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ON THE VALIDITY OF THE PUFFERFISH GENUS *OMEGOPHORA* WHITLEY (TETRAODONTIFORMES: TETRAODONTIDAE) WITH THE DESCRIPTION OF A NEW SPECIES

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ABSTRACT

Omegophora Whitley, 1934 is considered a valid generic name for two species from temperate Australian waters, and is redefined. The genus differs significantly in dorsal craniology from *Arothron*, particularly in the shape of frontals and prefrontals. *Omegophora armilla* (Waite and McCulloch) is redescribed, and *O. cyanopunctata* sp. nov. is described, being distinct from it on the basis of both morphology and osteology. Full synonymy is provided for *O. armilla*.

INTRODUCTION

Omegophora armilla (Waite and McCulloch, 1915) is a moderately common inhabitant of temperate Australian seas, where it has been recorded from southern Western Australia to southern New South Wales. Although some degree of sexual dimorphism is apparent in the colouring of *O. armilla* (Scott 1962), the species is easily distinguished from all other Australian pufferfishes by virtue of a thin, black ring, which encloses the upper half of, and on occasions completely encircles, the pectoral fin base.

Alternative generic allocations have been few since the original description (as *Tetraodon armilla*) by Waite and McCulloch (1915). In 1934, Whitley proposed a new name, *Omegophora*, but this has not been accepted by subsequent authors, despite Whitley's continued usage.

In this paper, validity of the genus *Omegophora* Whitley is reconsidered, and the type species, *O. armilla*, redescribed. In addition, examples of *Omegophora* representing a new species apparently restricted to the south-western coastline of Western Australia, are described.

METHODS AND ABBREVIATIONS

Measurements were taken by dial caliper and millimetre rule (to the nearest 0.1 mm for measurements less than 10 mm), in a manner similar to that outlined by Dekkers (1975).

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Fin ray counts include all visible rays, both branched and unbranched. Fin ray lengths were determined by measurement from the embedded base.

One example of each species was cleared and stained, and all others X-rayed, for the examination of osteology.

All measurements are from preserved specimens.

The following abbreviations are used in the text: SL — standard length; HL — head length; TL — total length; N — number of specimens examined; AMS — Australian Museum, Sydney; CSIRO — Commonwealth Scientific & Industrial Research Organisation, Fisheries & Oceanography Division, Cronulla; MAGNT — Museums and Art Galleries of the Northern Territory, Darwin; NMV — National Museum of Victoria, Melbourne; QVM — Queen Victoria Museum & Art Gallery, Launceston; SAM — South Australian Museum, Adelaide; WAM — Western Australian Museum, Perth.

SYSTEMATICS

Subsequent to its original description, *Tetraodon armilla* had three further generic allocations. Of these, neither *Sphoeroides* Anon. (see Shipp 1974; Tyler and Paxton 1979) nor *Arothron* Muller, 1841 (see Fraser-Brunner 1943; Hardy 1980; Tyler 1980) exhibit some of the characters considered herein to be diagnostic of *Omegophora.* Le Danois' (1959) referral of *Tetraodon armilla* to *Catophororhynchus scaber* (Eydoux and Souleyet, 1841) (in part) was without any valid reason, and cannot be seriously entertained.

Tyler (1980), who examined also *Arothron hispidus, A. nigropunctatus,* and *A. stellatus,* found that while some external features of *T. armilla* are suggestive of *Arothron,* others including aspects of the skull osteology are not. He concluded that comparison with further *Arothron* species may confirm the validity or otherwise of the name *Omegophora* Whitley. Morphological examination during this study of *Arothron immaculatus* (Bloch and Schneider, 1801) and *A. reticularis* (Bloch and Schneider, 1801) and osteological examination of *A. firmamentum* (Temminck and Schlegel, 1850), have confirmed the generic distinctiveness of *T. armilla* compared with various *Arothron* species. This disparity is further enhanced by the finding of a second *armilla*-like species.

In defining the genus *Omegophora,* Whitley (1934) considered it to be markedly different from *Tetraodon* Linnaeus, but referred for comparison only to Boulenger's (1916) figure of *T. lineatus* Linnaeus. However, Fraser-Brunner (1943) noted the characteristics of *Tetraodon* in more detail. Such characters as a nasal sac with two thick tentacles, a supra-anal branch of the lateral line, prefrontals separated by the ethmoid and in contact with the palatines, and the frontal notched anteriorly to the sphenotic, do not match those in *Omegophora.* In fact the combination of generically significant characters seen in *Omegophora* species has not been recorded for any other genus.

We recognise therefore, the validity of *Omegophora* Whitley for *armilla* and the new species described herein.

Genus *Omegophora* Whitley, 1934

Type-species: *Tetraodon armilla* Waite and McCulloch, 1915, by monotypy.

Diagnosis

Form robust; snout elongate; interorbital convex; nasal organ a single, distally expanded flap; eye completely adnate; pectoral fins bilobed, median rays shorter than those above or below; other fins rounded; no ventrolateral skinfold; anterior margin of gill opening lacking projecting spur or papillae; small spines densely cover back, sides, and belly, usually extending on to caudal peduncle; lateral line encircling eye with anterodorsal branch arising posterior to nasal organ; no lateral line posterior to pectoral fin on ventrolateral surface.

Prefrontals meet in midline immediately anterior to frontals, separating the latter from ethmoid; orbital margin of frontal concave; frontal extended towards pterotic by short, posterolateral wing; parasphenoid with dorsal extension in orbit; dorsal myodome represented by medial prongs of prootic extending to midline; distinct trituration teeth replaced more or less by raised, unevenly surfaced plates; no interhyal; single hypohyal; well developed first dorsal and anal fin rays; posterior prongs absent from last basal pterygiophores; several abdominal vertebrae with complete haemal arches.

Comparison with Other Genera of Tetraodontidae

Tyler and Paxton (1979) have discussed in some detail the relationships of several tetraodontid genera. While it is here considered unnecessary to reiterate in detail the generic characteristics, the following points can be made. *Omegophora*, being neither especially elongate, nor streamlined, is in this regard similar to *Sphoeroides* species. However, the possession of a single flap nasal organ not only distinguishes *Omegophora* from *Sphoeroides* and its nearest relatives (see Tyler and Paxton 1979), but also from *Arothron* and *Chelonodon*. Furthermore, the bilobed appearance of the pectoral fin is more suggestive of the genus *Canthigaster* (Subfamily Canthigasterinae).

The lateral line of *Omegophora* essentially follows the generalized pattern seen in most *Sphoeroides* species and *Arothron*. However, a variation in *Omegophora*, the anterodorsal extensions arising from the supraocular branch posterior to the nasal organ, is seen in neither *Sphoeroides* nor *Arothron*, or in any other of the tetraodontid genera represented by Australian species. The possession of abdominal vertebrae with complete haemal arches is a feature recorded for several genera as well as *Omegophora*; similarly for the oblique epural position (the somewhat horizontal placement in *O. cyanopunctata* cannot be reasonably compared with the horizontal placement in *Lagocephalus*, owing to the anteroposterior elongation of the epural

in the latter — Tyler 1970). The absence of distinct trituration teeth in *Omegophora* is perhaps less significant than it may at first appear, considering the raised, uneven inner surfaces of the premaxillary in *O. armilla* and to a lesser extent in *O. cyanopunctata.*

Omegophora essentially differs little from *Pelagocephalus, Sphoeroides, Fugu, Torquigener,* and *Amblyrhynchotes* (see Tyler and Paxton 1979), with regard to presence of first pharyngobranchial teeth, presence of a dorsal extension of the parasphenoid in the orbit, absence of an interhyal, absence of last basal pterygiophore posterior prongs, absence of a dorsal hypohyal, well developed first dorsal and anal fin rays, and absence of a ventrolateral skin fold on the caudal peduncle. However, medial prongs from the prootic are more strongly developed in *Omegophora* than in the above genera (as well as in *Arothron*), except in some species of *Sphoeroides.* In addition, the dorsal extension of the parasphenoid in the orbit in *Omegophora* is considerably more strongly developed than in *Arothron.*

Omegophora differs markedly from *Arothron* species in the shape of the frontals and prefrontals. The frontals of *Arothron* are greatly expanded over the orbit, whereas those in *Omegophora* (see **Fig. 3A, B**), particularly in *O. armilla,* are not much wider over the orbit than more posteriorly. In addition, the frontals of *Omegophora* are anteriorly tapered instead of ending abruptly in their articulation with the prefrontals and ethmoid (see Fraser-Brunner 1943, Fig. 2; Hardy 1980, Fig. 4). Furthermore, the exclusion of the ethmoid from the frontals by the prefrontals in *Omegophora* differs from the situation in *Arothron,* wherein the prefrontals are separated mostly by the ethmoid, which makes broad contact with the frontals. The prefrontals in *Omegophora* enclose the olfactory foramen, as is the case in *Arothron,* but are not as strongly down-turned anterior to the orbit.

Omegophora armilla (Waite and McCulloch, 1915)

(Ringed Toadfish or Pufferfish)

Figs 1A, B; 3A

Tetraodon armilla Waite and McCulloch, 1915: 457-458, 475, pl. 15 (Type locality: Great Australian Bight, between 22-140 fathoms); Waite, 1921: 196, fig. 328; McCulloch, 1921-22: 128; Waite, 1923: 227, fig. on 227; McCulloch, 1927: 102; Waite, 1928: 10; McCulloch, 1929: 427; Whitley, 1934: 160; Scott, 1963: 26; — 1965: 64; — 1971: 119, 141.

Omegophora armilla: Whitley, 1934: 160-161; — 1943: 144; — 1948: 32; — 1965: 59.

Sphaeroides armilla: Fraser-Brunner, 1943: 11; Scott, T.D., 1962: 296, pl. on 296; Halstead, 1967; Baslow, 1969: 197; Scott, Glover and Southcott, 1974: 327, 330, pl. on 330.

Catophororhynchus scaber (Eydoux and Souleyet): Le Danois, 1959: 208, 246, 252, 255 (in part).

Arothron armilla: Thomson, 1977: 63; Hutchins, 1979: 89, 100, pl. 79; Tyler, 1980.

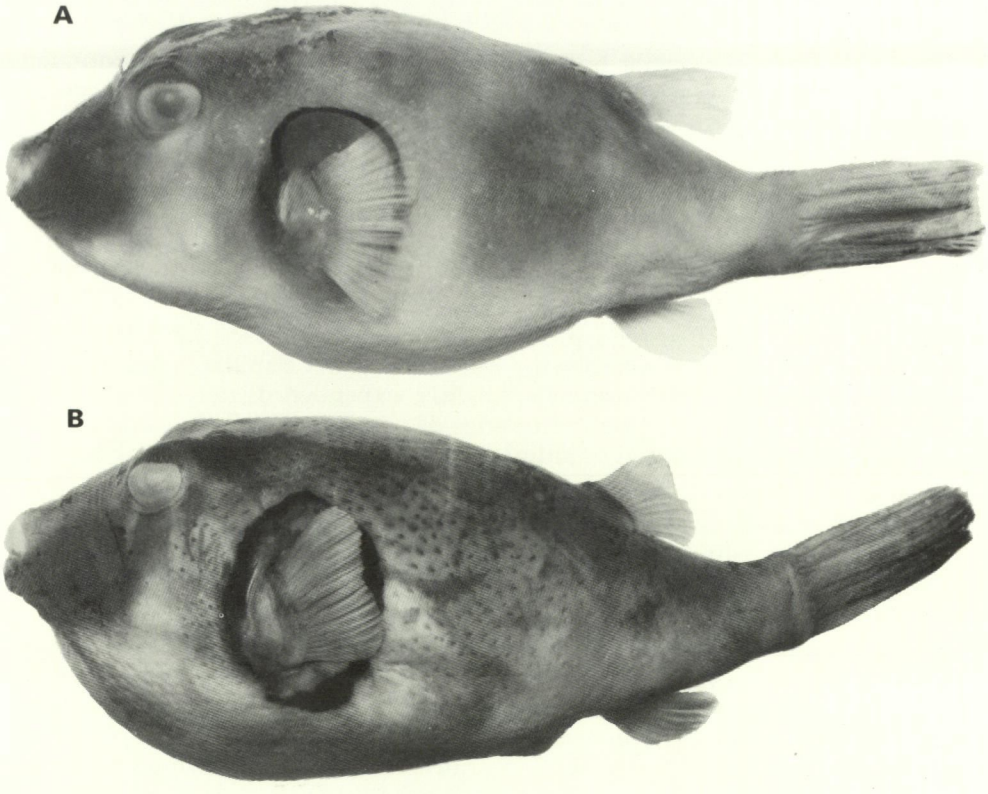

Fig. 1: (a) *Omegophora armilla*, WAM P.25754-001, 101 mm SL, showing the usual condition of the black ring, partially encircling the pectoral fin; (b) *Omegophora armilla*, AMS I.20234-012, 181 mm SL, showing the extreme condition of the black ring, completely encircling the pectoral fin.

Diagnosis

Distinguished from the only other known species in the genus by the thin, black ring enclosing the greater part or all of the pectoral fin base; broader ethmoid and maxillary; frontals more deeply concave over the orbit; deeper interorbital septum formed by the dorsal extension of the parasphenoid contacting the frontal and prefrontal.

Description

The proportions given below are based on the holotype, 10 paratypes, and 21 additional specimens, 71-200 mm SL (the range for paratypes and additional specimens appears in parentheses):

Dorsal rays 12 (11-13); anal rays 11 (9-11); pectoral rays 22 (20-23[1]); caudal rays 11 (11); vertebrae 8 + 11 (8 + 11, 8 + 12, 9 + 11 or 10 + 11).

Body elongate, somewhat bulky about head and pectoral region, rounded dorsally and flattened ventrally, tapering to the moderately thickened caudal peduncle; head length 3.1 (2.7-3.2) in SL; snout to anterior of vent 1.6 (1.3-1.6) in SL, to origin of dorsal fin 1.5 (1.3-1.5) in SL, to origin of anal fin 1.4 (1.3-1.4) in SL, to origin of pectoral fin 2.9 (2.4-2.9) in SL; width at base of pectoral fin 3.3 (2.5-3.5) in SL; depth from dorsal fin origin to anal fin origin 3.7 (3.3-4.2) in SL; depth at posterior of dorsal fin 4.4 (4.4-5.7) in SL; caudal peduncle length 4.7 (4.7-5.5) in SL; least depth of caudal peduncle 9.5 (7.5-9.5) in SL.

Mouth small, terminal on a protruding snout, width 3.9 (3.2-5.4) in HL; lips moderately thick, covered with numerous short papillae; chin lacking; nasal organ a small, single tentacle, slightly expanded distally, length 18.9 (15.7-29.1) in HL; snout to anterior edge of nasal organ 1.7 (1.6-2.1) in HL; posterior edge of nasal organ to anterior edge of eye 5.7 (5.7-8.2) in HL.

Eye smallish, round, completely adnate, slightly interrupts dorsal profile, lower border well above level of mouth corner, horizontal diameter 4.6 (3.7-5.9) in HL; least fleshy interorbital distance 3.0 (2.7-3.8) in HL and 9.5 (8.3-10.8) in SL; margin of gill opening without lobules; posterior of eye to anterior edge of gill opening 2.8 (2.4-3.1) in HL.

Pectoral fins more or less bilobed, the median rays shorter than those above or below, maximum length of pectoral fin from base 7.5 (6.5-8.2) in SL; top of base well below lower margin of eye; first ray about one-third length of second; dorsal fin wide and rounded, based slightly forward of vent, first ray (9.3-12.7) in SL (anteriormost 3 rays malformed in holotype); longest ray 8.2 (6.5-8.2) in SL; base 14.0 (11.4-14.4) in SL and 1.7 (1.5-2.2) in longest ray; anal fin wide and rounded, based almost posterior to dorsal fin base, first ray 11.3 (9.4-12.8) in SL; longest ray 8.9 (7.0-8.9) in SL; base 18.6 (14.8-18.6) in SL and 2.1 (1.8-2.6) in longest ray; caudal fin rounded, maximum length 4.6 (3.5-4.6) in SL (upper second and third rays malformed in holotype).

Ventrolateral skin fold absent; lateral line often indistinct in adults (indistinct in holotype), associated with small papillae, encircles eye with anterodorsal branch arising posterior to nasal organ and meeting in midline and preopercular branch extending almost to belly, continuing to caudal fin base, dropping sharply between pectoral and anal fins; dorsal branches of lateral line may meet in midline; second lateral line bridging middle of snout, almost meeting anterior part of eye encircling line, before dropping anteroventrally behind mouth on to belly, along lateral region of which it passes, curving towards but failing to meet pectoral fin base.

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[1] Fifteen pectoral fin rays on one side in SAM F1605; pectoral fin ray counts include the rudimentary uppermost ray.

Body spines short, multi-rooted, densely scattered over body from mid-snout to caudal peduncle though more sparse on ventral aspect of latter.

Colour of holotype in alcohol: after long preservation, dull brown over body and fins, slightly darker on snout and with paler patches on belly; darker brown band borders posterior of lower lip; clearly delineated, black semicircle curves posteriorly from upper anterior edge of gill opening almost to level of pectoral fin base.

Colour in life (based on colour transparencies of live fish under water): dorsal base colour light to medium brown or grey, sometimes with pale patches about mid-dorsum; two brown bars extend down each side of body, first passing obliquely through eye to lower jaw, joining with corresponding bar from other side, second just posterior to pectoral fin; interspaces on sides pale; ventral surface white; a thin, black ring, sometimes open ventrally, encircles pectoral fin base; area enclosed by ring medium brown or greyish; adult males with blue spots on the head and sides, and a thin, blue ring outside and encircling black ring; fins yellow, caudal more dusky with lowermost rays blackish.

Distribution

Relatively common around south-western Western Australia, from west of Lancelin Island (31°01'S, 115°19'E) and extending around the coasts of South Australia, Victoria, and New South Wales to Botany Bay (34°00'S, 151°11'E); uncommon in Tasmanian waters, although recorded from north-western Bass Strait (P. Last, pers. comm.), and several recorded off Flinders Island and one off King Island; also recorded (extralimital?) from York Sound, north-western Western Australia. Known from depths of up to 146 m.

Remarks

For their description of *Tetraodon armilla*, Waite and McCulloch (1915) referred to 12 specimens, and nominated one held in the South Australian Museum as type (holotype). Of the remaining 11 specimens, 10 are held in the Australian Museum, Sydney, being labelled 'cotypes'. We are unaware of the repository for the remaining specimen. Whitley's (1934) proposal of *Omegophora* for *Tetraodon armilla* referred to paratypes in the Australian Museum, but gave no indication of number present. There is little doubt regarding the identity of the types. The holotype (SAM F168), though previously unlabelled as such, corresponds in length (TL = 195 mm; c.f. 200 mm reported by Waite and McCulloch), in the malformation of the uppermost caudal fin ray, which was represented in the figure of the type, and in time of acquisition, which corresponds to the cruise of the trawler *Simplon* (the report of the latter formed the basis of the paper in which *Tetraodon armilla* was described).

Of the 10 paratypes located, nine have locality data corresponding exactly to those listed by Waite and McCulloch. The locality of the tenth (AMS

E.725) is missing from the description, apparently an oversight on the part of the authors.

Because of the extreme latitudinal range between York Sound and the next most northern Western Australian record for *O. armilla*, some doubt was initially cast on the authenticity of the northernmost record. However, the registration data for this specimen (MAGNT S.0232) is unambiguous, and the collector known for accuracy in collection details (G.F. Gow, pers. comm.).

Material Examined

(N = 67, two or more specimens in a lot indicated by number in parenthesis.)

Holotype: SAM F.168, 160 mm SL, *Simplon* trawling cruise, 16-30 September 1914, Great Australian Bight.

Paratypes (N = 10): AMS E.478, 94 mm SL, east coast of Flinders I., 73 m; AMS E.725, 109 mm SL, 16 August 1909, 66 km W of Kingston, S.A., 55 m; AMS E.953, 159 mm SL, Flinders I., AMS E.978, 126 mm SL, off St Francis I., Investigator Group, S.A.; AMS E.2304-5(2), 71-80 mm SL, Doubtful I. Bay, south-west W.A., 37-46 m; AMS I.10193, 106 mm SL, E of Flinders I., 73 m; AMS I.10344, 100 mm SL, 19 August 1905, Marsden Point, Kangaroo I.; AMS I.10388, 162 mm SL, 30 August 1909, Flinders I., 68 m; AMS I.12300, 111 mm SL, 30 November 1911, Doubtful I. Bay, south-west W.A., 37-46 m. (All specimens collected by F.I.S. *Endeavour*.)

Additional: Western Australia: York Sound, MAGNT S.0232; 31°05'S, 114°55'E, WAM P.9366; Rottnest I., WAM P.4154; WAM P.25754-001; due west of Rottnest I., WAM P.5651 (146 m), WAM P.7407-08 (2); Cockburn Sound, WAM P.5649 (skeletonized), WAM P.22183, WAM P.23294 (18 m), WAM P.24515 (14 m), WAM P.25713-001; Bunbury, CSIRO C.2585, WAM P.10481; Eagle Bay, Geographe Bay, AMS I.20234-012; King George Sound, Frenchmans Bay, WAM P.5052; Michaelmas I., WAM P.5041; Cheynes Beach, WAM P.5040; Leighton, WAM P.5667; south Western Australia, CSIRO C.1442.

South Australia: Off Port Lincoln, SAM F.3108; Outer Harbour, SAM F.1877, SAM F.2749; Sellicks Beach, SAM F.1976; St Vincents Gulf, AMS I.14; Glenelg, SAM F.3050; Investigator Strait, AMS I.20194-008; Corney Pt, Yorke Peninsula, SAM F.2145.

Victoria: 5 km SSE of Cape Woolomai, NMV A.744 (3); Bass Strait, NMV A.746 (2); off Phillip I., 38°32'S, 145°15'E, NMV A.627; Sorrento Ocean Beach, NMV A.747; Portsea Ocean Beach, NMV A.288; 27 km SSW of Lakes Entrance, 29-37 m, NMV A.745 (2), NMV A.748.

New South Wales: Off Botany Bay, 91 m, AMS I.14994; Wollongong, AMS IA.1837; off Eden, 119 m, AMS I.13789.

King Island, Bass Strait: Porky Beach, QVM 1970/5/22.

Great Australian Bight: CSIRO C.3504.

No data: WAM P.717; SAM F.1601 (3), SAM F.1602, SAM F.1605 (2), SAM F.1608, SAM F.1609 (3), SAM F.1610 (2).

Omegophora cyanopunctata sp. nov.

(Blue-spotted Pufferfish)

Figs 2, 3B; Table 1

Arothron sp.: Hutchins 1979: 100.

Holotype

WAM P.26942-001, 123 mm SL, female, B.C. Russell, 1 April 1978, Canal Rocks, Cape Naturaliste, W.A.

Paratypes

Eighteen specimens from Western Australia, AMS I.20219-012 (2 specimens), 55-101 mm SL, B.C. Russell, 20 March 1978, Rob I., Recherche Archipelago; AMS I.20220-013 (2 specimens), 88-96 mm SL, B.C. Russell, 20 March 1978, Lucky Bay, Recherche Archipelago; AMS I.20231-009, 146 mm SL, B.C. Russell, 27 March 1978, 0.5 km S of Carnac I., Cockburn Sound; AMS I.20233-016, 112 mm SL, collection data as for holotype; AMS I.20236-012, 99 mm SL, B.C. Russell, 4 April 1978, South Point, Two People Bay; AMS I.20243-005, 93 mm SL, B.C. Russell, 11 April 1978, Rottnest I.; AMS I.21732-001, 114 mm SL, G.S. Hardy, 23 December 1979, Busselton jetty, 2 m (skeletonized); WAM P.5648, 121 mm SL, off Middleton Beach; WAM P.24540, 87 mm SL, D. Parker, 28 November 1971, Carnac I., Cockburn Sound; WAM P.25763-001, 85 mm SL, J.B. Hutchins, 8 April 1977, Sandy Hook I., Recherche Archipelago; WAM P.25769-001, 112 mm SL, J.B. Hutchins, 2 April 1977, Sandy Hook I., Recherche Archipelago; WAM P.26003-004 (2 specimens), 79-86 mm SL, J.B. Hutchins, R. Steene, 16 March 1978, Lucky Bay, Recherche Archipelago; WAM P. 26564-001, 133 mm SL, Quarry Bay Beach, 1.5 km N of Cape Leeuwin; SAM F.4549 (ex WAM P.26602-001), 74 mm SL, N. Sinclair, 14 April 1980, Michaelmas I. (35°03'S, 118°02'E); WAM P.26928-001, 120 mm SL, N. Coleman, 7 April 1971, Busselton, 7.5 m.

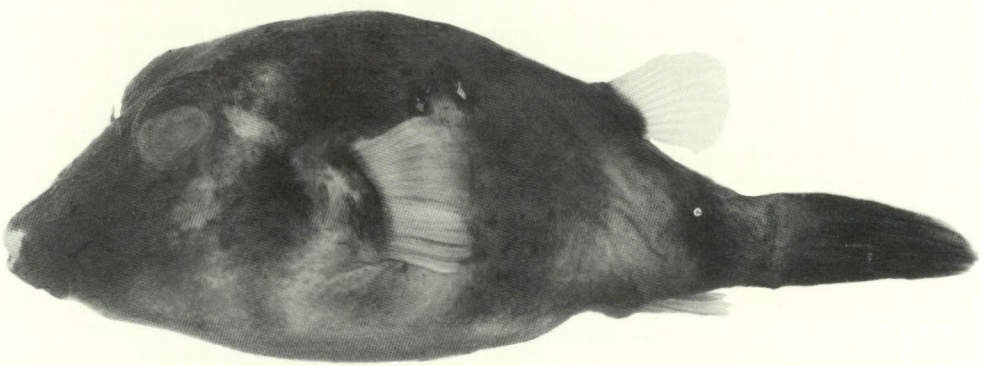

Fig. 2: *Omegophora cyanopunctata* sp. nov., holotype, WAM P.26942-001, 123 mm SL.

Diagnosis

Distinguished from *O. armilla* by the iridescent blue spots on cheeks and flanks, and lack of a thin, black ring over or surrounding pectoral fin base; narrower ethmoid and maxillary; shallower interorbital septum formed by the dorsal extension of the parasphenoid contacting the frontal and prefrontal.

Description

Measurements and counts of the holotype and five paratypes are presented in **Table 1.**

The following counts and proportions are based on 19 type specimens, 55-146 mm SL: dorsal rays 10-12; anal rays 9-11; pectoral rays 19-22; caudal rays 11; vertebrae 8 + 11 or 8 + 10.

Body elongate, somewhat bulky about the head and pectoral region, rounded dorsally and flattened ventrally, tapering to the moderately thickened caudal peduncle; head length 2.4-2.9 in SL; snout to anterior of vent 1.3-1.5 in SL, to origin of dorsal fin 1.3-1.4 in SL, to origin of anal fin 1.2-1.4 in SL, to origin of pectoral fin 2.1-2.6 in SL; width at base of pectoral fin 2.3-2.7 in SL; depth from dorsal fin origin to anal fin origin 3.5-4.0 in SL; depth at posterior of dorsal fin 4.6-5.9 in SL; caudal peduncle length 5.2-6.7 in SL; least depth of caudal peduncle 7.2-9.0 in SL.

Mouth small, terminal on a protruding snout, width 3.1-5.6 in HL; lips moderately thick, covered with numerous short papillae; chin lacking; nasal organ a small, simple tentacle, slightly expanded distally, length 13.3-34.4 in HL; snout to anterior edge of nasal organ 1.8-2.1 in HL; posterior edge of nasal organ to anterior edge of eye 5.5-8.9 in HL.

Eye smallish, round, completely adnate, slightly interrupts dorsal profile, lower border well above level of mouth corner, horizontal diameter 3.6-5.1 in HL; least fleshy interorbital distance 2.5-3.9 in HL and 6.8-10.4 in SL; margin of gill openings without lobules; posterior of eye to anterior edge of gill opening 2.5-3.5 in HL.

Pectoral fins more or less bilobed, the median rays shorter than those above or below; maximum length of pectoral fin from base 6.2-7.0 in SL; top of base just below lower margin of eye; first ray one-third length or shorter than second; dorsal fin wide and rounded, based slightly forward of vent, first ray 8.8-10.9 in SL; longest ray 6.0-7.4 in SL; base 11.4-13.6 in SL and 1.8-2.0 in longest ray; anal fin wide and rounded, based almost posterior to dorsal fin base, first ray 9.4-11.0 in SL; longest ray 7.1-8.3 in SL; base 14.0-17.5 in SL and 1.7-2.5 in longest ray; caudal fin rounded, maximum length 3.3-4.5 in SL.

Ventrolateral skin fold absent; lateral line may be indistinct in adults, associated with small papillae, encircles eye with traces of an anterodorsal branch posterior to nasal organ and a preopercular branch extending almost to lateral limit of belly, continues to caudal fin base, dropping sharply between pectoral and anal fins; dorsal branch of lateral line not meeting in midline; traces of second lateral line dorsally in middle of snout, continuous behind mouth on to belly, along the lateral region of which it passes, curving towards but failing to meet the pectoral fin base.

Body spines short, multi-rooted, densely scattered over body from mid-snout to dorsal fin, sometimes continuing sparsely on anterior part of caudal peduncle.

TABLE 1

Measurements (mm) and fin ray counts of selected type specimens of *Omegophora cyanopunctata*.

	Holotype WAM P.26942-001	Paratypes AMS I.20231-009	WAM P.26564-001	AMS I.20233-016	AMS I.20236-012	WAM P.25763-001
Standard length	123	146	133	112	99	85
Head length	48	53	47	44	38	31
Snout-vent length	86	100	94	78	72	61
Snout to origin of dorsal fin	92	106	96	84	74	63
Snout to origin of anal fin	93	107	105	88	78	65
Snout to origin of pectoral fin	52	60	52	48	48	34
Body width at base of pectoral fin	52	63	55	49	37	34
Dorsal fin origin to anal fin origin	34	43	33	32	28	22
Depth at posterior of dorsal fin	24	31	23	22	20	16
Caudal peduncle length	22	27	23	20	16	15
Caudal peduncle least depth	14	20	16	13	12	11
Snout to anterior edge of nasal organ	24	30	26	22	20	16
Posterior edge of nasal organ to eye	8.2	8.6	5.3*	6.3	5.3	5.1
Nasal organ length	3.6	1.7*	2.4	2.0	1.5	0.9
Eye horizontal diameter	11	11	11	9.5	8.7	7.8
Least fleshy interorbital width	16	21	15	13	12	9.2
Posterior of eye to anterior of gill opening	16	21	15	14	13	12
First dorsal ray length	12	12	13	11	10	9.3
Longest dorsal ray length	18	20	19	15	15	14
Base of dorsal fin	10	12	10	8.8	7.8	6.8
First anal ray length	12	11	13	11	10	8.5
Longest anal ray length	17	18	17	14	13	11
Base of anal fin	7.4	9.7	8.4	7.0	6.6	5.3
Maximum pectoral fin length	19	21	20	16	16	13
Maximum caudal fin length	29	33	32	25	27	22
Dorsal ray count	11	11	10	11	11	12
Anal ray count	9	10	10	10	10	10
Pectoral ray count	21/21	20/20	21/21	21/21	19/21	21/21
Sex	Female	Female	?	Female	Female	?

* Measurement affected by distortion.

Colour of holotype in alcohol (**Fig. 2**): dorsal surface of snout and head dark, grading into paler regions on cheek; further dark area anterior to gill opening; remaining dorsal and lateral surfaces consist of large mottled light and dark areas, with small, dark spots superimposed on flanks between pectoral and dorsal fins; bases of pectoral and dorsal fins dark; upper lip pale; middle of lower lip similarly pale, bordered on sides and behind by a broad, dark band; belly pale; caudal fin dark, other fins pale.

Colour in life: dorsal base colour brown to dark brown with numerous iridescent blue spots; three brown to dark-brown bars extend down each side of body, first passing obliquely through eye to lower jaw, joining with corresponding bar from other side, second enveloping gill slit and pectoral base and bifurcating ventrally, and the third just posterior to pectoral fin; interspaces on side pale brown to cream; ventral surface white with ventrolateral surface lined with yellow; adult males possess a black to brown circular blotch above pectoral base, surrounded or partly surrounded by an iridescent blue line or series of spots; fins yellow to orange, caudal more dusky with lowermost rays blackish.

Distribution

South-west corner of Western Australia, from Rottnest Island (32°00'S, 115°30'E) off Fremantle to the Recherche Archipelago (34°10'S, 122°15'E). Recorded from depths to 25 metres.

Osteological Comparisons of *Omegophora armilla* and *O. cyanopunctata*

The most noticeable difference between the two species lies in the distinctly heavier build of many of the skull and axial skeleton bones of *O. armilla* compared with *O. cyanopunctata*. This can be seen particularly in the broader ethmoid and wider maxillary in the former species (see **Fig. 3A, B**). In both species, the ethmoid is anteriorly fused extensively with the underlying vomer, and is overlain posteriorly by the prefrontals which meet in the midline. The orbital margin of the frontal is weakly concave in its posterolateral extension to the sphenotics in *O. cyanopunctata*, and more deeply so in *O. armilla*.

A further distinction between the species is the depth of the interorbital septum, formed by the dorsal extension of the parasphenoid contacting the frontal and prefrontal; the septum is deeper in *O. armilla*, and is reflected morphologically in the lower edge of the eye being markedly higher in relation to the pectoral fin base in that species.

In both species, the frontal is extended posterolaterally as a short wing towards the pterotic, leaving a moderately broad fossa between the lateral extensions of the frontal. Medial prongs extend from the prootic to the midline. In some other tetraodontids, these represent the remains of the dorsal myodome (Tyler 1963). A further anteromedial projection from the prootics in *O. cyanopunctata* is not so well developed in *O. armilla*.

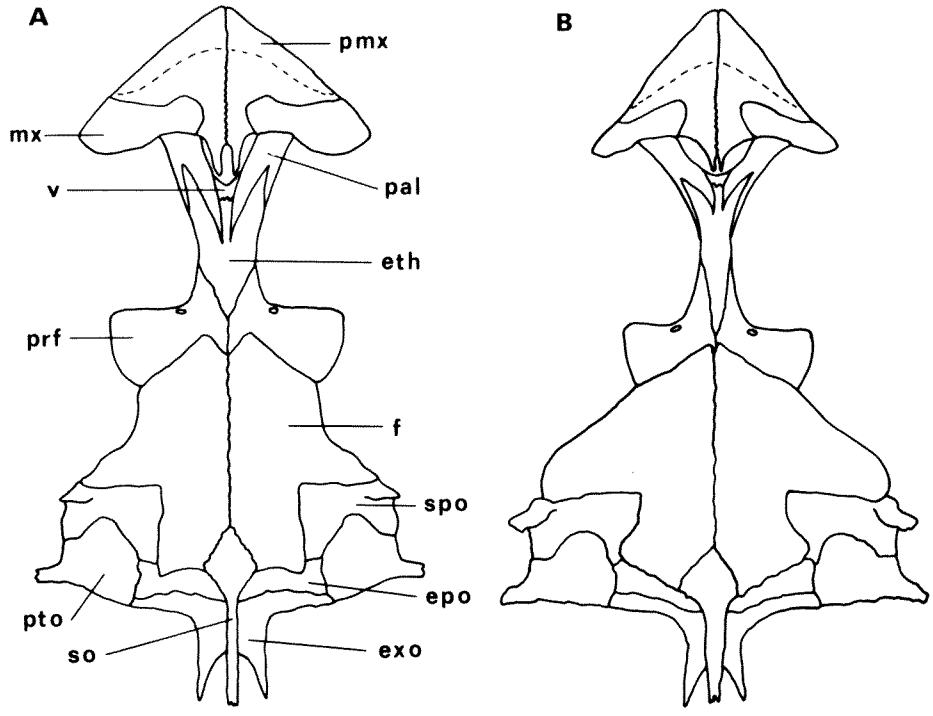

Fig. 3: (a) Skull osteology of *Omegophora armilla* (skull length 60 mm). Abbreviations: epo, eipotic; eth, ethmoid; exo, exoccipital; f, frontal; mx, maxillary; pal, palatine; pmx, premaxillary; prf, prefrontal; pto, pterotic; so, supra-occipital, spo, sphenotic; v, vomer; (b) Skull osteology of *Omegophora cyanopunctata* (skull length 54 mm).

The inner surface of the upper jaw, while lacking distinctly formed trituration teeth, has a raised, somewhat uneven surface, particularly in *O. armilla*, in which species the inner surface of the lower jaw is similarly uneven. In both species the pharyngobranchials all possess a number of small but distinct teeth. The first pharyngobranchial bears about 30 teeth (both species), the second pharyngobranchial bears about 20 teeth in *O. cyanopunctata* and about 25 teeth in *O. armilla*, and the third pharyngobranchial bears about 12 teeth in *O. cyanopunctata* and about 15 teeth in *O. armilla*. There is no interhyal and only a single hypohyal in both species.

The modal vertebral formula 8 + 11 = 19 is common to both species, as are the complete haemal arches of the four posteriormost abdominal vertebrae. However, variation in vertebral formula is greater in *O. armilla*. The haemal arch of the first caudal vertebra is not especially expanded laterally, though more so than those adjacent to it on either side. A similar, moderate laterial expansion occurs in the proximal articulating surface of the first basal pterygiophore of the anal fin. In both species, the posteriormost

dorsal and anal fin basal pterygiophores are distally comprised of several fused columnar elements.

The caudal skeleton is essentially typical of tetraodontids (Tyler 1964), with an autogenous haemal spine of the penultimate vertebra, a free parhypural, a lower hypural plate fused to the centrum, an upper free hypural plate, and a free epural, somewhat horizontally placed in *O. cyanopunctata*, and more obliquely placed in *O. armilla*. Both species however, lack an elongate urostyler projection from the centrum of the last vertebra, which in many other members of the family, separates for the most part the epural from the free upper hyprual plate (Tyler 1964).

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