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**Ichthyofaunal diversity of Indian seas and need for conservation**

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**Introduction**

Indian fish taxonomy has a long history, which started with Kautilya's *Arthashastra* 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. Bloch (1795) 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), Lacepède (1798-1803). Russell (1803), who worked on 200 fishes off Vishakapatnam, 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 (1828-1849) described 70 nominal species off Puducherry, Skyes (1839), Gunther (1860, 1872, 1880) and *The Fishes Of India* by Francis day (1865-1877) and another book *Fauna of British India* Series in two volumes (1889) describing 1,418 species are the two most indispensable works on Indian fish taxonomy to date. Alcock (1889, 1890) described 162 species new to science from Indian waters.

In the 20th century, the basis of intensive studies on the different families and groups of freshwater fishes was done by Chaudhuri (1912, 1916) along with Hora and his co-workers (1920-1951). Misra (1962) 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*. Talwar and Kacker (1984) gave a detailed description of 548 species under 89 families in his work *Commercial Sea Fishes of India. The FAO Species Identification Sheets For Fishery Purposes- Western Indian Ocean* (Fischer and Bianchi, 1984) is still a valuable guide for researchers. Recently, Talwar and Jhingran (1991a, 1991b) published description on 930 inland species of India known till date.

### **Species richness**

Of the 33,059 total fish species from the world, India contributes of about 2443 marine fishes owing to 7.4% of the total marine fish resources. Of the total fish diversity known from India, the marine fishes constitute 75.6 percent, comprising of 2443 species belonging to 927 genera, under 230 families of 40 orders (Gopi and Misra, 2015). By updating the recent new descriptions and additions the total number fish species of India was of the tune of 2492 species belonging to 941 orders, 240 families (Table 1). Among the fish diversity-rich areas in the marine waters of India, the Andaman and Nicobar archipelago shows the highest number of species, 1431, followed by the east coast of India with 1121 species and the west coast with 1071. As many as 91 species of endemic marine fishes are known to occur in the coastal waters of India. As of today, about 50 marine fishes known 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. However, only some species (10 elasmobranchs, 10 seahorses and one grouper) are listed in Schedule I of the Wildlife (Protection) Act, 1972 of the Government of India.

### **Marine and Coastal diversity**

#### ***Gujarat coast***

Gujarat has the longest coastline of more than 1,600 km and the most extensive continental shelf of nearly 164,000 km<sup>2</sup>, which represents

nearly 20% and 32 % of India's coastline and continental shelf. The EEZ of Gujarat covers 214,000 km. The fishery at present is dominated by fishes like ribbon fishes (*Trichiurus lepturus*), Bombay duck (*Harpodon nehereus*), croakers, carangids, threadfin breams, lizard fishes, tuna (*Euthynnus affinis*, *Thunnus tonggol*, *Katsuwonus pelamis*, *Thunnus albacores* and *Sarda orientalis*), seerfish, pomfrets, catfish, flatfishes and non-penaeid prawns. The Bombay duck (*Harpodon nehereus*) fishery was dominant at Nawabunder, Rajpara and Jaffrabad along the Saurashtra coast.

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 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 receives many rivers, including the Sabarmati, Mahi, Narmada, and Tapti. 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<sup>2</sup>. In the Gulf of Kachchh, there are 42 islands & some islets, covering a total area of about 410.6 km<sup>2</sup>. About 306 fish species are listed from the sea and coastal waters of Gujarat. Some of the important group of fishes that are occurring in the Arabian sea and also ventured into Gujarat waters include sharks, rays, sea horses, catfishes, groupers, ribbon fishes, jewfishes, mullets, puffer fish, coral fish, lady fish, etc. Out of total 306 reported species, 23 fish species were found in the IUCN's Red Data list. Importantly, 9 of these species belong to shark families, including the whale shark, are also listed in Schedule I of Wildlife Protection Act, 1972.

### ***Mumbai coast***

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 numerous west flowing river mouths, creeks, bays, headlands, promontories and cliffs. There are about 18 prominent creeks/estuaries along the coast many of which harbor mangrove habitats. Bombay duck fisheries form the mainstay of the commercially important fisheries of the coast from Ratnagiri to Broach. The coastline between Bombay and Kathiawar is found to be productive for Sciaenids, *Leptomelanosom aindicus* (= *Polynemus indicus*), *Polynemus* sp, perches and eels. The Gulf of Cambay and North Bombay coast are also rich in Bombay duck fisheries. About 285 species have been reported from the coast. Major finfishes along this coast was Bombay duck, ribbonfish, sharks, pomfrets, lizardfish, catfishes, oil sardine, anchovy, barracudas, fullbeaks, sailfish, Cobia, wolf herring, groupers, whitefish and mackerel.

### ***Konkan coast***

The Konkan coast stretches like a beautiful chain of 720 Km formed from the coastal districts of states of Maharashtra, Goa and Karnataka. 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 biological diversity. The Malvan Marine Sanctuary has spread over 29 km<sup>2</sup>; 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. Oil sardine along with *Sardinella fimbriata*, anchovies, clupeids, ribbon fishes, seerfishes, *Lactarius* sp., carangids, pomfrets,

croakers, catfish, whitefish, flatfishes, silver bellies also contribute much to the fisheries of both the coasts.

### ***Malabar Coast***

Malabar Coast which stretches from Goa to Kanyakumari supports vast habitats such as Mangroves, Swamps, coral reefs, Sea grass meadows, beaches, deltaic regions and fish species are the major coastal resources. About 308 fish species has been reported off Malabar Coast of which most of them are clupeids followed by, groupers, anchovies, scombrids and snappers butterfly fishes. Oil sardine along with Indian mackerel, threadfin beams, lizard fishes, eels, several carangids, sharks, rays, the Malabar sole, *Cynoglossus semifasciatus*, catfishes, small croakers, pomfrets, tuna, groupers, snappers, pigface breams, priacanthids, silverbellies, contribute to the commercial fishery along the Malabar coast. *Acanthurus matoides*, *A. xanthopteres*, *Apogon aureus*, *Chaetodon collare*, *Diodon hystrix*, *Gymnothorax javi marginatus*, *Pseudobalistes javimarginatus*, *Ostracion tuberculatum*, *Lactaia cornuta*, *Platax teira*, *Pterois volitans*, *Siganus javus*, *Tetrodon immaculatus* are important ornamental species for their abundance and economic value.

Characteristic features of the Malabar Coast are the upwelling, southwest monsoon, northeast monsoon, mud-bank along the southwest coast and high coastal production. Upwelling occurs in the region between Kanyakumari and Karwar during the onset of southwest monsoon. It starts in the southern region first and then extends northwards with the progress of southwest monsoon. Southwest monsoon season is the period when mud-banks are formed at some places along the southwest coast of India especially the Kerala coast. Mud banks of the Alleppey – region is formed by the subterranean mud and the Vembanad lake system provides the mud for this. The mud-banks between Parapanangadi and Tanur are the aggregation of coastal mud. The mud-banks at Chellanam, Narakkal, Valappad, Elathur, Quilandy, Muzhuppilangadi, Kottikalam, Anjur, Adakathubali, Kumbala, Uppala and Ullal are formed by the sediments and organic debris discharged from

river and estuaries. Mud-banks at Vypeen are formed from dredging operation (Rao *et al.*, 1992). Along the southwest coast in India the maximum production of phytoplankton takes place during the southwest monsoon months. The optimum hydrographic condition in the southwest monsoon months, the salinity of water falls from 35‰ to 30-31‰, the temperature decreases from 31-32°C to 23-25°C and abundance of nutrients like phosphate, nitrate and silicate become abundant due to upwelling and river discharges makes maximum phytoplankton production which is higher than some of the fertile seas of the world.

The peak of plankton biomass is observed during peak southwest monsoon and pre-monsoon periods that is during and after upwelling, while the abundance of fish eggs and larvae shows peak during the pre-monsoon (Joshi, 2013). Thus it is well known that the intensity of southwest monsoon plays an important role in the fluctuation of the fishery resources especially the pelagic fishes. The fish diversity occurs at the mud banks are characteristic of the fishing grounds off the south-west coast of India. About 50 species of fish were recorded from these regions. Fishes of the families Carcharinidae, Clupeidae, Dussumieridae, Dorosomidae, Engraulidae, Chirocentridae, Tachysuridae, Hemiramphidae, Sphyraenidae, Mugilidae, Polynemidae, Ambassidae, Theraponidae, Sillaginidae, Lactaridae, Siganidae, Carangidae, Gerridae, Leiognathidae, Pomadasyidae, Sciaenidae, Trichiuridae, Scomberomoridae, Stromateidae, Cynoglossidae, Chirocentridae and Drepanidae were come across in the landings (Raghunathan *et al.*, 1984).

### ***Lakshadweep***

The Union territory of Lakshadweep consists of 36 islands covering an area of 32 km<sup>2</sup> of which 10 islands are inhabited, 20,000 km<sup>2</sup> of lagoons and 4000 km<sup>2</sup> oceanic zones. Among the fishes of Lakshadweep, those of ornamental value are abundant. Of the 603 species of marine fishes belonging to 126 families that are reported from the islands, at least 300 species belong to the ornamental fish category. 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.

### ***Gulf of Mannar***

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<sup>2</sup>, 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<sup>2</sup> of coral islands and shallow marine habitat. The Gulf of Mannar alone produces about 20% of the marine fish catch in Tamil Nadu. Of the 2200 fish species distributed in Indian waters, 650 species have so far been recorded from the Gulf of Mannar. The finfish resources, mainly comprises of small pelagics, barracudas, silverbellies, 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, yellowfin 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***

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 Ramewaram Island on the Palk Bay side. This is one of the best fishing grounds for smaller sardines, silver bellies, common white fish and half beaks, mullets and sciaenids. The common fishes found in this area also include Sharks, Rays, Skates, Tiger-sharks rays, and Hammer-headed sharks.

#### ***Coromandel Coast***

Seer fishes are most abundant in the coromandel coast of Tamil Nadu along with miscellaneous fisheries formed of trichiurids and percoids. The flying-fish fishery is an important seasonal fishery on the east coast of India extending from Madras to Point Calimere along the Coromandel coast. Three species of flying-fish, viz., *Hirundichthys coromandelensis*, *Cheliopogon spilopterus* and *C. bahiensis*, are generally found in these waters, but more than 90% of the catch consists of *C. coromandelensis*.

#### ***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. Coral reefs are the most complex ecosystems in the seas. 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 1371 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. The chondrichthians constitutes of about 65 species under 40 genera under 21 families.



### West Bengal

The Sundarbans mangrove forests form a geographical landmark at the Ganges delta. 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 in the north east coast of India occupies 9630 Km<sup>2</sup> 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 sizes and shapes in Sundarbans and these are separated from each other by a network of tidal channels. Sundarban coast 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. Most commercially important marine and estuarine fishes are; *Lates calcarifer*, *Tenualosa ilisha*, *Liza parsia*, *Liza tade*, *Harpadon nehereus*, *Plotosus canius*, *Pampus argenteus*, *Rhinobatos annandalei*, *Pangasius pangasius*, *Polydactylus indicus*, *Chanos chanos*, *Eleutheronema tetradactylum*, *Leptomelanosoma indicum*, *Polynemous paradiseus* and *Pama pama*.

### Estuarine and Brackish water diversity

Estuaries are important buffer zones as it is a transition zone between freshwater environments and are subject to marine influences such as tides, waves and influx of saline water, fresh water and sediment. This inflow of both marine and fresh water brings lots of nutrients in both water and sediment makes them most productive habitats in the world. A total of 14 major, 44 medium and 162 minor rivers draining fresh water into the sea through about 53 estuaries in India. Several of Indian estuaries have become danger prone zones. Estuaries are the natural nurseries for many marine animals, but their fisheries have declined due to over exploitation of juveniles and anadromous stocks. Estuaries face threats are damming of rivers, construction of barrages, fishing pressure, and

pollution are the main cause for biodiversity loss and degradation of the ecosystem. Estuaries face problems of lack of effective planning and coordinated among the different stake holders in the implementation of management option, lack of critical knowledge on the ecological principles as well as sustainable management of resources, and low level of knowledge in the biodiversity value of goods and services provided by estuary (Joshi, 2013).

India has rich estuarine and other brackish water resources along the east and west coasts formed by the Ganges, Mahanadi, Brahmaputra, Godavari, Krishna, Cauvery, Narmada and Tapti rivers, and smaller coastal rivers along the west coast, mainly in Kerala, Karnataka and Goa. The total brackish water resources of India as estimated by the Government of India were 1.44 million ha. The states of Orissa, Gujarat, Kerala and West Bengal have rich brackish water resources. West Bengal is endowed with rich brackish water area, estimated to be 405,000 ha with Hooghly-Matlah estuary accounting for 8,029 km<sup>2</sup> and marshy area of Sunderbans to be 2,340 km<sup>2</sup>. The estuary serve as a nursery ground for migrantspecies proving spawning grounds for the migratory fishes such as *Hilsa ilisha*, *Polynemus paradiseus*, *Sillaginopsis domina*, *Pangasius pangasius*, *Pama pama*, *Polynemus tetradactylus* and *Leptomelanosoma indicum*. About 172 species of fishes has been reported from the estuary of which 99 occupy higher salinity zones. Orissa has a total brackish water resource 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. The major fauna includes *Tenuulosa ilisha*, *Nematalosa nasus*, *Sardinella sp.*, *Ilisha sp.*, *Mugil cephalus*, *Planiliza parsia* and other perches.

The Chilka lagoon is the biggest brackish water lagoon of the east coast of India and is designated as a Ramsar site since 1981. The area during summer and rainy season has been estimated to be 906 and 1,105 km<sup>2</sup> respectively. The brackish water of Andhra Pradesh is about 2.0 lakh

ha and mangrove swamp of 27,500 ha. It supports almost 268 species of fishes which includes *Nematalosa nasus*, *Mystus gulio*, *Planiliza macrolepis*, *Tenualosa ilisha* and *Gerres setifer*. Pulicat Lake is a very important brackish water lake of Nellore district of Andhra Pradesh and the rest in Tamil Nadu region with a total area 77,000 ha. The fishery includes *Nematalosa nasus*, *Planiliza macrolepis*, *Sillago sihama*, *Chanos chanos* etc. The Godavari estuarine system has an area of 330 km<sup>2</sup> drains to Bay of Bengal on the east coast in the state of Andhra Pradesh. The major fisheries are formed by *Gerres filamentosus*, *Caranx* sp., *Sillago sihama*, *Platycephalus* sp., *Lates calcarifer* and *Mugil cephalus*.

### **Threats and Conservation of ichthyofaunal diversity**

The major threats to ichthyofaunal diversity are:

- **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 surprisingly, this pollution is harming the entire marine food chain - all the way up to humans.
- **Unsustainable fishing:** 90% of the world's fisheries are already fully exploited or overfished, the catch of juveniles also pose threat to the diversity of fishes. Unsustainable fishing is the largest threat 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%. Even worse, the vast majority of the world's few marine parks and reserves are protected in name only. Without more and better managed Marine Protected Areas, the future of the ocean's rich biodiversity - and the local economies it supports - remains uncertain.

- **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. This intense human presence is taking its risk on marine life.
- **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, prospecting and drilling for these poses a major threat to sensitive marine habitats 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. Strategies are needed to deal with these phenomena, and to reduce other pressures on marine habitats already stressed by rising 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. Invasive species can dramatically change the structure and function of marine ecosystems by changing biodiversity and eliminating vital components of the food chain.

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 over exploitation 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.

Taxonomists also play an important role in supporting the study of the richness of diversity as well as protecting and making vigilant of the diverse system. The assessed diversity of the oceans is just a drop, and the unrevealed sources are yet to be explored making the world more biodiversity rich. Hence the need to conserve the ichthyofaunal diversity is 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 places worldwide, which can help 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 harmony with nature. Some of the measures such as control of excess fleet size, control of some of the gears like purse seines, ring seines, disco-nets, regulation of mesh size, avoid 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. Species diversity of marine Fishes of India

No	Order	Family	No. of Genera	No. of species
<b>Class: Elasmobranchii</b>				
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	Odontaspidae	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

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9	Torpediniiformes			
	24	Narkidae	2	4
	25	Narcinidae	2	7
	26	Torpedinidae	1	5
10	Rajiformes			
	27	Rhinobatidae	4	10
	28	Rhynchobatidae	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

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	48	Synphobranchidae	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



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	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	Oncirodidae	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

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	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	Platyroctidae	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

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	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

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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

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	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	Tetradothiformes			
	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
	240		941	2492

Reference: This table is prepared based on the lists published in Eschmeyer, W.N., 1998.; Eschmeyer, W. N. and R. Fricke (eds). 2015. Gopi, K.C. and Mishra, S. S., 2014.; Akhilesh et al.,2014.

### References

- Akhilesh, K.V., Bineesh, K.K., Gopalakrishnan, A., Jena, J.K., Basheer, V.S. and Pillai, N.G.K. 2014. *Checklist of Chondrichthyans in Indian waters*. Journal of Marine Biological Association of India, 56 (1). pp. 109-120.
- Alcock, A., 1890. *On the Bathybial Fishes collected in the Bay of Bengal during the season 1889-90*
- Arora, H.L. and Banerji, S.K., 1957, Flying-fish fishery along the Coromandel Coast. *Indian Journal of Fisheries*, 4(1), pp.80-91.
- Bloch, M.E. and Schneider, J.G., 1801. *Systema ichthyologiae: iconibus CX illustratum* (Vol. 1). Auctor. 1-584

- Chandra, G. and Sagar, R.L., 2003. Fisheries in Sundarbans: Problems and Prospects. Available at SSRN 2084014.
- Chaudhuri, B. L. 1912. Descriptions of some new species of freshwater fishes from north India. *Rec. Indian Mus. (Calcutta)* vol. 7: 437- 444, Pls. 5.
- Chaudhuri, B. L. 1916. Fauna of the Chilka Lake. Fish. Part I. *Mem. Indian Mus.* vol. 5 (no. 4): 403- 439.
- Cuvier, G.L.C.F.D. and Valenciennes, A., 1828. 1850. *Histoire naturelle des Poissons*, 22.
- Day, F., 1875. The Fishes of India being a natural history of the fishes part 1: know to inhabit the seas and fresh waters of India, Burma, and Ceylon.
- Eschmeyer, W. N. and R. Fricke (eds). CATALOG OF FISHES: GENERA, SPECIES, REFERENCES (<http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>). Electronic version accessed 11 Dec 2015.
- Eschmeyer, W.N., 1998. *Catalog of Fishes: Species of fishes MZ* (Vols. 1-3). California Academy of Sciences.
- Fischer, W. and Bianchi, G., 1984. FAO species identification sheets for fishery purposes: Western Indian Ocean (Fishing Area 51) vols.1- 5.
- Gopi, K.C. and Mishra, S.S., 2014. Diversity of Marine Fish of India. *Marine Faunal Diversity in India: Taxonomy, Ecology and Conservation*, p.171.
- Günther, A.C.L.G., 1937. *Catalogue of the Acanthopterygian Fishes in the Collection of the British Museum*. Adlard and Son, Limited.
- Hamilton, F. [Buchanan] 1822. *An account of the fishes found in the river Ganges and its branches. Fishes of Ganges*. Edinburgh & London., p. 1-405.
- Jones.S and Kumaran M. 1980. *Fishes of the Laccadive Archipelago*. Mathrubhumi press, Cochin. 720 pp.

- Joshi, K. K. 2013. *Marine Biodiversity of India– A Perspective for RFM*. In: ICAR funded Short Course on “ICT -oriented Strategic Extension for Responsible Fisheries Management, 05-25 November, 2013, Kochi pp. 37-55.
- Lacepede, B.G.E., 1798. *Histoire Naturelle des Poissons*, 1, Paris, 532 pp. 1800.
- Mahapatra B.K, Sarkar U.K, Lakra W.S. 2014. Pattern of fish biodiversity in Indian Sunderban. International Day for Biological Diversity Island Biodiversity. U. P. State Biodiversity Board.
- Misra, K. S. 1962., An aid to the identification of the common commercial fishes of India and Pakistan. *Rec. Indian Mus. (Calcutta)* vol. 57:1-320, Pls.1-4.
- Regunathan, A and Mathew, K. J. and Rao, D. S. and Gopinathan, C. P. and Kurup, N. S. and Murty, A. V. S. 1984. *Fish and fisheries of the mudbanks*. CMFRI, Bulletin, 31. pp. 60-71.
- Russell, P., 1803. *Descriptions and Figures of Two Hundred Fishes; Collected at Vizagapatam on the Coast of Coromandel, by Patrick Russell,... presented to The Hon. the Court of Directors of the East India Company, and Published by Their Order, Under the Superintendence of the Author. Vol. I [-Vol II].* G. & W. Nicol.
- Silas, E.G., 2003. History and development of fisheries research in India. *Journal of Bombay Natural History Society*, 100(2 & 3), pp.502-520.
- Sykes, W.H., 1839. On the fishes of the Deccan. In *Proceedings of the General Meetings for Scientific Business of the Zoological Society of London*(Vol. 6, pp. 157-165).
- Talwar, P.K. and Jhingran, A.G., 1991. *Inland Fishes Vol 1 & 2*.
- Talwar, P.K. and Kacker, R.K. 1984. *Commercial sea fishes of India*. Zoological Survey of India, Calcutta, 896 pp.