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NEW BIOGEOGRAPHIC DATA AND DNA BARCODES FOR THE INDIAN SWELLSHARK, *CEPHALOSCYLLIUM SILASI* (TALWAR, 1974) (ELASMOBRANCHII: CARCHARHINIFORMES: SCYLIORHINIDAE), FROM ANDAMAN WATERS

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Abstract. Indian swellshark, *Cephaloscyllium silasi* (Talwar, 1974), is reported for the first time in Andaman waters, India which is a considerable extension of its known distribution range with more than 1000 km toward eastern Indian EEZ. This is the first confirmed geographic distributional record of poorly known deep-water Indian swellshark, *C. silasi*, in the Andaman waters and first outside its type locality. A detailed morphological description of *C. silasi* collected from Andaman waters and comparison with other known materials along with the molecular barcodes are provided.

Keywords: new record, morphology, molecular systematics, Indian EEZ

The fish fauna of Indo-Pacific is one of the most diverse due to the zoogeographical importance of region (Randall 1998, Kimura et al. 2009, Hubert et al. 2012). Andaman Islands and surrounding waters in the Indian EEZ have a rich marine biodiversity that is largely unexplored. Rajan et al. (2012) reported 39 sharks from the waters around Andaman and Nicobar Islands of India.

Swellsharks of the genus *Cephaloscyllium* are very small to medium sized sharks, most of them having no commercial significance due to its small size and abundance. They are known as swellsharks or balloon sharks because of their characteristic ability to inflate/swell body by swallowing air or seawater to deter predation or when out of the water (Inoue and Nakaya 2006, Schaaf-Da Silva and Ebert 2008). Genus *Cephaloscyllium* Gill, 1862 currently contains 17 valid species (Weigmann 2016) of which the Indian swellshark, *Cephaloscyllium silasi* (Talwar, 1974), originally described from south-eastern Arabian Sea as "*Scyliorhinus* (*Halaelurus*) *silasi*" is the only valid species of genus in Indian EEZ (Akhilesh et al. 2014a).

The knowledge on the elasmobranch diversity in the Indian EEZ is rather scarce. In a recent checklist Akhilesh et al. (2014b) suggested that approximately 160 species are known from Indian waters with several species requiring confirmation of their taxonomic status. Bineesh et al. (2016) revealed the species composition of sharks and rays in the Indian commercial fishery using DNA barcoding and 11 elasmobranch species were confirmed first records for Indian waters.

The present report of *Cephaloscyllium silasi* from the region is a new addition to shark fauna of Andaman waters. This paper present the first report of *Cephaloscyllium silasi* with molecular confirmation based on DNA barcoding of recently collected specimens from deep waters in Andaman waters which is a considerable extension from its known distribution range east coast of Indian EEZ.

Three specimens of *Cephaloscyllium silasi* were collected from the deep-sea shrimp trawler bycatch landings from Junglighat fish landing centre, Port Blair, Andamans, India. The deep-sea shrimp trawler operated off North Sentinel Island of Andaman and Nicobar Islands (Fig. 1) at a depth range of 150–300 m. Morphometric measurements were recorded following Compagno (2001). The specimens were identified following (Talwar 1974, Compagno et al. 2005, Akhilesh et al. 2014a). Tissue samples collected were preserved in 95% ethanol and DNA was extracted by standard protocols (Miller et al. 1988). Partial sequence information of mitochondrial gene, Cytochrome c oxidase subunit I (*COI*) was generated (Ward et al. 2005) by bidirectional

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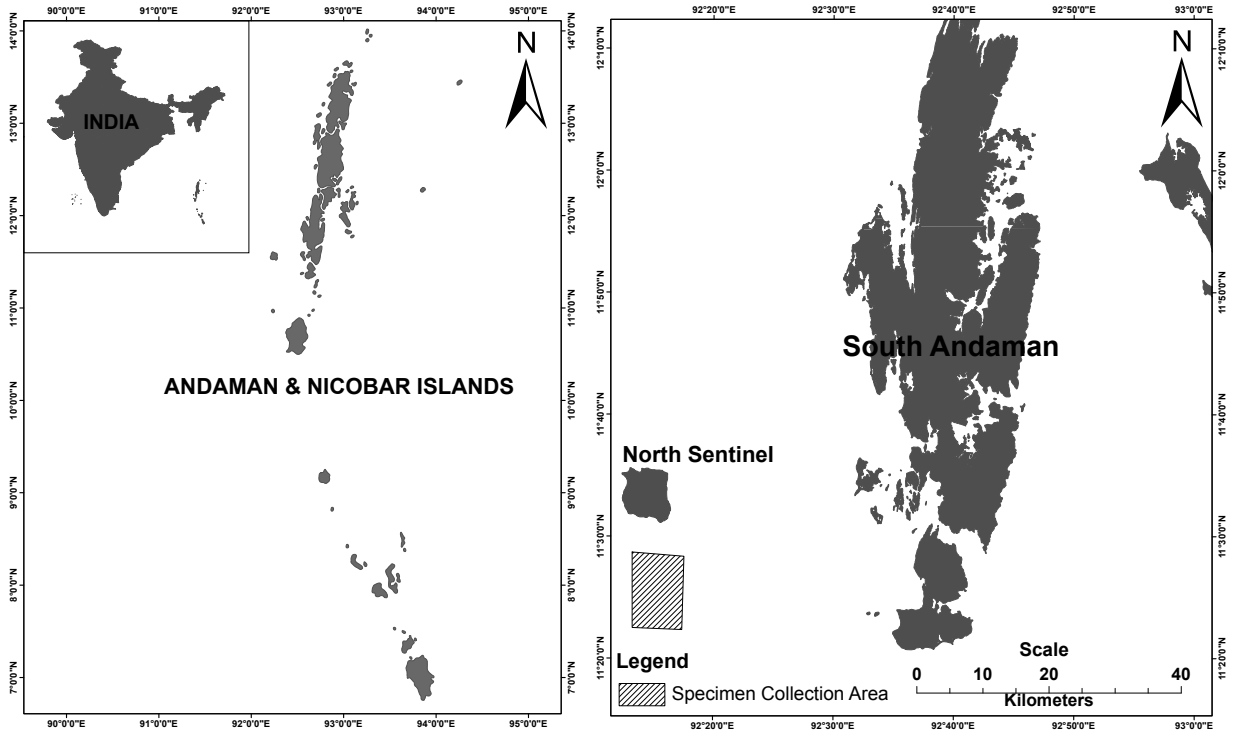

Fig. 1. Map showing collection location of *Cephaloscyllium silasi* from Andaman waters

sequencing using ABI 3730 sequencer. The edited sequences of *Cephaloscyllium silasi* were submitted to the NCBI database (KU841524 and KU841525). Additional sequences of *Cephaloscyllium* spp. were downloaded from the NCBI database for analysis, which are follows EU398669-EU398676, HM909795, DQ108322, and GU440268.

Family SCYLIORHINIDAE
Genus *Cephaloscyllium* Gill, 1862
Cephaloscyllium silasi (Talwar, 1974)

Description of material from Andaman waters. Stout body and expanded belly (Figs. 2–3). No labial furrows, anterior nasal flaps broadly triangular. Head depressed, flattened and broad, rounded in dorsal and ventrally, mouth large and arched. Proportional measurements in percentage of total length presented in Table 1.

Colour. Seven dark brown bands dorsally over body, two comparatively small bands near pectoral fins; remaining dorsal part of body pale brown. Ventral portion pale. Caudal tip end with small dark brown band.

Geographical distribution. Gulf of Aden (Manilo 1993) to Andaman waters. Many species from Andaman waters are recently been reported from southwest coast of India and vice versa suggesting a similar deep habitat in the region or a change in the current pattern.

DNA barcoding results. The partial sequence of mitochondria *COI* gene produced a mean value of 655 nucleotide base pairs. Pair-wise genetic distance values (K2P) based on *COI* sequences using MEGA 6.1. Neighbour Joining (NJ) trees of Kimura two parameter (K2P) distances were created to provide a graphic representation of the patterning of divergences (Fig. 4). A comparison of the DNA barcode of present Andaman specimens shows a 99.2% match with *Cephaloscyllium silasi* from India (GenBank: KF899707-KF899711).

Remarks. A detailed redescription with morphological data was presented from Arabian Sea, off Kollam (Kerala) south-west coast of India at a depth range of 250–500 m Akhilesh et al. (2014 a). Morphometric measurements of presently collected *Cephaloscyllium silasi* has been compared with that of Akhilesh et al. (2014a) for the species confirmation and its comparison with earlier reports. Compagno et al. (2005) and Ebert et al. (2013) suggested a *Cephaloscyllium* similar to *C. silasi* occurs in Andaman waters, with the present morphometric comparisons and genetic results we suggest it is a considerable range extension of *Cephaloscyllium silasi*.

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Table 1

Morphometric measurements (% TL) of *Cephaloscyllium silasi* from Andaman waters compared with known materials

Measurement	ZSI F 6562/2 (Female)	CMFRI/PFD/CS1, CS2, CS3 Mean (Female X 3)	PUMB 3522 (Male)	PUMB 3523 (Female)	NBFGR CH 1150 (Male)	SD
Total length (mm)	318	432.3	364	253	330	—
Pre-caudal length	76.7	79.9	78.3	77.5	77.0	1.3
Pre-second dorsal length	63.8	68.5	66.2	64.8	65.2	1.8
Pre-first dorsal length	49.1	53.8	51.1	50.2	51.8	1.8
Head length (direct)	24	27.0	25.0	22.5	24.5	1.6
Pre-branchial length	24	19.9	17.5	17.7	19.5	2.6
Pre-spiracular length	11.9	11.0	10.2	9.1	9.4	1.2
Pre-orbital length (direct)	7	6.7	6.0	5.5	4.9	0.9
Pre-oral length	4.1	3.9	4.9	4.7	4.8	0.5
Pre-narial length	2.5	4.0	2.5	2.4	2.1	0.7
Pre-pectoral length	22	26.0	20.4	20.9	21.3	2.2
Pre-pelvic length	45.7	50.2	46.4	45.5	44.2	2.3
Snout-vent distance	48.6	53.2	51.1	48.5	47.9	2.2
Pre-anal length	60.1	66.4	63.2	60.1	61.8	2.6
Interdorsal distance	8	7.3	9.3	9.5	10.0	1.1
Dorsal-caudal distance	8	7.0	9.3	9.9	7.0	1.3
Pectoral-pelvic distance	16.1	18.9	17.9	19.4	15.2	1.8
Anal-caudal distance	6.6	5.8	8.5	7.9	7.3	1.1
Eye length	3.4	2.7	3.0	3.2	3.6	0.4
Eye height	0.8	0.5	1.2	1.1	1.5	0.4
Interorbital width	8.9	9.1	8.2	8.5	9.7	0.6
Nostril width	2.9	3.5	4.4	2.6	3.6	0.7
Internarial space	2.4	1.8	2.7	3.6	3.0	0.7
Anterior nasal flap length	1.5	1.3	3.8	2.7	3.6	1.2
Spiracle length	1.1	0.6	1.1	0.4	0.9	0.3
Eye-spiracle distance	1.2	1.2	1.4	1.2	1.5	0.2
Mouth length	4.9	4.6	4.4	6.3	7.3	1.2
Mouth width	14.5	15.1	14.6	15.8	16.6	0.9
First gill slit height	3.8	3.4	1.8	2.1	1.8	0.9
Second gill slit height	3.7	3.6	3.8	2.8	2.1	0.7
Third gill slit height	3.2	3.2	3.6	2.4	2.4	0.5
Fourth gill slit height	3.1	3.3	3.3	2.8	2.1	0.5
Fifth gill slit height	2	2.1	1.6	2.0	1.8	0.2
Head height	7.2	11.2	9.1	8.9	9.3	1.4
Trunk height	9.3	13.4	8.8	10.7	11.2	1.8
Caudal peduncle height	3.2	2.7	3.6	4.3	3.9	0.6
Head width	20.4	21.9	19.0	19.4	20.9	1.2
Trunk width	14.4	20.0	20.3	20.8	21.8	2.9
Caudal peduncle width	2.4	2.1	2.5	4.3	3.9	1.0
Pectoral fin length	12.8	13.8	11.5	11.5	13.0	1.0
Pectoral fin–anterior margin length	14.5	14.7	12.9	13.0	15.5	1.1
Pectoral fin base length	8.9	8.4	8.2	8.3	9.4	0.5
Pectoral fin height	11.5	12.7	10.4	11.5	12.7	1.0
Pectoral fin–inner margin length	5.2	5.8	4.9	5.1	5.8	0.4
Pectoral fin–posterior margin length	11.2	11.9	9.6	9.1	12.7	1.5
Pelvic fin length	5	11.9	11.8	11.2	11.8	3.0
Pelvic fin–anterior margin length	6.6	6.2	6.0	5.5	7.0	0.5
Pelvic fin base length	5	8.9	8.0	7.5	9.1	1.6
Pelvic fin height	5.6	5.4	6.0	3.6	4.2	1.0
Pelvic fin–inner margin length	-	3.2	3.3	2.4	3.8	1.5
Pelvic fin–posterior margin length	7.4	7.2	8.5	5.9	9.7	1.4
First dorsal fin length	9.3	9.5	8.5	9.1	9.1	0.4
First dorsal fin–anterior margin	10	10.3	9.3	9.5	10.0	0.4
First dorsal fin base length	7.1	6.9	6.6	5.9	6.4	0.5
First dorsal fin height	6	6.0	6.0	5.1	6.7	0.5
First dorsal fin–inner margin	2.7	2.8	3.0	4.1	3.3	0.5
First dorsal fin–posterior margin	4.8	4.8	4.1	5.5	4.8	0.5
Second dorsal fin length	6.8	7.4	7.4	6.3	7.3	0.5
Second dorsal fin–anterior margin	6.4	6.6	5.8	5.5	6.7	0.5
Second dorsal fin base length	5.1	4.8	3.0	4.3	4.2	0.8
Second dorsal fin height	3.7	3.4	2.7	3.2	3.6	0.4
Second dorsal fin–inner margin	2.5	2.7	2.2	2.8	2.7	0.2
Second dorsal fin–posterior margin	3.3	3.4	2.5	2.4	3.3	0.5
Anal fin length	9.2	8.9	8.8	8.7	7.3	0.8
Anal fin–anterior margin length	7.9	7.4	5.8	6.7	7.0	0.8
Anal fin base length	6.7	5.8	6.3	6.3	5.8	0.4
Anal fin height	3.8	3.8	2.5	2.8	3.3	0.6
Anal fin–inner margin length	2.8	2.9	2.6	2.4	2.6	0.2
Anal fin–posterior margin length	4.3	3.9	3.5	3.6	4.2	0.4
Caudal fin–dorsal margin length	21.2	20.4	21.7	22.1	23.0	1.0
Caudal fin–preventral margin length	9.5	9.8	9.3	9.9	10.3	0.4
Caudal fin–subterminal margin length	4.1	4.0	4.4	4.3	4.2	0.2
Caudal fin–subterminal margin width	4.1	3.9	3.6	3.6	4.8	0.5
Caudal fin–terminal margin length	5.4	5.6	4.7	3.6	6.4	1.1
Caudal fin–terminal lobe length	6.3	6.5	5.2	5.9	6.1	0.5

Fig. 2. Dorsal profile of *Cephaloscyllium silasi* from Andaman waters

Fig. 3. Ventral view of the head of *Cephaloscyllium silasi* from Andaman waters

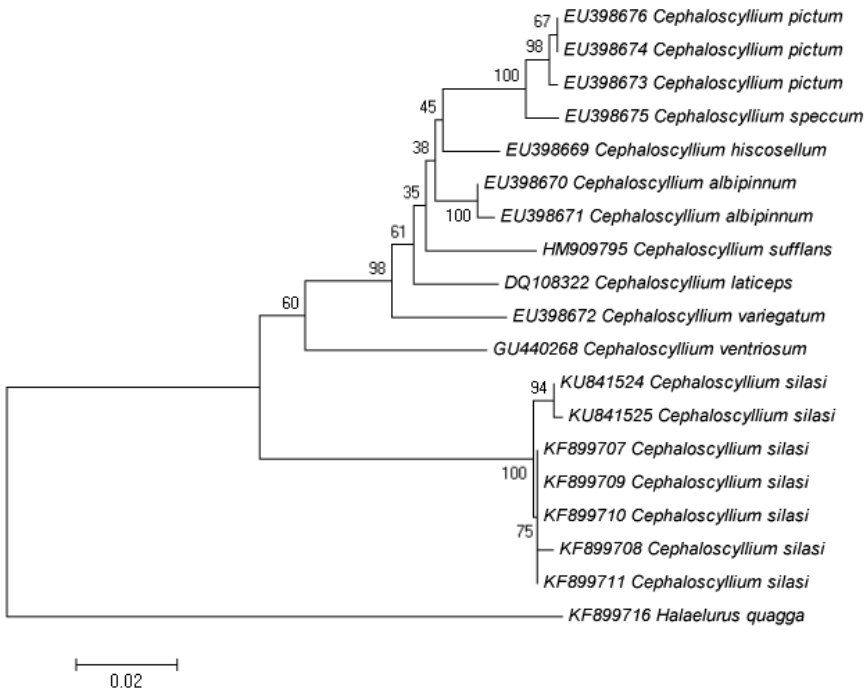

Fig. 4. Neighbour Joining (NJ) phylogenetic tree of *Cephaloscyllium* spp. inferred from DNA sequences of mitochondrial *COI* gene

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