A new species of the cardinalfish genus *Gymnapogon* (Perciformes, Apogonidae) from the Red Sea

Ofer Gon[1]✉ and Daniel Golani[2]

[1] *South African Institute for Aquatic Biodiversity (formerly the J.L.B. Smith Institute of Ichthyology), Private Bag 1015, Grahamstown 6140, South Africa (e-mail: O.Gon@ru.ac.za)*
[2] *Department of Evolution, Systematics and Ecology, Hebrew University, Jerusalem 91904, Israel (e-mail: dgolani@cc.huji.ac.il)*

Received: December 26, 2001 / Revised: June 10, 2002 / Accepted: June 24, 2002

Ichthyological Research

Ichthyol Res (2002) 49: 346–349

Abstract A new cardinalfish species, *Gymnapogon melanogaster*, is described from two specimens collected at night in the Gulf of Aqaba, Eilat, Israel. This species is characterized by having 9 dorsal and 8 anal fin soft rays; 14–15 pectoral fin rays; 2 + 11 gill rakers; a flat, bifurcated preopercular spine; a naked body without a papillae network; black pelvic fins; and a black stomach. It is similar to *Gymnapogon vanderbilti* (Fowler, 1938) that is known only from the Line Islands of the Central Pacific Ocean.

Key words Apogonidae · *Gymnapogon melanogaster* · New species · Red Sea

The genus *Gymnapogon* Regan, 1905 is a taxon of highly derived cardinalfish species. It contains fewer than ten species confined to the reefs and adjacent habitats of the Indo-West and Central Pacific Ocean. The species of this genus are small (usually less than 5 cm SL), semitransparent, cryptic fishes that are seldom seen and are collected with chemical ichthyocides. Unlike other apogonids it has a strong spine at the angle of the preopercle, lines of sensory papillae on the head and body, and no scales. The ventral part of the preopercle is an enlarged membranous skin flap. This character combination and the omission of the preopercular spine and skin flap from the original description of some species (see detailed review in Lachner, 1953) confused past authors. Regan (1905) related *Gymnapogon* to the genus *Telescopias* Jordan and Snyder, 1901 (presently regarded as a junior synonym of *Scombrops* Temminck and Schlegel, 1845). Tanaka (1915) described *Henicichthys foraminosus* and Herre (1939) described *H. philippinus* in the family Henicichthyidae. Tomiyama (1936) and Whitley (1936) classified *H. foraminosus* and *Australaphia annona*, respectively, in the Gobiidae. Whitley (1941) was the first to publish a synonymy for *Gymnapogon*, making *Henicichthys* Tanaka and *Australaphia* Whitley its junior synonyms. Stating that *Gymnapogon* is related to the Apogonidae, he wrote that this "puzzling little genus has been placed in a different family by almost every author who has dealt with it . . ." and proceeded to create a new family for it, the Gymnapogonidae. Fowler (1938) did not refer to earlier descriptions, possibly because he recognized *Acanthapogon vanderbilti* as an apogonid.

Gymnapogon africanus Smith, 1954 was the first member of this genus to be found in the Western Indian Ocean. Smith (1954) was also the first to separate the three pseudamine genera from all other apogonid genera at the subfamily level. Fraser (1972) followed Smith and provided several osteological synapomorphies to support the Pseudaminae. Baldwin and Johnson (1999) inferred a sister-group relationship between *Gymnapogon* and their new pseudamine genus *Paxton*. These two genera share most of the characters previously used to diagnose *Gymnapogon*, making it necessary to reestablish the monophyly of the latter genus with new characters.

In January 2001 the second author collected two specimens of *Gymnapogon* while hauling a beach seine at night on the North Beach of Eilat, Israel. These specimens are the first of this genus to be found in the Red Sea and represent a new species.

Materials and Methods

Specimens were borrowed from or lodged with the following institutions: Academy of Natural Sciences, Philadelphia (ANSP); Hebrew University, Jerusalem (HUJ); South African Institute for Aquatic Biodiversity, Grahamstown (RUSI).

The method of measuring follows Gon (1993). Measurements were taken to the nearest 0.1 mm. Ratios of body proportions were rounded to the nearest 0.05. The length of specimens listed throughout this article is the standard length (SL), measured from the tip of the upper jaw to the end of the hypural plate. The caudal fin length is the length of the longest ray of the upper lobe of this fin. Proportional measurements throughout this article are given as a percentage of the SL. Counts of pectoral fin rays were made on both sides of the fish and include the uppermost rudimentary ray. A developed gill raker is higher than the width of its base. The raker at the angle of the gill arch is included in the lower limb count. When a raker is found on the ceratobranchial–hypobranchial joint, it is included in the ceratobranchial gill raker count.

Gymnapogon melanogaster sp. nov.

(Fig. 1)

Holotype. HUJ 18632, 23.0 mm SL, Red Sea, Gulf of Aqaba, Eilat, North Beach, beach seine, 0–1.5 m, D. Golani, 13 January, 2001.

Paratype. RUSI 64526, 15.0 mm SL, collected with holotype.

Diagnosis. A species of *Gymnapogon* with 9 dorsal and 8 anal fin soft rays; 14–15 pectoral fin rays; 2 + 11 gill rakers; flat, bifurcated preopercular spine; naked body without papillae network; black pelvic fins; black stomach and pale intestine.

Description. Data in parentheses refer to the paratype when different from the holotype. Dorsal fin rays VI-I,9; anal fin rays II,8; pectoral fin rays 14 (15); total gill rakers 2 + 11; developed rakers 1 + 10 (1 + 11); ceratobranchial rakers 8.

Body elongate and compressed, its depth 21.7 (24.0) and head length 39.1 (38.0); body width 11.7 (14.0); snout length 8.0 (8.7); eye diameter 10.0 (10.7); interorbital width 5.65 (6.7); upper jaw length 15.65 (16.7); and lower jaw length 19.1 (20.0).

Preopercle edge and ridge smooth; lower end of posterior edge with broad, flat bifurcate spine; upper branch of spine horizontal, pointing caudad, and lower branch vertical, pointing ventrally (Fig. 2A); ventral part of preopercle edge a large, membranous skin flap extending beyond edge of gill membrane. Posterior nostril oval, about 4–5 times in eye diameter, close in front of orbit, its ventral edge at level of middle of eye; anterior nostril smaller, at about middistance between tip of snout and rear nostril.

Mouth large, slightly oblique; maxilla reaching posteriorly to vertical at posterior edge of orbit, its depth 3.7 (4.0); upper jaw with 4–5 incurved caniniform teeth anteriorly, the second tooth largest, followed by a narrow band of villiform teeth posteriorly; symphyseal canines of lower jaw broken (1–2 on each side in paratype); one series of 6–8 canines on posterior part of jaw; vomer with 1 caniniform tooth on right arm; palatines with single series of small conical teeth increasing in size posteriorly (paratype with toothless vomer and palatines).

Dorsal and anal fins damaged (first, second, and third dorsal spines of paratype measure 11.3, 13.3, and 12.0, respectively, but tips of latter two spines seem broken); pectoral fin 20.9, reaching over anterior edge of anus (20.0, reaching over posterior edge of anus); pelvic fin 25.4, reaching about three quarters of distance between pelvic insertion and anal fin origin (34.3, reaching base of second anal fin ray); pelvic spine 20.0 (24.3).

Distance from tip of snout to first dorsal fin origin 42.4 (42.0), to second dorsal fin origin 59.6 (58.7), to pelvic fin insertion 24.8 (30.3), and to anal fin origin 60.9 (59.3); dis-

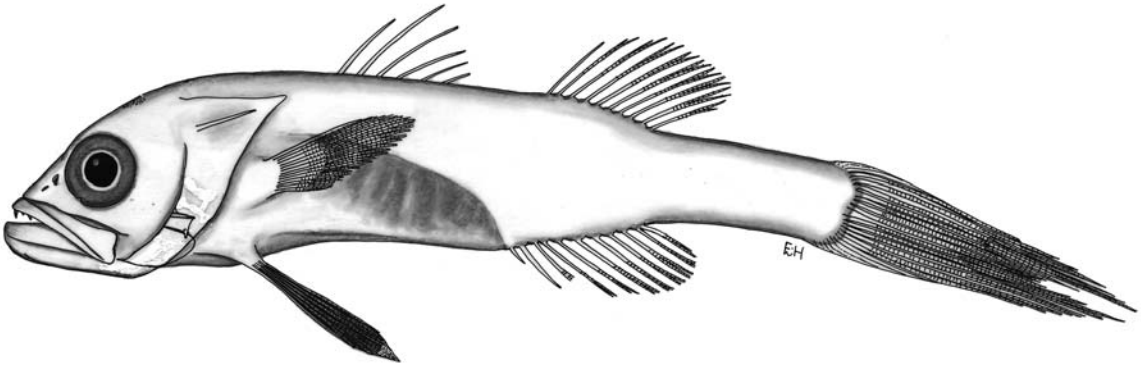

Fig. 1. *Gymnapogon melanogaster*, HUJ 18632, holotype, 23.0 mm SL, Eilat, Israel

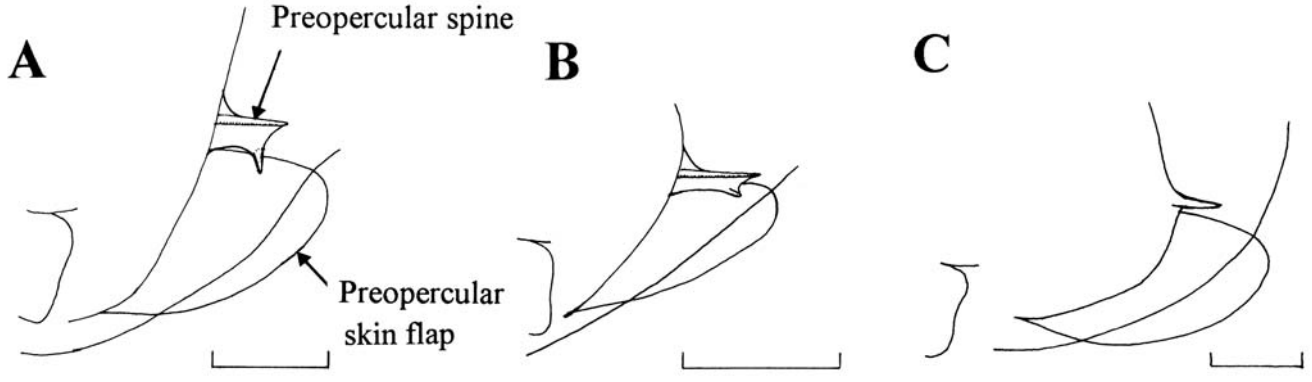

Fig. 2. The preopercular spine of the holotype (**A** HUJ 18632, 23.0 mm SL) and paratype (**B** RUSI 64526, 15.0 mm SL) of *Gymnapogon melanogaster* in comparison with the spine of *G. africanus* (**C** RUSI 778, paratype, 21.0 mm SL). *Bars* 1 mm

tance from pelvic insertion to anal fin origin 35.2 (30.7); caudal peduncle depth 8.9 (7.7) and its length 18.3 (18.0); caudal fin forked 31.5 (27.3).

Color in alcohol.—Body pale, without pigmentation except for a cluster of small dark brown spots on occiput; pelvic fins black with pale base and tip; other fins pale; peritoneum with scattered melanophores; stomach black and intestine pale.

Color in life.—Unknown.

Etymology. The species name is constructed from the Greek for black (*melano*) and stomach (*gaster*).

Remarks. The right pectoral fin of the holotype has 15 rays, as do both fins of the paratype. The holotype has a distinctly shorter pelvic fin than the paratype. The holotype's fin seems to be intact, and the difference could therefore be an ontogenetic one. The preopercular spine of the paratype is apparently not fully developed. The flat, bony flange that carries the spines is narrower than in the holotype, and its ventral spine is shorter and directed diagonally rather then vertically (Fig. 2A,B).

The flat, bifurcate preopercular spine (Fig. 2A,B) and the black stomach distinguish *Gymnapogon melanogaster* from all the other species of this genus as they have a single spine (Fraser, 1972). We compared *G. melanogaster* with *G. vanderbilti* and *G. africanus*. All three species have the same dorsal and anal fin ray counts. The former two species share the apparent absence of the papillae network on the head and the body and the dark pelvic fins. *Gymnapogon africanus* of the Western Indian Ocean is the closest geographically to *G. melanogaster*.

The original description and the illustration of the holotype of *G. vanderbilti* (Fowler, 1938: 198, pl. 8, fig. 18) include several inaccuracies. Fowler's counts of soft dorsal and anal rays were 8 and 9, respectively. The illustrated fish has 9 and 8 rays, respectively, or 8 and 7 if his indication of a split last ray (see explanation of his fin formulae in Fowler 1928: 13) is applied to the drawing. We concur with Lachner's (1953: 493, table 43) count of 9 soft dorsal rays and 8 soft anal rays, the last split ray being counted as a single element. The pectoral fins of most of our *G. vanderbilti* specimens are broken and frayed and therefore difficult to count. Fowler counted 12 pectoral rays. Lachner (1953: table 43) counted 15 rays in one specimen. Recent counts of the pectoral rays of the holotype of *G. vanderbilti* vary from 13–14 (T.H. Fraser, Mote Marine Laboratory, personal communication) to 14–15 (M. Sabaj, ANSP, personal communication). Our counts of 36 specimens (ANSP 158009) were usually 14 rays; 1 fish had 13 and 2 others had 15 rays. Fowler gave a count of 2 + 12 gill rakers for *G. vanderbilti*, but we counted a total of 2–3 + 9–10 rakers (1 fish with 3 rakers on the upper limb) and 1 + 9–10 developed rakers (2 with 10 rakers) in 37 specimens of the comparative material (ANSP 158009); the holotype of *G. vanderbilti* has 1 + 9 developed rakers (M. Sabaj, personal communication). *Gymnapogon melanogaster* has 1 or 2 more developed gill rakers (1 + 10–11). Fowler's drawing of the holotype of *G. vanderbilti* shows a small triangular serra on the posterior edge of the opercle in front of the upper end of the pectoral fin base. This serra is in fact on the posterior edge of the preopercle a short distance above the large spine at the angle of this bone (M. Sabaj, personal communication). There are no serrae on the posterior preopercular edge of the two specimens of *G. melanogaster*. Fraser (personal communication) informed us that the holotype and paratypes of *G. vanderbilti* have a more slender body and longer pelvic fins than in Fowler's illustration. Indeed, body depth in the comparative material is 22.1–23.0 (28.0 on the illustration) and the longest pelvic fin, although with a broken tip, is 25.3 (18.6 on the illustration), measured in a 16.6-mm fish. In the 15-mm paratype of *G. melanogaster* the pelvic fin measures 34.3. Further study is required to assess the importance of this character. We also find a significant difference between Fowler's illustration and our comparative material of *G. vanderbilti* in the length of the first dorsal fin spines. In two ANSP 158009 specimens, 16.3–16.9 mm, the anterior dorsal spines are long and only slightly damaged. When depressed against the body, the first dorsal spine (17.1–17.5) reaches the origin of the second dorsal fin, and the second dorsal spine (18.1) reaches the base of the second dorsal ray. Projected horizontally, none of the first dorsal fin spines of the drawing reaches the origin of the second dorsal fin. The first dorsal fin of *G. melanogaster* is lower. The proportional length of the first and second dorsal fin spines of the paratype is 11.3 and 13.3, respectively.

Smith (1954) warned that the papillae pattern found on the body and head of most *Gymnapogon* may not be diagnostic because its presence in preserved material depends on the initial handling of specimens and the method of preservation. Although not all our specimens of *G. africanus* had papillae, their place is evident as thin pale lines at least on part of the body, even in fish smaller than 20 mm. No such lines are evident in any of the specimens of *G. vanderbilti* and *G. melanogaster* we examined. These two species also share black pelvic fins. In *G. vanderbilti* there seems to be an ontogenetic change in the pelvic fin pigmentation. Most fish smaller than 16.0 mm have a dark band near the base of this fin. Fishes 16.0–18.0 mm usually have an additional band on the middle of the fin. Only the holotype and largest paratype, measuring 18.7 and 18.1 mm, respectively, have dark pelvic fins similar to *G. melanogaster* (M. Sabaj, personal communication). The dark pigmentation of the pelvic fins of the paratype (15.0 mm) of *G. melanogaster* is identical to that of the holotype (23.0 mm). In addition, *G. vanderbilti* differs from *G. melanogaster* in having a shorter pelvic spine (15.3–20.5), longer caudal peduncle (24.8–25.9), and shorter distance between pelvic insertion and anal fin origin (23.5–27.3). The smallest specimen of *G. vanderbilti* (ANSP 158009, 11.0 mm) has the preopercular spine, jaw dentition, and dark pigment at the base of the pelvic fins observed in larger fish, but it has no vomerine and palatine teeth.

Gymnapogon africanus is easily distinguished from *G. melanogaster* by having pale stomach and pelvic fins. In addition, *G. africanus* has a larger mouth (upper jaw 20.1–22.3 and lower jaw 22.8–25.3), shorter pelvic fin (18.0–20.8), and pelvic spine (12.1–13.0), deeper (10.6–12.55) and longer (24.2–28.8) caudal peduncle, and a shorter distance from pelvic insertion to anal fin origin (19.8–25.4).

Unidentified species of *Gymnapogon* were reported from the Chagos Archipelago (Winterbottom et al., 1989: 32, fig. 177; Winterbottom and Anderson, 1997: 9) and the Maldive Islands (Randall and Anderson, 1993: 16, pl. 3I) of the Western Indian Ocean, but none of these has the characteristic dark, long pelvic fins of *G. melanogaster*. The holotype and paratype of *G. melanogaster* were collected at midnight on a sandy bottom, using a 30-m-long experimental beach seine with decreasing mesh size from 40 mm on the sides to 2 mm in the center. The same net was used at the same locality for a long-term sampling program starting in 1984. More than 200 hauls were conducted, including 44 at night. Apogonids, most commonly *Apogon cyanosoma*, were collected only at night. Occasional species included *A. cookii, Archamia fucata, Cheilodipterus novemstriatus, C. pygmaios*, and *C. quinquelineatus*. *Fowleria aurita* and *Gymnapogon melanogaster* were caught only once. The nearest shelters to the sampling site consist of an adjacent shallow (1–1.5 m) small rocky area with disintegrating pylons of an old pier and coral knolls about 200 m offshore.

Comparative materials. *Gymnapogon vanderbilti*: ANSP, 68381, holotype, 18.7 mm; ANSP 68382, largest paratype, 18.1 mm; ANSP 158009, 50: 11.0–17.4 mm, all from Christmas Island, Line Islands. *Gymnapogon africanus*: Kenya: Shimoni, RUSI 778, paratypes, 4: 21.0–30.3 mm. Mozambique: Porto Amelia, RUSI 3827, 31.9 mm. Quilaluia Islands, RUSI 4043, 30.9 mm. Bazaruto Island, RUSI 777, paratype, 29.7 mm. Malongane, RUSI 50346, 18.5 mm; RUSI 50578, 3: 17.8–22.1 mm; RUSI 50648, 2: 23.1–23.6 mm. Ponta Mamoli, 3: 18.7–24.8 mm.

Acknowledgments We thank D. Didier and M. Sabaj of the Academy of Natural Sciences, Philadelphia, for loans of and for taking data from type specimens; T.H. Fraser of the Mote Marine Laboratory, Sarasota, kindly provided data on type specimens. We are grateful to E. Heemstra of the South African Institute for Aquatic Biodiversity, Grahamstown, South Africa, for the artwork presented in this article and to A. Lerner of the Hebrew University, Jerusalem, for his assistance in collecting the specimens.

Literature Cited

Baldwin CC, Johnson GD (1999) *Paxton concilians*: a new genus and species of pseudamine apogonid (Telesotei: Percoidei) from northwestern Australia: the sister group of the enigmatic *Gymnapogon*. Copeia 1999(4):1050–1071

Fowler HW (1928) The fishes of Oceania. Mem Bernice P Bishop Mus 10:i–iii + 1–540

Fowler HW (1938) The fishes of the George Vanderbilt South Pacific Expedition, 1937. Monogr Acad Nat Sci Phila 2:1–349

Fraser TH (1972) Comparative osteology of the shallow water cardinal fishes (Perciformes: Apogonidae) with reference to the systematics and evolution of the family. Ichthyol Bull JLB Smith Inst Ichthyol 34:1–105

Gon O (1993) Revision of the cardinalfish genus *Cheilodipterus* (Perciformes: Apogonidae), with descriptions of five new species. Indo-Pac Fishes 22:1–59

Herre AWCT (1939) A new *Henicichthys* from the Philippines. Copeia 1939(4):199–200

Jordan DS, Snyder JO (1901) A review of the cardinal fishes of Japan. Proc US Natl Mus 23:891–913

Lachner EA (1953) Family Apogonidae: cardinal fishes. In: Schultz LP, Herald ES, Lachner EA, Welander AD, Woods LP. Fishes of the Marshall and Marianas Islands. Bull US Natl Mus 202:412–498

Randall JE, Anderson RC (1993) Annotated checklist of the epipelagic and shore fishes of the Maldive Islands. Ichthyol Bull JLB Smith Inst Ichthyol 59:1–47

Regan CT (1905) On a collection of fishes from the inland Sea of Japan made by Mr. R. Gordon Smith. Ann Mag Hist Nat (Ser 7) 15:17–26

Smith JLB (1954) Apogonid fishes of the subfamily Pseudaminae from South-East Africa. Ann Mag Nat Hist (Ser 7) 12:775–795

Tanaka S (1915) Ten new species of Japanese fishes (in Japanese). Zool Mag Tokyo 27:565–568

Temminck CJ, Schlegel H (1842–1850) Pisces. In: von Siebold PF (ed) Fauna Japonica (parts 7–9, 1845:113–172)

Tomiyama I (1936) Gobiidae of Japan. Jpn J Zool 7:37–112

Whitley GP (1936) More ichthyological miscellania. Mem Queensl Mus 11:23–51

Whitley GP (1941) Ichthyological notes and illustrations. Aust Zool 10:1–50

Winterbottom R, Anderson RC (1997) A revised checklist of the epipelagic and shore fishes of the Chagos Archipelago, Central Indian Ocean. Ichthyol Bull JLB Smith Inst Ichthyol 66:1–28

Winterbottom R, Emery AR, Holm E (1989) An annotated checklist of the fishes of the Chagos Archipelago, Central Indian Ocean. R Ont Mus Life Sci Contrib 145:1–226