CHAPTER

01

Ichthyofaunal Diversity of India-challenges Ahead for a Mega Biodiversity Country

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Indian fish taxonomy has a long history, which started with Kautilya's *Arthasastra* describing fish as a source for consumption as early as 300 B.C and the epic on the second pillar of Emperor Ashoka describing the prohibition of consumption of fish during a certain lunar period, which can be interpreted as a conservation point of view. Modern scientific studies on Indian fishes could be traced to the initial works done by Linnaeus in 1758. M.E. Bloch is one of the pioneers in the field of fish taxonomy along with the naturalists, zoologists and botanists who laid the foundation for fisheries research in India such as Bloch and Schneider (1795-1801) and Lacepede (1798-1803). Russell worked on 200 fishes off Vizagapatanam during 1803. Hamilton (1822) described 71 estuarine fishes of India in his work *An Account of Fishes Found in the River Ganges and Its Branches.* The mid 1800s contributed much in the history of Indian fish taxonomy since the time of the expeditions was going through. Cuvier and Valenciennes work on taxonomy is indispensable to India and described 70 nominal species off Puducherry. Francis Day in the epoch-making book *"The Fishes of India: Being a Natural History of the Fishes Known to Inhabit the Seas and Fresh Waters of India, Burma, and Ceylon* and another book *Fauna of British India* Series in two volumes describing 1,418 species are the two most indispensable works on Indian fish taxonomy to date.

In the 20th century, the basis of intensive studies on the different families and groups of freshwater fishes was done by Chaudhuri along with Hora and his co-workers. Misra published *An Aid to Identification of the Commercial Fishes of India and Pakistan* and *The Fauna of India and Adjacent Countries (Pisces)* in 1976. Jones and Kumaran (1980) described about 600 species of fishes in the work *Fishes of Laccadive Archipelago* in 1980. Talwar and Kacker (1984) gave a detailed description of 548 species under 89 families in his work Commercial *Sea Fishes of India*. FAO *Species Identification Sheets for Fishery Purposes- Eastern Indian Ocean* (*Fisher* and Whitehead, 1974) and FAO *Species Identification Sheets for Fishery Purposes- Western Indian Ocean* (Fischer and Bianchi, 1984) are still a valuable guide for researchers. Talwar and Jhingran (1991a, 1991b) published description on 930 inland fish species of India known till date. Gopi and Misra (2014) reported 2443 species belonging to 230 families distributed along the Indian region. Reported that Gobiidae (190 spp), Pomacentridae (92), Labridae (85), Serranidae (85), Carangidae (66), Blennidae (65), Apogonidae (63), Chaetodontidae (48), Lutjanidae (45) were the high species rich families occurring along the Indian coast.

Species identification of finfish

Fisheries resources are one of the most important renewable resources. With increasing fishing pressure, the only option left for the sustainability of fisheries resources is their rational management. Scientific management is possible with a thorough knowledge of the dynamics of the fish stocks. For a meaningful study of the dynamics, knowledge of the natural history of the species is necessary

and this in turn can be acquired by the correct identification of fish species. Taxonomy of fishes assumes greater significance in tropical seas where an assembly of closely interrelated and morphologically analogous species occurs. The role of taxonomy and proper identification cannot be overstressed in studies of population dynamics. Acquaintance with the main species should be such that there should be no errors in identification of them in any special form such as racial differentiation, abnormalities, malformation due to decay or disease. As to species of less importance, collections and observations can be made for taxonomic studies which will be useful in future. Species identification study is also a step towards understanding the bewildering biodiversity that characterizes the marine ecosystem. Measuring linear dimensions of whole or parts of fish is probably the most widely used technique in taxonomic studies. Such observations are made with taps and calipers. Measurements are usually but not always taken along straight lines.

Species diversity

Taxonomists also play an important role in supporting the study of the richness of species diversity as well as protecting and making vigilant of the diverse system. The finfish species diversity in Indian region is rich and gives immense opportunity to the taxonomic research (Table 1). The assessed fish diversity of India is not comprehensive and the undescribed species revealed that they are yet to be explored making the country more biodiversity rich. Hence the need to explore the ichthyofaunal diversity of India to be looked into as they pose major threats that need to be tackled and sorted out. The role of Marine protected areas (MPAs) and fish sanctuaries have been designated in many parts of India, which can help to protect and restore threatened species. Human activities are the major causes for the loss of biodiversity and degradation of marine and coastal habitats, which needs immediate attention and comprehensive action plan to conserve the biodiversity for living harmoniously with nature. Some of the measures such as control of excess fleet size, control of some of the destructive gears, regulation of mesh size, avoiding habitat degradation of nursery areas of the some of the species, reduce the discards of the low value fish, protection of spawners, implementation of reference points and notification of marine reserves for protection and conservation of marine and coastal biodiversity. The Wild Life (Protection) Act, 1972 amended by the Government make sure of the species protected under this Act and any capture, killing and trade of these species is punishable.

Table 1**. Finfish species diversity in selected families of fishes of India**

Family	Common Name	No. of Species
Stromateidae	Pomfrets	2
Sphyrnidae	Hammer- head Shark	5
Sphyraenidae	Barracudas	7
Rajidae	Rays	8
Trichiuridae	Ribbon fish	8
Rhinobatidae	Guitar fish	10

Polynemidae	Threadfins	11
Mugilidae	Mullets	18
Scombridae	Mackerel, Tunas &Bonitos	22
Leiognathidae	Pony fishes	24
Holocentridae	Rabbit fishes	25
Carcharhinidae	Grey Shark	26
Clupeidae	Sardine	26
Mullidae	Goat fishes	27
Dasyatidae	Sting rays	28
Ophidiidae	Cusk eels	28
Haemulidae	Grunts	28
Nemipteridae	Threadfin breams	33
Engraulidae	Anchovy	34
Myctophidae	Lantern fish	41
Syngnathidae	Seahorses & Pipe fishes	42
Sciaenidae	Croakers	43
Lutjanidae	Snapper	45
Carangidae	Trevallies & Jacks	66
Serranidae	Groupers	85
Pomacentridae	Damsel & Clown fishes	92

Diversify of Marine Fishes of India

Of the 33,059 total fish species of the world, India contributes of about 2492 marine fishes owing to 7.4% of the total marine fish resources. Of the total fish diversity known from India, the marine fishes constitute 76 percent, comprising of 2492 species belonging to 941 orders, 240 families (Table 2). Andaman and Nicobar archipelago shows the highest number (1431) among the fish diversity-rich areas in the marine waters of India, followed by the east coast of India with 1121 species and the west coast with 1071. Around 91 species of endemic marine fishes are recognized to occur in the coastal waters of India. A total of 50 marine fishes identified from India fall into the Threatened category as per the IUCN Red List, and about 45 species are Near-Threatened and already on the path to vulnerability. Though, merely certain species (10 elasmobranchs, 10 seahorses and one grouper) are listed in Schedule I of the Wildlife (Protection) Act, 1972 of the Government of India for the protection of the species.

Table 2. **Species diversify of marine Fishes of India**

No	Order	Family	No. of Genera	No. of species
	Class: Elasmobranchii			
1	Hexanchiformes			
	1	Hexanchidae	2	2
2	Heterodontiformes			
	2	Heterodontidae	1	1
3	Echinorhiniformes			
	3	Echinorhinidae	1	1
4	Orectolobiformes			
	4	Rhincodontidae	1	1
	5	Hemiscylliidae	1	5
	6	Stegostomatidae	1	1
	7	Ginglymostomatidae	1	1
5	Lamniformes			
	8	Odontaspididae	2	3
	9	Pseudocarchariidae	1	2
	10	Lamnidae	2	3
	11	Alopiidae	1	3
6	Carcharhiniformes			
	12	Pseudotriakidae	1	1
	13	Scyliorhinidae	6	9
	14	Proscylliidae	1	1
	15	Triakidae	2	4
	16	Hemigaleidae	4	4
	17	Carcharhinidae	10	26
	18	Sphyrnidae	2	5
7	Squaliformes			
	19	Etmopteridae	2	7
	20	Somniosidae	2	2
	21	Centrophoridae	2	8
	22	Squalidae	1	5
8	Pristiformes			
	23	Pristidae	2	5
9	Torpediniformes			
	24	Narkidae	2	4
	25	Narcinidae	2	7
	26	Torpedinidae	1	5
10	Rajiformes			
	27	Rhinobatidae	4	10
	28	Rhyncobatidae	1	4
	29	Zonobatidae	1	1
	30	Acanthobatidae	1	1
	31	Rajidae	7	8

11	Myliobatiformes			
	32	Hexatrygonidae	1	1
	33	Dasyatidae	7	28
	34	Gymnuridae	2	4
	35	Myliobatidae	2	8
	36	Mobulidae	2	9
	37	Placiobatidae	1	1
	Sub class: Holocephali			
12	Chimaeriformes			
	38	Rhinochimaeridae	1	1
	39	Chimaeridae	1	1
	Class Actinopterygii			
13	Elopiformes			
	40	Elopidae	1	2
	41	Megalopidae	1	1
14	Albuliformes			
	42	Albulidae	1	2
15	Notacanthiformes			
	43	Halosauridae	2	5
	44	Notacanthidae	1	1
16	Anguilliformes			
	45	Anguillidae	1	5
	46	Moringuidae	1	6
	47	Muraenidae	10	38
	48	Synaphobranchidae	2	3
	49	Ophichthidae	17	24
	50	Colocongridae	1	1
	51	Congridae	12	17
	52	Muraenesocidae	4	6
	53	Nemichthyidae	2	2
	54	Serrivomeridae	1	1
	55	Nettastomatidae	2	2
17	Clupeiformes			
	56	Clupeidae	12	26
	57	Dussumieriidae	1	2
	58	Engraulidae	5	34
	59	Chirocentridae	1	2
	60	Pristigasteridae	4	12
18	Gonorynchiformes			
	61	Chanidae	1	1
19	Siluriformes			
	62	Ariidae	10	25
	63	Plotosidae	1	3
	64	Bagaridae	2	4
20	Stomiiformes			
	65	Gonostomatidae	4	6

	66	Sternoptychidae	4	8
	67	Phosichthyidae	2	3
	68	Stomiidae	6	9
21	Aulopiformes			
	69	Chlorophthalmidae	1	3
	70	Ipnopidae	2	4
	71	Synodontidae	4	23
	72	Paralepididae	2	3
	73	Evermannellidae	2	2
	74	Alepisauridae	1	2
22	Myctophiformes			
	75	Neoscopelidae	2	3
	76	Myctophidae	11	41
23	Lampriformes			
	77	Veliferidae	1	1
	78	Lophotidae	1	1
	79	Regalecidae	1	1
	80	Ateleopodidae	2	3
24	Polymixiiformes			
	81	Polymixiidae	1	4
25	Gadiformes			
	82	Bregmacerotidae	1	1
	83	Macrouridae	9	18
	84	Moridae	1	2
26	Ophidiiformes			
	85	Ophidiidae	16	28
	86	Carapidae	3	5
	87	Bythitidae	6	7
	88	Aphyonidae	1	1
27	Batrachoidiformes			
	89	Batrachoididae	4	6
28	Lophiiformes			
	90	Lophiidae	2	4
	91	Antennariidae	2	9
	92	Chaunacidae	1	1
	93	Ogcocephalidae	5	11
	94	Diceratiidae	1	1
	95	Oneirodidae	1	1
	96	Ceratiidae	1	1
29	Mugiliformes			
	97	Mugilidae	7	18
30	Atheriniformes			
	98	Atherinidae	4	9
	99	Notocheiridae	1	1
31	Beloniformes			
	100	Belonidae	4	8

	101	Hemiramphidae	5	16
	102	Zenarchopteridae	2	8
	103	Exocoetidae	6	18
32	Stephanoberyciformes			
	104	Melamphaidae	1	1
33	Cypridontiformes			
	105	Aplocheilidae	1	1
34	Beryciformes			
	106	Monocentridae	1	1
	107	Trachichthyidae	2	3
	108	Berycidae	2	4
	109	Holocentridae	4	25
35	Argentiniformes			
	110	Platytroctidae	3	4
	111	Alepocephalidae	9	14
36	Zeiformes			
	112	Parazenidae	1	1
	113	Grammicolepididae	2	2
	114	Zeidae	1	2
37	Gasterosteiformes			
	115	Pegasidae	2	4
38	Syngnathiformes			
	116	Aulostomidae	1	1
	117	Fistulariidae	1	3
	118	Centriscidae	2	4
	119	Macrorhamphosidae	1	1
	120	Solenostomidae	1	2
	121	Syngnathidae	14	42
39	Scorpaeniformes			
	122	Apistidae	1	1
	123	Aploactinidae	4	6
	124	Bembridae	1	1
	125	Dactylopteridae	1	5
	126	Peristediidae	5	7
	127	Platycephalidae	11	16
	128	Scorpaenidae	15	35
	129	Setarchidae	2	3
	130	Synanceiidae	5	13
	131	Tetrarogidae	9	12
	132	Triglidae	2	7
40	Polynemiformes			
	133	Polynemidae	5	11
41	Perciformes			
	134	Acropomatidae	2	5
	135	Ambassidae	2	11
	136	Apogonidae	19	63

137	Bathyclupeidae	1	1
138	Bramidae	3	3
139	Caesionidae	4	16
140	Caproidae	1	2
141	Carangidae	20	66
142	Centrogenyidae	1	1
143	Chaetodontidae	8	48
144	Coryphaenidae	1	2
145	Datnioididae	1	1
146	Drepaneidae	1	2
147	Echeneidae	3	6
148	Emmelichthyidae	1	1
149	Gerreidae	2	11
150	Haemulidae	3	28
151	Hapalogenyidae	1	1
152	Kyphosidae	1	3
153	Lactariidae	1	1
154	Latidae	2	2
155	Leiognathidae	9	22
156	Lethrinidae	5	24
157	Lobotidae	1	1
158	Lutjanidae	10	45
159	Malacanthidae	2	3
160	Menidae	1	1
161	Monodactylidae	1	3
162	Mullidae	3	27
163	Nemipteridae	4	33
164	Opistognathidae	1	7
165	Ostracoberycidae	1	1
166	Pempheridae	2	7
167	Plesiopidae	3	5
168	Pomatomidae	1	1
169	Priacanthidae	3	9
170	Pseudochromidae	4	9
171	Rachycentridae	1	1
172	Sciaenidae	19	43
173	Serranidae	19	85
174	Sillaginidae	2	11
175	Sparidae	7	12
176	Symphysanodontidae	1	3
177	Toxotidae	1	2
178	Acanthuridae	5	39
179	Ammodytidae	1	3
180	Blenniidae	26	65
181	Callionymidae	4	21
182	Cepolidae	2	4
183	Champsodontidae	1	2
184	Chiasmodontidae	3	3

	185	Cirrhitidae	4	8
	186	Clinidae	1	1
	187	Creediidae	1	1
	188	Eleotridae	11	18
	189	Ephippidae	3	4
	190	Gobiidae	71	190
	191	Kuhliidae	1	3
	192	Kurtidae	1	1
	193	Labridae	28	85
	194	Cichlidae	2	3
	195	Samaridae	2	2
	196	Microdesmidae	3	9
	197	Pentacerotidae	1	1
	198	Percophidae	2	3
	199	Pholidichthyidae	1	1
	200	Pinguipedidae	1	12
	201	Pomacanthidae	6	21
	202	Pomacentridae	19	92
	203	Scaridae	7	29
	204	Scatophagidae	1	1
	205	Schindleriidae	1	2
	206	Siganidae	1	17
	207	Terapontidae	2	4
	208	Trichonotidae	1	2
	209	Tripterygiidae	3	8
	210	Uranoscopidae	2	6
	211	Xenisthmidae	1	1
	212	Zanclidae	1	1
	213	Ariommatidae	1	1
	214	Centrolophidae	1	2
	215	Istiophoridae	3	5
	216	Nomeidae	2	3
	217	Scombridae	11	22
	218	Scombrolabracidae	1	1
	219	Stromateidae	1	2
	220	Trichiuridae	6	12
	221	Kraemeriidae	1	1
	222	Sphyraenidae	1	10
	223	Gempylidae	9	10
	224	Xiphiidae	1	1
42	Pleuronectiformes			
	225	Psettodidae	1	1
	226	Citharidae	1	1
	227	Paralichthyidae	2	9
	228	Bothidae	9	21
	229	Pleuronectidae	3	4
	230	Soleidae	11	27
	231	Cynoglossidae	3	21

43	Tetradotnifromes			
	232	Triacanthodidae	6	6
	233	Triacanthidae	3	5
	234	Balistidae	11	22
	235	Monacanthidae	14	22
	236	Ostraciidae	4	7
	237	Triodontidae	1	1
	238	Tetradontidae	8	32
	239	Diodontidae	3	6
	240	Molidae	3	4
			941	2492

Reference: Table prepared based on the list of species published in Eschmeyer, W. N., 1998; Fricke et al., 2018; Gopi, K. C. and Mishra, S. S., 2015, Joshi et al., 2017.

Ecosystem Services from Marine Ecosystems

Marine ecosystem services include: Provisional services, regulating services, supporting services and cultural services.

Provisional services are the goods obtained from marine and coastal ecosystems such as finfish, molluscs, seaweeds, shell, firewood, wood, medicine, genetic material and ornamental resources. Food provisioning in the form of fisheries catch is one of the vital services resulting from all coastal and marine ecosystems. Bioprocessing from the seas produces many foodstuffs such as antibiotics, antifreeze and antifouling compounds. Coral reefs provide several natural bioactive compounds, which are not available in the terrestrial environment. Mangrove forests are good reservoirs of chemical compounds, wood products and medicinal plants. The shark fin, air bladder from croakers, gill filaments from rays, pearls from oysters, shells of molluscs is essential supplies from marine fauna.

Regulating services are the welfares, human get from the regulation of ecosystem processes. This comprises climate regulation, sea erosion control, waste removal, water sanitization, air quality maintenance. Mangroves, seagrass, rocky, sandy, mudflats and estuaries play a significant role in shoreline protection, sea level rise, and protection from floods and soil erosion, processing of domestic waste and safeguarding land from storms. Mangroves have an inherent capacity to absorb heavy metals and other domestic effluents making the sea water clean. The coral reefs protect land from waves and storms and prevent sea shore erosion. Estuaries, brackish water and marshes play a dynamic part in preserving water cycle and filtering water from domestic wastes. Marine ecosystem plays vital role in climate regulation by way of adjusting carbon dioxide exchange between atmosphere and ocean. The photosynthesis of marine plants absorbs carbon dioxide and release oxygen.

Supporting services include a provision of different habitats, primary productivity, and nutrient cycling and soil formation. The majority of the marine species migrates to coastal zones like estuaries, mangroves and seagrass beds for breeding and larval development. Estuaries play a significant part as nursery zones for fisheries because it links between coastal, marine, and freshwater ecosystem.

Cultural services comprise tourism, recreation, aesthetic and spiritual services, traditional information and education and research services. The most significant cultural services provided by the coastal and marine ecosystem are tourism and recreation. The natural services are greatly prized by people and contribute to human well-being, thus providing important economic cost. The extensive stretches of beaches, rocky habitats, coral reefs, estuaries and brackish water waterways are the attractive scenic opportunities. Boating, walking, fishing, swimming, beach riding, scuba diving, religious ceremonials are certain activities that people relishing globally and are important economic activity.

Most important provisional service provided by the Marine Fisheries sector are the production food fishes. The estimated marine fish landings for India was 3.83 million tonnes in 2017 which was slightly higher than (5.5%) as compared to 2016. For the purpose of easy comparison fish production, the coastal area is divided into four regions ie North West coast (Gujarat, Maharashtra, Daman Diu), South West coast (Karnataka, Kerala, Goa), South East coast (Tamilnadu, Andhra Pradhesh, Pondicherry) and North East coast (Odisha, West Bengal). The production of fish from South West and North West coast was around 12.33 lakh tonnes and 12.32 tonnes respectively. The South East coast and North East coast contributed 8.82 lakh tonnes and 4.88 lakh tonnes respectively. The maritime states like Gujarat, Tamilnadu, Kerala and Karnataka contributed more than 5 lakh tonnes of fish to all India catch during 2017.

North West coast

The North West Coast consists of Gujarat, Maharashtra, and Daman & Diu which is the most productive area along the north west coast. Gujarat has the longest coastline of more than 1,600 km and the most extensive continental shelf of nearly 164,000 km^2, which represents nearly 20% and 32 % of India's coastline and continental shelf. The EEZ of Gujarat covers 214,000 km. The coast has broadly been divided into four sections: the Gulf of Kachchh, the Saurashtra coast, the Gulf of Khambhat and the South Gujarat coast. The ecological importance is that India's first Marine National Park was notified in the Gulf of Kachchh. In the ecological sense, the habitats exhibit considerable diversity and they include mangroves, salt marshes, coral reefs, beaches, dunes, estuaries, intertidal mudflats, gulfs, bays and wetlands. Gujarat has India's second largest extent of the area under the mangroves. The major rivers are Narmada, Tapti, Sabarmati, and Mahi. Gulf of Khambhat (Gulf of Cambay) is 190 km wide at its mouth between Diu and Daman, rapidly narrows to 24 km. The Gulf of Kachchh is rather shallow with a depth of nearly 60 m at the mouth to less than 20 m near the head. The total gulf area is about 7350 km^2. In the Gulf of Kachchh, there are 42 islands & some islets, covering a total area of about 410.6 km^2. About 306 fish species are listed from the sea and coastal waters of Gujarat. The Bombay duck (*Harpodon nehereus*) fishery is dominant at Nawabunder, Rajpara and Jaffrabad along the Saurashtra coast. Out of total 306 reported species, 23 fish species were found in the IUCN's Red Data list. Importantly, 10 of these species belong to Elasmobranch families, including the Whale shark, are also listed in Schedule I of Wildlife Protection Act, 1972. The Maharashtra coast that stretches between Bordi/Dahanu in the North and Redi/Terekhol in the South is about 720 km long and 30-50 km wide. The shoreline is indented by several west flowing river mouths, creeks, bays, headlands, promontories and cliffs. There are about 18 noticeable creeks/

estuaries along the coast, many of which harbor mangrove habitats. The Gulf of Cambay and North Bombay coast are also rich in Bombay duck fisheries. About 285 species have been reported from the coast.

Fish species diversity reported from North West coast are given below:

Whitefish:	*Lactarius lactarius*
Sardine:	*Sardinella longiceps*
Dolphinfish:	*Coryphaena hippurus*
Golden anchovy*:*	*Coilia dussumieri*
Indian mackerel*:*	*Rastrelliger kanagurta*
Bombayduck:	*Harpodon nehereus*
Wolfherring*:*	*Chirocentrus nudus, Chirocentrus dorab*
Lizardfish*:*	*Saurida tumbil, Saurida undosquamis*
Pomfrets:	*Pampus argenteus, Parastromateus niger*
Seerfishe*s:*	*Scomberomorus commerson , Scomberomorus guttatus*
Fullbeaks:	*Ablennes hians, Strongylura strongylura, Tylosurus sp.*
Ribbonfish:	*Trichiurus lepturus, Lepturacanthus savala, Eupleurogramus muticus*
Tuna*:*	*Euthynnus affinis ,Thunnus tonggol, Auxis thazard , Katsuwonus pelamis*
Polynemids:	*Polydactylus mullani, Polynemus indicus, Eleutheronema tetradactylum*
Threadfin breams*:*	*Nemipterus japonicus, Nemipterus randalli, Nemipterus bipunctatus*
Barracuda*:*	*Sphyraena putnamae, Sphyraena jello, Sphyraena obtusata* and *Sphyraena barracuda.*
Croakers*:*	*Johnius borneensis, Johnius macrorhynus, Otolithes cuvieri, Otolithes biauritus, Pennahia anea, Johnius belangeri, Protonibea diacanthus*
Catfishes:	*Osteogeneiosus militaris, Plicofolis dussumeiri, Nemapteryx caelata, Plicofolis tenuispinis*
Elasmobranchs:	*Scoliodon laticaudus, Himantura uarnacoides, Carcharhinus sorrah, Rhizoprionodon acutus, Rhizoprionodon oligolinx*
Groupers*:*	*Epinephelus diacanthus, Epinephelus tauvina, Epinephelus latifasciatus, Epinephelus areolatus*

South West coast

The South West coast stretches like a beautiful chain formed from the coastal districts of the states of Goa, Karnataka and Kerala. Many river mouths, creeks, small bays, cliffs and beaches,

interspersed with historic forts, lend an alluring charm to this landscape. Konkan is also rich in coastal and marine biodiversity. Mangrove forests, coral reefs, charismatic marine species like dolphins, porpoises, whales, sea turtles, etc., many species of coastal birds and other fauna make the Konkan coast a veritable treasure trove of biological diversity. The Malvan Marine Sanctuary has a spread over of 29 km^2; the sanctuary is rich in coral and marine life. The Karwar group of islands with its unique rocky with sandy shore supports a wide range of fauna. There are more than 170 different species of food fishes landing in the coast and is famous for its large shoals of Mackerel, *Rastrelliger kanagurta* dominating the coasts of Karnataka. Malabar Coast which stretches from Goa to Kanyakumari supports vast habitats such as Mangroves, Swamps, coral reefs, Sea grass meadows, beaches and deltaic regions. About 308 fish species have been reported off Malabar Coast, of which most of them are clupeids followed by, groupers, anchovies, scombrids, snappers and butterfly fishes.

The Union territory of Lakshadweep consists of 36 islands covering an area of 32 km^2 of which 10 islands are inhabited, 20,000 km^2 of lagoons and 4000 km^2 oceanic zones. Among the fishes of Lakshadweep, those of ornamental value are abundant. Of the 603 species of marine fishes that are reported from the islands at least 300 species belong to the ornamental fish group. Oceanic species of tuna such as Skipjack and Yellowfin tuna constitute the major tuna resources from Lakshadweep Islands. The main economy of the islanders is dependent on the tuna catch and fishing is done for nearly six months of the year from October to April. The most common species of sharks that occur in Lakshadweep are the Spade-nose shark/Yellow dog shark, and the Milk shark. The Blacktip Shark and Hammerhead shark are also commonly found in the waters around Lakshadweep.

Fish species diversity reported from South West coast were given below:

Whitefish:	*Lactarius lactarius*
Mackerel:	*Rastrelliger kanagurta*
Catfish:	*Netuma thalassina*
Priacanthids:	*Priacanthus hamrur, Cookeolus japonicus*
Threadfin breams:	*Nemipterus japonicus, Nemipterus randalli*
Eels:	*Muraenesox bagio, Muraenesox cinerius*
Pomfrets:	*Pampus argenteus, Pampus chinensis*
Sardines:	*Sardinella longiceps, Sardinella fimbriata, Sardinella gibbosa, Sardinella albella*
Whitebaits:	*Stolephorus devisi, Stolephorus commersonii, Stolephorus waitei, Stolephorus insularis, Stolephorus indicus*
Flatfishes:	*Cynoglossus macrostomus, Cynoglossus macrolepidotus, Cynoglossus bilineatus*
Ribbonfishes: *T*	*richiurus lepturus, Trichiurus auriga, Lepturacanthus savala,*

	Eupleurogramus muticus
Seerfishes:	*Scomberomorus commerson, Scomberomorus guttatus, Acanthocybium solandri*
Tunas:	*Thunnus albacares, Katsuwonus pelamis, Euthynnus affinis, Auxis thazard, Auxis rocheii, Thunnus tonggol, Sarda orientalis, Gymnosarda unicolor*
Groupers: *E*	*pinephelus diacanthus, Epinephelus flavocaeruleus, Epinephelus longispinis, Epinephelus areolatus, Variola louti, Cephalopholis miniata*
Snappers:	*Lutjanus bohar, Pristipomoides typus, Lutjanus gibbus, Pristipomoides multidens, Pristipomoides filamentosus, Aphareus rutilans, Aphareus virescens, Lutjanus kasmira, Lutjanus lutjanus, Lutjanus bengalensis, Lutjanus rivulatus.*
Croakers:	*Johneops sina, Otolithes ruber, Otolithes cuvieri, Johnius belangeri, Johnius anaeus, Nibea soldado, Johnius glaucus, Johnius macropterus*
Lizardfishes:	*Saurida tumbil, Saurida undosquamis, Trachinocephalus myops, Synodus englemani, Synodus gracilis*
Pigface breams:	*Lethrinus mahsena, Lethrinus cochyliatus, Lethrinus elongatus*
Skate:	*Rhina ancylostoma, Rhinobatos obtusus, Rhinobatos annandalei*
Carangids*:*	*Decapterus russellii, Selaroides leptolepis, Caranx ignobilis, Selar crumenophthalmus, Alectis indicus, Alectis ciliaris, Megalaspis cordyla, Scomberoides commersonianus, Elegatis bipinnulata*
Ray:	*Dasyatis microps, Himantura bleekeri, Himantura imbricata, Himantura fai, Himantura uarnak, Himantura jenkinsii, Himantura gerrardi, Mobula japonica, Mobula tarapacana, Taeniura meyeni, Pteroplatytrygon violacea, Rhinoptera javanica, Neotrygon kuhlii*
Sharks:	*Carcharhinus limbatus, Carcharhinus falciformis, Carcharhinus longimanus, Scoliodon laticaudus, Sphyrna lewini, Isurus oxyrinchus, Galeocerdo cuvieri, Alopias pelagicus, Alopias superciliosus, Carcharhinus leucas, Carcharhinus brevipinna, Carcharhinus amblyrhynchoides, , Carcharhinus albimarginatus, Carcharhinus sorrah, Prioncace glauca, Stegostoma fasciatum, Echinorhinus brucus, Nebrius ferrugineus, Triaenodon obesus, Loxodon macrorhinus*

South East coast

The Gulf of Mannar located in the Southern part of the Bay of Bengal with a string of 21 islands which has been declared as a marine National park under the Wild Life (Protection) Act 1972 by the Government of India. The reserve covers 10,500 km^2, which comprises of a variety of sensitive marine habitats like coral reefs, mangroves and sea grasses, and could be considered as one of the

most productive ecosystems. The core area of the reserve is comprised of a 560km^2 of coral islands and shallow marine habitat. The Gulf of Mannar and adjacent areas alone produces about 20% of the marine fish catch in Tamil Nadu. Of the 2492 fish species distributed in Indian waters, 1182 species have so far been recorded from the Gulf of Mannar. The finfish resources, mainly comprises of small pelagics, barracudas, silver bellies, rays, skates, eels, carangids, flying fish, full beaks and half beaks. The demersal finfish resources, mainly associated coral reefs are threadfin breams, grouper, snappers, emperor and reef associated fishes. Further, large pelagic species like skipjack tuna, yellow fin tuna, bigeye tuna, kawakawa, frigate tuna and seer fish, bill fishes, eagle rays are most abundant in offshore and oceanic areas, but also occur in coastal waters are found in certain areas of the Gulf of Mannar.

Palk Bay is situated on the southeast coast of India encompassing the sea between Point Calimere near Vedaranyam in the north and the northern shores of Mandapam to Dhanushkodi in the south. The Palk Bay itself is about 110 km long and is surrounded on the northern and western sides by the coastline of the State of Tamil Nadu in the mainland of India. The coastline of Palk Bay has coral reefs, mangroves, lagoons, and sea grass ecosystems. Elasmobranchs are the largest group of fishes and are well represented in the fishery wealth of the Rameswaram Island on the Palk Bay side.

Fish species diversity reported from South East coast are given below:

Dolphinfish:	*Coryphaena hippurus*
Cobia:	*Rachycentron canadum*
Indian halibut:	*Psettodes erumei*
Mackerel:	*Rastrelliger kanagurta, Rastrelliger faughni*
Lizardfishes:	*Saurida tumbil, Saurida undosquamis, Trachinocephalus myops*
Pomfrets:	*Pampus argenteus, Pampus chinensis*
Flying fish:	*Hirundichthys coromandelensis, Cheliopogon spilopterus, Cheliopogon spilopterus bahiensis*
Needlefishes:	*Strongylura strongylura, Strongylura leiura, Tylosurus crocodilus, Ablennes hians*
Sardines:	*Sardinella gibbosa, Sardinella longiceps, Sardinella albella, Sardinella fimbriata, Amblygaster clupeoides, Amblygaster sirm*
Tunas:	*Thunnus albacares, Katsuwonus pelamis, Euthynnus affinis, Auxis thazard, Auxis rocheii, Thunnus tonggol, Sarda orientalis, Gymnosarda unicolor*
Seerfish:	*Scomberomorus commerson, Scomberomorus guttatus, Scomberomorus lineolatus, Acanthocybium solandri*
Billfishes:	*Istiophorus indica, Istiophorus platypterus*, *Xiphias gladius*, *Tetrapterus audax*

Pigface breams:	*Lethrinus lentjan, Lethrinus nebulosus, Lethrinus miniatus, Lethrinus ramak, Lethrinus ornatus*
Threadfin breams:	*Nemipterus japonicus, Nemipterus randalli, Nemipterus bipunctatus, Nemipterus peronii, Scolopsis bimaculata, Scolopsis vosmeri*
Snappers:	*Lutjanus lutjanus, Lutjanus fulvus, Pristipomoides filamentosus, Lutjanus ehrenbergii, Lutjanus indicus, Lutjanus fulviflamma, Lutjanus madras, Lutjanus quinquelineatus*
Goatfish:	*Upeneus supravittatus, U.moluccensis, U.bensasi, U.sundaicus, U.sulphureus, U.tragula, U.taeniopterus, U.vittatus, Parupeneus indicus, Parupeneus heptacanthus.*
Silverbellies*:*	*Eubleekeria jonesi, Karalla dussumieri, Karalla daura, Leiognathus brevirostris, Leiognathus lineolatus, Leiognathus equulus, Gazza minuta,, Secutor ruconius, Devexim entum insidiator, Photopectoralis bindus, Eubleekeria splendens*
Croakers*:*	*Otolithes ruber, Kathala axillaris, Nibea maculata, Johnius carutta, J.dussumieri, Pennahia anea, Protonibea diacanthus, Johnieops dussumieri, Dendrophysa russelli, Nibea soldado, Panna microdon*
Carangids:	*Decapterus russellii, Selaroides leptolepis, Caranx ignobilis, Selar crumenophthalmus, Alectis indicus, Alectis ciliaris, Megalaspis cordyla, Scomberoides commersonianus, Elegatis bipinnulata, Parastromateus niger*
Groupers*:*	*Epinephelus malabaricus, Epinephelus undulosus, Epinephelus bleekeri, Epinephelus merra, Epinephelus coioides, Epinephelus fasciatus, Epinephelus aerolatus, Epinephelus latifasciatus, Epinephelus radiatus, Epinephelus longispinis, Cephalopholis sonnerati*
Catfishes*:*	*Netuma thalassina, Plicofollis tenuispinis, Plicofollis dussumieri, Arius arius, Arius maculata, Plotosus lineatus, Plotosus canius, Plotosus limbatus*
Sharks:	*Sphyrna lewini, Chiloscyllium griseum, Chiloscyllium falciformis, Carcharhinus brevipinna, Carcharhinus limbatus*
Rays*:*	*Mobula japonica, Mobula tarapacana, Manta birostris, Gymnura poecilura, Himantura gerrardi, Himantura imbricata, Himantura uarnak, Himantura fai, Rhinoptera javanica, Dasyatis zugei, Himantura marginata, Himantura jenkinsii, Dasyatis centroura, Taeniura meyeni, Neotrygon kuhlii, Pteroplatytrygon violacea, Pastinachus sephen, Pastinachus gracilicaudus, Gymnura poecilura, Aetobatus narinari, Aetomylaeus vespertilio, Aetobatus flagellum, Rhinoptera javanica*

Andaman and Nicobar islands

The Andaman and Nicobar islands situated in the Bay of Bengal constitutes of about 524 islands with a coastline of 1962 km. The major habitats of the coastal region include the bio diverse coral reefs with both fringing reefs off the east coast and barrier reefs off the west coast, mangroves, estuaries and wetlands. Fish communities reach their highest degree of diversity in these ecosystems, and differ enormously within and between reefs in the same area and between geographic regions since the confluence of Andaman fishes with the waters of pacific as well as Indian Ocean. A total of 1431 species under 586 genera with 175 families has been reported from Andaman waters. The number of reef fishes is the highest among the Indian reefs with a contribution of 72.5% of the recorded fishes of the region. Major species belong to the family Pomacentridae and Gobiidae.

North East coast

The North East coast consists of West Bengal and Orissa states along the North East coast of India. The Sundarbans biosphere reserve is a majestic natural region in the world which covers 102 swampy island, mangroves, estuaries, backwaters and waterways. The Sundarbans represent the largest remaining tract of coastal mangrove wetlands in tropical Asia formed at the estuarine phase of the Ganges-Brahmaputra river system. The Indian Sundarbans of India occupies 9630 Km^2 and are bounded by River Hooghly in the West, River Raimangal in the East, Bay of Bengal in the South and Dampier Hodges line in the North. There are 56 islands of various dimensions and shapes in Sundarbans and these are separated from each other by a network of tidal channels. Sundarban boast around 172 species of fishes. Along the coast the fisheries comprise of sardines, sharks anchovies and other miscellaneous clupeoids. Sundarbans is the nursery for nearly 90% of the aquatic species of the eastern coast, the coastal fishery of eastern India is dependent upon Sundarban. Orissa has a total brackish water reserve of 417,537 ha, estuaries, lakes and backwater account for 247,850 ha, 79,000 ha and 8,100 ha respectively. The Mahanadi estuary lies in the Cuttack and Puri districts of Orissa and drains into Bay of Bengal.

Fish species diversity reported from North East coast were given below:

Sea bass:	*Lates calcarifer*
Hilsa*:*	*Tenualosa ilisha*
Mullets*:*	*Liza parsia, Liza tade*
Pomfret:	*Pampus argenteus*
Milkfish*:*	*Chanos chanos*
Sardine*:*	*Sardinella longiceps*
Ribbonfishes:	*Trichiurus lepturus*
Mackerel:	*Rastrelliger kanagurta*
Lizardfish*:*	*Saurida undosquamis*

Flatfish:	*Cynoglossus arel*
Croakers:	*Otolithes ruber*
Goatfishes:	*Upeneus vittatus*
Golden anchovy:	*Coilia dussumieri*
Bombay duck:	*Harpadon nehereus*
Barracuda:	*Sphyraena jello, Sphyraena barracuda*
Threadfin breams:	*Nemipterus japonicus, Nemipterus randalli*
Tuna:	*Thunnus albacores, Katsuwonus pelamis, Auxis thazard*
Polynemids:	*Polydactylus indicus, Eleutheronema tetradactylum, Leptomelanosoma indicum, Polynemus paradiseus*

Challenges ahead for Ichthyofaunal mega diversity

The major challenges to Ichthyofaunal diversity are:

- **According to FAO**, the biodiversity research had been prioritized and several new fish identification tools have been developed. But the actual transfer and adoption of these fish identification tools in marine biodiversity management and conservation is minimal.
- **FAO urges** to take initiatives to strengthen the fish identification and biodiversity research among Scientists, stakeholders and the users. The strengthening of taxonomic research creates jobs for taxonomists, research funding and infrastructure facilities to conduct research on taxonomy leading to the revision and the stable nomenclature of different groups of fishes.
- **FAO requests** to develop more local reference collections of fish specimens in all the states for the purpose of reference museums, encourage, collaboration of fish taxonomy research.
- **Creation** of awareness programme on fish identification techniques to address the issue of fish species biodiversity, loss of biodiversity and fishery diversity.
- **Integration** of different methods comprising the classical and advanced taxonomy tools was developed in the past to achieve the common objective of precise and meticulous species identification.
- **Inventorisation** and deposition of all the available finfish species in the National and International Repositories for the research in taxonomy and establishment of a systematic catalogue.
- **Pollution**: Untreated sewage, garbage, fertilizers, pesticides, industrial chemicals, plastics. Most of the pollutants on land eventually make their way into the ocean, either deliberately dumped there or entering from water run-off and the atmosphere. Not unexpectedly, this pollution is damaging the entire marine food chain - all the way up to humans.

- **Unsustainable fishing**: Around 90% of the world's fisheries are already fully exploited or overfished, the catch of juveniles also pose danger to the diversity of fishes. Unsustainable fishing practices are the biggest danger to ocean life and habitats. Untargeted fish catching methods brings about large quantities of fishes and other fauna that leads to loss of the species.
- **Inadequate protection**: Oceans cover over 70% of our planet's surface, but only a tiny fraction of the oceans has been protected: just 3.4%. It is observed that the vast majority of the world's few marine parks and reserves are protected in name only.
- **Tourism and development**: Around the world, coastlines have been steadily turned into new housing and tourist developments, and many beaches all but disappear under flocks of holiday-makers each year.
- **Shipping**: Heavy traffic is leaving its marks of oil spills; ship groundings, anchor damage, and the dumping of rubbish, ballast water, and oily waste are endangering marine habitats around the world.
- **Oil and gas**: Important reserves of oil, gas, and minerals lie deep beneath the seafloor. However, mining and drilling for these pose a major threat to sensitive marine environments and species.
- **Aquaculture**: Fish farming is often regarded as the answer to declining wild fish stocks. But the farming of fish is actually harming wild fish, through the pollution from the farms discharge, escaped farmed fish, increased parasite loads, and the need to catch wild fish as feed.
- **Climate change**: Coral bleaching, rising sea levels, changing species distributions - global warming and climate change are already having a marked effect on the oceans. Policies are needed to deal with these phenomena, and to lessen other pressures on marine habitats already stressed by increasing water temperatures and levels.
- **Invasion of alien species**: The introduction of harmful aquatic organisms to new marine environments is believed to be one of the four greatest threats to the world's oceans. Those species are described as 'invasive' if they are ecologically and/or economically harmful.

Fishes are of immense value for human consumption, hence they are to be valued, nourished and conserved. Fish as well as fisheries forms the economic as well as social backbone of Indian society. Unfortunately, over dependence and overexploitation of these naturally bestowed resources has led to a heavy fall in the number and in turn affect the biodiversity of the system. These provide recreational, physiologic and aesthetic values to the people of interest. Fisheries have a great way to go as the income generated from these resources has shown a great demand in the future. This has been a resource of exchange in capital, investment and livelihood for majority. Fish culture, processing, trade and marketing has been providing with sufficient job opportunities for the common man. Various fishery agreements international as well as domestic have been of immense

importance. Institutes and researchers are greatly indebted to nature for the scientific information collected from various research activities.

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