

Review of the Groppos, *Grammatonotus* (Percoidei: Callanthiidae)

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*Beauty is truth, truth beauty, —that is all
Ye know on earth, and all ye need to know.*
John Keats, 1820, **Ode on a Grecian Urn**

Keywords

Callanthias, Splendid Perches, western Indian Ocean, Coral Triangle, Pacific Ocean.

Abstract

The family Callanthiidae contains two genera, *Grammatonotus* (with ten nominal and a few putative species) and *Callanthias* (the Splendid Perches, with seven species). We provide characters that distinguish callanthiids from other percoids and that distinguish *Grammatonotus* from *Callanthias*. Also provided are descriptions of *Grammatonotus* and its species, a key to the species of *Grammatonotus*, and comments on other aspects of the biology of *Grammatonotus*.

Zusammenfassung

Die Familie Callanthiidae enthält zwei Gattungen, *Grammatonotus* (mit zehn nominalen und einigen mutmaßlichen Arten) und *Callanthias* (mit sieben Arten). Wir stellen Charaktere zur Verfügung, die Callanthiiden von anderen Percoiden unterscheiden und die *Grammatonotus* von *Callanthias* Arten unterscheiden. Außerdem erfolgen Beschreibungen von *Grammatonotus* und seinen Arten, ein Schlüssel zu *Grammatonotus* Arten wird gegeben und Kommentare zu anderen Aspekten der Biologie von *Grammatonotus* bereitgestellt.

Sommario

La famiglia Callanthiidae contiene due generi, *Grammatonotus* (con dieci specie nominali e alcune putative) e *Callanthias* (noti come pesci splendidi, con sette specie). Forniamo un elenco dei caratteri che distinguono i callanthiidi dagli altri percoidi e che distinguono *Grammatonotus* da *Callanthias*. Vengono anche fornite descrizioni del

genere *Grammatonotus* e delle sue specie, inclusa una chiave dicotomica e commenti su altri aspetti della biologia di *Grammatonotus*.

INTRODUCTION

The genus *Grammatonotus* (the Groppos) is one of two genera in the marine perciform family Callanthiidae. Groppos are brightly colored fishes found in shallow to moderately deep waters (to depths of a few hundred meters), most commonly in areas with considerable relief. Gilbert (1905:618) described *Grammatonotus*, placed it in the Serranidae, and stated that it is “closely allied to *Callanthias*.” We concur with Gilbert on the close relationship of the two genera but agree with Gosline (1966:91, 95) that they do not belong in the Serranidae. Böhlke (1960:7-8) considered *Grammatonotus* to be related to *Lipogramma* (Grammatidae), writing (p. 7): “Apparently the Hawaiian *Grammatonotus* Gilbert is the closest described relative of *Lipogramma*.” Springer (1982:47) considered both *Grammatonotus* and *Callanthias* (reviewed by Anderson et al. 2015) to be representatives of the Grammatidae but wrote that “there is little evidence to unite” the five genera he included in that family. Later Gill & Mooi (1993:329) concluded that *Gramma* and *Lipogramma* are the only genera in the Grammatidae. The subfamily Callanthiinae, regarded by Ogilby (1899) who proposed the name, Fowler (1907), Katayama (1959, 1960a, b), and Katayama et al.

(1982) as a subfamily of the Serranidae, was raised to the familial level by Fourmanoir (1981). Johnson (1984) and Anderson & Johnson (1984) agreed with this, including both *Grammatonotus* and *Callanthias* in the Callanthiidae. The species of the two callanthiid genera, *Grammatonotus* and *Callanthias*, share three characters, a combination that is unusual among percoid fishes: nasal organ with poorly developed lamellae, presence of modified scales with unique ornamentation along body midlaterally (Fig. 1), and lateral line running along base of dorsal fin to terminate near base of ultimate dorsal soft ray or continuing posteriorly on dorso-lateral surface of caudal peduncle (Anderson & Johnson 1984; Johnson 1984; Anderson et al. 2015). Gill & Mooi (1993:329) offered what may be an additional synapomorphy for the two genera: “presence of a well-developed median frontal crest, with an associated elongation of the ossified sensory canal that serves the median posterior interorbital pore.” In addition, the species of those genera have an unusual arrangement of the supraneural bones in which supraneural bones do not interdigitate with the neural spines; instead they are oriented more or less obliquely with their proximal ends usually terminating anterior to or dorsal to distal end of anteriormost neural spine (Fig. 2). Springer & Johnson (2004:158) found no substantive differences between *Grammatonotus* and *Callanthias* in the skeletal structure of the dorsal part of the gill arches.

METHODS AND ABBREVIATIONS

We used the electronic version of the *Catalog of Fishes* (Eschmeyer et al., online) to check our literature citations for dates of publication, authorships, spellings, and related items. Characters in the generic diagnosis form part of the generic description and are not repeated unless necessary for clarification. Similarly, in each species account, characters in the generic description and generic and species diagnoses form part of the species description and are not repeated unless necessary for clarification. Counts and measurements were made following Hubbs & Lagler (1958), except as noted. Lateral-line scales were counted on both sides of each specimen when possible. Other scale counts, with exception of those around the caudal peduncle, were made on either side depending on condition of the specimen. Mid-body lateral scales were counted along a horizontal line extending from gill opening to middle of structural base of caudal fin. Counts of rows of cheek scales, rows of scales above

the lateral line, and scales above and below the lateral line, excluded any small scales at the orbit and at the bases of dorsal and anal fins. Rows of cheek scales were difficult to count because of missing scales and the irregularity of the rows. The count of scales below the lateral line was made along a posterodorsal series from anal-fin origin to (but excluding) the lateral-line scale. Gillrakers on the first gill arch and pseudobranchial filaments were counted on the right side, when possible. The first vertebra with a haemal spine was considered the first caudal vertebra; the urostylar vertebra, the last. Measurements were made with needlepoint dial calipers to nearest 0.1 mm. Those from the anterior end of the snout were taken from the premaxillary symphysis; those involving the orbit (snout length, orbit diameter, interorbital width, and postorbital length of head) were of the bony orbit. Measurement of the orbit was of horizontal diameter. Depth of body was measured from dorsal-fin origin vertically to ventral midline of body. Pectoral- and pelvic-fin lengths were of the longer (either left or right) fin. Lengths of caudal-fin lobes were taken from middle of fin base to distal tips of longest rays. Distance from more posterior rib of last pair of ribs to the first haemal spine was measured on radiographs produced on film (thus there was no discrepancy in size between the specimen and the image on the radiograph); this measurement was taken at the greatest point of separation between the rib and haemal spine; damaged or grossly distorted specimens were not measured. Sketches of caudal-fin shapes (Fig. 3) were made by tracing the outlines of fins from illustrations of the species.

The maps show the positions of capture for material we examined for which latitudes and longitudes were available and for collections where reasonably accurate localities could be determined from other information associated with the specimens studied. Some map symbols represent more than one collection. Institutional abbreviations are: AMS (Australian Museum, Sydney), BMNH (Natural History Museum, London), BPBM (Bernice P. Bishop Museum, Honolulu), CAS (California Academy of Sciences, San Francisco), CSIRO (Commonwealth Scientific and Industrial Research Organisation, National Research Collections Australia, Australian National Fish Collection, Hobart, Tasmania), GMBL (Grice Marine Biological Laboratory, College of Charleston), IOM (P. P. Shirshov Institute of Oceanology, Acad-

emy of Sciences, Moscow, Russia), MNHN (Muséum national d'Histoire naturelle, Paris), MUSORSTOM–MUS (Muséum national d'Histoire naturelle, Paris) and ORSTOM (Office de la Recherche Scientifique et Technique d'Outre-Mer, France), NSMT-P (National Museum of Nature and Science, Zoology Department, Division of Fishes, Tsukuba, Japan), PNM (National Museum of the Philippines, Manila), SAIAB (South African Institute for Aquatic Biodiversity, Grahamstown), USNM (National Museum of Natural History, Smithsonian Institution, Washington, D.C.), ZIN (Laboratory of Ichthyology, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia), ZMH (formerly ZIM; Zoologisches Institut und Zoologisches Museum der Universität, Hamburg), ZMMU (Zoological Museum, Biological Faculty, M. V. Lomonosov Moscow State University). Other abbreviations are: SL (standard length), NOAA (National Oceanic and Atmospheric Administration), ROV (remotely operated underwater vehicle).

Grammatonotus Gilbert 1905

Groppos

Figs 1-22, Tables I-VII, Maps 1-5

Grammatonotus Gilbert, 1905:618 (type species *Grammatonotus laysanus* Gilbert 1905:619, by original designation, also monotypic).

Zabulon Whitley, 1928:296 (type species *Heliastes roseus* Günther 1880:45, pl. XX, fig. D, by original designation, also monotypic).

Parabarossia Kotthaus, 1976:59 (type species *Parabarossia lanceolata* Kotthaus, 1976:60, figs. 388 & 389, by original designation, also monotypic).

Diagnosis: *Grammatonotus* can be distinguished from the other callanthiid genus, *Callanthias* Lowe, 1839 (type species *Callanthias paradisaicus* Lowe, 1839 = *C. ruber* [Rafinesque, 1810]), by the following. One opercular spine in *Grammatonotus*, two in *Callanthias*. Soft rays in dorsal fin usually 9 (rarely 8 or 10) in *Grammatonotus*, 10 or 11 (very rarely 9 or 12) in *Callanthias*. Soft rays in anal fin 9 in *Grammatonotus*, 10 or 11 (very rarely 9 or 12) in *Callanthias*. Branched caudal-fin rays 13 (7 + 6) in *Grammatonotus*, 15 (8 + 7) in *Callanthias*. Tubed lateral-line scales 14 to 23, in *Grammatonotus*, 21 to 47 in *Callanthias*. In *Grammatonotus* most posterior dorsal procurrent caudal-fin ray almost always articulating with fifth hypural and on-

ly occasionally with both most posterior epural and fifth hypural; in *Callanthias* this element articulating with most posterior epural and apparently in most cases also with fifth hypural. In *Grammatonotus* most posterior ventral procurrent caudal-fin ray almost always supported by haemal spine of penultimate vertebra and by parhypural; in *Callanthias* this fin ray articulating with haemal spine of penultimate vertebra. Distance from most posterior rib to first haemal spine usually appreciably shorter in *Grammatonotus* than in *Callanthias* (*Grammatonotus*: n = 28, range in % SL = 0.68 to 2.14, mean in % SL = 1.63; *Callanthias*: n = 172, range in % SL = 1.05 to 4.79, mean in % SL = 3.20; Anderson & Johnson, 1984:949). In *Grammatonotus* first caudal vertebra without parapophyses; in *Callanthias* parapophyses present on this vertebra. Also, *Grammatonotus* and *Callanthias* differ in ornamentation present on modified midlateral body scales (Fig. 1).

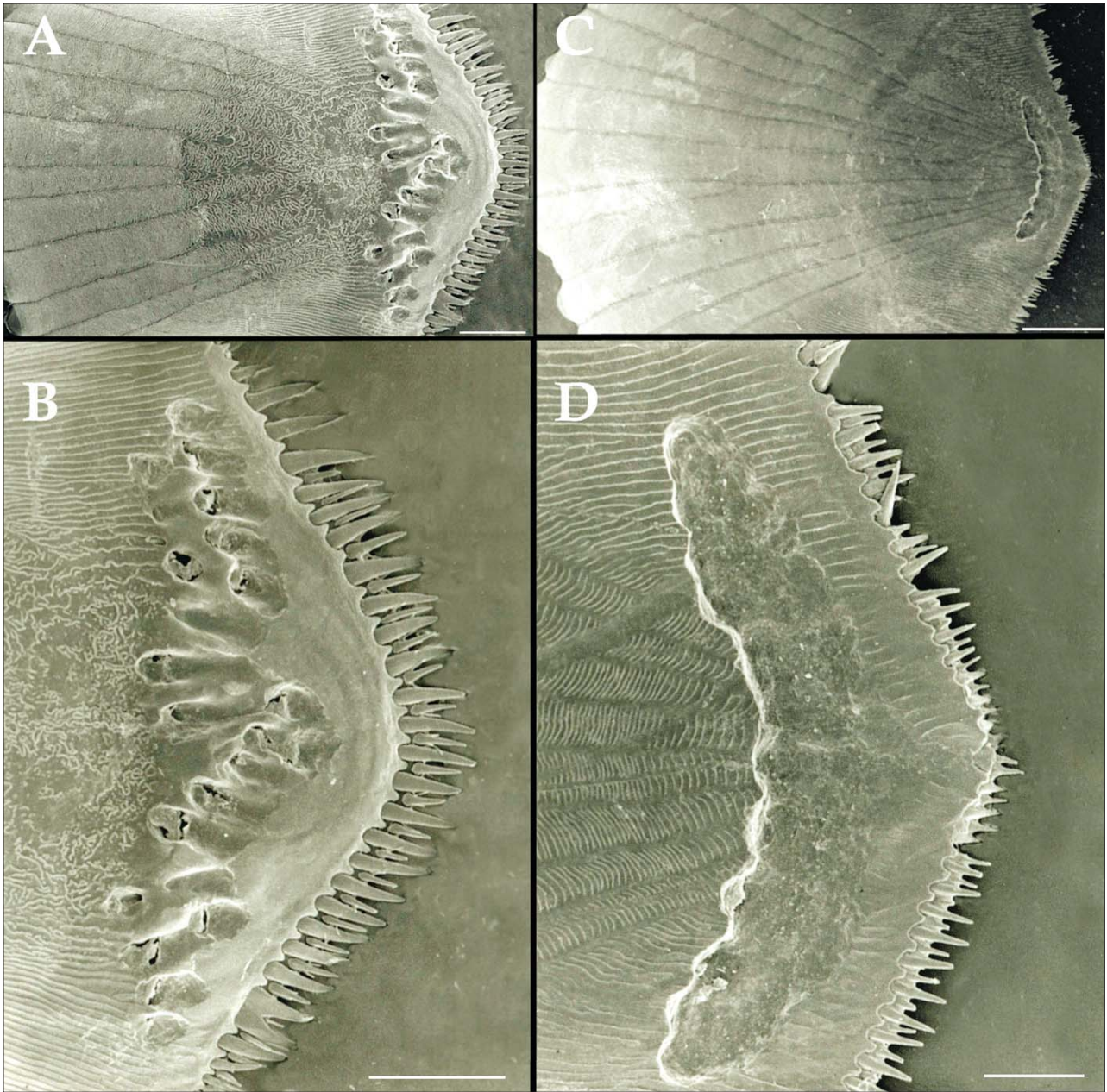
Description: Meristic data are in Tables I and II; morphometric data, in Tables III to VII. Dorsal fin not incised at junction of spinous and soft portions. Dorsal-fin rays usually XI, 9 (rarely X, 10 or XI, 8). Anal-fin rays III, 9. Pectoral-fin rays 18 to 21 (usually 19 or 20). Pelvic-fin rays I, 5. Caudal fin almost truncate, forked, rhomboid shaped with median rays produced, or ragged with several rays produced; lobes of fin variously produced (see Fig. 3). Principal caudal-fin rays 15 (8 + 7). Procurrent caudal-fin rays usually 6 both dorsally and ventrally. Branchiostegal rays 6. Pseudobranch with 10 to 19 filaments (number of filaments tending to increase slightly with increase in SL). Gillrakers long and slender; total number of gillrakers, including rudiments, on first gill arch 24 to 33 (usually 26 to 30). Lateral line ascending abruptly from its origin near opercle to run about a scale row or less below dorsal-fin base. Tubed lateral-line scales 14 to 23 (usually 15-18). Midbody lateral scales 20 to 27 (usually 22-25). Rows of cheek scales 4 or 5. Scales between dorsal-fin origin and lateral line 1 or 2. Scales between anal-fin origin and lateral line 6 to 10 (usually 8 or 9). Circum-caudal-peduncular scales 14 to ca. 19 (usually 15 or 16).

Vertebrae 24 (10 precaudal + 14 caudal). Parapophyses absent from first caudal vertebra. No spur on posteriormost ventral procurrent caudal-fin ray; penultimate ventral procurrent caudal-fin ray not shortened basally (see Johnson 1975). Parhypural autogenous, with well-developed hypurapophysis; hypural 1 + hypural 2 present as a single unit, no evidence of ontogenetic fusion; hypur-

al 3 + hypural 4 present as a single unit, no evidence of ontogenetic fusion; hypural 5 autogenous; epurals 3; a single uroneural pair (anterior) present. Epineurals associated with first 11 to 13 vertebrae. Ribs on vertebrae 3 through 10. Usually one trisegmental pterygiophore associated with dorsal fin, and one with anal fin. Configuration of supraneural bones, anterior neural spines, and anterior dorsal pterygiophores difficult to depict in the conven-

tional symbolization of Ahlstrom et al. (1976) because supraneural bones do not actually interdigitate with neural spines; the two supraneural bones are oriented obliquely with their proximal ends usually terminating anterior to or dorsal to distal end of anteriormost neural spine (Fig. 2).

Body compressed, rather slender to moderately deep. Mouth terminal and oblique; jaws almost equal. Maxilla reaching posteriorly to near middle



Figs 1A-D. Modified midlateral body scales. Scanning electron photomicrographs, lateral views: A. & B. *Callanthias australis*: LACM 42624-5, 113 mm SL; scale bars in A & B, each = 500 μm . C. & D. *Grammatonotus crosnieri*: MUSORSTOM 2, station 12, 117 mm SL; scale bar in C = 100 μm , in D 200 μm . Scanning electron photomicrographs by Robert Ashcraft.

Table I. Frequency distributions for numbers of fin rays in species of *Grammatonotus*; data for *G. ambiortus*, *G. lanceolatus*, and *G. surugaensis* are from the literature; those for *G. macrophthalmus* are mostly from the literature.

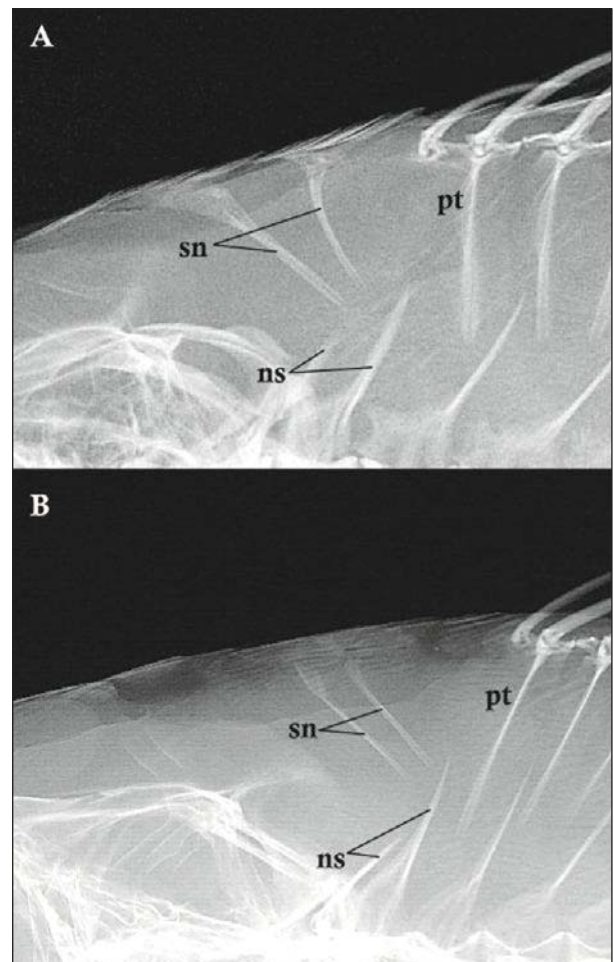
	Dorsal-fin rays		Anal-fin rays	
	X,10	XI,9	III,9	
<i>ambiortus</i>		5	5	
<i>brienne</i>		4	4	
<i>crosnieri</i>		9	9	
<i>lanceolatus</i>		3	3	
<i>laysanus</i>	1	16	18	
<i>macrophthalmus</i>		10	10	
<i>pelipel</i>		3	3	
<i>roseus</i>		5	5	
<i>surugaensis</i>		3	3	
<i>xanthostigma</i>		2	2	
Pectoral-fin, counts from left & right sides, when available				
	18	19	20	21
<i>ambiortus</i>			2	
<i>brienne</i>	3	5		
<i>crosnieri</i>	2	15	1	
<i>lanceolatus</i>		3		
<i>laysanus</i>		2	31	2
<i>macrophthalmus</i>		3	7	
<i>pelipel</i>		2	3	
<i>roseus</i>		10		
<i>surugaensis</i>	1	2		
<i>xanthostigma</i>		4		

of eye. Premaxilla protrusile. No supramaxilla. Interorbital convex to flattened. Anterior naris somewhat remote from eye; posterior naris much nearer eye. Section A₁ of adductor mandibulae simple, without anterodorsal extension. One opercular spine; distal margins of preopercle, interopercle, and subopercle essentially smooth, without spines or well-developed serrations in juveniles and adults. Postflexion larvae with slender opercular spine and small spines or serrations on distal margins of preopercle, interopercle, and subopercle; no enlarged head spines but small cleithral spine present just dorsal to base of pectoral fin (Johnson 1984:467, fig. E; Miskiewicz et al. 2000:280-282).

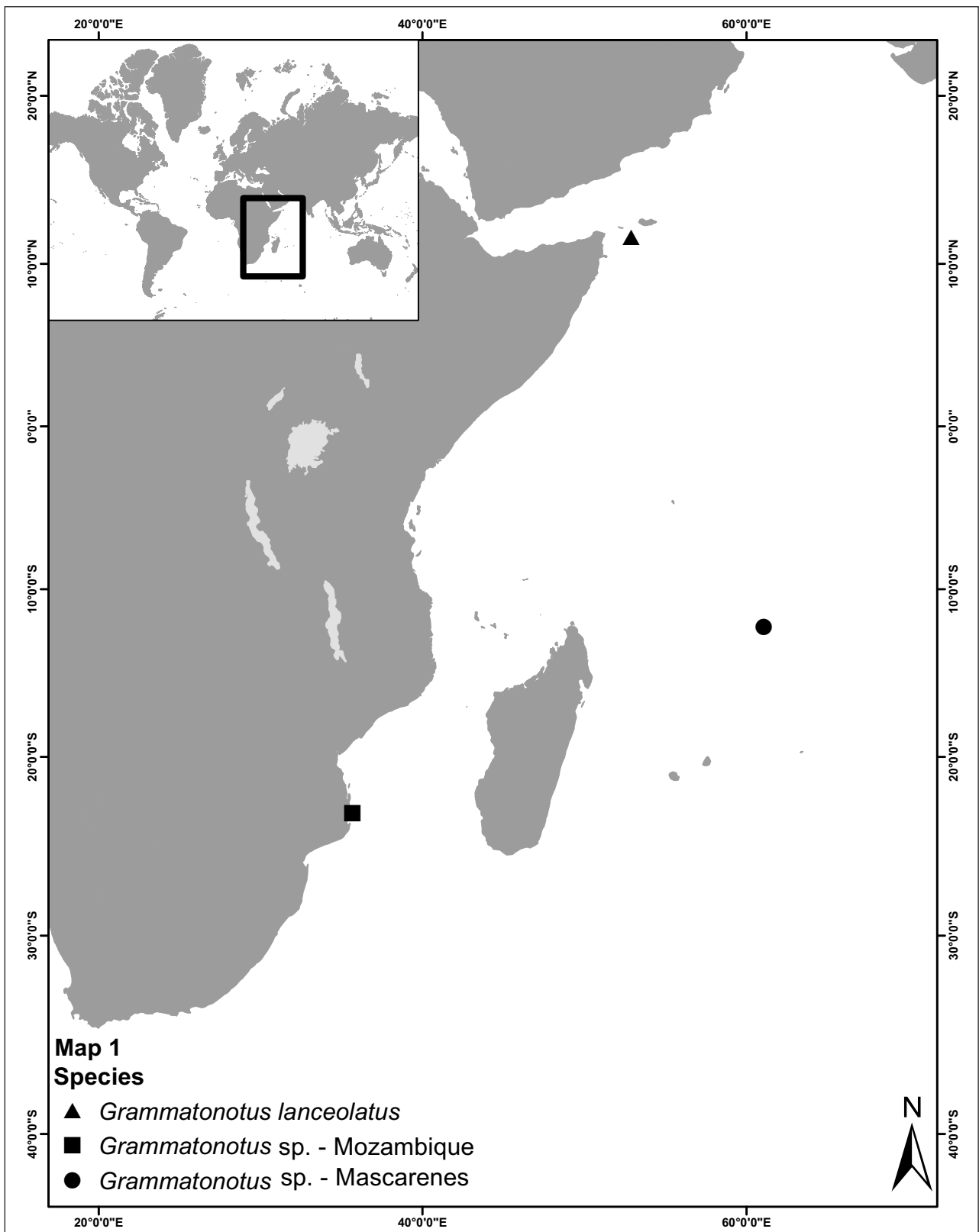
Premaxilla with outer series of conical teeth (often quite small) and usually one to a few small exerted canines or canine-like teeth at anterior end of jaw; inner band of villiform to small conical teeth, band

expanded near symphysis; no teeth at symphysis. Dentary with series of conical teeth (some near mid-jaw enlarged into small caniniform teeth); patch of villiform to conical teeth next to symphysis; one to a few exerted canines or caniniform teeth at anterior end of jaw; no teeth at symphysis. Vomerine teeth small, varying from villiform to conical – usually arranged in a crescent, chevron, or horseshoe-shaped patch, patch without posterior prolongation. Palatine usually with row or band of villiform or small conical teeth. No teeth on tongue or pterygoids.

Scales peripheral ctenoid (Roberts 1993:92); posterior field of a scale with primary and secondary cteni (i.e., no ctenial bases present in posterior



Figs 2A-B. Configurations of supraneural bones, anterior neural spines, and anterior dorsal pterygiophores in callanthiid fishes; **ns** = neural spine, **pt** = dorsal pterygiophore, **sn** = supraneural bone. A. *Callanthias japonicus*, ZUMT 51007, 138 mm SL. B. *Grammatonotus laysanus*, USNM 150525, 59 mm SL. Scans of radiographs by Sean Money; figure assembled by Albert E. Sanders.



Map 1. Localities for *Grammatonotus* from the western Indian Ocean. *G. lanceolatus*, *Grammatonotus* sp. (Mozambique), *Grammatonotus* sp. (Mascarenes).

field). Body with midlateral series of uniquely ornamented scales (Fig. 1). Secondary squamation (small accessory scales or squamulae residing on the surfaces of large scales) usually absent. Most of head, including maxilla, lower jaw (usually), dor-

sum of snout, and interorbital region with scales; gular region with or without scales, branchiostegal rays and membranes usually without scales. Dorsal and anal fins without scales; pectoral and pelvic fins usually without scales, but scales occasionally

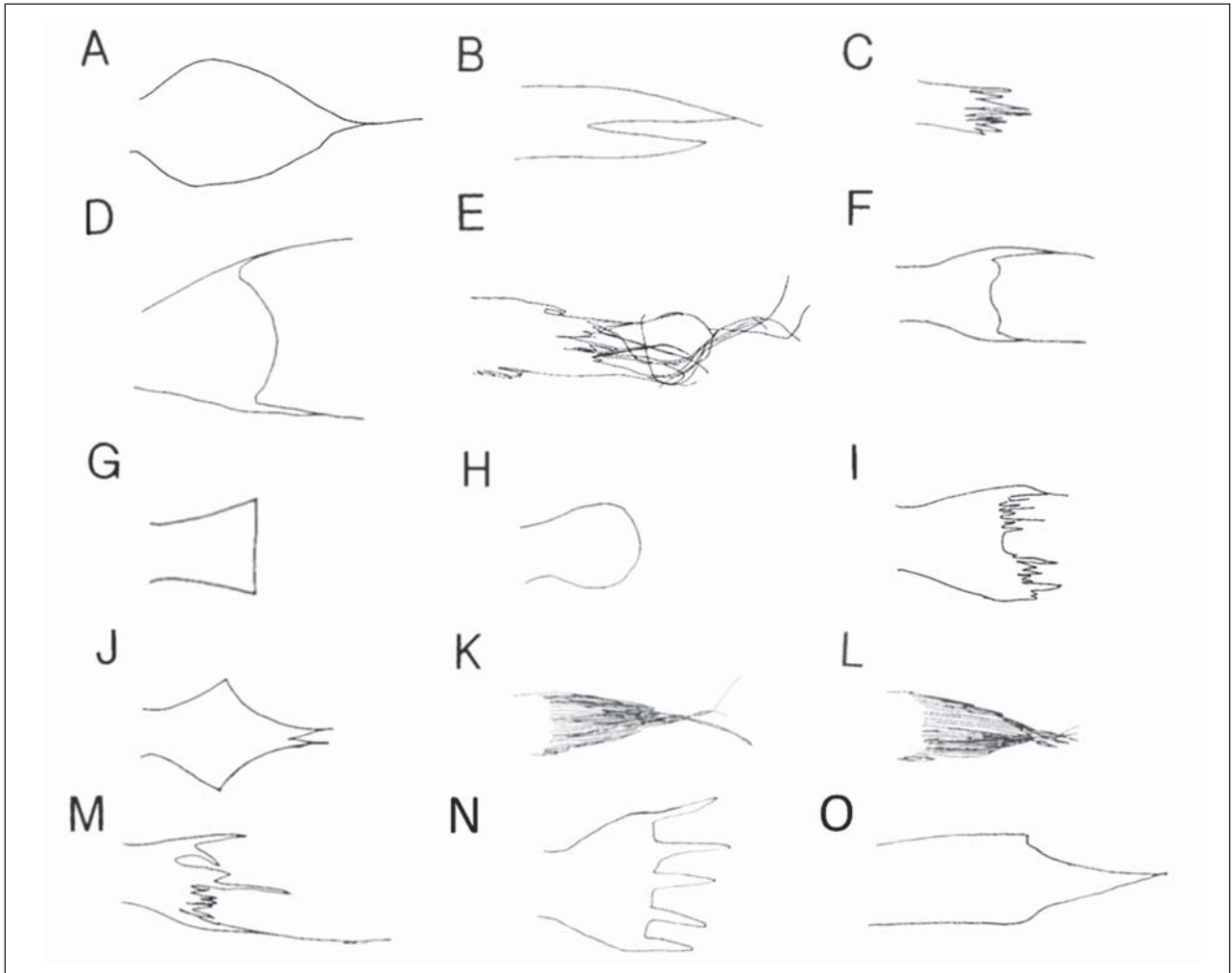


Fig. 3A-O. Caudal-fin shapes in species of *Grammatonotus*. **A.** *Grammatonotus brianne*: holotype, PNM 15196, 84.4 mm SL, Philippine Islands (from photograph by Luiz A. Rocha). **B.** *Grammatonotus crosnieri*: 71 mm SL, Philippine Islands (from photograph by Pierre Fourmanoir). **C.** *Grammatonotus lanceolatus*: holotype, ZMH 5283, 63.5 mm SL, SW of Socotra Island (Kotthaus, 1976:56, fig. 388). **D.** *Grammatonotus laysanus*: HUMZ 68678, 138 mm SL, Emperor Seamount Chain (Katayama *et al.*, 1982:370, fig. 1). **E.** *Grammatonotus macrophthalmus*: holotype, NSMT-P 18829, 117 mm SL, Kyushu-Palau Ridge (from photograph by Sandra J. Raredon). **F.** *Grammatonotus pelipel*: holotype, BPBM 41273, 49.3 mm SL, Pohnpei (Anderson & Johnson, 2017:192, fig. 5). **G.** *Grammatonotus pelipel*: paratype, USNM 432534, 28.1 mm SL, Pohnpei (Anderson & Johnson, 2017:192, fig. 6). **H.** *Grammatonotus roseus*: Kai Islands, Indonesia (Günther, 1880: pl. XX, fig. D). **I.** *Grammatonotus surugaensis*: holotype, NSMT-P19445, 81 mm SL, male (Katayama *et al.*, 1980:46, fig. 1). **J.** *Grammatonotus xanthostigma*: holotype, BPBM 41271, 60.2 mm SL, Pohnpei (Anderson & Johnson, 2017:190, fig. 1). **K.** *Grammatonotus* sp., SAIAB 84121, 106 mm SL, Mascarenes (from photograph by Sandra J. Raredon). **L.** *Grammatonotus* sp., SAIAB 82074, 67.1 mm SL, Mozambique (from photograph by Sandra J. Raredon). **M.** *Grammatonotus* sp., CSIRO H 5201-02, 76.5 mm SL, Western Australia (from photograph by Thor Carter, CSIRO). **N.** *Grammatonotus* sp., “crown tail,” Pao Pao Seamount, Tokelau Seamount Ridge, South Pacific (from photograph provided by the courtesy of the NOAA Office of Ocean Exploration and Research). **O.** *Grammatonotus* sp., Eifuku Seamount in the Mariana Arc, western Pacific (from photograph provided by the courtesy of NOAA Office of Ocean Exploration and Research).

Table II. Frequency distributions for numbers of gillrakers, tubed lateral-line scales, and caudal peduncular scales in species of *Grammatonotus*; data for *G. ambiortus*, *G. lanceolatus*, and *G. surugaensis* are from the literature; those for *G. macrophthalmus* are mostly from the literature. Counts of gillrakers are from the right side where possible; L & R = counts from both sides.

Gillrakers--total on first arch										
	24	25	26	27	28	29	30	31	32	33
<i>ambiortus</i>						1				
<i>brienne</i>			1	2	1					
<i>crosnieri</i>			2	3	1	3				
<i>lanceolatus</i>		1	1	–	1					
<i>laysanus</i>					2	4	5	3	2	1
<i>macrophthalmus</i> : literature			6	3	1					
<i>macrophthalmus</i> : this study L & R						2	1	–	1	
<i>pelipel</i> L & R					2					
<i>roseus</i>	1	1	–	1	2					
<i>surugaensis</i>	2	1								
<i>xanthostigma</i> L & R		1	–	–	2	1				
Tubed lateral-line scales, counts from left and right sides, when available										
	14	15	16	17	18	19	21	22	23	
<i>ambiortus</i>				1						
<i>brienne</i>		2	4	2						
<i>crosnieri</i>	1	3	2	3						
<i>lanceolatus</i>								1	2	
<i>laysanus</i>			4	6	11	–	1			
<i>macrophthalmus</i>		3	2							
<i>pelipel</i>		1	1	4						
<i>roseus</i>	1	2	5	2						
<i>surugaensis</i>			1	2						
<i>xanthostigma</i>		2	–	1	1					
Caudal peduncular scales										
	14	15	16	17						
<i>brienne</i>		1	2	1						
<i>crosnieri</i>			6							
<i>laysanus</i>		5	2							
<i>macrophthalmus</i>	1									
<i>pelipel</i>			3							
<i>roseus</i>		1	4							
<i>xanthostigma</i>			2							

present proximally on these fins and typically present at their fleshy bases; pelvic axillary scales present; modified scales (interpelvic process) overlapping pelvic-fin bases along midventral line; scales extending onto caudal fin (frequently well out onto fin to cover most of it).

Coloration: Very colorful fishes with shades of red, orange, yellow, and purple dominant.

Sexuality: Two small specimens (BPBM 28124, 41.1 mm SL; BPBM 37191, 38 mm SL) identified as *Grammatonotus* sp. are mature females (Randall 2007:200). Sexual maturity at such a small size

suggests that some species of the genus may be protogynous hermaphrodites. This would not be unprecedented for the family Callanthiidae, because Anderson et al. (2015:8-9) noted that adults of some species of *Callanthias* appear to change sex from female to male and speculated that all species of that genus may be protogynous.

Early life history: Fourmanoir (1976:68, fig. 28) illustrated a 13-mm specimen of *Grammatonotus* (identified as *Zabulon roseus*). Leis & Rennis (1983:77) commented on Fourmanoir's illustration, noting that the specimen depicted possessed a large

preopercular spine not present on their specimens of *Grammatonotus* and showed a 13.7-mm larva of *Grammatonotus* (p. 78, fig. 18) collected by midwater trawl in the Bismarck Sea. In addition, they mentioned (pp. 77-78) that the “pigment of late larval *Grammatonotus* is distinctive” consisting of “a heavy, internal, diagonal band through the body under the soft dorsal fin, a cluster of large stellate melanophores on the caudal peduncle, and a series of melanophores located at the angles of the myosepta. Melanophores are also scattered over the head.” Additionally (p. 78), they stated that “slab-sided body, low myomere count, round head, and pigment patterns” characterize the larvae of *Grammatonotus*. Johnson (1984:467, fig. 255 E) reproduced the illustration of the 13.7-mm larva presented by Leis & Rennis (1983: 78, fig. 18). Miskiewicz et al. (2000:280-284) provided an account of callanthiid larvae that includes characters distinguishing *Grammatonotus* from *Callanthias* and an illustration (fig. 63) depicting a 7.2-mm specimen collected in a plankton tow in the Mozambique Channel and the Bismarck-Sea specimen illustrated by Leis & Rennis (1983:78, fig. 18). Kanou et al. (2003) described six specimens (18.6-22.8 mm SL) identified as *Grammatonotus* sp. (cf. *G. surugaensis*) from Tosa Bay, Japan, in depths of 150 to 200 meters, and Mundy & Parrish (2004:414) reported a newly settled juvenile (BPBM 37135, 32 mm SL) collected at Hao Atoll, Tuamotu Archipelago, French Polynesia (18°04'12" S, 141°20'12" W; depth 705 meters).

Ecology: In a study of seamount fishes, Fujii (1986:68) considered *Grammatonotus laysanus* and *G. macrophthalmus* to be seamount-insular shelf species.

Distribution: *Grammatonotus* is widely distributed in tropical and subtropical seas mainly off insular coasts, being notably absent from the Atlantic Ocean.

Etymology: *Grammatonotus* is from the Greek: **gramma** – line (in compounds), **notos** – back, presumably an allusion to the lateral line.

**Key to the species of *Grammatonotus*
(except *G. ambiortus* for which we lack
adequate information)**

TRICHOTOMOUS

- 1a. Known from the western Indian Ocean 2
- 1b. Known from the Coral Triangle 4
- 1c. Known from the open Pacific 6

DICHOTOMOUS

- 2a. Predorsal length 36 to 38% SL. Head length 33

- to 37% SL. Depth of body 31 to 37% SL *G. lanceolatus*
- 2b. Predorsal length 32 to 37% SL. Head length 30 to 35% SL. Depth of body 28 to 33 % SL 3
- 3a. Diameter of bony orbit 11 to 15 % SL. Bony interorbital width 6 to 7% SL. Depth of caudal peduncle 12 to 16% SL. Pectoral-fin rays 18 to 20, usually 20 (mean 19.8) *Grammatonotus* sp., Mascarenes
- 3b. Diameter of bony orbit 9 to 11% SL. Bony interorbital width 5 to 6% SL. Depth of caudal peduncle 11 to 13% SL. Pectoral-fin rays 18 or 19 (mean 18.8) *Grammatonotus* sp., Mozambique
- 4a. Anal spines relatively short (in % SL: first 2.8 to 3.4, second 5.3 to 7.3, third 7.5 to 9.2). Bony orbit diameter 9.7 to 11.1% SL. Caudal fin rhomboid shaped with mid-caudal rays produced (Fig. 3A) *G. brianne*
- 4b. Anal spines relatively long (in % SL: first 4.5 to 10.3, second 7.9 to 14.3, third 9.6 to 15.3). Bony orbit diameter 11.0 to 14.9% SL. Caudal fin not rhomboid shaped 5
- 5a. Head length 28.5 to 33.9% SL. Snout length 4.3 to 5.4% SL. Second anal-spine length 9.4 to 14.3% SL. Caudal fin forked with upper and lower lobes well produced in individuals >70 mm SL (Fig. 3B) *G. crosnieri*
- 5b. Head length 33.0 to 35.6% SL. Snout length 5.1 to 6.5% SL. Second anal-spine length 7.9 to 9.3% SL. Caudal fin rounded or subtruncated (Fig. 3H) *G. roseus*
- 6a. Caudal fin rhomboid shaped with mid-caudal rays produced (Fig. 3J). Bright yellow spot at upper base of pectoral fin. Lower jaw without scales *G. xanthostigma*
- 6b. Caudal fin not rhomboid shaped. No yellow spot at upper base of pectoral fin. Lower jaw with or without scales 7
- 7a. Lower jaw with scales. Caudal fin ragged posteriorly (i.e., several caudal fin rays produced, Figs. 3E & I) 8
- 7b. Lower jaw without scales. Caudal fin rounded, truncate, or slightly emarginate; larger individuals usually with upper and lower lobes produced (Figs. 3D, F, & G) 9
- 8a. Total number of gillrakers on first arch 26 to 32. Diameter of orbit longer than postorbital length of head, 2.2 to 2.4 times in head length (postorbital 2.3 to 2.7 in head length; Katayama et al. 1982) *G. macrophthalmus*

- 8b. Total number of gillrakers on first arch 24 or 25. Diameter of orbit shorter than postorbital length of head, 2.6 to 2.7 times in head length (Katayama et al. 1980) *G. surugaensis*
- 9a. Side of body with 11 to 13 dark bars, most evident on specimens less than 30 mm SL. Diameter of orbit 7.5 to 9.6% SL. Postorbital length of head 14.6 to 16.2% SL. Predorsal-fin length 35.7 to 37.7% SL. Total number of gillrakers on first arch 28 (count based on only one specimen) *G. pelipel*
- 9b. No dark bars on side of body. Diameter of orbit 10.0 to 14.2% SL. Postorbital length of head 12.1 to 15.3% SL. Predorsal-fin length 30.7 to 36.8% SL. Total number of gillrakers on first arch 28 to 33 (mean 30.1) *G. laysanus*

***Grammatonotus ambiortus* Prokofiev 2006**

Ambiguous Groppo
Fig. 4; Tables I-III; Map 3

Grammatonotus ambiortus Prokofiev 2006:13, figs. 1 and 2 (original description; illustrations; holotype ZIN 53452, 120 mm SL; type locality western part of the Hawaiian Islands, *i. e.* seamounts of the Emperor Seamount Chain or Hawaiian ridges). Prokofiev 2015: 278, figs. 1a, b (description; illustrations; ZMMU 23141, four specimens, 31-65 mm SL; 01°24'8" N, 172° 52' E, near Tarawa Atoll, in the Gilbert Islands; depth ~350-600 m).

Comments: We have not examined any specimens of *Grammatonotus ambiortus*, but we have had access to a photograph and radiograph of the holotype (ZIN 53452, 120 mm SL). The photograph (Fig. 4) shows the holotype to be in poor condition. Data obtained from the radiograph are: dorsal-fin rays XI, 9; anal-fin rays III, 9; vertebrae 10 + 14; supraneurals 2; epineurals 11 pairs; epurals 3. Prokofiev (2006: 13, 16) reported for the



Fig. 4. *Grammatonotus ambiortus*, holotype, ZIN 53452, 120 mm SL; western part of the Hawaiian Islands. Photo by O. Voskoboinikova.

holotype: pectoral-fin rays 20 on each side; gillrakers on first arch 9 + 1 + 19 = 29 (total); tubed lateral-line scales ca. 17. For four specimens (ZMMU 23141, 31 to 65 mm SL), Prokofiev (2015: 278, 280) gave: dorsal-fin rays XI, 9; anal-fin rays III, 9; pectoral-fin rays 18 to 20; gillrakers on first arch 25 to 29 (total); tubed lateral-line scales 15 to 18; vertebrae 10 + 14. The holotype was collected in the western part of the Hawaiian Islands (*i. e.*, seamounts of the Emperor Seamount Chain or Hawaiian ridges), but the four specimens described by Prokofiev (2015) were obtained from eastern Micronesia (near Tarawa Atoll in the Gilbert Islands). In view of the great distance between the localities of capture for the holotype (Hawaiian Islands) and the Gilbert-Island specimens, it is very likely that they are not conspecific.

Prokofiev (2015:280) questioned the tentative identification as *G. macrophthalmus* of the specimen shown in plate 1 of Mundy & Parrish (2004) and stated that “the specimen described by Mundy & Parrish (2004) corresponds to *G. ambiortus*. Possibly *G. ambiortus* and *G. macrophthalmus* are only representatives of geographical forms.” If only geographic variants, *Grammatonotus ambiortus* Prokofiev, 2006, is a junior synonym of *Grammatonotus macrophthalmus* Katayama, Yamamoto & Yamakawa, 1982. We cannot comment further until we have had an opportunity to examine specimens of this species; it seems unlikely that a chance to do so will occur in the near future.

Etymology: “The name of the species is derived from ‘ambiortus’ (Greek) – standing simultaneously at two sites that reflects the presence in it of characters of the genera *Grammatonotus* and *Callanthias*” (Prokofiev 2006:16).

***Grammatonotus brianne* Anderson, Greene & Rocha 2016**

Batangas Groppo
Figs 3A, 5; Tables I, II, IV, VII; Map 2

Grammatonotus brianne Anderson, Greene & Rocha, 2016:290, fig. 1, tables 1 & 2, original description; illustration; holotype PNM 15196 (formerly CAS 237785), 84.4 mm SL; type locality Philippines, Luzon Island, off Batangas Province.

Anderson & Johnson 2017:188, 191, fig. 4 (compared with *G. xanthostigma*, illustration).

Diagnosis: A species of *Grammatonotus* distinguishable from the other described species of the

Table III. Morphometric data for three Pacific species of *Grammatonotus*. Standard length in mm; other measurements in percentage of standard length. Data taken from the literature (Katayama et al., 1982; Matsuura & Tachikawa, 1994; Prokofiev, 2006, 2015), except for two specimens of *G. macrophthalmus* and one *G. surugaensis* examined in this study. Slight damage indicated by +.

	<i>G. ambiortus</i>		<i>G. macrophthalmus</i>		<i>G. macrophthalmus</i>		<i>G. surugaensis</i>
	Literature		Literature		This study		This study
					Holotype	Non-type	Paratype
					NSMT-P	NSMT-P	NSMT-P
	n	Ranges	n	Ranges	18829	35093	19446
Standard length	5	31-120	10	95-119	117	95,3	74,3
Depth of body	5	30.0-34.3	10	28.6-33.3	27,9	31,6	35,7
Predorsal-fin length	4	33.3-38.7	1	35,9	30,5	33,7	31,0
Length of head	5	33.9-37.5	10	29.2-34.6	28,3	32,2	31,2
Length of snout			1	7,2	4,6	4,9	5,1
Diameter of orbit			1	15,7	13,1	16,6	11,3
Interorbital width			1	9,7	7,8	9,3	6,7
Postorbital length of head			1	13,3	10,7	13,6	13,6
Length of upper jaw			1	14,1	11,6	13,1	13,2
Pectoral-fin length	4	19.4-24.6	10	20.2-23.7	18,9	22,4	~25.0
Pelvic-fin length			10	22.4-27.5	21,6	damaged	~26.9
Length of caudal peduncle	5	15.2-21.8	1	21,3	15,8	15,7	22,1
Depth of caudal peduncle	4	12.1-15.4	1	16,5	14,5	15,6	17,5
Upper caudal-fin lobe, length					74,4	damaged	~37.3
Lower caudal-fin lobe, length					72,6	damaged	36.1+
Longest caudal-fin ray			8	54.1-84.7	72,6	damaged	
Depressed anal-fin length					42,7	32.6 +	31,6
Length of first anal spine					5,2	6,0	6,1
Length of second anal spine					7,7	8,7	7.1+
Length of third anal spine					9,5	11,5	7,8
Length of base of anal fin	4	16.7-21.5	1	21,8	19,7	21,7	15,2

genus by the following combination of characters: caudal fin rhomboid shaped with mid-caudal rays produced (Fig. 3A), lateral line usually disjunct (7 of 8 lateral lines disjunct, counts made on both sides of each available specimen), anal-fin spines short (see Tables IV, VII), and live coloration distinctive (see Fig. 5 and description of coloration below).

Description: Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 18 or 19. Caudal fin rhomboid shaped with median rays produced (Figs 3A, 5). Procurrent caudal-fin rays 6 dorsally, 6 or 7 ventrally. Pseudobranch with ca. 10 to ca. 14 filaments. Gillrakers 7 or 8 + 19 or 20, total on first gill arch 26 to 28. Tubed lateral-line scales 15 to 17 (lateral line usually disjunct, with 2 scales near opercle separated from main part of lateral

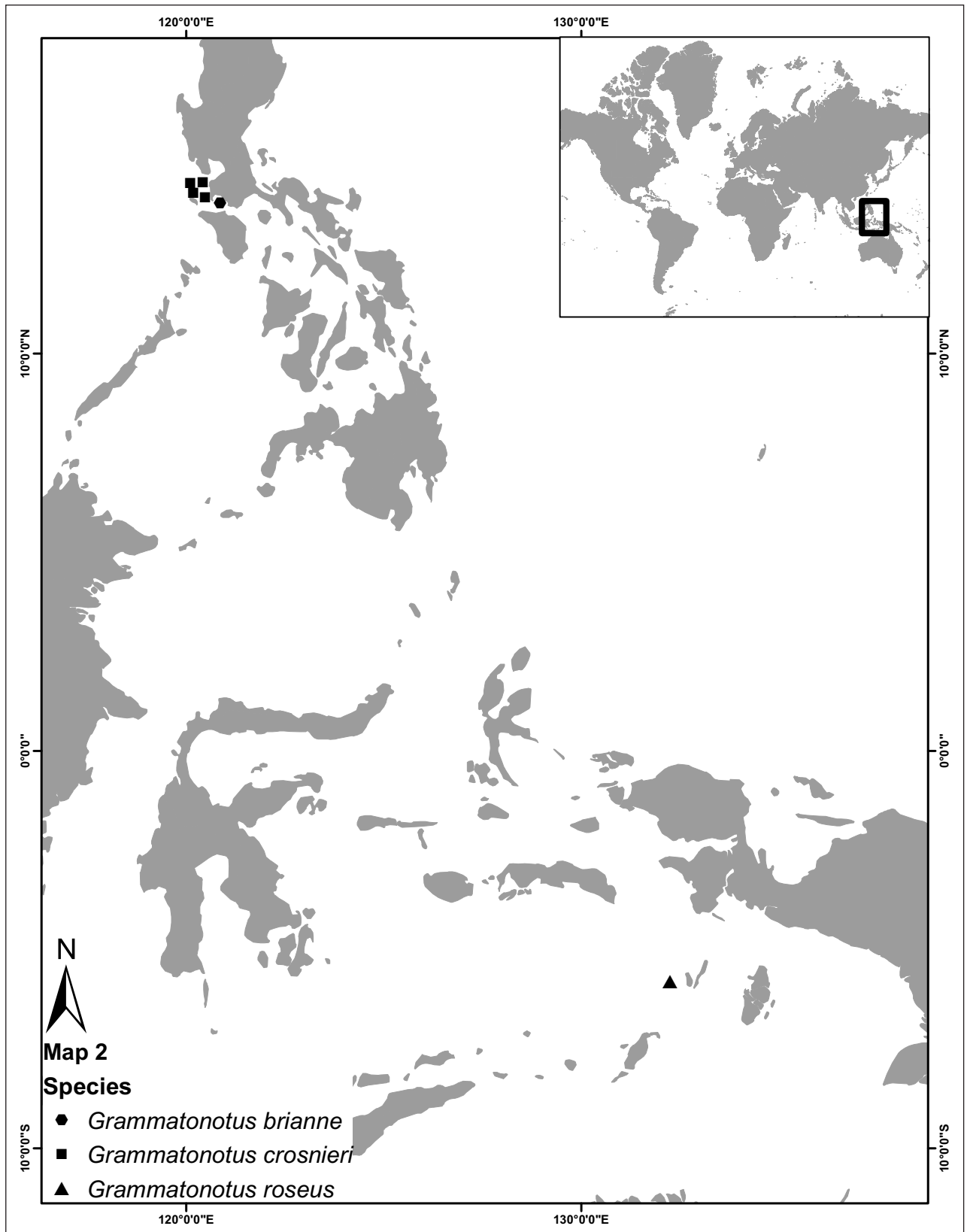
line); other tubed scales present in various places that are not in main part of lateral line. Midbody lateral scales 24 or 25. Scales between anal-fin origin and lateral line 8 or 9. Circum-caudal-peduncular scales 15 to 17. Morphometric data are presented in Tables IV & VII.

Coloration: Coloration based on digital photographs of two specimens (PNM 15196, formerly CAS 237785, 84.4 mm SL, the holotype [Fig. 5], and CAS 237786, 77.7 mm SL, a paratype): Dorsally head and body rosy to red; ventrally head and area below base of pectoral fin pale yellow to silvery; mid-body pink to pale rose above dull yellow; ventrally body pale yellow to faint purplish. Iris of eye yellow centrally with dark red to rose peripherally (widest ventrally); short band of blue at dorsalmost part of iris. Dorsal fin yellow to yellow

Table IV. Morphometric data for *Grammatonotus* from the Coral Triangle and adjacent waters off Australia (CSIRO H 643-5--off Queensland, CSIRO H5201-02--off Western Australia). Standard length in mm; other measurements in percentage of standard length. NM = not measured. NP = not produced. Slight damage indicated by +.

	<i>G. brianne</i>		<i>G. crosnieri</i>		<i>G. roseus</i>		CSIRO	CSIRO
	n	Range	n	Range	n	Range	H 643-5	H 5201-02
Standard length	4	72.9-84.4	9	41.9-118	5	49.2-64.6	66,3	76,5
Depth at dorsal-fin origin	4	33.0-35.4	9	30.5-39.2	5	35.4-37.2	32,4	34,6
Predorsal-fin length	4	30.6-33.5	9	29.9-39.6	5	32.8-38.1	36,5	37,4
Length of head	4	29.5-32.1	9	28.5-33.9	5	33.0-35.6	35,7	34,8
Length of snout	4	4.4-5.3	9	4.3-5.4	5	5.1-6.5	6,9	4,9
Diameter of bony orbit	4	9.7-11.1	9	11.0-14.9	5	13.2-14.6	14,0	13,1
Bony interorbital width	4	7.0-7.7	9	5.2-8.6	5	6.0-8.2	8,1	8,0
Postorbital length of head	4	12.4-14.2	9	10.8-15.0	5	13.4-14.2	13,0	14,8
Length of upper jaw	4	12.6-14.2	9	13.2-14.8	5	13.6-14.8	14,5	15,2
Pectoral-fin length	4	22.7-25.6	9	22.0-28.9	5	25.0-26.1	27,1	25,1
Pelvic-fin length	3	26.7-28.6	8	27.2-41.1+	2	24.8+-25.3	28,1	28,2
Length of caudal peduncle	4	23.8-24.6	9	21.9-27.0	5	21.1-23.1	21,0	23,0
Depth of caudal peduncle	4	14.4-16.2	9	14.1-17.7	5	14.8-16.2	14,9	16,1
Upper caudal-fin lobe, length	NP	---	7	38.2-117+	NM	---	Damaged	33.2+
Lower caudal-fin lobe, length	NP	---	7	31.5-108+	NM	---	Damaged	ca. 88.5
Mid-caudal-fin rays	4	58.6-82.2	NM	---	NM	---	Damaged	50.8+
Depressed anal-fin length	4	~39.2-42.2	8	33.4-70.1	2	36.5+-36.7+	37,3	38,8
Length of first anal spine	4	2.8-3.4	9	6.2-10.3	3	4.5-6.5	6,0	4,2
Length of second anal spine	4	5.3-7.3	7	9.4-14.3	5	7.9-9.3	7,4	8,0
Length of third anal-spine	4	7.5-9.2	9	11.1-15.3	4	9.6-11.4	9,0	9,4
Length of anal-fin base	4	18.0-20.3	9	16.4-20.4	5	18.1-21.4	20,7	19,9
Penultimate dorsal-fin ray	4	19.8-22.7	7	16.7-19.6	---	---	NM	18,0
Ultimate dorsal-fin ray	4	~16.0-19.0	7	12.8-16.8	1	14,2	NM	ca. 15.6
Penultimate anal-fin ray	4	18.2-21.5	8	16.6-21.5+	---	---	NM	17,3
Ultimate anal-fin ray	4	~13.7-18.0	8	12.6-15.4	---	---	NM	ca. 15.4

**Fig. 5.** *Grammatonotus brianne*, holotype, PNM 15196 (formerly CAS 237785), 84.4 mm SL; Batangas, southern Luzon, Philippine Islands. Photo by L. A. Rocha.



Map 2. Localities for *Grammatonotus* from the Coral Triangle. *G. brianne*, *G. crosnieri*, *G. roseus*.

orange proximally, light to dark purple distally (distal ends of dorsal spines yellow); anal fin light purple; pectoral fin pale yellow; pelvic fin light purple. Caudal fin pale to bright yellow proximally, pale yellow distally. Numerous bright yellow spots superimposed on ground coloration of proximal part of dorsal fin and all or most of caudal fin.

Comparisons: *Grammatonotus brianne* and *G. crosnieri* (Fourmanoir, 1981) have been collected off Batangas Province, Luzon, in the Coral Triangle. Another species of *Grammatonotus*, *G. roseus* (Günther, 1880), is also known from the Coral Triangle; the types and only known specimens of that species being from the Banda Sea off the Kai Islands, Indonesia. *Grammatonotus brianne* is most easily distinguished from those two species by the shape of the caudal fin (Fig. 3) – *G. brianne* with a rhomboid-shaped fin with mid-caudal rays produced, *G. crosnieri* with upper and lower lobes of caudal fin produced (examined specimens less than 70 mm SL with damaged caudal fins), and *G. roseus* with a subtruncated fin (Günther 1880: 45, plate XX [fig. D]). In Table IV, we present comparisons of morphometric data for the three species of *Grammatonotus* known from the Coral Triangle.

Distribution: This species is only known from specimens collected off Batangas Province, Luzon Island, Philippines.

Etymology: The name *brianne* is for Brianne M. Atwood, wife of one of the describers (Brian D. Greene) of the species.

Material examined: PHILIPPINES: Four specimens (72.9–84.4 mm SL) caught off Batangas Province, Luzon Island: Mabini Dive & Trek; 13°48.035'N, 120°54.635'E: depth of ca. 150 meters; collected by Brian Greene, 21/22 May 2014. PNM 15196 (formerly CAS 237785, holotype: 84.4 mm SL); CAS 237786 (paratype: 77.7 mm SL); CAS 237787 (paratype: 72.9 mm SL); USNM 432499 (formerly CAS 237788, paratype: 82.4 mm SL).

Grammatonotus crosnieri (Fourmanoir 1981)

Crosnier's Groppo, Uncle Phoo's Groppo
Figs 3B, 6; Tables I, II, IV; Map 2

Callanthias crosnieri Fourmanoir 1981:91, fig. 15 (original description; illustration; holotype MNHN 1978-79, 116 mm SL; type locality Philippines, off Batangas Province, southern Luzon Island, MUSORSTOM cruise Station 6, 14°01.2'N, 120°20.0' E, 200 meters).

Grammatonotus crosnieri (Fourmanoir 1981): Anderson 1999: 2556 (species account, illustration). Anderson, Greene & Rocha 2016:292, fig. 2, table 2 (species account, illustration).

Diagnosis: Total number of gillrakers on first arch 26 to 29. Caudal fin deeply forked (Fig. 3B), both lobes well produced in larger individuals.

Description: Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 18 to 20 (usually 19). Pseudobranch with 11 to 17 filaments. Gillrakers 8 or 9 + 18 to 20, total 26 to 29. Tubed lateral-line scales 14 to 17 (lateral line terminating as far anterior as base of 5th dorsal soft ray to as far posterior as between bases of 7th and 8th dorsal soft rays). Midbody lateral scales 23 to 25. Circum-caudal peduncular scales 16. Scales between anal-fin origin and lateral line 8 or 9. Epineural bones associated with first 12 vertebrae. Dorsum of snout, maxilla, and lower jaw with scales. Lateral aspect of snout and most of lachrymal without scales. Frequency distributions for countable characters are given in Tables I & II, and morphometric data are presented in Table IV.

Coloration: The following description is based on a color transparency provided by Pierre Fourmanoir of a 71 mm SL specimen of *Grammatonotus crosnieri* collected in the Philippines (see Fig. 6). Dorsum of head rosy, side of head ventral to orbit silvery, ventral midline of head rosy. Iris of eye mostly pallid with broad blue blotch above narrow rosy stripe at dorsal border, narrow rosy arch at ventral and posterior-ventral borders, and some yellow posteriorly. Bright rosy stripe (one or two scales high) ventral to dorsal fin and continuing on dorsal surface of caudal peduncle. Rest of body mostly pale yellow to rose with brownish rivulations, except for silvery area anterior and ventral to base of pectoral fin. Ventral half of spinous dorsal fin mostly yellowish green with distal portions of dorsal spines and most of soft dorsal fin rosy. Pectoral fin mostly dull orange; pelvic and anal fins mostly rose. Mid-



Fig. 6. *Grammatonotus crosnieri*, 71 mm SL, Philippine Islands. Photo by P. Fourmanoir.

dle of caudal fin mostly yellow; several of dorsalmost and ventralmost caudal-fin rays rosy.

Distribution: Known from the Philippines (off Batangas Province, southern Luzon Island) in depths of 150 to 210 meters and reported from the west coast of the Malay Peninsula in 200 to 400 meters (Fourmanoir 1981:92).

Etymology: The name *crosnieri* is for Alain Georges Paul Crosnier (1930--), French carcinologist who was an associate of Pierre Fourmanoir at ORSTOM (Office de la Recherche Scientifique et Technique Outre-Mer).

Material examined: Nine specimens, 41.9 to 118 mm SL. **PHILIPPINES**, off Luzon Island (Batangas Province): MNHN 1978-79 (holotype: 116 mm SL), MNHN 1978-80 (2 paratypes: 110-118), USNM 440408 (4: 41.9-116), USNM 440409 (2: 57.8-97.5).

Grammatonotus sp. cf. *G. crosnieri*

We have examined a specimen of *Grammatonotus* (USNM 150525, 58.7 mm SL) taken off Cabugan Grande Island, Philippines (10°22'15" N, 125°22'30" E) that resembles *G. crosnieri* in following traits: dorsal-fin rays XI, 9; anal-fin rays III, 9; pectoral-fin rays 18 (both sides); gillrakers 8 + 18 (26 total on first arch); lateral-line scales ca. 16 on left side (lateral line terminating at base of third dorsal soft ray on left side, at base of fourth on right); depth at origin of dorsal fin 34.8% SL; head length 32.4% SL. It differs from *G. crosnieri* in the absence of teeth on the vomer (teeth present in *G. crosnieri*). Both lobes of the caudal fin are damaged so its shape cannot be compared with that of *G. crosnieri*.

Grammatonotus lanceolatus (Kotthaus 1976)

Socotra Groppo

Figs 3C, 7; Tables I, II, V; Map 1

Parabarossia lanceolata Kottahaus 1976:60, figs. 388, 389 (original description; illustration; map; holotype ZMH (formerly ZIM) 5283, 63.5 mm SL; type locality SW of Socotra Island, METEOR Station 102, 11°33.9'N, 52°54'E to 11°38'N, 52°52'E, 175 to 337 meters.

Diagnosis: Tubed lateral-line scales 22 or 23. Mid caudal fin rays produced (Fig. 3C).

Description: Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 19. Caudal fin with middle rays produced (Fig. 3C). Gillrakers 7 or 8 + 18 to 20 total 25 to 28. Lateral line disjunct, tubed later-

al-line scales 22 or 23 (14 or 15 + 8). Epineural bones associated with first 12 vertebrae. Frequency distributions for countable characters are given in Tables I & II, and morphometric data are presented in Table V.

Coloration: Kotthaus (1976:61) wrote that the animals collected at METEOR Station 102 were scraped by the sharp bycatch (large quantities of siliceous sponges), with the result that the preserved specimens showed little of the original coloration, but added "Der Körper ist ziemlich gleichmäßig graubraun, während alle Flossen gelblich erscheinen, ebenso die Schnauze. Auf dem Operculum und unterhalb der Pektoralflosse ist ein silberblau schimmernder Fleck vorhanden." (= *The body is pretty evenly gray brown, while all fins, as well as the snout, appear yellowish. On the operculum, and below the pectoral fin a silver-blue shimmering spot is present.*)

Distribution: Known only from the western Indian Ocean off Socotra Island in depths of 175 to 337 meters.

Etymology: "NAME: '*lanceolata*' deutet auf die lanzettförmige Caudalflosse hin" (Kotthaus, 1976:61). (The name "*lanceolata*" refers to the lancet-shaped caudal fin.)

Material examined: WESTERN INDIAN OCEAN, off Socotra Island: ZMH (formerly ZIM) 5284 (one paratype, 48.8 mm SL [51.5 mm in Kotthaus 1976]).

Other *Grammatonotus* from the Western Indian Ocean

We have received on loan from SAIAB specimens of *Grammatonotus* collected in the Mascarenes and off Mozambique. Those specimens appear to represent species distinct from each other and from the only described western Indian Ocean species of *Grammatonotus*, *G. lanceolatus*, known from off the island of Socotra. We do not describe the SAIAB specimens as new species because most of them are

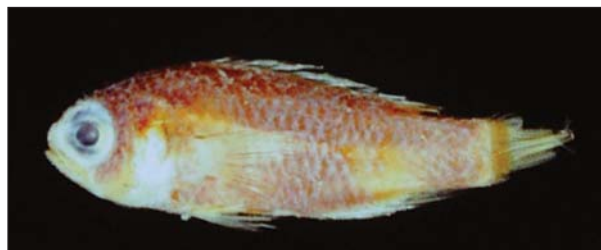


Fig. 7. *Grammatonotus lanceolatus*, paratype of *Parabarossia lanceolata* (= *Grammatonotus lanceolatus*), ZMH 5284, 48.8 mm SL, SW of Socotra. Photo by J. F. McKinney.

not in very good condition (with many scales missing); instead we present summaries of data for them.

Mascarenes (Figs 3K, 8): Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 18 to 20 (usually 20). Gillrakers 25 to 29 (7 to 9 + 17 to 20). Pseudobranchial filaments 13 to 16. Lateral-line scales mostly missing from all but two specimens: one of those has ca. 13 tubed scales below dorsal fin on left side and 2 + 16 tubed scales below dorsal fin on right side (on each side of caudal peduncle, hint of lateral line tubules in 4 or 5 scales). The other specimen has 13 tubed scales below dorsal fin on left side and 16 below dorsal fin on right side. Mid-body lateral scales 24 (in three specimens). Cheek-scale rows 4 or 5. Scales between origin of anal fin and lateral line 7 to 10. Circum-caudal-peduncular scales 19 (in one specimen). Epineurals 11 or 12 pairs. See Table V for morphometric data.

Material examined: SAIAB 84121 (11 specimens, 55.5 to 106 mm SL); Mascarene 14, western Indian Ocean, 12°17.02'S, 61°04.75'E; depth 275 to 276 meters; 24 October 2008; R/V DR.

FRIDTJOF NANSEN; collected by Denis Tweddle & Oddgeir Alvheim.

Mozambique (Figs 3L, 9): Dorsal-fin rays XI, 8 or 9. Anal-fin rays III, 9. Pectoral-fin rays 18 or 19. Gillrakers 27 or ~28 (8 + 19 or ~20). Too many scales missing to make counts. Epineurals at least 9 or 10 pairs. See Table V for morphometric data.

Material examined: SAIAB 82074 (2 specimens, 66.4 & 67.1 mm SL); PCH 2007-M56, 23°15.2' S, 35°40.8' E; depth 151 to 156 meters; 14 October 2007; R/V DR. FRIDTJOF NANSEN.

Grammatonotus laysanus Gilbert, 1905

Laysan Groppo

Figs 3D, 10; Tables I, II, VI; Map 4

Grammatonotus laysanus Gilbert 1905: 619, fig. 240 (original description; illustration; holotype USNM 51546, 36.7 mm SL; type locality Hawaiian Islands, off Laysan Island, ALBATROSS Station 3947, 25°52'55" N, 171°48'00" W, 97 to 199 fathoms (= 177 to 364 meters). – Gosline &



Fig. 8. *Grammatonotus* sp. from the Mascarenes, SAIAB 84121, 106 mm SL. Photo by S. J. Raredon.



Fig. 9. *Grammatonotus* sp. from Mozambique, SAIAB 82074, 67.1 mm SL. Photo by S. J. Raredon.

Table V. Morphometric data for *Grammatonotus* from the western Indian Ocean. Standard length in mm; other measurements in percentage of standard length. Types of *Parabarossia lanceolata* Kotthaus, 1976, (= *Grammatonotus lanceolatus*) were collected southwest of Socotra (holotype: ZMH 5283; two paratypes: ZMH 5284). Our measurements (A, J, N) of the smaller paratype differ from those of Kotthaus, in most cases only slightly. Herein depth of body was measured at origin of dorsal fin; Kotthaus's measurement was presumably of greatest depth. Specimens from the Mascarenes are cataloged as SAIAB 84121; those collected off Mozambique, as SAIAB 82074.

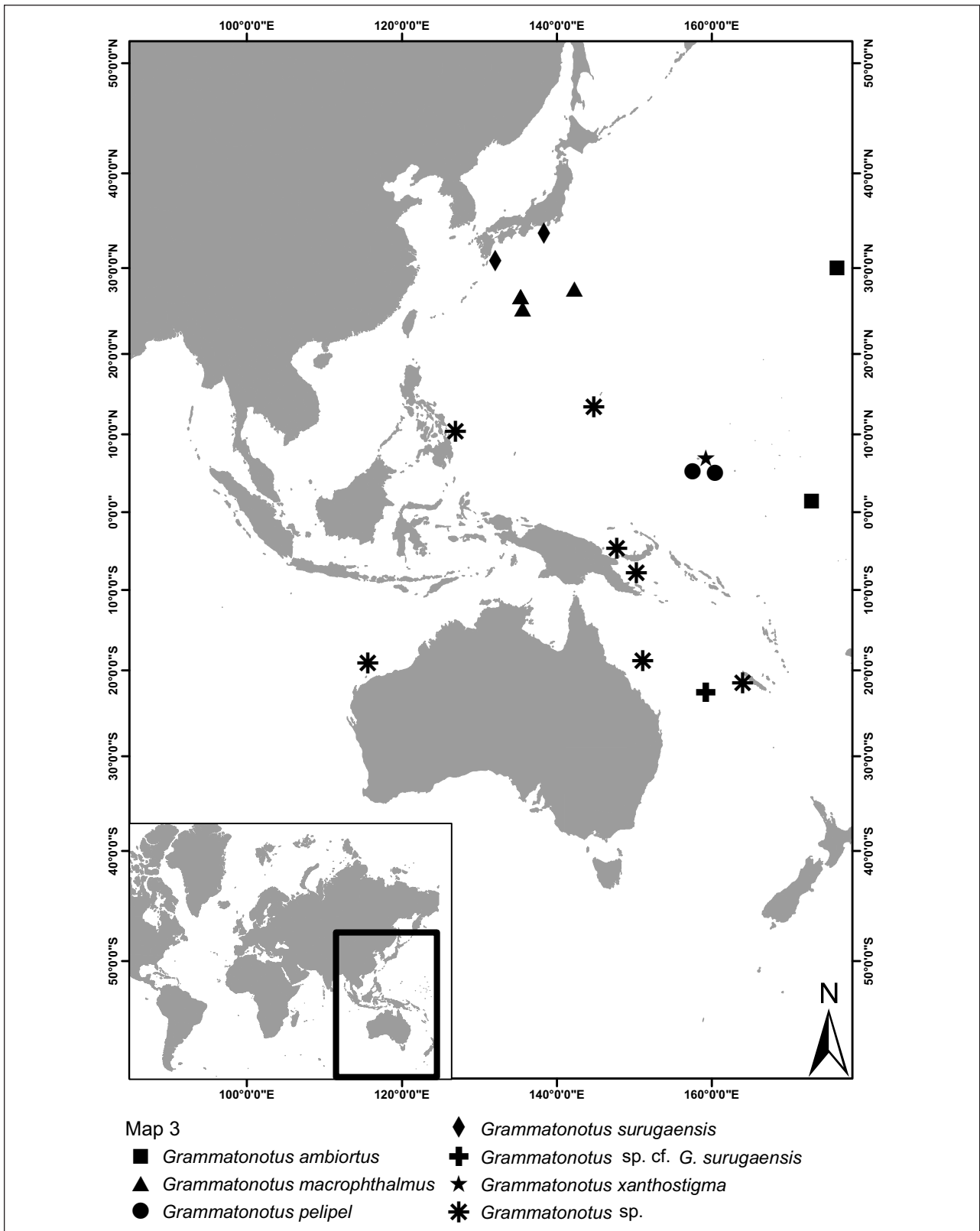
	<i>Grammatonotus lanceolatus</i>			<i>Grammatonotus</i>			
	SOCOTRA		SOCOTRA	MASCARENES		MOZAMBIQUE	
	N	RANGES		N	RANGES	N	RANGES
	Kotthaus, 1976		A, J, N				
	Holotype & two paratypes		Paratype				
Standard length	3	51.5-66.4	48,8	11	55.5-106	2	66.4-67.1
Depth of body	3	34.2-37.3	30,9	11	28.1-32.7	2	29.8-30.3
Predorsal length	3	36.5-38.1	38,3	11	32.1-36.6	2	32.8-34.6
Length of head	3	32.0-37.3	33,0	11	31.3-34.6	2	29.5-32.5
Length of snout	2	6.6-6.9	5,1	11	4.1-6.8	2	4.5-6.1
Diameter of orbit	3	11.3-12.3	12,3	11	10.9-14.6	2	9.4-11.0
Interorbital width			5,3	11	5.8-7.4	2	5.0-5.8
Postorbital length of head			15,8	11	12.8-15.6	2	13.1-13.4
Length of upper jaw	3	13.9-15.1	13,5	11	12.4-14.2	2	13.0-14.2
Pectoral- fin length	3	22.4-24.1	26,6	11	24.3-27.4	2	23.9-25.5
Pelvic-fin length	3	26.0-26.7	28,1	9	25.5-30.1	2	26.8-28.8
Length of caudal peduncle			21,3	11	21.0-24.9	2	20.9-23.2
Depth of caudal peduncle	3	14.6-17.0	12,9	11	12.1-15.9	2	10.6-13.0
Upper caudal-fin lobe, length				3	-42.5--55.1	1	31.4+
Lower caudal-fin lobe, length				5	-38.6 --66.5	1	35.2+
Length of mid-caudal-fin rays	2	38.9-41.9		4	-27.9--46.3	2	-40.5--41.9
Depressed anal-fin, length			37,9	8	28.4-35.4	2	40.8-41.0
Length of first anal spine				10	-2.4-4.4	2	3.9-4.4
Length of second anal spine				11	5.1-7.1	2	7.5-7.9
Length of third anal spine				10	6.1-8.7	2	9.3-9.7
Length of base of anal fin			18,6	11	16.7-18.4	2	19.7-20.9
Penult. dorsal-fin ray, length				4	-14.8--16.3	1	-18.2
Ultimate dorsal-fin ray, length				4	-11.0-13.9	1	-13.3
Penult. anal-fin ray, length				4	-14.4-17.6	2	-16.8-17.3
Ultimate anal-fin ray, length				7	12.4-13.6	2	-14.2-15.1

Brock 1965: 157 (compiled). – Katayama et al. 1982: 369, fig. 1 (in key, description, illustration). – Randall et al. 1985: 46, fig. 26 (comments on morphology, illustration). – Parin 1991:673, 679 (eastern Pacific, Nazca and Sala y Gómez ridges). – Parin et al. 1997:173 (distribution on seamounts in eastern Pacific). – Mundy & Parrish 2004: 413, 414 (miscellaneous notes). Mundy 2005: 351 (compiled). – Randall 2007: 200, fig. (description, color photograph).

Diagnosis: Total number of gillrakers on first arch 28 to 33, mean 30.1 (occasionally as many as

29 in several other species of *Grammatonotus*, 26 to 32 in *G. macrophthalmus*). Lower jaw without scales. Caudal fin “rounded with a long filament from each corner” (Randall et al. 1985:46).

Description: Dorsal-fin rays usually XI, 9 (rarely X, 10). Anal-fin rays III, 9. Pectoral-fin rays 19 to 21 (usually 20). Pseudobranch with 12 to 19 filaments, number of filaments tending to increase with increase in standard length. Gillrakers 8 to 10 + 19 to 23 total 28 to 33. Tubed lateral-line scales 16 to 21 (lateral line usually terminating ventral to base of last dorsal soft ray, occasionally somewhat anterior to this point or posterior to posterior end



Map 3. Localities for *Grammatonotus* from the western Pacific and the eastern Indian Ocean. *G. ambiortus*, *G. macrophthalmus*, *G. pelipel*, *G. surugaensis*, *Grammatonotus* sp. cf. *G. surugaensis*, *G. xanthostigma*, *Grammatonotus* sp.

of dorsal-fin base). Midbody lateral scales 20 to 26. Circum-caudal peduncular scales 14 to 16. Scales between anal-fin origin and lateral line 6 to 9. Epineural bones associated with first 11 or 12 vertebrae. Lateral aspect of snout, lachrymal, and lower jaw without scales. Frequency distributions for countable characters are given in Tables I & II; morphometric data, in Table VI.

Coloration: Katayama et al. (1982: 371, fig. 1) wrote “Color when fresh: Body violet red, lower side silvery; dorsal fin yellow; anal fin violet; caudal fin violet red, outer rays yellow; pectoral fin pale orange; pelvic fin violet red. In alcohol uniformly pale yellow.” Randall et al. (1985: 46, fig. 26) presented an illustration from a videotape, made from a submarine in a depth of 354 meters that shows a fish, identified as *G. laysanus*, with a short white longitudinal band beneath the middle of the dorsal fin. They noted (p. 46) that the white band “was red at times” and that the band “may be evident only in life” because it was “not mentioned in the color description by Katayama, Yamamoto & Yamakawa (1982).” Randall (2007:200) stated that the coloration is mainly pink and yellow.

Eastern Pacific specimens: Parin (1991: 679) and Parin et al. (1997: 173) reported *Grammatonotus laysanus* as occurring in the eastern Pacific over the Nazca and Sala y Gómez ridges in 240 to 330 meters. We have examined six specimens of *Grammatonotus* collected by Russian ichthyologists from that region. Because we have found no characters that distinguish them from *G. laysanus*, we treat them as belonging to that species.

Misidentifications: Fourmanoir (1971:492) re-

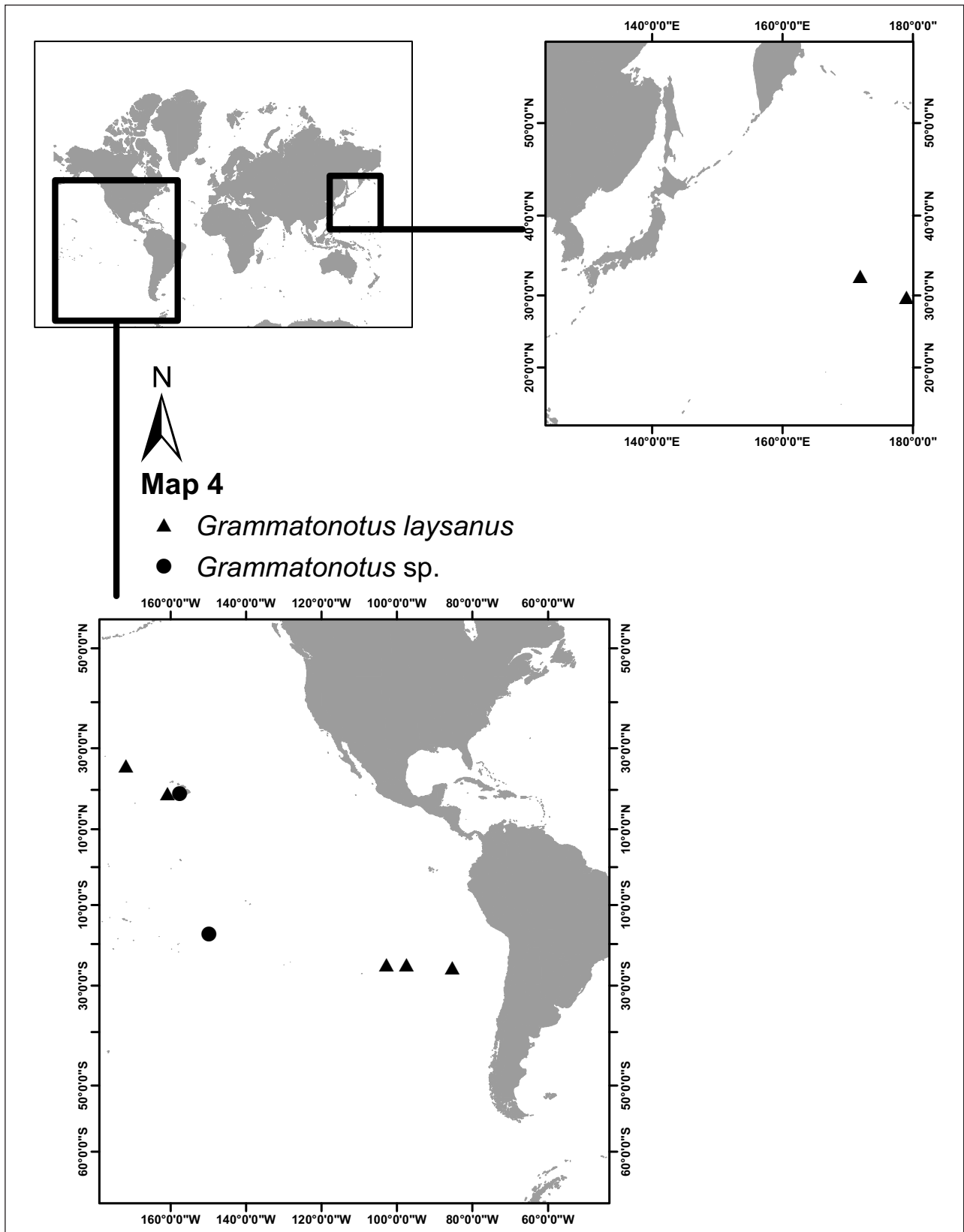
ported a number of small specimens (18-28 mm SL) from the southwestern Pacific that he identified as *Grammatonotus laysanus*. He provided the following (p. 492): “DESCRIPTION: D XI, 8, A III, 9, P 19, L. l. 26.” We have not found any specimens of *G. laysanus* with a dorsal-soft ray count of 8 or a lateral-line scale count of 26; additionally, 19 pectoral-fin rays is an unusual count for this species. Fourmanoir’s specimens appear to have been misidentified.

Distribution: This species has been reported from Johnston Atoll (Randall et al. 1985), Emperor Seamount Chain (Katayama et al. 1982), Hawaiian Islands (Gilbert 1905; Randall 2007), Kiritimati (Christmas Island), Line Islands (Mundy & Parrish 2004), and the region of the Nazca and Sala y Gómez ridges in the eastern Pacific (Parin 1991; Parin et al. 1997). Chave & Malahoff (1998: 101) reported *G. laysanus* as a species occasionally photographed from submersibles during surveys conducted in the Hawaiian Archipelago in 175 to 367 meters over hard substrates with holes. We have examined specimens collected in the main Hawaiian Islands, off the Northwestern Hawaiian Islands, over the Emperor Seamounts, and from the eastern Pacific (in the region of the Nazca and Sala y Gómez ridges) in depths of 177 to 364 meters. Also, one of the specimens (BPBM 18086, 22.9 mm SL) examined was taken by a plankton net that fished from 175 meters to the surface, but did not close.

Etymology: Named for Laysan, one of the Northwestern Hawaiian Islands, off of which the holotype was collected.



Fig. 10. *Grammatonotus laysanus*, BPBM 22714, 124 mm SL; Milwaukee Seamount. Photo by J. E. Randall.



Map 4. Localities for *Grammatonotus* from the central and eastern Pacific. *G. laysanus*, *Grammatonotus* sp.

Table VI. Morphometric data for *Grammatonotus laysanus*, *G. pelipel*, & *G. xanthostigma*. Standard length in mm, other measurements in percentage of standard length. NM = not measured. NP = not produced. + = slightly damaged.

	<i>G. laysanus</i>		<i>G. pelipel</i>		<i>G. xanthostigma</i>	
	n	Ranges	n	Ranges	n	Ranges
Standard length	18	22.9--137	3	28.1-49.3	2	60.2- 61.0
Depth at dorsal-fin origin	18	27.5--35.1	2	34.2-34.3	2	29.6-31.1
Predorsal-fin length	18	30.7--36.8	3	35.7-37.7	2	33.2-33.9
Length of head	18	28.9--34.9	3	31.0-34.0	2	29.8-30.2
Length of snout	18	4.3--8.0	3	4.3-5.3	2	4.7-4.9
Diameter of bony orbit	18	10.0--14.2	3	7.5-9.6	2	9.0-9.0
Bony interorbital width	18	5.0--7.8	3	5.9-6.8	2	5.6-5.7
Postorbital length of head	18	12.1--15.3	3	14.6-16.2	2	13.9-15.0
Length of upper jaw	17	11.6--15.1	1	12,8	2	12.3-12.8
Pectoral-fin length	16	21.2--26.8	1	27,4	2	23,4-24.1
Pelvic-fin length	15	26.7--36.3	1	29,6	2	26.6-27.6
Length of caudal peduncle	18	21.2--26.5	3	21.4-23.3	2	22.8-23.4
Depth of caudal peduncle	18	12.7--17.3	3	12.5-14.4	2	12.6-13.8
Upper caudal-fin lobe, length	16	41.8--88.9+	3	29.5-41.4+	NP	NP
Lower caudal-fin lobe, length	15	39.7+--81.1	2	29.5-46.7	NP	NP
Mid-caudal-fin rays	NM	NM	3	26.3-28.5	2	55.6-59.3
Depressed anal-fin length	15	30.1--44.5	3	31.3-36.5	2	39.7-42.7
Length of first anal-spine	13	4.6--7.4	1	5,7	2	3.7-3.8
Length of second anal-spine	15	6.6--10.2	1	9,1	2	6.7-7.2
Length of third anal-spine	14	8.5--12.2	1	10,3	2	8.0-8.7
Length of base of anal-fin	18	17.0--21.4	3	19.3-19.9	2	18.6-20.7
Length of penultimate dorsal-fin ray	14	15.6--27.5	NM	NM	2	18.9--19.6
Length of ultimate dorsal-fin ray	13	15.5--22.9	NM	NM	2	~14.6-15.6
Length of penultimate anal-fin ray	13	~15.8--23.1	NM	NM	1	18,0
Length of ultimate anal-fin ray	13	11.5--18.2	NM	NM	1	15,2

**Fig. 11.** *Grammatonotus macrophthalmus*, holotype, NSMT-P 18829, 117 mm SL; Kyushu Palau Ridge. Photo by S. J. Raredon.

Material examined: Eighteen specimens, 22.9 to 137 mm SL. **MAIN HAWAIIAN ISLANDS**, Oahu, off leeward coast: BPBM 18086 (1 specimen: 22.9 mm SL). **NORTHWESTERN HAWAIIAN ISLANDS**, Laysan Island: USNM 51546 (holotype: 36.7). **EMPEROR SEAMOUNTS**, Hancock Seamount: BPBM 22757 (9: 90.1-137). Milwaukee Seamount: BPBM 22714 (1: 124). **EASTERN PACIFIC**, near Bolshaya Seamount, on the continuation of the axis of the Sala y Gómez Ridge: IOM uncat. (1: 115). Sala y Gómez Ridge, near Kupol Seamount: USNM 443776 (formerly IOM uncat., 1: 76.1); near Utes Seamount: USNM 443777 (formerly IOM uncat., 4: 57.5-74.1).

Grammatonotus macrophthalmus Katayama Yamamoto & Yamakawa, 1982

Big-eyed Groppo

Figs 3E, 11, 12; Tables I-III; Map 3

Grammatonotus macrophthalmus Katayama, Yamamoto & Yamakawa 1982: 371, fig. 4, table 1 (original description; illustration; holotype NSMT-P 18829, 117 mm SL; type locality Kyushu-Palau Ridge, 26°46.0' N, 135°21.5' E ~ 26°45.6' N, 135°24.5' E, depth 330 meters). – Yamakawa 1982: 220, 221, 373 (description; illustration; Kyushu-Palau Ridge, 322 to 510 meters). – Matsuura & Tachikawa 1994:143 (description; Chichi-jima, Ogasawara Islands). – Senou 2002:732 (in key, meristic and locality data).



Fig. 12. Underwater photograph of a fish tentatively identified as *Grammatonotus macrophthalmus*; French Frigate Shoals, Northwestern Hawaiian Islands, depth 352 meters; courtesy of Bruce C. Mundy (see Mundy & Parrish, 2004, plate 1).

ta). – Kanou et al. 2003:43 & 44, figs. 2 & 3. Mundy & Parrish 2004:403-413, pl. 1, fig. 1, table 1 (tentative identification; description, illustration, northwestern Hawaiian Islands [French Frigate Shoals and Northhampton Seamount], habitat and behavior, ecology and biogeography). Mundy 2005:351 (compiled).

Diagnosis: Caudal fin ragged posteriorly, with several rays produced (Fig. 3E); caudal peduncular scales 14 (one specimen only).

Description: Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 19 or 20. Gillrakers 8 to 12 + 18 to 20 total 26 to 32. (As shown in Table II, our counts of gillrakers [29 to 32] differ from those in the literature [26 to 28], despite the fact that two of the specimens are represented in both series of counts.). Tubed lateral-line scales 15 or 16 (Katayama et al. 1982: 372, 373, table 1; Matsuura & Tachikawa 1994:143). Frequency distributions for countable characters are given in Tables I & II; morphometric data, in Table III.

Coloration: Katayama et al. (1982: 373) wrote “Color when fresh: Body yellowish pink; iris pink; dorsal and anal fins with pink margins; caudal fin pink; pectoral and pelvic fins pale pink. In alcohol, uniformly pale yellow.” Okamura et al. (1982: 220, fig. 146) presented an illustration of a specimen (109 mm SL) from the Kyushu-Palau Ridge, which has body yellowish with some red orange dorsally and silvery ventrally, spinous dorsal fin mainly yellowish basally (membranes of rest of fin damaged), pectoral fin pale, pelvic and anal fins with membranes mostly damaged, caudal fin bluish.

Mundy & Parrish (2004, plate 1) presented a photograph (taken from a submersible) of a specimen tentatively identified as *Grammatonotus macrophthalmus* and, as quoted below, gave a detailed description (p. 406) of its coloration.

When illuminated next to the submersible the fish showed the following colors:

The body was golden yellow from the posterior head to the abdomen, grading posteriorly to golden ocher on the tail to the base of the caudal fin. The snout and interorbital area to the insertion of the dorsal fin were magenta. The dorsum under the dorsal fin and on the caudal peduncle was lavender pink. Five triangular pink areas extended from the dorsal stripe ventrally on the dorsal one-third of the sides, approximately beneath spinous dorsal-fin rays 2-5, 7-9, 3-5 [sic], 8-9 and beneath middle of caudal peduncle. The middle three areas ex-

tended as bars ventrally on the sides, becoming faint on the lower sides. There was a stripe of diffuse magenta behind the eye to the posterior opercular edge. The iris was silvery except lavender dorsally. The chin, branchial region, thorax, and anterior ventral abdominal region were diffuse light blue, appearing gray in shadow when viewed from above. The pectoral fin was transparent. The pelvic fin was reflective bluish white anteroventrally with bright white tips, becoming translucent greenish white posterodorsally. The dorsal fin was golden ocher proximally, with a light blue stripe on its upper half and a purple stripe with pink spinous and soft ray tips distally. There was a second light blue stripe on lower half to one-third of the spinous dorsal-fin rays posteriorly. The anal fin was light ocher proximally, with a light blue stripe on the proximal one-third to half, a distal purple stripe, and lavender pink tips on the spinous and soft rays. The caudal fin base was golden ocher, the free filaments of the central rays were blue, the outer rays were purple with magenta outer edges, and the tips of the filamentous rays were pale bluish white at some angles. (See Fig. 12.)

Ecology and Ethology: Mundy & Parrish (2004: 406–407) observed from a submersible the species that they tentatively identified as *Grammatonotus macrophthalmus* in a variety of habitats (340–440 meters) near sediment-free areas with high relief, close to colonies of gold coral, but not in the immediate vicinity of the coral. At a site on French Frigate Shoals (northwestern Hawaiian Islands) temperatures logged by recorders left for a year ranged from 9.1 to 14.0° C. In most sightings, if not stunned by lights from the submersible, the fish moved quickly to cover in crevices. Fish were observed individually or in pairs, but not in bigger groups. “All individuals swam slowly with labriform motion, sculling with their pectoral fins, keeping their bodies straight and their caudal fins widespread, until alarmed by the submersible’s proximity. When startled, they darted rapidly with tail flexions” (p. 407).

Distribution: Kyushu–Palau Ridge (Katayama et al. 1982: 371; Yamakawa 1982: 373), Chichi-jima, Ogasawara Islands (Matsuura & Tachikawa 1994: 143); Northwestern Hawaiian Islands (French Frigate Shoals and Northhampton Seamount; Mundy & Parrish 2004; Mundy 2005: 351) in depths of 300 to 510 meters (Yamakawa 1982: 373; Senou 2002: 732). Prokofiev (2015:280) questioned the tentative identification as *G. macrophthalmus* of the specimen shown in plate 1 of Mundy & Parrish (2004) and stated that “the specimen described by Mundy and Parrish (2004)

corresponds to *G. ambiortus*. Possibly *G. ambiortus* and *G. macrophthalmus* are only representatives of geographical forms.”

Etymology: The name *macrophthalmus* (makros, long; ophthalmos, eye) is from the Greek and is an allusion to the size of the eye.

Material examined: Two specimens (95.3–117 mm SL). NSMT-P 18829 (holotype, 117 mm SL); Kyushu–Palau Ridge; 26°46.0' N, 135°21.5' E to 26°45.6' N, 135°24.5' E; depth 330 meters; 30 January 1978. NSMT-P 35093 (95.3 mm SL); Ogasawara Islands, Chichi-jima, washed up on Miyahohama Beach; 25 November 1991.

Grammatonotus pelipel Anderson & Johnson 2017

Barred Groppo

Figs 3F & G, 13, 14; Tables I, II, VI; Map 3

Grammatonotus pelipel Anderson & Johnson 2017: 191 (original description; holotype BPBM 41273, 49.3 mm SL; type locality off Pohnpei Island, Lat. 6.991784° N, Long. 158.137131° E, depth 151 meters.

Diagnosis: A species of *Grammatonotus* distinguishable from all other described species of the genus by its barred coloration – most evident in specimens less than 30 mm SL, barring only vaguely apparent in color photograph of largest specimen examined (49.3 mm SL), but very obvious in preserved individual. Shape of caudal fin distinctive, being truncate to slightly emarginate in small specimens, but with upper and lower lobes produced in largest individual known (Figs 3F & G).

Description: Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 19 or 20. Total number of gillrakers on first arch 28 (count from only one specimen). Lateral aspect of snout without scales. Lateral line disjunct with one or two most anterior tubed scales separated from the more posterior ones; number of tubed scales 15 to 17 (1 + 14, 2 + 14, 2 + 15). Midbody lateral scales ca. 23 (count from only one specimen). Rows of cheek scales 5. Scales between origin of anal fin and lateral line 9. Circum-caudal-peduncular scales 16. Epineural bones associated with first 11 or 12 vertebrae.

Coloration: Description of coloration is based on examination of digital photographs made by Brian D. Greene of freshly caught specimens. “Holotype (49.3 mm SL) with dorsum of head and narrow strip below dorsal fin rosy to purplish; ventral part

of snout and lower jaw bright yellow; rest of head mostly silvery except for purplish on opercle; side of body dull yellow to pale purplish. Hint of vertical bars along side of body in color photograph; these show up as ca. 11 or 12 dark bars on preserved specimen. Iris of eye with blue dorsally, pale yellow anteriorly and posteriorly. Dorsal fin bright yellow with narrow distal border of purple. Distal 50 to 60 per cent of anal fin bright yellow, broad band of purple proximally. Pectoral fin dull rose. Pelvic fin rather nondescript. Broken purplish vertical line at base of caudal fin; dorsalmost and ventralmost caudal-fin rays bright yellow and adjacent to purplish rays that are produced well beyond distal ends of mid-caudal rays; rest of fin mostly dull yellow (see Fig. 13). Two smaller specimens (each 28.1 mm SL) distinctly barred, 11–13 bars present (see Fig. 14). Third small specimen (20.6 mm SL) with some pigmentation dorsally that may be remnants of dark bars” (Anderson & Johnson 2017:191–192).

Distribution: This species is only known from specimens collected off Pohnpei Island, Senyavin Islands (part of the Caroline Islands group), western Pacific Ocean.

Etymology: The name *pelipel* is an allusion to the barring in the color pattern of this species. The barring in the young of this species resembles markings found in many Pohnpei tattoos. The Pohnpeian word “pelipel” means “tattoo” or “to tattoo.”

Material examined. Four specimens (20.6–49.3 mm SL) caught off Pohnpei Island (Gorgonian Buttress and Ahnd [Ant] Atoll). BPBM 41273 (holotype, 49.3 mm SL); Gorgonian Buttress; 6.991784°

N, 158.137131° E; depth 151 meters; collected by B. D. Greene, with hand net, 05 August 2015. BPBM 41268 (two paratypes, each 28.1 mm SL, one now USNM 432534); Ahnd (Ant) Atoll; 6.802793° N, 158.014694° E.; depth 136 meters; collected by R. L. Pyle, with hand net, 29 July 2015. BPBM 41267 (20.6 mm SL); Ahnd (Ant) Atoll; 6.802793° N, 158.014694° E.; depth 136 meters; collected by R. L. Pyle, with hand net, 29 July 2015.

***Grammatonotus roseus* (Günther 1880)**

Rosy Groppo

Figs 3H, 15; Tables I, II, IV; Map 2

Heliastes roseus Günther 1880:45, plate XX, fig. D (original description, illustration; lectotype – BMNH 1879.5.14.10, 64.6 mm SL; type locality off the Kai Islands, Indonesia, *Challenger* station 192).

Zabulon roseus Whitley 1928:297 (new combination)

Diagnosis: Caudal fin subtruncate or rounded (Günther 1880:45, plate XX, fig D; Fig. 3H).

Description: Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 19. Pseudobranch with 11 or 12 filaments. Gillrakers 7 to 9 + 17 to 19 – total 24 to 28. Tubed lateral-line scales 14 to 17 (lateral line terminating ventral to base of 4th, 6th, or 8th dorsal soft ray). Midbody lateral scales 24 to 27. Circum caudal-peduncular scales 15 or 16. Scales between anal-fin origin and lateral line 8 or 9. Epineural bones associated with first 12 vertebrae. Lateral aspect of snout and anterior part of lachry-



Fig. 13. *Grammatonotus pelipel*, holotype, BPBM 41273, 49.3 mm SL; Pohnpei. Photo by B. D. Greene.

mal without scales; gular region apparently without scales or with a few scales anteriorly; maxilla and lower jaw with scales. Frequency distributions for countable characters are given in Tables I & II; morphometric data, in Table IV.

Coloration: “Uniform rose coloured” (Günther 1880:45).

Distribution: Known only from the type specimens collected off the Kai Islands, Indonesia, at *Challenger* station 192 (5°49'15" S, 132°14'15" E, in 129 fathoms = 236 meters).

Comment: Along with the type specimens of *Heliastes roseus* (= *Grammatonotus roseus*), the lectotype and paralectotype of *Propoma roseum* (= *Symphysanodon typus*, family Symphysanodontidae) were also collected at *Challenger* station 192 (Anderson, 1970:333).

Etymology: The name *roseus* is from the Latin – “of roses,” presumably referring to the fresh coloration of the type specimens.

Material examined: Five specimens 49.2 to 64.6 mm SL. INDONESIA, off the Kai Islands (*Challenger* station 192): BMNH 1879.5.14.10 (lecto-

type: 64.6 mm SL); BMNH 1879.5.14.11 (paralectotype: 53.0 mm SL); BMNH 1890.2.26.141-3 (3 paralectotypes: 49.2-58.9 mm SL).

***Grammatonotus surugaensis* Katayama, Yamakawa & Suzuki 1980**

Suruga Groppo

Figs 3I, 16; Tables I-III; Map 3

Grammatonotus surugaensis Katayama, Yamakawa & Suzuki 1980: 45, fig. 1 (original description; illustration; holotype NSMT-P19445, 81 mm SL, male; type locality Japan, off Numazu, Suruga Bay, 120 meters). – Masuda et al. 1984: 138, plate 124-F (species account, illustration). – Senou 2002:732 (in key, meristic and locality data). – Shinohara et al. 2005:431 (Ryukyu Islands).

Diagnosis: Caudal fin ragged posteriorly, with several rays produced slightly (Fig. 3I); total number of gillrakers on first arch 24 or 25.

Description: Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 18 or 19. Pseudobranch with 16 filaments (data from only one specimen). Gillrakers 7 + 17 or 18 – total 24 or 25. Tubed lateral-line scales 16 or 17. Scales between anal-fin origin and lateral line 9 (data from only one specimen). Epineural bones associated with first 12 vertebrae. Posterior part of lachrymal and lower jaw with scales. Frequency distributions for countable characters are given in Tables I & II; morphometric data, in Table III.

Coloration: “This species seems not to be sexually dichromatic.” When fresh: “Body orange red, lower side silvery; iris yellow, with a red patch be-



Fig. 14. *Grammatonotus pelipel*, paratype, USNM 432534, 28.1 mm SL; Pohnpei. Photo by B. D. Greene.



Fig. 15. *Grammatonotus roseus*, lectotype of *Heliastes roseus* (= *Grammatonotus roseus*), BMNH 1879.5.14.10, 64.6 mm SL; Kai Islands, Indonesia. Photo by J. Maclaine.

low pupil and brown patch upper [above ?] pupil; dorsal fin yellow; anal fin yellow, with a broad lilac stripe; caudal fin yellow; pectoral fin pale; pelvic fin pale pink. In alcohol, uniformly pale yellow” (Katayama et al. 1980:48). Masuda et al. (1984: plate 124-F) presented a photo of a specimen of *G. surugaensis* that resembles the description in Katayama et al. (1980).

Distribution: Katayama et al. (1980:46) gave off Numazu, Suruga Bay (in a depth of 120 meters), and the Straits of Ōsumi as the localities of capture for their type material; Senou (2002: 732) gave those and additional localities (Boso Peninsula, Izu-Oshima Island, and Sagami Bay) as collection sites for the species with a depth range of 65 to 120 meters; and Shinohara et al. (2005:431) included it in a checklist of deep-sea fishes known from the waters around the Ryukyu Islands.

Etymology: *Grammatonotus surugaensis* was named for Suruga Bay, from which the holotype was collected.

Material examined: JAPAN, Straits of Ōsumi: NSMT-P 19446 (one paratype: 74.3 mm SL).

Grammatonotus sp. cf. *G. surugaensis*

Kanou et al. (2003:41) described six specimens (18.6-22.8 mm SL) collected from Tosa Bay (Pacific coast of Shikoku Island, Japan) in depths of 150 to 200 meters that they identified as *Grammatonotus* sp. (cf. *G. surugaensis*). We have not seen those specimens, but we have examined a specimen, 55



Fig. 16. *Grammatonotus surugaensis*, paratype, NSMT-P 19446, 74.3 mm SL; Straits of Ōsumi, Japan. Photo by J. F. McKinney.



Figs 17A-B. *Grammatonotus* cf. *G. surugaensis*, ORSTOM (Nouméa), 55 mm SL – left (A) and right (B) sides. Photos by S. J. Raredon.

mm SL (ORSTOM, Nouméa, New Caledonia), collected in the southwest Pacific, west of New Caledonia (22°34.7'S, 159°15.3'E, in 300 meters), that was identified as *Grammatonotus surugaensis* and is the specimen listed as that species by Rivaton (1989:152) from the Chesterfield-Island region (record noted by Fricke et al. 2011:387). Coloration in alcohol of the ORSTOM specimen: Left side (Fig. 17A) with seven dark (dull reddish brown in preservative) vertical bars: first bar anterior to anterior end of dorsal fin; second and third below spinous dorsal fin; fourth and fifth beneath soft dorsal fin – joined at base of fin and just below midline; sixth joining broad horizontal stripe on caudal peduncle; seventh on base of caudal fin; horizontal stripe joining fourth and fifth bars anteriorly. Right side (Fig. 17B) with large dark blotch beneath soft dorsal fin that extends over most of caudal peduncle and with lighter bar on base of caudal fin. The ORSTOM specimen differs from *G. surugaensis* in several respects, including, vomerine teeth present on either side of midline – but absent from midline (vs. crescent-shaped patch of vomerine teeth in *G. surugaensis*), total first arch gillrakers 27 (vs. 24 or 25), and lateral-line scales ca. 19 (vs. 16 or 17). Also, the pattern of coloration described above for the ORSTOM specimen is different from that presented in the original description of *G. surugaensis* (see section on coloration for *G. surugaensis*) and in the photograph in Masuda et al. (1984, pl.124, fig. F). The great distance between the type locality for *G. surugaensis* (Suruga Bay, Japan) and the southwest Pacific supports the view that the specimen obtained west of New Caledonia

represents an undescribed species, but we do not describe it as new because it is in only fair condition, with many scales missing and caudal fin damaged.

Grammatonotus xanthostigma Anderson & Johnson 2017

Yellowspot Groppo

Figs 3J, 18; Tables I, II, VI, VII; Map 3

Grammatonotus xanthostigma Anderson & Johnson, 2017:188, figs 1-3 (original description; illustrations; holotype BPBM 41271, 60.2 mm SL; type locality off Pohnpei Island at 6.991784° N, 158.137131° E in 142 meters).

Diagnosis: A species of *Grammatonotus* differing from the other described species of the genus, except *G. brianne*, by the following combination of characters: caudal fin rhomboid shaped with mid-caudal rays produced (Fig. 3J), lateral-line disjunct, anal-fin spines short (see Table VI), and live coloration (see Fig. 18 and description of coloration below). It is distinguished from *G. brianne* by absence of scales on lower jaw (present in *G. brianne*), measurements of several body parts (see Table VII), and shape of caudal fin (see Fig. 3J, and compare Figs 5 & 18). Caudal fin rhomboid shaped in both species, but posterior halves of dorsalmost and ventralmost borders of fin slightly concave in *G. xanthostigma* (gently rounded to convex in *G. brianne*). Also, *G. xanthostigma* with a bright yellow spot at upper base of pectoral fin (lacking in *G. brianne*).

Description: Dorsal-fin rays XI, 9. Anal-fin rays



Fig. 18. *Grammatonotus xanthostigma*, holotype, BPBM 41271, 60.2 mm SL; Pohnpei. Photo by B. D. Greene.

Table VII. Comparisons of selected measurements for *Grammatonotus brianne* and *G. xanthostigma*. Standard length in mm; other measurements in percentages of standard length.

	<i>G. brianne</i>		<i>G. xanthostigma</i>	
	n	Range	n	Range
Standard length	4	72.9-84.4	2	60.2-61.0
Depth at dorsal-fin origin	4	33.0-35.4	2	29.6-31.1
Predorsal-fin length	4	30.6-33.5	2	33.2-33.9
Diameter of bony orbit	4	9.7-11.1	2	9.0-9.0
Width of bony interorbital	4	7.0-7.7	2	5.6-5.7
Postorbital length of head	4	12.4-14.2	2	13.9-15.0
Length of caudal peduncle	4	23.8-24.6	2	22.8-23.4
Depth of caudal peduncle	4	14.4-16.2	2	12.6-13.8
Mid-caudal fin rays	4	58.6-82.2	2	55.6-59.3
Length of first anal spine	4	2.8-3.4	2	3.7-3.8

III, 9. Pectoral-fin rays 19. Procurrent caudal-fin rays 6 dorsally and ventrally. Pseudobranch with 11 to ca. 12 filaments. Total number of gillrakers on first arch 25 to 29. Lateral line disjunct with two most anterior tubed scales separated from the more posterior ones; number of tubed scales 15 to 18 (2 + 13, 2 + 15, 2 + 16; counts of lateral-line scales made on both sides of each specimen). Midbody lateral scales 23 or 24. Rows of cheek scales 5. Scales between origin of anal fin and lateral line 9. Circum-caudal-peduncular scales 16. Epineural bones associated with first 12 or 13 vertebrae. One trisegmental pterygiophore associated with dorsal fin, and one with anal fin.

Coloration: “Coloration based on digital pho-

tographs of two specimens (BPBM 41271, 60.2 mm SL, the holotype [Fig. 18], and USNM 432533, 61.0 mm SL, the paratype): Dorsally head and anterior two thirds of body rosy; rosy line along dorsum of caudal peduncle; ventrally head and area anterior to base of pectoral fin silvery to silvery pink; large blotch of grayish brown on posteroventral portion of opercle; mid-body and ventrum dull orange to yellow. Iris of eye with broad blue arch dorsally and narrow yellow stripe posteriorly; anteriorly adjacent to pupil, one specimen with narrow arch of yellow. Dorsal fin yellow proximally, bordered by light to dark purple distally (distal ends of dorsal spines and soft rays yellow). Anal fin purple with distal margin of yellow. Pectoral fin pale pink with bright yellow spot at upper base of fin. Pelvic fin purple. Anterior border of caudal fin outlined in rosy purple; caudal fin yellow, with some purplish near middle of distal end of fin; distal ends of produced mid-caudal rays bright yellow” (Anderson & Johnson 2017: 189-190).

“A digital photograph of another specimen (BPBM 41294, 57 mm SL) collected off Pohnpei in 137 meters on 16 July 2016 shows an individual with coloration closely resembling that described above. The major differences are in the pigmentation of the iris of the eye and in the absence of rosy purple outlining the anterior border of the caudal fin. We have not examined that specimen.” (Anderson & Johnson 2017:190).

Distribution: This species is known only from individuals captured off Pohnpei Island, Senyavin Is-



Fig. 19. *Grammatonotus* from off Western Australia, CSIRO H 5201-02, 76.5 mm SL. Photo by T. Carter (CSIRO).

lands (part of the Caroline Islands group), western Pacific Ocean.

Etymology: The name *xanthostigma* is from the Greek – xanthos (yellow), stigma (spot) – in reference to the yellow spot at the upper base of the pectoral fin.

Material examined: Two specimens (60.2 & 61.0 mm SL) caught off Pohnpei Island (Gorgonian Buttress); 6.991784°N, 158.137131°E.; depth 142 meters; collected by B. D. Greene, with hand net, 03 August 2015. BPBM 41271 (holotype, 60.2 mm SL), USNM 432533 (out of BPBM 41271, paratype, 61.0 mm SL).

CSIRO specimens of *Grammatonotus*

We received on loan from CSIRO (Hobart, Tasmania) two specimens of *Grammatonotus* – one collected off Western Australia, north of Monte Bello Islands, the other off Queensland from the Coral Sea. The specimen from the Coral Sea was listed as “*Grammatonotus cf macrophthalmus*” in Last et al. (2014: 217). We are uncertain as to the status of these specimens; consequently, we summarize the data we have obtained from them.

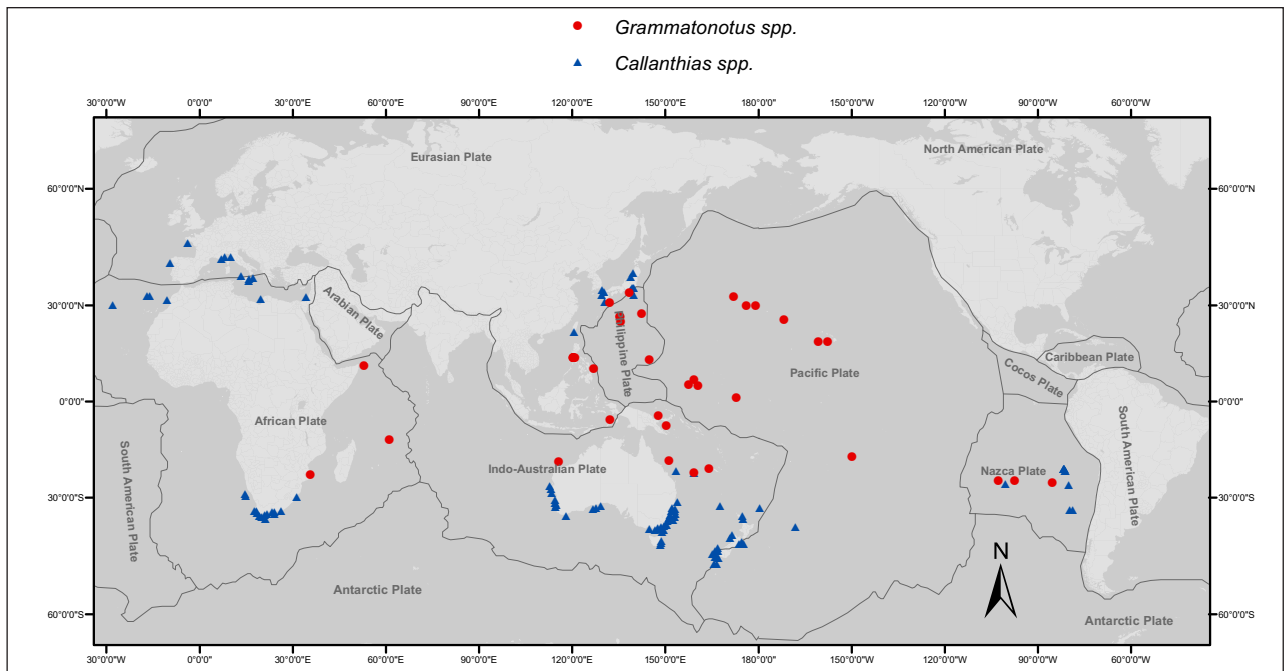
Principal caudal-fin rays 15 (8 + 7), procurrent caudal-fin rays 6 (dorsally and ventrally), vertebrae 24 (10 + 14), supraneural bones 2 (arranged as in other *Grammatonotus*), epurals 3. The specimen from the Coral Sea has one anal trisegmental ptery-

giophore; the other one has none. Neither specimen has any dorsal trisegmental pterygiophores. The one from the Coral Sea has epineurals associated with first 10 vertebrae; the one from off Western Australia, with the first 12 vertebrae.

Western Australia: Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 19 (both sides). Gillrakers 27 (8 + 19). Tubed lateral-line scales: anteriorly 15 just below dorsal fin on each side, lateral line extending to or near posterior end of dorsal fin; ventral to anterior lateral line another series of tubed scales (ca. 9 on left side, ca. 18 on right), beginning beneath posterior part of soft dorsal fin on left side, below fifth dorsal spine on right, and extending to base of caudal fin on each side. Mid-body lateral scales 21 (left), 22 (right). Circumcaudal-peduncular scales 17. Rows of cheek scales ca. 6 (left), ca. 7 (right). Scales between origin of anal fin and lateral line 9 (on each side). Lower caudal-fin lobe extremely long (approaching 90% SL). See Fig. 19 for coloration and Table IV for morphometric data.

Material examined: CSIRO H 5201-02 (one specimen, 76.5 mm SL); north of Monte Bello Islands; 19°34’S, 115°36’ E; depth 245 meters; 28 October 1998.

Queensland (Coral Sea): Dorsal-fin rays XI, 9. Anal-fin rays III, 9. Pectoral-fin rays 19 (both sides). Gillrakers 26 (7 + 19). Too many scales



Map 5. Comparison of localities for *Grammatonotus* with those for *Callanthias*.

missing to make counts. See Fig. 20 for coloration and Table IV for morphometric data.

Material examined: CSIRO H 643-5 (one specimen, 66.3 mm SL); Coral Sea, northeast of Whitsunday Group; 19°37'S, 150°30' E; depth 318 meters; 15 November 1985.

More *Grammatonotus* from the Hawaiian Islands

A specimen of 41.1-mm SL (BPBM 28124) collected in 198 meters (from Penguin Bank, off Molokai, Hawaiian Islands) was initially thought to be a juvenile of *G. laysanus*, despite its having a “diamond-shaped caudal fin” (unlike the shape of the caudal fin in *G. laysanus*). Later this specimen (figured in Randall 2007: 200) was found to be “a fully mature female,” as was another of 38 mm SL (BPBM 37191), that was caught with a hand net in 7.5 meters off Kahe Point, Oahu, Hawaiian Islands (Randall 2007: 200). We have examined the 41.1-mm SL specimen. It has the following counts: dorsal-fin rays XI, 9; anal-fin rays III, 9; pectoral-fin rays 19 (both sides); tubed lateral-line scales ca. 16 (both sides); mid-lateral body scales ca. 24; circum caudal-peduncular scales 16; scales between origin of anal fin and lateral line 9; gillrakers 9 + 19 (total 28). We have not examined the 38-mm SL specimen (BPBM 37191).

Additional specimens and reports of *Grammatonotus*

There are a number of other specimens of *Grammatonotus* that we have been unable to identify to species. Among them are a 41.5-mm SL specimen (GMBL 84-110) that was taken from the stomach of

an *Etelis carbunculus* caught in 300 meters off Maiao (ca. 64 km WSW of Moorea, Society Islands); two specimens (MNHN 1980-278, 11.5 & 12.0 mm SL) collected off New Caledonia; one (BPBM 30359, ca. 57 mm SL) from the stomach of a *Seriola* sp. obtained in 177 meters off Guam; and two (AMS I. 19753-027, 13.8 mm SL & AMS I. 19742-057, 15.6 mm SL) caught off Papua New Guinea.

Chave & Mundy (1994:386, 396) and Chave & Malahoff (1998:101) reported a species of *Callanthias* (in 171-360 meters, off the Hawaiian Archipelago and Johnston Atoll) and *Grammatonotus laysanus* (in 175-367 meters, off Johnston Atoll) observed over hard substrate with holes and noted that Ralston et al. (1986:147) saw what was apparently the same species of *Callanthias* (in 240-330 meters) at Johnston Atoll. Chave & Mundy (1994: 396) noted that their *Callanthias* sp. is probably a new species and that “Both sexes yellow and purple in color, small, and had rounded tails. They hovered near holes or among talus near cliffs.” Mundy (2005: 350) tentatively identified those individuals as representatives of an undescribed species of *Callanthias*. Chave & Mundy (1994: 396) noted that the species they called *Grammatonotus laysanus* occurred in “Small groups, usually a male (with a falcate tail) and two or three orange females, swam near small holes in steep slopes.” Mundy & Parrish (2004, plate 1) presented an underwater photograph of a fish tentatively identified as *Grammatonotus macrophthalmus*. That individual, like the ones mentioned above as *Callanthias* in Chave & Mundy (1994: 396), has considerable purple and yellow coloration, but unlike the specimens of



Fig. 20. *Grammatonotus* from the Coral Sea, CSIRO H 643-5, 66.3 mm SL. Photo by C. Devine (CSIRO).

Chave & Mundy the caudal fin is elongated and produced into numerous filaments. The Hawai'i Undersea Research Laboratory (HURL) has photographs of three species of callanthiids. Although individuals in some HURL photographs were formerly identified as belonging to the genus *Callanthias*, they are now considered as *Grammatonotus* (Christopher Kelley, *in litt.*, to WDA, 01 May 2013).

Observations of *Grammatonotus* made via ROV

Bruce Mundy and associates (Sarah Bingo, Christopher Kelley, Virginia Moriwake, and Meagan Putts, Hawai'i Undersea Research Laboratory, University of Hawai'i at Manoa) have provided us with numerous images and data on *Grammatonotus* observed via ROV during surveys conducted by the NOAA Ship *Okeanos Explorer* in the central and western Pacific. A few of the individuals observed have been identified to species by Mundy – *G. laysanus* (at Middle Bank in the Hawaiian Islands, Johnston Atoll, and Palmyra Atoll), and *G. macrophthalmus* (Mariana Islands) but most are identifiable only to genus. Some of the latter apparently represent undescribed species – one of these from Pao Pao Seamount in the Tokelau Seamount Ridge with five elongate rays in the caudal fin has been dubbed *Grammatonotus* sp. “crown tail” (Figs 3N, 21); another individual seen at Howland Island (an outlier of the Phoenix Islands) may be the same species. A *Grammatonotus* observed at Eifuku Seamount in the Marianas region may represent another undescribed species (Figs 3O, 22).

A Misidentification

Giltay (1933:53) reported two small specimens collected between Banda Neira and Goenoeng, Indonesia, as *Grammatonotus laysanus* (family “Pseudoplesiopidae”). Giltay’s description of the



Fig. 21. *Grammatonotus* sp. “crown tail” (with five elongate rays in the caudal fin) from Pao Pao Seamount in the Tokelau Seamount Ridge, South Pacific. Photograph courtesy of the NOAA Office of Ocean Exploration and Research.

specimens does not support placing them in the genus *Grammatonotus*. They may be pseudochromids; perhaps as suggested by Anthony C. Gill (*in litt.* to WDA, 20 February 2018) a species of *Pseudoplesiops*, possibly *P. rosae*.

Geographic distribution

Species of *Grammatonotus* are widely distributed in the Indo-Pacific and to a limited degree in the eastern Pacific, mainly off insular coasts, with more records from the tropics than from temperate waters. The genus is notably absent from the North American, Caribbean, Cocos, South American, and Antarctic plates. Its major foci of distribution are on the Eurasian, Philippine, Indo-Australian, and Pacific plates (see Map 5), displaying a distribution reminiscent of that shown in Springer (1982: 93, fig. 41) for eight species of the subgenus *Mirolabrichthys* of the serranid genus *Pseudanthias*. *Grammatonotus* species have been collected or observed in a broad range of depths (7.5 to ca. 350/600 meters). The distribution of *Grammatonotus* is in large part complementary to that of *Callanthias*, being more commonly collected in tropical than in temperate waters, whereas *Callanthias* is largely a subtropical and temperate genus, being almost completely absent from the Pacific Plate (see Map 5).

CONCLUSION

Grammatonotus is represented by ten described species and a number of specimens not currently assignable to species, but which probably represent undescribed taxa. In addition, we have seen photographs and videos, taken from submersibles and ROVs, of specimens of *Grammatonotus* that we cannot identify to species. *Grammatonotus* dwells in habitats that are poorly investigated, in large



Fig. 22. *Grammatonotus* sp. from Eifuku Seamount in the Mariana Arc, western Pacific. Photograph courtesy of the NOAA Office of Ocean Exploration and Research.

part due to their inaccessibility. With collecting in unexplored and previously poorly explored areas and more extensive use of submersibles and ROVs, we anticipate an appreciable increase in the number of specimens available for study with a concomitant recognition and description of new species. The fun has just begun.

ADDENDUM

While this study was in press, we received a pdf of a paper by Prokofiev (2018) on three “large-eyed” *Grammatonotus* (*G. ambiortus*, *G. cf. G. macrophthalmus*, and *G. crosnieri*) from the tropical western Pacific. Prokofiev provided detailed descriptions and comparisons of those taxa, paying particular attention to the shape of the caudal fin.

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man) and Isaure De Buron-Connors (French). Suggestions for improving the manuscript were received from Anthony C. Gill, Bruce C. Mundy, and William F. Smith-Vaniz. This is contribution number 508 of the Grice Marine Biological Laboratory, College of Charleston.

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