

Geographic Variation in a Cardinalfish, *Apogon dianthus* (Teleostei: Apogonidae)

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The description of *Apogon dianthus*, previously known from a single specimen from Palau, is expanded based on new material from Fiji, Papua New Guinea, Indonesia, the Philippines, and the Comoros. Specimens from Palau and the Comoros differ from those in other areas by having fewer gill rakers, a deeper caudal peduncle, and a shorter spine in the second dorsal fin.

Apogon dianthus was described by Fraser and Randall (2002) from a single specimen taken at Palau in the western Pacific Ocean. Since that time it has not been recorded from any other locality, nor have any additional specimens from Palau been reported. Greenfield and Randall (2004) described a new species from Easter Island, *Apogon rubrifuscus*, and said that it belonged to a group of species they referred to as “*talboti* look-alikes.” The *talboti* look-alikes have two predorsal (supraneural) bones instead of three as in the *A. talboti* group, and 12 pectoral-fin rays rather than the 13 in *A. talboti*. There also are differences in the membranous flap at the lower corner and along the lower margin of the preoperculum as illustrated in Greenfield and Randall (2004, fig. 4; see also Fig. 5 [here]). Greenfield and Randall (2004) commented “Because of this similarity, a number of specimens reside on museum shelves identified as *A. talboti*, but they are not.” *Apogon dianthus* is a member of the *talboti* look-alike group.

While conducting a survey of the marine fishes of Fiji, I collected a number of specimens of a species in the *talboti* look-alike group, and initially believed that it was an undescribed species; however, after reviewing the description of the single specimen of *A. dianthus* from Palau, I realized that it was very similar, although differing in several characters. In searching other collections, additional specimens similar to those in Fiji were discovered. A name often used for these *talboti* look-alike specimens was *A. unicolor* Steindachner & Doderlein, a member of the *A. talboti* group.

One additional specimen of *A. dianthus* from Palau was located at the FMNH, and ROM specimens very similar to those from Palau were found from the Comoros. In addition, specimens similar to the Fiji population were found from Papua New Guinea, Indonesia, and the Philippines.

The purpose of this paper is to provide an expanded description of *A. dianthus* that previously had been based on a single specimen, and to demonstrate the population differences between specimens from Fiji, Papua New Guinea, Indonesia, and the Philippines from those in Palau and the Comoros.

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MATERIALS AND METHODS

All counts and measurements follow Hubbs and Lagler (1964) except that the last two fin rays of the dorsal and anal fins are not counted as one unless it is clear that they are joined at the base, and the caudal-peduncle length is a straight line rather than an oblique measurement. Measurements were made to the nearest 0.1 mm using dial calipers and are expressed as percentages of standard length (SL). The length of fin spines was measured by placing one end of the caliper tip at the base of the spine pushed against the posterior base of anterior spine and the other caliper tip at the spine tip. Gill-raker counts include rudiments. The holotype, which is in poor condition, was remeasured to standardize comparisons made with other specimens. Measurements in Table 2 for Palau and the Comoros are based on two specimens from Palau and five from the Comoros; those for Fiji specimens are based on five individuals. In Table 2, the ranges are followed by the mean values. Only measurements of caudal-peduncle depth and the length of the spine of the second dorsal fin were taken on specimens from Papua New Guinea, the Philippines, and Indonesia and from additional specimens from Fiji and the Comoros. Institutional abbreviations are as given in Leviton et al. (1985).

SPECIES DESCRIPTION

Apogon dianthus Fraser and Randall (2002)

MATERIAL EXAMINED.—PALAU AND COMOROS: **Palau:** Holotype-BPBM 9360, 48.6 mm SL; FMNH 117466, 40.2 mm. **Comoros:** ROM 59135, 42.8 mm; ROM 59136, 39.6 mm; ROM 59137, 37.6 mm; ROM 59138, 32.2 mm; ROM 59139, 43.1 mm; ROM 59140, 44.9 mm; CAS 35491, (2, 47.3–47.6 mm). **Fiji, PAPUA NEW GUINEA, INDONESIA, AND PHILIPPINES:** **Fiji:** CAS 225484, 44.6 mm; CAS 225485, 43.3 mm; CAS 225486, (2, 25.2–38.7 mm); CAS 225487, 28.3 mm; CAS 225488, (2, 28.8–43.2 mm); CAS 225489, 45.2 mm; CAS 225490, 39.2 mm; CAS 225491, 40.4 mm; CAS 225492, (2, 39.3–39.5 mm); CAS 225493, (4, 29.3–38.6 mm); CAS 225494, (7, 39.2–47.4 mm); CAS 225495, 40.6 mm; ROM 43075, (3, 34.4–41.0 mm); ROM 43076, (3, 42.4–49.2 mm); ROM 43077, 23.6 mm; ROM 43078, 39.2 mm; ROM 43079, (2, 38.4–39.0 mm); ROM 43081, 39.0 mm. **Papua New Guinea:** USNM 262415, (5, 28.2–40.3 mm); BPBM 32552, 39.4 mm. **Indonesia:** USNM 262711, 49.9 mm. **Philippines:** USNM 262237, (3, 31.9–42.5 mm); ROM 54038, 47.5 mm.; ROM 54039, 48.5 mm.

DESCRIPTION.—Dorsal-fin elements VI–I,8; anal-fin elements II,9; pectoral-fin rays 12–13 (only two out of 44 had 13); pored lateral-line scales 22–24, usually 23 plus one or two more past hypural plate; predorsal scales six; scales above lateral line to origin of first dorsal fin one; scales below lateral line to origin of anal fin six; circumpeduncular scales 12; gill raker counts vary by location (Table 1).

Color of fresh specimens.—A photograph of the holotype of *Apogon dianthus* is presented in Figure 1. Photographs of specimens from Fiji (Fig. 2), and the Comoros (Fig. 3) also are shown.

VARIATION.—The range and modal number of gill rakers differ among specimens from Palau and the Comoros versus those from Fiji, Papua New Guinea, Indonesia, and the



FIGURE 1. Holotype of *Apogon dianthus*, BPBM 9360 from Palau, 48.6 mm SL. Photograph by J.E. Randall.



FIGURE 2. *Apogon dianthus* from Fiji, CAS 225484, 44.6 mm SL.



FIGURE 3. *Apogon dianthus* from the Comoros, ROM 59135, 42.8 mm SL. Photograph by R.W. Winterbottom.

Philippines, being higher in the latter group (Table 1). Two body proportions also differ between these two groups. The depth of the caudal peduncle is less in the Fiji group and the length of the spine in the second dorsal fin is greater (Table 2). The length of the second dorsal-fin spine divided into the caudal-peduncle depth for the two groups is plotted in Fig. 4. No significant differences in color were noted.

Remarks.—*Apogon dianthus* belongs to a group of *Apogon* species in the subgenus *Apogon* with two predorsal (supraneural) bones and a membranous flap at the lower corner and along the ventral margin of the preopercle

TABLE 1. Gill-raker counts of *Apogon dianthus* from various locations.

Location	Upper		Lower				
	4	5	14	15	16	17	18
Palau		2		2			
Comoros	4	5	3	4	2		
Fiji	34		1	25	7	1	
Papua New Guinea	6		1	5			
Indonesia	1				1		
Philippines	4		1	3			

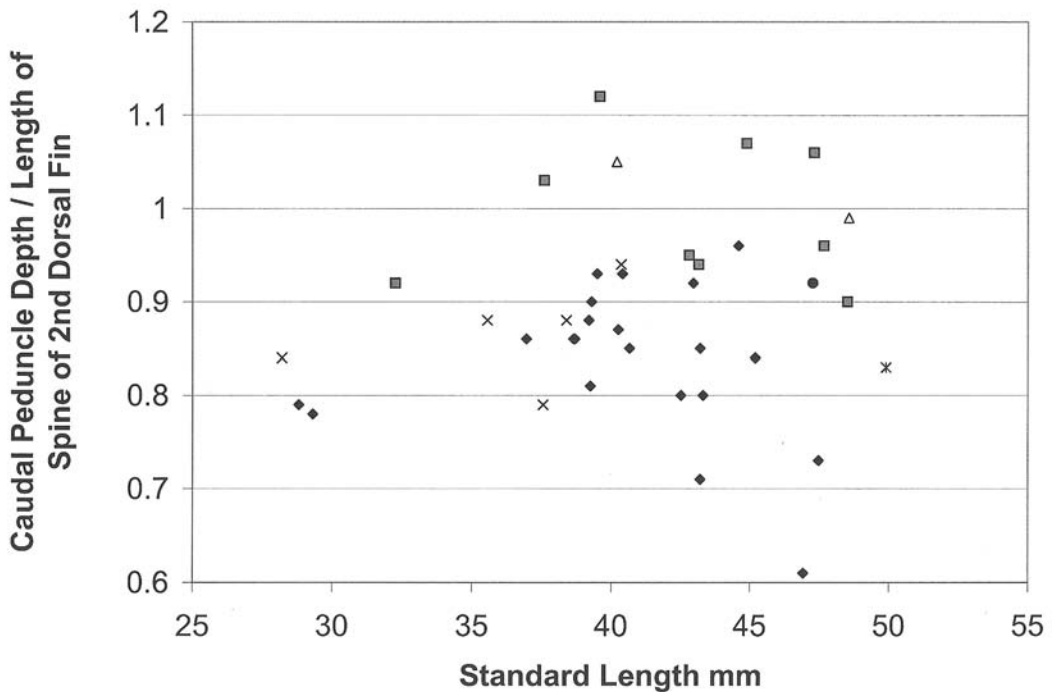


FIGURE 4. Standard length versus caudal-peduncle depth divided by length of spine of second dorsal fin for various *Apogon dianthus* populations. Solid diamonds – Fiji; solid squares – Comoros; X – Papua New Guinea; open triangles – Palau; solid circle – Philippines; asterisk – Indonesia.

TABLE 2. Body measurements of *Apogon dianthus* from various locations as percentage of standard length. Ranges are followed by means.

	<i>Palau-Holotype</i>	<i>Palau-FMNH</i>	<i>Comoros</i>	<i>Fiji</i>
Standard length	48.6	40.2	43.1–48.5	43.3–47.4
Head length	36.9	37.3	36.3–38.6; 37.7	37.6–40.4; 40.0
Eye diameter	13.2	11.9	11.7–13.5; 12.8	12.0–13.5; 12.6
Snout length	7.9	6.2	6.1–7.3; 6.7	5.0–8.1; 6.7
Bony interorbital width	6.7	6.2	6.9–8.0; 7.3	6.0–6.9; 6.3
Upper jaw length	19.9	20.1	19.5–20.7; 20.3	19.8–21.7; 21.1
Body depth	27.8	33.6	23.2–35.0; 31.8	32.4–35.2; 33.5
Body width	16.5	18.9	19.3–22.0; 20.6	18.0–20.0; 19.2
Predorsal length	41.9	38.3	38.7–42.6; 41.4	39.1–40.7; 40.0
Preanal length	60	60.1	57.6–61.3; 59.8	56.2–60.0; 58.5
Caudal-peduncle depth	13.7	13.7	12.9–14.5; 13.5	11.0–14.8; 12.6
Caudal-peduncle length	28	30.1	23.3–33.6; 28.9	27.0–39.2; 31.2
Prepectoral length	40.2	35.8	35.5–40.4; 37.7	36.9–39.9; 38.3
Prepelvic length	32.1	34.2	30.6–39.0; 35.0	33.2–35.6; 34.8
1 st dorsal-fin base	17.7	16.8	17.0–17.9; 17.5	14.2–16.6; 15.9
2 nd dorsal-fin base	14.8	12.9	13.0–14.8; 13.9	12.8–14.7; 13.9
Anal-fin base	12.2	13.6	12.6–14.5; 13.7	12.0–15.3; 13.2
1 st dorsal-fin spine	6.6	6.5	7.0–8.0; 7.4	6.2–7.9; 7.2
2 nd dorsal-fin spine	20.8	19.1	17.1–22.1; 19.9	19.7–23.3; 21.3
3 rd dorsal-fin spine	16.9	16.2	16.1–18.7; 17.4	17.5–19.2; 18.6
Spine 2 nd dorsal fin	13.9	13.1	12.1–14.7; 13.7	15.4–18.0; 16.1
Longest dorsal ray	----	24.6	23.6–27.5; 25.3	24.4–30.2; 26.9
1 st anal spine	4.4	3.5	3.1–4.4; 3.6	3.5–5.7; 4.3
2 nd anal spine	15.6	14.8	12.2–16.8; 14.5	14.6–16.5; 15.4
Longest anal ray	----	25.6	24.7–28.4; 26.5	24.8–26.4; 25.6
Caudal-fin length	----	----	34.0–40.2; 37.1	35.5–38.6; 36.9
Caudal-fin concavity	----	----	12.4–18.2; 15.3	13.4–17.7; 16.1
Pectoral-fin length	----	29.1	29.6–41.4; 32.5	29.3–44.3; 34.4
Pelvic-fin length	----	25.9	25.4–25.7; 25.6	25.3–27.5; 26.1

(Fig. 5). The other members of this group include *A. deetsie* Randall (1998), *A. caudicinctus* Randall and Smith (1988), and *A. rubrifuscus* Greenfield and Randall (2004). Although Greenfield and Randall (2004) distinguished *A. rubrifuscus* from *A. deetsie* and *A. caudicinctus*, they failed to differentiate it from *A. dianthus* in their comparisons. *Apogon dianthus* differs from *A. rubrifuscus* by having a much deeper caudal peduncle (11 % SL or greater, means 12.6 and 13.5, Table 2) versus 10% SL. *Apogon rubrifuscus* also is a much larger species (101.5 mm SL), whereas the largest specimen of *A. dianthus* I have seen is 48.6 mm SL.

Although there are differences between the specimens from Fiji and other South Pacific areas and those from Palau and the Comoros, until DNA samples can be obtained, I believe that it is best to be conservative and treat the Fiji specimens as *A. dianthus*. Two specimens from Fiji were preserved in ETOH, from CAS 225494 and CAS 225489, and are now cataloged in the University of Kansas tissue collection as KU 40246 and KU 40247, awaiting comparative DNA samples from Palau.

If, in fact, the specimens from Palau and the Comoros are the same, then this is another example of two widely disjunct populations such as that shown for *Blenniella gibbifrons* by Springer and

Williams (1994). In the current case, the intervening populations are from off the Pacific plate, reaching from Fiji into the Indo-Australian Archipelago and not an endemic found only in the archipelago, as is the case for *B. gibbifrons*, where *B. bilitonensis* separates the two *B. gibbifrons* populations.

The specimens from Fiji were taken most often from dropoff walls or deep spur and groove habitats, usually greater than 15 m in depth. The range of capture was 6.7–27 m, having been taken once in a 6.7 m coral-rubble habitat. Those from the Comoros also were from dropoff habitats at depths of 12–27 m.

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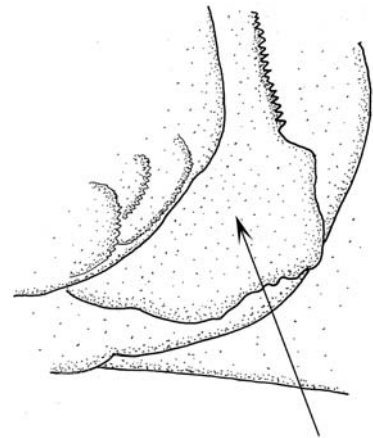


FIGURE 5. Preopercle and membranous flap of *Apogon dianthus*, CAS 225488, 43.2 mm SL.

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