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Conservation and Management of Tuna Fisheries in the Indian Ocean and Indian EEZ

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Abstract The focus of the study is to explore the recent trend and stock status of Indian Ocean and Indian EEZ, and its conservation and sustainable management of tuna fishereis. In the Indian Ocean, tuna catches increased rapidly from about 179,959 t in 1980 to about 832,246 t in 1995. They have continued to increase up to 2005 where the catch reached 1,318,648 t, forming about 26% of the world catch. However, since 2006 onwards there was a decline in tuna catch and in 2010 the catch was only 1,257,908 t. Tuna production in India continued to increase with fluctuations from 63,633 t during 2001-2005 to an of average 78,400 t during 2006-2010, and in 2010 the catch declined again to only 65,863 t. Tuna is an important but not a well managed fishery in the Indian Ocean and Indian EEZ. The Indian Ocean stock is currently overfished and has no proper management regulations aimed at with sustaining the stock. In the present study, sustainable management system is evaluated with information on tuna landings, stock status and major issues on tuna fishery. To address these major issues, appropriate tuna fishing policies are proposed to help sustainable development and management of tuna fishery resource in the Indian Ocean.

Keywords Fisheries; Tuna; IOTC; Resource; Sustainable management; Conservation

Introduction

Tunas are large, oceanic fish and are highly migratory pelagic species inhabiting tropical and subtropical waters of the world oceans. Tunas in general are considered to be opportunistic feeders, with teleost fish, crabs, squids and shrimps as their major food items. Tuna and tuna like species are the primary sources for a number of distant water fishing countries in both the high seas and Exclusive Economic Zones (EEZs) of coastal states. Main fishing gears used are pole and line, long-line, troll line, purse seine and drift gillnet. Tunas are the second largest product in the international seafood trade, with a value of total tuna export trade at $7,500 million in 2008 ($1,900 million in 1987). Because of the high demand for tuna and the significant overcapacity of tuna fishing fleets most of the stocks of principal tuna species are either optimally or even overexploited (Pillai, 2010; IOTC, 2011). Leading tuna catching nations in the Indian Ocean are Japan, Taiwan, Indonesia, South Korea, Spain and France.

The negative images of farmed animals present great opportunities for wild caught tuna and tuna products. Their global production has increased continuously from less than 0.6 million tones (mt) in 1950 to above 4.5 mt in 2008 (FAO, 2009). Principal market tuna species are mostly harvested from the Pacific (70.2%), Indian Ocean (20.4%), Atlantic and the Mediterranean Sea (9.4%) in 2008. Percentage composition of different species indicates that the catch was dominated by skipjack (*Katsuwonus pelamis*) 58% followed by yellowfin (*Thunnus albacares*) 25%, bigeye (*T. obesus*) 10%, and albacore (*T. alalunga*) 5% and the remaining by other tunas. Scientific advice on fisheries management is generally based on the results of the application of some stock assessment techniques (Hilborn and Walters, 1992). This paper provides an overview of the tuna fishery, stock status and major issues on Indian tuna fishery and recommendations. It traces the history of scientific advice and management of tuna, and examines the current status of tuna stocks and new areas for tuna fisheries research and developments.

2 Materials and Methods

The database used in the present study is the Indian

Ocean Tuna Commission (IOTC) based on nominal catch data of tuna from Indian Ocean and Indian EEZ.

3 Results

3.1 Tuna production in Indian Ocean

In Indian Ocean, tuna catches increased rapidly from about 237,986 tones (T) in 1980 to 654,754 t in 1995. They have continued to increase up to 2005; the catch was 1,318,648 t forming about 26% of the world catch. However, since 2006 onwards there was a decline in tuna catch and in 2010 the catch was only 1,257,908 t (Figure 1). The principal species caught in the Indian Ocean is skipjack and yellowfin. The catch of bigeye has also increased to around 150,000 t, due to increased targeting of tunas by longliners for *Sashimi* market and the use of FADs in the surface fishery. Although the catch of yellowfin tuna increased gradually in the past five decades, its relative importance decreased rapidly. Skipjack constituted about 38% of the total catch, yellowfin 26%, kawakawa 10%, bigeye 9%, albacore 3% and blue fin 1%. Purse seiners account for about 36% of the total tuna catch followed by gillnetters 31%, long liners 15%, bait boat 10%, pole and line 7% and the remaining by other gears (1%) as shown in Figure 2. In 2008 Indian Ocean tuna production declined to 1,148,911 t with estimated landed value of US$ 2.5 billion. Present decline in production of the Indian Ocean tuna fisheries may have serious ecological and socioeconomic consequences in the region. Analysis of landing data clearly indicated that overexploitation of targeted species threatens the sustainability of tuna populations. Though there had been substantial increase in the production of tunas in the Indian Ocean, the fast pace of development has ignored several patterns which are vital to sustain the tuna production in the capture fisheries. Information on a few of these vital parameters is either not available, and for a few other parameters, the available information has not been properly utilized. The IOTC has implemented certain measures to improve compliance of conservation and management measures. However, many of the member countries do not provide the required information needed to monitor the compliance of fishery management regulation.

3.2 Stock status

Estimates of total and spawning stock of yellowfin tuna (YFT) biomass continue to decline, probably due to overexploitation during 2003-2006. IOTC recommends maximum sustainable yield (MSY) of YFT should not exceed 3, 00000 t (IOTC, 2011). The preliminary estimate of bigeye catches in 2010 (1, 04,549 t) is optimal and current estimate of MSY is 11, 0000 t. Albacore, which is also slightly overfished, has MSY estimates ranging from 28,260 to 34,415 t in 2010, with the annual average of catch around 40,988 t over the past five years (IOTC, 2010, 2011).

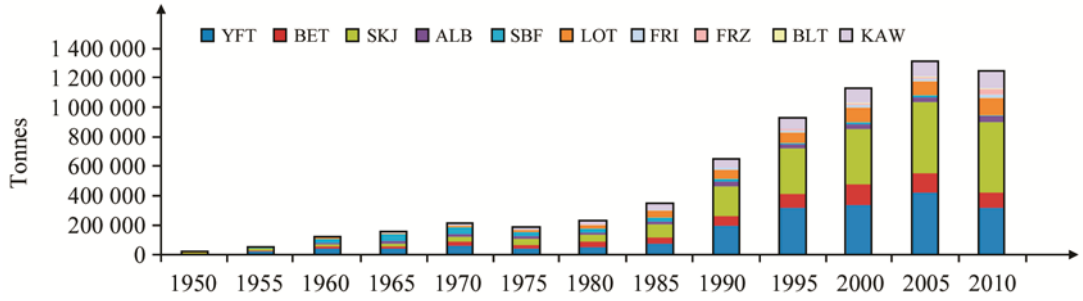

Figure 1 Trends in tuna catch in Indian Ocean from 1950-2010

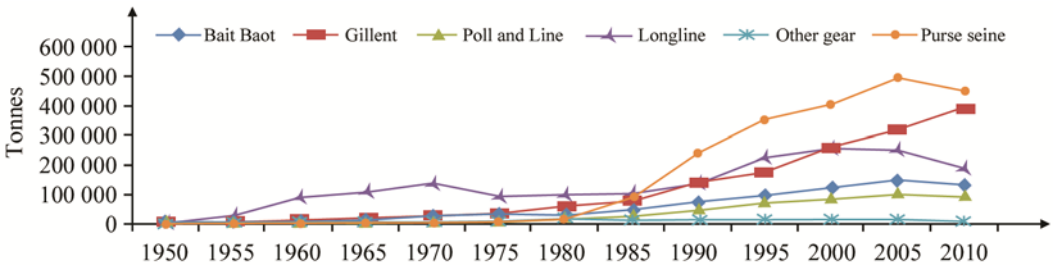

Figure 2 Gear-wise contribution of tuna in Indian Ocean from 1950-2010

So far, no stock assessment for skipjack tuna in the Indian Ocean and MSY has been estimated. Stock should be closely monitored. Evidence from retrospective records strongly suggests that major structural and functional changes due to overfishing of tunas occurred in Indian Ocean in recent years. Severe overfishing derives species ecological extinction because overfished populations no longer interact significantly with other species in the community (Jackson et al., 2001). Periodic reassessment of the tuna potential is also required with adequate inputs from exploratory surveys as well as commercial landings and this may prevent any unsustainable trends in the development of the tuna fishing industry in the Indian Ocean.

3.3 Tuna production of EEZ of India

Annual marine fish production in India during 2010 was 3.07 (mt) against a catchable potential of 3.93 (mt) (CMFRI, 2011). The Indian tuna fishery comprises two distinct segments, the coastal fishery and oceanic fishery. The oceanic fishery uses exclusively longlines, targeting large deep-swimming yellowfin and bigeye tunas. Tuna constitutes one of the important marine fisheries resources of India having an estimated annual catchable potential of about 2.78 lakh t in the EEZ. Coastal resources almost fully exploited and current focus is on oceanic/deep sea resources. India is yet to find a place in the tuna map of the Indian Ocean. The fishery resource of estimated potential tuna and tuna like species is 2,50,000 t; however, current production is around 65,863 t, most of which constituted by coastal tuna species. Figure 3 illustrates all Indian tuna production which has continued to increase with fluctuations from 63,633 t during 2001-2005, 78,400 t during 2006-2010, and 65,863 t in 2010. However, during the last couple of year's landings in drift gillnet, hook and line and troll lines operated by small and medium sized mechanized vessels are reported to have increased marginally (IOTC, 2011). Of the total tuna landings oceanic species formed 47% and neritic species 53%. Among the oceanic species skipjack constituted 21% followed by yellowfin 12%, bigeye 7%, and albacore 3% (Figure 4). Among the neritic tunas, kawakawa (*Euthynnus affinis*) was dominant (30%) followed by frigate tuna (14%), longtail tuna (7%) among others. In the tuna landings from the Indian coast, gillnets accounted for about 35% of the catch, pole and line 29%, long line 14 %, purse seine 14%, and the remaining by a variety of other gears 8% (Figure 5). The present annual export of tuna and tuna products amounts to 35,000 t valued at $53.22 million dollar, the major importing countries were Southeast

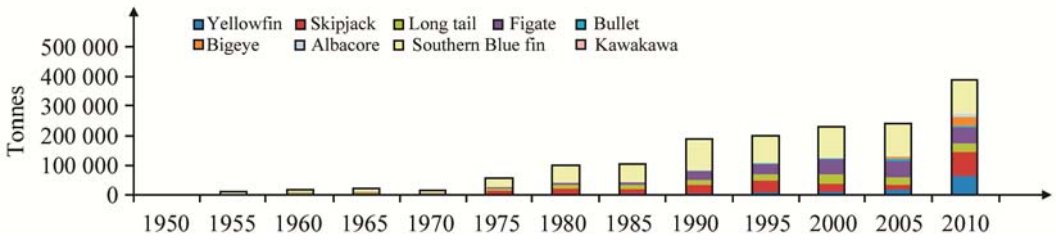

Figure 3 Trends in tuna catch in Indian EEZ from 1950-2010

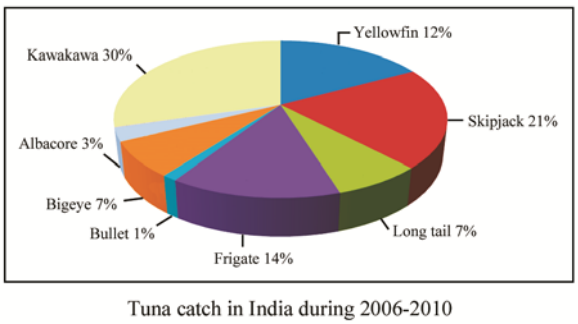

Figure 4 Species-wise contribution of tuna catch in Indian EEZ from 2006-2010

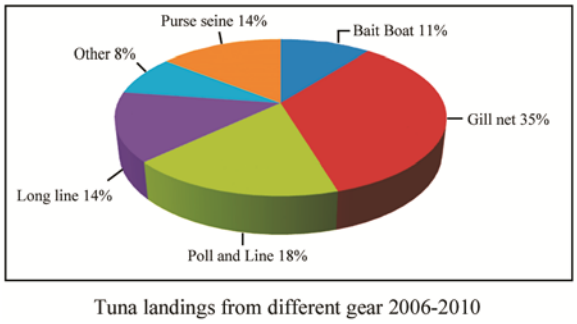

Figure 5 Gear-wise contribution of tuna in Indian EEZ from 2006-2010

Asia, Japan, UK and Middle East. Tuna capture from Indian seas has fallen by more than 25% in the last one year pushing down most tuna long-liners into great loss (Pillai, 2010).

The Indian Ocean has had a notable fishery of tuna exploitation. There have been calls for evaluating and improving approaches to manage tuna resources as stocks have undergone sequential depletion, with some dramatic instances of stock declines. The need for more holistic ecosystem-based fisheries management to manage tuna resource exploitations has been increasingly recognized as part of these calls, along with the recognition that there are broader issues to consider when managing a fishery. In Indian EEZ, while the near-shore waters up to 50 m depth are fully exploited, the waters beyond this depth are still believed to be relatively unexploited. Though India is blessed with rich coastal and oceanic tuna resources, unlike the coastal tuna fishery, there is no organized fishery for oceanic tunas. However, the fishery is also facing serious issues mainly due to declining yields. Deployments of drift gillnet, longline and high sea purse seine fishing fleet for the exploitation of oceanic tunas from Indian seas is discussed and suggestions for the sustainable development and management of the oceanic tuna fishery are given below.

3.4 Major issues on tuna fishery in Indian Ocean

The evolution of tuna longline fisheries in all oceans has changed the fishing strategies as different species have targeted. These tactic increases of longliners, simultaneously make the stock seem bigger but actually damaging the fish's breeding capacity (Botsford et al., 1997). The present study made an attempt to list down the main fishery management issues in the Indian Ocean as well as EEZ of India. These include (i) lack of reliable information on the status of stock position of tunas, (ii) lack of information on tuna migration, (iii) Illegal, Unregulated and Unreported fishing (IUU) activities which are one of the biggest threats to Indian Ocean tuna resources and ecosystem, (iv) Bycatches which is a very complex issue in the fishery and is of great concern to the government and stakeholders, (v) lack of real catch-statistical data for Indian Ocean countries, (vi) The El Nino Southern Oscillation (ENSO) phenomenon which is considered to be the main cause for inter annual climatic variability around the globe. The lack of proper studies on oceanographic environmental parameters variability during extreme climatic events (El Nino and La Nina) and its relationship with tuna catch in Indian Ocean, (vii) IOTC has implemented a number of measures to improve compliance with conservation measures. However, many of the nations do not provide the information needed to monitor compliance.

3.5 Major issues on tuna fishery in EEZ of India

(i) IUU activities are one of the biggest threats to Indian tuna fishery resources and ecosystem, (ii) lack of trained man power in manning tuna longliners and high sea purseiners, (iii) Investors are reluctant to invest in high sea tuna fishing as they are still not convinced whether it is a profitable venture, (iv) lack of geo-referenced tuna catch data and migratory patterns to effective conservation and management of tuna and tuna like fish population, (v) lack of studies on oceanographic environmental parameters variability during extreme climatic events and its relationship with tuna catch, (vi) permitting foreign tuna fishing vessels to operate in the Indian EEZ under the Letter of Permit (LOP) (vii) Indian fisherman are not familiar with the onboard modern post-harvest handling procedures for high priced *Sashimi* grade tuna, (viii) India yet to develop satellite based Potential Fishing Zone (PFZ) advisories for oceanic tuna to help Indian tuna vessel operators to save energy and scouting time, (ix) Tuna fishing around Lakshadweep is still a traditional practice of the Islanders. The island fishermen are resisting the entry of mainland fisherman in their waters, (x) Insufficient financial support for the introduction of deep sea fishing vessels in Indian EEZ, (xi) No proper deep sea fishing policy/ guidelines. We have presented major issues responsible for declines in many coastal and oceanic tunas over a short period. This present study indicates that tuna should be given due conservation attention equal to that given to other threatened large marine predators.

4 Conservation and Management

Many of the worlds tuna fish population are overexploited, and the ecosystems that sustain them are degraded (IOTC, 2010). As fishing pressure for tuna increases on a global scale, management and conservation measures are essential if the populations of tunas are to remain at desired levels of abundance. However,

the management of tunas is complicated by their trans-oceanic migratory nature, and calls for special cooperation among tuna fishing nations, since no one nation alone can manage tuna resources effectively. There are several international fisheries management organizations such as the International Commission for the Conservation of the Atlantic Tuna and Tuna-like species (ICCAT), the Inter-American Tropical Tuna Commission (IATTC), and the Convention for the Conservation of Southern Bluefin Tuna (CCSBT) etc., which are now responsible for management of the tuna fisheries in each Ocean. The Indian Ocean Tuna Commission (IOTC) is an intergovernmental organization mandated to manage tuna and tuna-like species in the Indian Ocean and adjacent seas. Tuna fisheries management to date has often been ineffective, focusing on maximizing the catch of a single target species and often ignoring habitat, predators and prey of the target species and other ecosystem components and interactions. To address the critical need for more effective and holistic management approach a variety of advisory panels (Botsford et al., 1997; Pikitch et al., 2004; Worm et al., 2005) have recommended ecosystem considerations to be regarded broadly and consistently in managing sustainable fisheries. There have been numerous prescriptions and admonitions to implement ecosystem-based fisheries management. The overall objective of conservation and management approach is to sustain healthy marine ecosystem and the fisheries. In particular Tuna Conservation and Fishery Management (TCFM) should give (a) early warning signs of pressure on the stock of major species -albacore, bigeye and yellowfin catches should not exceed the MSY level, (b) high seas drift gillnetting should be banned and FAD associated –fishing should be regulated, (c) annual species – wise stock assessment to be made, (d) the number of hooks and length of line to be regulated in longline fishing, (e) Introduction of large meshed purse seine for high sea tuna fishing, (f) capture based culture of tuna should be regulated/banned, (g) countries operating their vessels under Letter of Permission (LOP) agreement for tuna fishing should report their catches to the native country, (h) IUU fishing in Indian waters by other countries should be banned, (i) tagging experiments for skipjack and yellowfin in the Indian EEZ should be undertaken, (j) discourage rampant poaching which will be to the benefit of the Indian fishing industry, (k) ensure constant supply of high quality raw material and enable optimum utilization of the capacity of Indian processing plants, (l) provide essential support for training and research, (m) introduction of modified pole and line/longlines/hand lines/troll line for catching yellowfin tuna around Andaman Nicobar, Lakshadweep islands, (n) monitoring and data collection be further strengthened over the coming years, (o) As Indian tuna fisherman has capable of catching oceanic tunas, permitting foreign fishing vessels to operate in the Indian waters under LOP system have to be abolished, (p) With the collaboration of the tuna fishery bodies and International and National organization involved in tuna fishing, fisheries research and management can provide necessary technical information and modern post-harvest handling procedures for high priced *sashimi* grade tuna to fishermen community, (q) identify and resolve the technical problems associated with the sustainable management of tuna fishing on the Indian Ocean scale, taking into account conservation and socio-economic issues, (r) substantial lowering of the cost of production could be achieved, mainly through small scale fisheries, improved efficiency of fishing methods, reduced import of fishing fleet from developed countries, increased utilization of bycatch and discards, by creating value added products from them and by introducing a wide range of management measures. (s) Govt. of India should review the current situation of deep sea/oceanic fishing in the Indian EEZ and contiguous waters, and develop a sound and effective Deep Sea fishing Policy, (t)Tuna fishery sector has facing an insufficient financial support for the introduction of well devised deep sea fishing vessels in the EEZ of India. In countries such as Norway and Denmark, separate fisheries bank have been set up, obviously because of the distinctive characteristics of the fishery sector and the need to have separate banking set-up for the purpose. The developing countries like India, the system for fishery sector has been to set up the National Marine Fisheries bank which provides a guarantee to the financing of introducing deep sea fishing vessels and for securing other needed infrastructure facilities.

Another goal of TCFM is to reduce excessive level of bycatch (i.e.) (killing of non target undersized individuals of other related species) because juveniles

and unmarketable species often play important role in the marine ecosystem. In future, a greater utilization of by-catch species may be expected. Fishing may become more selective through gear modifications and changes in fishing areas and seasons. Also, research should be undertaken to determine the status of stocks of species caught incidentally. The development of new deep sea fishing policies will be a major step forward for efforts to halt the global decline of yellowfin, skipjack, albacore, bigeye and other tropical tuna species. It will not be easy to make the change from an established sustainable management system based on sustainable tuna fisheries to a TCFM focused approach that acknowledges the uncertainty inherent in Indian Ocean and EEZ of India. The difficulties are insurmountable; however it should not delay progress.

To date, global and regional climate variability assessments have focused on agricultural production; fisheries have not yet been systematically evaluated (Pedraza and Diaz Ochoa, 2006; Cheung et al., 2009). Fish population variability and fisheries activities are closely linked to weather and climate dynamics. While weather at sea directly affects fishing, environmental variability determines the distribution, migration, and abundance of fish. Population dynamics of tuna in the tropical Pacific Ocean are strongly influenced by ENSO (Lehodey et al., 1997). Such integrated predictions of the impact of climate change on Indian Ocean tuna fisheries are insufficient studies, particularly at national or smaller scales. However further investigation is required to ascertain the role of ENSO in the distribution of tunas in the Indian Ocean. Future research should focus more on longer time series data and investigate spatial variability of key environmental variables, such as sea surface temperature, sea level pressure, chlorophyll and food distribution in the Indian Ocean in relation to tuna distribution and its relationship with climate on different time scales.

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