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The eels of the genus *Nettenchelys*, with description of a new species from Taiwan (Teleostei: Anguilliformes: Nettastomatidae)

DAVID G. SMITH^{1*}, JAMES LIN², HONG-MING CHEN^{2,3} & JOHN J. POGONOSKI⁴

¹Smithsonian Institution, Museum Support Center, MRC 534, 4210 Silver Hill Road, Suitland, MD 20746, U.S.A.

Email: smithd@si.edu

²Department of Aquaculture, National Taiwan Ocean University, 2 Peining Road, Keelung 20224, Taiwan.

Email: happy221034@gmail.com

³Center of Excellence for the Oceans, National Taiwan Ocean University, 2 Peining Road, Keelung 20224, Taiwan.

Email: hmchen@mail.ntou.edu.tw

⁴CSIRO National Research Collections Australia, Australian National Fish Collection, G.P.O. Box 1538, Hobart, Tasmania 7000, Australia. Email: john.pogonoski@csiro.au

*Corresponding author.

Abstract

The species of the genus *Nettenchelys* are summarized. Nine species are recognized on the basis of adult specimens: *Nettenchelys dionisi* Brito, *N. erroriensis* Karmovskaya, *N. exoria* Böhlke & Smith, *N. gephyra* Castle & Smith, *N. inion* Smith & Böhlke, *N. paxtoni* Karmovskaya, *N. proxima* new species, *N. pygmaea* Smith & Böhlke, and *N. taylori* Alcock. Another species, *N. bellottii* (D'Ancona) is based on a larva. *Nettenchelys gephyra* is redescribed on the basis of additional specimens from northeastern Taiwan, Indonesia and Australia. *Nettenchelys proxima* new species is described from a specimen from southwestern Taiwan. *Nettenchelys* sp. reported by Uyeno & Sasaki (1983) is found to be a specimen of *Facciolella*. Information on larvae is updated based on new knowledge of the genus.

Key words: eel, new species, Nettastomatidae *Nettenchelys*

Introduction

The eels of the genus *Nettenchelys* (Anguilliformes, Nettastomatidae) are known from remarkably few specimens. Including the specimens reported here for the first time, the nine recognized species comprise a total of 30 adult specimens. Four of the species are known from a single specimen each. An additional 215 larval specimens were documented by Smith & Castle (1982). The discovery of 12 new adult specimens, including a new species, is therefore noteworthy and marks a good time to summarize our current knowledge of this genus.

Nettenchelys taylori was described as a new genus and species by Alcock (1898) on the basis of a single specimen collected in the Arabian Sea. The species has never been collected since, and the genus was never mentioned again in the literature until Smith *et al.* (1981) re-examined it and described four new species from the Atlantic (*N. exoria*, *N. inion*, and *N. pygmaea*) and western Pacific, (*N. gephyra*). Uyeno & Sasaki (1983) described, but did not name, a specimen from off Suriname in the western Atlantic that appeared distinct from any of the known species. Brito (1989) described a new species, *N. dionisi*, from two specimens collected in the eastern North Atlantic. Karmovskaya described two new species, *N. erroriensis* (1994) from the Indian Ocean and *N. paxtoni* (1999) from the western Pacific, each represented by a single specimen.

Meanwhile, Smith & Castle (1982) reported 215 specimens of larvae from all oceans, among which they could discern seven distinct morphotypes based on meristic and pigmentation characters. Only one of these, *N. pygmaea*, could be linked to a known adult. Although most of the larvae could not be identified, they did document the widespread occurrence of the genus from the Atlantic to the Central Pacific. D'Ancona (1928) had applied a name to one of these larvae, *Leptocephalus bellottii*, although at the time he did not know what its adult counterpart was. The name, however, remains valid and could be applied to the adult when and if the latter is ever found.

In this paper, we describe four new specimens from Taiwan, two from Indonesia, and six from Australia. Eleven of them represent *Nettenchelys gephyra*, which was known previously from a single specimen from New Caledonia. The twelfth specimen represents a new species, described here as *Nettenchelys proxima*.

We have examined the specimen described by Uyeno & Sasaki (1983) from Suriname (NSMT-P 40076) and found that it represents a species of *Facciolella*, not *Nettenchelys*. The fifth and posteriormost supraorbital pores, located just behind the eye, were apparently misinterpreted as the posterior nostrils. The posterior nostril actually opens as a slit in the upper lip, a diagnostic character in *Facciolella*.

Material and methods

The specimens reported here were collected by commercial fishing trawlers in the waters around Taiwan in depths of about 300–600m, and during scientific trawling in Australia and Indonesia in ca. 200–350m. Counts and measurements are as in Böhlke (1989) and Smith *et al.* (1981). Abbreviations are as follows: HL, head length; IO, infraorbital pores; LL, lateral line; PADR, preanal dorsal-fin rays; PAL, preanal length; PALL, preanal lateral-line pores; PAV, preanal vertebrae; PCV, precaudal vertebrae; PDL, predorsal length; PDLL, predorsal lateral-line pores; PDV, predorsal vertebrae; POM, preoperculomandibular pores; SO, supraorbital pores; ST, supratemporal pores; TL, total length; TV, total vertebrae. POM pores are expressed as those along the lower jaw associated with the dentary bone plus those associated with the preopercular bone. IO pores are expressed as those along the upper jaw plus those in the ascending branch of the canal behind the eye. All lengths are total length unless otherwise indicated.

Specimens are deposited in the following ichthyological collections: AMS (Australian Museum, Sydney, Australia), ASIZP (Academia Sinica, Taipei, Taiwan), CSIRO (Australian National Fish Collection, Hobart, Australia), NMMST (National Museum of Marine Science and Technology, Keelung, Taiwan), TOU-AE (National Taiwan Ocean University, Laboratory of Aquatic Ecology, Keelung, Taiwan), NTM (Museums and Art Galleries of the Northern Territory, Darwin, Australia), USNM (National Museum of Natural History, Washington, DC, USA). Institutional abbreviations follow Sabaj Pérez (2013). Original drawings and photographs are by James Lin. Eschmeyer's (2015) online catalog was consulted for nomenclatural and bibliographic details.

Genus *Nettenchelys* Alcock 1898

Nettenchelys Alcock 1898:149. Type species *Nettenchelys taylori* Alcock 1898, by monotypy. Feminine.

Diagnosis. Body elongate, round anteriorly, compressed posteriorly, deepest in middle and tapering at both ends, tail slender and attenuate, its tip delicate and frequently broken. Dorsal fin begins over gill opening or slightly behind, anal fin begins immediately behind anus, the fins confluent with caudal fin. Pectoral fin absent. Head and snout slender, elongate, and slightly depressed, snout projecting beyond tip of lower jaw. Anterior nostril tubular, near tip of snout; posterior nostril located on dorsal surface of head or body, from a point just posterior to eye to dorsal surface of body well behind dorsal origin (Fig. 1). Lateral line on body complete; 5 SO pores, 8–10 + 2–4 IO pores, 11–16 POM pores. Teeth small, conical, in narrow bands on jaws and vomer; vomerine tooth patch elongate, sometimes with a median series of enlarged teeth anteriorly.

Species. *Nettenchelys* contains nine known adult species: *N. dionisi* Brito 1989; *N. erroriensis* Karmovskaya 1994; *N. exoria* Böhlke & Smith in Smith *et al.* 1981; *N. gephyra* Castle & Smith in Smith *et al.* 1981; *N. inion* Smith & Böhlke in Smith *et al.* 1981; *N. paxtoni* Karmovskaya 1999; *N. proxima* n. sp.; *N. pygmaea* Smith & Böhlke in Smith *et al.* 1981; and *N. taylori* Alcock 1898. They are distinguished by the position of the posterior nostril (Figure 1), the presence or absence of the median supratemporal pore, infraorbital pore counts, and the form of the vomerine teeth (Table 1). A tenth species, *Nettenchelys belottii* (D'Ancona 1928), is known only from a larva.

Distribution. Tropical Atlantic and Indo-West Pacific, rarely collected as adults.

Remarks. All of the known specimens have regenerated tails. As a result, the total number of vertebrae, an important character in eels, is unknown for any of the species, except by inference from the number of myomeres in larvae.

TABLE 1.—Distinguishing characters in *Nettencheilus* species. Abbreviations as in Material and Methods. Sources from: 1. Brito (1989); 2. Karmovskaya (1994); 3. Karmovskaya (1999); 4. Smith *et al.* (1981); 5. Smith (1989); 6. This study. (*reported as abdominal vertebrae)

Character	<i>N. dionisi</i>	<i>N. erroriensis</i>	<i>N. exoria</i>	<i>N. geophyra</i>	<i>N. inion</i>	<i>N. paxtoni</i>	<i>N. proxima</i> n. sp.	<i>N. pygmaea</i>	<i>N. taylori</i>
single row of enlarged vomerine teeth anteriorly	Yes	No	No	Yes	No	No	Yes	Yes	No
ST	3	2	2	3	3	2	3	3	2
IO	9+3	9+3	8-10+3	8-9+3-4	9+3	9+3	9+2	8+3	8-9+3
POM	14-15	14	14-16	11-15	14	12	13	-	15
PDV	8	-	7	5-8	7	5	6	7-8	9
PAV	38-39	-	43-44	42-ca47	41	39	44	40-43	48
PCV	-	62*	58-59	79-101	50	63	78	75	-
PALL	42	42	40-43	39-51	41	40	43	40-42	48
PADR	-	86	-	ca72-112	-	-	96	-	-
PDL in % PAL	37.4-37.9%	37.7%	32-34%	27.9-39.8%	37%	33.7%	31%	33-35%	34%
HL in % PAL	34.3-35.5%	38.5%	31-34%	24.8-37.6%	38%	34.2%	27.6%	30-33%	33%
source	1	2	4 & 5 & 6	4 & 6	4 & 5 & 6	3	6	4 & 5 & 6	4

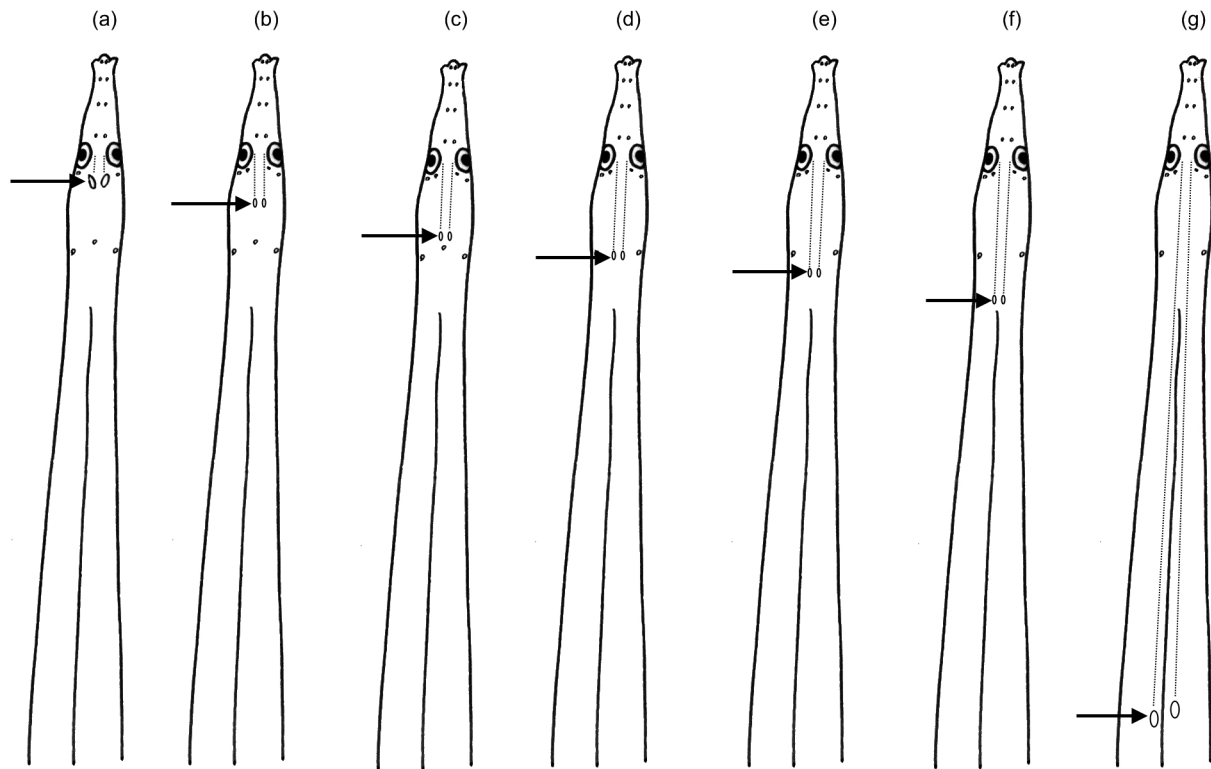


FIGURE 1. Position of the posterior nostrils in nine species of the genus *Nettenchelys* (modified after Karmovskaya, 1999). (a) *N. pygmaea*, *N. proxima*; (b) *N. gephyra* and *N. dionisi*; (c) *N. inion*; (d) *N. paxtoni*; (e) *N. exoria*; (f) *N. erroriensis*; and (g) *N. taylori*.

Key to the Species of *Nettenchelys* juveniles and adults

- | | | |
|---|---|---|
| 1 | Anteriormost vomerine teeth uniserial | 2 |
| - | Anteriormost vomerine teeth not uniserial | 5 |
| 2 | Posterior nostril located immediately behind eye | 3 |
| - | Posterior nostril approximately midway between eye and supratemporal canal | 4 |
| 3 | Small size, mature at 150–200 mm; PDV 7–8; PAV 40–43; PCV 75; IO pores 8+3; predorsal length 33–35% preanal, head length 30–33% preanal | <i>Nettenchelys pygmaea</i> (western Atlantic) |
| - | Larger size, greater than 250 mm; PDV 6; PAV 44; PCV 78; IO pores 9+2; predorsal length 31% preanal; head length 28% preanal | <i>Nettenchelys proxima</i> (Taiwan) |
| 4 | Anterior vomerine teeth not enlarged; PAV 38–39 | <i>Nettenchelys dionisi</i> (eastern Atlantic) |
| - | Anterior vomerine teeth enlarged; PAV 42–ca. 47 | <i>Nettenchelys gephyra</i> (western Pacific) |
| 5 | Posterior nostril on head just in front of supratemporal canal; median ST pore present | <i>Nettenchelys inion</i> (western Atlantic) |
| - | Posterior nostril on body behind supratemporal canal; median ST pore absent | 6 |
| 6 | Posterior nostril about midway between dorsal-fin origin and anus | <i>Nettenchelys taylori</i> (Indian Ocean) |
| - | Posterior nostril much closer to dorsal-fin origin than to anus | 7 |
| 7 | Posterior nostril close to dorsal-fin origin, approximately over the eighth LL pore | <i>Nettenchelys erroriensis</i> (northwestern Indian Ocean) |
| - | Posterior nostril before dorsal-fin origin, approximately over the second to fourth LL pore | 8 |
| 8 | Posterior nostril immediately behind supratemporal canal, over second LL pore; POM pores 12; PDV 5; PAV 39 | <i>Nettenchelys paxtoni</i> (western Pacific) |
| - | Posterior nostril midway between supratemporal canal and dorsal-fin origin, over fourth LL pore; POM pores 14–16; PDV 7; PAV 43–44 | <i>Nettenchelys exoria</i> (western Atlantic) |

Nettenchelys bellottii (D'Ancona 1928)

Fig. 2

Leptocephalus bellottii D'Ancona 1928:60, Pl 3 (figs. 16–17) (Red Sea). **Lectotype.** MSNVE P-8 (24 mm), designated by Smith & Castle (1982:14).

Diagnosis. Known only from a larva; adult characters not available.

Distribution. Red Sea.

Remarks. This species was described from two small specimens, 14.5 and 24 mm TL. The larger one, the lectotype, is clearly a larval *Nettenchelys*. The smaller one, the paralectotype, is doubtful; it lacks the characteristic midlateral spot, and the posterior pigmented swelling in the gut seems closer to the anus than it is in larval *Nettenchelys* (Fig. 2, bottom). We suspect that it may be a small specimen of *Saurenchelys*. D'Ancona did not give the total myomere counts, only the preanal counts (51 for the lectotype), and there are no other characters that could link the larva to an adult. Considering the restricted distributions of the known species of *Nettenchelys* and the prevalence of endemism in the Red Sea, it is unlikely that this is the larva of one of the nine described species. It most likely represents a distinct species that has not yet been collected as an adult. The name is available and could be applied to the species if the adult is ever found.



FIGURE 2. *Leptocephalus bellottii*, from D'Ancona, 1928. Above, paralectotype, 14.5 mm TL. Below, lectotype, 24 mm TL.

Nettenchelys dionisi Brito, 1989

Fig. 1b

?*Nettenchelys* sp. B Smith & Castle 1982:18 (eastern Atlantic). Larva.

Nettenchelys dionisi Brito 1989:877, figs. 2–4 (Canary Islands, eastern Atlantic, depth 350–400 m). **Holotype.** TFMC ZM-3 (female, 620 mm).

Material. Two specimens known, both gravid females. Holotype: TFMC ZM-3 (620 mm). Paratype: CCML 01/248 (446 mm).

Diagnosis. Anterior vomerine teeth uniserial but not enlarged; posterior nostril midway between eye and supratemporal canal. See Table 1 for additional characters.

Distribution. Known from the Canary Islands in the eastern North Atlantic.

Remarks. Smith & Castle (1982: 18) described a larva, *Nettenchelys* sp. B, based on two specimens collected in the eastern North Atlantic, one near the Azores and one near the Canary Islands (Smith & Castle 1982: fig. 12). These larvae may belong to *Nettenchelys dionisi*, a species that was unknown in 1982. Both the holotype and paratype of *N. dionisi* appear to be incomplete; the vertebral counts of 165 and 132 respectively seem far too low for a nettastomatid. The preanal lengths of the two specimens given by Brito (1989:table 1) are 30.8 and 37.2 %TL for the holotype and paratype respectively. If the specimens are incomplete, and if the paratype has lost more vertebrae than the holotype, then it would be expected that any proportional measurement given as a percentage of TL would be greater in the paratype. This is indeed what we see, providing further evidence that both specimens have lost part of the tail. The two specimens of *Nettenchelys* sp. B larvae have 235–236 total myomeres (Smith &

Castle 1982:18); if these represent the larvae of *N. dionisi*, then the adults would have a comparable number of vertebrae.

Nettenchelys erroriensis Karmovskaya 1994

Fig. 1f

Nettenchelys erroriensis Karmovskaya 1994:409, unnumbered figure (northwestern Indian Ocean, Error Seamount, 10°19'N, 56°10'E, depth 395–420 m). **Holotype.** ZMMU-19251 (female, 335 mm).

Material. Known only from the holotype.

Diagnosis. Anterior vomerine teeth not uniserial; posterior nostril behind head, near dorsal-fin origin, approximately over eighth LL pore; median ST pore absent. See Table 1 for additional characters.

Distribution. Known from Error Seamount in the western Arabian Sea.

Remarks. This species is well distinguished from *Nettenchelys taylori*, the other species known from the Arabian Sea, by the position of the posterior nostril. It apparently is not the adult of *Leptocephalus bellottii* from the Red Sea, as pointed out by Karmovskaya (1994:125, English translation version).

Nettenchelys exoria Böhlke & Smith 1981

Fig. 1e

Nettenchelys exorius Böhlke & Smith in Smith *et al.* 1981:556, figs. 8D, 9, 12 (western Atlantic off Florida, 29°41'N, 80°11'W, depth 347 m). **Holotype.** ANSP 142275 (female, 467 mm). Smith & Castle 1982:16; Smith 1989:602; Claro *et al.* 2000:20.

Material. Seven specimens known, 182–467 mm. Holotype: ANSP 142275. Paratypes: ANSP 130813 (1, 429 mm), ANSP 131739 (male, 329 mm). Others: ANSP 156856 [formerly UMML 20867] (1, 253 mm), FSBC [formerly FDNR] 17770 (1, 182 mm), FSBC 17771 (1, 395 mm), Instituto de Oceanología Cuba (1, 255 mm).

Diagnosis. Anterior vomerine teeth not uniserial; posterior nostril behind head, about midway between supratemporal canal and dorsal-fin origin, approximately over fourth LL pore; median ST pore absent; 14–16 POM pores; PDV 7; PAV 43–44. See Table 1 for additional characters.

Distribution. Adult specimens are known from the east coast of Florida, the Bahamas, and the south coast of Cuba. Larvae of either this species or *N. inion* have also been collected in the eastern Gulf of Mexico, the Greater Antilles, and in the Gulf Stream and the Sargasso Sea area (Smith & Castle 1982:16).

Remarks. This species was described from four specimens from the east coast of Florida and the Bahamas. Smith (1989:603) added two more specimens from northeastern Florida, and Claro *et al.* (2000:20) reported a specimen from the south coast of Cuba in the Caribbean.

Nettenchelys gephyra Castle & Smith 1981

Figs. 1b, 3, 4; Table 2

Nettenchelys gephyra Castle & Smith in Smith *et al.* 1981:553, figs. 8–11. **Holotype.** MNHN 1979–0150 (New Caledonia). Gloerfelt-Tarp & Kailola, 1984:60–61, 305 (Indonesia); Last *et al.*, 2014:208 (Australia).

Material examined. **Taiwan:** ASIZP 0063132 (1, 398 mm, mature female, egg size 1.0 mm), Daxi, Yilan, Taiwan, bottom trawl, 24°48'36"N, 122°7'48"E, depth 600 m, 27 April 2004. TOU-AE 6529 (1, 456 mm, mature female, egg size 1.0 mm), Daxi, Yilan, Taiwan, bottom trawl, 24°48'36"N, 122°7'48"E, depth 400 m, 19 July 2012; TOU-AE 6547 (1, 363 mm, mature female, egg size 1.0 mm), Daxi, Yilan, Taiwan, bottom trawl, 24°48'36"N, 122°7'48"E, depth 400 m, 25 July 2012. **Indonesia:** AMS I.22852-001 (1, 207 mm), Indonesia, Sumbawa, Saleh Bay, 08°27'S, 117°47'E, July 1981. AMS I.24306-001 (1, 366 mm), same locality and date, 180–300 m. **Australia:** AMS I.25834-002 (1, 275 mm), Australia, Queensland, 18° 01' S, 147°07'E, 300 m, 19 January 1986. CSIRO H 1106-05 (1, 240 mm), Australia, Queensland, 18° 01' S, 147° 01' E, 208–212 m, 29 November 1985. CSIRO H 1556-04 (2, 282–302 mm), Australia, Queensland, 22° 57' S, 153° 01' E, 325–338 m, 18 November 1985. CSIRO H 1668-02 (1, 283 mm), Australia, Queensland, 22° 57' S, 153° 01' E, 345–350 m, 17 November 1985. NTM S 11779.007 (1, 170 mm), Australia, Queensland, 18°00'S, 147°04'E, 260 m, 19 January 1986. **Other material.** Holotype: MNHN 1979-0150 (female, 431 mm), New Caledonia.

Diagnosis. Antermost vomerine teeth uniserial and enlarged; posterior nostril on top of head approximately midway between eye and supratemporal canal; median ST pore present; 79–101 PCV. See Table 1 for additional characters.

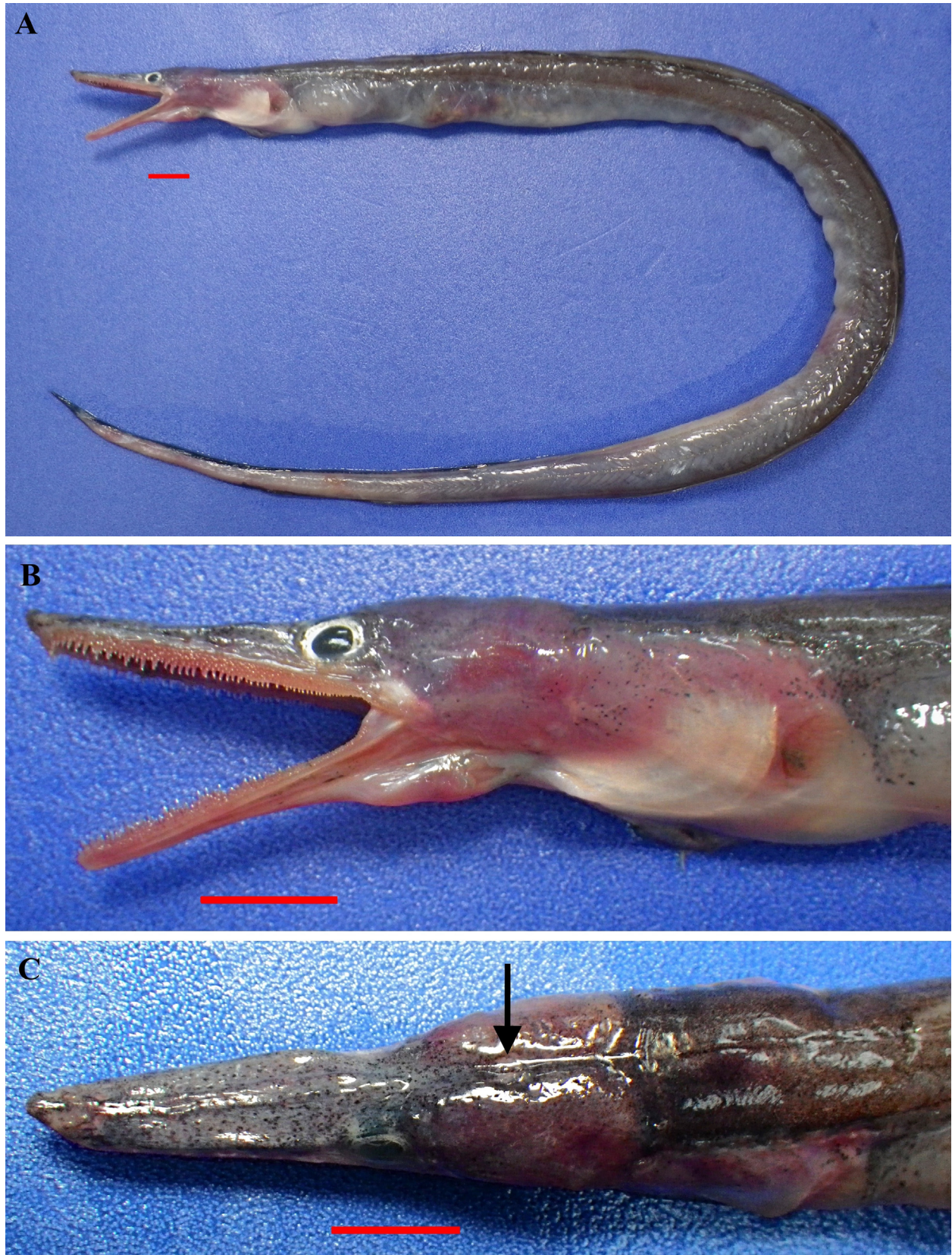


FIGURE 3. *Nettenchelys gephyra*, TOU-AE 6529, 456 mm TL, mature female, Taiwan. A, lateral view of whole body; B, lateral view of head; C, dorsal view of head, arrow indicating the position of posterior nostrils. Bar = 10 mm.

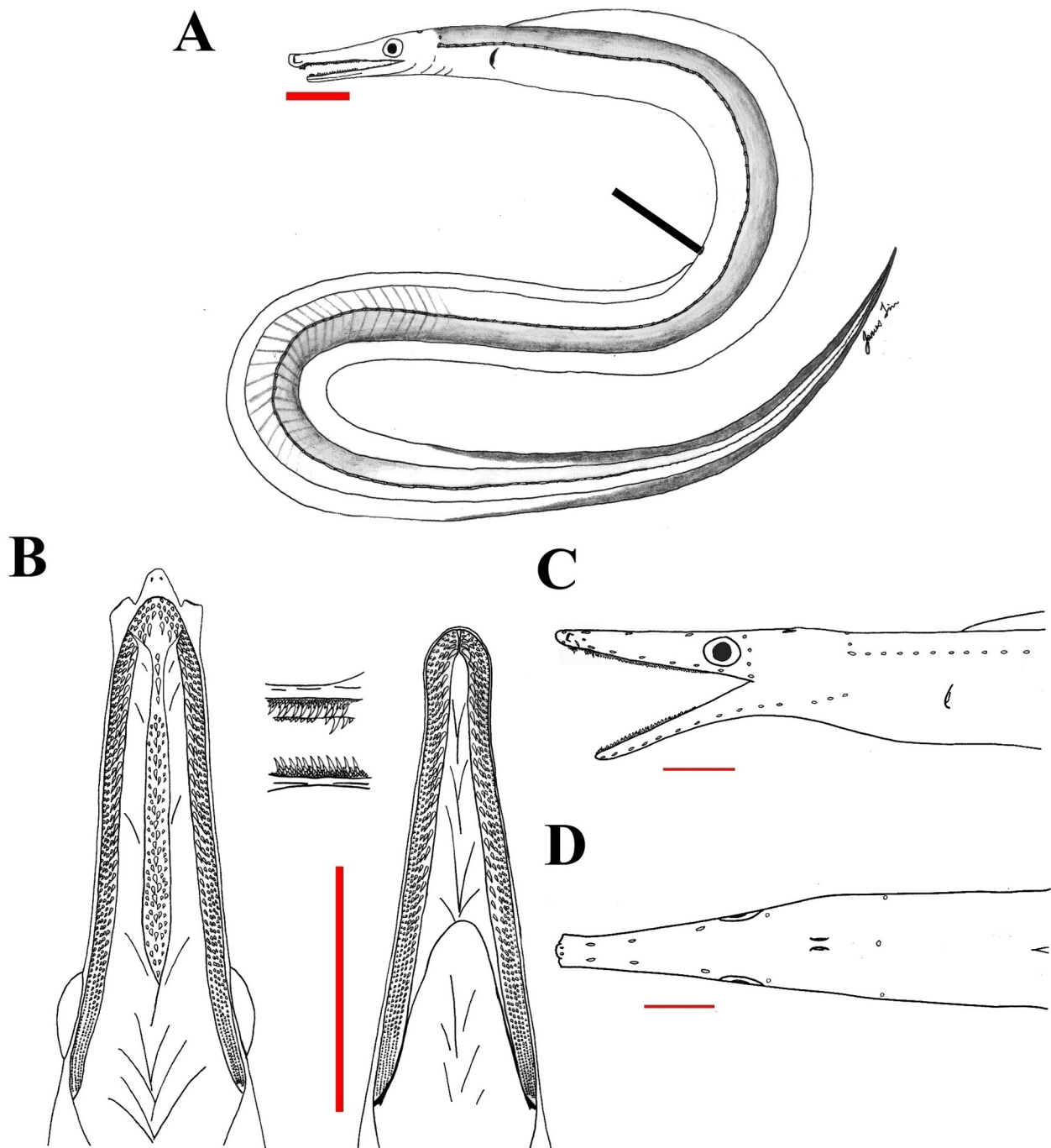


FIGURE 4. *Nettenchelys gephyra*: ASIZP 0063132, 393 mm TL, Taiwan. A, lateral view of body (black line indicates anus); B, dentition for *N. gephyra* from left to right: upper jaw, lateral view, and lower jaw; C, lateral view of head; D, dorsal view of head. Bar = 10 mm.

Description. Measurements as percent of preanal length: predorsal 27.9–39.8, head 24.8–37.6; as percent of head length: snout 33.0–42.4, eye 7.4–11.3, upper jaw 48.3–57.6, lower jaw 47.3–52.9, interorbital 3.4–7.6. TV 202+, PDV 5–8, PAV 42–ca. 47, PCV 79–101, PADR ca. 72–112, PALL 39–51, PDLL 7–8, IO 8–9 + 3–4, SO 5, POM 11–15, ST 3.

Head and snout elongate, slightly depressed, snout flexible. Anterior nostril tubular, near tip of snout; posterior nostril on top of head, about midway between posterior margin of eye and supratemporal canal. Origin of dorsal fin slightly behind gill opening. Anus before midbody. Intermaxillary teeth in a short patch, about as long as wide, continuous with maxillary teeth. Maxillary and dentary teeth in bands, the inner teeth larger than outer. Vomerine

tooth patch elongate, extending from slightly behind level of anterior nostrils to anterior margin of eye, consisting of a short median row of enlarged teeth at anterior end, followed by a narrow band of smaller teeth, the middle ones slightly enlarged.

Color in fresh specimens pink to dark purple or brown; snout and dorsal body dark purple to brown; abdominal region pink and pale; behind eye, occipital region, and around gill opening pink to purple; at midbody, myomeres become obvious, with darkish color. Dorsal and anal fins dark-edged, both becoming black posteriorly. In alcohol, light to dark brown dorsally, and pale below.

TABLE 2. Geographic variation in five characters in *Nettenchelys gephyra*

	PALL	Max pores	PCV	PAV	PADR
Taiwan	ca 46–51	8	91–101	45	102–112
Indonesia	39–41	9	79–80	42	ca 72–ca 79
Australia	42–c 46	8–9	85–92	42–45	ca 85–ca 95
New Caledonia	44	9	ca 92	ca 47	--

Distribution. New Caledonia, Australia, Indonesia, and Taiwan.

Remarks. Considerable variation occurs in this species over its range. This is particularly evident in the preanal lateral-line pores, maxillary pores, preanal vertebrae, precaudal vertebrae, and preanal dorsal rays (Table 2). The posterior nostril appears slightly closer to the eye in the Australian specimens than in the Taiwan specimens, although not nearly as close as in *N. proxima*. We hesitate to describe these variants as species based on such a small sample size and without any genetic information. We simply note the differences and leave the nomenclatural decisions to future studies when more information is available.

The typical IO pore count for this species is 9 + 3. One specimen from Australia had eight pores along the upper jaw, and another Australian specimen had an extra pore behind the eye on one side.

We also note an inconsistency in the number of POM pores reported by Smith *et al.* (1981:553 and fig. 11). The text states 17 POM pores, but the figure shows 13 (11+2). We suspect that the latter figure is correct. Smith *et al.* (1981) did not give vertebral counts for the holotype, but a radiograph of this specimen is available online (<http://science.mnhn.fr/institution/mnhn/collection/ic/item/search/form>). This image is divided into two parts, anterior and posterior. Assuming that there is no overlap or duplication in these two parts, we obtained the following counts: PDV ca. 8, PAV ca. 47, PCV ca. 92, TV 160+.

Nettenchelys inion Smith & Böhlke 1981

Fig. 1c

Nettenchelys inion Smith & Böhlke in Smith, *et al.* 1981:555, fig. 8C, 9 (western Atlantic, Straits of Florida, 25°36'N, 79°21'W, depth 458–531 m). **Holotype.** ANSP 142274 (male, 423 mm). Smith, 1989:603.

Material. Known only from the holotype.

Diagnosis. Anterior vomerine teeth not uniserial; posterior nostril on head just anterior to supratemporal canal; median ST pore present. See Table 1 for additional characters.

Distribution. Straits of Florida, western Atlantic. Larvae of either this species or *N. exoria* have also been collected in the eastern Gulf of Mexico, the Greater Antilles, and in the Gulf Stream and Sargasso Sea area of the western Atlantic.

Nettenchelys paxtoni Karmovskaya 1999

Fig. 1d

Nettenchelys paxtoni Karmovskaya 1999:833, fig. 1 (western Pacific, Vanuatu, 17°46'S, 168°15'W). **Holotype.** AMS I.34589-002 (male, 248 mm).

Material. Known only from the holotype.

Diagnosis. Anterior vomerine teeth not uniserial; posterior nostril just behind head, closer to supratemporal canal than to dorsal-fin origin, approximately over second LL pore; median ST pore absent; 12 POM pores; PDV 5; PAV 39. See Table 1 for additional characters.

Distribution. Off Efate Island, Vanuatu (New Hebrides), western Pacific.

Remarks. The specimen was taken from the stomach of a sea snake, suggesting that it may have come from relatively shallow water.

Nettenchelys proxima Smith, Lin & Chen, new species

Figs. 1a, 5–7

?*Nettenchelys gephyra*: Smith & Böhlke in Smith *et al.* 1981:555 (smaller specimen only)

Holotype. NMMST P 01524 (251 mm TL, immature female, egg size 0.05–0.09 mm), Donggang, Pingtung, Taiwan, bottom trawl, 22°12'57"N, 120°26'21"E, depth 300 m, 4 April 2002.

Other material. USNM 134972 (93 mm TL, poor condition), Philippines, ALBATROSS sta. 5187, 9°16'45"N, 123°21'15"E, depth 412 m, 31 March 1908.

Diagnosis. *Nettenchelys proxima* differs from all other species in the genus except *N. gephyra* and *N. pygmaea* in having an enlarged median series of teeth at the anterior end of the vomer. It differs from *N. gephyra* in having the posterior nostril immediately behind the eye (approximately midway between eye and supratemporal canal in *N. gephyra*), in having 78 PCV (79–101 in *N. gephyra*, but 91–101 in specimens from Taiwan), and in having 9 + 2 IO pores (8–9 + 3–4 in *N. gephyra*). It differs from *N. pygmaea* in its larger size (251 mm in the holotype, an immature female, vs. 201 mm for the largest known *N. pygmaea* and 151 mm for a mature female) and slight differences in some meristic and morphometric characters (Table 1).

Description. Measurements of holotype in mm and percent of preanal length: predorsal 27 (31.0), head 24 (27.6), depth at anus 4.9 (5.6); in mm and percent of head length: snout 9.3 (38.8), eye 2 (8.3), upper jaw 13.5 (56.3), lower jaw 12.6 (52.5), gill opening 1.4 (5.8), interbranchial 2.2 (9.2). Meristic features: TV 185+, PDV 6, PAV 44, PCV 78, PADR 96, PALL 43, PDLL 8, IO 9 + 2, SO 5, POM 10 + 3, ST 3.

Body and head elongate; tail narrow and tapering, incomplete in holotype; anus before midlength. Dorsal and anal fins continuous around tail, dorsal-fin origin behind gill opening, anal-fin origin immediately behind anus; height of dorsal fin about half body depth. Pectoral fin absent. Snout elongate, narrow, slightly depressed, its anterior tip soft and fleshy, extending a short distance beyond intermaxillary tooth patch. Eye well developed, about midway between snout tip and gill opening. Anterior nostril tubular, near tip of snout, directed anterolaterally; posterior nostril a simple, relatively large opening on top of head immediately behind posterior margin of eye. Lateral line complete.

Preoperculomandibular canal with ten pores in the mandibular section and three pores in the preopercular: first pore on edge of lower lip at tip of jaw; second pore below and behind first, along lower lip; third through tenth pores along lower lip spaced more or less evenly between second pore and posterior end of lower jaw; eleventh to thirteenth pores in an ascending arc behind tenth, the last one below the first LL pore. Supraorbital canal with five pores: first (ethmoid) pore on underside of tip of snout; second pore on upper side of snout before anterior nostril; third pore on top of snout above and immediately behind anterior nostril; fourth on top of snout about one third of distance between anterior nostril and eye; fifth on top of snout near anterior margin of eye. Infraorbital canal with nine pores along upper jaw and two behind eye: first pore on edge of upper lip below anterior nostril directly behind middle of anterior nostril base; second pore elevated above first and directly behind anterior nostril base; third pore below and behind second, along upper lip; fourth through ninth pores on edge of upper lip spaced more or less evenly between third pore and rictus; tenth pore above and slightly behind ninth, at level of lower half of eye; eleventh pore directly above tenth at level of upper half of eye and just below posterior nostril. Supratemporal canal with three pores: one median and one on each side.

Teeth mostly small, conical, in narrow bands on jaws and vomer. Intermaxillary tooth patch about as long as wide, the inner and posterior teeth somewhat larger, continuous with maxillary teeth. Maxillary teeth in about four rows, those of the inner row larger than outer. Vomerine tooth patch elongate, extending from shortly behind intermaxillary teeth to below anterior margin of eye; first four teeth slightly separated from remainder, distinctly enlarged and forming a single median row, increasing in size from anterior to posterior, these constituting the largest teeth in mouth; remainder of teeth in an elongate, narrow band, those in middle slightly larger than those on

outside. Dentary teeth in narrow bands, those of inner row larger than outer; largest dentary teeth larger than any of the maxillary teeth.

Color in preservative pale brown, fins dark-edged posteriorly.

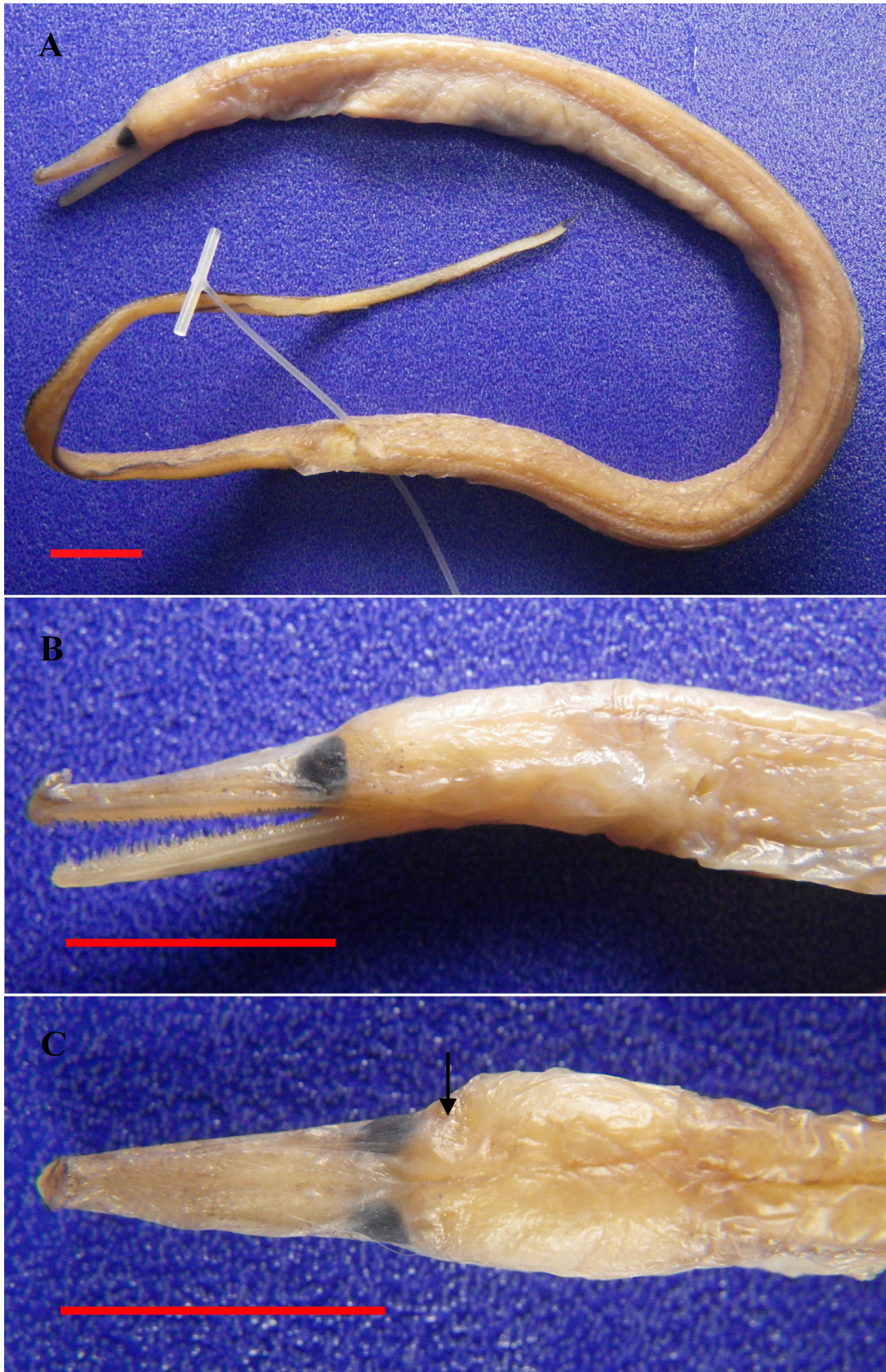


FIGURE 5. *Nettenchelys proxima* new species, holotype, NMMST P-01524, 251 mm TL, immature female, Taiwan. A, lateral view of whole body; B, lateral view of head; C, dorsal view of head, arrow showing the position of posterior nostrils. Bar = 10 mm.

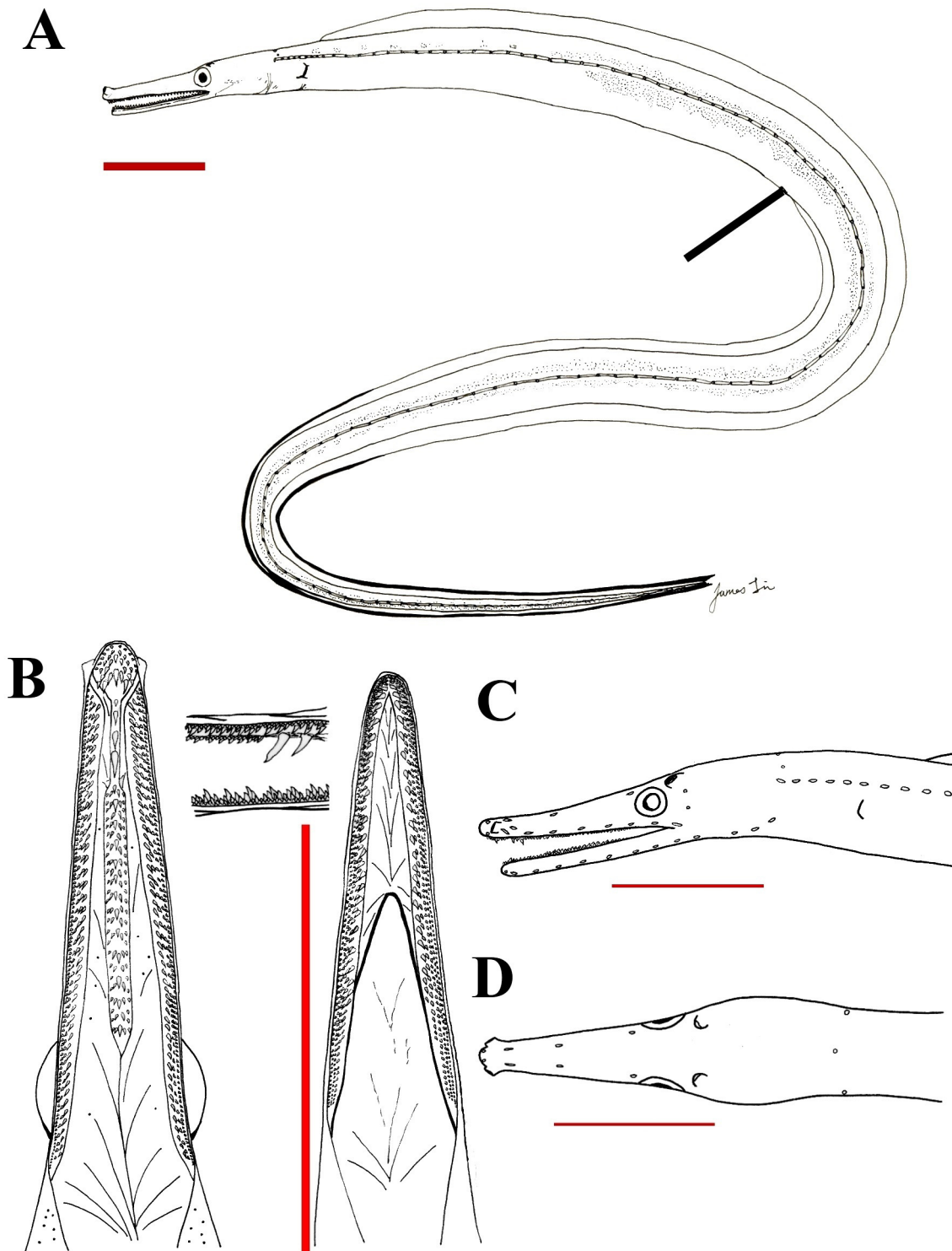


FIGURE 6. *Nentenchelys proxima* new species, holotype: NMMST P-01524, 251 mm TL, Taiwan. A, lateral view of body (black line indicates anus); B, dentition for holotype from left to right: upper jaw, lateral view, and lower jaw; C, lateral view of head; D, dorsal view of head. Bar = 10 mm.

Distribution. Taiwan and possibly Philippines. The geographic distribution of *N. proxima* specimens is shown in Fig. 7.

Etymology. From the Latin *proxima*, near, referring to the position of the posterior nostril, close to the eye; also referring to its close resemblance to *N. gephyra* and *N. pygmaea*. An adjective.

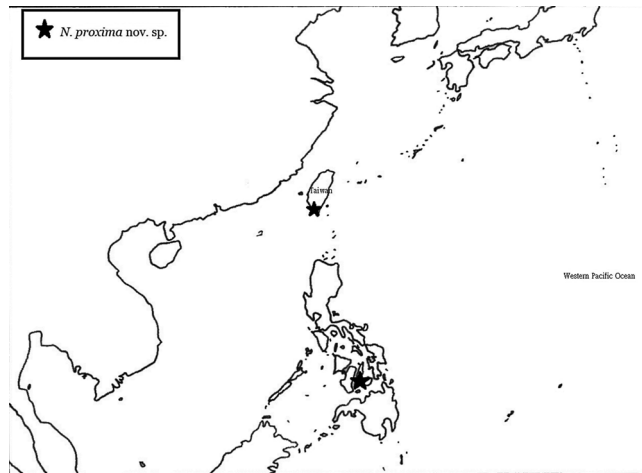


FIGURE 7. Geographic distribution of *Nettenchelys proxima*, based on holotype (NMMSTP 01524) and other material (USNM 134972).

Remarks. This new species resembles only *Nettenchelys gephyra* and *N. pygmaea* in having an enlarged series of median teeth at the anterior end of the vomer. It differs from the latter two species primarily in the characters mentioned in the diagnosis: nostril position, precaudal vertebrae, and size. It further differs from *N. gephyra* in PADR (96 vs. 102–112 in specimens from Taiwan), upper jaw length (56.3 vs. 49.0–55.5 % head in specimens from Taiwan), and lower jaw length (52.5 vs. 45.1–51.7 % head). It differs from *N. pygmaea* in PDV (6 vs. 7–8), PAV (44 vs. 40–43), PCV (78 vs. 75), postorbital pores (2 vs. 3), predorsal length (31 vs. 33–35 % preanal), and head length (27.6 vs. 30–33 % preanal). Because of the small sample size, however, it is uncertain how meaningful these minor differences are.

The second specimen listed, USNM 134972, was included in *Nettenchelys gephyra* by Smith *et al.* 1981, although they did not make it a paratype because of its small size and poor condition. We tentatively reassign it here to *N. proxima* because the posterior nostril seems to be closer to the eye than it is in *N. gephyra*, but its size and condition make its positive identification uncertain. Hence we exclude it from the type series.

***Nettenchelys pygmaea* Smith & Böhlke 1981**

Fig. 1a

Nettenchelys pygmaeus Smith & Böhlke in Smith *et al.* 1981:551, figs. 8A, 9, 10 (western Atlantic, Gulf of Mexico, 29°52'N, 87°06.5'W, depth 128 m). **Holotype.** ANSP 142277 (male, 175 mm). Smith 1989:600.

Material examined. Paratype, USNM 200779 (1, 151 mm, mature female), 10°42' N, 67°56'W, 210 m. **Other material.** Holotype: ANSP 142277. Paratypes: ANSP 130812 (1, 167 mm), USA 03460 (1, 201 mm).

Diagnosis. Anterior vomerine teeth uniserial, enlarged; posterior nostril on head shortly behind posterior margin of eyes; median ST pore present; PDV 7–8; PAV 40–43; PCV 75; IO pores 8+3; PDL 33–35 % PAL; HL 30–33 % PAL; small size, mature at 150–200 mm. See Table 1 for additional characters.

Distribution. Adults are known from two widely separate locations in the western Atlantic: the northern Gulf of Mexico and the southern Caribbean Sea. Larvae are known from a much wider area, including the western Gulf of Mexico, the Bahamas and the Gulf Stream off the east coast of the United States, the Antilles, and the Sargasso Sea. The number of myomeres in these larvae shows a slight difference between specimens from the Gulf of Mexico (ca. 220–236, seven specimens) and elsewhere (ca. 227–251, 22 specimens) (Smith & Castle 1982:16).

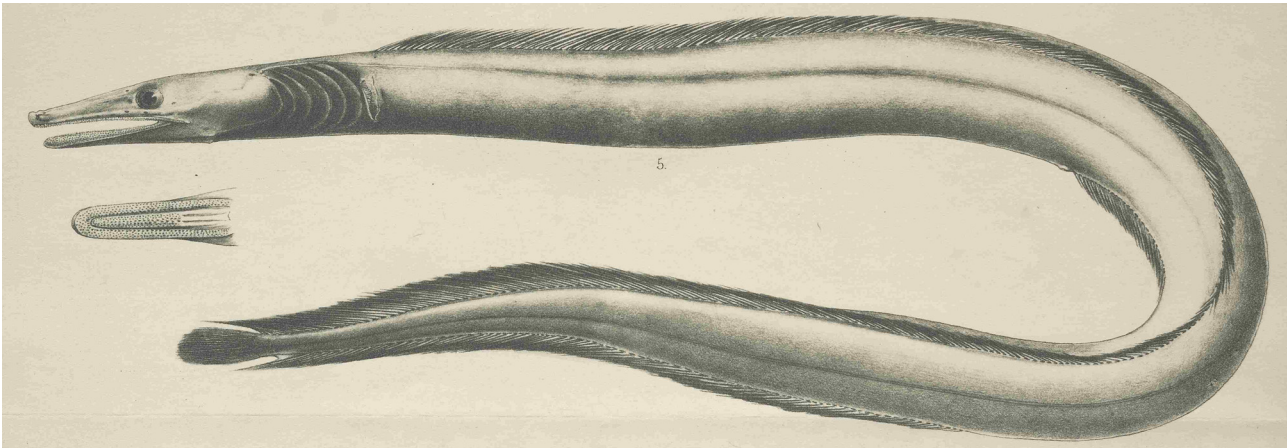


FIGURE 8. *Nettenchelys taylori*, holotype, from Alcock (1899), pl. 25, fig. 5. The apparent separation of the caudal fin from the dorsal and anal fins is an error.

***Nettenchelys taylori* Alcock 1898**

(Figs. 1, 8)

Nettenchelys taylori Alcock 1898: 150 (Indian Ocean, India, off Travancore Coast, 7°17'30"N, 76°54'30"E, depth 786 m).
Holotype ZSI F 3171/1 (female, 533 mm, incomplete). Alcock 1899: pl. 25, Fig. 5; Smith *et al.* 1981: 557.

Material. Known only from the holotype.

Diagnosis. Anterior vomerine teeth not uniserial; posterior nostril far behind head, midway between dorsal-fin origin and anus. See Table 1 for additional characters.

Distribution. Off the southwestern tip of India.

Remarks. This was the first species of *Nettenchelys* to be described, and it has not been collected since. It is distinguished by the extreme posterior displacement of the posterior nostril.

Notes on larvae

Because of the rarity of adult specimens, much of our knowledge of the abundance and distribution of *Nettenchelys* is based on their larvae. Smith & Castle (1982) recognized seven distinct groups of larvae. Two of these were identified to species, *Nettenchelys gephyra* and *N. pygmaea*. One was attributed to either *N. exoria* or *N. inion*, and the remaining four were given letter designations. A few comments are necessary in the light of current knowledge. In the Atlantic, the most numerous of the larvae were those of *Nettenchelys pygmaea*, known from 94 specimens. As noted above, there is a slight difference between specimens from the Gulf of Mexico and elsewhere. This should not be surprising, as a number of other eel species show a similar differentiation between the Gulf of Mexico and the Atlantic and Caribbean.

Two specimens described as *Nettenchelys* sp. B were described from the northeastern Atlantic near the Azores and the Canary Islands. As we explained above, these are most likely the larvae of *Nettenchelys dionisi*.

Seventy specimens were attributed to either *Nettenchelys exoria* or *N. inion*; the two species could not be distinguished as larvae. Larvae of this group were found in the open Atlantic and the northern Caribbean, but not in the western Gulf of Mexico. The absence of both these and *N. pygmaea* in the southern Caribbean may be an artifact of collecting.

In the Indo-Pacific, 43 specimens were assigned to *Nettenchelys gephyra*, distributed widely from the Red Sea to the Central Pacific. Based on what we now know, it is unlikely that all these larvae represent *N. gephyra*. The identification was made on the basis of a single metamorphic specimen from Dana station 3735 II, taken in the central Philippines (9°33'N, 122°19'E), which showed enlarged teeth on the anterior midline of the vomer. This character distinguishes *N. gephyra* from *N. taylori*, the only other Indo-Pacific species known to Smith & Castle

(1982) at the time, but not from *N. proxima*, which also has enlarged anterior vomerine teeth. The posterior nostril of this specimen was located between the posterior half of the eyes rather than midway between the eye and the supratemporal canal as in *N. gephyra*; it is uncertain whether this was the definitive position or whether it might have moved posteriorly later in metamorphosis. Two other metamorphic specimens were mentioned, but neither their dentition nor their posterior nostril was described. The remaining specimens were all premetamorphic, and no characters were available to distinguish them. Total myomeres were given as 233–258, but a geographical analysis was not made. Tabeta (1988) and Hatooka (2002) reported larvae of *Nettenchelys gephyra* in Japanese waters, and Kim *et al.* (2005) described a larva from Korean waters that they identified as *Nettenchelys gephyra*.

Three specimens from the southwestern Indian Ocean were described as *Nettenchelys* sp. A. These were identical to those described as *N. gephyra* but had significantly more myomeres (265–273).

Finally, two groups were described that differed from all the others by having three midlateral spots rather than one. These specimens were collected from widely separate locations: New Guinea and Hawaii in the Pacific (*Nettenchelys* sp. C, two specimens) and the Caribbean in the Atlantic (*Nettenchelys* sp. D, one specimen). Nothing can be added to these accounts.

We record three additional *Nettenchelys* larvae from northeastern Australia and the Coral Sea: AMS I.42403-014 (1, ca. 48 mm), 12° 33' S, 144° 32' E; AMS I.42081-001 (ca. 60 mm), 13° 05' S, 151° 17' E; AMS I.42215-019 (ca. 95 mm), 12° 45' S, 146° 35' E. They generally agree with the description of *Nettenchelys gephyra* given by Smith & Castle (1982), but the two smaller ones are in rather poor condition, and myomere counts are difficult to obtain. Little more can be added.

Conclusion

Since the revision of *Nettenchelys* by Smith *et al.* (1981), 16 additional adult specimens have been reported, representing five species. The scarcity and diversity of these specimens suggests that the true diversity of the genus is considerably greater than currently recognized. Whether the scarcity is real or an artifact based on their cryptic habits cannot be determined, although the relative abundance of larvae suggests the latter. These are not species that one can go out and collect at will. They turn up sporadically and unpredictably, and this pattern will probably continue in the future.

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