

## A new species of Cardinalfish in *Neamia* (Apogonidae, Perciformes) from Mauritius, Indian Ocean, with a review of *Neamia octospina*

Thomas H. Fraser<sup>1</sup> and Gerald R. Allen<sup>2</sup>

<sup>1</sup> Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, Florida 34236, U.S.A.

<sup>2</sup> Department of Aquatic Zoology, Western Australian Museum, Francis Street, Perth, Western Australia 6000, Australia

---

**Abstract** – Smith and Radcliffe described *Neamia octospina* in 1912. The genus was considered monotypic until a second species was discovered recently in the marine waters of Mauritius, Indian Ocean. *Neamia notula* sp. nov., differs from *N. octospina* in having 14 instead of 17–21 pectoral rays; eighth dorsal spine hidden by skin instead of visible, larger eyes, more slender body depth and an opercular spot instead of none. *Neamia octospina*, a widespread species, is reviewed. There is consistent variation in pectoral-fin ray counts between the Indian Ocean and West Pacific. There is no other morphological evidence to support recognition of more than one widespread species at this time.

### INTRODUCTION

Smith and Radcliffe in Radcliffe (1912) based *Neamia* on a deeply notched dorsal fin with nine visible dorsal spines, ctenoid scales, villiform teeth in the jaws, no teeth on the palatines, a smooth preopercle margin and rounded fins. *Neamia* represents a derived apogonid genus with many modifications, and relationships with *Apogonichthys*, *Foa*, *Fowleria*, and *Neamia* have been hypothesized by Fraser (1972). All known species among these genera have rounded caudal fins, smooth preopercle ridge and edges, a single reduced supramaxilla, smooth posttemporals, low number of well developed gill rakers (5–9), and one pair of uroneurals. Table 1 provides a comparison of selected characters for these four genera.

No comprehensive review of the collections of *Neamia* has been made as a part of any study. Klunzinger first described a species of *Neamia* in 1884 as *Apogon sphenurus* (suppressed) from the Red Sea. Smith and Radcliffe in Radcliffe, 1912, described *Neamia octospina* from the Philippine Islands. Smith (1955) first reported *Neamia octospina* from the Indian Ocean. Another species was described by Whitley in 1964 from Australia as *Apogonichthys coggeri*, but he missed the small, but visible, eighth spine in the dorsal fin. Gon (1987a) presented data that Klunzinger's use of the *Apogon sphenurus* name satisfies the Zoological Code but should be suppressed in favor of the more wide-spread use of *Neamia octospina*. He reported on two of the types and five West Indian Ocean specimens. An opinion suppressing this name was made in 1989 in the Bulletin of Zoological Nomenclature. Paxton *et al.* (1989) later synonymized *Apogonichthys coggeri* with *Neamia octospina*.

The discovery of a second species with a hidden eighth dorsal spine, an opercular spot, no palatine teeth, a completely pored lateral line and a body shape similar to *Fowleria*, at first suggested a new species in *Apogonichthys*. Examination of internal characters from x-ray photography revealed derived characters shared only with *Neamia octospina*. The purpose of this paper is to describe the new species and report on the variation and distribution of *Neamia octospina*.

Methods of taking and recording meristic data and measurements are given in Fraser and Lachner (1985). All measurements are in millimeters to the nearest 0.1. The following acronyms are used to designate institutions and collections cited and follow general usage given in Eschmeyer (1998): AMS Australian Museum, Sydney; ANSP Academy of Natural Sciences, Philadelphia; BPBM Bernice P. Bishop Museum, Honolulu; CAS California Academy of Sciences, San Francisco; HJH Hebrew University, Jerusalem, Israel; ROM Royal Ontario Museum, Toronto, Canada; RUSI J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa; TAU Tel Aviv University, Israel; USNM collections of the former United States National Museum, deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.; WAM Western Australian Museum, Perth, Western Australia; ZMB Universitat Humboldt, Berlin, Germany. Field station numbers are listed for additional collection information, for example, VGS 69-23. Radiographs (x-ray) have been taken from type material of both species. These radiographs are in the possession of the first author.

**Table 1** Comparison of selected characters for *Neamia*, *Apogonichthys*, *Foa*, and *Fowleria*.

Character	<i>Neamia</i>	<i>Apogonichthys</i>	<i>Foa</i>	<i>Fowleria</i>
Hypural plate	1+2, 3+4 fused	1 to 4 free	1 to 4 free, or 1+2 fused	1 to 4 free
Urostylar centrum	3+4 hypurals fused	4 <sup>th</sup> hypural fused	hypurals free	hypurals free
Uroneurals	reduced or elongate	elongate	reduced	elongate
3 <sup>rd</sup> epural	reduced or slender	elongate	elongate	elongate
Eighth dorsal spine	visible or hidden	hidden	absent	absent
Vomerine teeth	1-3 rows	1-2 rows	1-2 rows	in a band
Palatine teeth	none	none to a few	1-2 rows	none
Ectopterygoid teeth	none	none to a few	none	none
Pored lateral line scales	complete	complete	pits posteriorly	complete or pits posteriorly
Basisphenoid	absent	reduced	reduced	absent
First pharyngobranchial	present	absent	absent	absent
Infraorbital shelf	on 3 <sup>rd</sup>	on 3 <sup>rd</sup>	on 3 <sup>rd</sup>	on 3 <sup>rd</sup> , 4 <sup>th</sup> , and 5 <sup>th</sup>

## SYSTEMATICS

### *Neamia* Smith and Radcliffe in Radcliffe, 1912

#### Diagnosis

An apogonine with three hypurals, 1 and 2 fused, 3 and 4 fused, 5 free, hypurals 3+4 fused to urostylar centrum; one pair of reduced or slender uroneurals; three epurals; three supraneurals; two supernumerary dorsal spines; smooth preopercle edges and ridge, smooth posttemporal; no basisphenoid; a reduced supramaxilla; no palatine teeth; lateral-line scales extending from posttemporal to base of caudal fin, all ctenoid with simple pores; rounded caudal fin; nine dorsal spines, eighth spine visible or hidden by skin, dorsal fin deeply notched and considered separate, the ninth spine at beginning of second dorsal fin; dorsal-fin rays 9; anal-fin rays 8; 14-21 pectoral rays; pale stomach, intestine and peritoneum.

#### *Neamia notula* sp. nov.

Figures 1a, 2; Table 2

#### Holotype

USNM 347045; (34.0 mm SL); Mauritius, Baie de la Petite Riviere, off Albion Fisheries Research Centre, Sta M-8, 24 m, 25 Apr 1995.

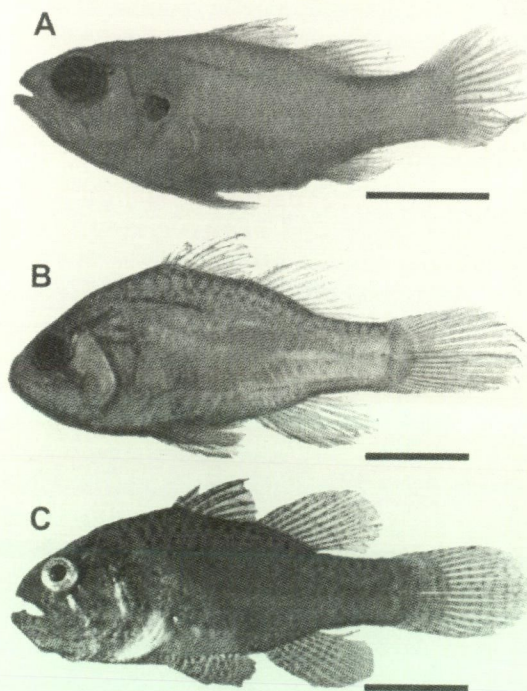
#### Paratypes

USNM 349188; (31.5 mm SL), taken with holotype, 1995. USNM 347044; (30.2 mm SL); Mauritius, La Preneuse, Black River Pass, Sta M-26, 34-36 m, 12 May 1995.

#### Comparative material

*Fowleria* sp. India: USNM 205215; 11(20-58 mm SL), Musal Tivu, Manauli Reef, LW-3, L. P. Woods, 20 Dec 1963. *Fowleria flammea* USNM 345020; 6(26-37 mm SL), Papua New Guinea, Madang Harbour, 30 May, 1970, x-ray. *Apogonichthys nanae* Holotype

USNM 62947; (22.1 mm SL), Japan, Naha, Okinawa I., x-ray. *Apogonichthys marmorata* Syntypes AMS I. 16311-001, formerly F 421; (34.9-39.6 mm SL), Australia, Cape Greenville, x-ray. *Apogon auritus* Holotype MNHN 8760; (54.4 mm SL), Mauritius. *Apogonichthys polystigma* Syntype RMNH 5611; (60.2 mm SL), Sumatra, Priaman. *Apogon punctulatus* Syntypes SMF 4685; (32.4 mm SL), Eritrea, Massaua, 1834. SMF 4686; (28.6 mm SL), same data as 4685. *Apogon variegatus* Syntypes MNHN 1973-42; (25.7-



**Figure 1** a, Holotype of *Neamia notula*, USNM 347045 from Mauritius, 34.0 mm standard length; b, *Neamia octospina*, USNM 262495 from Kranket I., New Guinea, 36.2 mm standard length; c, *Neamia octospina*, a fresh specimen from a color slide by J.T. Williams, USNM uncataloged from Useparapara, Tonga Islands, 36.2 mm standard length. Scale = 10.0 mm.

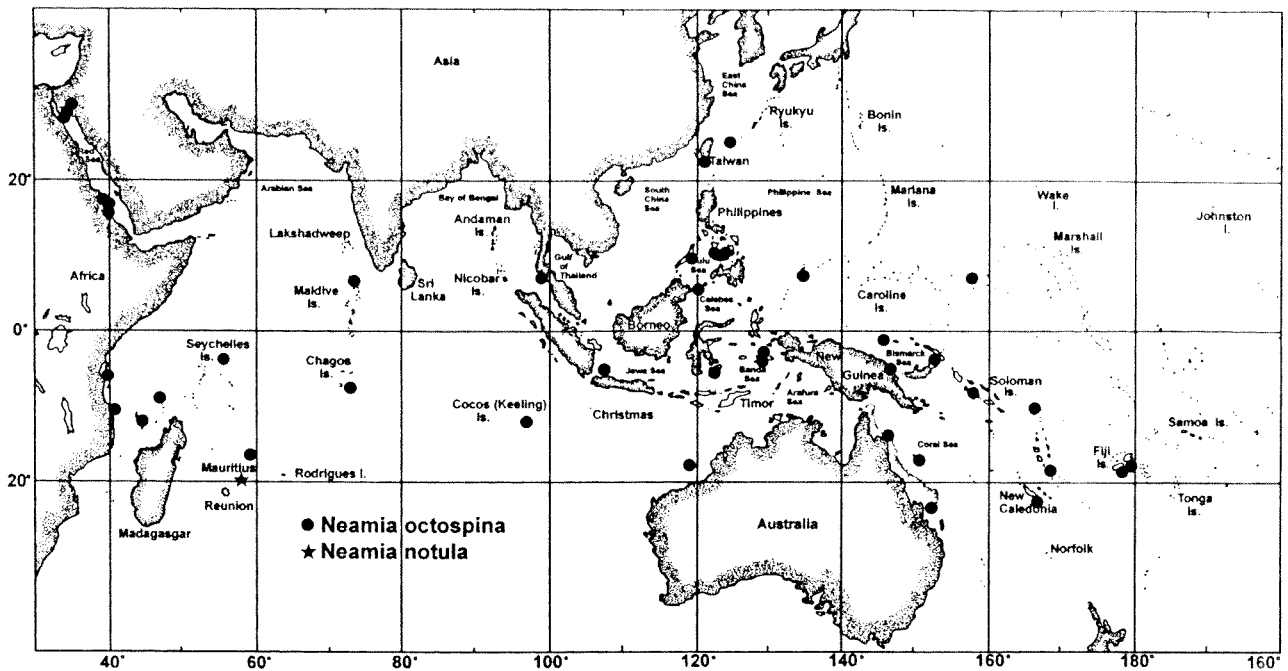


Figure 2 Distribution of the collection sites for *Neamia notula* ★ and *Neamia octospina* ● examined or cited from literature in this study.

33.5 mm SL), Madagascar, Nosy-Bé, x-ray. *Apogonichthys isostigma* Holotype USNM 51736; (50.3 mm SL), Samoa, Apia, x-ray.

### Diagnosis

A species of *Neamia* with seven visible first-dorsal spines, spine 8 hidden by skin, darkish spot on the opercle below opercular spine with darkish blotch above, faint mark behind eye above the center line, body otherwise pale, 14 pectoral rays, four predorsal scales, eye diameter 12–13 % and body depth 35–40% of standard length.

### Description

For general body shape see Figure 1a. Proportions measurements of holotype (in parentheses) and paratypes represented as % of standard length): greatest body depth 35–40 (40.0); head length 40–45 (42.6); eye diameter 12–13 (12.6); snout length 8.6–9.3 (9.1); bony interorbital width 4.4–6.0 (4.4); upper jaw length 20–22 (21.5); caudal peduncle depth 16–17 (16.8); caudal peduncle length 20–22 (20.0); first dorsal-fin spine length 2.6–3.5 (2.6); second dorsal-fin spine length 9.4–11 (9.4); third dorsal-fin spine length 19 (19.1); fourth dorsal-fin spine length 17–19 (17.3); spine in second dorsal fin 9.7–10 (9.7); first anal-fin spine length 2.0–3.3 (2.0); second anal-fin spine length 10 (10.0); pectoral fin length 23–24 (23.8); pelvic fin length 25 (24.7).

Dorsal fin VII-I,9, spine 8 hidden; anal fin II,8; pectoral fin 14-14; pelvic fin I,5; principal caudal rays 9+8; pored lateral line scales 23; transverse scale rows above lateral line 2; transverse scale rows below lateral line 6; median predorsal scales 4;

circumpeduncular scale rows 12 (5+2+5). Total rudiments and gill rakers 13–14 (2+0-5+6-7, holotype 2+0-5+7), well developed gill rakers 0 upper arch, 5 lower arch.

Villiform teeth in a band of about five rows becoming two rows on side of premaxilla; villiform band of about five rows becoming two rows on side of dentary; one to three rows of villiform teeth on vomer; none on palatine, ectopterygoid, endopterygoid or basihyal.

Vertebrae 10+14. Three hypurals, 1+2 and 3+4 fused; hypurals 3+4 fused to urostylar centrum, one pair of slender uroneurals, three epurals, a free parhypural. Three supraneurals, two supernumerary spines on first dorsal pterygiophore. Status of basisphenoid and suspensory pharyngeal unknown. Vestigial supramaxilla. Posttemporal smooth on posterior margin. Preopercle smooth on vertical and horizontal margins. Infraorbital edges smooth.

Scales weakly ctenoid on body, cycloid on nape, opercle, cheek, interopercle and breast. Pored lateral-line scales simple, extending from posttemporal to base of caudal fin. Anterior nostril with a short tube, posterior nostril flat. Caudal fin rounded.

Life colours: Kuitert and Kozawa (1999) have the fresh-dead, with abdominal area distended, holotype of *Neamia notula* identified as *Fowleria aurita* (p. 51) from a photograph by P. C. Heemstra. Head and body reddish with blackish mark from ventral portion of eye becoming thicker along the posterior edge of eye onto nape; posterior nostril area blackish; blackish blotches on upper portion of

opercle and preopercle; semi-rounded blackish mark inside a pale, narrow edged area posteriorly and much wider anteriorly; base of pectoral fin with pale blotch; pale marks on reddish lips; iris mostly reddish, ventrally with partially yellowish semicircle; ventral portion of membrane between first, second and third dorsal spine blackish, rest of first dorsal fin light pinkish; second dorsal fin pale with a orange-reddish stripe near base of fin; caudal-fin membranes pale, fin rays orange-reddish; anal, pelvic and pectoral fins pale.

Colour in ethyl alcohol. Head and body pale, spot on opercle with a line of melanophores above opercular spine, faint mark behind eye above centerline, five-six melanophores behind eye anterior to the top of the opercle. All fins pale, without any apparent marks or spots. Pale stomach, intestine and peritoneum.

### Remarks

The new species shares a rounded caudal fin, smooth posttemporal edge, smooth preopercle edges and reduced supramaxilla with species of *Apogonichthys*, *Foa*, *Fowleria* and *Neamia*. Other selected characters for these genera are given in Table 1. The radiographs suggest the basisphenoid is reduced (no belophram portion, status of the meningost portion not possible) in the new species. The eighth dorsal spine is reduced, hidden by skin, unlike *Neamia octospina*, making *N. notula* similar to *Apogonichthys* in the sequence of reduction (clearly splitting the dorsal fin). Both *Foa* and *Fowleria* lack even the ossified evidence of the eighth spine (Fraser, 1972). *Neamia notula* shares with *N. octospina* the two fused hypural plates (1+2 and 3+4) and the fusion of hypural plate 3+4 to the urostylar centrum. Partial fusion of hypural plates 1 and 2 occurs in *Foa fo* (Fraser, 1972). Species of *Apogonichthys* have the fourth hypural plate fused to the terminal centrum. *Foa* and *Fowleria* have the basal percoid organization of five free hypurals. *Neamia octospina* has a reduced pair of uroneurals like *Foa*, while *N. notula* has a longer pair more like

*Apogonichthys* and *Fowleria*. Information on the status of the first pharyngobranchial, shelves on the infraorbitals and ceratohyal shape is unobtainable from the radiographs for the *N. notula*. All specimens of *N. notula* have the body shape somewhat distorted by expanded swimbladders. Nevertheless, this species has the general physiognomy of an *Apogonichthys* with a preserved color pattern similar to some *Fowleria*. Species of *Foa* and *Fowleria* have simple pored lateral-line scales from the posttemporal for up to 10–11 scales followed by one pit in each scale thereafter to the base of the caudal fin, while both *Neamia* and *Apogonichthys* have simple pored lateral-line scales complete from the posttemporal to the base of the caudal fin. No uniquely shared derived characters were identified for *Neamia notula* and species of either *Foa* or *Fowleria*. We place this species in *Neamia* because of the shared derived caudal skeleton characteristics not known in any *Apogonichthys*, *Foa* or *Fowleria*.

*Neamia notula* is known only from Mauritius in 24–36 m. *Neamia octospina* has been collected from stations as deep as 17–22 m., but has been most commonly collected in depths less than 6 m. This species differs from *Neamia octospina* in having the eighth dorsal spine hidden by skin, 14 pectoral rays instead of 17–21 (Table 2), 4 predorsal scales instead of 6, larger eye of 12–13% SL instead of 8.6–10% SL, more slender body of 35–40% SL instead of 40–45% SL and a darkish opercular spot instead of three marks radiating from the eye.

Specimens of *Fowleria aurita* and *Fowleria vareigata* were taken with *Neamia notula*. The opercular spot and the marking above it are similar to the opercular spot and markings found in these species of *Fowleria*, but both can be externally distinguished from the new species most easily by having posterior lateral line scales with a single pit in each scale instead of pored scales. One undescribed species, probably belonging in *Fowleria*, from the northern Indian Ocean has all lateral-line scales pored like *Neamia*.

**Table 2** Frequency of the pectoral-fin ray counts for *Neamia notula* and *Neamia octospina*.

	Pectoral Fin-Rays							
	14	15	16	17	18	19	20	21
<i>Neamia octospina</i>								
Red Sea /West & Central Indian Ocean								
Right				2	22	4		
Left				1	26	2		
Total				1	48	6		
East Indian /Pacific Ocean								
Right					5	51	21	
Left					3	57	12	1
Total					8	108	33	1
<i>Neamia notula</i>	3							

**Etymology**

The species name, *notula*, is the diminutive of the feminine Latin noun *nota*, meaning mark, and refers to the spot on the opercle.

*Neamia octospina* Smith and Radcliffe in  
Radcliffe, 1912

Figures 1b, 1c, 2, Table 2

*Apogon sphenurus* Klunzinger, 1884 [suppressed for purposes of priority by Commission on Zoological Nomenclature (Opinion 1564, 1989)].

*Apogonichthys coggeri* Whitley, 1964.

**Material Examined**

*Apogon sphenurus* ZMB 74 (26.6 mm SL), Eritrea, Mits'iwa (Massawa). *Apogonichthys coggeri* Holotype. AMS IB 6016 (40.1 mm SL), Australia, Gillett Cay, 20 Oct. 1962, x-rayed. Paratypes. AMS IB 6017 (42.3 mm SL), same data as holotype. AMS IB 6018 (39.3 mm SL), same data as holotype. *Neamia octospina* Holotype. USNM 70251 (27.9 mm SL), Philippines, Palawan, Rasa I., Mantaguin Bay, x-rayed. **Indian Ocean:** **Egypt:** Gulf of Aquba: USNM 349100, (34): El Himeira, VGS 69-24, 9 Sep 1969, 21-28 m. USNM 349106, (30-32), El Himeira, VGS 69-23, 8 Sep 1969, 9-12 m. TAU P.4549, (37), Dahab. HUI 11780, (34), Sanafir I. HUI 5887, (34), Ras Muhammad. **Israel:** TAU P.7548, (17), Gulf of Aqaba, Eilat. **Eritrea:** USNM 349110, 7(17-25), Sciumm I., 15°32'31"N, 40°00'00"E, VGS 69-10, 9 Aug 1969, 0-7 m. USNM 349107, 6(19-30), Difein I., VGS 69-15, 15 Aug 1969, 0-4 m. HUI 6217, (29). HUI 11938, (31-36), South Red Sea. **St. Brandon's Shoals:** USNM 261694, (34), Siren I., VGS 76-18, Apr 11 1976, 15 m. USNM 261697, (35), VGS 76-19, Apr 12 1976, 17-22 m. USNM 261749, 3(38-45), Ile Raphael, VGS 76-20, Apr 12 1976 16. 0-9 m. USNM 261753, (39), near Ile Raphael, VGS 76-7, Apr 3 1976, .5-1 m. **Zanzibar:** RUSI 4520, (30-33). Rusi 4524, (36). **Mozambique:** RUSI 1060, (31), Mozambique I., June 1950. **Comoro Is.:** ROM 61759, (12.0), Recif du Sable Blanc. Patch Reef, 12°58'52"S 45°12'45"E, 14 Nov 1988. **Seychelles Is.:** RUSI 4522, (29-30), Mahe I. RUSI 4525, 3(21-28), Aldabra, Nov 1954. **Chagos:** USNM 349102, (27), Diego Garcia Atoll, HA 67-14, 21 Jun 1967, 0-2 m. ROM 44365, 3(15.4-30.4), Three Brothers, 6°08'24"S 71°33'52"E, 28 Feb 1979. **Cocos-Keeling Is.:** ANSP 131038, (18.5-26), West Island, CK-4, 24 Feb 1974, 0.5-2.0 m. ANSP 131035, (31.5-36), Direction Island, CK-16, 2 Mar 1974. ANSP 131036, (36), CK-23, Prison Island, 7 Mar 1974. ANSP 131037, (24-30), Lagoon near West Island pier, CK-11, 28 Feb 1974. ANSP 131034, 6(31-39.5), Direction Island, CK-17, 2 Mar 1974. **Thailand:** ROM 71568, (15.6), Andaman Sea, Phuket Co., Ko Hi Bay, 7°44'30"N 98°22'32"E, 12 Nov 1993, 6-11 m. **Pacific Ocean Australia: Queensland:** USNM

203779, 7(28-37), One Tree I., VGS 66-9, 27 Nov 1966, 0-1 m. USNM uncat, (32), One Tree I., VGS 66-18, 9 Dec 1966, 0-1 m AMS I. 20463-018, 2(36-39), One Tree I. AMS I. 20205-008, (32), One Tree I. USNM 349109, (34), One Tree I., VGS 64-4 or 5, 18-19 Nov 1966, 1-1.8 m. AMS I. 20487-001, (22), One Tree I. ANSP 123389, 1( ), Little Hope Island, TSA-2, 3 Jan 1969. AMS I. 30995-005, (26), Yonge Reef. AMS I. 19472-077, (19), Yonge Reef. AMS I. 20770-078, 4(25-27), Charles Hardy I. AMS I. 19456-063, (29), Lizard I. AMS. I. 19607-052, (31), Lizard I. AMS I. 15622-017, (35), Capricorn Group. AMS I. 15680-007, 2(31-34), Capricorn Group. **Coral Sea:** WAM 29642.012, 3(14-32), Diamond Islet, N.W. Cay, 17°25'S 150°48'E, 15 Nov 1987. **Western Australia:** WAM 28022.021, (39), Rowley Shoals, Clerke Reef, 17°18'S 119°22'E, 4 Aug 1983. WAM 28032.009, (37-42), Rowley Shoals, Clerke Reef, 17°18'S 119°22'E, 12 Aug 1983. **Timor Sea:** AMS I. 33720-017, (20.9), Ashmore Reef. **Caroline Islands:** **Pohnpei:** USNM 224755, (36), VGS 80-4, Sep 4 1980, .5-1 m. BPBM 31183, (28), 20 Jul 1955. **Fiji Islands:** USNM 262479, 13(29-36), Lau Group, Matuku I., 19°09'38"S, 179°45'23"E, VGS 82-3, Apr 23 1982, .3-1 m. USNM 262480, (31), Kandavu I., Levuka, 18°56'15"S, 178°21' 10"E, VGS 82-24, May 13 1982, 0-7 m. ROM 43634, (32.2-36.3) Lauthala Bay, 18°10'28"S 178°28'40"E, 11 Apr 1983. ROM 44174, (18.2-32.3), Cagelai Island, Viti Levu, 18°08'90" S 175°25'90"E, 12 Apr 1982. **Indonesia:** USNM 261564, (31), Saparua, SE Tip of Haria Bay, 3°35'S, 128°36'E, VGS 74-5, Mar 5 1974, 1.5-4.6m. USNM 261568, (29-32), Pulau Tikus, 5°51'25"S, 106°34'15" E, VGS 74-34, Apr 5 1974, 0-4.6m. USNM 261579, 3(31-33), Ambon, 3°38'00"S, 128°17' 30"E, VGS 74-23, Mar 18 1974, 0-1.5 m. USNM 261580, (26), Buton I., 5°24'30"S, 122°37'28"E, VGS 74-26, Mar 28 1974, 1-7.7 m. **Papua New Guinea:** USNM 261045, (25), Hermit Is., Akib I. 1°32'30"S, 145°02'30"E, VGS 78-9, Oct 29 1978. USNM 261046, (26), Massas I., 5°10'18"S, 145°51'24"E, VGS 78-21, Nov 06 1978, 0-18 m. USNM 262495, (36), Kranket I., 5°11'30"S, 145°50'42"E, VGS 78-22, Nov 7 1978, 0-1 m. USNM 349104, (24), Madang Harbour, BBC 1487, 26 May 1970, 9 m. WAM 30342.002, 4(16-29), Madang, 5°10'00"S 145°51'00"E, 9 Oct 1991. WAM 30353.026, (33), Madang, 5°10'00"S 145°51'00"E, 26 Oct 1991. **Keraward I.:** USNM 349101, (29), Duke of Kirk Grp., 4°14'S, 152°26'E, TeVega Cr. 6, Sta 234. **Philippine Islands: Negros Oriental:** USNM 261014, (33), 9°04'00"N, 123°08'48"E, SP-78-44, Jun 14 1978, 0-1.6m. USNM 261017, (31), 9°23'00"N, 123°15' 30"E, SP-78-46, Jun 18 1978, 0-2.5 m. USNM 268126, (12), 9°04'N 123°10'48" E, LK 79-4, Apr 28 1979, 0-3 m. USNM 268127, (30-32), 9°03'06"N, 122°59'06"E, LK 79-2, Apr 24 1979, 0-3 m. USNM 329247, (29), 9°06'30"N, 122°55'24"E, LK 79-3, Apr 26 1979, 0-2 m. USNM 329248, 6(17-33), 9°04'N, 123°10'48"E, LK 79-4, Apr 28 1979, 0-3 m. USNM

268125, 4(27-29), 9°03'06"N, 122°59'42"E, SP-79, May 18 1979. ROM 53931, 3(22.4-36.7), Bohol Strait, 9°26'12"N 123°23'06"E, 21 May 1987. ROM 54010, (35.5), Bohol Sea, Tonga Point, 9°12'16"N 123°27'16"E, 14 May 1987. ROM 54983, (34.4), Mindanao Sea, Tonga Point, Drop Off, 9°12'16"N 123°27'16"E, 8 May 1987. Apo I.: USNM 261015, (31), 9°04'25"N, 123°16'05"E, SP-78-34, Jun 06 1978, 0-6m. USNM 262305, 5(32-34), 9°04' 15"N, 123°16'20"E, SP-78-35, Jun 07 1978, 0-6m. USNM 268124, 7(31-35), 9°04'30"N, 123°16'24"E, LK 79-20, May 18 1979, 0-2.5 m. Cuyo Is.: USNM 261016, (29), Tagauayan I., 10°58'18"N, 121°12'28"E, SP-78-24, May 25 1978, 0-14 m. Palawan I.: USNM 349103, (30), Puerto Princesa, 7°44'N, 118°45'E, 2 Jun 1979, 6-12 m.. Mactan I.: USNM 268128, (10), 10°17'09"N 124°00'06"E, SP-78-29, Jun 02 1978, 0-40 m. Sibutu Is.: USNM 314521, (35), 4°52'00"N 119°26'51"E, EM 88-6, May 26 1988, 1.5-6 m. USNM 314546, (30-34), 4°38'40"N, 119°27'06"E, EM 88-7, May 27 1988, 1.5-6 m. Taiwan: USNM 349104, (29), SW of Ch'uan-fan-shih, VGS 68-10, 30 Apr 1968, 7-8 m. New Caledonia: ROM 65793, 3(29.8-33.4), Passe De Dumbea, 22°19'50"S 166°16'50"E, 5 Sep 1991. ROM 65814, 3(29.0-31.4), West of Isle Nge, 22°19'40"S 166°18'20"E, 5 Sep 1991. Solomon Islands: USNM 349105, (30), New Georgia, C-72, 4-5 Jun 1944. Palau: CAS 84315, (34), GVF 526, Urukthapel I., 7°15'35"N, 134°23'12"E, 20 Jul 1955, 0-2 m. Vanuatu: CAS 84316, (29-35), Efate I., 17°44'3"S, 168°18'36"E, GVF 1828, 8 Oct 1958, 1-3.7 m. USNM uncat., (36), Banks Is., Useparapara, 13°22'26"S 167°27'30"E, JTW 97-30, 21 May 1997, 1-12 m.

### Diagnosis

A *Neamia* with eighth dorsal spine visible, 17-21 pectoral-fin rays, 5-6 predorsal scales, body uniform or with faint markings on upper body scales, 3 brownish marks radiate from posterior portions of orbit, eye diameter 8.6-10% and body depth 40-45% of standard length.

### Description

Range of proportions as % of standard length: greatest body depth 40-45; head length 40-45; eye diameter 8.6-10; snout length 7.6-8.8; bony interorbital width 5.8-6.6; upper-jaw length 21-24; caudal-peduncle depth 15-20; caudal-peduncle length 19-22; first dorsal-fin spine length 3.3-4.7; second dorsal-fin spine length 8.0-10; third dorsal-fin spine length 17-22; fourth dorsal-fin spine length 15-19; spine in second dorsal fin 8.7-10; first anal-fin spine length 3.5-5.4; second anal-fin spine length 11-13; pectoral fin length 31-35; pelvic fin length 26-29.

Dorsal fin VIII-I,9, deeply notched without membrane attaching the eighth spine to the ninth spine; anal fin II,8; pectoral fin 17-21, rarely 17 or 21 (Table 2); pelvic fin I,5; principal caudal rays 9 +

8; pored lateral-line scales 22-23; transverse scale rows above lateral line 2; transverse scale rows below lateral line 6-7; median predorsal scales 5-6; circumpeduncular scale rows 13 (5+2+6). Total gill rakers 13-16, 1-2 rudiments and 1-2 well developed on upper arch, 6-7 well-developed and 4-7 rudiments (plates) on lower arch.

Villiform teeth in band on premaxilla and dentary; two rows on vomer; none on palatine ectopterygoid, endopterygoid or basihyal.

Vertebrae 10+14. Three hypurals (1+2 and 3+4 fused), one pair of reduced uroneurals, three epurals, third reduced, a free parhypural. Three supraneurals, two supernumerary spines on first dorsal pterygiophore. Basisphenoid absent. Supramaxilla present, reduced. Posttemporal smooth on posterior margin. Preopercle smooth on vertical and horizontal margins. Infraorbital shelf present on third bone.

Scales ctenoid on body, nape and breast. Scales cycloid on cheek and opercle, sometimes one scale ctenoid. Pored lateral-line scales simple, extending from posttemporal to base of caudal fin. Anterior nostril with a short tube, posterior nostril flat. Caudal fin rounded.

Live colours: From Smith (1961): " Alive, translucent pink much as in Pl 46, F...". From Whitley (1964) - "Colour in life, pinkish yellow with white flanks and belly, slightly pellucid. Fins white to hyaline with brown spots along their bases. Pupil dark blue, iris silver with several pink and orange spots. Several brown marks, fringed by silver, radiate from eye." From Ida and Moyer (1974) - "The body and all the fins are transparent except for three radiating black lines from the eye." Kuitert and Kozawa (1999) have a live photograph of *Neamia octospina* by G. R. Allen as a tanish, semi-translucent fish with three radiating brownish lines from the eye. The colour transparency with ROM 65793 has the specimen with three reddish radiating lines from the eye, iris broken up into reddish and whitish areas, body reddish above and posterior to a whitish abdomen, upper and lower jaws whitish, pelvic and vertical fins with faint spotting on the spines and fin rays, but not on membranes.

Colour in alcohol: Colour in 70% ethyl alcohol. Body and fins pale without markings or scales with faint markings on upper body, fins pale or with faint spotting on fin rays, head with none to three faint eye marks posteriorly from the eye onto cheek, side of the head to posttemporal and onto anterior nape.

Habitat: Ida and Moyer (1974) reported their specimen was caught from a deep coral hollow.

### Remarks

This species is known from the Red Sea to the West Pacific (Figure 2). It has been reported from the Maldivic Islands (Gon, 1987a), from Taiwan

(Shao and Chen, 1986) and from Ishigaki-jima, southern Japan (Ida and Moyer, 1974). *Neamia octospina* extends onto the Pacific Plate in the Carolina Islands chain at Pohnpei consistent with the discussion of other examples by Springer (1982, p. 124), but not elsewhere (Figure 2).

Whitley (1964) described a new species, *Apogonichthys coggeri* from Swain Reefs. He provided life color notes and noted that one specimen carried eggs in its mouth. He missed the small, visible eighth spine in the first dorsal fin of the holotype and paratypes. This type material has, in addition to eight first dorsal spines, no palatine teeth, pored lateral line scales from the posttemporal past the hypural plate, smooth preopercular edges and ridge, rounded caudal fin and 19–21 pectoral fin-rays. These characteristics along with the life and preserved color pattern are consistent with *Neamia octospina*. We agree with Paxton *et al.* (1989) that *Apogonichthys coggeri* is a junior synonym of *Neamia octospina*.

Variation in the number (4) of pectoral-fin rays is greater than observed variation within other species of cardinal fish. Usually, counts are invariant for most species and in some there are rarely a one or two fin-ray variation within a species. The western and central Indian Ocean and Red Sea material (west of and including Chagos Is.) tends to have 18 pectoral-fin rays while the Eastern Indian Ocean and West Pacific material (east of and including Cocos Keeling Is.) tends to have 19 or 20 (Table 1). No other significant differences were identified. The largest specimen was 45 mm SL (western form) and 42 mm SL (eastern form). If new information reveals other differences, then the Red Sea-Western Indian Ocean form will require a new name. *Neamia octospina* has the highest pectoral-fin ray count of any known apogonid.

The small eye diameter may suggest that this species is active during the day.

#### ACKNOWLEDGEMENTS

For the use of museum facilities we extend thanks to many colleagues that have helped during the past several years while working on this genus. Ofer Gon (RUSI) kindly provided pectoral fin-ray counts for some specimens (RUSI, HUI, TAU and ZMB) from the Red Sea and western Indian Ocean. D. Catania, W. N. Eschmeyer and T. Iwamoto at California Academy of Sciences, A. Suzumoto, Bernice P. Bishop Museum, W. Saul, Philadelphia Academy of Sciences, S. L. Jewett, D. G. Smith, J. T. Williams of the Smithsonian Institution (USNM), all aided in curatorial processes and during visits by the senior author. D. G. Smith and J. T. Williams helped with photography and x-rays. Leonard P. Schultz funds and office space were provided by V. G. Springer (USNM) for several study trips to the

Smithsonian. J. E. Randall (BPBM) provided useful comments for an early draft of the manuscript.

#### REFERENCES

- Fraser, T.H. (1972). Comparative osteology of the shallow water cardinal fishes (Perciformes: Apogonidae) with references to the systematics and evolution of the family. *Ichthyological Bulletin of the J.L.B. Smith Institute of Ichthyology* 34: 1–105.
- Gon, O. (1987). The cardinal fishes (Perciformes; Apogonidae) collected in the Maldive Islands during the Xarifa Expedition (1957/58). *Special Publication, J.L.B. Smith Institute of Ichthyology* 42: 1–17.
- Gon, O. (1987a). *Apogon sphenurus* Klunzinger, 1884, a senior synonym of *Neamia octospina* Smith and Radcliffe 1912. *Japanese Journal of Ichthyology* 34: 91–95.
- Gon, O. (1987b). *Neamia octospina* Smith and Radcliffe, 1912 (Osteichthyes, Perciformes): proposed conservation of the specific name. *Bulletin of Zoological Nomenclature* 44: 251–252.
- Ida, H. and Moyer, J.T. (1974). Apogonid fishes of Miyake-jima and Ishigaki-jima, Japan, with description of a new species. *Japanese Journal of Ichthyology* 21: 113–128.
- International Commission on Zoological Nomenclature. (1989). Opinion 1564. *Bulletin of Zoological Nomenclature* 46: 213–214.
- Klunzinger, C.B. (1884). *Die Fische des Roten Meeres. Eine kritische Revision mit Bestimmungs-tabellen. Teil I. Acanthopteri veri Owen*. Stuttgart, 133 pp.
- Kuiter, R.H. and Kozawa, T. (1999). *Pictorial Guide. Fishes of the Indo-West Pacific, Apogonidae*. Zoonetics ERBook, Anthus (Nexus) and Aquatic Photographics.
- Paxton, J.R., Hoese, D.F., Allen, G.R. and Hanley, J.E. (1989). *Zoological catalogue of Australia. Pisces – Petromyzontidae to Carangidae. Vol. 7*. Australian Government Publishing Service, Canberra, 665 pp.
- Radcliffe, L. (1912). Descriptions of fifteen new fishes of the family Cheilodipteridae from the Philippine Islands and contiguous waters. *Proceeding of the United States National Museum* 41: 431–446.
- Shao, K.-T. and Chen, J.-P. (1986). Ten new records of cardinalfishes from Taiwan, with a synopsis of the family Apogonidae. *Journal of Taiwan Museum* 39: 61–104.
- Smith, J.L.B. (1955). The fishes of Aldabra. Part II. *Annals and Magazine of Natural History* (12)8: 689–696.
- Smith, J.L.B. (1961). Fishes of the family Apogonidae of the western Indian Ocean and Red Sea. *Ichthyological Bulletin of the J.L.B. Smith Institute of Ichthyology* 22: 373–418.
- Springer, V.G. (1982). Pacific plate biogeography with special reference to shorefishes. *Smithsonian Contributions to Zoology* 367: 1–182.
- Whitley, G.P. (1964). Fishes from the Coral Sea and the Swain Reefs. *Records of the Australian Museum* 26: 145–195.