

Revision of Indo-West Pacific
Lizardfishes of the Genus *Synodus*
(Pisces: Synodontidae)

ROGER CRESSEY

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 342

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ABSTRACT

Cressey, Roger. Revision of Indo-West Pacific Lizardfishes of the Genus *Synodus* (Pisces: Synodontidae). *Smithsonian Contributions to Zoology*, number 342, 53 pages, 44 figures, 4 tables, 1981.—Twenty-one species of Indo-West Pacific *Synodus* are described (six new species) with a key to all species: *Synodus variegatus* (Lacépède) (synonyms: *S. dermatogenys* Fowler, *S. houlti* McCulloch), *S. binotatus* Schultz, *S. capricornis* Cressey and Randall, *S. doaki* Russell and Cressey, *S. englemanni* Schultz, *S. fuscus* Tanaka, *S. gibbsi*, new species (East Africa), *S. hoshinonis* Tanaka, *S. indicus* (Day) (synonym: *S. dietrichi* Kotthaus), *S. jaculum* Russell and Cressey, *S. kaianus* (Günther), *S. macrocephalus*, new species (Indian Ocean), *S. macrops* Tanaka, *S. oculus*, new species (Andaman Sea, South China Sea), *S. randalli*, new species (Red Sea), *S. rubromarmoratus* Russell and Cressey, *S. sagineus* Waite (synonyms: *Xystodus banfieldi* Ogilby, *X. sagineus* Whitley), *S. similis* McCulloch, *S. tectus*, new species (western Pacific), *S. ulae* Schultz, *S. usitatus*, new species (Hawaiian Islands, Japan). Two characters not previously used for adult lizardfish identification are the form of the dermal flap of the anterior nares and the peritoneal spots (previously described as pigment spots or abdominal spots from postlarvae). Description and numbers of these spots from all adult species provide an important character for identifications of larval and postlarval lizardfishes. Geographic variation in vertebral counts is discussed for *S. variegatus*, *S. binotatus*, and *S. englemanni*. *Synodus similis*, previously considered a synonym of *S. hoshinonis* by Matsubara (1938), is shown to be a valid species. *Synodus japonicus* (Houttuyn) is considered a nomen dubium.

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Revision of Indo-West Pacific Lizardfishes of the Genus *Synodus* (Pisces: Synodontidae)

Roger Cressey

Introduction

This revision of Indo-West Pacific *Synodus* is the outgrowth of a project (Cressey and Cressey, 1979) describing the parasitic copepods of Indo-West Pacific lizardfish (*Saurida*, *Trachinocephalus*, and *Synodus*). Many collections of Indo-West Pacific *Synodus* housed in the Smithsonian Institution and elsewhere were identified as *Synodus variegatus* (Lacépède). The copepods from these identified hosts represented several species of *Metataeniacanthus*, a genus of poecilostome copepods parasitic on the gill filaments or pseudobranchs of their hosts. This suggested the possibility that the "*Synodus variegatus*" represented more than one species. Since there was no specialist working with synodontids, I undertook to investigate *Synodus* taxonomy in order to provide correct host names for the parasite paper.

The parasite work has been published (Cressey and Cressey, 1979), and the present paper is the result of my efforts at host identifications.

ACKNOWLEDGMENTS.—Many people have been helpful during the course of this study, particularly the many curators that lent me material from the museums and collections listed below. Also, during the course of the study, R. Winter-

bottom, V. Springer, L. Knapp, and B. Collette collected *Synodus* for me during their field work in Indo-Pacific areas, for which I am grateful. Special thanks go to my earlier co-authors, J. Randall and B. Russell, for their advice and contributions. Robert Gibbs made himself available for general ichthyological advice, for which I constantly consulted him. He is probably responsible for any good in this paper, and inadequacies undoubtedly result from my neglecting to follow his advice. The manuscript was read by R. Gibbs, B. Collette, and J. Randall, and their helpful suggestions are appreciated. Final thanks go to my wife Hillary, who patiently listened to the outcries of frustration of a parasitic-copepod taxonomist struggling with a totally alien group. The illustrations were done by Penelope K. Hollingsworth.

Materials and Methods

The descriptions of the 19 species of *Synodus* included herein are based on the examinations of about 1500 preserved specimens housed in the various museums listed below. X-rays were made of 981 specimens. Measurements and counts used follow those of Hubbs and Lagler (1958:19-26). Characters not previously used in the diagnoses of adult *Synodus* are discussed separately below.

Specimens housed in or borrowed from the

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following places were examined during the course of the study.

Australian Museum, Sydney (AMS)
 Academy of Natural Sciences, Philadelphia (ANSP)
 British Museum (Natural History), London (BMNH)
 Bernice P. Bishop Museum, Honolulu (BPBM)
 California Academy of Sciences, San Francisco (CAS)
 Field Museum of Natural History, Chicago (FMNH)
 Hebrew University, Jerusalem (HUJ)
 J.L.B. Smith Institute of Ichthyology, Grahamstown (RUSI)
 Kyoto University, Fisheries Research Station, Kyoto (FAKU)
 Museum of Comparative Zoology, Harvard University (MCZ)
 National Museum, Wellington, New Zealand (NMNZ)
 National Taiwan University, Taipei (NTU)
 Natural History Museum, Los Angeles County, Los Angeles (LACM)
 Queensland Museum, Brisbane (QM)
 Smithsonian Institution, Washington, D.C. (USNM, former United States National Museum, collections in the National Museum of Natural History, Smithsonian Institution)
 Rijksmuseum van Natuurlijke Historie, Leiden (RMNH)
 Royal Ontario Museum, Toronto (ROM)
 Western Australian Museum, Perth (WAM)
 Zoological Institute and Zoological Museum, Hamburg (ZIM)
 Zoological Survey of India, Calcutta (ZSI)

DISCUSSION OF CHARACTERS

ALLOMETRIC CHARACTERS.—Analysis of the morphometric data for four species of *Synodus* (*englemani*, *binotatus*, *sageneus*, and *variegatus*) for which I had adequate size ranges indicate distinct allometric influence in three characters.

The samples were divided into four size groups (less than 75 mm, 76–100 mm, 101–150 mm, and greater than 150 mm). In species for which the size range was not well represented, the three characters showing allometry were consistent with the data from larger samples.

Diameter of Bony Orbit: In all cases the mean percent SL was greatest in the smallest specimens, decreasing in each larger size group (5.78 in less than 75 mm, 4.77 in 76–100 mm, 4.40 in 101–150 mm, and 3.56 in over 150 mm, a decrease of 38.4 percent overall in *S. sageneus*, for example).

The data for *S. variegatus* indicated an overall decrease of 38.5 percent; *S. macrops*, which characteristically has a large eye and is a deeper-water species, showed only a 18.9 percent SL decrease, whereas *S. kaianus*, also a deeper-water species, had a 28.9 percent SL decrease overall.

Least Width of Bony Interorbital: This character increases from the smallest to the largest specimens. The data for *S. variegatus* are 1.96 percent SL (<75 mm), 2.29 percent SL (76–100 mm), 2.45 percent SL (101–150 mm), and 2.87 percent SL (>150 mm). This represents an overall increase of 46.4 percent. For *S. sageneus* the overall increase was 29.9 percent; for *S. englemani* it was 27.2 percent.

Pectoral-Fin Length: Pectoral-fin length as a percent SL decreases with size. In four size groups of *S. sageneus* the percent SL was 14.6 (<75 mm), 13.4 (76–100 mm), 12.5 (101–150 mm), and 11.5 (>150 mm); an overall decrease of 21.2 percent. In *S. variegatus* the overall decrease was 13.4 percent; in *S. englemani*, 8.0 percent.

The remaining 13 morphometric characters used in this study did not show allometric growth.

OTHER CHARACTERS.—**Procurrent Caudal Rays:** Visible only by X-ray, the procurrent caudal rays are of some value in separating species. Although there is considerable overlap of the number of rays between species, in about half of the species the total of dorsal and ventral procurrent rays combined never exceeds 29, whereas in others the counts are commonly in the low to mid 30's. The number of dorsal rays is usually greater than, occasionally equal to, but never less than the number of anal rays.

Teeth on Free End of Tongue: In *Synodus* these teeth are caniniform and conspicuous. The number of teeth, however, is not the same for all species. I have given data on the approximate numbers for all Indo-West Pacific species. In some species the free end of the tongue is relatively narrow, and the teeth are arranged not more than two or three across the width of the tongue. In other species with wider tongues, the teeth may be five or six across the width. The teeth do not appear to be arranged in rows.

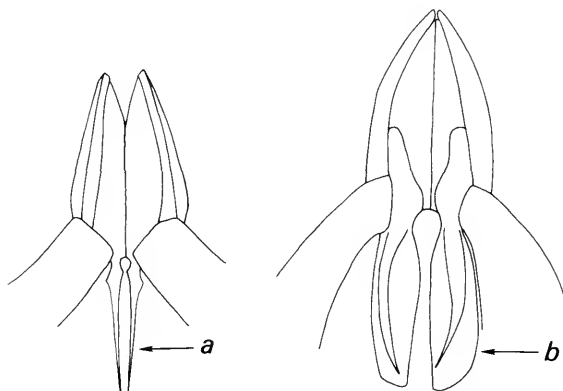


FIGURE 1.—Diagrammatic representation of *Synodus* pelvic girdle types showing narrow posterior pelvic process (a) and wide posterior process (b).

Posterior Pelvic Process: The process of the pelvic girdle is of two forms in *Synodus*. The most common is a wide flat process with a central ridge and, less commonly, a long narrow process without lateral expansion (Figure 1). All of the species with the narrow process are from deeper water (generally 75–200 m). It should be pointed out, however, that four species with a wide process (*S. doaki*, *S. hoshinonis*, *S. indicus*, and *S. usitatus*) are also common in deeper water.

Peritoneal Spots: The presence of a series of pigment spots, visible through the ventral body wall, in larval and postlarval synodontids is well documented (Gopinath, 1946; Gibbs, 1959; Anderson et al., 1966, for recent works). The number of these spots has been suggested as a means of identifying larval and postlarval lizardfishes. The present work shows that these spots persist in adult synodontids as well and consequently are a useful taxonomic tool for identifying adult lizardfishes. These spots were first used as a species diagnostic character in recent papers by Cressey and Randall (1978) and Russell and Cressey (1979). Although these spots are no longer visible through the body wall of the adult, they are easily seen just beneath the peritoneum when the peritoneal cavity is opened. The anteriormost spot generally lies in the anteriormost portion of the

cavity, and the posteriormost spot is usually near the level of the origin of the anal fin. The spots appear as glossy black discs. A few species characteristically have some spots fragmented (these clusters are considered one spot in the counts herein). *Synodus binotus* often lacks peritoneal spots (may have up to three), and *S. kaianus*, with a black peritoneum, apparently has none (at least as an adult).

Since it is likely that the systematics of adult synodontids will be better known than the larval and postlarval forms, identification of larval and postlarval lizardfishes will be enhanced by the studies of the adults. The peritoneal spot counts given here for the known 21 Indo-West Pacific *Synodus* should be applicable to the immature forms as well.

Dermal Flap of Anterior Nares: Although past authors have alluded to the presence of a dermal flap on the anterior nares of some *Synodus* species (Jordan and Herre, 1907; Fowler, 1912; Matsubara, 1938; and Chen and Yeh, 1964), the nature of the dermal flap never has been used as a character for separating species. In my examinations of the 21 species described herein, I found the shape of the flap to be a very useful character.

In some cases more than one species may possess the same shaped flap (*S. englemanni*, *S. jaculum*, and *S. capricornis*, for example). Since it is easily observed, however, the choices for identification can be quickly narrowed to only a few. In general, the basic forms are: short and rounded, short and pointed, long and pointed, long and rounded ("short" is defined as the tip of the flap not extending much beyond the anterior margin of the nares when depressed; a "long" flap extends well beyond the anterior edge of the nares).

Other Characters: Vertebral counts include hypural. Anderson et al. (1975), in a study based on 10 species of western Atlantic lizardfishes, determined that the number of vertebrae is in a ratio of close to 1:1 to the number of pored lateral-line scales, with most specimens having more scales than vertebrae. Fin-ray counts include branched and unbranched rays.

Copepod Parasites

A report on the parasitic copepods of Indo-West Pacific lizardfishes was published by Cressey and Cressey in 1979.

The copepods are from the two copepod orders Poecilostomatoida and Siphonostomatoida. The poecilostomes are represented by the taeniacanthid genus *Metataeniacanthus*, and the siphonostomes by the caligid genus *Abasia*. *Metataeniacanthus* is so far known only from Indo-West Pacific *Trachinocephalus* and *Synodus*. *Abasia* is so far reported only from western Atlantic and Indo-West Pacific *Saurida* and *Synodus*.

The Indo-West Pacific *Synodus* from which parasitic copepods have been reported are listed below with their parasites.

- Synodus englemani* Schultz
Metataeniacanthus epigri Cressey and Cressey
Abasia pillaii Cressey and Cressey
Synodus hoshinonis Tanaka
Metataeniacanthus nudus Cressey and Cressey
Abasia tripartita (Shiino)
Synodus tectus, new species
Metataeniacanthus pacificus Cressey and Cressey
Synodus indicus (Day)
Metataeniacanthus gibbsi Cressey and Cressey
Synodus jaculum Russell and Cressey
Metataeniacanthus conepigri Cressey and Cressey
Synodus kaianus (Günther)*
Abasia pusilla Cressey and Cressey
Synodus macrocephalus, new species
Metataeniacanthus aquilonius Cressey and Cressey
Synodus macrops Tanaka
Metataeniacanthus aquilonius Cressey and Cressey
Synodus oculus, new species
Metataeniacanthus indiscretus Cressey and Cressey
Synodus ulae Schultz
Abasia platyrostris Pillai
Abasia pusilla Cressey and Cressey
Abasia tripartita (Shiino)

Synodus variegatus (Lacépède)

Metataeniacanthus vulgaris Cressey and Cressey

*New record since Cressey and Cressey, 1979.

The remaining species of Indo-West Pacific *Synodus* are apparently unparasitized by copepods. In a few cases the sample sizes of fishes were small, and further collecting may turn up additional parasitized species.

Genus *Synodus* Gronow, 1763

TYPE-SPECIES.—*Synodus synodus* (L.).

DIAGNOSIS.—A member of the Synodontidae with: pelvic-fin rays 8, inner and outer rays shorter than the middle rays; supramaxillae 0; caudal epurals 1; combined dorsal and ventral caudal procurent rays 20–37; furcal scales absent; branchiostegal rays 15–18; postcleithra 2; vertebrae 44–65; vertebrae under dorsal-fin origin 15–20; vomer absent; ectopterygoid teeth absent; endopterygoid teeth absent; caudal fin without scales (except hypurals); palatine teeth of two single bands.

REMARKS.—During the course of this study I found that *Synodus*, *Saurida*, and *Trachinocephalus* could be separated easily on the basis of the presence or absence of scales on the caudal fin. In *Saurida*, *Harpadon*, and *Bathysaurus*, each procurrent and principal ray bears a row of scales. In *Trachinocephalus* only the procurrent rays bear a row of scales. In *Synodus* there are no scales on the caudal-fin rays. I was able to examine only a few specimens of *Harpadon* and *Bathysaurus*, so the presence of scales on the caudal fin of those genera as a generic character is tentative.

I have included *Xystodus* Ogilby in *Synodus* (see discussion of *S. sageneus*).

Key to Indo-West Pacific Species of *Synodus*

1. Anteriormost palatine teeth longer than the more posterior teeth and in a discrete group 2
- Anteriormost palatine teeth not longer than others and not in a discrete group 12
2. Scales above lateral line, 3.5 (rarely 4.5) 3
- Scales above lateral line, 5.5 (rarely 6.5) 7

3. Conspicuous pigmented area on upper distal corner of operculum 4
No conspicuous pigmented area on operculum 5
4. Peritoneal spots 10–11 *tectus*, new species
Peritoneal spots 12–13 *hoshinonis* Tanaka
5. Pectoral fin not extending beyond a line from origin of pelvic to origin of dorsal fin 6
Pectoral fin extending well beyond a line from origin of pelvic to origin of dorsal fin 11
6. Pectoral fin short of a line from origin of pelvic to origin of dorsal fin; about 30 teeth on free end of tongue *fuscus* Tanaka
Pectoral fin just to a line from origin of pelvic to origin of dorsal fin; about 50 teeth on free end of tongue *doaki* Russell and Cressey
7. Postoral portion of cheeks naked 8
Postoral portion of cheeks scaly *englemani* Schultz
8. Caudal peduncle with conspicuous black lateral spot; very short nasal flap on anterior nares *jaculum* Russell and Cressey
Caudal peduncle without conspicuous black spot; anterior nasal flap short or long 9
9. More than 62 lateral-line scales; nasal flap spatulate or very short . . . 10
Lateral-line scales 55–61; nasal flap with flagellum *variegatus* (Lacépède)
10. Nasal flap of anterior nares long and spatulate; usually 6 spots on snout *ulae* Schultz
Nasal flap of anterior nares very short, triangular; usually 2 spots on snout *capricornis* Cressey and Randall
11. Nasal flap of anterior nares long and triangular; peritoneal spots 14 *randalli*, new species
Nasal flap of anterior nares long and spatulate; peritoneal spots 0–3 *binotatus* Schultz
12. Posterior pelvic process narrow (Figure 1) 13
Posterior pelvic process wide (Figure 1) 16
13. Pectoral fin short of a line from origin of pelvic to origin of pectoral fin; peritoneum black *kaianus* (Günther)
Pectoral fin to or beyond a line from origin of pelvic to origin of dorsal fin; peritoneum pale or brown 14
14. Lateral-line scales 58 or more; dorsal fin with 2 broad bars *gibbsi*, new species
Lateral-line scales less than 58; dorsal fin with more than 2 narrow bars when barred 15
15. Peritoneum entirely dark or at least in dorsal half, peritoneal spots 5–6 *macrops* Tanaka
Peritoneum pale, peritoneal spots 7–8 16
16. Snout distinctly rounded in dorsal aspect (Figure 26a); length of nasal flap nearly equal to base width *oculeus*, new species
Snout pointed in dorsal aspect (Figure 26b); length of nasal flap much greater than base width *macrocephalus*, new species

17. Base of anal fin longer than base of dorsal fin *sageneus* Waite
 Base of anal fin shorter than base of dorsal fin 18
18. Pectoral fin extending beyond a line from origin of pelvic to origin of dorsal fin *usitatus*, new species
 Pectoral fin extending to or short of a line from origin of pelvic to origin of dorsal fin 19
19. Not more than 30 teeth on free end of tongue; no pigment spots on upper distal corner of operculum *rubromarmoratus* Russell and Cressey
 More than 30 teeth on free end of tongue; 2 or 3 pigment spots on upper distal corner of operculum 20
20. Pectoral fin short of a line from origin of pelvic to origin of dorsal fin; nasal flap long, triangular *indicus* (Day)
 Pectoral fin extends to a line from origin of pelvic to origin of dorsal fin; nasal flap short, rounded *similis* McCulloch

***Synodus variegatus* (Lacépède, 1803)**

FIGURES 2, 3, 36

Salmo variegatus Lacépède, 1803:157 [Mauritius].

Synodus dermatogenys Fowler, 1912:566 [Hawaiian Islands].

Synodus houli McCulloch, 1921:165 [Queensland, Australia].

MATERIAL EXAMINED (749 specimens).—*Neotype*: BPBM 20192, ♂, SL 151 mm, MAURITIUS, 6 Nov 1973, between Trou d'Eeu Douce and Palmar, reef flat, 0–1 m, J. E. Randall and M. M. Smith. RED SEA (25): USNM 191730 (2), 217693 (4), 217701 (4), 217741 (2), 217744 (1), 217757 (3), 217759 (5), 217780 (1), 217795 (1); CAS 40094–5 (2). MOZAMBIQUE (15): RUSI 3929. SOUTH AFRICA (5): RUSI 74-355 (1), 76-28 (1), 76-32 (2), 10988 (1). COMORES ISLANDS (4): USNM 217702 (2); CAS 35467 (1), 39876 (1). ALDABRA-SEYCHELLES ISLANDS (92): USNM 217672 (14), 217675 (13), 217676 (2), 217680 (2), 217681 (6), 217682 (5), 217688 (4), 217690 (3), 217694 (4), 217696 (4), 217698 (1), 217713 (3), 217716 (12), 217717 (5), 217740 (10), 217742 (2); CAS 35335-6 (2). TANZANIA-KENYA (52): USNM 217718 (1), 217721 (2), 217760 (23); BMNH 1865.2.24.52 (1), 1867.3.7.5.95 (2); LACM 30859-3 (24). MALAGASY REPUBLIC (9): USNM 217660 (7), 217714 (1), 217758 (1). MAURITIUS (8): BMNH 2.22.2.34 (1); RUSI OR312378 (4); FMNH 75386 (1); BPBM 16367 (1), 20192 (1). CARAGADOS ISLANDS (17): USNM 217621 (8),

217678-9 (7), 217695 (1), 217704 (1). AMIRANTE ISLAND (4): USNM 217712. FARQUIER ISLANDS (12): USNM 217668 (2), 217720 (10). CHAGOS ISLANDS (3): USNM 217674 (2), 217692 (1). MALDIVES ISLANDS (38): CAS 35338 (4); FMNH 75371 (3), 75372 (2), 75374 (13), 75375 (3), 75376 (4), 75377 (3), 75380 (1), 75382 (1), 75384 (1), 75385 (3). INDIA-SRI-LANKA (22): USNM 217670 (2), 217685 (1), 217703 (1), 217747 (3), 217750 (4); CAS 14531 (1); MCZ 46072 (3); FMNH 75370 (2), 75373 (3), 75381 (2). MENTAWAI ISLAND (22): USNM 217707 (11), 217710 (10), 217753 (1). WESTERN AUSTRALIA (3): WAM P25312-002 (1), P25374-010 (2). BAWEAN ISLAND (5): USNM 217714. MOLLUCCAS (28): USNM 211019 (11), 217722 (1), 217745 (2), 217761 (14). PHILIPPINE ISLANDS (29): USNM 135970 (4), 136231 (1), 136254 (1), 150893 (1), 150894 (1), 150895 (1); CAS 20323 (2), 40085–7 (6), 68352 (11); BMNH 1933.11.39.40 (1). VIETNAM (14): CAS 30617 (8), 40090 (5), 40091 (1). NORTH BORNEO (23): FMNH 51862 (8), 51863 (15). CHINA (3): BMNH 1851.12.27.192 (1); CAS 39967 (1), 61218 (1). OKINAWA (4): BPBM 19084. PAPUA, NEW GUINEA (1): USNM 217691. TROBRIAND ISLAND (7): USNM 217683 (2), 217697 (1), 217699 (4). TAIWAN (6): USNM 217719 (1), 217751 (1), 217754 (1); NTU 00226-7 (2), 102263 (1). Queensland, AUSTRALIA (31): USNM 217711 (2), 217743 (2);

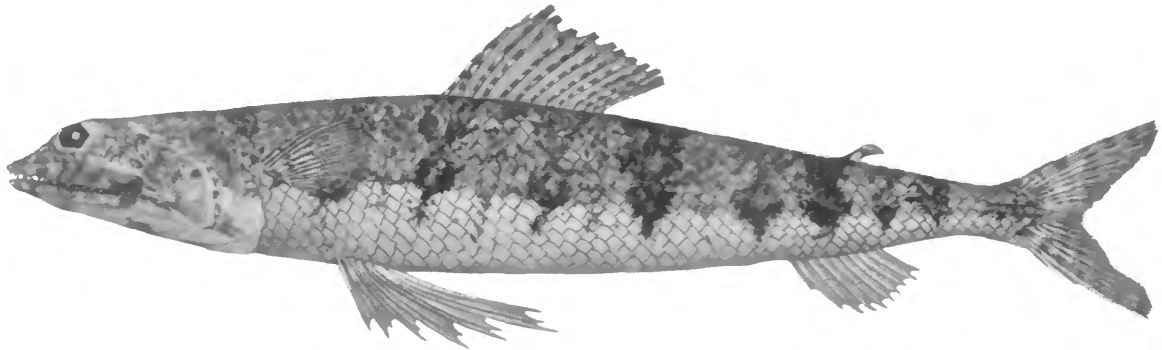


FIGURE 2.—*Synodus variegatus* (Lacépède), USNM 192950, 160 mm SL, Peng-hu Hsien, Taiwan.

MCZ 36737 (1); ANSP 123602 (2), 123628 (16); AMS I.19224-001 (1), I.19225-001 (4), I.15636-002 (1), I.18350-001 (1), I.17017-001 (1). LORD HOWE ISLANDS (1): BPBM 14775. PALAU ISLAND (43): CAS 39961 (2), 40077 (6), 40078 (9), 40083 (24), 40084 (2). MARIANA ISLANDS (26): USNM 143696 (6), 154596 (5), 193354 (2); CAS 30616 (1); ANSP 91704 (1), BPBM 7292 (9). SOLOMON ISLANDS (9): USNM 189907 (2), 189908 (3), 189910 (2), 189915 (1), 217708 (1); SANTA CRUZ ISLANDS (1): CAS 39970. NEW CALEDONIA (2): CAS 19205-6. KAPINGAMARANGI ATOLL (20): CAS 40074 (6), 40075 (2), 40076 (12). MARSHALL ISLANDS (68): USNM 140821 (11), 140824 (8), 140825 (19), 140826 (7), 140829 (8), 140830 (4), 140831 (4), 166514 (2), 217686 (2), 217689 (2), 217746 (1). GILBERT ISLANDS (2): USNM 167434. FIJI (35): USNM 82920 (2), 217667 (1), 217677 (7), 217684 (7), 217755 (16); BMNH 1849.2.14.596 (1); CAS 39971 (1). SAMOAN ISLANDS (14): USNM 52451 (1), 115406 (4), 115407 (3), 115410 (1), 115412 (1); BPBM 6144 (1), 17452 (3). CAROLINE ISLANDS (48): CAS 39952 (12), 39958 (1), 39963 (9), 40070 (2), 40071 (1), 40072 (12), 40073 (1), 40093 (1). TONGA ISLANDS (6): USNM 217796. PHOENIX ISLANDS (1): USNM 115411. COOK ISLANDS (2): CAS 40088 (1); BPBM 10707 (1). SOCIETY ISLANDS (31): BPBM 10276 (6), 11971 (3); CAS 39964 (8), 40079 (1), 40080 (7), 40081 (4), 40082 (2). TUAMOTU ARCHAPELAGO

(2): USNM 217709. LINE ISLANDS (2): USNM 217797 (1); BPBM 14095 (1). HAWAIIAN ISLANDS (20): USNM 51031 (1), 82832 (1), 109347 (4), 143697 (1), 160667 (1); CAS 7669 (5), 40092 (2), 40097 (1); ANSP 28130-34 (4).

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 10–13 (usually 12); anal-fin rays 8–10 (usually 9); pored lateral-line scales 56–61 (usually 59); transverse scale rows 5.5/7; vertebrae 55–60 (usually 58); combined dorsal and anal procurrent rays 26–34; anterior palatine teeth longest and in a discrete group; peritoneal spots 10–12; posterior pelvic process wide.

Synodus variegatus is easily confused with *S. englemani* Schultz, *S. ulae* Schultz, *S. capricornis* Cressey and Randall, *S. doaki* Russell and Cressey, and *S. binotatus* Schultz, as all of these species have similar color patterns with saddle-like dorsal bands. *Synodus englemani* (with which it is often collected) has more lateral-line scales (60–63) and vertebrae (59–62), fewer peritoneal spots (7–10), a short-dermal flap of the anterior nares (long in *variegatus*), and scales on the postoral portion of the cheek (*variegatus* naked). *Synodus ulae* and *S. capricornis* have much higher lateral-line scale and vertebral counts. *Synodus doaki* and *S. binotatus* have fewer transverse scale rows above the lateral line (3.5).



FIGURE 3.—*Synodus variegatus* (Lacépède), detailed enlargement of snout region.

DESCRIPTION (neotype plus range).—Dorsal-fin rays 11 (10–13); anal-fin rays 8 (8–10); pectoral-fin rays 11 (11–13); pelvic-fin rays 8; procurrent rays 27 (26–34), dorsal 15 (14–18), anal 12 (12–16); lateral line continuous, 59 (56–61) pored scales; scale rows above lateral line from dorsal origin 5.5; scale rows below lateral line to anal origin 7; predorsal scales 17 (17–18); rows of cheek scales 7 (5–7); vertebrae 55–60; peritoneal spots 10 (10–12).

Percentages of Standard Length: Mean (range): head length 29.4 (27.3–31.8); snout length 6.0 (5.1–6.7); upper jaw length 18.5 (15.8–20.7); diameter of bony orbit 4.9 (3.6–6.7); least width of bony interorbital 2.4 (1.8–3.1); snout to dorsal origin 43.2 (39.1–46.8); snout to adipose origin 84.2 (77.3–86.2); snout to anal origin 77.6 (69.5–80.9); snout to pelvic insertion 35.8 (31.8–37.9); snout to pectoral insertion 28.0 (25.6–29.7); first-dorsal-ray length 10.2 (7.8–11.3); longest-dorsal-ray length 13.8 (11.6–15.2); pectoral-fin length 11.4 (8.9–13.6); pelvic-fin length 24.7 (20.4–29.7); dorsal-fin base 15.3 (12.0–17.4); anal-fin base 8.7

(7.1–10.5); based on 20 specimens 56.6 mm to 180.4 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks naked. Snout sharply pointed, broader than long; anterior nostril on each side bearing a dermal flap with mesial distal corner produced as a process extending well beyond anterior edge of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 55 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching to a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Light brown and dark brown pigmented areas on light tan background in preserved material. A series of 8 to 9 dark brown saddle-like bands, widest dorsally, constricted toward lateral line, widening at the lateral line to a diamond shape with the ventral apex elongated. Two lighter brown bands anterior to first dark band, which is at origin of the dorsal fin; bands then alternating dark brown and light brown to end of body. Dorsal tip of snout usually with 4 terminal and 2 subterminal pigment spots. All fins except anal usually crossed with narrow dark bars perpendicular to rays.

DISTRIBUTION, HABITAT, AND GEOGRAPHIC VARIATION.—This species occurs throughout the Indo-West Pacific (see Figure 36) and is generally confined within the maximum boundaries of the 28°C isotherm (Hutchins and Scharff, 1947). Of the species considered here it is the most common in museum collections. This may be due in part to its shallow-water habitat, making it a relatively easy species to collect. Collection data indicate that *S. variegatus* is found at depths less than 20 m, and in most cases (44 of 63 collections) less than 5 m. *Synodus variegatus* thus appears to be ecologically separated from all other Indo-West

TABLE 1.—Geographic variation of vertebral counts in 3 species of Indo-West Pacific *Synodus*. (Zone 1 = Red Sea, western and southern Indian Ocean; Zone 2 = India-Andaman Sea-South China Sea; Zone 3 = Australasia; Zone 4 = western Pacific north of Taiwan to New Zealand line; Zone 5 = north and south central Pacific east of 180°; arrows indicate directions of increase)

Species	n	Zones				
		1 ←	2 ←	3 →	4 →	5
<i>Synodus variegatus</i>	377	58.37 (57-60)	57.28 (55-59)	57.08 (56-59)	57.84 (57-60)	58.32 (57-61)
<i>Synodus englemani</i>	153	60.55 (60-62)	60.11 (60-61)	60.12 (59-61)	60.26 (59-61)	60.87 (59-62)
<i>Synodus binotatus</i>	112	53.15 (52-55)	52.25 (51-54)	51 (51)	53.10 (51-55)	53.53 (53-54)

Pacific *Synodus* except *S. sageneus*, *S. binotatus*, *S. englemani*, and *S. jaculum*. The remaining known species inhabit deeper water.

An area by area analysis of average vertebral counts suggests that there may be a gradual increase in number from lower average counts (56-57) in waters of Sri-Lanka to Taiwan to highest average counts (58+) at the periphery of the range with intermediate average counts (57-58) in the central West Pacific (Table 1). Within the limited populations on which each of the averages were based, there were no cases of a range of more than four vertebrae (in most cases three). From this it may be concluded that within restricted areas the vertebral number is more stable than is suggested by the overall data for the species throughout its range.

REMARKS.—The material on which Lacépède based the description of this species apparently no longer exists. I examined six specimens from the type-locality (Mauritius), and all of them are the species described here as *S. variegatus*. Since this material did not contradict Lacépède's brief description and illustration, I assume that they represent the same species described by him in 1803.

Synodus japonicus (Houttuyn), described from Japan, has been placed in synonymy with *S. variegatus* by various authors. I have examined five species from Japan, none of which is *S.*

variegatus. The original description is too vague to allow a determination of the true nature of *S. japonicus*, there is no type available, and *Synodus japonicus* should be considered a nomen dubium.

Since no holotype exists, I have selected a neotype (BPBM 21092) from the type-locality (Mauritius).

Synodus variegatus is commonly parasitized on the gill filaments by the copepod *Metataeniocanthus vulgaris* Cressey and Cressey and less commonly on or under the pseudobranch by *M. solidus* Cressey and Cressey. These two species are specific to *S. variegatus*, and their presence will confirm the identification of the host species.

Synodus binotatus Schultz, 1953

FIGURES 4, 5, 39

Synodus binotatus Schultz, 1953:35 [Marshall Islands].

MATERIAL EXAMINED (122 specimens).—*Holotype*: USNM 140801, MARSHALL ISLANDS. *Paratypes* (32): USNM 140802-6 (11), 140808-0 (5), 140811-3 (17); MARSHALL AND JOHNSTON ISLANDS. ADEN (1): USNM 217595. COMORES (9): USNM 217663-4 (3), 217734 (6). SOUTH AFRICA (1): RUSI 76-9. ALDABRA (4): USNM 217597 (1), 217604 (1), 217773 (2). SEYCHELLES (25): CAS 39887 (1); ANSP 111131 (7), 111144 (4), 111223 (1), 111226 (1), 111230 (2), 111232 (5), 112145 (1), 112169 (3). AMIRANTE ISLAND (3):

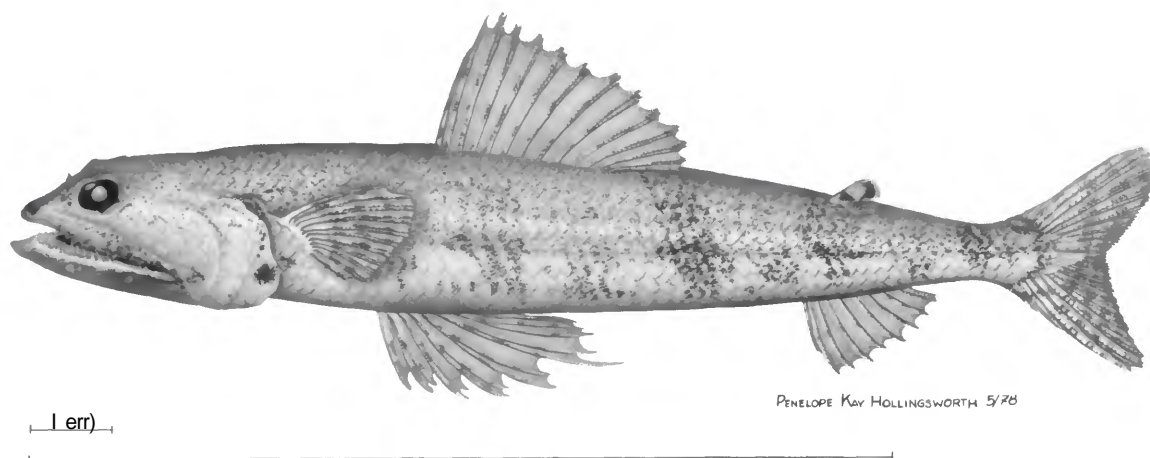


FIGURE 4.—*Synodus binotatus* Schultz, USNM 218948, 117 mm SL, Apo Island, Philippines.

USNM 217598 (1), 217601 (2). MALDIVES (7): FMNH 75387-90. CHAGOS ISLAND (5): USNM 217596 (3), 217600 (2). SRI-LANKA (1): USNM 217599. COCOS-KEELING (1): ANSP (uncataloged). PRATAS REEF (1): CAS 39966. TAIWAN (1): USNM 217602. AUSTRALIA (3): AMS 19223001. SANTA CRUZ ISLAND (1): CAS 39969. CAROLINE ISLAND (1): CAS 39959. PALAU (6): BPBM 7212 (2), 9363 (4). MARSHALL ISLANDS (1): USNM 166515. AMERICAN SAMOA (1): BPBM 17557. TONGA ISLANDS (5): USNM 217662. SOCIETY ISLANDS (2): BPBM 6921. GAMBIER ISLAND (2): BPBM 13552. JOHNSTON ISLAND (6): BPBM 8947 (5), 8976 (1). HAWAIIAN ISLANDS (3): USNM 217603 (1); CAS 39951 (1); BPBM 6463 (1).

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 12-14 (usually 13); anal-fin rays 8-10 (usually 9); pored lateral-line scales 52-55 (usually 54); transverse scale rows 3.5/5; vertebrae 51-55 (usually 53); combined dorsal and anal procurrent rays 27-33; anterior palatine teeth longest and in a discrete group; peritoneal spots 0-3; posterior pelvic process wide.

Synodus binotatus can be separated from all known Indo-West Pacific *Synodus* except *S. usita-*

tus, new species, *S. oculus*, new species, and *S. macrocephalus*, new species, by the relatively long pectoral fin, which extends well beyond a line from the base of the pelvic fin to the base of the dorsal fin. *Synodus usitatus* has higher lateral-line scale and vertebral counts (58 avg.). *Synodus oculus* and *S. macrocephalus* have a narrow posterior pelvic process.

DESCRIPTION.—Dorsal-fin rays 12-14; anal-fin rays 8-10; pectoral-fin rays 12; pelvic-fin rays 8; procurrent rays 27-33, dorsal 15-18, anal 12-15; lateral line continuous, 52-56 pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 14-15; rows of cheek scales 5-6; vertebrae 51-55; peritoneal spots 0-3.

Percentages of Standard Length: Mean (range): head length 29.5(27.2-31.7); snout length 6.2(5.0-7.3); upper jaw length 19.6(17.7-22.1); diameter of bony orbit 5.7(4.6-6.6); least width of bony interorbital 2.7(1.9-3.5); snout to dorsal origin 43.6(40.6-46.5); snout to adipose origin 85.6(83.2-88.3); snout to anal origin 77.4(75.3-79.9); snout to pelvic insertion 37.4(34.5-40.0); snout to pectoral insertion 28.5(25.2-30.6); first-dorsal-ray length 10.2(7.9-12.4); longest-dorsal-ray length 13.7(11.5-16.9); pectoral-fin length 14.5(12.6-16.9); pelvic-fin length 27.6(25.1-30.2);



FIGURE 5.—*Synodus binotatus* Schultz, detailed enlargement of snout region.

dorsal-fin base 17.4(14.5–19.0); anal-fin base 9.8(8.1–11.1); based on 20 specimens 56.1 to 125.7 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long; anterior nostril on each side bearing a prominent spatulate dermal flap reaching well beyond anterior margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 40 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching beyond a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Light brown and dark brown pigmented areas on light tan background in preserved material. A series of 4 dark brown dorsal saddle-like bands with 3 lighter brown

bands between. First dark band at origin of dorsal fin. These bands similar to those of *S. variegatus* and *englemani* but usually lighter. All fins barred. Adipose fin with prominent basal pigment area and a spot or stripe distally. Snout with 2 conspicuous terminal spots.

DISTRIBUTION, HABITAT, AND GEOGRAPHIC VARIATION.—*Synodus binotatus* is a common shallow-water inhabitant throughout the Indo-West Pacific and is generally confined within the 28°C isotherm (Hutchins and Scharff, 1947). Of the 21 collections with depth data, none were from waters deeper than 20 m, most being from 10 m or less (16 of 21).

This species is often collected with *S. variegatus* and *S. englemani*.

As in *S. variegatus* an analysis of geographic variation in vertebral counts shows lower average counts in populations bordering Southeast Asia and Australia with higher average counts in more peripheral populations (see map of *S. binotatus* distribution, Figure 39). Although the range of vertebral counts is 51–55, there is never a range of more than three in any given population.

***Synodus capricornis* Cressey and Randall, 1978**

FIGURES 6, 40

Synodus capricornis Cressey and Randall, 1978:767 [Easter Island].

MATERIAL EXAMINED (6 specimens).—*Holotype*: BPBM 6560, EASTER ISLAND. *Paratypes*: BPBM 6562 (1), USNM 218461 (1), EASTER ISLAND; BPBM 16860 (2), USNM 218462(1), PITCAIRN ISLAND.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 12–14 (usually 13); anal-fin rays 8–10 (usually 9); pored lateral-line scales 65–66 (usually 65); transverse scale rows 5.5/7; vertebrae 64–65 (usually 65); combined dorsal and anal procurent rays 32–33; anterior palatine teeth longest and in a discrete group; peritoneal spots 10–12; posterior pelvic process wide.

Synodus capricornis can be separated from all other Indo-West Pacific *Synodus* except *S. ulae* by

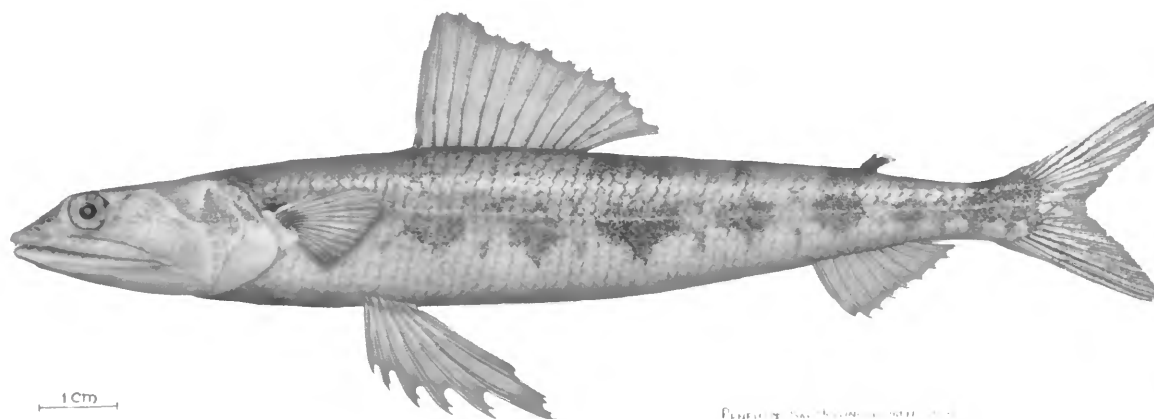


FIGURE 6.—*Synodus capricornis* Cressey and Randall, BPBM 6560, 131 mm SL, Easter Island.

its high lateral-line scale and vertebral count (65–66). It can be separated from *S. ulae* by the large spatulate dermal flap on the anterior nares of *S. ulae* (short and triangular in *S. capricornis*).

DESCRIPTION.—Dorsal-fin rays 12–14; anal-fin rays 8–10; pectoral-fin rays 14; pelvic-fin rays 8; procurent rays 32–33, dorsal 16–18, anal 15–16; lateral line continuous, 65–66 pored scales; scale rows above lateral line from dorsal origin 5.5; scale rows below lateral line to anal origin 7; predorsal scales 15; rows of cheek scales 5; vertebrae 65–66; peritoneal spots 10–12.

Percentages of Standard Length: Mean (range): head length 29.6 (27.8–31.9); snout length 6.5 (5.8–7.0); upper jaw length 17.6 (16.6–18.8); diameter of bony orbit 5.3 (4.9–5.8); least width of bony interorbital 3.4 (2.7–3.8); snout to dorsal origin 42.3 (40.9–43.7); snout to adipose origin 86.3 (84.9–87.4); snout to anal origin 82.4 (81.4–83.2); snout to pelvic insertion 35.7 (34.0–37.2); snout to pectoral insertion 28.3 (25.6–30.5); first-dorsal-ray length 9.0 (8.5–10.0); longest-dorsal-ray length 13.3 (12.6–14.6); pectoral-fin length 10.8 (9.7–11.6); pelvic-fin length 21.7 (20.2–23.7); dorsal-fin base 16.2 (15.0–16.8); anal-fin base 8.3 (7.0–9.5); based on 6 specimens 74.2 to 185.4 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion

of cheeks naked. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a short triangular dermal flap as in *S. englemanni*. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 40 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, the fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneal color pale.

COLOR PATTERN.—Snout with 2 dark spots at tip; lateral saddle-like pigmented areas as in *S. variegatus* in preserved specimens.

DISTRIBUTION AND HABITAT.—Known only from Easter and Pitcairn islands and occurs at moderate depths of 70 to 130 ft.

REMARKS.—This species closely resembles *S. ulae* and may be the southern counterpart of that species.

Synodus doaki Russell and Cressey, 1979

FIGURES 7, 8, 40

Synodus doaki Russell and Cressey, 1979:166 [New Zealand].

MATERIAL EXAMINED (12 specimens).—*Holotype*: NMNZ 5676, NEW ZEALAND. *Paratypes* (9):

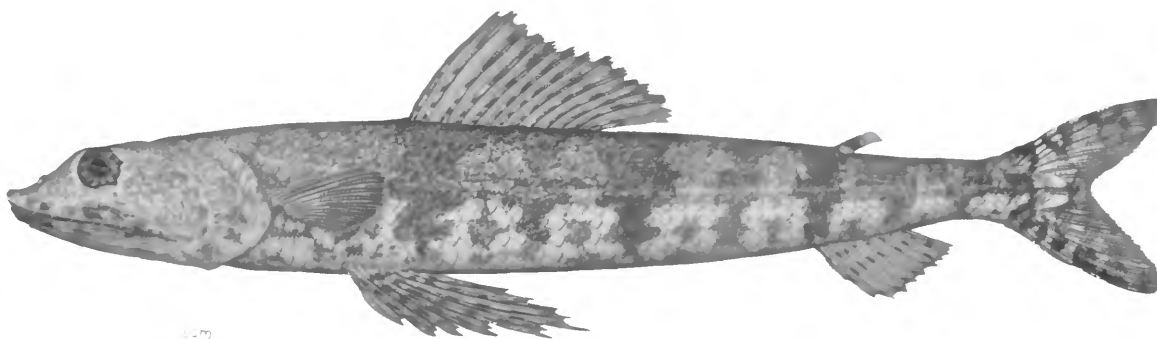


FIGURE 7.—*Synodus doaki* Russell and Cressey, NMNZ 6168, 171 mm SL, Poor Knights Island, New Zealand.

NMNZ 5677, 5678, 6168, NEW ZEALAND; AMS I.15338, 18351-001, 18773-001; QUEENSLAND; BPBM 14655, NEW SOUTH WALES; BPBM 21057, LEEWARD ISLANDS; USNM 218793, KENYA. *Other Specimens*: FMNH 55488, JAPAN; USNM 222027, SOMALIA.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 13–15 (usually 14); anal-fin rays 8–9 (usually 8); pored lateral-line scales 55–58 (usually 57); transverse scale rows 3.5/7; vertebrae 55–58 (usually 57); combined dorsal and anal procurrent rays 31–35; anterior palatine teeth longest and in a discrete group; peritoneal spots 11–12; posterior pelvic process wide.

Synodus doaki has 3.5 scales above the lateral line; *S. variegatus*, *S. englemani*, *S. capricornis*, *S. jaculum*, and *S. ulae* have 5.5. *Synodus sageneus* has 4.5 scales above the lateral line. The discrete group of longer anterior palatine teeth of *S. doaki* distinguishes it from *S. indicus*, *S. similis*, *S. kaianus*, *S. macrops*, *S. rubromarmoratus*, *S. macrocephalus*, *S. oceleus*, *S. gibbsi*, and *S. usitatus*. *Synodus doaki* has a peritoneal spot count of 11–12, which separates it from *S. binotatus* (0–3) and *S. fuscus* (7–10). *Synodus hoshinonis* has a prominent black pigmented area at the upper distal corner of the operculum; *S. doaki* lacks this pigmented area.

DESCRIPTION.—Dorsal-fin rays 13–15; anal-fin rays 8–9; pectoral-fin rays 12–13; pelvic-fin rays

8; procurrent rays 31–35; dorsal 17–19, anal 14–16; lateral line continuous, 56–58 pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 7; predorsal scales 14–17; rows of cheek scales 5–6; vertebrae 55–58; peritoneal spots 11–12.

Percentages of Standard Length: Mean (range): head length 29.9 (27.6–32.0); snout length 7.4(6.4–8.6); upper jaw length 19.6(17.3–21.0); diameter of bony orbit 5.3(4.5–6.5); least width of bony interorbital 2.9(1.9–3.5); snout to dorsal origin 42.7(40.0–44.3); snout to adipose origin 84.1(78.4–87.8); snout to anal origin 77.3(72.3–80.3); snout to pelvic insertion 37.3(34.9–39.8); snout to pectoral insertion 29.7(26.5–31.6); first-dorsal-ray length 10.0(9.1–11.4); longest-dorsal-ray length 15.1(13.6–17.5); pectoral-fin length 12.7(11.5–13.8); pelvic-fin length 24.1(22.1–26.0); dorsal-fin base 17.7(14.3–19.5); anal-fin base 9.6(8.5–11.3); based on 8 specimens 69.1 to 231.2 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long. The original description by Russell and Cressey, 1979, states that the snout is longer than broad. Reexamination of the original material indicates this to be in error, and I correct it herein; anterior nostril on each side bearing a conspicuous leaflike flap on its posterior margin

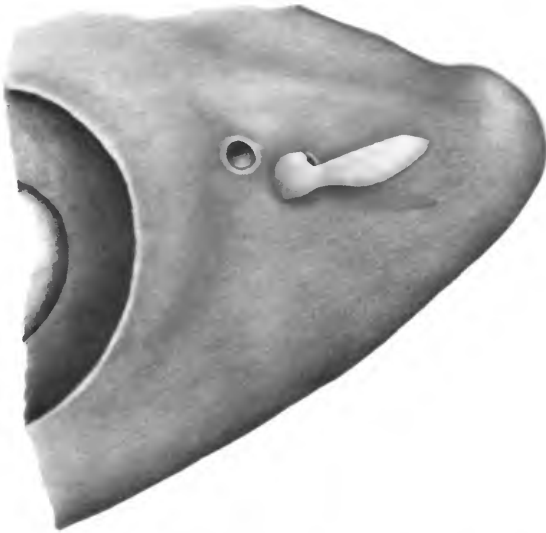


FIGURE 8.—*Synodus doaki* Russell and Cressey, detailed enlargement of snout region.

extending well beyond margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front not largest and not in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 50 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins not reaching beyond a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Fresh colors as follows: body pale with 8 undulated reddish bars extending from middorsal line almost to midventral line; the first and alternate bars paler. Three lengthwise reddish streaks along the back and upper sides, one just below middorsal line, one between middorsal line and lateral line, the other just above lateral line. A series of reddish blotches along the lower part of the sides between the first and seventh vertical bars. Head reddish, cheeks and operculum pale, marbled with red. Lips broadly barred with red, a pair of red spots at tip

of snout. Eye marked with red, pupil bright red. All fins marked with red transverse bands.

In alcohol colors are faded almost completely.

DISTRIBUTION AND HABITAT.—This species has been recorded from Somalia, Japan, east coast of Australia, New Zealand, and the Leeward and Hawaiian islands. Although the Australia—New Zealand specimens were collected in relatively shallow water (19–30 m), the Hawaii and Somalia specimens were collected at depths of 61 to 140 m. The scattered records of *S. doaki* may be due to its preference for deeper water, and hence it is not often collected. It is apparently a widely distributed species.

Synodus englemani Schultz, 1953

FIGURES 9, 10, 37

Synodus englemani Schultz, 1953:41 [Marshall Islands].

MATERIAL EXAMINED.—*Holotype*: USNM 140815, RONGELAP. *Paratypes* (7): USNM 140816 (2), 152980 (1), 152981 (3), 202547 (1), BIKINI. RED SEA (81): USNM 217626 (35), 217626 (12), 217630 (1), 217650 (4), 217786 (1), 217787 (13), 217789 (12), 217790 (3), 217792 (1); BPBM 13869 (1). COMORES (42): USNM 217654 (8), 217661 (82), 217785 (5); CAS 32554 (7), 32563 (8), 35028 (12), 35206 (1), 39889 (4). ALDABRA-SEYCHELLES (1): CAS 39335. TANZANIA-KENYA (3): BMNH 1965.2.25.52 (1), BMNH 1966.11.16.1013-6 (2). SOUTH AFRICA (4): RUSI 76-11 (1), 9439 (2); BMNH 1917.10.1.3 (1). MALAGASY REPUBLIC (6): USNM 217629 (4), 217633 (1), 217657 (1). SOMALIA (2): ZIM H4909. CARAGADOS (12): USNM 217632 (2), 217636 (1), 217637 (2), 217639 (1), 217642 (4), 217645 (2). ARABIA (1): BMNH 1887.11.11.287. AMIRANTE ISLAND (3): USNM 217652 (2), 217658 (1). MALDIVES (2): FMNH 75379 (1); BPBM 18904 (1). INDIA-SRI-LANKA (5): USNM 217649 (3); CAS 39947 (1); MCZ 46972 (1). COCOS-KEELING (1): ANSP (uncataloged). WEST JAVA SEA (2): USNM 217655 (1), 217784 (1). MOLLUCAS (28): USNM 136277 (2), 209781 (8), 209840 (1), 210498 (3), 217655 (1), 217781

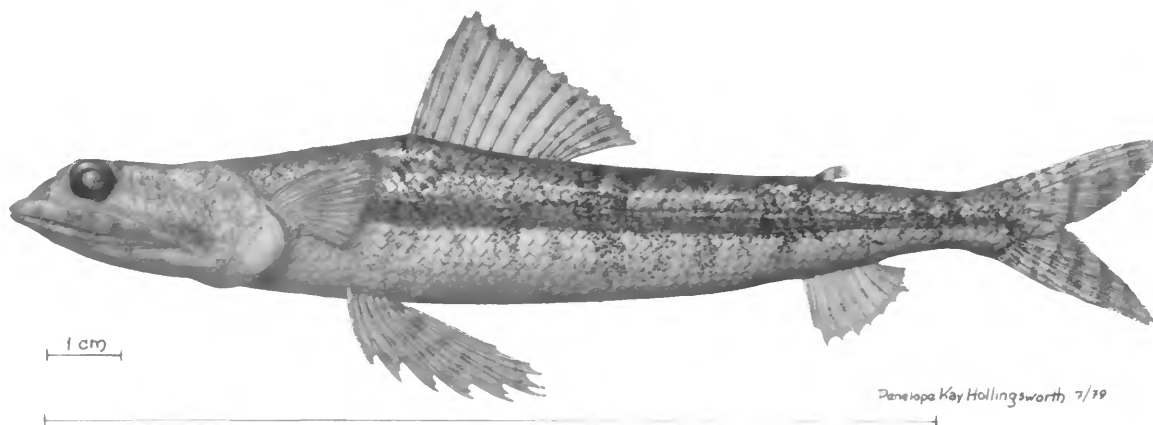


FIGURE 9.—*Synodus englemani* Schultz, USNM 217620, 135 mm SL, between New Britain and New Ireland.

(1), 217783 (9), 217793 (2); BMNH 1858.4.21.473 (1). PHILIPPINES (18): USNM 56204 (1), 131110 (10), 136267–8 (2); CAS 26575 (5). VIETNAM (2): CAS 39875. CHINA (1): BMNH (no cat. number). OKINAWA (1): USNM 143701 (originally a paratype of *S. ulae*). NEW GUINEA (9): USNM 217628 (7), 217653 (1); BMNH 1974.5.25.56 (1). NEW BRITAIN (11): USNM 217620 (7), USNM 217635 (2); AMS 17503–014 (2). QUEENSLAND, AUSTRALIA (6): USNM 217623 (1), AMS 19222–001 (4); MCZ 36737 (1). PALAU (3): CAS 39965 (1), 39972 (2). CAROLINE ISLANDS (4): CAS 39953 (1), 39962 (3). MARIANA ISLANDS (1): CAS 39874. SOLOMON ISLANDS (4): USNM 217631 (2); ANSP 80138 (1); BPBM 15983 (1). KAPINGAMARANGI ATOLL (4): CAS 39954–5 (2), 39957 (1), 39974 (1). MARSHALL ISLANDS (5): USNM 217512 (3), 217624 (1), 217648 (1). FIJI (5): USNM 217622. SAMOA (5): USNM 217651 (2); BPBM 17494 (2), 17433 (1). TONGA (6): USNM 217791. COOK ISLANDS (2): BPBM 13948. SOCIETY ISLANDS (8): BPBM 6062 (1), 6099 (1), 8113 (3), 11281 (3). AUSTRAL ISLAND (1): BPBM 13713. MARQUESAS (1): BPBM 11839. GAMBIER ISLAND (4): BPBM 839 (1), 14315 (1), 14274 (2). LINE ISLANDS (1): BPBM 14095. HAWAIIAN ISLANDS (10): USNM 217660 (1); CAS 30074 (1), 30494 (7), 68349 (1). RAPA ISLAND (5): BPBM 12960 (2), 13029 (1), 17194 (1), 17322 (1).

PITCAIRN ISLAND (3): BPBM 16768 (1), 16789 (2).

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 11–13 (usually 13); anal-fin rays 8–10 (usually 9); pored lateral-line scales 60–62 (usually 61); transverse scale rows 5.5/7; vertebrae 59–62 (usually 60); combined dorsal and anal procurent rays 29–37; anterior palatine teeth longest and in a discrete group; peritoneal spots 7–10; posterior pelvic process wide.

Synodus englemani is easily confused with *S. variegatus*. The characters separating these species are given with the description of *S. variegatus*. *Synodus englemani*, however, seems most closely related to *S. jaculum* Russell and Cressey, sharing a number of meristic characters with it. *Synodus jaculum* differs by the presence of a conspicuous dark lateral patch on the caudal peduncle of *S. jaculum* and a higher peritoneal spot count (11–13). *Synodus ulae* and *S. capricornis* have higher vertebral counts. *Synodus ulae* has a large spatulate dermal flap on the anterior nares. All other species of Indo-West Pacific *Synodus* have a transverse scale count above the lateral line of 3.5 or 4.5 (4.5 in *S. sagineus* vs. 5.5 in *S. englemani*).

DESCRIPTION.—Dorsal-fin rays 11–13; anal-fin rays 8–10; pectoral-fin rays 13; pelvic-fin rays 8;

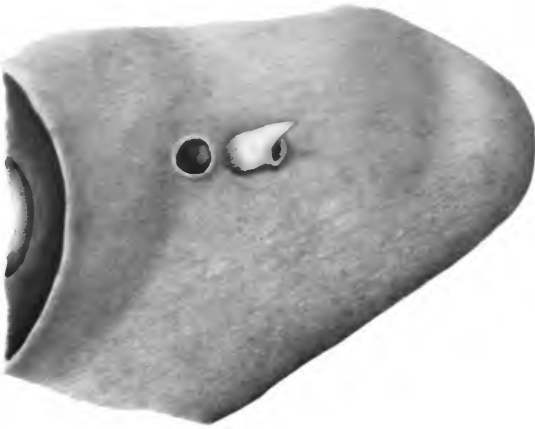


FIGURE 10.—*Synodus englemani* Schultz, detailed enlargement of snout region.

procurrent rays 29–37, dorsal 15–19, anal 14–18; lateral line continuous, 60–63 pored scales; scale rows above lateral line from dorsal origin 5.5; scale rows below lateral line to anal origin 7; predorsal scales 18–19; rows of cheek scales 10–11; vertebrae 59–62; peritoneal spots 7–10.

Percentages of Standard Length: Mean (range): head length 30.7(29.0–32.4); snout length 6.7(5.7–8.1); upper jaw length 19.0(16.0–21.4); diameter of bony orbit 5.4(4.3–6.2); least width of bony interorbital 3.4(2.4–4.0); snout to dorsal origin 43.5(40.9–46.5); snout to adipose origin 85.2(81.9–88.3); snout to anal origin 77.4(73.3–81.3); snout to pelvic insertion 36.5(34.4–38.8); snout to pectoral insertion 29.0(27.6–31.2); first-dorsal-ray length 10.6(8.1–12.1); longest-dorsal-ray length 14.2(12.7–16.2); pectoral-fin length 11.7(10.5–13.0); pelvic-fin length 23.9(20.7–26.9); dorsal-fin base 16.0(14.5–18.4); anal-fin base 9.0(7.3–11.3); based on 20 specimens 71.2 mm to 150.8 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a short dermal flap, the posterior edge produced as a short triangular process. Interorbital space concave, occipital region bony. Palatine

teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 40 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, the fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—As in *S. variegatus* except in some preserved specimens a dark, wide stripe is present along the lateral line at the level of the lateral triangular pigmented areas. Schultz alludes to the presence of this stripe as a means of separating this species from *S. variegatus*. Although I have never seen a preserved specimen of *S. variegatus* with this stripe, many specimens of *S. englemani* examined during the course of this study did not show it either. Color photos of fresh specimens taken by J. E. Randall show both conditions.

DISTRIBUTION AND HABITAT.—This species occurs throughout the Indo-West Pacific and is generally confined within the 28°C isotherm (Hutchins and Scharff, 1947). Collection data indicate that this species is occasionally found in depths less than 5 m (6 of 50 collections), commonly in depths 5 and 40 m (43 collections), and rarely in depths more than 40 m (one collection at 60 m). This species is often found in collections with *S. variegatus* as their depth ranges overlap, but *S. englemani* is more common at the deeper portion of their combined ranges, whereas *S. variegatus* is more common at the shallow portion.

REMARKS.—The parasitic copepod *Metataenia-canthus epigri* Cressey and Cressey is common on the gills of this host and is specific to it.

Synodus fuscus Tanaka, 1917

FIGURES 11, 41

Synodus fuscus Tanaka, 1917:38 [Japan].

MATERIAL EXAMINED.—FORMOSA STRAIT (2): CAS 28325 (1); NTU 103416 (1). JAPAN (18):

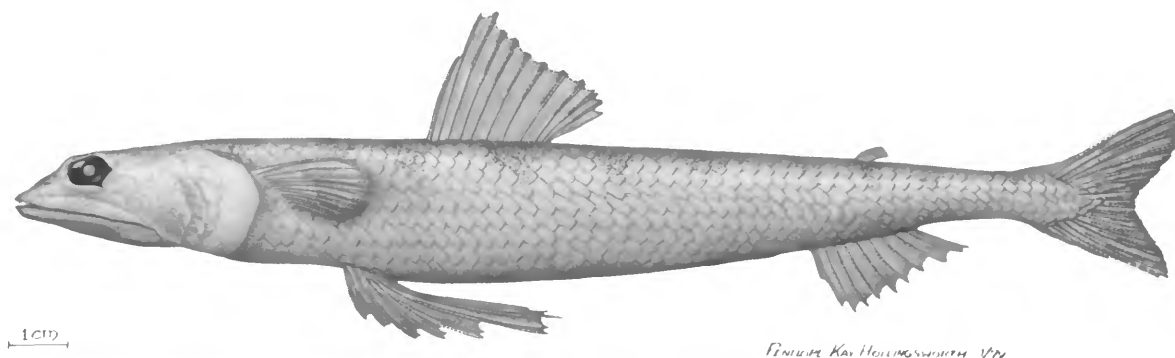


FIGURE 11.—*Synodus fuscus* Tanaka, FAKU 11827, 172 mm SL, Wakasa Bay, Japan Sea.

CAS 23460 (1), FAKU 2261, 2262, 4762, 4764, 4770, 4774, 4781, 4782, 4788, 4811, 4813, 4816, 4817, 4820, 6558, 11824, 11827 (1 specimen per number).

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 10–12 (usually 11); anal-fin rays 8–10 (usually 9); pored lateral-line scales 53–55 (usually 55); transverse scale rows 3.5/5; vertebrae 53–55 (usually 55); combined dorsal and anal procurrent rays 23–27; anterior palatine teeth longest and in a discrete group; peritoneal spots 9–10; posterior pelvic process wide.

Synodus fuscus is a rather nondescript species without decisive external characters that easily separate it from other Indo-West Pacific *Synodus*. The pectoral fin of *S. fuscus* is short (not reaching a line between the origins of the pelvic and dorsal fins). All other species except *S. indicus*, *S. rubromarmoratus*, *S. kaianus*, and *S. sageneus* have a pectoral fin reaching to or beyond this line. The base of the anal fin of *S. sageneus* is longer than the base of the dorsal fin, unlike that of *S. fuscus*. The vertebral count of *S. kaianus* is higher (58–63). The peritoneal spot count of *S. rubromarmoratus* is higher (12), and its anterior palatine teeth, unlike those of *S. fuscus*, are not longest or in a discrete group.

DESCRIPTION.—Dorsal-fin rays 10–12; anal-fin rays 8–10; pectoral-fin rays 12; pelvic-fin rays 8;

procurrent rays 23–27, dorsal 12–15, anal 11–13; lateral line continuous, 53–55 pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 15–18; rows of cheek scales 4–6; vertebrae 53–55; peritoneal spots 9–10.

Percentages of Standard Length: Mean (range): head length 27.7(23.8–30.6); snout length 6.6(5.6–7.5); upper jaw length 17.4(15.2–18.3); diameter of bony orbit 5.2(4.2–5.8); least width of bony interorbital 3.1(2.3–3.7); snout to dorsal origin 45.4(43.0–49.3); snout to adipose origin 87.9(84.8–93.6); snout to anal origin 80.7(76.3–87.2); snout to pelvic insertion 37.3(33.5–42.2); snout to pectoral insertion 27.4(25.2–29.8); first-dorsal-ray length 9.7(7.3–11.0); longest-dorsal-ray length 14.6(13.0–16.0); pectoral-fin length 11.9(10.9–12.9); pelvic-fin length 20.9(19.0–23.9); dorsal-fin base 12.7(11.0–14.3); anal-fin base 8.8(7.7–10.0); based on 9 specimens 112.6 to 221.7 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, about as broad as long; the anterior nostril on each side bearing a long broad flap, widest near middle, extending well beyond margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly,

those in front somewhat larger and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 30 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins not reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle narrow. Peritoneum pale.

COLOR PATTERN.—In preserved material dorsum somewhat darker than ventral surface, no trace of any pattern of pigment patches or spots, fins unmarked.

DISTRIBUTION AND HABITAT.—This species is known only from Formosa Strait and Japan. The only record indicating depth of capture is 60 m for the CAS Formosa Strait specimen.

REMARKS.—The peritoneal spots are very small and often broken up as clusters of three or four. In the counts herein each of these clusters is considered as one spot.

Synodus gibbsi, new species

FIGURES 12, 13, 41

MATERIAL EXAMINED.—*Holotype*: USNM 218389, ♂, SL 159.9 mm, and 34 paratypes, USNM 217737, SL 94.5–180.9 mm, TANZANIA (6°51'S, 39°54'E), 19 Nov 1965, R/V *Anton Bruun*, Cruise 9, Sta 422, 100 m, H. A. Fehlman. One paratype, ZSI-F 7280/2 (same data as types above). Four paratypes, USNM 217736, SL 111–198 mm, TANZANIA (6°52'S, 39°54'E), 20 Nov 1965, R/V *Anton Bruun* Cruise 9, Sta 423, 200 m, H. A. Fehlman.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 11–13 (usually 12); anal-fin rays 10–11 (usually 11); pored lateral-line scales 58–61 (usually 59); transverse scale rows 3.5; vertebrae 58–60 (usually 59); combined dorsal and anal procurrent rays 24–28; anterior palatine teeth not longest and not in a discrete group; peritoneal spots 7–8; posterior pelvic process narrow, 2–3 conspicuous broad bars on the dorsal fin.

The narrow posterior process of the pelvic girdle separates this species from all known Indo-West Pacific *Synodus* except *S. macrops*, *S. kaianus*, *S. oculus*, and *S. macrocephalus*. The higher vertebral count of *S. gibbsi* (58–60) separates it from *S. macrops* (51–55), *S. oculus* (52–56), and *S. macrocephalus* (50–55). The peritoneum of *S. gibbsi* is pale, whereas that of *S. kaianus* is black.

DESCRIPTION (holotype plus range).—Dorsal-fin rays 12(11–13); anal-fin rays 11(10–11); pectoral-fin rays 13(13–14); pelvic-fin rays 8; procurrent rays 27(24–28), dorsal 15(13–15), anal 12(11–13); lateral line continuous, 59(58–61) pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5.5; predorsal scales 16(15–16); rows of cheek scales 4(4–5); vertebrae 59(58–60); peritoneal spots 7(7–8).

Percentages of Standard Length: Mean (range): head length 26.6(25.2–27.7); snout length 7.4(6.8–8.1); upper jaw length 16.1(15.2–16.9); diameter of bony orbit 5.9(5.3–6.6); least width of bony interorbital 3.1(2.2–3.5); snout to dorsal origin 41.7(38.9–44.6); snout to adipose origin 86.9(84.2–89.4); snout to anal origin 78.5(76.0–82.6); snout to pelvic insertion 37.6(35.3–39.8); snout to pectoral insertion 27.2(26.2–29.6); first-dorsal-ray length 9.5(7.3–11.1); longest-dorsal-ray length 15.4(12.9–17.0); pectoral-fin length 13.7(12.6–14.7); pelvic-fin length 21.3(19.0–22.8); dorsal-fin base 13.1(12.2–14.5); anal-fin base 10.5(9.0–11.9); based on 11 specimens 95.3 to 186.5 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a triangular flap extending well beyond margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front not largest and not in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 20 in number. Teeth caniniform, larger

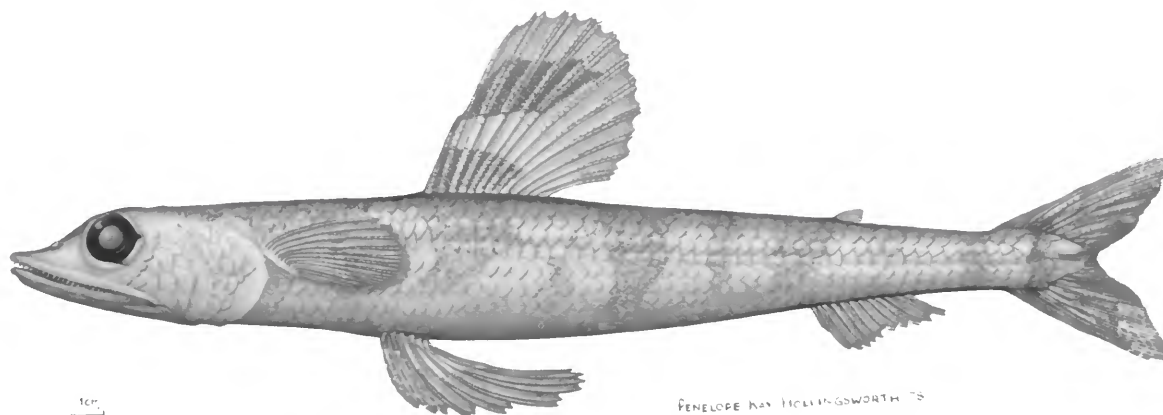


FIGURE 12.—*Synodus gibbsi*, new species, holotype USNM 218389, 159.9 mm SL, Tanzania.

teeth with arrow-shaped tips. Pectoral fins reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle narrow. Peritoneum pale.

COLOR PATTERN.—Preserved material with poorly distinguished saddle-like bands; dorsal fin with 2 to 3 conspicuous bars, which are the most conspicuous marking on preserved specimens; other fins unmarked in preserved specimens.

DISTRIBUTION AND HABITAT.—The only two col-

lections are from waters off Tanzania. One was made at 100 m, and the other at 200 m, indicating that this species prefers deeper water than most other known species.

ETYMOLOGY.—This new species is named for Robert H. Gibbs, Jr., good friend and colleague and one of the early workers to show the value of peritoneal spots in identifying postlarval lizardfishes.

Synodus hoshinonis Tanaka, 1917

FIGURES 14, 15, 43

Synodus hoshinonis Tanaka, 1917:38 [Japan].

MATERIAL EXAMINED.—RED SEA (5): BMNH 1960.3.15.45–46 (2); FMNH 45293 (1); HUI 6235 (1), 6315 (1). MOZAMBIQUE (1): USNM 217765. ANDAMAN SEA (23): USNM 217509 (3), 217764 (1), 217768 (1), 217771 (6), 217772 (10), 217773 (1), 217775 (1). WESTERN AUSTRALIA (2): AMS (uncataloged). JAPAN (6): USNM 64651 (3); BMNH 1905.06.53 (1), 1923.2.26.156.7 (2).

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 12–14 (usually 13); anal-fin rays 8–10 (usually 10); pored lateral-line scales 55–57 (usually 55); transverse scale rows 3.5/5; vertebrae 54–57 (usually 54); combined dorsal and anal procurrent rays

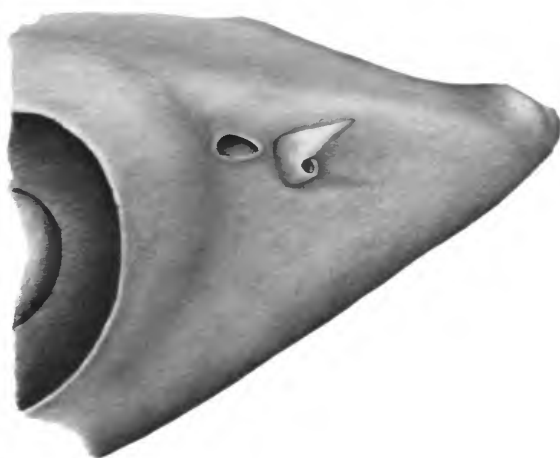


FIGURE 13.—*Synodus gibbsi*, new species, detailed enlargement of snout region.

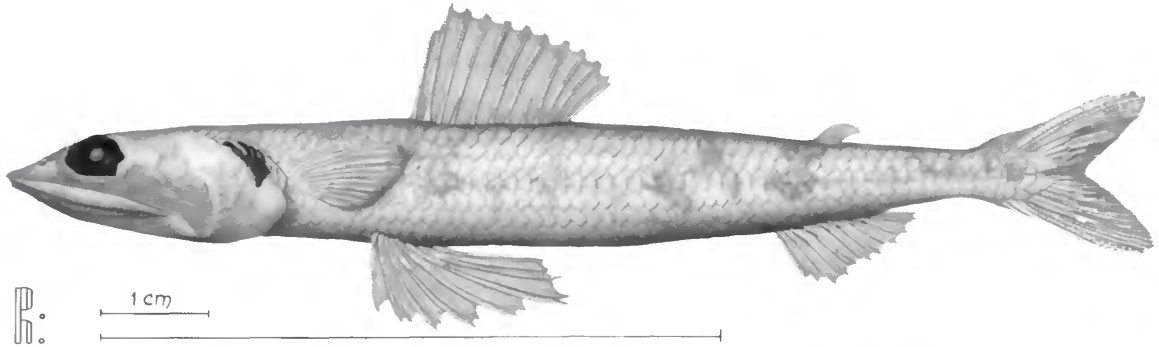


FIGURE 14.—*Synodus hoshinonis* Tanaka, USNM 217772, 105 mm SL, Andaman Sea.

25–29; anterior palatine teeth longest and in a discrete group; peritoneal spots 12–13; posterior pelvic process wide; prominent black pigment spot on upper distal corner of operculum.

Synodus hoshinonis possesses a prominent black pigmented area at the upper distal corner of the operculum. The pigment spot is split dorsally into 3 to 4 dorsally directed finger-like processes. This spot separates this species from all except *S. tectus*, *S. similis*, and *S. indicus*. The spots of *S. similis* are reduced to three discrete spots, and those of *S. indicus* further reduced to two smaller spots. *Synodus hoshinonis* has a lower vertebral count than *S. similis* (54–56 vs. 58–59). *Synodus tectus* has 10–11 peritoneal spots, whereas *S. hoshinonis* has 12–13. Superficially *S. hoshinonis* and *S. tectus* cannot be separated, but each is host to different species of *Metataeniacanthus*, and the peritoneal spot counts of the two do not overlap.

DESCRIPTION.—Dorsal-fin rays 12–14; anal-fin rays 8–10; pectoral-fin rays 11–12; pelvic-fin rays 8; procurrent rays 25–29, dorsal 14–16, anal 11–14; lateral line continuous, 55–57 pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 14–15; rows of cheek scales 4–5; vertebrae 54–57; peritoneal spots 12–13.

Percentages of Standard Length: Mean (range): head length 28.7(26.7–31.5); snout length 6.8(5.4–7.8); upper jaw length 17.7(16.1–19.6); diameter of bony orbit 6.2(4.7–7.2); least width

of bony interorbital 3.0(2.5–3.7); snout to dorsal origin 42.0(40.3–44.8); snout to adipose origin 83.9(80.8–86.6); snout to anal origin 76.2(71.9–79.2); snout to pelvic insertion 35.5(32.8–38.0); snout to pectoral insertion 27.6(25.8–29.4); first-dorsal-ray length 10.2(8.3–11.5); longest dorsal-ray length 13.0(11.9–17.4); pectoral-fin length 12.2(11.6–13.7); pelvic-fin length 23.1(21.2–25.0); dorsal-fin-base 15.7(13.9–18.0); anal-fin base 9.6(8.6–11.2); based on 16 specimens 91.2 to 197.5 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a short, rounded process barely reaching anterior margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 40 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Dorsum with alternating light and dark brown saddle-like patches extend-

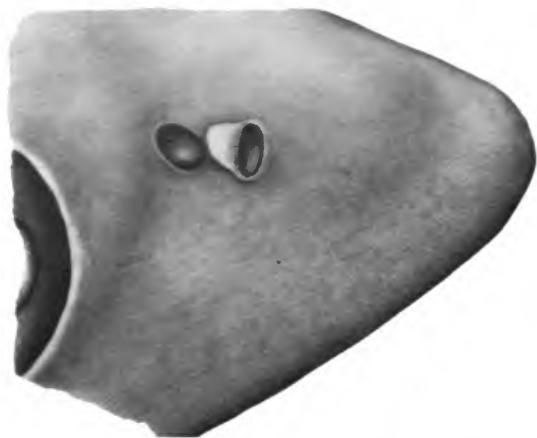


FIGURE 15.—*Synodus hoshinonis* Tanaka, detailed enlargement of snout region.

ing laterally to form diamond-shaped patches at level of the lateral line. Pattern similar to that of *Synodus englemani*. Snout without spots. Fins of preserved specimens pale. A conspicuous black patch at upper distal corner of operculum.

DISTRIBUTION, HABITAT, AND GEOGRAPHIC VARIATION.—*Synodus hoshinonis* is known from the Red Sea, Mozambique, Andaman Sea, Western Australia, and Japan. The depth of capture data for six collections from the Andaman Sea indicate this species is found at moderate depths (66–96 m) and taken in benthic trawls (Gulf of Mexico shrimp trawl). Although the sample size is small, the vertebral count data suggests that the Red Sea and western Indian Ocean specimens have higher vertebral counts (55–57, mean 56, of six specimens) than the Andaman (54–56, mean 54.6, of 20 specimens) and Japan (54–56, mean 54.3, of three specimens) material.

REMARKS.—This species is superficially similar to *S. tectus* but differs from the new species in that it is host to a different species of parasitic copepod (*Metataeniacanthus nudus* Cressey and Cressey), has a higher peritoneal spot count (12–13 vs. 10–11), and occurs in the Red Sea, Indian Ocean, and Japan (*S. tectus* is found in the West Pacific).

Synodus indicus (Day, 1873)

FIGURES 16, 17, 43

Saurus indicus Day, 1873:526 [India].

Synodus indicus.—Barnard, 1925:227.

Synodus dietrichi Kotthaus, 1967:72 [Somalia].

MATERIAL EXAMINED.—*Paralectotype*: RMNH 8817 (1), INDIA. RED SEA (21): ZIM 4910. SOMALIA (308): USNM 217606 (1), 217607 (1), 217608 (1); ZIM 4905 (59), 4908 (49), 4909 (197). ZANZIBAR (2): MCZ 6910. INDIA (3): USNM 222059 (2); CAS 14531 (1). SRI-LANKA (2): USNM 217609. THAILAND (5): USNM 217511 (3), 217605 (1), 217610 (1). WESTERN AUSTRALIA (3): WAM P25398-010 (1); AMS (2, uncatalogued). PHILIPPINES (1): USNM 218947.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 11–13 (usually 12); anal-fin rays 9–11 (usually 10); pored lateral-line scales 52–58 (usually 56); transverse scale rows 3.5/5; vertebrae 52–58 (usually 56); combined dorsal and anal procurent rays 27–32; anterior palatine teeth not longest and not in a discrete group; peritoneal spots 9–11; posterior pelvic process wide.

Synodus binotatus, *S. capricornis*, *S. englemani*, *S. doaki*, *S. fuscus*, *S. jaculum*, *S. hoshinonis*, *S. ulae*, and *S. variegatus* possess an anterior group of longer palatine teeth. In *S. macrops*, *S. macrocephalus*, *S. kaianus*, *S. oculus*, and *S. gibbsi*, the posterior pelvic process is narrow. The peritoneal spot count of *S. fuscus* is lower than that of *S. indicus* (9–11 vs. 7–10). The base of the anal fin of *S. sageneus* is longer than the base of the dorsal fin; in *S. indicus* it is not. The peritoneal spot count of *S. usitatus* is 14–17, whereas in *S. indicus* it is 9–11. The dermal flap of *S. rubromarmoratus* is long but of uniform width throughout its length, long and not triangular as in *indicus*. The dermal flap of *S. similis* is short and broad (as in *hoshinonis*).

DESCRIPTION.—Dorsal-fin rays 11–13; anal-fin rays 9–11; pectoral-fin rays 13; pelvic-fin rays 8; procurent rays 27–32, dorsal 14–17, anal 12–15;

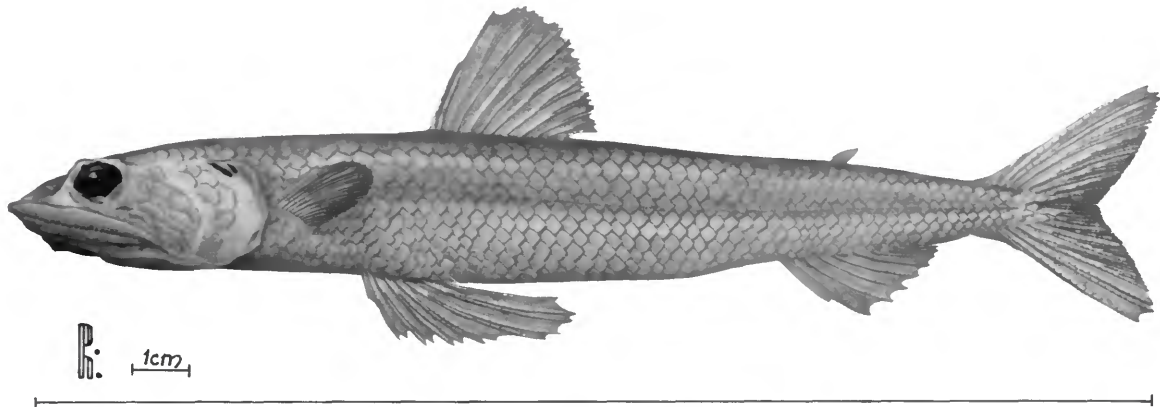


FIGURE 16.—*Synodus indicus* (Day), USNM 217608, 168 mm SL, Somali Republic.

lateral line continuous, 52–58 pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 14–16; rows of cheek scales 4–5; vertebrae 52–58; peritoneal spots 9–11.

Percentages of Standard Length: Mean (range): head length 29.2(27.0–32.1); snout length 6.7(5.3–7.7); upper jaw length 17.7(16.1–20.1); diameter of bony orbit 5.5(4.0–6.7); least width of bony interorbital 2.5(1.4–3.7); snout to dorsal origin 44.5(41.0–48.4); snout to adipose origin 86.2(82.0–91.1); snout to anal origin 79.2(73.3–85.4); snout to pelvic insertion 37.9(34.3–42.4); snout to pectoral insertion 27.6(25.2–30.6); first-dorsal-ray length 10.7(7.4–13.4); longest-dorsal-ray length 15.9(13.7–19.9); pectoral-fin length 12.6(10.0–14.0); pelvic-fin length 24.2(18.0–27.1); dorsal-fin base 14.3(12.6–16.0); anal-fin base 9.6(7.6–11.9); based on 20 specimens 70.5 to 188.3 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long; anterior nostril on each side bearing a long triangular dermal flap extending well beyond anterior border of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in

front not largest and not in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 40 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins not reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Dorsal half of body darker than ventral and somewhat mottled. No distinct pigment pattern in preserved material. Two small

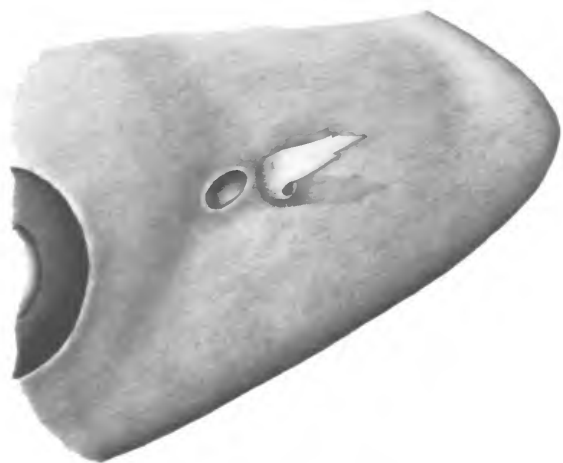


FIGURE 17.—*Synodus indicus* (Day), detailed enlargement of snout region.

black pigment areas at upper distal corner of operculum. Fins unmarked.

DISTRIBUTION, HABITAT, AND GEOGRAPHIC VARIATION.—*Synodus indicus* occurs throughout the northern Indian Ocean from the Gulf of Aden to the Andaman Sea. South of the equator it has been collected off Zanzibar and off Rawley Shoals, Australia. A single specimen has been collected from the Philippines. Collection data indicate that this species is found at depths of 20 to 100 m (average depth for eight collections 61 m).

Vertebral counts are lowest (52–54) at the easternmost limits of the range (Philippines, W. Australia, Andaman Sea); somewhat intermediate (53–55) in the midportion of the range (India, Sri-Lanka); and highest (55–58) in the westernmost limits of the range (Gulf of Aden, Somalia, Zanzibar). The modal vertebral number (56) based on the material studied may be biased since most of the material examined was from the western portion of the range.

REMARKS.—Day's description of this species in 1873 lacks detail enough to ascertain which species in modern collections represents the same that Day described. Confusion as to the deposition of the type material further complicated the problem. In 1976 Whitehead and Talwar published a lengthy biographical account of Day with suggestions as to the fate of much of his collection. They have suggested (p. 153) that the type specimens of *Synodus indicus* may have been deposited in Calcutta (ZSI 2337), Sydney (AMS B7672), and Leiden (RMNH 8817). I requested the loan of this material with the following results. Dr. Tiwari of the Zoological Survey of India advised me that the specimen in question (designated as the lectotype by Norman in 1935) could not be sent as it is very fragile (the caudal portion is missing), and the specimen could only be handled in a " cursory examination." The identity of the Calcutta specimen thus remains in doubt. Norman examined this specimen and made the following remark (Norman, 1935:114): "This was sent to me as an unnamed specimen (no. 2337) and marked 'no history.'" He did note that it was

from the Indian Museum–Day collection. Whitehead and Talwar (1976:134) discuss the catastrophic flood in 1943, which inundated the collection of the Zoological Survey of India temporarily housed at Benares. This might explain the mutilated condition of the Calcutta specimen.

The specimen deposited in the Australian Museum was sent to me, and it is *Saurida tumbil* rather than *Synodus indicus*. The label reads "Saurida tumbil—Registered as Type of *Saurus indicus* Day from Madras, purchased from F. Day, Sept. 1885 but it is clearly neither the genus nor the species."

The Leiden specimen proved to be *Synodus* and was labeled: "*Synodus indicus* Day Coll. F. Day, no. 2761, Madras." This specimen agrees with the original description and subsequent illustration and almost certainly represents part of the type series (a paralectotype). My concept of *S. indicus* is based on this specimen.

In 1967 Kotthaus described a new species, *Synodus dietrichi*, from collections made off Somalia and the Gulf of Aden during the *Meteor* cruise in 1965. I have examined the types of this species housed in the Zoologisches Institut und Zoologisches Museum in Hamburg (ZIM 4905-8) and have determined that this species is a synonym of *S. indicus*.

Synodus indicus is commonly parasitized on the gills by the copepod *Metataeniacanthus gibbsi* Cressey and Cressey. The presence of this copepod species on the paralectotype from Leiden and the Kotthaus material of *Synodus dietrichi* reinforces the conclusion that these two host species are synonymous. This copepod is specific to *Synodus indicus* and parasitizes it throughout most of its known range.

***Synodus jaculum* Russell and Cressey, 1979**

FIGURES 18, 38

Synodus jaculum Russell and Cressey, 1979:169 [Great Barrier Reef].

MATERIAL EXAMINED.—*Holotype*: AMS I.19470-005, Great Barrier Reef, AUSTRALIA. *Paratypes*: AMS I.18340-001, I.18340-002, I.19222-

001, I.19473-054, Great Barrier Reef, AUSTRALIA; AMS I.18303-001, I.19696-004, New South Wales, AUSTRALIA; AMS I.17262-053, PAPUA, NEW GUINEA; AMS I.17503-014, NEW BRITAIN; USNM 217640, COMORES ISLANDS; USNM 217621, SRI-LANKA; USNM 217673, 217748, 217782, SOUTH CHINA SEA; USNM 217794, LINE ISLANDS. *Other Material*: SOUTH AFRICA (8): RUSI 9214 (3), 10178 (1), 10180 (4). CHAGOS (3): USNM 220540 (1), 220542 (1), 220549 (1). SRI-LANKA (4): USNM 217625 (2), MCZ 46972 (2). SOUTH CHINA SEA (3): USNM 217752 (1), 217756 (2). TAIWAN (4): USNM 217646 (1), 217647 (1), 217652 (2). MOLUCCAS (1): USNM 210079. CELEBES (7): USNM 217641 (2), 217659 (5). PAPUA, NEW GUINEA (13): USNM 217634 (12), 217638 (1). PALAU (2): CAS 39960 (1), 39961 (1). AUSTRALIA (3): ANSP 123628. KAPINGAMARANGI ATOLL (8): CAS 39956. SOCIETY ISLANDS (6): BPBM 6912 (1), 8334 (2), 11528 (3). MARQUESAS ISLANDS (14): BPBM 11860 (7), 12443 (2), 12641 (1), 12827 (4).

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 11–13 (usually 12); anal-fin rays 8–10 (usually 9); pored lateral-line scales 59–62 (usually 61); transverse scale rows 5.5–6.5/9; vertebrae 59–62 (usually 60); combined dorsal and anal procurrent rays 28–33; anterior palatine teeth longest and in a discrete group; peritoneal spots 11–13; posterior pelvic process wide; black pigment spot on caudal peduncle (sometimes lacking on very pale preserved specimens).

Synodus jaculum seems most closely related to *S. englemani*. It differs from *S. englemani* by its lack of scales on the postoral portion of the cheeks, higher peritoneal spot count (11–13 vs. 7–10), and its black pigment spot on the caudal peduncle. The posterior pelvic process of *S. jaculum* is wide (narrow in *S. oculus*, *S. macrocephalus*, *S. macrops*, *S. gibbsi*, and *S. kaianus*). Its vertebral count (59–62) is higher than *S. binotatus* (51–55), *S. indicus* (52–58), *S. fuscus* (53–55), *S. hoshinonis* (54–57), *S. rubromarmoratus* (52–55), *S. sageneus* (49–54). *Synodus jaculum* has 5.5 scales above the lateral line (*S.*

kaianus, *S. similis*, and *S. usitatus* have 3.5. *Synodus capricornis* has higher vertebral counts (64–65 vs. 59–62). *Synodus jaculum* has a very short dermal flap on the anterior nares (*S. variegatus* and *S. ulae* are long). The black pigment spot on the caudal peduncle, when present, will separate *S. jaculum* from all known Indo-West Pacific *Synodus* (the South China Sea specimens are very pale, and the spot is lacking).

DESCRIPTION.—Dorsal-fin rays 11–13; anal-fin rays 8–10; pectoral-fin rays 12–13; pelvic-fin rays 8; procurrent rays 28–33, dorsal 15–18, anal 13–16; lateral line continuous, 59–62 pored scales; scale rows above lateral line from dorsal origin 5.5/6.5; scale rows below lateral line to anal origin 9; predorsal scales 18–22; rows of cheek scales 4–7; vertebrae 59–62; peritoneal spots 11–12.

Percentages of Standard Length: Mean (range): head length 32.1(29.3–35.5); snout length 6.1(5.3–7.2); upper jaw length 19.6(17.7–20.8); diameter of bony orbit 5.6(4.4–6.7); least width of bony interorbital 3.3(2.7–3.9); snout to dorsal origin 44.3(42.1–47.0); snout to adipose origin 85.9(82.8–89.4); snout to anal origin 78.9(76.0–82.0); snout to pelvic insertion 36.4 (34.2–38.3); snout to pectoral insertion 29.9(28.2–31.5); first-dorsal-ray length 10.3(8.6–12.1); longest-dorsal-ray length 15.2(13.1–18.6); pectoral-fin length 11.7(10.3–13.7); pelvic-fin length 25.6(22.0–28.3); dorsal-fin base 15.4(13.4–17.8); anal-fin base 7.6(5.8–9.7); based on 20 specimens 44.9 to 114.0 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks naked. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a short, triangular flap on its posterior margin, not extending beyond margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 50 in number. Teeth canini-

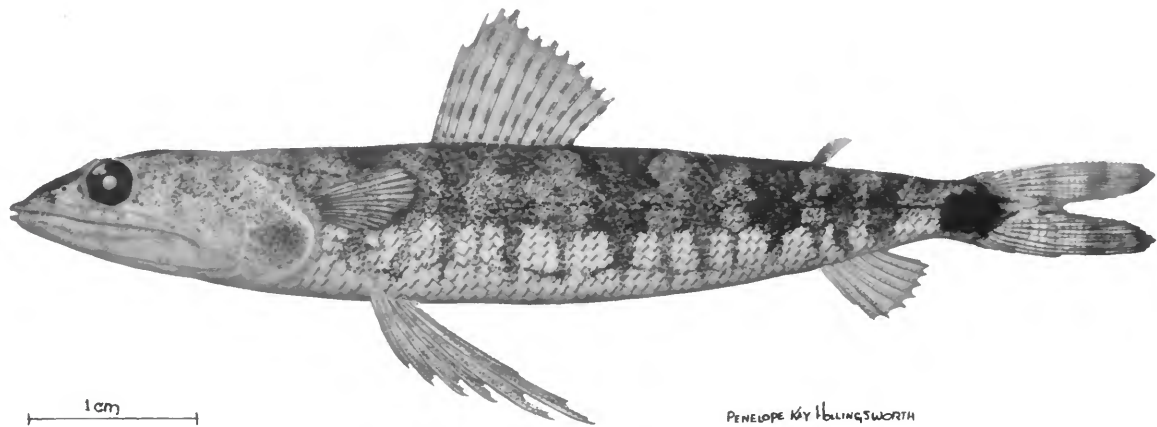


FIGURE 18.—*Synodus jaculum* Russell and Cressey, AMS I.18303-001, 59 mm SL, off Clovelly Pool, New South Wales, Australia.

form, larger teeth with arrow-shaped tips. Pectoral fins reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Preserved specimens with lateral brown saddle-like bands as in *S. variegatus*. Dark pigmented area usually present on caudal peduncle.

DISTRIBUTION, HABITAT, AND GEOGRAPHIC VARIATION.—*Synodus jaculum* is apparently a widespread species throughout the Indo-West Pacific. Collection data indicate that it is usually associated with coral reefs, recorded occasionally in shallow water (less than 10 m) but more common at depths of 50–100 m. Specimens with 6.5 scales above the lateral line were from the Line Islands.

REMARKS.—Since publication of the original description of this species (Russell and Cressey, 1979), I have examined considerably more material, which accounts for differences in data in the present description.

The parasitic copepod *Matataeniacanthus coneptigri* Cressey and Cressey is common on or under the pseudobranch and occasionally on the gills of this host species.

Synodus kaianus (Günther, 1880)

FIGURES 19, 20, 41

Saurus kaianus Günther, 1880:50 [Arafura Sea].

Synodus kaianus.—Gilbert, 1903:588.

MATERIAL EXAMINED.—*Holotype*: BMNH 1879.5.14.594, ARAFURA SEA, WESTERN AUSTRALIA (1): AMS (uncataloged). SOUTH CHINA SEA (1): USNM 217734. JAPAN (11): USNM 217779 (10); CAS 32266 (1). HAWAIIAN ISLANDS (11): USNM 126556 (4), 217617 (2); CAS 8539 (3), 30139 (1), 30155 (1).

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 10–13 (usually 12); anal-fin rays 10–11 (usually 11); pored lateral-line scales 59–63 (usually 60); transverse scale rows 3.5/5; vertebrae 58–63 (usually 60); combined dorsal and anal procurrent rays 23–28; anterior palatine teeth not longest and not in a discrete group; peritoneal spots none; peritoneum black; posterior pelvic process narrow; tip of lower jaw fleshy.

Synodus kaianus differs from all other Indo-West Pacific *Synodus* except *S. macrops* by its black peritoneum. The vertebral count of *S. kaianus* is much higher than that of *S. macrops* (58–63 vs. 51–55).

DESCRIPTION (holotype plus range).—Dorsal-

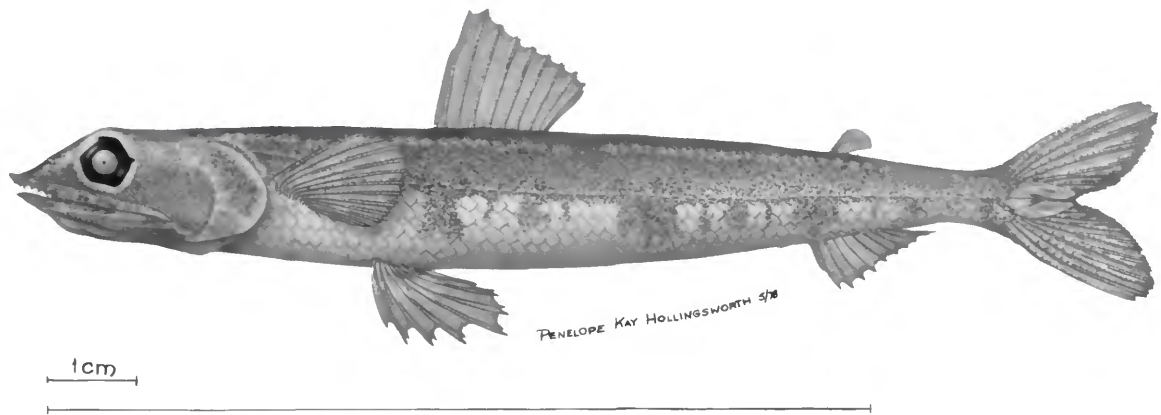


FIGURE 19.—*Synodus kaianus* (Günther), USNM 217779, 135 mm SL, Kochi, Japan.

fin rays 12(10–13); anal-fin rays 10(10–11); pectoral-fin rays 13(12–13); pelvic-fin rays 8; procurrent rays 24(23–28), dorsal 13(12–15), anal 11(11–13); lateral line continuous 60(59–63) pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 18(16–18); rows of cheek scales 5(4–5); vertebrae 60(58–63); peritoneal spots none.

Percentages of Standard Length: Mean (range): head length 26.6 (25.1–30.2); snout length 7.8(7.0–9.2); upper jaw length 17.3(15.8–19.7); diameter of bony orbit 6.7(5.4–8.3); least width of bony interorbital 3.1 (2.2–3.7); snout to dorsal origin 43.7(40.0–47.8); snout to adipose origin 87.1(81.9–89.9); snout to anal origin 79.0(74.4–82.8); snout to pelvic insertion 37.5(34.8–40.2); snout to pectoral insertion 28.0(25.9–30.7); first-dorsal-ray length 8.9(7.6–11.2); longest-dorsal-ray length 14.5(10.9–17.8); pectoral-fin length 13.9(12.0–15.7); pelvic-fin length 17.9(14.4–22.4); dorsal-fin base 11.7(10.4–14.3); anal-fin base 8.7(7.2–10.1); based on 15 specimens 73.5 to 209.5 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, slightly longer than broad; the anterior nostril on each side bearing a short, truncate flap, extending only

slightly beyond edge of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front not largest and not in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 30 in number, free end of tongue narrow anteriorly (only 2–3 teeth across). Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins not reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle narrow. Peritoneum black.

COLOR PATTERN.—Dorsum uniformly dark. Three large blocks of pigment just below lateral line, first below origin of dorsal fin, second slightly posterior to dorsal fin, third below adipose fin origin. Between each of the larger blocks of pigment are three patches, the middle patch of the three larger than outer two. This pigment pattern is unique to this species and makes *S. kaianus* easily recognized. Fins unmarked.

DISTRIBUTION, HABITAT, AND GEOGRAPHIC VARIATION.—This species has been reported from the South China Sea, Timor Sea, Arafura Sea, Japan, and Hawaii (Figure 41). The depth of capture (270–300 m) of the South China Sea specimen indicates that this species may prefer deeper water than most other Indo-West Pacific species, and

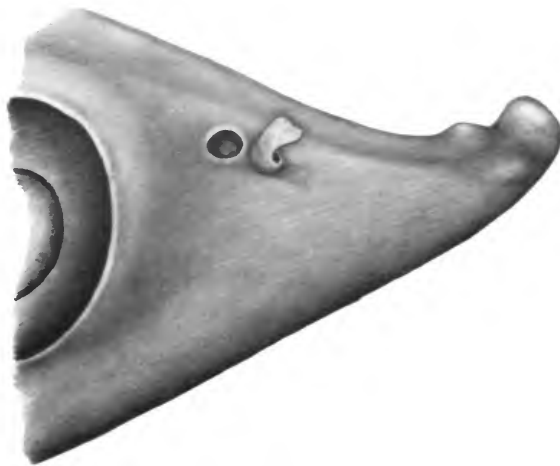


FIGURE 20.—*Synodus kaianus* (Günther), detailed enlargement of snout region.

that depth preference might account for its scarcity in collections and its scattered distribution records.

The specimens examined from Hawaii generally have higher vertebral, dorsal-fin ray, anal-fin ray, and procurrent caudal-fin ray counts than those from Japan. The means of the Hawaiian specimens respectively are 62, 12.3, 10.8, and 25.3, whereas the Japan specimens are 59.5, 11.3, 10.4, and 24.3. The specimen from the South China Sea has a vertebral count of 62. The holotype from the Arafura Sea has 60 vertebrae. The count differences between the Hawaiian and Japan material suggest that two species may be involved, but since there is overlap in these counts, I have refrained from separating them. No other characters were found with differences between these two populations.

REMARKS.—A number of characters indicate a close relationship between this species and *S. macrops*: the black peritoneum, fleshy tip of the lower jaw, thin posterior process of the pelvic girdle, and occurrence in relatively deep water.

The pigment of the peritoneum is much denser than that of *S. macrops*, with the pigment contained in closely clustered stellate spots. The larger peritoneal spots (referred to in spot counts)

found in other species are apparently lacking. In a few specimens I carefully removed major portions of the peritoneum for microscopic examination. Although the small stellate masses were easily seen, I could find no trace of the larger peritoneal spots.

Synodus macrocephalus, new species

FIGURES 21, 26b, 42

Synodus macrops.—Cressey and Cressey, 1979:12 [in part].

MATERIAL EXAMINED.—*Holotype*: USNM 217776, SL 158.1 mm, SOMALIA, R/V *Anton Bruun*, Cruise 9, Sta 463, 75–175 m (trawl), 17 Dec 1964. *Paratypes* (6): USNM 217739, SL 97.0–165.0 mm, ARABIAN SEA (off Bombay), R/V *Anton Bruun*, Cruise 4B, Sta 202A, 52.5 fms (trawl), 13 Nov 1963. *Other Material*: ANDAMAN ISLANDS (1): USNM 217616.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 11–13 (usually 13); anal-fin rays 9–11 (usually 10); pored lateral-line scales 55–56 (usually 56); transverse scale rows 3.5/5; vertebrae 55 (usually 55); combined dorsal and anal procurrent rays 26–27; anterior palatine teeth not longest and not in a discrete group; peritoneal spots 7; posterior pelvic process narrow.

The narrow posterior pelvic process separates this species from all known Indo-West Pacific *Synodus* except *S. gibbsi*, *S. kaianus*, *S. macrops*, and *S. oculus*. The vertebral counts of *S. macrocephalus* are lower (55) than those of *S. gibbsi* (58–61) and *S. kaianus* (58–63). The pectoral fin of *S. macrocephalus* extends beyond a line from the origin of the pelvic fin to the origin of the dorsal fin—that of *S. macrops* does not. Also, the peritoneal spot counts of *S. macrocephalus* are higher than those of *S. macrops* (7 vs. 5–6). *Synodus macrocephalus* has a pointed snout, whereas that of *S. oculus* is rounded. The bony interorbital space is greater in *S. oculus* than in *S. macrocephalus* (5.6 vs. 4.2 percent SL). *Synodus macrocephalus* shares the parasitic copepod *Metataeniacanthus aquilonius* Cressey

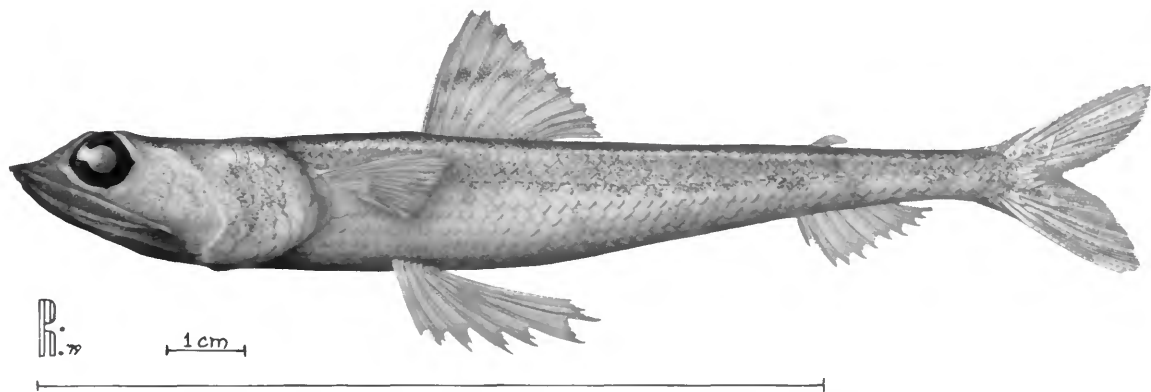


FIGURE 21.—*Synodus macrocephalus*, new species, holotype USNM 217776, 156.1 mm SL, Somalia.

and Cressey with *S. macrops*. This in addition to other shared morphological features (narrow posterior pelvic process, vertebral counts, lateral external markings) seems to indicate that they may be closely related. *Synodus oculus* also appears to be closely related, sharing the same morphological similarities cited for *S. macrops* and also a similar dermal flap on the anterior nares (*S. oculus* does not share the same parasitic copepod species).

DESCRIPTION (holotype plus range).—Dorsal-fin rays 13(11–13); anal-fin rays 9(9–11); pectoral-fin rays 12; pelvic-fin rays 8; procurrent rays 26 (26–27), dorsal 14, and anal 12(12–13); lateral line continuous, 55(55–56) pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 15; rows of cheek scales 3(3–4); vertebrae 55; peritoneal spots 7.

Percentages of Standard Length: Mean (range): head length 31.6 (30.4–32.1); snout length 7.4(7.0–8.0); upper jaw length 19.1(18.3–19.8); diameter of bony orbit 7.3(7.0–7.7); least width of bony interorbital 4.2 (4.1–4.3); snout to dorsal origin 44.8(42.2–46.2); snout to adipose origin 87.3(84.6–88.3); snout to anal origin 78.2(76.5–78.4); snout to pelvic insertion 40.0(37.8–41.8); snout to pectoral insertion 31.5(30.1–33.1); first-dorsal-ray length 9.5(7.9–11.2); longest-dorsal-ray length 13.4(11.7–14.1); pectoral-fin length

15.2(14.9–15.4); pelvic-fin length 23.5(22.8–24.8); dorsal-fin base 11.8(9.5–13.3); anal-fin base 9.7(8.7–10.7); based on 7 specimens 97.0 to 158.1 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a broad triangular flap extending beyond margin when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front not largest and not in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 30 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching beyond a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixty ray) longest. Posterior bony process of pelvic girdle narrow. Peritoneum pale.

COLOR PATTERN.—Preserved specimens are darker above lateral line with a series of darker blotches along lateral line. The blotches are not well defined and not present in all specimens. Dorsal fin with 2 to 3 bars. Other fins unmarked.

DISTRIBUTION AND HABITAT.—This species is known only from the western Indian Ocean. The specimens were collected in shrimp trawls at depths of 75 to 175 m.

REMARKS.—When the paper (Cressey and Cressey, 1979) was published describing the copepods parasitic on Indo-West Pacific lizardfish, I believed that the specimens described above were *Synodus macrops* and reported them as hosts of the parasitic copepod *Metataeniacanthus aquilonius* Cressey and Cressey. Subsequent examination of the fishes, as part of the work resulting in this revision, indicated that some of the specimens reported as *S. macrops* actually represented this new species. The map showing the distribution of *S. macrops* (Figure 52) given in the earlier work is incorrect. As pointed out earlier, the presence of the same parasitic copepod species on both hosts indicates a probable close phylogenetic relationship between them.

Synodus macrops Tanaka, 1917

FIGURES 22, 23, 42

Synodus macrops Tanaka, 1917:38 [Japan].

MATERIAL EXAMINED.—WESTERN AUSTRALIA (2): AMS (uncataloged). GUADALCANAL ISLAND (2): BPBM 15570. SOUTH CHINA SEA (3): USNM 136225 (1); CAS 30749 (2). FORMOSA STRAIT (5): NTU 00228 (1), 00448 (1); CAS 15930 (2), 29998 (1). JAPAN (Inland Sea–Pacific) (26): USNM 217778 (9); FAKU 1056, 2063, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2272, 2273, 2274, 2277, 4322, 4757, 4760 (1 specimen each).

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 11–12 (usually 12); anal-fin rays 10–11 (usually 10); pored lateral-line scales 51–55 (usually 54); transverse scale rows 3.5/5; vertebrae 51–55 (usually 54); combined dorsal and anal procurrent rays 20–26; anterior palatine teeth not longest and not in a discrete group; peritoneal spots 6–7; posterior pelvic process narrow; peritoneum pigmented dark brown; tip of lower jaw fleshy.

The pigmented peritoneum of *S. macrops* separates it from all known species of Indo-West Pacific *Synodus* except *S. kaianus*. The vertebral

count of *S. macrops* is much lower than *S. kaianus* (51–55 vs. 58–63).

DESCRIPTION.—Dorsal-fin rays 11–12; anal-fin rays 10–11; pectoral-fin rays 12; pelvic-fin rays 8; procurrent rays 20–26, dorsal 11–14, anal 9–12; lateral line continuous, 51–55 pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 15–16; rows of cheek scales 4; vertebrae 51–55, peritoneal spots 5–6.

Percentages of Standard Length: Mean (range); head length 26.9 (24.2–29.9); snout length 5.8 (5.4–7.0); upper jaw length 15.8 (13.6–17.9); diameter of bony orbit 7.7 (5.9–9.8); least width of bony interorbital 2.6 (2.2–3.1); snout to dorsal origin 41.8 (39.2–45.9); snout to adipose origin 86.3 (82.6–91.6); snout to anal origin 76.2 (72.3–79.9); snout to pelvic insertion 35.8 (32.9–38.6); snout to pectoral insertion 26.2 (23.9–29.1); first-dorsal-ray length 11.1 (9.5–13.2); longest-dorsal-ray length 15.1 (12.1–16.7); pectoral-fin length 13.3 (10.6–15.0); pelvic-fin length 19.8 (18.7–21.5); dorsal-fin base 12.5 (10.4–14.2); anal-fin base 10.1 (8.8–12.3); based on 20 specimens 51.9 to 175.0 mm, SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a long triangular flap, extending well beyond margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front not largest and not in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 30 in number; free end of tongue narrow, 2–3 teeth across distal half. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle narrow. Peritoneum brown to black.

COLOR PATTERN.—Dorsum without discrete

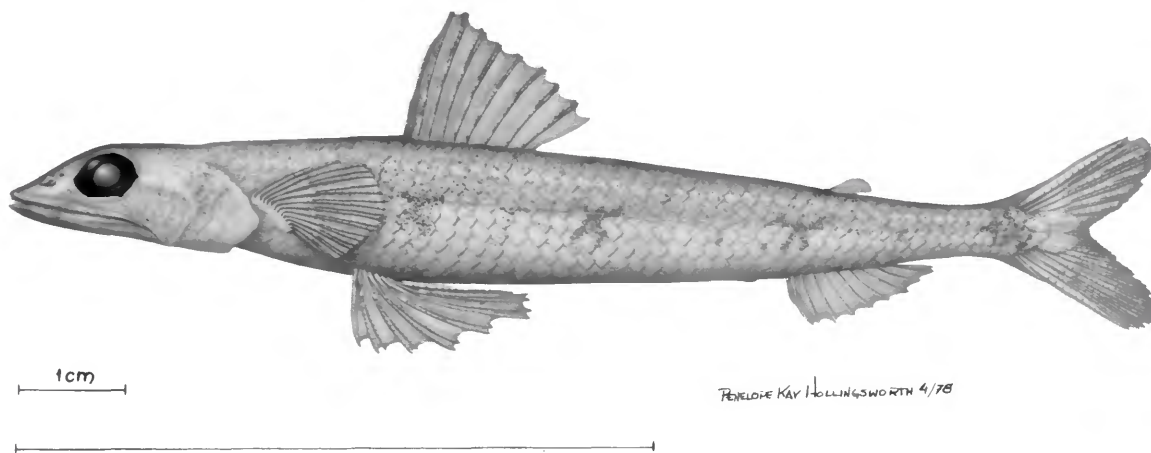


FIGURE 22.—*Synodus macrops* Tanaka, CAS 15930, 105 mm SL, Formosa Strait.

patches of pigment in preserved material, uniformly darker than ventral surface. Three conspicuous lateral dark X-shaped patches with smaller, poorly defined dark patches between. One X-shaped patch at level of origin of dorsal fin, one near middle of body, one at level of anal fin. Fins pale.

DISTRIBUTION AND HABITAT.—*Synodus macrops* is recorded from Western Australia, Guadalcanal Island, South China Sea, Formosa Strait, and Japan, indicating a wide distribution in the West Pacific and easternmost Indian Ocean. Depth of capture data for six collections record this species from 35 to 173 m with a mean depth of 101 m (Guadalcanal specimens from 35 m).

REMARKS.—The parasitic copepod *Metataenia-canthus aquilonius* Cressey and Cressey is common on the gills of this host. The copepod is also found on *Synodus macrocephalus*, which may indicate a close phylogenetic relationship between these two *Synodus* species.

Synodus oculus, new species

FIGURES 24, 25, 26a, 42

Synodus species.—Cressey and Cressey, 1979:11.

MATERIAL EXAMINED.—*Holotype*: USNM 217612, SL 88.7 mm, Macclesfield Bank, SOUTH CHINA SEA, R/V *Cape St. Mary*, Sta 65, 76.8–82.3 m, 22 Jun 1964, coll. W. L. Chan. *Paratypes*: USNM 217510 (1), SL 83.9 mm, ANDAMAN SEA, R/V *Anton Bruun*, Cruise 1, Sta 22, 96 m, 10°37'N, 97°34'E, 24 Mar 1963; USNM 217611 (1), SL 81.5 mm, SOUTH CHINA SEA, R/V *Cape St. Mary*, Sta 29, 75–80.5 m, 16°04'N, 114°41'E, 14 Jun

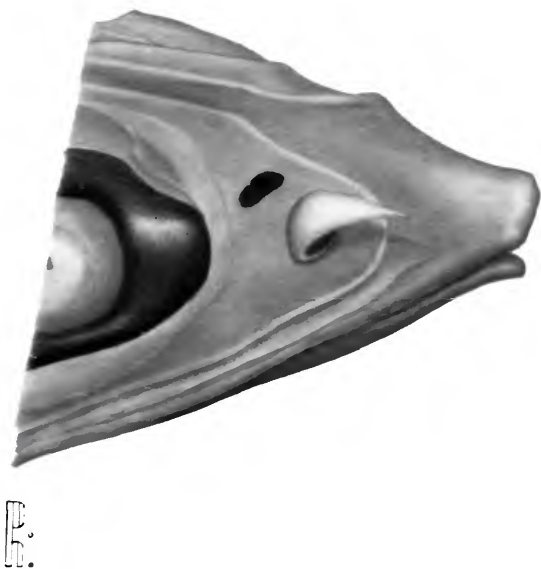


FIGURE 23.—*Synodus macrops* Tanaka, detailed enlargement of snout region.

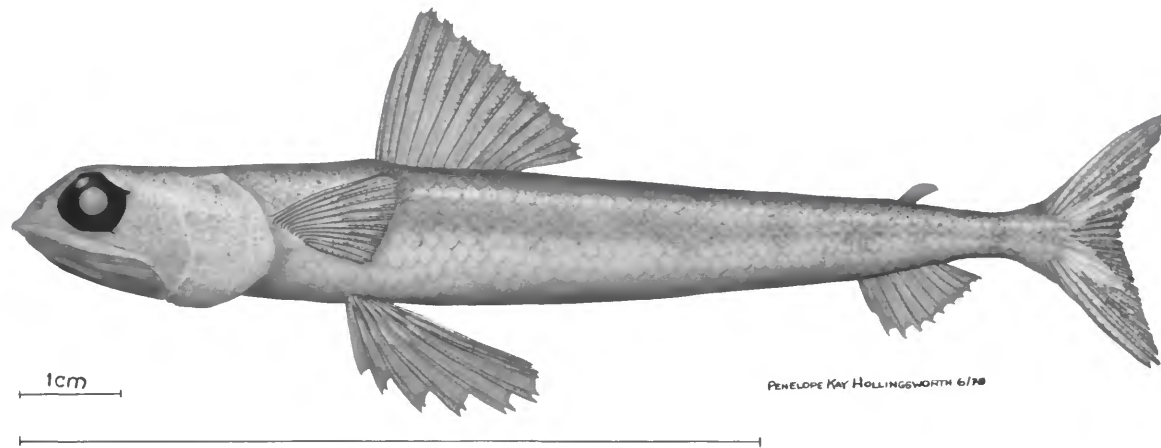


FIGURE 24.—*Synodus oculus*, new species, holotype USNM 217612, 88.7 mm SL, Macclesfield Bank, South China Sea.

1964, coll. W. L. Chan; USNM 217613 (1), SL 81.2 mm, SOUTH CHINA SEA, R/V *Cape St. Mary*, Sta 64, 82.3–84.1 m, 16°03'N, 114°43'E, 21 Jun 1964, coll. W. L. Chan; USNM 217738 (3), SL 59.8, 70.8, 88.5 mm, ANDAMAN SEA, R/V *Anton Bruun*, Cruise 1, Sta 28, 66 m, 11°49'N, 92°53'E, 27 Mar 1963; USNM 222194 (1), SL 156.9 mm, SOMALIA, R/V *Anton Bruun*, Cruise 9, Sta 463, 75–175 m, 11°24'N, 51°35'E, 17 Dec 1964.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 12–13 (usually 13); anal-fin rays 9–10 (usually 10); pored lateral-line scales 54–57 (usually 56); transverse scale rows 3.5/4; vertebrae 54–56 (usually 55); combined dorsal and anal procurrent rays 24–25; anterior palatine teeth not longest and not in a discrete group; peritoneal spots 7–8; posterior pelvic process narrow.

The narrow posterior pelvic process of this new species separates it from all known Indo-West Pacific *Synodus* except *S. gibbsi*, *S. kaianus*, *S. macrops*, and *S. macrocephalus*. The vertebral count of *S. oculus* (54–56) is lower than that of *S. kaianus* and *S. gibbsi* (58–63 and 58–61 respectively). In addition the peritoneum of *S. kaianus* is black. The dermal flap of the anterior nares of *S. oculus* is broad and rounded; that of *S. macrops* is long

and triangular. The peritoneal spot count of *S. macrops* is lower (5–6 vs. 7–8). *Synodus oculus* seems closely related to *S. macrocephalus* but can be easily separated from it by its more rounded snout and proportionally larger eye (9.0 vs. 7.3 percent SL) and wider interorbital space (5.6 vs. 4.2 percent SL). It has the highest dorsal-fin ray (longest ray 18 percent SL) of all known Indo-West Pacific *Synodus* (*S. macrocephalus*, 13.4 percent).

DESCRIPTION (holotype plus range).—Dorsal-fin rays 13(12–13); anal-fin rays 10(9–10); pectoral-fin rays 12; pelvic-fin rays 8; procurrent rays 25(24–25), dorsal 14(13–14), anal 11; lateral line continuous, 56(54–57) pored scales, scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 4; predorsal scales 13–14 (holotype scales missing); rows of cheek scales 4(3–4); vertebrae 55(54–56); peritoneal spots 8(7–8).

Percentages of Standard Length: Mean (range): head length 30.9 (29.9–32.0); snout length 6.6(5.4–7.2); upper jaw length 17.5(16.7–18.1); diameter of bony orbit 9.1(7.3–10.1); least width of bony interorbital 5.6(4.9–6.7); snout to dorsal origin 44.2(41.5–46.6); snout to adipose origin 87.3(83.8–89.8); snout to anal origin 78.4(75.8–80.2); snout to pelvic insertion 39.5(37.3–41.0); snout to pectoral insertion 30.0(28.4–31.6); first-

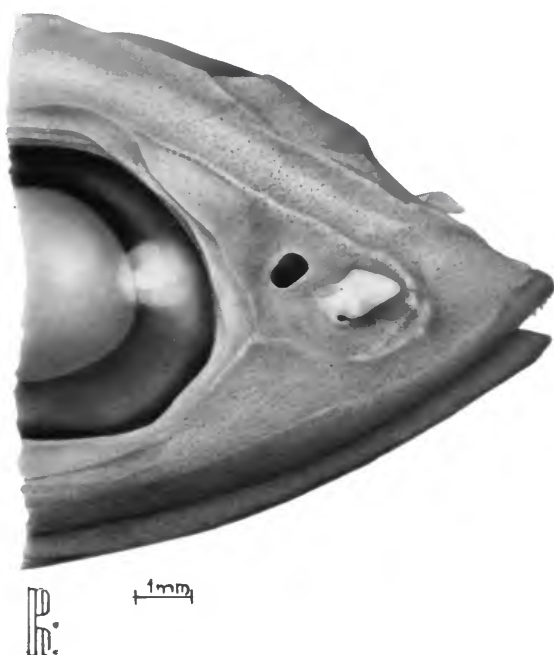


FIGURE 25.—*Synodus oculus*, new species, detailed enlargement of snout region.

dorsal-ray length 10.5(8.2–11.8); longest-dorsal-ray length 18.0(16.2–19.2); pectoral-fin length 14.7(13.7–16.2); pelvic-fin length 25.2(23.1–27.1); dorsal-fin base 14.6(14.0–15.8); anal-fin base 9.8(7.8–10.7); based on 9 specimens 59.8 to 156.9 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout not sharply pointed, broader than long; the anterior nostril on each side bearing a broad, rounded flap extending beyond edge of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front not largest and not in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 30 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching beyond a line from base of pelvic fins to origin

of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle narrow. Peritoneum pale.

COLOR PATTERN.—Preserved specimens usually pale. Some suggestion of dorsal pigment on Andaman Island specimens. Fins unmarked.

DISTRIBUTION AND HABITAT.—This species is so far known from Somalia, Andaman Sea, and South China Sea. Depth of capture data for four collections indicate this species is found at depths of 66 to 96 m.

ETYMOLOGY.—The Latin *oculeus* (full of eyes) alludes to the relatively large eyes of this species.

REMARKS.—The parasitic copepod *Metataenia-canthus indiscretus* Cressey and Cressey was described from this host (as *Synodus* species). In that paper (Cressey and Cressey, 1979), we erroneously reported a collection from this same host from Netherlands East Indies. Subsequently, I found specimens of Atlantic *Synodus* in that collection (by Longley) together with Indo-West Pacific species, indicating that the locality record was



FIGURE 26.—Dorsal aspect of snouts of *Synodus oculus*, new species (a), and *Synodus macrocephalus*, new species (b).

questionable and should be discounted. This copepod is specific to this host.

***Synodus randalli*, new species**

FIGURES 27, 40

MATERIAL EXAMINED.—*Holotype*: BPBM 24807, SL 113 mm, off Port Sudan, RED SEA, 80 fms, hook and line, 8 Jan 1980, coll. A. Medina and J. Randall.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 13; anal-fin rays 8; pored lateral-line scales 55; transverse scale rows 3.5/4; vertebrae 54; combined dorsal and anal procurrent rays 29; anterior palatine teeth longest and in a discrete group; peritoneal spots 14; posterior pelvic process wide.

The high peritoneal spot count separates *S. randalli* from all known Indo-West Pacific *Synodus* except *S. usitatus*. Of the four known species with more than 12 peritoneal spots, *S. usitatus* and *S. rubromarmoratus* have short anterior palatine teeth; those of *S. randalli* are long. *Synodus jaculum* has 5.5 scales above the lateral line; *S. randalli* has 3.5. *Synodus hoshinonis* has a short rounded flap on the

anterior nares and a conspicuous black pigmented area on the operculum; *S. randalli* has a long, triangular flap and no conspicuous black pigmented area on the operculum.

DESCRIPTION—Dorsal-fin rays 13; anal-fin rays 8; pectoral-fin rays 12; pelvic-fin rays 8; procurrent rays 29, 16 dorsal, 13 anal; lateral line continuous, 55 pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 4; predorsal scales 13; rows of cheek scales 5–7; vertebrae 54; peritoneal spots 14.

Percentages of Standard Length: Head length 28.3; snout length 7.2; upper jaw length 17.9; diameter of bony orbit 6.8; least width of bony interorbital 3.5; snout to dorsal origin 44.0; snout to adipose origin 83.1; snout to anal origin 82.2; snout to pelvic insertion 38.6; snout to pectoral insertion 35.5; first-dorsal-ray length broken; longest-dorsal-ray length 15.7; pectoral-fin length 13.2; pelvic fin length 24.1; dorsal-fin base 16.0; anal-fin base 8.4; based on 1 specimen 113 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader

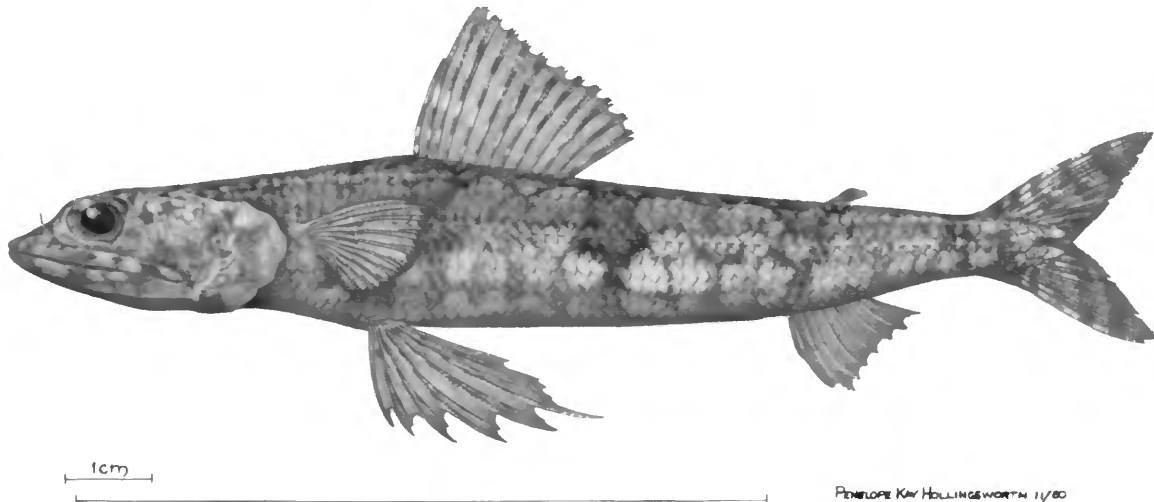


FIGURE 27.—*Synodus randalli*, new species, holotype BPBM 24807, 113 mm SL, off Port Sudan, Red Sea.

than long; the anterior nostril on each side bearing a long triangular dermal flap extending well beyond the anterior edge of the nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 40 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fin reaching beyond a line from base of pelvic fin to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle wide. Peritoneum pale.

COLOR PATTERN.—Preserved specimens pale. Color photo (by J. Randall) shows a series of reddish brown saddle-like bands similar to those found in *S. variegatus*. Dorsal-fin with 3 to 4 similarly colored bars. A conspicuous spot on the adipose fin.

DISTRIBUTION AND HABITAT.—This species is known only from a single specimen from the Red Sea captured at a depth of 80 fathoms.

ETYMOLOGY.—This species is named for Dr. J. E. Randall, who collected the specimen and has been an enthusiastic supporter of this revision.

***Synodus rubromarmoratus* Russell and
Cressey, 1979**

FIGURES 28, 29, 41

Synodus rubromarmoratus Russell and Cressey, 1979:172 [Great Barrier Reef].

MATERIAL EXAMINED.—*Holotype*: AMS I.19450-027, Lizard Island, AUSTRALIA. *Paratypes* (12): AMS I.19450-024 (10), USNM 218792 (2), Lizard Island, AUSTRALIA. TAIWAN (4): USNM 217615. PHILIPPINES (2): USNM 136282.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 10–12 (usually 11); anal-fin rays 9; pored lateral-line scales 54–55 (usually 54); transverse scale rows 3.5/5–6; vertebrae 52–55 (usually 53); combined dorsal and anal procurrent rays 24–29; anterior

palatine teeth not longest and not in a discrete group; peritoneal spots 12–13; posterior pelvic process wide.

The pectoral fin of *S. rubromarmoratus* does not reach to a line from the origin of the pelvic fin to the origin of the dorsal fin. This separates it from all known Indo-West Pacific species except *S. fuscus*, *S. indicus*, *S. kaianus*, and *S. sageneus*. The anterior palatine teeth of *S. fuscus* are long and in a discrete group, and the peritoneal spot count of *S. fuscus* is lower (9–10). The dermal flap on the anterior nares of *S. indicus* is long, triangular, and pointed (*S. rubromarmoratus*, broad and blunt). The peritoneum of *S. kaianus* is black (*S. rubromarmoratus*, pale). The anal-fin base of *S. sageneus* is longer than the dorsal-fin base.

This species superficially resembles *S. macrops*, *S. macrocephalus*, and *S. oculus* and might be easily confused with them, but the narrow posterior pelvic processes of those three species separate them from *S. rubromarmoratus*.

DESCRIPTION.—Dorsal-fin rays 10–12; anal-fin rays 9; pectoral-fin rays 11–12; pelvic-fin rays 8; procurrent rays 24–29; dorsal 13–16, anal 11–14; lateral line continuous, 54–55 pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5–6; predorsal scales 14–16; rows of cheek scales 5; vertebrae 52–55; peritoneal spots 12–13.

Percentages of Standard Length: Mean (range): head length 26.9(23.8–29.2); snout length 5.7(4.8–6.4); upper jaw length 14.9(12.9–16.7); diameter of bony orbit 6.4(5.2–7.4); least width of bony interorbital 2.2(1.7–2.5); snout to dorsal origin 43.0(40.7–45.0); snout to adipose origin 84.4(81.7–88.1); snout to anal origin 77.7(75.4–80.4); snout to pelvic insertion 35.4(31.3–38.2); snout to pectoral insertion 25.8(23.5–27.6); first-dorsal-ray length 11.3(8.7–16.6); longest-dorsal-ray length 16.2(14.3–17.8); pectoral-fin length 12.0(10.9–13.0); pelvic-fin length 22.2(20.2–24.7); dorsal-fin base 12.1(10.2–13.5); anal-fin base 8.8(6.9–9.6); based on 17 specimens 49.0 to 73.5 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion

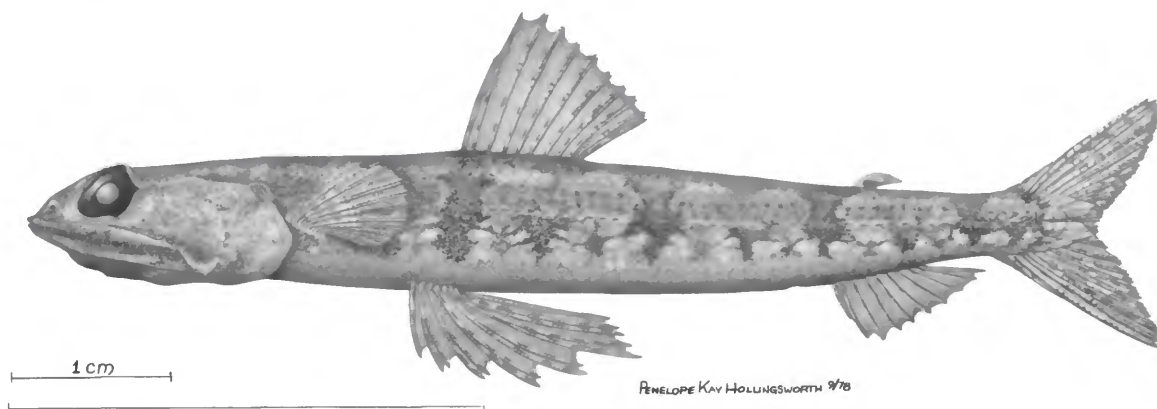


FIGURE 28.—*Synodus rubromarmoratus* Russell and Cressey, USNM 218792, 71 mm SL, Mrs. Watson's Bay, Lizard Island, Great Barrier Reef.

of cheeks scaly. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a long leaflike flap on posterior margin extending well beyond anterior edge of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front not largest and not in a discrete group. Lingual teeth small, those on free end of tongue largest and about 25 in number. Teeth caniniform. Pectoral fins not reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Preserved specimens with 8 lateral patches of pigment similar in configuration to those of *S. variegatus*. In life, body mottled with red (see Russell and Cressey, 1979, for more complete life-color description).

DISTRIBUTION, HABITAT, AND VARIATION.—Known only from the western Pacific (southern tip of Taiwan, Philippines, Great Barrier Reef). Occurs in shallow (0–6 m Taiwan specimen) to moderately deep water (15 m Great Barrier Reef specimens).

The Taiwan specimens have only five rows of scales below the lateral line (others have six) and were from a generally rocky habitat with some nearby coral.

REMARKS.—This species may be relatively small since, of the 18 specimens known, the largest is only 73.5 mm SL.

No parasitic copepods are known from this species.

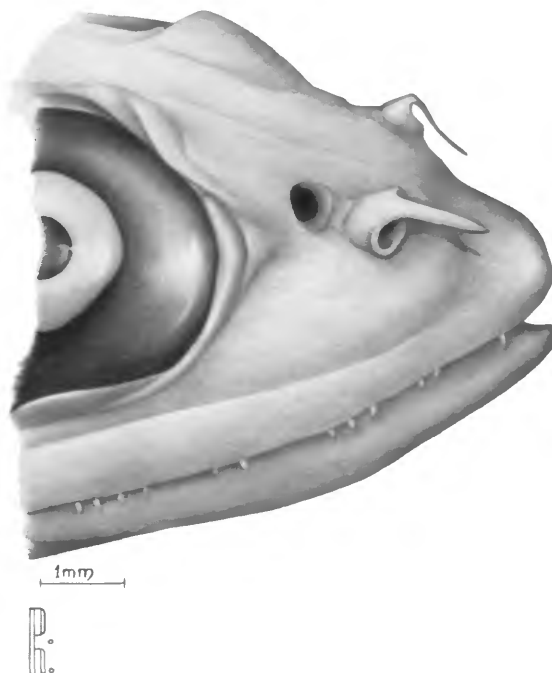


FIGURE 29.—*Synodus rubromarmoratus* Russell and Cressey, detailed enlargement of snout region.

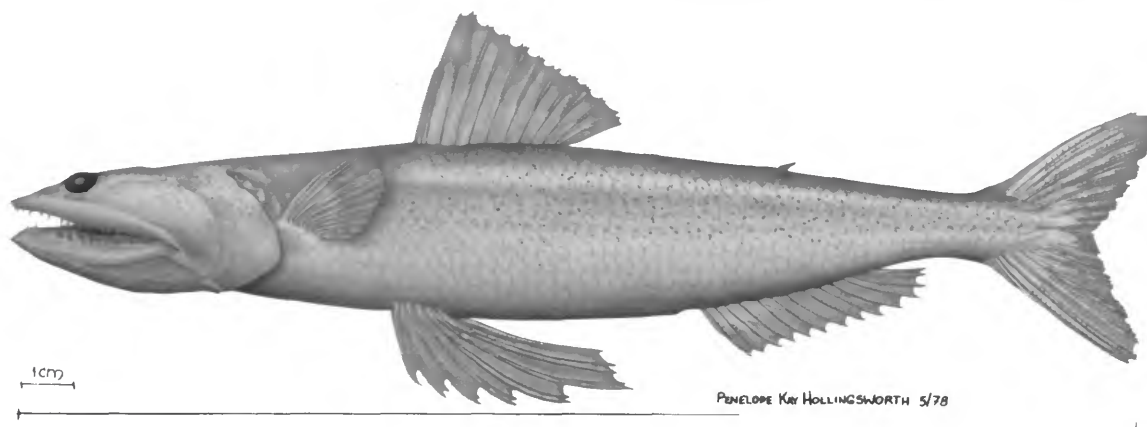


FIGURE 30.—*Synodus sageneus* Waite, USNM 217619, 191 mm SL, Hikkadua, Sri-Lanka.

Synodus sageneus Waite, 1905

FIGURES 30, 31, 44

Synodus sageneus Waite, 1905:58 [Western Australia].

Xystodus banfieldi Ogilby, 1910:6 [Queensland, Australia].

Xystodus sageneus Whitley, 1943:173.

MATERIAL EXAMINED.—*Holotype*: WAM P25509-001, Fremantle, WESTERN AUSTRALIA. SRI-LANKA (3): USNM 217618 (1), 217619 (1), FMNH 89077 (1); GULF OF CARPENTERIA (7): AMS I.6140 (1), I.15557-035 (6). Queensland, AUSTRALIA (7): AMS IA.1301 (1), IA.6485 (1), 6486 (1), IA.6691 (1), IA.6794 (1), IA.6824 (1), I.20938-006 (1). NEW GUINEA (1): ANSP 81548.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 12–13 (usually 12); anal-fin rays 12–15 (usually 13); pored lateral-line scales 51–55 (usually 52); transverse scale rows 3.5/5; vertebrae 49–54 (usually 51); combined dorsal and anal procurrent rays 25–29; anterior palatine teeth not longest and not in a discrete group; peritoneal spots 5–6; posterior pelvic process wide; base of anal fin longer than base of dorsal fin.

The greater length of the anal-fin base vs. dorsal-fin base separates this species from all other known Indo-West Pacific *Synodus*.

DESCRIPTION (holotype plus range).—Dorsal-fin rays 12(12–13); anal-fin rays 15(12–15); pectoral-fin rays 13; pelvic-fin rays 8; procurrent rays 25(25–29), dorsal 13(13–15), anal 12(11–14); lateral line continuous, 52(50–55) pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 18; rows of cheek scales 7(6–7); vertebrae 52(49–54); peritoneal spots 5–6.

Percentages of Standard Length: Mean (range): head length 28.9(26.9–29.9); snout length 6.2(5.3–7.1); upper jaw length 18.1(16.0–19.5); diameter of bony orbit 4.4(3.2–6.5); least width of bony interorbital 3.2(2.4–4.0); snout to dorsal origin 44.2(41.2–46.8); snout to adipose origin 86.2(79.4–92.4); snout to anal origin 67.1(62.5–73.1); snout to pelvic insertion 35.8(33.4–40.6); snout to pectoral insertion 27.0(25.5–28.9); first-dorsal-ray length 9.6(7.8–12.3); longest-dorsal-ray length 15.5(13.7–17.7); pectoral-fin length 12.8(10.9–16.4); pelvic-fin length 26.1(23.6–28.4); dorsal-fin base 14.7(12.7–16.1); anal-fin base 18.8(15.8–21.6); based on 16 specimens 41.6 to 232.2 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader

than long; the anterior nostril on each side bearing a broad flap extending beyond margin of nares when depressed anteriorly. Posterior nares with scalloped edge. Ventral edge of adipose eyelid extended ventrally encircling a suborbital pit, edge of eyelid fimbriate around pit opening. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front not largest and not in a discrete group. Lingual teeth short, not as well developed as in other species, those on free end of tongue largest and about 35 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins not quite reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Some preserved specimens with darker dorsum. Faint lateral, poorly defined, diamond-shaped pigment areas with ventral portion extending below lateral line. Waite (1905: 59) described the holotype as “yellow above and

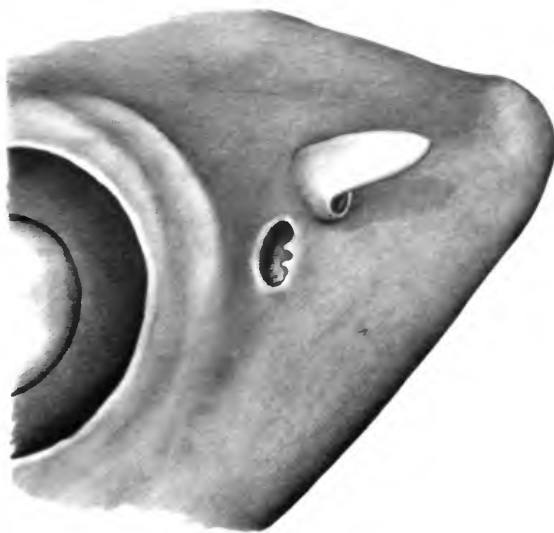


FIGURE 31.—*Synodus sagineus* Waite, detailed enlargement of snout region.

silvery beneath.” The preserved holotype is now very dark dorsally and ventrally. Specimens from Sri-Lanka have little pigment.

DISTRIBUTION, HABITAT, AND GEOGRAPHIC VARIATION.—This species is known from Sri-Lanka, western Australia (Freemantle), north and north-eastern Australia, and Dutch East Indies (Sorong). Collection data indicate that this species is present in waters 12–22 m and caught in prawn trawls (probably not a coral reef inhabitant). The vertebral counts of the Sri-Lanka specimens were higher (53–54) than the Australian and New Guinea material (49–52).

REMARKS.—In 1910 Ogilby (p. 6) described the synodontid *Xystodus banfieldi* from waters off the coast of northern Queensland. Whitley (1943: 173), after examining the type of *X. banfieldi*, placed it in synonymy with Waite’s *Synodus sagineus* but retained Ogilby’s genus *Xystodus* for this species. Whitley stated that the director of the Queensland Museum at that time, Mr. H. Longman, “suggested that owing to a mechanical error, certain features were reversed in the original description which is inaccurate in several respects.” Anderson et al. (1966:35) opined that a separate genus for *sagineus* is not justified. After examining the specimens reported here and considering the accounts of this species by Waite, Ogilby, and Whitley, I agree with that opinion and use Waite’s name as the correct one for this species.

The descriptions of this species by Waite and Ogilby refer to the absence of the adipose fin as a character of the species. Whitley pointed out that although this seems to be the case in larger specimens, an adipose fin is present in “small examples.” One of the specimens reported here from Sri-Lanka (SL 178.2 mm) has a very small adipose fin. An adipose fin was present on all of the smaller specimens. Examination of the holotype was inconclusive regarding this character. A remnant of tissue was present at the usual site of the adipose fin. When large specimens of this species are compared with equally large specimens of other species of *Synodus*, the adipose fin is certainly much reduced in *S. sagineus*.

***Synodus similis* McCulloch, 1921**

FIGURES 32, 44

Synodus similis McCulloch, 1921:167 [Queensland, Australia].

MATERIAL EXAMINED.—*Holotype*: QM I.3542, AUSTRALIA (Capricorn Group). NEW ZEALAND (3): NMNZ 6166 (2), 6167 (1). RAPA ISLAND (1): BPBM 13061.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 13–14 (usually 14); anal-fin rays 9–10 (usually 10); pored lateral-line scales 58–59 (usually 59); transverse scale rows 3.5/6; vertebrae 58–59 (usually 59); combined dorsal and anal procurrent rays 29–33; anterior palatine teeth longest and in a discrete group; peritoneal spots 10–12; posterior pelvic process wide. Two or three black pigment spots on upper distal corner of operculum (posteriormost very small when present).

Synodus similis has two discrete operculum spots. *Synodus hoshinonis* has one large spot. *Synodus indicus* has two discrete spots smaller than those of *S. similis*. The pectoral fin of *S. similis* reaches a line from the origin of the pelvic fin to the origin of the dorsal fin. The pectoral fin of *S. indicus* is short of this line. The remaining species of Indo-West Pacific *Synodus* do not have opercular spots.

DESCRIPTION (holotype plus range).—Dorsal-fin rays 13(13–14); anal-fin rays 9(9–11); pectoral-fin rays 13; pelvic-fin rays 8; procurrent rays 32 (29–33), dorsal 16(15–17), anal 16(14–16); lateral line continuous, 58(58–59) pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 6; predorsal scales 15–16; rows of cheek scales 4; vertebrae 58(58–59); peritoneal spots 11(10–12).

Percentages of Standard Length: Mean (range): head length 28.6(27.0–30.3); snout length 6.8(5.6–7.4); upper jaw length 16.7(14.9–18.3); diameter of bony orbit 5.2(4.7–5.7); least width of bony interorbital 3.6(3.0–4.0); snout to dorsal origin 42.2(41.0–43.2); snout to adipose origin 85.3(84.2–87.0); snout to anal origin 77.5(74.4–

79.6); snout to pelvic insertion 34.6(34.0–35.9); snout to pectoral insertion 26.8(25.6–28.5); first-dorsal-ray length 9.5(8.7–10.3); longest-dorsal-ray length 15.2(13.3–17.4); pectoral-fin length 12.8(12.3–13.3); pelvic-fin length 25.3(23.6–26.9); dorsal-fin base 16.1(15.2–17.1); anal-fin base 9.1(8.3–10.1); based on 5 specimens 112.2 to 162.0 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a short rounded process not extending beyond margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 50 in number. Teeth caniniform, larger teeth with arrows-shaped tips. Pectoral fins reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Preserved specimens with poorly distinguished markings (some evidence of dorsal saddle-like bands and lateral patches). A color photo of a fresh specimen taken by J. E. Randall (BPBM 13061, Rapa) indicates well-defined, dorsal, saddle-like, reddish-brown patches and lateral patches of the same color (this same specimen was faded in preservative). The dorsal and anal fins of the photographed specimen are barred.

DISTRIBUTION AND HABITAT.—This species has been recorded so far only in the South Pacific from the Tropic of Capricorn and south, extending from the east coast of Australia to Rapa Island at depths of 80 to 110 feet. Allen et al. (1976) record this species (as *S. hoshinonis*) from Lord Howe Island. Barry C. Russell, author of the synodontid portion of that paper, confirmed that it was actually *S. similis*.

REMARKS.—Matsubara (1938) placed this spe-

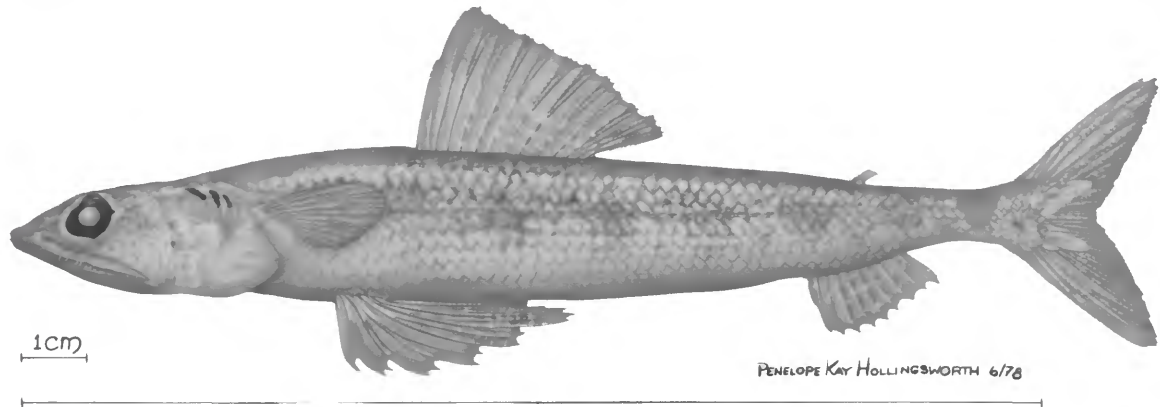


FIGURE 32.—*Synodus similis* McCulloch, BPBM 13061, 157 mm SL, Rapa Island.

cies in synonymy with *Synodus hoshinonis* Tanaka. After comparing material of *S. hoshinonis* from Japan and elsewhere with the material reported here as *S. similis*, it was apparent that they were unquestionably different species. Matsubara does not state his reasons for placing *S. similis* in synonymy, but I suspect that the dark spots on the operculum of both was a strong factor.

I have included meristic data for the holotype to supplement the original description.

Synodus tectus, new species

FIGURE 43

MATERIAL EXAMINED.—*Holotype*: USNM 218935, SL 175 mm, Visayan Sea, PHILIPPINES, 41 fms, 5 Jun 1978, coll. L. Knapp. *Paratypes*: USNM 136223 (1), SL 83 mm, PHILIPPINES, *Albatross*, off Corregidor Light, 38 fms, 2 Jan 1908; USNM 217762 (2), 73–133 mm, SOUTH CHINA SEA, Macclesfield Bank, R/V *Cape St. Mary*, Sta 19, 76.8–80.5 m, 13 Jun 1964, coll. W. L. Chan; USNM 217763 (1), SL 90 mm, SOUTH CHINA SEA, Macclesfield Bank, R/V *Cape St. Mary*, Sta 51, 80.5–87.8 m, 18 Jun 1964, coll. W. L. Chan; USNM 217766 (1), SL 119 mm, Manila fish market, PHILIPPINES, 13 May 1969, coll. F. Schwartz; USNM 217767 (1), SL 93 mm, same data as above; USNM 217770 (2), SL 120 mm,

Macclesfield Bank, SOUTH CHINA SEA, R/V *Cape St. Mary*, Sta 17, 69.6–80.5 m, 13 Jun 1964, coll. W. L. Chan; USNM 217774 (1), SL 131 mm, Macclesfield Bank, SOUTH CHINA SEA, R/V *Cape St. Mary*, Sta 20, 78.7–80.5 m, 13 Jun 1964, coll. W. L. Chan; USNM 218936 (1), SL 124 mm, Visayan Sea, PHILIPPINES, 26 fms, 4 Jun 1978, coll. L. Knapp; USNM 218952 (6), SL 111–126 mm, Visayan Sea, PHILIPPINES, 38 fms, 5 Jun 1978, coll. L. Knapp; AMS I.20218-001 (5), SL 76–84 mm, ARAFURA SEA, *Alpha Helix*, 30 fms, 16 Mar 1975, coll. J. Paxton; AMS I.20751-014 (6); 44–126 mm, SL 44–126 mm, Lizard Island, AUSTRALIA, 0–25 m, prawn trawl, 2 Aug 1979, coll. B. Russell; AMS I.20752-018 (1) SL 131 mm, same data as above.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 13–14 (usually 14); anal-fin rays 9–10 (usually 9); pored lateral-line scales 55–57 (usually 55); transverse scale rows 3.5/5; vertebrae 54–56 (usually 55); combined dorsal and anal procurrent rays 24–31; anterior palatine teeth longest and in a discrete group; peritoneal spots 10–11; posterior pelvic process wide; prominent pigment spot at upper distal corner of operculum. For comparisons see *S. hoshinonis*.

DESCRIPTION (holotype plus range).—Dorsal-fin rays 13 (13–14); anal-fin rays 9 (9–10); pec-

toral-fin rays 12; pelvic-fin rays 8; procurent rays 30 (24–31), dorsal 15 (13–16), anal 15 (11–15); lateral line continuous, 55 (55–57) pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 13 (13–15); rows of cheek scales 5 (4–5); vertebrae 54 (54–56); peritoneal spots 11 (10–11).

Percentages of Standard Length: Mean (range): head length 28.6 (27.1–30.3); snout length 6.4 (5.4–7.1); upper jaw length 17.3 (16.0–18.0); diameter of bony orbit 6.7 (5.6–8.0); least width of bony interorbital 3.2 (2.9–3.3); snout to dorsal origin 41.9 (40.2–44.0); snout to adipose origin 84.7 (82.3–87.7); snout to anal origin 76.6 (73.6–78.9); snout to pelvic insertion 35.4 (33.6–37.2); snout to pectoral insertion 27.2 (25.3–29.2); first-dorsal-ray length 10.5 (8.7–12.1); longest-dorsal-ray length 14.3 (13.5–15.1); pectoral-fin length 12.3 (11.6–13.0); pelvic-fin length 22.9 (21.8–24.3); dorsal-fin base 16.1 (14.7–18.0); anal-fin base 9.3 (8.9–10.0); based on 7 specimens 92.9 to 172.8 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, cheeks, and operculum, postoral portion of cheeks scaly. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a short, rounded process barely reaching anterior margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 40 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—As in *S. hoshinonis*.

DISTRIBUTION AND HABITAT.—*Synodus tectus* so far has only been collected from the western Pacific Ocean (South China Sea south to Great Barrier Reef). Depth of capture data for six col-

lections indicate this species is found at moderate depths of 25 to 82 m (five collections over 50 m). The Queensland collection (Lizard Island) was made on a sand-weed bottom.

ETYMOLOGY.—The Latin *tectus* (disguised) alludes to its external similarity to *S. hoshinonis*.

REMARKS.—This species is host for the parasitic copepod *Metataeniacanthus pacificus* Cressey and Cressey.

Synodus ulae Schultz, 1953

FIGURES 33, 34, 40

Synodus ulae Schultz, 1953:38 [Hawaiian Islands].

MATERIAL EXAMINED.—*Holotype:* USNM 52671, HAWAII. *Paratypes:* HAWAII (8): USNM 55272 (3), 55376 (4), 58525 (1); JAPAN (2): USNM 59778 (1), 59805 (1). *Other Material:* JAPAN (14): USNM 64661 (3), 71006 (1); BPBM 18953 (2), 18976 (1); CAS 29706 (5); FMNH 55458 (1); BMNH 1923.2.26.158-9 (1). HAWAII (36): USNM 88134 (2), 143699 (3), 217732 (1); CAS 10492 (1), 11312 (1), 39948-50 (14), 68350 (1); FMNH 47682 (3); ANSP 77716 (1), 80136 (1), 80143-4 (2), 91705 (1), 97780 (2), 97832 (3).

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 13–14 (usually 14); anal-fin rays 8–10 (usually 9); pored lateral-line scales 62–66 (usually 65); transverse scale rows 5.5/8; vertebrae 62–65 (usually 64); combined dorsal and anal procurent rays 30–38; anterior palatine teeth longest and in a discrete group; peritoneal spots 11–12; posterior pelvic process wide.

Synodus ulae can be separated from all other Indo-West Pacific species of *Synodus* except *S. capricornis* by its high lateral-line scale and vertebral counts 62–66, 62–65, respectively. It can be separated from *S. capricornis* by the nature of the dermal flap on the anterior nares: long and spatulate in *S. ulae*, short and triangular in *S. capricornis*.

DESCRIPTION.—Dorsal-fin rays 13–14; anal-fin rays 8–10; pectoral-fin rays 13; pelvic-fin rays 8;

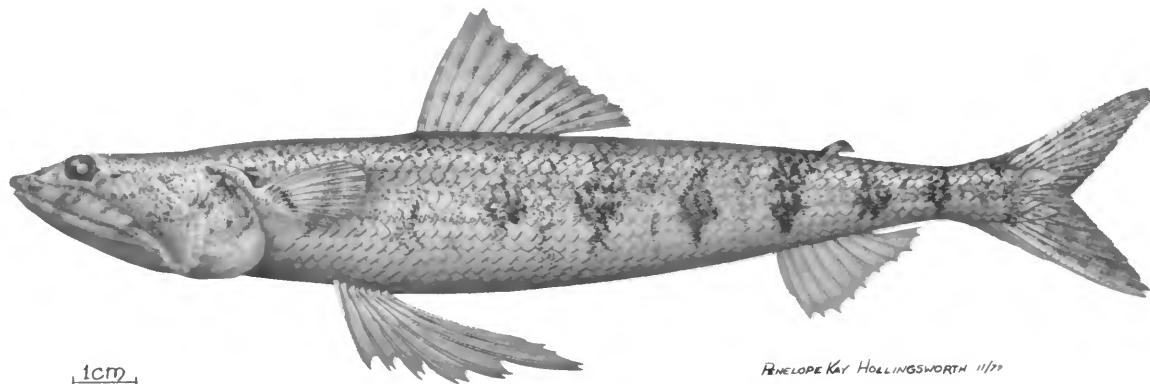


FIGURE 33.—*Synodus ulae* Schultz, USNM 071006, 180 mm SL, Misaki, Japan.

procurrent rays 30–38, dorsal 16–19, anal 14–18; lateral line continuous, 62–66 pored scales; scale rows above lateral line from dorsal origin 5.5; scale rows below lateral line to anal origin 8; predorsal scales 19; rows of cheek scales 6–7; vertebrae 62–65; peritoneal spots 11–12.

Percentages of Standard Length: Mean (range): head length 29.9(24.3–33.2); snout length 6.1(5.3–6.7); upper jaw length 19.1(17.1–20.3); diameter of bony orbit 4.9(3.7–6.5); least width of bony interorbital 2.9(2.1–3.6); snout to dorsal origin 43.8(41.0–45.1); snout to adipose origin 87.3(83.2–92.3); snout to anal origin 80.1(77.5–84.4); snout to pelvic insertion 36.4(34.6–38.4); snout to pectoral insertion 28.7(26.0–30.6); first-dorsal-ray length 10.2(8.7–12.3); longest-dorsal-ray length 15.2(13.8–18.5); pectoral-fin length 12.4(10.5–14.5); pelvic-fin length 27.2(23.6–31.2); dorsal-fin base 16.8(14.6–18.5); anal-fin base 8.5(6.3–10.1); based on 20 specimens 69.0 to 242.4 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, extending onto cheeks and operculum, postoral portion of cheeks naked. Snout sharply pointed, broader than long; the anterior nostril on each side bearing a long spatulate dermal flap on posterior border, extending well beyond anterior edge of nares when depressed anteriorly.

Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 50 in number. Teeth caniniform, larger teeth with

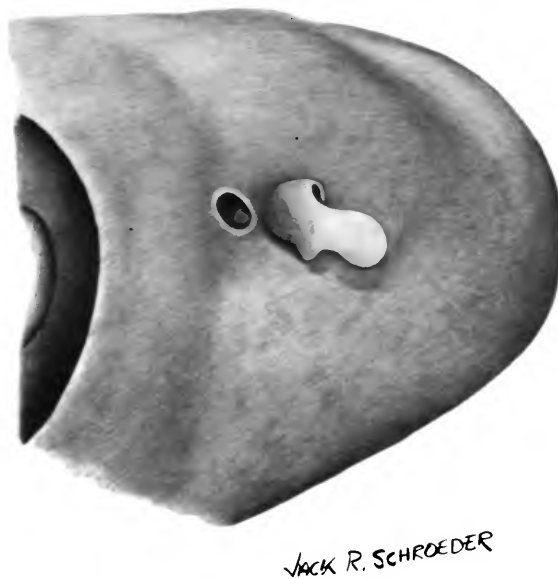


FIGURE 34.—*Synodus ulae* Schultz, detailed enlargement of snout region.

arrow-shaped tips. Pectoral fins reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, the fifth branched ray (sixth ray) longest. Posterior bony process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Preserved material as in *S. variegatus*.

DISTRIBUTION AND HABITAT.—This species has been collected only in Japan, Okinawa, and Hawaii, and may be restricted to that range. Depth of capture data is lacking for most of the collections examined with a range from “tidepool” to 66 fms given for only three of the 31 collections studied. Several collections were mixed with *S. variegatus*, however, indicating that *S. ulae* is found in shallow water.

REMARKS.—One of Schultz’s paratypes (USNM 143701) is actually a specimen of *Synodus englemani*.

Synodus usitatus, new species

FIGURES 35, 44

MATERIAL EXAMINED.—*Holotype*: BPBM 15484, SL 123.2 mm, and 2 paratypes, BPBM 26544, SL 115.6, and USNM 225068, 96.2 mm, off Oahu, HAWAII, 27 Aug 1973, 55 fms, shrimp trawler *Valiant Maid*. *Paratype*: FAKU 5780, SL 95.5 mm, off Kumanonada, Mie Prefecture, JAPAN, 25 Mar 1938.

DIAGNOSIS AND COMPARISONS.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 12 anal-fin rays 8–9 (usually 9); pored lateral-line scales 58–60 (usually 58); transverse scale rows 3.5/5; vertebrae 57–59 (usually 57); combined dorsal and anal procurrent rays 26–29; anterior palatine teeth not longest and not in a discrete group; peritoneal spots 14–17; posterior pelvic process wide.

The pectoral fin of *S. usitatus* extends well beyond a line from the origin of the pelvic fin to the origin of the dorsal fin. All other known species of Indo-West Pacific *Synodus* except *S. binotatus*, *S. macrocephalus*, and *S. oculus* are short of or just to this line. *Synodus macrocephalus* and *S.*

oculus have a narrow posterior pelvic process. The vertebral and peritoneal spot counts of *S. binotatus* are lower than those of *S. usitatus* (51–55, 0–3 vs. 57–59, 14–17 respectively).

DESCRIPTION (holotype plus range).—Dorsal-fin rays 12(11–12); anal-fin rays 8(8–9); pectoral-fin rays 13; pelvic-fin rays 8; procurrent rays 27 (26–29), dorsal 14(14–15), anal 13(12–14); lateral line continuous, 58 (58–59) pored scales; scale rows above lateral line from dorsal origin 3.5; scale rows below lateral line to anal origin 5; predorsal scales 15(15–16); rows of cheek scales 4; vertebrae 57(57–59); peritoneal spots 14(14–17).

Percentages of Standard Length: Mean (range): head length 29.4 (28.5–31.2); snout length 5.6(5.3–6.0); upper jaw length 18.6(17.3–20.1); diameter of bony orbit 6.3(5.9–6.6); least width of bony interorbital 2.3(2.1–2.5); snout to dorsal origin 43.0(41.6–44.3); snout to adipose origin 86.6(86.1–87.5); snout to anal origin 81.0(77.7–84.5); snout to pelvic insertion 35.9(34.8–37.5); snout to pectoral insertion 27.2(25.6–30.0); first-dorsal-ray length 9.3(8.6–10.0); longest-dorsal-ray length 15.3(13.3–17.3); pectoral-fin length 12.7(12.5–13.0); pelvic-fin length 25.7(24.3–27.0); dorsal-fin base 12.9(12.1–13.5); anal-fin base 9.0(7.8–9.9); based on 4 specimens 95.5 to 123.2 mm SL.

Body fusiform, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, extending onto cheeks and operculum, postoral portion of cheeks scaly. Snout not sharply pointed, broader than long; the anterior nostril on each side bearing a broad triangular dermal flap extending well beyond anterior margin of nares when depressed anteriorly. Interorbital space concave, occipital region bony. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front not largest and not in a discrete group. Lingual teeth well developed, those on free end of tongue largest and about 35 in number. Teeth caniniform, larger teeth with arrow-shaped tips. Pectoral fins reaching beyond a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, fifth branched ray (sixth ray) longest. Posterior bony

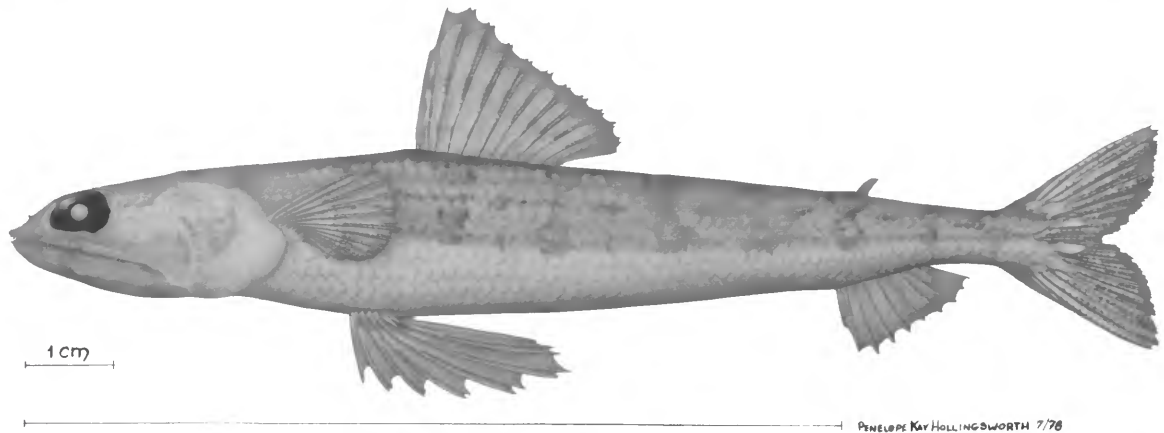


FIGURE 35.—*Synodus usitatus*, new species, holotype BPBM 15484, 123.2 mm SL, off Oahu, Hawaii.

process of pelvic girdle broad. Peritoneum pale.

COLOR PATTERN.—Dorsum dark, a series of five saddle-like bands alternating dark and lighter with dark band at origin of dorsal fin, second near end of dorsal-fin base, third and fourth between dorsal fin and adipose fin, last near base of adipose fin; less conspicuous pigmented areas between each of the darker bands; dorsal fin with two to three faint bars; other fins unmarked except posterior edge of caudal fin of one specimen with pale band (from photo of fresh specimen by J. E. Randall).

DISTRIBUTION AND HABITAT.—This new species has been collected from Hawaii and Japan. The three Hawaiian specimens were collected at 55 fathoms, indicating a preference for deeper water than most other known Indo-West Pacific *Synodus*. Depth of capture data are unavailable for the Japan specimen. After this paper went to press, an additional specimen was sent to me from the Indian Ocean coast of Sumatra-Java by P. Whitehead (BMNH).

ETYMOLOGY.—The Latin *usitatus* (ordinary) alludes to a lack of any outstanding markings.

Literature Cited

- Anderson, W. W., J. W. Gehringer, and F. W. Berry
 1966. Family Synodontidae: Lizardfishes. In Fishes of the Western North Atlantic. *Memoirs of the Sears Foundation for Marine Research*, 1(5):30–102.
1975. The Correlation between Numbers of Vertebrae and Lateral-Line Scales in Western Atlantic Lizardfishes (Synodontidae). *Fishery Bulletin*, 73(1):202–206.
- Barnard, K. H.
 1925. Monograph of the Marine Fishes of South Africa. *Annals of the South African Museum*, 21(1): 418 pages.
- Chen, T., and C. Yeh
 1964. A Study of the Lizard-fishes (Synodontidae) Found in Waters of Formosa and Adjacent Islands. *Tunghai University Biological Bulletin*, 23: 23 pages.
- Cressey, R., and H. B. Cressey
 1979. The Parasitic Copepods of Indo-West Pacific Lizardfishes (Synodontidae). *Smithsonian Contributions to Zoology*, 296: 71 pages.
- Cressey, R., and J. Randall
 1978. *Synodus capricornis*, a New Lizardfish from Easter and Pitcairn Islands. *Proceedings of the Biological Society of Washington*, 91(3):767–774.
- Day, F.
 1873. On Some New Fishes of India. *The Journal of the Linnean Society, Zoology*, 11:524–530.
- Fowler, H. W.
 1912. Notes on Salmonoid and Related Fishes. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 63(3):551–571.
- Gibbs, R. H., Jr.
 1959. A Synopsis of the Postlarvae of Western Atlantic Lizard-fishes (Synodontidae). *Copeia*, 1959(3):232–236.
- Gilbert, C. H.
 1903. The Deep-Sea Fishes of the Hawaiian Islands. *United States Fisheries Commission Bulletin*, 23(2): 577–713.
- Gopinath, K.
 1946. Notes on the Larval and Post-larval Stages of Fishes Found along the Trivandrum Coast. *Proceedings of the National Institute of Science of India*, 12(1):7–21.
- Günther, A.
 1880. Report on the Shore Fishes Procured during the Voyage of HMS *Challenger* in the Years 1873–76. *Challenger Reports, Zoology*, 4: 82 pages.
- Hubbs, C. L., and K. F. Lagler
 1958. Fishes of the Great Lakes Region. *Bulletin of the Cranbrook Institute of Science*, 26: 218 pages. [Revised edition.]
- Hutchins, L. W., and M. Scharff
 1947. Maximum and Minimum Monthly Mean Sea Surface Temperature Charted from the “World Atlas of Sea Temperatures.” *Journal of Marine Research*, 6:264–268.
- Jordan, D. S., and A. Herre
 1907. A Review of the Lizard-fishes or Synodontidae of the Waters of Japan. *Proceedings of the United States National Museum*, 32:513–524.
- Kotthaus, A.
 1967. Fische des Indischen Ozeans: A, Systematischer Teil II: Ordnung Iniomi. In “*Meteor*” *Forschungsergebnisse*, D(1):71–84.
- Lacépède, B.G.E.
 1803. *Histoire Naturelle des Poissons*. Volume 5, 803 pages. Paris.
- McCulloch, A. R.
 1921. Notes and Illustrations of Queensland Fishes, No. 2. *Memoirs of the Queensland Museum*, 7(3):164–178.
- Matsubara, K.
 1938. A Review of the Lizardfishes of the Genus *Synodus* Found in Japan. *Journal of the Imperial Fisheries Institute*, 33(1): 36 pages.
- Norman, J. R.
 1935. A Revision of the Lizard-fishes of the Genera *Synodus*, *Trachinocephalus*, and *Saurida*. *Proceedings of the Zoological Society of London*, 1:99–135.
- Ogilby, J. D.
 1910. On New or Insufficiently Described Fishes. *Proceedings of the Royal Society of Queensland*, 23(1): 55 pages.
- Russell, B., and R. Cressey
 1979. Three New Species of Indo-West Pacific Lizardfish (Synodontidae). *Proceedings of the Biological Society of Washington*, 92(1):166–175.
- Schultz, L. P.
 1953. Synodontidae. In Fishes of the Marshall and Marianas Islands. *Bulletin of the United States National Museum*, 202(1): 660 pages.
- Tanaka, S.
 1917. Eleven New Species of Fishes from Japan. *Dobutsugaku zasshi* (Zoological Magazine, Tokyo), 19: 17–21. [In Japanese.]

Waite, R.

1905. Notes on Fishes from Western Australia, No. 3.
Records of the Australian Museum, 6(2):55-82.

Whitehead, P.J.P., and P. K. Talwar

1976. Francis Day (1829-1889) and His Collections of

Indian Fishes. *Bulletin of the British Museum (Natural History), Historical Series*, 5(1): 189 pages.

Whitley, G. P.

1943. Ichthyological Notes and Illustrations (Part 2).
The Australian Zoologist, 10(2):167-187.

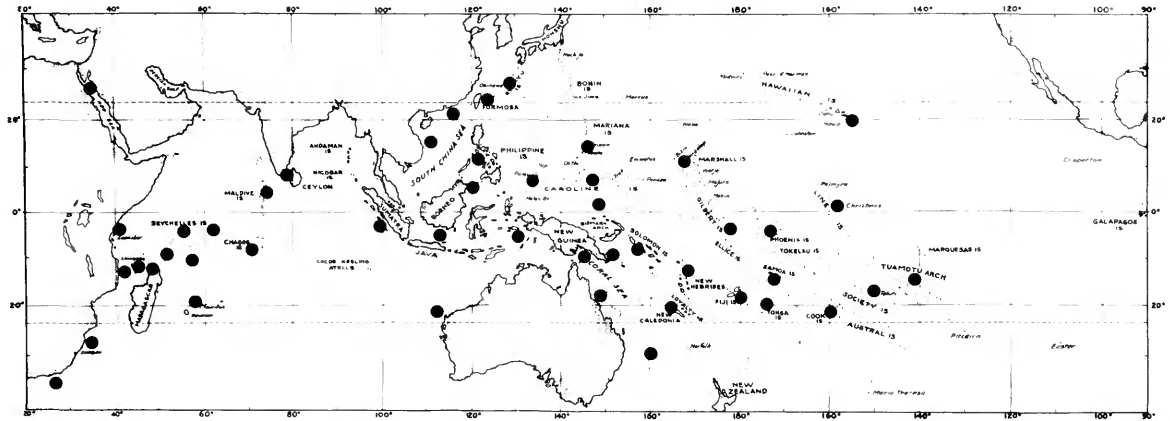


FIGURE 36.—Distribution of *Synodus variegatus* (Lacépède).

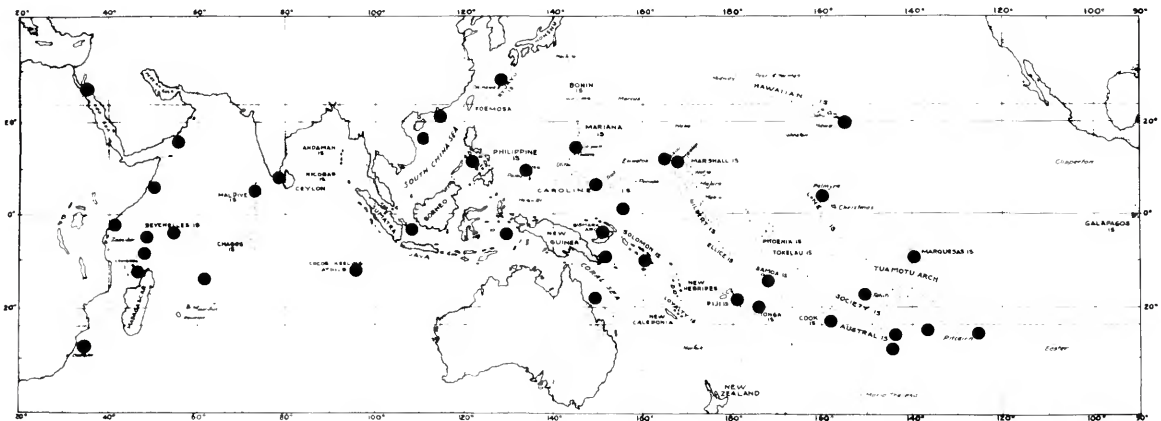


FIGURE 37.—Distribution of *Synodus englemani* Schultz.

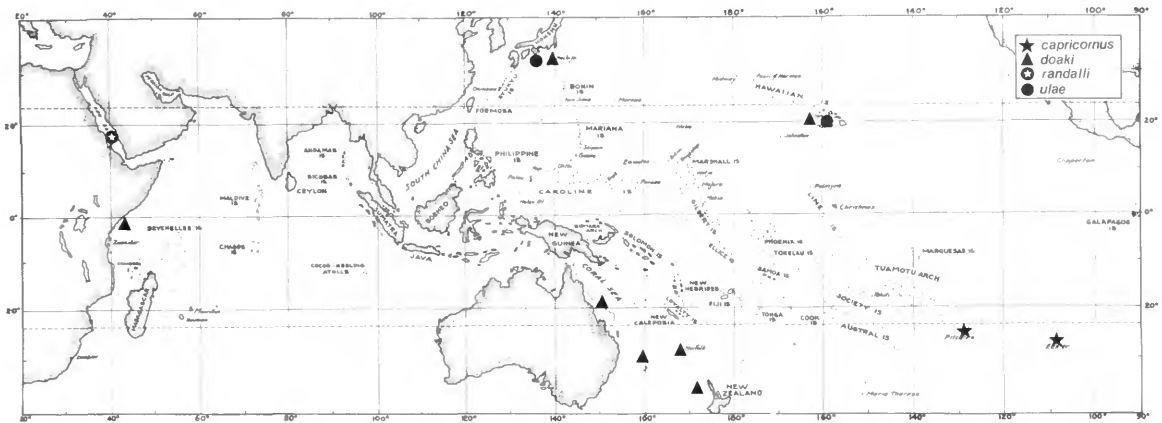


FIGURE 40.—Distribution of *Synodus capricornis* Cressey and Randall, *S. doaki* Russell and Cressey, *S. randalli*, new species, and *S. ulae* Schultz.

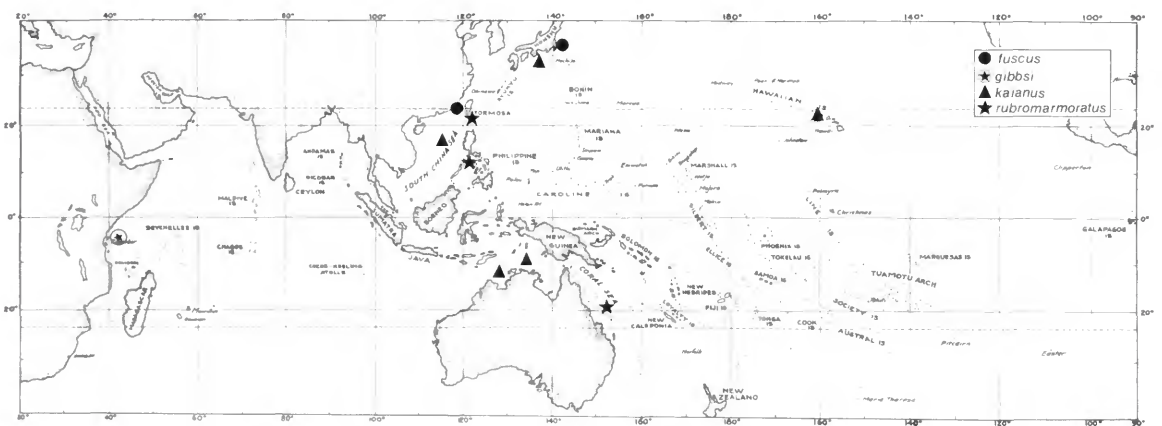


FIGURE 41.—Distribution of *Synodus fuscus* Tanaka, *S. gibbsi*, new species, *S. kaianus* (Günther), and *S. rubromarmoratus* Russell and Cressey.

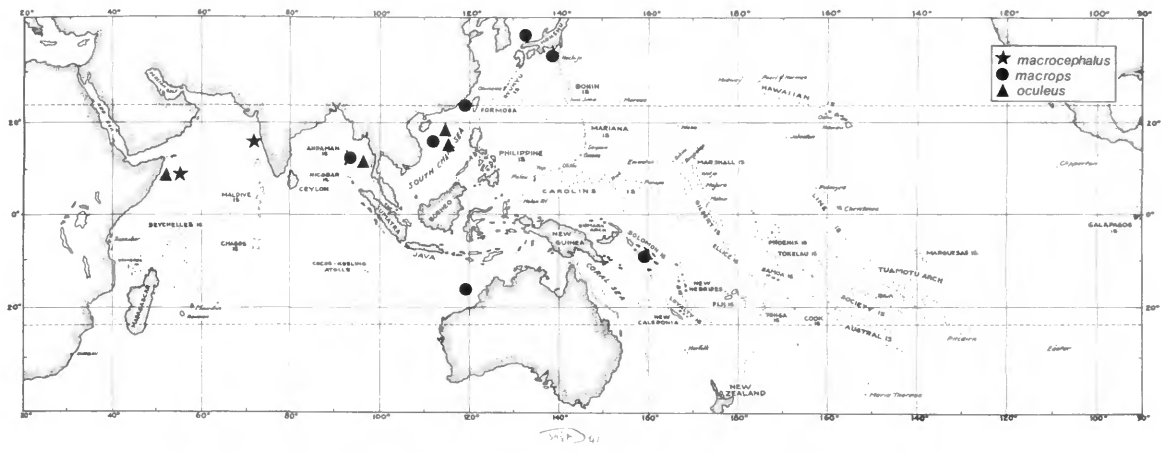


FIGURE 42.—Distribution of *Synodus macrocephalus*, new species, *S. macrops* Tanaka, and *S. oculus*, new species.

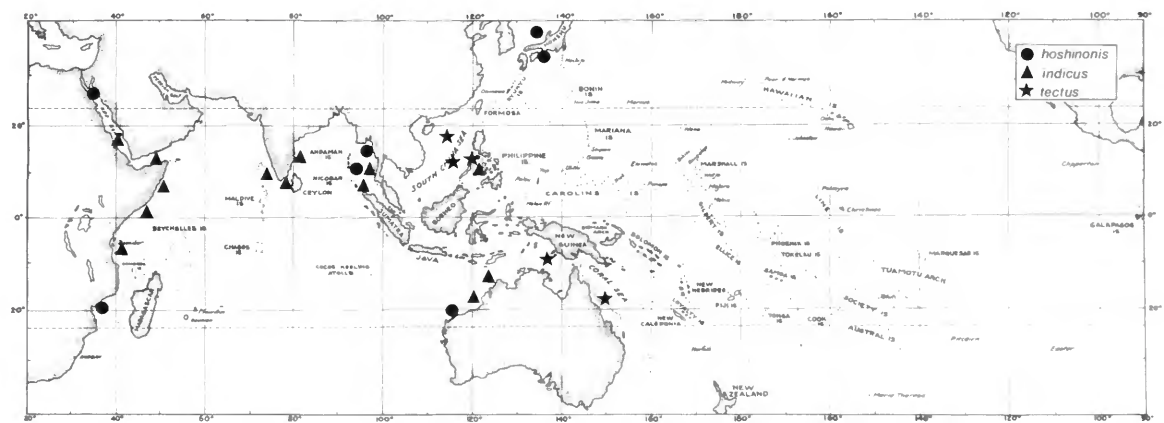


FIGURE 43.—Distribution of *Synodus hoshinonis* Tanaka, *S. indicus* (Day), and *S. tectus*, new species.

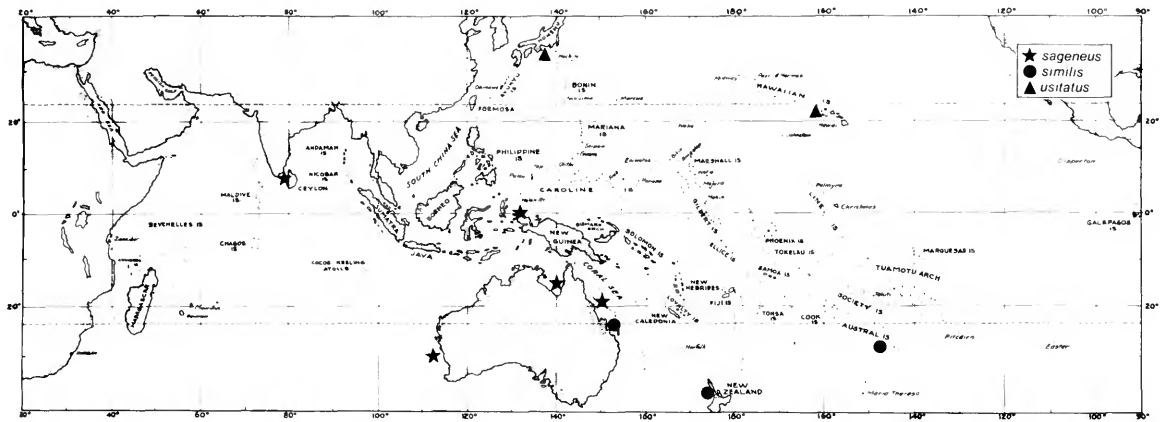


FIGURE 44.—Distribution of *Synodus sageneus* Waite, *S. similis* McCulloch, and *S. usitatus*, new species.

TABLE 2.—Synopsis of selected meristic and nonmeristic characters of Indo-West Pacific *Synodus*

Species	vertebrae	dorsal-fin rays	anal-fin rays	procurrent caudal rays	scales above 1.1	scales below 1.1	peri-toneal spots	free tongue teeth*	posterior pelvic process	postoral cheek scales	peritoneum color	pectoral fin length**
<u>binothus</u>	51-55	12-14	8-10	27-33	3.5	5	0-3	40	wide	present	pale	beyond
<u>capricornis</u>	64-65	12-14	8-10	32-33	5.5-6.5	7	10-12	40	wide	absent	pale	to
<u>doaki</u>	55-58	13-14	9-11	31-35	3.5	7	11-12	50	wide	present	pale	to
<u>englemanni</u>	59-62	11-13	8-10	29-37	5.5-6.5	7	7-10	40	wide	present	pale	to
<u>fuscus</u>	53-55	10-12	8-10	23-27	3.5	5	9-10	30	wide	present	pale	short
<u>gibbsi</u>	58-60	11-13	10-11	24-28	3.5	5	7-8	20	narrow	present	pale	to
<u>hoshinonis</u>	54-57	12-14	8-10	25-29	3.5	5	12-13	40	wide	present	pale	to
<u>indicus</u>	52-58	11-13	9-11	27-32	3.5	5	9-11	40	wide	present	pale	short
<u>jaculum</u>	59-62	11-13	8-10	28-33	5.5	9	11-13	50	wide	absent	pale	to
<u>katianus</u>	58-63	10-13	10-11	23-28	3.5	5	0	30	narrow	present	black	short
<u>macrocephalus</u>	55	11-13	9-10	26-27	3.5	5	7	30	narrow	present	pale	beyond
<u>macrops</u>	51-55	11-12	10-11	20-26	3.5	5	5-6	30	narrow	present	brn-blik	to
<u>oculeus</u>	54-56	12-13	9-10	24-25	3.5	4	7-8	30	narrow	present	pale	beyond
<u>randalli</u>	54	13	8	29	3.5	4	14	40	wide	present	pale	beyond
<u>rubromarmoratus</u>	52-55	10-11	9	24-29	3.5	5-6	12-13	25	wide	present	pale	short
<u>sagenus</u>	49-54	12-13	12-15	25-29	4.5	5	5-6	35	wide	present	pale	short
<u>similis</u>	58-59	13-14	9-11	29-33	3.5	6	10-12	50	wide	present	pale	to
<u>tectus</u>	54-56	13-14	9-10	24-31	3.5	5	10-11	40	wide	present	pale	to
<u>ulae</u>	62-65	13-14	8-10	30-38	5.5	8	11-12	50	wide	absent	pale	to
<u>usitatus</u>	57-59	12	8-9	26-29	3.5	5	14-17	35	wide	present	pale	beyond
<u>variegatus</u>	55-61	10-13	8-10	26-34	5.5	7	10-12	55	wide	absent	pale	to

* approximate

** relative to a line from the origins of the pelvic and dorsal fins

TABLE 3.—Frequency distribution of vertebrae in Indo-West Pacific *Synodus*

Species	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
<u>binotatus</u>			6	16	53	32	3										
<u>capricornis</u>																1	5
<u>doaki</u>							1	3	3	3							
<u>englemani</u>											16	75	43	3			
<u>fuscus</u>					4	5	9										
<u>gibbsi</u>										5	27	6					
<u>hoshinonis</u>						13	10	5	1								
<u>indicus</u>				1	4	3	7	58	17	2							
<u>jaculum</u>											9	26	8	2			
<u>kaianus</u>										1	4	7	1	5	3		
<u>macrocephalus</u>							7										
<u>macrops</u>			2	6	8	16	12										
<u>oculeus</u>						2	5										
<u>randalli</u>						1											
<u>rubromarmoratus</u>				2	11	5	1										
<u>sageneus</u>	1	1	7	5	1	3											
<u>similis</u>										2	3						
<u>tectus</u>						4	17	6									
<u>ulae</u>														7	8	16	13
<u>usitatus</u>									3		1						
<u>variegatus</u>							2	6	64	146	67	10					

TABLE 4.—Frequency distribution of dorsal- and anal-fin rays of Indo-West Pacific *Synodus*

Species	dorsal					anal							
	10	11	12	13	14	8	9	10	11	12	13	14	15
<u>binotatus</u>			7	18	3	6	18	5					
<u>capricornis</u>			1	3	2	1	3	2					
<u>doaki</u>				2	4		2	2	1				
<u>englemani</u>		1	11	21		9	22	6					
<u>fuscus</u>	5	5	1			12	9	1					
<u>gibbsi</u>		5	7	3				11	12				
<u>hoshinonis</u>			2	8	2	1	4	8					
<u>indicus</u>		1	21				6	6	1				
<u>jaculum</u>		2	6	4		5	3	3					
<u>kaianus</u>	1	2	7	2				5	6				
<u>macrocephalus</u>		2	1	4			2	3					
<u>macrops</u>		4	9					7	6				
<u>oculeus</u>			1	3			1	2					
<u>randalli</u>				1		1							
<u>rubromarmoratus</u>		4	1			6	3						
<u>sageneus</u>			3	2						1	2	2	1
<u>similis</u>				2	3		1	3	1				
<u>tectus</u>				8	3		4	4					
<u>ulae</u>				7	9	6	19	3					
<u>usitatus</u>			4			1	2						
<u>variegatus</u>	3	16	31	1		33	18	2					

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