Article

A review of the genus *Neoconger* (Anguilliformes: Moringuidae), with the description of a new species

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Abstract

The genus *Neoconger* (family Moringuidae) is reviewed and our knowledge of it brought up to date. Six species are recognized, based on genetic and morphological information. *Neoconger mucronatus* Girard, 1858 occurs in the western Gulf of Mexico. *Neoconger torrei* (Howell Rivero, 1932) occurs in the Caribbean and along the coast of the Guianas. *Neoconger anaelisae* (Tommasi, 1960) occurs along the northern coast of Brazil. *Neoconger hygomi* n. sp. is described from a single specimen collected many years ago off Brazil's southern coast. It is distinguished from the other species by the number of predorsal vertebrae (48 vs 32–45) and preanal vertebrae (55 vs 41–49). *Neoconger vermiformis* Gilbert, 1890 occurs in the eastern Pacific from the northern Gulf of California to Panama and northern Colombia. *Neoconger tuberculatus* (Castle, 1965) is known from two larvae collected off southeastern Australia. In addition, another species known only from larvae is reported from the Caribbean but is not named.

Key words: Taxonomy, Pisces, Anguilliformes, Moringuidae, *Neoconger*, review

Introduction

The Moringuidae is a family of burrowing eels that inhabit tropical oceans worldwide with the apparent exception of the eastern Atlantic. Two genera are currently recognized. *Neoconger* is characterized by the anus near midlength (see definition below) the dorsal-fin origin (DFO) over or before the level of the anus, and the upper and lower jaws nearly equal in length. *Moringua* has the anus behind midlength and the DFO distinctly behind the anus; the lower jaw is usually longer than the upper jaw. *Moringua* is known for its extreme ontogenetic variation in morphology. Immatures, mature males, and mature females differ so greatly in appearance that distinct generic names have been applied to them in the past. In *Neoconger*, these variations are much less. Except for the final stages of maturity, individuals of both genera spend most of their time buried in bottom sediment, *Moringua* chiefly in sand and *Neoconger* in mud.

The genus *Neoconger* along with its single included species, *N. mucronatus*, was described in 1858 by Girard from specimens collected at St. Joseph's Island, Texas by the United States and Mexican Boundary Survey conducted in

1848–1855. He did not assign it to a family and did not list the specimens upon which it was based. Those specimens were deposited in the Smithsonian Institution under the catalog number USNM 861. There were originally five specimens; one of these was transferred to the Museum of Comparative Zoology at Harvard University (MCZ 36006). Smith & Castle (1972) selected one of the remaining four specimens as the lectotype, and the remaining three specimens were removed and recatalogued as paralectotypes under USNM 204928. Although Girard did not assign his species to a family, the name suggests that he considered it to belong in the Congridae. Later authors placed it variously in the Muraenesocidae (Jordan & Evermann 1896) and Echelidae (Howell Rivero 1932), both poorly defined families which contained a heterogeneous assemblage of species.

Gilbert (1890) described the second species in the genus, *N. vermiformis*, from the Gulf of California in the eastern Pacific. Although the specimens clearly belong to *Neoconger*, Gilbert for some reason compared his new species to *Neoconger perlongus* Poey, which is actually an ophichthid and a synonym of *Myrophis punctatus* (Smith & Castle 1972: 207).

Howell Rivero (1932) was apparently unaware of *Neoconger* when he described a specimen from Cuba as a new genus and species, *Chrinorhinus torrei*.

Ginsburg (1951) examined a number of specimens of *N. mucronatus* and gave the most complete account of the species to that date. He synonymized *Chrinorhinus* (see below) with *Neoconger* and questioned the validity of the species *torrei*.

Tommasi (1960) described a larva collected off northeastern Brazil as *Leptocephalus anaelisae*, He did not assign it to a family, but the illustration clearly shows a larval *Neoconger* (see Figure 11).

Finally, Castle (1965) described two larval specimens from New South Wales, Australia as *Leptocephalus tuberculatus*. These remain the only confirmed records of the genus from outside the Western Hemisphere.

Smith & Castle (1972) studied the genus in detail and determined that it belongs in the Moringuidae. They recognized three species: *Neoconger mucronatus* in the western Atlantic, *N. vermiformis* in the eastern tropical Pacific, and *N. tuberculatus* off eastern Australia.

Smith (1989a) included data on additional specimens from the Gulf of Mexico, Puerto Rico and Brazil. He also (Smith 1989b) included data from leptocephali, which are much more numerous in collections than adults. These data indicate four distinct populations in the Western North Atlantic: one in the western Gulf of Mexico, one in the Caribbean, one in the Amazon region of Brazil, and one in the Brazilian South Atlantic. He suggested that these populations might represent distinct species, but refrained from describing them based on the limited evidence available.

The advent of genetic sampling in the years since suggests that many of the presumed species of fishes in this area actually represent complexes of genetically as well as morphologically distinct species. The collection of new specimens on the north coast of Brazil (Marceniuk *et al*. 2019) has allowed us to obtain a COI sequence and compare it to a larval specimen collected in the Gulf of Mexico. This comparison confirms that those two specimens represent distinct species. In this paper, we describe the Amazonian specimens in detail and apply a name to them. The correlation between genetic and morphological distinction indicates that the other two populations also represent distinct species. In addition to those, Smith (1989b) described a larva that does not match any of the previously known species. In this paper, we describe all these species and apply names to those for which we have adult specimens. The one species that does not have an existing name available is described as new.

We also include a discussion of the two nominal species in the Pacific, thus bringing our knowledge of this genus up to date. More work undoubtedly remains to be done, but the present study represents a significant advance and a new starting point.

Methods and materials

Measurements are as follows. Total length (TL) from tip of snout to tip of tail, including caudal fin; preanal length from tip of snout to anus; head length (HL) from tip of snout to upper edge of pectoral-fin base; predorsal length from tip of snout to origin of dorsal fin; midlength refers to the point midway between the tip of the snout and the end of the tail including the caudal fin; body depth measured at anus; snout length from tip of snout to anterior margin of eye; eye diameter measured horizontally; snout to rictus from tip of snout to angle of mouth; interorbital width dorsal distance between clear margins of eyes; pectoral-fin length from base of dorsal-most ray to tip of longest

ray; gill opening measured between upper and lower ends; interbranchial distance measured between lower ends of gill openings. Predorsal vertebrae are those from the first vertebra back to and including the one intersected by a vertical line from the base of the first dorsal-fin ray; preanal vertebrae are those from the first vertebra back to and including the one intersected by a vertical line from the base of the first anal-fin ray; precaudal vertebrae are those from the first vertebra back to and including the first vertebra with a closed haemal arch; total vertebrae include the hypural plate as a single vertebra. The larval form of eels and their relatives is referred to as leptocephalus (pleural leptocephali), which was the name originally given to them before their identity was known. LVBV (last vertical blood vessel) refers to the last (posteriormost) vertical blood vessel in larvae. Depth of capture of specimens is given in fathoms (fm) or meters (m).

The presentation of the species accounts is arranged geographically rather than alphabetically or chronologically, beginning in the Gulf of Mexico and proceeding southward through the Caribbean Sea and coast of South America, and westward to the Pacific. This is done because geographic distribution is the most important factor in speciation and should be emphasized.

Institutional abbreviations are as follows. AMS, Australian Museum, Sydney; ANSP, Academy of Natural Sciences of Drexel University, Philadelphia; BOLD (Barcode of Life Database); CAS California Academy of Sciences, San Francisco; CAS-SU, Stanford University, now housed at CAS; DPND, Project Deepend, Nova Southeastern University, Florida; FLMNH, Florida Museum of Natural History, Gainesville; FSBC, Florida State Board of Conservation, Tallahassee; MCZ, Museum of Comparative Zoology, Harvard University; TCWC, Texas Cooperative Wildlife Commission, Texas A & M University; UMML, University of Miami Marine Laboratory (now Rosenstiel School of Marine, Atmospheric, and Earth Science); USNM, National Museum of Natural History, Smithsonian Institution; ZMUC, Natural History Museum of Denmark.

A COI sequence (578 pb) was obtained from a specimen from the Brazilian coast off the mouth of the Amazon (MPEG 38951) and compared with sequences of two leptocephali from the eastern Gulf of Mexico and the Yucatan Channel obtained from GenBank/BOLD (Table 1). Vouchers and tissues of the specimen sequenced here were deposited in the fish collection of the Museu Paraense Emílio Goeldi (MPEG) in Belém, Pará, Brazil, the Laboratory for Fish Biology and Genetics (LBP) of the Department of Morphology of Universidade Estadual Paulista (UNESP) in Botucatu, São Paulo, Brazil, and Zoological collection at Santa Cecília University (AZUSC) in Santos, São Paulo, Brazil. Genomic DNA was obtained using the DNeasy Blood and Tissue Kit (Qiagen), according to the manufacturer instructions. Mitochondrial COI gene was amplified by PCR using the FishF1 and FishR1 primers (Ward *et al*. 2005). Amplifications were performed in a total volume of 12.5 μl with 1.25 μl of 10X buffer (10 mM Tris - HCl+15 mM MgCl2), 0.5 μl dNTPs (200 nM of each), 0.5 μl of each primer (5 mM), 0.05 μl Platinum® Taq Polymerase (Invitrogen - 5 units – μl), 1 μl template DNA (12 ng), and 8.7 μl ddH2O. The amplification protocol consisted of initial denaturation at 95 °C for two minutes, followed by 35 cycles of denaturation at 94 °C for 30 seconds, hybridization at 64 °C for one minute, extension at 72 °C for one minute and final extension at 72 °C for ten minutes. All PCR products were first visually identified on a 1% agarose gel and then purified using ExoSap - IT® (USB Corporation) following manufacturer instructions. The purified PCR products were sequenced using the "Big DyeTM Terminator v 3.1 Cycle Sequencing Ready Reaction Kit" (Applied Biosystems), purified again by ethanol precipitation and loaded on an automatic sequencer 3130 - Genetic Analyzer (Applied Biosystems).

Consensus sequences from forward and reverse strands were obtained using Geneious Pro 8.1.8 (Kearse *et al*. 2012). Alignments were generated using MUSCLE algorithm (Edgar 2004) under default parameters. After alignment, the matrix was checked by eye for any obvious misalignments, and to detect potential cases of sequencing errors. The presence of stop codons was checked using Geneious. The genetic distances (K2P) (Kimura 1980) were executed in the program Mega 6.06 (Tamura *et al*. 2013).

TABLE 1. Genbank and BOLD number of sequences used in the present study. The specimens listed in GenBank/BOLD as *Neoconger mucronatus* are actually *Neoconger torrei*. See text.

Species identification		Locality	GenBank/BOLD Accession Number
Present Study	**GenBank/BOLD**		
Neoconger anaelisae	*Neoconger* sp.	Pará, Brazil	MW386164
Neoconger torrei	*Neoconger mucronatus*	Quintana Roo, Mexico	GU224984.1
Neoconger torrei	*Neoconger mucronatus*	Gulf of Mexico, USA	MG856392.1

Genus *Neoconger* Girard, 1858

Neoconger Girard, 1858: 171. Type species *Neoconger mucronatus* Girard, 1858 by monotypy. Masculine.
Chrinorhinus Howell Rivero, 1932. Type species *Chrinorhinus torrei* Howell Rivero, 1932 by monotypy. Masculine.
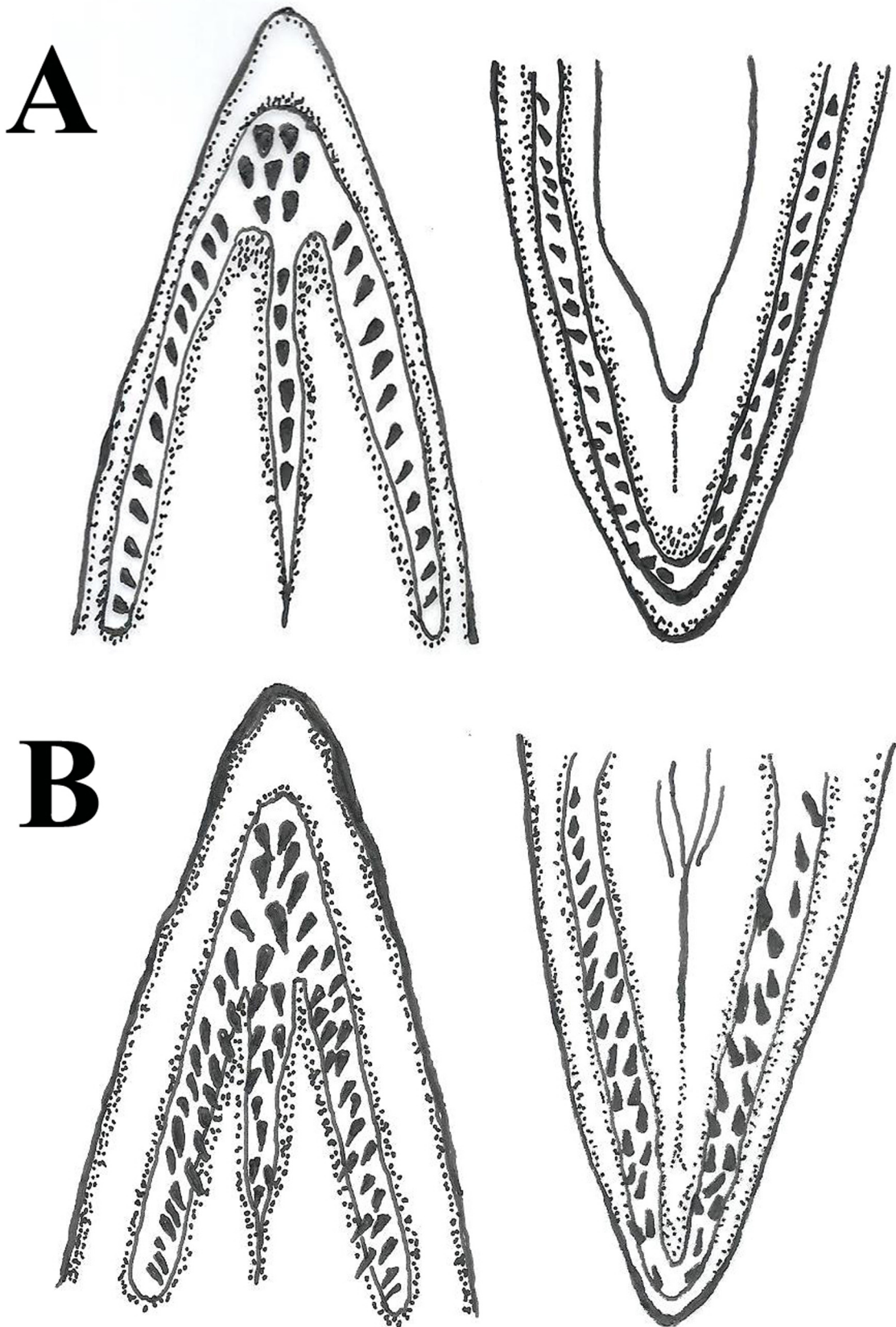

FIGURE 1. Tooth patterns in species of *Neoconger*. A, teeth in one row. B, teeth in two rows.

Characters (after Smith 1989a). Body moderately elongate, cylindrical anteriorly, strongly compressed near end of tail; anus near midlength; tip of tail soft and blunt, caudal fin well developed and not stiffened. Dorsal and anal fins low and fleshy, confluent with caudal fin; dorsal fin begins over or somewhat anterior to level of anus; pectoral fin small but not rudimentary. Gill opening crescentic and transverse, on lower half of side, upper corner touching middle to upper edge of pectoral-fin base. Lateral line incomplete, ending near level of anus, pores increasing in number with growth, up to a point; head pores present only on lower jaw.

Head conical and smoothly tapering anteriorly, tip of snout projecting slightly beyond lower jaw, rictus behind level of eye. Eye small, covered by transparent skin, larger in mature males. Anterior nostril on side of snout somewhat behind tip, without a tube in females and immatures, becoming tubular in mature males. Posterior nostril larger, immediately before eye, elongate in an anteroventral to posterodorsal direction, with a raised rim higher on anterior side, lower at posterodorsal corner. Upper lip continuous with skin of cheek; lower lip separated from skin of jaw by a slight groove. Tongue adnate.

Stomach moderate in length, ending before anus. Gas bladder very small, thin-walled, near anus.

Teeth small, smooth, pointed, recurved (Fig. 1). Maxillary and dentary teeth in one or two rows (usually one). Intermaxillary teeth somewhat larger, in two or three irregular rows, not separated from maxillary and vomerine teeth. Vomerine teeth in one or two rows, reaching almost to posterior end of maxillary row.

Color gray or grayish brown with no spots, stripes, or other distinctive markings.

Maximum size about 300 mm TL.

Some sexual dimorphism is present. Like the related genus *Moringua*, males appear to be smaller than females. Two mature males of *Neoconger mucronatus* measured 107 and 159 mm in TL. Eleven confirmed females measured 187–302 mm. See further details under *N. mucronatus*.

Distribution. Known from tropical and subtropical waters in the western Atlantic, eastern Pacific, and western Pacific off southeastern Australia, at depths of less than 200 m.

Habits and behavior. All evidence suggests that juvenile and pre-spawning adult *Neoconger* spend most of their time buried in the sediment and come out only for a brief time to feed and spawn (Smith 1989: 62). Unlike *Moringua*, *Neoconger* prefers mud rather than sand (Smith 1989a; Smith & Castle 1972). This may explain the relative rarity of specimens in collections. Their fossorial habits would render them largely inaccessible to trawl nets. Divers spend little time making rotenone collections in barren muddy habitats, and would thus be unlikely to collect them. The relative abundance of larvae compared to adults indicates that these eels are more common than they seem.

Species. Three species have previously been recognized in this genus: *Neoconger mucronatus* Girard, 1858 in the western Atlantic from the Gulf of Mexico to Brazil; *Neoconger vermiformis* Gilbert, 1890 in the eastern Pacific from the northern Gulf of California to Panama and northern Colombia; and *Neoconger tuberculatus* (Castle 1965), known only from two leptocephali collected off New South Wales, Australia. The species are all much alike in general appearance, differing only in certain meristic and morphometric characters

The record of an adult *Neoconger* from Fiji reported by Smith (1989a: 60) is erroneous. The specimen in question, CAS 217641, is not *Neoconger* but a member of the *Moringua raitaborua* group. These eels are characterized by low vertebral counts, relatively stout body, and jaws nearly equal in length. They differ from *Neoconger* in having the anus well behind midlength and the DFO behind the anus.

Etymology. From the Latin *neo*, new, and *Conger*, a genus of eels. Apparently referring to a resemblance to the Congridae.

Neoconger mucronatus Girard, 1858
(Figures 2, 4, 9; Tables 2, 3)

Neoconger mucronatus Girard, 1858: 171; St. Josephs Island, Texas, lectotype USNM 861. Smith & Castle 1972: 200 (redescription, synonymy, lectotype designation, osteology, life history). Smith 1989a: 60 (updated account with additional material and analysis).

Study material (18 specimens, 98–302 mm TL). LECTOTYPE: USNM 861 (female, 302), St. Joseph Island, Texas. PARALECTOTYPES: MCZ 36006 (1, 267), same data as lectotype. USNM 204928 (3 females, 263–267), same data as lectotype. OTHER MATERIAL: ANSP 94213 (1 female, 256), 28° 01.5'N, 96° 48.5'W, 7 fm (12.8

m), 15 Aug 1960, Oregon 2916. ANSP 110071 (1, 265[+]), 27° 45'N, 96° 10'W, 40–45 fm (73.2–82.3 m), 2 Feb 1958, Silver Bay 276. ANSP 136001 (1, 176), Texas. FSBC 9078 (1 male, 159), off Port Mansfield, Texas, 35 fm (64.0 m), 7 Sep 1975. TCWC 3981.1 (1 male, 107), 25° 20.0'N, 97° 02.0'W, 40–45 m, 10-ft otter trawl, 18 Nov 1975. TCWC 6097.1 (6 females, 187–265), 18° 50.0' N, 93° 43.0' W, 158–170 m, 10-ft otter trawl, 12 Nov 1975. USNM 154997 (1 female [?], 98), 27° 03' 30" N, 97° 04' 38" W, 18 fm (32.9 m), 17 Feb 1939, Pelican 121-4. USNM 154998 (1 female, 209), 27° 46' N, 96° 55' 30" W, 11 fm (20.1 m), 20 Apr 1938, Pelican 38-2. Uncatalogued (1, cleared and stained), no data.

FIGURE 2. *Neoconger mucronatus*, paralectotype, MCZ 36006.

Diagnosis. *Neoconger mucronatus* differs most distinctly from the geographically adjacent *Neoconger torrei* in the total number of vertebrae, 94–99 vs 104–107 respectively. It differs from *N. anaelisae* in the number of predorsal vertebrae (38–44 vs 32–34). It differs from *N. hygomi* in the number of predorsal vertebrae (38–44 vs 48), preanal vertebrae (43–47 vs 55), precaudal vertebrae (ca. 50–52 vs 58), and total vertebrae (94–99 vs 107). It differs from *N. vermiformis* in the number of predorsal vertebrae (38–44 vs 34–38), preanal vertebrae (43–47 vs 41–44), and

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precaudal vertebrae (ca. 50–52 vs 45–ca 49). Larvae have a sharp intestinal loop; the posterior lateral melanophore is present, the anterior ventral melanophore is absent.

Description. See genus account for general appearance. Morphometric characters in % TL: preanal length 48.4–53.5, predorsal length 45.3–54.2, head length 8.9–11.1, depth at anus 2.9–4.8. In % HL: snout 17.8–21.9, eye 7.8–8.2 in males and 3.1–7.1 in females, snout-rictus 27.6–31.9, gill opening 9.5–18.5, interbranchial 9.4–11.2 in males and 11.8–18.5 in females, pectoral-fin length 32.7–34.5 in males and 17.0–24.5 in females. Meristic characters: lateral-line pores 22–40, mandibular pores 6, pectoral-fin rays 9–12, predorsal vertebrae 38–44, preanal vertebrae 43–47, total vertebrae 94–99, precaudal vertebrae ca. 50–52.

Mandibular pores arranged as follows (Fig. 4). First pore at level of anterior nostril. Second pore slightly posterior to level of anterior nostril. Third pore slightly anterior to level of posterior nostril. Fourth pore between level of anterior nostril and anterior margin of eye. Fifth pore directly below eye. Sixth pore behind level of eye, approximately below level of rictus.

TABLE 2. Numbers of vertebrae in species of *Neoconger*

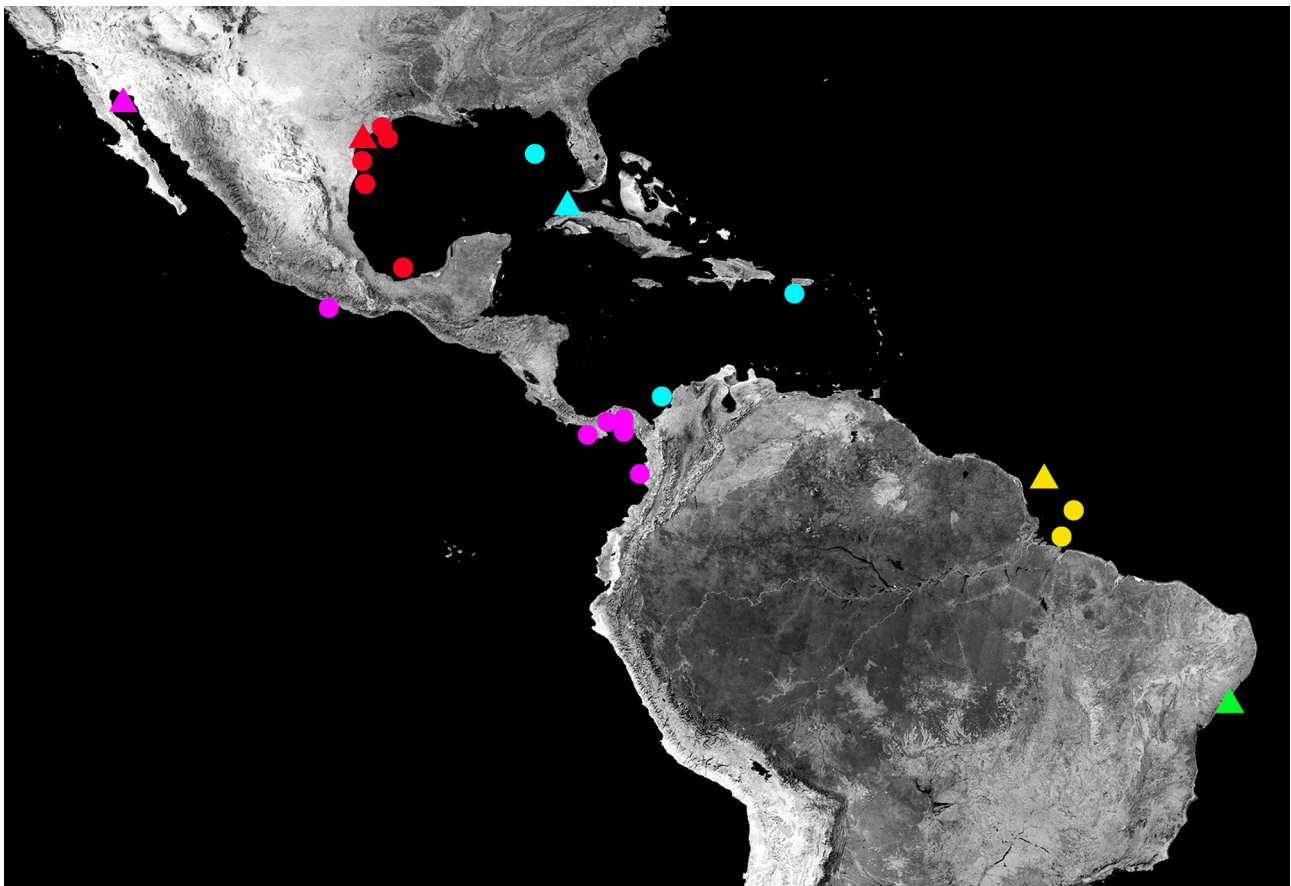| Species	Predorsal	Preanal	Total
N. mucronatus	38–44	43–47	94–99
N. torrei	42–45	48–49	104–107
N. anaelisae	32–34	42–44	98–104
N. hygomi	48	55	107
N. vermiformis	34–38	41–44	93–102

FIGURE 3. Map showing the distribution of the species of adult *Neoconger*. red = *N. mucronatus*, blue = *N. torrei*, yellow = *N. anaelisae*, green = *N. hygomi*. Pink = *N. vermiformis*. Triangles = holotypes.

TABLE 3. Characters in six species of *Neoconger* larvae

Species	Intestinal loop	Anterior ventral melanophore	Posterior ventral melanophore
N. mucronatus	Sharp	Absent	Present
N. torrei	Sharp	Present	Present
N. anaelisae	Flat	Present	Present
N. species	Sharp	Absent	Absent
N. vermiformis	Sharp	Present	Present
N. tuberculatus	Sharp	Absent	Present

TABLE 4. K2P genetic distance and standard errors obtained among the *Neoconger* species that were barcoded. Interspecific distances are below diagonal and intraspecific distances are in the main diagonal in bold.

|	1	2
1 *Neoconger torrei* (n=2)	0.002±0.002	
2 *Neoconger anaelisae* (n=1)	0.040±0,009	**0.000±0.000**

Color in preservative gray to brown, sometimes with darker reticulations. Freshly caught specimens may show some red color on vertical fins, head, and pectoral fins, apparently caused by blood in superficial vessels and tissue. Pores on lower jaw sometimes surrounded by whitish area. Stomach and intestine pale.

Maximum size appears to be about 300 mm TL. The largest specimen examined was the lectotype, 302 mm TL.

The two confirmed males differ in several characters from the 12 females: lesser preanal length (48.4–50.5 vs 51.3–53.5 %TL), lesser predorsal length (45.3–45.8 vs 49.4–54.2 %TL), greater eye diameter (7.8–8.2 vs 3.1–7.1 %HL), longer pectoral fin (32.7–34.5 vs 16.0–24.5 %HL), fewer predorsal vertebrae (38 vs 41–44), and fewer preanal vertebrae (43 vs 46–47).

Distribution. Found in the western Gulf of Mexico between the mouth of the Mississippi River and the Yucatan Peninsula at depths of 12–170 m., where it seems to be reasonably common. This area is characterized by predominantly muddy bottoms.

Etymology. Latin *mucro* (sharp, pointed); *natus* (born). Apparently referring to the relatively pointed anterior end of the head.
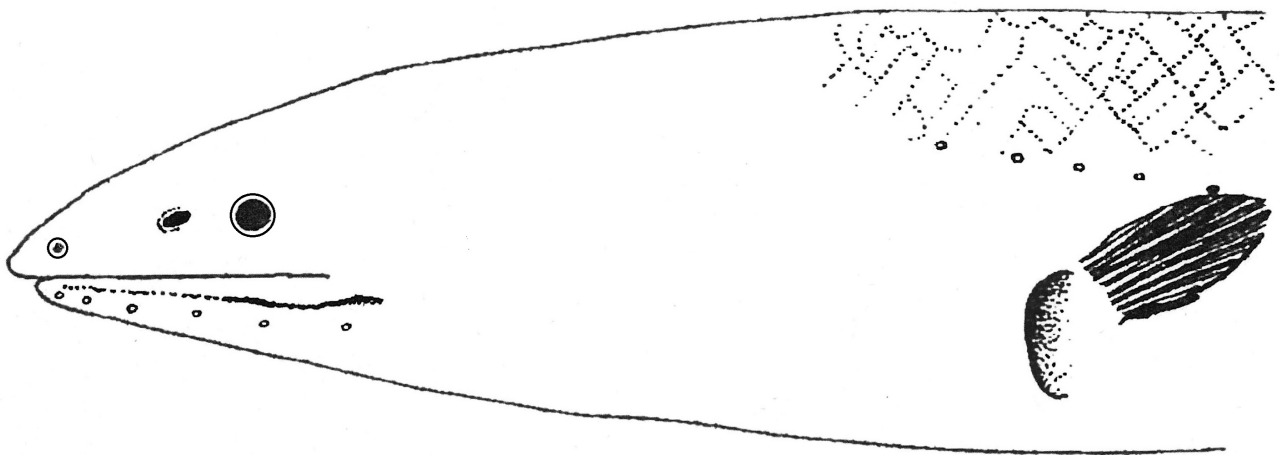
FIGURE 4. Head pores in *Neoconger mucronatus*, modified from Smith 1989a: fig 50.

Neoconger torrei **(Howell Rivero, 1932)**
(Figure 10A; Tables 1–5)

Chrinorhinus torrei Howell Rivero, 1932: 9; Havana, Cuba, holotype MCZ 32786.
Neoconger torrei, Ginsburg, 1951: 446–447.
Neoconger mucronatus, Smith & Castle, 1972: 200 (in part); Smith 1989a: 60 (in part).

Study material (4 adult specimens, 143–193 mm TL). HOLOTYPE: MCZ 32786 (1, 168), Havana, Cuba. OTHER MATERIAL: ANSP 139683 (1, 143), Puerto Rico, Guayanilla Bay, 3 m, dredged from mud, 1978. FLMNH 222149 (1, 193), Colombia, Gulf of Morrosquillo, 9.67° N, 76.03° W, 45–55 m, 13 July 1966, R/V Pillsbury 371. FLMNH 223294 (1, 188+), Colombia, Gulf of Morrosquillo, 9.52° N, 75.99° W, 33–36 m, 13 July 1966, Pillsbury 366. GENBANK number MG 856392, specimen voucher DPND 3073 (1 leptocephalus, 46 mm SL), 26.93° N, 86.37° W to 27.00° N, 86.43° W, 20 May 2016.

Diagnosis. *Neoconger torrei* differs from *N. mucronatus* in the number of total vertebrae (104–107 vs 94–99) and preanal vertebrae (48–49 vs 43–47). It differs from *N. anaelisae* in the number of predorsal vertebrae (42–45 vs 32–34). It differs from *N. hygomi* in the number of predorsal vertebrae (42–45 vs 48) and preanal vertebrae (48–49 vs 55). It differs from *N. vermiformis* in the number of total vertebrae (104–107 vs 93–102), preanal vertebrae (48–49 vs 41–44), and predorsal vertebrae (42–45 vs 34–38). Larvae with a sharp intestinal loop; posterior lateral melanophore and anterior ventral melanophore present.

Description. See genus account for general appearance. Morphometric characters in % TL: preanal length 49.4–52.4, predorsal length 48.3–49.7, head length 9.5–10.7, depth at anus 3.6–4.3. In % HL: snout 18.8–20.6, eye 3.9–6.9, interorbital 15.0–15.4, snout-rictus 26.2–28.7, gill opening 9.7–15.0, interbranchial 10.7–16.2, pectoral-fin length 16.6–19.8. Meristic characters: lateral-line pores 21–40, pectoral-fin rays 11–13, predorsal vertebrae 42–45, preanal vertebrae 48–49, total vertebrae 104–107, precaudal vertebrae ca. 50–51. Mandibular pores as in *N. mucronatus*.

Color in preservative gray to brown.

The largest intact specimen is FLMNH 222149 at 193 mm TL and 101 mm preanal, although FLMNH 223294, which has lost part of its tail and measures 188+ TL, has a preanal length of 121 mm, indicating that it is actually larger than FLMNH 222149.

Distribution. Adults are known from Cuba, Puerto Rico, and the Caribbean coast of Colombia. Based on the distribution of larvae, Smith (1989a: 64) suggested that this species (referred to as the high-count form) might extend as far south and east as the northern border of Brazil (see below under Remarks).

Remarks. This species is known from only four adult specimens, of which only two yielded a complete vertebral count. One specimen, the holotype, was partially deossified, and the vertebrae were not visible on the radiograph. Another specimen was damaged and had lost part of its tail. Still, that is sufficient to distinguish it completely from the neighboring species *Neoconger mucronatus*. The number of predorsal and preanal vertebrae distinguish it from the other species.

The leptocephalus illustrated by Smith & Castle (1972, fig. 20), collected near the French Guiana-Brazil border (DANA station 1174), appears to be this species. The intestinal loop is sharp and the anterior ventral melanophore is present. Smith (1989a: 64) reported larvae of this species to occur as far as the northern border of Brazil.

The barcoded larval specimen (DPND 3075 that proved genetically distinct from the Amazonian adult *Neoconger anaelisae* (MPEG 38951; see below) was collected in the eastern Gulf of Mexico off the northwestern coast of Florida. The specimen had been damaged when the tissue sample was taken, hence the myomere count was not available. However, it possessed the anterior ventral melanophore, which is present in *Neoconger torrei* but absent in *N. mucronatus*. In addition, it was collected in the area affected by the Gulf Loop Current, which brings water up from the Caribbean, then loops in a clockwise direction and exits through the Straits of Florida into the Gulf Stream.

The other barcoded specimen linked to this in the tree, GU 224984 (not seen by us), is also a larva. GenBank gives the location as 20.1293° N, 86.3499° W, just south of the Yucatan Channel off the eastern coast of Mexico near Cozumel, which would put it in the Caribbean Sea.

Etymology. Named for Dr. Carlos de la Torre, a prominent Cuban scientist of the early 20th century, who studied Cuban fishes.

Neoconger anaelisae (Tommasi, 1960)
(Figures 5, 6, 11; Tables 1–5)

Leptocephalus anaelisae Tommasi, 1960: 93, fig. 3; off the Amazon region of Brazil, 02° 27.5' N, 44° 02.5' W, holotype lost.
   Smith 1989b: 701 (synonym of *Neoconger mucronatus*). Melo & Caires 2016: 2 (leptocephali described by Tommasi; synonym of *Neoconger mucronatus*).
Neoconger mucronatus, Smith, 1989a: 60 (in part).
Neoconger sp., Marceniuk *et al.*, 2019: 7, 13, table 1, fig. 4b (listed; photograph). Caires *et al.* 2021: 127 (short description; photograph).

FIGURE 5. *Neoconger anaelisae*, lectotype, MPEG 38951, freshly caught.

FIGURE 6. *Neoconger anaelisae*, lectotype, MPEG 38951, preserved.

Study material (3 specimens, 132–254 mm TL). HOLOTYPE (by monotypy, no catalog number given): lost. NEOTYPE (designated here): MPEG 38951 (1, 254 mm TL), Brazil, Amapá Prov., 03° 44' 05" N, 50° 18' 48" W, 58.5 m, 16 Mar 2018. OTHER MATERIAL: AZUSC 5785 (1, 135), Brazil, Pará Prov., 0° 05' 56" N, 48° 31' 10" W, 10 m, 09 Aug 2018. USNM, 214062 (1, 156), Brazil, Pará Prov., 1.87° N, 48.35° W, 42–44 m, Geomar sta. 156.

   Diagnosis. *Neoconger anaelisae* has fewer predorsal vertebrae (32–34) than any of the other Atlantic species (38–48) and overlaps only slightly with *N. vermiformis* (34–38). It further differs from *N. mucronatus* in total vertebrae (98–104 vs 94–99); from *N. torrei* in preanal vertebrae (42–44 vs 48–49) and total vertebrae (98–104 vs 104–107); from *N. hygomi* in preanal vertebrae (42–44 vs 55) and total vertebrae (98–104 vs 107); and slightly from *N. vermiformis* in total vertebrae

(98–104 vs 93–102). The larva has a flatter intestinal loop than the other species; the posterior lateral melanophore is present, but the anterior ventral melanophore is apparently absent (see Notes on Leptocephali below).

Description. See genus account for general appearance. Morphometric characters in % TL: preanal 48.7–53.8, predorsal 37.2–39.7, head 10.7–11.1, depth at anus 3.0–3.5. In % HL: snout 19.2–21.7, eye 3.1–4.8, interorbital 13.2–13.7, snout-rictus 34.9–40.8, gill opening 7.5–12.8, interbranchial 12.8–23.5, pectoral fin 14.5–20.2. Meristic characters: lateral-line pores 32–35, predorsal vertebrae 32–34, preanal vertebrae 42–44, precaudal vertebrae 49–56, total vertebrae 98–104. Mandibular pores as in *N. mucronatus*.

Color of freshly caught specimen gray to reddish brown.

The largest specimen is 254 mm TL.

Distribution. The three adult specimens were collected on the continental shelf off the coast of northern Brazil near the mouth of the Amazon River. The holotype of *Leptocephalus anaelisae* was collected in the same general area but farther offshore (2° 27.5' N, 44° 02.5' W). Smith (1989a: 64) reported that the larvae of this species extend northward to the Guianas and the eastern Caribbean, where they co-occur with larvae of *Neoconger torrei*. If this pattern occurs in adults as well, it would be added evidence for the distinction of these two species.

Remarks. The description of *Leptocephalus anaelisae* is somewhat problematic. The single type specimen is lost, and the reported number of total myomeres (93) is well below the vertebral counts of the adults (98–104). In addition, the specimen is stated to lack a pectoral fin, which is present in all larval *Neoconger*. Nevertheless, the illustration clearly shows a *Neoconger* larva, and the type locality is close to the area where the three adult specimens were collected. We therefore designate one of the adult specimens, MPEG 38951, as the neotype and hence fix the name to that specimen. Supporting the morphological diagnosis, the DNA barcoding sequences from *Neoconger anaelisae* show that the analyzed specimen has a K2P genetic distance between 4.0% and 23 distinct haplotypes (Table 4 and Table 5) from *N. torrei* (see above), corroborating its recognition as a distinct species.

Etymology. Named by Tommasi for his daughter, Ana Elisa.

Neoconger hygomi Smith n. sp. (Figures 7, 8; Table 2)

Neoconger mucronatus (non Girard, 1858); Smith, 1989a: 60 (in part).

Study material. HOLOTYPE: ZMUC P312001 (261 mm TL), Brazil, Cotinguiba, State of Sergipe, ca. 10° 52' S, 37° 07' W, coll. 1857.

Diagnosis. *Neoconger hygomi* has more predorsal vertebrae than any other species in the genus (48 vs. maximum 45), and more preanal vertebrae (55 vs. maximum 49). The number of total vertebrae (107) is matched only by *N. torrei* (104–107).

Description. See genus account for general appearance. Morphometric characters in % TL: preanal 52.5, predorsal 51.7, head 10.0, depth at anus 2.1. In % HL: snout 17.7, eye 5.4, interorbital 10.8, snout-rictus 28.8, gill opening 11.9, interbranchial 18.5, pectoral fin 20.4. Meristic characters: predorsal vertebrae 48, preanal vertebrae 55, precaudal vertebrae 58, total vertebrae 107. Mandibular pores as in *N. mucronatus*.

Maxillary and dentary each with one row of rather large, pointed, recurved teeth. Vomer long, ending below eye, anteriorly with two rows of robust, blunt teeth (six teeth in each row) and posteriorly with four less robust teeth in one median row.

Color after many years in preservative light gray with no markings.

The only known specimen is 261 mm TL.

Distribution. The specimen was stated to come from Cotinguiba, Brazil, south of the equator and south of the so-called hump of Brazil. The precise location is uncertain. Cotinguiba refers to a small river that empties into the larger Sergipe River some 15 km from the Atlantic Ocean.

Remarks. Castro & Bonecker (2005: 8, fig. 10; 2006: 41) reported three small specimens of larval *Neoconger* (5.8–7.9 mm SL) from the Brazilian coast not far south of Sergipe. The specimens were too small to count the myomeres, but they are most likely *N. hygomi*. This suggests that the species occurs more extensively along the South Atlantic coast of Brazil.

Etymology. Named for Vilhelm Hygom, a Danish ship captain who collected oceanographic material for the Zoological Museum in Copenhagen. The name was applied to the specimen in manuscript form in the museum but never published.

FIGURE 7. *Neoconger hygomi*, holotype, ZMUC P312001, whole.

FIGURE 8. *Neoconger hygomi*, holotype, ZMUC P312001, head.

Neoconger species

Neoconger sp. Smith 1989b: 702.

This species is represented only by larvae. The corresponding adult has not been found. Therefore, we refrain from formally describing and naming it.

Study material. From Smith 1989b. Dana 1214 (1, 43), Central Caribbean, 14° 21' N, 76° 50' W, 26 Jan 1922. University of the West Indies FERP 7374-A-10-11-B (1, 46), Jamaica. Dana 1186 (2, 36–37), Virgin Islands, 17° 58.5' N, 64° 41' W, 1 Dec 1921. Dana 1189 (1), Virgin Islands, 17° 58.5' N, 64° 41' W, 8 Dec 1921. Dana 1192 (1), Virgin Islands, 17° 43.4' N, 64° 54.3' W, 16 Dec 1921. Dana 1195 (1, 43), Virgin Islands, 19° 01' N, 65° 23'W, 3 Jan 1922. Dana 1196 (1, 43), Virgin Islands, 17° 43' N, 64° 56' W, 4 Jan 1922. Dana 1289 (1, 41), Virgin Islands, 17° 43' N, 64° 56' W, 15 Apr 1922. Dana 1202 (1, 40), Panama (Caribbean), 09° 40' B, 79° 56' W, 10 Jan 1922. UMML, Pillsbury 384 (1, 41), Colombia (Caribbean), 10° 24.2' N, 75° 58' W, 15 Jul 1966. UMML, Pillsbury 426 (1, 21), Panama (Caribbean), 09° 48.2' N, 79° 18' W, 20 Jul 1966. ANSP 155452 (1, 22), Yucatan Channel, 20° 34' 06" N, 87° 01'00" W, 35–55 m, 8 Nov 1975. ANSP 155453 (1, 43), Yucatan Channel, 21°27'12" N, 86°00'00" W, 27–63 m, 8 Nov 1975. ANSP 155454 (1, 31), Yucatan Channel, 20°36'18" N, 87°00'30" W, 30 m, 8 Nov 1975.

Diagnosis. This species differs from all the others in lacking the posterior lateral melanophore. It further differs from *N. torrei* and *N. anaelisae* in lacking the anterior ventral melanophore. In addition, it has more predorsal myomeres than the other species (57–62 vs 39–56). It has more total myomeres on average than the other species (105–110 vs 93–108). It differs from *N. anaelisae* in having a sharper intestinal loop.

TABLE 5. Nucleotide differences observed in COI sequences among the samples analyzed.

	3	6	9	12	15	16	18	19	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72
Neoconger anaelisae	C	A	A	A	A	C	T	C	T	T	C	C	A	C	T	T	T	C	C	G	G	C	T	C	A	A
Neoconger torrei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	75	78	81	84	87	90	93	94	96	97	99	102	105	108	111	114	117	120	121	123	124	126	129	130	132	135
Neoconger anaelisae	C	C	T	A	A	G	C	G	A	A	A	C	G	G	T	C	C	A	C	T	G	G	A	T	A	A
Neoconger torrei	.	.	.	.	.	.	.	G	.	.	.	T	.	A	.	.	.	.	.	.	.	.	.	.	.	.

	138	141	144	147	150	153	156	159	162	165	168	171	174	177	180	183	184	186	187	189	190	192	195	198	201	204
Neoconger anaelisae	C	T	C	A	T	G	A	C	C	A	A	C	C	A	C	C	A	T	A	C	G	A	C	C	G	C
Neoconger torrei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	A	.	.	.	.	.

	205	207	208	210	211	213	214	216	217	218	219	222	225	226	227	228	229	231	234	237	240	242	243	246	249	252
Neoconger anaelisae	C	A	C	T	C	A	C	G	G	C	C	C	A	G	G	C	G	A	A	C	T	C	C	T	C	A
Neoconger torrei	G	.	.	.	T	.	.	.	.	.	.	.	G	.	.	.	.	.	.	.	.	.	.	.	.	.

	255	258	261	264	267	270	271	273	274	276	277	279	282	283	285	288	291	294	297	300	303	306	309	310	312	313
Neoconger anaelisae	A	T	A	C	C	A	C	A	G	C	G	G	C	C	G	A	T	C	A	A	C	A	T	T	A	A
Neoconger torrei	.	.	.	T	.	G	.	.	.	.	.	.	.	.	A	.	.	.	.	.	.	.	.	.	.	.

	315	318	321	324	325	327	330	331	333	336	339	340	342	345	348	351	352	354	357	358	360	363	366	369	372	375
Neoconger anaelisae	C	T	C	A	T	A	C	C	C	A	G	G	T	A	C	T	C	A	G	G	T	C	C	C	T	T
Neoconger torrei	T	.	.	.	.	.	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	378	381	382	383	384	387	390	393	396	399	400	402	403	404	405	406	407	408	411	414	417	420	421	422	423	424
Neoconger anaelisae	A	C	C	A	A	T	G	G	T	T	G	C	A	T	C	A	A	A	A	T	A	C	C	C	G	T
Neoconger torrei	A	.	.	.	.	.	.	A	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	C	.

	426	429	430	432	433	435	436	438	439	441	442	444	445	447	450	453	454	456	457	459	460	462	463	465	466	468
Neoconger anaelisae	A	C	G	A	T	A	T	C	G	T	C	T	G	G	A	C	G	C	C	C	C	T	C	C	C	A
Neoconger torrei	.	.	.	.	.	G	A	A	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	C	.

	471	472	474	477	480	481	483	486	489	492	495	498	501	502	504	505	507	510	513	516	519	520	522	525	528	531
Neoconger anaelisae	C	C	C	A	A	C	G	A	A	G	C	A	A	A	A	T	A	T	C	A	C	C	A	C	A	C
Neoconger torrei	.	.	.	.	.	G	A	.	.	A	.	.	.	.	.	.	.	C	.	G	.	.	.	.	.	.

	73	534	535	537	540	543	546	547	549	552	555	558	561	564	565	567	570	576	577
Neoconger anaelisae	G	T	T	T	C	A	T	G	A	C	A	C	A	C	C	C	T	C	C
Neoconger torrei	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.

Description (from Smith 1989b). Total myomeres 105–110, predorsal myomeres 57–62, preanal myomeres 56–63, LVBV 57–60, nephric myomeres 53–57, dorsal-fin rays 140–187, anal-fin rays 136–195. Morphometric characters in %SL: preanal 63–73, predorsal 64–73, head 7–12, greatest depth 21–30. Anterior ventral melanophore and posterior lateral melanophore absent; pigment present only on intestinal loop. Largest specimen 46 mm SL.

Distribution. Known from the Caribbean: Colombia, Panama, Virgin Islands, and Yucatan Channel, where it co-occurs with *N. torrei*.

Remarks. This larva is known from only 22 specimens, as opposed to 265 specimens for the other western Atlantic species (Smith 1989b: 702, 703). Considering that larvae are much more frequently collected than adults, this suggests that the present species may be less common than the co-occurring *N. torrei*, and hence less likely to be collected as adults.

Etymology. None.

Neoconger vermiformis Gilbert, 1890
(Figure 10B; Tables 2, 3, 6)

Neoconger vermiformis Gilbert, 1890: 57; Eastern Pacific, Gulf of California, lectotype USNM 44292. Smith & Castle 1972: 200 (redescription, lectotype designation).

Study material (108 specimens, 39–230 mm). LECTOTYPE: USNM 44292 (female, 146 mm TL), Mexico, Gulf of California, 30° 31'N, 114° 25'W, 30 fm (54.9 m), 27 Mar 1889. PARALECTOTYPES: CAS-SU 22 (3, not examined), same data as lectotype. USNM 125072 (8, 61–125 mm TL), same data as lectotype. OTHER MATERIAL: ANSP 119126 (1, 118) Pacific, Colombia, Boca Baudo at Pizzaro, two small bays in mangroves opposite lumber yard, depth (0–1 foot) (0–0.3 m), 7 Nov 1970, L. Knapp. CAS-SU 67347 (2, not seen; formerly SU 46978), Zaca Expedition, eastern Pacific, no further data. CAS 38795 (1, not seen), Mexico, Guerrero, 16° 38' 30" N. 99° 40'W, 51 m, 29 Nov 1937, mud bottom, Zaca 189 D-4. CAS-SU 11 (1, not seen) Gulf of Panama, 08° 06' 30" N, 78° 51' 00: W, 33 fm (59 m), 5 Mar 1888, gray sand and broken shells, Albatross 2797. CAS 30835 (1, not seen), Gulf of Panama, 8° 54' 36" N, 79° 31' 48" W, Naos Is., on beach, found dead on beach in fish kill, 20 Apr 1973, L. G. Abele, J. B. Graham. CAS 213466 (1, not seen), Gulf of Panama, 07° 36' 28" N, 81 08' 46" W, 8–9 m, 26 Apr 2000, RV Urraca, trawl. CAS 218088 (4, not seen), Panama, Gulf of Chiriqui, Isla de Colba, 2 May 2003, D. R. Robertson. FLMNH 226880 (6, 176–230), Gulf of Panama, 08° 40.5' N, 79° 30.7' W, 12–15 fm (22–27 m), 1 May 1967, Pillsbury 483. FLMNH 226881 (1, 177), 08° 33.2' N, 79° 35.4' W, 14–17 fm (26–31 m), 1 May 1967, Pillsbury 484. FLMNH 226882 (1, 209), 08° 26.2' N, 7943.2' W, 6–8 fm (11–15 m), 1 May 1967, Pillsbury 485. FLMNH 226883 (4, 179–206), 08° 20' N, 79° 49.7' W, 11 fm (20 m), 1 May 1967, Pillsbury 486. FLMNH 226884 (5, 160–199), 08° 18.1' N, 80° 00.5' W, 10 fm (18 m), 1 May 1967, Pillsbury 487. FLMNH 226885 (1, 172), 08° 13.1' N, 80° 09.6' W, 9 fm (16 m), 1–2 May 1967 Pillsbury 488. FLMNH 226886 (1, 186), 08° 06.3 N, 80° 18.2' W, 10–12 fm (18–22 m), 2 May 1967, Pillsbury 490. FLMNH 226887 (2, 190–212), 08° 45.2' N, 79° 10.3' W, 18–20 fm (33–37 m), 6 May 1967, Pillsbury 533. FLMNH 226888 (1, 216), 08° 38.6' N, 78° 51.9' W, 17 fm (31 m), 6 May 1967, Pillsbury 535. FLMNH 226889 (1, 225), 08° 35.6' N, 78° 40.7' W, 10 fm (18 m), 6 May 1967, Pillsbury 536. FLMNH 226932 (1, 60), 07° 50.7' N, 80° 09.8' W. 9–10 fm (16–18 m), 2 May 1967, Pillsbury 492. USNM 46592 (1, 229), 8° 44' N, 79° 09'W, 29.5 fm (54 m), 6 Mar 1888, Albatross 2799. USNM 128412 (1, 43.5), Panama Canal Zone, Farfan Beach, 26 Feb 1937, S. F. Hildebrand. USNM 128413 (5, 39–45), Panama, Pearl Is., 14–17 Mar 1937, S. F. Hildebrand. USNM 128414 (7, 41–44), Panama City, San Francisco Beach, 26 Feb 1937, S. F. Hildebrand. USNM 128415 (2, 39–71), Panama, Venado Beach, 26 Feb 1937, S. F. Hildebrand. USNM 128416 (18, no data), Panama Canal Zone, Miraflores Locks, east side upper chamber, 28 Apr 1937, A. O. Foster. USNM 128417 (7, 43–134), Panama Canal Zone, Miraflores Locks, east side upper chamber, 24 Mar 1937, S. F. Hildebrand. USNM 128418 (3, 113–133), Panama Canal Zone, Miraflores Locks, east side upper chamber, 28 Apr 1937, S. F. Hildebrand. USNM 128424 (6, 40.5–149), Panama Canal Zone, Miraflores Locks, west side lower chamber, 2 Mar 1937, S. F. Hildebrand. USNM 204929 (4, 69–144), Panama, Panama Canal dredge effluent, Fort Amador, Pacific coast, 16 Mar 1967, H. Wright, I. Rubinoff, R. Rubinoff. USNM 204930 (4, 71–137), Panama, Panama Canal dredge effluent, Fort Amador, Pacific coast, 17 Mar 1967, H. Wright, I. Rubinoff, R. Rubinoff. USNM 379273 (1, cleared and stained), Panama, Veraguas Province, Gulf of Chiriqui, Coiba Island, 2–21 May 2003, D. R. Robertson. USNM 444957 (2, cleared and stained), removed from USNM 128416.

Diagnosis. *Neoconger vermiformis* differs from *N. mucronatus* in the number of predorsal vertebrae (34–38 vs 38–44). It differs from *N. torrei* in the number of predorsal vertebrae (34–38 vs 42–45), preanal vertebrae (41–44 vs 48–49), and total vertebrae (93–100 vs 104–107). It differs from *N. anaelisae* in the number of predorsal vertebrae (34–38 vs 32–34). It differs from *N. hygomi* in the number of predorsal vertebrae (34–38 vs 48), preanal vertebrae (41–44 vs 55), and total vertebrae (93–102 vs 107). Larvae with a sharp intestinal loop; posterior lateral melanophore and anterior ventral melanophore present (see below).

Description. See genus account for general appearance. Morphometric characters in % TL: preanal 47.4–52.9, predorsal 38.1–46.6, head 10.6–14.8, depth at anus 3.4–5.8. In % HL: snout 17.4–22.2, eye 3.7–7.9, snout-rictus 24.2–32.2, gill opening 6.7–19.5, interbranchial 8.8–16.9, pectoral fin 5.1–30.2. Meristic characters: lateral-line pores 32–50, predorsal vertebrae 34–38, preanal vertebrae 41–44, total vertebrae 93–102. Mandibular pores as in *N. mucronatus*.

Color in preservative gray to brown.

The specimens range in size from 39 to 230 mm TL.

Distribution. *Neoconger vermiformis* occurs along the western coast of North and Central America from the northern Gulf of California to Panama and northern Colombia. The type series of nine specimens was collected in the northern Gulf of California, and one specimen was collected off the state of Guerrero in southern Mexico. All the others (85 specimens) were collected in the Gulf of Panama and adjacent northern Colombia, including the Pacific end of the Panama Canal.

Remarks. The number of known adult specimens of this species greatly exceeds that of all the other species. One reason for this disparity may be the greater extent of favorable habitat in the Gulf of Panama and the area around the entrance to the canal. Another reason may be the amount of collecting work done in that area. Samuel F. Hildebrand made numerous collections there in 1937, and the RV Pillsbury cruise to the Gulf of Panama in 1967 sampled the offshore area extensively. Suitable habitat in other areas may be more limited and sampled more sporadically.

The number of total vertebrae in specimens from Mexico and Panama overlap completely, but there is some discrepancy (Table 6). The specimens from Mexico have 95–98 (n=9, mean 95.8), whereas those from Panama have 93–102 (n=26, mean 98.7). No genetic information is available for this species, and without such evidence the significance of these differences cannot be determined.

Smith & Castle (1972: 238) reported 106 specimens of larval *Neoconger vermiformis* collected in the Gulf of Panama. The number of total myomeres (95–102) matches the number of vertebrae in adults (93–102). The number of preanal myomeres is given as 45 and predorsal myomeres as 33–44. The intestinal loop is sharp, and both the anterior ventral melanophore and posterior lateral melanophore are present.

Neoconger tuberculatus (Castle, 1965)
(Figure 12; Table 3)

Leptocephalus tuberculatus Castle, 1965: 131, fig. 1 F–H; Manly Beach, Sydney, New South Wales, Australia, coll. 1907; 32.7 mm TL ("type") and 33.5 mm ("paratype") AMS IA. 2477.

Diagnosis. Based on the available information (Castle 1965; Smith 1989b), the larva of *Neoconger tuberculatus* has fewer preanal myomeres (46–48) than any of the Atlantic species (49–60). It further differs from *N. torrei* in lacking the anterior ventral melanophore (vs present); from *N. anaelisae* in having a sharper intestinal loop and lacking the anterior ventral melanophore (vs present). It differs from *Neoconger* species in having the posterior lateral melanophore (vs absent) and fewer LVBV myomeres (51–53 vs 57–60). It differs from *N. vermiformis* in lacking the anterior ventral melanophore (vs present).

Description (from Castle 1965). Intestinal loop sharp, anterior ventral melanophore absent, posterior lateral melanophore present. Predorsal myomeres 53–54, preanal myomeres 46–48, LVBV 51–53, total myomeres 100–101, dorsal-fin rays 180–182, anal-fin rays 147–165.

Distribution. Coast of New South Wales near Sydney, Australia.

Remarks. This species was described from two larval specimens collected in 1907 at Manly Beach near Sydney in southeastern Australia. It has not been reported since, and no adult specimens of *Neoconger* are known from the area, or anywhere in the Indo-West Pacific.

Smith & Castle (1972: 245) briefly reported finding two specimens of larval *Neoconger* in the ZMUC that were collected in 1893 and were originally from the Godefroy Museum in Hamburg, Germany. The locality was given only as "Sydhavet" (South Sea). Total myomeres were given as 99 and 100 myomeres, close to the values in *N. tuberculatus*. No further information is available, but it is one additional piece of evidence for *Neoconger* in the Indo-Pacific, assuming that Sydhavet does refer to that ocean.

TABLE 6. Numbers of total vertebrae in *Neoconger vermiformis*

Vertebrae	93	94	95	96	97	98	99	100	101	102
G. Calif.		1	3	3	1	1				
Panama	1	0	1	3	1	5	2	8	4	1

Notes on leptocephali

Leptocephali have been described and illustrated for the five known species of adult *Neoconger*. Two other species are known only from larvae. These leptocephali are moderately deep-bodied with a preanal length of about 60–70 %TL and the dorsal-fin origin slightly anterior to that point. The intestine terminates in a distinct arch or loop shortly before the anus. A single melanophore of variable size is located just posterior to the top of the arch. All but one of the species has a midlateral melanophore near the posterior end of the body. Some species have a small melanophore on the ventral surface at about midlength of the intestine. See Table 3 for a summary of characters for the species.

Neoconger mucronatus. (Figure 9). The intestinal loop is sharp and prominent, with a relatively small melanophore, its width less than half the height of the loop. The posterior lateral melanophore is present, but the anterior ventral melanophore is absent. Total myomeres are 94–99. It occurs in the central to western Gulf of Mexico.

Neoconger torrei. (Figure 10A). The intestinal loop is sharp and prominent, with a melanophore that is distinctly larger than that of *N. mucronatus*. Both the posterior lateral melanophore and the anterior ventral melanophore are present. Total myomeres are 104–107. It occurs in the Caribbean and extends southeastward off the Guianas.

Neoconger anaelisae. (Figure 11). The intestinal loop is much flatter in this species than in all the others. The posterior lateral melanophore and the melanophore on the intestinal loop ("en la vuelta final del intestino") are present. The anterior ventral melanophore is not mentioned by Tommasi and is presumably absent. Myomeres were given by Tommasi as 93, but this seems too low. See the account of this species above.

Neoconger **species.** (No illustration available). This species differs from all the others in lacking the posterior lateral melanophore. The anterior ventral melanophore is also absent. There are 105–110 total myomeres (Smith 1989b: 703). Only 22 specimens are known, and the adult has not been identified. It is known from the Caribbean, where it overlaps with *Neoconger torrei*.

Neoconger vermiformis. (Figure 10B). The intestinal loop is sharp and prominent, and both the posterior lateral and the anterior ventral melanophores are present. The melanophore on the intestinal loop is small. Total myomeres are 93–102.

Neoconger tuberculatus. (Figure 12). The intestinal loop is sharp, though perhaps not quite as prominent as in the other species, with a moderate-size melanophore. The posterior lateral melanophore is present, but the anterior ventral melanophore is absent. Total myomeres are 100–101.
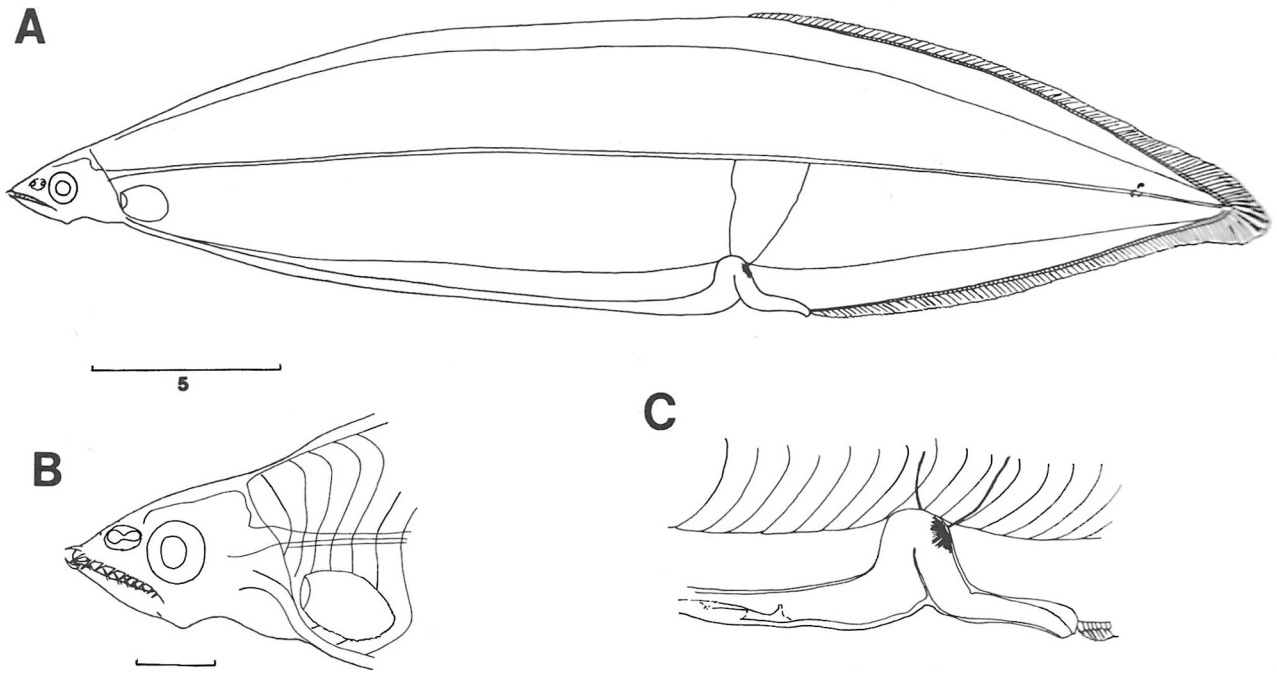
FIGURE 9. Leptocephalus of *Neoconger mucronatus*, from Smith 1989b: fig. 721.
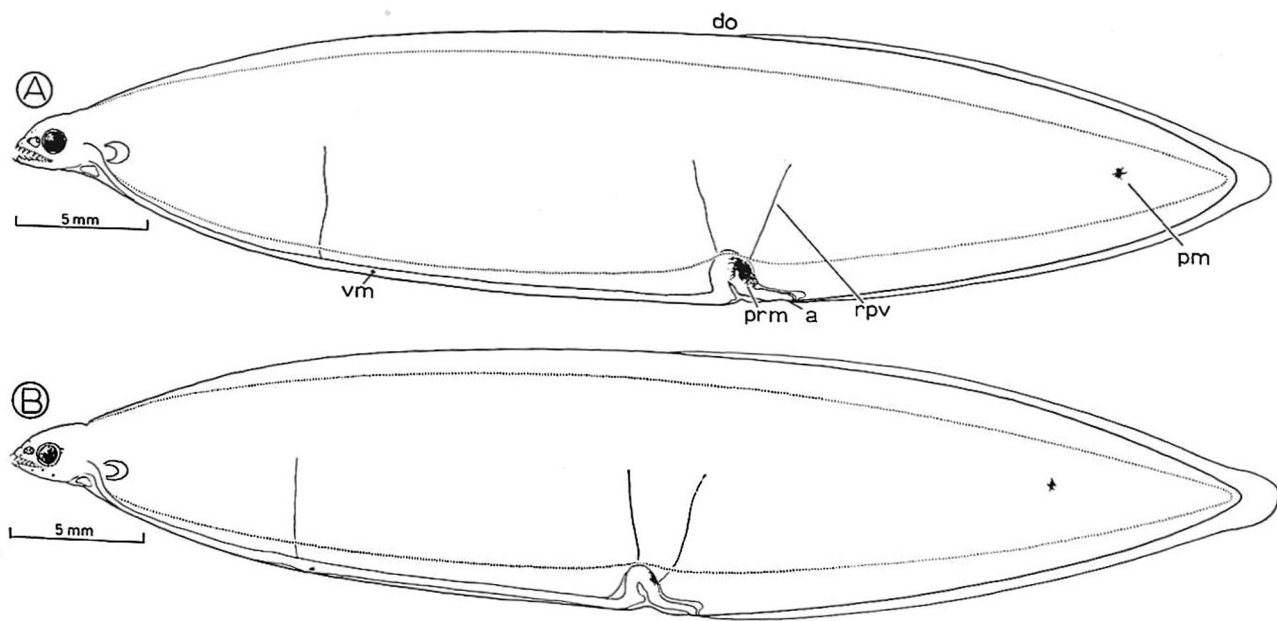

FIGURE 10. A, leptocephalus of *Neoconger torrei*. B, leptocephalus of *Neoconger vermiformis*. From Smith & Castle 1972: fig. 20. (a, anus; do, dorsal-fin origin; pm, postanal melanophore; prm, preanal melanophore; rpv, renal portal vein; vm, first [anterior] ventral melanophore.)
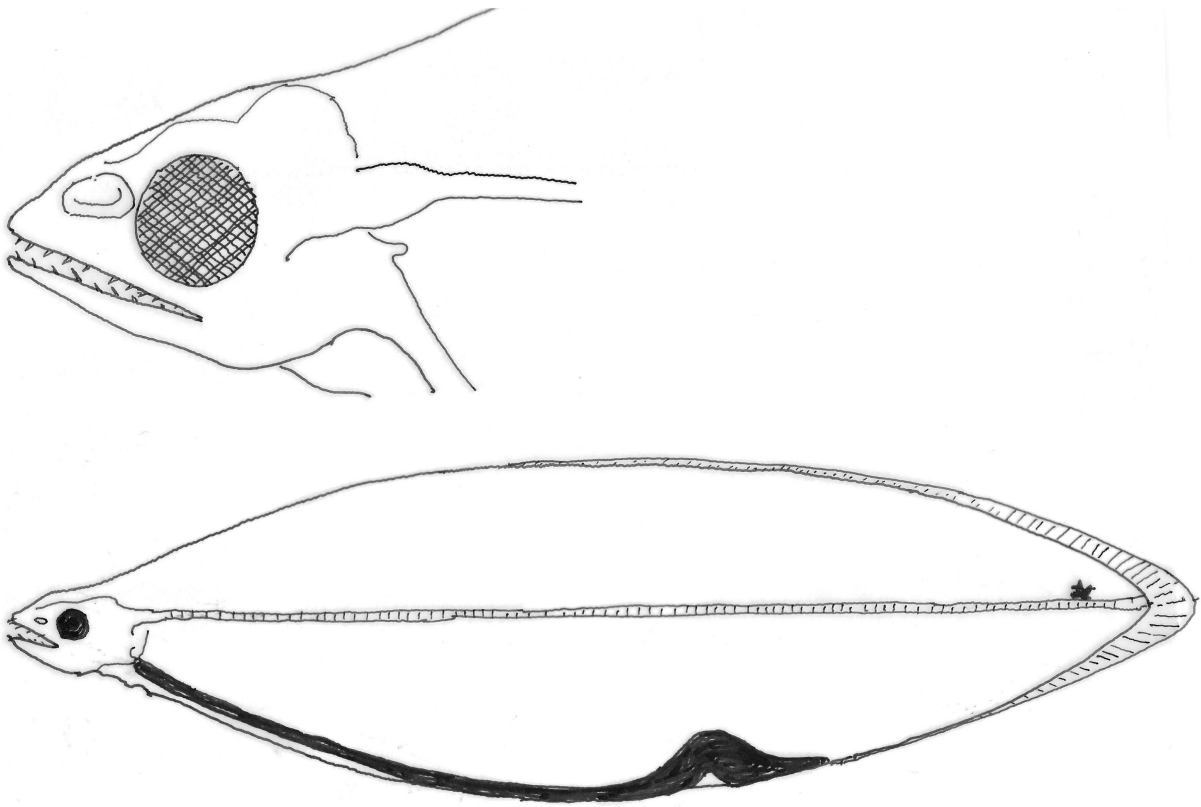
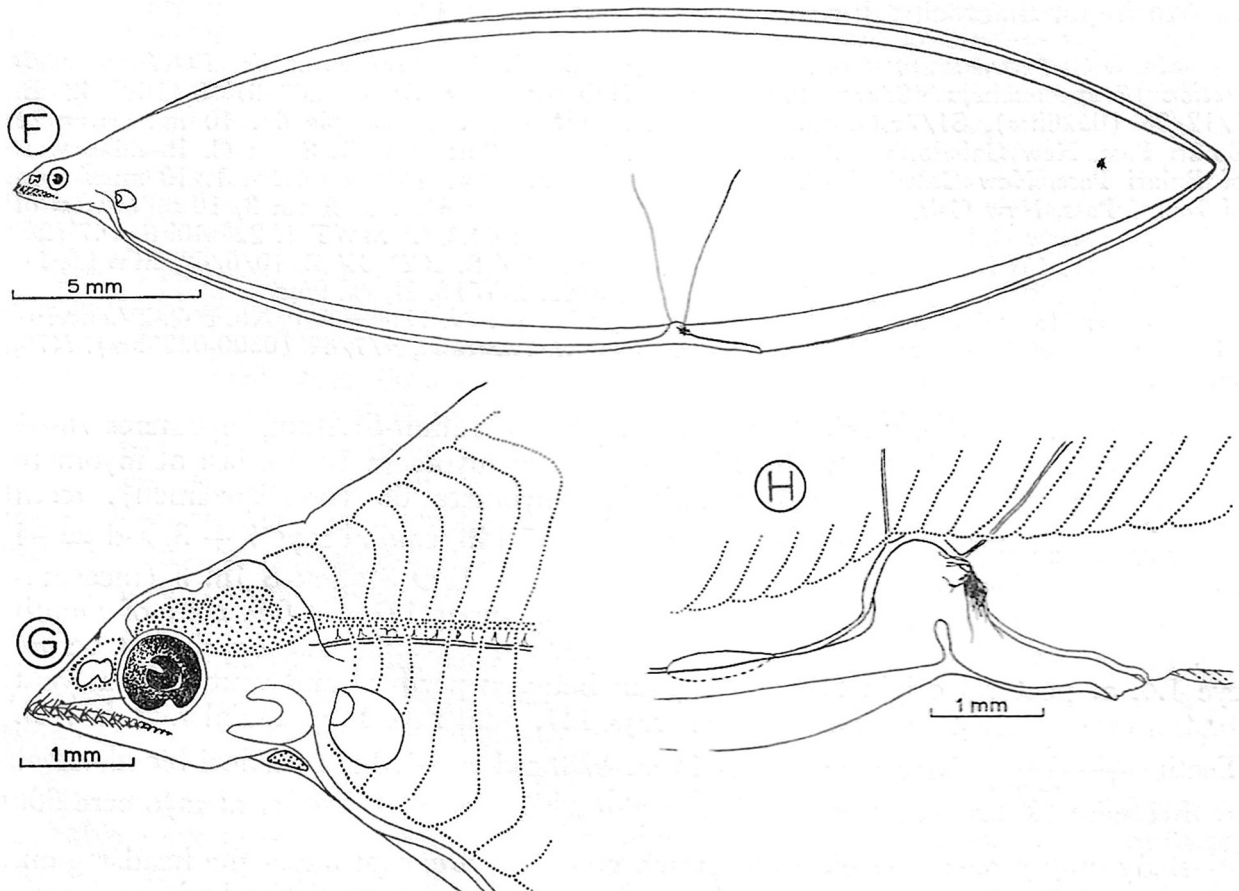**FIGURE 11.** Leptocephalus of *Neoconger anaelisae*, from Tommasi 1960: fig. 3.

FIGURE 12. Leptocephalus of *Neoconger tuberculatus*, from Castle 1965: text-fig. 1 F–H.

Acknowledgements

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