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Aioliops, a New Genus of Ptereleotrine Fish (Pisces: Gobioidei) from the Tropical Indo-Pacific with Descriptions of Four New Species

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ABSTRACT. *Aioliops* is a new genus of ptereleotrine fish that is found on coral reefs from Australia to Indonesia and as far north as the Philippines. Four species compose the genus and all are described as new: *A. brachypterus, A. megastigma, A. novaeguineae* and *A. tetrophthalmus.* These species are readily identifiable by a dark stripe along the dorsolateral surface of the body and a large dark spot on the caudal fin. Osteology of the new genus along with morphology and colour variations of the species are described, and the relationship of *Aioliops* to allied genera is discussed.

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The ptereleotrine gobioids are a group of small, Indo-Pacific fishes that are associated with a variety of habitats, including coral reefs, sand channels and mangrove zones, and are found at depths up to 98 m. These fishes may be seen in large groups, in pairs, or singly, and a few have become popular aquarium species because of their striking colours.

Species of *Aioliops* represent some of the smaller fishes in the subfamily, with the largest mature adults attaining lengths of 24 mm. Unlike *Parioglossus,* which lives primarily in mangrove zones or shallow reef flats and which the new genus superficially resembles, *Aioliops* is found near drop-offs on coral reefs at depths up to 25 m. Fishes of both genera, however, are more likely to be seen in groups rather than singly or in pairs.

Aioliops brachypterus has been collected from the Philippines; *A. megastigma* from Indonesia and the Philippines; *A. novaeguineae* from Papua New Guinea, Irian Jaya and questionably from the Timor Sea; and *A. tetrophthalmus* from tropical eastern Australia. The genus appears to have a limited distribution compared to other related genera, and yet it is not uncommon. Its distribution probably reflects difficulties in capturing individuals as most attempts are thwarted when the fish dart off in different directions. With the use of rotenone, however, groups of 10–30 fish may be collected, although it is just as likely to capture only one or two as the schools often move away when approached. The genus was first collected in 1970, and most of the material has been collected by only five workers.

Classification of the suborder, Gobioidei, based on osteological characters, can be traced back to Regan (1911). Since then, Gosline (1955) placed the microdesmids among the gobioids; Miller (1973) summarized the numerous studies on gobioid classification and proposed another classification; Birdsong (1975) criticized Miller's classification but refrained from proposing an alternate one; Springer (1983) elaborated on the skeletal characters noted by Birdsong and discussed the monophyly of the suborder; and Hoese (1984) recognized 6 families of the suborder and listed characteristic features of each. We follow Hoese (1984) in provisionally placing *Aioliops* in the family Microdesmidae, based on the long posterior pelvic process and single pterygiophore preceding the first hemal spine.

The new genus, *Aioliops,* has been created on the basis of osteological as well as other morphological characters which are not all shared with other ptereleotrines. These characters include: caudal vertebrae having open neural arches with slightly elevated posterior portions and no lateral foramen (except *A. brachypterus* which has closed neural arches

with reduced basal portions and large lateral foramen); a prominent dorsolateral process near the posterior end of the anguloarticular; one pair of interorbital pores; large, ctenoid scales or no scales; and short-based dorsal and anal fins.

The species of *Aioliops* all share the same basic colour pattern which is a dorsolateral stripe along the body and a large, dark caudal-fin spot. Differences in pigmentation exist, and these are often the easiest characteristics to use for distinguishing species.

Aioliops megastigma, A. novaeguineae and *A. tetrophthalmus* are similar in having ctenoid scales, a naked predorsal, three preopercular pores, six spines in the first dorsal fin and four segmented pelvic rays. Of these species, *A. novaeguineae* differs osteologically in having the urostyle fused with the lower hypural plate.

The fourth species, *A. brachypterus,* differs from the others in having no scales, two preopercular pores, five spines in the first dorsal fin and three segmented pelvic rays. It also differs osteologically from the others in having no ventral postcleithrum and closed neural arches on the caudal vertebrae.

Materials and Methods

Measurements and counts follow those described by Hubbs & Lagler (1974) except as noted below. All fish lengths refer to standard lengths (SL). All measurements including standard lengths were taken with an ocular micrometer and recorded to the nearest 0.1 mm. Raw data were converted to percentage of standard length, and t-values of the Students T Test or f-values from Analysis of Variance were computed to determine any significant differences between meristics. Rays refer to segmented rays. The last dorsal and anal ray as counted is branched through the base. The transverse scale count is taken from the anal-fin origin upward and backward to the second dorsal fin. Body depth is taken at the anal-fin origin. Caudal-fin spot length is the distance from the anterior edge to the posterior edge of the spot. Stripe depth is the depth of the lateral stripe at its deepest point below the first dorsal fin. Head-pore counts are from one side of the head (Fig. 1). Comparisons of certain characteristics of the different genera in the subfamily are given in Tables 1 and 2. The following meristic tables are provided for each species: dorsal and anal fins (Table 3); pectoral, pelvic, segmented caudal and branched caudal fins (Table 4); longitudinal and transverse scales (Table 5); circumpeduncle scales and total gill-rakers on the outside face of the first gill arch (Table 6); measurements of the holotypes (Table 7); and morphometric proportions of the four species (Table 8). Vertebrae were counted from radiographs. Osteology was examined from specimens cleared with trypsin and stained with alizarin, and several of these specimens were counter-stained with alcian blue. Illustrations were made with the aid of a camera lucida.

Abbreviations for institutions from which material was examined follow Leviton *et al.* (1985).

Comparative material examined. Material of *Parioglossus* examined is given in Rennis and Hoese (1984). Material other than cleared and stained material of *Ptereleotris* is listed in Randall & Hoese (1985).

Table 1. Comparison of selected characters within the subfamily Ptereleotrinae. (Number after character refers to Fig. 17.)

Character	Genera				
	Aioliops	*Nemateleotris*	*Oxymetopon*	*Parioglossus*	*Ptereleotris*
Segmented dorsal rays	9-12	8-32	26-31	13-19	23-39
Segmented anal rays	9-11	26-31	27-30	13-19	22-37
Pectoral rays	14-18	19-21	20-26	15-20	21-26
Segmented pelvic rays (3)	3-4	5	4	4	4
Longitudinal scales (8)	0 or 37-44 cten/cycl	110-160 cten/cycl	85-105 cten/cycl	0 or 61-109 cycl	121-170 mosly cycl
Filamentous dorsal spines (1)	no	yes	yes or no	yes or no	yes or no
Preopercular pores (9)	2-3	3	3	0, 2	2
Interorbital pore(s)	paired	median	paired	paired	median
Terminal lateral canal pore (10)	+	+	+	-	+
Pterygiophore formula (12)	3(22110)	3(22110)	3(22110)	3(22110)	3(32010)
Jaws	weakly protrusible	weakly protrusible	highly protrusible	highly protrusible	highly protrusible
Body (7)	moderately compressed	moderately compressed	strongly compressed	moderately compressed	moderately compressed

Cleared and stained material. *Nemateleotris decora:* AMS I.19476-045, 50 mm, Yonge Reef, Queensland, Australia. *Nemateleotris magnificus:* AMS I.17027-001, 32 mm, Palau. *Oxymetopon* sp.: AMS (unregistered), 86 mm, Port Moresby, Papua New Guinea. *Ptereleotris evides:* AMS I. 15643-014, 2(51-53 mm), One Tree Island, Queensland, Australia; AMS (unregistered FTL 743), 26 mm, Lizard Island lagoon, Queensland, Australia. *Ptereleotris heteroptera:* AMS I.15682-031, 84 mm, One Tree Island, Queensland, Australia. *Ptereleotris monoptera:* AMS I.15678-007, 70 mm, One Tree Island, Queensland, Australia. *Ptereleotris zebra:* AMS I.15621-012, 4(51-74 mm), One Tree Island, Queensland, Australia.

Other material. *Oxymetopon compressus:* BMNH 1965.11.6.2, 66 mm, HOLOTYPE, Hong Kong. *Oxymetopon typus:* RMNH 4471, 111 mm, HOLOTYPE, Timor. *Oxymetopon* sp.: SIO 80-213, 103 mm, Taiwan; AMS (unregistered), 90 mm, Port Moresby, Papua New Guinea.

Table 2. Comparison of various osteological features of five ptereleotrine genera. (Number after character refers to Fig. 17.)

Character	*Nemateleotris*	*Aioliops*	*Oxymetopon*	*Ptereleotris*	*Parioglossus*
Process on anguloarticular	small	large	absent	absent	absent (rudimentary in *P. palustris*)
Anterior zygapophyses (11)	vertebrae 2-5	vertebrae 2-4	vertebrae 2-4	vertebrae 2-5 (2-11 in *P. monoptera*)	prominent on all precaudal and most caudal vertebrae
Palatopterygoid strut (5)	about 45°	about 45°	almost vertical	almost vertical	almost vertical
Lacrimal (4)	+	−	+	+	reduced
Scapula (2)	well ossified	mostly cartilage	well ossified	mostly cartilage	mostly cartilage
Ventral postcleithrum	+	±	−	+	+
Articular process of premaxilla (6)	shorter than ascending	shorter than ascending	subequal to ascending	subequal to ascending	subequal to ascending
Frontal (13)	not prominent	not prominent	strongly prominent	not prominent	not prominent

Table 3. Frequency distributions of dorsal- and anal-fin counts for species of Aioliops (* indicates holotype count).

Species	First Dorsal Fin			Second Dorsal Fin			Anal Fin	
	IV	V	VI	I,9	I,10	I,9	I,10	I,11
A. brachypterus	1	7*		4	4*		3	5*
A. megastigma			31*	7	24*	4	26*	1
A. novaeguineae			32*	27*	6	7	26*	
A. tetrophthalmus			33*	17*	8		23*	

Table 4. Frequency distributions of pectoral-, pelvic-, segmented caudal- and branched caudal-fin ray counts for species of *Aioliops* (* indicates holotype count).

Species	Pectoral Fin					Pelvic Fin			Segmented Caudal Fin	Branched Caudal Fin	
	14	15	16	17	18	I,2	I,3	I,4	9+8	7+5	7+6
A. brachypterus	1	5*	2			.5	7.5*		8*	1	7*
A. megastigma		2*	10	17	2			31*	31*		31*
A. novaeguineae		1	20*	12				33*	33*		33*
A. tetrophthalmus		1	19*	3				33*	33*		33*

Table 5. Frequency distributions of longitudinal- and transverse-scale counts for species of *Aioliops* (* indicates holotype count).

Species	Longitudinal Scales								Transverse Scales			
	37	38	39	40	41	42	43	44	10	11	12	13
A. megastigma	1	1	1	1	2	1	1	2*			8*	3
A. novaeguineae		4	4	3		2*			5	9*		
A. tetrophthalmus		1	7	3*	1	1			10*	7	2	

Table 6. Frequency distributions of circumpeduncle-scale counts and total gill-raker counts on outer face of first arch for species of *Aioliops* (* indicates holotype count).

Species	Circumpeduncle Scales				Gill Rakers			
	12	13	14	15	14	15	16	17
A. brachypterus					4			
A. megastigma	3*	7	2		2	5	2*	2
A. novaeguineae		6*	3		2	1	5*	
A. tetrophthalmus	1	5	8	4*		12*	2	

Table 7. Measurements of the holotypes of *Aioliops* species (in mm).

Character	*A. brachypterus*	*A. megastigma*	*A. novaeguineae*	*A. tetrophthalmus*
Sex	♂	♀	♀	♂
Standard length	19.0	23.7	18.5	18.4
Head length	5.3	5.7	4.8	4.9
Head width	2.6	3.2	2.7	2.6
Predorsal length	6.6	7.3	6.2	6.3
Body depth	2.7	3.4	2.9	3.1
Mouth	1.7	2.1	1.5	1.8
Eye	1.9	2.1	1.6	1.8
Snout	.9	.8	.7	.6
Caudal-peduncle length	3.9	4.9	4.4	4.3
Caudal-peduncle depth	2.0	2.3	2.1	2.2
Pectoral-fin length	3.7	4.5	4.2	4.2
Pelvic-fin length	3.0	3.7	3.3	3.5
Caudal-fin length	3.6	4.4	3.5	3.8
Third dorsal spine length	1.6	2.0	1.6	1.7
Stripe depth	.7	.7	.4	.5
Caudal-fin spot length	1.8	2.1	1.7	1.8
Preopercular pores	2	3	3	3

Table 8. Standard lengths (mm) and morphometric proportions (percent of SL) for species of *Aioliops*. Morphometric proportions for Timor Sea specimens of *A. novaeguineae* are included in ranges except for stripe depth and caudal-fin spot length where they are placed in parentheses.

Character	*A. brachypterus*	*A. megastigma*	*A. novaeguineae*	*A.tetrophthalmus*
Number examined	8	20	29	33
Standard length (SL)	16.7-19.9	15.9-23.7	12.7-19.5	9.6-22.2
(mean length)	(18.8)	(18.5)	(16.7)	(16.7)
Head length	24.5-27.8	24.1-28.7	24.4-29.3	24.1-30.9
Head width	13.0-14.7	12.5-16.0	11.2-16.0	11.3-18.5
Predorsal length	34.7-36.0	30.8-36.8	31.8-36.4	31.2-38.1
Body depth	14.2-15.8	14.3-19.2	14.9-18.2	14.7-19.7
Mouth	7.8-9.1	7.9-10.5	8.0-10.9	7.2-11.3
Eye	8.4-10.6	8.3-10.7	8.7-10.9	8.8-11.5
Snout	4.0-5.9	3.0-4.3	2.8-4.3	2.8-4.5
Caudal-peduncle length	18.9-20.8	20.6-25.6	21.0-25.6	22.1-27.9
Caudal-peduncle depth	10.5-11.2	9.5-13.5	9.1-13.0	9.2-13.6
Pectoral-fin length	17.0-20.8	17.8-22.8	18.8-23.6	18.1-24.2
Pelvic-fin length				
(males)	14.3-14.9	16.4-20.6	19.0-21.5	16.8-20.8
(females)	12.5-14.2	15.6-19.8	15.9-19.1	15.3-21.0
Caudal-fin length	17.3-20.8	18.6-24.3	19.0-23.5	19.6-24.0
Third dorsal spine length	6.2-8.4	8.3-12.1	8.2-12.5	7.0-12.1
Stripe depth (males)	3.7	2.4-3.8	1.6-2.0 (1.4)	1.9-2.7
(females)	1.5-2.1	1.5-3.1	1.3-2.3 (1.2)	1.6-2.7
Caudal-fin spot length (males)	9.5-10.7	9.6-14.5	9.4-13.8 (12.2)	7.1-12.1
(females)	9.5-9.8	8.3-11.9	9.2-13.0 (10.2)	7.2-10.4
Preopercular pores	2	3	3	3

Aioliops n. gen.

Type species. *Aioliops tetrophthalmus* n. sp., Great Barrier Reef, Queensland, Australia.

Diagnosis. Dorsal fins IV–VI (usually V–VI) + I, 9–10; anal fin I, 9–11; pectoral fins 14–18; pelvic fins separate, I, 3–4; segmented caudal fin 9 + 8; branched caudal fin usually 7 + 6; total gill rakers on outer face of first gill arch, 14–17, compressed and elongate; vertebrae 10 + 16; branchiostegals 5. Head and body compressed; body elongate; ventral and dorsal profiles straight; mouth terminal, oblique; maxilla reaching posteriorly to a point below anterior to middle of pupil; upper jaw slightly protrusible; snout short, round to truncate in side view, less than eye diameter; anterior nostril a short tube or a simple pore; posterior nostril a simple pore; vomer, tongue, and palatines edentate; upper and lower jaws with conical, recurved teeth in 2

rows anteriorly, outer teeth larger than inner; outer anterior teeth of lower jaw directed outward; posteriorly, teeth in 1 or 2 rows; tongue tip round to truncate, tip free from floor of mouth; interorbital about equal to eye diameter; head papillae present, slight variation in number of papillae within and between species (Figs 1, 2); all head pores paired, 7 or 8 on each side of head: posterior nostril pore, interorbital pore, supraocular pore, infraorbital pore, terminal lateral canal pore, 2–3 preopercular pores; gill membrane attached to isthmus below posterior preopercular margin or beneath anterior third of operculum. Head naked; body scales present or absent, when present, mostly ctenoid, 37–44 in longitudinal series; scales on body present from just posterior to pectoral-fin base to caudal fin with 2 rows on caudal fin; posterior scales large; scales beneath first dorsal fin smaller, frequently cycloid; scales absent dorsal to a straight line from spine of second dorsal fin to pectoral-fin base origin; scales on lateral and ventral area of belly cycloid; scales absent from pectoral-fin base and prepelvic area. Caudal fin slightly emarginate.

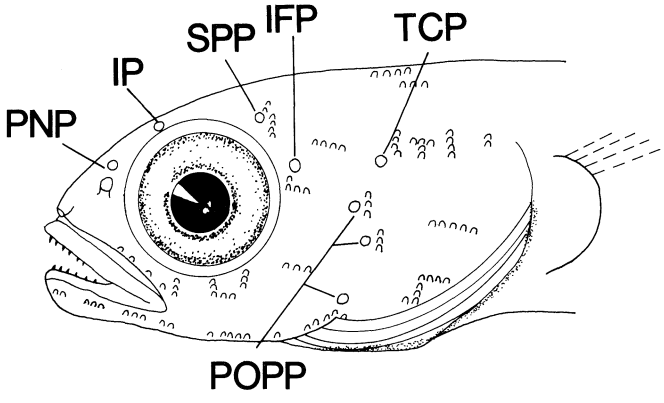

Fig. 1. Head papillae pattern for *Aioliops tetrophthalmus* and head pore terminology for *Aioliops* species. **IFP**, infraorbital pore; **IP**, interorbital pore; **POPP**, preopercular pore; **PNP**, posterior nostril pore; **SPP**, supraocular pore; **TCP**, terminal lateral canal pore.

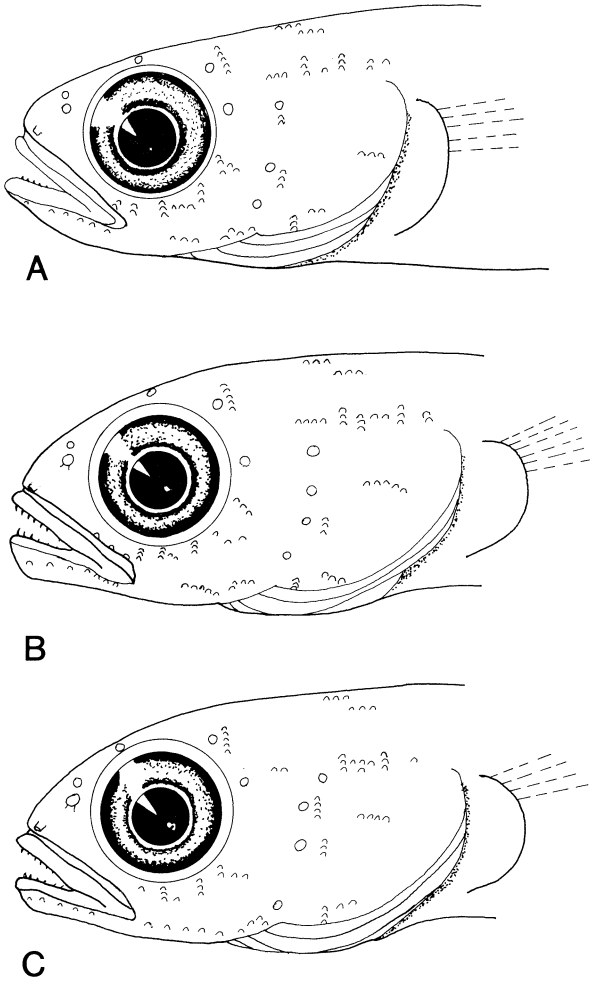

Fig. 2. Head papillae patterns showing slight variations in: **A**, *Aioliops brachypterus;* **B**, *A. megastigma;* and **C**, *A. novaeguineae.*

Osteology. JAWS AND PALATINE BONES (Fig. 3). Premaxillary (PMX) with short ascending process (ASC PMX); articular process of premaxilla (AR PMX) fused with ascending process; postmaxillary process (PM PMX) low; maxillary shaft (MX) slender; dentary (D) with a large, round, coronoid process (COR D);

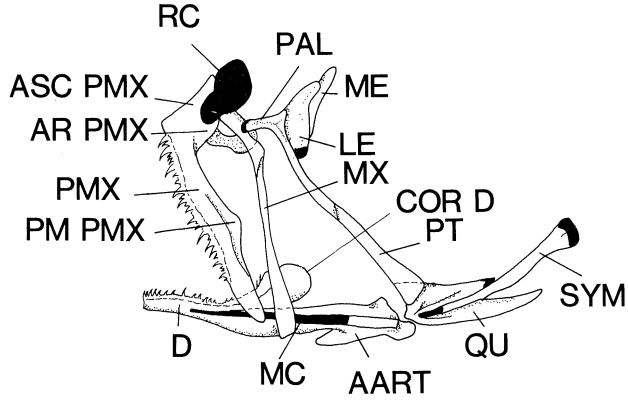

Fig. 3. Jaws and palatine bones of *Aioliops novaeguineae* (left lateral view). Cartilage is shown in black.

anguloarticular (AART) with long, slender, dorsal ramus and short, stout, ventral ramus; prominent dorsolateral process near posterior end of anguloarticular to which tendons from adductor mandibulae attach; retroarticular present; Meckel's cartilage (MC) slender, running along dorsal ramus of anguloarticular; rostral cartilage (RC) large, strongly bound to premaxillae; nasal bone absent; palatine (PAL) L-shaped, articulating with lateral ethmoid (LE); anterior tip of palatine cartilaginous, ectopterygoid (PT) slender.

HYOMANDIBULAR ARCH AND OPERCULAR BONES (Fig. 4). Quadrate (QU) fan-shaped anteriorly with tapered arm posteriorly; symplectic (SYM) slender, laterally expanded at its posterior end, anterior end with cartilage; metapterygoid (MPT) short, slender; no endopterygoid; hyomandibula (HYO) with 3 struts, these articulating with sphenotic, pterotic and operculum; hyomandibula joins metapterygoid

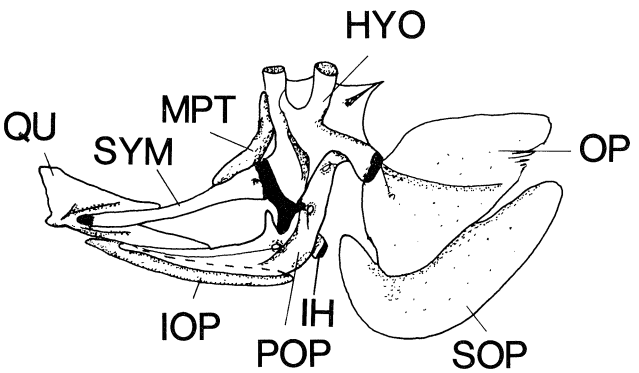

Fig. 4. Hyomandibular arch and opercular bones of *Aioliops novaeguineae* (left lateral view). Cartilage is shown in black.

anteriorly and preoperculum posterolaterally; hyomandibula joined to symplectic by cartilage; 3–5 pseudobranchs present; preoperculum (POP) crescentic with slender, slightly flattened process at inner face of angle, not reaching symplectic; interoperculum (IOP) slender; operculum (OP) triangular; suboperculum (SOP) J-shaped.

CRANIAL BONES (Fig. 5). Lacrimal absent; lateral ethmoid (LE) fan-shaped, ventral edge cartilaginous; median ethmoid (ME) large, overlapped by frontals; vomer (V) toothless, flattened dorsoventrally; vomer and anterior part of parasphenoid (PS) overlain with ethmoid cartilage; ring of cartilage around eye; dorsal flange of sphenotic (SPH) separated by thin line of cartilage from supraoccipital (SOC); sphenotic

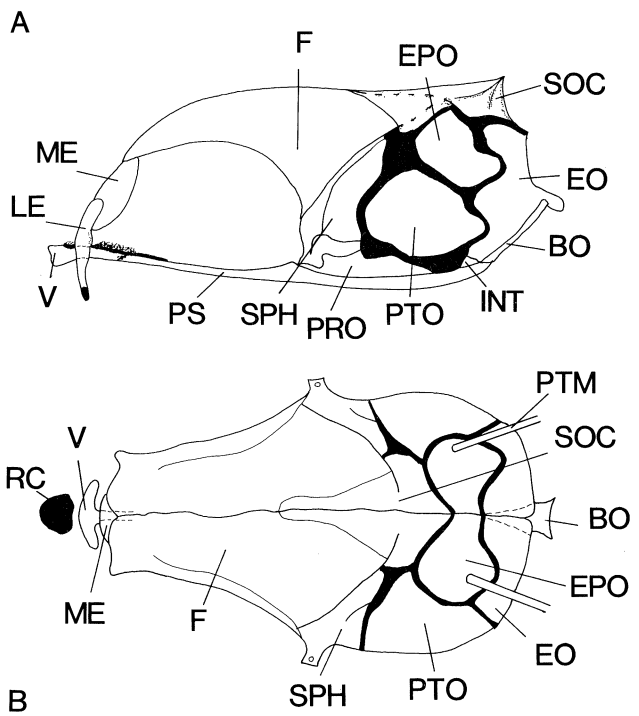

Fig. 5. Cranial bones of *Aioliops novaeguineae*. **A**, left lateral view; **B**, dorsal view. Cartilage is shown in black.

separated from pteroic (PTO) and epioccipital (EPO) by cartilage; proximal end of sphenotic with foramen; supraoccipital (SOC) diamond-shaped with prominent sagittal crest along midline; supraoccipital ridge separates epioccipitals; exoccipitals (EO) overlapped by supraoccipital along most of dorsal midline; exoccipital condyles present; basioccipital (BO) small, Y-shaped; frontal (F) large; subtemporal fossa present, bounded by prootic (PRO), exoccipital, intercalar (INT) and pterotic.

HYAL BONES (Fig. 6). Dorsal and ventral hypohyal (DH, VH) present; anterior ceratohyal (ACH) slender anteriorly, rectangular posteriorly; 5 branchiostegals; first branchiostegal (B1) off slender portion of anterior ceratohyal; branchiostegals 2–4 (B2–4) off rectangular

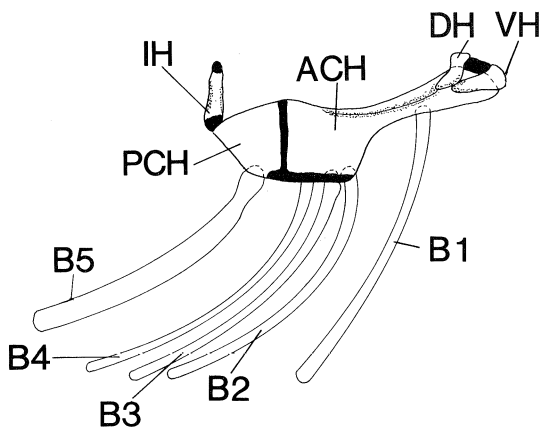

Fig. 6. Hyal bones of *Aioliops novaeguineae* (left medial view). Cartilage is shown in black.

portion of anterior ceratohyal; branchiostegal 5 (B5) off triangular-shaped posterior ceratohyal (PCH); portion of ventral edge of ceratohyal and epihyal cartilaginous; interhyal (IH) cylindrical, cartilaginous at both ends, articulating with posterior ceratohyal ventrally and hyomandibula dorsally, and in contact with preoperculum.

HYAL BONES AND BRANCHIAL ARCH (Fig. 7). Basihyal (BH) spatulate, anteriorly tipped with cartilage; urohyal laterally compressed with dorsal knob connecting to basibranchial 1 (BB1); basibranchial 1 cartilaginous; basibranchial 2 (BB2) slender, posteriorly expanded, both ends with cartilage; basibranchial 3 (BB3) long, slender, both ends tipped with cartilage; basibranchial 4 (BB4) cartilaginous; hypobranchial 1 (HB1) with outer lateral process and cartilaginous at both ends; ceratobranchial 1 (CB1) with cartilaginous tips, 11–13 long, slender ossified gillrakers (GR) along outer edge, approximately 10 pairs long, slender, cartilaginous gill filaments (GF) along median edge; inner edge with 9–10 ossified toothpatches (TP) each bearing 4–5 short, slender teeth; epibranchial 1 (EB1) bifid, each arm with a cartilaginous extension; anterior arm of epibranchial 1 long and slender with 3–4 gill rakers on ossified part of arm and 1 on cartilaginous

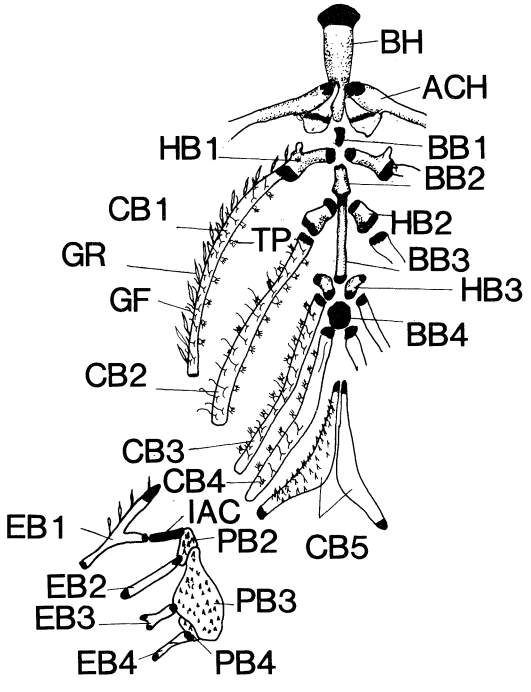

Fig. 7. Hyal bones and branchial arch of *Aioliops novaeguineae* (ventral view). Cartilage is shown in black.

extension; posterior arm connecting with long, slender interarcual cartilage (IAC); hypobranchial 2–3 (HB2–3) with cartilaginous tips; ceratobranchial 2–4 (CB2–4) with ossified toothpatches on sides; cartilaginous gill filaments on median edge; anteriorly epibranchials 2–4 (EB2–4) articulate with their respective infrapharyngobranchials (PB2–4); ceratobranchials 5 (CB5) contiguous but not fused, tipped with cartilage at both ends.

PECTORAL GIRDLE AND PELVIC FINS (Figs 8, 9). Posttemporal (PTM) forked, dorsal arm connected to

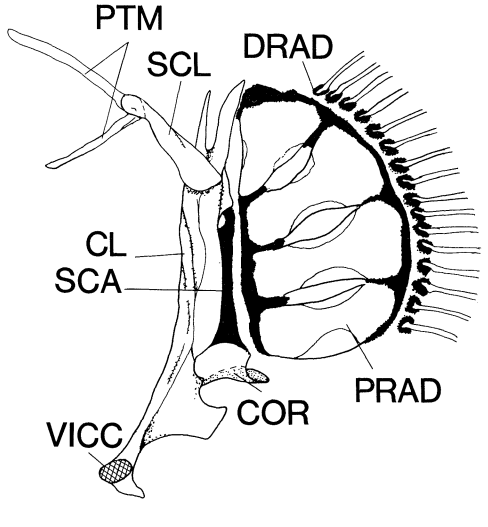

Fig. 8. Pectoral girdle of *Aioliops novaeguineae* (left side). Cartilage is shown in black. Cross-hatching indicates cartilage on underside of bone.

epioccipital, lower arm to intercalar; posteriorly, posttemporal joined to supracleithrum (SCL); cleithrum (CL) bifid dorsally; dorsal postcleithrum absent; ventral postcleithrum absent in *A. brachypterus,* present but small in *A. megastigma, A. novaeguineae* and *A. tetrophthalmus;* paired cleithra joined ventrally, ventral intercleithral cartilage (VICC) present; scapula (SCA) unossified or ossification dorsally above foramen only; large foramen present dorsally in cartilaginous area; coracoid (COR) completely ossified except at attachments to scapula and cleithrum; 4 proximal radials (PRAD); cartilage surrounding posterior margins, anterior margins of ventral 3 radials and anterior and posterior junctions between radials; usually 15–17 cartilaginous distal radials (DRAD) each associated with a pectoral-fin ray; pelvic bone (PL) conical, anteriorly joined by pelvic intercleithral

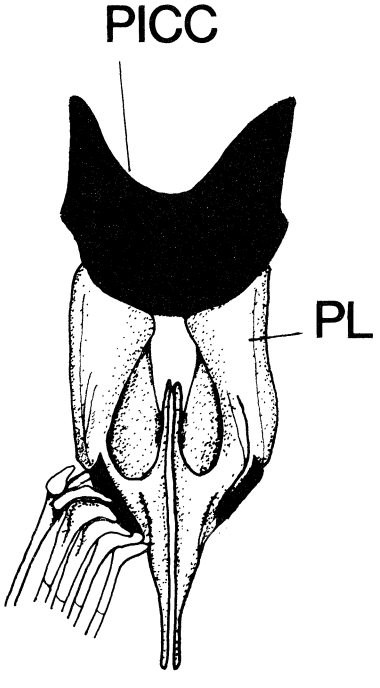

Fig. 9. Pelvic fins of *Aioliops novaeguineae* (ventral view). Cartilage is shown in black.

produced into slender projections extending well beyond fin-ray attachments; ventromedially pelvics bear long, slender anteriorly directed processes which diverge from each other or remain contiguous; posteriorly, pelvics bear 1 spine and 3 or 4 rays attached by cartilage; spine with dorsal, ventral and medial processes connecting it to pelvic; spine and rays in alignment.

VERTEBRAL COLUMN AND MEDIAN FINS (terminology from Springer, 1983 and Birdsong, 1975). Two pterygiophores between neural spines 3 and 4, 2 between neural spines 4 and 5, 1 between neural spines 5 and 6, 1 between neural spines 6 and 7 [3(22110)] (see comments for *A. brachypterus);* dorsal-fin pterygiophores slender with ventral and posterior

cartilaginous tips; proximal and medial radials of first 2 pterygiophores of second dorsal fin fused; tips cartilaginous; remainder of rays with proximal and medial radials separated with cartilage; spine and all rays except last with partially ossified distal radials; distal radial on last ray absent; first anal-fin pterygiophore precedes first hemal spine; proximal and medial radials of first anal pterygiophore fused; pterygiophore 1 supports anal spine and first ray; second through penultimate pterygiophores with proximal medial and distal radials, each tipped with cartilage; last pterygiophore with no distal radial; vertebral column with 10 precaudal and 16 caudal vertebrae; precaudal vertebrae and occasionally anterior caudal vertebrae

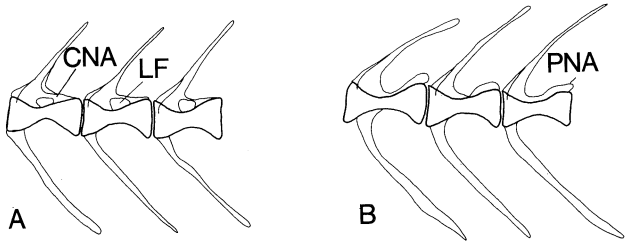

Fig. 10. Caudal vertebrae of: **A,** *Aioliops brachypterus* showing closed neural arch and lateral foramen and **B,** *A. novaeguineae* showing open neural arch and slightly elevated posterior section.

with epipleural ribs becoming progressively further from pleural ribs posteriorly; vertebrae 2–10 with pleural ribs; vertebrae 2–4 with anterior zygapophyses; vertebrae 1–4 or 5 with sides of neural arch usually closed by a process extending from above base of neural spine to posterior end of centrum, lateral foramen present; vertebrae 5–6 to 8–9 with neural arch usually closed, posterior and central sections reduced, foramen present; vertebrae 9–10 to 22, neural arch open, no foramen, posterior section (PNA) usually slightly elevated (Fig. 10B), except for *A. brachypterus* which has closed neural arches (CNA) with lateral foramen (LF) present on vertebrae 9–20 but with low central and posterior sections (Fig. 10A), and vertebrae 21–22 with no central or posterior section and no foramen; neural spines arising from anterior part of centrum on vertebrae 1–20, from anterior to middle part on vertebrae 21–23, and from posterior part on vertebrae 24–25; precaudal vertebrae with parapophyses becoming progressively larger posteriorly; hemal and neural spines of penultimate vertebra broad.

CAUDAL FIN (Fig. 11). Lower hypural plate (LHP) with anteroventral flange; urostyle (US) fused with upper hypural plate (UHP) in all species; urostyle fused with lower hypural plate of *A. novaeguineae* and articulates with lower hypural plate of *A. brachypterus, A. megastigma* and *A. tetrophthalmus;* hypural 5 (HYP 5) slender; one large epural (EPU) present, composed of cylindrical strut and anterior flange; parhypural (PHYP) with anterior flange; neural spine (NS) broad proximally, blade-like distally; dorsal and ventral procurrent cartilage (DPC,VPC) present, each with 7–8 procurrent rays; upper hypural plate with 7 branched rays, uppermost sometimes displaced slightly above plate; lower hypural plate with 6 branched rays, lowermost sometimes displaced slightly below plate; hypural 5, parhypural, last hemal spine (HS) and epural each with one simple, segmented ray.

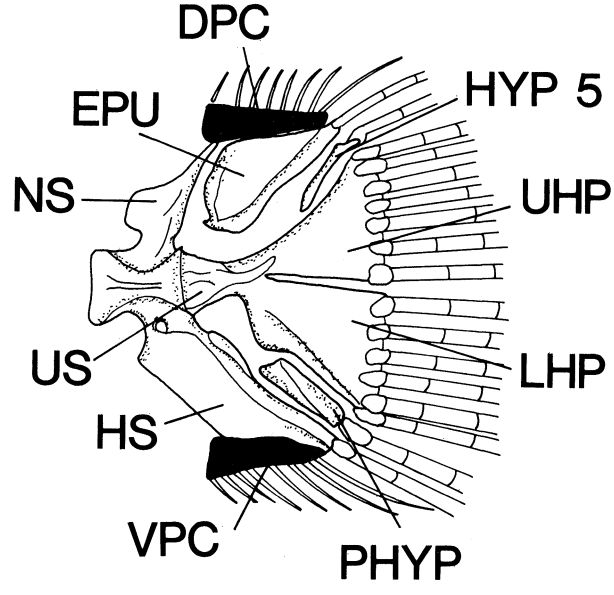

Fig. 11. Caudal fin of *Aioliops novaeguineae* showing urostyle fused with lower hypural plate (left side). Cartilage is shown in black.

Etymology. From the Greek *aiolos* = swift, God of the Wind, and *iops* (masculine) = small fish, named for the speed with which this small fish avoids capture.

Key to Species of *Aioliops*

1. Scales present on body; 3 preopercular pores; usually 6 dorsal spines; pelvic fins I, 4; gill membrane attachment below posterior preopercular margin. 2

——No scales on body; 2 preopercular pores; usually 5 dorsal spines; pelvic fins I, 3; gill membrane attachment behind posterior preopercular margin. .. .. *A. brachypterus*

2. Second dorsal fin usually I, 9; transverse scales usually 10–11; brown stripe on and to either side of ventral midline; anterior edge of caudal-fin spot

extending onto caudal-fin scales in both sexes and may extend onto caudal peduncle. 3

——Second dorsal fin usually I, 10; transverse scales 12–13; no brown stripe on and to either side of ventral midline; anterior edge of caudal-fin spot not extending onto caudal-fin scales although males may have lighter speckling anterior to main spot which extends onto caudal-fin scales. ..... *A. megastigma*

3. Pelvic-fin rays of males usually extending to anus; caudal-fin spot extending onto caudal peduncle ventral to midline; scattered brown speckling usually present on dorsal midline anterior to caudal peduncle; lateral stripe extending onto dorsal caudal-fin rays. ..... *A. novaeguineae*

——Pelvic-fin rays of males not extending to anus; caudal-fin spot not extending onto caudal peduncle, usually extending onto last row of caudal-fin scales; scattered brown speckling rarely present on dorsal midline anterior to caudal peduncle; lateral stripe not extending onto dorsal caudal-fin rays. ... *A. tetrophthalmus*

Aioliops brachypterus n.sp.

Figs 12, 16

Type material. HOLOTYPE: NSMT P.44087, Mini Rock Island, El Nido Island, Philippines, 5 June 1984, ♂, 19.0 mm. PARATYPES: LICPP 1984275, taken with holotype, 7(17–20 mm).

Diagnosis. (Based on 8 specimens, 2 ♂ and 6 ♀, from one sample.) Dorsal fins IV–V (usually V) + I, 9–10; anal fin I, 10–11; pectoral fins 14–16; pelvic fins I, 3 (one specimen with I, 2 on one side only), all segmented rays unbranched; scales absent; anterior nostril a simple pore; 2 preopercular pores, other pores as for genus; posterior teeth of both jaws in one row; gill membrane attaching to isthmus beneath anterior third of operculum; snout long (4.0–5.9% of SL); caudal peduncle length short (18.9–20.8% of SL); first dorsal fin short (length of third dorsal spine 6.2–8.4% of SL); pelvic fin short (12.5–14.9% of SL); caudal fin short (17.3–20.8% of SL); males with predorsal area dark; females with dorsolateral stripe commencing above or behind posterior preopercular margin; dark stripe, on and to either side of ventral midline posterior to anus; roundish spot on caudal fin, spot extending onto ventral portion of caudal peduncle; ventral postcleithrum absent; vertebrae 10–20 with neural arches closed and foramen present.

Description. Snout round to truncate in side view, 1.8–2.1 in eye; gill rakers on outer face of first arch 3 + 1 + 10 (= 14). First dorsal fin originating about eye diameter or slightly more than eye diameter posterior to pectoral-fin base origin; no elongate or filamentous dorsal spines, spine 2 longest, slightly longer than 3, spines 1 and 4 about equal, less than 2 and 3, spine 5 shortest; dorsal and anal segmented rays 2 and 3 longest, posterior segmented rays decreasing in length to last ray; first dorsal- and anal-fin segmented ray unbranched, other rays branched; pectoral fins with round margin; second segmented pelvic ray longest.

Colour in alcohol. Body yellow; males with top of head from first dorsal fin to tip of upper lip dark; females with sparse to dense patch of brown chromatophores across head from just posterior to eye to over posterior portion of operculum and with small patch of round, brown chromatophores just ventral to infraorbital pore; males with brown patch extending from infraorbital pore posteriorly over dorsal portions of preoperculum and operculum and with brown speckling on tip of lower lip, suborbital, and dorsal and ventral edges of pectoral-fin base; both sexes with brown chromatophores on bases of pectoral-fin rays, and

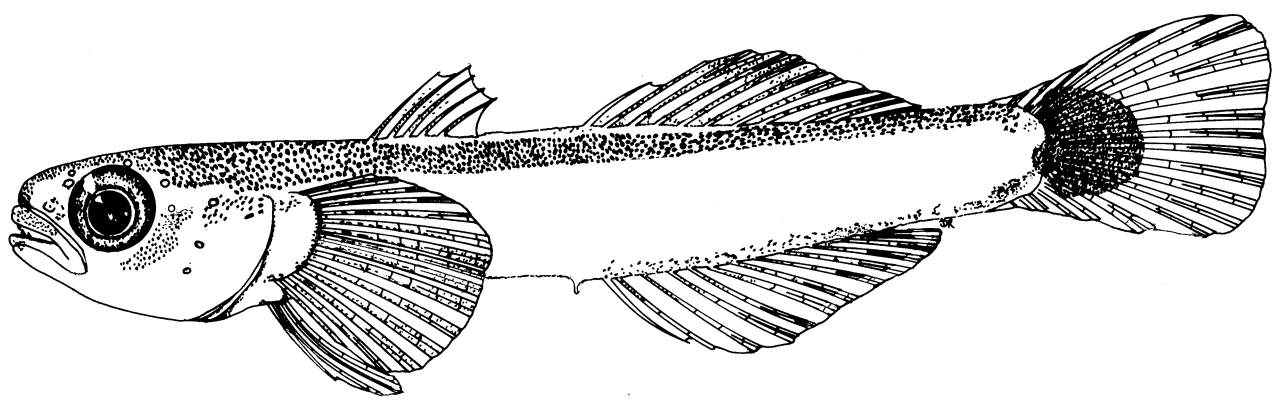

Fig. 12. Holotype of *Aioliops brachypterus*, Philippines, ♂, 19.0 mm (NSMT P.44087).

occasionally pelvic-fin base and rays; females with subdermal brown stripe on lateral portion of gut, males with subdermal pigmentation on most of gut; males with several brown chromatophores scattered anteriorly on lateral portion of trunk (obscured by pectoral fin); females with brown speckling on belly; sparse brown speckling at base of dorsal fins; dorsolateral stripe of males commencing beneath first dorsal fin, stripe of females beginning above posterior preopercular margin to middle of opercular margin; stripe extending along trunk and tail to upper edge of caudal peduncle where both sides of stripe are connected by randomly scattered chromatophores across dorsal midline; lateral stripe deeper in males than females, stripe below first dorsal fin 1.2–1.3 in pupil diameter for males, 1.6–2.0 in pupil diameter for females; both sexes with speckling on and to either side of ventral midline from anus to caudal peduncle; roundish black spot on caudal fin, ventral half of spot extending onto caudal peduncle; spot partially covering rays 2–3 to 16–17; average number of partially pigmented caudal-fin rays, 14; spot length about equal to eye diameter; dorsal, anal and pectoral fins lightly spotted; pelvic fins pale.

Distribution. Mini Rock Island, El Nido Island, the Philippines.

Etymology. From the Greek *brachy* = short and *pteron* = fin, named for the relatively short lengths of the dorsal, caudal and pelvic fins.

Comments. Although the ventral half of the caudal-fin spot extends onto the caudal peduncle of both *A. brachypterus* and *A. novaeguineae* the lack of scales, 5 dorsal spines, 3 ventral rays which are all unbranched, more restricted gill opening and 2 preopercular pores easily distinguish *A. brachypterus* from the other three species. *Aioliops brachypterus* is also distinctive in the genus in having a longer snout, shorter caudal peduncle length, shorter pelvic-fin length, shorter caudal-fin length, shorter first dorsal-fin height, significantly lower pectoral-fin ray counts ($p<0.001$) and significantly higher anal fin-ray counts ($p<0.01$) compared to the other species. The depth of the lateral stripe beneath the first dorsal fin of the males is larger than those of *A. novaeguineae* and *A. tetrophthalmus* but approximately equal to that of *A. megastigma.*

The densely pigmented predorsal region of the male is the most obvious colour difference separating *A. brachypterus* from the other species. However, more subtle differences are present such as the higher number of partially pigmented caudal-fin rays (average of 14 for *A. brachypterus* and 7.5–10 for the other species) and the point of origin of the female lateral stripe which is over or behind the posterior preopercular margin in *A. brachypterus.*

The absence of the ventral postcleithrum distinguishes this species osteologically from the other species. Although *A. brachypterus* has only 5 dorsal spines, the one cleared and stained specimen has 6 pterygiophores associated with the first dorsal fin. Of the radiographs taken, one shows a faint spot where the sixth pterygiophore would normally occur while the quality of the other 6 radiographs are too poor to determine if the pterygiophore is present. On the basis of its presence in the cleared and stained specimen, it is assumed that the pterygiophore formula is normally 3(22110).

Within the species there is sexual dimorphism. The pelvic fins are longer and the lateral stripe is deeper in males. Both sexes are pigmented in similar areas, however, males have a much higher concentration of spots on the predorsal region.

One of the 8 specimens is unique in having a first dorsal fin of 4 spines and pelvic fins with counts of I, 2/I, 3. As this was the only specimen found with lower counts, it is presumed to be atypical.

Aioliops megastigma n.sp.

Figs 13, 16

Type material. HOLOTYPE: NSMT-P.44114 El Nido Island, Philippines, 6–25 March 1983, ♀, 23.7 mm. PARATYPES: AMS I.25434-001, north of Lesser Mendjangan Island, Karimundjawa Islands, Indonesia, 5°53′S 110°25′E, V. Springer & M. Gomon, 30 May 1974, 2(19–20 mm); AMS I.25435-001, Bararin Island, Palawan Province, Philippines,

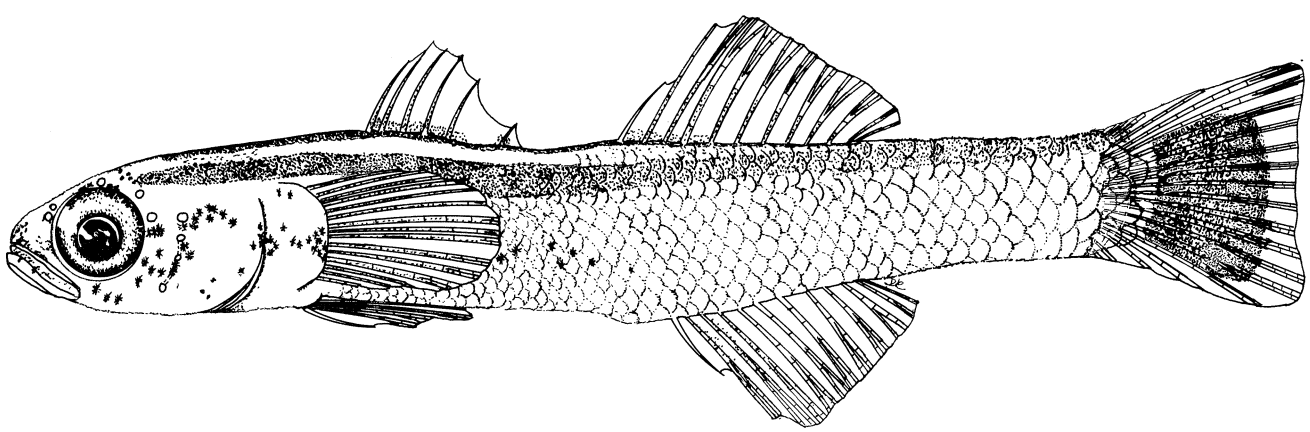

Fig. 13. Holotype of *Aioliops megastigma,* Philippines, ♀, 23.7 mm (NSMT P.44114).

10°53′N 120°56′E, 0–15 m, Smithsonian team, 23 May 1978, 2(16–17 mm), cleared and stained 1(16 mm); CAS 57923 same data as I.25435-001 1(18 mm); LICPP 1984269, Mini Rock Island, El Nido Island, Philippines, 5 June 1984, 4(16–20 mm); USNM 246731, same data as AMS I.25434-001, 8(18–20 mm); USNM 257044, south-west coast of Karimundjawa Island, Indonesia, 5°53′S 110°26′E, 1–13 m, V. Springer, 29 March 1974, 3(16–18 mm); USNM 257054, same data as AMS I.25435-001, 11(16–18 mm).

Diagnosis. Dorsal fins VI + I, 9–10 (usually I, 10); anal fin I, 9–11 (usually I, 10); pectoral fins 15–18; pelvic fins I, 4; scales present, 37–44 in longitudinal series, 12–13 in transverse series; anterior nostril a short tube; 3 preopercular pores, other pores as for genus; posterior teeth of both jaws in one row; gill membrane attached to isthmus below posterior margin of preoperculum; dark stripe on dorsal midline; depth of male lateral stripe 2.4–3.8% of SL; round to oblong spot on caudal fin beginning about pupil diameter posterior to caudal peduncle.

Description. Snout round in side view, 2.0–3.2 in eye; gill rakers of first gill arch 3–4 + 1 + 10–13 (= 14–17). First dorsal fin originating about eye diameter or slightly more than eye diameter posterior to pectoral-fin base origin; no elongate or filamentous dorsal spines; spines 2–3 about equal in length, spine 4 slightly shorter, spines 1 and 5 about equal in length, shorter than 2–4, spine 6 shortest; dorsal and anal segmented rays 2 and 3 longest, posterior rays decreasing slightly in length to last ray; all dorsal and anal segmented rays branched except first dorsal segmented ray which is unbranched; pectoral fins oblong; pelvic fins not reaching to anus in either sex; pelvic ray 3 longest; innermost pelvic ray unbranched, others branched.

Colour of fresh material. Background colour whitish; snout, preoperculum and operculum yellowish grey; dark brown, lateral stripe along dorsolateral portion of body originating just posterior to supraocular pore and continuing to end of caudal peduncle; dark brown stripe along dorsal midline from nape to end of caudal peduncle; large, dark brown, vertically oblong spot on caudal fin beginning about pupil diameter posterior to caudal peduncle; belly bright blue; wide yellowish orange stripe along ventral midline from beginning of anal fin to end of caudal peduncle and extending onto lower third of body; fins clear.

Colour in alcohol. Background colour of body and head yellow; snout, upper lip and tip of lower jaw with small brown chromatophores slightly speckled in females, moderately speckled in males; small, brown chromatophores on throat, suborbital, preoperculum, upper portion of operculum, pectoral-fin base, and occasionally just dorsal to pectoral-fin base in both sexes, denser in males than females, and occasionally absent in one or more of these locations in females; males with brown speckling on anterior portion of branchiostegal membrane, prepelvic area, and frequently pelvic-fin base and anterior portion of pelvic rays; brown speckling across posterior portion of interorbital in males and on head just posterior to eyes in both sexes; occasionally entire head of males covered in moderately spaced, round, brown chromatophores; brown, subdermal chromatophores on lateral portion of gut in both sexes; males with brown chromatophores at base of urogenital papilla and randomly scattered on belly; both sexes with several brown chromatophores along lateral area of trunk, denser in males than females and frequently absent in females; chromatophores occasionally extending along tail of males and forming dense patch on lateral midline just anterior to caudal fin; narrow brown stripe along dorsal midline from just posterior to eye and continuing to end of second dorsal fin; random speckling on midline posterior to second dorsal fin; dark brown stripe commencing just posterior to supraocular pore in females and just anterior to supraocular pore in males, continuing along dorsolateral portion of body and terminating on anterior portion of dorsal caudal-fin rays; depth of lateral stripe below first dorsal fin approximately equal to pupil diameter; large, brown to black, round to oblong spot on caudal fin usually occurring on rays 2–5 to 13–17 in males and 4–6 to 12–15 in females, but may cover part of all segmented rays; average number of partially pigmented caudal-fin rays, 10; spot length equal to or greater than eye diameter in females, greater than eye diameter in males; anterior edge of spot about a pupil's diameter posterior to end of caudal peduncle; males with mid-anterior portion of spot occasionally lighter and extending onto caudal peduncle; males with proximal quarter of dorsal fins dark; dorsal fins of females and anal and pectoral fins of both sexes lightly speckled; pelvic fins whitish.

Distribution. Indonesia (excluding Irian Jaya) and the Philippines.

Etymology. From the Greek *mega* = large and *stigma* = spot, named for the large caudal-fin spot, and treated as a noun in apposition.

Comments. *Aioliops megastigma* is separated geographically from *A. novaeguineae* and *A. tetrophthalmus,* but has been collected from the Philippines with *A. brachypterus.* This species, however, is readily distinguished from *A. megastigma* by the absence of scales, 2 preopercular pores, 5 dorsal spines and a more restricted gill opening. *Aioliops megastigma* is distinct from *A. novaeguineae* and *A. tetrophthalmus* in having a significantly higher ($p<0.01$) dorsal-fin ray count (usually 10 for *A. megastigma* compared to usually 9 for the other two species) and a significantly higher ($p<0.001$) number of transverse scale rows (12–13 for *A. megastigma* compared to 10–11 (rarely 12) for the other two species). In addition *A. megastigma* has a significantly higher ($p = 0.05$) number of pectoral-fin rays compared to *A. tetrophthalmus* (usually 17 for *A. megastigma,* usually 16 for *A. tetrophthalmus).*

Colour differences may also be used to separate the species. Males of *A. novaeguineae* and *A. tetrophthalmus* have a narrower lateral stripe, a midventral stripe on the tail and a more rounded caudal-fin spot which originates on or anterior to the caudal-

fin scales. The average number of caudal-fin rays partially covered by the spot is higher in *A. megastigma* (10) than in the other two species (7.5, 8.3).

Colour differences between the two sexes are slight. Males are frequently more densely pigmented and usually have a slightly deeper lateral stripe (2.4–3.8% of SL for males, 1.5–3.1% of SL for females) and a slightly larger caudal-fin spot (9.6–14.5% of SL for males, 8.3–11.9% of SL for females) than females.

Aioliops novaeguineae n. sp.

Figs 14, 16

Type material. HOLOTYPE: USNM 276500, Milne Bay, Basilaki Island, Papua New Guinea, 0–3 m, 22 Aug 1975, ♀, 18.5 mm. PARATYPES: AMS I.17089-043, Madang Harbour, Krankett Island, Papua New Guinea, 5°11′S 145°50′E, 2–8 m, coral with sand patches, B. Collette, B. Goldman & G. Palmer, 30 May 1970, 1(16 mm); AMS I.25548-001, collected with holotype, cleared and stained, 2(17–19 mm); USNM 244194, Hawaii Island, Marchesa Bay, Batanta Island, Irian Jaya, Indonesia, 0°50′S 130°57′E, 0–6 m, B. Collette & party, 2 July 1979, 31(12–18 mm), cleared and stained, 4(17–18 mm); USNM 257042, Siar Island, Madang, Papua New Guinea, 0–2 m, W. Ponder & P. Colman, 31 May 1970, 1(15 mm); USNM 257046, Krankett Island, Madang Harbour, Papua New Guinea, 1–8 m, B. Collette, 30 May 1970, 9(12–15 mm); USNM 261548, collected with holotype, 7(11–19 mm).

Other material. AMS I.21316-054, South Reef lagoon, Scott Reef, Timor Sea, 14°10′S 121°55′E, 7–10 m, *Acropora* coral and sand, F. Talbot, 20 Sept 1979, 2(14–17 mm).

Diagnosis. Dorsal fins VI + I, 9–10 (usually I, 9); anal fin I, 9–10 (usually I, 10); pectoral fins 15–17 (usually 16–17); pelvic fins I, 4; scales present, 38–42 in longitudinal series, 10–11 in transverse series; anterior nostril a short tube; 3 preopercular pores, other pores as for genus; posterior teeth in one row; gill membrane attached to isthmus below posterior margin of preoperculum; pelvic fins of males long, reaching to anus (19.0–21.5% of SL); dark stripe present on and to either side of ventral midline posterior to anus; round to oval, black spot on caudal fin, spot extending onto ventral portion of caudal peduncle; urostyle fused with lower hypural plate.

Description. Two specimens collected from the Timor Sea have slight colour differences and may represent a separate species; however due to a lack of material from that locality and the similarities between those specimens and *A. novaeguineae,* they are included in the description of *A. novaeguineae.* Snout round in side view, 2.1–3.7 in eye; gill rakers on outer face of first arch 3 + 1 + 10–12 (=14–16). First dorsal fin originating about eye diameter posterior to pectoral-fin base origin; no elongate or filamentous dorsal spines; spines 2–3 longest and about equal in length, longer than spine 4, spines 1 and 5 about equal in length, shorter than 2–4, spine 6 shortest; dorsal and anal segmented rays 2 and 3 longest, posterior rays decreasing in length to last ray; all dorsal and anal segmented rays branched except first dorsal segmented ray which is unbranched; pectoral fins oblong; pelvic fins not reaching to anus in females; pelvic ray 3 longest; innermost pelvic ray unbranched, others branched.

Colour in alcohol. The following colour description represents all specimens, including those from the Timor Sea unless otherwise stated. Background colour yellow; snout, upper lip and tip of lower lip with small, brown chromatophores; throat frequently spotted in males, occasionally spotted in females; brown, subdermal chromatophores over skull and brown chromatophores on dorsal portion of head just posterior to eye; females with several small chromatophores just ventral and posterior to infraorbital pore and occasionally just posterior to corner of jaw; males usually with small chromatophores just posterior to corner of jaw and lower portion of preoperculum, a series of chromatophores just below infraorbital pore to upper portion of operculum and occasionally with most of preoperculum spotted; males with several chromatophores on anterior portion of branchiostegal membrane, over pectoral-fin base, and just ventral to pectoral-fin base except male from Timor Sea which is unspotted in these areas; subdermal stripe on lateral portion of belly in females, entire belly of males subdermally pigmented; belly of males with small, brown chromatophores; belly of females unspotted; males with several small, brown chromatophores on lateral portion of trunk and occasionally on tail; male from Timor Sea with posterior portion of caudal peduncle with densely spaced, brown chromatophores; females frequently with small dark speckling around anus, males frequently with base of urogenital papilla dark brown; narrow stripe along entire dorsal midline

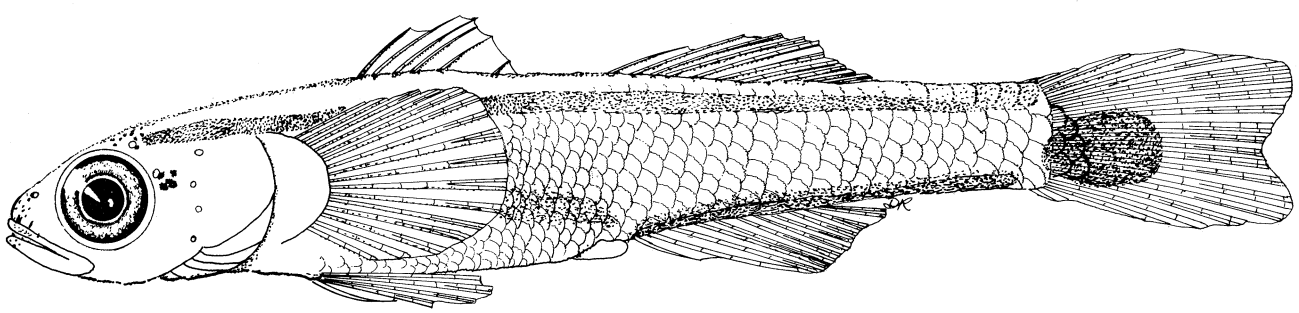

Fig. 14. Holotype of *Aioliops novaeguineae,* Papua New Guinea, ♀, 18.5 mm (USNM 276500).

although spotting occasionally sparse on predorsal area; specimens from Timor Sea without dorsal midline stripe, speckling restricted to base of dorsal fins and on dorsal portion of tail posterior to second dorsal fin; brown to black stripe, depth below first dorsal fin about half pupil diameter (one third pupil diameter for Timor Sea specimens), originating just posterior to supraocular pore and extending along dorsolateral portion of body to caudal peduncle and occasionally extending less densely onto anterior portion of dorsal caudal-fin rays; ventral stripe originating at anus and terminating on caudal peduncle anterior to caudal fin; dark brown, round to oval spot on caudal fin-rays 6–8 to 14–16 for specimens from Papua New Guinea and fin rays 8–9 to 16 for specimens from the Timor Sea; average number of partially pigmented caudal-fin rays, 8.3 (7.5 for Timor Sea specimens) spot extending onto caudal peduncle below lateral midline; spot length equal to or slightly greater than eye diameter; dorsal and pectoral fins lightly spotted; others clear.

Distribution and ecology. Papua New Guinea, Irian Jaya and possibly the Timor Sea; found on coral reef drop-offs from 1–10 m.

Etymology. Named *novaeguineae* for the type locality.

Comments. The fusion of the lower hypural plate to the urostyle distinguishes this species osteologically from the other three species as well as other species in the subfamily. Colour similarities between *A. novaeguineae, A. tetrophthalmus* and females of *A. brachypterus* may cause some confusion when trying to identify the species, however, the following morphometric and meristic characters of *A. novaeguineae* allow easy separation from *A. brachypterus:* ctenoid scales, 3 preopercular pores, anal fin usually I, 9–10, and pelvic fins I, 4. The males of *A. brachypterus* are much more densely pigmented on the head and lateral portions of the body and are not likely to be misidentified. Differences between *A. novaeguineae* and *A. tetrophthalmus* are more subtle, and other than the pelvic fins, which are longer in the males of *A. novaeguineae,* the most prominent distinguishing feature is the caudal-fin spot which does not extend onto the caudal peduncle in *A. tetrophthalmus.* Certain other colour differences occur, but due to fading, preserving techniques or age of the specimens, these differences are often difficult to see. *Aioliops megastigma* can be separated from *A. novaeguineae* by the number of dorsal-fin rays (usually I, 10 for *A. megastigma),* a ventral stripe in *A. novaeguineae* as opposed to no ventral stripe in *A. megastigma,* a stripe depth less than the pupil diameter versus a stripe depth about equal to the pupil diameter in *A. megastigma,* and a caudal-fin spot which originates anteriorly on the caudal peduncle versus a spot which originates about a pupil diameter posterior to the caudal peduncle in *A. megastigma.*

Sexual dimorphism appears to be limited to the length of the pelvic fins (longer in males) and to slight colour variations, with males more densely pigmented than females.

No morphometric or meristic differences are evident between the specimens from Papua New Guinea and those from the Timor Sea other than the depth of the lateral stripe which is deeper in the former and the average number of rays covered by the caudal-fin spot which is less for the two Timor Sea specimens. However, these features could not be considered statistically different from *A. novaeguineae* without examining more material. The pelvic-fin length of *A. novaeguineae* males seems to be unique in the genus in reaching to the anus, and as the pelvic-fin rays of the male collected from the Timor Sea also reach to the anus, the implication is that these are the same species.

The Timor Sea is not separated from the Papua New Guinea region by any land form or deep water body, and it is likely that the range of *A. novaeguineae* extends to the north-eastern Indian Ocean. The area off north-western Australia has not been extensively sampled and any further collecting in the Timor Sea and eastern Indian Ocean should help to resolve the question as to whether a fifth species of *Aioliops* is present.

Aioliops tetrophthalmus n. sp.

Figs 15, 16

Type material. All from Great Barrier Reef, Queensland, Australia. HOLOTYPE: AMS I.22723-008, Mrs Watsons Bay, Lizard Island, 14°40′S 145°27′E, 0–4 m, D. Hoese & party, 15 Sept 1981, ♂, 18.4 mm. PARATYPES: AMS I.18740-120, Yonge Reef, 14°35′S 145°36′E, 14 m, AMS party, 8 Nov 1975, 1(15 mm); AMS I.18755-131, Palfrey Island lagoon, Lizard Island, 14°40′S 145°27′E, 4–8 m, coral and sand, AMS party, 2 Nov 1975, 3(12–18 mm); AMS I.18805-070, 1 mile north of Lizard Island, 14°40′S 145°28′E, sand cay, D. Hoese & H. Larson, 28 Jan 1975, 4(10–15 mm); AMS I.19442-085, North Direction Island, 14°44′S 145°31′E, 12 m, sand and coral, Lizard Island team, 5 Nov 1975, 10(9–15 mm); AMS I.19473-215, Coconut Beach, Lizard Island, 14°40′S 145°27′E, 2–7 m, coral and sand, AMS party, 24 Nov 1975, 1(16 mm); AMS I.20779-140, Tijou Reef, Cape York, 13°05′S 143°57′E, 0–25 m, coral and sand, AMS party, 22 Feb 1979, 3(18–20 mm); AMS I.20956-006, Tijou Reef, Cape York, 13°04′S 143°57′E, 3–12 m, coral bommie, silt and sand, AMS party, 23 Feb 1979, 7(15–18 mm), cleared and stained 2(15–16 mm); AMS I.20994-002, lagoon entrance, Lizard Island, 14°39′S 145°27′E, 2–7 m, coral, sand and rubble, D. Hoese & H. Larson, 11 Dec 1978, 36(8–15 mm), cleared and stained, 3(10–11 mm); AMS I.21539-088, between Bird and South Island, Lizard Island, 14°42′S 145°27′E, 2–8 m, D. Hoese & H. Larson, 8 Feb 1975, 3(11–20 mm), cleared and stained, 2(17–18 mm); AMS I.22581-037, back reef slope, Escape Reef North, 15°49′S 145°50′E, 10–14 m, coral and sand, AMS party, 29 Oct 1981, 3(12–19 mm), cleared and stained, 2(17–19 mm); AMS I.22723-003, collected with holotype, 5(18–22 mm); AMS I.25269-001, North point, Lizard Island, 14°40′S 145°28′E, 5 m, H. Larson, 20 Sept 1981, 4(11–18 mm); ANSP 156917, same data as AMS I.20994-002, 2(12–16 mm); BMNH 1985.7.27.1-2, same data as AMS I.21539-088, 2(15–18 mm); BPBM 30644, same data as AMS I.22581-037, 2(12–16 mm); CAS 57354, south side

of Palfrey Island, Lizard Island lagoon, 14°42′S 145°27′E, 3–10 m, coral, sand and rubble, AMS party, 21 Nov 1975, 3(13–16 mm); NMV A3510, same data as AMS I.22581-037, 2(13–14 mm); NTM S.11674-001, same data as AMS I.20779-140, 2(17–18 mm); QM I.21688, same data as AMS I.20956-006, 2(15–17 mm); USNM 273305, collected with holotype, 2(19–21 mm); WAM P28454-001, Lizard Island, 14°41′S 145°26′E, 1–8 m, D. Hoese & party, 27 Nov 1975, 2(15–20 mm).

Additional material. AMS I.19108-131, Bird Islet, Lizard Island, 1(9 mm) AMS I.19461-078, Decapolis Reef, 1(11 mm).

Diagnosis. Dorsal fins VI + I, 9–10 (usually I, 9); anal fin I, 10; pectoral fins 15–17 (usually 16–17); pelvic fins I, 4; scales present, 38–42 in longitudinal series, 10–12 (usually 10–11) in transverse series, anterior nostril a short tube; 3 preopercular pores, other pores as for genus; posterior teeth of both jaws in 1–2 rows; gill membrane attached to isthmus below posterior margin of preoperculum; dark stripe present on and to either side of ventral midline posterior to anus; round spot on caudal fin, extending anteriorly onto one row of caudal-fin scales.

Description. Snout short (2.3–3.7 in eye), round in side view; gill rakers on outer face of first arch 3 + 1 + 10–12 (= 14–16). First dorsal fin originating about eye diameter posterior to pectoral-fin base origin; no elongate or filamentous dorsal spines; spines 2–3 longest and about equal in length, spines 1 and 5 about equal in length, shorter than 2–4, spine 6 shortest; dorsal and anal segmented rays 2 and 3 longest, posterior rays decreasing in length to last ray; all dorsal and anal segmented rays branched except first dorsal segmented ray which is unbranched; pectoral fins oblong, pelvic ray 3 longest, not reaching to anus in either sex; innermost pelvic ray unbranched, others branched.

Colour of fresh material. Background colour whitish yellow; head with many small, round, black and reddish orange chromatophores; several small black and reddish orange chromatophores on pectoral-fin base and breast; few scattered melanophores on lateral portion of trunk anteriorly; black stripe along dorsolateral portion of body from just posterior to eye to end of caudal peduncle; thin black stripe along ventral midline from anal spine to end of caudal peduncle; anterior half of caudal fin with large round, black spot surrounded dorsally, posteriorly, and ventrally by wide, yellow margin; first dorsal fin with orange stripe across midportion of fin; second dorsal and anal fins with minute white spots, pectoral fins clear; pelvic fins white with broad, transverse, pale brown bands, often broken into irregularly shaped spots.

Colour in alcohol. Specimens less than 15 mm are not as heavily pigmented as larger specimens and may be lacking some of the pigment described below: background colour whitish yellow; snout, upper lip, tip of lower lip and occasionally suborbital, throat and anterior portion of branchiostegal membrane with brown speckling; males with brown pigment on suborbital and throat more often than females; females occasionally with brown patch just ventral to infraorbital pore; males with brown chromatophores on preoperculum and anterior half and occasionally dorsoposterior portion of operculum; males with brown chromatophores on pectoral-fin base and just dorsal to pectoral-fin base, chromatophores occasionally on anterior portion of pectoral-fin rays; dense patch of brown chromatophores on breast of males; scattered brown chromatophores over posterior portion of interorbital although spotting may be confined to sides and absent from midline; males usually with dark belly; belly of females pale; brown subdermal stripe on either side of belly in both sexes, more prominent in females; males frequently with few to many small brown chromatophores randomly scattered over trunk ventral to lateral stripe; females occasionally with narrow brown speckling around anus; brown speckling on dorsal midline at bases of dorsal fins and posterior to second dorsal fin; few spots rarely present on head posterior to skull; lateral stripe commencing from over or just anterior to preoperculum and terminating at end of caudal peduncle; depth of stripe under first dorsal fin less than pupil diameter; ventral midline stripe terminating at or slightly before posterior end of caudal peduncle; large, brown, round spot on caudal fin from rays 5–8 to 13–16; average number of partially pigmented caudal-fin rays, 7.5; anterior edge of spot extending onto one row of caudal-fin scales although light speckling occasionally extends onto caudal

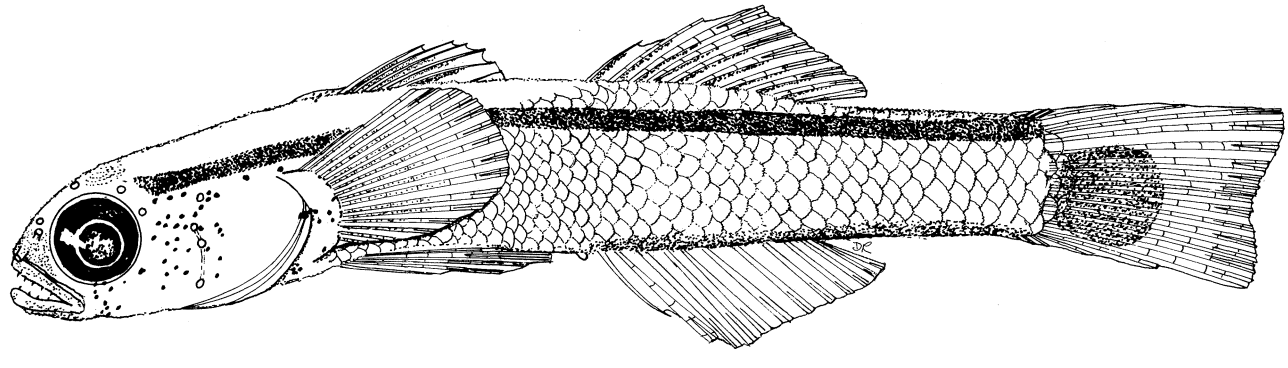

Fig. 15. Holotype of *Aioliops tetrophthalmus*, Lizard Island, Queensland, ♂, 18.4 mm (AMS I. 22723-008).

peduncle; anterior portion of spot originates less than pupil diameter (usually 0.3–0.5 pupil diameter) posterior to caudal peduncle, length of spot about equal to eye diameter; dorsal, anal and pectoral fins lightly spotted; pelvic fins clear.

Distribution and ecology. Tropical eastern Australia; found on coral reef drop-offs from 1–25 m.

Etymology. From the Greek *tetra* = four and *ophthalmus* = eye, named for the four-eyed appearance created by the caudal-fin spot.

Comments. *Aioliops tetrophthalmus* can be distinguished from *A. brachypterus* by the presence of scales, 3 preopercular pores, pelvic fins I, 4 and anal fin usually I, 9–10. It can also be distinguished from *A. megastigma* by a second dorsal fin usually with I, 9 (I, 10 for *A. megastigma),* and 10–11 transverse scales (compared to 12–13).

Aioliops tetrophthalmus is very similar in colouration to *A. novaeguineae* but differs in the anterior origin of the caudal-fin spot which is on the caudal-fin scales in *A. tetrophthalmus* but on the caudal peduncle in *A. novaeguineae.* Several other colour differences exist, such as the posterior extension of the lateral stripe onto the caudal fin in *A. novaeguineae,* but not in *A. tetrophthalmus,* and the average number of pigmented caudal-fin rays (8.3 in *A. novaeguineae* and 7.5 in *A. tetrophthalmus).* However, these colour patterns also vary within each species due to the condition of the specimens and cannot be used as distinguishing features alone.

There appears to be no sexual dimorphism in the

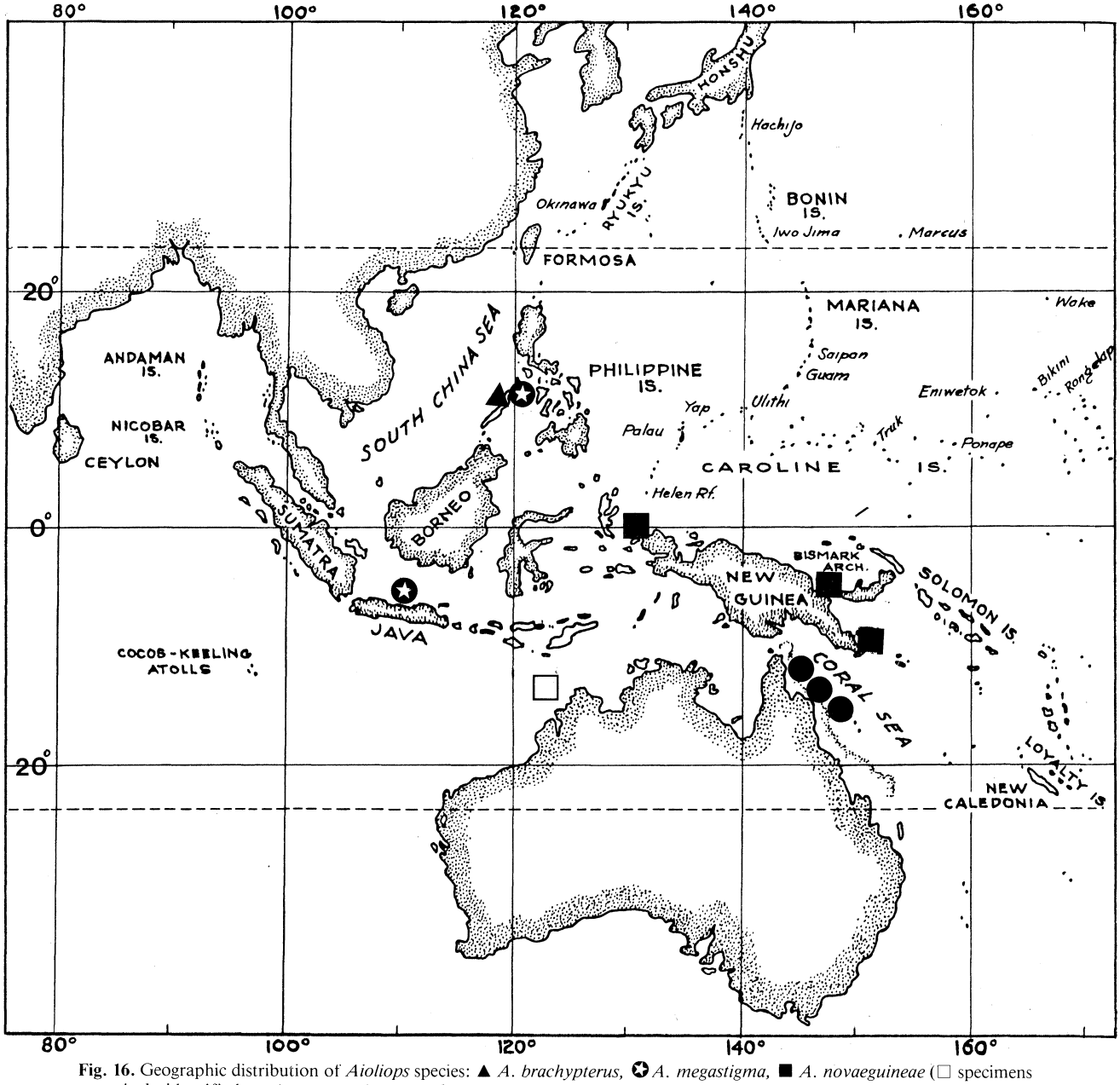

Fig. 16. Geographic distribution of *Aioliops* species: ▲ *A. brachypterus,* ✪ *A. megastigma,* ■ *A. novaeguineae* (□ specimens tentatively identified as *A. novaeguineae)* and ● *A. tetrophthalmus.*

species; colour differences are limited to the males being slightly more pigmented than the females.

Remarks on Osteology and Comparison to Other Ptereleotrines

With few exceptions, the osteological characters of *Aioliops* match those described by Hoese (1984) for the subfamily Ptereleotrinae: separate dorsal fins, articular process of the premaxilla fused with the ascending process and a single pterygiophore preceding the first hemal spine. Distinguishing osteological features of *Aioliops* are: no lacrimal, cartilaginous rostral, sphenotic separated from supraoccipital by cartilage, frontal not extending between sphenotic and supraoccipital, prominent dorsolateral process near posterior end of anguloarticular and, with the exception of *A. brachypterus,* open neural arches with slightly elevated basal portions and no lateral foramen on the caudal vertebrae.

In external morphology, species of *Aioliops* are distinguishable from other genera in having: 2 or 3 preopercular pores; one interorbital head pore which is paired laterally; oblique mouth; large, ctenoid scales or no scales; anterior nostril a short tube or a simple pore; pelvic fins with 3–4 segmented rays; second dorsal fin I, 9–10; anal fin I, 9–11; and gill opening extending to below or behind the posterior margin of the preoperculum.

Allied genera are *Parioglossus* Regan (revised by Rennis & Hoese, 1985), *Nemateleotris* Fowler (revised by Randall & Allen, 1973), *Ptereleotris* Gill (revised by Randall & Hoese, 1985) and *Oxymetopon* Bleeker (revised by Klausewitz & Conde, 1981). Comparisons of certain characters are shown in Tables 1 and 2.

When first discovered by D.F.H., it was believed that *Aioliops* was most closely related to *Parioglossus.* This was based on the similarity in head pore pattern, small size and low number of dorsal and anal rays in the two genera. Both genera also have laterally paired interorbital pores, but, since the posterior interorbital pore is often paired in juveniles of gobioid fishes, it was considered possible that this pattern was simply related to the small size of the species in the two genera. Examination of external features and osteological features, however, suggested that the two genera were not as closely related as initially thought. Because the relationships of the ptereleotrines are not known, character state polarities discussed below were hypothesized, where possible, from eleotridid fishes.

Most species of eleotridids have ctenoid scales, but species with cycloid scales do occur. Similarly, preopercular pores are often absent, but when present, there are usually 4–6 pores. The anterior interorbital head canals are separate in eleotridids. Although ontogenetically, the interorbital pores begin development as paired pores, in some genera the posterior interorbital pore is median and connected by tubes to both canals. All eleotridid genera have 5 segmented pelvic rays, have some ossification of the

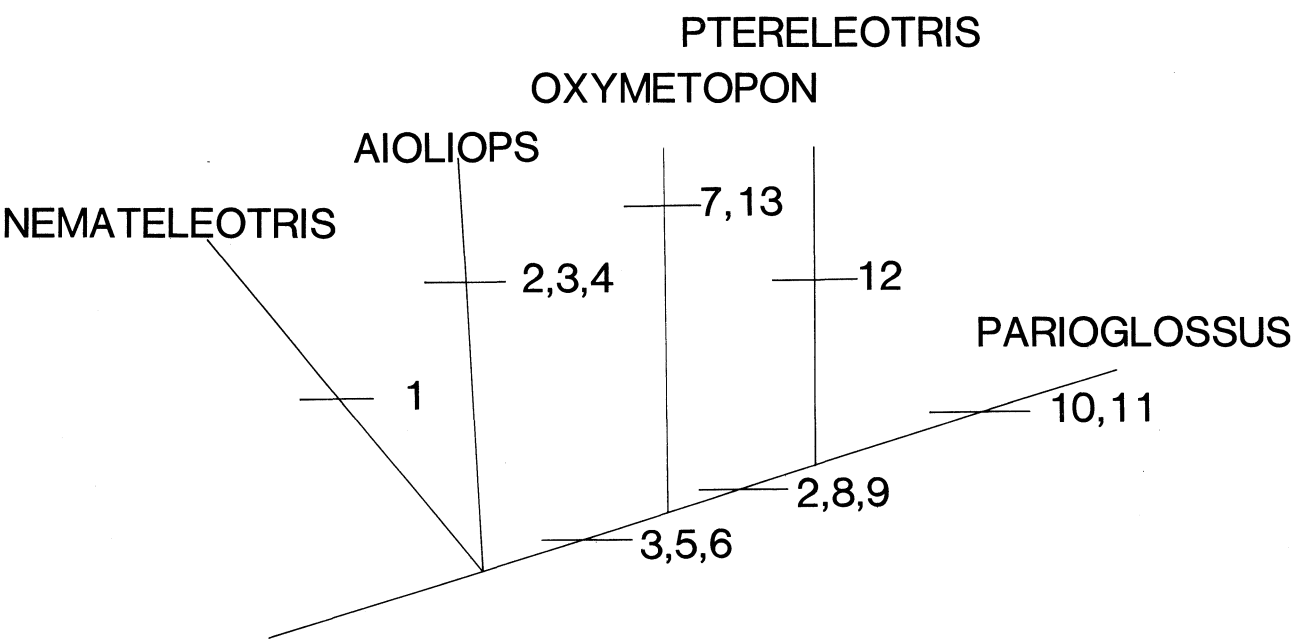

Fig. 17. Tentative phylogeny of the Ptereleotrinae based on some osteological and other morphological characters (see 'Remarks on osteology and comparison to other ptereleotrines' section for discussion of character state polarities). The following characters are interpreted to be advanced character state polarities: **1,** elongate dorsal fin spines; **2,** cartilaginous scapula; **3,** reduced number of pelvic-fin rays; **4,** lacrimal absent; **5,** vertical palatopterygoid strut; **6,** articular process of premaxilla subequal to ascending process; **7,** body and head compressed; **8,** cycloid or no scales; **9,** reduced preopercular pore number; **10,** terminal canal pore absent, **11,** prominent anterior zygapophyses on all precaudal and most caudal vertebrae; **12,** pterygiophore formula of 3(3201 0); **13,** bony frontal.

scapula, have a mouth that is only slightly oblique with a very oblique palatopterygoid strut, have separate ascending and articular processes of the premaxillae, have a well developed lacrimal, and have zygapophyses that are poorly developed. When pores are present, the lateral canal is typically well developed in primitive eleotridids.

Species of *Nemateleotris* appear to be the most primitive of the ptereleotrines in having ctenoid scales over most of the body, 3 preopercular pores, 5 segmented pelvic rays and a dorsolateral process on the anguloarticular for the attachment of a tendon of the adductor mandibulae. The process is present or absent in eleotridids, but is presumed primitive here. Species of *Ptereleotris* and *Parioglossus* are clearly specialized in several features in relation to those of *Nemateleotris*. Members of both genera have a highly oblique, protrusible mouth, with the palatopterygoid strut being almost vertical (5)(number refers to Fig. 17), numerous small, cycloid scales (8), 4 segmented pelvic rays (3), a poorly ossified or cartilaginous scapula (2), 0 or 2 preopercular pores (9) and very elongate ascending and articular processes of the premaxilla (6)(the two processes are connected to each other near the tip in ptereleotrines). Species of both genera also lack or have a rudimentary dorsolateral process on the anguloarticular for the attachment of a tendon of the adductor maxillae. *Ptereleotris* species are specialized and unique in exhibiting the pterygiophore formula of 3(32010) (12), while *Parioglossus* species are specialized in lacking the terminal lateral canal pore above the preoperculum (10) and prominent development of anterior zygapophyses (11). Consequently, it is suggested here that *Nemateleotris* is the sister group to *Ptereleotris* and *Parioglossus*. Species of *Nemateleotris* are presumably specialized in the filamentous anterior spines of the first dorsal fin (1). Filamentous spines occur in the other genera, but these are usually middle or posterior spines and are not as strongly developed as those of *Nemateleotris*. Species of *Oxymetopon* share with *Ptereleotris* and *Parioglossus* species the highly protrusible mouth and almost vertical palatopterygoid strut (5), but display the more primitive features of ossified scapula, ctenoid scales on the body, scales on the head and 3 preopercular pores. *Oxymetopon* species are specialized in the strongly compressed head and body (7), with a prominent bony, median frontal (13)and large supraoccipital crest. In the single cleared and stained specimen examined, only the dorsal section of the rostral cartilage stained with alcian blue, and if found in all species of *Oxymetopon,* this feature may also prove to be a specialization, since in other gobioids with an unossified rostral the rostral stains evenly with alcian blue. Therefore, it appears most likely that members of the genus *Oxymetopon* form the primitive sister group to *Ptereleotris* and *Parioglossus* species, with *Nemateleotris* forming the sister group to these genera.

The relationships of *Aioliops* are not as clear. The members of the genus appear primitive in having moderately sized, ctenoid scales (although one species has no scales), 3 preopercular pores in some species, slightly protrusible mouth and oblique palatopterygoid strut. Species are specialized in the absence of a lacrimal (4). The process on the anguloarticular for the tendon attachment of the adductor maxillae is very large, and this may represent the primitive condition or a specialization in relation to species of *Nemateleotris*. The only specializations in common with *Ptereleotris* and *Parioglossus* are the reduction in ossification of the scapula (2) and reduced number of pelvic rays (3). Reduction in ossification of the scapula is common in small-sized gobioids, and reduction in pelvic-ray numbers also occurs among various other gobioid fishes. As one species of *Aioliops* has a further reduced number of pelvic-fin rays compared to other species, it is difficult to determine whether pelvic-fin ray reduction occurred independently from *Nemateleotris* with species of *Nemateleotris* and *Aioliops* evolving from the same parental taxa, and the character being homoplasous for the other genera, or whether *Nemateleotris* forms the primitive sister group to all the other genera. *Aioliops* also presents problems as the small size of the species may be one reason why certain characters are not present or are reduced. Because its relationships are unclear and several character states are unresolved, it remains ambiguous as to whether *Nemateleotris* and *Aioliops* collectively form a primitive sister group to *Oxymetopon, Parioglossus* and *Ptereleotris* (Fig. 17), or whether *Aioliops* forms a sister group to other ptereleotrines or to *Parioglossus* and *Ptereleotris*.

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