*Journal of the Marine Biological Association of the United Kingdom*

**cambridge.org/mbi**

# A new species of the congrid eel genus *Ariosoma* (Teleostei: Anguilliformes: Congridae) from the Southeast coast of India, Bay of Bengal

Paramasivam Kodeeswaran[1,2], A. Kathirvelpandian[1], Anil Mohapatra[3] and T. T. Ajith Kumar[1]

[1]ICAR-National Bureau of Fish Genetic Resources, Lucknow, Uttar Pradesh – 226 002, India; [2]Faculty of Fisheries Science, Kerala University of Fisheries and Ocean Studies, Kochi – 682 506, India and [3]Estuarine Biology Regional Centre, Zoological Survey of India, Gopalpur-on-Sea, Ganjam, Odisha – 761 002, India

**Research Article**

This article was registered in Zoobank under urn:lsid:zoobank.org:pub:98BAE7FA-18E2-45E7-ACE8-50C571552154.

**Cite this article:** Kodeeswaran P, Kathirvelpandian A, Mohapatra A, Ajith Kumar TT (2024). A new species of the congrid eel genus *Ariosoma* (Teleostei: Anguilliformes: Congridae) from the Southeast coast of India, Bay of Bengal. *Journal of the Marine Biological Association of the United Kingdom* **104**, e51, 1–8. https://doi.org/10.1017/S0025315424000420

Received: 30 November 2022
Revised: 5 December 2023
Accepted: 13 April 2024

**Keywords:**
*A. gnanadossi*; Bathymyrinae; Bay of Bengal; molecular analyses; systematics

**Corresponding author:**
T. T. Ajith Kumar;
Email: ttajith87@gmail.com

**Abstract**

A new species of congrid eel genus, *Ariosoma* is described here based on two mature female specimens collected from trawl by-catch landings at Thoothukudi fishing harbour, off Thoothukudi, Bay of Bengal. The new species can be easily distinguished from its congeners in having pre-anal length 48.7–49.1% TL; dorsal-fin origin just before pectoral-fin insertion; body bicoloured, pale brown dorsally and silvery white ventrally; preopercular portion dark; pectoral fin reddish with dark spot at the base; SO canal with six pores; pre-dorsal vertebrae 10–11; pre-anal vertebrae 61–64; total vertebrae 162–163. Further, the new species differs from all the congeners of Indian waters in having more total vertebrae, except *A. albimaculatum* (162–163 vs 129–153 in others; 161–164 in *A. albimaculatum*). The new species identity was also supported by molecular analyses using the mitochondrial COI gene and the result revealed that the new species is closely related to *Ariosoma maurostigma* and *Ariosoma albimaculatum* with a pair-wise genetic distance of 11.4% and 11.6% followed by *A. melanospilos* with 16.8%.

## Introduction

The family Congridae is represented by 234 valid species in three subfamilies. The genus *Ariosoma* Swainson, 1838 consists of 40 valid species, with 32 species distributed in the Indo-West Pacific, 6 in the Atlantic, and 2 in the Eastern Pacific Ocean. Hitherto, eight species of the genus *Ariosoma* have been described or documented from the Indian waters, viz. *Ariosoma albimaculatum* Kodeeswaran *et al.*, 2023, *Ariosoma anago* (Temminck and Schlegel, 1846) (Mishra and Krishnan, 2003), *Ariosoma bengalense* Ray *et al.*, 2022, *Ariosoma gnanadossi* Talwar and Mukherjee, 1977, *Ariosoma indicum* Kodeeswaran *et al.*, 2022b, *Ariosoma majus* (Asano, 1958) (Roy *et al.*, 2021), *Ariosoma maurostigma* Kodeeswaran *et al.*, 2022a, *Ariosoma melanospilos* Kodeeswaran *et al.*, 2021. Among them, *A. albimaculatum*, *A. bengalense*, *A. gnanadossi*, *A. indicum*, *A. maurostigma* and *A. melanospilos* were originally described from the Indian waters. During a recent survey, two unknown specimens of eel were recovered from the landings of bycatch in the Thoothukudi landing centre, Tamil Nadu. After detailed examination, the specimens share several morphological characteristics with *A. gnanadossi,* but a significant difference was observed in vertebral counts which distinguish the unknown species from *A. gnanadossi*. Further attempts to collect a few more specimens ended up futile.

## Materials and methods

Two mature female specimens (424–440 mm total length) were collected from trawl by-catch landings at Thoothukudi fishing harbour (8°47'40.4"N; 78°09'34.8"E), off Thoothukudi, Bay of Bengal (Figure 1). The specimens were photographed freshly and small pieces of muscle & pectoral fin-clips were incised and preserved in 99.9% ethanol for molecular analyses. Specimens were preserved in 10% formalin for taxonomical studies and deposited in the national fish repository of the ICAR – National Bureau of Fish Genetic Resources (NBFGR), Lucknow, India and Estuarine Biology Regional Centre (EBRC), Zoological Survey of India, Gopalpur-on-Sea, Odisha, India.

Counts and measurements were carried out following Smith and Kanazawa (1977) and Smith (1989). Body proportions are expressed as a percentage of total length (TL) and head length (HL). Vertebral counts followed Böhlke (1982) aiding digital radiograph. Teeth, lateral-line and cephalic pores were examined with the aid of Nikon SMZ1270 Stereomicroscopes following Smith *et al.* (2018). Head pores abbreviations are IO, infraorbital; POM, preopercular-mandibular; SO, supraorbital; ST, supratemporal. Morphometric measurements

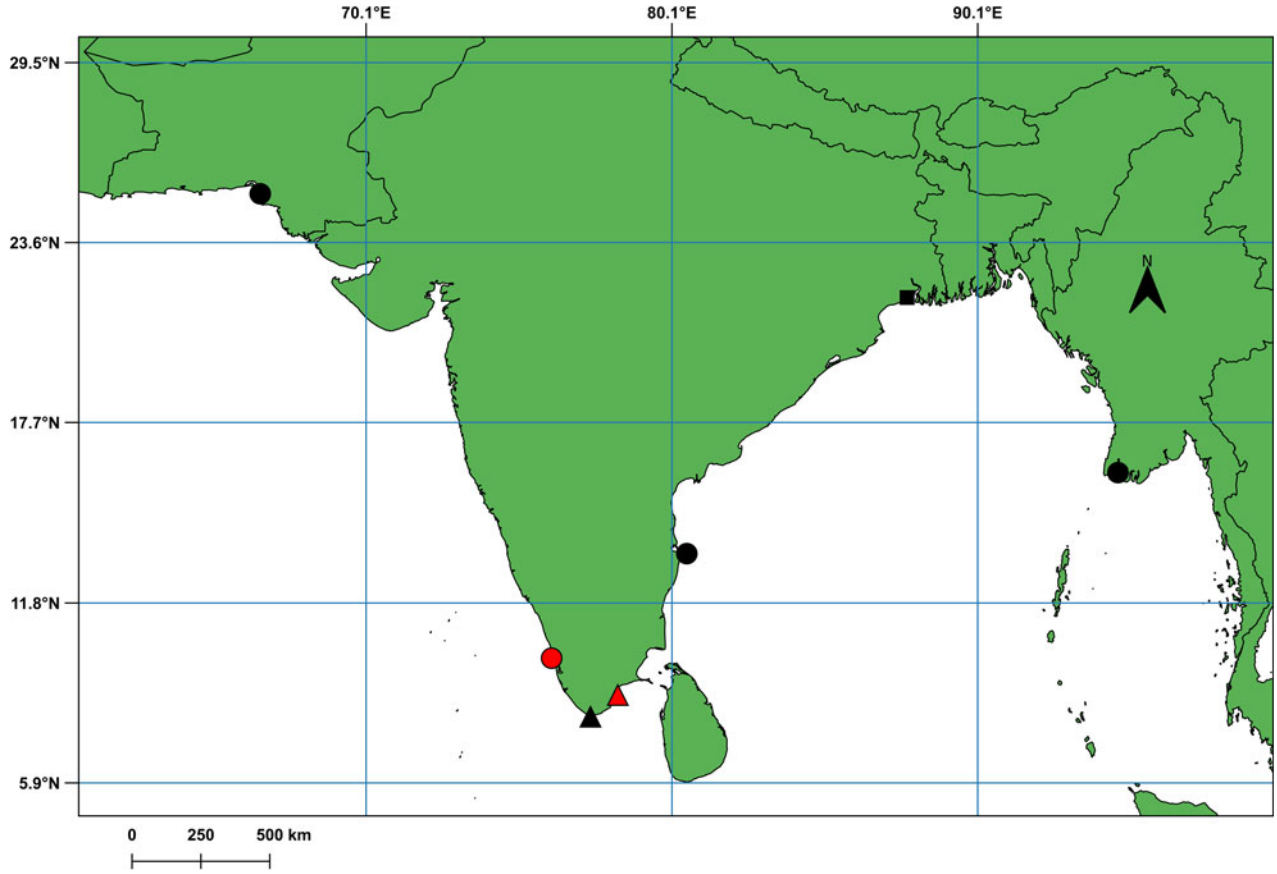


**Figure 1.** Map showing the distributional status of *Ariosoma* species recorded in India; *Ariosoma gnanadossi* (closed circle); *Ariosoma maurostigma* (red circle); *Ariosoma majus* (black square); *Ariosoma melanospilos* (black triangle); *Ariosoma thoothukudiense* (red triangle).

in proportion with TL and HL of the holotype and paratype in parentheses are documented. Information taken for the specimens other than the present study was indicated.

### *Genetic analyses*

Genomic DNA extraction was done using the salting-out method (Sambrook and Russel, 2001). Molecular analyses were performed using COI gene of mitochondrial origin owing to the availability of sequence data for the genus *Ariosoma*. The partial mitochondrial cytochrome oxidase subunit 1 (COI) gene was amplified using universal primers (Ward *et al.*, 2005). Polymerase chain reaction (PCR) amplification was assayed in 25 $\mu$l reactions inclosing 10X assay buffer (100 mM Tris, 500 mM KCl, pH 9.0), 20 mM MgCl2, 10 pmol of each primer, 200 $\mu$M of each dNTP, 0.25 U Taq DNA polymerase and 25 ng of template DNA. The PCR thermal cycle was performed with an initial denaturation at 95 °C for 5 min, denaturation at 94 °C for 30 s, annealing at 52 °C for 40 s, extension at 72 °C for 1 min (35 cycles) and final extension at 72 °C for 10 min. The obtained PCR bands were visualised on agarose gel electrophoresis (1.5%) containing ethidium bromide, abetted under Gel Doc™ XR + (Bio-Rad, India). The amplified PCR products were sequenced using ABI 3730XL sequencer at the sequencing facility. Sequences were edited and aligned using clustalW multiple alignments (Thompson *et al.*, 2003) with the assistance of software BioEdit version 5.0.9 (Hall, 1999) and deposited in the GenBank. The COI gene sequences were aligned with the sequences of other valid species of the genus *Ariosoma* retrieved from GenBank. The phylogenetic tree was reconstructed assisting the maximum likelihood (ML) method in combination with HKY + G + I (Hasegawa *et al.*, 1985) with 1000 bootstrap replicates. The genetic divergence values between and within species were ascertained using the K2P distance parameter in MEGA X software (Kumar *et al.*, 2018). *Japonoconger proriger* (MF956462) was used as an outgroup for reconstructing the phylogenetic tree.

## Results

### *Ariosoma thoothukudiense*, new species

Proposed common name urn:lsid:zoobank.org:act:94FD8F68-5E30-442A-89D6-150C292A6A6B: Thoothukudi stout conger

Figures 2–6; Table 1

***Holotype***. NBFGR/CONATHO, (440 mm TL, mature female), collected from trawl by-catch, Thoothukudi fishing harbour, off Thoothukudi, Bay of Bengal, 12 Sep. 2021, coll. by P. Kodeeswaran.

***Paratype***. EBRC/ZSI/F 13324, (424 mm TL, mature female), same data as holotype.

***Diagnosis***. An elongated eel species of *Ariosoma* distinguished from all other congeners by the following combination of characters: anus positioned at mid-point of total length, pre-anal length 48.7–49.1% of TL; dorsal-fin origin just before pectoral-fin insertion; body bicoloured, pale brown dorsally and silvery white ventrally; preopercular portion dark; pectoral fin reddish with dark spot at base; short vomerine teeth patch, four rows with pointed teeth in anterior portion, tapering posteriorly with two or three rows of blunt teeth followed by three uniserial teeth posteriorly; intermaxillary teeth with five transverse rows, barely visible when mouth closed and separated from vomerine and maxillary by fine gap; SO canal with 6 pores; pre-dorsal vertebrae 10–11; pre-anal vertebrae 61–64; total vertebrae 162–163.

***Description.*** Morphometric and meristic data are provided in Table 1. In TL: head length 5.0 (5.0); pre-anal length 2.0 (2.1);

https://doi.org/10.1017/S0025315424000420 Published online by Cambridge University Press

**Table 1.** Meristics and morphometrics of *Ariosoma thoothukudiense*, *A. gnanadossi* and *A. indicum* from Indian waters

| | *Ariosoma thoothukudiense* sp. nov. | | *Ariosoma gnanadossi* | *Ariosoma indicum* |
|---|---|---|---|---|
| | Holotype | Paratype | Holotype (ZSI F7146/2) | Holotype (paratypes) |
| Total length (mm) | 440.1 | 424.1 | 283 | 362 (223–433) |
| %TL | | | | |
| Head length | 19.9 | 20.1 | 17.5 | 18.1 (16.3–17.7) |
| Depth at gill opening | 7.7 | 7.5 | 6.9 | 6.0 (5.1–6.7) |
| Depth at anus | 6.7 | 7.2 | 5.3 | 5.1 (5.1–6.3) |
| Width at anus | 4.3 | 4.8 | 3.9 | 4.2 (3.8–4.5) |
| Pre-dorsal length | 18.9 | 18.5 | 16.3 | 17.4 (15.9–17.2) |
| Pre-anal length | 49.1 | 48.7 | 40.9 | 43.1 (40.0–42.6) |
| Trunk length | 27.0 | 25.7 | 22.1 | 25.3 (21.2–25.7) |
| Tail length | 50.9 | 49.9 | 60.1 | 57.3 (54.9–57.9) |
| %HL | | | | |
| Snout length | 18.0 | 19.5 | 19.2 | 20.1 (17.7–22.4) |
| Eye diameter | 17.4 | 16.4 | 19.2 | 15.5 (15.1–17.7) |
| Interorbital width | 15.2 | 12.4 | 18.2 | 12.9 (11.8–15.7) |
| Upper jaw length | 26.8 | 28.9 | 19.2 | 29.0 (25.8–30.2) |
| Gill opening width | 17.4 | 20.6 | 28.3 | 18.0 (15.1–20.7) |
| Interbranchial width | 10.4 | 11.7 | 10.1 | 10.7 (9.3–12.5) |
| Pectoral-fin length | 40.6 | 41.7 | 42.4 | 45.8 (37.5–46.7) |
| Meristics | | | | |
| Pre-dorsal vert. | 11 | 10 | 8 | 10 (9–10) |
| Pre-anal vert. | 64 | 61 | 47 | 49 (49–53) |
| Total vert. | 163 | 162 | 146 | 145 (141–146) |
| Lateral-line pores | | | | |
| Pre-dorsal pores | 10 | 9 | 10 | 7 (8–10) |
| Pre-anal pores | 63 | 60 | 44 | 47 (43–47) |
| Total pores | 155 | 148 | 145 | 136 (130–137) |

pre-dorsal length 5.3 (5.4); trunk length 3.7 (3.9); tail length 2.0 (2.0) and depth at gill opening 13.0 (13.4). In HL: snout length 5.5 (5.1); eye diameter 5.7 (6.1); interorbital width 6.6 (8.0); upper jaw 3.7 (3.5); gill opening width 5.7 (4.8); interbranchial width 9.6 (8.6) and pectoral fin 2.5 (2.4).

Body moderately elongated, anterior portion cylindrical, followed by more laterally compressed caudal portion; tip of caudal fin stiff and conical; anus positioned at mid-point of total length, pre-anal length 48.7–49.1% TL; origin of dorsal fin just before pectoral-fin insertion, above ninth to tenth lateral-line pores, continuous to confluent with caudal and anal fin. Anal fin origin just behind anus. Pectoral fin well-developed, with broad base and conical distally. Large gill opening, much larger than eye diameter, its upper origin reaches almost upper half of pectoral-fin base; interbranchial width much smaller than gill opening and eye diameter.

Head large, 5.0 times in TL, deepest at half the length between gill opening and snout tip and tapering anteriorly towards tip of snout; snout relatively moderate, anteriorly conical or blunt in dorsal view, its length 1.0–1.2 times eye diameter, projecting beyond lower jaw; snout much smaller in length than lower jaw; fleshy portion of snout projecting anteriorly beyond the end of intermaxillary tooth patch; rictus positioned just behind mid-length of eye. Tubular anterior nostril moderate in size, at snout tip, and posterior nostril a moderately smaller elliptical pore, in front of mid-eye orbit diameter. Upper and lower jaw with well-developed flange. Tongue rather long and wide; anterior portion free from bottom of oral cavity, with blunt tip Lateral line almost complete and inconspicuous; first lateral-line pore commences at about level of supratemporal canal and terminates well before caudal-fin base; 10 (9) pre-dorsal pores; 63 (60) pre-anal pores and 155 (148) total pores.

Head pores small. SO canal with 6 pores; first (ethmoidal pore) relatively small, on ventral side of snout tip; second is of medium size, in front of anterior nostril, third pore slightly enlarged, on dorsal surface of snout just behind anterior nostril, fourth pore circular and small-sized, fifth pore minute, at anterior interorbital margin, sixth pore minute behind eye orbit. IO canal with 8 (4 + 4) pores, first pore medium size, behind anterior nostril; second pore below posterior end of posterior nostril; third pore below anterior eye-orbit margin; fourth pore above or slightly before rictus, below mid-eye, fifth pore behind rictus, at posterior margin of eye and three pores in ascending branch of canal behind eye. POM pores 10; 7 in mandibular section, 6 before rictus and 1 behind rictus; preopercular section with 3 pores in a longitudinal row. ST pores 3 (Figure 2).

Pre-dorsal vertebrae 11 (10); pre-anal vertebrae 64 (61); total vertebrae 163 (162).

https://doi.org/10.1017/S0025315424000420 Published online by Cambridge University Press

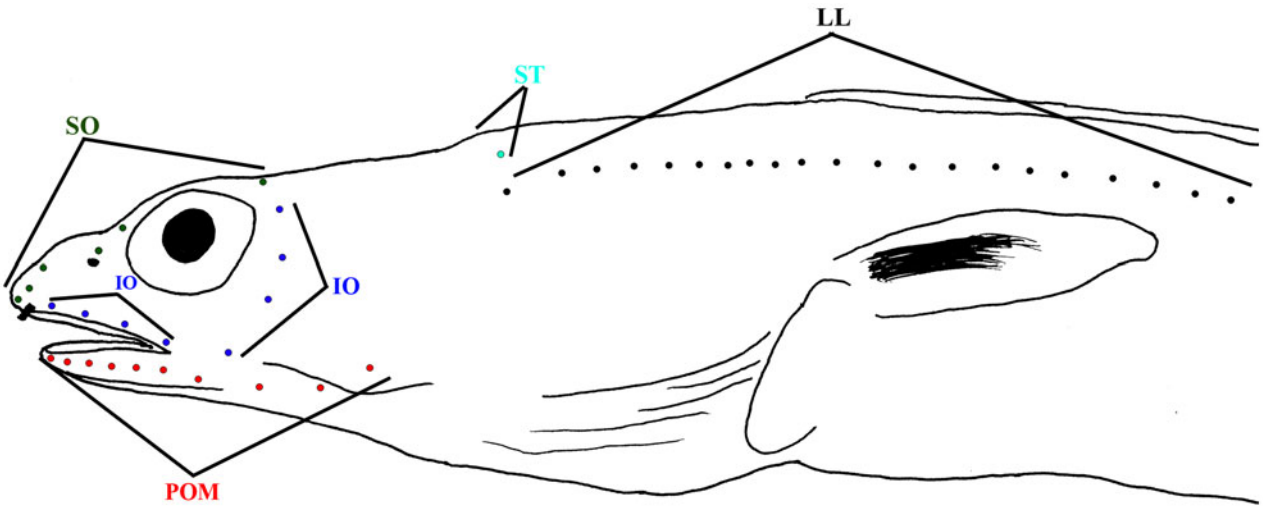


**Figure 2.** Line drawing showing the head pores and anterior lateral-line pores of *Ariosoma thoothukudiense,* Green - SO; Blue - IO; Red - POM; Black - LL; Celeste - ST.

Teeth moderate-sized, conical, pointed, or blunt (Figure 3). Slightly curved intermaxillary teeth with five transverse rows, barely visible when mouth closed, separated from vomerine and maxillary teeth by a minute gap. Maxillary and mandibular teeth continuous in bands; anterior part of maxillary teeth wider with four rows, middle portion with three to two irregular rows, innermost blunt and outermost teeth pointed, followed by uniserial pointed teeth posteriorly. Vomerine teeth pointed or blunt, anterior portion with four rows of pointed teeth, reaches just before posterior nostril, tapering posteriorly with two to three rows of blunt teeth followed by three uniserial teeth. Mandibular teeth form wider anteriorly and narrower posteriorly.

***Colour (in fresh specimens)***. Body bicoloured, dorsal pale brownish and ventral silvery white. Dorsal and anal fin creamy-white with broad black margin; caudal fin sandal-white, upper and lower margins broad black; caudal tip dull grey (Figure 4). Head slightly darker than body, dorsal surface of head with no distinct bands; preopercular portion dark; pectoral fin reddish with dark spot at base (Figure 5A, B). Extremities of lower jaw with minute dark pigmentation patches; ventral surface lower jaw with numerous minute dark pigmentation patches before and after the rictus (Figure 5C). Eyes bright with medium-sized dark pupil, surrounded by golden yellowish ring (Figure 5A). Colour in formalin somewhat duller than in fresh fish or almost beige and bicoloured; pectoral fin translucent and the dark on preopercular remains the same (Figure 6A).

***Morphometric data of holotype (in mm)***. TL 440.1, HL 87.4, depth at gill opening 33.9, depth at anus 29.4, width at anus 18.8, pre-dorsal length 83.3, pre-anal length 216.3, trunk length 118.8, tail length 222.9, snout length 18.8, eye diameter 15.2, interorbital width 13.3, upper jaw length 23.4, gill opening width 15.2, inter-branchial width 9.1, pectoral fin length 35.5.

***Distribution***. Indian Ocean: two specimens from off Thoothukudi, Bay of Bengal.

***Etymology***. The species is named for its type specimens collection site Thoothukudi, Tamil Nadu, India.

***Comparisons***. *Ariosoma thoothukudiense* shares several characters with *Ariosoma sereti* Karmovskaya, 2004 from the Marquesas Islands by having similar pre-anal vertebrae, pre-anal pores count and dark spot on the preopercular area. But it differs from the latter in having fewer total vertebrae (162–163 vs 168–172 in *A. sereti*); more SO pores (6 vs 5); fewer POM pores (10 vs 12); vomerine patch with four rows of pointed teeth at anterior portion (vs three rows); smaller snout length (18.0–19.5% HL vs 21.6–25.6% HL); smaller eye (16.4–17.4% HL vs 20.0–26.0% HL); larger interorbital width (12.4–15.2% HL vs 5.9–7.8% HL); larger gill opening width (17.4–20.6% HL vs 13.5–15.1% HL) (Karmovskaya, 2004).

*Ariosoma thoothukudiense* differs from *Ariosoma multivertebratum* Karmovskaya, 2004 by having fewer total vertebrae (162–163 vs 183–189 in *A. multivertebratum*) (Karmovskaya, 2004). Further, *A. thoothukudiense* shares similar vertebral counts with

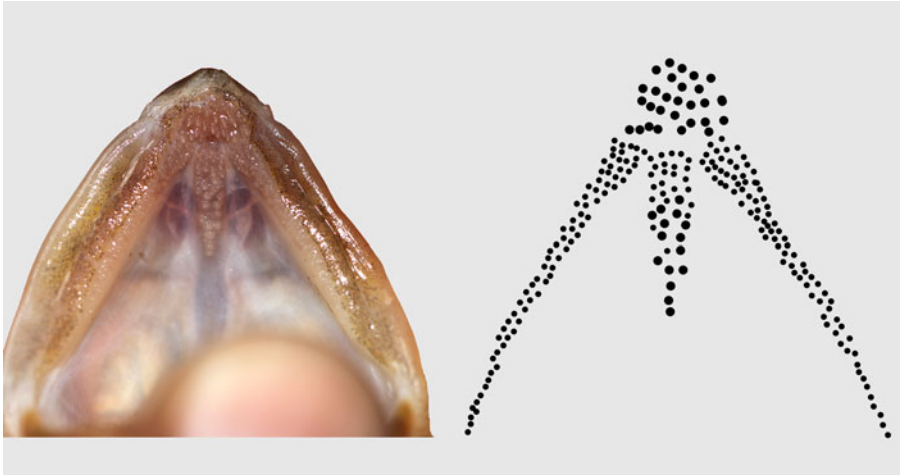

**Figure 3.** Dentition of upper jaw of *Ariosoma thoothukudiense,* NBFGR/ CONATHO, holotype, 440 mm TL.

https://doi.org/10.1017/S0025315424000420 Published online by Cambridge University Press

**Figure 4.** *Ariosoma thoothukudiense,* NBFGR/CONATHO, holotype, 440 mm TL, mature female, fresh colouration. Scale bar 40 mm.

*Ariosoma selenops* Reid, 1934 from western Atlantic but it differs in having more pre-anal pores (60–63 vs 51–59); more SO pores (6 vs 4), IO pores (8 vs 7), ST pores (3 vs 0) (Reid, 1934; Smith, 1989). The new species differs from the Indian water congeners such as *A. bengalense*, *A. majus, A. maurostigma* and *A. melanospilos* in having substantially more vertebrae (162–163 vs146–149 in *A. bengalense*; 141–144 in *A. majus*; 136–142 in *A. maurostigma*; 144–153 in *A. melanospilos*); more pre-anal vertebrae (61–64 vs 46–49 in *A. bengalense*; 51–52 in *A. majus*; 47–51 in *A. maurostigma*; 55–56 in *A. melanospilos*).

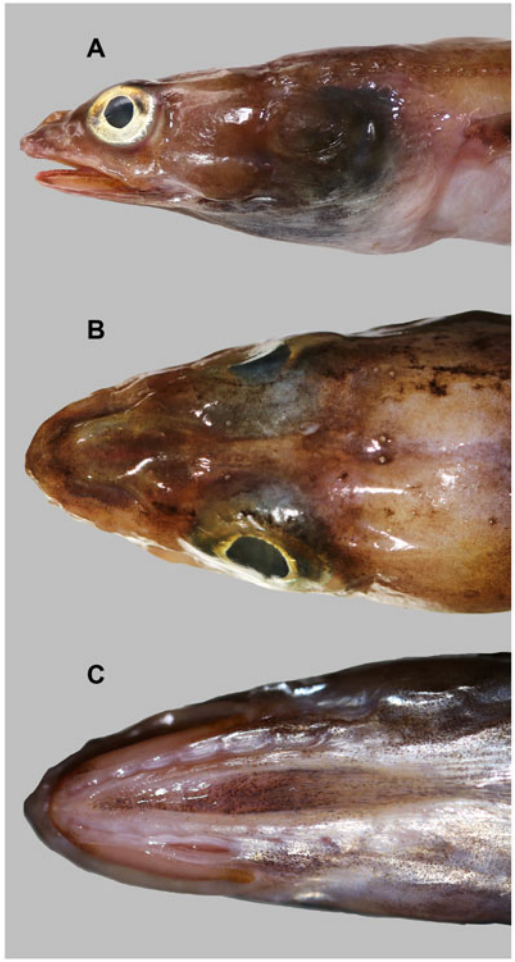


**Figure 5.** (A) Lateral, (B) dorsal and (C) ventral view of head of *Ariosoma thoothukudiense,* NBFGR/CONATHO, holotype, 440 mm TL.


**Figure 6.** (A) *Ariosoma thoothukudiense*, NBFGR/CONATHO, holotype, 440 mm TL; (B) *Ariosoma gnanadossi*, ZSI F7146/2, holotype, 283 mm TL, after preservation.

Further, the new species differs from *A. gnanadossi* in having more pre-anal vertebrae (61–64 vs 47 in *A. gnanadossi*); more total vertebrae (162–163 vs 146); more pre-anal pores (60–63 vs 44); smaller gill opening width (17.4–20.6% HL vs 28.3% HL); longer upper jaw length (26.8–28.9% HL vs 19.2% HL); shorter tail length (49.9–50.9% TL vs 60.1% TL); longer pre-anal length (48.7–49.1% TL vs 40.9% TL); longer trunk length (25.7–27.0% TL vs 22.1% TL); lateral-line pores terminate well before the tail tip (vs pores almost ends at the tail tip).

*Ariosoma thoothukudiense* differs from sympatric species *A. indicum* in having more pre-anal vertebrae (61–64 vs 49–53 in *A. indicum*); more total vertebrae (162–163 vs 141–146); more pre-anal pores (60–63 vs 43–47); more total pores (148–155 vs 130–137); longer head length (19.9–20.1% TL vs 16.3–17.4% TL); larger depth at gill opening (7.5–7.7% TL vs 5.1–6.7% TL); longer pre-anal length (48.7–49.1% TL vs 40.0–42.6% TL); shorter tail length (49.9–50.9% TL vs 54.9–57.9% TL). Further, the new species shares similar vertebral counts with *A. albimaculatum* but readily differs by having fewer pre-anal vertebrae (61–64 vs 66–68 in *A. albimaculatum*); smaller pre-anal length (48.7–49.1% in vsTL 49.7–55.7% TL); smaller gill opening width (17.4–20.6% HL vs 18.5–27.9% HL); larger pectoral fin (40.6–41.7% HL vs 29.6–36.0% HL); smaller trunk length (25.7–27.0% TL vs 30.4–33.7% TL); longer tail length (49.9–50.9% TL vs 44.6–48.2% TL); absence of white spot or dot on dorsal-fin origin and dark mark on posterior-dorsal margin of eye orbit (vs present).

The new species shares similar total vertebrae with *Ariosoma shiroanago* (Asano, 1958) from Taiwan waters, but it can be easily distinguished from the latter by having more pre-dorsal vertebrae (10–11 vs 8–9 in *A. shiroanago*); more pre-anal vertebrae (61–64 vs 58–59); more pre-dorsal pores (9–10 vs 6–7); more pre-anal pores (60–63 vs 59); larger gill opening width (17.4–20.6% HL vs 12.1–14.0% HL); longer pectoral fin (40.6–41.7% HL vs 29.2–29.5% HL); larger body depth at gill opening (7.5–7.7% TL vs 5.2–5.5% TL); longer pre-dorsal length (18.5–18.9% TL vs 14.5–16.0% TL); longer head length (19.1–20.1% TL vs 16.7–17.9% TL) (Smith *et al.*, 2018). The new species differs from other congeners such as *A. anago*, *Ariosoma anale* (Poey, 1860), *Ariosoma anagoides* (Bleeker, 1853), *Ariosoma balearicum* (Delaroche, 1809), *Ariosoma dolichopterum* Karmovskaya 2015, *Ariosoma emmae* Smith *et al.*, 2018, *Ariosoma fasciatum* (Günther, 1872), *Ariosoma megalops* Fowler, 1938, *Ariosoma meeki* (Jordan and Snyder, 1900), *Ariosoma ophidiophthalmus*

https://doi.org/10.1017/S0025315424000420 Published online by Cambridge University Press

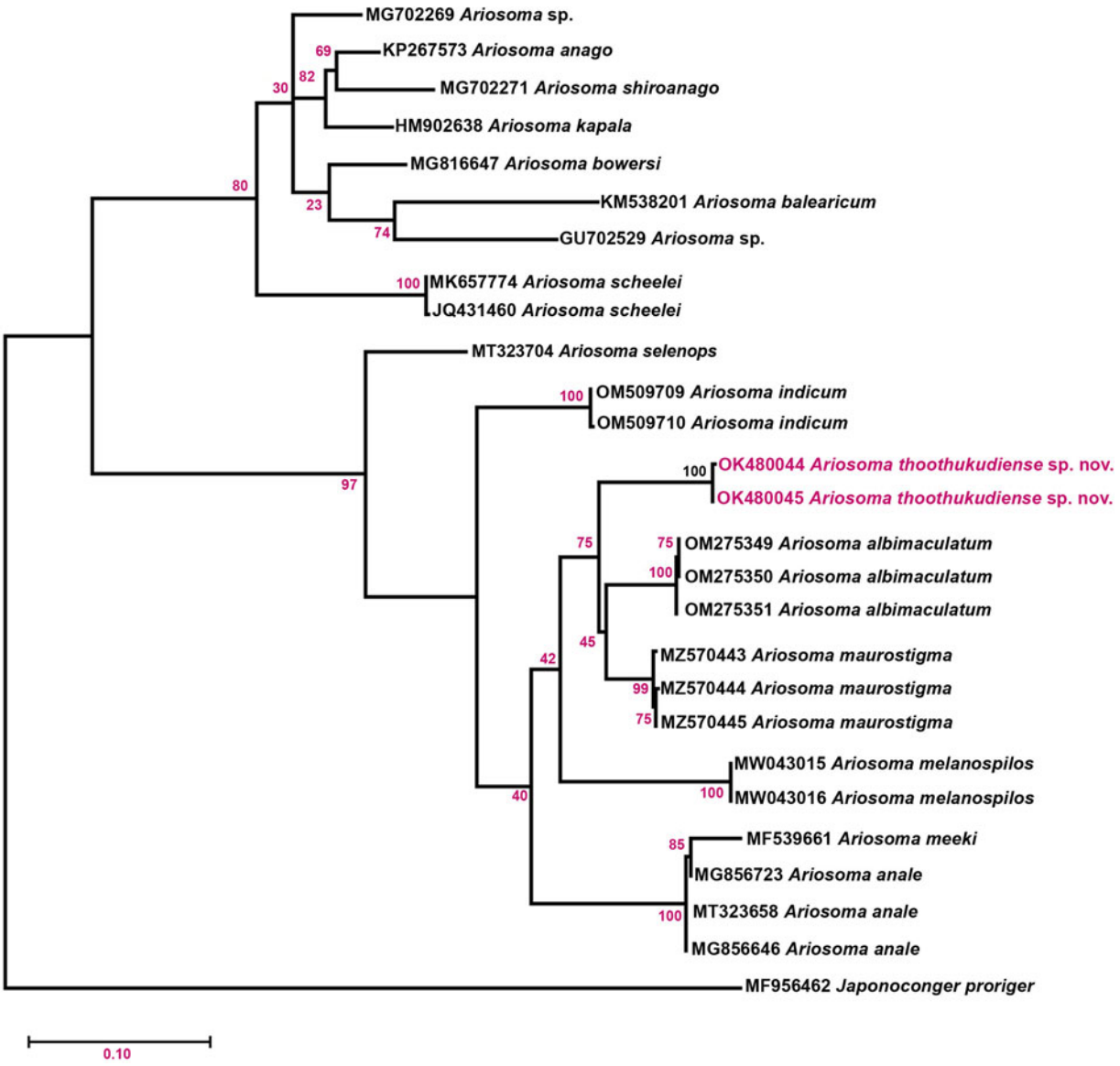


**Figure 7.** The maximum likelihood tree of *Ariosoma thoothukudiense*, based on partial mitochondrial COI gene sequences.

Karmovskaya, 1991, *Ariosoma sazonovi* Karmovskaya, 2004, *Ariosoma scheelei* (Strömman, 1896) and *Ariosoma sokotranum* Karmovskaya, 1991 in having more total vertebrae (162–163 vs 116–158 in others) (Karmovskaya, 1991, 2004, 2018; Smith *et al.*, 2018).

***Molecular analyses***. The accession numbers for the sequences generated in the present study were OK480044 and OK480045. In the maximum likelihood tree (Figure 7), the new species *A. thoothukudiense* forms a sister clade to *A. maurostigma* and *A. albimaculatum* from the Indian waters with high bootstrap values with 11.4% & 11.6% pair-wise K2P genetic distance. Further, *A. thoothukudiense* shows 16.8% genetic divergence with sympatric species *A. melanospilos*, followed by 18.5% with Atlantic species, *A. anale,* and 19.6% with Indian water species *Ariosoma indicum*, 19.9% with *A. selenops* and 21.5% with *A. meeki*. *Ariosoma thoothukudiense* exhibited maximum K2P genetic divergence with *A. balearicum* (26.1%) followed by *A. shiroanago* (25.7%), *A. scheelei* (23.5%), and *A. anago* (22.7%).

## Discussion

The new species described here is an addition to eight species previously described or reported by Kaup (1856), Talwar and Mukherjee (1977), Roy *et al.* (2021), Kodeeswaran *et al.* (2021, 2022a, 2022b, 2023) and Ray *et al.* (2022) which forms the ninth species of the conger eel genus *Ariosoma* known from the Indian waters. The species *Ariosoma gnanadossi* exhibits wider distribution in the Indian Ocean, however, it was known only by a few specimens. In India, it was known only by holotype caught along the Bay of Bengal (Talwar and Mukherjee, 1977) and later four specimens were collected by Sumod (2018). This species was also documented from Pakistan (Moazzam and Osmany, 2015; Psomadakis *et al.*, 2015) along the Northern Indian Ocean and from Myanmar mentioned as *Ariosoma* cf. *gnanadossi* (Psomadakis *et al.*, 2019) and placed in the checklist of Bangladesh (Habib and Islam, 2020). The new species genetically closer to *A. maurostigma* forms a sister clade with a divergence of 11.4% and *A. albimaculatum* was another elongated eel described from the Indian waters which shows a genetic divergence value of 11.6% with *A. thoothukudiense*, indicating that the new species might have evolved after *A. albimaculatum* and *A. maurostigma* with the absence of spots or marks on the head and posterior margin of eye orbit and also the species were arranged in separate sister groups.

## Materials examined

*Ariosoma albimaculatum*: NBFGR/CONAALB, holotype (487 mm TL), collected from Colachel fishing harbour, off

https://doi.org/10.1017/S0025315424000420 Published online by Cambridge University Press

Kanyakumari, Arabian Sea; NBFGR/CONAALB.1, (364 mm TL), NBFGR/CONAALB.2, (323 mm TL), NBFGR/CONAALB.3–4 (2: 240–269 mm TL), collected from deep-sea trawl by-catch, Colachel fishing harbour, off Kanyakumari, Arabian Sea.

*Ariosoma bengalense*: EBRC/ZSI/ F12898, holotype (304 mm TL), Petua Ghat, West Bengal, Bay of Bengal; EBRC/ZSI/ F12899, paratype (216 mm TL), Petua Ghat, West Bengal, Bay of Bengal.

*Ariosoma gnanadossi*: ZSI F7146/2, holotype (283 mm TL), collected from the depth of 250 metres, Off Madras, east coast of India, Bay of Bengal.

*Ariosoma indicum*: NBFGR/CONAIND, holotype (362 mm TL); NBFGR/CONAIND.1–2 (2: 355–371 mm TL), EBRC/ZSI/ F13597 (2: 337–438 mm TL); NBFGR/CONAIND.3–9 (7: 335–433 mm TL) taken with holotype, all collected from Kalamukku Fishing Harbour, Kochi, Arabian Sea. EBRC/ZSI/F13604 (7: 223–356 mm TL) non-types, collected from Digha Mohana, West Bengal, Bay of Bengal.

*Ariosoma majus*: EBRC/ZSI/F 11528 (2 specimens: 246–290 mm) collected from Deshpran Fishing Harbour (21° 47.752' N, 87° 52.869' E), West Bengal, east coast of India, Bay of Bengal.

*Ariosoma maurostigma*: NBFGR/CONAMAUR, holotype (233.4 mm TL); NBFGR/CONAMAUR.1–3, paratypes, (3: 202.9–295.8 mm), NBFGR/CONAMAUR.4 (1: 229.8 mm TL) taken with holotype. NBFGR/CONAMAUR.5 (15: 181.4–292.8 mm TL); EBRC/ZSI/F12905, (4: 206–273 mm TL) all collected from Kalamukku Fishing Harbour, Kochi, Arabian Sea.

*Ariosoma melanospilos*: NBFGR/CONAMEL, holotype (302.3 mm), Colachel fishing harbour (8°10′ 21.92″N, 77°15′2.98″ E), southwest coast of India, Indian Ocean. ZSI F 14502/2, paratype (296.5 mm) same collection details as holotype.

**Data Availability.** The data that support the findings of this study are available from the corresponding author, upon reasonable request.

**Acknowledgements.** The authors are grateful to the Director of ICAR-National Bureau of Fish Genetic Resources (NBFGR), Lucknow, for providing financial support under the Institute project on Exploration in marine islands and encouragements. AM thanks Dr Dhriti Banerjee, Director, Zoological Survey of India for providing necessary working facilities. Authors thanks Dr Emma S. Karmovskaya, Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia for valuable comments and suggestions regarding this species. PK thanks Dr T. Ravikumar, Dr B. Sivaraman, faculties, and Mr. R. Tamil Selvan and Mr. P. Subash, students at Fisheries College and Research Institute, Thoothukudi, TNJFU, Tamil Nadu for their assistance in sample collection.

**Author contributions.** PK collected, examined, and identified the specimens, and prepared the manuscript. PK and AK performed molecular analyses and revised the manuscript. AM examined and confirmed the species identity, and revised the manuscript. TTA revised the manuscript. All authors read and approved the final version of the manuscript.

**Financial support.** This research was funded by the ICAR - National Bureau of Fish Genetic Resources, Lucknow.

**Competing interests.** None.

**Ethical standards.** This work does not contain any experimental studies with live animals. Dead fish samples were collected directly from the fishing harbours/ landing centres and used for genetic and morphological investigations.

## References

**Asano H** (1958) Studies on the conger eels of Japan. I. Description of two new subspecies referable to the genus *Alloconger*. *Zoological Magazine Tokyo* **67**, 191–196.

**Bleeker P** (1853) Bijdrage tot de kennis der Muraenoïden en Symbranchoïden van den Indischen Archipel. *Verhandlingen van het Bataaviasch Genootschapvan Kunsten en Wetenschappen* **25**, 1–76.

**Böhlke EB** (1982) Vertebral formulae for type specimens of eels (Pisces: Anguilliformes). *Proceedings of the Academy of Natural Sciences of Philadelphia* **134**, 31–49.

**Delaroche FE** (1809) Suite du mémoire sur les espèces de poissons observées à Iviça. Observations sur quelques-uns des poissons indiqués dans le précédent tableau et descriptions des espèces nouvelles ou peu connues. Annales du Muséum d'Histoire Naturelle, Paris 13: 313–361, pls. 20–25.

**Fowler HW** (1938) Studies of Hong Kong fishes. No. 3. *Hong Kong Naturalist* **6**, 1–52.

**Günther A** (1872) Report on several collections of fishes recently obtained for the British Museum. *Proceedings of the Zoological Society of London* **3**, 652–675, pls. 53–70.

**Habib KA and Islam MJ** (2020) An updated checklist of Marine Fishes of Bangladesh. *Bangladesh Journal of Fisheries* **32**, 357–367.

**Hall TA** (1999) BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. *Nucleic Acids Symposium Series* **41**, 95–98.

**Hasegawa M, Kishino H and Yano TA** (1985) Dating of the human-ape splitting by a molecular clock of mitochondrial DNA. *Journal of Molecular Evolution* **22**, 160–174.

**Jordan DS and Snyder JO** (1900) A list of fishes collected in Japan by Keinosuke Otaki, and by the United States steamer Albatross, with descriptions of fourteen new species. *Proceedings of the United States National Museum* **23**, 335–380.

**Karmovskaya ES** (1991) New species of conger eel (Congridae) from the western Indian Ocean. *Voprosy Ikhtiologii* **3**, 891–897, [In Russian. English translation in Journal of Ichthyology 32, 1–8.].

**Karmovskaya ES** (2004) Benthopelagic bathyal conger eels of families Congridae and Nettastomatidae from the western tropical Pacific, with descriptions of ten new species. *Journal of Ichthyology* **44**, S1–S32.

**Karmovskaya ES** (2015) New species of the genus Ariosoma, A. dolichopterum (Bathymyrinae), from the waters of Central Vietnam. *Journal of Ichthyology* **55**(6), 906–910. http://dx.doi.org/10.1134/S0032945215060077

**Karmovskaya ES** (2018) On the species composition of eels of the genus *Ariosoma* (Anguilliformes: Congridae) from NhaTrang and Van Phong Bays (South China Sea, Central Vietnam). *Journal of Ichthyology* **58**, 455–472.

**Kaup JJ** (1856) *Catalogue of Apodal Fish in the Collection of the British Museum*. London: Taylor & Francis.

**Kodeeswaran P, Jayakumar TKT, Akash S, Ajith Kumar TT and Lal KK** (2021) A new species of Congrid eel, *Ariosoma melanospilos* sp. nov., from Indian waters with taxonomic description of *A. dolichopterum* (Congridae: Bathymyrinae). *Marine Biodiversity* **51**, 47.

**Kodeeswaran P, Mohapatra A, Dhinakaran A, Ajith Kumar TT and Lal KK** (2022a) A new species of the congrid eel genus *Ariosoma* (Anguilliformes: Congridae) from the Southwest coast of India. *Journal of Fish Biology* **100**, 775–782.

**Kodeeswaran P, Kathirvelpandian A, Acharya A, Mohanty SR, Mohapatra A, Ajith Kumar TT and Lal KK** (2022b) *Ariosoma indicum* sp. nov., a new species of congrid eel (Anguilliformes: Congridae: Bathymyrinae) from the Indian waters. *Journal of Fish Biology* **100**, 1447–1454.

**Kodeeswaran P, Dhas D, Ajith Kumar TT and Lal KK** (2023) Description of a new congrid eel, *Ariosoma albimaculata* sp. nov. (Anguilliformes: Congridae), from the southwest coast of India, Arabian Sea. *Ichthyological Research* **70**, 233–242.

**Kumar S, Stecher G, Li M, Knyaz C and Tamura K** (2018) MEGA X: molecular evolutionary genetics analysis across computing platforms. *Molecular Biology and Evolution* **35**, 1547–1549.

**Mishra SS and Krishnan S** (2003) Marine fishes of Pondicherry and Karaikal. Records of the Zoological Survey of India, Occasional Paper No. 216: 1–52.

**Moazzam M and Osmany HB** (2015) Eels of Order Anguilliformes occurring in the coastal and offshore waters of Pakistan. *International Journal of Biology and Biotechnology* **12**, 679–702.

**Poey F** (1860) Memorias sobra la historia natural de la Isla de Cuba, acompañadas de sumarios Latinos y extractos en Francés. *Tomo 2. La Habana* **2**, 97–336.

**Psomadakis PN, Osmany HB and Moazzam M** (2015) *Field Identification Guide to the Living Marine Resources of Pakistan*. FAO Species Identification Guide for Fishery Purposes. Rome: FAO. pp. X+386. 42 colour plates.

**Psomadakis PN, Thein H, Russell BC and Tun MT** (2019) *Field Identification Guide to the Living Marine Resources of Myanmar*. FAO

https://doi.org/10.1017/S0025315424000420 Published online by Cambridge University Press

Species Identification Guide for Fishery Purposes. Rome: FAO and MOALI, 694 pp., 63 colour pls.

**Ray D, Acharya S, Khatua T, Roy D, Mohapatra A and Mishra SS** (2022) A new species of conger eel, *Ariosoma* (Congridae: Bathymyrinae), from the Bay of Bengal, India. *Zootaxa* **5165**, 133–143.

**Reid ED** (1934) Two new congrid eels and a new flatfish. *Smithsonian Miscellaneous Collections* **91**, 1–11, pl. 1.

**Roy D, Khatua T, Ray D and Mohapatra A** (2021) First Report of Conger Eel (Anguilliformes: Congridae) *Ariosoma majus* (Asano, 1958) From Indian Ocean. *Thalassas: An International Journal of Marine Sciences* **37**, 93–96.

**Sambrook J and Russel DW** (2001) *Molecular Cloning: A Laboratory Manual*, Vol. **1**. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory, p. 112.

**Smith DG** (1989) Family congridae. In Böhlke EB (ed.), *Fishes of the Western North Atlantic*, Pt 9, 1. New Haven: Memoir Sears Foundation for Marine Research, pp. 460–567.

**Smith DG and Kanazawa RH** (1977) Eight new species and a new genus of congrid eels from the western north Atlantic with redescriptions of *Ariosoma analis*, *Hildebrandia guppyi*, and *Rhechias vicinalis*. *Bulletin of Marine Science* **27**, 530–543.

**Smith DG, Ho HC, Huang JF and Chang YH** (2018) The congrid eel genus *Ariosoma* in Taiwan (Anguilliformes: Congridae), with description of a new species. *Zootaxa* **4454**, 84–106.

**Strömman PH** (1896) *Leptocephalids in the University Zoological Museum at Upsala*. Uppsala: Almqvist & Wiksell, 1–53, pls. 1–5.

**Sumod KS** (2018) *Deep-sea eels (Teleostei: Anguilliformes) of the Indian EEZ: systematics, distribution and biology* (PhD thesis). Cochin University of Science and Technology, Kerala, India.

**Swainson W** (1838) *On the Natural History and Classification of Fishes, Amphibians, & Reptiles, or Monocardian Animals*. Vol. **1**. London: A. Spottiswoode, 368 pp.

**Talwar PK and Mukherjee M** (1977) A note on a new bathypelagic eel, *Ariosoma gnanadossi*, from the Bay of Bengal. *Indian Journal of Animal Sciences* **47**, 432–434.

**Temminck CJ and Schlegel H** (1846) Pisces, in Fauna Japonica, Sive Descriptio Animalium Quae in Itinere per Japoniam Suscepto Annis 1823–30 Colle-git, Notis Observationibus et Adumbrationibus Illustravit P.F. de Siebold. Fauna Japonica, Sive Descriptio Animalium Quae in Itinere per Japoniam, Batavia: Lugduni Batavorum, 1846, parts 10–14, pp. 173–269.

**Thompson JD, Gibson TJ and Higgins DG** (2003) Multiple sequence alignment using ClustalW and ClustalX. *Current Protocols in Bioinformatics* **1**, 2–3.

**Ward RD, Zemlak TS, Innes BH, Last P and Hebert PDN** (2005) DNA barcoding Australia's fish species. *Philosophical Transactions of the Royal Society B: Biological Sciences* **360**, 1847–1857.

https://doi.org/10.1017/S0025315424000420 Published online by Cambridge University Press