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A REVISION OF THE SNAKE-EEL GENUS *CALLECHELYS*
(ANGUILLIFORMES: OPHICHTHIDAE) WITH THE
DESCRIPTION OF TWO NEW INDO-PACIFIC SPECIES AND A
NEW CALLECHELYIN GENUS

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Species of the tropical snake-eel genus *Callechelys*, family Ophichthidae, subfamily Ophichthinae, are reviewed. An identification key for the species of the tribe Callechelyini and synonymies, illustrations, and diagnoses are provided for each of the valid species of *Callechelys*: *C. bilinearis*, *C. bitaeniata*, *C. catostoma*, *C. cliffi*, *C. eristigma*, *C. galapagensis*, *C. guineensis*, *C. leucoptera*, *C. lutea*, *C. marmorata*, *C. muraena*, and *C. springeri*. *Callechelys papulosa* n. sp. is described from Papua, New Guinea, and differs in its morphometry, coloration, and vertebral number. *Callechelys randalli* n. sp. is described from Fatu Hiva, Marquesas, and differs from the closely-related *C. catostoma* in its body elongation and higher vertebral numbers. A neotype for *C. catostoma* is designated. *Callechelys striatus* Smith is synonymized with *C. catostoma*. *Callechelys sibogae* Weber is referred to *Bascanichthys* and *C. maculata* Chu, Wu and Jin is provisionally referred to *Yirrkala*. The status of all nominal species of *Callechelys* is confirmed. *Xestochilus* gen. nov. is erected for *Callechelys nebulosus* Smith; it differs from other callechelyins in the unique condition of its snout, lips, dentition, and branchiostegal rays. Its range is extended to include Polynesia, Micronesia, Indonesia and the Red Sea. The distribution of *C. catostoma* is extended to Hawaii, the western Indian Ocean, and the Red Sea.

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Although the snake-eels and worm-eels of the family Ophichthidae are known to have achieved perhaps the greatest diversity of body form and adaptive radiation within the anguilliform fishes, few can be accused of being beautiful. The species of the genus *Callechelys* are exceptional, however, in their possession of an elongate mane and generally colorful livery, such that Kaup (1856a, b) was correct in creating the generic name to include the Greek Καλλος, meaning beautiful. Since Storey's (1939) review, the species of *Callechelys* have only received regional treatments: the western Atlantic (McCosker et al. 1989); the eastern Atlantic (Blache and Cadenat 1971); the eastern Pacific (McCosker and Rosen-

blatt 1972, 1995); the western Indian Ocean (Smith 1962); South Africa (McCosker and Castle 1986); and Australia (McCosker in prep.). The osteology and intrafamilial relationships of several species were described by McCosker (1977) and the leptocephali of the western Atlantic species by Leiby (1989). A considerable number of specimens of *Callechelys* have accumulated in recent years, allowing for the first time a revision of the genus. In doing so, I discovered that *C. nebulosus*, described by Smith (1958) from the western Indian Ocean, is widespread in the Indo-Pacific and has affinities elsewhere within the tribe Callechelyini.

The purpose of this paper is to provide an update of recent taxonomic actions concerning *Callechelys*, a key to their identification, a listing of all nominal species and their status, the description of two new Indo-Pacific species, and the creation of a new generic name for *C. nebulosus*.

MATERIALS AND METHODS

Measurements are straight-line, made either with a 300 mm ruler with 0.5 mm gradations (for total length, trunk length, and tail length) and recorded to the nearest 0.5 mm, or with dial calipers (all other measurements) and recorded to the nearest 0.1 mm. Body length comprises head and trunk lengths. Head length is measured from the snout tip to the posterodorsal margin of the gill opening; trunk length is taken from the end of the head to mid-anus; maximum body depth does not include the median fins. Head pore terminology follows that of McCosker et al. (1989:257), such that the supraorbital pores are expressed as the ethmoid pore + pores in supraorbital canal, e.g., 1 + 3, and the infraorbital pores are expressed as pores along the upper jaw + those in vertical part of canal behind eye (the "postorbital pores"), e.g., 4 + 2, in that frequently the last pore included along the upper jaw is part of the postorbital series. Gill arch examination was accomplished after removal and clearing and counterstaining with alcian blue and alizarin red dyes (Dingerkus and Uhler 1977). Vertebral counts (which include the hypural) are taken from radiographs. The mean vertebral formula (MVF) expresses the average of predorsal (which begins above the head in all *Callechelys*, indicated in the formula by "H"), preanal, and total vertebrae (Böhlke 1982). The number of specimens examined for vertebral analysis are listed after "total vertebrae" as "n = ". Institutional abbreviations follow the Standard Symbolic Codes for Institutional Research Collections in Herpetology and Ichthyology (Leviton et al. 1985).

KEY TO THE SPECIES OF THE TRIBE
CALLECHELINI

- 1a. Anal fin absent 2
- 1b. Anal fin present 6
- 2a. Anterior nostril a hole, without a raised rim; four supraorbital pores; head brown or black, with white markings (not spotted), dorsal fin white *Letharchus* . . . 3
- 2b. Anterior nostril tubular; three supraorbital pores; head and dorsal fin spotted or mottled *Paraletarchus* . . . 5
- 3a. Trunk and tail cream-colored, overlain with a broad brown mid-lateral stripe running the entire length of the body; vertebrae 157–164 *Letharchus aliculatus* McCosker 1974 (Brazil)
- 3b. Trunk and tail uniform dark brown to black; vertebral range 135–151 4
- 4a. Supraorbital pores linear when viewed from above; vertebrae 135–142 *Letharchus velifer* Goode and Bean 1882 (western Atlantic)
- 4b. Second supraorbital pore displaced medially when viewed from above; vertebrae 144–151 *Letharchus rosenblatti* McCosker 1974 (eastern Pacific)
- 5a. Background body color dark tan to dark brown, spotted anteriorly, the spots coalescing along the posterior trunk and tail to become uniformly dark; vertebrae 156–167 *Paraletarchus pacificus* (Osburn and Nichols 1916) (eastern Pacific)
- 5b. Background body color cream to tan, overlain with numerous brown spots; vertebrae 170–180 *Paraletarchus opercularis* (Myers and Wade 1941) (Galápagos Islands)
- 6a. Incision on underside of snout, if present, not extending beyond anterior nostril base (Figs. 1b–d); vomerine and/or anterior intermaxillary teeth absent 7
- 6b. Median groove on underside of snout extends to and beyond anterior nostril bases (Fig. 1a); vomerine and intermaxillary teeth present *Callechelys* . . . 9
- 7a. Underside of snout with a raised platform before, between, and ending behind anterior nostril tubes (Figs. 1b, c), appearing

- laterally as a horizontal slit above lip; anterior intermaxillary teeth present; a short crease in underside of snout, not extending beyond anterior nostril bases; vertebrae 135–165 8
- 7b. Underside of snout without a raised platform between tubular anterior nostrils (Fig. 1d); underside of snout without a median crease; anterior intermaxillary and vomerine teeth absent; vertebrae 148–152 *Aprognathodon platyventris* Böhlke 1967 (western Atlantic)
- 8a. An elongate Y-shaped platform on underside of snout (Fig. 1b); anterior intermaxillary teeth partially hidden by skin folds; snout and nape smooth; vertebrae 157–165 *Xestochilus nebulosus* (Smith 1962) (Red Sea and Indian Ocean to central Pacific)
- 8b. A V-shaped platform on underside of snout (Fig. 1c); anterior intermaxillary teeth exposed; snout and nape with numerous papillae; vertebrae 135 *Leuropharus lasiops* Rosenblatt and McCosker 1970 (eastern Pacific)
- 9a. Body evenly colored, marbled or striped, not spotted 10
- 9b. Body covered with numerous brown to black spots 16
- 10a. Body uniform brown to black, not striped or marbled 11
- 10b. Body not uniformly colored, with longitudinal stripes, marbling, or a combination of both 12
- 11a. Body chocolate brown to dark brown, fins colorless; face smooth; tail 2.1–2.3 in TL *Callechelys leucoptera* (west Africa)
- 11b. Body dark black, fins black like body (a white spot beneath eye); face covered with pits; tail 2.7 in TL *Callechelys papulosa* (New Guinea)
- 12a. A prominent fleshy ridge from the snout tip to dorsal fin origin; vomerine teeth neatly biserial; coloration yellow to tan, speckled and spotted with darker, coalescing spots *Callechelys marmorata* (east Africa to central Pacific)
- 12b. Fleshy ridge along mid-snout region absent; vomerine teeth few, not in two rows; bold stripes along body 13
- 13a. Body with two dark lateral stripes along body and one along the dorsal fin; body moderately elongate, its depth 28–36 in TL *Callechelys bilinearis* (western Atlantic eastward to St. Helena Island)
- 13b. Body with two stripes, the dorsal fin margin black, the fin pale, and a single mid-body stripe along the length of the trunk and tail, the lateral line within the band; body variously elongate, its depth 48–76 in TL 14
- 14a. Tail very short, more than 3.5 in TL; a pair (rarely two pairs) of large recurved intermaxillary fangs; ethmoidal pore (at snout tip) absent 15
- 14b. Tail 2.5–2.7 times in TL; four intermaxillary teeth, none enlarged as recurved fangs; ethmoidal pore present *Callechelys bitaeniata* (western Indian Ocean)
- 15a. A small but conspicuous barbel on lip between anterior and posterior nostrils; body depth 48–73; vertebrae 192–205 *Callechelys catostoma* (east Africa to central Pacific)
- 15b. Lip continuous between anterior and posterior nostrils, no conspicuous barbel; body depth 59–73; vertebrae 220–224 *Callechelys randalli* (Marquesas Islands, central Pacific)
- 16a. Color pattern of numerous fine dark spots, not much larger than eye diameter, over a pale tan or brown body; fins with a distinct white or pale edging 17
- 16b. Color pattern pale with dark round or oblong spots and blotches, mostly larger than snout; fins without a distinct white or pale edging 18
- 17a. Tail 2.2–2.4 in TL; depth 19–31 in TL; color tan with numerous fine brown spots on body and fins *Callechelys cliffi* (eastern Pacific)
- 17b. Tail 2.5–2.7 in TL; depth 27–38 in TL; color pale, overlain with numerous eye-sized brown spots and mottling *Callechelys muraena* (western Atlantic)
- 18a. Tail very short, 3.2–3.7 in TL; depth 38–52 in TL; color mostly cream, overlain with numerous dark spots about as long as snout *Callechelys eristigma* (eastern Pacific)

- 18b. Tail longer, 2.1–3.2 in TL; depth 17–39 in TL; color various, but with dark spotting over a paler background 19
- 19a. Coloration pale to yellow, overlain with spots mostly smaller than snout; anal fin pale; tail 2.4–2.8 in TL; depth 38–53 in TL *Callechelys lutea* (Hawaii to Midway Island)
- 19b. Coloration pale, spotting mostly larger than snout, coalescing to form large blotches in some species; anal fin spotted; tail 2.2–3.1 in TL; depth 26–59 in TL 20
- 20a. Tail 2.8–3.1 in TL; depth 45–59 in TL 21
- 20b. Tail 2.2–2.3 in TL; depth 26–38 in TL
Callechelys galapagensis (Galápagos Islands)
- 21a. Tail 2.8–2.9 in TL; total vertebrae 169–171; dorsal spots of large individuals coalesce into dark saddles
Callechelys springeri (North Carolina and Florida, western Atlantic)
- 21b. Tail 2.9–3.1 in TL; total vertebrae 171–186; dorsal spots of large individuals not coalesced into saddles
Callechelys guineensis (eastern and western Atlantic)

Genus *Callechelys* Kaup, 1856

- Callechelys* Kaup, 1856a:51 (type species *Callechelys Guichenoti* Kaup, 1856 = *Dalophis marmorata* Bleeker 1853, by monotypy).
- Cryptopterygium* Ginsburg 1951:482 (type species *Cryptopterygium holochroma* Ginsburg 1951 = *Gordichthys springeri* Ginsburg 1951, by original designation and by monotypy).

DIAGNOSIS. — Ophichthid eels, subfamily Ophichthinae, tribe Callechelyini (sensu McCosker 1977) with body moderately to very elongate, laterally compressed throughout body and trunk, and longer than tail. Dorsal fin origin on nape, above supraoccipital, well before gill openings. Pectoral fins absent. Snout acute, rounded at tip, overhanging lower jaw, grooved on underside. Gill openings low lateral to entirely ventral, converging forward, their length much greater than isthmus. Head pores reduced; three supraorbital pores, two preopercular pores, and three pores in supratemporal canal. Teeth conical,

slender, small and uniserial on jaws, those of intermaxillary larger and separated from those of vomer by a gap. Body coloration variable: striped, barred, spotted, mottled or uniform.

ETYMOLOGY. — From the Greek Καλλος (beauty) and ἔγγελος (eel). Treated as feminine according to Opinion 915 of the Bulletin of Zoological Nomenclature, 1970.

REMARKS. — A more comprehensive description of *Callechelys* osteology is available in McCosker (1977) and McCosker et al. (1989).

Callechelys bilinearis Kanazawa (Fig. 2; Tables 1, 2, 4)

Callechelys bilinearis Kanazawa 1952:72 (Bermuda, holotype FMNH 48973).

DIAGNOSIS. — Moderately elongate, body depth 28–36 in TL; head 12–14 in TL; tail 2.6–3.6 in TL; maxillary teeth 8–12, dentary teeth 12–19; boldly colored with two dark lateral stripes along body and one stripe along dorsal fin; MVF H-97-160; total vertebrae 155–167 (n = 25).

SIZE. — Reported to 1724 mm by Cervigón (1973); the largest observed by McCosker et al. (1989) was 871 mm.

ETYMOLOGY. — From the Latin *bilinearis* (two-lined), an adjective.

DISTRIBUTION. — An insular species, widespread throughout the tropical western Atlantic, and the most common species of Atlantic *Callechelys* (McCosker et al. 1989:307). Records include Bermuda, throughout the West Indies, from islands of Central and South America, and from St. Helena and Ascension islands in the mid-Atlantic. Not known from North American coastal waters or from the eastern Atlantic. Captured using rotenone between depths of 1–22 m.

REMARKS. — This species is unmistakable in its appearance and would not be mistaken for any of its congeners.

MATERIAL EXAMINED. — A listing of the material examined is in McCosker et al. (1989:307–308); not included was SIO 70-376, 285 mm, from San Blas, Panama, which was captured in 1 m of water, expanding the range of depth of capture reported therein.

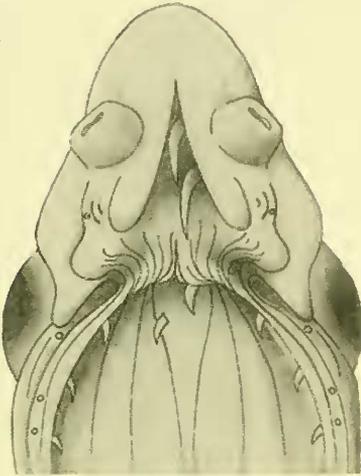
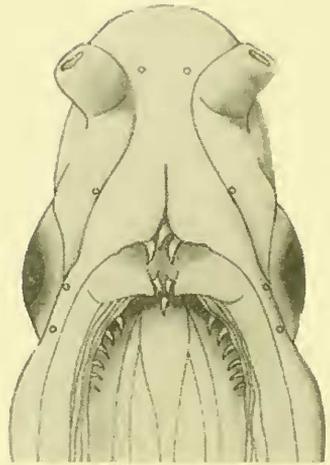
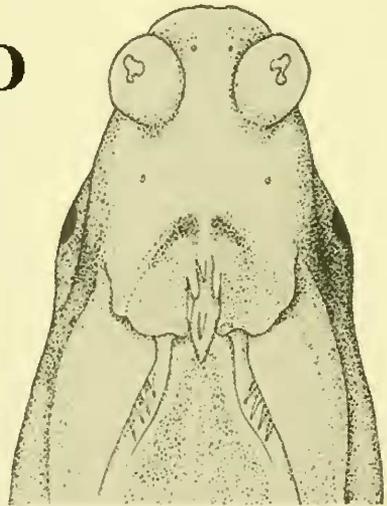
A**B****C****D**

FIGURE 1. Underside of the snouts of: A) *Callechelys catostoma*, CAS 91786, 621 mm; B) *Xestochilus nebulosus*, CAS 92202, 392 mm; C) *Leuropharus lasiops*, SU 57313, 174 mm (from Rosenblatt and McCosker 1970, fig. 8); D) *Aprognathodon platyventris*, ANSP 138770, 244 mm (from McCosker et al. 1989, fig. 289).

***Callechelys bitaeniata* (Peters)**
(Fig. 3; Tables 1, 2, 4)

Ophichthys bitaeniatus Peters 1878:556, unnumbered plate, figs. 2–2a (Mombasa, east Africa, holotype ZMB 10052).

Callechelys bitaeniatus, Storey 1939:68.

Callechelys canaliculatus Smith 1958:836, Pl. 27
(Pinda, Mozambique, holotype RUSI 103).

DIAGNOSIS. — Elongate, body depth 48–60 in TL; head 14.0–16.7 in TL; tail 2.5–2.64 in TL; 2 pairs of fangs on intermaxillary, 3–5 on vomer, maxillary teeth 5–8, dentary 9–10; body color-

TABLE 1. Tail proportion (in thousandths) and vertebral number of the valid species of *Callechelys*.

Species	Tail/TL	Vertebral Range	Vertebral Mean	N
<i>bilinearis</i>	278–385	155–167	160.0	25
<i>bitaeniata</i>	379–400	185–194	189.0	5
<i>catostoma</i>	278–312	192–205	198.6	27
<i>cliffi</i>	417–455	149–158	155.0	14
<i>eristigma</i>	270–312	154–163	158.0	37
<i>galapagensis</i>	435–455	170–174	172.0	4
<i>guineensis</i>	323–345	172–182	178.0	12
<i>leucoptera</i>	435–476	162–165	164.0	4
<i>lutea</i>	357–417	210–219	214.3	8
<i>marmorata</i>	348–356	174–183	180.0	21
<i>muraena</i>	370–400	139–144	142.0	7
<i>papulosa</i>	490	215	—	1
<i>randalli</i>	278–288	220–224	222.0	2
<i>springeri</i>	345–357	168–171	169.0	3

tion pale to milky yellow, overlain on dorsal 2/5 of flank by a wide, dark brown stripe from mid-head to tail, the stripe stopping at the dorsal fin base below a narrow, pale stripe above the base; the remainder of the fin dark brown, darkest at the margin; anal fin pale, the margin of males irregularly dusky in the anterior 2/3 of its length; MVF H-109-189.0; total vertebrae 185–194 (n = 5).

SIZE. — The largest reported specimen is 820 mm (Smith 1958, 1962), a male from Pinda, Mozambique.

ETYMOLOGY. — From the Latin *bitaeniata* (two-striped), an adjective.

DISTRIBUTION. — From Mozambique, Kenya, and Aldabra Atoll.

REMARKS. — Smith (1958)¹ described *Callechelys canaliculatus* on the basis of five adult specimens from east Africa, and later (1962), after having compared them to Peters' type, placed it in the synonymy of *C. bitaeniata*. I, too, have examined the type of *O. bitaeniatus* and some of Smith's specimens of *C. canaliculatus* (including a radiograph of the type), and after examining the vertebral counts of those specimens, agree with his action. The striped appearance of *C. bitaeniata* might cause it to be mistaken for *C. catostoma* or *C. randalli*; how-

ever, both are very different in their dentition and body proportions.

MATERIAL EXAMINED. — ZMB 10052, 311 mm, Mombasa, the holotype of *Ophichthys bitaeniatus*. RUSI 103, 780 mm, the holotype of *Callechelys canaliculatus* (examined only from a radiograph), Mozambique, Pinda. RUSI 5217, 2(760–764 mm), Mozambique, Pinda. RUSI 31804, 565 mm (tail broken and regrown, head and trunk length 360 mm), Mozambique, Bazaru.

Callechelys catostoma (Forster) (Figs. 1a, 4; Tables 1–4)

Sphagebranchus catostomus Forster in Bloch and Schneider 1801:536, based on Forster manuscript (Tahiti, no types known; neotype CAS 91793).

Callechelys melanotaenia Bleeker 1864:66 (Amboina, holotype RMNH 7180).

Callechelys melanotaenia Bleeker 1865:pl. 193, fig. 2.

Ophichthys melanotaenia, Günther 1870:87.

Leptenchelys pinnaceps Schultz in Schultz et al. 1953:79, fig. 16 (Bikini Atoll, holotype USNM 141691).

Callechelys striatus Smith 1958:838, pl. 27, fig. c (Baixo Pinda, Mozambique, holotype RUSI 96).

Callechelys catostomus, Randall and Wheeler 1991:761.

¹Smith's 1958 publication, cited as 1957 by all subsequent authors, was published on 23 April 1958.

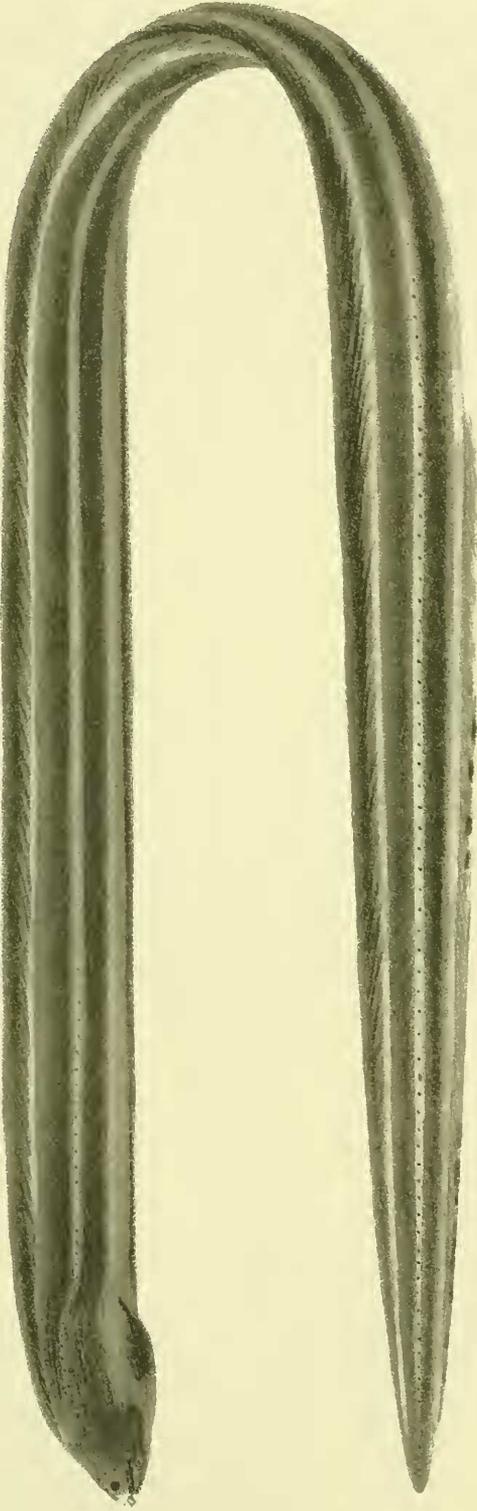


FIGURE 2. *Callecheilus bilinearis*, ANSP 98336, 760 mm (from McCosker et al. 1989, fig. 291).

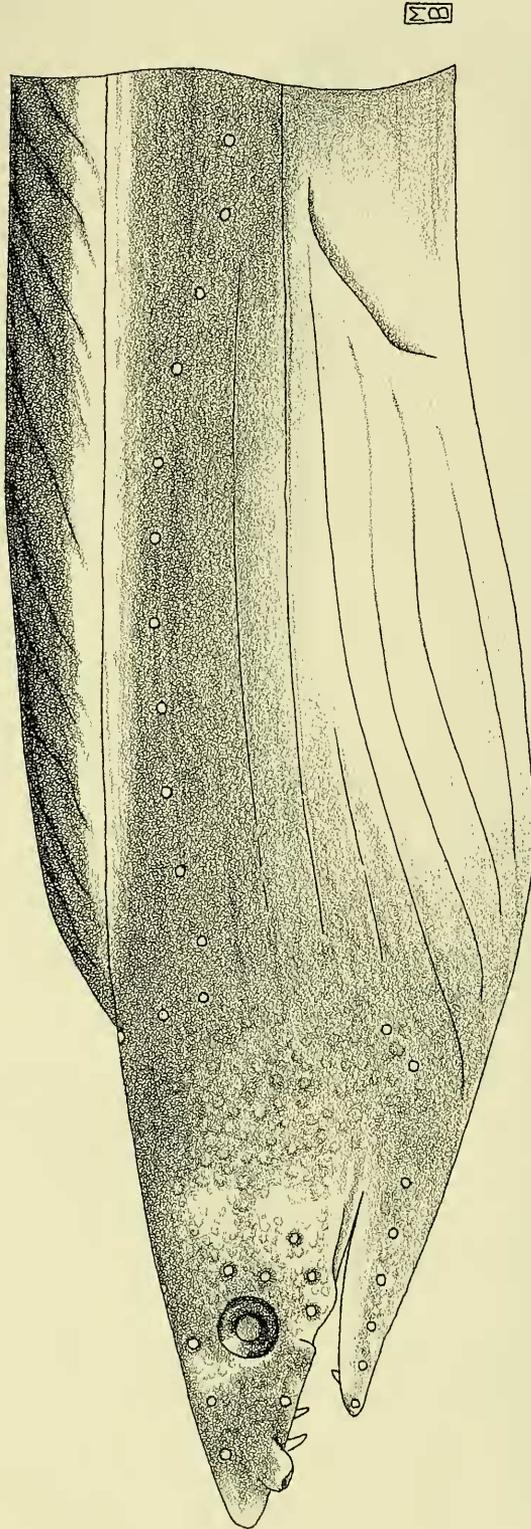


FIGURE 3. *Callechelys bitaeniata*, RUSI 31804, 565 mm (tail tip broken and regrown).

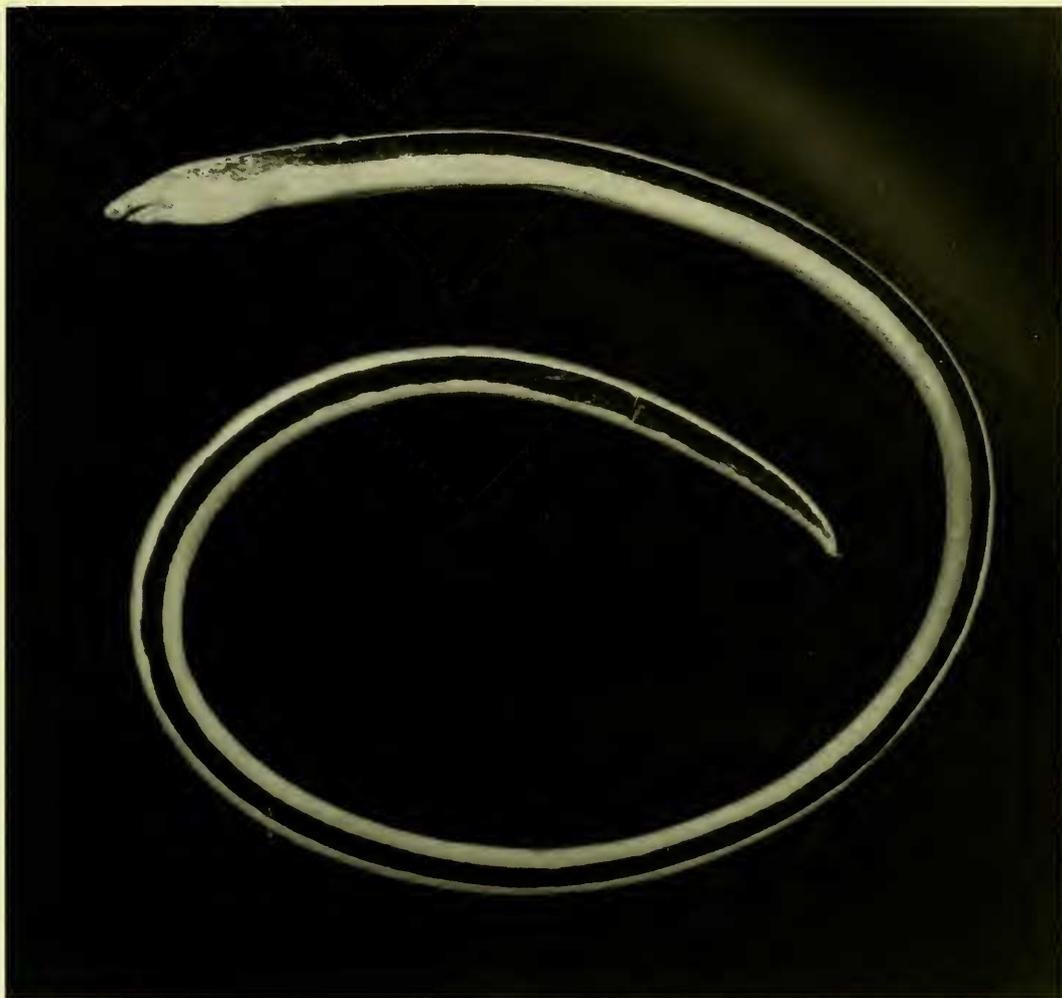


FIGURE 4. *Callechelys catostoma*, BPBM 10190, 520 mm. Photograph by J. E. Randall.

DIAGNOSIS. — Very elongate, body depth 48–73 in TL; head 19 in TL; tail 3.2–3.6 in TL; teeth recurved, 2 (rarely 3 or 4) large anterior intermaxillary fangs within groove between anterior nostrils, maxillary 4–6, dentary 8–10; ethmoidal pore absent; skin of throat and vent area with prominent longitudinal grooves; a small but conspicuous barbel between anterior and posterior nostrils; coloration cream-colored, with a prominent dark brown or black band along back from head to near tail tip, the band beginning at lateral line and extending to dorsal fin base, the ventral surface and median fins pale, except for thin dark median edge of dorsal; cephalic pores within brown spots, those over branchial basket

often within pale spots; MVF H-130-199; total vertebrae 192–205 ($n = 27$).

SIZE. — To 770 mm.

ETYMOLOGY. — From the Greek Κάτω (inferior) and στόμα (mouth).

DISTRIBUTION. — Widespread in the tropics from Hawaii, Polynesia and the Phoenix islands throughout Oceania, south to Lord Howe and north to the Ryukyus in the western Pacific, across the Indian Ocean to east Africa and the Red Sea. It is found from shallow sand habitats to a depth of 32 m.

My taxonomic decisions, as well as the discovery of additional specimens, has considerably expanded the range of this species. The Hawaiian

TABLE 2. Vertebral counts of holotypes of valid species of *Callechelys* and their synonyms.

Species	Preanal	Total
<i>Callechelys bilinearis</i>	98	163
<i>Ophichthys bitaeniatus</i>	107	185
<i>Callechelys canaliculatus</i>	106	194
<i>Callechelys catostoma</i> ¹	127	197
<i>Callechelys melanotaenia</i>	134	207
<i>Leptenchelys pinnaceps</i>	—	204
<i>Callechelys striatus</i>	128	196
<i>Callechelys cliffi</i>	80	155
<i>Callechelys eristigma</i>	105	159
<i>Callechelys galapagensis</i>	92	172
<i>Ophichthys guineensis</i>	119 ²	186
<i>Caecula pantherina</i>	—	179
<i>Callechelys perryae</i>	114	177
<i>Callechelys luteus</i>	123	216
<i>Dalophis marmorata</i>	107	174
<i>Callechelys guichenoti</i>	110	183
<i>Callechelys muraena</i>	80	141
<i>Callechelys papulosa</i>	126	215
<i>Callechelys randalli</i>	147	220
<i>Gordichthys springeri</i>	105	171
<i>Cryptoperygium holochroma</i>	108	168

¹ Neotype, designated herein

² Preanal count based on lateral line pores

record is the first for that archipelago and is based on BPBM 29292, a 412 mm male with vivid coloration, normal dentition, and H-123-193 vertebrae. It was caught by J. E. Randall and party using rotenone over sand in 32 m.

REMARKS. — A color photograph of *C. catostoma* appears in Randall et al. (1990:44).

The 91 mm-long specimen (CAS 91791) from Kapingamirangi is a just-transformed juvenile. It lacks dentition. Having been in isopropyl alcohol for 43 years, it is now pale yellow throughout except for numerous patches of dark pigmentation, about equal in size to its orbit and which it has retained from its larval condition. There are eight equally-spaced, stellate patches along the ventral midline from behind the gill openings to before the anus. Beginning approximately 3/4 head length behind the anus, there are four pairs of equally-spaced patches located about midway between the lateral line and the anal fin.

The taxonomy of this colorful Indo-Pacific species is fraught with complications, exemplified by the four nominal species that I have united herein. I have examined a large series of this form, ranging from Hawaii to the Red Sea, including all of the type specimens of the nominal species. Whereas a modest range in vertebral number exists from east to west (Table 3), that difference is proportionally small. I can find no other characters that would indicate differences among populations.

Wheeler (1981) and Randall and Wheeler (1991), based on Whitehead's (1978) description of Forster's watercolor of a striped eel from Tahiti, recognized Schneider's (in Bloch and Schneider 1801) description of *Sphagebranchus catostomus* as the senior synonym of *Callechelys melanotaenia* Bleeker (1864). Bleeker described *melanotaenia* in an 1864 fascicle of his serially published *Atlas Ichthyologique* and redescribed it in 1865(a). The illustrations appeared in an 1865(b) fascicle of the *Atlas* (cf. Boeseman 1983:4). Confusion exists about a possible syntype of *C. melanotaenia* ascribed by Günther (1870:71) to be the type. Bleeker did not mention the specimen that is now in the British Museum collection (BMNH 1867.11.28.291, 481 mm), and I agree with Storey (1939) who suspected that the unique holotype is within the Leiden Museum collection (RMNH 7180, 516 mm). Bleeker's holotype of *melanotaenia*, as illustrated in the *Atlas*, differed from the norm in its dentition. It typically has flanking pairs, rather than the single pair, of recurved intermaxillary fangs, which are unique to this species and *C. randalli* (see Figs. 1a, 12a). (The British Museum specimen, also from Ambon, has the normal dental condition.)

Smith (1958) described *Callechelys striatus* from the western Indian Ocean, noting that it had but a single pair of intermaxillary fangs; he presumed that Klunzinger's (1871:612) mention of *Ophichthys melanotaenia* from the Red Sea was also *striatus* in that it had only two large fangs. Smith assumed that *melanotaenia* was restricted to the eastern Indian and Pacific oceans based on Bleeker's (1865b, pl. 193, fig. 2, erroneously cited as fig. 1 in the text) illustration of the dentition of the four-toothed Ambon specimen and Schultz's (1943, fig. 2f) illustration of a specimen from Canton Island, central Pacific, as having three intermaxillary teeth (reproduced by

TABLE 3. Total vertebral counts of specimens of *Callechelys catostoma*.

Location	Range	Mean	N
Hawaii	193	—	1
Palmyra Id. (Line Is.)	199–201	200.0	2
Tahiti (Society Is.)	195–201	198.0	4
Enewetak (Marshall Is.)	204	—	1
Lord Howe Id.	193	—	1
Escape Reef (Coral Sea)	197	—	1
Palau Is.	196–205	200.5	6
Ishigaki Id. (Ryukyu Is.)	203	—	1
Ambon Id. (Indonesia)	200–205	202.5	2
Diego Garcia (Chagos)	198	—	1
Aldabra/Seychelles	195–203	197.3	6
Eilat (Red Sea)	192	—	1
All localities	192–205	198.6	27

Schultz in 1953, as fig. 11f, to indicate the dentition of Enewetak specimens). David Smith has examined Schultz's Canton Island specimen (USNM 115939) and advised me that it (and all other *C. "melanotaenia"* in the USNM collection) has but a single pair of intermaxillary fangs. I have examined 67 specimens of Red Sea, Indian and Pacific Ocean specimens of *C. catostoma* and have found seven individuals (some from within large collections of 2-fanged conspecifics) with more than a single pair, indicating that such occasional variation does occur. For the reasons stated above, *Callechelys striatus* Smith (1958) is also considered to be a junior synonym of *C. catostoma*.

McCosker (1970) placed *Leptenchelys pinnaceps* Schultz (1953), based on juvenile specimens from the Marshall Islands, in the synonymy of *C. melanotaenia*; it is herein included in *C. catostoma*.

In that the type specimen of *Sphagebranchus catostomus* does not exist (Wheeler 1981), I herein designate CAS 91793 to be the neotype of *Callechelys catostoma*. It is an adult female with developing ova (ca. 0.7 mm diameter), in excellent condition, and from the locality of the holotype. It has a single pair of recurved intermaxillary fangs, vertebral formula H-127-197, the normal composition of cephalic pores for this species, typical coloration, and the following measurements (in mm): TL 471; head length 26.9; trunk length 304.1; tail length 140;

dorsal fin origin 8.8; length of snout 3.5; upper jaw length 8.2; eye diameter 1.5; and body depth behind gill openings 8.

MATERIAL EXAMINED. — NEOTYPE: CAS 91793, 471 mm, SOCIETY ISLANDS, Tahiti, Moorea, lagoon between Papetaoi and Paopao bays (field number GVF 1170), collected over sand in 0–1.3 m using rotenone by J. E. Randall on 28 August 1956. RMNH 7180, 516 mm, holotype of *Callechelys melanotaenia*, Amboina. BMNH 1867.11.28.291, 481 mm, incorrectly called the type or a syntype of *Callechelys melanotaenia*, Amboina. RUSI 96, 473 mm, holotype of *Callechelys striatus*, Mozambique. MARSHALL ISLANDS — USNM 141691, 97 mm, the holotype of *Leptenchelys pinnaceps*, Bikini Atoll. HAWAII — BPBM 29292, 412 mm, Hawaii, off Kailua. POLYNESIA — CAS 91797, 560 mm; CAS 91794, 4(332–496 mm), collected with the neotype, Tahiti. BPBM 12017, 164 mm, Moorea. PHOENIX ISLANDS — BPBM 3542, 595 mm; BPBM 12502, 550 mm, Palmyra Island. GILBERT ISLANDS — AMS IA.18055, 9(300–470 mm), Betio Island. PALAU — CAS 91796, 6(335–503 mm), Agulpelu Reef. CAS 28686, 28(70–540 mm), Chol Island. CAS 91785, 2(383–538 mm), Babelthaup Island. CAS 91789, 2 (200–454 mm), Taprakl Reef. CAS 91795, 420 mm, Ngaruagl Reef. CAS 91792, 295 mm, Kayangel. BPBM 10190, 3(520–548 mm), Bairakaseru. CAROLINE ISLANDS — CAS 91786, 621 mm, Ifaluk Atoll.

TABLE 4. Status of the nominal species of *Callechelys*. Sources are: 1. This study, 2. McCosker et al. 1989, 3. Smith 1962, 4. Randall and Wheeler 1991, 5. McCosker and Rosenblatt 1972, 6. Storey 1939, 7. McCosker 1977, 8. Blache et al. 1979, 9. Blache and Cadenat 1971, 10. McCosker 1979, 11. McCosker 1970.

Nominal Species	Current Status	Source
<i>Callechelys bilinearis</i> Kanazawa 1952	<i>Callechelys bilinearis</i>	2
<i>Ophichthys bitaeniatus</i> Peters 1878	<i>C. bitaeniata</i>	1
<i>Callechelys canaliculatus</i> Smith 1958	<i>C. bitaeniata</i>	1, 3
<i>Sphagebranchus catostomus</i> Forster 1801	<i>C. catostoma</i>	1, 4
<i>Callechelys cliffi</i> Böhlke and Briggs 1954	<i>C. cliffi</i>	1
<i>Callechelys eristigmus</i> McCosker and Rosenblatt 1972	<i>C. eristigma</i>	1
<i>Callechelys galapagensis</i> McCosker and Rosenblatt 1972	<i>C. galapagensis</i>	1
<i>Callechelys guichenoti</i> Kaup 1856	<i>C. marmorata</i>	5, 7
<i>Callechelys fijiensis</i> Seale 1935	<i>Bascanichthys fijiensis</i>	6
<i>Ophichthys (Sphagebranchus) guineensis</i> Osorio 1894	<i>C. guineensis</i>	2, 8
<i>Cryptopterygiium holochroma</i> Ginsburg 1951	<i>C. springeri</i>	2
<i>Caecula leucoptera</i> Cadenat 1954	<i>C. leucoptera</i>	9
<i>Callechelys longissimus</i> Cadenat and Marchal 1963	<i>Phaenomonas longissima</i>	2
<i>Callechelys luteus</i> Snyder 1904	<i>C. lutea</i>	1, 10
<i>Callechelys maculata</i> Chu, Wu and Jin 1981	<i>Yirrkala? maculata</i>	1
<i>Dalophis marmorata</i> Bleeker 1853	<i>C. marmorata</i>	1, 5
<i>Callechelys melanotaenia</i> Bleeker 1864	<i>C. catostoma</i>	1, 4
<i>Callechelys muraena</i> Jordan and Evermann 1887	<i>C. muraena</i>	2
<i>Callechelys myersi</i> Herre 1932	<i>Bascanichthys myersi</i>	6
<i>Callechelys nebulosus</i> Smith 1962	<i>Xestochilus nebulosus</i>	1
<i>Caecula pantherina</i> Cadenat 1956	<i>C. guineensis</i>	2, 8
<i>Callechelys papulosa</i> new species	<i>C. papulosa</i>	1
<i>Callechelys perryae</i> Storey 1939	<i>C. guineensis</i>	2, 8
<i>Callechelys peninsulæ</i> Gilbert 1892	<i>Myrichthys xysturus</i>	6, 7
<i>Leptenchelys pinnaceps</i> Schultz 1953	<i>C. catostoma</i>	4, 11
<i>Callechelys randalli</i> new species	<i>C. randalli</i>	1
<i>Callechelys sibogae</i> Weber 1913	<i>Bascanichthys sibogae</i>	1
<i>Gordiichthys springeri</i> Ginsburg 1951	<i>C. springeri</i>	2
<i>Callechelys striatus</i> Smith 1958	<i>C. catostoma</i>	1

CAS 80993, 495 mm; CAS 91790, 4(280–410 mm); CAS 91788, 2(325–385 mm); CAS 91787, 2(367–540 mm); CAS 91791, 4(91–497 mm), Kapingamirangi Atoll. TIMOR SEA — CAS 29138, 2 tails only, from the stomachs of sea snakes, Ashmore Reef. AUSTRALIA — AMS IA.22631-036, 4(98–590 mm), Queensland, Escape Reef. I.15564, adult (head and trunk), from the stomach of a lethrinid (*Lethrinus chrysostomus*), Queensland, Fairfax Island. AMS IA.3252, 770 mm; I.5193, 475 mm, Lord Howe Island. CHAGOS ARCHIPELAGO — USNM 313851, 270 mm, Diego Garcia Atoll. ALDABRA ATOLL — USNM 313852, 4(307–393 mm). RED SEA — SIO 71-165, 425 mm, Eilat.

***Callechelys cliffi* Böhlke and Briggs**
(Fig. 5; Tables 1, 2, 4)

Callechelys cliffi Böhlke and Briggs 1954:275 (Gulf of California, Fraile Bay; holotype CAS-SU 47521).

DIAGNOSIS. — Moderately elongate, body depth 19–31 in TL; head 9–13 in TL; tail 2.2–2.4 in TL; maxillary teeth 7–8, dentary teeth 14–16; coloration tan with numerous fine brown spots on head, body and fins; median fins with white margins; MVF H-85-155; total vertebrae 149–158 (n = 14).

SIZE. — The largest specimen reported by McCosker and Rosenblatt (1972) was 455 mm.

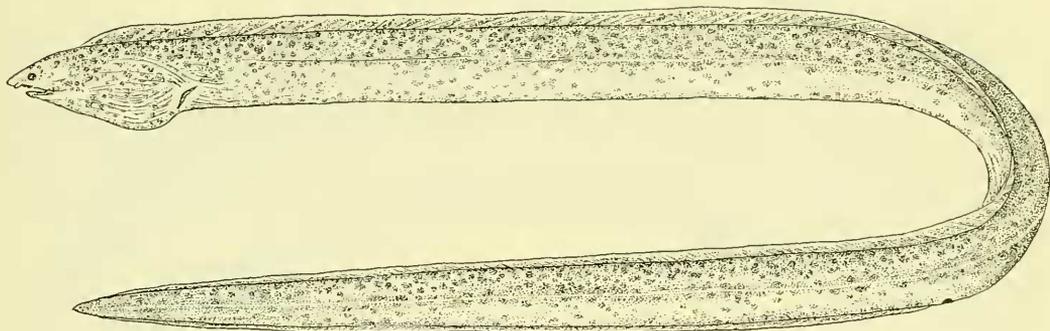


FIGURE 5. *Callechelys cliffi*, SIO 62-42, 455 mm (from McCosker and Rosenblatt 1972, fig. 4).

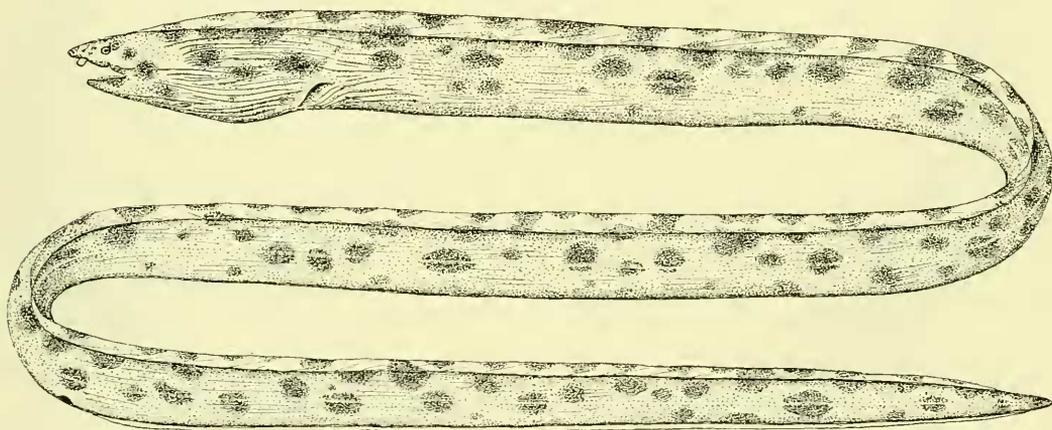


FIGURE 6. *Callechelys eristigma*, SIO 65-263, 503.5 mm (from McCosker and Rosenblatt 1972, Figs. 1a).

ETYMOLOGY. — Named for Frank S. Cliff, who captured the type specimen; treated as a noun in the genitive case.

DISTRIBUTION. — Known from the Gulf of California, Mexico, to the Gulf of Panama. All specimens were either dip-netted at the surface under night lights or collected with ichthyocides over sand bottoms to 30 m depth.

REMARKS. — A color photograph of *C. cliffi* appears in Allen and Robertson (1994:52).

MATERIAL EXAMINED. — A listing of the material examined is in McCosker and Rosenblatt (1972:22), as well as additional specimens from the Perlas Archipelago of the Gulf of Panama: USNM 318277, 105 mm, Isla San Jose; USNM 318293, 349 mm, Isla del Rey.

Callechelys eristigma McCosker and Rosenblatt
(Fig. 6; Tables 1, 2, 4)

Callechelys eristigma McCosker and Rosenblatt 1972:16, fig. 1 (Gulf of California, Isla San Jose, holotype SIO 65-263).

DIAGNOSIS. — Very elongate, body depth 38–52 in TL; head 12–15 in TL; tail 3.2–3.7 in TL; maxillary teeth 5–6, dentary teeth 6–7; coloration mostly cream, overlain with numerous dark spots that extend on to dorsal fin, anal fin pale; MVF H-105-158; total vertebrae 154–163 ($n = 37$).

SIZE. — The largest specimen recorded by McCosker and Rosenblatt (1972) was 1126 mm.

ETYMOLOGY. — From the Greek ερι (very) and στίγμα (spot), regarded as an adjective.

DISTRIBUTION. — Known from the Gulf of California, Mexico, to the Gulf of Chiriqui, Panama, and the Cocos Islands, generally over a sand and rock bottom at 5–25 m.

MATERIAL EXAMINED. — A listing of the material examined is in McCosker and Rosenblatt (1972:18).

***Callechelys galapagensis* McCosker and Rosenblatt**
(Fig. 7; Tables 1, 2, 4)

Callechelys galapagensis McCosker and Rosenblatt 1972:18, fig. 3 (Galápagos Islands, Isla Santa Cruz, holotype SIO 72-1, formerly UCLA 64-39).

Callechelys marmoratus, nec Bleeker, Fowler 1932:3. Fowler 1938:251.

Callechelys luteus, nec Snyder, Storey 1939:69.

DIAGNOSIS. — Moderately elongate, body depth 26–38 in TL; head 12–14.5 in TL; tail 2.2–2.3 in TL; maxillary teeth 7–8, dentary teeth 15–17; mostly cream-colored, overlain with numerous dark oblong markings that vary in length from size of eye to upper jaw, spots extending onto fin, spots smaller and more densely aggregated in anterior head region, the ventral and dorsal surface more spotted than the flanks; MVF H-91-172; total vertebrae 170–174 (n = 4).

SIZE. — The largest specimen reported by McCosker and Rosenblatt (1972) was 818 mm, the holotype.

ETYMOLOGY. — Named for the type locality.

DISTRIBUTION. — Known only from the Galápagos Islands, from tidepools to 10 m depth.

REMARKS. — The smallest paratype (248 mm) of *C. galapagensis* differed in coloration from that of the larger specimens in having a chocolate brown background coloration, although the general spotting was similar.

MATERIAL EXAMINED. — A complete listing of the material examined is in McCosker and Rosenblatt (1972:20).

***Callechelys guineensis* (Osorio)**
(Fig. 8; Tables 1, 2, 4)

Ophichthys (Sphagebranchus) guineensis Osorio 1894:179 (Ile de Sao Tome, Cape Verde Islands, neotype MNHN B.1635).

Callechelys perryae Storey 1939:71, figs. 2, 4 (Sanibel Island, Florida, holotype CAS-SU 33027).

Caecula pantherina Cadenat 1956:1267, fig. 1 (Sénégal, holotype MNHN B.1635)

Callechelys pantherina, Cadenat 1961:235.

Callechelys guineensis, Blache, Bauchot and Saldanha 1979:97 (*C. perryae* and *C. pantherina* synonymized with *C. guineensis*, holotype of *Caecula pantherina* designated as the neotype of *Ophichthys guineensis*).

DIAGNOSIS. — Elongate, body depth 45–59 in TL; head 15–18 in TL; tail 2.9–3.1 in TL; maxillary teeth 4–5, 9–11 on dentary; coloration cream to tan overlain with numerous dark brown spots and blotches; MVF H-115-178; total vertebrae 172–186 (n = 12).

SIZE. — The largest reported specimen is 1080 mm (Blache et al. 1979).

ETYMOLOGY. — Named for the type locality, a former Portuguese colony.

DISTRIBUTION. — Apparently widely distributed throughout the tropical Atlantic from shallow water to a depth of 15 m, but infrequently taken (McCosker et al. 1989). In the western Atlantic, it is known from eastern and western Florida, Puerto Rico, the Bahamas, St. Barthelemy, and possibly Venezuela. In the eastern Atlantic it is known from Sénégal and the Cape Verde Islands.

REMARKS. — McCosker et al. (1989:309) cautiously recognized *Callechelys springeri* as distinct from *C. guineensis* on the basis of its lower total and preanal vertebral counts. The coloration of *C. guineensis* is somewhat variable, particularly in spot size, as illustrated by Böhlke and Chaplin (1968:108). The leptocephalus of *C. guineensis* was described by Leiby (1989).

MATERIAL EXAMINED. — A complete listing of the material examined is in McCosker et al. (1989:309–310).

***Callechelys leucoptera* (Cadenat)**
(Fig. 9; Tables 1, 2, 4)

Caecula leucoptera Cadenat 1954:241, fig. 2 (Sénégal, Isle de Gorée, lectotype MNHN 1964-527).

Callechelys leucoptera, Cadenat 1961:235.

Callechelys leucoptera, Blache and Cadenat 1971:192 (lectotype established).

DIAGNOSIS. — Very elongate, body depth 53–62 in TL; head 13–14 in TL; tail 2.1–2.3 in TL; maxillary teeth 6, dentary 10; body uniform

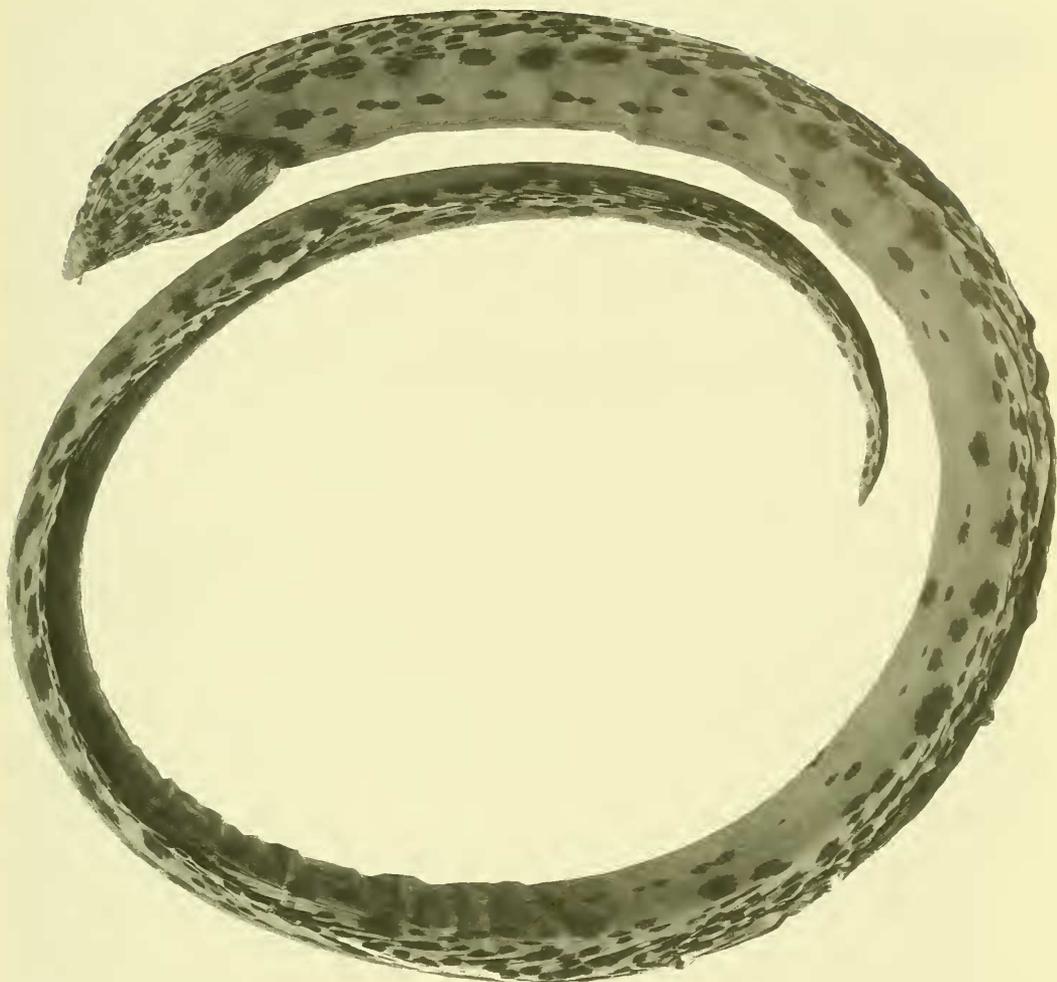


FIGURE 7. *Callechelys galapagensis*, UCLA 64-40, 767 mm (from McCosker and Rosenblatt 1972, fig. 3a).

brown to black, snout and chin paler, fins colorless; total vertebrae 162–165, mean = 164 ($n = 4$).

SIZE. — The largest specimen reported (Blache and Cadenat 1971) is 730 mm TL.

ETYMOLOGY. — From the Greek λευκός (white), and Πτερόν (fin).

DISTRIBUTION. — Eastern Atlantic, from Sénégal to the Ivory Coast. Blache and Cadenat (1971:199) suggest that it lives in shallow water to depths of 45 m, in that several specimens were taken from the stomachs of a grouper (*Epinephelus aeneus*) and a ray (*Rhynchobatus lubberti*).

MATERIAL EXAMINED. — MNHN 1964-527, 545 mm, the lectotype, from Gorée, Sénégal.

***Callechelys lutea* Snyder**
(Pl. 1; Tables 1, 2, 4)

Callechelys luteus Snyder 1904:517, pl. 3, fig. 5 (Hawaiian Islands, south coast of Molokai Island, holotype USNM 50864).

Ophichthys marmorata, nec Bleeker, Günther (1910:404).

Callechelys marmoratus, nec Bleeker, Fowler (1928:43).

DIAGNOSIS. — Elongate, depth 38–53 in TL; head 13–18 in TL; tail 2.4–2.8 in TL; maxillary teeth 5–6, dentary teeth 8–10; coloration yellow to cream, overlain with numerous yellow, and brown to dark brown spots between size of eye

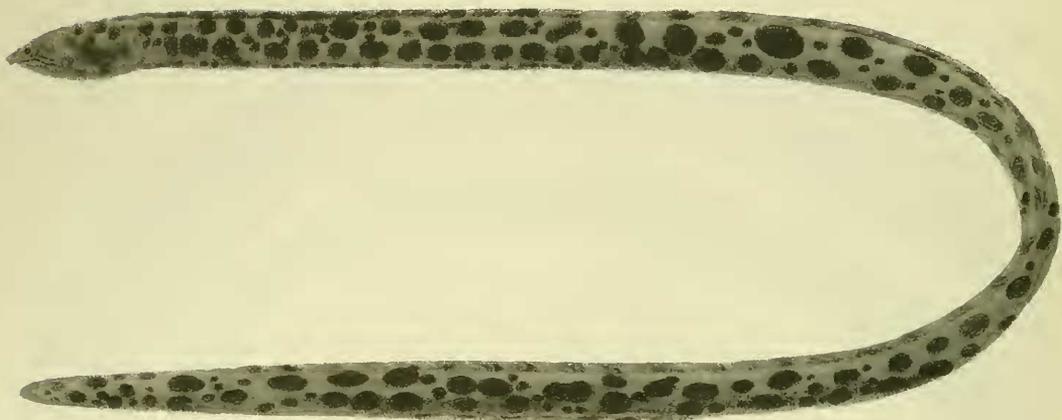


FIGURE 8. *Callechelys guineensis*, ANSP 98333, 722 mm (from McCosker et al. 1989, fig. 295).

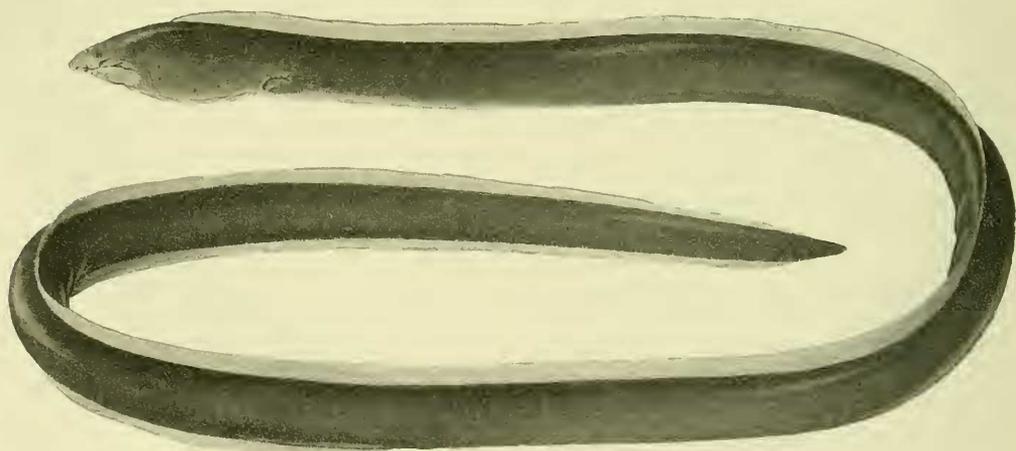


FIGURE 9. *Callechelys leucoptera*, IFAN 61-19, 730 mm (from Blache and Cadenat 1971, fig. 26).

and upper jaw, spotting extends onto dorsal fin, but ventral surface and anal fin pale; spotting of large adults becomes very dense as freckles on head (cf. Randall 1996:34); MVF H-124-214; total vertebrae 210–219 ($n = 8$).

SIZE. — The largest specimen examined was 1038 mm. Randall (1996:34 and pers. comm.) photographed the head of a large adult at 24 m off Molokini, the proportions of which indicate that the specimen was approximately 1.5 m in length.

ETYMOLOGY. — From the Latin *luteus* (yellow).

DISTRIBUTION. — Known only from the Hawaiian Islands, Midway Island (McCosker 1979:63), and French Frigate Shoals.

REMARKS. — It appears that after larval settlement, adults of most *Callechelys* spend most of their lives within the sediment. They do not form permanent burrows, as do heterocongrids and some ophichthins, but rather move through the interstitial habitat. *Callechelys lutea* is exceptional and has on rare occasions been dip-netted beneath lights at the sea surface at night and has been seen with its head protruding from the sand by divers at various Hawaiian locations (J. E. Randall, pers. comm.).

During my only diving experience (16 May 1993) at Molokini Island (20°37'N, 156°30'W), a small collapsed caldera 5 km west of Maui Island, I observed two individuals at 15 m over the sand bottom of the crater. One was much darker than the other and was extended approxi-

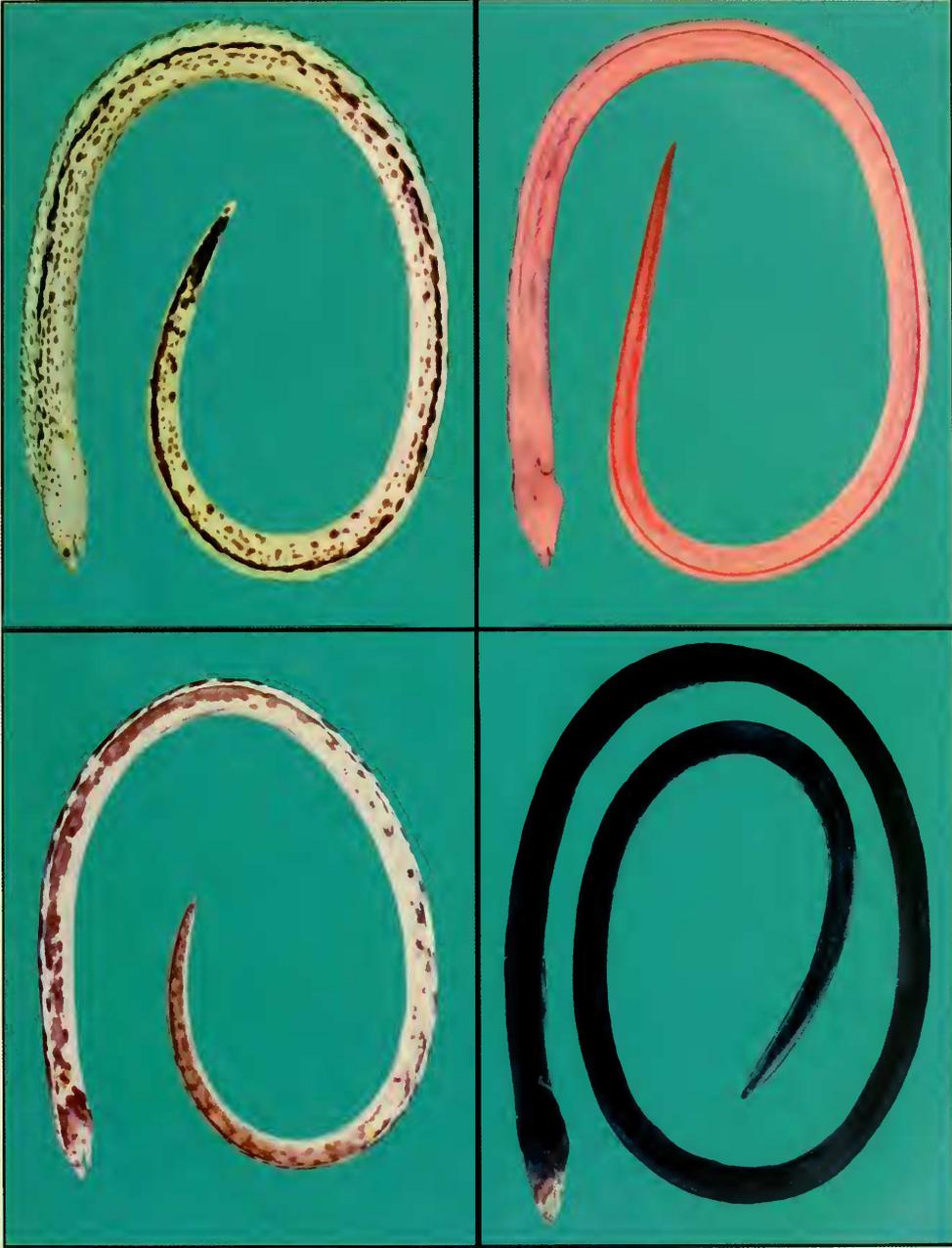


PLATE 1. Top left) *Callecheilus lutea*, BPBM 36873, 353 mm; top right) *Callecheilus marmorata*, BPBM 34700, 316 mm; lower left) Holotype of *Callecheilus papulosa* n. sp., BPBM 36290, 551 mm; lower right) *Xestochilus nebulosus*, BPBM 29234, 356 mm. All photographs by J. E. Randall.

mately 15 cm from the sand. Its dorsal fin was elevated and it was nervously flapping its lower jaw at the lighter specimen, which was extended on to the level of its gill openings, and was, in like manner, flapping its jaw. The interaction went on for several minutes, but I was unable to determine its significance. Ed Robinson (in litt. to the author, 14 April 1997), a professional dive tour operator who has made many dives at Molokini during the last 20 years, relates that

Most of the time I find them very shy, and quick to withdraw into the sand. They do seem to be social, since I have often observed small individual(s) in close proximity (within 12") of a larger individual, and large individuals within a few feet of each other. They don't seem to establish permanent burrows since I have rarely found them in the same place two days in a row . . . they move backwards under the sand, rather quickly, I might add.

MATERIAL EXAMINED. — USNM 50864, 830 mm, the holotype, Hawaiian Islands, south coast of Molokai Island. HAWAII — BPBM 7965, 585 mm, Hawaii, Kona coast. BPBM 8166, 440 mm, Oahu, Kaena Point. BPBM 12381, 680 mm, Oahu, Coconut Island. BPBM 36873, 2(132–353 mm), Oahu, Makua. CAS 13978, 2(480–491 mm); CAS 33488, 190 mm, Oahu, Waikiki. UH 959 (now at BPBM), 565 mm, Oahu, Kaneohe Bay. FRENCH FRIGATE SHOALS — LACM 47321-1, 3(515–645), S of East Id. MIDWAY ISLAND — SIO 68-497, 1038 mm.

***Callechelys marmorata* (Bleeker)**
(Pl. 1; Tables 1, 2, 4)

Dalophis marmorata Bleeker 1853a:247 (Siboga, Sumatra, holotype BMNH 1867.11.28.260).
Sphagebranchus? marmoratus, Kaup 1856b:26.
Callechelys Guichenoti Kaup 1856b:28, fig. 13 (Tahiti, holotype MNHN 2126).
Ophichthys marmoratus, Günther 1870:88.
Callechelys marmoratus, Bleeker 1864:66.

DIAGNOSIS. — Elongate, depth 37–50 in TL; head 13.4–16.3 in TL; tail 2.66–2.87 in TL; a prominent fleshy ridge from middle of snout to base of dorsal fin; a pair of stout teeth at intermaxillary, surrounded by papillae; jaw teeth minute, 8–10 in maxillary, 12–16 on dentary; vomerine teeth neatly biserial, 3–4 pairs followed by 1 or 2 single smaller teeth; body col-

oration yellowish white to cream in life, overlain by chocolate to black spots on body and fins; in preservative, cream to tan, overlain with large dark blotches, coalesced ventrally and in tail region (particularly in larger specimens); head with smaller, eye-sized spots and freckles on chin; fins with black spots onto bases, their margins black nearly throughout; MVF H-109-180; total vertebrae 174–183 (n = 21).

SIZE. — The largest known specimen is the type, approximately 860 mm in length. Its broken jaw suggests that it was taken by a fisherman with hook and line. Winterbottom et al. (1989:12, fig. 51) report on a 767 mm specimen taken with a spear in the lagoon at the Chagos Archipelago. The largest I examined was 655 mm, a specimen taken from the stomach of a sea snake captured in the Timor Sea. These facts suggest that large individuals of this species, like many species of *Callechelys*, are not easily captured with rotenone ichthyocides.

ETYMOLOGY. — From the Latin *marmoratus* (marbled).

DISTRIBUTION. — Widespread in the Indo-Pacific, from Polynesia to east Africa and the Red Sea (Klausewitz 1969). It is usually collected over sand or sand and rock bottoms using ichthyocides from tidepool depths to 37 m.

REMARKS. — This species is unmistakable in its coloration, in having biserial vomerine dentition, and a notable fleshy ridge between its snout and the origin of its dorsal fin. Smaller fish (25 cm) have a slightly larger head and shorter tail, and generally less dark coloration. A color photograph of the head and anterior trunk of *C. marmorata* appears in Randall et al. (1990:44).

Bleeker twice described *Dalophis marmorata* in 1853. The first (1853a:247) was merely a listing of its body depth and fin formula at the end of his description of *Dalophis moluccensis*. The latter, in his *Bijdrage tot de kennis der Muraenoiden en Symbranchoiden . . .* (1853b:37), provided its complete description and comparison to other species. On the advice of W. N. Eschmeyer, I recognize the earlier work as the original description in that its publication preceded the latter and it satisfies Arts. 11 and 16 of the IUCN.

A large collection of *C. marmorata* made on 29 September 1957 by the George Vanderbilt Foundation (CAS 91808) in Palau provided an opportunity to examine the sexual condition and

gut contents of 62 individuals (225–575 mm). The rotenone collection was made over a sandy bottom with areas of short eel grass. The depth was from 0–1.3 m, the tide was rising, and the area covered was approximately 2,800 m². The field notes suggest that “50% of the biota (was) sampled” and that “ca. 15 species of fishes (were) collected.” Other species in that collection included 35 *Schismorhynchus labialis* and six *Muraenichthys sibogae* (family Ophichthidae), 24 *Synodus variegatus* (Synodontidae), 53 *Diplagrammus goramensis* (Callionymidae), 12 *Trachinotus bailloni* (Carangidae), 4 *Polydactylus sexfilis* (Polynemidae), and single specimens of congrid, labrids, and kraemeriids. Thirty-two of the 62 *C. marmorata* (mean = 423 mm, range = 340–575 mm) were females with developing ova (~ 0.5–1 mm in diameter), 22 (mean = 353, range = 255–440 mm) were male (several were ripe, two were spent), and the gonadal state of the remainder (mean = 254 mm, range = 225–300 mm) was not determined. The condition of the specimens did not allow histological examination of their gonads; however, on the basis of my examination, it appears that females mature at and attain a larger size than do males. At least half of the specimens examined had large concentrations of calcareous algae within their gut cavity. Dissection demonstrated that the algae had previously been consumed by polychaete worms, which were consumed intact by the eels. No other identifiable gut contents were discovered.

MATERIAL EXAMINED. — BMNH 1867.11.28.260, 860 mm, Siboga, Sumatra, the holotype of *Dalophis marmorata*. MNHN 2126, 473 mm, Tahiti, the holotype of *Callechelys Guichenoti*. POLYNESIA — CAS 91804, 486 mm, Tahiti; CAS 13961, 512 mm, Moorea. MARSHALL ISLANDS — CAS 43342, 437 mm; CAS 53746, 8(213–439 mm); CAS 58951, 430 mm; BPBM 29235, 3(160.5–226 mm), Enewetak. GUAM — BPBM 11822, 4(91–117 mm). CAROLINE ISLANDS — CAS 91800, 356 mm; CAS 91806, 459 mm, Yap. CAS 91801, 8(398–575 mm), Ifaluk Atoll. CAS 91805, 2(325–452 mm), Kapingamirangi. FIJI — USNM 259668, 2(353–393 mm). PALAU — CAS 91803, 545 mm, Aulup-tagel Island. CAS 91802, 2(490–530 mm), Babelthaup Island. CAS 91799, 14(125–595 mm); CAS 91789, 4(160–392 mm), Kayangel Atoll. CAS 91807, 63(108–485 mm), Chol Island.

CAS 91808, 62(225–575 mm), Agulpelu Reef. AUSTRALIA — AMS IA 34318-027, 280 mm, Queensland, Townshead Island. AMS IA 939, 465 mm, Lord Howe Island. TIMOR SEA — CAS 29137, 655 mm, Ashmore Reefs. MALDIVES — BPBM 34700, 316 mm. CHAGOS ARCHIPELAGO — USNM 313842, 565 mm, Diego Garcia Atoll. ALDABRA ATOLL — RUSI 5220 (x-ray only); RUSI 5223 (x-ray only). MOZAMBIQUE — RUSI 5218 (x-ray only). RED SEA — USNM 313825, 420 mm, Israel, Ras Burqua.

***Callechelys muraena* Jordan and Evermann**
(Fig. 10; Tables 1, 2, 4)

Callechelys muraena Jordan and Evermann 1887:466
(Snapper Banks, Florida, holotype USNM 37966).

DIAGNOSIS. — Moderately elongate, body depth 27–38 in TL; head 11–14 in TL; tail 2.5–2.7 in TL; maxillary teeth 7–11, dentary 11–19; coloration pale, overlain with numerous eye-sized brown spots and mottling, median fins brown at bases, pale or yellow at margins; MVF H-83-142; total vertebrae 139–144 (n = 7).

SIZE. — A small species; the largest reported by McCosker et al. (1989) was 590 mm.

ETYMOLOGY. — From the Latin *muraena* (moray); treated as a noun in apposition.

DISTRIBUTION. — A rare species, infrequently taken in the western Atlantic between North Carolina and Florida, and from the Gulf of Mexico off northern Florida, and from the Yucatan Peninsula. It has been captured by trawl and by dredge at depths of 27–115 m.

REMARKS. — The leptocephalus of *C. muraena* was described and illustrated by Leiby (1989).

MATERIAL EXAMINED. — A complete listing of the material examined is in McCosker et al. (1989:309–311).

***Callechelys papulosa*, new species**
(Pl. 1; Figs. 11, 12b; Tables 1, 2, 4)

DIAGNOSIS. — Extremely elongate, depth 61 in TL; head 17 in TL; tail 2.7 in TL; maxillary teeth 5, dentary 7; body coloration black, except for white patches behind eye, on jaws and snout; numerous small pits on face; vertebral formula H-126-215.

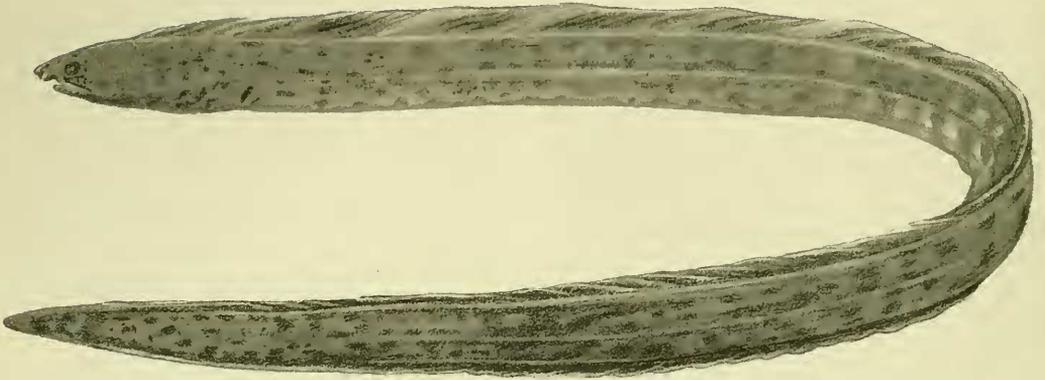


FIGURE 10. *Callechelys muraena*, ANSP 151696, 232 mm (from McCosker et al. 1989, fig. 298).

COUNTS AND MEASUREMENTS OF HOLOTYPE (in mm). — Total length 551; head 32.5; trunk 314.5; tail 204; predorsal distance 10.8; body depth at gill openings 9.0; body width at gill openings 6.0; body depth at anus 8.3; body width at anus 6.3; snout 3.4; tip of snout to rictus of jaw 7.9; tip of snout to tip of lower jaw 2.6; eye diameter 1.4; interorbital distance 2.6; isthmus width 2.2. Vertebral formula H-126-215. Left lateral line pores 208, 12 in branchial region, 126 before anal fin, the last within 3 mm of the tail tip.

DESCRIPTION. — Body extremely elongate, its depth at gill openings 61 in TL, laterally compressed throughout its length, its width behind gill openings 92 in TL, tapering posteriorly to a hard finless point. Head and trunk 1.6 and head 17 in TL. Snout acute, rounded at tip. Lower jaw included, closer to a line drawn from margin of eye than to base of anterior nostrils. Eye small, about equal in diameter to length of anterior nostril tubes, its center above middle of upper jaw. Margin of upper lip slit by posterior nostril which opens into mouth and appears as a short barbel beneath eye. A posterodorsally-directed shallow pocket in upper lip begins in lip behind posterior nostril and extends behind margin of eye. Tip and dorsal surface of snout and chin covered with microscopic hair-like prickles. Lower jaw, cheeks, nape, and dorsal surface of head and branchial basket covered with hundreds of small acne-like round pits (Fig. 11), about equal in size to cephalic pores. Tongue adnate. Branchial basket expanded.

Cephalic (Fig. 11) and lateral line pores obvious, those behind eye and along lower jaw difficult to discern from skin pits. Five mandibular, 2

preopercular, 1 + 3 supraorbital, 4 + 2 infraorbital, and single interorbital and supratemporal pores. Twelve lateral line pores above branchial region, 126 before the anal fin, 208 total.

Teeth small and conical (Fig. 12b). An anterior intermaxillary tooth (the largest), flanked by a single tooth, closely followed by a pair, all within lateral skin folds of the snout; this is followed by a gap, then a patch of 5 irregularly uniserial vomerine teeth. Jaw teeth uniserial and smaller, 7 on each side of maxilla and 9 (with 2 gaps) on right and 11 on the left side of dentary.

Body coloration based on photographs of holotype (Pl. 1) when fresh and specimen in isopropanol. Trunk, tail, and anal fin black. Dorsal fin appears black in preservative, but when elevated the fin appears nearly transparent (except near tail tip), revealing the black underlying fin rays. Anus, isthmus, trailing margin of gill opening, axillary region, snout tip and chin pale white. Tip and lateral edges of lower jaw and patches behind eyes chalky white. A white spot on upper lip in advance of posterior nostril flap.

SIZE. — Known only from the 551 mm holotype, a mature male.

ETYMOLOGY. — From the Latin *papulosa*, meaning blistered or pimples, in reference to its facial condition.

DISTRIBUTION. — Known from Papua New Guinea.

REMARKS. — On the basis of its coloration and pock-marked physiognomy, *C. papulosa* would not be mistaken for any of its congeners. Its uniform black tail, trunk and head, except for the striking white patches behind its eyes, cheeks and chin, and surrounding the anus, are unique. As well, it has more vertebrae than any other

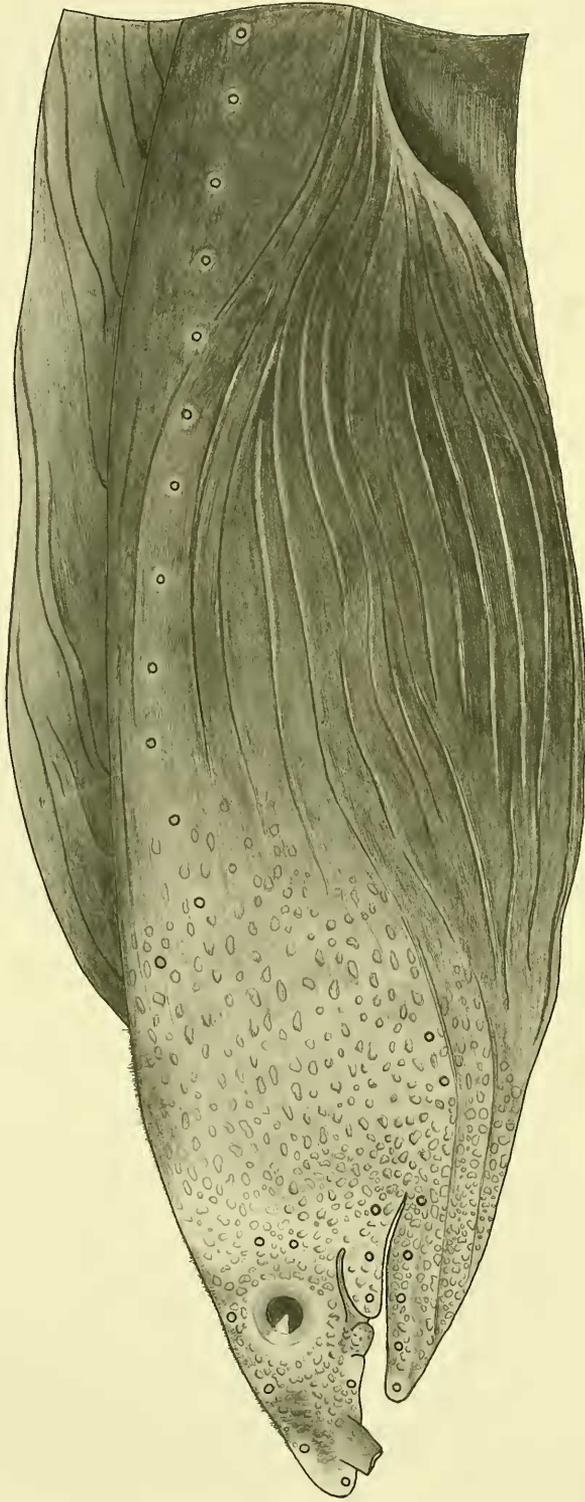


FIGURE 11. Holotype of *Callecheilus papulosa* n. sp., BPBM 36290, 551 mm.

Callechelys save *C. lutea* and *C. randalli*. The presence of acne-like round facial pits is shared by *C. bitaeniata*, *C. catostoma*, and *C. randalli*; however, in none is the condition so dramatically developed. *Callechelys bitaeniata* differs from *C. papulosa* in its coloration and vertebral number, and the latter two species differ from *C. papulosa* in having comparatively shorter tails and in the development of their anterior intermaxillary dentition.

It seems likely that the extreme development of facial pits is associated with a sensory function. That, and the restriction of the white coloration to the orbital, cheeks, snout and chin region, indicates that *C. papulosa* resides within a burrow with only its snout and eyes protruding, awaiting passing prey.

MATERIAL EXAMINED. — HOLOTYPE: BPBM 36290, 551 mm, PAPUA NEW GUINEA, D'Entrecasteaux Islands, Normandy Island, Buname Bay, west of Make-ia Point. Collected in 10 m using rotenone over a silty sand and sparse sea grass bottom by J. L. Earle on 17 December 1993.

***Callechelys randalli*, new species**
(Figs. 12a, 13; Tables 1, 2, 4)

DIAGNOSIS. — Extremely elongate, body depth 59–73 in TL; head 15–18 in TL; tail 3.5–3.6 in TL; teeth recurved, 2 or 4 large anterior intermaxillary fangs, maxillary 4, dentary 7; ethmoidal pore absent; skin of throat and vent area with prominent longitudinal grooves; body coloration white with a wide brown stripe from mid-head to tail tip; MVF H-146.5-222; total vertebrae 220–224 (n = 2).

COUNTS AND MEASUREMENTS (in mm) OF HOLOTYPE AND PARATYPE (in parentheses). — Total length 464 (219); head 26.2 (14.5); trunk 309 (141.5); tail 129 (63); predorsal distance 13 (6.5); body depth at gill openings ~7.8 (~3); body width at gill openings ~5.3 (~2.6); body depth at anus ~5.5 (~2.8); body width at anus ~4.9 (~2); snout 4 (~2.3); tip of snout to rictus of jaw 8.1 (~4.7); tip of snout to tip of lower jaw 3.4 (2.2); eye diameter 1.2 (~0.8); interorbital distance 2.2 (~1.2); isthmus width 2.4 (~1). Vertebral formula H-147-220 (H-146-224). Left lateral line pores 217, 9 in branchial region, 147 before anus, the last within 4.5 mm of the tail tip.

DESCRIPTION. — Body extremely elongate, its depth at gill openings 59–73 in TL, laterally compressed throughout its length, its width behind gill openings 84–88 in TL, tapering posteriorly to a hard finless point. Head and trunk 1.4 and head 15–18 in TL. Snout acute, rounded at tip. Lower jaw included, closer to a line drawn from base of anterior nostrils than to margin of eye. Eye moderate in size, its diameter about twice the length of anterior nostril tubes, its center above middle of upper jaw. Margin of upper lip slit by posterior nostril which opens into mouth. Lip smooth between anterior and posterior nostrils, without an apparent barbel. A posterodorsally-directed, shallow pocket in upper lip begins in lip behind posterior nostril and extends behind margin of eye. Nape, cheeks and dorsal surface of head and branchial basket covered with numerous small acne-like round pits smaller in size than cephalic pores. Tongue adnate. Branchial basket expanded.

Cephalic (Fig. 13) and lateral line pores obvious, those above branchial basket difficult to discern. Five mandibular, 2 preopercular, 3 supraorbital (ethmoidal pore absent), 4 + 2 infraorbital, and single interorbital and supratemporal pores. Eleven lateral line pores above branchial region, 147 before the anal fin, 217 total.

Teeth recurved, moderate in size for *Callechelys* (Fig. 12a). Two pairs (that of the holotype; the paratype has a pair of large teeth and a large space in the intermaxillary region from which a tooth may have been removed) of linearly-arranged large recurved anterior intermaxillary teeth within the snout groove, followed by a space, and a smaller tooth pair. Five widely-spaced teeth on each maxilla and 8 widely-spaced teeth on each dentary.

Coloration of holotype in isopropanol white, overlain by a wide brown stripe from mid-head to tail tip, its width about 3/4 or more of the body depth; ventral surface and upper dorsal surfaces and base of dorsal fin white; dorsal fin margin dark brown; anal fin and extreme tail tip white. Snout, chin, and most of throat white. A brown band about equal to eye diameter lies behind eyes and across behind mid-orbit. An irregular brown freckling on cheeks and behind post-orbital band. Lateral line and cephalic pores not surrounded by white spots; a faint white spot lies above each lateral line pore from mid-trunk nearly to tail tip.

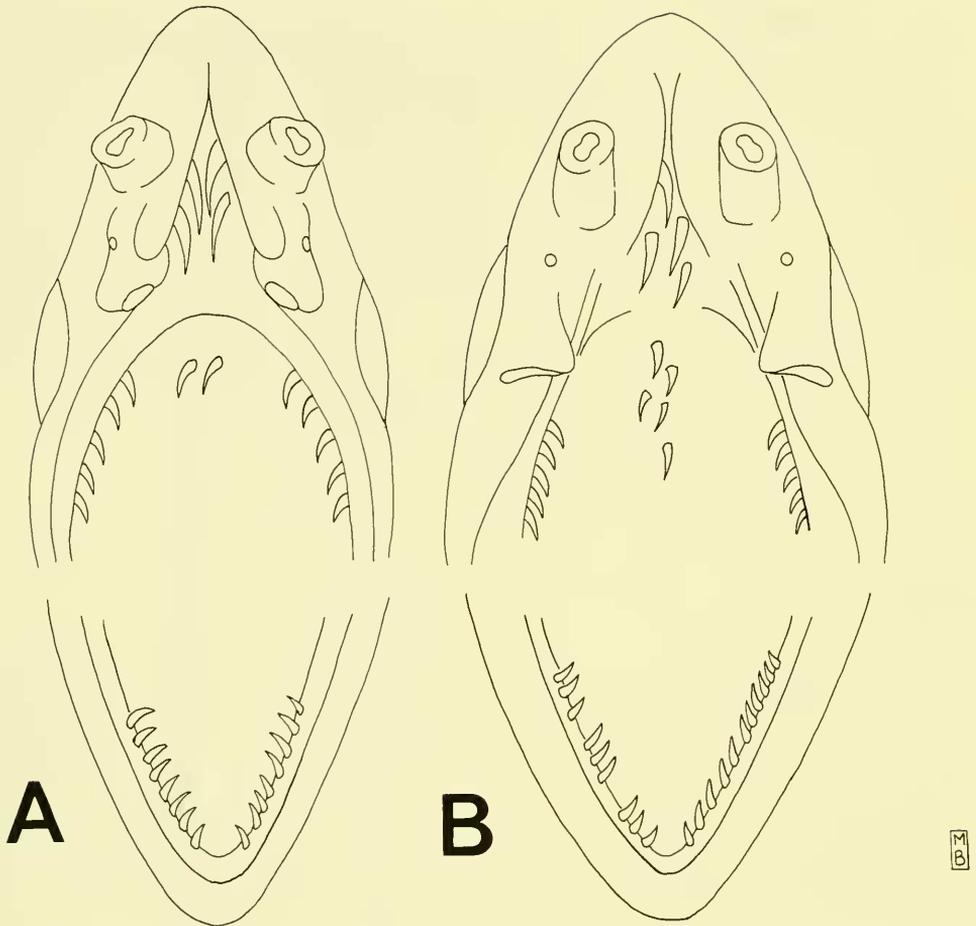


FIGURE 12. Semi-diagrammatic representation of the dentition of the holotypes of A. *Callechelys randalli* n. sp., BPBM 11844, 464 mm, and B. *Callechelys papulosa* n. sp., BPBM 36290, 551 mm.

SIZE. — The largest known is the holotype, a 464 mm male.

ETYMOLOGY. — Named in honor of John E. Randall, friend and the collector of this and many of the specimens reported herein.

DISTRIBUTION. — Known from the Marquesas Islands.

REMARKS. — The new species is most closely related to, and could easily be mistaken for, the shallow-water *Callechelys catostoma*. The two share the unique synapomorphy of large, recurved anterior intermaxillary fangs and the absence of a pair of ethmoidal pores. *Callechelys randalli* differs in having more vertebrae (220–224 vs. 192–205), a generally more slender body, a wider brown body stripe, and lacks a lip barbel.

It is distinguishable from all other species of *Callechelys* in the unique specializations described above as well as in the characters mentioned in the key.

The large anterior intermaxillary fangs, a shared synapomorphy of *C. randalli* and *C. catostoma*, differ in number but not in condition between the two type specimens. The holotype has two pairs of fangs and the paratype has a pair and what appears to be the empty socket of a third. Variation in the number of these fangs occurs in *C. catostoma* as well (see Remarks concerning that species); however, its typical condition is to have two linearly-arranged fangs slightly adjacent to a fleshy flap along the

midline, and atypically to have three or four teeth.

It is not surprising that so few specimens of this or other species of *Callechelys* have been captured in deep water poison stations. These eels are rarely seen above the sand surface (*C. lutea* is exceptional) and are very slow to react to rotenone. By the time that individuals have succumbed to the ichthyocide, most collectors have far exceeded the time at depth safely allowed by conventional scuba diving.

MATERIAL EXAMINED. — **HOLOTYPE:** BPBM 11844, 464 mm, CENTRAL PACIFIC, Marquesas Islands, Fatu Hiva, off point at north end of Hanau Bay. Collected over sand in 35 m using rotenone by J. E. Randall, D. B. Cannon and R. McNair on 21 April 1971. **PARATYPE:** CAS 91839, 219 mm, collected with the holotype.

***Callechelys springeri* (Ginsburg)**
(Fig. 14; Tables 1, 2, 4)

Gordiichthys springeri Ginsburg 1951:484, fig. 16 (from the stomach of a shark caught off Salerno, Florida, holotype USNM 121604).

Cryptopterygium holochroma Ginsburg 1951:482, fig. 15 (off Cape Fear, North Carolina, holotype USNM 154994).

Callechelys springeri, Rosenblatt and McCosker 1970:494. (Robins et al. 1980:71, as first revisers, synonymized *C. holochroma* with *C. springeri*).

Callechelys holochromus, McCosker and Rosenblatt 1972:22.

DIAGNOSIS. — Elongate, body depth 45–53 in TL; head 14–18 in TL; tail 2.8–2.9 in TL; maxillary teeth 4–5, 9–10 on dentary; coloration cream, overlain with dark brown to black spots and blotches; MVF H-108-169; total vertebrae 168–171 (n = 3).

SIZE. — The largest reported specimen is a 801 mm female (McCosker et al. 1989).

ETYMOLOGY. — Named for Stewart Springer, who obtained the type specimen; treated as a noun in the genitive case.

DISTRIBUTION. — Known from three specimens from off North Carolina and central Florida, between depths of 22–36 m.

REMARKS. — The three known specimens of *C. springeri* are in such poor condition that McCosker et al. (1989) cautiously recognized them as distinct from *C. guineensis*, an inhabitant of shallower water (see above). The vertebral

counts and colorations differ slightly and there is a slight difference (although significant overlap) in the mean tail proportions. The leptocephalus of *C. springeri* is not known; those described by Leiby (1984:412) as "*Callechelys* species cf. *springeri*" were tentatively reidentified by Leiby (1989) as *Gordiichthys randalli*.

MATERIAL EXAMINED. — USNM 121604, 372 mm, from the stomach of a *Carcharhinus milberti* taken off Salerno, Florida, the holotype of *Gordiichthys springeri*. USNM 154994, 801 mm, off Cape Fear, North Carolina, the holotype of *Cryptopterygium holochroma*. FLORIDA ATLANTIC: ANSP 151698, 367 mm, 27°42'N, 80°04.5'W.

***Xestochilus*, new genus**

Type species *Callechelys nebulosus* Smith 1962:452.

DIAGNOSIS. — Ophichthid eels, subfamily Ophichthinae, tribe Callechelyini (sensu McCosker 1977) with an elongate body, its depth 45–55 in TL, laterally compressed throughout its length; body and trunk longer than tail. Dorsal fin origin on nape, above supraoccipital, well before gill openings. Pectoral fins absent. Snout short and acute, rounded at tip, overhanging lower jaw; a short groove extends anteriorly to (but not reaching) level of anterior nostril bases (Fig. 1b). Anterior nostrils tubular, posterior nostril opens entirely into mouth; upper lip entire, without a crease, split, or barbel at location of posterior nostril. Numerous papillae along periphery of oral cavity. Gill openings low lateral, their aspect vertical, their length much greater than isthmus. Branchiostegal rays numerous, ca. 1/4 not attached to hyoid; epiphyal rays broadened at their bases; urohyal simple, not branched. Scapula present. Gill arches like those of all Callechelyini (McCosker 1977, table 3). Head pores reduced; three supraorbital pores, two preopercular pores, an ethmoidal pore and three pores in supratemporal canal. Teeth conical, slender, small and uniserial on jaws, those of intermaxillary followed by a single tooth on vomer. Body coloration striped and mottled.

ETYMOLOGY. — From the Greek ξεστός (shaven), and χείλος (lip, neuter), in reference to its smooth upper lip.

REMARKS. — Subsequent to my creation of the tribe Callechelyini (McCosker 1977), I have

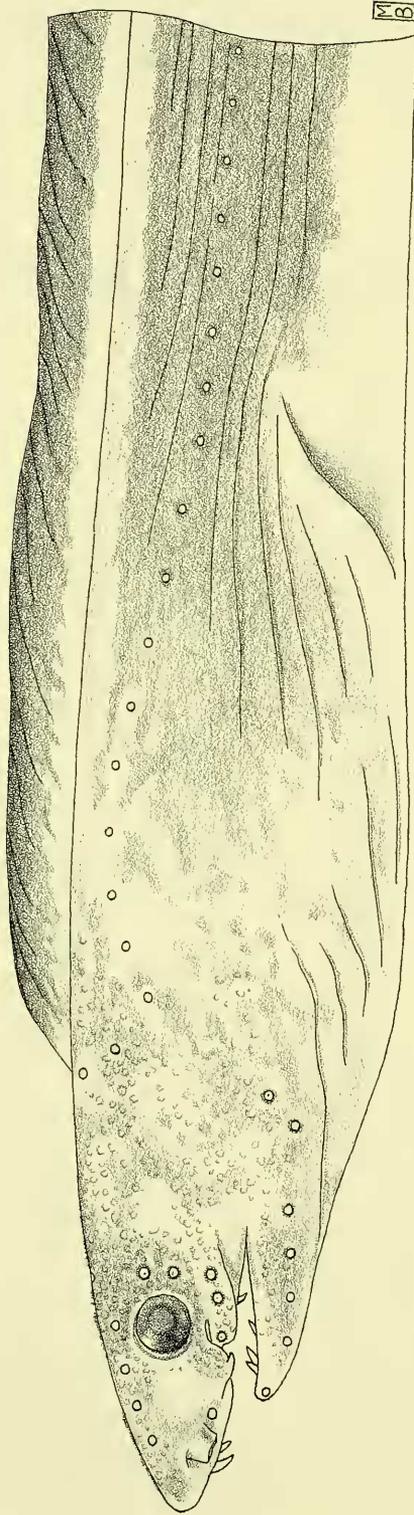


FIGURE 13. Holotype of *Callecheilus randalli* n. sp., BPBM 11844, 464 mm.

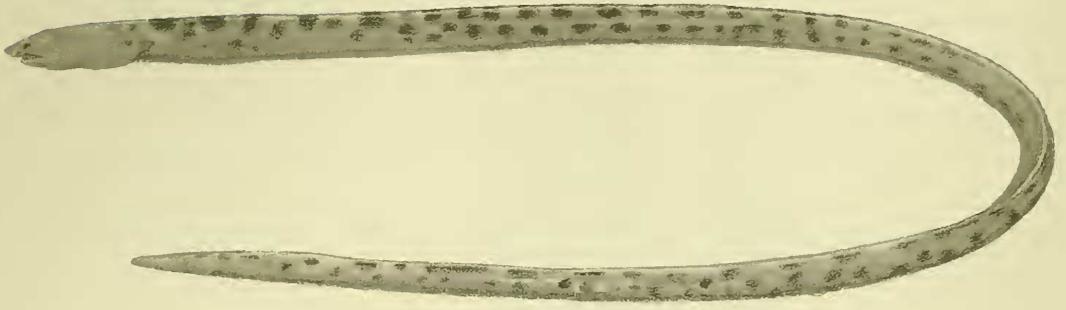


FIGURE 14. *Callechelys springeri*, ANSP 151698, 367 mm (from McCosker et al. 1989, fig. 301).

had the opportunity to examine all of the known species. The poorly known Indian Ocean *C. nebulosus* has turned out to be much more widely distributed, and the opportunity to carefully examine larger specimens has convinced me that it does not belong in *Callechelys*. Unfortunately, *Leuropharus lasiops* is still known only from the small type specimen and I am thereby unable to stain, clear, dissect and adequately understand the anatomy of that taxon.

The unique specializations of *Xestochilus nebulosus* include: the barely-grooved underside of its snout; the continuous upper lip; the state of its vomerine and intermaxillary dentition; and the presence of unattached branchiostegal rays. Other differences between it and other callechelyins are described in the preceding diagnoses and key.

***Xestochilus nebulosus* (Smith)**
(Pl. 1, Fig. 1b, Table 4)

Callechelys bitaeniatus nec Peters, Smith 1958:835.
Callechelys nebulosus Smith 1962:452, pl. 65, fig. D
(Pinda, Mozambique, holotype RUSI 115).

DIAGNOSIS. — Elongate, body depth 46–55 in TL; head 13.7–17.7 in TL; tail 2.5–2.6 in TL; a low fleshy crest on forehead between interorbital and supratemporal pores; 2–3 stout teeth at intermaxillary, not in a line, followed by a pair of stout teeth at anterior vomer; jaw teeth minute, 7–9 maxillary, 12–14 dentary; coloration changes with size, in all sizes the jaw corner and preopercular pores are conspicuously brown or black, the median fins are pale except dorsal in trunk and anterior tail region which has a dark membrane; smaller specimens are tan to light olive with a

complete brown band along the flanks from behind head to tail tip; in larger specimens (25 cm), the band breaks up in the anterior trunk region and brown spotting appears on the head, throat, and chest; largest specimens (35 cm) have numerous small spots on head and trunk region, the tail remaining as a brown band; MVF H-93-160; total vertebrae 155–165 (n = 19).

SIZE. — The largest reported (Smith 1962) was 470 mm, the holotype, from Pinda, Mozambique.

ETYMOLOGY. — From the Latin *nebulosus* (clouded).

DISTRIBUTION. — Described from Mozambique and Aldabra, my examination of additional material of *X. nebulosus* has extended its range to include the Marshall Islands, the Marquesas Islands, Palau, Indonesia, and the Red Sea. It was collected over sand bottoms with rotenone between depths of 2.5–42 m.

REMARKS. — Small specimens of *Xestochilus nebulosus* could be mistaken for young *C. bitaeniata* or *C. catostoma*. Upon careful examination, *Xestochilus* is easily identifiable on the basis of the shortness of its snout groove (Fig. 1b). The holotype of *C. nebulosus* has the vertebral formula H-93-161.

The Agulpelu Reef, Palau, shallow water collection of 29 September 1957 (see Remarks under *Callechelys marmorata*) included numerous specimens of *C. catostoma* and *C. marmorata* along with *X. nebulosus*.

MATERIAL EXAMINED. — RUSI 115, 470 mm, Pinda, Mozambique, the holotype of *Callechelys nebulosus*. PALAU — CAS 92201, 2(288–368 mm), Kayangel Atoll; CAS 92202, 5(235–392 mm), Agulpelu Reef. MARSHALL ISLANDS — CAS 53745, 7(244–326 mm); BPBM

29234, 2(314–346 mm), Enewetak. MARQUE-SAS ISLANDS — BPBM 11914, 2(151–224 mm), Tahuata; BPBM 12603, 235 mm, Nuku Hiva; BPBM 11846, 4(181–330 mm), Fatu Hiva. INDONESIA — USNM 313844, 5(175–338 mm), Ambon Island. RED SEA — SIO 71-165, 334 mm, Eilat; USNM 273656, 300 mm, Eilat; SIO 71-197, 2(283–355 mm, the smaller cleared and stained), Wesat.

STATUS OF SPECIES PREVIOUSLY REFERRED TO *CALLECHELYS*

Described below are those ophichthids that have been described as species of, or have been subsequently referred to *Callechelys* but now belong in other genera (Table 4).

Weber (1913) described *Callechelys sibogae* based on a 237 mm specimen from the south coast of Timor. Although having the general appearance of a species of *Callechelys* and described as lacking pectoral fins, its body proportions and general physiognomy are those of a *bascanichthyin*. Close examination of the holotype (ZMA 109.034) discloses that it has small, rounded pectoral fins (ca. 0.7 mm in length) and is referable to *Bascanichthys*.

Callechelys maculatus Chu, Wu and Jin (1981) was briefly described from two specimens (206–338 mm) from Pingtan Island (119°45' E, 25°30' N) of the Peoples Republic of China. I have examined the 206 mm paratype (No. A 01318). It has the general appearance of a *callechelyin*; however, on closer examination it is seen to possess a flattened snout (underside), vertebral formula 2-70-143, a dorsal fin origin behind the neurocranium, and other osteological features typical of a *sphagebranchin*. I provisionally refer it to the genus *Yirrkala* pending a careful osteological analysis.

Between 1885–1906, Jordan, and with various coauthors, referred species now recognized as *Bascanichthys* to *Callechelys*, including: *Sphagebranchus scuticaris* Goode and Bean (1880); *S. teres* Goode and Bean (1882); and *Caecula bascanium* Jordan (1885). Similarly, Deraniyagala (1931) placed *Sphagebranchus longipinnis* Kner and Steindachner (1866) and *Ophichthys kirkii* Günther (1870) in *Callechelys*. Storey (1939) referred all of the above-men-

tioned species as well as several other species then recognized within *Callechelys* to *Bascanichthys*, including: *Ophichthys filaria* Günther (1872); *Callechelys myersi* Herre (1932); and *C. fijiensis* Seale (1935).

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LITERATURE CITED

- ALLEN, G. R. AND D. R. ROBERTSON. 1994. Fishes of the tropical eastern Pacific. Univ. Hawaii Press, Honolulu. 332 pp.
- BLACHE, J., M. L. BAUCHOT, AND L. SALDANHA. 1979. Désignation d'un neotype pour *Callechelys guineensis* (Osorio, 1894), et validation de l'espèce (Pisces, Anguilliformes, Ophichthidae). *Cybiurn*, Sér. 3, 3(7):97-98.
- BLACHE, J. AND J. CADENAT. 1971. Contribution à la connaissance des Poissons anguilliformes de la côte occidentale d'Afrique. Dixième note: les genre *Myrichthys*, *Bascanichthys* et *Callechelys* (Fam. des Ophichthidae). *Bull. de l'I. F. A. N.*, Sér. A 33(1):158-201.
- BLEEKER, P. 1853a. Derde bijdrage tot de kennis der ichthyologische fauna van Ceram. *Nat. Tijdschr. Ned. Ind.* 5:233-248.
- . 1853b. Bijdrage tot de kennis der Muraenoïden en Symbranchoïden van den Indischen Archipel. *Verh. Bat. Gen.* 25:1-76.
- . 1864. Atlas Ichthyologique des Indes Orientales Néerlandaises, publié sous les auspices du gouvernement colonial. Tome 4, Murenes, Synbranchies, Leptocéphales. Leiden. 132 pp.
- . 1865a. Description des deux espèces inédites des genres *Callechelys* et *Pisoodonophis*. *Ned. Tijdschr. Dierk.* 2:213-216.
- . 1865b. Atlas Ichthyologique des Indes Orientales Néerlandaises, publié sous les auspices du gouvernement colonial. Tome 4, Murenes, Synbranchies, Leptocéphales. Leiden. plates 193-204.
- BLOCH, M. E. AND J. G. SCHNEIDER. 1801. *M. E. Blochii, systema ichthyologiae iconibus CX illustratum. Post obitum auctoris opus inchoatum absolvit, correxit, interpolavit.* Sander, Berlin. 584 pp.
- BOESEMAN, M. 1983. Forward. Pp. 1-12 in *Atlas Ichthyologique des Indes Orientales Néerlandaises*. Smithsonian Institution, Washington, D. C.
- BÖHLKE, E. B. 1982. Vertebral formulae of type specimens of eels (Pisces: Anguilliformes). *Proc. Acad. Nat. Sci. Philadelphia* 134:31-49.
- BÖHLKE, J. E. 1967. The descriptions of three new eels from the tropical West Atlantic. *Proc. Acad. Nat. Sci. Philadelphia* 118(4):91-108.
- BÖHLKE, J. E. AND J. C. BRIGGS. 1954. *Callechelys cliffi*, a new ophichthid eel from the Gulf of California. *Stanford Ichthyol. Bull.* 4(4):275-278.
- BÖHLKE, J. E. AND C. C. G. CHAPLIN. 1968. Fishes of the Bahamas and adjacent tropical waters. Livingston Pub. Co., Wynnewood, Pennsylvania. 771 pp.
- CADENAT, J. 1954. Note d'ichtyologie Ouest-Africaine. VI. Sur quelques espèces d'Apodes du genre *Caecula*. *Bull. de l'Institut. Français d'Afrique Noire*, Sér. A 16(1):238-244.
- . 1956. Note d'ichtyologie Ouest-Africaine. XVI. — Description d'une espèce nouvelle d'Ophichthyidae: *Caecula pantherina*. *Bull. de l'Institut. Français d'Afrique Noire*, Sér. A 18(4):1267-1271.
- . 1961. Notes d'ichtyologie Ouest-Africaine. XXXIV. Liste complémentaire des poissons de mer . . . de l'I. F. A. N. à Gorée. *Bull. de l'Institut. Français d'Afrique Noire*, Sér. A 23(1):231-245.
- CERVIGÓN, F. 1973. Los peces marinos de Venezuela. Complemento III. *Contribuciones Cientificas, Universidad de Oriente*, No. 4. 70 pp.
- CHU, Y. T. H., H. WU, AND X. JIN. 1981. Four new species of the families Ophichthyidae and Neenchelidae. *J. Fish. China* 5(1):21-27.
- DERANIYAGALA, P. E. P. 1931. Further notes on the anguilliform fishes of Ceylon. *Spolia Zeylanica* 16(2):131-137.
- DINGERKUS, G. AND L. D. UHLER. 1977. Enzyme clearing of alcian blue stained whole small vertebrates for demonstration of cartilage. *Stain Tech.* 52:229-232.
- FOWLER, H. W. 1928. The fishes of Oceania. *Bernice P. Bishop Mus. Mem.* 10. 540 pp.
- . 1932. The fishes obtained by the Pinchot South Seas Expedition of 1929, with descriptions of one new genus and three new species. *Proc. U. S. Natl. Mus.* 80(6):1-16.
- . 1938. The fishes of the George Vanderbilt South Pacific Expedition. 1937. *Zool. results, part 3. Monog. Acad. Nat. Sci. Philadelphia no. 2.* 349 pp.
- GINSBURG, I. 1951. The eels of the northern Gulf coast of the United States and some related species. *Texas J. Sci.* 3(3):431-485.

- GOODE, G. B. AND T. H. BEAN. 1880. Catalogue of a collection of fishes obtained in the Gulf of Mexico, by Dr. J. w. Velie, with descriptions of seven new species. Proc. U. S. Natl. Mus. 2(98):333-345.
- . 1882. Descriptions of twenty-five new species of fish from the Southern United States, and three new genera, *Letharchus*, *Ioglossus*, and *Chriodorus*. Proc. U. S. Natl. Mus. 5(297):412-437.
- GOSLINE, W. A. 1951. The osteology and classification of the ophichthid eels of the Hawaiian Islands. Pacific Sci. 5(4):298-320.
- GÜNTHER, A. 1870. Catalogue of the fishes in the British Museum. Vol. 8. Catalogue of the Physostomi, containing the families Gymnotidae . . . in the British Museum. British Museum, London. xxv + 549 pp.
- . 1872. On some new species of reptiles and fishes collected by J. Brenchley, Esq. Ann. Mag. Nat. Hist., Ser. 4, 10(60):418-426.
- . 1910. Andrew Garrett's fische der Südsee. J. Mus. Godeffroy 9(17):389-514.
- HERRE, A. W. C. T. 1932. Five new Philippine fishes. Copeia 1932(3):139-142.
- JORDAN, D. S. 1885. A catalogue of the fishes known to inhabit the waters of north America, north of the Tropic of Cancer, with notes on the species discovered in 1883 and 1884. Rept. U. S. Comm. Fish, for 1884. 185 pp.
- JORDAN, D. S. AND B. M. DAVIS. 1891 (1892). A preliminary review of the apodal fishes or eels inhabiting the waters of America and Europe. Rep. U. S. Comm. Fish and Fisheries for 1888, 16(9):581-677.
- JORDAN, D. S. AND B. W. EVERMANN. 1887. Description of six new species of fishes from the Gulf of Mexico, with notes on other species. Proc. U. S. Natl. Mus. 9(586):466-476.
- JORDAN, D. S. AND A. SEALE. 1906. The fishes of Samoa. Bull. Bur. Fisheries (1905) 25:173-488.
- KANAZAWA, R. H. 1952. More new species and new records of fishes from Bermuda. Fieldiana, Zoology, 34(7):71-100.
- KAUP, J. J. 1856a. Uebersicht der Aale. Archiv für Natur. 22(1):41-77.
- . 1856b. Catalogue of apodal fish, in the collection of the British Museum. British Museum, London. viii + 163 pp.
- KLAUSEWITZ, W. 1969. Fische aus dem Roten Meer. X. *Callechelys marmoratus* (Bleeker), ein Neunachweis für das Rote Meer (Pisces, Apodes, Ophichthidae). Senckenbergiana Biol. 50(1/2):39-40.
- KLUNZINGER, C. B. 1871. Synopsis der Fische des Rothen Meeres, II Theil. Verh. Zool.-Bot. Ges. Wien 21:441-688.
- KNER, R. AND F. STEINDACHNER. 1866. Neue Fische aus dem Museum der Herren Joh. Ces. Godeffroy und Sohn in Hamburg. Sitzungber. Akad. Wiss. Wien. 54:356-395.
- LEIBY, M. M. 1984. Leptocephalus larvae of the tribe Callechelyini (Anguilliformes, Ophichthidae, Ophichthinae) in the western North Atlantic. Bull. Marine Sci. 34:398-423.
- . 1989. Family Ophichthidae. Pp. 764-897 in Fishes of the Western North Atlantic, part nine, vol. 2. E. B. Böhlke, ed. Yale Univ., New Haven.
- LEVITON, A. E., R. H. GIBBS, JR., E. HEAL, AND C. E. DAWSON. 1985. Standards in herpetology and ichthyology: part I. Standard symbolic codes for institutional resources collections in herpetology and ichthyology. Copeia 1985:802-832.
- MCCOSKER, J. E. 1970. A review of the eel genera *Leptenchelys* and *Muraenichthys*, with the description of a new genus, *Schismorhynchus*, and a new species, *Muraenichthys chilensis*. Pacific Sci. 24:505-516.
- . 1974. A revision of the ophichthid eel genus *Letharchus*. Copeia 1974(3):619-629.
- . 1977. The osteology, classification, and relationships of the eel family Ophichthidae. Proc. Calif. Acad. Sci., Ser. 4, 41(1):1-123.
- . 1979. The snake eels (Pisces, Ophichthidae) of the Hawaiian Islands, with the description of two new species. Proc. Calif. Acad. Sci., Ser. 4, 42(2):57-67.
- MCCOSKER J. E., E. B. BÖHLKE, AND J. E. BÖHLKE. 1989. Family Ophichthidae. Pp. 254-412 in E. Böhlke, ed., Fishes of the Western North Atlantic, part nine, vol. 1. Yale Univ., New Haven.

- MCCOSKER, J. E. AND P. H. J. CASTLE. 1986. Family Ophichthidae. Pp. 176–186 in *The Sea Fishes of Southern Africa*. M. Smith and P. Heemstra, eds. Macmillan Pub., Johannesburg.
- MCCOSKER, J. E. AND R. H. ROSENBLATT. 1972. Eastern Pacific snake-eels of the genus *Callechelys* (Apodes: Ophichthidae). *Trans. San Diego Soc. Nat. Hist.* 17(2):15–24.
- . 1995. Ophichthidae. Pp. 1326–1341, vol. 3, in *Guia FAO para la identificación de especies para los fines de la pesca. Pacífico centro-oriental*. W. Fischer et al., eds. FAO, Rome.
- MYERS, G. S. AND C. B. WADE. 1941. Four new genera and ten new species of eels from the Pacific coast of tropical America. *Allan Hancock Pacific Exped.* 9(4):65–111.
- OSBURN, R. C. AND J. T. NICHOLS. 1916. Shore fishes collected by the "Albatross" expedition in Lower California with descriptions of new species. *Bull. Amer. Mus. Nat. Hist.* 35:139–181.
- OSORIO, B. 1894. Estudos ichthyologicos ácerca da fauna dos dominios portuguezes da Africa. 3^e nota: Peixes marítimos das ilhas de S. Thomé, do Principe e ilheo das Rolas. *J. Sci. Math., Phisicas e Nat. da Acad. Real das Sci. de Lisboa, Ser. 2, 3(9):173–182.*
- PETERS, W. C. H. 1878. Ueber eine neue merkwürdige Art von fliegenden Fischen, *Exocoetus cirriger*, aus China, und einen neuen Muraeniden, *Ophichthys bitaeniatus*, aus Mombas. *Monatsb. Akad. Wiss. Berlin:* 555–556.
- RANDALL, J. E. 1996. *Shore fishes of Hawaii*. Natural World Press, Vida, Oregon. 216 pp.
- RANDALL, J. E., G. R. ALLEN. AND R. C. STEENE. 1990. *Fishes of the Great Barrier Reef and Coral Sea*. Univ. Hawaii Press, Honolulu. 507 pp.
- RANDALL, J. E. AND A. WHEELER. 1991. Reidentification of seven tropical Pacific fishes collected and observed by the Forsters during the voyage of *HMS Resolution, 1772–75*. *Copeia* 1991(3):760–767.
- ROBINS, C. R., R. M. BAILEY, C. E. BOND, J. R. BROOKER, E. A. LACHNER, R. N. LEA, AND W. B. SCOTT. 1980. *A list of common and scientific names of fishes from the United States and Canada* (fourth edition). *Amer. Fisher. Soc., Spec. Pub.* 12. 174 pp.
- ROSENBLATT, R. H. AND J. E. MCCOSKER. 1970. A key to the genera of the ophichthid eels, with descriptions of two new genera and three new species from the eastern Pacific. *Pacific Sci.* 24:494–505.
- SCHULTZ, L. P. 1943. *Fishes of the Phoenix and Samoan Islands collected in 1939 during the expedition of the U. S. S. "Bushnell."* *Bull. U. S. Natl. Mus. No. 180.* 316 pp.
- SCHULTZ, L. P. AND COLLABORATORS. 1953. *Fishes of the Marshall and Marianas Islands. Families from Asymmetrontidae through Siganidae.* *Bull. U. S. Natl. Mus. No. 202 (1):*1–685.
- SEALE, A. 1935. *The Templeton Crocker Expedition to western Polynesian and Melanesian islands, 1933.* *Proc. Calif. Acad. Sci. (Ser. 4)* 21(27):337–378.
- SMITH, J. L. B. 1958. *The fishes of Aldabra. Part IX. (With a new eel from east Africa).* *Ann. Mag. Nat. Hist., Ser. 12, 10:*833–842.
- . 1962. *Sand-dwelling eels of the western Indian Ocean and the Red Sea.* *Rhodes Univ. Ichthyol. Bull.* 24:447–466.
- SNYDER, J. O. 1904. *A catalogue of the shore fishes collected by the steamer "Albatross" about the Hawaiian Islands in 1902.* *U. S. Bur. Fish. Bull.* 22:513–538.
- STOREY, M. H. 1939. *Contributions toward a revision of the ophichthid eels. 1. The genera Callechelys and Bascanichthys, with descriptions of new species and notes on Myrichthys.* *Stanford Ichthyol. Bull.* 1(3):61–84.
- WEBER, M. 1913. *Die fische der Siboga-Expedition.* *Siboga-Expeditie* 32(57):1–710.
- WHEELER, A. 1981. *The Forsters' fishes. Pp. 781–803 in The journal of the H. M. S. Resolution 1772–1775.* James Cook. Genesis Publications, Duildford, England.
- WHITEHEAD, P. J. P. 1978. *The Forster collection of zoological drawings in the British Museum (Natural History).* *Bull. Brit. Mus. (Nat. Hist.), Hist. Ser.* 6:25–47.
- WINTERBOTTOM, R., A. R. EMERY, AND E. HOLM. 1989. *An annotated checklist of the fishes of the Chagos Archipelago, Central Indian Ocean.* *Life Sci. Contrib.* 145. 226 pp.

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