A REVISION OF THE CARDINALFISH GENUS *EPIGONUS* (PERCIFORMES, APOGONIDAE), WITH DESCRIPTIONS OF TWO NEW SPECIES[1]

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ABSTRACT. A study of the deep-sea Apogonidae results in a revision of the genus *Epigonus* Rafinesque. Twelve species are recognized, including two new forms—*E. oligolepis* and *E. pectinifer*. *E. fragilis* (Jordan and Jordan) is resurrected and redescribed on the basis of new material, and *Hynnodus atherinoides* Gilbert and *H. megalops* Smith and Radcliffe are synonymized with *E. occidentalis* Goode and Bean.

Species descriptions include discussions of distribution, geographic variation, ontogenetic change, and taxonomic problems. An investigation of the types of *E. lenimen* (Whitley) reveals that the holotype and paratypes are not conspecific. Instead, the paratypes are members of *E. denticulatus* Dieuzeide. A key to the species of *Epigonus* is provided at the beginning of the paper.

INTRODUCTION

Selected species of *Epigonus* have been harvested by man for at least two hundred fifty years. Vaillant (1888: 25) remarked that *E. telescopus* was recognized in ancient times, and Risso (1810: 303) reported that this species was prized for its firm, delicious-tasting meat, although it was rarely taken. The presence of common names for *E. telescopus* in vocabularies of western Mediterranean and North Atlantic fishing communities (Döderlein, 1889) provides additional evidence of man's long-term awareness of the species. *E. telescopus* is still occasionally sold in the markets of southwestern Europe.

Two other species of *Epigonus* are captured by commercial fishermen. *E. denticulatus* is edible (Dieuzeide et al., 1953: 218) and is taken in the Mediterranean. Until recently this form was mistaken for the young of *E. telescopus*. *E. crassicaudus* is caught by Chilean fishermen. Like *E.*

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telescopus, it is not taken in sufficient numbers to support a separate fishery but is captured by fishermen trawling for more abundant deepwater organisms.

Although African *Epigonus* are not presently exploited, tropical eastern Atlantic stocks may represent future sources of protein for mankind. Surveys sponsored by the Organisation of African Unity and the U.S. Agency for International Development revealed these fishes are "of possible potential importance (not necessarily by present marketing standards) [Williams, 1968: 79]." The same may be true for Caribbean and Gulf of Mexico *Epigonus*; however, complete data have not been compiled for the latter areas.

A major hindrance to the evaluation of deep-sea cardinalfish stocks has been taxonomic confusion. The systematic history of *Epigonus* began in 1810 with Risso's description of *Pomatomus telescopus* and Rafinesque's account of its synonym *Epigonus macrophthalmus*. During the following seventy-one years, work on the genus was primarily limited to re-descriptions of *E. telescopus* and discussions of its biology (*e.g.*, Cuvier, 1828; Valenciennes, 1830; Capello, 1868; Moreau, 1881).

The surge in oceanographic exploration during the last quarter of the nineteenth and beginning of the twentieth centuries rapidly increased the number of nominal *Epigonus*-like species. Among the forms described between 1881 and 1920 were *Apogon pandionis* Goode and Bean, 1881; *E. occidentalis* Goode and Bean, 1896; *Hynnodus atherinoides* Gilbert, 1905; *Oxyodon macrops* Brauer, 1906; and *Hynnodus megalops* Smith and Radcliffe, 1912. In the following decade, three new species and two new genera appeared in the literature.

Much of the confusion associated with the taxonomy of *Epigonus* stems from material described prior to 1930. Early taxa were based on small samples. Because many nations participated in oceanographic research, specimens were deposited in scattered institutions and descriptions appeared in diverse publications. Consequently, it was difficult for workers to obtain either comparative material or a broad overview of the group's systematics. These shortcomings were aggravated by inaccurate, under-illustrated descriptions based on ill-considered characters. It was common, for example, to use dentition patterns to define generic boundaries, yet tooth arrangements are difficult to observe, easily damaged, and subject to ontogenetic and geographic variation. As a result, an inordinately large number of *Epigonus*-like forms was recognized by the end of the 1920's.

Although generic taxonomy was streamlined by Fowler and Bean in 1930 and Matsubara in 1936, species-level taxonomy became increasingly complex. New forms were described in 1935, 1950, 1954, and 1959. In addition, misidentifications of *Epigonus* were published in several widely circulated works on regional faunas (*e.g.*, Smith, 1949b and 1961; Gosline and Brock, 1960).

The aim of the present study is to clarify the species-level systematics of the *Epigonus*-like fishes. Data from traditional characters are evaluated and augmented by information from characters not previously examined for this group. A special effort is made to discuss features such as dentition patterns that caused taxonomic confusion in the past. The ecology, functional anatomy, zoogeography, and evolution of *Epigonus* will be discussed in future works on the genus.

METHODS

Measurements were made to the nearest tenth of a millimeter by the use of Helios needlepoint dial calipers; characters larger than 190 mm were measured with a meter rule or GPM Anthropometer. Measurements routinely taken include:

Standard length (SL)—from tip of snout to base of caudal fin.

Head length (HL)—from tip of snout to tip of opercular spine.
Body depth—between dorsal and ventral surfaces of body at level of pelvic fin base.
Head height—from quadratomandibular joint vertically to bony rim above eye.
Eye diameter—between anterior and posterior margins of orbit as defined by first and sixth suborbitals.
Snout length—from tip of snout to anterior margin of orbit.
Interorbital width—shortest distance between bony rims above eyes.
Maxillary length—from tip of snout to posterior margin of maxilla.
Lower jaw length—from tip of mandible to quadratomandibular joint.
Caudal peduncle depth—shortest distance between dorsal and ventral surfaces of caudal peduncle.
Caudal peduncle length—from posteriormost anal fin ray to caudal fin base.
First spine length (first spine of first dorsal fin, D_1I; first spine of second dorsal fin, D_2I; second spine of anal fin, AII; pelvic fin spine, P_2I)—from base to tip of spine along anterior edge.

Counts were made under a dissecting microscope with the use of dissecting needles or insect pins. A Fibre-Lite High Intensity Illuminator proved invaluable for examinations of oral, branchial, and visceral structures. Gill raker and branchiostegal counts were made on the left side of specimens; remaining counts and measurements were made on the right side whenever possible. Counts made include: fin spines (indicated by Roman numerals), fin rays (indicated by Arabic numerals), branchiostegal rays, rakers on first gill arch, lateral line scales, pyloric caeca, vertebrae (precaudal + caudal, including hypural fan), pleural and epipleural ribs, and basal pterygiophores between neural spines 9 and 10.

Osteological data were obtained from radiographs taken at the Woods Hole Oceanographic Institution, the Museum of Comparative Zoology, and the Harvard University School of Public Health. Holotypes of *Oxyodon macrops* and *Scepterias lenimen* were radiographed at the Zoologisches Museum der Humboldt Universität and Australian Museum, respectively. More comprehensive osteological studies were based on cleared and stained specimens prepared by trypsin digestion (Taylor, 1967). Osteological terminology follows that presented by Gosline (1961) and Mead and Bradbury (1963). Suborbital bones are numbered from 1 to 8 beginning with the rostralmost element (lacrimal).

Statistical data were analyzed with the use of the Harvard Computation Laboratory's IBM 360/65 digital computer. Standard techniques described by Mayr (1969: 189–193) and Simpson et al. (1960: 65–68, 83–88) were employed for analyzing meristic data. Morphometric characters were examined with the aid of regression techniques specified by Simpson et al. (1960: 215–233, 238) and Bailey (1959: 91–99).

Before undertaking regression analyses, morphometric data were plotted against SL. Graphs were drawn according to a BMD 05D plotting routine (Dixon, 1967: 71) and served as visual tests for linearity of scatter. Only characters exhibiting linear scatters were analyzed by regression techniques. As a second precaution against nonlinearity, subadult specimens (< 40 mm SL) were excluded from statistical samples.

Data from several morphometric characters are presented both as ratios (*i.e.*, percent of SL or HL) and as regression parameters. The former are intended only as identification aids. As Royce (1957: 17) points out, heterogenic growth makes the use of ratios in fish taxonomy inefficient and may lead to erroneous conclusions.

Collection and institution names are abbreviated as follows in this paper:

ABE —Collection of Dr. T. Abe, Tokyo
AM —Australian Museum, Sydney

BMNH —British Museum (Natural History), London
BPBM —Bernice P. Bishop Museum, Honolulu
CM —Carnegie Museum; collections presently housed in FMNH, Chicago
DM —Dominion Museum, Wellington
EBM —Estación de Biologia Marina, Universidad de Chile, Viña del Mar
FMNH —Field Museum of Natural History, Chicago
IRSN —Institut Royal des Sciences Naturelles de Belgique, Brussels
ISH —Institut für Seefischerei, Hamburg
LACM —Los Angeles County Museum of Natural History, Los Angeles
MCZ —Museum of Camparative Zoology, Harvard University, Cambridge
MNHN —Muséum National d'Histoire Naturelle, Paris
MZF —Museo Zoologico di Firenze, Florence
RUSI —J.L.B. Smith Institute of Ichthyology, Rhodes University, Grahamstown
SAM —South African Museum, Cape Town
SMF —Natur-Museum Senckenberg, Frankfurt am Main
SU —Stanford University; collections presently housed in the California Academy of Sciences, San Francisco
TABL —Tropical Atlantic Biological Laboratory, Miami
UMML —Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami
USNM —National Museum of Natural History, Washington, D.C.
UZM —Universitetets Zoologiske Museum, Copenhagen
ZMB —Zoologisches Museum der Humboldt Universität, Berlin

Descriptions are based on material listed by Mayer (1972: Appendix II). Additional data were obtained from examinations of the seventeen specimens listed below. All seventeen fishes were radiographed.

E. robustus: ISH 1132/66, 3 specimens, 121.1–142.5 mm, WALTHER HERWIG Sta. 237/66, 36°00′S, 52°58′W, 800 m. ISH 189/71, 9 specimens, 147.0–198.0 mm, WALTHER HERWIG Sta. 121/71, 37°44′S, 54°43′W, 800 m. ISH 269/71, 1 specimen, 147.5 mm, WALTHER HERWIG Sta. 340/71, 38°50′S, 54°25′W, 1000 m. ISH 430/71, 1 specimen, 124.1 mm, WALTHER HERWIG Sta. 348/71, 38°20′S, 54°33′W, 997–1040 m.

E. fragilis: LACM 32668–6, 1 specimen, 72.5 mm, 2 mi. off Haleiwa, Oahu, Hawaii, 65 fms. SU 32262, 2 specimens, 90.0–93.9 mm, Honolulu, Hawaii.

Distributions were determined from material examined and from published accounts. Because of the confusion in *Epigonus* taxonomy, published data were used only if species identifications could be verified from included descriptions, illustrations, etc. Data from specimens of doubtful identity were not considered. A complete list of station data taken from the literature is provided by Mayer (1972: Appendix II).

No attempt has been made to provide exhaustive synonymies for *Epigonus* species. References are cited only if they (1) are taxonomically or zoogeographically important; (2) provide outstanding descriptions, illustrations, or synonymies; or (3) represent verifiable misidentifications. Non-taxonomic accounts have been omitted, as have references to cruise summaries and faunal lists.

SYSTEMATICS

Statistical data are presented in tables accompanying species descriptions; meristic

characters with low variability are reported in the text as value, followed in parentheses by number of specimens exhibiting that value. Meristic and mensural data from holotypes of new species are presented in the Appendix.

Genus *Epigonus* Rafinesque, 1810

Epigonus Rafinesque, 1810: 64. (Type species: *Epigonus macrophthalmus* Rafinesque, 1810 by monotypy. A synonym of *Pomatomus telescopus* Risso, 1810.)

Telescops Bleeker, 1876: 261. (Type species: *Pomatomus telescopium* [sic!] Risso, 1810 by original designation. *Pomatomus* deemed inapplicable.)

Pomatomichthys Giglioli, 1880: 20. (Type species: *Pomatomichthys constanciae* Giglioli, 1880 by monotypy. A synonym of *Pomatomus telescopus* Risso, 1810.)

Hynnodus Gilbert, 1905: 217. (Type species: *Hynnodus atherinoides* Gilbert, 1905 by monotypy. A synonym of *Epigonus occidentalis* Goode and Bean, 1896.)

Oxyodon Brauer, 1906: 287. (Type species: *Oxyodon macrops* Brauer, 1906 by monotypy.)

Xystrania Jordan, 1917: 46. (Type species: *Glossamia pandionis* Goode and Bean, 1881 by original designation. *Glossamia* deemed inapplicable.)

Scepterias Jordan and Jordan, 1922: 44. (Type species: *Scepterias fragilis* Jordan and Jordan, 1922 by monotypy.)

Parahynnodus Barnard, 1927: 525. (Type species: *Parahynnodus robustus* Barnard, 1927 by monotypy.)

Diagnosis. *Epigonus* is distinguished from other lower perciform genera by a mosaic of characters including 8 suborbital bones, all lacking subocular shelves; large, thin-walled swimbladders with posterodorsal ovals; VII or VIII first dorsal fin spines; I,9 or I,10 second dorsal fin elements; II,9 anal fin elements; 15–23 pectoral fin rays; and 17–35 gill rakers. No member of the genus exhibits fang-like conical teeth, such as are found in *Cheilodipterus*, or anteriorly projecting teeth, such as are found in *Rosenblattia*.

Description. Body elongate, fusiform; dorsal and ventral profiles slightly convex, similar. Mouth oblique, terminal; upper jaw protrusile; maxilla excluded from gape, sheathed by lacrimal anteriorly, free posteriorly; supramaxilla absent. Eye large, round or oval. Nostrils paired, rounded or slit-like, two on each side of head.

Premaxillae, mandibles, vomer, and palatines edentulous or bearing conical teeth; tongue and endopterygoids rarely dentigerous; ectopterygoids edentulous. Gill rakers moderate to long, 17–35; branchiostegal rays 7 (3 + 4); pseudobranchiae present.

Opercular spine either weak, flattened and poorly ossified, or pungent and bony; spine ventral to one or more horny or membranous spinelets. Preopercle with double edge; angle frequently produced.

Dorsal fins VII–I,9, VII–I,10, or VIII–I,10, separated by distinct interdorsal space; rudimentary subcutaneous eighth spine present in seven-spined forms. Anal fin II,9; pectoral fins 15–23; pelvic fins I,5; caudal fin forked, 9 + 8 principal rays, upper- and lowermost rays unbranched.

Scales large, deciduous, ctenoid. Lateral line complete, extending parallel to dorsal profile on dorsolateral surface of trunk, descending to midline on posterior portion of caudal peduncle, continuing on tail; lateral line scales 33–51; canal simple, broadening into deltoid or Y-shaped tube at rear edge of scale. Scale pockets covering most of body including occiput, soft dorsal, anal, and caudal fins; scales absent from snout; no axillary scale at base of P_2I spine.

Suborbitals 8, all lacking subocular shelves. Vertebrae 25; basapophyses on vertebrae 3 or 4. Predorsals 3, first and second interdigitating between neural spines 2 and 3, third located behind neural spine 3. Caudal skeleton with 2 autogenous haemal spines, 6 hypurals (hypural 1 = parhypural *sensu* Monod, 1968), 3 epurals, 2 (rarely 1) pairs of uroneurals. Actinosts 4, 3½ borne by scapula.

Swimbladder large, thin-walled, lacking anterior or posterior projections to cranium and neural arches; diaphragm absent; oval posterodorsal; retia mirabilia well developed. Stomach U- or Y-shaped; pyloric

caeca 5–34, may be modified into luminescent organs; intestines simple, folded into three segments. Specimens dioecious; no evidence of hermaphroditism or oral brooding.

Habitat: Engybenthic; continental slope between approximately 200 and 1200 meters.

Key to Species of *Epigonus*

1a Opercular spine weak, poorly ossified, or absent (opercular spine refers to the ventralmost reinforced projection from the posterodorsal edge of the opercle) 2
b Opercular spine pungent, bony 7
2a Lateral line scales 46–51; tongue edentulous or bearing scattered tooth patches 3
b Lateral line scales 33–36; tongue covered with tooth patches (Fig. 1A) ..... *E. oligolepis*
3a Gill rakers 23–34; premaxillary teeth short, conical or villiform, not visible when mouth closed 4
b Gill rakers 17–21; premaxillary teeth elongate, thin, inwardly recurved, visible when mouth closed ..... *E. macrops*
4a Pyloric caeca 7–14; first dorsal fin VII, rarely VIII; vertebral count 10 + 15; specimens not exceeding 220 mm SL 5
b Pyloric caeca 21–34; first dorsal fin VIII, rarely VII (D_1VIII often small or rudimentary); vertebral count 11 + 14; specimens to 550 mm SL ..... *E. telescopus*
5a Body long, shallow; depth 15.8–23.6% SL; peduncle length 25.4–32.2% SL; caudal peduncle ring absent 6
b Body short, deep; depth 22.4–29.6% SL; peduncle length 22.0–26.3% SL; caudal peduncle ring present on specimens shorter than 110–120 mm SL (Fig. 1B) ..... *E. pandionis*
6a Gill rakers 28–34; pyloric caeca 10–14; head length 31.2–38.6% SL; 2 pterygiophores between neural spines 9 and 10, rarely 1 ..... *E. denticulatus*
b Gill rakers 25–26, pyloric caeca 7–8; head length 30.0–34.0% SL; 1 pterygiophore between neural spines 9 and 10 ..... *E. fragilis*
7a Body moderate to deep, 20.0–32.0% SL; dorsal fins VII–I,9, rarely VII–I,10; gill rakers 26–35 8
b Body shallow, 14.0–19.5% SL; dorsal fins VII–I,10, rarely VII–I,9; gill rakers 22–27 ..... *E. occidentalis*
8a Gill rakers of lower arch simple, awl-shaped 9
b Gill rakers of lower arch pectinate (Fig. 1C) ..... *E. pectinifer*
9a Tongue edentulous 10
b Tongue covered with tooth patches ..... *E. trewavasae*
10a Head length 28.0–36.6% SL; head height 14.7–18.8% SL; gill filaments moderate or short 11
b Head length 36.8–41.9% SL; head height 18.9–21.1% SL; gill filaments long ..... *E. crassicaudus*
11a Fin spines long, D_2I 14.8–18.7% SL, AII 13.0–20.8% SL; interorbital width 8.7–10.2% SL; eyes large, 40.0–51.1% HL ..... *E. lenimen*
b Fin spines moderate, D_2I 10.0–12.6% SL, AII 9.2–13.3% SL; interorbital width 6.5–8.2% SL; eyes moderate to small, 37.4–42.2% HL ..... *E. robustus*

Epigonus telescopus (Risso, 1810)
Figure 2

Pomatomus telescopus Risso, 1810: 301, plate IX, fig. 31 (original description; Nice; holotype examined, MNHN B862); Lowe, 1841: 173; Capello, 1868: 160; Moreau, 1881: 386, fig. 125; Vaillant (in part), 1888: 376.

Epigonus macrophthalmus Rafinesque, 1810: 64 (original description; no type locality; holotype lost).

Pomatomus telescopium Cuvier, 1828: 171 (incorrect emendation of *Pomatomus telescopus* Risso, 1810); Valenciennes, 1830: 495; Valenciennes, 1837–1844: 6, plate I; Günther, 1859: 250; Cocco, 1885: 85; Holt and Calderwood, 1895: 405, plate LXII.

Pomatomus cuvieri Cocco, 1829: 143 (original description; seas of Messina; holotype not examined).

Pomatomus cuvierii Valenciennes, 1830: 501 (incorrect emendation of *Pomatomus cuvieri* Cocco, 1829).

?*Pomatomichthys constanciae* Giglioli, 1880: 20 (original description; Straits of Messina; holotype not examined, MZF 3089); Goode and Bean, 1896: 234.

Epigonus telescopus Goode and Bean, 1896: 232; Cligny, 1903: 9; Barnard, 1927: 523; Gall, 1931: 1, fig. 1; Fowler, 1936: 736, fig. 326; Smith, 1949b: 206, fig. 474.

Scepterias lenimen, Whitley (in part) (not Whitley, 1935), 1968: 56.

Diagnosis. *E. telescopus* is the largest species of the genus, growing to over 550 mm SL. Specimens are characterized by 21–34 pyloric caeca and eight first dorsal

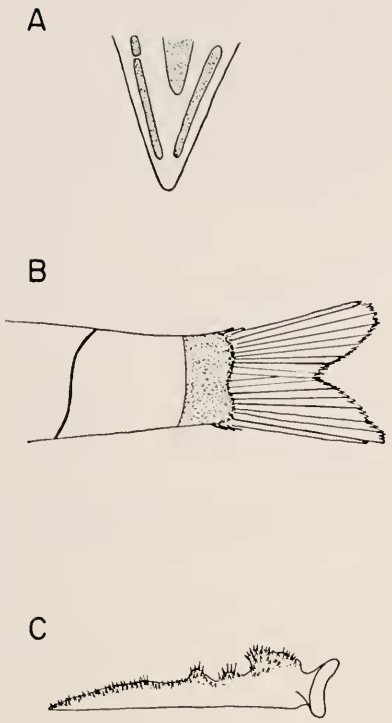

Figure 1. A. Tongue of *E. oligolepis*. Stippled areas indicate tooth patches; shape and size of tooth patches may vary among specimens. B. Caudal peduncle of young *E. pandionis* showing anterior ring and posterior band. C. Gill raker of *E. pectinifer* showing nub-like processes.

fin spines. The opercular spine is blunt and poorly ossified and distinguishes the species from *E. occidentalis*, *E. trewavasae*, *E. pectinifer*, *E. robustus*, *E. lenimen*, and *E. crassicaudus*, which have pungent opercular spines. Unlike remaining congeners, *E. telescopus* possesses 11 + 14 vertebrae.

Description. Meristic data presented in Table 1; regression data for morphometric traits presented in Table 2.

Body thickset, shortened; anterodorsal profile slightly convex, rising most steeply from tip of snout to interorbital region; body moderate to deep, 21.2–26.3% SL; caudal peduncle short, 19.0–26.5% SL.

Head moderate to deep, height 13.3–17.2% SL; length 30.5–37.9% SL; snout blunt; angle of gape moderate to large; lower jaw equalling or protruding slightly beyond upper jaw. Maxilla rarely exceeding ⅓–⅔ eye length, posterior margin of maxilla broad, posteriormost point near ventral surface of bone; maxillae of large specimens scaled. Eye round, 49.5–58.9% HL; circumorbital tissues scaled, scale pockets particularly apparent in large specimens; anterodorsal rim of orbit projecting into profile in small forms, reaching profile in larger forms; interorbital width 9.0–10.9% SL.

Dentition variable with age (see Ontogenetic change); premaxillae, mandibles, vomer, and palatines dentigerous; tongue edentulous.

Opercle bearing short, poorly ossified spine ventral to 1–8 membranous or poorly ossified spinelets; spine and spinelets separated by shallow gap; spinelets occasionally obscured by underlying membranes. Preopercle variable with age; angle rounded, slightly produced in specimens shorter than

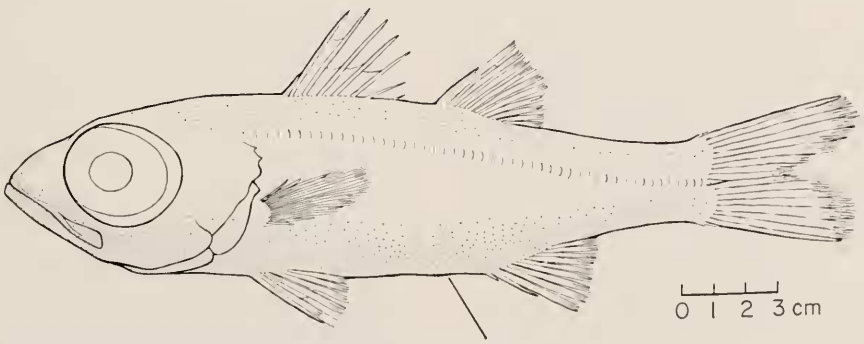

Figure 2. *Epigonus telescopus*, 220.0 mm SL, ISH 70/63.

TABLE 1. *EPIGONUS TELESCOPUS* MERISTIC DATA. $\bar{X}$ = MEAN; SD = STANDARD DEVIATION; n = NUMBER OF SPECIMENS.

	$\bar{X}$	Range	SD	n
Pectoral fin rays	20.85	19–23	0.71	54
Gill rakers	24.40	23–26	0.85	52
Lateral line scales	48.14	46–50	1.09	50
Pyloric caeca	25.25	21–34	3.59	16

200 mm SL, broadly produced in larger forms; minute serrations on angle and ventral surface of bone, rarely along posterior surface dorsal to angle; striations radiating from inner edge of angle. Interopercles and subopercles without striations, occasionally bearing minute serrations on posteroventral surfaces. Gill rakers simple, awl-like.

First dorsal fin VII (7), VIII (46), eighth spine small or rudimentary, lacking membranous connection to preceding spines; second dorsal fin I,9 (1), I,10 (52), I,11 (1); anal fin II,9 (56); D_1I long, 3.5–6.3% SL; D_2I, AII short, 5.3–9.5%, 5.7–10.6% SL respectively; P_2I moderate, 6.5–11.9% SL.

Vertebrae 11 + 14 (18); epipleural ribs

TABLE 2. *EPIGONUS TELESCOPUS* REGRESSION DATA. b = REGRESSION COEFFICIENT ± 95% CONFIDENCE INTERVAL; a = Y INTERCEPT; n = NUMBER OF SPECIMENS. ALL REGRESSIONS ON SL.

	b	a	n
HL	0.35 ± 0.01	1.60	50
Body depth	0.25 ± 0.01	−2.43	48
Head height	0.19 ± 0.00	0.45	45
Eye diameter	0.13 ± 0.01	6.57	44
Snout length	0.10 ± 0.00	−2.19	49
Interorbital width	0.10 ± 0.00	−0.32	52
Maxillary length	0.16 ± 0.00	0.00	48
Lower jaw length	0.19 ± 0.00	−0.61	50
Caudal peduncle depth	NONLINEAR		
Caudal peduncle length	0.21 ± 0.01	3.35	51
D_2I	0.06 ± 0.02	3.89	11
AII	0.06 ± 0.01	4.18	31
P_2I	NONLINEAR		

Table 3. Ontogenetic changes in the dentition of *E. telescopus*.

A. PREMAXILLARY DENTITION			
	‹200 mm SL	200-400 mm SL	› 400 mm SL
Extent	1/2-2/3 of ventral surface	2/3-7/8 of ventral surface	2/3-7/8 of ventral surface
Pattern	1 row	1-2 irregular rows tapering to 1 row	Multiple irregular rows
B. MANDIBULAR DENTITION			
	‹150 mm SL	150-250 mm SL	› 250 mm SL
Extent	Entire coronoid surface	Entire coronoid surface	Entire coronoid surface
Pattern	1 row	2-3 irregular rows tapering to 1-2 rows	3, 4, or 5 irregular rows
C. VOMERINE DENTITION			
	‹ 175 mm SL		› 175 mm SL
Extent	Center of vomer		Entire face of vomer
Pattern	Scattered teeth in few irregular rows		Numerous teeth in multiple irregular rows
D. PALATINE DENTITION			
	‹ 150 mm SL		› 150 mm SL
Extent	Length of ventral surface		Length of ventral surface
Pattern	1-2 irregular rows tapering to 1 row		2-5 irregular rows tapering to 1 row

7 (11), 8 (2), inserting on vertebrae 1–7 or 1–8 respectively; pleural ribs 9 (17), inserting on vertebrae 3–11.

Large specimens black or brown-violet, iridescent in life (Risso, 1810; Steindachner, 1891; Dons, 1938). Color in alcohol variable with mode of collection and preservation; skin often abraded, revealing underlying white-orange tissue; scale pockets mottled with black or brown, melanophores more densely packed near caudal edges; pigment darker in larger fish; skin oily, cutaneous fat deposits adding rust-colored tint; opercular area black. Guanine deposits occasionally occurring on opercular, thoracic, and abdominal regions; iris black with silver highlights; branchial membranes black; mouth darkening with age (see Ontogenetic change).

Description based on 54 specimens 68.1–553 mm SL.

Ontogenetic change. Several marked ontogenetic changes occur in *E. telescopus*, the most noticeable involving dentition patterns. Tooth-bearing bones of young specimens exhibit relatively prominent conical teeth. Teeth become more numerous with growth but appear smaller and form weak conical or villiform bands. As Table 3 illustrates, older specimens have more complex tooth patches with larger numbers of tooth rows.

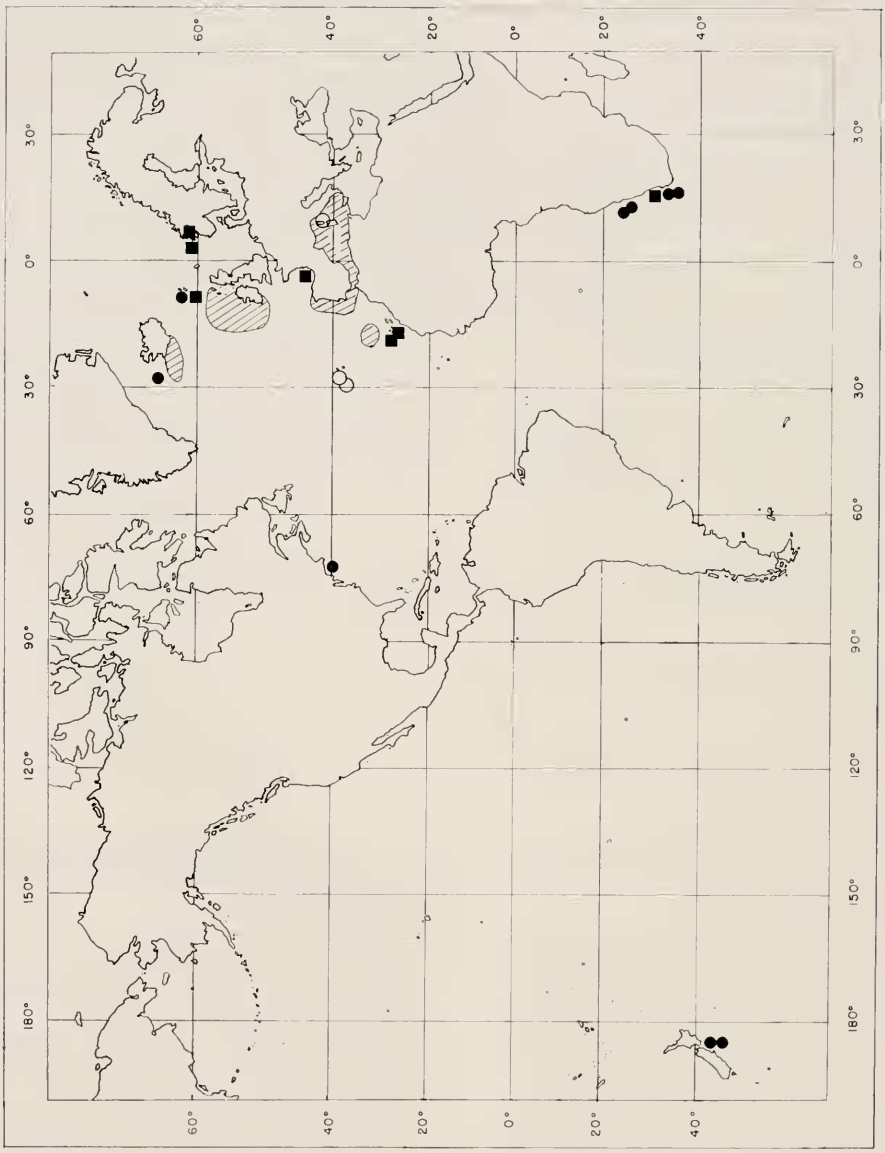

Figure 3. Distribution of *E. telescopus*. ● individual haul of demersal adults; ■ report of adults from the literature; ○ report of pelagic juveniles from the literature; cross-hatching indicates areas where *E. telescopus* are frequently taken.

A second change involves oral pigmentation. Young individuals have white or pale yellow mouths; melanin is present only in the vicinity of the pharynx. By the time specimens reach 175–225 mm SL, black pigment extends anteriorly to cover the entire tongue. Shortly thereafter, the palate becomes totally blackened, and by 300 mm SL, the entire mouth is dark.

The above changes are associated with alterations in intestinal length. Measurements of fourteen specimens ranging from 90.7–553 mm SL indicate that intestinal length increases from 66–73% SL in small specimens (90.7–128.5 mm) to 98–108% SL in moderate-sized individuals (220–250 mm). Thereafter, intestines grow more slowly, reaching 110–115% SL in the largest specimens. The coincidence of rapid intestinal growth, dentition changes, and development of oral pigment suggests that *E. telescopus* modifies its feeding habits with growth.

Distribution. *E. telescopus* has an antitropical distribution in the Atlantic, occurring from Iceland to the Canary Islands and reappearing along the western coast of South Africa (Fig. 3). Specimens have also been taken in the Subtropical Convergence region east of New Zealand. The species is well known in the western Mediterranean and has been captured once off the eastern coast of North America. A single specimen is known from shallow water off Norway (Dons, 1938).

Adults are taken by bottom trawl or longline and are most abundant from 300 to 800 meters; however, specimens have been captured from water as shallow as 75 to 80 meters to as deep as 1000 to 1200 meters. Koefoed (1952) reports four pelagic juveniles from the Azores; Bertolini (1933) mentions the presence of juveniles in the Tyrrhenian Sea.

Earlier workers reported the range of *E. telescopus* to include St. Helena (Valenciennes, 1837–1844; Günther, 1868; Bauchot and Blanc, 1961), tropical west Africa (Osorio, 1898; Poll, 1954; Bauchot and Blanc, 1961), and the Indian Ocean (Steindachner, 1907; Fowler, 1935). These accounts are based on misidentified or tenuously identified material. The specimens described by Günther, Poll, and Bauchot and Blanc are *E. pandionis*, while that examined by Fowler is *Scombrops*-like. Valenciennes' identification is based on an unpublished description and figure by a St. Helena resident and must be regarded with suspicion. Reports by Steindachner and Osorio could not be evaluated, because neither includes a description or figure of the material studied.

Geographic variation. The scarcity of material from South Africa and New Zealand makes it difficult to judge the degree to which Northern and Southern Hemisphere populations of *E. telescopus* have diverged. Comparisons of dorsal and pectoral fins, pleural and epipleural ribs, lateral line scale counts, gill rakers, and pyloric caeca reveal no subspecific differences (coefficients of difference $\leqslant 0.44$). Morphometric characters, on the other hand, exhibit greater variability. Of eight traits successfully analyzed, three are significantly different at both the 95%, 98%, and 99% levels of confidence (Table 4). These differences suggest that northern and southern populations represent geminate subspecies; however, additional material must be collected, especially from the Southern Hemisphere, before definitive statements can be made on intraspecific variability.

Taxonomic notes. *Pomatomichthys constanciae* Giglioli, 1880 is provisionally considered a junior synonym of *E. telescopus* on the basis of work by Tortonese and Queirolo (1970). These authors re-examined and, for the first time, figured the holotype of *P. constanciae*. The latter species is known only from the type specimen. The original description (Giglioli, 1880) is incomplete; no adequate redescription has ever been published.

Data from the papers mentioned above indicate a similarity between *P. constanciae*

TABLE 4. COMPARISON OF REGRESSION COEFFICIENTS FROM NORTHERN AND SOUTHERN HEMISPHERE POPULATIONS OF *E. TELESCOPUS*. DATA EVALUATED AT THE 95%, 98%, AND 99% LEVELS OF CONFIDENCE. DF = DEGREES OF FREEDOM; Nb = REGRESSION COEFFICIENTS OF NORTHERN HEMISPHERE SPECIMENS; Sb = REGRESSION COEFFICIENTS OF SOUTHERN HEMISPHERE SPECIMENS; SD = SIGNIFICANT DIFFERENCE BETWEEN TABULAR AND CALCULATED VALUES OF t; t = CALCULATED VALUES OF t.

					Significance		
	Nb	Sb	DF	t	95	98	99
HL	0.35	0.36	46	1.54	—	—	—
Body depth	0.25	0.24	44	0.82	—	—	—
Head height	0.20	0.18	41	3.88	SD	SD	SD
Eye diameter	0.13	0.12	40	1.75	—	—	—
Snout length	0.09	0.10	45	3.19	SD	SD	SD
Interorbital width	0.10	0.10	48	1.05	—	—	—
Maxillary length	0.15	0.16	12	0.16	—	—	—
Lower jaw length	0.19	0.19	14	0.71	—	—	—
Caudal peduncle depth	NONLINEAR						
Caudal peduncle length	0.21	0.22	47	0.58	—	—	—
D_2 I	INSUFFICIENT DATA						
A II	0.06	0.04	23	3.80	SD	SD	SD
P_2 I	NONLINEAR						

TABLE 5. COMPARISON OF DORSAL AND PECTORAL FIN COUNTS FROM *E. TELESCOPUS*, *P. CONSTANCIAE*, AND *E. TREWAVASAE*. DATA FOR *P. CONSTANCIAE* FROM GIGLIOLI (1880) AND TORTONESE AND QUEIROLO (1970); REMAINING DATA FROM PRESENT STUDY.

	E. telescopus	P. constanciae	E. trewavasae
First dorsal fin	VIII, rarely VII	VII	VII
Second dorsal fin	I, 10, rarely I, 9	I, 9	I, 9, rarely I, 10
Pectoral fin	19 - 23	18	16 - 18

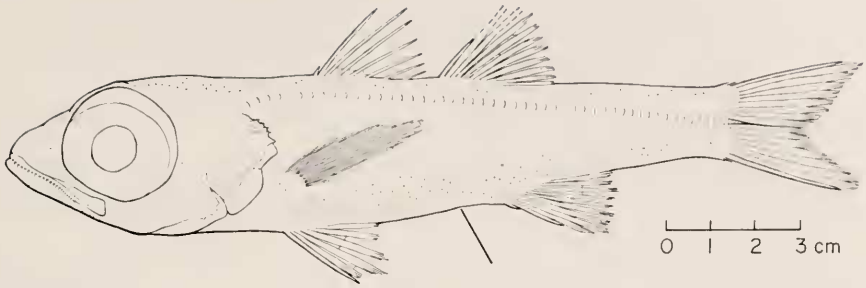

Figure 4. *Epigonus macrops*, 154.6 mm SL, USNM 207679.

and *E. telescopus* but also suggest an affinity between *P. constanciae* and *E. trewavasae* Poll, 1954. As is shown in Table 5, dorsal and pectoral fin counts fall within the range of *E. trewavasae* rather than *E. telescopus*. Tortonese and Queirolo's figure similarly shows the holotype to possess a sharp opercular spine, short D_1I, and long P_2I—all characteristics of *E. trewavasae*. Mensural data fail to differentiate *P. constanciae* from either species. Unlike *E. trewavasae* but like *E. telescopus*, the holotype lacks lingual teeth (Giglioli, 1880).

In view of the uncertainty surrounding *P. constanciae*, a closer study of this form must be undertaken. The problem is all the more pressing, because *E. trewavasae* is recorded from the Mediterranean for the first time in this paper.

Common names. Comprehensive lists of common names for *E. telescopus* are provided by Döderlein (1889), Nobre (1935), and Bini (1968). Three names not recorded in these works are "Mejluza"—Gran Canaria (Steindachner, 1891), "Devil-fish"—North Sea area (Ehrenbaum, 1928), and "Big-eyed cardinal fish"—New Zealand (Anonymous, 1961).

Epigonus macrops (Brauer, 1906)
Figure 4

Oxydon macrops Brauer, 1906: 288, fig. 172 (original description; Indian Ocean, land-locked sea on west coast of Sumatra, VALDIVIA Sta. 186, 03°21′01″S, 101°11′05″E, 903 m; syntype examined, ZMB 17678); Weber and de Beaufort, 1929: 351, fig. 81; Norman, 1939: 60.

Diagnosis. E. macrops may be distinguished from all congeners by its low gill raker counts (17–21). It is further characterized by eight fully developed first dorsal fin spines and eight pyloric caeca, one of which may function as a luminescent organ.

Description. Meristic values presented in Table 6; regression data for morphometric traits presented in Table 7.

Body elongate; anterodorsal profile rising steeply to occipital area; thereafter, weakly convex, almost horizontal to first dorsal fin; body depth 19.7–24.1% SL; caudal peduncle length 22.0–26.7% SL.

Head length 34.1–38.5% SL; head height 17.2–21.9% SL; snout blunt; angle of gape large; lower jaw protruding beyond upper jaw. Maxilla rarely exceeding ⅓–⅔ eye length; posterior margin of maxilla broad, bearing posteriormost point at ventral surface of bone. Eye round to oval, 39.7–48.3% HL; anterodorsal rim of orbit projecting strongly into dorsal profile; interorbital region wide, 9.5–11.7% SL.

Teeth conical, frequently recurved. Premaxillary and mandibular teeth prominent, needle-like, arranged in single row along length of jaws; mandibular teeth occasionally forming double row near symphysis; vomerine teeth few, moderate, arranged in 2–4 irregular rows or in a triangular or diamond-shaped patch; palatines bearing 2–6 teeth, arranged in single row covering anterior half or second quarter of bone; tongue edentulous.

Opercular spine short, weak, bony, ven-

TABLE 6. *EPIGONUS MACROPS* MERISTIC DATA. $\overline{X}$ = MEAN; SD = STANDARD DEVIATION; n = NUMBER OF SPECIMENS.

	$\overline{X}$	Range	SD	n
Pectoral fin rays	18.87	18–19	0.35	30
Gill rakers	18.63	17–21	0.87	32
Lateral line scales	48.61	46–50	0.83	28
Pyloric caeca	8.00	8	0.00	15

tral to 3–10 spinelets; spine and spinelets separated by shallow, occasionally narrow gap. Preopercular angle weakly produced, rounded, serrate; serrations occasionally extending to posterior and ventral surfaces of bone, rarely absent; striations radiating from inner edge of angle. Subopercle and interopercle generally serrated, occasionally striated. Gill rakers short, awl-like.

First dorsal fin VII (1), VIII (29); second dorsal fin I,9 (1), I,10 (31); anal fin II,9 (30), II,10 (1). D_1I, D_2I, AII short, equalling 1.2–2.9%, 5.3–7.7%, 5.9–9.9% SL respectively; P_2I moderate, 11.7–14.1% SL.

Vertebrae 10 + 15 (25); epipleural ribs 6 (23), inserting on vertebrae 1–6; pleural ribs 8 (24), inserting on vertebrae 3–10.

TABLE 7. *EPIGONUS MACROPS* REGRESSION DATA. b = REGRESSION COEFFICIENT ± 95% CONFIDENCE INTERVAL; a = Y INTERCEPT; n = NUMBER OF SPECIMENS. ALL REGRESSIONS ON SL.

	b	a	n
HL	0.35 ± 0.02	1.48	26
Body depth	0.22 ± 0.02	0.51	31
Head height	0.18 ± 0.02	1.74	19
Eye diameter	0.14 ± 0.02	3.41	29
Snout length	0.08 ± 0.01	−0.18	22
Interorbital width	0.11 ± 0.01	0.36	30
Maxillary length	0.14 ± 0.01	1.31	22
Lower jaw length	0.18 ± 0.01	1.18	31
Caudal peduncle depth	0.12 ± 0.01	−1.53	29
Caudal peduncle length	0.24 ± 0.02	0.70	30
D_2I	0.02 ± 0.02	7.05	13
AII	0.04 ± 0.01	4.73	22
P_2I	0.13 ± 0.02	0.49	16

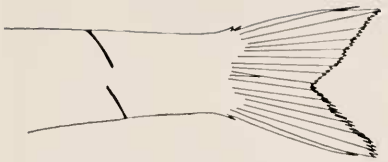

Figure 5. Caudal peduncle of young *E. macrops* bearing anterodorsally canted ring.

Specimens probably black in life. Color in alcohol variable with preservation; scale pockets covered with black melanophores near posterior edges; skin frequently abraded, revealing pink-yellow musculature; opercular bones transparent, colored black by underlying branchial membranes; iris black; mouth black in adults. Young bearing anterodorsally canted caudal peduncle ring (see Ontogenetic change). First pyloric caecum modified into luminescent organ (see Remarks).

Description based on 32 specimens 77.8–206.0 mm SL.

Ontogenetic change. The transition from juvenile to adult in *E. macrops* is marked by changes in pigmentation and body shape. Pelagic juveniles 15–37.9 mm SL and young demersal forms 77.8–79.8 mm SL bear a thin, black, anterodorsally tilted ring circling the center portion of the caudal peduncle (Fig. 5). Specimens larger than 90 mm SL lack this marking. Melanophores forming the rings are deeply embedded in the peduncle musculature and cannot be obliterated by abrading the surface of the fish.

Adult *E. macrops* are characterized by black oral and branchial membranes. Although these areas are colorless or poorly pigmented in specimens smaller than 40 mm SL, the former surfaces darken and the latter become covered with brown melanophores by the time fish reach 80 mm SL.

Juvenile *E. macrops* appear longer and shallower than adults. Ratio-on-size diagrams for interorbital width (*i.e.*, interorbital width/SL vs. SL) indicate allometric growth takes place in small specimens. Similar statements are probably true for head height, eye length, and caudal peduncle measurements but could not be tested because of damage to juvenile specimens.

Distribution. E. macrops adults are taken exclusively by bottom trawls between 550 and 1100 meters in the Indian Ocean, Gulf of Mexico, Caribbean Sea, and Western Atlantic. Specimens are most abundant between 640 and 920 meters. Pelagic juveniles are known from the Caribbean at depths of 120 to 550 meters (Fig. 6).

Geographic variation. No investigation made because of inadequate Indian Ocean samples.

Taxonomic notes. Brauer's description of *Oxyodon macrops* (1906) is based on two syntypes from the eastern Indian Ocean (172 and 212 mm total length). Of these, only the larger is in the Zoologisches Museum der Humboldt Universität; the smaller has been lost. The misplaced type may have been deposited in the Zoologisches Institut der Universität Leipzig and may reappear when portions of this collection, presently stored in Berlin, are sorted and catalogued (Karrer, personal communication).

Remarks. Specimens of *E. macrops* bear eight pyloric caeca; one of these appears modified into a bioluminescent organ. The luminescent caecum arises from the midventral surface of the pylorus just before the duodenum and main body of pyloric appendages (Fig. 7). It extends ventrally until it reaches the floor of the abdominal cavity, bends anteriorly and inserts into a pouch formed by the black peritoneal lining of the body cavity. At the posterior edge of the pelvic girdle, the caecal pouch lies over a thin, translucent portion of the body wall which may function as a bioluminescent window. Externally the bioluminescent window is covered by a single large scale. The caecal pouch is lined with silver or silver-gray pigment. Guanine deposits appear most concentrated anterodorsally.

Although there is no direct evidence to

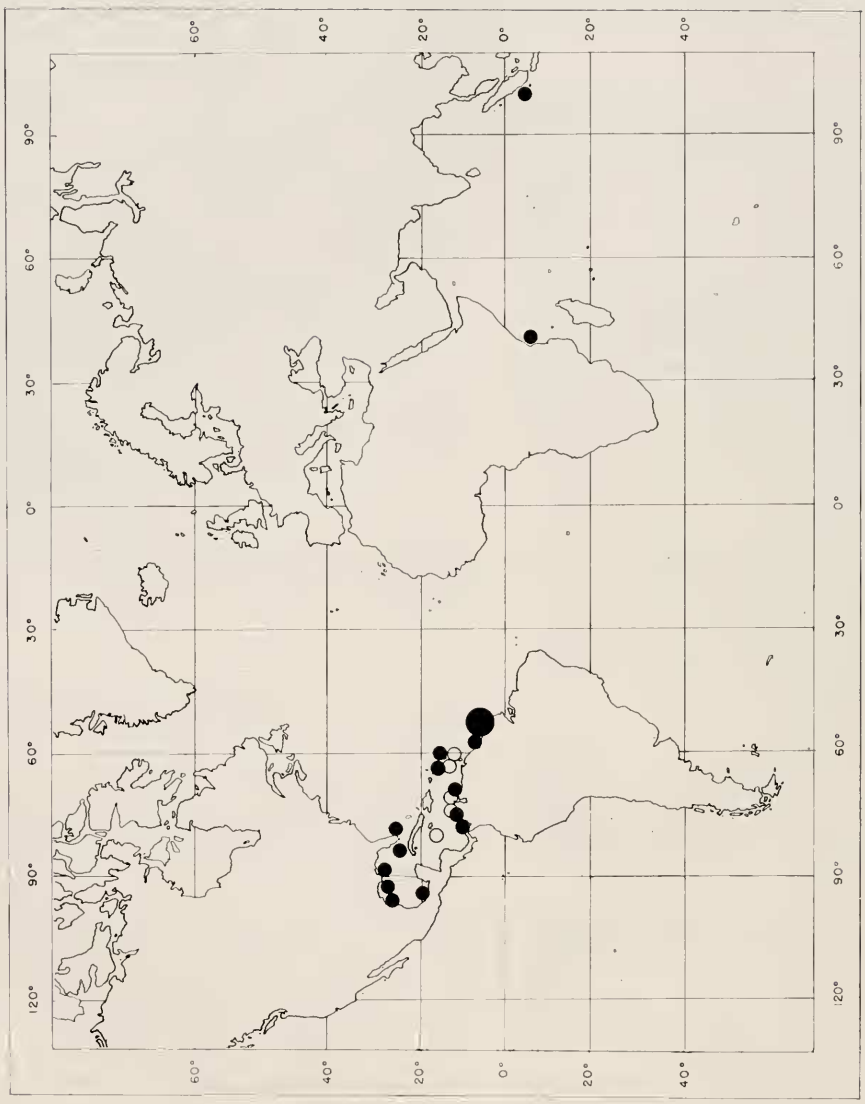

Figure 6. Distribution of *E. macrops*. ● individual haul of demersal adults; ● five or more hauls of demersal adults; ○ individual haul of pelagic juveniles.

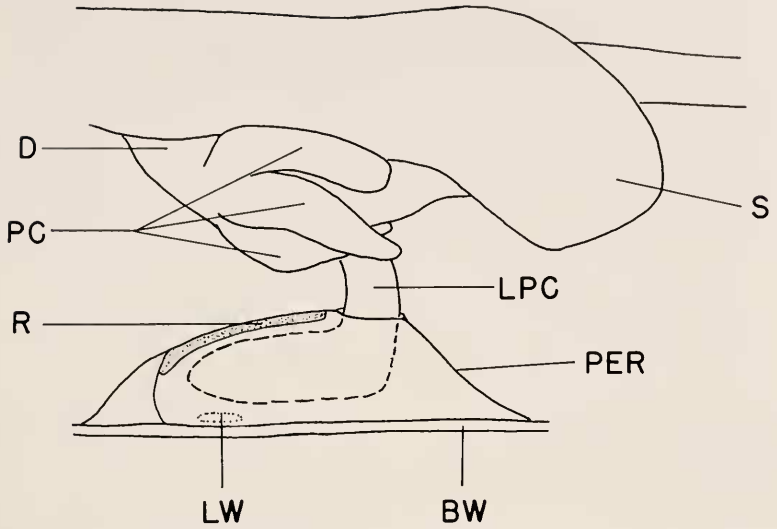

Figure 7. Luminescent organ of *E. macrops*. BW, body wall; D, duodenum; LPC, luminescent pyloric caecum; LW, luminescent window; PC, nonluminescent pyloric caeca; PER, peritoneum; R, reflector; S, stomach.

support the claim that *E. macrops* is luminescent, the modifications described above are similar to those found in several luminescent perciforms. *Pempheris klunzingeri* and *Parapriacanthus ransonneti* (Pempheridae) have luminescent organs embedded in the thoracic ventral musculature formed from, or directly associated with, the first pair of pyloric caeca (Haneda et al., 1966). Luminescent shallow-water apogonids such as *Apogon ellioti* and *Siphamia majimai* also have luminescent organs associated with the alimentary canal. In both of the latter forms, anal and/or thoracic organs are connected by duct to the intestine. As in *E. macrops*, tissue above the luminescent structures may serve as a reflector (Iwai, 1959; Haneda et al., 1966).

Common names. None.

Epigonus pandionis (Goode and Bean, 1881)
Figure 8

Apogon pandionis Goode and Bean, 1881: 160 (original description; off entrance to Chesapeake Bay; holotype examined, USNM 26228); Jordan and Gilbert, 1882: 564.

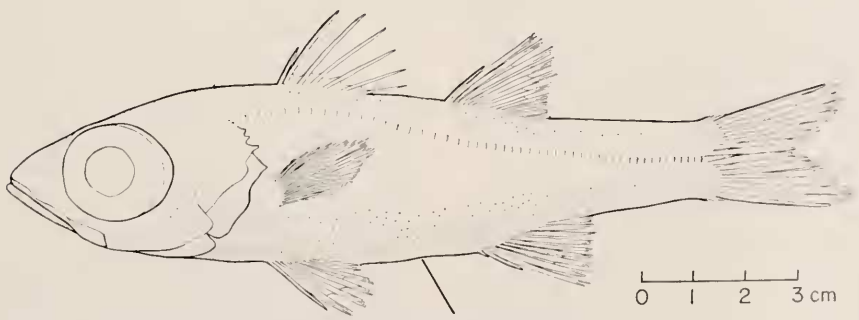

Figure 8. *Epigonus pandionis*, 141.7 mm SL, TABL uncatalogued.

TABLE 8. *EPIGONUS PANDIONIS* MERISTIC DATA. $\bar{X}$ = MEAN; SD = STANDARD DEVIATION; n = NUMBER OF SPECIMENS.

	$\bar{X}$	Range	SD	n
Pectoral fin rays	17.81	17–19	0.57	97
Gill rakers	27.84	26–30	0.88	101
Lateral line scales	47.63	46–49	0.66	81
Pyloric caeca	10.81	10–13	0.74	72

Glossamia pandionis Goode and Bean, 1896: 231.
Xystramia pandionis Jordan, 1917: 46.
Epigonus telescopus, Poll (not Risso, 1810), 1954: 89, fig. 26; Bauchot and Blanc (in part), 1961: 70.

Diagnosis. *E. pandionis* is the most robust species of the genus. Specimens shorter than 110–125 mm SL are distinguished by a posterodorsally canted ring circling the caudal peduncle.

E. pandionis differs from *E. macrops* and *E. telescopus* by bearing VII (rarely VIII) spines in the first dorsal fin and 10–13 pyloric caeca. It is unlike *E. oligolepis* because it has 46–49 lateral line scales and may be distinguished from *E. trewavasae*, *E. pectinifer*, *E. robustus*, *E. lenimen*, *E. crassicaudus*, and *E. occidentalis* because it lacks a pungent, bony opercular spine. *E. pandionis* most closely resembles *E. fragilis* and *E. denticulatus* but is differentiated by its short caudal peduncle (22.0–26.3% SL) and deep body (22.4–29.6% SL). It further differs from *E. denticulatus* by exhibiting gill raker counts of 26–30 and a single basal pterygiophore between neural spines 9 and 10.

Description. Meristic values presented in Table 8; regression data for morphometric traits presented in Table 9.

Body shortened, robust; anterodorsal profile convex, particularly between occiput and first dorsal fin; body deep, 22.4–29.6% SL; caudal peduncle short, broad, length 22.0–26.3% SL.

Head length 33.0–39.0% SL; head height 19.0–22.2% SL; snout blunt; angle of gape large; upper jaw subequal to lower jaw. Maxilla reaching ⅖–½ eye length; posterior margin broad, posteriormost point at ventral edge of bone. Eye round or slightly oval, 37.4–48.7% HL; anterodorsal rim of orbit projecting into profile in smaller specimens, reaching profile in larger forms; interorbital region wide, 9.2–11.5% SL.

Dentition variable with age (see Ontogenetic change); premaxillae, mandibles, vomer, and palatines dentigerous, bearing conical, occasionally recurved teeth; tongue edentulous.

Opercular spine short, horny, ventral to 2–5 (usually 3–4) poorly ossified spinelets; spine separated from spinelets by gap; spinelets occasionally obscured by underlying membranes. Preopercular angle broad, rounded, moderately produced; striations radiating from inner ridge to edges of angle; serrations along posterior and ventral surfaces of bone. Subopercle and interopercle bearing scattered serrations. Gill rakers awl-like.

First dorsal fin VII (95), VIII (5); second dorsal fin I,9 (2), I,10 (97), I,11 (1), II,10 (1); anal fin II,8 (2), II,9 (96), II,10 (1); D_1I long, 3.6–8.1% SL; D_2I, AII, P_2I short, equalling 5.0–8.6%, 5.0–8.7%, 8.9–12.7% SL respectively.

Vertebrae 10 + 15 (36); epipleural ribs 6 (25), 7 (1), inserting on vertebrae 1–6 and 1–7 respectively; pleural ribs 8 (36), inserting on vertebrae 3–10.

Table 9. *Epigonus pandionis* regression data. b = regression coefficient ± 95% confidence interval; a = Y intercept; n = number of specimens. All regressions on SL.

	b	a	n
HL	0.36 ± 0.01	0.04	77
Body depth	0.29 ± 0.01	−2.64	75
Head height	0.21 ± 0.01	−0.30	67
Eye diameter	0.16 ± 0.01	−0.15	80
Snout length	0.08 ± 0.00	0.05	73
Interorbital width	0.11 ± 0.00	0.33	74
Maxillary length	0.17 ± 0.01	−0.35	74
Lower jaw length	0.19 ± 0.00	−0.01	78
Caudal peduncle depth	0.12 ± 0.00	−0.61	80
Caudal peduncle length	0.24 ± 0.01	0.54	81
D_2 I	0.05 ± 0.01	1.69	46
AII	0.05 ± 0.01	2.11	56
P_2 I	0.10 ± 0.01	0.71	75

Pigmentation variable with age (see Ontogenetic change); scale pockets mottled with black; fin membranes black; opercular region of adults black-slate gray; mouth primarily light; iris black. Specimens frequently abraded, underlying tissue pale yellow-rust brown; guanine deposits rare, if present occurring on opercular complex, isthmus, thorax, or abdomen; silvered forms generally from old collections.

Descriptions based on 104 specimens 45.7–194.0 mm SL.

Ontogenetic change. Maturation in *E. pandionis* is accompanied by changes in pigmentation and dentition. The most striking transformation involves caudal peduncle markings. Specimens smaller than 85 mm SL bear a thin, black, posterodorsally sloped ring circling the central portion of the caudal peduncle. Melanophores forming the ring are deeply embedded in peduncle musculature and are not easily abraded. A broader, more superficial band of pigment circles the caudal peduncle at the base of the caudal fin (Fig. 1B). As specimens grow beyond 85 mm, the rings become fainter and begin to disappear. Fish larger than 110 mm SL may completely lack peduncle markings, and by 125 mm SL, rings are absent from virtually all specimens. Since *E. pandionis* becomes sexually mature at approximately 110 mm SL, altered markings may reflect changes in habit or behavior associated with reproductive individuals.

Gill rakers and branchial membranes are converted from pale yellow to black. Specimens smaller than 55 mm SL bear scattered black melanophores on gill rakers but lack opercular pigmentation. By 60 mm SL rakers have become totally dark, and traces of melanin have appeared on membranes lining the opercle. Pigment becomes denser with growth and spreads ventrally. By 100 mm SL the opercle is completely lined with dark tissue. Since

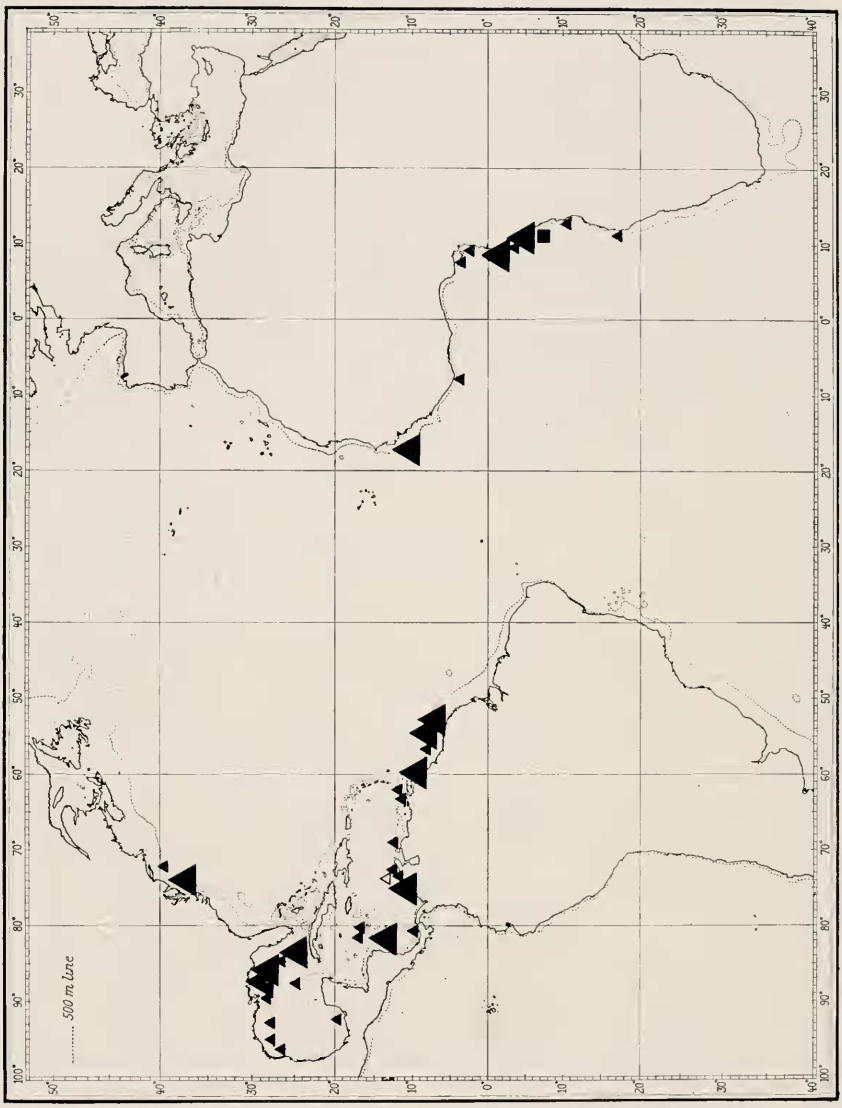

Figure 9. Distribution of *E. pandionis*. ▲ individual haul of demersal adults; ▲ three or more hauls of demersal adults; △ individual haul of pelagic juveniles; ■ report of adults from the literature.

opercular bones are translucent, the process appears outwardly as a darkening of the opercle.

Ontogenetic changes in dentition involve the production of increasingly complex tooth patches. Specimens smaller than 80 mm SL bear single rows of teeth on the premaxillae and palatines. Mandibular teeth are arranged in patterns analogous to those found on the premaxillae or in double rows that taper to a single row posteriorly. Vomerine teeth occur in 1–2 chevron-shaped clumps. As growth takes place, teeth are added to all dentigerous surfaces. Large specimens (>130 mm SL) have as many as 3–4 tooth rows on palatines and anterior segments of dentaries and premaxillae. Vomerine teeth may become sufficiently numerous to cover the entire face of the bone.

Distribution. E. pandionis is amphi-Atlantic, occurring primarily in the Caribbean, Gulf of Mexico, and Gulf of Guinea (Fig. 9). The species has been taken as far north as New Jersey and as far south as French Guiana in the western Atlantic. It occurs between Portuguese Guinea and Angola in the eastern Atlantic. Adults are captured exclusively by bottom trawls between 210 and 600 meters. American forms are most numerous from 300 to 500 meters, while African populations are most abundant between 260 and 450 meters. A single pelagic juvenile (35.5 mm SL, MCZ 48839) was taken at 275 to 300 meters in the Caribbean.

Geographic variation. Statistical analyses provide conflicting assessments of the similarity of African and American populations. Meristic characters reveal little variability. Coefficients of difference calculated for standard counts are always less than or equal to 0.49—far below conventional levels of subspecies recognition. Mensural data, on the other hand, suggest there are considerable differences between the populations. Of thirteen traits analyzed, seven separate eastern and western populations at the 95% level of confidence, five separate them at the 98% level, and two separate them at the 99% level (Table 10).

A closer examination of the characters exhibiting significant differences reveals that regression coefficients of American *E. pandionis* are always greater than those of African forms. Since regression coefficients are a measure of relative growth, observed intraspecific variation may reflect environmental factors.

Water temperature is a major parameter determining growth rates in fishes. If other factors are controlled, rates of growth increase proportionally with temperature (Brown, 1957: 391). With this in mind, it is interesting that temperatures are generally higher and superficial warm-water layers thicker in the western tropical Atlantic (Ekman, 1953). At 300 meters Gulf of Mexico and Caribbean temperatures vary from 10 to 18° C while west African temperatures range between 9 and 11° C. At 500 meters the difference is slightly less pronounced—8–13° C as opposed to 6–8° C (from temperature profiles in Fuglister, 1960; Wüst, 1964; and Nowlin and McLellan, 1967). One would therefore expect western Atlantic *E. pandionus* to grow more rapidly and exhibit larger regression coefficients than eastern Atlantic forms. In view of these findings, the two morphs are not considered to represent separate subspecies.

Remarks. See *E. trewavasae*: Remarks for discussion of *E. pandionis sensu* Lozano (1934), Navarro et al. (1943), and Maurin (1968).

Specimens of doubtful identity. Five specimens were examined that resembled *E. pandionis* but could not, with certainty, be placed in the species. Four were taken in the Atlantic, the fifth in the Gulf of Oman (see Mayer, 1972: Appendix II for complete data). These fishes were not considered when preparing the description of *E. pandionis*, nor were they used in morphometric, meristic, or distribution analyses.

The Atlantic specimens include three

TABLE 10. COMPARISON OF REGRESSION COEFFICIENTS FROM EASTERN AND WESTERN ATLANTIC POPULATIONS OF *E. PANDIONIS*. DATA EVALUATED AT THE 95%, 98%, AND 99% LEVELS OF CONFIDENCE. DF = DEGREES OF FREEDOM; Eb = REGRESSION COEFFICIENTS OF EASTERN ATLANTIC SPECIMENS; SD = SIGNIFICANT DIFFERENCE BETWEEN TABULAR AND CALCULATED VALUES OF t; t= CALCULATED VALUES OF t; Wb = REGRESSION COEFFICIENTS OF WESTERN ATLANTIC SPECIMENS.

	Wb	Eb	DF	t	Significance 95	98	99
HL	0.36	0.37	60	0.97	—	—	—
Body depth	0.29	0.29	71	0.31	—	—	—
Head height	0.22	0.20	63	2.41	SD	SD	—
Eye diameter	0.17	0.15	76	2.14	SD	—	—
Snout length	0.09	0.08	69	3.00	SD	SD	SD
Interorbital width	0.11	0.11	70	2.13	SD	—	—
Maxillary length	0.18	0.16	70	3.35	SD	SD	SD
Lower jaw length	0.20	0.18	74	2.63	SD	SD	SD
Caudal peduncle depth	0.13	0.12	76	2.39	SD	SD	—
Caudal peduncle length	0.23	0.24	77	1.16	—	—	—
D_2 I	0.05	0.06	32	1.83	—	—	—
A II	0.05	0.05	52	0.91	—	—	—
P_2 I	0.10	0.10	71	0.83	—	—	—

fishes from St. Helena. The most recently collected (UZM P45148) was incorrectly identified as *E. telescopus* by Bauchot and Blanc (1961). The two older forms (BMNH 1868.3.11.14/15) are probably the fish discussed by Günther (1868). The remaining specimen (USNM 207703) was taken in the Caribbean.

The four Atlantic individuals are basically similar to *E. pandionis* but exhibit shallower heads (17.4–19.8% SL), narrower interorbital regions (8.6–9.4% SL), fewer pyloric caeca (8–9), and fewer gill rakers (25–27). In these respects they resemble *E. fragilis*. Little is known about the habits of the variants; station data are available for only the Caribbean form, which was taken at relatively shallow depths. Exact determination of the variants' status must await the capture of additional material.

The Indian Ocean form (BMNH 1889.4.15.24) is distinguished from *E. pandionis* by its shallow body (22.5% SL), narrow interorbital region (8.3% SL), dentigerous glossohyal, numerous weak opercular spinelets, and elongate gill filaments. The last trait suggests the fish may have inhabited an oxygen minimum layer. As with the Atlantic variants, additional material must be collected before the status of the form can be determined.

Common names. None.

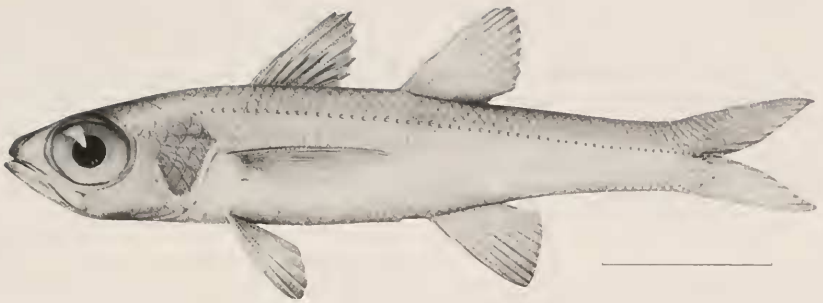

Figure 10. *Epigonus fragilis*, HOLOTYPE, 89.1 mm SL, CM 3900/FMNH 55204 (from Jordan and Jordan, 1922).

Epigonus fragilis (Jordan and Jordan, 1922) Figure 10

Scepterias fragilis Jordan and Jordan, 1922: 45, plate II, fig. 2 (original description; Honolulu market; holotype examined, CM 3900/FMNH 55204).

?*Hynnodus fragilis* Pietschmann, 1930: 13.

Diagnosis. *E. fragilis* most closely resembles *E. pandionis* but may be distinguished by its shallow body (18.8–21.1% SL) and short, shallow head (length 31.7–34.0% SL, height 16.0–17.4% SL). Unlike *E. pandionis*, *E. fragilis* lacks peduncle rings on specimens smaller than 100–120 mm SL.

In the past *E. fragilis* has been confused with *Hynnodus atherinoides*, a junior synonym of *E. occidentalis*. *E. fragilis* may be distinguished on the basis of body depth (see above), pectoral fin counts (16–17), and the absence of a pungent, bony opercular spine. Weak opercular armor, together with second dorsal fin counts of I,10 differentiate *E. fragilis* from *E. trewavasae*, *E. pectinifer*, *E. robustus*, *E. lenimen*, and *E. crassicaudus*. Gill raker counts of 25–26 separate *E. fragilis* from all remaining congeners except *E. telescopus*. *E. fragilis* may be distinguished from the latter by the presence of 7–8 pyloric caeca.

Description. *E. fragilis* is known from only five specimens. Of these, the holotype is of little descriptive value. The specimen is severely dehydrated and has become discolored, brittle, and shrunken. The following account is based primarily on two recently captured specimens of *E. fragilis* (LACM 32668-6 and USNM 207704) and two forms collected by D. S. Jordan in 1921 (SU 23246). The latter are mentioned in the original description of *E. fragilis* but are not designated as types.

All meristic and mensural data are presented in the text. Detailed statistical analyses were not undertaken because of small sample size.

Body elongate; anterodorsal profile convex, rising without interruption from tip of snout to first dorsal fin. Body depth 18.8–21.1% SL; caudal peduncle length 25.4–26.9% SL.

Head short, 31.7–34.0% SL; head height 16.0–17.4% SL; snout blunt, 7.2–7.9% SL; angle of gape moderate; jaws equal. Maxilla reaching ½ eye length; posteriormost point of maxilla at ventral edge of bone. Eye round, 38.1–41.5% HL; anterodorsal rim of orbit reaching profile; interorbital width 8.8–9.4% SL.

Dentition variable with age. Teeth conical; premaxillary teeth in irregular double rows anteriorly, tapering to single row posteriorly, occupying anterior ½–¾ of bone. Mandibular dentition more prominent than that of premaxilla; teeth recurved, occupying from ¾ to entire length of dentary, arranged in single or double rows near symphysis and single row posteriorly. Vomerine teeth recurved, arranged in oval or diamond-shaped patch, covering entire face of bone in adults. Palatine teeth

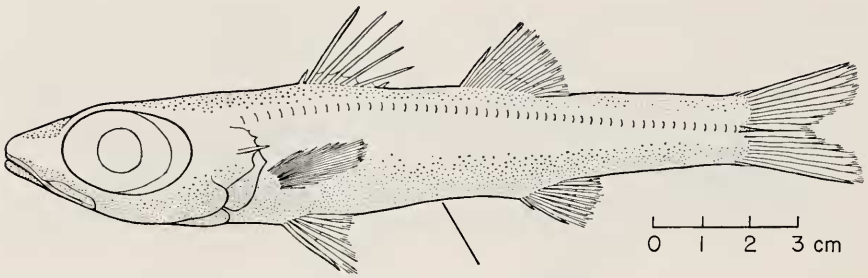

Figure 11. *Epigonus occidentalis*, 152.7 mm SL, MCZ 48840.

medially recurved, arranged in single–triple rows anteriorly, tapering to single row posteriorly; tongue edentulous.

Opercular spine weak, ventral to 7–9 small serrae; angle of preopercle produced, rounded, ornamented with striations and weak serrations; subopercle and interopercle unornamented. Gill rakers 25 (3), 26 (1), simple, awl-like. Pyloric caeca 7(1), 8 (2).

First dorsal fin VII (4), VIII (1); second dorsal fin I,10 (5); anal fin II,9 (5); pectoral fin 16 (1), 17 (3); D_1I moderate to long, 5.9–8.9% SL; D_2I short, 6.9% SL; P_2I long, 10.1–10.2% SL; AII broken.

Vertebrae 10 + 15 (4); epipleural ribs not visible on radiographs; pleural ribs 8 (4), inserting on vertebrae 3–10. Pored lateral line scales 49 (2).

Color in alcohol yellow-brown; fin membranes dark; iris silver-black; mouth light; branchial membranes light, darkening with age.

Distribution. E. fragilis is endemic to the Hawaiian Islands (Fig. 12). The species is demersal and has been taken between 120 and 125 meters.

Taxonomic notes. Six years after *E. fragilis* was described, Fowler (1928) synonymized the species with a second Hawaiian apogonid, *Hynnodus atherinoides* Gilbert, 1905. The synonymy achieved moderate acceptance and appeared in several publications (*e.g.*, Matsubara, 1936; Tinker, 1944; Gosline and Brock, 1960). Fowler's conclusions were based on a 33-mm specimen (BPBM 3914) obtained by the Tanager Expedition. The specimen is in extremely poor condition. All coloration has been lost, most of the muscle tissue has decomposed, and much of the skeleton has become decalcified. Although it is impossible to identify the fish because of its condition, the following traits suggest it is neither *E. fragilis* nor *H. atherinoides*: dorsal fin elements—VIII–I,8; anal fin elements—II,6; vertebrae—11 + 14. These data differ from Fowler's report of VI–I,8 dorsal elements, no anal spines, and 7 anal rays.

As was discussed in the diagnosis, *E. fragilis* is distinct from *H. atherinoides*. Fowler's synonymy appears to have been based on inaccurate data taken from an incorrectly identified fish.

Common names. None.

Epigonus occidentalis Goode and Bean, 1896
Figure 11

Epigonus occidentalis Goode and Bean, 1896: 233, plate LXVI, fig. 236 (original description; Steamer BLAKE, off Barbados, 237 fms.; holotype examined, MCZ 28032).

Hynnodus atherinoides Gilbert, 1905: 618, plate 79 (original description; ALBATROSS Sta. 3867, Pailolo Channel, Hawaii, 284–290 fms.; holotype examined, USNM 51601); Jordan and Jordan, 1922: 44; Fowler and Bean, 1930: 121.

Hynnodus megalops Smith and Radcliffe, 1912 (*in* Radcliffe, 1912): 445, plate 38, fig. 3 (original description; ALBATROSS Sta. 5388, 12°51′30″N, 123°26′15″E, between Burias and Luzon, Philippines, 226 fms.; holotype examined, USNM 70255).

Table 11. *Epigonus occidentalis* meristic data. $\overline{X}$ = mean; SD = standard deviation; n = number of specimens.

	$\overline{X}$	Range	SD	n
Pectoral fin rays	20.21	19–21	0.59	56
Gill rakers	24.68	22–27	1.08	60
Lateral line scales	48.15	46–51	0.97	46
Pyloric caeca	9.27	8–13	1.05	45

Table 12. *Epigonus occidentalis* regression data. b = regression coefficient ± 95% confidence interval; a = Y intercept; n = number of specimens. All regressions on SL.

	b	a	n
HL	0.34 ± 0.02	0.72	48
Body depth	0.19 ± 0.02	−1.72	48
Head height	0.15 ± 0.01	0.53	49
Eye diameter	0.16 ± 0.01	0.66	49
Snout length	0.08 ± 0.00	0.06	49
Interorbital width	0.08 ± 0.01	0.83	39
Maxillary length	0.13 ± 0.01	0.88	51
Lower jaw length	0.15 ± 0.01	1.26	51
Caudal peduncle depth	0.10 ± 0.01	−0.90	54
Caudal peduncle length	0.23 ± 0.01	1.50	53
D_2 I	0.05 ± 0.00	1.42	34
AII	0.05 ± 0.01	2.18	42
P_2 I	0.09 ± 0.01	0.67	47

Diagnosis. *E. occidentalis* is distinguished from all other congeners by the combination of shallow body depth (14.1–19.5% SL), reduced gill raker counts (22–27), and the presence of a pungent, bony opercular spine. It is frequently confused with *E. denticulatus*.

Description. Meristic values presented in Table 11; regression data for morphometric traits presented in Table 12.

Body elongate, cigar-shaped; anterodorsal profile weakly convex, flattened, rising gradually from tip of snout to interorbital region, leveling off toward occipital region, and rising gradually to base of first dorsal fin. Body depth 14.1–19.5% SL, body

width subequal to or greater than body depth; caudal peduncle narrow, length 22.4–28.1% SL.

Head length 30.5–37.9% SL; head height 13.3–17.2% SL; angle of gape moderate to small; lower jaw equalling or protruding slightly beyond upper jaw. Maxilla reaching ¼–⅔ eye length; posterior margin of maxilla moderate to narrow, posteriormost point at ventral edge of bone. Eye long, oval, 40.6–52.3% HL; anterodorsal rim of orbit reaching or projecting into dorsal profile; interorbital region narrow, 5.6–8.5% SL.

Teeth conical; premaxillary and mandibular teeth frequently recurved, arranged in simple single row or single row widening to double or triple rows near symphysis; teeth covering ⅔ to entire length of premaxilla and ¾ to entire length of dentary; vomerine teeth arranged in 1–4 irregular rows; palatines rarely edentulous, teeth 1–10, arranged in single row, covering anterior ¼–½ of bone; tongue edentulous.

Opercular spine pungent, bony, ventral to 1–3 poorly ossified spinelets; spine separated from spinelets by shallow indentation. Preopercular angle produced, rounded or pointed, bearing serrations and striations; subopercle serrate, occasionally striate; interopercle variable, frequently serrate. Gill rakers short, awl-like.

First dorsal fin VII (59); second dorsal fin I,10 (59); anal fin II,8 (1), II,9 (59); D_1I, D_2I, AII, P_2I short, equalling 1.1–4.2%, 4.8–7.8%, 4.8–9.2%, and 8.0–11.3% SL respectively.

Vertebrae 10 + 15 (35); epipleural ribs 6 (19), 7 (5), inserting on vertebrae 1–6 or 1–7 respectively; pleural ribs 7 (31), 8 (1), inserting on vertebrae 2–9 or 3–9.

Color in alcohol variable with preservation; skin frequently removed by trawling; underlying tissue pale yellow, yellow-pink, occasionally marked with rust brown; scale pockets and fin membranes black; opercular area black-slate gray, occasionally tinged with silver; lower jaw, branchiostegal membranes, and thoracic and abdominal regions occasionally silvered; guanine most prevalent on specimens from old collections. Mouth color variable with age (see Ontogenetic change); iris and branchial region dark.

Description based on 62 specimens 58.2–178.9 mm SL.

Ontogenetic change. The most striking age-related change in *E. occidentalis* is the development of oral pigmentation. As in *E. telescopus* and *E. macrops*, immature forms bear pigmentless or slightly pigmented mouths, while adults have blackened oral membranes. Pigmentation first appears in specimens 80–110 mm SL. Melanophores develop just anterior to the pharynx and spread rostrally, covering a third of the roof and floor of the mouth and half of the tongue by the time specimens reach 115–130 mm SL. By 150 mm SL the tongue is completely black, and by 175–180 mm the entire mouth is dark. Branchial membranes undergo an analogous transformation before specimens reach 58 mm SL.

A faint black ring circling the middle of the caudal peduncle was observed on three small *E. occidentalis* ($<$ 65 mm SL). Similar markings were absent from larger individuals. The rings are reminiscent of markings observed on young *E. macrops* and *E. pandionis* and probably represent a juvenile feature that is lost with growth.

Distribution. E. occidentalis has been taken in the Caribbean, Gulf of Mexico, and western tropical Atlantic. It is also known from the Philippine and Hawaiian Islands (Fig. 12). The species is caught by bottom trawls between 360 and 735 meters. Adults are most abundant in the Caribbean from 500 to 550 meters.

Geographic variation. E. occidentalis, as here defined, includes two nominal species —*Hynnodus atherinoides* Gilbert, 1905 and *H. megalops* Smith and Radcliffe, 1912. The former originally represented a Hawaiian endemic; the latter represented a Philippine form. In 1930 Fowler and Bean synonymized the Pacific morphs. In the

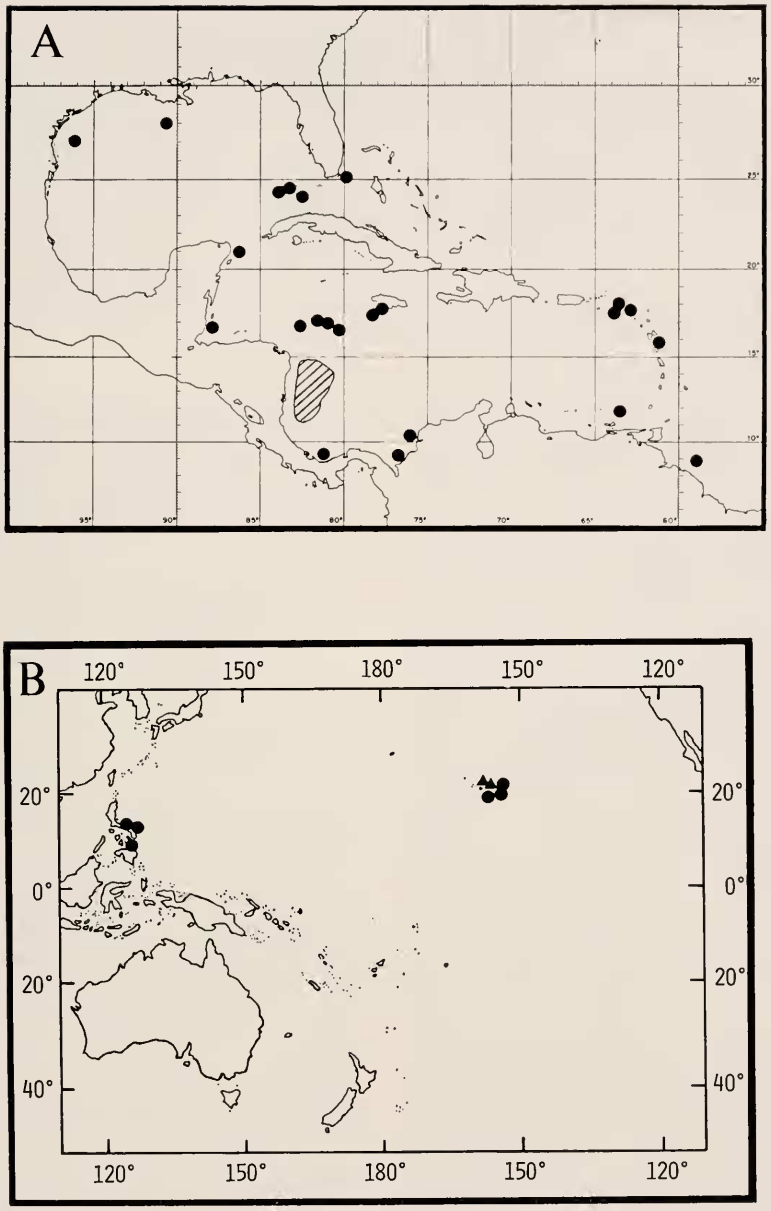

Figure 12. Distribution of *E. fragilis* and *E. occidentalis*. Map A shows localities in the Caribbean and Gulf of Mexico. Map B shows localities in the western Pacific. ▲ *E. fragilis*, individual haul of demersal adults; ● *E. occidentalis*, individual haul of demersal adults; cross-hatching indicates areas where *E. occidentalis* are frequently taken.

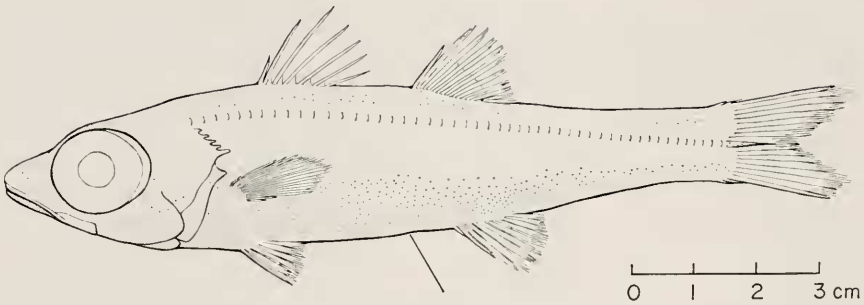

Figure 13. *Epigonus denticulatus*, 115.1 mm SL, UMML 12463.

authors' opinions, characters separating the two forms were "simply minor discrepancies of portraiture and should never have been credited as specific distinctions [p. 122]."

Although descriptions and illustrations of *H. atherinoides* and *H. megalops* suggest a link with *E. occidentalis*, detailed comparisons of the three forms were never made. To a large extent this was the result of inadequate sampling. Until the initiation of the OREGON cruises in 1950, few *E. occidentalis* were available for study. Pacific forms are still poorly represented; only seven specimens have been collected. Reports of additional material by Fowler (1928), Matsubara (1936), Smith (1949a,b, 1961), Kamohara (1952), and Moreland (1957) are based on misidentifications.

Comparisons of *E. occidentalis* and the *H. atherinoides–H. megalops* complex provide no evidence to support their status as separate species. Analyses of head length, body depth, head height, eye diameter, snout length, interorbital and maxillary widths, caudal peduncle length and depth, and AII and P_2I lengths reveal no significant differences between the populations at either the 95%, 98%, or 99% levels of confidence. Meristic data also show considerable overlap for most characters; however, the coefficients of difference for pyloric caeca and gill raker counts are above conventional levels of subspecies recognition (1.68 and 1.99, respectively). In addition, Atlantic and Pacific populations may be distinguished by minor qualitative characters such as:

(1) short, rounded preopercular angles in Atlantic forms; longer, pointed angles in Pacific specimens;
(2) fusion of uroneurals 1 and 2 in Atlantic forms (based on 3 alizarin preparations); separate occurrence in Pacific forms (based on 1 alizarin preparation).

On the basis of the above information, Atlantic and Pacific forms are placed in the same species but considered members of separate subspecies. Formal description of the subspecies must await the capture of additional Pacific specimens.

Remarks. A single unripe female *E. occidentalis* (USNM 197353, 172.1 mm SL) was found carrying small egg masses in the anterior portion of its mouth (anterior to the tongue and vomer). The masses contained 125 oval eggs 0.40–0.55 mm in diameter. The presence of eggs in the mouth of an *Epigonus* is of interest, because several shallow-water apogonids exhibit oral brooding. No such activity has ever been reported for deep-sea forms.

Although it is difficult to say with certainty, the *E. occidentalis* eggs are probably not incubating clutches, but rather non-apogonid ova ingested during trawling. Unlike the egg masses of typical oral brooding apogonids, those found in *E. occidentalis* are broken, disrupted, and contain very few eggs. An 84.9-mm specimen of *Cheilodipterus affinis* was reported in-

Table 13. *Epigonus denticulatus* meristic data. $\bar{X}$ = mean; SD = standard deviation; n = number of specimens.

	$\bar{X}$	Range	SD	n
Pectoral fin rays	19.09	18–20	0.56	54
Gill rakers	30.98	28–34	1.10	58
Lateral line scales	48.12	46–49	0.76	43
Pyloric caeca	11.83	10–14	0.85	42

cubating 21,000 eggs 0.35–0.4 mm in diameter (Smith et al., 1971: 8–9). The ova fully occupied the oral and branchial chambers and extensively distended the head. These conditions were not observed in *E. occidentalis*.

It is possible that the eggs represent the remnants of a larger mass that was spit out and partially reingested. However, were this the case, one might expect to find eggs in the stomach (Sakomoto, 1930) or gill rakers. No eggs were found in either region.

Finally, Breder and Rosen (1966) state that eggs of oral brooding apogonids are held together by fibers attaching to one pole. The eggs of *E. occidentalis* are loosely embedded in an open matrix of fibers. Grape-like egg clusters characteristic of *Apogon semilineatus* (Ebina, 1931: 20) were not observed.

Common names. None.

Epigonus denticulatus Dieuzeide, 1950
Figure 13

Pomatomus telescopus, Vaillant (in part) (not Risso, 1810), 1888: 376.

Scepterias lenimen, Whitley (in part) (not Whitley, 1935), 1935: 230; Whitley (in part), 1940: 420.

Epigonus atherinoides, Matsubara (not Gilbert, 1905), 1936: 120, fig. 1A; Smith, 1961: 378, fig. 3; Kamohara, 1952: 37, fig. 31.

Hymnodus atherinoides, Smith (not Gilbert, 1905), 1949a: 101; Smith, 1949b: 210, fig. 495A.

Epigonus denticulatus Dieuzeide, 1950: 89, figs. 1–2 (original description; Algerian Coast at 200–500 m; holotype not examined); Tortonese, 1952: 72, 1 fig.; Dieuzeide et al., 1953: 216, 2 figs.; Tortonese and Queirolo, 1970: 33, fig. 6.

Diagnosis. *E. denticulatus* lacks a fully ossified opercular spine, bearing instead 3–7 membranous projections. This feature distinguishes it from *E. occidentalis*, *E. trewavasae*, *E. pectinifer*, *E. robustus*, *E. lenimen*, and *E. crassicaudus*, which have pungent, bony opercular spines. *E. denticulatus* is differentiated from *E. telescopus*, *E. macrops*, and *E. fragilis* by the presence of 10–14 pyloric caeca and 28–34 gill rakers. It differs from *E. oligolepis* by bearing 46–51 lateral line scales. *E. denticulatus* closely resembles *E. pandionis* but may be distinguished on the basis of the former's shallow body (15.8–23.6% SL), long caudal peduncle (25.9–32.2% SL), and short D_1I (2.4–3.7% SL).

Description. Meristic values presented in Table 13; regression data for morphometric traits presented in Table 14.

Body fusiform, slightly compressed; anterodorsal profile rising gradually above snout, becoming steeper and slightly convex over eyes, thereafter rising gradually to first dorsal fin; body moderate to shallow, depth 15.8–23.6% SL; caudal peduncle narrow, length 25.9–32.2% SL.

Head moderate to short, 31.2–38.6% SL; head height 16.0–19.8% SL; snout short, blunt; angle of gape moderate to large; lower jaw protruding slightly beyond upper jaw. Maxilla reaching ⅓–½ eye length,

Table 14. *Epigonus denticulatus* regression data. b = regression coefficient ± 95% confidence interval; a = Y intercept; n = number of specimens. All regressions on SL.

	b	a	n
HL	0.32 ± 0.01	2.88	57
Body depth	0.25 ± 0.01	-4.09	54
Head height	0.16 ± 0.01	0.86	56
Eye diameter	0.14 ± 0.01	1.39	58
Snout length	0.07 ± 0.00	0.33	56
Interorbital width	0.09 ± 0.00	0.37	55
Maxillary length	0.14 ± 0.01	1.37	56
Lower jaw length	0.15 ± 0.01	1.61	57
Caudal peduncle depth	0.11 ± 0.01	-0.78	57
Caudal peduncle length	0.28 ± 0.01	0.61	57
D_2I	0.05 ± 0.01	2.24	36
A II	0.06 ± 0.01	1.43	40
P_2I	0.08 ± 0.01	0.92	41

posteriormost point near ventral surface of bone. Eye round or slightly oval, 40.3–48.0% HL; anterodorsal rim of orbit reaching dorsal profile, projecting into profile in smaller specimens; interorbital width 8.2–10.4% SL.

Teeth small, conical, occasionally recurved; premaxilla bearing single row of teeth along anterior ⅛–¾ (usually ½) of bone. Mandibular teeth arranged along length of dentary in irregular single row, occasionally double near symphysis; larger specimens with 3–4 rows near symphysis. Vomerine teeth variable, arranged in 1–4 irregular rows. Palatine dentition occupying length of bone, arranged in simple single row or double row tapering to single row posteriorly; large specimens bearing 3–4 rows of teeth anteriorly. Tongue generally edentulous, rarely bearing isolated tooth patches on glossohyal or edges of tongue.

Opercle lacking bony spine, bearing instead 3–7 (usually 5–6) jagged, membranous projections; projections often obscured by underlying tissues. Peropercular angle produced, broadly rounded, striations radiating from inner edge, angle occasionally serrate; subopercle and interopercle occasionally serrate. Gill rakers simple, awl-like.

First dorsal fin VII (53); second dorsal fin I,9 (1), I,10 (56), 10 (1); anal fin II,8 (1), II,9 (57). D_1I moderate, 2.4–3.7% SL; D_2I, AII, P_2I short, 5.2–8.0%, 6.0–8.2%, 7.9–10.0% SL respectively.

Vertebrae 10 + 15 (44); epipleural ribs 6 (32), 7 (1), inserting on vertebrae 1–6 or 1–7 respectively; pleural ribs 8 (44), inserting on vertebrae 3–10.

Color in alcohol variable with preservation; skin frequently removed by trawling, underlying tissue pink-brown or yellow; scale pockets mottled with numerous brown-black melanophores, dorsal surfaces of body and head more heavily pigmented.

Guanine deposits frequently occurring on gill cover, ventral surface of mandible, isthmus, thoracic region, and abdomen to anus; iris black; mouth light; branchial region dark.

Description based on 58 specimens 57.0–187.5 mm SL.

Ontogenetic change. Two young specimens of *E. denticulatus* (29.2 mm SL, MCZ 48846, and 49.7 mm SL, MCZ 48847) were examined in the course of this investigation. These specimens were taken by midwater trawls made in the central North Atlantic and Gulf of Mexico and reveal that the life cycle of *E. denticulatus* includes a pelagic juvenile stage.

The pelagic young resemble adults in most respects. For example, the juveniles bear diagnostic gill raker counts and opercular ornamentation. However, slight changes in body shape are associated with growth. The 29.2 mm specimen has a more shallow body, shorter head, narrower interorbital region, and smaller eyes than demersal adults. Similar trends are present but less apparent in the larger juvenile.

Juvenile dentition patterns are basically like those of adults but involve fewer and relatively larger recurved teeth. Oral and branchial regions are light in young specimens. The latter areas darken with age.

Distribution. E. denticulatus is the only cosmopolitan species in the genus (Fig. 14). Specimens have been taken from the southwest coast of Japan, the Gulf of Mexico, and the Caribbean. In addition, the species occurs continuously from the western Mediterranean, south along the western coast of Africa to the tip of the continent. It reappears south of the Great Australian Bight and southeast of New Zealand.

Adults are generally taken by bottom trawls between 300 and 600 meters, although specimens have been captured from as shallow as 200 meters and as deep as 830 meters. Pelagic juveniles have been taken by IKMT between 130 to 145 meters and 350 to 425 meters.

Geographic variation. E. denticulatus may be divided into North Atlantic, Southern Hemisphere, and Japanese populations. North Atlantic forms include material from the Mediterranean, northeast Atlantic, Caribbean, and Gulf of Mexico. Southern Hemisphere populations contain specimens from the southeast Atlantic, Australia, and New Zealand.

Statistical analyses reveal surprisingly little divergence between North Atlantic and Southern Hemisphere specimens. Coefficients of difference for standard meristic characters are far below accepted levels for subspecies recognition (all are $\leqslant 0.53$), and regression coefficients for mensural data are virtually identical. Only maxillary lengths differ significantly at the 95% level of confidence. It is clear from the data that North Atlantic and Southern Hemisphere *E. denticulatus* do not represent separate subspecies.

Detailed analyses of the Japanese population could not be undertaken because of inadequate sampling. Only one specimen was available from the area. On the basis of this fish, the Japanese population appears closely allied to the rest of the species. With the exception of eye diameter, standard counts and measurements made on the Japanese morph fall within the 95% and 99% confidence intervals of remaining *E. denticulatus*. Eye diameter falls outside the 95% confidence interval but within the 99% confidence interval.

The similarity of *E. denticulatus* populations, despite the wide range of the species, suggests (1) there may be considerable gene flow between populations, (2) the present distribution may have been achieved only recently, or (3) evolution is occurring very slowly. Discovery of a pelagic juvenile in the mid-North Atlantic gives credence to the first hypothesis and provides a mechanism for the dispersal of a species with demersal adults such as *E. denticulatus*.

Common names. "Castagnera brüna" in Monaco (Bini, 1968).

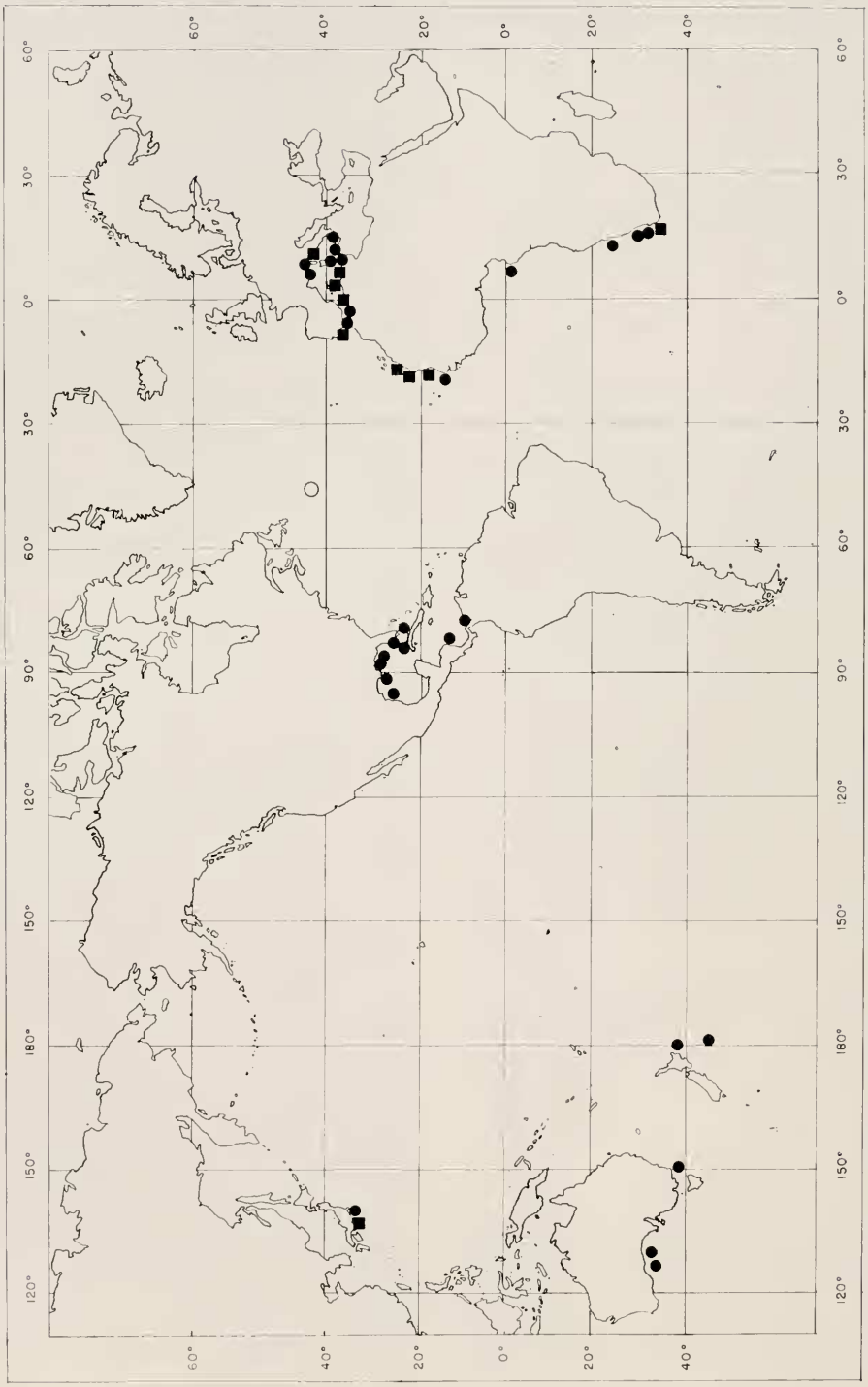

Figure 14. Distribution of *E. denticulatus*. ● individual haul of demersal adults; ○ individual haul of pelagic forms; ■ report from the literature.

Epigonus oligolepis sp. nov.
Figure 15

Holotype: One specimen, 90.8 mm SL, taken from the Straits of Florida by M/V COMBAT, Sta. 436: 21 July 1957, 1319 to 1530 hrs.; 24°13′N, 81°42′W; 300 fms., 40′ flat trawl. USNM 207718.

Paratypes: One specimen, 126.7 mm SL, M/V OREGON, Sta. 4731: 27 February 1964; 27°35′N, 92°32′W; 250–300 fms.; 40′ flat trawl. MCZ 48848.

Three specimens, 52.7–72.7 mm SL, Steamer ALBATROSS, Sta. 2643: 9 April 1886; 25°25′00″N, 79°55′15″W; 211 fms. USNM 109430.

Three specimens, 53.7–84.2 mm SL, M/V OREGON, Sta. 5043: 26 September 1964; 12°01′N, 61°53.5′W; 210–250 fms.; 40′ shrimp trawl. USNM 207719.

One specimen (cleared and stained), 62.0 mm SL, locality data identical with those of preceding lot. USNM 207720.

One specimen, 117.1 mm SL, M/V OREGON, Sta. 3741: 26 August 1962; 29°10′N, 88°01.5′ W; 300–340 fms.; 100′ flat trawl. USNM 207721.

Diagnosis. E. oligolepis is distinguished from all congeners by lateral line scale counts of 33–36 and the presence of lingual and endopterygoid teeth.

Description. Meristic values presented in Table 15; regression data for morphometric traits presented in Table 16.

Body elongate, moderately compressed; anterodorsal profile rising gradually from tip of snout to interorbital region, rising more steeply and becoming slightly convex to occiput, thereafter rising gradually to base of first dorsal fin; body depth 19.8–24.5% SL; caudal peduncle length 23.9–27.2% SL.

Head moderate to long, 34.4–43.0% SL; head height 16.6–18.8% SL; snout pointed; angle of gape moderate; lower jaw protruding beyond upper jaw. Maxilla reaching ⅖–½ eye length; posterior margin of maxilla rounded, posteriormost point between midline and ventral margin of bone. Eye round to slightly oval, 40.1–43.7% HL; anterodorsal rim of orbit reaching or projecting into dorsal profile; interorbital width 8.5–9.6% SL.

Teeth small, conical; premaxilla edentulous or bearing few teeth on anterior ⅓–⅖ of bone; mandibular teeth arranged in single or double row anteriorly, single row posteriorly; teeth covering anterior half of bone and occasionally extending along length of dentary. Vomer covered with irregular tooth patches, teeth extending posteriorly along midline of palate; palatine teeth arranged in single or multiple rows anteriorly, single row posteriorly, covering from half to entire length of bone; endopterygoid dentigerous; auxiliary tooth patches occurring between vomer, palatines, and endopterygoids; tongue dentigerous, bearing lateral and glossohyal tooth patches (Fig. 1A).

Opercular spine weak, poorly ossified, ventral to 2–6 membranous spinelets; spine and spinelets separated by moderate gap; spinelets occasionally obscured by underlying membranes. Preopercular angle rectangular or slightly produced; preopercle, subopercle and interopercle unserrated. Gill rakers simple, awl-like.

First dorsal fin VII (10); second dorsal fin I,10 (10); anal fin II,8 (1), II,9 (9). Fin spines moderate; D_1I 2.7–4.0% SL; D_2I 10.9–12.1% SL; AII 10.3–12.2% SL; P_2I 11.0–13.6% SL.

Vertebrae 10 + 15 (10), epipleural ribs 7 (4), 8 (1), inserting on vertebrae 1–7 or 1–8 respectively; pleural ribs 7 (10), inserting on vertebrae 3–9.

Color in alcohol variable with preservation; specimens frequently abraded revealing underlying pale yellow or pink-purple tissue. Recently collected specimens bear scale pockets mottled with numerous melanophores; dorsal surfaces of head and trunk more heavily pigmented; iris black. Specimens from old collections devoid of melanin, bearing silver on opercular region, isthmus, thoracic region, and abdomen to anus; iris silver. Mouth light, dotted with brown or black melanophores; branchial region light in small specimens, darkening with age.

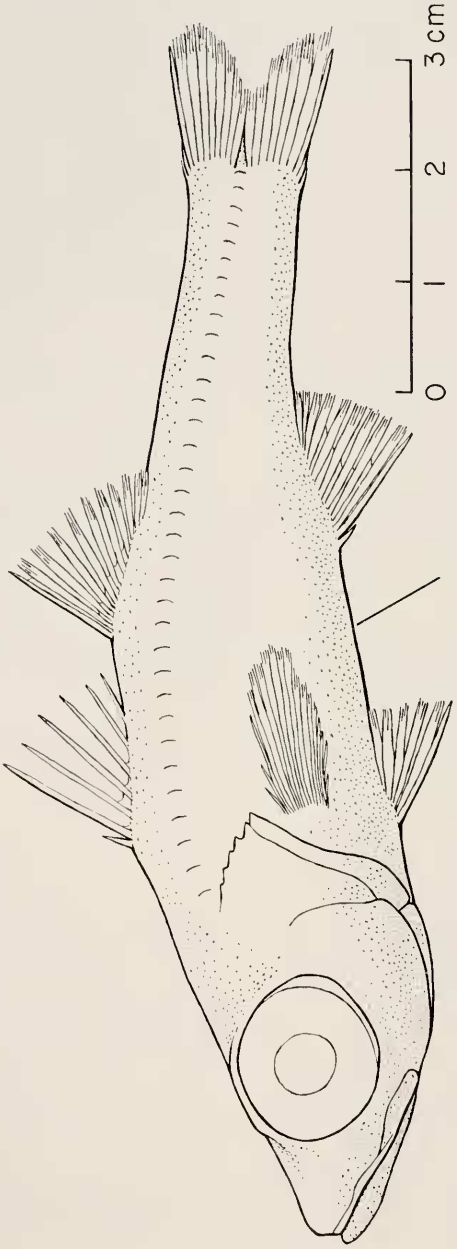

Figure 15. *Epigonus oligolepis*, HOLOTYPE, 90.8 mm SL, USNM 207718.

Table 15. *Epigonus oligolepis* meristic data. $\overline{X}$ = mean; SD = standard deviation; n = number of specimens.

	$\overline{X}$	Range	SD	n
Pectoral fin rays	17.20	16–18	0.79	10
Gill rakers	30.50	29–31	0.71	10
Lateral line scales	34.70	33–36	1.06	10
Pyloric caeca	8.83	8–10	0.75	6

Table 16. *Epigonus oligolepis* regression data. b = regression coefficient ± 95% confidence interval; a = Y intercept; n = number of specimens. All regressions on SL.

	b	a	n
HL	0.36 ± 0.11	0.88	7
Body depth	0.26 ± 0.02	−2.45	10
Head height	0.21 ± 0.06	−2.56	5
Eye diameter	0.15 ± 0.03	0.48	9
Snout length	0.08 ± 0.03	0.97	5
Interorbital width	0.10 ± 0.01	−0.51	9
Maxillary length	0.18 ± 0.02	−0.92	6
Lower jaw length	0.17 ± 0.02	1.45	10
Caudal peduncle depth	0.11 ± 0.02	−1.20	10
Caudal peduncle length	0.26 ± 0.04	0.58	9
D_2 I	0.13 ± 0.01	−1.07	6
AII	0.12 ± 0.02	−0.33	10
P_2 I	0.12 ± 0.03	0.13	9

Description based on 10 specimens 53.7–126.7 mm SL.

Ontogenetic change. Two juvenile *E. oligolepis* (32.0–32.2 mm SL, USNM 207722) were taken by bottom trawls from the Gulf of Mexico. These specimens exhibit many traits characteristic of adult forms but differ in head shape, meristics, and dentition. Unlike adults, young *E. oligolepis* have smaller eyes (38.2–39.4% HL) and wider interorbital regions (10.4% SL). Dorsal fin and gill raker counts are reduced to VI–I,10 and 26 respectively. Premaxillary, mandibular, and lingual tooth patterns are similar to those of mature individuals, but dentition associated with

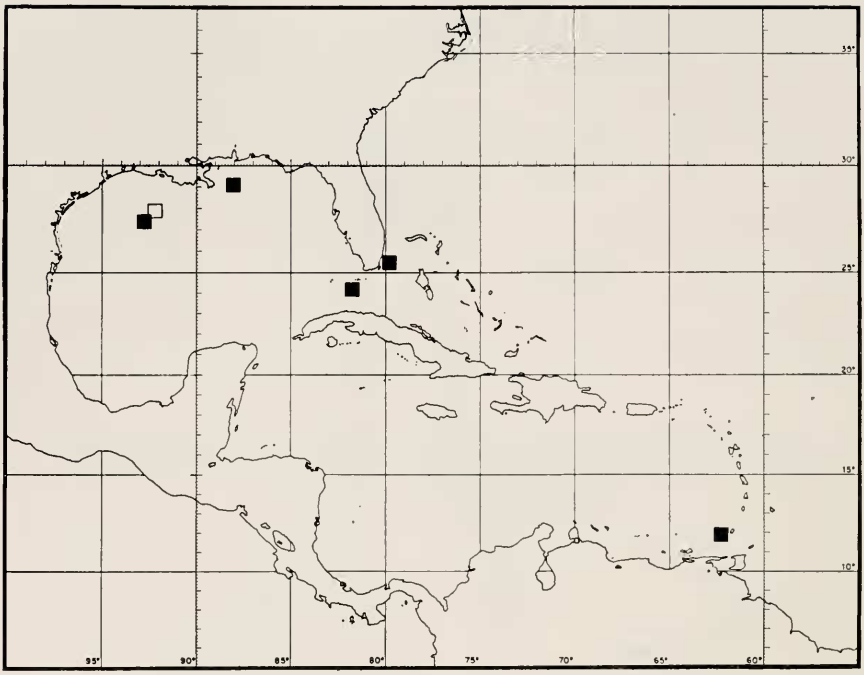

Figure 16. Distribution of *E. oligolepis*. ■ individual haul of demersal adults; □ individual haul of demersal juveniles.

the roof of the mouth is strongly reduced. Vomers and palatines are edentulous or bear 1–4 teeth; auxiliary tooth patches have not developed. Endopterygoid teeth are present but few in number, relatively long, and medially recurved.

Distribution. E. oligolepis is endemic to the Gulf of Mexico-Caribbean region (Fig. 16). Specimens have been taken by bottom trawls between 380 and 660 meters.

Remarks. The type specimens of *E. oligolepis* exhibit two seemingly disparate color patterns. One lot, taken in 1886 by the ALBATROSS, is devoid of melanin but bears extensive guanine deposits. Remaining fish, all more recently collected, bear no silver but are dotted with numerous melanophores. These differences are artifacts of preservation.

Specimens collected by early workers were generally placed directly into ethanol, while material obtained today is fixed in 10 percent formalin (Hubbs and Lagler, 1958: 16–17). When ethanol is used as a fixative, it leaches out melanins but does not affect guanine deposits. Specimens become pale, but silver pigment is retained. Formalin has the opposite effect; it blackens melanophores but destroys guanine crystals. The appearance of preserved specimens is thus dependent on fixative composition, concentration, and immersion time. An alcohol-formalin mixture containing one tablespoon of full strength formalin per two gallons of 65–75 percent ethanol might be used instead of conventional fixatives to preserve both guanine and melanin deposits (Myers, personal communication).

Etymology. Oligolepis (Greek), few scales, from *oligos*, few, and *lepis*, scale; a noun in apposition, refers to the reduced number of lateral line scales characterizing the species.

Common names. None.

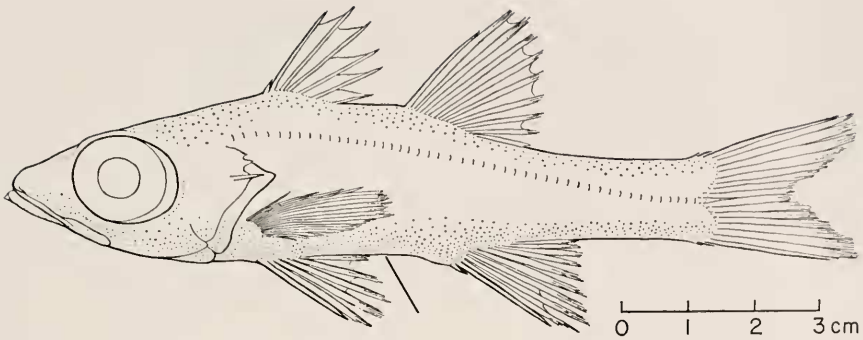

Figure 17. *Epigonus trewavasae*, 98.6 mm SL, USNM 207723.

Epigonus trewavasae Poll, 1954
Figure 17

Glossamia pandionis, Lozano (not Goode and Bean, 1881), 1934: 89; Navarro, 1942: 202; Navarro et al., 1943: 136, plate XXII, fig. A.

Epigonus trewavasae Poll, 1954: 91, fig. 27 (original description; NOORDENDE III Sta. 52, 06°08′S, 11°30′E, 280–290 m; holotype examined, IRSN 209).

Epigonus pandionis, Maurin (not Goode and Bean, 1881), 1968: 69, fig. 36.

Diagnosis. *E. trewavasae* is most likely to be confused with *E. robustus*, *E. lenimen*, *E. crassicaudus*, and *E. pectinifer*. It is distinguished from the first three species by vertebral counts of 10 + 15 and the presence of glossohyal and lateral lingual teeth. The fourth form, *E. pectinifer*, bears only glossohyal teeth or a totally edentulous tongue. *E. trewavasae* may be further differentiated from *E. pectinifer* on the basis of the former's 30–35 awl-like gill rakers and long, pungent D_2I and AII (12.7–16.5% SL, 13.8–16.8% SL respectively). *E. trewavasae* is unlike remaining congeners because it bears a pungent, bony opercular spine, second dorsal fin counts of I,9, and pectoral fin counts of 16–18.

Description. Meristic values presented in Table 17; regression data for morphometric traits presented in Table 18.

Body elongate; anterodorsal profile flat, rising without interruption from snout to base of first dorsal fin; body moderate to deep, 23.1–27.0% SL; caudal peduncle length 24.3–27.5% SL.

Head length 33.7–38.1% SL; head height 16.6–18.7% SL; snout pointed; angle of gape small to moderate; lower jaw protruding beyond upper jaw, bearing two nubs on anterior surface of mandible. Maxilla reaching slightly less than ½ eye length; posterior margin of maxilla narrow, rounded, or bearing posteriormost point near midline of bone; short, pungent mustache-like process projecting from posteroventral surface of maxillary head. Eye round, slightly oval in younger specimens, 41.1–49.1% HL; anterodorsal rim of orbit reaching profile; interorbital width 8.8–10.8% SL.

Dentition variable with age (see Ontogenetic change); teeth conical, small, frequently microscopic, present on premaxillae, mandibles, and vomer; palatines occasionally edentulous; tongue bearing lateral and glossohyal tooth patches.

Opercular spine pungent, bony, surmounted by 2–3 horny spinelets; spine and spinelets separated by large gap; spinelets often obscured by underlying opercular membranes. Preopercular angle narrowly produced, unserrated or bearing serrations on angle and ventral surface of bone; interopercle and subopercle unserrated or weakly serrated. Gill rakers simple, awl-like.

First dorsal fin VII (14); second dorsal fin I,9 (13), I,10 (1); anal fin II,9 (14); D_1I moderate, 2.4–3.2% SL; D_2I, AII, P_2I,

TABLE 17. *EPIGONUS TREWAVASAE* MERISTIC DATA. $\overline{X}$ = MEAN; SD = STANDARD DEVIATION; n = NUMBER OF SPECIMENS.

	$\overline{X}$	Range	SD	n
Pectoral fin rays	17.54	16–18	0.66	13
Gill rakers	33.15	30–35	1.46	13
Lateral line scales	47.69	47–49	0.75	13
Pyloric caeca	7.00	6– 8	0.60	12

TABLE 18. *EPIGONUS TREWAVASAE* REGRESSION DATA. b = REGRESSION COEFFICIENT ± 95% CONFIDENCE INTERVAL; a = Y INTERCEPT; n = NUMBER OF SPECIMENS. ALL REGRESSIONS ON SL.

	b	a	n
HL	0.38 ± 0.03	−2.03	13
Body depth	0.29 ± 0.02	−4.43	12
Head height	0.19 ± 0.01	−1.26	12
Eye diameter	0.17 ± 0.02	−0.49	13
Snout length	0.07 ± 0.02	1.19	13
Interorbital width	0.09 ± 0.01	1.41	13
Maxillary length	0.15 ± 0.02	0.69	13
Lower jaw length	0.16 ± 0.01	0.39	13
Caudal peduncle depth	0.13 ± 0.01	−1.79	13
Caudal peduncle length	0.26 ± 0.02	−0.08	13
D_2 I	0.15 ± 0.03	−0.32	12
AII	0.18 ± 0.03	−0.65	11
P_2 I	0.14 ± 0.01	0.36	13

long, pungent, 12.7–16.5%, 13.8–16.8%, 13.8–16.2% SL respectively.

Vertebrae 10 + 15 (12); epipleural ribs 6 (9), 7 (2), inserting on vertebrae 1–6 or 1–7 respectively; pleural ribs 7 (8), 8 (4), inserting on vertebrae 3–9 or 3–10 respectively.

Color variable with preservation; specimens abraded, revealing underlying yellow to yellow-pink tissue; fin membranes dark; scale pockets covered with dense brown or black melanophores; dorsal surface of trunk more heavily pigmented than ventral; opercles brown, black, or slate gray; guanine deposits occurring occasionally on opercular region and from isthmus to bases of paired fins; iris black with silver highlights; mouth light; branchial re-

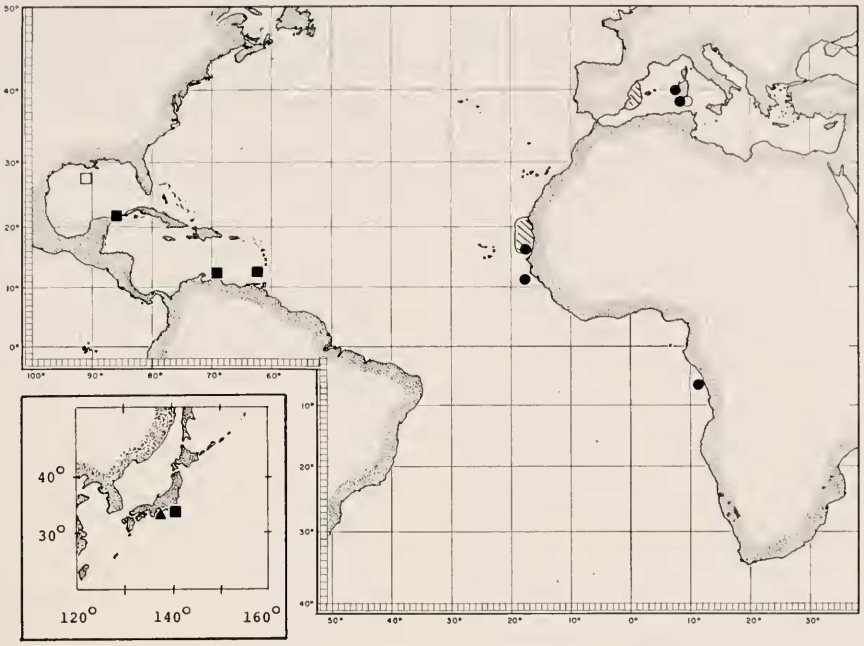

Figure 18. Distributions of *E. trewavasae* and *E. pectinifer*. Large map shows localities in the Atlantic; insert shows localities off Japan. *E. trewavasae:* ● individual haul of adults; ○ individual haul of juveniles; cross-hatching indicates areas of capture cited in the literature. *E. pectinifer:* ■ individual haul of adults; □ individual haul of juveniles; ▲ report from the literature.

gion light in small specimens, becoming black with age.

Description based on 13 specimens 70.9–153.9 mm SL.

Ontogenetic change. The most striking ontogenetic changes in *E. trewavasae* are associated with the development of adult tooth patterns. Large specimens bear irregular double or triple rows of premaxillary and mandibular teeth that taper to a single row posteriorly. Vomers are covered with minute conical teeth, while palatines are either edentulous or bear single to double rows of teeth.

Dentition patterns are simple in small specimens but become more complex as teeth are added during growth. A 29.8-mm juvenile lacks both premaxillary and mandibular teeth. By 70–75 mm SL teeth are present in single rows on the jaws, and by 145 mm SL adult tooth patterns prevail. As premaxillary tooth patches widen, they extend posteriorly and eventually cover the first half of the bone. Analogous expansion occurs in vomerine tooth patches.

Distribution. E. trewavasae is known from equatorial west Africa, northwest Africa, and the western Mediterranean (Fig. 18). It has been taken by bottom trawls between 200 and 600 meters.

Geographic variation. Statistical comparisons of African and Mediterranean *E. trewavasae* were not made because of small sample size. As additional material is collected, the following intraspecific differences should be examined:

(1) vomerine and palatine teeth more strongly developed in Mediterranean forms;
(2) chin nubs more strongly developed in African forms;
(3) preopercular serrations more strongly developed in Mediterranean forms.

Although the significance of these features

is unknown, they suggest that African and Mediterranean forms may represent separate subspecies.

Taxonomic notes. Pomatomichthys constanciae Giglioli, 1880 may be a synonym of *E. trewavasae* Poll, 1954. See *E. telescopus*: Taxonomic notes, for a discussion of this possibility.

Remarks. Dieuzeide (1950: 104–105) reported that specimens designated as *Glossamia pandionis* by Lozano (1934) and Navarro et al. (1943) were actually misidentified *E. denticulatus*. This is incorrect. Lozano's report is based on a single specimen (131 mm total length) taken from the Catillian coast. Among the characters cited for this fish are dorsal fin counts of VII–I,9, pectoral counts of 16, and an AII subequal to the eye diameter (p. 89). All of these are characters diagnostic of *E. trewavasae*. *E. denticulatus* bears 10 rays in the second dorsal fin, 18–20 pectoral rays, and an AII equalling half the eye diameter.

Navarro et al.'s specimens also appear to be *E. trewavasae*. Although no description is provided, the account includes a photograph (plate XXII, fig. A) that shows the fish have deep bodies, pungent opercular spines, and long D_2I, AII, and P_2I's. All of these features are characteristic of *E. trewavasae*.

More recently, Maurin (1968) mistook *E. trewavasae* for *E. pandionis*. Proportional measurements of body depth, head height, AII, and P_2I made on Maurin's figure 36 (p. 69) fall within ranges characteristic of *E. trewavasae*; however, published gill raker counts of 28–30 (p. 70) are lower than expected.

Common names. None.

Epigonus pectinifer sp. nov.
Figure 19

Holotype: A 114.3-mm SL specimen taken from the Caribbean west of Grenada by M/V OREGON, Sta. 5043: 26 September 1964, 12°01′N, 61°53.5′W, 210–250 fms., 40′ shrimp trawl. USNM 207725.

Paratypes: One specimen, 97.4 mm SL, 16 September 1964, Suruga Bay, commercial trawl. ABE 64–2085.

One specimen, 100.6 mm SL, 14–31 October 1964, Suruga Bay, commercial trawl. ABE 64–2245.

One specimen, 99.8 mm SL, 14–31 October 1964, Suruga Bay, commercial trawl. ABE 64–2248.

Two specimens, 95.2–117.1 mm SL, station data identical with those of holotype. MCZ 48850.

One specimen (cleared and stained), 108.1 mm SL, station data identical with those of holotype. MCZ 48851.

One specimen, 94.8 mm SL, R/V PILLSBURY, Sta. P–582: 23 May 1967; 21°10′N, 86°18′W; 250–155 fms.; 10′ otter trawl. UMML 30378.

One specimen, 111.2 mm SL, M/V OREGON, Sta. 4405: 27 September 1963; 11°53′N, 69°28′W; 215 fms.; 40′ flat trawl. USNM 207726.

Ten specimens, 101.8–120.6 mm SL, station data identical with those of holotype. USNM 207727.

Nine specimens 81.5–118.9 mm SL, station data identical with those of holotype. USNM 207728.

Two specimens (cleared and stained), 94.8–98 mm SL, station data identical with those of holotype. USNM 207729.

Epigonus robustus, Matsubara (not Barnard, 1927), 1936: 121, fig. 1B; Kamohara, 1952: 37.

Diagnosis. E. pectinifer is characterized by comb-like gill rakers on the lower half of the first gill arch. This feature, together with glossohyal dentition (present in most specimens) and vertebral counts of 10 + 15, differentiate *E. pectinifer* from *E. robustus*, *E. lenimen*, and *E. crassicaudus*. *E. pectinifer* most closely resembles *E. trewavasae* but is distinguished by less extensive lingual dentition, fewer gill rakers (26–30), and shorter D_2I and AII (11.2–12.7% SL and 11.9–14.0% SL respectively). *E. pectinifer* may be separated from remaining congeners by its pungent, bony opercular spine, second dorsal fin counts of I,9, and pectoral fin counts of 15–18.

Description. Meristic values presented in Table 19; regression data for morphometric traits presented in Table 20.

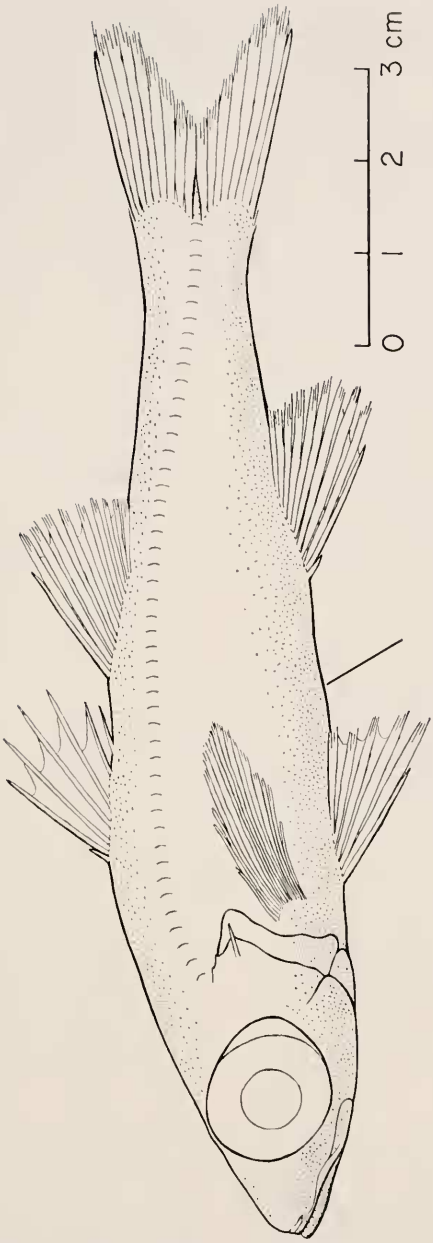

Figure 19. *Epigonus pectinifer*, PARATYPE, 111.4 mm SL, USNM 207727.

TABLE 19. *EPIGONUS PECTINIFER* MERISTIC DATA. $\overline{X}$ = MEAN; SD = STANDARD DEVIATION; n = NUMBER OF SPECIMENS.

	$\overline{X}$	Range	SD	n
Pectoral fin rays	16.03	15–18	0.57	29
Gill rakers	27.59	26–30	0.98	29
Lateral line scales	48.14	47–49	0.58	29
Pyloric caeca	6.10	5– 7	0.41	29

TABLE 20. *EPIGONUS PECTINIFER* REGRESSION DATA. b = REGRESSION COEFFICIENT ± 95% CONFIDENCE INTERVAL; a = Y INTERCEPT; n = NUMBER OF SPECIMENS. ALL REGRESSIONS ON SL.

	b	a	n
HL	0.35 ± 0.05	−2.21	27
Body depth	0.28 ± 0.03	−4.95	28
Head height	0.18 ± 0.03	−2.83	19
Eye diameter	0.17 ± 0.03	−3.18	28
Snout length	0.09 ± 0.03	0.03	26
Interorbital width	0.10 ± 0.03	−1.84	28
Maxillary length	0.17 ± 0.04	−2.10	26
Lower jaw length	0.15 ± 0.03	0.55	28
Caudal peduncle depth	0.84 ± 0.03	1.88	28
Caudal peduncle length	0.27 ± 0.04	−0.22	28
D_2 I	0.11 ± 0.02	0.62	24
A II	0.12 ± 0.02	0.32	24
P_2 I	0.11 ± 0.02	1.30	28

Body elongate; anterodorsal profile flat or slightly convex, rising without interruption from snout to base of first dorsal fin; body depth 21.1–24.6% SL; caudal peduncle narrow, length 25.1–28.7% SL.

Head short to moderate, 31.3–35.7% SL, shallow, 14.2–16.9% SL; snout wide, pointed; angle of gape small; lower jaw protruding slightly beyond upper jaw; nubs at anterior end of mandible paired, barely discernible, or absent. Maxilla reaching ⅓–½ eye length, posterior margin narrow, rounded, or bearing posteriormost point near midline of bone; short, pungent, mustache-like process projecting from posteroventral surface of maxillary head. Eye round or slightly oval, 38.7–45.4% HL; anterodorsal rim of orbit not

reaching profile; interorbital width 7.7–9.4% SL.

Teeth small, conical; premaxilla edentulous or bearing teeth anteriorly; when present, teeth 1–15, arranged in single row. Mandibular teeth covering all or part of dentary, arranged in single row. Vomerine teeth strong, arranged in tightly packed oval patch. Palatines edentulous or bearing teeth anteriorly; when present, teeth 1–6, arranged in single row; tongue with glossohyal teeth, rarely edentulous.

Opercular spine pungent, bony, ventral to 2–3 horny spinelets; spine and spinelets separated by large gap; spinelets occasionally obscured by underlying membranes. Preopercular angle narrowly produced, serrated; subopercle and interopercle unserrated or weakly serrated. Gill rakers pectinate, bearing nub-like projections proximally along mesial surfaces (Fig. 1C); pectinate structure variable in extent, most prominent on ventral portions of gill arch.

First dorsal fin VII (28); second dorsal fin I,9 (29); anal fin II,9 (29); D_1I short, 1.6–2.8% SL; D_2I moderate, 11.2–12.7% SL; AII, P_2I, 11.9–14.0% SL.

Vertebrae 10 + 15 (29); epipleural ribs 6 (17), 7 (13), inserting on vertebrae 1–6 or 1–7 respectively; pleural ribs 8 (29), inserting on vertebrae 3–10.

Color in alcohol brown-black; fin membranes black; scale pockets covered with densely packed melanophores; skin often abraded, revealing underlying yellow-pink tissue; iris black; branchial region white to dark gray; mouth light.

Description based on 30 specimens 81.5–120.6 mm SL.

Ontogenetic change. A 33.8-mm *E. pectinifer* was taken by bottom trawl in the Gulf of Mexico (USNM 207731). The specimen appears similar to adults and provides little evidence of ontogenetic change. The major difference is the presence of six rather than seven first dorsal fin spines.

Distribution. E. pectinifer is known from the Caribbean Sea, Gulf of Mexico, and eastern coast of Japan (Fig. 18). Specimens were taken between 280 and 550 meters.

Geographic variation. Definitive comparisons of Japanese and American *E. pectinifer* were not undertaken, because only three oriental specimens were available for study. The latter forms were, however, individually compared with American fish. The analyses revealed virtually no differences between the populations aside from a slight tendency toward broader caudal peduncles and shorter maxillae and mandibles by the Japanese specimens.

Remarks. A teratological specimen of *E. pectinifer* was taken from the Yucatan Channel (109 mm SL, UMML 30379). The fish was captured at depths characteristic of *E. pectinifer* and bears diagnostic traits such as 27 gill rakers (many are pectinate), VII + I dorsal fin spines, 16 pectoral fin rays, and 10 + 15 vertebrae. The tongue is edentulous. Unlike the condition in typical forms, opercles are not fully ossified and lack spines and spinelets. Similarly, the lateral line is incomplete on the right side and bears only 43 pored scales on the left. Other differences include enlarged teeth and chin nubs, 10 rather than 9 dorsal rays, and 8 rather than 5–7 pyloric caeca.

The aberrant specimen was not considered in preparing the species description.

Etymology. Pectinifer (Latin), comb-bearer, from *pecten*, comb, and *ferare*, to bear; a noun in apposition, refers to the comb-like gill rakers characterizing this species.

Common names. None.

Epigonus robustus (Barnard, 1927)
Figure 20

Epigonus macrops Gilchrist and von Bonde, 1924: 14, plate I, fig. 3 (original description; S.S. PICKLE Sta. 344, 30°12′00″S, 14°25′00″E, 510 fms.; Sta. 347, 31°58′00″S, 16°00′00″E, 670 fms.; syntype examined, RUSI 669; name suppressed, junior homonym of *Oxyodon macrops* Brauer, 1906); Barnard, 1927: 523; Smith, 1961: 377, fig. 2.

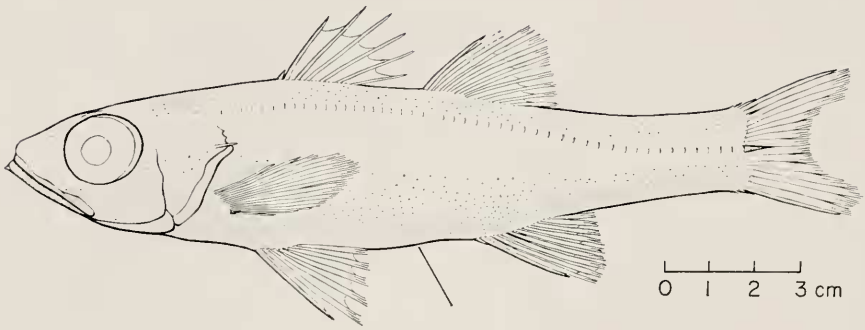

Figure 20. *Epigonus robustus*, 154.6 mm SL, LACM 11449-7.

Parahynnodus robustus Barnard, 1927: 525, plate XXII, fig. 4 (original description; off Cape Point, 460 fms.; holotype in poor condition, not examined, SAM 13080).
Hynnodus robustus Smith, 1949b: 210, fig. 495.

Diagnosis. *E. robustus* strongly resembles *E. pectinifer*, *E. trewavasae*, and *E. lenimen*. It may be distinguished from the former two species by the absence of lingual teeth. In addition, unlike *E. pectinifer*, it has awl-like gill rakers. *E. robustus* differs from *E. lenimen* by having a narrow interorbital region (6.5–8.2% SL), short D_2I (10.0–12.6% SL) and short AII (9.2–13.3% SL). *E. robustus* may be distinguished from *E. crassicaudus* by the former's short head (28.0–34.0% SL) and shallow body (20.3–24.6% SL). It differs from remaining congeners by bearing a pungent, bony opercular spine, vertebral count of 11 + 14, and nine rays in the second dorsal fin.

Description. Meristic values presented in Table 21; regression data for morphometric traits presented in Table 22.

Body elongate, moderately compressed; anterodorsal profile weakly convex, rising without interruption from tip of snout to base of first dorsal fin; body depth 20.3–24.6% SL; caudal peduncle moderate to long, 25.3–30.7% SL.

Head short, shallow, length 28.0–34.0% SL, height 14.8–16.3% SL; snout short, pointed; angle of gape moderate to large; lower jaw protruding beyond upper jaw, bearing two nubs of variable prominence on anterior surface of mandible. Maxilla reaching ⅓–½ eye length; posterior margin of maxilla narrow, rounded or bearing posteriormost point near midline of bone; small, weak mustache-like process projecting from posteroventral surface of maxillary head. Eye round to oval, small, 37.4–42.4% HL; anterodorsal rim of orbit not reaching dorsal profile; interorbital region narrow, 6.5–8.2% SL.

Teeth small, conical; premaxilla edentulous or bearing single row of teeth on anterior half of bone; mandibular dentition covering all or part of dentary, arranged in double row anteriorly, tapering to single row posteriorly; vomer bearing 1–6 irregular rows of teeth; palatines edentulous or bearing teeth on anterior half of bone; tongue edentulous.

Opercular spine pungent, bony, ventral to 2–3 membranous or horny spinelets; spine separated from spinelets by wide gap; spinelets often obscured by underlying membranes. Preopercular angle not produced, serrations on posterior and/or ventral surfaces of bone rarely absent; subopercle and interopercle serrated. Gill rakers simple, awl-like.

First dorsal fin VI (1), VII (27), VIII (1); second dorsal fin I, 9 (28), II, 8 (1); anal fin II, 9 (29). D_1I short, 1.4–2.5% SL; D_2I, AII, P_2I moderate to long, 10.0–12.6%, 9.2–13.3%, 11.7–15.3% SL respectively.

Vertebrae 11 + 14 (29); epipleural ribs

Table 21. *Epigonus robustus* meristic data. $\overline{X}$ = mean; SD = standard deviation; n = number of specimens.

	$\overline{X}$	Range	SD	n
Pectoral fin rays	16.79	16–18	0.55	29
Gill rakers	31.68	30–33	0.93	29
Lateral line scales	48.76	47–50	0.91	29
Pyloric caeca	6.36	5–8	0.78	28

Table 22. *Epigonus robustus* regression data. b = regression coefficient ± 95% confidence interval; a = Y intercept; n = number of specimens. All regressions on SL.

	b	a	n
HL	0.28 ± 0.02	5.35	28
Body depth	0.28 ± 0.02	−7.80	28
Head height	0.17 ± 0.02	−1.65	20
Eye diameter	0.11 ± 0.01	2.44	28
Snout length	0.06 ± 0.02	1.80	23
Interorbital width	0.09 ± 0.01	−1.97	28
Maxillary length	0.12 ± 0.01	2.14	24
Lower jaw length	0.14 ± 0.01	1.27	27
Caudal peduncle depth	0.13 ± 0.01	−1.69	28
Caudal peduncle length	0.25 ± 0.02	5.32	28
D_2 I	0.08 ± 0.02	5.49	21
A II	0.07 ± 0.02	8.18	15
P_2 I	0.09 ± 0.02	6.74	24

6 (2), 7 (8), inserting on vertebrae 1–6 or 1–7 respectively; pleural ribs 9 (29), inserting on vertebrae 3–11.

Color variable with preservation, pale yellow to rust brown; scale pockets outlined by small black or brown melanophores; opercular region tinged with black; iris black; mouth light, mottled with brown or black melanophores; branchial region black. Body very oily; body cavity filled with rust brown fat globules; viscera and swimbladder often completely enveloped in fat.

Description based on 29 specimens 121.1–198.0 mm SL.

Distribution. Most specimens of *E. ro-*

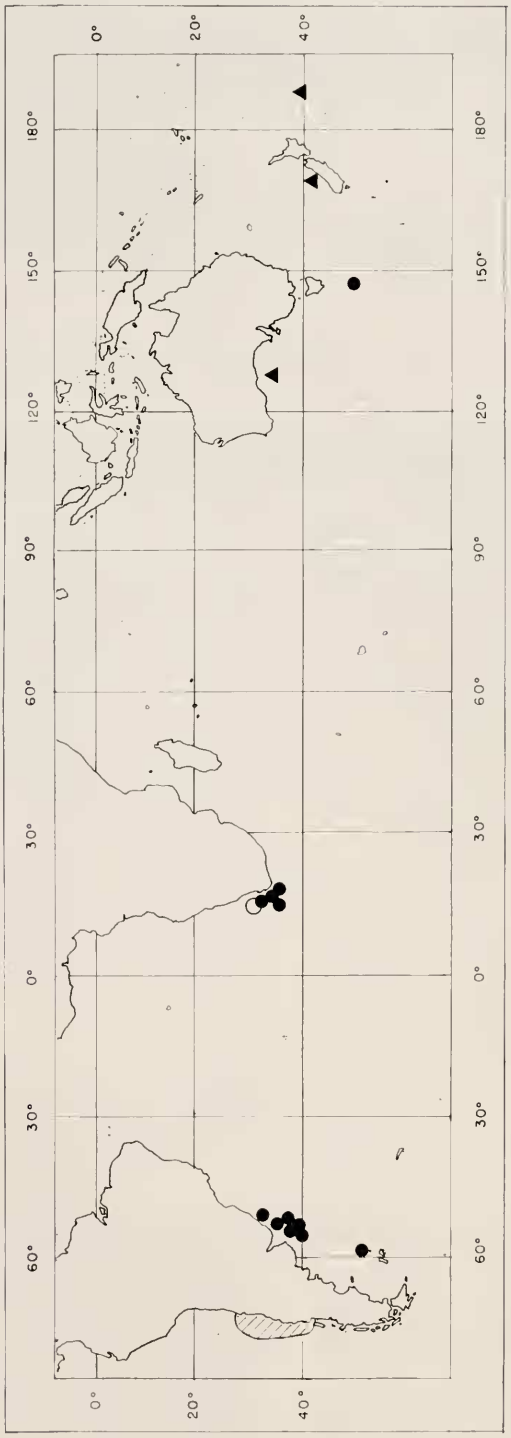

Figure 21. Distributions of *E. robustus*, *E. lenimen*, and *E. crassicaudus*. ● individual haul of *E. robustus* adults; ○ individual haul of *E. robustus* juveniles; ▲ individual haul of *E. lenimen*; cross-hatching indicates range of *E. crassicaudus*.

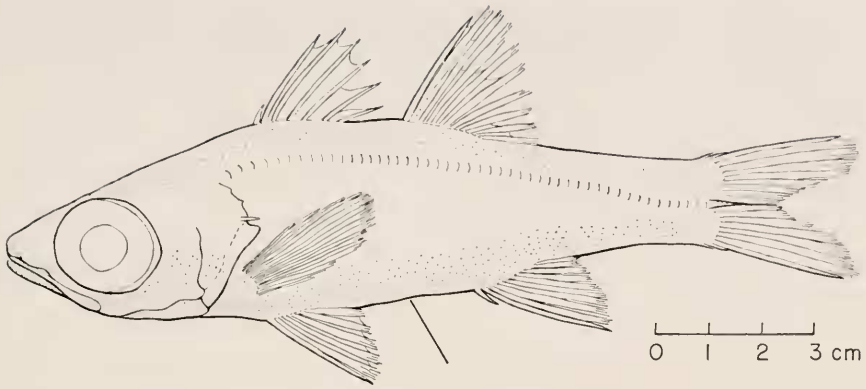

Figure 22. *Epigonus lenimen*, 139.0 mm SL, UZM P45165.

bustus have been taken by bottom trawls between 800 and 1225 meters off southeastern South America, South Africa, and Australia (see Fig. 21). One specimen (ISH 430/71) was taken by a deep pelagic trawl.

Geographic variation. No investigation was undertaken because insufficient material was available from South Africa and Australia.

Taxonomic notes. Epigonus macrops Gilchrist and von Bonde, 1924 was described from two syntypes; the larger was 198 mm (SL?). These specimens, together with many others collected by the Fisheries and Marine Biological Survey, were lost while being transferred to the South African Museum. A portion of the material was subsequently rediscovered at Rhodes University, Grahamstown. From the contents Smith (1961: 378) described a specimen that he believed to be "Gilchrist and von Bonde's type of *macrops* from 600 fathoms off St. Helena Bay." This fish was re-examined during the present study.

Smith's specimen measures 162.2 mm SL and thus cannot be the larger syntype; however, it conforms to the descriptions and proportions supplied by Gilchrist and von Bonde and probably represents the smaller type for which no length was published.

An unusual aspect of the syntypes is that the locations at which they were captured will never be precisely known. The specimens were taken at different stations. Although these are recorded in both the original description of *E. macrops* and in the 1921 report of the Fisheries and Marine Biological Survey (Gilchrist, 1922), neither account specifies which data are associated with which syntype.

Common names. None.

Epigonus lenimen (Whitley, 1935)
Figure 22

Scepterias lenimen Whitley (in part), 1935: 230 (original description; Great Australian Bight: south from Eucla, 350–450 fms.; holotype examined, AM E3368); Whitley, 1940: 420, fig. 33; Whitley (in part), 1968: 56.
Epigonus lenimen Scott, 1962: 191, 1 fig.

Diagnosis. E. lenimen is distinguished from *E. robustus* and *E. crassicaudus* by its broad interorbital region (8.7–10.2% SL), long D_2I (14.9–18.7% SL), and large eyes (40.0–51.1% HL). It is further differentiated from *E. crassicaudus* by shorter head lengths (32.7–36.6% SL) and shallower head heights (16.2–18.8% SL). *E. lenimen* lacks lingual teeth but has 11 + 14 vertebrae and thus may be distinguished from *E. trewavasae* and *E. pectinifer*. Unlike remaining congeners, *E. lenimen* bears a pungent, bony opercular spine, nine second dorsal fin rays, and 16–18 pectoral fin rays.

Table 23. *Epigonus lenimen* meristic data. $\overline{X}$ = mean; SD = standard deviation; n = number of specimens.

	$\overline{X}$	Range	SD	n
Pectoral fin rays	16.96	16–18	0.58	28
Gill rakers	30.29	28–34	1.27	24
Lateral line scales	48.12	47–50	0.91	26
Pyloric caeca	7.33	7–9	0.56	24

Table 24. *Epigonus lenimen* regression data. b = regression coefficient ± 95% confidence interval; a = Y intercept; n = number of specimens. All regressions on SL.

	b	a	n
HL	0.35 ± 0.01	−0.12	29
Body depth	0.28 ± 0.02	−3.32	27
Head height	0.19 ± 0.01	−1.08	27
Eye diameter	0.18 ± 0.01	−1.60	27
Snout length	0.08 ± 0.01	0.31	27
Interorbital width	0.10 ± 0.01	−0.59	26
Maxillary length	0.16 ± 0.01	0.08	27
Lower jaw length	0.16 ± 0.01	0.55	28
Caudal peduncle depth	0.11 ± 0.01	−0.14	28
Caudal peduncle length	0.24 ± 0.02	2.26	26
D_2 I	0.17 ± 0.02	−0.79	18
A II	0.21 ± 0.02	−2.36	22
P_2 I	0.19 ± 0.01	−2.13	28

Description. Meristic values presented in Table 23; regression data for morphometric traits presented in Table 24.

Body elongate; anterodorsal profile flat or weakly concave, rising without interruption to first dorsal fin, more steeply inclined behind occiput in large specimens; body moderate to deep, 21.5–27.5% SL; caudal peduncle moderate to long, 23.6–29.3% SL. Head length 32.7–36.6% SL; head height 16.2–18.8% SL; snout moderately pointed; angle of gape moderate, variable with age; lower jaw protruding slightly or not at all; no prominent nubs on anterior surface of mandible. Maxilla reaching ⅓–½ eye length; posterior margin

Table 25. Comparison of *E. lenimen* paratypes with specimens of *E. lenimen* and *E. denticulatus*. Paratype meristics reported as value, followed in parentheses by number of specimens exhibiting that value. Ratios are expressed as percentages.

	E. lenimen	E. lenimen paratypes	E. denticulatus
Dorsal fin rays	8 — 9	9(1), 10(11)	10
Pectoral fin rays	16 — 18	19(6), 20(6)	18 — 20
Vertebrae	11 + 14	10 + 15	10 + 15
Pyloric caeca	7 — 9	10(1), 11(3) 12(7)	10 — 14
BH/SL	21.5 — 27.5	18.4 — 21.7	15.8 — 23.6
D_2 I/SL	14.9 — 18.7	6.0 — 7.6	5.3 — 8.0
A II/SL	13.0 — 20.8	6.2 — 7.1	6.0 — 8.2
P_2 I/SL	12.5 — 18.7	8.5 — 9.9	7.9 — 10.0

of maxilla narrow, rounded, or bearing posteriormost point near midline of bone; weak mustache-like process projecting from posteroventral surface of maxillary head, process occasionally absent. Eye large, oval, 40.0–51.1% HL; anterodorsal rim of orbit reaching dorsal profile; interorbital width 8.7–10.2% SL.

Teeth small, conical; premaxilla edentulous or bearing single row of teeth occupying anterior half of bone. Mandible edentulous or bearing single row of teeth occupying up to ¾ of dentary; tooth row occasionally double near symphysis. Vomer edentulous or bearing up to seventeen teeth arranged in diamond-shaped patch or in 1–3 irregular rows; palatines edentulous or bearing 1–2 teeth anteriorly; tongue edentulous.

Opercular spine pungent, bony, ventral to 1–5 (usually 2) membranous or horny spinelets; spine and spinelets separated by wide gap; spinelets frequently obscured by underlying membranes. Preopercular angle narrowly produced, occasionally serrated; subopercle and interopercle unserrated or weakly serrated. Gill rakers simple, awl-like.

First dorsal fin VII (29); second dorsal fin I,8 (1), I,9 (28); anal fin II,8 (2), II,9 (26); D_1I moderate, 2.0–4.1% SL; D_2I, AII long, 14.9–18.7%, 13.0–20.8% SL respectively; P_2I moderate to long, 12.3–18.7% SL.

Vertebrae 11 + 14 (29); epipleural ribs 6 (6), 7 (12), 8 (2), inserting on vertebrae 1–6, 1–7, or 1–8 respectively; pleural ribs 9 (28), inserting on vertebrae 3–11.

Color in alcohol variable; skin often abraded, revealing underlying pale pink-yellow tissue; fin membranes and scale pockets mottled with numerous black melanophores; head, opercular region, and fin bases deep rust brown. Guanine deposits variable, occurring on ventral portions of opercular region, isthmus, pectoral and pelvic fin bases, and abdomen to anus; silver chromatophores on dorsal, anal, pectoral, or pelvic fin rays; iris black with silver highlights; mouth light, dotted with melanophores; branchial region light in small specimens, blackening with age.

Description based on 32 specimens 40.0–147.8 mm SL.

Distribution. *E. lenimen* is known from three localities (Fig. 21). The holotype

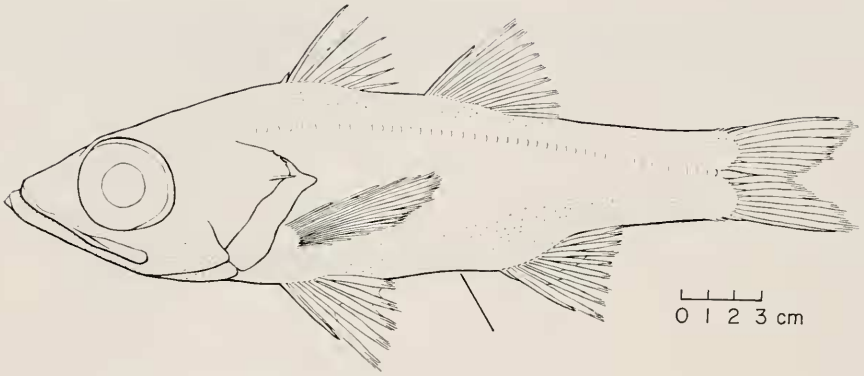

Figure 23. *Epigonus crassicaudus*, 259.0 mm SL, MCZ 48855.

was taken south of Australia between 622 and 823 meters. Remaining specimens were taken off New Zealand between 530 and 660 meters.

Taxonomic notes. Although G. P. Whitley was the first to describe *E. lenimen* (1935), inaccuracies in his papers have produced several problems. The most serious involve the type series and type locality of the species.

The original description of *E. lenimen* designates a holotype and nine paratypes. A figure of the new form was not included but was published in a subsequent paper (Whitley, 1940: fig. 33). Both the description and the illustration were based exclusively on the holotype. Whitley realized that the paratypes were different from the holotype but considered them to be poorly preserved specimens (Whitley, 1935: 320).

A re-examination of the type series reveals that the paratypes are not conspecific with the holotype. They are, instead, members of *E. denticulatus*. As is shown in Table 25, counts and measurements from the paratypes always fall within ranges characteristics of *E. denticulatus*. Pectoral fin counts, vertebral number, pyloric caecum counts, and fin spine lengths are particularly noteworthy in this respect. The paratypes further resemble *E. denticulatus* by bearing dentigerous palatines and weak opercular armor. *E. lenimen*, on the other hand, is characterized by edentulous palatines and pungent opercular spines.

Confusion over the type locality stems from Whitley's 1940 paper. The locality is cited as "from 190–320 fathoms, S.W. from Eucla, Great Australian Bight [p. 420]." This contradicts the data presented in the original description: "Great Australian Bight; south from Eucla, 350 to 450 fathoms [p. 231]." The 1940 citation is extremely similar to station data listed for paratypes AM E3581–3582 in 1935 ("Great Australian Bight; SW from Eucla, 190–320 fathoms. 126° 45½′E long. [p. 231]"). In the absence of other information, it must be concluded that erroneous locality data were inserted in the 1940 publication through an editorial oversight.

The most recent taxonomic questions arise from Whitley's check list of New Zealand fishes (1968). This work includes two incorrect citations in the synonymy of *E. lenimen*. The first is based on a fish taken off the Chatham Islands and tentatively identified as *Hynnodus atherinoides* (Moreland, 1957). This specimen was later re-identified as *Grahamichthys radiatus* (Moreland, personal communication). The second misidentified specimen is a "Big-eyed Cardinal Fish" captured off Cape Palliser, New Zealand (Anonymous, 1961). This fish is actually a specimen of *E. telescopus* and is presently in the collec-

tions of the Dominion Museum (DM 3072, examined).

Common names. None.

Epigonus crassicaudus de Buen, 1959
Figure 23

Epigonus crassicaudus de Buen, 1959: 196 (original description; preabysmal zone off Valparaiso, Chile; holotype not examined, EBM 10.183).

Diagnosis. E. crassicaudus is strongly compressed. It reaches 260–270 mm SL and is the second largest species in the genus. *E. crassicaudus* may be distinguished from *E. trewavasae*, *E. pectinifer*, *E. robustus*, and *E. lenimen* by its deep head (18.9–21.2% SL) and deep body (24.3–32.0% SL). It differs from remaining congeners by bearing 9 rays in the second dorsal fin and 6–7 pyloric caeca.

Description. Meristic values presented in Table 26; regression data for morphometric traits presented in Table 27.

Body elongate, compressed; anterodorsal profile rising from tip of snout to occiput, becoming moderately convex from occiput to base of first dorsal fin. Body deep, 24.3–32.0% SL; caudal peduncle broad, moderate to short, 21.6–26.4% SL.

Head long, deep, postorbital portion greatly expanded, length 36.8–41.9% SL; height 18.9–21.2% SL; snout moderately pointed in small specimens, blunt in adults; angle of gape moderate to small; mandible long, strongly protuberant, young bearing two weak nubs on anterior surface of lower jaw. Maxilla reaching ⅓–½ eye length; posterior margin of maxilla broad, rounded or bearing posteriormost point between midline and ventral surface of bone. Eye round, small, 34.2–39.6% HL; surrounded by numerous small scale pockets; anterodorsal rim of orbit reaching dorsal profile; interorbital region narrow, 6.2–8.5% SL.

Teeth small, conical, occasionally villiform, larger in small specimens; premaxillary teeth arranged in irregular single or double rows tapering to single row posteriorly and covering from ⅓ to entire length of bone; mandibular teeth arranged in multiple rows, tapering to single row posteriorly, covering from ½ to entire length of dentary; vomer edentulous or bearing up to six irregular rows of minute teeth; palatines edentulous or bearing 1–3 teeth anteriorly; tongue edentulous.

Opercular spine pungent, bony, ventral to 3–5 flat, horny spinelets; spine separated from spinelets by narrow gap; spinelets often obscured by underlying membranes. Preopercular angle slightly produced, posterior and/or ventral surfaces serrated; subopercles and interopercles serrated. Gill rakers awl-like, short; gill filaments long.

First dorsal fin VII (22); second dorsal fin I,9 (20), I,10 (2); anal fin II,8 (1), II,9 (21); D_1I 2.0–3.6% SL; D_2I 9.8–13.2% SL; AII 10.3–14.0% SL; P_2I 13.0–15.5% SL.

Vertebrae 11 + 14 (25); epipleural ribs 6 (2), 7 (16), inserting on vertebrae 1–6 or 1–7 respectively; pleural ribs 9 (25), inserting on vertebrae 3–11.

Color in alcohol variable with preservation; skin frequently abraded, exposing underlying pink tissue and orange-rust fat deposits; skin extremely oily; fin membranes black; scale pockets mottled with numerous black melanophores; dorsal portion of body darker than ventral; forehead, snout, anterior half of mandible, and circumorbital area heavily invested with black pigment; opercles black or slate gray. Guanine deposits occasionally on opercles, isthmus, pectoral and pelvic fin bases, and abdomen to anal fin; iris variable—black, silver, or black with silver highlights; mouth and branchial region light, darkening with age.

Description based on 27 specimens 80.3–262.5 mm SL.

Ontogenetic change. Two juvenile *E. crassicaudus* (12.2 mm SL, MCZ 48857, and 21.7 mm SL, MCZ 48858) were taken off the Chilean coast by midwater trawl. Although these forms bear characteristics diagnostic of the species, they differ con-

TABLE 26. *EPIGONUS CRASSICAUDUS* MERISTIC DATA. $\overline{X}$ = MEAN; SD = STANDARD DEVIATION; n = NUMBER OF SPECIMENS.

	$\overline{X}$	Range	SD	n
Pectoral fin rays	18.05	17–19	0.58	22
Gill rakers	32.27	31–34	0.70	22
Lateral line scales	47.86	46–49	0.85	21
Pyloric caeca	6.87	6– 7	0.35	15

TABLE 27. *EPIGONUS CRASSICAUDUS* REGRESSION DATA. b = REGRESSION COEFFICIENT ± 95% CONFIDENCE INTERVAL; a = Y INTERCEPT; n = NUMBER OF SPECIMENS. ALL REGRESSIONS ON SL.

	b	a	n
HL	0.39 ± 0.02	0.47	20
Body depth	0.30 ± 0.04	−3.75	21
Head height	0.21 ± 0.02	−1.62	18
Eye diameter	0.14 ± 0.01	0.74	21
Snout length	0.08 ± 0.01	0.08	19
Interorbital width	NONLINEAR		
Maxillary length	0.17 ± 0.01	−0.49	20
Lower jaw length	0.20 ± 0.01	−1.17	22
Caudal peduncle depth	0.12 ± 0.01	−0.65	20
Caudal peduncle length	0.22 ± 0.03	4.32	20
D_2 I	0.10 ± 0.02	3.34	12
AII	0.11 ± 0.02	2.63	17
P_2 I	0.14 ± 0.01	0.05	16

siderably in appearance and habit from adults.

Most striking is the juvenile pigment pattern. Pelagic specimens are basically pale yellow with large, brown patches covering most of the caudal peduncle. Caudal peduncle rings, like those found on *E. pandionis* young, are absent, although myotomes are outlined by thin brown bands. Brown pigment extends anteriorly as a band from the caudal peduncle to the frontal region of the head. A poorly defined black stripe extends across the snout to the anterior rim of the orbit. In general, juvenile *E. crassicaudus* resemble *E. telescopus* young figured by Koefoed (1952: plate IIA).

The midwater capture of *E. crassicaudus*

juveniles suggests that the life cycle of the species includes a pelagic stage. Unfortunately, the data available are not sufficient to determine the duration of this stage.

Distribution. *E. crassicaudus* is endemic to the waters off central Chile (Fig. 21). Adults have been captured by bottom trawls made between 200 and 400 meters; juveniles were taken by midwater trawls fishing from 200 to 270 meters.

Common names. None.

Species *Incertae Sedis*

Microichthys coccoi Rüppell, 1852: 1 (original description; "Mare siculum"; holotype not examined, SMF 1069).

The original description of *M. coccoi* provides only a superficial account of the holotype. Subsequent papers either paraphrase Rüppell's work (*e.g.*, Canestrini, 1860; Döderlein, 1889) or are based on material not compared to the holotype (*i.e.*, Facciola, 1900; Caporaicco, 1926; Gonzales, 1946). It is questionable whether the latter specimens are conspecific with the holotype.

Most recent revisers (*e.g.*, Schultz, 1940; Norman, 1957) have synonymized *Microichthys* with *Apogon*; however, the data are inconclusive and also suggest an affinity with *Epigonus* (Fraser, 1972: 5). A reexamination of the holotype must be undertaken to clarify the status of *M. coccoi*.

A second species of *Microichthys*—*M. sanzoi* Spartà, 1950—does not appear to be an *Epigonus* on the basis of vertebral and dorsal fin counts. The only known specimen of this species has been lost (Tortonese, personal communication).

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LITERATURE CITED

Anonymous. 1961. Caught only 3 times before. Wellington Evening Post.

Bailey, N. T. 1959. Statistical Methods in Biology. New York: John Wiley and Sons, Inc. 200 pp.

Barnard, K. H. 1927. A monograph of the marine fishes of South Africa, Part II. Ann. South African Mus., **12**(2): 419–1065.

Bauchot, M. L., and M. Blanc. 1961. Poissons marins de l'Est Atlantique Tropical, II. Percoidei (Téléostéens Perciformes) 1ère partie. Atlantide Rep. No. 6: 65–100.

Bertolini, F. 1933. Apogonidae. Fauna e flora del Golfo di Napoli. Uova, larve e stadi giovanili di Teleostei. Pubbl. Staz. Zool. Napoli, **38**: 306–309.

Bini, G. 1968. Atlante dei Pesci delle Coste Italiane, Vol. IV. Roma: Mondo Sommerso Editrice. 163 pp.

Bleeker, P. 1876. Systema Percarum revisum. Pars I et II. Arch. Néerl. Sci., **11**: 274–340.

Brauer, A. 1906. Die Tiefsee-Fische. I. Systematischer Teil. Wiss. Ergeb. Deut. Tiefsee-Exped. "Valdivia," 1898–1899, **15**: 1–420.

Breder, C. M., and D. E. Rosen. 1966. Modes of Reproduction in Fishes. Garden City, N. Y.: Natural History Press. 941 pp.

Brown, M. E. 1957. Experimental studies on growth. *In* The Physiology of Fishes, Vol. 1, M. E. Brown (ed.). New York: Academic Press, Inc., pp. 361–400.

Buen, F. de. 1959. Notas preliminares sobre la fauna marina preabismal de Chile, con descripción de una familia de rayas, dos géneros y siete especies nuevos. Bol. Mus. Nac. Hist. Natur., **27**(3): 171–201.

Canestrini, J. 1860. Zur Systematik der Percoiden. Verh. Zool. Bot. Ver. Wien, **10**: 291–314.

Capello, F. de B. 1868. Peixes novos de Portugal e da Africa occidental e caractéres distinctivos d'outras especies já conhecidas. J. Sci. Math. Phys. Natur. Acad. Real Sci. Lisboa, **1**(2): 154–169.

Caporaicco, L. di. 1926. Il cranio de "Microichthys coccoi" Rüpp. Monit. Zool. Ital., **37**(6): 127–132.

Cligny, A. 1903. Poissons des Côtes d'Espagne et de Portugal (Océan Atlantique). Première partie. Boulogne. 30 pp.

Cocco, A. 1829. Su di alcuni nuovi pesci de' mari di Messina. Giorn. Sci. Lett. Art. Sicil., **7**(77): 138–147.

———. 1885. Indice Ittiologico del Mare di Messina. Nat. Sicil., **4**(4): 85–88.

Cuvier, G. 1828. Des pomatomes. *In* Histoire Naturelle des Poissons, Tome Second, G. Cuvier and A. Valenciennes. Paris: F. G. Levrault, pp. 169–174.

Dieuzeide, R. 1950. Sur un *Epigonus* nouveau de la Méditerranée (*Epigonus denticulatus*, nov. sp.). Bull. Sta. Aquic. Pêche Castiglione, N.S., No. 2: 89–105.

———, M. Novella, and J. Roland. 1953. Catalogue des poissons des Côtes algériennes. II. Ostéoptérygiens. Bull. Sta. Aquic. Pêche Castiglione, N.S., No. 5: 1–258.

Dixon, W. J. (ed.). 1967. BMD Biomedical Computer Programs. Univ. Calif. Publ. Automatic Computation No. 2. Berkeley: Univ. Calif. Press. 600 pp.

Döderlein, P. 1889. Manuale Ittiologico del Mediterraneo. Fascicolo IV. Palermo: Giornali di Sicilia. 188 pp.

Dons, C. 1938. Notes on fishes III. *Epigonus telescopus* (Risso), new to Norway. Det Kgl. Nor. Vidensk. Selsk. Forh., **11**(35): 141–142.

Ebina, K. 1931. Buccal incubation in the two sexes of a percoid fish, *Apogon semilineatus* T. & S. J. Imp. Fish. Inst. Tokyo, **27**(1): 19–21.

Ehrenbaum, E. 1928. Rare fishes in the North Sea. Nature (London), **121**(3053): 709.

Ekman, S. 1953. Zoogeography of the Sea. London: Sidgwick and Jackson, Ltd. 417 pp.

Facciola, L. 1900. Sul *Microichthys coccoi* Rüpp. Monit. Zool. Ital., **11**(5): 188–194.

Fowler, H. W. 1928. The fishes of Oceania. Mem. Bernice P. Bishop Mus., **10**: 1–540.

———. 1935. South African fishes received from Mr. H. W. Bell-Marley in 1935. Proc. Acad. Nat. Sci. Philadelphia, **87**: 361–408.

———. 1936. The marine fishes of West Africa

based on the collection of the American Museum Congo Expedition, 1909–1915. Bull. Amer. Mus. Nat. Hist., **70**(2): 607–1493.

———, and B. A. Bean. 1930. The fishes of the families Amiidae, Chandidae, Duleidae, and Serranidae obtained by the United States Bureau of Fisheries Steamer "Albatross" in 1907 to 1910, chiefly in the Philippine Islands and adjacent seas. Bull. U.S. Nat. Mus., **10**(100): 1–334.

Fraser, T. H. 1972. Comparative osteology of the shallow water cardinal fishes [Perciformes: Apogonidae] with reference to the systematics and evolution of the family. Ichthyol. Bull. J. L. B. Smith Inst. Ichthyol., Rhodes Univ., No. 34: 1–105.

Fuglister, F. C. 1960. Atlantic Ocean atlas of temperature and salinity profiles and data from the International Geophysical Year of 1957–1958. Woods Hole Oceanogr. Inst. Atlas Ser., 1: 1–209.

Gall, J. le. 1931. *Epigonus telescopus* Risso 1810. *In* Faune Ichthyologique. Copenhagen, Conseil Permanent International pour l' Exploration de la Mer, 2 pp.

Giglioli, E. H. 1880. Elenco dei Mammiferi, degli Uccelli e dei Rettili Ittiofagi Appartenenti alla Fauna Italica e Catalogo degli Anfibi e dei Pesci Italiani. Firenze: Stamperia Reale. 85 pp.

Gilbert, C. H. 1905. The deep-sea fishes of the Hawaiian Islands. *In* The Aquatic Resources of the Hawaiian Islands. II, D. S. Jordan and B. W. Evermann (eds.). Bull. U. S. Fish. Comm., **23**: 575–716.

Gilchrist, J. D. F. 1922. Report No. 2 for the year 1921. Fish. Mar. Biol. Surv. South Africa, Rep. No. 2: 1–84.

———, and C. von Bonde. 1924. Deep-sea fishes procured by the S. S. "Pickle" (Part II). Fish. Mar. Biol. Surv. South Africa, Rep. No. 3, Spec. Rep. VII: 1–24.

Gonzales, T. 1946. Contributo alla conoscenza dello sviluppo post-embrionale in *Microichthys coccoi*, Rüppell. Boll. Pesca Piscicolt. Idrobiol., Ser. 22, **1**(1): 39–46.

Goode, G. B., and T. H. Bean. 1881. Description of a new species of fish, *Apogon pandionis*, from deep water off the mouth of Chesapeake Bay. Proc. U. S. Nat. Mus., **4**: 160–161.

———, and ———. 1896. Oceanic Ichthyology. Washington, D. C.: Smithsonian Institution. 553 pp.

Gosline, W. A. 1961. The perciform caudal skeleton. Copeia, **1961**(3): 265–270.

———, and V. E. Brock. 1960. Handbook of Hawaiian Fishes. Honolulu: Univ. Hawaii Press. 372 pp.

Günther, A. 1859. Catalogue of the Fishes in the British Museum, Vol. I. London. 524 pp.

———. 1868. Report on a collection of fishes made at St. Helena by J. C. Melliss, Esq. Proc. Zool. Soc. London, pp. 225–228.

Haneda, Y., F. H. Johnson, and O. Shimomura. 1966. The origin of luciferin in the luminous ducts of *Parapriacanthus ransonneti*, *Pempheris klunzingeri*, and *Apogon ellioti*. *In* Bioluminescence in Progress, F. H. Johnson and Y. Haneda (eds.). Princeton: Princeton Univ. Press, pp. 533–545.

Holt, E. W., and W. L. Calderwood. 1895. Survey of fishing grounds, west coast of Ireland, 1890–1891. Report on the rarer fishes. Scient. Trans. R. Dublin Soc., Ser. 2, **5**: 361–524.

Hubbs, C. L., and K. F. Lagler. 1958. Fishes of the Great Lakes Region. Ann Arbor: Univ. Michigan Press. 213 pp.

Iwai, T. 1959. Notes on the luminous organ of the apogonid fish, *Siphamia majimai*. Ann. Mag. Natur. Hist., Ser. 13, **2**(21): 545–550.

Jordan, D. S. 1917. Notes on *Glossamia* and related genera of cardinal fishes. Copeia, No. 44: 46–47.

———, and C. H. Gilbert. 1882. Synopsis of the fishes of North America. Bull. U. S. Nat. Mus., **16**: 1–1018.

———, and E. K. Jordan. 1922. A list of the fishes of Hawaii, with notes and descriptions of new species. Mem. Carnegie Mus., **10**(1): 1–92.

Kamohara, T. 1952. Revised descriptions of the offshore bottom-fishes of Prov. Tosa, Shikoku, Japan. Rep. Kôchi Univ. Nat. Sci., No. 3: 1–22.

Koefoed, E. 1952. Zeomorphi, Percomorphi, Plectognathi. Rep. Sci. Res. Michael Sars N. Atl. Deep-Sea Exped. 1910, **4**, Pt. 2(2): 1–26.

Lowe, R. T. 1841. A synopsis of the fishes of Madeira; with principal synonyms, Portuguese names, and characters of the new genera and species. Trans. Zool. Soc. London, **2**(14): 173–200.

Lozano, L. 1934. Algunos peces pelágicos o de profundidad procedentes del Mediterráneo occidental. Bol. Soc. Españ. Hist. Natur., **34**: 85–92.

Matsubara, K. 1936. Biometry of two species of Japanese cardinal-fishes, with special reference to their taxonomy. J. Imp. Fish. Inst. Tokyo, **31**: 119–130.

Maurin, C. 1968. Écologie ichthyologiques des fonds Chalutables atlantiques (de la baie ibéro-marocaine à la Mauritanie) et de la Mediterranée occidentale. Thèses presentées à la Faculté des Sciences de l'Université de Nancy. No. d'Ordre: A. O. 2 182. 145 pp.

Mayer, G. F. 1972. Systematics, functional anatomy, and ecology of the cardinalfish genus *Epigonus* (Apogonidae). Ph. D. Thesis, Harvard University. 190 pp.

Mayr, E. 1969. Principles of Systematic Zoology. New York: McGraw-Hill, Inc. 428 pp.

Mead, G. W., and M. G. Bradbury. 1963. Names of bones. *In* Fishes of the Western North Atlantic, H. B. Bigelow and W. C. Schroeder (eds.). Mem. Sears Found. Mar. Res., **1**(3): 20–23.

Monod, T. 1968. Le complexe urophore des poissons téléostéens. Mém. Inst. Fondam. Afr. Noire, No. 81. 705 pp.

Moreau, E. 1881. Histoire Naturelle des Poissons de la France. Vol. II. Paris: G. Masson. 572 pp.

Moreland, J. 1957. Appendix 6: Report on the fishes. New Zealand Dep. Sci. Ind. Res. Bull., **122**: 34.

Navarro, F. de P. 1942. Nota preliminar sobre los peces de la costa de Africa, desde el Cabo Bojador à la Bahia de Tanit (Resultados de una compaña industrial de pesca d'arrastre). Bol. Real Soc. Españ. Hist. Natur., **40**(5–6): 189–214.

———, F. Lozano, J. M. Novaz, E. Otero, and J. Sáinz Pardo. 1943. La pesca d' arrastre en los fondos del Cabo Blanco y del Banco Arguín (Africa Sahariana). Trab. Inst. Españ. Oceanogr. Número 18. 225 pp.

Nobre, A. 1935. Descrição dos Peixes de Portugal. Vertebrados (mamiferos, reptis e peixes). I. Fauna Marinha de Portugal. Pôrto. 574 pp.

Norman, J. R. 1939. Fishes. Sci. Rep. John Murray Exped., **7**(1): 1–116.

———. 1957. A Draft Synopsis of the Orders, Families and Genera of Recent Fish and Fish-like Vertebrates. London: British Museum (Natural History). 649 pp.

Nowlin, W. D., jr., and H. J. McLellan. 1967. A characterization of the Gulf of Mexico waters in winter. J. Mar. Res., **25**(1): 29–59.

Osorio, B. 1898. Da distribuição geographica dos peixes e crustaceos colhidos nas possessões Portuguezos d'Afrique occidental e existentes no Museu Nacional de Lisboa. J. Sci. Math. Phys. Natur. Acad. Real Sci. Lisboa, Ser. 2, **5**: 185–202.

Pietschmann, V. 1930. Remarks on Pacific fishes. Bull. Bernice P. Bishop Mus., **73**: 1–24.

Poll, M. 1954. Poissons IV. Téléostéens acanthoptérygiens (première partie). Résultats scientifiques. Expédition Océanographique Belge dans les Eaux Côtières Africaines de l'Atlantique Sud (1948–1949), 4(3A): 1–390.

Radcliffe, L. 1912. Descriptions of fifteen new fishes of the family Cheilodipteridae, from the Philippine Islands and contiguous waters. Proc. U. S. Nat. Mus., **41**(1868): 431–446.

Rafinesque, C. S. 1810. Indice d' Ittiologia Siciliana; Ossia, Catalogo Metodico dei Nomi Latini Italiani, e Siciliani dei Pesci, che si Rinvengono in Sicilia: Disposti Secondo un Metodo Naturale e Seguito da un Appendice che Contiene la Descrizione di Alcuni Nuovi Pesci Siciliani. Messina: Presso Giovanni del Nobolo. 70 pp.

Risso, A. 1810. Ichthyologie de Nice ou Histoire naturelle des poissons du départment des Alpes Maritimes. Paris: Chez F. Schoell. 388 pp.

Royce, W. R. 1957. Statistical comparison of morphological data. *In* Contributions to the Study of Subpopulations of Fishes, J. C. Marr (coordinator). U. S. Fish. Wildl. Serv. Spec. Sci. Rep. Fish., No. 208: 7–28.

Rüppell, W. 1852. Verzeichniss der in dem Museum der Senckenbergischen naturforschenden Gesellschaft aufgestellten Sammlungen. Vierte Abteilung. Fische und deren Skelette. Frankfurt-a.M.: J. D. Sauerländer. 40 pp.

Sakamoto, K. 1930. Buccal incubation in the percoid fish, *Apogon lineatus* T. & S. J. Imp. Fish. Inst. Tokyo, **26**(1): 9–10.

Schultz, L. P. 1940. Two new genera and three new species of cheilodipterid fishes, with notes on the other genera of the family. Proc. U. S. Nat. Mus., **88**(3085): 403–423.

Scott, T. D. 1962. The Marine and Fresh Water Fishes of South Australia. Adelaide: South Australian Branch of the British Science Guild. 338 pp.

Simpson, G. G., A. Roe, and R. C. Lewontin. 1960. Quantitative Zoology. New York: Harcourt, Brace and World, Inc. 440 pp.

Smith, C. L., E. H. Atz, and J. C. Tyler. 1971. Aspects of oral brooding in the cardinalfish *Cheilodipterus affinis* Poey (Apogonidae). Amer. Mus. Novitates, No. 2456: 1–11.

Smith, J. L. B. 1949a. Forty-two fishes new to South Africa, with notes on others. Ann. Mag. Natur. Hist., Ser. 12, **2**: 97–111.

———. 1949b. The Sea Fishes of Southern Africa. South Africa: Central News Agency, Ltd. 550 pp.

———. 1961. Fishes of the family Apogonidae of the western Indian Ocean and the Red Sea. Ichthyol. Bull. Rhodes Univ., No. 22: 373–418.

Spartà, A. 1950. Su di una nuova specie di *Microichthys*: *M. sanzoi* (n. sp.). Boll. Pesca, Piscicolt. Idrobiol., Ser. 26, **5**(2): 202–206.

Steindachner, F. 1891. Ichthyologische Beiträge (XV). Über einige seltene und neue Fischarten aus dem canarischen Archipel. Sitzber. Akad. Wiss. Wien, **100**(1): 343–374.

———. 1907. Fische aus Südarabien und Sokótra. Denkschr. Akad. Wiss. Wien, **71**: 123–168.

Taylor, W. R. 1967. An enzymatic method of clearing and staining small vertebrates. Proc. U.S. Nat. Mus., **122**(3596): 1–17.

Tinker, S. W. 1944. Hawaiian Fishes. Honolulu: Tongg Publishing Company. 404 pp.

Tortonese, E. 1952. Un percoide marino e batifilo nuovo per l'ittiofauna italiana (*Epigonus denticulatus* Dienz.). Boll. Pesca Piscicolt. Idrobiol. Ser. 28, **7**(1): 72–74.

———, and L. C. Queirolo. 1970. Contributo allo studio dell 'ittiofauna del Mar Ligure orientale. Ann. Mus. Civ. St. Natur. Genova, **78**: 21–46.

Vaillant, L. 1888. Poissons. Expéditions Scientifiques du Travailleur et du Talisman pendant les Années 1880, 1881, 1882, 1883. Paris: G. Masson. 406 pp.

Valenciennes, A. 1830. Additions et corrections aux tomes II, III, IV, et V. *In* Historie Naturelle des Poissons, Tome Sixieme, G. Cuvier and A. Valenciennes. Paris: F. G. Levrault, pp. 495–559.

———. 1837–1844. Ichthyologie des îles Canaries, ou Histoire naturelle des poissons raportés par M. M. Webb et Berthelot. *In* Histoire Naturelle des Îles Canaries, P. B. Webb and S. Berthelot (eds.). Vol. 2, Pt. 2. Paris, pp. 1–109. [pp. 1–8 published Dec. 1842; plate 1 published May 1837.]

Weber, M., and L. F. de Beaufort. 1929. The Fishes of the Indo-Australian Archipelago. V. Anacanthini, Allotriognathi, Heterosomata, Berycomorphi, Percomorphi: Families Kuhliidae, Apogonidae, Plesiopidae, Pseudoplesiopidae, Priacanthidae, Centropomidae. Leiden: E. J. Brill, Ltd. 458 pp.

Whitley, G. P. 1935. Studies in ichthyology. No. 9. Rec. Aust. Mus. Sydney, **19**(4): 215–250.

———. 1940. Illustrations of some Australian fishes. Aust. Zool., **9**(4): 397–428.

———. 1968. A check-list of the fishes recorded from the New Zealand region. Aust. Zool., **15**(1): 1–102.

Williams, F. 1968. Report on the Guinean Trawling Survey, Vol. I. General Report. OAU Scientific, Technical and Research Commission, Publication 99. 828 pp.

Wüst, G. 1964. Stratification and Circulation in the Antillean-Caribbean Basins. New York: Columbia Univ. Press. 201 pp.

APPENDIX

The following chart lists all meristic and morphometric data for the holotypes of *E. oligolepis* sp. nov. and *E. pectinifer* sp. nov. Measurements are given in millimeters.

	E. oligolepis USNM 207718	*E. pectinifer* USNM 207725
MERISTIC DATA		
Dorsal fin	VII-I, 10	VII-I, 9
Anal fin	II, 9	II, 9
Pectoral fin	18	15
Pelvic fin	I, 5	I, 5
Lateral line scales	34	47
Gill rakers	31	27
Pyloric caeca	10	6
Vertebrae	10 + 15	10 + 15
Pleural ribs	7	8
Epipleural ribs	7	6
MORPHOMETRIC DATA		
SL	90.8	114.3
HL	33.2	40.5
Body depth	21.2	28.1
Head height	17.1	18.8
Eye diameter	14.5	16.1
Snout length	7.8	10.9
Interorbital width	8.4	10.0
Maxillary length	15.6	18.2
Lower jaw length	16.3	18.5
Caudal peduncle depth	8.9	11.7
Caudal peduncle length	23.6	32.1
D_2 l	10.9	13.7
A ll	11.1	13.7
P_2 l	12.3	14.4