

***Apogon dianthus*, a new species of cardinalfish (Perciformes: Apogonidae) from Palau, western Pacific Ocean with comments on other species of the subgenus *Apogon***

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**Abstract.**—A new species, *Apogon dianthus*, in the subgenus *Apogon* Lacépède, 1802 is described from a single specimen from Palau. It has 12 pectoral-fin rays, 15 well-developed gill rakers, four predorsal scales, and a pink, translucent body lacking any dark markings or dark edges on the scales. It is related to *A. deetsie* Randall, 1998, known from the Hawaiian Islands and Tuamotu Archipelago which has blackish bars on the body, six predorsal scales, 12 pectoral-fin rays, and 13–15 well-developed gill rakers. Thirty-eight species are recognized in the subgenus *Apogon*, which is the most widespread group of cardinalfishes. Nearly 24% of the species are peripheral island endemics in the Pacific and Atlantic Oceans. Only one of these species is presently known to have a widespread Pacific Plate distribution.

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Cardinalfishes in the subgenus *Apogon* have been characterized as having a pale stomach, intestine and peritoneum, unossified ventral preopercle flaps, very simple lateral-line scale architecture, one supernumerary dorsal spine, no uroneurals and two supraneurals (Fraser 1972, 1998). Members of this subgenus have been found in all tropical regions, reaching virtually all tropical and subtropical islands including many remote islands, for example Easter, Marquesas, Hawaii, Clipperton, Galápagos, Bermuda, Ascension and St. Helena. We provide a list of 38 species and three uncertain names by region (Table 1), although the species composition of the Atlantic Ocean (19) and Eastern Pacific (6) is much better understood than that of the Indo-Pacific region (13+). The recently described species, *A. susanae* Greenfield, 2001, is uniquely distributed throughout the Pacific Plate (Springer 1982). All other species in the region are restricted to islands or island groups. We expect the number of species in the Indo-Pacific eventually to exceed that of the Atlantic.

During a 1970 field trip to the Palau Islands, a single specimen of an unidentified *Apogon* was collected. We did not locate additional specimens in museum collections despite the fact that the islands of Palau were intensely collected by various ichthyologists as part of a multi-year program supported by the George Vanderbilt Foundation of Stanford University. None has turned up in the abundant material at the National Museum of Natural History from the 'Albatross' Expeditions and more recent field trips to the Philippines, Indonesia, and Palau. It is suspected that this species is normally found at depths usually not collected by SCUBA gear. We therefore provide a description of this species to contribute to the overall knowledge of Indo-Pacific *Apogon*. Another undescribed species in this subgenus is being described by Gerald Allen and John E. Randall.

#### Methods

Methods of taking and recording meristic data and measurements are given in Fraser

Table 1.—List of species placed in the subgenus *Apogon* and their general distribution. Species with an ‘I’ are peripheral island endemics, and a ‘P’ Pacific Plate species and with a ‘U’ have uncertain species status.

Species of <i>Apogon</i> ( <i>Apogon</i> )	Indo-Pacific Ocean								
	Atlantic Ocean			Indian		Pacific			
	Western	Central	Eastern	Western	Eastern	Western	Central	Eastern	
<i>americanus</i>	x								
<i>aurolineatus</i>	x								
<i>axillaris</i>		xI							
<i>binotatus</i>	x								
<i>gouldi</i>	xI								
<i>imberbis</i>			x						
<i>lachneri</i>	x								
<i>leptocaulus</i>	x								
<i>maculatus</i>	x								
<i>mosavi</i>	x								
<i>phenax</i>	x								
<i>pillionatus</i>	x								
<i>planifrons</i>	x								
<i>pseudomaculatus</i>	x								
<i>quadrisquamatus</i>	x								
<i>robbyi</i>	x								
<i>robinsi</i>	x								
<i>townsendi</i>	x								
<i>atradorsatus</i>									xI
<i>atricaudus</i>									xI
<i>dovii</i>									x
<i>guadalupensis</i>									xI
<i>pacificus</i>									x
<i>retrosella</i>									x
<i>campbelli</i>				x					
<i>coccineus</i>				x					
<i>caudicinctus</i>						x			
<i>crassiceps</i>						x			
<i>deetsie</i>							x I, P		
<i>dianthus</i>						x			
<i>doryssa</i>						x	x		
<i>erythrinus</i>							x I, P		
<i>indicus</i>				x		x	x		
<i>lativittatus</i>							x I, P		
<i>marquesensis</i>							x I, P		
<i>semiornatus</i>				x	x	x	x		
<i>susanae</i>							x P		
sp A					x	x			
<i>cardinalis</i>						xU			
<i>hypselonotus</i>						xU			
<i>kominatoensis</i>						xU			

& Lachner (1985). All measurements are in millimeters to the nearest 0.1 mm. All proportions are based on standard length and all material is reported by standard length rounded to the nearest millimeter, except for the primary type material. All x-ray

photographs are in data files maintained by the first author. The acronyms used in the lists of materials to designate institutions and collections cited, follow general usage given in Leviton et al., (1985) and Eschmeyer (1998).

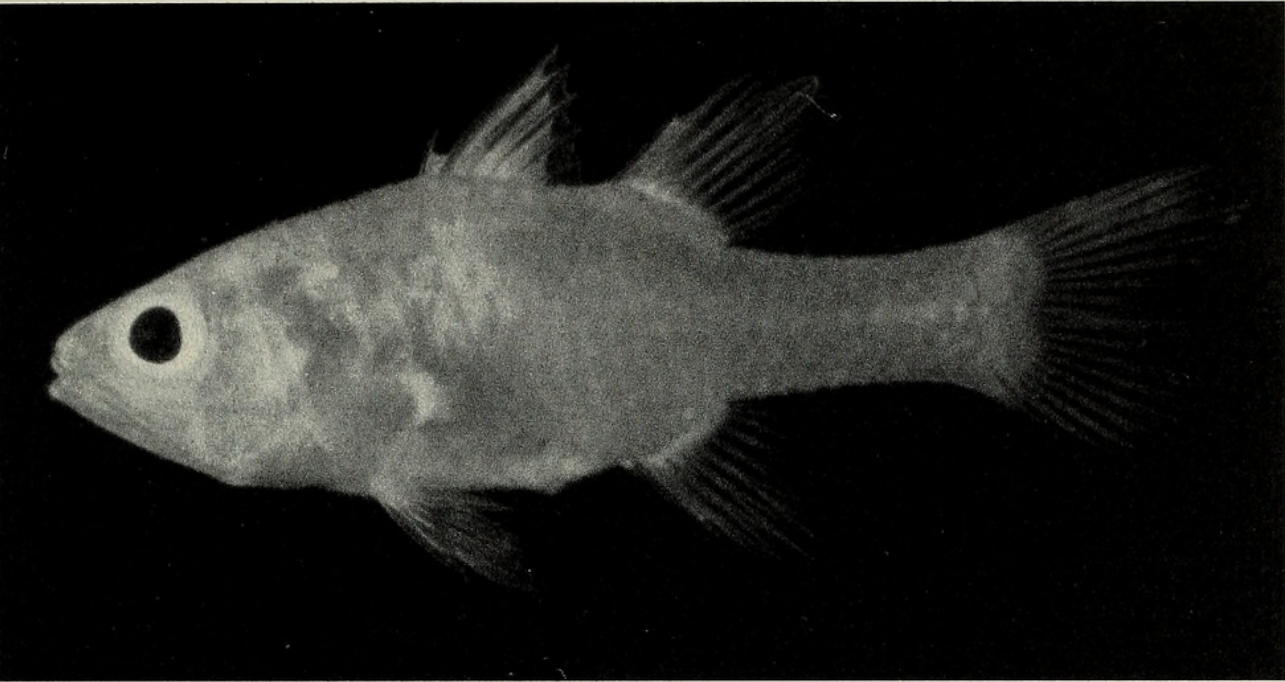


Fig. 1. The holotype of *Apogon dianthus* from Palua, Pacific Ocean, 48.0 mm SL.

*Apogon dianthus*, new species  
Fig. 1

*Material examined*.—Holotype BPBM 9360, 48.0 SL, Palau Islands, 420 m southwest of Malakal Pass. Cave at base of coral head on 60° slope. Chemfish, 18 m, J. E. Randall, A. R. Emery, and E. S. Helfman. 17 Apr 1970. x-ray.

*Comparative material*.—*Amia dieneacea* holotype USNM 70243; 31.8; Philippine Is., Jolo Is., Sulade I.; 17 Sep 1909; x-ray. *Amia guadalupensis* holotype USNM 87545; 84.0; Mexico, Guadalupe Is.; x-ray. *Apogon atradorsatus* holotype SU 6357; 71.0; Galapagos Is., Charles I.; x-ray. *Apogon atricaudus* syntypes SU 5708; 12(40–65); Mexico, Revillagigedo Is., Socorro I.; x-ray. *Apogon campbelli* syntypes RUSI 348; 39.5; Mozambique, Delagoa Bay; x-ray. USNM 112207; 34.0; same data; x-ray. *Apogon caudicinctus* holotype BPBM 13002; 50.9; Rapa; 0–3 m; 14 Feb 1971. *Apogon coccineus* lectotype SMF 973; 35.0; Eritrea, Massawa; x-ray. paralectotypes SMF 4705; 25.5 mm SL; SMF 4705; 26.2; same data; x-ray. *Apogon crassiceps* holotype MCZ 28314; 26.3; Fiji, Suva Reef. *Apogon deetsie* BPBM 37400; 40.4;

Hawaiian Is., Oahu I.; 10 Oct 1969. *Amia doryssa* holotype USNM 51812; 34.8; Samoa, Apia; x-ray. paratype SU 8684; 30.3; same data. *Apogon erythrinus* holotype USNM 50876; 35.5; Hawaii, Puako Bay; x-ray. paratypes USMN 55316; 39.1; USNM 55321; 27.9; both x-ray. SU 7733; 29.7; Hawaii, Honolulu; Albatross; 1902; SU 7734; 24.2–27.2; Hawaii, Kanai, Hanalei Bay. *Apogon hypselonotus* RMNH 5571; 30.0, 38.0 TL; Batu Archipelago. *Apogon lativittatus* holotype BPBM 11665 Marquesas Is., Fatu Hiva; 18 April 1971. paratypes BPBM 11032; 5(20–49); Marquesas Is., Ua Pou, Vaeho Bay; 29 Apr 1971; x-ray. *Apogon leptocaulus* paratype ANSP 117463; 41.9; Bahamas, Providencia I.; *Apogon semiornatus* RUSI 1868; 22.7; Mauritius, Round I.; 3 Mar 1971; x-ray. *Apogon warreni* holotype BMNH 1906.11.19.50; 40.7 mm SL; South Africa, Kosi Bay. *Apogon susanae* holotype CAS 85037; 30.2; Ifaluk Atoll; 1 Nov 1953; x-ray. *Apogon indicus* holotype USNM 341643; 28.8; Mauritius, Le Morne; 6–8 m; x-ray. A. sp A USNM 349197; 49.5; Philippines, Balicasag I., 9°31'14"N, 123°40'00"E; 0–24 m; 10 Aug 1978.

*Diagnosis.*—A member of the subgenus *Apogon*, with 12 pectoral-fin rays; 15 well-developed gill rakers; lacking bars, stripes or other markings on the fins, scales and body.

*Description.*—Proportions (percentage of standard length): greatest body depth 33.1; head length 40.6; eye diameter 11.9; snout length 9.2; bony interorbital width 6.9; upper-jaw length 20.4; caudal-peduncle depth 14.2; caudal-peduncle length 27.9; first dorsal-fin spine length 6.7; second dorsal-fin spine length 21.0; third dorsal-fin spine length 17.5; fourth dorsal-fin spine length 14.4; spine in second dorsal fin 13.1; first anal-fin spine length 2.7; second anal-fin spine length 14.4; pectoral-fin length 30.6; pelvic-fin length 35.0.

Dorsal fin VI-I,9; anal fin II,8; pectoral fin 12; pelvic fin I,5; principal caudal rays 9 + 8; many scales missing, counts not made of pored lateral-line scales and circumpeduncular scales, remaining scales ctenoid; one row of scales above lateral line, six transverse scale rows below lateral line, four median predorsal scales, simple pore on lateral-line scale with single opening; first gill arch with two rudiments and three rakers on upper arch; two rudiments and 12 rakers on lower arch; total rudiments and rakers 19 (2+3-12+2), well develop rakers 15 (3+12); second gill arch with rudiments and short rakers 2+1-11+3.

Villiform teeth in several rows on premaxilla; several rows on dentary; a single short row with a posterior group on palatine; one short row on vomer; none on ectopterygoid, endopterygoid or basihyal.

Vertebrae 10 + 14. Five free hypurals, no uroneurals, three epurals, a free parhypural. Two supraneurals, one supernumerary spine on first dorsal pterygiophore. Basisphenoid present. Supramaxilla absent. Posttemporal smooth on posterior margin. Preopercle ridge smooth, vertical edge serrate, ventral edge unossified flap. Infraorbital edge smooth. Skin at end of snout without free edge near anterior nostril.

*Color in alcohol.*—Head, body and fins

without marks, spots or other indications of color pattern (Fig. 1). Stomach and intestine pale, peritoneum pale with minute melanophores.

*Life colors.*—Light orange-pink body, slightly translucent, tip of jaw pale red, fin rays pink with membranes clear. From notes of J. E. Randall shortly after collection.

*Distribution.*—Known only from Palau; should be expected elsewhere in the West Pacific.

*Etymology.*—From the Latin word *dianthus*, a genus of plants, some with pink flowers, here treated as a masculine adjective using *dianth* and the suffix -us, referring to the pink body color.

*Remarks.*—Three groups of similar Indo-Pacific species of *Apogon* with one supernumerary dorsal spine, a ventral unossified portion of the preopercle and very simple pore architecture on the lateral-line scales may be related. These groupings, only one of which has a subgeneric name, for simplicity of identification can be separated from one another by having two or three supraneurals, none or one pair of uroneurals, scales on body about same size as pored lateral-line scales or becoming increasingly smaller, dark or pale peritoneum, and dark or pale stomach and intestine. *Apogon dianthus* can be added to those species which have been recognized as a subgenus, *Apogon*, by having a pale stomach, intestine and peritoneum, no uroneurals and two supraneurals. Species comparisons are discussed among several possible phenetic groupings within the subgenus *Apogon*.

*Apogon dianthus* has pale lining (epithelium) of the stomach, intestine and peritoneum, no free edge of skin near the anterior nostril and one full scale between the pored lateral-line scales and the second and third dorsal spine. It is distinguished from other species in having three developed rakers on the upper limb of the first arch gill (first raker about twice the length of the preceding rudiment and less than half the length of the second raker) and 12 pectoral-fin

rays. *Apogon deetsie* and *Apogon* sp. (being described by Allen and Randall) with two or three developed upper arch gill rakers, 12 circumpeduncular scales and 13–16 well-developed gill rakers are likely to be confused with *A. dianthus*. *Apogon* sp. has 13 pectoral-fin rays and darkish bars on the caudal peduncle. *Apogon deetsie*, a Hawaiian endemic, has 12 pectoral-fin rays, 1-2+2-3 rudiments and rakers on the upper limb of the first gill arch and 11-12+1-2 rakers and rudiments on the lower limb arch of the first gill arch and blackish bars on the body. Another species with two upper arch gill rakers, *Apogon coccineus*, has 13 pectoral-fin rays and 10–11 well-developed gill rakers, is smaller in size and is restricted to the western Indian Ocean.

Those species usually with one developed gill raker on the upper arch and 13–14 pectoral-fin rays include *A. campbelli* Smith, 1949, *A. crassiceps* Garman, 1903, *A. erythrinus* Snyder, 1904, *A. hypselonotus* Bleeker, 1855, *A. indicus* Greenfield, 2001, *A. lativittatus* Randall, 2001, *A. marquesensis* Greenfield, 2001, and *A. susanae*. Some species which usually have 12 pectoral-fin rays, including *A. caudicinctus* Randall & Smith, 1988, *A. doryssa* Jordan & Seale, 1906, *A. semiornatus* Peters, 1876, *A. warreni* Regan, 1908 (= *semiornatus*), and *A. diencaea* (Smith & Radcliffe in Radcliffe, 1912) (= *semiornatus*), can be distinguished from *A. dianthus* by the presence of one developed gill raker on the upper arch instead of three, and 8–11 well-developed lower gill rakers instead of 12.

Greenfield (2001) noted that several reddish, translucent species without dark markings could be further differentiated by: end of the snout without a free edge near the anterior nostril and two full scales present between the pored lateral-line scales and the second and third dorsal spines (*A. erythrinus*, *A. indicus*, *A. marquesensis* and *A. susanae*); and end of the snout with a free edge near the anterior nostril and one full scale present between the pored lateral-line scales and the second and third dorsal

spines (*A. campbelli*, *A. coccineus* Rüppell, 1835, *A. crassiceps*, *A. hypselonotus*, *A. kominatoensis* Ebina, 1935). Greenfield did not place *A. doryssa* (also reddish and translucent) in either of these groups because of other slight differences. Based on these characters, *A. dianthus* has one character from each group, creating some uncertainty about its relationships with species in these phenetic groupings.

*Apogon kominatoensis* described by Ebina (1935) as having 'Gill-rakers 4 + 12, of which 5 are rudiments, . . .', is clearly distinguished from *A. dianthus* by the lower number of well-developed gill rakers. Status of the type material is uncertain according to Gon (in litt). The holotype of *A. cardinalis* (Seale, 1909) was likely destroyed during World War II. Seale noted that *A. cardinalis* was related to *A. erythermus*, a misspelling of *erythrinus*. He further mentioned about 13 short, sharp, pointed gill rakers on the lower limb and the presence in preservative of dusky marks at the base of dorsal fin and a brown spot on the nuchal region. In life the color pattern was described as ' . . . uniform bright cardinal, without stripes or bands; a slight tint of yellow on side of belly, and a brownish blotch on opercles just posterior to eye, fins all uniform red.'

A western Atlantic species, *A. leptocaulus* Gilbert, 1972, has a similar preserved color pattern. However, it differs in being deep red with reddish fins instead of being pink, in having 17–20 instead of 13–15 well-developed gill rakers on the first gill arch and in having 7–8 instead of six predorsal scales.

All the eastern Pacific species of *Apogon* have 12 pectoral-fin rays and gill raker and rudiment counts similar to *A. dianthus*. Three Eastern Pacific species *A. atradorsatus* Heller & Snodgrass 1903, *A. atricaudus* Jordan & McGregor in Jordan & Evermann 1898 and *A. guadalupensis* (Osburn & Nichols, 1916) lack bars, stripes or other darkish markings on the head and body. They are distinguished from *A. dianthus* by

having much smaller body scales, higher predorsal scale counts (9) and dusky pigmentation on the first dorsal fin and tips of the anal and second dorsal fins.

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