
Sharks and rays in Indian commercial fisheries: need for revision of taxonomy

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India is one of the leading chondrichthyan fishing nations, with an estimated landing of 52,602 tonnes (sharks 44.6%, rays 51.5% and skates 3.9%) in 2012, contributing 1.3% to the total marine fish landings in the country. While there is a targeted fishery for sharks and rays, these groups constitute an important bycatch of commercial fisheries for bony fishes and shellfishes as well. The fishery is dominated by species belonging to families Carcharhinidae, Dasyatidae, Alopiidae, Sphyrnidae and Mobulidae. Earlier publications during different periods have recorded that 84 to 114 species occurring Indian seas. A study by Akhilesh (2013) catalogued 220 chondrichthyans listed from India, including 60 species of uncertain taxonomic status indicating the need for species diversity surveys. Thus there is confusion and inconsistencies in species identification, which is an impediment for arriving at conclusions on species listing and protection. The present paper is an attempt to highlight this issue with examples and stress the need to resolve the issues through conventional and molecular identification techniques.

Chondrichthyans were collected at various fish landing sites along the Indian coast from April 2008 to October 2013. Species identification was based on standard keys. Tissue samples were collected and preserved in 95% ethanol and DNA was extracted. Partial sequence of COI gene was PCR amplified and the neighbour-joining (NJ) tree was constructed using MEGA 3.1.

The following eleven elasmobranch species found in the bycatch landings are first records from the Indian waters: *Isurus paucus*, *Deania profundorum*, *Centrophorus zeehani*, *Centrophorus*

atromarginatus, *Hexanchus griseus*, *Zameus squamulosus*, *Chiloscyllium burmensis*, *Rhynchobatus australiae*, *Rhinobatos thouin*, *Aetomylaeus vespertilio*, *Himantura granulata*. The species identity was confirmed using DNA barcode comparison.

In this study, 105 species of chondrichthyans from 56 genera, 34 families, 10 orders from two subclasses, the Holocephali (Rhinochimaeridae and Chimaeridae, two species) and the Elasmobranchii (sharks and rays, 103 species) were barcoded for a 655bp region of COI from 484 specimens. Species were represented by one to seven numbers, and a total of 484 sequences were generated. The average Kimura 2 parameter (K2P) distances separating individuals within species was 0.32%, and the average distance separating species within genera was 6.73%. The sequence variability of *Dipturus* sp. A shows the possibility of cryptic speciation that warrants further taxonomic examination.

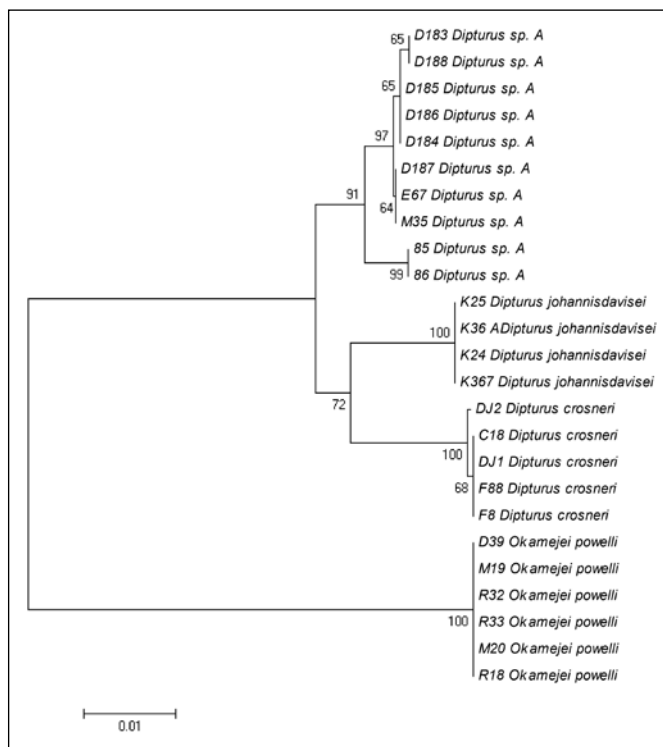


Fig. 1. K2P distance neighbour joining tree of COI sequence from Rajidae

The partial sequence of 16S rRNA was also used along with COI genes in certain families such as Rajidae, Scyliorhinidae and Centrophoridae that are showing considerable morphological similarity and overlapping characters. In Rajidae, four species belonging to two genera (*Dipturus* and *Okamejei*) were examined, with an average interspecies distance of 5.25%.

The mean interspecies distance within the family was 4.5%. One species is not yet formally described, shown here as *Dipturus* sp. A (Fig. 1). In Dasyatidae, using COI genes eleven species of *Himantura* were barcoded. Of the eleven species, three species were undescribed, *Himantura* sp. A, *Himantura* sp. B and *Himantura* sp. C. The average genetic distance within species in the family Dasyatidae was 0.84% and within species in the genus *Himantura* was 7.45%. The average interspecies distance in the family was 10.32%. The partial sequence of 16SrRNA and COI were generated for several undescribed species such as *Apristurus* sp. A, *Iago* sp. A and *Torpedo* sp. A. The present study demonstrates that sequencing a ~650 bp region of mtDNA COI permits discrimination of 100% of 105 species of chondrichthyans.

Critical analysis of past literature, new published data on elasmobranchs and our study show that at least 150 valid species of elasmobranchs occur in Indian waters. However, confusion persists on confirmation of species identity. The ambiguity in species identity needs a systematic revision with support from molecular analysis. Molecular results have confirmed seven new species to Indian waters which require formal species descriptions, showing the need for undertaking surveys along the coast to confirm the species diversity of chondrichthyans. Taxonomic revision of families such as Triakidae, Centrophoridae, Torpedinidae, Dasyatidae, Rajidae, Rhynchobatidae and Rhinidae should be initiated with wide regional sampling, comparisons and collaborations using conventional and molecular techniques. As many of these are distributed in the region, it is suggested IUCN regional status assessment workshops may be conducted to validate the Arabian and Bay of Bengal species, which are under Data Deficient and Not Evaluated categories.