMMB-P36998, 44.3 mm SL. B. NMMB-P37063, 41.7 mm SL. The arrow indicates the first haemal spine.

small, 5.4–6.3 in HL, covered in skin. Two gill openings, small, distinctly smaller than eye diameter, situated at each base of pectoral fins forming single pore.

Mouth large, upper-jaw length 1.3–1.4 in HL, reaching vertical through posterior margin of eye; lower jaw smaller than upper jaw, its length 1.8–2.0 in HL.

Posterior portion of maxilla exposed. Premaxilla and dentary bearing small conical teeth somewhat inwardly pointing. Palatine with teeth. Vomer toothless. Hypobranchial I with teeth; ceratobranchial I and epibranchial I toothless.

	This study						Pietsch & Arnold. (2017)
	NMMB-P36998			NMMB-P37063			n=7
SL (mm)	44.3			41.7			17.0–64.0
<b>Morphometrics</b>	mm	%SL	%HL	mm	%SL	%HL	%SL
Head length (HL)	16.1	36.3	100	16.9	40.5	100	
Illicium length	3.0	6.8	18.6	3.1	7.4	18.3	5.9–11.3
Esca length	2.9	6.5	18.0	2.8	6.7	16.6	3.9–7.2
Second dorsal-fin spine	9.0	20.3	55.9	10.7	25.7	63.3	17.4–28.1
Third dorsal- fin spine	10.4	23.5	64.6	11.9	28.5	70.4	23.0–31.3
Caudal-fin length	14.7	33.2	91.3	13.4	32.1	79.3	
Eye diameter	3.0	6.8	18.6	2.7	6.5	16.0	5.5–11.3
Upper-jaw length	12.4	28.0	77.0	12.1	29.0	71.6	
Lower-jaw length	8.9	20.1	55.3	8.6	20.6	50.9	
<b>Meristics</b>							
Dorsal-fin rays	III, 12			III, 12			III, 12
Pectoral-fin rays	9/9			9/9			9
Anal-fin rays	7			7			7
Pelvic-fin rays	5/5			5/5			5
Vertebrae	11+8=19			11+8=19			5+14=19

**Table. 1.** Meristic and morphometric characters of *Nudiantennarius subteres* (Smith & Radcliffe, in Radcliffe, 1912). Data from the other specimens were adopted from Pietsch and Arnold (2017). Paired-fin characters are presented as left/right. SL= standard length.

**Coloration.**

When fresh (Fig. 1), body brownish, with darker patterns along dorsal-lateral side of body and caudal fin. Esca and illicium pale, except for tip of esca blackish (Fig. 3A). Abdomen somewhat

darker than dorsal portion. One or more ocelli situated behind base of third dorsal-fin spine. Exposed pectoral- and pelvic-fin rays with orange and reddish color. Preserved specimens slightly lighter, with overall similar color pattern as when fresh

(Fig. 2).

### Distribution.

This species was previously known only from specimens collected from Luzon in the Philippines (holotype) and Indonesia (Pietsch and Arnold, 2017). The examined specimens represent the first record from Taiwan and a northern-most specimen-based record for this species. Although previous reports suggested that it inhabits relatively deep waters, up to 128 m (Pietsch and Grobecker, 1987), a recent study (Pietsch & Arnold, 2017) reported specimens and observations from depths 3–30 m.

### Remarks.

The two present specimens were identified as *N. subteres* based on the following characters: dermal spinules bifurcate, mostly evident on head, second, and third dorsal-fin spines, nearly naked elsewhere; illicium naked and esca distinct; a longer second dorsal-fin spine; dorsal-fin rays 12; pectoral-fin rays 9; anal-fin rays 7.

*Nudiantennarius subteres* can be distinguished from other frogfish genera in Taiwan (i.e., *Antennarius*, *Antennatus*, *Fowlerichthys*, & *Histrio*; Shen and Wu, 2011; Shao, 2022) in having dermal spinules mostly reduced, only present in the head region (vs. covering the entire bodies of *Antennarius*, *Antennatus*, & *Fowlerichthys*); illicium well-developed (vs. tiny in *Histrio*) (Pietsch and Grobecker, 1987).

Although the numbers of caudal centra reported by Pietsch and Grobecker (1987) and Pietsch and Arnold (2017) were 14, both of our specimens possessed only 8. Since the first anal-fin pterygiophore is inserted between the 11<sup>th</sup> and 12<sup>th</sup> vertebra, and no haemal spine was found before the insertion (Fig. 4), it is likely that the authors included all vertebrae that possessed parapophysis in their counts, thereby accounting for this discrepancy. Otherwise, the remaining meristic and morphometric values (Table 1) agree well with the data provided by Pietsch and Arnold (2017). The record from southern Japan (Lindberg et al., 1997) needs to be verified because no further records (neither voucher specimens nor publications) support it.

### Acknowledgements

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