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Apogon dhofar, a new cardinalfish (Perciformes: Apogonidae) from the northwestern Indian Ocean

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Abstract

The Dhofar cardinalfish *Apogon dhofar* n. sp. is described from 21 specimens collected in the Arabian Sea, Northwest Indian Ocean off southern Oman. It differs from the very similar *A. pseudotaeniatus* Gon, 1986 in its higher gill-raker count (12-17 developed rakers vs. 9-11) and coloration. *Apogon dhofar* has narrower dark vertical bars (one scale row or less in width vs. two or more for *A. pseudotaeniatus*) which are often indistinct or absent in life and tend to fade with size; and a caudal spot which is much smaller (2 - 3 % SL vs. 4 - 6 % SL for *pseudotaeniatus*) and often absent in life. Both *A. dhofar* and *A. pseudotaeniatus* have small dark chromatophores covering their bodies, but *A. dhofar* differs in having these chromatophores concentrated under the posterior edge of each scale producing a reticulate pattern on the body. *Apogon dhofar* has been collected in very shallow (tidepools) and relatively deep (60+ m) water.

Introduction

The cardinalfishes of the genus *Apogon* are distributed worldwide in shallow tropical seas, occasionally entering estuaries and the lower reaches of rivers. Nelson (1994) estimates at least 110 species in the genus and Randall et al, (1990) note that several undescribed apogonid species exist on museum shelves and more remain to be discovered in the sea.

During numerous field collections along the Omani coastline from 1987 to 1990 I was unable to identify the most common apogonid observed in the southern region of Oman. Diving collections by the author, John E. Randall, and others in 1988-1990, and trawl collections by the R/V "Rastrelliger" in 1990 formed the basis for this study. My examination of the specimens indicated that they represent a new species which is described below.

Materials and methods

Type specimens are deposited in The Natural History Museum, London (BMNH), California Academy of Sciences, San Francisco (CAS), Bernice P. Bishop Museum, Honolulu (BPBM), J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa (RUSI), and National Museum of Natural History, Washington, D.C. (USNM). Comparative material was examined from BMNH, BPBM and CAS.

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Measurements follow Gon (1993), and definitions of lateral line scale counts and gill-raker counts, which are important in apogonid taxonomy, are repeated herein. Lateral-line scale counts include pored scales (the last of which is typically pointed and elongate) which extend on to the caudal fin. Total gill-raker counts include rudiments. Developed gill-raker counts include rakers which have a freely movable tip and a length at least equal to the width of the base. Measurements were made to the nearest tenth of a millimeter using dial calipers, and unless noted otherwise, were taken from the left side. Data in parentheses in the description refer to paratypes.

Apogon dhofar, new species

Figures 1 & 3-5, Tables 1 & 2

Holotype. CAS 82327, 79.5 mm SL, Oman: Arabian Sea, NW Indian Ocean, Eagles Retreat near Mirbat, 16°58'0"N, 54°42'50"E, 8 m, rotenone, 25 April 1990, J.K.L. Mee and J.E. Randall.

Paratypes. BMNH 1995.9.20.1-2, 2 ex. (53.1-56.4 mm SL), Oman: Arabian Sea, NW Indian Ocean, near Kuria Muria Islands, 17°53'N, 56°20'E, 45-50 m, trawl, FAO R/V "Rastrelliger" station 101, 20 February 1990, J.K.L. Mee. BPBM 36328, 53.9 mm SL, Oman: Rahah Bay, west side, 17°0' N, 54°49'2" E, 0-1.5 m tidepool, rotenone, 6 February 1993, J.E. Randall and I. McLeish. BPBM 35869, 2 ex. (64.2-67.3 mm SL), Oman: Rahah Bay, Hole-in-the wall, 17°0' N, 54°49'2" E, 24 m, 19 October 93, J.L. Earle. BPBM 35916, 2 ex. (79.3-100.0 mm SL), Oman: same location as holotype, 10 m, rotenone, 25 October 93, J.L. Earle. CAS 82330, 5 ex. (36.5-69.8 mm SL), same data as BMNH 1995.9.20.1-2. CAS 82331, 4 ex. (52.4-82.0 mm SL), Oman: Arabian Sea, NW Indian Ocean, Sharqirah Bay, 18°40'N, 57°28'E, 66-73 m, trawl, FAO R/V "Rastrelliger" station 110, 23 February 1990, J.K.L. Mee. RUSI 49074, 62.5 mm SL, Oman: Arabian Sea, NW Indian Ocean,

Figure 1. Underwater photograph of *Apogon dhofar* (not collected), 3 m depth, Sudah, Oman.

Figure 2. Underwater photograph of adult *Apogon pseudotaeniatus* (not collected), Gulf of Aqaba, Red Sea (photograph: John E. Randall).

Sudah Harbor, 17°03'N, 55°04'E, hand nets while snorkeling, 26 April 1989, J.K.L. Mee. RUSI 49075, 41.6 mm SL, same data as BMNH 1995.9.20.1-2. USNM 337776, 48.5 mm SL, same data as RUSI 49074. USNM 337777, 72.5 mm SL, same data as BMNH 1995.920.1-2.

Diagnosis

Dorsal fin elements VII + I,8-9; anal rays II,8; pectoral rays 15 (rarely 16); lateral-line scale rows 27-28; predorsal scales 3; gill rakers 19-21; developed gill rakers 12-17; preopercle edge serrated; body depth 2.4-2.9 in SL; a dark caudal spot about 3.5-7 in eye diameter centered on caudal base frequently present; two narrow dark bars located below anterior third of dorsal-fin bases frequently present; dark chromatophores covering body concentrated under posterior edges of scales to form reticulate pattern on body. Reticulate pattern not as distinct in juveniles.

Apogon dhofar differs from *A. pseudotaeniatus* in having a higher number of total and developed gill rakers (Table 2). Although Gon (1986) reports 9-11 developed gill rakers for *A. pseudotaeniatus*, all of the specimens examined for this study have 11. *Apogon dhofar* also differs from *A. pseudotaeniatus* in the presence and size of the two vertical bars and caudal spot. The vertical bars, if present, are one scale row or less wide in *A. dhofar*, and two or more scale rows wide and always present in *A. pseudotaeniatus*. The horizontal diameter of the caudal spot, if present in *A. dhofar*, is about half the size as in *A. pseudotaeniatus* (2-3 % of SL vs. 4-6 %). Both the vertical bars and the caudal spot may be faint or not visible in living adult *A. dhofar* (Fig. 1), while always visible in *A. pseudotaeniatus* (Fig. 2). *Apogon dhofar* and *A. pseudotaeniatus*, like many percoid fishes, have tiny dark chromatophores covering their bodies, however, where *A. pseudotaeniatus* has these relatively evenly scattered over the body, *A. dhofar* has them concentrated under the posterior edges of the scales to produce a reticulated pattern. *Apogon dhofar* is slightly more slender than *A. pseudotaeniatus* (body depth 2.5-2.9 vs.

2.3-2.4 in SL). Caudal peduncle depth is also less in *A. dhofar* than in *A. pseudotaeniatus* (6.3-7.4 vs. 5.9-6.2 in SL).

Apogon dhofar might also be confused with several other Indian Ocean species of *Apogon* which have small and sometimes faint caudal spots. *Apogon spilurus* Regan, 1905 and *Apogon micromaculatus* Kotthaus, 1970 have a similar size caudal spot but the placement of this spot is always above the lateral line near the dorsal surface of the caudal peduncle (vs. the center of the caudal peduncle on the lateral line in *A. dhofar*). These two species also have a faint row of dark dots on the base of the anal fin and a short dark line extending from the tip of the snout to the anterior edge of the eye which *A. dhofar* lacks. In addition they have a higher predorsal scale count (5 vs. 3). My examination of the types of *A. spilurus* and a reading of the description of *A. micromaculatus* suggests that these two species may be synonymous.

Apogon gularis Fraser and Lachner, 1984 is a relatively deep-dwelling apogonid which is uniquely distinctive among apogonids in having a forward positioned anus. Although Fraser and Lachner's description does not mention any caudal spot, the five specimens that I have examined for this study, including one paratype, show an indistinct concentration of dark chromatophores on the caudal peduncle at the same location as the caudal spot in *A. dhofar*. This faint caudal spot is similar to that seen in larger *A. dhofar*.

Large *A. kallopterus* Bleeker, 1856 might also be confused with *A. dhofar*. *Apogon kallopterus* is one of the most wide-ranging apogonids in the Indo-Pacific, although it has not yet been reported from the Arabian Sea, Gulf of Oman, or Arabian Gulf. It is similar to *A. dhofar* in having dark chromatophores concentrated on the posterior edges of the scales to form a reticulate pattern. It can be distinguished from *A. dhofar* at most sizes by the presence of a dark horizontal mid-body stripe (Fraser & Lachner, 1985, and their Figs. 3 & 4) which *A. dhofar* lacks. Large *A. kallopterus* may lack this stripe while still showing a caudal spot and can be separated from *A. dhofar* by their lower pectoral-ray count (13-14 according to Fraser & Lachner, 1985 vs. 15-16, see Table 1).

Figure 3. Paratype of *Apogon dhofar*, 53.9 mm SL, BPBM 36328 (photograph: John E. Randall).

Table 1. Proportional measurements (in % SL) and selected counts of type specimens of *Apogon dhofar* and *A. pseudotaeniatus*. N.b., no caudal spot is visible on the holotype and four largest paratypes.

	Holotype CAS 82327	Paratypes	*A. pseudotaeniatus*
Standard length (mm)	79.5	36.5 -100.0 n = 20	55.0 - 87.0 n=7
Body depth	38.9	34.0 - 40.9 n = 20	40.2 - 42.2 n=7
Body width	17.7	10.7 - 18.0 n = 20	13.5 - 18.1 n=7
Length of head	42.8	41.9 - 47.4 n = 19	41.6 - 44.5 n=7
Length of snout	8.0	8.0 - 10.5 n = 20	8.4 - 10.6 n=7
Eye diameter	12.8	11.7 - 15.0 n = 20	11.9 - 13.7 n=7
Interorbital width	9.2	7.2 - 9.9 n = 20	7.9 - 8.5 n=7
Length of upper jaw	20.3	17.8 - 20.4 n = 20	18.5 - 19.7 n=7
Length of lower jaw	22.9	22.5 - 25.0 n = 20	22.0 - 23.9 n=7
Length of 1st dorsal fin base	14.8	11.8 - 14.3 n = 20	13.6 - 17.6 n=7
Length of 1st dorsal spine	2.8	2.5 - 4.7 n = 20	2.4 - 4.0 n=7
Length of 2nd dorsal spine	8.9	6.7 - 9.1 n = 20	5.4 - 9.4 n=7
Length of longest dorsal spine	21.3	17.6 - 23.7 n = 20	18.5 - 24.9 n=7
Length of 2nd dorsal fin base	16.1	14.3 - 17.7 n = 20	15.1 - 19.1 n=7
Length of 2nd dorsal fin spine	18.9	15.9 - 20.6 n = 19	16.0 - 21.0 n=7
Length of longest dorsal ray	27.0	22.2 - 28.0 n = 20	22.7 - 29.4 n=7
Length of anal fin base	16.5	11.7 - 16.5 n = 20	12.9 - 14.9 n=7
Length of 1st anal spine	4.3	3.0 - 5.3 n = 20	2.7 - 4.0 n=7
Length of 2nd anal spine	15.0	13.7 - 17.7 n = 20	13.3 - 16.6 n=7
Length of longest anal ray	22.4	19.9 - 25.1 n = 20	20.1 - 24.0 n=7
Length of pectoral fin	27.3	21.9 - 30.8 n = 20	25.2 - 29.0 n=7
Length of pelvic fin	27.8	21.7 - 28.1 n = 20	25.5 - 30.6 n=7
Length of pelvic fin spine	16.9	15.0 - 19.5 n = 20	15.6 - 18.5 n=7
Depth of caudal peduncle	16.0	13.4 - 16.0 n = 20	15.8 - 16.9 n=7
Length of caudal peduncle	23.5	19.7 - 27.5 n = 20	20.5 - 23.5 n=7
Caudal spot diameter	-	1.8 - 3.0 n = 16	4.0 - 5.4 n=7
Predorsal length	43.3	40.1 - 46.3 n = 20	41.4 - 44.1 n=7
Preanal length	62.0	60.3 - 69.2 n = 20	62.6 - 67.9 n=7
Prepelvic length	37.5	33.1 - 37.8 n = 20	33.5 - 36.2 n=7
Pectoral ray count (left/right)	15/15	15/15 n = 18	15/15 n=7
		15/16 n = 1	n=7
		16/16 n = 1	n=7
Lateral-line scales	28	27-28 n = 20	28 n=7

Description

Dorsal fin rays VII + I,9; anal fin rays II,8; last dorsal and anal fin rays frequently split to base; pectoral fin rays 15 (15-16); principal caudal fin rays 9 + 8; pored lateral-line scales 28 (27-28); scales between lateral line and dorsal fin origin 2; scales between lateral-line and anal fin origin 6, predorsal scales 3; branchiostegal rays 7; gill rakers 5 (4-7) + 16 (14-16); developed gill rakers 16 (12-17); vertebrae 10 + 14.

Body short and compressed, depth 2.6 (2.4-2.9) in SL; head length 2.3 (2.1-2.4) in SL; width 2.2 (2.1-3.2) in depth; dorsal profile of head straight; eye moderate, eye diameter 3.3 (3.0-3.8) in head length; interorbital space slightly convex, its width 4.7 (4.5-6.0) in head length; snout short, 5.4 (4.3-5.6) in head length.

Front nostril small, round, with a short flap, located near upper lip at level of lower margin of pupil; rear nostril larger, oval, placed closer to eye than to front nostril, at level of center of orbit. Mouth terminal, large and oblique; upper jaw 2.1 (2.1-2.4) in head length, lower jaw longer 1.9 (1.7-2.0) in head length; maxilla reaching posteriorly under rear margin of pupil, partly covered by suborbital bone; a polyserial band of small, conical teeth on both jaws, vomer, and palatines; band on upper jaw wider, its outer row of teeth larger; teeth at symphysis of lower jaw sometimes slightly enlarged. Posttemporal bone serrated; preopercle edge serrated, the ridge smooth; gill opening wide, free from isthmus, extending forward under front margin of eye; gill rakers slender, moderately long, longest not more than half diameter of eye; gill filaments shorter than gill rakers.

Body covered with large ctenoid scales; lateral line complete, following dorsal profile of body and extending through center of caudal peduncle on to caudal fin; pored lateral-line scales about the same size as body scales adjacent to them; last lateral-line scale elongate and pointed; opercular bones scaled; interorbital space and snout naked; no scales on fin membranes.

Origin of first dorsal fin on a vertical with upper end of pectoral fin base; first dorsal-fin base 6.7 (5.2-6.7) in SL; first dorsal spine 2.0 (1.8-2.8) in second spine; second dorsal spine 2.6 (2.1-3.0) in longest dorsal spine; third dorsal spine longest 2.8 (1.9-2.8) in head length; second dorsal-fin base 6.2 (5.6-7.6) in SL; spine of second dorsal fin 2.3 (2.1-2.6) and longest dorsal ray 1.6 (1.5-2.0) in head length; origin of anal fin under first or second dorsal-fin ray; anal fin base 6.1 (6.1-8.1) in SL; first anal spine 3.6 (3.0-4.9) in second spine; second anal spine 2.8 (2.5-3.0) in head length, margin of first dorsal fin slightly rounded dorsally; margin of second dorsal fin somewhat pointed dorsally; anal and pelvic fins somewhat pointed ventrally; pectoral fin somewhat pointed dorsally, its upper rays longest 3.7 (3.6-4.2) in SL; pelvic insertion slightly in advance of pectoral-fin base; pelvic-fin length 1.5 (1.6-1.9) in head length and nearly reaching first

Figure 4. Holotype of *Apogon dhofar*, 79.5 mm SL, CAS 82327, Eagles Retreat near Mirbat, Oman; photographed from right side because of missing scales on left side (photograph: John E. Randall).

Table 2. Gill-raker counts of holotype and 20 paratypes of *Apogon dhofar* and *A. pseudotaeniatus*.

Developed gill rakers	11	12	13	14	15	16	17
Apogon dhofar		1	3	4	9	3	1
Apogon pseudotaeniatus	7						
Total gill rakers	17	18	19	20	21		
Apogon dhofar			1	11	9		
Apogon pseudotaeniatus	1	2	4				

anal spine, and pelvic spine 2.5 (2.3-3.1) in head length; anus near origin of anal fin, on a vertical with the first rays of the second dorsal fin; caudal peduncle short and deep, depth 1.5 (1.3-1.7) in length and length 4.3 (4.2-5.0) in SL. Caudal fin emarginate.

Color (holotype in alcohol). Grey-brown body, covered with tiny dark chromatophores which are concentrated under the posterior edges of the scales to produce a reticulated pattern; anterior rays of both dorsal fins dark; all fins except pectorals dusky, the pelvics darker.

All paratypes under 80 cm SL have two narrow, often very faint, vertical bars (Fig. 3), under the anterior third of each dorsal-fin base. Bars are most distinct in the two smallest paratypes (36.5 and 41.6 mm SL) which also show the least chromatophore reticulation pattern. Sixteen of the paratypes show some evidence of a tiny dark caudal spot at the center of the caudal peduncle usually on the 23rd or 24th lateral line scale (Fig. 3). Both vertical bars and caudal spot appear to be more prominent following death, and may not be noticeable in living adult fish (Fig. 1).

Color of holotype when fresh (Fig. 4): body silvery grey covered with tiny dark chromatophores as described for preserved specimens; head sometimes faintly greenish in life; anterior spines or rays of dorsal, anal and pelvics black with the pelvics darkest; outer margin of pelvics (when viewed from an angle) white (Fig. 1); pectorals hyaline.

Distribution

Apogon dhofar has only been collected off southern Oman from Raysut in the south, 300 km north to the vicinity of the Kuria Muria Islands. It is often the most commonly noted apogonid in these areas. Its distribution is the center of seasonal upwelling during which sea temperatures drop to 16-18° C (versus 25-30° C during non-upwelling periods) (Barratt, 1984).

The most northerly records of *A. dhofar* are from photographs of uncollected specimens. Figure 5 shows what appears to be a juvenile *A. dhofar* photographed but not collected at Masirah Island by John E. Randall. Neither I, nor Randall and colleagues (pers. comm.) have observed any other *A. dhofar* at Masirah. Figure 6 shows a similar uncollected apogonid which also appears to be a juvenile

Figure 5. Underwater photograph of what is possibly a juvenile *Apogin dhofar*, about 35 mm SL (not collected), Masirah Island, Oman (photograph: John E. Randall).

Figure 6. Underwater photograph of what is possibly a juvenile *A. dhofar* from the Gulf of Oman,about 25 mm SL (not collected), Fahal Island near Muscat, 15 m depth, 4 February 1990 (photograph: Bob Bedford).

A. dhofar, from Fahal Island in the Gulf of Oman near Muscat. Both photographs were taken during the winter months when water temperatures are at their coolest in the Gulf of Oman. The proximity of the most southerly collections to the Yemen-Oman border make it likely that *A. dhofar* will eventually be collected in Yemeni waters.

Etymology

Dhofar is a region of the southern Sultanate of Oman, off the coast of which this fish is found. It is treated as a noun in apposition.

Discussion

Apogon dhofar is unusual in occurring both in very shallow and relatively deep habitats. Although some apogonids, such as *A. fleurieu* (Lacépede, 1801) have been reported from near the surface and trawled from 70+ m (Randall et al., 1990), I am not aware of any having been collected from tidepools and trawled from 60+ m. Gon (1986) notes that *A. pseudotaeniatus* may be a deeper water species as the only two of his types with capture depth data were collected in 20 m. Baranes and Golani (1993) record a single specimen of *A. pseudotaeniatus* collected at 150 m in the Gulf of Aqaba. Indian Ocean species of *Apogon* mentioned as similar to *A. dhofar* which appear to occur exclusively in relatively deep water include *A. spilurus, A. micromaculatus,* and *A. gularis.*

Apogon dhofar is a non-cryptic apogonid, easily observed during daylight hours. It is most often noted in small groups but has not been found in large schools like many non-cryptic apogonids. Two paratypes, 67.0 and 100.0 mm SL, were females full of eggs. Both were collected in the winter which corresponds with warmer water temperatures and calm sea conditions.

Comparative material

Apogon gularis, CAS 53044, paratypes, 5 ex. (45.5-51.0 mm SL), Burma: Mergui Archipelago, 10°39'N, 97°06'E, 290 m, trawl, R/V Anton Bruun, Station 22A, cruise 1, 24 March 1963. BPBM 35804, 2 ex. (46.9-47.3 mm SL), Oman: Arabian Sea, NW Indian Ocean, off Al Ashkarah, 21°34'N, 59°34'E, 60-62 m, trawl, FAO R/V "Rastrelliger" station 136, 2 March 1990, J.K.L. Mee. CAS 82328, 3 ex. (48.5-50.2 mm SL), same data as BPBM 35804.

Apogon pseudotaeniatus, BPBM 30551, paratype, 86.5 mm SL, Red Sea: Gulf of Aqaba, Eilat, 20 m, 16 May 79. BPBM 31878, 75.0 mm SL, Red Sea: Gulf of Aqaba, Taba, 30m, 15 Nov 86. BPBM 27717, 3 ex. (55.0-63.8 mm SL), India: Kerala, Vizhinjam, 12.5m, 14 Feb 80. BPBM 18768, 2 ex. (77.2-87.0 mm SL), Sri Lanka: Negombo, 8m, 30 Mar 75.

Apogon spilurus, BMNH 1904.5.25.113-115, syntypes, 3 ex. (31.0-48.2), Kurachee, 1904. BPBM 32715, 12 ex. (62-77 mm SL), Somali Coast, 11°14' N, 51°08' E, Trawl, Anton Bruun Cruise 9, 17 Dec 64. CAS 82329, 2 ex. (61.6 mm SL), Arabian Sea, NW Indian Ocean, off Raysut, Oman, 17°35' N, 55°20' E, 23-26 m, trawl, FAO R/V "Rastrelliger", station 97, 19 February 1990, J.K.L. Mee.

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