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An annotated checklist of sharks of south Tamil Nadu, Southeast coast of India

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Abstract
The shark resource of India is one of the richest elasmobranch fisheries resources in the world with 88 species. An annotated checklist of sharks occurring in South Tamil Nadu situated along Southeast coast of India is presented. The present checklist is the result of a large biodiversity study on the shark resources of south Tamil Nadu conducted between August 2017 and July 2018. Documenting sharks in specific regions and understanding their taxonomy and diversity in particular ecosystems are very important for conservation and management of these decreasing resources. In this regard, occurrence and abundance data of shark species were collected from three different marine fish landing centers viz., Therespuram, Chinnamuttom and Thoothoor located along south Tamil Nadu coast to understand the shark diversity. The number of individuals in each species was also recorded. In the present study, 45 species of sharks belonging to four orders, 13 families and 22 genera were recorded. The order, Carcharhiniformes had the largest number of species (32), followed by Lamniformes (5). Likewise, the family, Carcharhinidae (24) had the largest species representation followed by Sphyrnidae (4) and Alopiidae (3). This checklist represents the first detailed, verified checklist of shark resources from south Tamil Nadu.

Keywords: Shark, elasmobranch, checklist, biodiversity, South Tamil Nadu

1. Introduction

Sharks are one of the most vulnerable groups due to their biological characteristics. Global concern over these apex predators is increasing as high exploitation rates are decreasing their stocks [4, 8, 14]. India is one of the major shark fishing nations in the world and currently stands at the second position, next only to Indonesia. In India, the production of elasmobranchs was to the tune of 52,840.8 t in which sharks formed 45% of the total elasmobranch landings during 2016. Tamil Nadu is one of the major shark producing states in India. Tamil Nadu and Pondicherry together contributed 25.9% of the total elasmobranch landings [5].

Considering the importance of India as a major shark fishing nation and vulnerability of sharks to fishing, it is important that the country evolves a management plan for shark fisheries. Developing strategies for conservation and management of shark populations are becoming increasingly important globally, especially because many species are exceptionally vulnerable to overfishing. A major limiting factor in the formulation and implementation of adequate management measures to regulate or preserve shark fishing at sustainable levels in India is the lack of coherent information spread over a sufficiently large time period that should form the basis for proper status assessment of the stock. Documenting sharks in specific regions and understanding their taxonomy and diversity in particular ecosystems are very important for conservation and management of these decreasing resources. Shark research is limited in South Tamil Nadu despite its rich diversity, long history and huge fishery. An impediment to shark research in South Tamil Nadu is a lack of comprehensive taxonomic studies/revisions and conclusive checklists. This paper presents an extended, updated checklist of sharks reported from South Tamil Nadu coast, together with comments on the dominant species and status of IUCN.

2. Material and Methods

The occurrence and abundance data of different shark species were collected fortnightly from the commercial catches of trawl net, drift gill net, bottom set gill net and hook and lines from the three landing centres namely, Therespuram (7' 40" 000 N and 80' 30" 500 E), Chinnamuttom (8' 20" 000 N and 77' 20" 500 E)

and Thoothoor (8' 10" 000 N and 76' 20" 500 E) situated along the south Tamil Nadu coast from August, 2017 to July, 2018 (Fig. 1). Some of the shark species landed were very large in size in both length and weight. The shark specimens including such large specimens were identified in the landing centre itself. But, those specimens that were difficult to identify in the field were collected and kept in an insulated ice box with ice to maintain the quality of sharks till they reached the laboratory. The fish specimens were cleaned, photographed and finally preserved in 10% formalin. The specimens were identified using the guides developed by Compagno [6], Fischer and Bianchi [11] and Raje *et al*. [23]. As these guides had figurative keys, the identity of the sharks was established without any ambiguity. The shark checklist presented in this paper is based on a review of available publications, monographs and catalogues on their diversity, taxonomy, life history, ecology and fishery; along with reports of exploratory surveys from South Tamil Nadu coast. The shark species recorded from the above-mentioned three fish landing centres were classified order-wise and family-wise. Then, frequency of occurrence of each shark species during the study period were tabulated and presented in the form of a pie chart. WoRMS (World Register of Marine Species) and Fishbase were also referred to confirm the identity of the shark species and to know their status of the International Union for Conservation of Nature and Natural Resources (IUCN).

Fig 1: Map showing the study area

3. Results and Discussion

In the present study, 45 species of sharks belonging to four orders, 13 families and 22 genera were recorded along South Tamil Nadu Coast of India (Table 1). Among these four orders, Carcharhiniformes had the largest number of species (32), followed by Lamniformes (5). Of the 13 families, Carcharhinidae (24) had the largest species representation followed by Sphyrnidae (4) and Alopiidae (3).

Ebert *et al*. [9] described 500 shark species belonging to 34 families in the world and reported 13 orders of chondrichthyan fishes from Taiwanese waters, representing 52 chondrichthyan families (31 shark, 19 batoid, 2 chimaeroid) and 98 genera (64 shark, 31 batoid, 3 chimaeroid). According to fishbase, there are currently 503 species of sharks, 699 species of rays, and 49 species of chimaeras in the class Chondrichthyes [19]. Mansor *et al*. [22] produced a field guide on commercial marine fishes of the South China Sea area describing 8 species of sharks and 8 species of rays. Ali *et al*. [2] recorded 89 species of elasmobranch in EEZ of Malaysia. Fowler *et al*. [12] recorded 32 species of sharks and 41 species of rays in both inland and marine waters of Sabah, Malaysia. Last and Compagno [20] reported 243 species of elasmobranchs that includes (136 sharks, 103 rays and 4 Chimaera) from the South East Asian region. Vidthayanon and Premcharoen [24] reported 145 species of elasmobranchs (74 sharks, 70 batoids) from Thailand waters. Compagno *et al*. [7] recorded 163 species of elasmobranchs including 94 sharks, 66 rays and 3 species of chimaeras from the Philippines waters whereas Last *et al*. [21] recorded 139 species of sharks and rays from the Philippines waters. White *et al*. [25] recorded 137 species (78 sharks, 56 rays and three chimaeras) from Indonesia. On the other hand, Fahmi [10] recorded 213 species of elasmobranchs including 112 sharks, 98 rays and 3 chimaeras from Indonesia.

Gopi and Mishra [15] reported 154 species of elasmobranch which includes sharks, rays and skates under 77 genera belonging to 10 orders in India. Akhilesh *et al*. [1] reported the existence of at least 157 valid species of elasmobranch, which includes 88 species of sharks belonging to 44 genera from 21 families in Indian waters. Froese and Pauly [13] listed 119 species of elasmobranchs in Indian waters. Raje *et al*. [23] listed 47 species of sharks in commercial landings along the Indian coast. Appukutan and Nair [3] reported 65 species of sharks, of which over 20 species belonging to the families, Carcharhinidae and Sphyrnidae.

Karuppasamy [18] reported 44 elasmobranch species belonging to 7 orders, 13 families and 23 genera from Wadge Bank that extends from Kanyakumari to Vizhinjam, South India. Gowthaman [16] reported 73 species of elasmobranchs (including 41 species of shark) belonging to 6 orders, 21 families and 42 genera in Gulf of Mannar, Tamil Nadu, South east coast of India. Joshi *et al*. [17] recorded 51 species of sharks belonging to 25 genera, 15 families and 7 orders in the Gulf of Mannar Ecosystem. In line with the number of shark species reported by Gowthaman [16], Joshi *et al*., [17] and Karuppasamy [18], almost same number of shark species (45) has been recorded from the South Tamil Nadu coast in the present study.

Among the total species recorded under 4 orders, Carcharhiniformes contributed 71 percentage of total number of species recorded with 32 species, followed by Lamniformes (11%) with 5 species and Orectolobiformes and Squaliformes contributing 9% with 4 species each (Fig. 2).

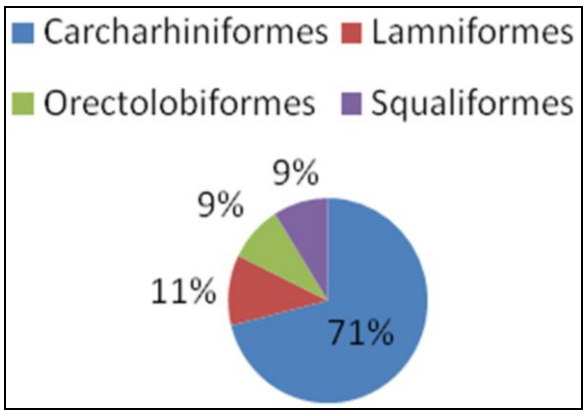

Fig 2: Pie-Chart Showing Order-wise Species Composition

Species abundance for the top five dominant species in each station is shown in Table 2. Of the 45 species recorded, 24 species were found to be commonly represented in all the three stations. Six species were found to be represented only in Thoothoor and one species was exclusively represented in Chinnamuttom.

Table 1: Checklist of Sharks in South Tamil Nadu Coast

S. No	Scientific Name	Common Name	Family	IUCN	Station	No. Recorded
	Order – Carcharhiniformes					
1	*Carcharhinus albimarginatus* (Rüppell, 1837)	Silvertip shark	Carcharhinidae	VU	TT	8
2	*Carcharhinus altimus* (Springer, 1950)	Bignose shark	Carcharhinidae	DD	TT	11
3	*Carcharhinus amblyrhynchoides* (Whitley, 1934)	Graceful shark	Carcharhinidae	NT	TT & CM	58
4	*Carcharhinus amblyrhynchos* (Bleeker, 1856)	Blacktail reef shark	Carcharhinidae	NT	TT	1
5	*Carcharhinus amboinensis* (Müller & Henle, 1839)	Pigeye shark	Carcharhinidae	DD	TT	15
6	*Carcharhinus brevipinna* (Müller & Henle, 1839)	Spinner shark	Carcharhinidae	NT	TT, CM & TP	1101
7	*Carcharhinus dussumieri* (Müller & Henle, 1839)	Whitecheek shark	Carcharhinidae	NT	TT & CM	22
8	*Carcharhinus falciformis* (Müller & Henle, 1839)	Silky shark	Carcharhinidae	VU	TT, CM & TP	7001
9	*Carcharhinus leucas* (Müller & Henle, 1839)	Bull shark	Carcharhinidae	NT	TT, CM& TP	120
10	*Carcharhinus limbatus* (Müller & Henle, 1839)	Blacktip shark	Carcharhinidae	NT	TT, CM& TP	666
11	*Carcharhinus longimanus* (Poey, 1861)	Oceanic whitetip shark	Carcharhinidae	VU	TT & CM	767
12	*Carcharhinus macloti* (Müller & Henle, 1839)	Hardnose shark	Carcharhinidae	NT	TT & TP	37
13	*Carcharhinus melanopterus* (Quoy & Gaimard, 1824)	Blacktip reef shark	Carcharhinidae	NT	TT, CM & TP	137
14	*Carcharhinus obscurus* (Lesueur, 1818)	Dusky shark	Carcharhinidae	VU	TT & CM	1265
15	*Carcharhinus sealei* (Pietschmann, 1913)	Blackspot shark	Carcharhinidae	NT	TT & CM	90
16	*Carcharhinus sorrah* (Müller & Henle, 1839)	Spot-tail shark	Carcharhinidae	NT	TT, CM & TP	811
17	*Galeocerdo cuvier* (Péron & Lesueur, 1822)	Tiger shark	Carcharhinidae	NT	TT, CM & TP	449
18	*Loxodon macrorhinus* Müller & Henle, 1839	Sliteye shark	Carcharhinidae	LC	TT, CM & TP	180
19	*Negaprion acutidens* (Rüppell, 1837)	Sicklefin lemon shark	Carcharhinidae	VU	TT & CM	23
20	*Prionace glauca* (Linnaeus, 1758)	Blue shark	Carcharhinidae	NT	TT & CM	89
21	*Rhizoprionodon acutus* (Rüppell, 1837)	Milk shark	Carcharhinidae	LC	TT, CM & TP	2390
22	*Rhizoprionodon oligolinx* Springer, 1964	Grey sharpnose shark	Carcharhinidae	LC	TT, CM & TP	945
23	*Scoliodon laticaudus* Müller & Henle, 1838	Spadenose shark	Carcharhinidae	NT	TT, CM & TP	394
24	*Triaenodon obesus* (Rüppell, 1837)	Whitetip reef shark	Carcharhinidae	NT	TT, CM & TP	58
25	*Chaenogaleus macrostoma* (Bleeker, 1852)	Hooktooth shark	Hemigaleidae	VU	TT & CM	5106
26	*Eridacnis radcliffei* Smith, 1913	Pygmy ribbontail catshark	Proscylliidae	LC	CM & TP	188
27	*Eusphyra blochii* (Cuvier, 1816)	Winghead shark	Sphyrnidae	EN	TT	7
28	*Sphyrna lewini* (Griffith & Smith, 1834)	Scalloped hammerhead	Sphyrnidae	EN	TT, CM & TP	2159
29	*Sphyrna mokarran* (Rüppell, 1837)	Great hammerhead	Sphyrnidae	EN	TT, CM & TP	1337
30	*Sphyrna zygaena* (Linnaeus, 1758)	Smooth hammerhead	Sphyrnidae	VU	TT, CM & TP	115
31	*Iago omanensis*	Bigeye houndshark	Triakidae	LC	TT, CM & TP	592

	(Norman, 1939)					
32	*Mustelus mosis* Hemprich & Ehrenberg, 1899	Arabian smooth-hound	Triakidae	DD	TT, CM & TP	522
	Order – Lamniformes					
33	*Alopias pelagicus* Nakamura, 1935	Pelagic thresher	Alopiidae	VU	TT, CM & TP	771
34	*Alopias superciliosus* Lowe, 1841	Bigeye thresher	Alopiidae	VU	TT, CM & TP	1682
35	*Alopias vulpinus* (Bonnaterre, 1788)	Common thresher	Alopiidae	VU	TT, CM & TP	231
36	*Isurus oxyrinchus* Rafinesque, 1810	Shortfin mako	Lamnidae	VU	TT, CM & TP	822
37	*Isurus paucus* Guitart, 1966	Longfin mako	Lamnidae	VU	TT	14
	Order – Orectolobiformes					
38	*Nebrius ferrugineus* (Lesson, 1831)	Tawny nurse shark	Ginglymostomatidae	VU	CM & TP	18
39	*Chiloscyllium griseum* Müller & Henle, 1838	Grey bambooshark	Hemiscylliidae	NT	TT, CM & TP	2165
40	*Chiloscyllium punctatum* Müller & Henle, 1838	Brownbanded bambooshark	Hemiscylliidae	NT	CM & TP	1095
41	*Stegostoma fasciatum* (Hermann, 1783)	Zebra shark	Stegostomatidae	EN	TT	9
	Order – Squaliformes					
42	*Centrophorus granulosus* (Bloch & Schneider, 1801)	Gulper shark	Centrophoridae	DD	TT & CM	1616
43	*Centrophorus moluccensis* Bleeker, 1860	Smallfin gulper shark	Centrophoridae	DD	TT & CM	1661
44	*Echinorhinus brucus* (Bonnaterre, 1788)	Bramble shark	Echinorhinidae	DD	TT & CM	324
45	*Squalus acanthias* Linnaeus, 1758	Picked dogfish	Squalidae	VU	TT & CM	740

Note: IUCN – International Union for Conservation of Nature and Natural Resources; VU – Vulnerable; LC – Least Concern; NT – Near Threatened; DD – Data Deficient; EN – Endangered; TT – Thoothoor; CM – Chinnamuttom; TP – Therespuram

Table 2: Major shark species along South Tamil Nadu coast

Species	Number of individual specimens recorded
Thoothoor	
Carcharhinus falciformis	4609
Sphyrna lewini	951
Alopias superciliosus	890
Rhizoprionodon acutus	781
Carcharhinus brevipinna	709
Chinnamuttom	
Chaenogaleus macrostoma	4900
Carcharhinus falciformis	2238
Centrophorus moluccensis	1626
Centrophorus granulosus	1578
Carcharhinus obscurus	838
Therespuram	
Chiloscyllium griseum	1529
Rhizoprionodon acutus	811
Chiloscyllium punctatum	785
Sphyrna lewini	427
Carcharhinus limbatus	377

In the present investigation, highest number of shark species recorded at Thoothoor landing centre might be due to use of the selective craft and gear like specific shark targeting boat and hook and line employed by the highly skilled dynamic fishermen of Thoothoor who have been venturing into the deep waters exclusively for sharks. In addition, of all these 45 species, 14 species (31.11%) are reported to be under the category 'Vulnerable', 5 species (11.11%) under 'Least Concern', 16 species (35.55%) under 'Near Threatened', 6 species (13.33%) under 'Data Deficient' and 4 species (8.88%) under 'Endangered' by IUCN. As sharks are one of the most vulnerable groups due to their biological characteristics, appropriate strategies need to be evolved for the sustainable exploitation and conservation of shark resources.

4. Conclusion

There was no organised shark fishery in the country in the past and the sharks were caught incidentally and formed only a bycatch of the gears then used. However, shark fishery management warrants species-specific and gear-specific approaches. Despite several international commitments, there has been little action to better understand, manage and protect elasmobranch species in India other than the Indian Wildlife

(Protection) Act, 1972. It is the need of the hour to develop strategies for the conservation and management of sharks. In this context, the present checklist is expected to help to evolve strategies for the sustainable utilization and conservation of sharks along south Tamil Nadu coast.

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