Biodiversity of the ray fish along the southeast coast of India with their conservation status: A comprehensive overview

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Abstract: Ray fish play the most important role in the benthic and coral reef ecosystem. Their diversity was studied in Tamil Nadu and Pondicherry coasts. The batoids are on the verge of threat and extinction to conserve adequate data for understanding the aspects of ray fish such as their IUCN status, common name, offspring produced, length at birth, maturity, maximum growth, feeding habits, and environment in which they thrive well were recorded. According to various literature, a total of 48 species of ray fishes belonging to 5 families were represented in Tamil Nadu (Parangipettai, Nagapattinam, Gulf of Mannar, and Chennai), and in Pondicherry 7 species of ray fish were reported. 4 critically endangered species *Rhinobatos granulatus*, *Rhinobatos variegatus*, *Rhinobatus obtusus*, *Rhinobatus annandalei*, and 16 endangered species were testified. The present report not only highlights the comprehensive data of ray fish which seek immediate attention for conservation but also helps in monitoring the status of the entire ray fish community of the southeast coastal waters.

Keywords: Sting Ray, Electric ray, guitarfish, the devil and manta rays, butterfly ray, eagle ray, Diversity, conservation of Ray Fish, bycatch, Dasyatidae, Narcinidae, Myliobatidae, Rhinobatidae, Gymnuridae.

I. Introduction

The contribution of ray fishes to the marine environment is vital. These bottom-dwelling cartilaginous fishes have been a part of the massive aquatic ecosystem since time immemorial. They are not only aesthetically charming to the eyes but also have various economic importance and nutritive properties. Over the years they have developed some remarkable features. They are flat, with pectoral fins infused to the heads, fins, eyes, and tail on the dorsal side, mouth gill slits, and cloaca on the ventral side. Their life span is between 15 to 25 years and can grow anywhere from 4 inches to 23 feet. They are not confined to the marine environment, there are species that habitat in freshwater as well as both marine and freshwater. Out of approximately 33,059 marine and freshwater species in the world, India has 3231 species which is nearly 9.7% (Eschmeyer and Fong, 2014)[1]. Of which the marine water fish species are 2443(75.6%) and freshwater fish species 788 (Gopi and Mishra, 2015) [2]. There are around 600 ray fish species in the entire world. 65 valid ray fish species are found on the south coast of India. These rays belong to some of the utmost endangered marine species across the world (Srinivasan et al, 2021) Rays can be classified into two suborders, Torpedinoidei which includes electric ray fishes, numb fishes, and torpedoes. Myliobatoidei which includes stingrays, whip-tailed rays, butterfly rays, eagle rays, cow-nosed rays, devil rays, and manta rays.

II. Diversity of Ray fishes in Tamil Nadu and Pondicherry

About 71 percent of the surface of the Earth is covered by the ocean, a vast body of salt water. Although there is only one ocean on our globe, the Pacific, Atlantic, Indian, and Arctic oceans are the four conventional divisions made by oceanographers and nations around the world. The ocean is still a mystery, in spite of its immense size and influence on every living thing on Earth. Humans have never charted, explored, or even seen more than 80% of the ocean. Compared to our ocean floor, much more of the moon's and Mars' surfaces have been mapped and analyzed. The number of distinct species that live in the water is unknown. Some oceanographers think there are fewer species because many marine ecosystems are impacted by pollution, overfishing, rising water temperatures, and other issues. Yet, oceanographers may be in for a lot more pleasant

surprises in the years to come. Some scientists believe there are still between a few hundred thousand and a few million undiscovered species in the ocean, which means that more than 90% of the known species may still be undiscovered. At the moment, scientists are aware of about 226,000 ocean species.

The vast variety of life on Earth is referred to as biodiversity. It can be applied more precisely to all the species found in a certain area or environment. Every living creature, including plants, microorganisms, animals, and people, is referred to as bio diversity. Every living creature, including plants, microorganisms, animals, and humans, is referred to as biodiversity. The systems that sustain all life on Earth, including humans, depend on biodiversity. We cannot have the healthy ecosystems that we depend on to give us the air we breathe, the food we eat, and people also love nature itself without a variety of animals, plants, and microorganisms. Marine biodiversity, or the variety of species found in the ocean and seas, is a crucial component of the economic, social, and environmental pillars of sustainable development. It supports the planet's healthy functioning and provides services that promote human health, well-being, and prosperity.

A comprehensive study of various literature led to a total of 52 valid species of ray fishes that occur in Tamil Nadu and Pondicherry waters belonging to 5 different families. The Dasyatidae is dominant with 25 different species, then Myliobatidae with 10 species, Narcinidae/ Torpenidae with 7 species, Rhinobatidae with 6 species, and the least Gymnuridae consisting of only 4 species. (Ravi et al, 2007[10], Rajakumar and Perumal[4], 2004, Suresh and Raffi[12], 2006, Joshi et al, 2016[9], Mohanraj et al, 2009[7], Srinivasan et al, 2021)[11].

India is considered to be one of the top three elasmobranch fishing countries. Most of the non-commercial rays are mere victims of bycatch or accidental catch due to a lack of selectivity. The ray fishes get trapped in trawlers, long lines, or gill nets during the fishing of edible rays, larger fishes, and eels. In the past decade, the catch has been declining, this indicates that the species is under serious threat. Conservation is the major concern of the hour because they are not only slow growing but also yield very few pubs (Srinivasan et al 2021)[11]. According to the United Nations Food and Agriculture Organization (FAO) landing of rays declined by 20% over the decade (Liu et al. 2021)[5]. The data collected focused mainly on the Gulf of Mannar, Chennai, Nagapattinam, Parangipettai, and Pondicherry.

Parangipettai (11º 29', lat.; 79º46' long.) is a coastal village situated on the northern bank of the velar estuary, Tamil Nadu. From the Parangipettai area, 14 species of ray fish were reported. 4 species from the Dasyatidae (sting rays) family – *Dasyatis imbricate, Dasyatis jenkinsii, Dasyatis zugei, and Pteroplatytrygon violacea*. 4 species from the family Rhinobatidae (guitarfish) – *Rhinobatos granulatus, Rhina ancylostoma, Rhynchobatus djeddensis, Rhinobatus obtusus.* 3 species from the family Narcinidae/ Torpenidae (electric rays) – *Narcine timei, Narke dipterygia, and Narcine brunnea.* 3 species from the Myliobatidae (eagle, devil, and cow nose ray) family – *Aetobatus narinari, Aetomylus nicinoffi, and Mobula mobular.* There were no records of the family Gymnuridae (butterfly rays). (Ravi et al, 2007, Rajakumar and Perumal, 2004, Suresh and Raffi, 2016)[12]

Nagapattinam (10.7672ºN, 79.8449ºE) is one of the most important districts in Tamil Nadu, situated at the mouth of the river Kaduvayar in the Bay of Bengal. 14 species were reported from the Nagapattinam area. 7 species from the Dasyatidae family – *Dasyatis imbricata, Dasyatis jenkensii, Dasyatis kuhlii, Dasyatis sephen, Dasyatis uarnak, Himantura undulata, Himantura fai.* 3 species from the Myliobatidae family- *Aetobatus narinari, Rhinoptera javanica, and Mobula diabola.* 2 species from the Narcinidae family- *Narcine timlei, Narke dipterygia.* 2 species from Gymnuridae – *Gymnura poecilura, Gymnura zonura.* There was no record of the family Rhinobatidae. (Ravi et al, 2007)[10].

The Gulf of Mannar ecosystem extends from Rameswaram and Kanyakumari to about 19000 km sqr and lies between 78º 11' E and 79º 15’ E longitude and 8º 49’ N and 9º 15’ N latitude. The aqua fauna diversity of the Gulf of Mannar is undoubtedly enriched with a variety of exotic marine species, including ray fishes with 41 species reported. The Dasyatidae family is the highest with 17 species – *Dasyatis microps, Dasyatis kuhlii, Dasyatis sephen, Dasyatis zugei, Himantura imbricata, Himantura bleekeri, Himantura gerrardi, Himantura jenkinsii, Himantura marginata, Himantura uarnak, Himantura walga, Himantura undulata, Pteroplatytrygon violacea, Taeniura lymma, Taeniura meyeni, Urogymnus granulatus, Urogymnus arperrimus.* The Myliobatidae family was recorded with 10 species – *Aetobatus narinari, Aetobatus flagellum, Aetomylus nicinoffi, Mobula mobular, Mobular diabola, Mobula thurstoni, Manta birostris, Rhinoptera jayakari, Rhinoptera javanica, Myliobatus maculatus.* The Rhinobatidae family had 6 species- *Rhinobatos granulatus, Rhinobatos vaiegatus,*

Rhinobatos obtusus, Rhinobatos annandalei, Rhina ancylostoma, Rhynchobatus djeddensis. The Narcinidae family had 5 species- *Narcine indica, Narcine brunnea, Narcine timlei, Narke dipterygia, and Torpedo marmorata.* The Gymnuridae family had 3 species- *Gymnura poecilura, Gymnura japonica, and Gymnura micrura.* (Joshi et al, 2016)

The marine community of Chennai has an enormous diversity of ray fishes, of which 17 species were reported. The Dasyatidae family had 8 species- *Dasyatis imbricata, Dasyatis alcockii, Dasyatis jenkensii, Dasyatis kuhlii, Dasyatis sephen, Dasyatis uarnak, Dasyatis zugei, Himantura bleekeri.* The family Myliobatidae had 4 species- *Aetobatus narinari, Mobula diabola, Manta birostris, Rhinoptera javanica.* The Rhinobatidae family also had 4 species- *Rhinobatus granulatus, Rhina ancyclostoma, Rhynchobatus djeddensis, and Rhinobatus obtusus.* 1 species from the family Gymnuridae – *Gymnura poecilura.* No species were reported from the family Narcinidae. (Mohanraj et al. 2009)[7].

Puducherry/Pondicherry region is located on the coromandel coast between 11º45' and 12º03'N latitudes and 79º37' and 79º53'E longitudes with an area of 293km^2 and 24km coastal shoreline area. The waters of Pondicherry had their fair share of a variety of ray fishes. A total of 7 species were reported. 4 species from the family of Narcinidae – *Narcine timlei, Narcine prodorsalis, Narke dipterygia, and Torpedo panthera.* 3 species were reported from the family Dasyatidae- *Brevitrygon imbricata, Neotrygon kuhlii, and Pareobatis jenkinsii.* No species from the family Myliobatidae, Rhinobatidae, and Gymnuridae. (Srinivasan et al, 2021)

Common Name, Offspring Produced, Length At Birth, Maturity And Maximum, Feeding, Environment, and Iucn Status. (www.fishbase.se and World Register of Marine Species www.marinespecies.org)

A. Narcinidae/Torpenidae

Narcine indica (Henle, 1834) is commonly called as large spotted numb fish. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in the Gulf of Mannar.

Narcine timlei (Bloch & Schneider, 1801) is commonly called spotted numb fish. They are demersal, tropical, and found only in the marine environment. The length at birth is around 6 cm, the length at maturity is 14cm and they grow to a maximum of 38cm. The biology is not well studied yet, but females give birth to 2-3 pups during each gestation. These soft bottom-dwelling rays feed on the bottom-living organisms. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Parangipettai, Nagapattinam, the Gulf of Mannar, and Chennai.

Narcine prodorsalis (Bessednov, 1966) is commonly called Tonkin numb fish. They are demersal, tropical, and found only in the marine environment. They grow to a maximum length of 40cm. According to the recent IUCN Red List status, they are Endangered. These rays were reported in Pondicherry. [13]

Narke dipterygia (Bloch & Schneider, 1801) is commonly called a numb ray. They are demersal, tropical, and found only in the marine environment. The length at maturity is 15cm and they grow to a maximum of 35cm. They are viviparous, females give birth to 4-6 pups during each gestation. These rays feed on crustaceans and polychaetes. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Parangipettai, Nagapattinam, the Gulf of Mannar, and Pondicherry.

Narcine brunnea (Annandale, 1909) is commonly called brown numb fish. They are demersal, tropical, and found only in the marine environment. They grow to a maximum of 22cm. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Parangipettai and the Gulf of Mannar.

Torpedo marmorata (Risso, 1810) is commonly called a marbled electric ray. They are reef-associated, sub-tropical, and found in both marine and brackish waters. The length at birth is 12cm, maturity is 35cm and they grow to a maximum of 100cm. They are viviparous, females give birth to 2-32 pups during each gestation. These rays feed on the small benthic fishes- Trachurus, Mugil, Mullus, Dicentrarchus, Spondyliosoma, Boops, Labrus, and Das. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in the Gulf of Mannar.

Torpedo panthera (Olfers, 1831) is commonly called a panther electric ray. They are demersal, tropical, and found only in the marine environment. The length at maturity is 28cm and they grow to a maximum of 100cm.

They are ovoviviparous. These rays feed on invertebrates and small reef fishes. According to the recent IUCN Red List status, they are Data Deficient. These rays were reported in Pondicherry.

B. Dasyatidae

Brevitrygon imbricata (Bloch & Schneider, 1801) is commonly called a scaly whip ray or Bengal whip ray. They are demersal, tropical, and found in marine, brackish and fresh waters. The length at maturity is 19cm and the maximum is 140cm. They are ovoviviparous. These rays feed on the benthic living invertebrates. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Pondicherry.

Dasyatis imbricata (Schneider, 1801) are demersal, tropical, and found in marine, brackish as well as fresh water. These are reported in Parangipettai, Nagapattinam, and Chennai.

Dasyatis alcockii (Annandale, 1909) are found in both marine and brackish water. These are reported in Chennai.

Dasyatis microps (Annandale, 1908) are commonly called small-eyed sting rays. They are benthopelagic, deep-water, and found in both marine and brackish waters. The length at birth is 33cm and they grow to a maximum of 320cm. They are ovoviviparous, females give birth to one pup during each gestation. According to the recent IUCN Red List status, they are Data Deficient. These rays were reported in the Gulf of Mannar.

Dasyatis jenkensii (Annandale, 1909) is commonly called Jenkins whip ray. They are demersal, tropical, and found in both marine and brackish waters. The length at maturity is 70cm and they grow to a maximum of 130cm. They are ovoviviparous. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Parangipettai, Nagapattinam, and Chennai.

Dasyatis kuhlii (Muller & Henle, 1841) is commonly called a blue spotted sting ray. They are reef-associated, tropical, and found in both marine and brackish waters. The length at birth is 16cm, maturity is 27cm and they grow to a maximum of 70cm. They are ovoviviparous, females give birth to 1-2 pups during each gestation. These rays feed on crabs and shrimps. These rays were reported in Nagapattinam, the Gulf of Mannar, and Chennai.

Dasyatis sephen (Forsskal,1775) is commonly called a cow tail sting ray. They are reef-associated, amphidromous, and found in marine, brackish and fresh waters. The length at birth is 18cm, maturity is 98cm and they grow to a maximum of 300cm. They are ovoviviparous. These rays feed on bony fishes, worms, shrimps, and crabs. According to the recent IUCN Red List status, they are Near Threatened. These rays were reported in Nagapattinam, the Gulf of Mannar, and Chennai.

Dasyatis uarnak (Gmelin,1789) is commonly called a reticulate whip ray. They are amphidromous, reef-associated, and found in both marine and brackish waters. The length at birth is 21cm, maturity is 83cm and they grow to a maximum of 200cm. They are ovoviviparous, females give birth to 3-5 pups during each gestation. These rays feed on small fishes, bivalves, crabs, shrimps, worms, and jellyfish. According to the recent IUCN Red List status, they are Endangered. These rays were reported in Nagapattinam and Chennai.

Dasyatis zugei (Muller & Henle, 1841) is commonly called a pale-edged sting ray. They are demersal, amphidromous, and found in both marine and brackish waters. The length at birth is 8cm, maturity is 19cm and they grow to a maximum of 29cm. They are ovoviviparous, females give birth to 1-4 pups during each gestation. These rays feed on bottom-dwelling organisms, small crustaceans, and fishes. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Parangipettai, the Gulf of Mannar, and Chennai.

Himantura imbricata (Bloch & Schneider, 1801) is commonly called a Bengal whip ray. They are demersal, tropical, and found in marine, brackish and fresh waters. The length at maturity is 19cm and they grow to a maximum of 140cm. They are ovoviviparous. These rays feed on the benthic living invertebrates. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in the Gulf of Mannar.

Himantura bleekeri (Blyth, 1860) is commonly called Bleeker's whip ray. They are benthopelagic, tropical, and amphidromous and found in both marine and brackish waters. They grow to a maximum of 112cm. They are

ovoviviparous. These rays feed on small crustaceans and bottom-living invertebrates. According to the recent IUCN Red List status, they are Endangered. These rays were reported in the Gulf of Mannar and Chennai.

Himantura gerrardi (Grey, 1851) is commonly called a sharp-nose whip ray. They are demersal, tropical, and found in both marine and brackish waters. The length at birth is 18cm, maturity is 64cm and they grow to a maximum of 200cm. They are ovoviviparous, females give birth to 1-4 pups during each gestation. These rays feed on the bottom crustaceans including shrimps, crabs, and small lobsters. According to the recent IUCN Red List status, they are Endangered. These rays were reported in the Gulf of Mannar.

Himantura jenkinsii (Annandale, 1909) is commonly called Jenkin's whip ray. They are demersal, tropical, and found in both marine and brackish waters. The length at maturity is 70cm and they grow to a 130maximum of cm. They are ovoviviparous. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in the Gulf of Mannar.

Himantura marginata (Blyth, 1860) is commonly called a black-edge whip ray. They are benthopelagic, tropical, and amphidromous and found in both marine and brackish waters. They grow to a maximum of 179cm. They are ovoviviparous. According to the recent IUCN Red List status, they are Data Deficient. These rays were reported in the Gulf of Mannar.

Himantura uarnak (Gmelin, 1789) is commonly called a honeycomb sting ray. They are reef-associated, amphidromous, and found in both marine and brackish waters. The length at birth is 21cm, maturity is 83cm and they grow to a maximum of 200cm. They are ovoviviparous, females give birth to 3-5pups during each gestation. These rays feed on small fishes, bivalves, crabs, shrimps, worms, and jellyfish. According to the recent IUCN Red List status, they are Endangered. These rays were reported in the Gulf of Mannar.

Himantura walga (Muller & Henle, 1841) is commonly called a scaly or dwarf whip ray. They are demersal, tropical, and found in marine waters. The length at birth is 8cm, maturity is 16cm and they grow to a maximum of 45cm. They are ovoviviparous, females give birth to 1-2 pups during each gestation. According to the recent IUCN Red List status, they are Near Threatened. These rays were reported in the Gulf of Mannar.

Himantura undulata (Bleeker, 1852) is commonly called a leopard whip ray. They are demersal, tropical, and found in marine waters. The length at birth is 20cm, maturity is 87cm and they grow to a maximum of 140cm. They are ovoviviparous. According to the recent IUCN Red List status, they are Endangered. These rays were reported in Nagapattinam and the Gulf of Mannar.

Himantura fai (Jordan & Seale, 1906) is commonly called a pink whip ray. They are found in marine waters. The length at birth is 55cm, maturity is 115cm and they grow to a maximum of 183cm. They are ovoviviparous. These rays feed on decapod crustaceans, cephalopods, and teleost fishes. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Nagapattinam.

Neotrygon kuhlii (Muller & Henle, 1841) is commonly called a blue spotted sting ray. They are reef-associated, tropical, and found in marine waters. The length at birth is 16cm, maturity is 27cm and they grow to a maximum of 70cm. They are ovoviviparous, females give birth to 1-2 pups during each gestation. These rays feed on the crabs and shrimp. According to the recent IUCN Red List status, they are Data Deficient. These rays were reported in Pondicherry.

Pteroplatytrygon violaceae (Bonaparte, 1832) is commonly called a pelagic sting ray. They are pelagic oceanic, sub-tropical, and found in marine waters. The length at birth is 15cm, maturity is 45cm and they grow to a maximum of 96cm. They are ovoviviparous, females give birth to 2-9 pups during each gestation. These rays feed on the coelenterates including medusae, squid, decapod, crustaceans, and fishes. According to the recent IUCN Red List status, they are Least Concerned. These rays were reported in Parangipettai and the Gulf of Mannar.

Pareobatis jenkinsii (Annandale, 1909) is commonly called Jenkins whip ray. They are demersal, tropical, and found in both marine and brackish waters. The length at maturity is 70cm and they grow to a maximum of 130cm. They are ovoviviparous. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Pondicherry.

Taeniura lymma (Forsskal, 1775) is commonly called a blue-spotted ribbon tail sting ray. They are reef-associated, tropical, and found in marine waters. The length at birth is cm, maturity is 20cm and they grow to a maximum of 70cm. They are ovoviviparous, females give birth to 7 pups during each gestation. These rays feed on mollusks, shrimps, worms, and crabs. According to the recent IUCN Red List status, they are Least Concerned. These rays were reported in the Gulf of Mannar.

Taeniura meyeni (Muller & Henle, 1841) is commonly called a round ribbon tail ray. They are reef-associated, tropical, and found in marine waters. The length at birth is 33cm, maturity is 105cm and they grow to a maximum of 330cm. They are ovoviviparous, females give birth to 7 pups during each gestation. These rays feed on the bottom fishes, bivalves, crabs, and shrimps. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in the Gulf of Mannar.

Urogymnus granulatus (Maclyeay, 1883) is commonly called a mangrove whip ray. They are reef-associated, tropical, and found in both marine and brackish waters. The length at birth is 28cm and they grow to a maximum of 141cm. They are ovoviviparous. These rays feed on small fishes, bottom-dwelling crustaceans, and large infauna. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in the Gulf of Mannar.

Urogymnus asperrimus (Bloch & Schneider, 1801) is commonly called a porcupine whip ray. They are reef-associated, tropical, and found in both marine and brackish waters. They grow to a maximum of 147cm. They are ovoviviparous. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in the Gulf of Mannar.

C. Gymnuridae

Gymnura poecilura (Shaw, 1804) is commonly called a long-tailed butterfly ray. They are demersal, tropical, and found in marine waters. The length at birth is 24cm, maturity is 48cm and they grow to a maximum of 250cm. They are ovoviviparous, females give birth to 7 pups during each gestation. These rays feed on crustaceans and clams. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Nagapattinam, the Gulf of Mannar, and Chennai.

Gymnura zonura (Bleeker, 1852) is commonly called a zone-tail butterfly ray. They are reef-associated, tropical, and found in marine waters. The length at birth is 27cm, maturity is 47cm and they grow to a maximum of 106cm. They are ovoviviparous. According to the recent IUCN Red List status, they are Endangered. These rays were reported in Nagapattinam.

Gymnura japonica (Temminck & Schlegel, 1850) is commonly called a Japanese butterfly ray. They are demersal, tropical, and found in marine waters. The length at birth is 20cm, maturity is 57cm and they grow to a maximum of 100cm. They are ovoviviparous, females give birth to 3 pups during each gestation. These rays feed on benthic animals. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in the Gulf of Mannar.

Gymnura micrura (Bloch & Schneider, 1801) is commonly called a smooth butterfly ray. They are demersal, deep water, and found in both marine and brackish waters. The length at maturity is 35cm and they grow to a maximum of 137cm. They are ovoviviparous. These rays feed on fish, shrimps, other crustaceans, and clams. According to the recent IUCN Red List status, they are Near Threatened. These rays were reported in the Gulf of Mannar.

D. Myliobatidae

Aetobatus narinari (Euphrasen, 1790) is commonly called a white spotted eagle ray. They are benthopelagic, amphidromous, subtropical, and found in both marine and brackish waters. The length at birth is 17cm, maturity is 107 cm and they grow to a maximum of 140cm. They are ovoviviparous, females give birth to 2-4 pups during each gestation. These rays feed on polychaetes, bivalves, gastropods, cephalopods, shrimps, and small fishes. According to the recent IUCN Red List status, they are Endangered. These rays were reported in Parangipettai, Nagapattinam, the Gulf of Mannar, and Chennai.

Aetobatus flagellum (Bloch & Schneider, 1801) is commonly called a longheaded eagle ray. They are benthopelagic, amphidromous, tropical, and found in both marine and brackish waters. They grow to a maximum of 72cm. They are ovoviviparous. These rays feed on the hard-shelled and bottom-dwelling invertebrates. According to the recent IUCN Red List status, they are Endangered. These rays were reported in the Gulf of Mannar.

Aetomylus nicinoffi (Schneider, 1801) is commonly called a banded eagle ray. They are demersal, amphidromous, tropical, and found in both marine and brackish waters. The length at birth is 17cm, maturity is 40cm and they grow to a maximum of 65cm. They are ovoviviparous, females give birth to 4 pups during each gestation. These rays feed on worms, crustaceans, snails, and bony fishes. According to the recent IUCN Red List status, they are Vulnerable. These rays were reported in Parangipettai and the Gulf of Mannar.

Mobula mobular (Bonnaterre, 1788) is commonly called devil fish. They are pelagic neritic, oceanodromous, and subtropical and found in both marine and brackish waters. They grow to a maximum of 520cm. They are ovoviviparous. With long gestation periods of 1-3 years and producing one pub (Lawson et al, 2017) These rays feed on small pelagic fishes and crustaceans. According to the recent IUCN Red List status, they are Endangered. These rays were reported in the Gulf of Mannar.

Mobula diabola (Shaw, 1804) is commonly called devil ray. They are found in marine waters. These rays were reported in Parangipettai, Nagapattinam, the Gulf of Mannar, and Chennai.

Mobula thurstoni (Lloyd, 1908) is commonly called a smooth tail or bent fin mobula. They are pelagic oceanic, subtropical, and found in marine waters. The length at birth is 65cm, maturity is 152cm and they grow to a maximum of 220cm. They are ovoviviparous. These rays feed on the planktonic crustaceans, small shrimp-like animals. According to the recent IUCN Red List status, they are Endangered. These rays were reported in the Gulf of Mannar.

Manta birostris (Walbaum, 1792) is commonly called a giant manta. They are reef-associated, oceanodromous, subtropical, and found in marine waters. The length at birth is 122cm, maturity is 413cm and they grow to a maximum of 910cm. They are ovoviviparous, females give birth to 2 pups during each gestation. These rays feed on plankton and small fishes. According to the recent IUCN Red List status, they are Endangered. These rays were reported in the Gulf of Mannar and Chennai.

Rhinoptera jayakari (Boulenger, 1895) is commonly called an oman cownose ray. They are benthopelagic, tropical, and found in marine waters. The length at maturity is 78cm and they grow to a maximum of 90cm. They are ovoviviparous. According to the recent IUCN Red List status, they are Endangered. These rays were reported in the Gulf of Mannar.

Rhinoptera javanica (Muller & Henle, 1841) is commonly called a flap nose ray. They are reef-associated, tropical, and found in both marine and brackish waters. The length at birth is 60cm and they grow to a maximum of 165cm. They are ovoviviparous. These rays feed on clams, oysters, and crustaceans. According to the recent IUCN Red List status, they are Endangered. These rays were reported in Nagapattinam, the Gulf of Mannar, and Chennai.

Myliobatus maculatus (Gray, 1834) is commonly called a dotted eagle ray. They are reef-associated, tropical, and found in both marine and brackish waters. The length at maturity is 60cm and they grow to a maximum of 200cm. They are ovoviviparous. These rays feed on crustaceans and mollusks. According to the recent IUCN Red List status, they are Endangered. These rays were reported in the Gulf of Mannar.

E. Rhinobatidae

Rhinobatos granulatus (Cuvier, 1829) is commonly called granulated/ sharp nose guitarfish. They are demersal, tropical, and found in marine waters. They grow to a maximum of 280cm. They are ovoviviparous, females give birth to 6-10 pups during each gestation. These rays feed on the large fish. According to the recent IUCN Red List status, they are Critically Endangered. These rays were reported in Parangipettai, the Gulf of Mannar, and Chennai.

Rhinobatos variegatus (Nair & Lal Mohan, 1973) is commonly called stripe-nose guitarfish. They are demersal, in deep water, and found in marine waters. The length at birth is 18cm, maturity is 44cm and they grow to a maximum of 75cm. They are ovoviviparous, females give birth to 6 pups during each gestation. According to the recent IUCN Red List status, they are Critically Endangered. These rays were reported in the Gulf of Mannar.

Rhina ancylostoma (Bloch & Schneider, 1801) is commonly called bow-mouth guitarfish. The length at birth is 45cm, and the maturity is 165cm. They are ovoviviparous, females give birth to 4 pups during each gestation. According to the recent IUCN Red List status, they are Not Evaluated. These rays were reported in Parangipettai, the Gulf of Mannar, and Chennai.

Rhynchobatus djeddensis (Forsskal, 1775) is commonly called a giant guitarfish. They are found in both marine and brackish waters. The length at birth is 43cm and they grow to a maximum of 177cm. They are ovoviviparous, females give birth to 4 pups during each gestation. According to the recent IUCN Red List status, they are Not Evaluated. These rays were reported in Parangipettai, the Gulf of Mannar, and Chennai.

Rhinobatus obtusus (Muller & Henle, 1841) is commonly called a wide nose guitar fish. They are demersal, tropical, and found in marine waters. The length at maturity is 48cm and they grow to a maximum of 93cm. They are ovoviviparous. According to the recent IUCN Red List status, they are Critically Endangered. These rays were reported in Parangipettai, the Gulf of Mannar, and Chennai.

Rhinobatus annandalei (Norman, 1926) is commonly called Annandale's guitarfish. They are demersal, amphidromous, tropical, and found in both marine and brackish waters. The length at birth is 20cm, maturity is 68cm and they grow to a maximum of 93cm. They are ovoviviparous, females give birth to 6 pups during each gestation. According to the recent IUCN Red List status, they are Critically Endangered. These rays were reported in the Gulf of Mannar.

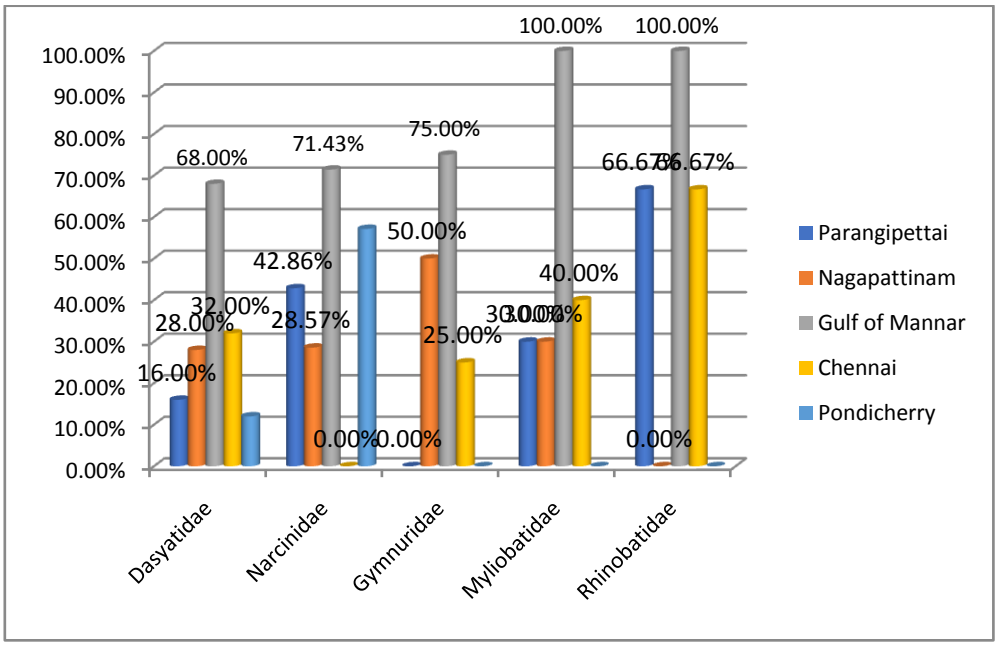

Figure.1. Bar graph showing the percentage of all the five families of ray fish reported in Parangipettai, Nagapattinam, Gulf of Mannar, Chennai, and Pondicherry.

The Gulf of Mannar has the highest diversity of Ray fishes followed by Parangipettai.

Ray fishes are not confined to just marine waters, they are observed in brackish waters and also freshwater. This is mostly because them being amphidromous(migrating between salt water and fresh water) and oceanodromous (migrating from seawater to seawater). While migrating or during certain phases in their life cycles, they spend a certain amount of time in the other aquatic environment. Of the 52 species, 4 species spend their lives in marine,

brackish, and fresh waters: *Bevitrygon imbricata, Dasyatis imbricata, Dasyatis sephen, and Himantura imbricata.* All these belong to the family Dasyatidae. 25 species confined to exclusively marine environments (6 Narcinidae, 8 Dasyatidae, 3 Gymnuridae, 5 Myliobatidae, 3 Rhinobatidae), and 22 species are subjected to both marine and brackish environments (1 Narcinidae, 13 Dasyatidae, 1 Gymnuridae, 5 Myliobatidae, 2 Rhinobatidae). Most of the rays are demersal and tropical. (www.fishbase.se , www.marinespecies.org)

III. Conservation of Ray fishes in Tamil Nadu and Pondicherry

The status of maximum world's rays has been evaluated using a standard international system to depict the risk of extinction of species: the International Union for the Conservation of Nature's (IUCN) Red List of Threatened Species. According to IUCN, 10% of Chondrichthyes come in the category threatened (critically endangered, endangered, and vulnerable) from which 60% are skates and rays. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has placed manta rays, devil rays *Mobula* spp., and guitarfish Rhinobatidae on the Appendix II list (Liu et al, 2021). Following recent IUCN (2022) there are 4 species listed as Critically Endangered (CR), 16 species under Endangered (EN), 19 species under Vulnerable(V), 3 species under Near Threatened (NT), 3 species under Least Concerned (LC), 5 species under Data Deficient (DD), 2 species under Not Evaluated (NT) (Table 1). From the table it is clear that from the total 14 species of Parangipettai, 2 species are Critically Endangered, 2 species Endangered, 7 Vulnerable, 1 Least Concerned, and 2 Data Deficient. Of the 14 species of Nagapattinam, 6 are Endangered, 6 are Vulnerable, 1 is Near Threatened, and 1 is Data Deficient. Of the 41 species of the Gulf of Mannar, 4 are Critically Endangered, 13 are Endangered, 15 are Vulnerable, 3 are Near Threatened, 2 are Least Concerned, 1 are Data Deficient, and 3 are Not Evaluated. Of the 17 species of Chennai, 2 are Critically Endangered, 6 are Endangered, 4 are Vulnerable, 1 is Near Threatened, 1 is Data Deficient and 3 Not Evaluated. Of the 7 species of Pondicherry, 1 Endangered, 4 Vulnerable, 2 Data Deficient.

A recent assessment of global oceanic rays suggested that several species have been exploited or even collapsed (Liu et al. 2021)[5]. According to the derived data, four species are to be extremely prioritized for conservation as they are Critically Endangered: *Rhinobatos granulatus* (Cuvier, 1829), *Rhinobatos variegatus* (Nair & Lal Mohan, 1973), *Rhinobatus obtusus* (Muller & Henle, 1841), *Rhinobatus annandalei* (Norman, 1926). Three of these inhibit in marine water, one in both marine and brackish water. 16 species must be next highly prioritized for conservation as they are Endangered: *Narcine prodorsalis* (Bessednov,1966*), Dasyatis uarnak* (Gmelin,1789), *Himantura bleekeri* (Blyth, 1860), *Himantura gerrardi* (Grey, 1851*), Himantura uarnak* (Gmelin, 1789), *Himntura undulata* (Bleeker, 1852), *Gymnura zonura* (Bleeker,1852), *Aetobatus narinari* (Euphrasen, 1790), *Aetobatus flagellum* (Bloch & Schneider, 1801), *Mobula mobular* (Bonnaterre, 1788), *Mobula diabola* (Shaw, 1804), *Mobula thurstoni* (Lloyd, 1908), *Manta birostris* (Walbaum, 1792), *Rhinoptera jayakari* (Boulenger,1895), *Rhinoptera javanica* (Muller & Henle 1841), *Myliobatus maculatus* (Gray, 1834). 8 of these inhibit in marine water, and Eight in both marine and freshwater.

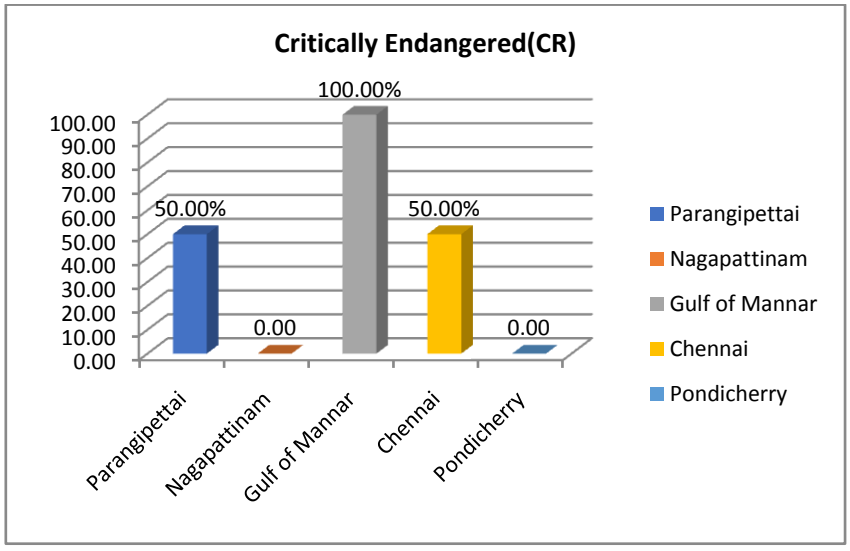

Figure.2. Total percentage of Critically Endangered species in Tamil Nadu and Pondicherry

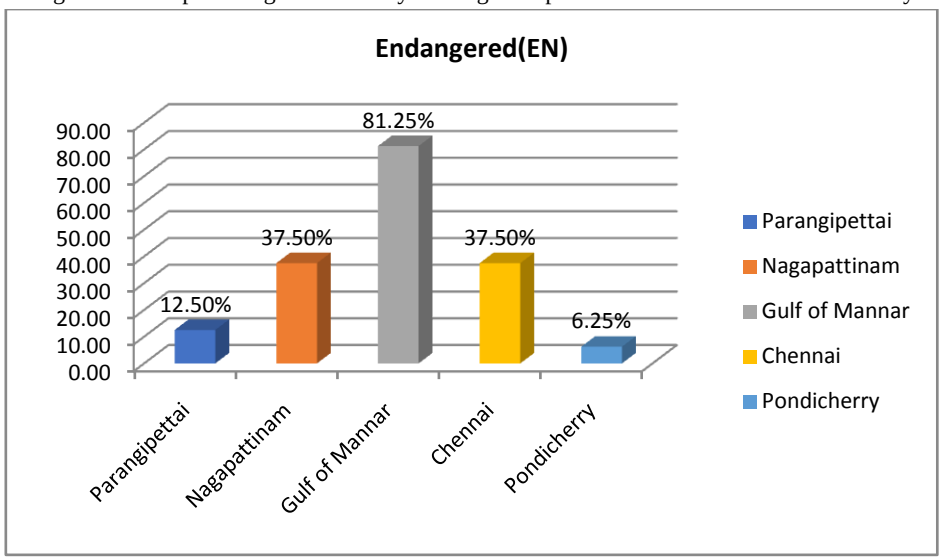

Figure. 3 Total percentage of Endangered species of Tamil Nadu and Pondicherry

Table 1: List of Ray fishes in Tamil Nadu and Pondicherry with IUCN status.

Class: Chondricthyes, subclass: Elasmobranchii, order: Rajiformes

Sl.no.	Family: Narcinidae / Torpenidae(Electric ray)	IUCN	P	N	GM	C	Pon
1	Narcine indica (Henle, 1834)* Narcine timlei	VU			+		
2	Narcine timlei (Bloch & Schneider, 1801)	VU	+	+	+		+
3	Narcine prodorsalis (Bessednov,1966)	EN					+
4	Narke dipterygia (Bloch & Schneider 1801)	VU	+	+	+		+
5	Narcine brunnea (Annandale, 1909)	VU	+		+		
6	Torpedo marmorata (Risso, 1810)	VU			+		
7	Torpedo panthera (Olfers, 1831)	DD					+
	sub order: Myliobatoidae						
	Family: Dasyatidae (Stingrays)						
8	Brevitrygon imbricata(Bloch & Schneider,1801)	VU					+
9	Dasyatis imbricata (Schneider ,1801)* Brevitrygon imbricata	VU	+	+		+	
10	Dasyatis alcockii (Annandale, 1909)* Himantura alcockii	NE				+	
11	Dasyatis microps (Annandale, 1908)* Megatrygon microps	DD			+		
12	Dasyatis jenkensii (Annandale, 1909)* Pateobatis jenkinsii	VU	+	+		+	
13	Dasyatis kuhlii (Muller & Henle, 1841)* Neotrygon kuhlii	DD		+	+	+	
14	Dasyatis sephen (Forsskal ,1775)* Pastinachus sephen	NT		+	+	+	
15	Dasyatis uarnak (Gmelin,1789)* Himantura uarnak	EN		+		+	
16	Dasyatis zugei (Muller & Henle, 1841)* Telatrygon zugei	VU	+		+	+	
17	Himantura imbricata (Bloch & Schneider, 1801) * Brevitrygon imbricata	VU			+		
18	Himantura bleekeri (Blyth, 1860) * Pateobatis bleekeri	EN			+	+	
19	Himantura gerrardi (Grey, 1851)* Maculabatis gerrardi	EN			+		
20	Himantura jenkinsii (Annandale, 1909)* Pateobatis jenkinsii	VU			+		
21	Himantura marginata (Blyth, 1860)	DD			+		
22	Himantura uarnak (Gmelin, 1789)	EN			+		
23	Himantura walga (Muller & Henle, 1841) * Brevitrygon walga	NT			+		
24	Himntura undulate (Bleeker, 1852)	EN		+	+		

25	Himantura fai (Jordan& Seale 1906)* Pateobatis fai	VU		+			
26	Neotrygon kuhlii (Muller and Henle, 1841)	DD					+
27	Pteroplatytrygon violacea (Bonaparte, 1832)	LC	+		+		
28	Pareobatis jenkinsii (Annandale,1909)	VU					+
29	Taeniura lymma (Forsskal, 1775)	LC			+		
30	Taeniura meyeni (Muller & Henle, 1841)	VU			+		
31	Urogymnus granulatus (Maclyeay, 1883)	VU			+		
32	Urogymnus asperrimus (Bloch & Schneider, 1801)	VU			+		
	Family Gymnuridae (Butterfly rays)						
33	Gymnura poecilura (Shaw, 1804)	VU		+	+	+	
34	Gymnura zonura (Bleeker,1852)	EN		+			
35	Gymnura japonica (Temminck and Schlegel, 1850)	VU			+		
36	Gymnura micrura (Bloch & Schneider, 1801)	NT			+		
	Family Myliobatidae (Eagle, Devil, and Cow nose rays)						
37	Aetobatus narinari (Euphrasen, 1790)	EN	+	+	+	+	
38	Aetobatus flagellum (Bloch & Schneider, 1801)	EN			+		
39	Aetomylus nicinoffi (Schneider	VU	+		+		
40	Mobula mobular (Bonnaterre, 1788)	EN			+		
41	Mobula diabola (Shaw, 1804)* Mobula mobular	EN	+	+	+	+	
42	Mobula thurstoni (Lloyd, 1908)	EN			+		
43	Manta birostris (Walbaum, 1792)	EN			+	+	
44	Rhinoptera jayakari (Boulenger,1895)	EN			+		
45	Rhinoptera javanica (Muller & Henle 1841)	EN		+	+	+	
46	Myliobatus maculatus (Gray, 1834)* Aetomylaeus maculatus	EN			+		
	Order: Rhinoptritiformes						
	Family: Rhinobatidae (Guitar ray)						
47	Rhinobatos granulatus (Cuvier, 1829)*Glaucostegus granulatus	CR	+		+	+	
48	Rhinobatos variegatus (Nair & Lal Mohan, 1973)* Acroteriobatus variegatus	CR			+		
49	Rhina ancylostoma (Bloch & Schneider, 1801)	NE	+		+	+	
50	Rhynchobatus djeddensis (Forsskal,1775)	NE	+		+	+	
51	Rhinobatus obtusus (Muller & Henle, 1841) *Glaucostegus obtusus	CR	+		+	+	
52	Rhinobatus annandalei (Norman, 1926)	CR			+		

Note:

i. IUCN global status, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, DD = Data Deficient, LC = Least Concerned, NE = Not Evaluated.

ii. Distribution abbreviations, P = Parangipettai, N = Nagapattinam, GM = Gulf of Mannar, C = Chennai, Pon = Pondicherry.

IV. Conclusion

The rapid expansion of anthropogenic activities threatens ocean-wide biodiversity. The elasmobranches are not exceptional to this. Though sharks, rays, and skates aren't a common meal worldwide yet in the past few decades their population has been declining drastically due to overfishing. Their status in the aquatic food web is explicit and it cannot be declined that the ocean ecosystem will fall apart once these magnificent organisms go extinct. Their constant movement near coral reefs provides water flow for the polyps for filter feeding. They are habitat engineers that create microhabitats for tiny invertebrates by excavating the benthic layer for food. They are a major component in the aquatic food chain as they control the abundance of various organisms by feeding

on them and maintaining the nutrient cycle. Past research on sharks and rays in India lacks relevance to their conservation and their management. Studies on these ray fishes are biased in many Indian states. Rays are one of the understudied organism that lacks proper research. Hence the study of regional species' critical habitat and their IUCN status is the need of the hour. India is one of the biggest fishing nations in the world, whose shark and ray species are facing a very high risk of extinction with several species already locally or regionally extinct. This paper focuses on identifying vulnerable species for conservation through regional species risk assessment and determining areas for conservation based on habitat use. Further extensive research needs to be done on aggregation sites, especially sites used for spawning, nurseries, and feeding. And also developing successful management measures by understanding the socio-economic drivers of Chondrichthyes fisheries and improving conservation measures by reviewing the existing policies on regulations for Chondrichthyes.

Reference:

1. Eschmeyer, W.N. & Fong, Jon.: Species of fishes by family/subfamily. On-line version dated 1 Oct.https://www.researchgate.net/publication/311570043_Species_of_fishes_by_familysubfamily, (2015).

2. Gopi, K. C., and S. S. Mishra: "Diversity of marine fish of India." *Marine faunal diversity in India*. Academic Press, 171-193. (2015).

3. Henle, Jacob. *Ueber Narcine, eine neue Gattung electrischer Rochen: nebst einer Synopsis der electrischen Rochen*. Eichler, 1834.

4. Joshi, K. K., et al.: "Checklist of fishes of the Gulf of Mannar ecosystem, Tamil Nadu, India." *Journal of the Marine Biological Association of India* 58.1, 34-54. (2016).

5. Liu, Kwang-Ming, Ya-Wen Huang, and Hua-Hsun Hsu. : Management Implications for skates and rays based on analysis of life history parameters. *Frontiers in Marine Science* (2021).

6. Mogalekar, H. S., et al.: Estuarine fish diversity of Tamil Nadu, India. (2017).

7. Mohanraj, G., et al.: Status of elasmobranchs fishery in Chennai, India.*Asian Fisheries Science* 22.2, 607-615. (2009).

8. Mohidin, Nur Arina Hayati, et al.:A Review on Ray Capture According to Fishing Gear Worldwide., *Jurnal Ilmiah Perikanan dan Kelautan* 13.1 ,68-82. (2021).

9. Rajkumar, M., and P. Perumal. "On an abnormal sting-ray caught off Parangipettai, east coast of India."

10. Ravi, V., and T. Veeramani.: Stingray And Electric Ray (Chondrichthys: Rajiformes) Diversity Along Parangipettai and Nagapattinam Coasts, TAMIL NADU".

11. Srinivasan, Nithya & Ravitchandirane, Vaithilingam &. B, Gunalan: Oceanography Fish Open Access J Diversity and Taxonomical Identification of Rays in Pondicherry (Puducherry) Coastal Waters. Oceanography & Fisheries Open Access Journal. 14. 10.19080/OFOAJ.2021.14.555876. (2021).

12. Suresh, T. V., and S. M. Raffi: Occurrence of pelagic stingray Pteroplatytrygon violacea (Bonaparte, 1832) in the inshore waters of Parangipettai, Southeast coast of India. (2016).

13. Froese, R. and D. Pauly. Editors.:FishBase. *Narcine prodorsalis* Bessednov, 1966. Accessed through: World Register of Marine Species at: https://www.marinespecies.org/aphia.php?p=taxdetails&id=275397 on 2022-12-18, (2022).