

First records of the seamothe, *Pegasus nanhaiensis* (Actinopterygii: Syngnathiformes: Pegasidae), from the southern South China Sea, with notes on fresh coloration

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Abstract

Three seamothe specimens (45.5–56.9 mm standard length; SL) (Syngnathiformes: Pegasidae), originally identified as *Pegasus later-narius* Cuvier, 1829, but now recognized as representing *P. nanhaiensis* Zhang, Wang et Lin, 2020, a species recently described from the northern South China Sea off Yangjiang and Beihai, China, were obtained at a local fish market in Maha Chai, Samut Sakhon Province, Thailand on 6 July 2012, having been caught in the northern Gulf of Thailand. In addition, single specimens, reported as *P. later-narius* or *Spinipegasus later-narius* from Bidong Island, South China Sea off the Malay Peninsula (46.1 mm SL) and from Ko Kradat, Trat Province, eastern Gulf of Thailand (66.1 mm SL), were re-identified here as *P. nanhaiensis*. Thai specimens and Malaysian record represent the first records of *P. nanhaiensis* from Thailand and Malaysia, respectively, and from outside Chinese coastal waters. Additionally, the Bidong specimen is the southernmost record for the species. The fresh coloration of *P. nanhaiensis* is described for the first time.

Keywords

Pegasus later-narius, distribution, southernmost record, Bidong Island, Malaysia, Gulf of Thailand

Introduction

The Indo-West Pacific genus *Pegasus* Linnaeus, 1758, characterized by having 11 tail rings, no spine on the dorsal surface of the last dorsal ring, and the eyes not visible in ventral view (Pálsson and Pietsch 1989), includes five valid species, viz., *Pegasus lancifer* Kaup, 1861, *Pegasus later-narius* Cuvier, 1829, *Pegasus nanhaiensis* Zhang, Wang et Lin, 2020, *Pegasus tetrabelos* Osterhage, Pogonoski, Appleyard et White, 2016, and *Pegasus volitans* Linnaeus, 1758 (see Zhang et al. 2020; Fricke et al. 2021).

Pegasus nanhaiensis was originally described on the basis of 17 specimens from the northern South China Sea (off Yangjiang and Beihai) (Zhang et al. 2020), no further specimens having been recorded since. However, three specimens, collected from the northern Gulf of Thailand prior to that description, were re-identified here as *P. nanhaiensis*, two having been reported as *P. later-narius* by Matsunuma (2013). These three specimens, therefore, represent the first records of *P. nanhaiensis* from the Gulf of Thailand and the first records outside Chinese coastal waters. In addition, previous records of *P. later-narius* (or as *Spinipegasus later-narius*) from the eastern Gulf of Thailand and

the eastern Malay Peninsula were re-identified here as *P. nanhaiensis*. As Zhang et al. (2020) described the coloration of dry specimens only, a fresh color description of *P. nanhaiensis* is provided here for the first time.

Methods

Counts and measurements followed Osterhage et al. (2016) and Zhang et al. (2020). Measurements were made to the nearest 0.1 mm with digital calipers under a dissecting microscope. Standard length is abbreviated as SL. Terminology of body parts and determination of sex followed Palsson and Pietsch (1989). The following description was based solely on the three specimens from the northern Gulf of Thailand (Figs. 1–3). Photographs of the lateral view of tail rings I–VI (Fig. 3) were taken with a Nikon D850 camera using the internal focus bracketing function (focus step width 1, number of shots 30); a set of multifocal images were then collated into an overall well-focused composite image using Combine ZP (free software: available at <https://combinezp.software.informer.com>). Institutional codes follow Sabaj (2020). Comparative material of *P. laternarius* (6 specimens, 24.5–55.1 mm SL, from Japan) examined in this study are as follows: KAUM–I. 420, female, 55.1 mm SL, east of Sakinoyama, Kataura, Kasasa, Minami-satsuma, Kagoshima, 31°25'44"N, 130°11'49"E, 27 m depth, set net, 6 Mar 2006; KAUM–I. 3234, female, 24.5 mm SL, KAUM–I. 3247, female, 28.0 mm SL, Kaihama Beach, Kasasa, Minami-satsuma, Kagoshima, 31°24'37"N, 130°11'32"E, 0.5 m depth, hand net, 17 Mar 2007; KAUM–I. 17604, female, 37.0 mm SL, off Kouzaki-yama, Kataura, Kasasa, Minami-satsuma, Kagoshima, 31°26'00"N, 130°10'05"E, 36 m depth, set net, 17 Mar 2007; KAUM–I. 31094, male, 36.6 mm SL, east of Sakinoyama, Kataura, Kasasa, Minami-satsuma, Kagoshima, 31°25'44"N, 130°11'49"E, 27 m depth, set net, 13 Mar 2010; KAUM–I. 105955, male, 49.0 mm SL, fish market in Tei, Yasu, Kounan, Kochi, 33°31'42"N, 133°45'14"E, 24 Oct 1981.

Results

Family Pegasidae Bonaparte, 1831 *Pegasus* Linnaeus, 1758

Pegasus nanhaiensis Zhang, Wang et Lin, 2020

Figs. 1–4; Table 1

Pegasus laternarius (not of Cuvier 1829): Palsson and Pietsch 1989: 23, fig. 11 (Ko Kradat, Trat Province, eastern Gulf of Thailand, southern South China Sea); Matsunuma 2013: 68, unnumbered figs. (northern Gulf of Thailand, southern South China Sea; incorrectly reported as Cuvier 1816).

Pegasus nanhaiensis: Zhang et al. 2020: 523, figs. 1, 3A, 3C, and 4A (type locality: off Yangjiang, China; paratype localities: off Yangjiang and Beihai, China, northern South China Sea).

Spinipegasus laternarius (not of Cuvier 1829): Hibino 2021: 14, unnumbered figs. (Bidong Island, off east coast of Malay Peninsula, southern South China Sea; incorrectly reported as Cuvier 1816).

Material examined. Three specimens from the northern Gulf of Thailand: KAUM–I. 47679, female, 45.5 mm SL, KAUM–I. 47680, male, 56.9 mm SL, KAUM–I. 47681, male, 49.7 mm SL, trawl, purchased at a fish market in Maha Chai, Samut Sakhon Province, Thailand, 6 July 2012 (originally deposited in Kasetsart University).

Description. Measurements are given in Table 1. Body depressed, encased in bony plates. Eyes not visible in ventral view. Rostrum of male long, club-shaped, with many small surface spines; that of female very short, pointed. Mouth small, inferior, toothless. Gill opening restricted to small dorsolateral hole behind head. Two rows each with two small tubercles on dorsum of head. Carapace comprising three pairs of dorsal plates (d_{1-3}), four pairs of dorsolateral plates (dl_{1-4}), paired superior pectoral-fin plates (pp.s.), and two paired extralateral plates (el_{1-2}); rounded hump-like tubercles on each dorsal plate (d_{1-3}); small posteriorly directed tubercles on lateral edges of each dorsolateral plate (dl_{1-4}). [KAUM–I. 47680 with hook-shaped tubercle between paired dorsal plates (d_2); absent in KAUM–I. 47679 and 47681]. Plastron comprising five paired ventrolateral plates (vl_{1-5}), paired gular plates (g), pectoral plates (p), ventral plates (v), anal plates (a) and inferior pectoral-fin plates (pp.i.) and an unpaired pre-anal plate (ip). Anus located between preanal plate and tail ring I. KAUM–I. 47679 with 6 inwardly directed spines (7 and

Table 1. Measurements of *Pegasus nanhaiensis*.

Character	This study		Zhang et al. (2020)		
	Northern Gulf of Thailand, southern South China Sea		China, northern South China Sea		
	Males	Female	Holotype	Paratypes	
	<i>n</i> = 2	<i>n</i> = 1	<i>n</i> = 1	males <i>n</i> = 11	females <i>n</i> = 5
			[mm]		
Standard length (SL)	49.7–56.9	45.5	61.7	47.1–57.8	53.8–62.3
Precaudal length (PCL)	53.8–61.4	46.8	67.4	52.3–64.4	55.0–62.9
			[% of SL]		
Carapace length	47.5–49.3	53.9	47.1	48.6–53.2	51.4–54.5
Tail length	48.5–51.7	48.9	49.8	46.7–52.8	45.1–49.8
Prepectoral width	40.9–41.4	44.8	40.8	40.3–46.0	44.4–47.5
Interpectoral width	29.7–30.3	35.7	29.0	29.7–34.9	34.0–36.3
Carapace width	29.7–30.7	37.0	29.9	28.8–34.7	34.8–37.0
Body depth	18.7–19.7	19.8	17.9	16.5–20.9	16.1–20.0
Rostrum length	14.0–15.7	6.9	13.8	13.9–17.4	4.8–6.3
Rostrum width at tip	4.9–5.0	1.6	4.8	3.0–4.3	1.0–1.6
Orbit length	8.9–10.2	10.1	8.9	9.2–11.3	9.7–10.8
Interorbital width	9.5–11.2	10.7	9.7	9.1–11.2	8.7–10.7
Head width	26.6–27.7	30.5	26.4	26.7–31.8	30.2–32.4
Length of 5 th pectoral ray	32.9–34.4	36.8	33.6	30.9–40.3	35.1–38.3
Height from dorsal to anal fins	10.4–10.7	10.2	11.3	10.2–12.8	10.0–12.2
Rostrum tip to pelvic fin length	50.9–51.2	45.8	49.6	49.5–53.6	41.2–46.6
Rostrum tip to anal fin length	66.8–67.0	65.3	65.3	67.0–66.4	67.0–73.1
Length from base of pectoral fin to pelvic fin	27.7–28.0	29.2	27.5	28.4–31.4	28.4–31.4

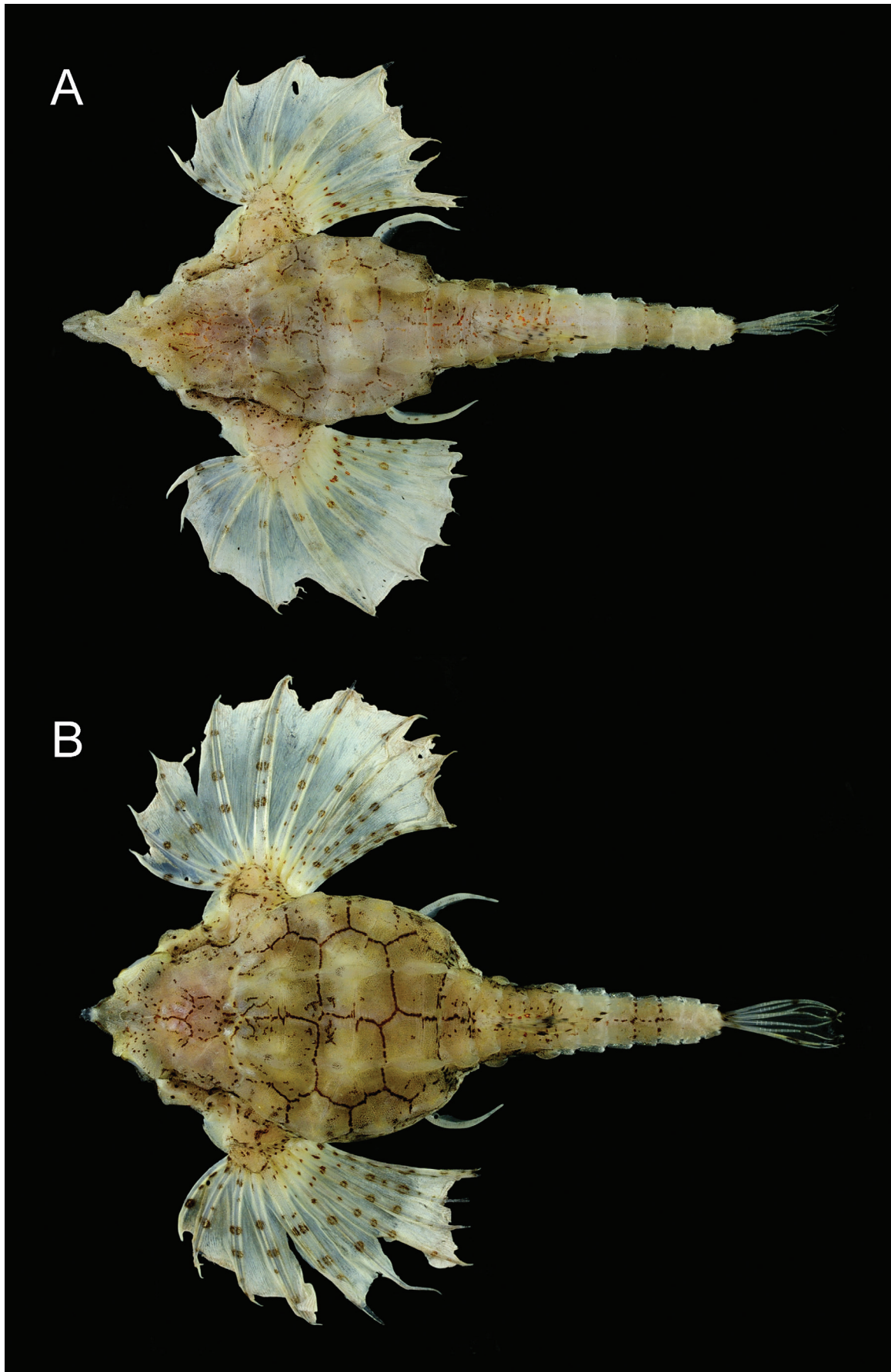


Figure 1. Dorsal views of *Pegasus nanhaiensis* from the northern Gulf of Thailand. **A:** KAUM-I. 47680, male, 56.9 mm SL; **B,** KAUM-I. 47679, female, 45.5 mm SL.

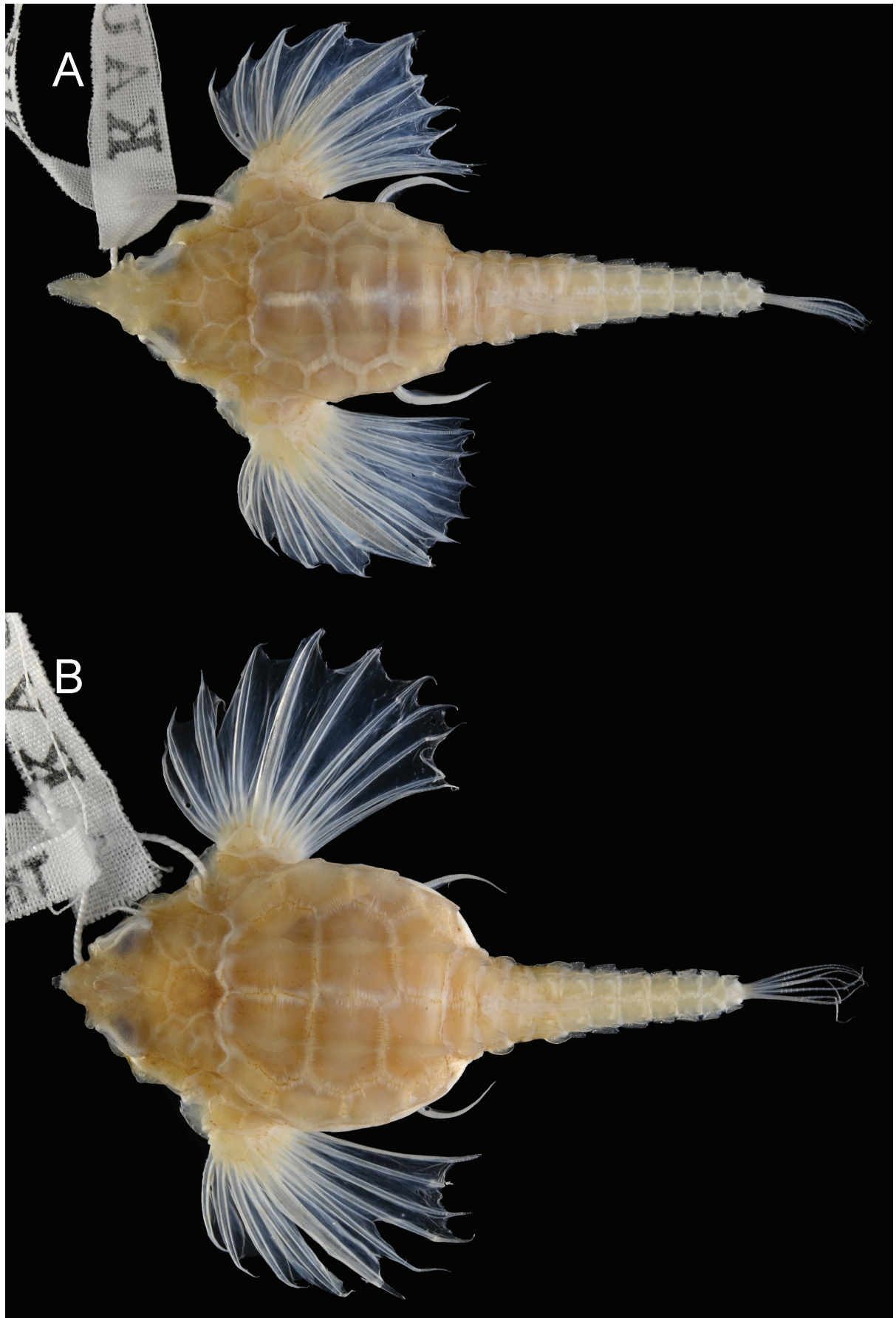


Figure 2. Dorsal views of preserved specimens of *Pegasus nanhaiensis* from the northern Gulf of Thailand. **A:** KAUM-I. 47680, male, 56.9 mm SL; **B,** KAUM-I. 47679, female, 45.5 mm SL.

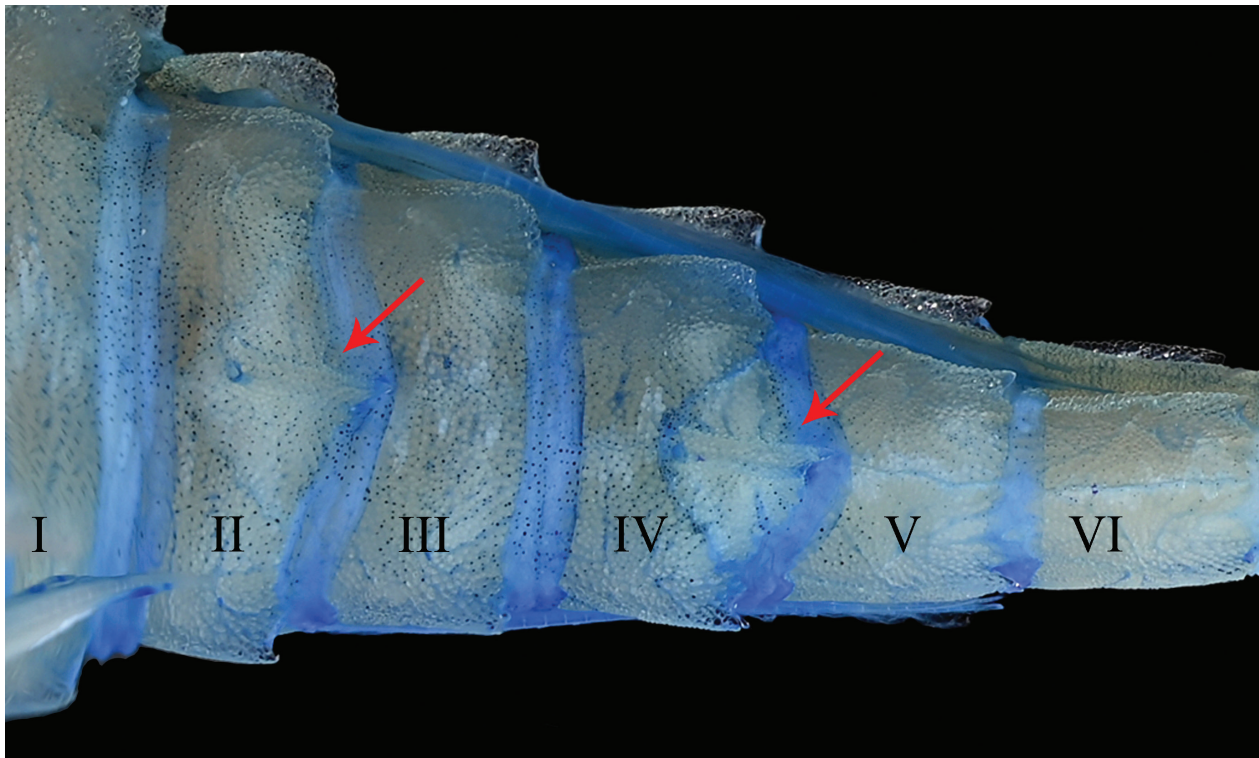


Figure 3. Lateral view of tail rings I–VI of *Pegasus nanhaiensis* (KAUM–I. 47680, male, 56.9 mm SL) stained with cyanine blue. Red arrows indicate caudolateral plates overlapping junctions between tail rings II and III and IV and V, respectively.

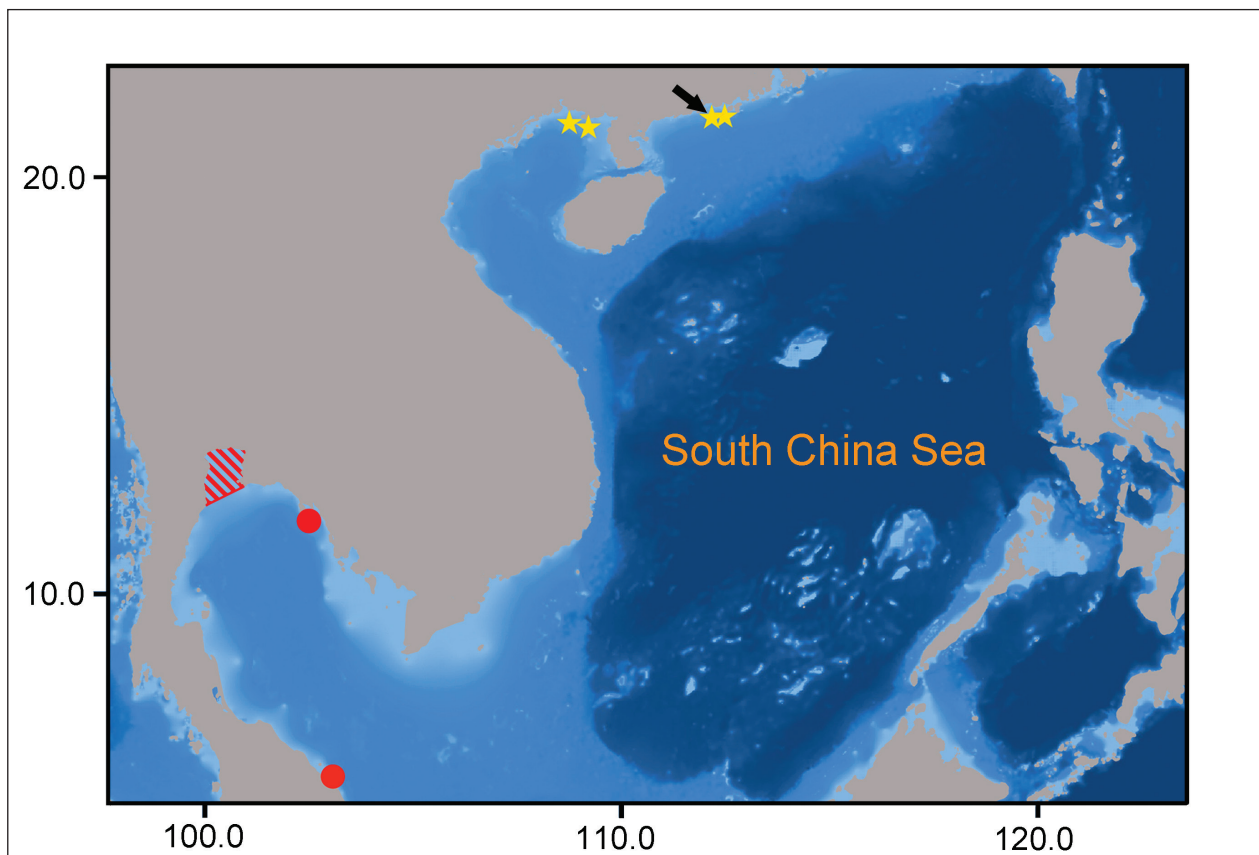


Figure 4. Distributional records of *Pegasus nanhaiensis*. Yellow stars: type series localities (black arrow: type locality); red circles and striped area: localities of presently reported specimens (specimens from northern Gulf of Thailand were obtained at a fish market; their approximate collection locality indicated).

5 in KAUM-I. 47680 and 47681, respectively) on dorsal surface of ventrolateral plate (vl_1). Small central tubercles on each pectoral and ventral plate; interventral and pre-anal plates with bulge, the latter plate with posteriorly directed tubercle; small, posteriorly directed tubercles on lateral edges of each vl_2 – vl_4 . Tail elongate, with 11 tail rings (I–XI); 9th and 10th tail rings fused together, anterior 8 rings mobile; small, posteriorly directed tubercles on corners of each tail ring, their tips sharply pointed; tubercles smaller on posterior tail rings; anteriorly directed spines on anterior of tubercles on tail rings IX, X, and XI; two paired caudolateral plates overlapping junctions between tail rings II and III and IV and V; dorsal surface of last tail ring lacking spine. Wing-like pectoral fins large, inserted horizontally, with 11 rays (10 and 12 rays on left and right side, respectively, in KAUM-I. 47679), 5th ray stout, thicker than other rays. Pelvic fins with 1 spine and 2 rays; each pelvic fin separated without membrane, inserted into an unpaired interventral plate; first spine very long, extended posteriorly. Dorsal and anal fins short, each with 5 soft rays, extending from center of dorsal and ventral tail ring II to center of tail ring IV, respectively. Caudal fin with 8 unbranched rays.

Coloration when fresh (Figs. 1A–1B). Dorsal body surface pale yellow to dark yellowish-brown with numerous reddish-brown to black spots; clear hexagonal patterns apparent on dorsal plate (d_{1-3}) and dorsolateral plate (dl_{1-4}), with distinct boundaries. Blurred black blotches on rounded hump-like tubercles on dorsal plates in KAUM-I. 47679 (absent in KAUM-I. 47680). Dorsal surface of ventrolateral plate (vl_1) whitish. Base color of dorsal surface tail rings I–IV, posterior half of VII and VIII brown; that of V–VI, anterior of VII and IX–XI white. Numerous reddish-brown spots on dorsal surface of tail rings I–IV, brown spots on dorsal tail rings VI–VII in KAUM-I. 47680 (reddish to brown spots on I–VIII in KAUM-I. 47679). Base color of pectoral-fins whitish; 2–9 brown blotches on each ray. Pelvic-fins white; small brown blotches on each ray. Dorsal and caudal fins translucent white, small brown blotches on each ray.

Color in alcohol (Figs. 2A–2B). Dorsal body surface and tail rings light reddish-yellow. Faint yellowish-brown spots on dorsal body and tail rings I–IV in KAUM-I. 47680 (dorsal body and tail rings I–VIII in KAUM-I. 47679). Margins of majority of dorsal plates white (some slightly yellowish-brown). Each fin translucent white.

Discussion

The presently reported specimens were consistent with the diagnosis of *Pegasus nanhaiensis*, provided by Zhang et al. (2020), all having a rounded hump-like tubercle on each of dorsal plates I, II, and III; clear, distinctly bounded hexagonal patterns on the dorsal plates (d_{1-3}), and dorsolateral plates (dl_{1-4}); two paired caudolateral plates overlapping the junctions between tail rings II and III and IV and V (Fig. 3); and a bulge on the margin of the ventral plate connecting with the paired pelvic fins. Al-

though the rostrum length in the female and rostrum tip width in males in this study differed slightly compared with the original description (6.9% of SL and 4.9%–5.0% of SL, respectively, in the presently reported specimens vs. 4.8%–6.3% and 3.0%–4.8%, respectively, in the type series; Table 1), such minor differences were regarded here as intraspecific variations. *Pegasus nanhaiensis* is similar to *P. laternarius* in sharing 11 tail rings, thickened fifth pectoral-fin ray, the fused 9th and 10th tail rings, and a wider carapace (carapace width 28.8%–37.0% of SL in the former, 24.7%–35.8% in the latter), whereas other congeners have 12 (in *P. tetrabelos* and *P. volitans*) and 14 (in *P. lancifer*) tail rings, normal fifth pectoral-fin ray (not thickened; in *P. lancifer* and *P. volitans*), the posterior 3 (in *P. tetrabelos* and *P. volitans*) and 7 (in *P. lancifer*) tail rings fused together and a slender carapace (21.3%–28.1% of SL in *P. lancifer*, 13.5%–18.1% of SL in *P. tetrabelos* and 12.8%–15.5% of SL in *P. volitans*). *Pegasus nanhaiensis* can be distinguished from *P. laternarius* by the above-mentioned diagnostic characters (the latter with a pointed, roughly triangular tubercle on each of dorsal plates I, II, and III; no hexagonal pattern on dorsal plates; three paired caudolateral plates on tail rings II and III, III and IV, and IV and V) (Pálsson and Pietsch 1989; Osterhage et al. 2016; Zhang et al. 2020; this study). In addition, 16S rDNA and COI analyses put *P. nanhaiensis* into a different clade from *P. laternarius*, separated by a genetic distance of 3.51–3.53 percentage points (Zhang et al. 2020).

Pegasus nanhaiensis was previously known only from the type specimens from the northern South China Sea, off Yangjiang and Beihai, China (Zhang et al. 2020), the three specimens described herein representing the first records of *P. nanhaiensis* from the Gulf of Thailand. In addition, a single specimen (ZMUC P 842, 66.1 mm SL), reported as *P. laternarius* by Pálsson and Pietsch (1989: 23, fig. 11) from Ko Kradat, eastern Gulf of Thailand and a single specimen (FRLM 55093, 46.1 mm SL), reported as *Spinipegasus laternarius* (Cuvier, 1829) by Hibino (2021: 14, unnumbered figs.) from off Bidong Island, east off the Malay Peninsula, South China Sea, were re-identified here as *P. nanhaiensis*, based on clear, distinctly bounded hexagonal patterns on the dorsal plates (d_{1-3}) and dorsolateral plates (dl_{1-4}) from their photographs, respectively. The Bidong specimen represents the southernmost record of the species (Fig. 4), suggesting that *P. nanhaiensis* is widely distributed in coastal waters of the South China Sea.

The coloration of *P. nanhaiensis* was previously known only from dried specimens (Zhang et al. 2020), the fresh color description of the species being provided here for the first time. Although the dorsal and lateral body surfaces were dark brown and the first four segments of the tail rings darker than the remaining tail rings in the dried specimens (Zhang et al. 2020), the dorsal surface was yellow to dark yellowish-brown and tail rings I–IV and the posterior half of VII and VIII brown (remaining rings yellowish-white) in the presently reported fresh specimens from Thailand.

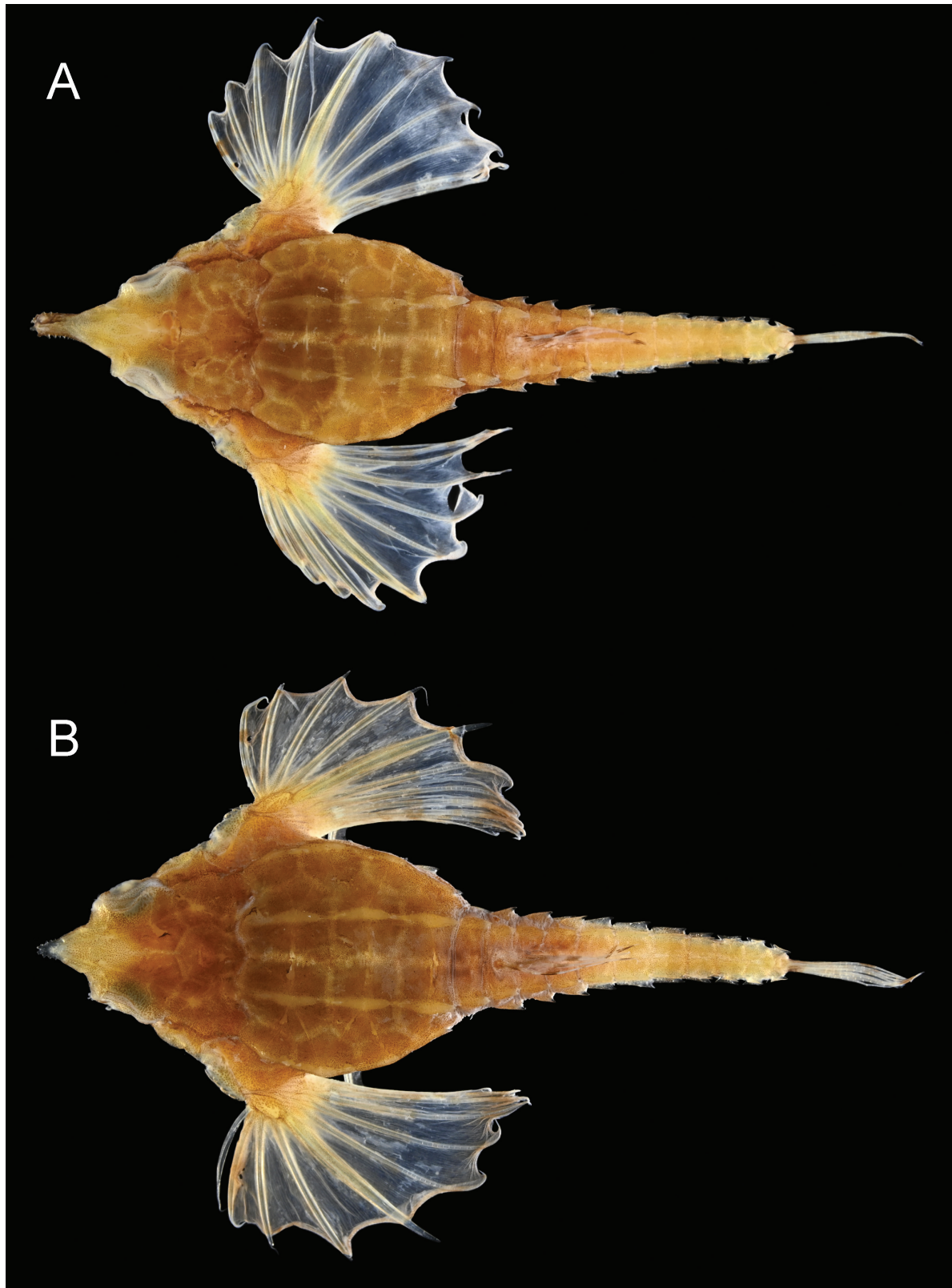


Figure 5. Dorsal views of preserved specimens of *Pegasus laternarius* from Japan. **A:** KAUM-I. 31094, male, 36.6 mm SL; **B,** KAUM-I. 17604, female, 37.0 mm SL.

The clear hexagonal patterns on the surface dorsal plate, found in fresh specimens of *P. nanhaiensis* (Fig. 1), was lost in preserved specimens (Fig. 2), which became indistinguishable from preserved *P. laternarius* on this basis (Figs. 2 and 5).

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