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Pisces Anguilliformes: Deepwater snake eels (Ophichthidae) from the New Caledonia region, Southwest Pacific Ocean

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ABSTRACT

This paper reports upon the snake eels collected by trawl during the 1985 MUSORSTOM 4 New Caledonia Expedition. The 14 specimens comprised five new ophichthid taxa which are described herein: *Ophichthus exourus* sp. nov. from 400-520 m (also from Fiji); *O. genie* sp. nov. from 430-500 m (also from Maldives); *O. mystacinus* sp. nov. from 450-580 m; *Yirrkala insolitus* sp. nov. from 59 m; and *Rhinophichthus penicillatus* gen. et sp. nov. from 435 m. The dorsal fin location of the new species of *Yirrkala* provides an expanded character state within the genus. *Rhinophichthus* differs from other generalized ophichthins in its very conical snout, and includes *Ophichthys unicolor* Regan from South Africa. The affinities of the new taxa are with Indo-west Pacific ophichthids, however the collections are too few to allow significant conclusions about the bathyal ophichthid fauna of the region.

RÉSUMÉ

Pisces Anguilliformes: Poissons-serpents d'eau profonde (Ophichthidae) de la région néo-calédonienne (Pacifique sud-ouest).

Les 14 spécimens de poissons-serpents (famille des Ophichthidae) récoltés en 1985, au cours de la campagne de chalutage profond MUSORTOM 4, au large de la Nouvelle-Calédonie, sont étudiés et cinq espèces nouvelles sont décrites : *Ophichthus exourus* sp. nov. récoltée entre 400 et 520 m de profondeur (et aussi aux Fidji); *O. genie* sp. nov. récoltée entre 430 et 500 m (et aussi aux Maldives); *O. mystacinus* sp. nov. récoltée à 450-580 m; *Yirrkala insolitus* sp. nov. récoltée à 59 m et *Rhinophichthus penicillatus* gen. et sp. nov. récoltée à 435 m. La position de la nageoire dorsale de la nouvelle espèce de *Yirrkala* constitue un état évolué de ce caractère. De même le genre *Rhinophichthus*, par son museau très conique, semble particulièrement évolué; il inclut *Ophichthys unicolor* Regan décrite d'Afrique du Sud. Ces nouveaux taxa ont des affinités indo-pacifiques, cependant la collection est trop réduite pour permettre des conclusions significatives sur la faune ophichthienne bathyale de la région.

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INTRODUCTION

The 1985 MUSORSTOM oceanographic survey of the bathyal fauna of New Caledonia resulted in many interesting ichthyological discoveries. The specimens of ophichthid eels were captured from depths well below those normally inhabited by most ophichthid species. They were forwarded to me by Bernard SÉRET for identification and, although few in number - only 14 representing five taxa - the quality far exceeded the quantity, in that those specimens comprise three genera (one undescribed) and five undescribed species of ophichthid eels. The affinities of those new species seem to lie with Indo-west Pacific congeners. The new genus and its two species cannot yet be identified with any known sister group.

TAXONOMY

The snake eels and worm eels of the anguilliform family Ophichthidae are the most diverse and speciose of true eels (McCOSKER *et al.*, 1989). The more than 260 species distributed among 57 genera inhabit all tropical oceans and seas. They occupy habitats ranging from the intertidal zone to depths of 750 m or more, living amongst coral and rock reefs and sand and mud bottoms, some entering estuaries and rivers, and others having adapted to life in midwater. Ophichthids are of limited direct economic importance, however all seem to be edible and several large species are taken as a bycatch of trawl and trap fisheries and are consumed. In that they are abundant in many habitats, it is reasonable to assume that they are of indirect importance to commercial fisheries in their role as both predator and prey.

A systematic revision of the family Ophichthidae has yet to be achieved on a worldwide basis, although McCOSKER (1977) provided a comprehensive treatment of the genera. Several species are so widespread in distribution that they occupy both the Indian and Pacific oceans, however none are worldwide and others seem to be limited to island archipelagos or to limited coastal zones. Faunal treatments of ophichthids that may be helpful for the identification of genera and species have been prepared for: the western Atlantic (McCOSKER *et al.*, 1989); southeast Africa (McCOSKER & CASTLE, 1986); Indian Ocean and Red Sea (SMITH, 1962); Hawaii (McCOSKER, 1979); eastern Pacific (McCOSKER & ROSENBLATT, 1995); and Australia (McCOSKER in preparation).

Deepwater trawling and trapping in recent years has resulted in the collection of many new species of ophichthids. Because of their secretive, burrowing behavior, many species are able to avoid capture, particularly in deep water. If the success of the MUSORSTOM project is any indication, it is likely that many species will be discovered as a result of future deepwater surveys.

MATERIALS AND METHODS

All of the specimens collected from New Caledonia resulted from the 1985 MUSORSTOM 4 Expedition.

The first half of that expedition, aboard R. V. *"Vauban"*, investigated the "Grand Passage" between the northern lagoon of the mainland and Surprise Atoll. A total of 57 stations were sampled with beam trawls (stations "CP"), otter trawls (stations "CC"), Warren dredges, and Charcot dredges between 34-720 m depth (see RICHER DE FORGES, 1990). The otter trawl had a 15 m headrope and is known as a "shrimp trawl"; the beam trawl was 4 m wide and fitted with 20 mm mesh, lined with 5 mm mesh for the bag. The habitat, described by RICHER DE FORGES & BARGIBANT (1985) and RICHER DE FORGES (1990), is that of a "narrow sill situated at about 600 m depth. The bottoms encountered were mostly rocky, but with some soft areas carpeted with pumice stones. At the far extremity of the northern lagoon, sand with *Halimeda* was found as deep as 550 m and more. To the south of the Mainland, New Caledonia extends in a gentle sloping valley from 200 to 500 m. Here the bottoms are of sandstone slabs, relatively flat, and trawling is possible." These efforts resulted in numerous congrid eels but only 14 specimens of ophichthids, captured during five beam trawls and three otter trawls.

Specimen 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 ethmoidal pore + pores in supraorbital canal, *i.e.*, 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"), *i.e.*, 4 + 2, in that frequently the last pore included along the upper jaw is part of the postorbital series. Radiographic techniques are described in BÖHLKE (1989). Gill arch examination was accomplished after removal and clearing and counterstaining with alcian blue and alizarin red dyes (DINGERKUS & UHLER, 1977). The mean vertebral formula (MVF) is expressed as the average of predorsal, preanal, and total vertebrae (BÖHLKE, 1982). Vertebral counts (which include the hypural) are taken from radiographs. Institutional abbreviations follow the Standard Symbolic Codes for Institutional Research Collections in Herpetology and Ichthyology (LEVITON *et al.*, 1985). Other abbreviations are as follows: DFO = dorsal fin origin; HL = head length; IO = interorbital width; TL = total length.

RESULTS

Key to the species of deepwater MUSORSTOM ophichthid eels from the New Caledonia region*

1. Pectoral fins present; body moderately elongate, its depth < 45 times in total length **2**
— Pectoral fins absent; body elongate, its depth > 45 times in total length ..... ***Yirrkala insolitus***

2. Snout conical, sharply pointed; jaw teeth uniserial ... ***Rhinophichthus penicillatus***
— Snout rounded at tip, not conical and extended; maxillary teeth biserial **3**

3. Pectoral fin short, paddle-shaped, about 1.3-1.4 in upper jaw; posterior margin of orbit above rictus of jaw; teeth of mandible uniserial ..... ***Ophichthus exourus***
— Pectoral fin elongate, nearly as long as jaw; posterior margin of orbit well in advance of rictus or jaw; jaw teeth biserial **4**

4. Dorsal fin origin about mid-trunk; body depth 23-28 times in total length ..... ***Ophichthus mystacinus***
— Dorsal fin origin above pectoral fins; body depth 31-42 times in total length ..... ***Ophichthus genie***

*This key concerns only those ophichthids captured during the MUSORSTOM collections. It is not meant to be comprehensive in that the numerous shallow-water ophichthids from New Caledonia are not included.

FAMILY OPHICHTHIDAE

DIAGNOSIS. — Body elongate, snake-like in large species, worm-like in some smaller species; cylindrical anteriorly, generally laterally compressed posteriorly. Snout pointed to blunt, mouth either terminal or inferior. Jaw teeth variable, from molariform to conical to large and fanglike; from single to multiple rows, a few species without teeth on vomer. Nostrils widely separated, the posterior inside the mouth or penetrating through a valve or hole in or above the upper lip, the anterior usually in a short tube. Gill openings midlateral to entirely ventral,

a constricted opening in one subfamily (Myrophinae), variable in the other (Ophichthinae). Branchial region supported by numerous overlapping branchiostegal rays. Gill arches uniquely developed with first epibranchial connected by a continuous cartilaginous strap to the second infrapharyngobranchial; no more than first basibranchial ossified; the third hypobranchial usually cartilaginous. Dorsal and anal fins, when present, continuous around the caudal in one subfamily (Myrophinae) and absent, forming a hard finless point in the other (Ophichthinae); pectoral fins present or absent; pelvic fins absent. Lateral line system extends onto head, the sides connected through a frontal and a temporal canal. Coloration variable, from uniform (although usually darker dorsally) to mottled, spotted, barred or striped.

REMARKS. — As currently recognized, the Ophichthidae comprise two subfamilies, the Myrophinae and the Ophichthinae, and six tribes, the Myrophini, the Benthenchelyini, the Bascanichthyini, the Callechelyini, the Sphagebranchini, and the Ophichthini (McCOSKER, 1977; McCOSKER *et al.*, 1989). Ophichthid eels also differ from related eel families in the following manner:

1) Congridae, which possess posterior nostrils at the level of the eye;

2) Muraenidae, which lack pectoral fins, possess small branchial openings, and have posterior nostrils at the level of the eye;

3) Muraenesocidae, which possess posterior nostrils at the level of the eye, and have the vomer bearing a median series of large teeth flanked by a row of small teeth;

4) Chlopsidae (previously the Xenocongridae), which usually have multiple rows of vomerine teeth and an incomplete lateral line, limited to one or two pores in the branchial region.

Genus ***OPHICHTHUS*** Ahl, 1789

Innominado Parra, 1787: 96 (a junior synonym of *Muraena ophis* Linnaeus, 1758, non-binomial).

Ophichthus Ahl, 1789: 5 (type species *Muraena ophis* Linnaeus, 1758, by original designation. Improperly emended to *Ophichthys* by other authors).

Ophis Turton, 1807: 87 (type species "*O. maculata* ... Spotted Serpent. Shaw Zool., iv. p. 22 ... Bloch t. 154," = *Muraena ophis* Linnaeus, 1758, by monotypy).

Cogrus Rafinesque, 1810: 62 (type species *Cogrus maculatus* Rafinesque, 1810, by monotypy).

Ophithorax McClelland, 1844: 212 (type species *Ophisurus ophis* Lacépède, 1800 = *Muraena ophis* Linnaeus, 1758, by JORDAN, 1919, as first reviser).

Centrurophis Kaup, 1856: 42 (type species *Ophisurus spadiceus* Richardson, 1844 = *Ophichthys cephalazona* Bleeker, 1864, by JORDAN, 1919, as first reviser).

Poecilocephalus Kaup, 1856: 43 (type species *Poecilocephalus bonaparti* Kaup, 1856, by monotypy).

Microdonophis Kaup, 1856: 43 (type species *Microdonophis altipinnis* Kaup, 1856, by monotypy).

Coecilophis Kaup, 1856: 44 (type species *Ophisurus compar* Richardson, 1844 = *Ophisurus apicalis* Bennett, 1830, by monotypy).

Scytalophis Kaup 1856: 46 (type species *Scytalophis magnioculis* Kaup, 1856 = *Ophisurus gomesii* Castelnau, 1855, by JORDAN, 1919, as first reviser).

Leptorhinophis Kaup, 1856: 46 (type species *Ophisurus gomesii* Castelnau, 1855, by JORDAN 1919, as first reviser).

Cryptopterus Kaup, 1860: 11 (type species *Cryptopterus puncticeps* Kaup, 1860, by monotypy).

Uranichthys Poey, 1867: 256 (type species *Muraena hauannensis* Bloch & Schneider, 1801 = *Muraena ophis* Linnaeus, 1758, by JORDAN & DAVIS, 1891, as first revisers).

Paramyrus Günther, 1870: 51 (type species *Conger cylindroideus* Ranzani, 1839, by JORDAN & DAVIS, 1891, as first revisers).

Oxyodontichthys Poey, 1880: 254 (type species *Ophichthys macrurus* Poey, 1867 = *Ophisurus gomesii* Castelnau, 1855, by original designation).

Omochelys Fowler, 1918: 3 (type species *Pisodonophis cruentifer* Goode & Bean, 1896, by original designation; described as a subgenus of *Pisodonophis* Kaup, 1856).

Syletor Jordan, 1919: 343 (type species *Pisodonophis cruentifer* Goode & Bean, 1895, by original designation).

Styletor Jordan, 1919, in JORDAN, EVERMANN & CLARK, 1930: 86 (*lapsus pro Syletor* Jordan, 1919).

Acanthenchelys Norman, 1922: 296 (type species *Acanthenchelys spinicauda* Norman, 1922, by original designation).

Cryptopterenchelys Fowler, 1925: 1 (substitute name for *Cryptopterus* Kaup, 1860, preoccupied; described as a subgenus of *Ophichthus* Ahl, 1789).

Zonophichthus Whitley, 1930: 250 (type species *Ophichthys cephalazona* Bleeker, 1864, by original designation).
Gisenchelys Fowler, 1944: 188 (type species *Ophichthys zophochir* Jordan & Gilbert, 1881, by original designation; described as a subgenus of *Ophichthus* Ahl, 1789).
Syletophis Whitley, 1950: 44 (substitute name for *Syletor* Jordan, 1919, preoccupied).
Antobrantia Pinto, 1970: 13 (type species *Antobrantia ribeiroi* Pinto, 1970 = *Muraena ophis* Linnaeus, 1758, by original designation).

DIAGNOSIS. — Moderately to very elongate ophichthid eels of the subfamily Ophichthinae, tribe Ophichthini, with head and trunk shorter than tail; dorsal fin origin above or behind gill openings; pectoral fins present and developed; snout and jaws moderately elongate; lips without numerous barbels or fringes; anterior nostrils opening via a tube; posterior nostrils opening into mouth or along lower edge of lip; eye moderately developed; gill openings lateral, elongate, nearly vertical and crescentic; teeth conical and numerous, but never caniniform; tail tip a finless point; and coloration variable, often marked, but generally uniform and darker dorsally.

REMARKS. — The genus *Ophichthus (sensu lato)* is the most speciose of ophichthids, with approximately 55 tropical and subtropical species worldwide. Several subgenera are recognizable within *Ophichthus,* though a worldwide revision has yet to be attempted (McCOSKER, 1977).

Ophichthus exourus sp. nov.

Figs 1-2a; Tabl. 1

MATERIAL EXAMINED AND TYPES. — 2 specimens.
New Caledonia. MUSORSTOM 4: stn CP 178, 18°56,30'S, 163°12,90'E, 520 m, 18.09.1985: holotype, 590 mm TL (MNHN 1995-425).
Fiji. Viti Levu, off Suva Barrier Reef, prawn trap set in 400 m, 28.08.1980: 1 paratype, 429 mm TL (CAS 89552).

OTHER MATERIAL EXAMINED. — *Ophichthus brachynotopterus*: Madagascar, 1971: 1 paratype, 442 mm TL (MNHN 1979-22); 1 paratype, 413 mm TL (MNHN 1979-23).
Ophichthys serpentinus: Cape of Good Hope, 1860: holotype, 495 mm TL (MCZ 9200).
Ophichthus mystacinus: holotype and paratypes, described below.

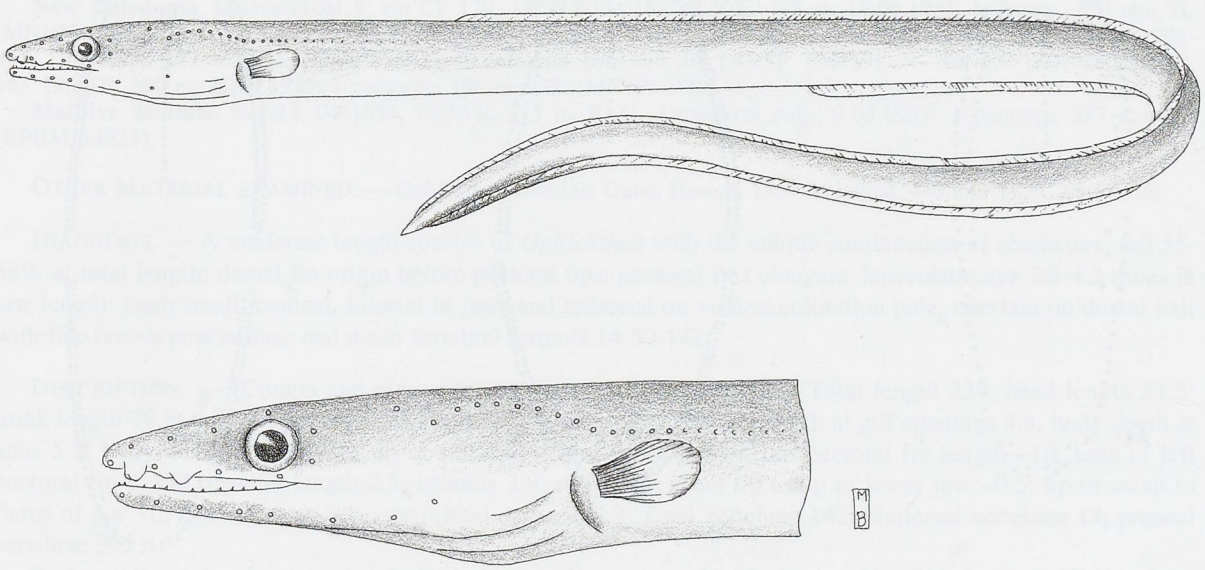

FIG. 1. — *Ophichthus exourus* sp. nov., holotype, 590 mm TL (MNHN 1995-425), New Caledonia, 18°56,30'S, 163°12,90'E, MUSORSTOM 4, stn CP 178, 520 m.

DIAGNOSIS. — A moderate length species of *Ophichthus* with the unique combination of characters: head and trunk robust, tapering evenly to tail tip; tail 59-60% of total length; dorsal fin origin in anterior third of trunk; pectoral fins small, paddle-shaped; jaw not elongate; eye large, above end of jaw; teeth conical, numerous and small, biserial in maxillary, uniserial on mandible and vomer; coloration yellowish tan, brown dorsally, the fins pale; and mean vertebral formula 20.5-60.5-176.5.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 590; head length 47.6; trunk length 185.4; tail length 357; body depth at gill openings 20; body width at gill openings 17; body depth at anus 15; body width at anus 14.5; tip of snout to dorsal fin origin 89; left pectoral fin length 12.7; base of left pectoral fin 4.5; gill opening length 6; isthmus 6.7; snout 13.5; tip of snout to rictus of jaw 17.9; eye diameter 6.1; interorbital distance 6.7. Total vertebrae 176; predorsal vertebrae 20; preanal vertebrae 61.

Body moderately elongate, its depth behind gill openings 26-29 times and width behind gill openings 35-38 times in TL. Body cylindrical anteriorly, laterally compressed in tail region, tapering evenly from robust head and trunk to much reduced tail tip. Head and trunk 2.5 times and head 12-12.5 times in TL. Head elongate, conical when viewed from above, somewhat flattened dorsally. Snout pointed, conical from above. Lower jaw reaches snout tip. Anterior nostrils in a short tube; posterior nostril in outer edge of upper lip and covered by a flap, appearing as a slit in the upper lip well before and beneath the orbit. A small but obvious protuberance in lip between anterior and posterior nostrils. Eye large, its posterior margin slightly behind rictus of jaw.

Median fins moderately developed. Dorsal fin origin above anterior third of trunk and less than a head length behind gill opening. Pectoral fins short and paddle-shaped. Median fins expanded before naked tail tip, lying within a groove.

Cephalic pores (Fig. 1) small and difficult to discern. Six mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 3 + 2 infraorbital, and single interorbital and supratemporal pores. Nine lateral line pores above branchial region. Lateral line pores of trunk and tail minute.

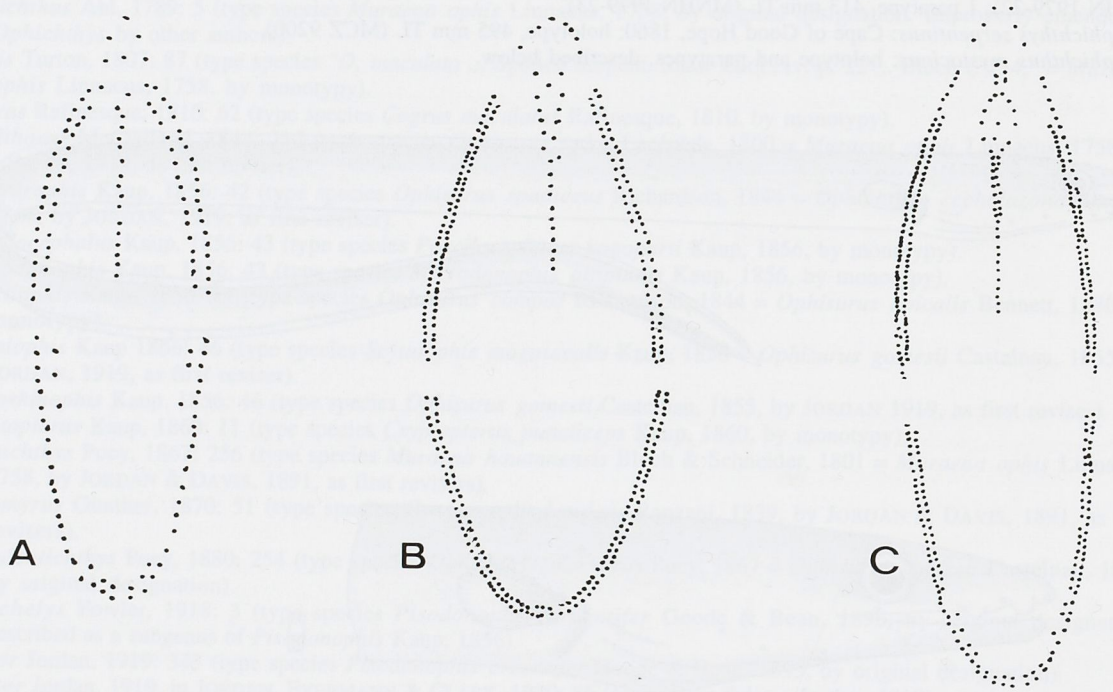

FIG. 2. — Schematic diagram of dentition of: **A**, *Ophichthus exourus* sp. nov., holotype, 590 mm TL (MNHN 1995-425); **B**, *O. genie* sp. nov., paratype, 337 mm TL (BPBM 34923); **C**, *O. mystacinus* sp. nov., paratype, 429 mm TL (CAS 89552).

Teeth (Fig. 2a) small, nearly equal in size, conical, and separated at their bases. A small rosette of 7 teeth at snout tip, followed by 15 neatly-aligned uniserial vomerine teeth. Maxillary teeth biserial, an outer row of 20-21 small teeth, flanked by 16 larger, more widely-spaced teeth. Lower jaw teeth uniserial, about 21-23 on each side, with 4-5 inner teeth scattered on inner edge.

Body coloration in ethyl alcohol yellow, overlain on upper flanks with a dusting of microscopic brown spots which are denser above the lateral midline. Median fins arise from pale longitudinal bands, the dorsal band becoming darker in posterior half of body such that fin appears as a sharp white line along the dorsum. Fins colorless except membrane of anal fin which is darkened before the tail tip. Peritoneum black.

SIZE. — To 669 mm. The holotype, 590 mm, and the paratype are females with developing ova, approximately 0.5 mm in diameter.

ETYMOLOGY. — From the Greek, *exourus*, ending in a tapered point.

DISTRIBUTION. — Known from the MUSORSTOM New Caledonia collections and from Fiji, between 450-520 m depth.

REMARKS AND COMPARISONS. — *Ophichthus exourus* is within the subgenus *Coecilophis* Kaup (*cf.* McCOSKER, 1977). It appears most closely related to the deepwater species *O. serpentinus* Seale (1917) from Madagascar, and *O. mystacinus*, described herein from deepwater off New Caledonia. I have compared the holotypes and paratypes of those species to the new species, and find *O. exourus* to differ from *O. brachynotopterus* and *O. mystacinus* by having a shorter pectoral fin and uniserial (rather than biserial) mandibular teeth. Both *exourus* and *serpentinus* have uniserial mandibular dentition, however they differ in their vomerine dentition (strictly uniserial vs. biserial anteriorly, respectively) and in their vertebral numbers (176-177 vs. 165-167, respectively).

Ophichthus genie sp. nov.

Figs 2b-3; Tabl. 1

MATERIAL EXAMINED AND TYPES. — 6 specimens.

New Caledonia. MUSORSTOM 4: stn CP 170, 18°57,00'S, 163°12,60'E, 485 m, 17.09.1985: holotype, 230 mm TL (MNHN 1998-43). — Stn CP 171, 18°57,80'S, 163°14,00'E, 435 m, 17.09.1985: 1 paratype, 217 mm TL (MNHN 1998-44); 1 paratype 232 mm TL (CAS 89551); 1 paratype 206 mm TL (ANSP 174853). — Stn CC 201, 18°55,80'S, 163°13,80'E, 500 m, 20.09.1985: 1 paratype, 196 mm TL (MNHN 1998-45).

Maldive Islands. Stn R3, 04°19'N, 72°55'E, 215 m, R. C. ANDERSON coll., 9.03.1991: 1 paratype 337 mm TL (BPBM 34923).

OTHER MATERIAL EXAMINED. — *Ophichthus kunaloa*: Oahu, Hawaii, 1969: holotype, 440 mm TL (CAS 29136).

DIAGNOSIS. — A moderate length species of *Ophichthus* with the unique combination of characters: tail 55-58% of total length; dorsal fin origin before pectoral tips; pectoral fins elongate, lanceolate; eye 2.8-4.2 times in jaw length; teeth small, conical, biserial in jaws and uniserial on vomer; coloration pale, overlain on dorsal half with fine brown punctations; and mean vertebral formula 14-57-142.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 230; head length 21.5; trunk length 79.5; tail length 129; body depth at gill openings 7.3; body width at gill openings 4.8; body depth at anus 5.9; body width at anus 4.5; tip of snout to dorsal fin origin 29; left pectoral fin length ~10; base of left pectoral fin 2; gill opening length 2.5; isthmus 3.9; snout 4.6; snout tip to tip of lower jaw ~0.5; tip of snout to rictus of jaw 10; eye diameter 3.1; interorbital distance 3.2. Total vertebrae 142; predorsal vertebrae 14; preanal vertebrae 59.

Body moderately elongate, its depth behind gill openings 31-42 times and width behind gill openings 35-54 times in TL. Body cylindrical in anterior trunk region, laterally compressed posteriorly. Head and trunk 2.2-2.4 times and head 10.0-10.7 times in TL. Snout short, broad and swollen in appearance at anterior nostril

bases. Lower jaw included, nearly reaches snout. Anterior nostrils in forward-directed tubes that reach snout tip; posterior nostril in lip, covered by a flap with an anterior barbel that extends to or below the lip (see Fig. 1). Eye large, its center above posterior 1/3 of upper jaw.

Dorsal fin low in anterior trunk region, elevated posteriorly. Its origin just in advance of end of pectoral rays. Pectoral fins elongate, lanceolate, the middle rays longest.

Cephalic pores (Fig. 3) very reduced but discernible. Six or seven mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 4 + 2 infraorbital, and single interorbital and supratemporal pores. Eight lateral line pores above branchial region. Lateral line pores of trunk and tail not possible to discern, minute and covered with a waxy exudate.

Teeth (Fig. 2b) small and conical, nearly subequal. An intermaxillary rosette of 7 teeth, followed by a gap, then a patch of 8 teeth followed by 15 uniserial vomerine teeth. Jaw teeth biserial, the rows irregular, each with approximately 38-40 pairs.

Body coloration of small (195-232 mm) specimens in ethanol pale yellow, overlain on snout, nape, and dorsal half with a fine peppering of minute brown punctations which end, particularly in smaller specimens, abruptly at the lateral line. All fins clear. Body coloration of largest specimen (337 mm) in isopropanol pale yellow, with a pale brown band across shoulders beginning behind temporal pore band, becoming diffuse in region of lateral line before end of pectoral fins. Cheeks bright yellow. Body and tail covered throughout with a fine peppering of minute brown spots. Peritoneum white with a fine gray/black speckling. Median fins and posterior half of pectoral fins clear.

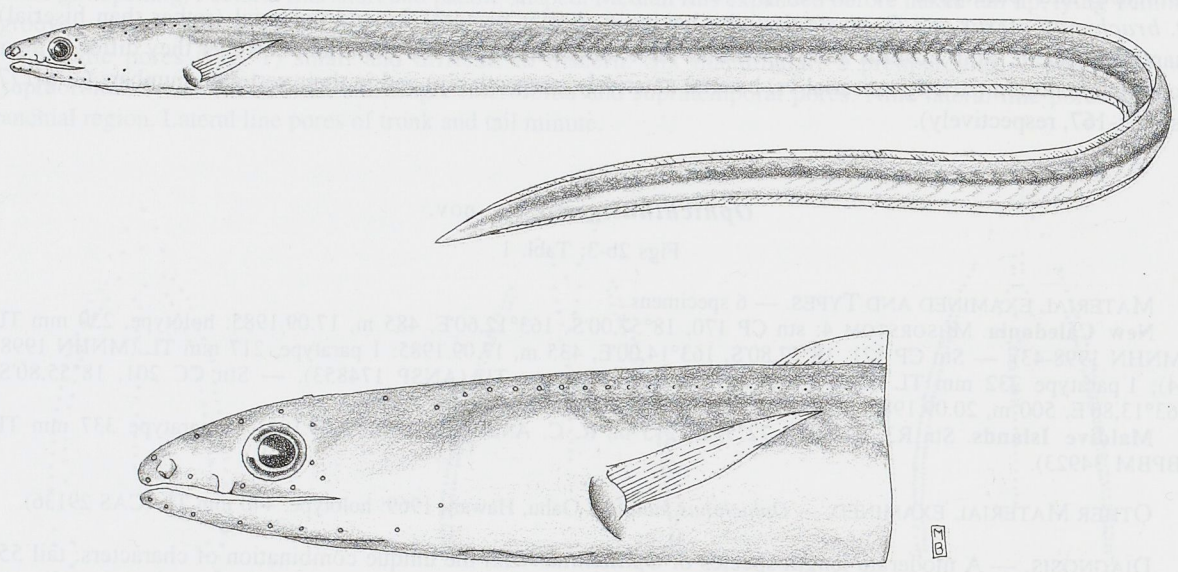

FIG. 3. — *Ophichthus genie* sp. nov., holotype, 230 mm TL (MNHN 1998-43), New Caledonia, 18°57,00'S, 163°12,60'E, MUSORSTOM 4, stn CP 170, 485 m.

SIZE. — To 337 mm. The holotype, 230 mm TL, is a female with developing ova (~0.5 mm egg diameter). The largest known specimen, BPBM 34923, is also a female with developing ova (slightly smaller in diameter than those of the holotype).

ETYMOLOGY. — Named in honor of Eugenia B. BÖHLKE, friend and contributor to knowledge of apodal fishes.

DISTRIBUTION. — Known from the type series, collected between 435-500 m depth in New Caledonia and from the Maldives.

REMARKS AND COMPARISONS. — The new species is similar to other species of *Ophichthus*, subgenus *Coecilophis* Kaup (*cf.* McCOSKER, 1977), which share a preference for deep sand and mud substrates. All possess small dentition, posterior nostrils along the lip (rather than opening into the mouth) and preceded by a flap, two rather than three preopercular pores, and a plain coloration, often with a dark smudge along the anal fin near the tail tip. Its closest relatives appear to be *O. kunaloa* McCosker, 1979, a deepwater Hawaiian species that has more vertebrae (MVF 17.5-66.5-183 vs. 14-57-142 for *O. genie*) and appears to be more robust (depth 27.5-31.5 times in total length vs. 31-42 times for *O. genie*).

	O. genie		*O. mystacinus*		*O. exourus*	
	mean	range	mean	range	mean	range
Total length (in mm)	-	196-337	-	336-429	-	590-669
Head/TL	96.8	93-101	110	107-117	82	81-83
Trunk/TL	334	317-356	295	293-298	318	314-321
Tail/TL	569	552-582	595	590-598	600	596-605
Depth/TL	30.2	24-32	40	36-43	36	34-38
DFO/TL	139	126-155	243	235-258	158	151-166
Pectoral fin/HL	423	388-471	430	392-458	283	267-300
Snout/HL	208	197-226	246	227-280	268	252-284
Upper jaw/HL	437	382-482	537	499-561	373	369-376
Eye/HL	134	115-144	126	110-141	120	112-128
IO/HL	117	101-156	142	119-170	138	135-141
Vertebrae						
Predorsal	14	12-16	33.8	31-35	20.5	20-21
Preanal	57	56-59	61.8	60-63	60.5	60-61
Total	143.3	139-147	172.8	169-174	176.5	176-177

TABLE 1. — Proportions (in thousandths) and counts of the holotypes and paratypes of *Ophichthus genie*, *O. mystacinus* and *O. exourus*. Abbreviations are: TL = total length; HL = head length; DFO = dorsal fin origin; IO = interorbital width.

Ophichthus mystacinus sp. nov.

Figs 2c, 4; Tabl. 1

MATERIAL EXAMINED AND TYPES. — 4 specimens.

New Caledonia. MUSORSTOM 4: stn CC 202, 18°58,00'S, 163°10,50'E, 580 m, 20.09.1985: holotype, 426 mm TL (MNHN 1998-46); 1 paratype, 429 mm TL (CAS 89552). — Stn CP 180, 18°56,0'S, 163°17,70'E, 450 m, 18.09.1985: 1 paratype, 336 mm TL (BPBM 37308). — Stn CC 201, 18°55,80'S, 163°13,80'E, 500 m, 20.09.1985: 1 paratype, 383 mm TL (MNHN 1998-47).

OTHER MATERIAL EXAMINED. — *Ophichthus brachynotopterus*: Madagascar, 1971: 1 paratype, 442 mm TL (MNHN 1979-22); 1 paratype, 413 mm TL (MNHN 1979-23).

DIAGNOSIS. — A moderate length species of *Ophichthus* with the unique combination of characters: tail 59-60% of total length; dorsal fin origin about mid-trunk; pectoral fins elongate, the central rays threadlike; jaw elongate; eye large; teeth conical, numerous and small, biserial in jaws and anteriorly on vomer; coloration yellowish tan, brown dorsally, the fins pale; and mean vertebral formula 33.8-61.8-172.8.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 426; head length 47.1; trunk length 125; tail length 254; body depth at gill openings 16; body width at gill openings 14; body depth at

anus 13; body width at anus 11; tip of snout to dorsal fin origin 110; left pectoral fin length 20.3; base of left pectoral fin 3.8; gill opening length 4.3; isthmus 8.7; snout 11; snout tip to tip of lower jaw 2.5; tip of snout to rictus of jaw 26; eye diameter 6; interorbital distance 5.6. Total vertebrae 174; predorsal vertebrae 35; preanal vertebrae 62.

Body moderately elongate, its depth behind gill openings 23-28 times and width behind gill openings 29-35 times in TL. Body cylindrical anteriorly, laterally compressed in tail region. Head and trunk 2.4-2.5 and head 8.6-9.3 in TL. Head elongate, conical when viewed from above, somewhat flattened dorsally. Snout pointed, sharply conical from above. Lower jaw nearly reaches snout tip. Anterior nostrils in a short tube; posterior nostril in upper lip and covered by a flap, appearing as a slit in the upper lip before and beneath the orbit. Eye large, its center above middle of upper jaw.

Median fins low and poorly developed, lying within a groove for most of their length. Dorsal fin origin just anterior to mid-trunk. Pectoral fins elongate, the central rays threadlike and longest. Median fins expanded before naked tail tip, lying within a groove.

Cephalic pores (Fig. 4) small and very difficult to discern. Six mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 4 + 2 infraorbital, and single interorbital and supratemporal pores. Nine lateral line pores above branchial region. Lateral line pores of trunk and tail minute, not possible to discern.

Teeth (Fig. 2c) small, nearly equal in size, conical and sharply pointed, and separated at their bases. A small rosette of 5 teeth at snout tip, followed by 12 neatly-aligned pairs extending nearly to mid-vomer, followed by about 14 uniserial teeth. Six uniserial, closely-spaced teeth in the outer row of the upper jaw, followed by two rows of about 45 teeth which form pairs for most of their length, the last few becoming more randomly placed. Lower jaw with about 4-5 pairs anteriorly, followed by a row of about 15 teeth, then about 25-30 irregular pairs.

Body coloration in ethyl alcohol tan, overlain with a dusting of microscopic brown spots which are denser above the lateral midline, giving the body and tail a brown dorsal cast. Area surrounding base of anterior nostril tubes has a high density of dark punctations, particularly as seen from above, appearing like a faint mustache. Chin, throat, belly, and lower edge of tail and tail tip yellow. Peritoneum white with a fine black speckling. Median fins clear. Pectoral fins yellow. The hindmost (ca. the length of the head) ventral surface of the tail is black, including a black smudge on the membrane of the anal fin.

SIZE. — To 429 mm. The holotype, 426 mm, is a male with undeveloped gonads.

ETYMOLOGY. — From the Greek, *mystacinus*, mustachioed.

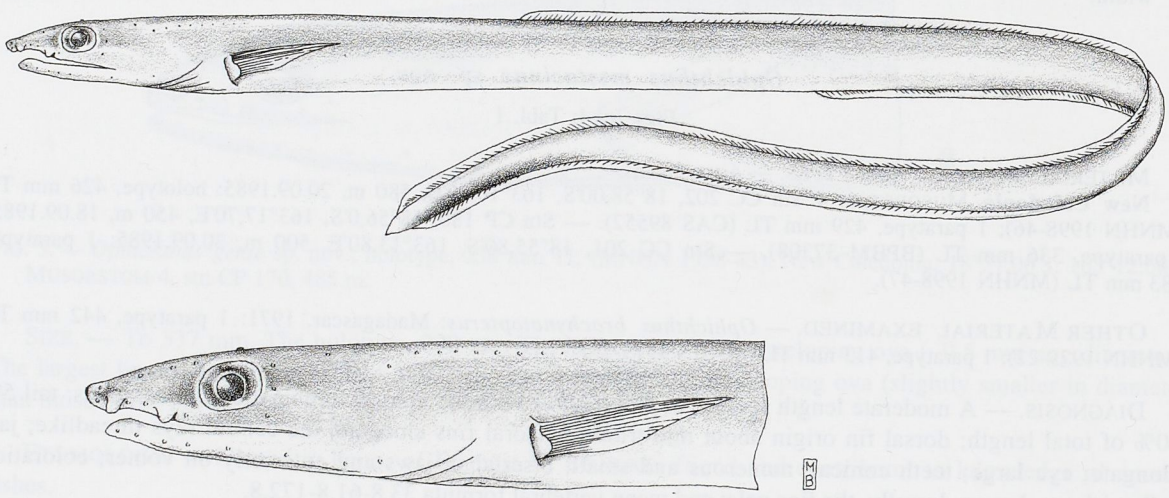

FIG. 4. — *Ophichthus mystacinus* sp. nov., holotype, 426 mm TL (MNHN 1998-46), New Caledonia, 18°58,00'S, 163°10,50'E, MUSORSTOM 4, stn CC 202, 580 m.

DISTRIBUTION. — Known only from the MUSORSTOM New Caledonia collections, between 450-580 m depth.

REMARKS AND COMPARISONS. — *Ophichthus mystacinus* is similar to other species of *Ophichthus* of the subgenus *Coecilophis* Kaup (*cf.* McCOSKER, 1977). It appears most closely related to *O. brachynotopterus* Karrer, 1982, a deepwater (355-478 m) species from northwest Madagascar. I have compared the paratypes of that species to the new species, and find *O. brachynotopterus* easily separable from *O. mystacinus* by the former's: vertebral number (178 vs. 169-174); shorter pectoral fin (3.6-4.0 times in head vs. 2.2-2.6); and shorter snout (4.6-4.7 times in head vs. 3.6-4.4). As well, *O. brachynotopterus* appears to have a somewhat shorter head and larger eye.

Genus ***RHINOPHICHTHUS*** nov.

TYPE SPECIES. — *Rhinophichthus penicillatus* sp. nov.

DIAGNOSIS. — Elongate ophichthids, subfamily Ophichthinae, tribe Ophichthini (sensu McCOSKER, 1977), with tail much longer than head and trunk; median fins low; dorsal fin arising behind pectoral fin; pectoral fin base arising above and occupying less than half of gill opening; gill openings lateral, elongate, nearly vertical and crescentic; eye moderately developed, above posterior third of jaw; jaws moderately developed, but not elongate; snout conical, tapering evenly to a sharp point; underside of snout separated in advance of anterior nostril bases exposing the teeth; teeth conical, numerous and small, uniserial or biserial; 2 preopercular pores; gill arches developed, similar to those of *Ophichthus*, however fifth ceratobranchial present and ossified as a thin rod for anterior 80 %, the remainder cartilaginous, and upper pharyngeal tooth plates fused. Other characters those of the two species.

ETYMOLOGY. — From the Greek, *rhinos*, snout, and *Ophichthus*, a genus of snake eel; gender masculine.

REMARKS. — In general appearance, the species of *Rhinophichthus* appear similar to that of the elongate-snouted species of *Ophisurus*. They differ in the condition of the snout (clavate rather than conical) and in their dentition (enlarged and fanglike, particularly those of the intermaxillary). With the exception of the condition of the snout and its associated tissues, *Rhinophichthus* is very similar to the generalized species of *Ophichthus*. The appearance of the snout of *Rhinophichthus* is more comparable to that of species within the tribe Sphagebranchini, particularly those of the genera *Apterichtus* and *Ichthyapus*. Those eels generally occupy shallow water sand habitats and are capable of burrowing quickly into the substrate with either end, an adaptation which I presume that *Rhinophichthus penicillatus* enjoys as well. Other adaptations displayed by the new species, such as the nearly uniform coloration, small and numerous teeth, fairly large eye, posterior nostril along upper lip and covered by a flap, and poorly developed median fins, are typical of other deep-dwelling ophichthids.

An additional taxon that I can assign to *Rhinophichthus* is *Ophichthys unicolor* Regan, 1908. It, and its synonym *Ophichthys algoensis* Barnard, 1925 (a replacement name for *Ophichthys triserialis* Barnard, 1923, preoccupied) were described from Algoa Bay, South Africa, from 40 and 50 fathoms, respectively (SMITH, 1962; McCOSKER & CASTLE, 1986). Differences between *O. unicolor* and the new species are described in the Remarks below. A complete osteological analysis of *Rhinophichthus* may demonstrate that its ancestry is shared with that of species of *Ophichthus*.

Rhinophichthus penicillatus sp. nov.

Figs 5-6a; Tabl. 2

MATERIAL EXAMINED. — 3 specimens.

New Caledonia. MUSORSTOM 4: stn CP 171, 18°57,80'S, 163°14,00'E, 435 m, 17.09.1985: holotype, 457 mm TL (MNHN 1998-48); 1 paratype, 359 mm TL (MNHN 1998-49); 1 paratype, 427 mm TL, gill arches removed and cleared and counterstained (CAS 89553).

OTHER MATERIAL EXAMINED. — *Ophichthys unicolor*: Algoa Bay, South Africa, 1906: holotype ~ 271 mm TL (BMNH 1906.11.19.39).

Ophichthys algoensis: Algoa Bay, South Africa, 1904: holotype, 300 mm TL (SAM 12776).

DIAGNOSIS. — An elongate ophichthine, genus *Rhinophichthus*, with the unique combination of characters: tail 66-67 % of total length: dorsal fin origin behind pectoral tips; pectoral fins small and paddle-shaped, not elongate; eye large; dentition small, conical and uniserial throughout; coloration pale, slightly darker dorsally, fins pale; and mean vertebral formula 12-54-173.

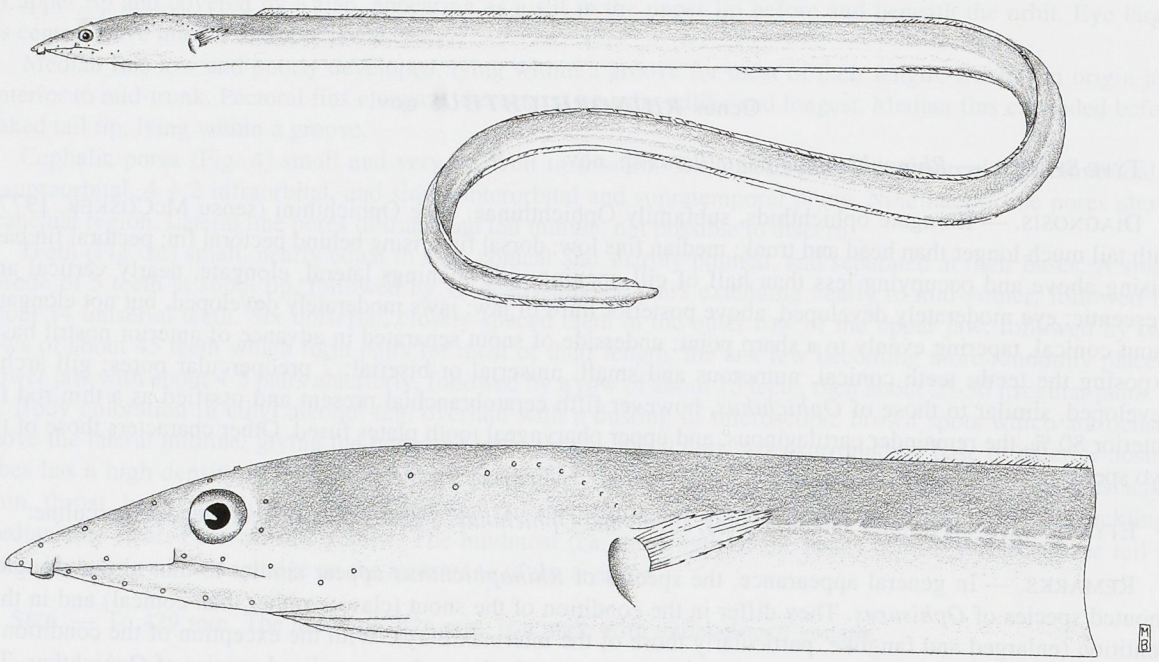

FIG. 5. — *Rhinophichthus penicillatus* sp. nov., holotype, 457 mm TL (MNHN 1998-48), New Caledonia, 18°57,80'S, 163°14,00'E, MUSORSTOM 4, stn CP 171, 435 m.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 457; head length 35; trunk length 119; tail length 303; body depth at gill openings 10.2; body width at gill openings 8.5; body depth at anus 10.5; body width at anus 9.5; tip of snout to dorsal fin origin 47; left pectoral fin length 6.7; base of left pectoral fin 2.3; gill opening length 5.2; isthmus 4.5; snout length 9.7; snout tip to tip of lower jaw 2.8; tip of snout to rictus of jaw 14.3; eye diameter 3.2; interorbital distance 3.4. Total vertebrae 173; predorsal vertebrae 12; preanal vertebrae 54.

Body elongate, its depth behind gill openings 45-53 times and width behind gill openings 39-59 times in TL. Body cylindrical, laterally compressed only posteriorly. Head and trunk 3 times and head 13-14 times in TL. Snout elongate, conical, and split on its underside with lateral folds extending ahead of the nostril bases. Lower jaw included, extending just beyond posterior base of anterior nostrils. Anterior nostrils tubular; posterior nostril in upper lip, visible externally as a slit beneath anterior edge of orbit. Eye large, the posterior edge of the orbit only slightly in advance of corner of jaw. Branchial basket expanded; head shape evenly tapered.

Median fins low, lying within a groove and slightly expanded before tail tip. Dorsal fin origin behind pectoral tips. Pectoral fins small and paddle-shaped, their central rays the longest. Caudal fin tip naked, pointed but not sharp.

Cephalic pores small but visible (Fig. 5). Six mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 4 + 2 infraorbital, and single interorbital and supratemporal pores. Seven lateral line pores above branchial region. Lateral line pores of trunk and tail too small to accurately discern.

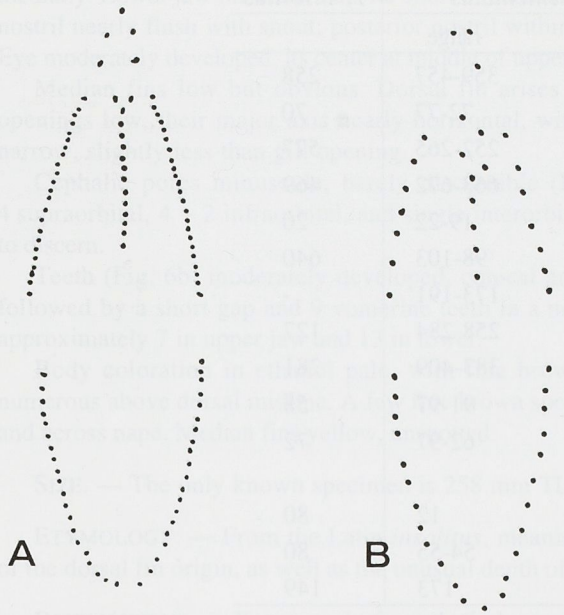

FIG. 6. — Schematic diagram of dentition of holotypes of **A**, *Rhinophichthus penicillatus* sp. nov., 457 mm TL (MNHN 1998-48), and **B**, *Yirrkala insolitus* sp. nov., 258 mm TL (MNHN 1998-50).

Teeth (Fig. 6a) small, conical and nearly subequal, evenly spaced but not close-set. A narrow rosette of 5 teeth just behind snout tip, followed by a space, 3 teeth, and 12 uniserial vomerine teeth. Jaw teeth neatly uniserial; 20-22 in upper jaw and 15-17 in lower jaw.

Body coloration in ethanol uniformly pale yellow, overlain on upper half of head, trunk, and tail with numerous fine brown punctations. Chin, throat, belly and underside of snout pale. Peritoneum white. All fins clear.

SIZE. — The largest known specimen, the holotype, is 457 mm long. It is a female with developing ova (egg diameter ~0.5 mm).

ETYMOLOGY. — From the Latin *penicillus*, a pencil, and *-atus*, having the nature of, in reference to the sharpened-pencil appearance of both ends of this eel.

DISTRIBUTION. — Known only from the MUSORSTOM New Caledonia collections, from 435 m depth.

REMARKS AND COMPARISONS. — The new species is easily separable from any known ophichthid. Although quite generalized in most of its external morphology, its conical snout and other ophichthin characters are shared only by the poorly-known *Ophichthus unicolor* Regan, which I assign to the genus *Rhinophichthus*. I examined the dried and poorly-preserved holotype of *O. unicolor* in 1982 and recently compared the holotype of its synonym, *Ophichthys algoensis* Barnard, to specimens of *R. penicillatus*. *R. unicolor* differs in having fewer vertebrae (156 vs. 173) and biserial rather than uniserial dentition.

Genus *YIRRKALA* Whitley, 1940

Yirrkala Whitley, 1940: 410 (type species *Y. chaselingi* Whitley, 1940, by original designation).
Pantonora Smith, 1964: 719 (type species *Ophichthys tenuis* Günther, 1870, by original designation).

DIAGNOSIS. — Ophichthin eels, tribe Sphagebranchini, with the following characteristics: body elongate, cylindrical, shorter than tail; snout conical; dorsal fin arises above head, along trunk, or above anus; pectoral fins absent; gill openings ventral, longer than isthmus; teeth conical, generally uniserial; coloration usually uniform or darker dorsally, although striped in one species.

REMARKS. — In earlier works (McCOSKER, 1977: 69; McCOSKER & CASTLE, 1984: 185), I considered the type species, *Y. chaselingi*, to be a junior synonym of *Sphagebranchus lumbricoides* Bleeker. Subsequent examination of additional material has demonstrated that WHITLEY's *chaselingi* is a valid species. My revision of the genus, recognizing approximately 10 valid Indo-Pacific species, is currently in preparation.

The new species shares all of the external morphological characteristics of the genus *Yirrkala*, however its dorsal fin origin is far posterior to that of its congeners. Such a condition is not significant enough to merit generic recognition, and that character state within the genus should therefore be expanded to range from before the gill openings to above the anus.

	R. penicillatus		*Y. insolitus*
	mean	range	
Total length (in mm)	-	359-457	258
Head/TL	75	72-77	70
Trunk/TL	259	252-265	577
Tail/TL	666	663-672	469
Depth/TL	21	19-22	20
DFO/TL	101	98-103	640
Pectoral fin/HL	182	173-191	-
Snout/HL	273	258-284	127
Upper jaw/HL	395	383-409	281
Eye/HL	95	91-97	58
IO/HL	81	62-97	72
Vertebrae			
Predorsal	12	12	80
Preanal	54.7	54-55	80
Total	173	173	149

TABLE 2. — Proportions (in thousandths) and counts of the holotype and paratypes of *Rhinophichthus penicillatus* and the holotype of *Yirrkala insolitus*. Abbreviations are: TL = total length; HL = head length; DFO = dorsal fin origin; IO = interorbital width.

Yirrkala insolitus sp. nov.

Figs 6b-7; Tabl. 2

MATERIAL EXAMINED. — 1 specimen.

New Caledonia. MUSORSTOM 4: stn CP 148, 19°23,40'S, 163°31,90'E, 59 m, 14.09.1985: holotype, 258 mm TL (MNHN 1998-50).

OTHER MATERIAL EXAMINED. — *Yirrkala chaselingi*: Queensland, Australia: holotype, 610 mm TL (AM IB.481).
Sphagebranchus gjellerupi: New Guinea, 1910: holotype, 153 mm TL (ZMA 104.146).
Sphagebranchus lumbricoides: Timor: holotype, 230 mm TL (BMNH 1867.11.28.300).
Ophichthys misolensis: Misol Island: holotype, 283 mm TL (BMNH 1870.8.3.112).
Dalophis moluccensis: Ceram: holotype, 405 mm TL (BMNH 1867.11.28.289).
Ophichthys tenuis: locality unknown, possibly Mauritius: lectotype ~530 mm TL (BMNH 1965:1.2.1).
Ophichthys timorensis: Timor: holotype ~205 mm TL (BMNH 1867.11.28.322).

DIAGNOSIS. — An elongate species of *Yirrkala* with the unique combination of characters: head 7% of total length (TL); tail 47% of TL; dorsal fin origin above anus; teeth conical, moderately developed, uniserial on jaws and vomer; coloration pale, overlain with fine brown punctations above midline; and vertebral formula 80-80-149.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 258; head length 18; trunk length 149; tail length 121; body depth at gill openings 5.3; body depth at anus 4.6; body width at gill openings 3.3; body width at anus 3.3; origin of dorsal fin 165; left gill opening length 1.4; isthmus 1.2; snout length 2.3; snout tip to tip of lower jaw ~ 1.8; tip of snout to rictus of jaw 5.0; eye diameter 1.0; interorbital distance 1.3. Total vertebrae 149; predorsal vertebrae 80; preanal vertebrae 80.

Body very elongate, its depth at gill openings 49 times in TL, tapering posteriorly to an acute, finless point. Body and tail nearly cylindrical throughout, becoming laterally compressed in posterior 10%. Head and trunk 1.55 times and head 14.3 times in TL. Snout acute at tip, conical from above, rounded on underside and split

medially. Lower jaw included, falls far short of anterior nostril edge and barely exceeds anterior pupil edge. Anterior nostril nearly flush with snout; posterior nostril within upper lip, visible externally as a slit beneath center of eye. Eye moderately developed, its center at middle of upper jaw.

Median fins low but obvious. Dorsal fin arises above level of anus and ends 1/2 HL from tail tip. Gill openings low, their major axis nearly horizontal, without an anterior lateral membrane or duplication. Isthmus narrow, slightly less than gill opening.

Cephalic pores minuscule, barely discernible (Fig. 7). Four mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 4 + 2 infraorbital, and single interorbital and supratemporal pores. Lateral line pores not possible to discern.

Teeth (Fig. 6b) moderately developed, conical and uniserial. An anterior chevron of 3 intermaxillary teeth, followed by a short gap and 9 vomerine teeth in a nearly uniserial row, descending in size. Jaw teeth uniserial, approximately 7 in upper jaw and 13 in lower.

Body coloration in ethanol pale, with fine brown punctations above the lateral midline, becoming more numerous above dorsal midline. A few fine brown spots on throat and chin, forming fine dotted lines between eyes and across nape. Median fins yellow, unspotted.

SIZE. — The only known specimen is 258 mm TL, a female with unripe gonads.

ETYMOLOGY. — From the Latin *insolitus*, meaning unusual or strange, in reference to the posterior location of the dorsal fin origin, as well as the unusual depth of capture of an *Yirrkala*.

DISTRIBUTION. — Known only from the holotype, from 59 m off New Caledonia.

REMARKS AND COMPARISONS. — The new species differs from all its known congeners in the location of its dorsal fin origin, far posterior to that of all other species. Other body characteristics differ little from the condition of other known species of *Yirrkala*, and I find no reason to not consider it congeneric. Its habitat is deeper than that of most of its congeners, which are known from shallow water sand and mud bottoms, and some enter freshwater streams.

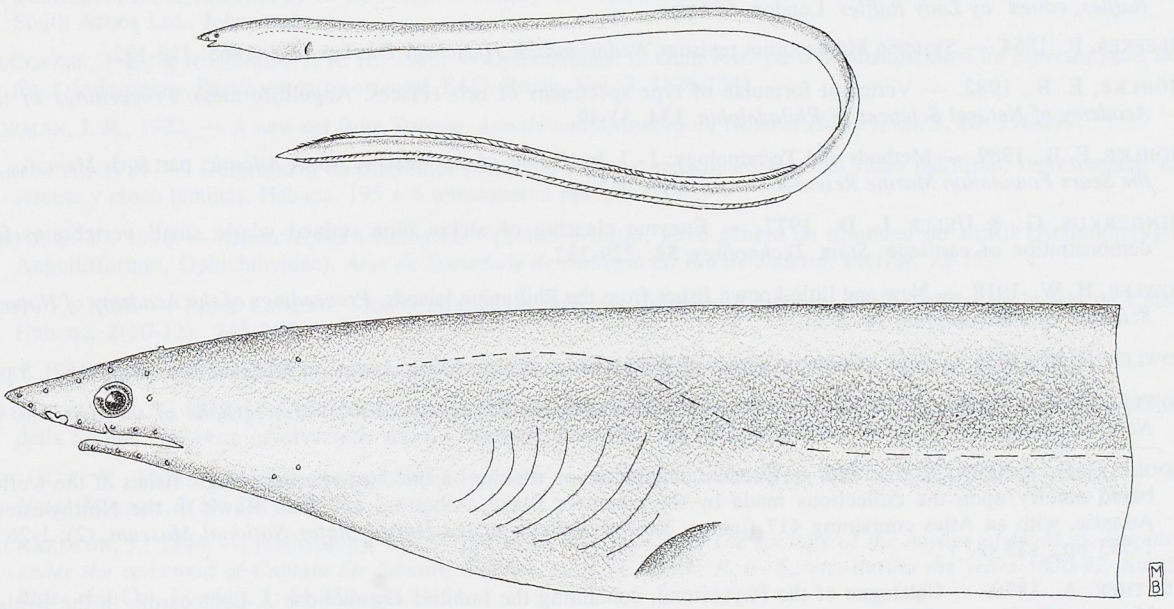

FIG. 7. — *Yirrkala insolitus* sp. nov., holotype, 258 mm TL (MNHN 1998-50), New Caledonia, 19°23,40'S, 163°31,90'E, MUSORSTOM 4, stn CP 148, 59 m.

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