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

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*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 Heterocongrinae1,2. 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 (NBFGFR), Lucknow, India with accession number NBFGFR/CONBSIM.1.

**Molecular analysis**

Collected tissue samples were preserved in 95 % ethanol. Genomic DNA was extracted using salting
out method. The partial mitochondrial cytochrome oxidase subunit 1 (COI) gene was amplified with the aid of universal primers. 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 model with the aid of software MEGA X.

**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:* Uncatalogued [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

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

<table>
<thead>
<tr>
<th></th>
<th>Present study</th>
<th>Jayakumar et al.</th>
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<tr>
<td>Arabian Sea</td>
<td>NBFGR/CO</td>
<td>Bay of Bengal</td>
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<tr>
<td>Total length</td>
<td>185.67</td>
<td>273.12</td>
</tr>
<tr>
<td>Head length</td>
<td>5.8</td>
<td>6.3</td>
</tr>
<tr>
<td>Depth at gill opening</td>
<td>14.9</td>
<td>15.6</td>
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<tr>
<td>Depth at anus</td>
<td>18.3</td>
<td>19.5</td>
</tr>
<tr>
<td>Width at anus</td>
<td>24.0</td>
<td>25.1</td>
</tr>
<tr>
<td>Depth at dorsal-fin origin</td>
<td>15.0</td>
<td>16.4</td>
</tr>
<tr>
<td>Pre-dorsal length</td>
<td>5.1</td>
<td>5.6</td>
</tr>
<tr>
<td>Pre-pectoral</td>
<td>5.9</td>
<td>5.9</td>
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<tr>
<td>Pre-anal length</td>
<td>2.4</td>
<td>2.3</td>
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<tr>
<td>Trunk length</td>
<td>4.5</td>
<td>4.1</td>
</tr>
<tr>
<td>Tail length</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Distance between origins of dorsal and anal fin</td>
<td>3.3</td>
<td>3.9</td>
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</table>

<table>
<thead>
<tr>
<th>Bay of Bengal</th>
<th>Uncatalogued</th>
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<tbody>
<tr>
<td>Total length</td>
<td>303.3</td>
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<tr>
<td>Head length</td>
<td>6.12–6.24</td>
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<tr>
<td>Depth at gill opening</td>
<td>19.78–20.96</td>
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<td>Depth at anus</td>
<td>19.60–26.68</td>
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<tr>
<td>Pre-dorsal pores</td>
<td>36–45</td>
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<tr>
<td>Pre-anal pores</td>
<td>127–137</td>
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<td>Total pores</td>
<td>124</td>
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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 located 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](image-url)
the Bay of Bengal as mentioned in Jayakumar et al.\textsuperscript{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: Vietnam\textsuperscript{8}, South China Sea\textsuperscript{15} and Taiwan\textsuperscript{16}; Queensland, Australia; single specimen from West Bengal and Nagapattinam Coast; 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).

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**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 teethed 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 description\(^8\).

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 – 5.25 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 Pacific\(^2\) and also documented from the Bay of Bengal\(^7\), 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 changes\(^18\) and also it may happen due to improper taxonomic study and documentation\(^19\). 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 Sea\(^20\). 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 specimens\(^2\); 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*

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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.

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