REVISION OF THE GENUS *SYMPHYSANODON* (PISCES: LUTJANIDAE) WITH DESCRIPTIONS OF FOUR NEW SPECIES[1]

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ABSTRACT

The genus is redescribed; four new species — two from the western Atlantic and two from the Pacific — are described; *S. typus*, from the Pacific and until recently the only known species of the genus, is redescribed; and a key to the species is provided. Discussions are presented on the systematic position of the genus, the synonymies of species, and the zoogeography and phylogeny of the genus; species are compared; and brief comments are made on distributions.

Two new species of *Symphysanodon* (Pisces: Lutjanidæ) have been collected in the West Indies and Caribbean Sea during cruises of the research vessels *Combat, Oregon, Silver Bay,* and *Undaunted* of the FWS (U.S. Fish and Wildlife Service) and the *Gerda* and *John Elliott Pillsbury* of the Institute of Marine Sciences, University of Miami. A third new species has been collected off Hawaii—off a lava flow by William A. Gosline and coworkers and during cruises of the FWS research vessel *Townsend Cromwell* by Paul J. Struhsaker. A fourth new species has been obtained off Japan by students of Kochi University. Until the discovery of the Atlantic species, this genus was known only from the Kai Islands, New Guinea, the Philippines, Japan, and Hawaii. Three scientific names have been proposed for Pacific *Symphysanodon;* this study shows that all three apply to the same species (*S. typus*). Anderson (1967) mentioned two undescribed species of *Symphysanodon* from the western Atlantic and presented a key for their separation; they are described herein.

The following abbreviations are used: AM, The Australian Museum (Sydney); AMNH, The American Museum of Natural History; ANSP, The Academy of Natural Sciences of Philadelphia; BLBG, BCF (Bureau of Commercial Fisheries) Biological Laboratory (Brunswick, Ga.); BPBM, Bernice P. Bishop Museum (Honolulu, Hawaii); BMNH, British Museum (Natural History); BOC, Bingham Oceanographic Collections, Yale University; CU, Cornell University; FMNH, Field Museum of Natural History (Chicago, Ill.); HBL, BCF Biological Laboratory (Honolulu, Hawaii); IRSNB, Institut Royal des Sciences Naturelles de Belgique (Brussels); LACM, Los Angeles County Museum of Natural History; MCZ, Museum of Comparative Zoology, Harvard University; MNHN, Museum National d'Histoire Naturelle (Paris, France); RMNH, Rijksmuseum van Natuurlijke Historie (Leiden, Netherlands); SU, Stanford University; TABL, BCF Tropical Atlantic Biological Laboratory (Miami, Fla.); TU, Tulane University; UF, Florida State Museum, University of Florida; UH, University of Hawaii; UMML, Rosenstiel School of Marine and Atmospheric Sciences, University of Miami; UMMZ, Museum of Zoology, The University of Michigan; USNM, U.S. National Museum; UW, College of Fisheries, University of Washington; YU, Yamaguchi University (Yamaguchi City, Japan); ZIKU, Zoological Institute, Kochi University (Kochi, Japan); and ZSZM, Zoologisches Staatsinstitut und Zoologisches Museum (Hamburg, West German Federal Republic). SL designates standard length.

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METHODS

Measurements and counts were made according to the methods of Hubbs and Lagler (1958), except for the following: depth of head was measured just posterior to orbit; length of orbit, as longest horizontal distance between fleshy margins of orbit; width of bony interorbital, above vertical midline of eye; depth of body, from origin of first dorsal spine vertically to ventral surface of body; and lengths of caudal fin lobes, from middle of origin of caudal fin to distal ends of longest rays. The last ray of dorsal and anal fins was counted as one when branched to the base.

Pelvic fins and caudal-fin lobes with long filaments were difficult to measure. Some of the filamentous fins were measured by stretching them out along a meter stick. Other measurements were made with needlepoint-micrometer-dial calipers. When the two pectoral and two pelvic fins were of unequal length, the longer fin was measured.

Where possible, gill rakers (including rudiments, when present) on the anterior gill arch and pectoral-fin rays were counted on the right side, pored lateral-line scales on the left side.

Most specimens had lost many scales and consequently accurate counts of pored lateral-line scales were made on fewer than a third of those examined. Approximate counts of lateral-line scales were recorded for a number of specimens. Accurate and approximate counts of scales are combined in table 1 and distinguished in table 2.

GENUS *SYMPHYSANODON* BLEEKER

Symphysanodon Bleeker, 1878: 60—also p. 26 in author's undated reprint—(type species *Symphysanodon typus* Bleeker, 1878, by original designation—by virtue of the name *typus*).

Propoma Günther, 1880: 39 (type species *Propoma roseum* Günther, 1880 [= *Symphysanodon typus* Bleeker, 1878], by monotypy).

Rhyacanthias Jordan, 1921: 646 (type species *Rhyacanthias carlsmithi* Jordan, 1921 [= *Symphysanodon typus* Bleeker, 1878], by original designation).

Snout relatively blunt. Anterior ends of premaxillaries incised, forming a conspicuous notch —the notch receiving the anterior ends of the dentaries. Extreme dorsalmost margin of maxillary covered by very narrow suborbital with mouth closed. Mouth terminal; mandible inclined dorsally when mouth closed; jaws about equal. A bony elevation (which may be pronounced) on posterodorsal surface of dentary. Two narial openings on each side. Pseudobranchiæ present. Gill arches four, a slit behind the fourth. Premaxillary with small teeth—usually larger anteriorly; premaxillary notch toothless. Dentary with small teeth usually extending from bony elevation almost to the symphysis; teeth on and near bony elevation usually larger; usually a number of relatively large, exserted teeth at anterior end of dentary—these teeth fitting into notch in upper jaw when mouth closed; symphysis toothless. Teeth, when present, on vomer, palatines, and pterygoids small; no teeth on tongue. Dorsal fin continuous and not incised at junction of spines and soft rays. Opercle with two flattened spines, the ventral one longer and more prominent. Scales ctenoid; posterior part of snout, interorbital, preorbital, suborbital, maxillary, ventral surface of mandible, preopercle, interopercle, opercle, and subopercle with scales; dorsal and anal fins without scales, but with scaly sheaths at their bases; large modified scales associated with pelvic fins, just dorsal to each pelvic spine (axillary scales) and in the ventral midline between the pelvic fins somewhat overlapping their anteromedial borders. Lateral line gently curved beneath the dorsal fin; cephalic lateral-line system well developed. Pronounced sexual dimorphism in at least one species (and probably in two).

Dorsal-fin rays usually IX, 10. Anal-fin rays III, 7 or 8. Pectoral-fin rays 15 to 18. Pelvic-fin rays I, 5. Principal caudal-fin rays 17 (9 + 8). Vertebrae 25 (10 precaudal + 15 caudal). Branchiostegal rays 7. Gill rakers well developed, rather long and slender, 9 to 14 + 22 to 29—total on anterior gill arch 31 to 42. Pored lateral-line scales 43 to 54.

SYSTEMATIC POSITION OF THE GENUS *SYMPHYSANODON*

Symphysanodon, which has been variously considered as a serranid or as a lutjanid, superficially resembles the members of the serranid subfamily Anthiinæ and is unlike (in at least its superficial appearance) the more generalized lutjanids, such as *Lutjanus* and its allies. Kamohara and Katayama (1959) placed *Symphysanodon* in the subfamily Anthiinæ of the Serranidæ; Katayama (1960) placed it in the Serranidæ, but did not refer it to a subfamily. Gosline and Brock (1960) and Munro (1967) included this genus with the Lutjanidæ.

Gosline (1966) provisionally combined a number of serranid subfamilies (sensu Katayama, 1960) along with certain genera (such as *Roccus* and *Percichthys*) into the family Percichthyidæ, but retained the subfamily Anthiinæ (sensu Katayama, 1960) in the Serranidæ. He excluded *Symphysanodon* from the Serranidæ, but did not allocate it to a family. Gosline did note, however, that *Symphysanodon* shows a closer resemblance to lutjanids than to serranids in fin-ray counts and in the possession of parietal crests and well-developed axillary scales associated with the pelvic fins.

On the basis of a number of osteological characters Katayama (1968) stated that *Symphysanodon* resembles the Percichthyidæ (of Gosline, 1966) more than the Serranidæ (as restricted by Gosline, 1966). Katayama (1968) mentioned that *Symphysanodon* differs from the Lutjanidæ in the myodome not opening to the exterior through a foramen, in the sensory canal of the frontal bone lacking an inner branch connecting with the corresponding one of the opposite side, in having an oblong foramen near the upper margin of the ceratohyal, and in having 25 vertebrae. (Most Lutjanidæ have 24 vertebrae. According to Gosline (1966), the Percichthyidæ have 25 vertebrae—frequently more, members of the Anthiinæ tend to have 26, and the other subfamilies of the Serranidæ— the Epinephelinæ and the Serraninæ—have 24.) Katayama (1968) also listed a number of osteological structures of *Symphysanodon* which are more similar morphologically to the corresponding structures of the Lutjanidæ than to those of the Percichthyidæ. These structures are: jaw bones, suspensorium and opercular apparatus, pectoral girdle, and pelvic girdle. In addition, he noted that *Symphysanodon* is closer to the Lutjanidæ (than to the Percichthyidæ) in possessing fronto-parietal crests and axillary scales associated with the pelvic fins. In concluding his paper on *Symphysanodon,* Katayama (1968) remarked that he ". . . would like to place *Symphysanodon typus* Bleeker under Lutjanidæ . . ." and that this genus seems to be closely related to the members of the subfamily Etelinæ.

On the basis of the studies by Gosline (1966) and Katayama (1968) and my own investigations, I assign *Symphysanodon* to the Lutjanidæ (in which its greatest affinities are with the Etelinæ).

KEY TO THE SPECIES OF *SYMPHYSANODON*

Gill-raker counts are of the total number on the anterior gill arch (including rudiments, when present); scale counts are of the number of pored lateral-line scales on the body (excluding those posterior to the caudal base); gill-raker and scale counts of individual specimens appear to be correlated (see table 1).

A. Depth of body 2.8 to 3.0 times in SL (33.4–36.0 percent SL). Anal soft rays usually 8 (7 in about 10 percent of specimens examined). Gill rakers 39 to 42. Scales 45 or 46 ..... *octoactinus,* western Atlantic.

TABLE 1.—*Relation of total number of gill rakers on anterior gill arch to number of pored lateral-line scales in* Symphysanodon

[t = *S. typus;* k = *S. katayamai;* m = *S. maunaloae;* b = *S. berryi;* o = *S. octoactinus;* numbers within the body of the table represent the individuals with each gill raker-scale combination]

Total gill rakers	43	44	45	46	47	48	49	50	51	52	53	54
42				o1								
41			o3									
40				o1								t1
39			o1				b1	b1				
38						b2	b2		b1	b1	t1	t1
37				m1		b1	b2	b8		t2	t1	
36	m1					b6	b6	b1	b1			
35						b1	b4	k1 b5	b2			
34			m1	m2	m1		b2	b1				
33	m1		m1	m2	m3							
32		m1	m1	m1	m1							
31			m1									

Lateral-line scales

AA. Depth of body 3.2 to 4.7 times in SL (21.3–ca. 31 percent SL). Anal soft rays 7. Gill rakers 31 to 40. Scales 43 to 54 ..... B

B. Anal fin long, length of depressed anal fin 2.6 times in SL (ca. 39 percent SL). Depth of body 3.2 times in SL (ca. 31 percent SL) ..... *katayamai*, Japan.

BB. Anal fin short, length of depressed anal fin 3.1 to 4.4 times in SL (22.8–32.6 percent SL). Depth of body 3.4 to 4.7 times in SL (21.3–29.0 percent SL) C

C. Scales 43 to 47. Gill rakers 31 to 37. Sum of gill rakers plus scales 76 to 81, 83 .... *maunaloæ*, Hawaii.

CC. Scales 48 to 54. Gill rakers 34 to 40. Sum of gill rakers plus scales 83 to 92, 94 ..... D

D. Scales 48 to 51 (rarely 52). Gill rakers 34 to 39. Pectoral-fin rays 16 to 18, usually 17. Vertical limb of preopercle usually with well-developed serrae at all sizes; usually a single spine (most frequently serrate, often bifid) or spinelike process at angle of preopercle. First pelvic soft ray noticeably produced in males larger than ca. 85 mm. SL, extremely filamentous in large males. Caudal-fin lobes frequently produced into excessively long filaments in large males ..... *berryi*, western Atlantic.

DD. Scales 52 to 54. Gill rakers 36 to 38, 40. Pectoral-fin rays 15 to 17, usually 16. Vertical limb of preopercle with small serrae in small specimens (80 mm. SL or smaller), finely serrate, slightly roughened, or almost smooth in specimens larger than 100 mm. SL; usually a well-developed spine at angle of preopercle in specimens 80 mm. SL or smaller, spine or spinelike process present or absent in specimens larger than 100 mm. SL. First pelvic soft ray only slightly produced, not extending to anal fin. Caudal-fin lobes produced, but apparently never produced into excessively long filaments ..... *typus*, New Guinea, Kai Islands, Philippine Islands, and Hawaii.

KEY TO *SYMPHYSANODON BERRYI* AND *S. TYPUS*

Measurements of certain body parts can be used to distinguish specimens of *S. berryi* and *S. typus* of similar sizes. Because I had no specimens of *S. typus* between 80 and 100 mm. SL, that size range is excluded in the following key.

A. Specimens 80 mm. SL or smaller ..... B

AA. Specimens larger than 100 mm. SL C

B. Length of depressed anal fin 22.8 to 25.8 percent SL. First anal spine 3.3 to 5.2 percent SL (usually 3.9–4.9). Length of base of anal fin 12.7 to 15.3 percent SL (usually 13.0–14.9) ..... *berryi.*

BB. Length of depressed anal fin 27.7 to 30.2 percent SL. First anal spine 5.0 to 6.2 percent SL. Length of base of anal fin 14.7 to 16.4 percent SL ..... *typus.*

C. Length of third anal spine 12.5 to 15.0 percent SL (usually 12.7–14.6). Length of second anal spine 10.6 to 13.4 percent SL (usually 10.9–13.0). Length of first anal spine 3.4 to 5.6 percent SL (usually 3.9–5.1). Length of base of anal fin 13.4 to 15.8 percent SL (usually 13.6–15.3). Length of depressed anal fin 23.4 to ca. 27.6 percent SL (usually 24.0–26.2) ..... *berryi.*

CC. Length of third anal spine 10.8 to 12.0 percent SL. Length of second anal spine 10.0 to 10.5 percent SL. Length of first anal spine 5.4 to 6.1 percent SL. Length of base of anal fin 15.6 to 20.8 percent SL. Length of depressed anal fin 26.6 to 32.6 percent SL ..... *typus.*

SYMPHYSANODON TYPUS BLEEKER

Figure 1; tables 1 to 4

Symphysanodon typus Bleeker, 1878: 61, pl. 3, fig. 1—also p. 27, pl. 2, fig. 1, in author's undated reprint—(original description and illustration; holotype ZSZM H 398, 112 mm. SL; type locality New Guinea). ..... Bleeker, 1880: 28, pl. 5, fig. 2 (description apparently based on same material as that of Bleeker, 1878, and illustration; New Guinea). ..... Jordan and Seale, 1906: 268 (reference to original description). ..... Weber and de Beaufort, 1936: 309, fig. 65 (synonymy referring in part to *S. typus* and in part to *S. maunaloæ*, compiled description [probably representing *S. typus*], illustration [after Günther, 1880], and distribution referring to *S. typus* and in part to *S. maunaloæ*). ..... Tinker,

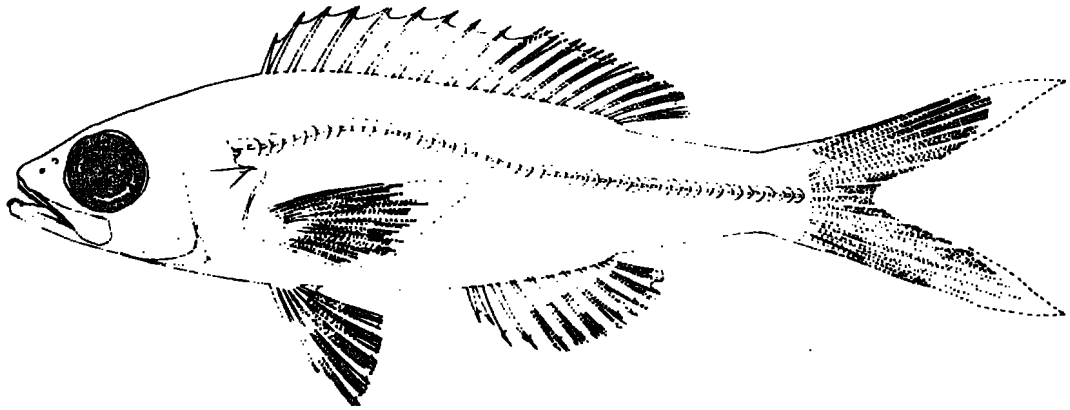

FIGURE 1.—Holotype of *Symphysanodon typus* (ZSZM H 398), 112 mm. SL.

1944: 200, fig. (illustration [drawn from Jordan and Jordan, 1922]; notes on color, size, and distribution [based on ?]). ------ Ladiges, von Wahlert, and Mohr, 1958: 163 (listing of ZSZM H 398 from New Guinea as lectotype of *S. typus*, herein considered as an attempt to designate this specimen as the lectotype of *S. typus;* indication that ZSZM H 398 may be holotype of *S. typus*). ..... Munro, 1958: 192 (reference to original description). ..... Gosline and Brock, 1960: 183–184, 327 (at least in part; partial synonymy; characters which can be used to identify *Symphysanodon;* Hawaii). ..... Anderson, 1967: 2, 11 (compiled meristic data referring in part to *S. typus*, in part to *S. maunaloæ*, and in part to *S. katayamai;* distribution referring in part to *S. typus*, in part to *S. maunaloæ*, and in part to *S. katayamai*). ..... Munro, 1967: 288 (characters which can be used to identify *Symphysanodon;* note that *S. typus* has been recorded from west New Guinea).

Propoma roseum Günther, 1880: 39, pl. 20, fig. B (original description and illustration; lectotype, herein designated, BMNH 1879.5.14.164–5, 107 mm. SL; type locality off Kai Islands). ..... Fowler, 1925: 39 (remarks concerning familial position of *Propoma roseum* Günther and similarity of *P. roseum* to *Rhyacanthias carlsmithi* Jordan).

Rhyacanthias carlsmithi Jordan, 1921: 647, fig. 3 (original description and illustration; holotype USNM 84099, ca. 148 mm. SL; type locality off a lava flow from Mauna Loa, Alika, Kau District, Hawaii). ..... Jordan and Jordan, 1922: 46, fig. 3 (reference to original description, illustration [after Jordan, 1921], and locality of collection). ..... Fowler, 1925: 39 (mention of similarity to *Propoma roseum* Günther).

Symphysodon typus, Herre, 1950: 151 (lapsus calami for *Symphysanodon;* synonymy; description of six specimens taken off the Philippines).

DIAGNOSIS

Body slender, the depth 22.1 to 29.0 percent SL. First pelvic soft ray only slightly produced, not extending to anal fin. Anal fin short, length of depressed anal fin 26.6 to 32.6 percent SL. Caudal fin deeply forked, both lobes produced, but apparently never produced into excessively long filaments. Anal soft rays 7. Gill rakers 10 to 12 + 25 to 28—total 36 to 38, 40. Pored lateral-line scales 52 to 54.

DESCRIPTION

Maxillary extending posteriorly to about middle of eye or slightly beyond. Length of upper jaw contained in length of mandible 0.95 to 1.08 times. Interorbital region flattened. Small teeth present on vomer (in a small patch), palatines (in a single band on each), and mesopterygoids (in patches) of two largest specimens (ca. 148 and 165 mm. SL)—teeth, if present, on ectopterygoids of two largest specimens confined to anterior tip of bone; teeth not apparent on vomer, palatines,

mesopterygoids, and ectopterygoids of other specimens (50–112 mm. SL). Vertical limb of preopercle with fine serrae in small specimens (80 mm. SL or smaller), finely serrate, slightly roughened, or almost smooth in specimens more than 100 mm. SL; horizontal limb of preopercle smooth or almost smooth; usually a well-developed spine at angle of preopercle in specimens 80 mm. SL or smaller, spine or spinelike process present or absent in specimens more than 100 mm. SL. Anterior part of snout and most of gular region without scales; usually one to several scales present in midline of anterior part of gular region; largest specimen examined (165 mm. SL) with a few scales on the membrane covering the fourth branchiostegal ray on each side (no other scales seen on branchiostegal membranes of this specimen), no scales apparent on branchiostegal membranes of other specimens.

Counts

Frequency distributions for the following counts are given in tables 2, 3, and 4. Dorsal-fin rays IX, 10. Anal-fin rays III, 7. Pectoral-fin rays 15 to 17. Gill rakers 10 to 12 + 25 to 28—total 36 to 38, 40. Pored lateral-line scales 52 to 54. Sum of total number of gill rakers on anterior gill arch plus number of pored lateral-line scales of individual specimens 89 to 92, 94.

(The holotype of *Rhyacanthias carlsmithi*, USNM 84099, is a dried specimen, ca. 148 mm. SL. Because the dorsal- and pectoral-fin rays and gill rakers were not counted with certainty on this specimen, data for these counts are omitted from tables 3 and 4.)

TABLE 2.—*Frequency distributions of number of pored lateral-line scales in* Symphysanodon

[The upper number in a block represents accurate counts, the lower number approximate counts]

Species	43	44	45	46	47	48	49	50	51	52	53	54	$\bar{X}$
typus	..	..	..	..	..	..	..	..	..	2	2	1	52.80
	..	..	..	..	..	..	..	..	..	1*	.	1	53.00
katayamai	..	..	..	..	..	..	..	1*	..	..	..	..	50.00
	..	..	..	..	..	..	..	..	..	..	..	..	....
maunaloae	2	..	4*	4	3	..	..	..	..	..	..	..	45.46
	..	1	..	2	2	..	..	..	..	..	..	..	46.00
berryi	..	..	..	..	..	7	10	10*	4	1	..	..	49.44
	..	..	..	..	..	3	7	6	.	..	..	..	49.19
octoactinus	..	..	3	2*	..	..	..	..	..	..	..	..	45.40
	..	..	1	..	..	..	..	..	..	..	..	..	45.00

*Includes holotype.

Measurements

Ranges of selected measurements are presented in percentage of standard length followed by the value for the holotype of *S. typus* in parentheses. For some characters variation with size is indicated. Length of head 27.7 to 33.5 (32.0)—32.2 to 33.5 in specimens 50 to 80 mm. SL, 27.7 to 32.2 in those of 105 to 165 mm. SL. Depth of head 19.1 to 24.2 (21.0)—19.1 to 21.9 in specimens 50 to 80 mm. SL, 21.0 to 24.2 in those

TABLE 3.—*Frequency distributions of numbers of fin rays in* Symphysanodon

Species	Dorsal-fin rays				Anal-fin rays		Pectoral-fin rays				
	VIII,11	IX,9	IX,10	X,10	III,7	III,8	15	16	17	18	$\bar{X}$
typus			11*	....	12*	..	1	7*	2	..	16.10
katayamai			1*	....	1*	.....		1*	.....		16.00
maunaloae		3	23*	....	26*	..	3	19*	4	..	16.04
berryi	1	1	132*	....	134*	.....		12	107*	15	17.02
octoactinus		1	17*	1	2	17*	..	18*	1	..	16.05

*Includes holotype.

TABLE 4.—*Frequency distributions of number of gill rakers in* Symphysanodon

Species	Upper limb							Lower limb									Total (= upper limb + lower limb)												
	9	10	11	12	13	14	$\bar{X}$	22	23	24	25	26	27	28	29	$\bar{X}$	31	32	33	34	35	36	37	38	39	40	41	42	$\bar{X}$
typus		2	6*	3	.....		11.09	.....			1	8*	1	1	..	26.18	.....					3	4*	3	....	1	.....		37.27
katayamai			1*	.....			11.00	.....		1*	.....					24.00	.....				1*	.....							35.00
maunaloae	4	19*	3	.....			9.96	4*	12	8	1	1	.....	.....		23.35	1	5*	11	6	1	1	1	.....					33.31
berryi	1	69	61*	3	.....		10.49	.....		9	57	50*	17	1	..	25.58	.....		9	39	39	30*	14	3	.....				36.07
octoactinus				5	12*	2	12.84	.....			1	10*	6	2		27.47	.....						6	4*	6	3	40.32		

*Includes holotype.

105 to 165 mm. SL. Length of snout 6.1 to 8.2 (ca. 6.2). Horizontal diameter of fleshy orbit 8.1 to 12.0 (11.0)—ca. 11.1 to 12.0 in specimens 50 to 80 mm. SL, 8.1 to 11.0 in those 105 to 165 mm. SL. Width of suborbital 0.7 to 1.3 (ca. 1.1). Height of cheek 4.2 to 6.2 (5.4). Length of upper jaw 12.4 to 15.0 (14.2). Length of mandible 12.5 to 14.6 (14.4). Width of bony interorbital 6.6 to 8.7 (8.7). Depth of body 22.1 to 29.0 (27.0)—22.1 to 26.5 in specimens 50 to 80 mm. SL, 26.7 to 29.0 in those 105 to 165 mm. SL. Least depth of caudal peduncle 9.9 to 12.1 (10.9) —9.9 to 10.7 in specimens of 50 to 80 mm. SL, ca. 10.6 to 12.1 in those 105 to 165 mm. SL. Pectoral fin usually reaching a vertical through base of first or second dorsal soft ray; length of longer pectoral fin ca. 25.8 to ca. 29.7 (broken). Pelvic fin not extending to anal fin, first pelvic soft ray not greatly produced; length of longer pelvic fin ca. 22.3 to 25.4 (broken). Length of base of anal fin 14.7 to 20.8 (15.9)—14.7 to 16.4 in specimens 50 to 80 mm. SL, 15.6 to 20.8 in those 105 to 165 mm. SL. Length of depressed anal fin 26.6 to 32.6 (broken)—27.7 to 30.2 in specimens 50 to 80 mm. SL, 26.6 to 32.6 in those 105 to 165 mm. SL. Lengths of dorsal spines: first 4.9 to 6.3 (—),[4] second 9.3 to 10.5 (—),[4] third 10.8 to 13.6 (—),[4] fourth 11.2 to 14.6 (—),[4] longest (fifth or sixth) 11.9 to 15.7 (13.2), last 11.2 to 13.4 (—).[4] Lengths of anal spines: first 5.0 to 6.2 (6.0), second 9.5 to >10.8 (10.5), third 10.8 to 13.1 (12.0)—12.3 to 13.1 in specimens 50 to 80 mm. SL, 10.8 to 12.0 in those 105 to 165 mm. SL. Caudal fin deeply forked, both lobes produced, but apparently never produced into excessively long filaments. Length of upper lobe of caudal fin ca. 36.5 to >42 (broken). Length of lower lobe of caudal fin ca. 35.8 to >48 (broken)—based on measurements of three specimens only.

Coloration

Several color descriptions of *Symphysanodon typus* have been published. Bleeker (1878 and 1880) stated ". . . colore corpore pinnisque dilute roseo; iride aurantiaco-flava; caudali lobo superiore apice macula lata fusca." Günther (1880) remarked "Apparently rose coloured during life; caudal fin yellowish. Lower parts silvery." Jordan (1921) observed "Color uniform whitish when received, probably rosy silvery in life, with no markings or shades anywhere." Herre (1950) stated "Our specimens were roseate in life, turning to dull reddish brown in preservative. Thinly sprinkled over the sides are black circular dots. The fins, evidently clear red in life, are colorless to palè tan." Gosline and Brock (1960), presumably describing *S. typus*, gave the color as plain greenish.

In alcohol, specimens more than 100 mm. SL are straw colored—with some individuals showing scattered flecks of dark pigment. Specimens 80 mm. SL or smaller are darker with considerable numbers of dark pigment spots—two rows of spots on dorsal surface of caudal peduncle, sides of body with numerous spots more or less arranged in rows, many lighter punctulations scattered among the more linearly arranged larger spots (this particularly evident dorsally), head usually with relatively few spots. The caudal fin is mainly straw colored, other fins mostly pale. (Pigment spots are not easily seen without magnification.)

COMMENTS ON THE HOLOTYPE OF *SYMPHYSANODON TYPUS*

Bleeker (1878) stated that he identified 118 species of fishes during a visit to the museum at Hamburg. Three of these, including *S. typus*, were described as new. In addition, Bleeker (1878) included *S. typus* in a list of the species examined in the museum at Hamburg. He also wrote that "M. le docteur J. G. Fischer, directeur de cet établissement, a eu la complaisance de m'adresser un premier envoi, composé de collections faites à la Nouvelle-Guinée, à Singapore, au Japon, en Chine et à l'île Maurice." (There is no indication as to which species were sent to Bleeker nor whether they were sent as a loan or as a gift.)

Whitehead, Boeseman, and Wheeler (1966) stated ". . . there is no evidence that Bleeker parted with specimens from his own personal collection after his return to Holland in 1860, except in the case of the British Museum sale. Neither is there any evidence that he did so before this date." They also noted that ". . . types contained in material on loan from other institutions were always stated by Bleeker to have been returned."

[4] This measurement not taken on holotype.

A. C. Wheeler and M. Boeseman informed me that they could not find any specimens listed as *S. typus* in the collections of the British Museum (Natural History) (Wheeler, in litt., October 27, 1966) and Rijksmuseum van Natuurlijke Historie (Boeseman, in litt., August 7, 1967). In addition, Boeseman wrote that he did not find *S. typus* listed in Bleeker's Auction Catalogue, 1879. From the preceding it seems that if type material of *S. typus* were sent to Bleeker, it was sent on loan and later returned. All of the type material of *S. typus*, then, should be at Hamburg.

Ladiges et al. (1958) listed a specimen (at Hamburg) cataloged as ZSZM H 398 as the "lectotype (holotype?)" of *Symphysanodon typus* Bleeker, 1878. This is apparently the only reference to a "lectotype" of this species, and, although it was not clearly stated, I assume that this was an attempt to designate ZSZM H 398 as the lectotype of *S. typus*. This attempt was apparently based on the lack of a definite statement by Bleeker (1878) as to the number of specimens he referred to in preparing his original description. In a few places in the original description of *S. typus* it appears as if Bleeker had more than one specimen at hand, but at the end of the description he gave the length of the described specimen ("Longitudo speciminis descripti") as 151‴ (which apparently means 151 mm. total length). In view of his mentioning the length of the described specimen, I think that Bleeker based his description on only one specimen. This position is supported by the facts that the Hamburg specimen (ZSZM H 398) appears to be almost equal in total length (147 + mm.) to Bleeker's specimen and it is the only type specimen of *S. typus* known. I regard this specimen (ZSZM H 398) as the holotype of *S. typus*.

SYNONYMY

Bleeker published two descriptions and two illustrations of *Symphysanodon typus* (1878: 61, pl. 3, fig. 1, and 1880: 28, pl. 5, fig. 2). The descriptions are apparently of the same material. The illustrations, although not identical, are so similar that one may be a copy of the other, and each is a good likeness of the holotype of *S. typus* (ZSZM H 398).

I examined the holotype of *S. typus* (ZSZM H 398), the two syntypes of *Propoma roseum* (BMNH 1879.5.14.164–5), and the holotype of *Rhyacanthias carlsmithi* (USNM 84099), and found that they are conspecific.

Günther (1880) did not clearly indicate the number of specimens upon which he based his original description of *P. roseum*. In two instances he presented body proportions in a manner implying that he had two specimens, whereas he later stated "Length of specimen, 5½ inches." Because the two syntypes of *P. roseum* are almost the same length (105 and 107 mm. SL; at least 5½ inches total length), length cannot be used as a criterion for determining which was intended when Günther gave length of specimen. He described the spine at the angle of the preopercle as flat and projecting. The syntype of 107 mm. SL has a spine at the angle of the left preopercle similar to that described by Günther, but the one of 105 mm. SL lacks a projecting spine at the angle of either preopercle. Except for the caudal fin, the specimen of 107 mm. SL is in better condition than the one of 105 mm. SL. I, therefore, designate as the lectotype of *Propoma roseum* the specimen of 107 mm. SL, which retains BMNH 1879.5.14.164–5; the paralectotype, the specimen of 105 mm. SL, has been assigned a new catalog number (BMNH 1968.8.1.2).

SEXUAL DIMORPHISM

External sexual dimorphism has not been reported for *Symphysanodon typus* and did not exist in the specimens of this species that I examined.

COMPARISONS

Symphysanodon typus may be separated from both *S. octoactinus* and *S. katayamai* by its more slender body, from *S. katayamai* by its shorter depressed anal fin, from *S. maunaloæ* by its possession of more pored scales in the lateral line, and from *S. berryi* by its usual possession of more pored scales in the lateral line and by differences in certain body proportions (see keys). The relation of numbers of total gill rakers on the anterior gill arch to pored lateral-line scales may be used to separate specimens of *S. typus* from those of the other species of the genus (table 1).

DISTRIBUTION

I examined specimens of *Symphysanodon typus* from all of its known localities of capture: New Guinea, Kai Islands, Philippine Islands, and Hawaii. Depth data are available for only two collections—65 fath. (119 m.) off the Philippine Islands and apparently 129 fath. (236 m.) off Kai Islands. Gosline and Brock (1960) stated that *S. typus* ". . . apparently lives well offshore . . ." and that it ". . . has never been seen in the market and has been recorded from Hawaii only on the basis of specimens killed by lava flows." *S. typus* is known from Hawaii only from specimens killed by lava flows. (Gosline, Brock, Moore, and Yamaguchi, 1954, discussed the fish kill resulting from the 1950 eruption of Mauna Loa.)

MATERIAL EXAMINED

I examined 12 specimens, 50 to 165 mm. SL.

Holotype

ZSZM H 398 (112 mm. SL), New Guinea.

Other Material

BMNH 1879.5.14.164–5 (1 specimen, 107 mm. SL; herein designated as the lectotype of *Propoma roseum*), off Kai Islands, *Challenger* station 192.[5] ..... BMNH 1968.8.1.2 (1, 105; the paralectotype of *P. roseum*) from same station as lectotype of *P. roseum*. ..... BMNH 1890.2.26.30 (1, 106), off Kai Islands?, locality of capture not definitely known, but probably from same locality (or general area) as the type specimens of *P. roseum*. ..... UW 12413 (6, 50–80), off the coast of Cavite Province, Luzon, in the south entrance to Manila Bay, Philippine Islands, 65 fath. (119 m.), by beam trawl, October 2, 1948. ..... USNM 84099 (1, ca. 148; holotype of *Rhyacanthias carlsmithi*), off a lava flow from Mauna Loa, Alika, Kau District, Hawaii, by Tom Reinhardt, October 1919 (probably October 6). ..... UH uncataloged (1, 165), picked up off lava flow, Kona, Hawaii, FWS vessel *Henry O'Malley*, June 3, 1950.

[5] Günther (1880) gave the following for *Challenger* station 192: off Kai Islands, 129 fath. Tizard, Moseley, Buchanan, and Murray (1885: 556) stated "The two trawlings, taken in 129 to 140 fathoms (Station 192). . ." and on p. 1012 (op. cit.) gave the data for *Challenger* station 192 as lat. 5° 49′ 15″ S., long. 132° 14′15″ E., 140 fath., September 26, 1874. According to U.S. Naval Oceanographic Office chart H.O. 5592, this position is in the Kai Islands—ca. 7 nautical miles SE. of Taam and ca. 13 nautical miles NW. of Kai Tanimbar.

SYMPHYSANODON KATAYAMAI NEW SPECIES

Figure 2; tables 1 to 4

Symphysanodon typus (non Bleeker, 1878), Kamohara and Katayama, 1959: 2, fig. 2 (synonymy in part of *S. typus* and in part of *S. maunaloæ;* description and illustration representing *S. katayamai* from Japan; distribution referring in part to *S. typus,* in part to *S. maunaloæ,* and in part to *S. katayamai*). ..... Katayama, 1960: 168, pl. 86 (synonymy referring in part to *S. typus,* in part to *S. maunaloæ,* and in part to *S. katayamai;* description and illustration representing *S. katayamai;* distribution referring in part to *S. typus,* in part to *S. maunaloæ,* and in part to *S. katayamai*). ..... Anderson, 1967: 2, 11 (compiled meristic data referring in part to *S. typus,* in part to *S. maunaloæ,* and in

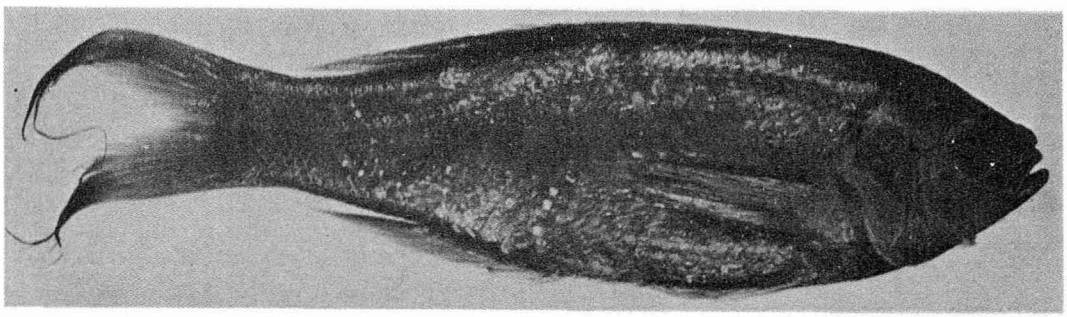

FIGURE 2.—Holotype of *Symphysanodon katayamai* (ZIKU 8206), 163 mm. SL.

part to *S. katayamai;* distribution referring in part to *S. typus,* in part to *S. maunaloæ,* and in part to *S. katayamai*). ..... Katayama, 1968: 105, figs. 1 to 5 (comments on osteology and systematic position).

DIAGNOSIS

Body relatively deep, the depth about 31 percent SL. First pelvic soft ray only slightly produced, not extending to anal fin. Anal fin longer than in other species of *Symphysanodon,* length of depressed anal fin about 39 percent SL. Caudal fin deeply forked, both lobes produced into filaments. Anal soft rays 7. Gill rakers 11 + 24—total 35. Pored lateral-line scales 50.

DESCRIPTION OF THE HOLOTYPE

Maxillary extending posteriorly to beneath posterior part of eye. Length of upper jaw contained in length of mandible 1.00 time. Dorsal profile convex, curving gently to above posterior portion of eye, and rather steeply from this point forward to tip of snout; a slight concavity above nostril region; interorbital region convex; ventral profile convex. Small teeth present in an elliptical patch on vomer and in narrow bands on palatines and ectopterygoids, no teeth apparent on mesopterygoids. Vertical limb of preopercle smooth except for a few small serrae; horizontal limb of preopercle smooth; angle of preopercle slightly produced posteriorly—possibly the remnant of a spine or spinelike process. Anterior part of snout with scales; a single scale present in midline of anterior part of gular region, remainder of gular region without scales; no scales apparent on branchiostegal membranes.

Counts

The following counts are repeated in tables 2, 3, and 4. Dorsal-fin rays IX, 10. Anal-fin rays III, 7. Pectoral-fin rays 16. Gill rakers 11 + 24—total 35. Pored lateral-line scales 50. Sum of total number of gill rakers on anterior gill arch plus number of pored lateral-line scales 85.

Measurements

Selected measurements are presented in percentage of standard length. Length of head 27.2. Depth of head 21.8. Length of snout 7.3. Horizontal diameter of fleshy orbit 7.4. Width of suborbital 1.3. Height of cheek 7.3. Length of upper jaw 13.5. Length of mandible 13.6. Width of bony interorbital 8.1. Depth of body 31.1. Least depth of caudal peduncle 14.0. Pectoral fin reaching a vertical through base of first dorsal soft ray; length of longer pectoral fin 28.2. Pelvic fin reaching anterior portion of vent; first pelvic soft ray not greatly produced. Length of longer pelvic fin 26.6. Length of base of anal fin 18.1. Length of depressed anal fin 38.9. Lengths of dorsal spines: first 6.2, second 9.4, third—damaged, fourth—damaged, longest (sixth) 13.0, last—damaged. Lengths of anal spines: first >5.5—tip broken, second 9.8, third >10.5—tip broken. Caudal fin deeply forked, both lobes produced into filaments; filaments not produced to the extent of those on some large males of *S. berryi.* Length of upper lobe of caudal fin ca. 58.0. Length of lower lobe of caudal fin ca. 56.0.

Coloration

Kamohara and Katayama (1959, under *S. typus*) described the coloration of this species in Formalin[6] (presumably shortly after capture) as "reddish, a broad longitudinal orange band on the side of body; dorsal yellowish; tip of each lobe of caudal yellowish."

After more than 10 years in Formalin the holotype has faded to a light straw color without any distinctive concentrations of pigment.

OTHER SPECIMENS AND OTHER DESCRIPTIONS

Kamohara and Katayama (1959) described three specimens, 164 to 181 mm. (presumably SL), from Kashiwajima, Kochi Prefecture, Japan, under the name *Symphysanodon typus* Bleeker, 1878. Katayama (1960) repeated (with slight variation) the description given by Kamohara and Katayama. One of the three specimens (ZIKU 8206) mentioned by Kamohara and Katayama (1959) is described herein as the holotype of *Symphysanodon katayamai.* In most respects the earlier descriptions of Japanese *Symphysanodon* agree with the holotype of *S. katayamai,* and in all but two of the meristic characters (numbers of pectoral-fin rays and gill rakers) the count given in the earlier descriptions is identical with that of the holotype. (Pectoral-fin rays were given as 16 or 17, the holotype has 16; gill

[6] The use of trade names in this publication does not imply endorsement of commercial products.

rakers as 11 or 12 + 22 or 23, total 33 to 35, the holotype has 11 + 24, total 35.)

Another of the specimens (YU uncataloged) mentioned by Kamohara and Katayama (1959) was made available to me on loan. This is the specimen on which Katayama (1968) based an osteological study. Because it had been dissected, little of its external morphology could be studied. However, in its extant characters it appears to be conspecific with the holotype of *S. katayamai* (ZIKU 8206). Katayama reported small teeth on the mesopterygoid of this specimen (YU uncataloged). I did not see teeth on the mesopterygoids of the holotype (ZIKU 8206), and the skull was missing from the dissected specimen. Katayama (1968) recorded the number of vertebrae in the dissected specimen as 11 + 14 = 25. My count of the vertebrae from a radiograph of the same specimen is 10 + 15 = 25. This discrepancy is due to differences in determining which vertebra is the first caudal vertebra. (I considered the most anterior vertebra possessing a hemal spine associated with pterygiophores of the anal fin as the first caudal vertebra.)

The third specimen mentioned by Kamohara and Katayama is in the collections of the Zoological Institute, Kochi University (Kochi, Japan). Although I have not seen this specimen, I presume it to be a representative of *S. katayamai.*

SEXUAL DIMORPHISM

Sexual dimorphism is unknown in *Symphysanodon katayamai.*

COMPARISONS

Symphysanodon katayamai may be readily distinguished from other species of the genus by its longer depressed anal fin. The relation of numbers of total gill rakers on the anterior gill arch to pored lateral-line scales may be used to separate *S. katayamai* from all other species of *Symphysanodon* except *S. berryi* (table 1).

DISTRIBUTION

Symphysanodon katayamai is known only from off Kashiwajima, Kochi Prefecture, Japan. No data on the depths inhabited by this species are available.

ETYMOLOGY

This species is named for Masao Katayama, Yamaguchi University, Yamaguchi City, Japan, who made it possible for me to examine specimens of *Symphysanodon* from Japan.

MATERIAL EXAMINED

Holotype

ZIKU 8206 (163 mm. SL), collected off Kashiwajima, Kochi Prefecture, Japan, by S. Noda, K. Amaoka, and T. Hirata, October 15, 1957.

Other Material, Not Considered as Type Material

YU uncataloged (one dissected specimen), data the same as those for holotype. Because this specimen was extensively dissected, I do not consider it a type specimen.

SYMPHYSANODON MAUNALOAE NEW SPECIES

Figure 3; tables 1 to 4

Rhyacanthias species, Jordan, 1921: 648–649, fig. 4 (description of a small specimen, 3⅔ inches in total [?] length, assumed to be the young of *Rhyacanthias carlsmithi;* comments on three other specimens, 2½ to 4 inches in total [?] length, referred with doubt to *R. carlsmithi;* illustration, labeled as *Rhyacanthias carlsmithi* (young), presumably of one of the aforementioned specimens; killed by lava flow from Mauna Loa off Alika, Kau District, Hawaii).

Symphysanodon typus (non Bleeker, 1878), Fowler, 1928: 186 (synonymy of *S. typus;* description of a small specimen, 58 mm. total [?] length, from Alika, Kau District, Hawaii, erroneously considered as a paratype of *Rhyacanthias carlsmithi*). ..... Weber and de Beaufort, 1936: 309, fig. 65 (synonymy referring in part to *S. typus* and in part to *S. maunaloæ,* compiled description [probably representing *S. typus*], illustration [of *Propoma roseum* (= *S. typus*) after Günther, 1880], and distribution referring to *S. typus* and in part to *S. maunaloæ*). ..... Gosline and Brock, 1960: 183–184, 327 (probably in part; partial synonymy of *S. typus;* characters which can be used to identify *Symphysanodon;* Hawaii). ..... Anderson, 1967: 2, 11 (compiled meristic data referring in part to *S. typus,* in part to

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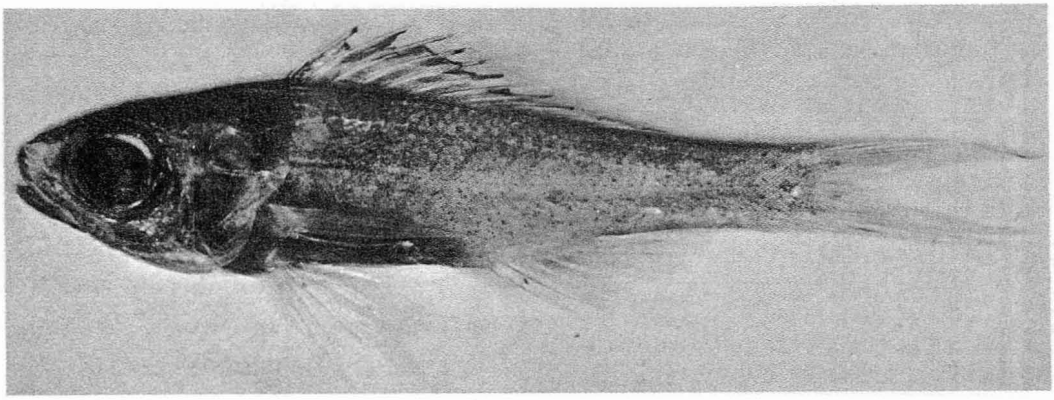

FIGURE 3.—Holotype of *Symphysanodon maunaloae* (USNM 204389, formerly HBL uncataloged), 69 mm. SL.

S. maunaloæ, and in part to *S. katayamai;* distribution referring in part to *S. typus*, in part to *S. maunaloæ*, and in part to *S. katayamai*).

DIAGNOSIS

Body slender, the depth 21.3 to 25.8 percent SL. First pelvic soft ray well produced in a few specimens, but only slightly produced in most (not extending to anal fin). Anal fin short, length of depressed anal fin ca. 24.0 to 29.2 percent SL. Caudal fin deeply forked, both lobes produced, but apparently never produced into excessively long filaments. Anal soft rays 7. Gill rakers 9 to 11 + 22 to 26—total 31 to 37. Pored lateral-line scales 43 to 47.

DESCRIPTION

Maxillary extending posteriorly to about middle of eye or a little beyond. Length of upper jaw contained in length of mandible 0.93 to 1.09 times. Interorbital region flattened. No teeth apparent on vomer, palatines, or pterygoids. Small serrae on vertical limb of preopercle, horizontal limb almost smooth or with a few serrae, mainly near angle; a spine or spinelike process at angle (spine or spinelike process often serrate). No scales on anteriormost part of snout; apparently a few scales in midline of anterior part of gular region in a specimen of 51 mm. SL (no other indications of scales in gular region of this specimen), scales not apparent in gular region of other specimens; frequently one to several scales present on membrane between the third and fourth branchiostegal rays, no other scales apparent on branchiostegal membranes.

Counts

Frequency distributions for the following counts are given in tables 2, 3, and 4. Dorsal-fin rays IX, 10 (IX, 9 on three specimens). Anal-fin rays III, 7. Pectoral-fin rays 15 to 17. Gill rakers 9 to 11 + 22 to 26—total 31 to 37. Pored lateral-line scales 43 to 47. Sum of total number of gill rakers on anterior gill arch plus number of pored lateral-line scales of individual specimens 76 to 81, 83.

Measurements

Ranges of selected measurements are presented in percentage of standard length followed by the value for the holotype of *S. maunaloæ* in parentheses. Length of head 32.0 to 35.6 (34.0). Depth of head 19.5 to 24.0 (21.0). Length of snout 6.4 to 8.2 (7.3). Horizontal diameter of fleshy orbit 10.3 to 14.0 (ca. 12.8). Width of suborbital ca. 0.6 to 1.0 (0.6). Height of cheek 3.8 to 5.6 (4.2). Length of upper jaw 12.5 to 15.1 (14.7). Length of mandible 12.5 to 15.7 (14.5). Width of bony interorbital 7.3 to 9.3 (8.3). Depth of body 21.3 to 25.8 (23.7). Least depth of caudal peduncle 9.6 to 11.9 (10.5). Pectoral fin usually reaching a vertical through base of first or second dorsal soft ray; length of longer pectoral fin 24.3 to 28.1 (26.1). Pelvic fin usually not extending to anal fin, but the first pelvic soft ray produced at least as far as middle of anal fin in several speci-

mens (the medial branch of the first pelvic soft ray reaching approximately to the distal end of the depressed anal fin in three specimens). Length of longer pelvic fin ca. 21.9 to >54 (>40). Length of base of anal fin 13.5 to 16.1 (14.4). Length of depressed anal fin ca. 24.0 to 29.2 (26.7). Lengths of dorsal spines: first 4.3 to 7.3 (6.2), second 10.2 to 13.6 (13.2), third 13.6 to 17.4 (16.5), fourth 15.8 to 18.7 (17.7), longest dorsal spine the fourth on all specimens examined, last 10.7 to 14.5 (14.1). Lengths of anal spines: first 4.0 to 5.5 (5.1), second 10.7 to 14.6 (13.1), third 12.7 to 15.6 (14.8). Caudal fin deeply forked, both lobes produced, but apparently never produced into excessively long filaments. Length of upper lobe of caudal fin ca. 31.2 to ca. 48.9 (39.0). Length of lower lobe of caudal fin ca. 30.0 to ca. 43.1 (>30).

Coloration

Paul J. Struhsaker (personal communication, July 1969) made the following observations on specimens of *S. maunaloæ* collected during *Townsend Cromwell* cruise 35 at station 12 "light reddish over upper parts and caudal; iris pink; darkish vertical bar just behind operculum and above pectoral; also dark bar between eyes."

Jordan (1921) wrote concerning one specimen (designated as "*Rhyacanthias*, species") "Color plain, probably red in life" and later concerning three other specimens (of "*Rhyacanthias*, species") ". . . the back is quite dark in color, made so by a multitude of dark punctulations; the upper fins and caudal also dusky, scales on opercle with a dusky area at base."

Specimens in alcohol have dark punctulations scattered profusely over body (pigment more heavily concentrated dorsally than ventrally). Most individuals are more heavily pigmented in an area which extends for a few scale rows above and below the anteriormost lateral-line scales. Larger, darker flecks of pigment are usually present in irregular rows on sides of body and in two rows on dorsal surface of body anterior and posterior to dorsal fin. The dorsal fin usually has considerable pigment distally; both lobes of caudal fin usually pigmented; other fins mostly pale.

SYNONYMY

Jordan (1921) in a separate section after his description of *Rhyacanthias carlsmithi* described —under the heading "*Rhyacanthias*, species"— a small specimen of 3⅓ inches (ca. 93 mm.) total [?] length, which he assumed to be the young of *R. carlsmithi*. Because Jordan gave the lateral-line scale count as 47—"as nearly as can be counted," this specimen is probably one of *S. maunaloæ*.

Jordan (1921) mentioned three other specimens (under the heading "*Rhyacanthias*, species"), 2½ to 4 inches (ca. 64–ca. 102 mm.) in total [?] length, which he referred with doubt to *R. carlsmithi*. There are three specimens of *Symphysanodon* in the U.S. National Museum (USNM 84101), ca. 42 to ca. 63 mm. SL, from Hawaii that have been labeled as paratypes of *R. carlsmithi*. Because Jordan designated no paratypes and gave no indication that he considered any specimen as a paratype of *R. carlsmithi*, these are not paratypes, but are probably three of the specimens Jordan (1921) mentioned under "*Rhyacanthias*, species." These specimens (USNM 84101) are in such poor condition that it is difficult to identify them to species; however, on the basis of numbers of gill rakers they probably are specimens of *S. maunaloæ*.

Fowler (1928) described a specimen, 58 mm. total [?] length, from the Bishop Museum (no catalog number given) under *Symphysanodon typus* and erroneously stated that it was a paratype of *Rhyacanthias carlsmithi*. I examined a specimen (ca. 49 mm. SL, 54 + mm. total length) of *Symphysanodon maunaloæ* from the Bishop Museum (BPBM 3982), presumably the specimen described by Fowler, and probably one of the specimens Jordan (1921) mentioned under "*Rhyacanthias*, species."

Jordan (1921) gave the catalog number of the specimen of *Rhyacanthias* of 3⅓ inches (see above) as USNM 24101, but gave no reference to a collection for the three specimens of 2½ to 4 inches. The reference to USNM 24101 is in error (the USNM catalog lists 24101 as *Hemilepidotus* sp. from Alaska); USNM 84101 must have been intended. Because the three specimens at the U.S. National Museum and the one at the Bishop Museum were collected by the same individual at apparently the same time and locality as that of the holotype of *Rhyacanthias carlsmithi*, they are with the greatest likelihood the

four small specimens referred to by Jordan (1921) under "*Rhyacanthias*, species."

SEXUAL DIMORPHISM

Seven specimens of *Symphysanodon maunaloæ* (62–86 mm. SL) have the pelvic fin well produced (with the medial branch of first pelvic soft ray reaching anterior part of base of anal fin or beyond), whereas in the other specimens (47–86 mm. SL) the pelvic fin, although usually produced, falls short of the anal fin. I attempted to determine the sex of several individuals, but, because of the relatively small size of the specimens, had only limited success. It seems, however, that the well-produced pelvic fin is a male characteristic (as it is in *S. berryi*).

COMPARISONS

Symphysanodon maunaloæ is easily distinguished from *S. katayamai* and *S. octoactinus* by its more slender body, from *S. katayamai* by its shorter depressed anal fin, and from *S. typus* and *S. berryi* by its possession of fewer pored scales in the lateral line. In addition, the relation of numbers of total gill rakers on the anterior gill arch to pored lateral-line scales may be used to separate specimens of *S. maunaloæ* from specimens of the other species of *Symphysanodon* (table 1).

DISTRIBUTION

Symphysanodon maunaloæ has been collected only off the Hawaiian Islands. The only information available on the depths inhabited by *S. maunaloæ* is from one trawl-station off the northeastern coast of the island of Hawaii (average depth to bottom at this station 130 fath. (238 m.)) and one off the southern coast of Lanai (122 fath. (223 m.)). The other collections of this species were made off lava flows from Mauna Loa. (Gosline, Brock, Moore, and Yamaguchi (1954) discussed the fish kill resulting from the 1950 eruption of Mauna Loa.)

ETYMOLOGY

This species is named for the active volcano Mauna Loa.

MATERIAL EXAMINED

I examined 30 specimens, ca. 42 to ca. 86 mm. SL.

Holotype

USNM 204389, formerly HBL uncataloged, (69 mm. SL), off northeastern coast of island of Hawaii, trawl set: lat. 20°07′ N., long. 155°25′ W., trawl hauled in: lat. 20°08′ N., long. 155°28′ W., average depth to bottom 130 fath. (238 m.), *Townsend Cromwell* cruise 35, station 12, March 31, 1968.

Paratypes

15 specimens, 62 to 86 mm. SL, from same station as holotype, formerly HBL uncataloged; USNM 204388 (12, 63–86) and BPBM 9779 (3, 62–86). ..... BPBM 9778, formerly HBL uncataloged, (1, 84), off southern coast of Lanai in Kealaikahiki Channel, Hawaiian Islands, lat. 20° 43′ N., long. 156° 49′ W., 122 fath. (223 m.), *Townsend Cromwell* cruise 33, station 25, November 4, 1967. ..... UH uncataloged (9, 47–62), collected off lava flow from Mauna Loa, Kona, Hawaii, by Gosline, Hayes, Keen, and Ellis, June 7, 1950. A total of 25 paratypes, 47 to 86 mm. SL.

Other Material, Not Part of the Type Series

BPBM 3982 (1, ca. 49), Alika, Kau District, Hawaii, by Tom Reinhardt, October 1919 (probably October 6). ..... USNM 84101 (3, ca. 42–ca. 63), off lava flow from Mauna Loa, Hawaii, collected by Tom Reinhardt, October 1919 (probably October 6). These specimens (BPBM 3982 and USNM 84101) were in poor condition and not considered during the preparation of the description of the species.

SYMPHYSANODON BERRYI NEW SPECIES

Figure 4; tables 1 to 4

DIAGNOSIS

Body slender, the depth 22.3 to 28.2 percent SL. First pelvic soft ray noticeably produced in males more than ca. 85 mm. SL, extremely filamentous in large males. Anal fin short, length of depressed anal fin 22.8 to ca. 27.6 percent SL. Caudal fin deeply forked, the upper and lower lobes produced into long filaments in large males. Anal soft rays 7. Gill rakers 9 to 12 + 24 to 28—total 34 to 39. Pored lateral-line scales 48 to 52.

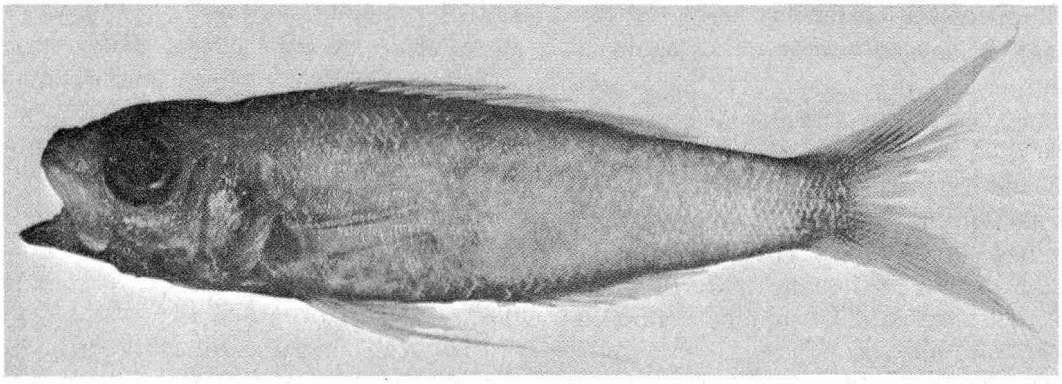

FIGURE 4.—Holotype of *Symphysanodon berryi* (USNM 204086), a male, 115 mm. SL.

DESCRIPTION

Maxillary usually extending posteriorly to beyond middle of eye. Length of upper jaw contained in length of mandible 0.92 to 1.00 time. Interorbital region flattened. No teeth apparent on vomer, palatines, and pterygoids. Dentition better developed and coarser in males than in females. Serrae on vertical limb of preopercle usually well developed; horizontal limb with fewer serrae (mostly near angle) or sometimes almost smooth; usually a single spine (most frequently serrate, often bifid) or spinelike process at angle. Anterior part of snout without scales; scales usually absent (or at least not apparent) on gular region and branchiostegal membranes; on a very few specimens a number of scales present in mid-line of anterior part of gular region, on some others extremely small scales may be embedded in this region; a few specimens with a scale (rarely two) on membrane between third and fourth branchiostegal rays (rarely on membrane covering the third or fourth branchiostegal ray).

Counts

Frequency distributions for the following counts are given in tables 2, 3, and 4. Dorsal-fin rays IX, 10 (VIII, 11 on one specimen and IX, 9 on one). Anal-fin rays III, 7. Pectoral-fin rays 16 to 18. Gill rakers 9 to 12 + 24 to 28—total 34 to 39. Pored lateral-line scales 48 to 52. Sum of total number of gill rakers on anterior gill arch plus number of pored lateral-line scales of individual specimens 83 to 90.

Measurements

Ranges of selected measurements are presented in percentage of standard length followed by the value for the holotype of *S. berryi* in parentheses. Length of head 30.7 to 36.0 (32.8). Depth of head 20.1 to 23.3 (23.1). Length of snout 6.2 to 8.9 (8.9). Horizontal diameter of fleshy orbit 10.0 to 13.2 (10.0). Width of suborbital 0.8 to 1.2 (1.1). Height of cheek 4.4 to 6.4 (5.7). Length of upper jaw 14.0 to 16.5 (14.6). Length of mandible 13.6 to 15.9 (14.2). Width of bony interorbital 7.2 to 9.0 (8.0). Depth of body 22.3 to 28.2 (26.1). Least depth of caudal peduncle 9.5 to 11.8 (11.6). Pectoral fin usually reaching a vertical through base of first or second dorsal soft ray; length of longer pectoral fin 23.7 to 27.2 (24.4). Pelvic fin usually not extending to vent in females; first pelvic soft ray noticeably produced in males more than ca. 85 mm. SL, increasing in length with increase in SL, extremely filamentous in large specimens; medial branch of first pelvic soft ray reaching past fork of caudal fin in some large males. Length of longer pelvic fin ca. 20.3 to >87 (ca. 54), varying in females from ca. 21.2 to 24.5 and in males from ca. 30.0 to >87 in specimens more than ca. 85 mm. SL. Length of base of anal fin 12.7 to 15.8 (14.9). Length of depressed anal fin 22.8 to ca. 27.6 (25.1). Lengths of dorsal spines: first 5.5 to 7.5 (6.7), second 10.1 to 12.3 (11.4), third 14.0 to 16.5 (15.4), fourth 16.0 to 18.9 (16.7), longest (fourth, fifth, or sixth—most frequently the fourth or fifth) 16.0 to 18.9 (16.7), last ca. 12.3 to >15.7 (14.2). Lengths of anal spines: first 3.3 to 5.6 (4.3), second 9.9 to 13.4 (11.6), third 11.1 to 15.0 (12.6). Caudal fin deeply forked; the upper and lower lobes produced into fila-

ments in large males (filaments becoming extremely long in largest males), increasing in length with increase in SL. Length of upper lobe of caudal fin ca. 29.4 to >128 (ca. 44), varying from ca. 30.1 to >35 in females more than ca. 80 mm. SL and from ca. 34.3 to >128 in males more than ca. 85 mm. SL. Length of lower lobe of caudal fin ca. 28.0 to >111 (ca. 39), varying from ca. 29.5 to >34 in females more than ca. 80 mm. SL and from ca. 32.4 to >111 in males more than ca. 85 mm. SL.

Values for depth of body, lengths of fins and fin-lobes, length of base of anal fin, and lengths of anal spines are based on measurements of more than 110 specimens; those for all other morphometric characters listed above on measurements of a graded size series.

Coloration

Live coloration is unknown, but a 35–mm. color photograph was taken shortly after capture of a male specimen (TABL 101317, 120 mm. SL) from *Silver Bay* station 5191. Iris silvery, except for a little orange on dorsal curvature, some dull yellow to dark gray on anterior curvature, a little light gray on ventral curvature, and considerable dark gray on posterior curvature. Head mostly bright orange. Body mainly bright orange, except ventrolateral surface of anterior end of body silver with some orange. Area beneath base of dorsal fin red-orange. Dorsal spines and soft rays mostly orange. First interradial membrane of dorsal fin red-orange; a somewhat triangular silvery area on proximal portions of second through sixth interradial membranes; an elliptical orange to red-orange area on proximal portions of seventh through ninth interradial membranes; distal part of membrane of soft dorsal fin dull orange; remainder of dorsal fin mostly dull yellow. Area above base of anal fin bright orange. Anal fin not clearly visible. Pectoral fin orange basally, rest of fin pale to silvery. Pelvic spine and filamentous first pelvic soft ray silvery, rest of pelvic fin orange proximally grading into light orange or pink and then into dull yellow distally. Outer rays (including filamentous ones) of both lobes of caudal fin red-orange; inner two or three rays of each lobe and midcaudal rays dull yellow to silvery distally (i.e., dull yellow to silvery inner area of caudal fin crescent shaped), orange proximally.

A less distinct, 35–mm. color photograph of a smaller specimen presumably from *Silver Bay* station 5191 shows no pronounced differences from the above description except that the fins (particularly the dorsal and pelvic fins) are paler.

A 35–mm. color photograph of a male specimen (TABL 101316, 134 mm. SL) from *Oregon* station 5414 shows some differences from the preceding description. Iris mostly orange. Head and fins much less brightly colored. Dorsolateral surface of body dull orange overlying pale blue. Ventrolateral surface of body mostly silvery with some pale blue on caudal peduncle.

All photographed specimens were collected during daylight. Those from *Silver Bay* station 5191 were photographed in sunlight, the one from *Oregon* station 5414 in artificial light (PROX-O-LITE). It is not known whether the differences in coloration mentioned are real or a result of differences in lighting used in the photography. (Frederick H. Berry and George C. Miller made the photographs, which are deposited in the collection of color slides at TABL.)

Thirty-one days after capture (and shortly after transfer to isopropyl alcohol) notes were made on the color remaining on the three specimens of *S. berryi* (TABL 101315, 92–99 mm. SL) collected by the *Undaunted* off British Honduras. Dorsal part of head with considerable orange on two specimens (females of 92 and 98 mm. SL). Dorsal part of body (particularly above lateral line) with much orange on the female of 98 mm. SL. Membrane of dorsal fin (particularly spiny dorsal) with much dark pigment on all three specimens. Filament of lower caudal lobe red on one specimen (a male of 99 mm. SL). Distal tip of upper caudal lobe with some dark pigment on both female specimens. Distal tip of lower caudal lobe with some dark pigment in female of 92 mm. SL.

In alcohol, specimens greater than ca. 80 to 90 mm. SL are usually a light straw color except for small spots of dark pigment usually arranged in irregular rows along the side of the body and in one or two (usually two) rows on the dorsal surface of the caudal peduncle; heavy

concentrations of smaller spots of dark pigment frequently apparent on opercle and preopercle and usually present in an area which extends for a few scale rows above and below the anteriormost lateral-line scales. Specimens less than ca. 80 to 90 mm. SL show a similar pattern of pigmentation, but usually are more heavily covered with the smaller spots of pigment, particularly on the head and dorsolateral surface of the body. The dorsal fin shows considerable dark pigment on most specimens less than ca. 100 to 110 mm. SL, mostly pale in larger specimens; the caudal fin usually has some dark pigment in specimens less than ca. 80 mm. SL, usually straw colored proximally and pale distally in specimens more than ca. 80 mm. SL; other fins pale. (Pigment spots may be difficult to distinguish on some specimens without magnification.)

PREVIOUS REFERENCE TO *SYMPHYSANODON BERRYI*

In an earlier publication (Anderson, 1967) I presented a key for the identification of two undescribed species of western Atlantic *Symphysanodon*. The species designated as "*Symphysanodon* sp. A" is *S. berryi*.

SEXUAL DIMORPHISM

The sex was determined on 108 specimens (56 males, 73–137 mm. SL, and 52 females, 67–123 mm. SL). The 52 males more than 84 mm. SL and one of 73 mm. SL have the first pelvic soft ray noticeably produced; many males of more than 100 mm. SL have the medial branch of the first pelvic soft ray produced into a long filament which reaches the base of the caudal fin or beyond. Most males of more than 100 mm. SL have the caudal fin lobes produced into long filaments. None of the females have the first pelvic soft ray or caudal fin lobes produced into long filaments. In addition, the dentition is better developed and coarser in males than in females. Two specimens (105 and 125 mm. SL) on which I was unable to determine the sex have the first pelvic soft ray well produced and, thus, may be presumed to be males. The other specimens on which the sex was not determined are small (49–83 mm. SL, most of them less than 70 mm. SL).

Sexual dimorphism was not observed in the other characters studied.

COMPARISONS

Symphysanodon berryi may be separated from *S. octoactinus* and *S. katayamai* by its more slender body and by its shorter depressed anal fin, from *S. maunaloæ* by its possession of more pored scales in the lateral line, and from *S. typus* by its usual possession of fewer pored scales in the lateral line and by differences in certain body proportions (see keys). The relation of numbers of total gill rakers on the anterior gill arch to pored lateral-line scales may be used to separate specimens of *S. berryi* from those of all other species of the genus except *S. katayamai* (table 1). *S. berryi* seems to differ from the other species of *Symphysanodon* (with the apparent exception of *S. maunaloæ*) in exhibiting pronounced sexual dimorphism.

DISTRIBUTION

S. berryi has been collected in the western Atlantic off the Bahamas, Dominican Republic, Puerto Rico, Tobago, Mexico, British Honduras, Honduras, and Nicaragua in 120 to 260 fath. (220–476 m.). Specimens of *S. berryi* were collected at *Pillsbury* station 582. The depth data for this station are 250 to 20 fath. (458–37 m.). According to Thomas H. Fraser (in litt., April 22, 1968), *Pillsbury* station 582 was made going up the slope at Arrowsmith Bank. The vessel turned sharply in about 20 fath. and terminated the tow in about 155 fath. (283 m.). The net probably did not fish as shallow as 20 fath.

One specimen of *S. berryi* was collected in company with one of *S. octoactinus* at *Gerda* station 693 off Grand Bahama Island in 160 to 150 fath. (293–274 m.).

ETYMOLOGY

This species is named for Frederick H. Berry, who first brought it to my attention and who has taught me, stimulated my interest, and encouraged me.

MATERIAL EXAMINED

I examined 136 specimens, 47 to 137 mm. SL.

Holotype

USNM 204086 (a male, 115 mm. SL), off southern coast of Great Inagua Island, Bahamas,

lat. 20°45′ N., long. 73°33′ W., 217 to 200 fath. (397–366 m.), *Oregon* station 5414, May 24, 1965.

Paratypes

43 specimens, 87 to 137 mm. SL, from same station as holotype: AM I. 15402-001 (1 specimen, 122 mm. SL), AMNH 28501 (2, 110–128), ANSP 112724 (2, 112–120), BPBM 7305 (1, 109), BMNH 1969.5.16.2–3 (2, 118–121), BOC 5988 (1, 125), CU 64262 (2, 109–119), IRSNB 474 (1, 133), LACM 30769-1 (2, 115–120), MCZ 46518 (2, 110–135), MNHN 1969-165 (2, 106–111), RMNH 26071 (1, 121), SU 67142 (2, 114–124), TABL 101316 (10, 93–134), TU 57443 (2, 116–120), UF 16425 (2, 112–125), UH uncataloged (1, 114), UMMZ 188888 (2, 92–112), USNM 204087 (3, 88–137), UW 200444 (1, 87), and ZSZM 4201 (1, 118). ..... UMML 2679 (4, 73–93), north of Little Bahama Bank, lat. 27°29′ N., long. 78°58′ W., 200 fath. (366 m.), *Combat* station 236, February 2, 1957. ..... UMML 20774 (1, 74), off southern coast of Grand Bahama Island, lat. 26°34′ N., long. 78°26-25′ W., 160 to 150 fath. (293–274 m.), *Gerda* station 693, July 21, 1965. ..... 26 specimens, 49 to 86 mm. SL, off eastern coast of the Dominican Republic, lat. 18°24′ N., long. 68°05′ W., 200 fath. (366 m.), *Silver Bay* station 5190, October 17, 1963; TABL 101313 (6, 56–83), UMML 15814 (17, 60–78), and USNM 204088 (3, 49–86). ..... 24 specimens, 71 to 120 mm. SL, off western coast of Puerto Rico, lat. 18°26.5′ N., long. 67°41′ W., 260 fath. (476 m.), *Silver Bay* station 5191, October 18, 1963; TABL 101317 (21, 71–120), and USNM 204089 (3, 96–108). ..... FMNH 66922 (1, 54), off the southern coast of Isla de Vieques, Puerto Rico, lat. 18°05′ N., long. 65°21′ W., 120 fath. (220 m.), *Oregon* station 2627, September 29, 1959. ..... 7 specimens, 75 to 102 mm. SL, off western coast of Puerto Rico, lat. 18°03′ N., long. 67°27′ W., 150 to 180 fath. (274–329 m.), *Oregon* station 2643, October 5, 1959; FMNH 66923 (4, 75–100) and UMML 7487 (3, 77–102). ..... UMML 7043 (2, 86–87), off western coast of Puerto Rico, lat. 18°14′ N., long. 67°20′ W., 210 fath. (384 m.), *Oregon* station 2646, October 5, 1959. ..... TABL 106432 (1, 81), off northwestern coast of Tobago, lat. 11°30′ N., long. 60°46′ W., 200 to 240 fath. (366–439 m.), *Oregon* station 5028, September 22, 1964. ..... UMML 23902 (6, 83–96), east of Arrowsmith Bank, off Quintana Roo, Mexico, lat. 21°10′ N., long. 86°18′ W., 250 to 20 fath. (458–37 m.), *Pillsbury* station 582, May 23, 1967. ..... TABL 101315 (3, 92–99), south southwest of Glovers Reef, off British Honduras, lat. 16°35′ N., long. 87°56′ W., 150 to 175 fath. (274–320 m.), *Undaunted* cruise 6703, station 76 (TABL 67–174), May 19, 1967. ..... FMNH 66918 (8, 80–119), off northeastern coast of Honduras, lat. 16°39′ N., long. 82°29′ W., 225 fath. (412 m.), *Oregon* station 1870, August 21, 1957. ..... FMNH 66919 (1, 99), off eastern coast of Nicaragua, lat. 11°31′ N., long. 83°09′ W., 150 fath. (274 m.), *Oregon* station 1903, September 9, 1957. ..... 6 specimens, 75 to 112 mm. SL, off eastern coast of Nicaragua, lat. 11°34′ N., long. 83°07′ W., 125 fath. (229 m.), *Oregon* station 1904, September 9, 1957; FMNH 66920 (5, 75–112) and FMNH 66921 (1, 108). A total of 133 paratypes, 49 to 137 mm. SL.

Other Material, Not Part of the Type Series

UMML 24751 (1, 47), collection data the same as that for UMML 23902. ..... TABL 106275 (1, 87), collection data the same as that for TABL 101317. These specimens (UMML 24751 and TABL 106275) were not considered during the preparation of the description of the species.

SYMPHYSANODON OCTOACTINUS NEW SPECIES

Figure 5; tables 1 to 4

DIAGNOSIS

Body deeper than in other species of *Symphysanodon*, the depth 33.4 to 36.0 percent SL. First pelvic soft ray not greatly produced. Anal fin short, length of depressed anal fin 28.5 to 32.3 percent SL. Caudal fin deeply forked, but the lobes apparently never greatly produced. Anal soft rays 7 or 8 (usually 8). Gill rakers 12 to 14 + 26 to 29—total 39 to 42. Pored lateral-line scales 45 or 46.

DESCRIPTION

Maxillary extending posteriorly to approximately middle of eye or a little beyond. Length

of upper jaw contained in length of mandible 1.04 to 1.13 times. Interorbital region flattened. A band of small toothlike irregularities on palatines of largest specimen (FMNH 66924, 108 mm. SL), teeth not apparent on palatines of other specimens; teeth not apparent on vomer or pterygoids. Preopercle almost smooth or with small serrae (particularly in region of angle); rarely with a spinelike process at angle. Anterior part of snout, most of gular region, and most of branchiostegal membranes without scales; often one to several scales present in midline of anterior part of gular region; frequently one to several scales present on the membrane covering the fourth branchiostegal ray.

Counts

Frequency distributions for the following counts are given in tables 2, 3, and 4. Dorsal-fin rays[7] IX or X, 9 or 10 (usually IX, 10). Anal-fin rays III, 7 or 8 (usually 8). Pectoral-fin rays 16 or 17 (usually 16). Gill rakers 12 to 14 + 26 to 29—total 39 to 42. Pored lateral-line scales 45 or 46. Sum of total number of gill rakers on anterior gill arch plus number of pored lateral-line scales of individual specimens 84, 86, 88.

Measurements

Ranges of selected measurements are presented in percentage of standard length followed by the value for the holotype of *S. octoactinus* in parentheses. Length of head 33.9 to 36.3 (34.6). Depth of head 27.4 to 30.9 (29.0). Length of snout 6.4 to 8.6 (7.6). Horizontal diameter of fleshy orbit 12.1 to 15.4 (14.4). Width of suborbital 0.6 to 1.0 (0.8). Height of cheek 5.6 to 8.0 (7.3). Length of upper jaw 14.4 to 16.5 (16.1). Length of mandible 16.0 to 18.4 (18.0). Width of bony interorbital 9.0 to 10.5 (9.9). Depth of body 33.4 to 36.0 (34.8). Least depth of caudal peduncle 12.0 to 13.2 (12.8). Pectoral fin usually reaching a vertical through base of third or fourth dorsal soft ray; length of longer pectoral fin 28.3 to >30.9 (30.5). Pelvic fin usually reaching anal fin; first pelvic soft ray not greatly produced. Length of longer pelvic fin ca. 25.8 to ca. 27.9 (ca. 25.8). Length of base of anal fin 16.5 to 18.8 (18.4). Length of depressed anal fin 28.5 to 32.3 (30.9). Lengths of dorsal spines: first 6.1 to 7.8 (>6.3), second 10.1 to 11.5 (10.7), third 12.8 to 14.7 (>13.1), fourth 13.8 to 16.5 (>15.6), longest (fifth, sixth, or seventh—most frequently the fifth) 15.4 to 18.4 (16.6), last 14.1 to 16.4 (15.2). Lengths of anal spines: first 7.0 to 9.1 (7.3), second 13.0 to 14.9 (14.4), third 14.9 to 18.0 (16.4). Caudal fin deeply forked, the lobes apparently never greatly produced (however, caudal fin damaged on most specimens). Length of upper lobe of caudal fin ca. 38.6 to >42.0 (ca. 41.4). Length of lower lobe of caudal fin ca. 37.2 to 39.1 (ca. 37.2).

[7] One specimen (UMML 11050, 58 mm. SL) has 10 dorsal spines. The ninth spine in the series appears to be intercalated between what would normally be the last two dorsal spines. It is shorter than either the spine anterior or posterior to it and arises abnormally close to the last spine.

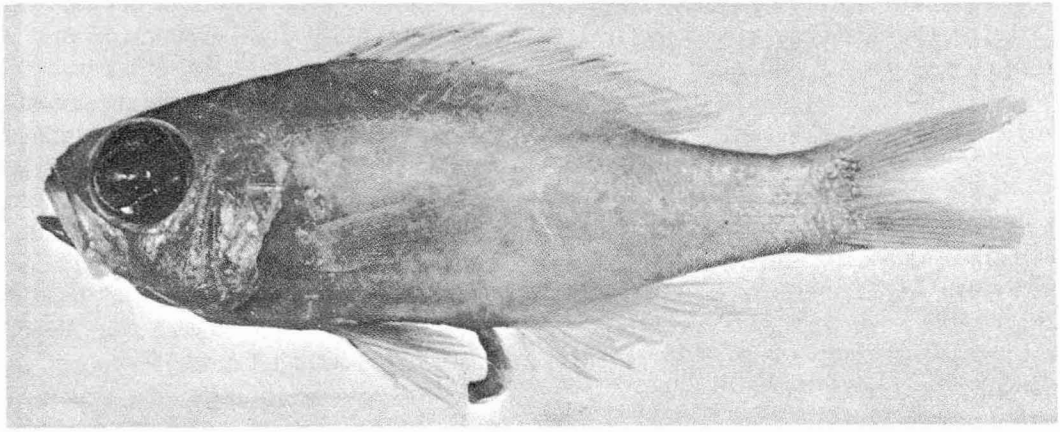

FIGURE 5.—Holotype of *Symphysanodon octoactinus* (USNM 204084, formerly UMML 20775), 79 mm. SL.

Coloration

No information is available on live coloration. In alcohol, specimens are a uniform straw color except for a variable number of small spots of dark pigment scattered over head and body (some larger spots of pigment usually present, mainly above the lateral line). Dorsal fin and proximal part of caudal fin usually have a considerable number of small spots of dark pigment (caudal fin of holotype with a very narrow dusky border distally); other fins mostly pale. (Pigment spots are not easily seen without magnification.)

PREVIOUS REFERENCE TO *SYMPHYSANODON OCTOACTINUS*

The species designated as "*Symphysanodon* sp. B" by Anderson (1967: 12) is *S. octoactinus*.

SEXUAL DIMORPHISM

No external evidence of sexual dimorphism was observed in *S. octoactinus*.

COMPARISONS

Specimens of *Symphysanodon octoactinus* may be readily distinguished from specimens of all other species of the genus by their deeper bodies, by their usual possession of an additional anal soft ray, and by the relation of number of total gill rakers on the anterior gill arch to number of pored lateral-line scales (table 1).

DISTRIBUTION

Symphysanodon octoactinus has been collected in the western Atlantic off the Bahamas, Puerto Rico, Nicaragua, and Panama in 85 to 160 fath. (156–293 m.). The holotype of *S. octoactinus* was caught along with one specimen of *S. berryi* at *Gerda* station 693 off Grand Bahama Island in 160 to 150 fath. (293–274 m.).

ETYMOLOGY

The name *octoactinus*, suggested by Albert Schwartz (Miami Dade Junior College), is from the Greek (octo, eight; actis, ray) and refers to the usual number of anal soft rays (eight) found in this species. This name should be considered as an adjective.

MATERIAL EXAMINED

I examined 19 specimens, 58 to 108 mm. SL.

Holotype

USNM 204084, formerly UMML 20775, (79 mm. SL), off southern coast of Grand Bahama Island, lat. 26°34′ N., long. 78°26–25′ W., 160 to 150 fath. (293–274 m.), *Gerda* station 693, July 21, 1965.

Paratypes

FMNH 66924 (1, 108 mm. SL), off western coast of Puerto Rico, lat. 18°24′ N., long. 67°15′ W., 100 fath. (183 m.), *Oregon* station 2655, October 6, 1959. ..... UMML 12273 (2, 69–85), off eastern coast of Nicaragua, lat. 12°32′ N., long. 82°25′ W., 85 fath. (156 m.), *Oregon* station 3577, May 23, 1962. ..... 15 specimens, 58 to 101 mm. SL, off northern coast of Panama, lat. 09°02′ N., long. 81°26′ W., 100 fath. (183 m.), *Oregon* station 3595, May 30, 1962; ANSP 112723 (1, 75), BMNH 1969.5.16.4 (1, 76), TABL 101314 (2, 69–101), UMML 11050 (8, 58–78), and USNM 204085 (3, 70–82). A total of 18 paratypes, 58 to 108 mm. SL.

ZOOGEOGRAPHY AND PHYLOGENY OF THE GENUS *SYMPHYSANODON*

All of the specimens of *Symphysanodon* known are from the western Pacific, central Pacific, or western Atlantic, and most specimens (155 of 200) are from a relatively small area in the western Atlantic (the Caribbean Sea and off the islands of the West Indies) from which a large number of collections have been made within the last 20 years.

Species of *Symphysanodon* show a marked predilection for moderate depths—65 to 260 fath. (119–476 m.)—around islands. The three Pacific species (*S. typus, S. katayamai,* and *S. maunaloæ*) have been captured exclusively off insular areas, whereas the two western Atlantic species (*S. berryi* and *S. octoactinus*) have been collected off both the Caribbean coast of continental America and off islands in the West Indies. Most of the specimens of *S. berryi* have been collected off islands in the West Indies, but most of those of *S. octoactinus* are from the Caribbean Sea off Central America.

Although depth data for Pacific *Symphysanodon* are meager (only four depth records, none for *S. katayamai*), these species may frequent somewhat shallower waters—65 to 130

fath. (119–238 m.)—than do the Atlantic species—85 to 260 fath. (156–476 m.). Of the Atlantic species, *S. berryi* has been found in deeper waters—120 to 260 fath. (220–476 m.)—than has *S. octoactinus*—85 to 160 fath. (156–293 m.).

When habitats suitable for *Symphysanodon* have been more extensively explored in the Pacific, Indian Ocean, and eastern Atlantic, more secure foundations for developing explanations for the patterns of distribution of the species of the genus will be available. However, from the accessible data, it seems that the genus may have evolved in the central western Pacific and spread northward to colonize the area off Japan and eastward to the Hawaiian Islands. If *Symphysanodon* arose in the western Pacific and spread to the central Pacific, two routes for invading the western Atlantic would have been available—one from the western Pacific via the Indian Ocean and eastern Atlantic and the other from the central Pacific via the eastern Pacific. The route via the eastern Pacific would have been shorter and less encumbered by land as a barrier.

On the basis of our fragmentary knowledge of *Symphysanodon*, it seems that the wide-ranging species, *S. typus*, may resemble the progenitor of the contemporary species of the genus more closely than do any of the other modern species and that some (perhaps all) of the modern species may be derivatives of a *typus*-like ancestor. Descent from a *typus*-like predecessor seems to have been the case for *S. maunaloæ* and perhaps also for *S. katayamai*.

The geographically well-separated species *S. typus* (western and central Pacific) and *S. berryi* (western Atlantic) are the most difficult to separate when morphological characters are used. Their similar morphology might be the result of parallelism (or convergence) within the genus or of slight divergence from a rather recent common ancestor. If *S. typus* and *S. berryi* have diverged comparatively recently, the more likely route for colonization of the western Atlantic by *Symphysanodon* would have been via the eastern Pacific.

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LITERATURE CITED

ANDERSON, WILLIAM D., JR.
1967. Field guide to the snappers (Lutjanidæ) of the western Atlantic. U.S. Fish Wildl. Serv., Circ. 252, iii + 14 pp., 29 figs.

BLEEKER, PIETER.
1878. Quatrième mémoire sur la faune ichthyologique de la Nouvelle-Guinée. Arch. Néerl. Sci. Ex. Natur. 13: 35–66, pls. 2–3. [Author's undated reprint, 32 pp., pls. 1–2.]
1880. Musei Hamburgensis species piscium novas minusque cognitas descripsit et depingi curavit. Abh. Naturwiss. Ver. Hamburg 7(1): 25–30, pl. 5.

FOWLER, HENRY W.
1925. Note on *Propoma roseum* Gunther. Copeia 1925(142): 39–40.
1928. The fishes of Oceania. Mem. Bernice P. Bishop Mus. 10, iii + 540 pp., 82 figs., 49 pls.

GOSLINE, WILLIAM A.
1966. The limits of the fish family Serranidæ, with notes on other lower percoids. Proc. Calif. Acad. Sci., 4th Ser., 33: 91–111, 10 figs.
GOSLINE, WILLIAM A., and VERNON E. BROCK.
1960. Handbook of Hawaiian fishes. Univ. Hawaii Press, Honolulu, 372 pp., 277 figs.
GOSLINE, W. A., V. E. BROCK, H. L. MOORE, and Y. YAMAGUCHI.
1954. Fishes killed by the 1950 eruption of Mauna Loa. I. The origin and nature of the collections. Pac. Sci. 8: 23–27, 3 figs.
GÜNTHER, ALBERT.
1880. Report on the shore fishes. *In* Zoology of the voyage of H.M.S. *Challenger* 1(6), 82 pp., 32 pls. (reprint ed. 1963, J. Cramer, Weinheim).
HERRE, ALBERT W. C. T.
1950. Twenty-six noteworthy Philippine fishes. Philippine J. Sci. 79: 137–154.
HUBBS, CARL L., and KARL F. LAGLER.
1958. Fishes of the Great Lakes region. Cranbrook Inst. Sci., Bull. 26 (revised ed.), xi + 213 pp., 251 figs., 44 pls.
JORDAN, DAVID STARR.
1921. Description of deep-sea fishes from the coast of Hawaii, killed by a lava flow from Mauna Loa. Proc. U.S. Nat. Mus. 59: 643–656, 8 figs.
JORDAN, DAVID STARR, and ERIC KNIGHT JORDAN.
1922. A list of the fishes of Hawaii, with notes and descriptions of new species. Mem. Carnegie Mus. 10(1): 1–92, 7 figs., 4 pls.
JORDAN, DAVID STARR, and ALVIN SEALE.
1906. The fishes of Samoa. Description of the species found in the archipelago, with a provisional check-list of the fishes of Oceania. Bull. Bur. Fish. 25: 173–455, 111 figs., pls. 33–53.
KAMOHARA, TOSHIJI, and MASAO KATAYAMA.
1959. A new and a rare anthinid fishes from Kochi Prefecture, Japan. Rep. Usa Mar. Biol. Sta. 6(1): 1–5, 2 figs.
KATAYAMA, MASAO.
1960. Fauna Japonica. Serranidæ (Pisces). Tokyo News Serv. Ltd., Tokyo, viii + 189 pp., 86 pls.
1968. Notes on the osteology and systematic position of *Symphysanodon typus* Bleeker. Bull. Fac. Ed., Yamaguchi Univ. 17(2): 105–111, 5 figs.
LADIGES, WERNER, GERHARD VON WAHLERT, and ERNA MOHR.
1958. Die Typen und Typoide der Fischsammlung des Hamburgischen Zoologischen Staatsinstituts und Zoologischen Museums. Mitt. Hamburg. Zool. Inst. 56: 155–167.
MUNRO, IAN S. R.
1958. The fishes of the New Guinea region. Terr. Papua New Guinea, Fish. Bull. 1: 97–369, 1 fig., 3 maps (reprinted from the Papua New Guinea Agr. J. 10: 97–369).
1967. The fishes of New Guinea. Victor C. N. Blight, Sydney, New South Wales, xxxvii + 650 pp., 23 figs., 6 color pls., 78 black and white pls.
TINKER, SPENCER W.
1944. Hawaiian fishes: a handbook of the fishes found among the islands of the central Pacific Ocean. Tongg Publ. Co., Honolulu, 404 pp., 506 figs., 8 pls.
TIZARD, T. H., H. N. MOSELEY, J. Y. BUCHANAN, and JOHN MURRAY.
1885. Narrative of the cruise of H.M.S. *Challenger* with a general account of the scientific results of the expedition. *In* Report on the scientific results of the voyage of H.M.S. *Challenger* during the years 1873–76. Narrative, Vol. I, Second Part, pp. i–viii + 511–1110, chromo-lithographic pls. F-O, photographic pls. 20–35, charts 31–43, diagrams 13–22, figs. (woodcuts) 179–340, tail pieces 13–22.
WEBER, MAX, and L. F. DE BEAUFORT.
1936. The fishes of the Indo-Australian Archipelago, 7. E. J. Brill, Leiden, xvi + 607 pp., 106 figs.
WHITEHEAD, P. J. P., M. BOESEMAN, and A. C. WHEELER.
1966. The types of Bleeker's Indo-Pacific elopoid and clupeoid fishes. Zool. Verh. Leiden 84: 1–159, 1 fig., 19 pls.

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