Studies on the Present Status of Diversity indices, Biology and Conservation methods of Tuna fish (Family: Scombridae) in Threshpuram fish landing along the Southeast Coast at Thoothukudi District, Tamil Nadu

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Abstract:

Gulf of Mannar is an endowed with a rich variety of marine organisms because its biosphere includes ecosystems of coral reefs, rocky shores, estuaries, mangrove forests and sea grass beds. Tamil Nadu is situated between 8" 5' and 13" 35' north and 76' 15' and 80' 20' along the South East coast of India bordering the Bay of Bengal. Tuna is a sleek and streamlined fish, adapted for speed. It has two closely spaced dorsal fins on its back and is a high protein fish that belongs to the tribe Thunnini, a subgrouping of the Scombridae (mackerel) family. As a result of overfishing, some tuna species are threatened with extinction. Sampling was done every fortnight in the above landing centres. The specimens were collected from the catches of trawl net, bottom set gill nets and hook and lines on an average of fifty boats per sampling day. The data collected were station-wise for calculation of various biodiversity indices. The weight and length of the fish species were measured by measuring materials. The present study was carried out for a period of six months from October 2019 to March 2020. Euthynnus affinis and Katsuwomus pelamis available in high. From the 4 species of tuna monitored by the IUCN, 24.32 % were reported to be Near Threatened, 21.73 % Vulnerable and 7.52 % Endangered. This means that approximately 56 % of the total tuna species are facing major conservation threats.

Keywords: Tuna, Diversity indices, Conservation, Gears etc.

Introduction

Fish are one of the most important protein rich foods in the world. More than 250 species of fish contribution in fishery resources in India, especially Tamil Nadu. Gulf of Mannar is an endowed with a rich variety of marine organisms because its biosphere includes ecosystems of coral reefs, rocky shores, estuaries, mangrove forests and sea grass beds. Tamil Nadu is situated between 8” 5’ and 13” 35’ north and 76’ 15’ and 80’ 20’ along the South East coast of India bordering the Bay of Bengal. These ecosystems support a wide variety of fauna and flora. Fish are at present in high demand in food markets; they are widely consumed in many parts of the world because they possess high protein content. Tuna are remarkable and impressive wild animal. Tunas fishes belong to 6 genera, viz., Thunnus, Katsuwonus, Euthynnus, Auxis (tribe Thunnini) and Sarda (bonitos) and Gymnosarda (tribe Sardini) of the family Scombridae. These ecosystems support a wide variety of fauna and flora. Fish are at present in high demand in food markets; they are widely consumed in many parts of the world because they possess high protein content. CMFRI hasreported 601 species of fishes from the Lakshadweep waters. Fisheries of Lakshadweepcan be broadly divided into Tuna Fishery, Non-Tuna Fishery (comprised of Sharks, Seer fishers, Rays, Perches, etc.) and Marine Ornamental Fishes. The fishing season in the Lakshadweep is from October to May. The common species of tuna in the Lakshadweep water are skipjack (Katsuwonuspelamis), Yellow fin (Thunnus albacare), Frigate(Auxisthazard) and Little tuna (Euthynnusaffinis).Major fishing activity revolves around the Pole and Line fishing of the Skipjack Tuna (Katsuwonuspelamis). Tuna fishes are considered as the largest and most specialized commercially important group of species among all fish. Tuna and tuna like marine fishes are important biological resources, which are dominant in the offshore fishery catch in SriLanka. Yellowfin tuna Thunnus albacares is a large tuna species found in the Pacific, Indian and Atlantic oceans. It is an important component of tuna fisheries worldwide and is one of the major target species for the tuna fishery in the major oceans, and popularly catched marine fish with annual availability of 44,013 t on overseas fishery in Korea during 2013. It is used extensively in raw cuisine such as sushi and sashimi. Byproducts such as scales, heads, skin, fat, visceral, and roe are generated increasingly and discarded as waste, without any attempt to recover the essential nutrients. Among by-products, roes are highly nutritious material rich in essential fatty acids and amino acids. Fish roes are produced in large quantities during the spawning seasons, which constitute about 1–3 % of the weight of fish. Currently roe obtained from fish such as salmon, cod, and pollock have a potential commercial market, especially they have a higher demand in Asian countries. Yellowfin tuna roe is an abundant and underutilized byproduct that can be used as a unique protein source. The roe can be used to recover protein that may be converted into a higher value food ingredient suitable for use as an emulsifier in food and feed systems. During the year 2014–2015, marine products export from India reached 10,51,243 tonnes and there are 465 seafood freezing plants along the Indian coast, with a built in capacity of 20,256 MT. In Indian Exclusive Economic Zone, tuna potential is estimated as 2,78,000 tonnes.

Review of Literature

Bones are regarded often as rich in collagen proteins and micronutrients such as calcium and phosphorus (Toppe,J et al, 2007). Fish products, when eaten together with the bones, provide proteins and fats and are also considered as good sources of many of the micronutrients of significance as most of the minerals are found in high amounts in fish bones (Gordon and Roberts, 1977; Julshamn et al, 1978). However, apart from eating small sized fish species whole (with the bones inclusive), consumption of fish bones of larger fish could also provide good levels of micronutrients (Hsu et.al.,1999). The Little tuna, *Euthynnus alletteratus* is shown a wide distribution in the world’s oceans. Among major tuna fisheries, skipjack tuna *Katsuwonus pelamis* is the largest fishery in all the oceans around the world and the largest marine fishery in Sri Lanka as well (Kristinsson and Rasco 2000). Albacore tuna, *Thunnus alalunga* is a temperate species widely distributed in the tropical, sub-tropical and temperate zones worldwide (Badii F, et.al.2007) where it supports major commercial fisheries. Byproducts such as scales, heads, skin, fat, visceral, and roe are generated increasingly and discarded as waste, without any attempt to recover the essential nutrients (Chalamaiah et al. 2010). Morphometric parameters can provide insights into the delineation of a fish stock structure and are also used in studies of fish biology, physiology and ecology and in fisheries stock assessment (Sathivel et al. 2009). In particular, the length-weight relationship of fish is important as it provides information not only on the condition and estimation of isometric / allometric growth of fish but it is also used for converting fish numbers in biomass, monitoring changes in average weight, as well as for deriving the species composition of the catch in multispecies fisheries (Oscoz et al., 2005). In order to reduce uncertainty when evaluating a fish stock, it is important to first reduce possible causes of variability of the parameters from length-weight analyses (Carroceda and Colmenero, 2015). Currently, for the stock assessment of Indian Ocean albacore, is making use of the length-weight relationship by rather than the previous equation by the Indian Ocean, based on the gillnet fishery, as it includes a broader size range and because both oceans share similar geographical features. Particularly for albacore, variations could occur as they are known to develop separate groups at particular stages of their life cycle and also exhibit heterogeneity within the same region or Oceans.

Materials and Methods

The data was collected by observations made at local landing a site along the South east coast of Tamil Nadu across one station name is Threshpuram. Sampling was done every fortnight in the above landing centre. The specimens were collected from the catches of trawl net, bottom set gill nets and hook and lines on an average of fifty boats per sampling day. The data collected were station for calculation of various biodiversity indices. Identification of species was confirmed using standard Monographs and Fish Identification books (FAO Fish Identification sheets, Species Catalogue, Smith's Sea fishes). The present study was carried out for a period of six months from October 2019 to March 2020.

Estimation of Biodiversity:

Shannon Index (H)

The Shannon index is an information statistic index, which means it assumes one species are represented in a sample and tha they are randomly sampled. Where P is the propotion (n/N) of individual of one particular species found (n) divided by the total number of individual found (N), ln is the natural log, ∑ is the sum of the calculation, and s is the number of species.

$$H = \sum P_i \ln P_i$$

i = l

Simpson's diversity index (D)

Simpson's diversity index (D) is a measure of diversity, which takes into account both species richness, and evenness of abundance among the species present. In essence it measure the probability that one type of individuals randomly selected from an area will belong to the same species. The formula for calculating D is presented as: Where n_i is the total number of organisms of one individual species, N is the total number of organisms of all species. The value D ranges from 0 to1.

$$D = \frac{\sum n_i(n_i)}{N\,(N-1)}$$

Brillouin index (*HB*)

The Brillouin index measures the diversity of a collection, as opposed to the Shannon index which measures a sample. Where N is the total number of individuals in the sample, ni is the number of individuals belonging to the ith species and s the species number.

$$HB = \frac{\ln N - \sum_{i-1}^{s} \ln n_i}{N}$$

Margalef's diversity index (D_{Mg})

Measurement of species richness Margalef's index was used as a simple measure of species richness (Margalef, 1958). This measured is strongly dependent on sampling size and effort. Where S is the total number of species, N is the total number of individual in the sample, In is the natural logarithm

$$D_{Mg} = \frac{(S-I)}{In\ N}$$

Pielou's evenness index

The evenness of a community can be represented by pleilou's evenness index: Where is the number derived from the shannon diversity index and is the maximum possible value of equal to: J' is constrained between 0 and 1. Where h' is shannon Weiner diversity and S is the total number of species in a sample, across all samples in dataset.

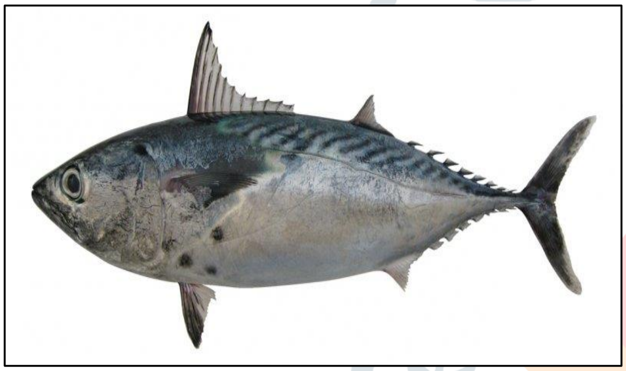
$$J = \frac{H'}{\ln(S)}$$

Results and Discussion:

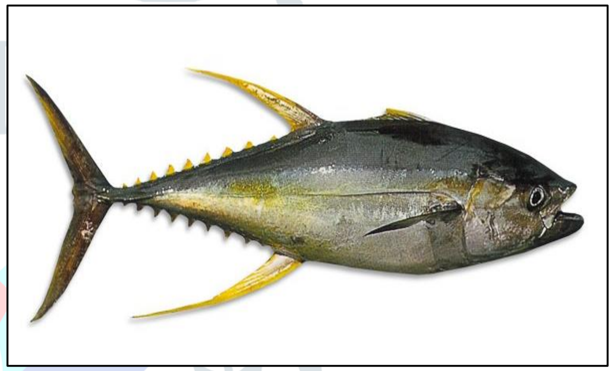
A total of 2375 numbers of tuna fishes from four types of species were collected from Threshpuram fish landing centre (Table1.). The Shannon – Wiener diversity index (H' log_2) was calculated to be ranges of 1.094 – 1.386. Ajmal khan et.al. (2005) reported H' in the range of 1.6695 – 3.3874 for brachyurans crabs of the species in the range of 4-25 in Pitchavaram mangroves forest. The high value of Shannon diversity index (H') observed presently is due to increase in the number of species and their abundance (Fig.1). The spatial variations in simpson's diversity index (D) was calculated to be ranges of 0.7186 – 0.8117. This established with the study directed by Sreenivasan and Natarajan (1999) who obtained 'D' in the range of 0.995 – 0.968 in Hare Island of Gulf of Mannar. The spatial variations in brillouin index (HB) was estimated to be ranges of 0.8776 – 1.204. The value found rarely surpasses 4.6 and both the Brillouin and Shannon Indices incline to give similar proportional measures. The spatial variations in Margalef species richness (d) was calculated to be ranges of 0.7791 – 1.378. The fine range in 'd' value in the present study is due to less variance in the number of the species. Kolanginathan (2008) estimated 'd' in the range of 11.075 – 12.952 for gastropods characterized by species in the range of 117 – 141 in the Gulf of Mannar. Spatial variations in pielou's evenness index (J') was estimated to be ranges of 0.9912 – 0.9997 for Therespuram. Mostly, species evenness declines when the species richness and the species diversity growth. Species evenness also declines when the individual species governance increase (Clarke and Warwick, 2001). Thus, it could be inferred that the species evenness is mainly influenced by species richness.

A medium sized coastal species. Upper part of body has numerous blue black broken wavy lines directed backwards and upwards while belly is silvery white. The first and second dorsal fins are contiguous. A few conspicuous black spots are present on sides of body between pectoral and pelvic fins. Thunnus albacares (yellowfin tuna) Body elongate and fusiform, metallic blue or blue black above and belly with about 20 broken nearly vertical pale lines. Dorsal and anal fins very long in large specimens while pectoral fin are moderately long. Common size in commercial catches 70-150 cm (Plate 1.). Thunnus obesus (bigeye tuna) A large oceanic species with a very broad and robust body that is slightly compressed laterally and completely covered with scales. Upper part of the body is black to greenish blue while side and belly are silvery white. Caudal portion is short while eyes and head are fairly large. The first dorsal fin is deep yellow, second dorsal and anal fin slightly yellow while finlet. The fecundity of tunas like other multiple-spawning fish is not fixed at the beginning of their spawning period. Their annual fecundity is indeterminate because tunas spawn numerous times during the season or year and can be roughly estimated from estimates of batch fecundity (number of oocytes released per spawning) and spawning frequency of the species. However batch fecundity is influenced by the body length and weight and inter-annual and geographic variation in batch fecundity is reported in tunas. Caudal fin is widely expanded. Katsuwomus pelamis (skipjack tuna) is oceanic species with a robust body. Backside metallic blue tinged with violet and three to five conspicuous longitudinal, dusky to black striped below lateral line on each side of the body. First two dorsal fins separated by a short interspace.

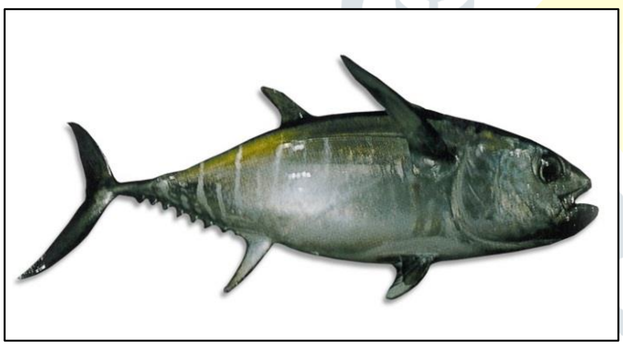
Plate 1. Showing the four types of Tuna fish



Euthynnus affinis



Thunnus albacares



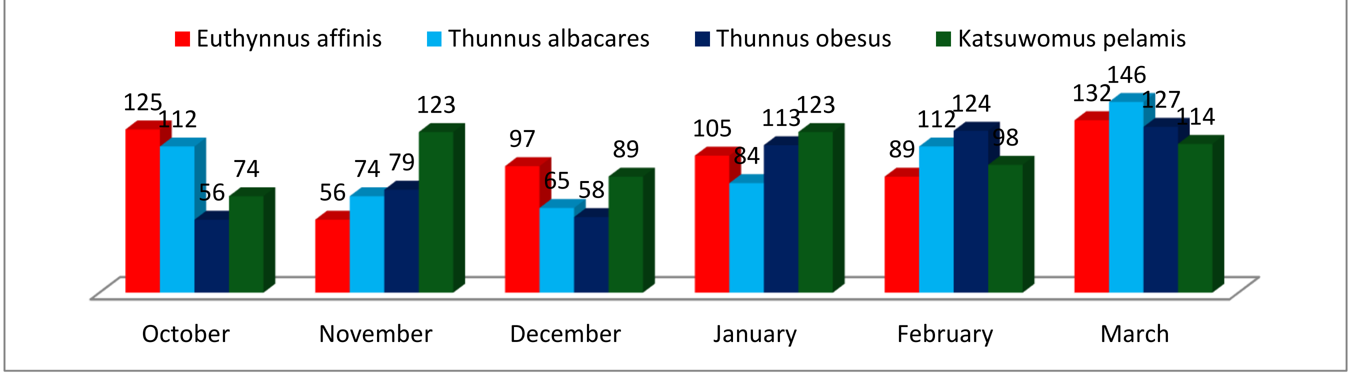
Thunnus obesus

Katsuwomus pelamis

Table 1. Number of Individuals species catches in Threshpuram fishing centre

S. No.	Species Name	October	November	December	January	February	March
1.	Euthynnus affinis	125	56	97	105	89	132
2.	Thunnus albacares	112	74	65	84	112	146
3.	Thunnus obesus	56	79	58	113	124	127
4.	Katsuwomus pelamis	74	123	89	123	98	114

Fig:1 Number of Species Month wise data in Threshpuram Fishing Centre



Conservation Methods:

Tuna are a top predator and food source in the marine food chain and help to maintain a balance in the ocean environment. Ocean predators keep populations of marine life in check to prevent an upset of the ecological balance. The FAO has recently carried out a project "Management of tuna fishing capacity: conservation and socio-economics". Under the auspices of the project, the capacity of tuna fishing fleets and trends in tuna catches in the world were described (Miyake, Miyabe and Nakano, 2004), the markets for tuna and the status of tuna stocks of the world have been addressed and management options for the future were considered. In a statement attached to their report, the workshop participants concluded that effective rights-based management systems will lead to elimination of overcapacity in the tuna fleets. According to the IUCN, most tuna stocks are fully exploited (meaning there is no room for fishery expansion) and some are already overexploited (there is a risk of stock collapse). According to the International Seafood Sustainability Foundation, 65% of tuna stocks are at a healthy level of abundance, but 13% are considered overfished.

Conclusion

It is evident that tuna fisheries have evolved rapidly since the 1980s and more of the highly valued oceanic species are represented in the catches presently. However, most of these developments have occurred as a result of the initiatives taken by fishermen in the small-scale sector. Although tuna is one of the most important items in world seafood trade, the contribution by India towards global production is negligible. Fishing for tuna is not pursued seriously by the fishermen who perceive the returns as inadequate. It will also be worthwhile to develop appropriate market linkages so that it becomes an economically viable proposal for fishermen and entrepreneurs who wish to venture into tuna fishing. This in turn is expected to relieve the fishing pressure on coastal fishery resources and ease the conflicts between the various fishing sectors in Indian waters to a certain extent. The high percentage of omega-3 fatty acids in tuna meat brings the balance into the blood vessels, reducing the cholesterol in the arteries. Given the rapid developments in tuna fishing, especially for yellow fin tuna, in Indian waters as well as neighboring countries in the Indian Ocean, it is important to develop a strong shared database on the exploitation of tuna resources including gear-wise fishery trends and other biological data including length composition of the landings.

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