



Gymnapogon sagittarius, a new species of cardinalfish (Perciformes: Apogonidae) from the South China Sea and Andaman Sea

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Abstract

The new cardinalfish *Gymnapogon sagittarius* sp. nov. is described on the basis of eight specimens from Vietnam, Malaysia and the Andaman Sea. The new species is most similar to the Red Sea species *G. melanogaster* Gon and Golani 2002 (known only from two specimens) in having 9 soft dorsal-fin rays, 8 soft anal-fin rays, and 13 total gill rakers, but differs in having 16 pectoral-fin rays (vs. 14 or 15 rays in *G. melanogaster*), body depth 12.0–15.1% of SL (mean 14.2%) (vs. 21.7–24.0%), eye diameter 5.2–6.1% (5.6%) (vs. 10.0–11.6%), interorbital width 3.7–4.4% (4.0%) (vs. 5.7–8.2%), and longest pelvic-fin soft ray length 12.0–15.6% (14.1%) (vs. 25.4–34.3%).

Keywords *Gymnapogon melanogaster* · Taxonomy · Morphology · Teleostei

Introduction

The apogonid genus *Gymnapogon* Regan 1905 (Apogonidae), characterized by VI–I, 9–11 dorsal-fin rays, II, 8–10 anal-fin rays, no supraneural, fused hypurals (parhypural + 1 + 2 and 3 + 4 + terminal central), a free fifth hypural, two epurals, and scaleless head and body (Fraser 1972, 2016, 2019), contains the following ten nominal species:

Gymnapogon africanus Smith 1954, *Gymnapogon annona* (Whitley 1936), *Gymnapogon foraminosus* (Tanaka 1915), *Gymnapogon janus* Fraser 2016, *Gymnapogon japonicus* Regan 1905, *Gymnapogon melanogaster* Gon and Golani 2002, *Gymnapogon philippinus* (Herre 1939), *Gymnapogon urosipilotus* Lachner 1953, *Gymnapogon vanderbilti* (Fowler 1938), and *Gymnapogon velum* Fraser 2019.

During a taxonomic study of *Gymnapogon*, eight unidentified specimens from Vietnam, Malaysia, and the Andaman Sea were found in museum collections or collected during field surveys by the authors. Although the specimens shared several characters with *G. melanogaster*, they differed from the latter in having a greater number of pectoral-fin rays, lesser body depth and interorbital width, and shorter length of the longest pelvic-fin soft ray. They are described herein as a new species of *Gymnapogon*.

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Materials and methods

Counts and measurements generally followed Yoshida and Motomura (2016). Measurements were made to the nearest 0.1 mm with needle-point calipers under a dissecting microscope. Standard length is abbreviated as SL. Curatorial procedures for the newly collected specimens followed Motomura and Ishikawa (2013). Osteological characters, including vertebral counts, were observed on radiographs of three specimens of *Gymnapogon sagittarius* (KAUM–I.

16929; KAUM–I. 51643; KAUM–I. 94804). The formula for the configuration of supraneural bones, anterior neural spines and anterior dorsal-fin pterygiophores follows Ahlstrom et al. (1976). Institutional codes follow Sabaj (2016).

Gymnapogon sagittarius sp. nov.

(New English name: Sagittarius Cardinalfish) (Figs. 1, 2, 3, 4; Table 1)

Holotype. KAUM–I. 94804, 63.5 mm SL, Ha Long Bay, Ha Long, northern Vietnam (20°55'N, 107°05'E), 30 October 2016, trawl.

Paratypes. 7 specimens, 33.9–61.6 mm SL. **THAILAND:** HUMZ 212494, 51.1 mm SL, Phuket Fishing Port; HUMZ 225138, 52.7 mm SL, Phuket Fishing Port, 3–4 December 2014; KAUM–I. 51643, 52.0 mm SL, Kuraburi Fishing Port, Amphoe Kuraburi, Ranong Province (09°22'N, 98°23'E), trawl; KAUM–I. 60981, 33.9 mm SL, off Phuket, (05°22'N, 103°15'E), purse seine; THNHM-F 15380, 52.6

mm SL, Phuket Fishing Port, 21 April 2011; THNHM-F 15381, 50.9 mm SL, Phuket Fishing Port, 3–4 December 2014. **MALAYSIA:** KAUM–I. 16929, 61.6 mm SL, off Kuala Terengganu, Terengganu (05°22'N, 103°15'E), 11 December 2008, trawl.

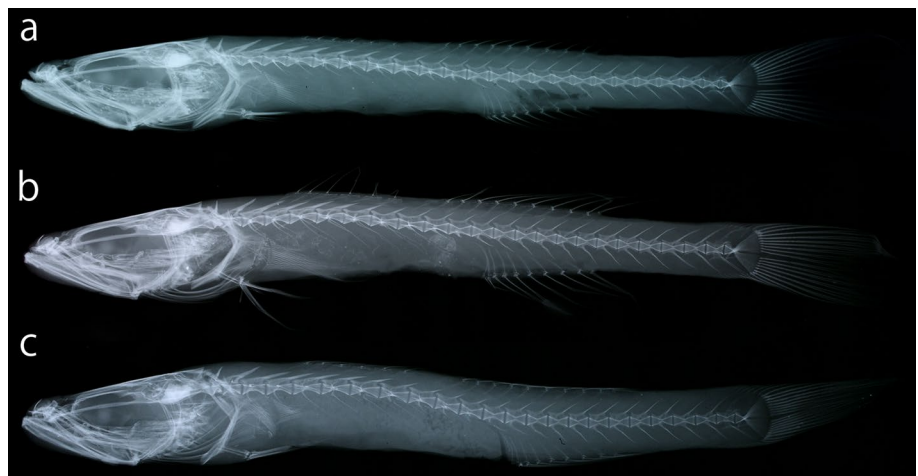
Diagnosis. A species of *Gymnapogon* with the following combination of characters: dorsal-fin rays VI–I, 9; anal-fin rays II, 8; pectoral-fin rays 16 or 17 (usually 16); developed gill rakers 10 or 11 (11); total gill rakers (including rudiments) 13 or 14 (13); body depth 12.0–15.1% of SL (mean 14.2%); eye diameter 5.2–6.1% of SL (5.6%); interorbital width 3.7–4.4 % of SL (4.0%); longest pelvic-fin soft ray length 12.0–15.6% of SL (14.1%); single large spine near angle of preopercle; silver stripe on mid-lateral surface of body; black pigmentation absent on caudal-fin base; all fins semi-transparent.

Description. Meristics and morphometrics of the type specimens are shown in Table 1. Data for the holotype are presented first, followed by paratype data (if different) in parentheses. Vertebrae 10 + 14. Formula for supraneural

Fig. 1 Photographs of *Gymnapogon sagittarius* sp. nov. **a** Holotype, KAUM–I. 94804, 63.5 mm SL, Ha Long Bay, Ha Long, Vietnam; **b** paratype, KAUM–I. 16929, 61.6 mm SL, Kuala Terengganu, Terengganu, Malaysia



Fig. 2 Radiographs of *Gymnapogon sagittarius* sp. nov. **a** Holotype, KAUM–I. 94804, 63.5 mm SL; **b** paratype, KAUM–I. 16929, 61.6 mm SL; **c** paratype, KAUM–I. 51643, 52.0 mm SL



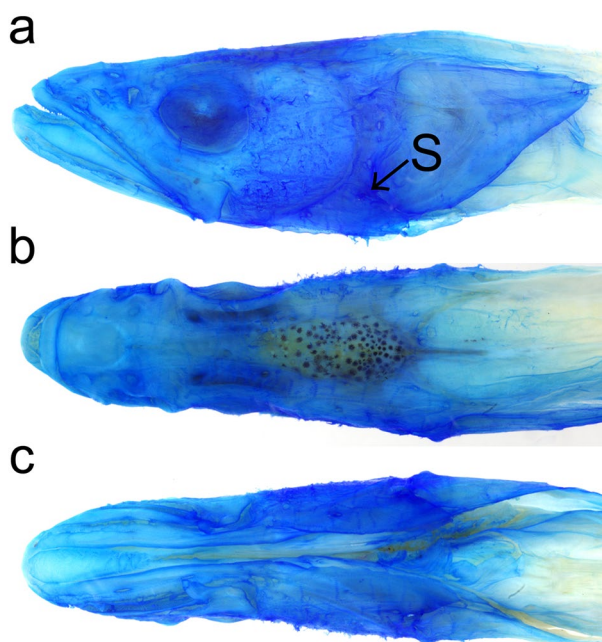


Fig. 3 Head of *Gymnapogon sagittarius* sp. nov. stained by cyanine blue (KAUM-I. 94804, 63.5 mm SL). **a** Left side in lateral view; **b** dorsal view, and **c** ventral view. *S* preopercular spine

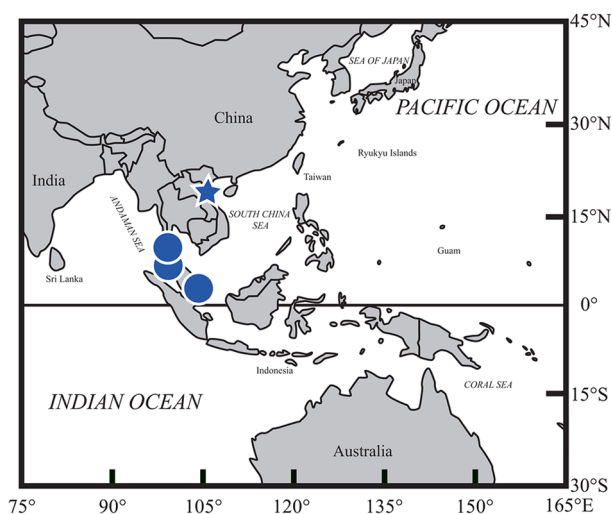


Fig. 4 Distributional records of *Gymnapogon sagittarius* sp. nov., based on specimens examined. *Star* (holotype locality), *circles* (paratype localities)

bones, anterior neural spines and anterior dorsal pterygiophores //1/1+1/1/1/1/.

Body elongate, moderately deep, compressed. Caudal peduncle moderately deep. Head large, compressed. Eye large, oval. Mouth large, oblique, forming angle of ca. 30 degrees to horizontal axis of body. Posterior margin of

maxilla extending beyond vertical through posterior margin of pupil. Upper jaw length less than half head length. Lower jaw projecting. Upper jaw with 2–4 rows recurved caniniform teeth anteriorly, followed by villiform teeth posteriorly. Lower jaw with villiform teeth, 2 or 3 rows of caniniform teeth posteriorly. Vomer with 2 or 3 rows of conical teeth. Palatines with 1 or 2 rows of conical teeth. Anterior nostril with a short tube, oval opening, uppermost margin below level of dorsal margin of pupil. Posterior nostril oval, opening vertically, uppermost margin below level of dorsal margin of pupil. Opercular margin smooth; preopercular margin smooth, with single large spine and skin flap at corner. Gill rakers slender, moderately long. Gill filaments shorter than gill rakers.

First dorsal-fin origin posterior to vertical through pectoral-fin base; third spine of first dorsal fin longest. Posterior end of first dorsal-fin base posterior to vertical through posterior tip of depressed pelvic fin. Second dorsal-fin origin anterior to vertical through anal-fin origin; first soft ray of second dorsal fin unbranched, remaining rays branched. Posterior end of second dorsal-fin base posterior to vertical through end of anal-fin base. Anal-fin origin below base of second soft ray of second dorsal fin; first spine of anal fin shorter than second; all anal-fin soft rays branched. Pelvic-fin origin anterior to vertical through origin of first dorsal fin. Posterior tip of depressed pelvic fin reaching to vertical through fourth spine base of first dorsal fin. Pectoral fin long, posterior tip extending beyond vertical through sixth spine of first dorsal fin; uppermost one (one or two) and lowermost two soft rays unbranched, remaining rays branched. Caudal fin forked, lobes pointed; 9 + 8 segmented rays, upper two and lower two rays unbranched, remaining rays branched. Anus anterior to vertical through first soft ray base of second dorsal fin.

Color when fresh (Fig. 1). Head pinkish-white, silvery-white ventrally. Pupil black; iris copper. Body white with silvery stripe from uppermost opercular margin to below end of second dorsal fin-base. Fins semi-translucent.

Color in alcohol. Head and body uniformly pale whitish with scattered black pigmentation on parietal region. Black pigmentation absent on caudal-fin base. Fins semi-translucent. Peritoneum with pale; stomach tan and intestine pale.

Distribution. Currently known only from the South China Sea and Andaman Sea, including Vietnam, Thailand, and Malaysia (Fig. 4). This species is most likely to inhabit sandy and muddy bottoms in relatively deep water.

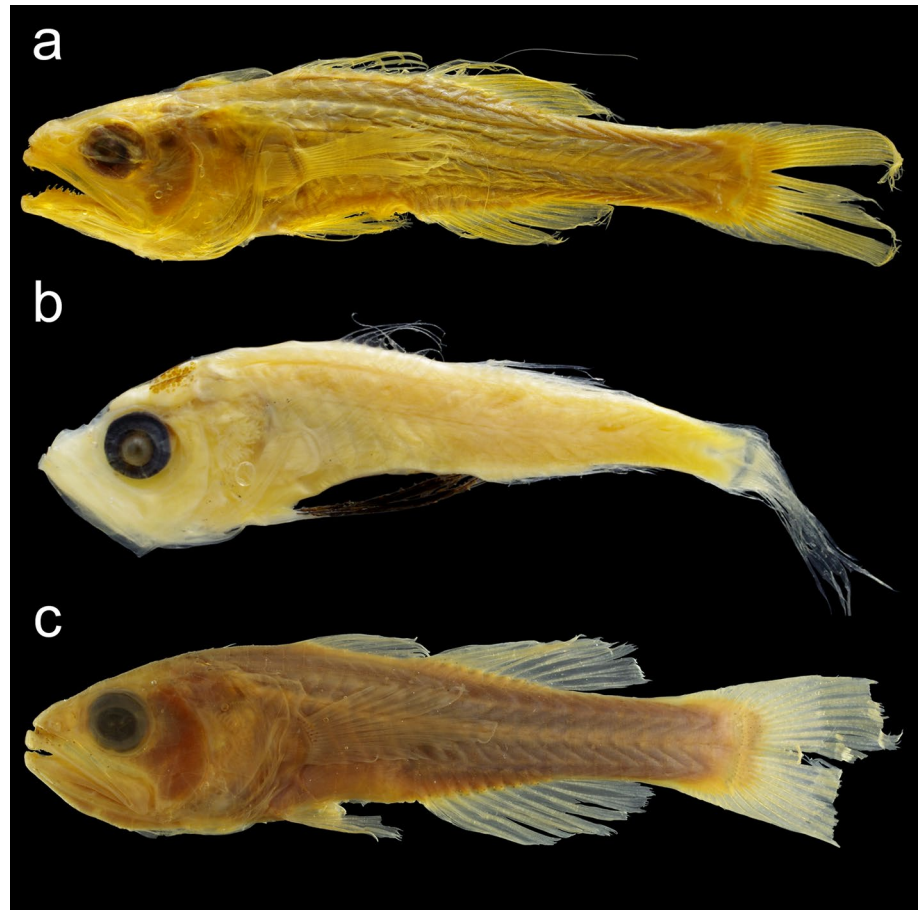
Etymology. The specific name “*sagittarius*” is derived from Latin, meaning “archer”, in an allusion to the long narrow (arrow-like) body shape. It is treated as a noun in apposition.

Comparisons with related congeners. The new species is similar to *G. africanus* (Fig. 5a), *G. melanogaster* (Fig. 5b), and *G. philippinus* (Fig. 5c), all four species

Table 1 Meristics and morphometrics of *Gymnapogon sagittarius* sp. nov., *G. melanogaster*, *G. africanus*, and *G. philippinus*

	<i>Gymnapogon sagittarius</i> sp. nov.		<i>G. melanogaster</i>		<i>G. africanus</i>	<i>G. philippinus</i>	
	Holotype	Paratypes	Paratype		Holotype	Holotype	Paratypes
	KAUM-I. 94804	<i>n</i> = 7	SAIAB 64526	SAIAB 64526	SAIAB 358	CAS 134379	CAS 134381
							<i>n</i> = 4
Standard length (SL; mm)	63.5	33.9–61.6	Mode	14.6	37.2	31.4	19.7–28.0
Dorsal-fin rays	VI-I, 9	VI-I, 9	VI-I, 9	VI-I, 9	VI-I, 9	VI-I, 9	VI-I, 9
Anal-fin rays	II, 8	II, 8	II, 8	II, 8	II, 8	II, 8	II, 8
Pectoral-fin rays (left / right)	16 / 16	17–16 / 16	16 / 16	15 / 15	14 / 14	14 / 14	14 / 14
Pelvic-fin rays	I, 5	I, 5	I, 5	I, 5	I, 5	I, 5	I, 5
Developed gill rakers	1 + 10 = 11	1 + 9–10 = 10–11	11	2 + 11 = 13	1 + 8 = 9	1 + 9 = 10	1 + 8–9 = 9–10
Gill rakers including rudiments	2 + 11 = 13	2–3 + 11 = 12–13	13	2 + 11 = 13	2 + 9 = 11	2 + 10 = 12	2–3 + 9–10 = 11–12
Principal caudal-fin rays	9 + 8	9 + 8	9 + 8	9 + 8	9 + 8	9 + 8	9 + 8
% of SL			Mean				
Body depth	13.9	12.0–15.1	14.2	24.0	22.6	24.5	26.1–27.9
Body width	7.6	6.7–8.8	7.4	12.3	12.6	11.8	13.5
Head length	36.1	33.1–37.2	35.0	39.7	35.5	39.2	39.1–41.2
Snout length	8.0	7.1–8.1	7.7	7.5	9.1	9.9	7.5–9.4
Eye diameter	5.7	5.2–6.1	5.6	11.6	9.1	8.6	7.9–9.3
Interorbital width	3.9	3.7–4.4	4.0	8.2	9.4	8.3	6.6–8.0
Upper jaw length	14.0	13.0–14.3	13.8	17.1	19.4	18.8	19.3–20.3
Caudal-peduncle depth	7.1	6.8–6.9	6.8	8.2	10.8	10.8	10.2–12.0
Caudal-peduncle length	21.9	19.6–21.4	20.8	19.2	26.3	24.8	22.8–27.0
Pre-dorsal-fin length	37.8	36.9–38.7	38.0	41.8	38.2	37.9	39.8–41.4
Dorsal-fin base length	40.9	39.7–43.3	41.4	44.5	34.1	35.4	35.0–36.1
1st dorsal-fin spine length	7.4	7.0–9.8	8.4	10.3	8.1	15.6	—
2nd dorsal-fin spine length	8.3	8.0–10.9	9.4	10.3	10.8	14.3	—
3rd dorsal-fin spine length	10.4	10.0–11.5	10.5	12.3	12.1	12.1	12.4–14.2
4th dorsal-fin spine length	8.8	8.3–10.3	9.7	8.2	11.8	11.5	12.0
1st spine length of 2nd dorsal fin	—	4.7–7.1	5.9	—	10.2	8.6	8.0
Longest dorsal-fin soft ray length	11.5	9.4–10.9	10.4	—	16.7	17.5	15.0–19.5
Pre-anal-fin length	63.0	61.8–65.4	63.1	61.0	54.8	55.7	53.9–56.6
Anal-fin base length	15.6	14.2–15.1	14.6	15.8	16.9	18.2	17.3–19.3
1st anal-fin spine length	2.0	2.0–2.9	2.5	—	5.1	5.1	3.0–4.4
2nd anal-fin spine length	—	3.8–5.6	4.7	—	8.3	9.2	6.7
Longest anal-fin soft ray length	11.5	9.6–11.9	10.3	14.4	16.7	16.6	15.4
Pectoral-fin base length	3.6	3.2–4.0	3.6	6.2	5.6	6.1	6.1–6.4
Pectoral-fin length	18.6	17.4–19.8	18.6	20.5	22.6	27.4	26.9–28.3
Pre-pelvic-fin length	30.7	29.0–30.6	29.7	33.6	34.9	36.6	32.0–33.2
Pelvic-fin spine length	10.4	8.6–10.6	9.5	—	10.5	9.6	—
Longest pelvic-fin soft ray length	15.3	12.0–15.6	14.1	32.9	13.7	—	18.6–19.9

Fig. 5 **a** Holotype of *Gymnapogon africanus* (SAIAB 358, 37.2 mm SL, Shimoni, Kenya); **b** paratype of *Gymnapogon melanogaster* (SAIAB 64526, 14.6 mm SL, Eilat, Israel); **c** holotype of *Henicichthys philippinus* (CAS 134379, 31.4 mm SL, Luzon, Philippines)



sharing 9 soft dorsal-fin rays and 8 soft anal-fin rays (Fraser, 2016; this study: Table 1). However, *G. sagittarius* sp. nov. differs from *G. africanus* and *G. philippinus* in having higher numbers of total gill rakers (12 or 13 vs. 11 in *G. africanus* and 11 or 12 in *G. philippinus*; Table 1) and pectoral-fin rays (16 vs. 14 in *G. africanus* and *G. philippinus*; Table 1). In addition, the new species is easily distinguished from *G. philippinus* by the absence of black pigmentation on the caudal-fin base (vs. present in the latter).

Gymnapogon sagittarius sp. nov. and *G. melanogaster* share the same numbers of dorsal- and anal-fin soft rays, and similar counts of total gill rakers (including rudiments) (Gon and Golani 2002; this study). However, a comparison of the two species showed *G. sagittarius* to be distinguished by a higher count of pectoral-fin rays [16 or 17 (vs. 14 or 15 in *G. melanogaster*)], simple spine near the angle of the preopercle (vs. bifurcated spine), and semi-translucent pelvic fin (vs. black) (Gon and Golani 2002; this study), and the following morphometric features: narrower body [body depth 12.0–15.1% of SL (mean 14.2%) vs. 24.0% in paratype of *G. melanogaster* examined in this study (Table 1), 21.7–24.0% in holotype and paratype given by Gon and Golani (2002)] and interorbital space [width 3.7–4.4% (4.0%) vs. 8.2% (Table 1), 5.7–6.7%], smaller eyes [diameter 5.2–6.1%

(5.6%) vs. 11.6% (Table 1), 10.0–10.7%], and shorter length of longest pelvic-fin soft ray [length 12.0–15.6% (14.1%) vs. 32.9% (Table 1), 25.4–34.3%].

Comparative material. *Gymnapogon africanus* (1 specimen, 37.2 mm SL): SAIAB 358, holotype of *G. africanus*, 37.2 mm SL, Shimoni, Kenya. *Gymnapogon annona* (1 specimen, 34.9 mm SL): AMS IA 6469, holotype of *Australaphia annona*, 34.9 mm SL, Lindeman Island, Whitsunday Passage, Queensland, Australia, April 1935. *Gymnapogon japonicus* (39 specimens, 26.4–36.2 mm SL): BMNH 1905.6.6.113–122, 39 syntypes of *G. japonicus*, 26.4–36.2 mm SL, Inland Sea of Japan, R. Gordon Smith. *Gymnapogon melanogaster* (1 specimen, 14.6 mm SL): SAIAB 64526, paratype of *G. melanogaster*, 14.6 mm SL, Gulf of Aqaba, Eilat, Israel, Red Sea, 0–1.5 m, D. Golani, 13 January 2001. *Gymnapogon philippinus* (5 specimens, 19.7–31.4 mm SL): CAS 134379, holotype of *Henicichthys philippinus*, 31.4 mm SL, tidepool at Nasugbu, Luzon, Philippines; CAS 134381, 4 paratypes of *H. philippinus*, 19.7–28.0 mm SL, tidepool at Dumaguete, Oriental Negros, Philippines. *Gymnapogon urospilotus* (1 specimen, 26.1 mm SL): USNM 142404, holotype of *G. urospilotus*, 26.1 mm SL, Kwajalein Atoll, Marshall Islands, 1 September 1946. *Gymnapogon*

vanderbilti (1 specimen, 18.5 mm SL): ANSP 68381, holotype of *Acanthapogon vanderbilti*, 18.5 mm SL, Kiritimati, Line Islands.

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