



A new cardinalfish of the genus *Apogonichthyoides* (Perciformes, Apogonidae) from Raja Ampat Islands, with a key to species

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Abstract

Another deep-water cardinal fish of the genus *Apogonichthyoides* is described from Fiabacet Island, Western Papua, Indonesia. Collected at 73 m, *Apogonichthyoides erdmanni* has very distinctive markings on the head and body. It is brown with a dark spot on the body below the anterior lateral line, two slightly darker body bars and darker markings on the head, all similar features to those of the Philippine species *Apogonichthyoides uninotatus*. The new species has vivid, horizontal dark cheek and post-ocular marks, a small oval spot between the eye and tip of upper preopercular arm, yellowish anal, second dorsal and caudal fins, a narrow basicaudal bar less than 1/3 the length of the caudal peduncle, a vertical bar under the posterior half of the second dorsal-fin base reaching the base of the anal fin, small dark spots on the lower half of the body onto the lower portion of the caudal peduncle and a body spot smaller than the pupil of the eye. *Apogonichthyoides uninotatus* has a faint diagonal cheek mark, a faint horizontal post-ocular mark, a faint dash between the eye and the tip of the upper preopercular arm, brownish anal, second dorsal and caudal fins, a broad basicaudal bar more than 2/3 the length of the caudal peduncle, a broad body bar as a chevron including all of the second dorsal-fin base reaching the base of the anal fin, no small dark spots on the lower half of body and a body spot larger than the pupil of the eye. A key to twenty-two species of *Apogonichthyoides* is provided.

Key words: *Apogonichthyoides erdmanni*, species key, Apogonidae, cardinalfish

Introduction

The Bird's Head region of Indonesia, which comprises Papua Barat Province and the easternmost portion of Papua Province, lies at the extreme western end of New Guinea. It contains the world's highest diversity of coral reef-associated fishes. Allen and Erdmann (2009) provided a comprehensive list containing 1476 species in 111 families. The westernmost portion of this region known as the Raja Ampat islands contains an amazing wealth of marine habitats, and consequently is home to an exceptionally rich and varied reef fish fauna. Allen and Erdmann (2009) listed 1310 species and this total has since increased to 1,426 (Allen unpublished data). Apogonidae are particularly well represented with 120 species in 17 genera. Although it is unlikely that any of the species are endemic to the Raja Ampat Islands, due to its proximity to the New Guinea mainland and nearby Halmahera, at least four species are apparently endemic to the greater Bird's Head region including *Ostorhinchus oxygrammus* (Allen, 2001), and two undescribed species of *Siphamia*. The present paper describes a species of the genus *Apogonichthyoides* that was collected by colleague M. Erdmann in 73 m depth off southeastern Misool, one of the principle islands of the Raja Ampat Group.

Deep-water apogonids are rarely collected by any method and usually represented by few specimens in museum collections. We describe this species on the basis of a single specimen because it is unlikely that additional specimens will be available in the near future due to its relatively inaccessible habitat. Moreover, the highly distinctive color pattern is well developed in our adult specimen and good photographs were obtained when it was fresh. We believe the present description will contribute to a better understanding of the genus *Apogonichthyoides*, which

until recently was poorly known. Fraser and Allen (2010) characterized the genus, provided a discussion of known species and presented a key to one species group. The current paper also includes a key to the 22 species now recognized in the genus.

Methods

Methods for making counts and measurements are given in Fraser (2005). The gill-raker count was broken down into rudiments and rakers by arch. All digital photographs were processed through Adobe Photoshop CS4 extended software. Other figures were obtained from Leica MZ9 stereoscope with camera lucida tracings, scanned on a flat-bed scanner and completed in Photoshop. The holotype is deposited in Museum Zoologicum Bogoriense, Cibinong, Java, Indonesia (MZB).

Apogonichthyoides erdmanni n. sp.

(Figures 1–2)

Type material examined. Holotype: MZB 20018, 39.2 mm SL, 51.1 mm TL, Indonesia, West Papua, Raja Ampat Islands, SE of Misool Island, Fiabacet Island, 2°13.022'S 130°33.800'E, 73 m., 19 Feb 2011, Clove oil mixed with ethanol, digital color photograph, M. V. Erdmann.

Comparative material. *Amia uninotata* Holotype USNM 70248 (1, 43.9), Philippines, Bisucay I., near Cuyo, Albatross, 9 Apr 1909, x-ray. Paratype USNM 339043 (1,40.0), Philippines, Palawan Is., Tara I., Mindoro Strait, Albatross, 15 Dec 1908, 3–6 m., x-ray.

Description. For general body shape see Fig. 1a–c. Range of proportions (as percentage of standard length): body depth 35.5; head length 44.4; eye diameter 14.8; snout length 8.7; bony interorbital width 9.2; upper-jaw length 21.7; caudal-peduncle depth 15.3; caudal-peduncle length 23.0; first dorsal-fin spine length 3.8; second dorsal-fin spine length 9.7; third dorsal-fin spine length 19.1; fourth dorsal-fin spine length 17.1; spine in second dorsal fin 15.6; first anal-fin spine length 2.8; second anal-fin spine length 12.5; pectoral-fin length 28.8; pelvic-fin length 26.0.

Dorsal fin VII-I,9; anal fin II,8; pectoral fin 15-15; pelvic fin I,5; principal caudal rays 9 + 8; pored lateral line scales 24; transverse scale rows above lateral line 1 with very small scale at base of first dorsal fin between large scales; transverse scale rows below lateral line 5; median predorsal scales 3, last scale at origin of first dorsal fin V-shaped and almost hidden; circumpeduncular scale rows 12 (5 +2+5).

Band of villiform teeth premaxilla and dentary; one to two rows on the palatine; one row on vomer; none on ectopterygoid, endopterygoid or basihyal.

Supramaxilla absent; posttemporal serrate on posterior margin; preopercle ridge smooth, edges serrate throughout margin; infraorbital edges smooth

Scales cycloid on nape and anterior part of breast; two large ctenoid pelvic scales; cycloid to very short row of ctenii on cheek; scales mostly missing on opercle; last pored lateral line scale very elongate.

Anterior nare a long tubule, posterior nare without raised ridge.

Pores pattern on the head are shown in Figs. 2A–C. Mucous on the head obscured dorsal pores on the central region and supertemporal expanded nape area; cheek and preopercular pores not well defined.

Free neuromasts obscured on head; linear lines of free neuromasts associated with principal caudal fin-rays: seven present along ventral edges of upper branched rays (3–9) and on four on dorsal edges of lower branched rays (11–14); free neuromasts lines absent on caudal fin ray number 10, upper unbranched and branched caudal rays (1–2), and lower unbranched and branched caudal rays (15–17).

Fresh color pattern. (Fig. 1A): dorsal, snout and lips of head a pale yellow, light brown below and behind eye and body light brown; two slightly darker bars on body, broad bar from base of second dorsal fin to base of anal fin and one on caudal peduncle at base of caudal fin; three dark brown marks at edge of eye, first narrowly along anterior edge of eye passing under eye extending as a thick stripe to edge of opercle, second as a thick stripe from posterior edge of eye to edge of opercle, third as an oval spot at posterior of eye above second stripe; rounded dark spot under first dorsal fin below lateral line smaller than pupil of eye; first dorsal fin dark edging from base of first two

spines to distal half of third and fourth spines, pale yellow below with numerous small white spots; second dorsal fin pale yellow with proximal whitish base; anal fin distally yellow with fine melanophores, proximally with white band grading into pale yellow; caudal fin yellow with fine melanophores; spine of pelvic fin light brown with many small white spots, longer rays light brown grading to pale yellow on shorter fin rays.

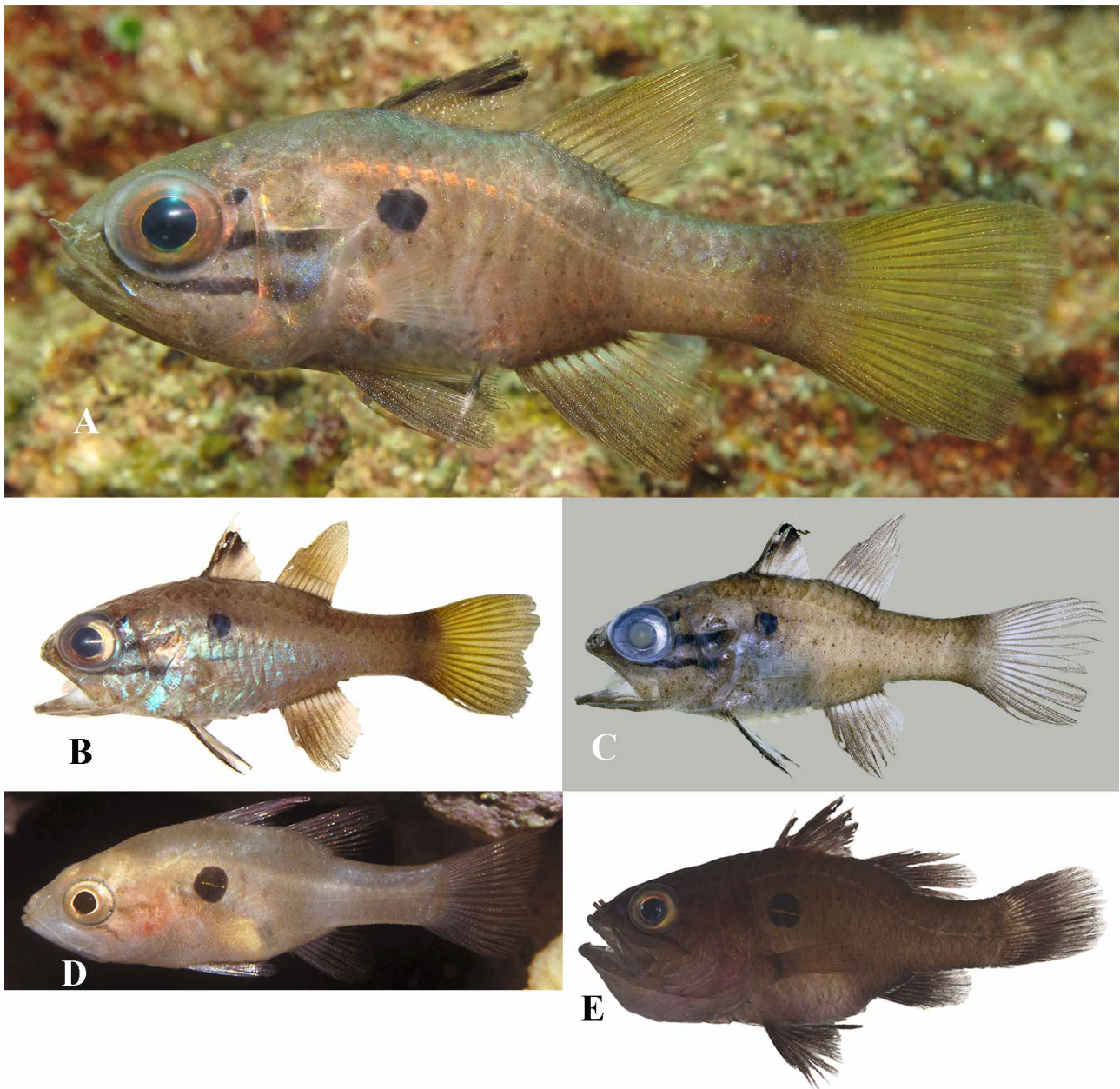


FIGURE 1. Holotype of *Apogonichthyoides erdmanni*, 39.2 mm SL, 51.1 mm TL. A. Fresh, pinned from below, left side, by Mark V. Erdmann. B. Post mortem, right side, by Mark V. Erdmann, lined feature in second dorsal and anal an artifact of wet fins on surface. C. Right side, in 70% ethyl alcohol by Thomas H. Fraser. *Apogonichthyoides uninotatus*. D. Live, Coron I., Calamianes Is., Philippines, by G.R. Allen. E. Postmortem buccal male, USNM 395671, 41 mm SL, Apo Reef, Mindoro Occidental, Philippines, by J.T. Williams.

Post mortem color pattern. (Fig. 1B): Head and body brown, scales above lateral line outlined in brown; caudal peduncle with complete brown bar, no bar below second dorsal fin to anal fin; three dark brown mark at edge of eye; first narrowly along anterior edge of eye passing under eye extending as a thick stripe to edge of opercle, second as a thick stripe from posterior edge of eye to edge of opercle, third as an oval spot at posterior of eye above second stripe; rounded dark spot under first dorsal fin below lateral line smaller than pupil of eye; first dorsal fin dark brown at base of first and second spines and distally on third to fifth spines, pale membranes from near fifth

though seventh spine; second dorsal fin with a narrow stripe of melanophores separate proximal pale band from distal yellow with fine melanophores; anal fin with pale proximal band grading to fine melanophores with yellow; caudal fin yellow membranes with fine melanophores on fin rays; pelvic spine and outer fin rays dark brown, inner rays whitish.

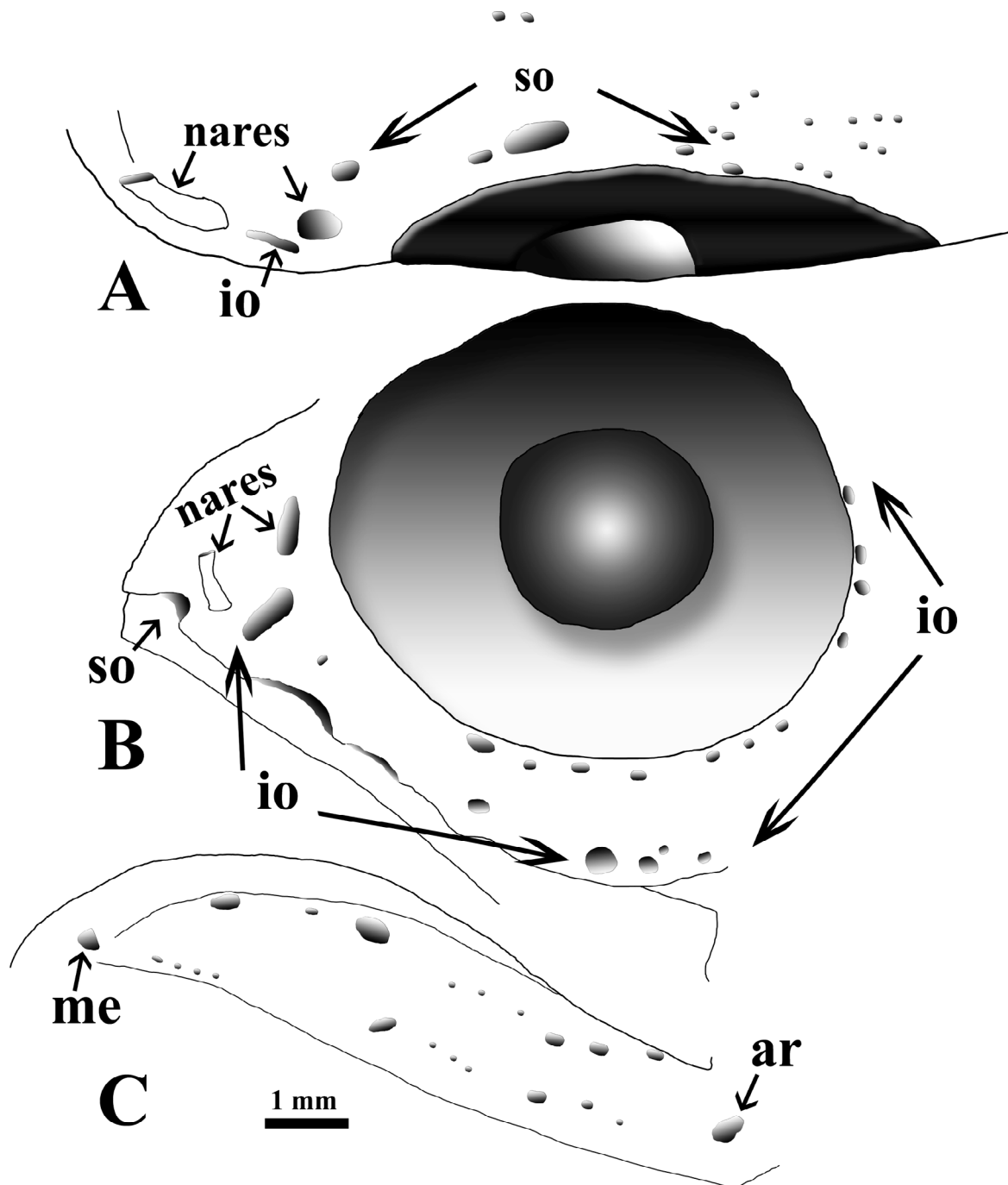


FIGURE 2. Semi-diagrammatic views of the head pore patterns from the holotype of *Apogonichthyoides erdmanni*. A. Partial view of the supraorbital pores on the left side of the head. B. Partial view of the right side infraorbital pores minus the cheek and preopercle, reversed, and partial view of maxilla. C. Ventral view of the left lower jaw. so = supraorbital, io = infraorbital, me = mental, and ar = articular.

Preserved color pattern. (Fig. 1C): In 70% ethyl alcohol the head and body with a brown ground color; tip of lower jaw and snout with fine dense brown spots; narrow, dark horizontal stripe from under eye becoming broad from eye onto opercle; broad dark stripe from posterior edge of eye to near tip of opercle flap; short broad mark near upper posterior edge of eye; dark round spot about equidistance from base of first dorsal fin to upper edge of pectoral fin, spot smaller than diameter of eye; cheeks with small brown spots extending on to sides scattered small

brown spots on body, mostly below lateral line scales except on caudal peduncle; faint brown basicaudal bar slightly wider than pupil of eye, no other body bars apparent; black first dorsal from first two spines, most of distal membrane between third and fourth spines, about one-half of distal membrane black between fourth and fifth spines, spines and membranes pale posterior of fifth spine; second dorsal fin pale proximal one third of fin, distally with many fine brown spots; anal fin with proximal one fifth pale and distally with many fine brown spots; caudal fin with fine brown spots on membranes and fin-rays becoming less dense on membranes of inner rays; pelvic spine and first ray black to tips, inner rays pale; pectoral fin pale; scales above lateral line darkly edged.

Etymology. Named for Mark Erdmann of Conservation International, Indonesia Marine Program, who collected and photographed the type specimen. Mark has worked closely with the second author for the past six years and is responsible for numerous new discoveries, resulting from his deep scuba collections around the East Indian region.

Habitat. The specimen was collected at 73m at the base of a sheer drop off exposed to moderate to strong currents. The specimen was sheltering under a large block of dead coral rubble that rested on a moderate, silty sand slope.

Remarks. *Apogonichthyoides erdmanni* is similar in head markings to the Philippine species *A. uninotatus* (Smith and Radcliffe in Radcliffe, 1912). The new species has vivid, horizontal dark cheek and post-ocular marks, a small oval spot between the eye and tip of upper preopercular arm, yellowish anal, second dorsal and caudal fins, a narrow basicaudal bar less than 1/3 the length of the caudal peduncle, a vertical bar under the posterior half of the second dorsal-fin base reaching the base of the anal fin, small dark spots on the lower half of the body onto the lower portion of the caudal peduncle and a body spot smaller than the pupil of the eye. *Apogonichthyoides uninotatus* has a faint diagonal cheek mark, a faint horizontal post-ocular mark, a faint dash between eye and tip of upper preopercular arm, brownish anal, second dorsal and caudal fin, a broad basicaudal bar more than 2/3 the length of the caudal peduncle, a broad body bar as a chevron including all of the second dorsal-fin base reaching the base of the anal fin, no small dark spots on lower half of body and a body spot larger than the pupil of the eye (Fig. 1D &E).

Free neuromast patterns have not been described for *Apogonichthyoides*. Bergman (2004) mentions *Apogonichthyoides timorensis* in the remarks section of *Ostorhinchus*, but did not provide illustrations of the species. The free neuromasts were obscured and difficult to see in the new species. Several specimens of *Apogonichthyoides taeniatus* (UF 29838) had 7+5=12 free neuromast lines on branched caudal fin rays while the single specimen of *A. erdmanni* had 7+4=11 visible under the microscope.

The dorsal head pore pattern is partially done (Fig. 2), complete for the snout and areas adjacent to the eye, missing the central and posterior areas of the head and nape. No information is presented for the preopercular or posttemporal regions. One larger supraorbital pore is present, a characteristic seen among other apogonids and in those *Apogonichthyoides* examined to date (*erdmanni*, *miniatus* and *umbratilis*), absent in *timorensis*.

Key to adult species of *Apogonichthyoides*

1	Anal fin II,8; second dorsal fin I,9;	2
-	Anal fin II,9; second dorsal fin I,10 or 11.	<i>Apogonichthyoides opercularis</i>
2	No dark stripes on body above and/or below lateral line	4
-	Dark stripes on body	3
3	Faint bars on upper body; ocellated spot on anterior body above pectoral fin and below lateral line; 14–15 pectoral fin rays.	<i>Apogonichthyoides taeniatus</i>
-	No body bars; no ocellated spot on body; dark spot mid soft dorsal fin near base; 16 pectoral fin rays	<i>Apogonichthyoides brevicaudatus</i>
4	Pectoral fin rays 14	5
-	Pectoral fin rays 15–17 (rarely 14)	7
5	Inside of mouth behind symphysis of dentaries pale	6
-	Inside of mouth with dark spot behind symphysis of dentaries	<i>Apogonichthyoides cantoris</i>
6	Two bars on body; wide blotch on caudal peduncle	<i>Apogonichthyoides gardineri</i>
-	Two or three bars on body; two faint bars and one dark bar on caudal peduncle.	<i>Apogonichthyoides umbratilis</i>
7	Body patterns various, frequently with two dark bars or saddles, one under each dorsal fin; a third dark bar sometimes present posteriorly on caudal peduncle, bars/saddles sometimes faint (<i>A. timorensis</i>), absent (adult <i>A. enigmaticus</i>) or with medium to small dark spots on scales	8
-	Body and all fins except caudal fin dark brown or with multiple narrow body bars; caudal fin pale or white; no dark spot above	

	pectoral fin and below lateral line	<i>Apogonichthyoides niger</i>
8	Dark spot as ocellus or if not, spot red or brown on anterior body below lateral line	9
-	No dark spot or ocellus on anterior body below lateral line	13
9	Dark ocellated spot usually present between lateral line and pectoral fin; body with bars and/or a basicaudal spot.	10
-	Dark/red spot between lateral line and pectoral fin; body with or without faint bars; no basicaudal spot	20
10	Dark basicaudal peduncle bar	12
-	No dark basicaudal peduncle bar	11
11	Small ocellated spot on body, much smaller than pupil of eye; small dark spot at origin of first dorsal fin, and at origin and end of pale second dorsal fin	<i>Apogonichthyoides heptastygma</i>
-	Large ocellated spot on body, larger than pupil of eye; proximal portion of second dorsal fin dark, distal portion of soft dorsal and caudal fin pale or yellow	<i>Apogonichthyoides atripes</i>
12	Dark basicaudal peduncle spot wider than narrow bar; developed gill rakers 12–15.	<i>Apogonichthyoides pharaonis</i>
-	Dark basicaudal peduncle spot within bar; developed gill rakers 10–12	<i>Apogonichthyoides nigripinnis</i>
13	Dark bars/saddles on body and/or dark edging to all body scales	14
-	No dark bars/saddles; scale edges unmarked on body	17
14	Dark bar below both dorsal fins about 1–2 scales wide, both confluent with leading edge of fin above them; no dark or dusky bar posteriorly on caudal peduncle; dark caudal spot usually present (may be faint or absent in adult <i>A. enigmaticus</i>)	15
-	Dark bars below dorsal fins usually 3–4 scales wide, frequently indistinct; second bar below posterior half of second dorsal fin; dusky to dark bar posteriorly on caudal peduncle; dark caudal spot absent	<i>Apogonichthyoides timorensis</i>
15	Total developed gill rakers 9–11; bars below dorsal fins black, usually two scales wide and extend ventrally beyond pectoral fin; scale edge pale	16
-	Total developed gill rakers 12–17; when present bars below dorsal fins dark brown above lateral line, usually one scale wide, fading out at level of pectoral fin; scales edge dark	<i>Apogonichthyoides enigmaticus</i>
16	Intestine pale, axil of pectoral dark	<i>Apogonichthyoides sialis</i>
-	Intestine blackish, axil of pectoral pale.	<i>Apogonichthyoides pseudotaeniatus</i>
17	Developed gill rakers 8–9; one developed gill raker on upper limb body; no series of blackish spots or irregular spots on body	18
-	Developed gill rakers 10–11; two developed gill rakers on upper limb; body with 7–9 series of small blackish spots, more or less one per scale.	<i>Apogonichthyoides regani</i>
18	No teeth on ectopterygoid	19
-	Tooth patch on ectopterygoid	<i>Apogonichthyoides chrysurus</i>
19	Irregular dark spots on head and body, pectoral fin rays 17	<i>Apogonichthyoides eupilotus</i>
-	Few scattered small dark dots on body, pectoral fin rays 14.	<i>Apogonichthyoides maculipinnis</i>
20	Cheek and post ocular dark marks; faint dark bars under second dorsal and on caudal peduncle	21
-	No cheek or post ocular dark marks; no faint bars on body or caudal peduncle.	<i>Apogonichthyoides miniatus</i>
21	Faint diagonal cheek mark, body spot larger than pupil of eye	<i>Apogonichthyoides uninotatus</i>
-	Dark horizontal cheek mark, body spot smaller than pupil of eye	<i>Apogonichthyoides erdmanni</i>

Acknowledgements

We thank Larry Page and Robert H. Robins of the Florida Museum of Natural History, Gainesville, Florida for their help with the loan of the holotype to the first author. Both individuals assisted the first author during visits to the museum. We thank Jeffrey T. Williams (USNM) for providing a photograph and David Greenfield (CAS) for useful comments improving this paper.

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