



Range extension of a Conger eel, *Bathymyrus simus* Smith, 1965 (Anguilliformes: Congridae) in the Arabian Sea, Western Indian Ocean

P Kodeeswaran^{a,b}, J Anand^a, T T Ajith Kumar^{*a} & K K Lal^a

^aICAR-National Bureau of Fish Genetic Resources, Lucknow – 226 008, India

^bFaulty of Fisheries Science, Kerala University of Fisheries and Ocean Studies, Kochi, Kerala – 682 506, India

*[E-mail: ttajith87@gmail.com]

Received 27 April 2021; revised 18 June 2022

Bathymyrus simus Smith, 1965, a thorny-snout conger eel, which was poorly known with few specimens and distributed in Western Pacific Ocean (Vietnam and South China Sea) and Bay of Bengal. The present study deals with a range extension of 3,500 km based on an odd male specimen collected from the Arabian Sea, Western Indian Ocean. The study also provides detailed taxonomic description with insights into their fresh colouration, phylogenetic analysis and its distributional range. Further an updated key to the congeners of the genus *Bathymyrus* was also provided.

[**Keywords:** Bathymyrinae, New record, Molecular analysis, Morphology]

Introduction

Conger eels of the family Congridae Kaup, 1856 are small to large size eels distributed throughout the temperate and tropical waters of the world oceans and dwell from the continental shelf or slope to the deep sea with 224 valid species belonging to 32 genera under three subfamily viz. Congrinae, Bathymyrinae and Heterocongrinae^{1,2}. The genus *Bathymyrus* Alcock, 1889 belonging to the subfamily Bathymyrinae Bohlke, 1949 is represented by three valid species. *Bathymyrus echinorhynchus* Alcock, 1889 distributed along the Indo-West Pacific: Oman east to China, south to New Caledonia²; *B. simus* Smith, 1965 along Western Pacific: Vietnam, South China Sea and Taiwan² and *B. smithi* Castle, 1968 along Western Indian Ocean: Mozambique². Hitherto two species of the genus *Bathymyrus* viz. *B. echinorhynchus* and *B. smithi* have been recorded from the Western Indian Ocean³⁻⁶ and later Jayakumar *et al.*⁷ reported *B. simus* based on single specimen collected from the Nagapattinam fishing harbour, Tamil Nadu and Digha fishing harbour, West Bengal from Eastern Indian Ocean, respectively. A single male specimen of *B. simus* was collected from the deep-sea trash landings at Mangalore fishing harbour, Western Indian coast. The present report provides information about the first distributional record of *B. simus* based on a single specimen collected from the Arabian Sea, Western Indian Ocean.

Materials and Methods

Sampling and morphological identification

A single male specimen of conger eel was collected from the landings of deep sea trawler at Mangalore fishing harbour (12°51'15.6" N, 74°49'59.7" E), Karnataka, West coast of India, Arabian Sea on 14 December 2020. The identification of the specimen was done, based on the morphometric and meristic characters given by Smith⁸ & Jayakumar *et al.*⁷. All the measurements were taken by using "Mitutoyo CD-6" ASX digital caliper to the nearest 0.1 mm and the results were expressed in percentage of Total Length (TL) and Head Length (HL). Vertebral counts were documented, following Bohlke⁹ using digital radiographs. Teeth patterns, cephalic and lateral line pores were counted with the help of Magnus Stereozoom MSZ-TR Trinocular Microscope. Head pores abbreviations follows: IO (infraorbital), LL (lateral line), POM (preoperculomandibular), SO (supraorbital), ST (supratemporal commissure). The specimen was preserved in 10 % formaldehyde and deposited in the national fish repository museum of the ICAR - National Bureau of Fish Genetic Resources (NBFGR), Lucknow, India with accession number NBFGR/CONBSIM.1.

Molecular analysis

Collected tissue samples were preserved in 95 % ethanol. Genomic DNA was extracted using salting

out method¹⁰. The partial mitochondrial cytochrome oxidase subunit 1 (COI) gene was amplified with the aid of universal primers¹¹. The PCR was done in 25 µL reactions which entailed of 10X assay buffer (100 mM Tris, 500 mM KCl, pH 9.0), 20 mM MgCl₂, 10 p moles of each primer, 200 µM of each dNTP, 0.25 U Taq DNA polymerase and 25 ng of template DNA. The PCR thermal cycle was made with the condition of initial denaturation at 95 °C for 5 min, denaturation at 94 °C for 30 sec, annealing at 54 °C for 45 sec, extension at 72 °C for 1 min (35 cycles) and final extension at 72 °C for 10 min. The amplified PCR products were visualised on 1.5 % of agarose gel electrophoresis containing ethidium bromide aided under Gel Doc™ XR+ (Bio-Rad, India). Sequences acquired in the present study were aligned manually using BioEdit version 5.0.9^(ref. 12) and deposited in GenBank. The NCBI accession number of the submitted gene sequence is MW644815. The COI gene sequences was aligned and complied with the other sequence of the genus *Bathymyrus* in the GenBank and BOLD. The phylogenetic tree was plotted with Maximum Likelihood (ML) method in connotation with Tamura Nei + Gamma distribution model and 1000 bootstrap replicates. The genetic divergence between species and within species was projected using Kimura 2P model¹³ with the aid of software MEGA X¹⁴. The sequence of *Parabathymyrus brachyrhynchus* (KU942803) and *Ariosoma anale* (MG856623) was used as out-group for phylogenetic analysis.

Results

Family: Congridae

Bathymyrus simus Smith, 1965

Material examined: NBFGR/CONBSIM.1, single specimen, male, 185.67 mm TL, Mangalore fishing harbour, Karnataka coast, Arabian Sea, India (12°51'15.6" N, 74°49'59.7" E), 14 December 2020 (Fig. 1).

Comparative material examined: Un-catalogued [as specimen is partially damaged], single specimen, male, 273.12 mm TL, Royapuram fishing harbour, Chennai, Tamil Nadu coast, Bay of Bengal, India (13°07'24.49" N, 080°17'52.20" E), 23 October 2020.

Description: Morphometric and meristic data are provided in Table 1; whereas, morphometric measurements in proportion with total length and head length are also furnished. Head length 5.8 in TL; preanal length 2.4; predorsal length 5.7; trunk length 4.5; tail length 1.8 and depth at gill opening 14.9.

Snout length 6.9 in HL; eye diameter 6.3; interorbital width 9.2; upper jaw 3.8; gill opening width 4.4; interbranchial width 3.5; pectoral fin 3.1.

Moderate sized robust bodied eel with less compressed anteriorly and tapering posteriorly; anus



Fig. 1 — *Bathymyrus simus*, 185.67 mm TL, NBFGR/CONBSIM.1, collected from Arabian Sea, Western Indian Ocean

Table 1 — Morphometric and meristic data of *Bathymyrus simus* Smith, 1965 collected from Arabian Sea and Bay of Bengal

	Present study		Jayakumar
	Arabian Sea NBFGR/CO NBSIM.1	Bay of Bengal uncatalogued	<i>et al.</i> ⁷ Bay of Bengal
Morphometric			
Total length (mm)	185.67	273.12	265–303.3
	<i>In TL</i>		
Head length	5.8	6.3	6.12–6.24
Depth at gill opening	14.9	15.6	-
Depth at anus	18.3	19.5	19.78–20.96
Width at anus	24.0	25.1	19.60–26.68
Depth at dorsal-fin origin	15.0	16.4	-
Pre-dorsal length	5.1	5.6	5.42–5.60
Pre-pectoral	5.9	5.9	5.90–6.06
Pre-anal length	2.4	2.3	2.22–2.26
Trunk length	4.5	4.1	3.56–3.68
Tail length	1.8	1.8	1.77–1.86
Distance between origins of dorsal and anal fin	3.3	3.9	3.50–3.76
	<i>In HL</i>		
Snout	6.9	6.2	6.19–6.95
Eye	6.3	6.6	7.19–7.26
Interorbital	9.2	6.3	12.9–19.9
Upper jaw	3.8	3.3	-
Gill opening	4.4	4.0	4.34–4.83
Interbranchial	3.5	3.3	-
Pectoral fin	3.1	2.6	2.87–2.97
Pectoral fin-base length	16.5	14.6	-
Height of rostral process	12.1	10.1	8.13–8.58
Meristic			
Pre-dorsal vertebrae	11	-	-
Pre-anal vertebrae	44	-	-
Total vertebrae	130	-	127–137
Pre-dorsal pores	9	-	-
Pre-anal pores	54	-	36–45
Total pores	124	-	-

well before the mid length of the body, preanal length 41 % of TL. Dorsal fin origin just behind the pectoral-fin base and well before the upper end of gill opening; dorsal and anal fins confluent to form rounded caudal fin. Anal fin origins just behind the point of anus. Well-developed translucent pectoral fin with blunt edge. Larger gill opening, much larger than eye diameter, upper end reach above the half of the pectoral base. Greater interbranchial width; even greater than eye diameter and gill opening.

Head larger 5.8 times in TL. Relatively larger snout with rostral expansion of the premaxillaries upward over the snout. A small tubular anterior nostril at anterior end of snout and an elongated oval shaped posterior nostril in front of the eye orbit. Relatively small sized jaw, upper jaw extends beyond the tip of lower jaw, both the jaws with well-developed flanges. Broad tongue with conical blunt tip.

Lateral line complete, first pore begins well behind the last row of spots on the dorsal head and terminates just before the caudal fin. Predorsal pores 9, preanal pores 54 and total pores 124.

Head pores moderately large (Fig. 2a). SO canal with 4 pores, first two pores relatively large in size, positioned ventral side of snout tip; third pore just behind the anterior tubular nostril; fourth pore at above the posterior nostril. IO canal have 4 pores located at the upper jaw; there is no pores in between and behind the eyes. POM possess 7 pores, 6 pores before the rictus and 1 behind rictus. ST pores 0.

Predorsal vertebrae 11; preanal vertebrae 44; total vertebrae 130. Moderately large villiform teeth on intermaxillary, roughly with three transverse rows of curved pungent teeth; short vomerine teeth with three transverse row; vomerine and intermaxillary separated by a small gap; continuous maxillary and mandibular teeth; anterior portion with three to two rows followed by uniserial teeth. Pointer mandibular teeth with three rows on anteriorly and uniserial posteriorly. Relatively large, curved and pointed sixteen premaxillaries teeth extends upward over the snout.

Colouration of the freshly collected specimen: Uniformly a pale brown colour body with close set of numerous circular dark dots on the nape. Dorsal and anal fins, creamy brown with black margin; pectoral fin translucent; tip of the caudal fin pale green. Dental rostral expansion base dark with translucent tip. Snout brownish red in colour; gill opercula pinkish; eye dusky yellow with black pupil; interorbital region with dark shade (Fig. 1).

Colouration of the formalin preserved specimen: Body, snout and chin almost pale brown; at glimpse sight seldom bicolour, upper half darker and lower lighter. Dorsal fin milky white with hind margin black and dorsal-fin base possess dark shade; anal-fin base white with black margin; tip of the caudal fin translucent. A close set of numerous circular blackdots remains on the nape. Base of the dental rostral expansion brown with whitish tip. Eye entirely pale white (Fig. 2b).

Meristic and Morphometric counts: Counts and measurements of the collected specimen in mm: total length 185.7, preanal length 76.1, tail length 105.1, trunk length 41.7, predorsal length 32.39, head length 13.8, depth at anus 10.1, width at anus 7.7, snout length 4.6, eye diameter 5.0, upper jaw length 8.5, interorbital width 9.1, gill opening 7.2, pectoral-fin length 10.2. Vertebral formula 11-44-130.

Molecular analysis: *Bathymyrus simus* from the present study (Arabian Sea) shows 4.3 % and 4.6 % difference from the *B. simus* from Vietnam waters and Australian waters, respectively and 0.1 % from

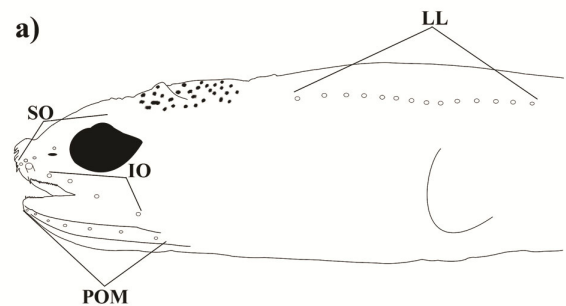


Fig. 2 — a) Line drawing showing the head pores and anterior lateral line pores of *Bathymyrus simus*; b) Lateral view of anterior portion of head

the Bay of Bengal as mentioned in Jayakumar *et al.*⁷ (Fig. 3). There is no other sequence of the genus *Bathymyrus* was available in the NCBI to compare the present data. The difference in generic data may reveal this could be a distinct species, but there is no taxonomic data for Vietnam and Australian specimens to compare and confirm the identity of those species with the present specimen.

Distribution: Known distribution range of *B. simus* was Western Pacific: Vietnam⁸, South China Sea¹⁵ and Taiwan¹⁶; Queensland, Australia; single specimen from West Bengal and Nagapattinam Coast⁷; single specimen from Chennai coast, Bay of Bengal, Eastern Indian Ocean and the present study reports westwards range extension in Arabian Sea, Western Indian Ocean (Fig. 4).

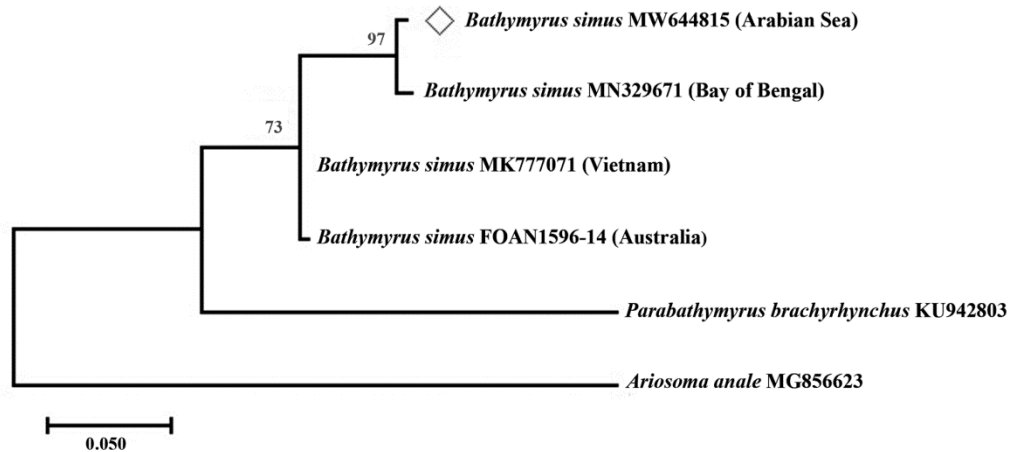


Fig. 3 — Phylogenetic position of *Bathymyrus simus* based on the maximum likelihood analysis

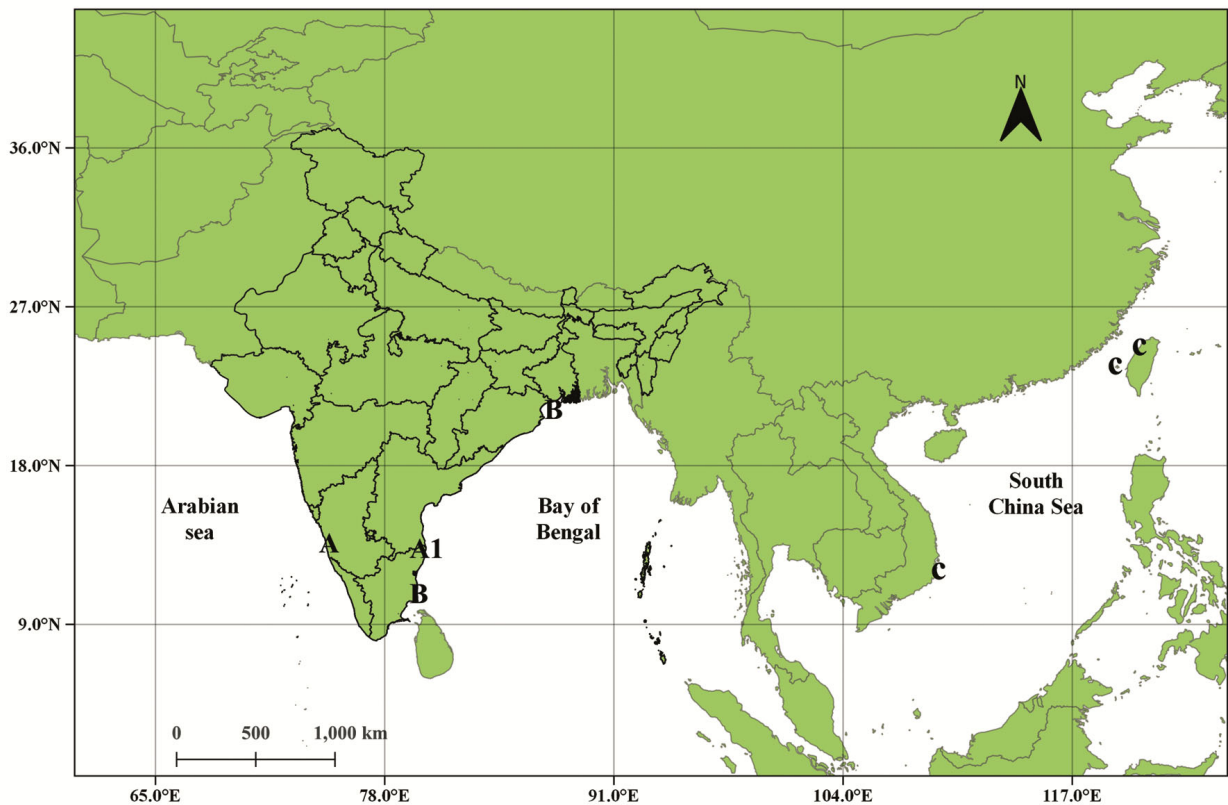


Fig. 4 — Map showing the distributional records of *Bathymyrus simus* Smith, 1965: A) Arabian Sea, Western Indian Ocean (Present study); A1) Bay of Bengal, Chennai coast (Present study); B) Bay of Bengal; C) Western Pacific: Vietnam, South China Sea and Taiwan

Discussion

The genus *Bathymyrus* can be defined by moderate sized eel with stout body and short trunk; well-developed dorsal and anal fins confluent to form round caudal fin; location of anus well before the mid-length; well-developed pectoral fin; moderate jaw with close set of uniserial incisor teeth; conical toothed premaxillae expanded forward and upward over the snout; tongue broad and free; both lips with well-developed flanges; gill opening larger; tubular anterior nostril and oval aperture posterior nostril on low down on cheek before the eye is in agreement with the original description⁸.

In Arabian Sea, two species of *Bathymyrus* has been reported which includes *B. echinorhynchus* and *B. smithi*. *Bathymyrus simus* is differing from the known congeners by possessing numerous dark spots on the dorsal surface (vs. lack of dark spots on the nape in other species)⁸. *Bathymyrus simus* differ from *B. smithi* in having fewer vertebral count 130 (vs. 150 – 155 in *B. smithi*)^{2,4}. *Bathymyrus simus* differ from *B. echinorhynchus* in having larger head and predorsal length (5.8 in TL vs. 5.2 – 5.3 in TL and 5.7 in TL vs. 4.7 – 4.8 in TL)¹⁷.

Bathymyrus simus is poorly known from few specimens existed in the museum collection (The SAIAB - South African Institute for Aquatic Biodiversity Collection Facility; JLB Smith Collections Management Centre and specimen in CSIRO, Australian National Fish Collection)² and also rarely cited in the literature. Ho *et al.*¹⁶ stated that this species was rarely documented and also distributed only in off southwestern Taiwan. This species is known only from Western Pacific² and also documented from the Bay of Bengal⁷, which was over 3500 km coast line distance from the present study site. The geographic distributional ranges of marine species are always affected by the climate changes¹⁸ and also it may happen due to improper taxonomic study and documentation¹⁹. Even though, with the documentation of 14 species belonging to 10 genera of fishes from the family Congridae, there was no evidence for the documentation of *B. simus* from the Arabian Sea²⁰. In this milieu, the present study firmly reports the range extension of *Bathymyrus simus* from Western Pacific to Western Indian Ocean denoting the westernmost record of this species and also represent the first museum deposition of this species from the Western Indian Ocean. The species of the genus *Bathymyrus* were described and deposited with very

little number of specimens²; hence it needs an urgent revision to get clarity on taxonomic identity and distribution status (David. G. Smith, pers. com.). Henceforth, the present study will provide a significant step on the way towards the revision of this genus.

Updated key to the species of the conger eel genus *Bathymyrus*^{3,8,17}

- 1a. Head 5.5 – 5.8 in total length; head with close set of numerous circular dark dots and streaks; lateral line pores 124 – 125; total vertebrae 127 – 130 *Bathymyrus simus*
 1b. Head with no definite marking and streaks 2
 2a. Head 5.2 – 5.3 in total length; lateral line pores 125 – 130; total vertebrae probably 130 *B. echinorhynchus*
 2b. Head 6.5 in total length; lateral line pores 141 – 149; total vertebrae probably 150 – 155; very much slender eel *B. smithi*

Acknowledgements

The authors are extending gratitude to the Director, ICAR-National Bureau of Fish Genetic Resources for facilities and encouragements. Second author (JA) is thanking to the DST-SERB for financial support. The authors are also grateful to Dr. David G. Smith, Smithsonian Institution Museum, United States for confirming the species identity and suggestion regarding the distributional status.

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Author Contributions

PK: Collection, identification, molecular analysis and manuscript preparation; JA: Collection; TTA: Critical analysis and manuscript edition; and KKL: Overall conceptual guidance.

References

- Smith D G, Congridae, In: *The living marine resources of the Western Central Pacific. FAO species identification guide for fishery purposes. Volume III. Batoid fishes, chimaeras and Bony fishes part 1 (Elopidae to Linophrynidae)*, edited by Carpenter K E & Niem V H, (FAO, Rome), 1999, pp. 1398–2068.
- Fricke R, Eschmeyer W N & Van der Laan R, *Eschmeyer's Catalog of Fishes: Genera, Species*, <http://researcharchive.calacademy.org/research/ichthyology/fishcatmain.asp>. Electronic version (13-04-2021).

- 3 Castle P H J, Description and osteology of a new eel of the genus *Bathymyrus* from off Mozambique, (Special Publication, Department of Ichthyology, Rhodes University), 4 (1968) 1–12.
- 4 Castle P H J, The congrid eels of the western Indian Ocean and the Red Sea, *Ichthyol Bull, Rhodes Uni*, 33 (1968) 685–726.
- 5 Moazzam M & Osmany H B, Eels of order Anguilliformes occurring in the coastal and offshore waters of Pakistan, *Int J Bio Biotech*, 12 (4) (2015) 679-702.
- 6 Psomadakis P N, Osmany H B & Moazzam M, *Field identification guide to the living marine resources of Pakistan*, (FAO Species Identification Guide for Fishery Purposes. Rome, FAO), 2015, pp. X+386, 42 colour plates.
- 7 Jayakumar T T K, Ajith Kumar T T & Lal K K, First Record of the Rare Eel *Bathymyrus simus* Smith 1965 (Anguilliformes: Congridae) from the Indian Ocean with a Taxonomic Description, *Thalassas: Int J Mar Sci*, 36 (1) (2020) 177–184. <https://doi.org/10.1007/s41208-019-00182-y>
- 8 Smith J L B, The Indian genus *Bathymyrus* Alcock, 1889 with description of a new species from Vietnam, *Occasional Papers of the Department of Ichthyology, Rhodes University*, 2 (1965) 1–11.
- 9 Böhlke E B, Vertebral formulae for type specimens of eels (Pisces: Anguilliformes), *Proc Acad Nat Sci Philadelphia*, 1982, pp. 31-49.
- 10 Sambrook J & Russel D W, *Molecular cloning: a laboratory manual*, (Cold Spring Harbor, NY: Cold Spring Harbor Laboratory), 1 (2001) pp.112
- 11 Ward R D, Zemlak T S, Innes B H, Last P R & Hebert P D, DNA barcoding Australia's fish species, *Phil Trans Royl Soc Biol Sci*, 360 (1462) (2005) 1847-1857.
- 12 Hall T A, BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. *Nucl Aci Symp Ser*, 41 (1999) 95–98. https://doi.org/10.14601/Phytopathol_Mediterr-14998u1.29
- 13 Kimura M, A simple method for estimating evolutionary rate of base substitution through comparative studies of nucleotide sequences, *J Mol Evol*, 16 (1980) 111–120. <https://doi.org/10.1007/BF01731581>
- 14 Kumar S, Stecher G, Li M, Knyaz C & Tamura K, MEGA X: Molecular Evolutionary Genetics Analysis across computing platforms. *Mol Biol Evol*, 35 (2018) 1547–1549. <https://doi.org/10.1093/molbev/msy096>
- 15 Randall J E & Lim K K P, A checklist of the fishes of the South China Sea, *Raf Bull Zool*, (Supplement) 8 (2000) 569–667.
- 16 Ho H C, Smith D G, McCosker J E, Hibino Y, Loh K H, *et al.*, Annotated checklist of eels (orders Anguilliformes and Saccopharyngiformes) from Taiwan, *Zootaxa*, 4060 (1) (2015) 140–189. <http://dx.doi.org/10.11646/zootaxa.4060.1.16>
- 17 Alcock A W, Natural history notes from H. M.'s Indian marine survey steamer 'Investigator,' Commander Alfred Carpenter, R.N., D.S.O., commanding. No. 12. Descriptions of some new and rare species of fishes from the Bay of Bengal, obtained during the season of 1888–89, *J Asia Soc Beng*, 58 (3) (1889) 296–305.
- 18 Rutledge K M, First record of Gorgona guitarfish (*Pseudobatos prahli*) off the Baja California peninsula with updated key to the guitarfishes of the North Eastern Pacific, *J Fish Biol*, 98 (2) (2021) 583-586. <https://doi.org/10.1111/jfb.14585>
- 19 Kodeeswaran P, Praveenraj J & Jayakumar N, New Record of Bearded Ghoul, *Inimicus didactylus* (Pallas, 1769) (Scorpaeniformes: Synanceiidae) from the Southeast Coast of India, *Thalassas: Int J Mar Sci*, 36 (2) (2020) 539-542. <https://doi.org/10.1007/s41208-020-00228-6>
- 20 Manilo L G & Bogorodsky S V, Taxonomic composition, diversity and distribution of coastal fishes of the Arabian Sea, *J Ichthy*, 43 (1) (2003) p. S75.