Received: 11 October 2013

IOTC–2013–WPTT15–45

A COMPARISON OF CHANGES IN THE EXPLORATION AND EXPLOITATION OF OCEANIC TUNA RESOURCES IN THE INDIAN EEZ IN 1970-2012

A.Anrose*, C.Babu and M.K.Sinha
Fishery Survey of India, Fishing Harbor Complex, Royapuram, Chennai-600013
*email: anrosefsi@yahoo.com

Abstract

The Indian EEZ is about 2.8% of the surface area of the Indian Ocean. As per IOTC, from the Indian Ocean in the year 1970 harvested 41,813 tons of Yellowfin tuna whereas from the Indian seas only 600 tons of Yellowfin tuna. During 70's Tuna is one of the least exploited resources of Indian Seas, the average catch of Yellowfin tuna for 1970-79 period being 1,768 tons and skipjack tuna 1,191tons. The peak production of Yellowfin tuna of 3720 tons and skipjack 2396 tons was reordered in 1979. Exploration and exploitation of the oceanic tuna resources in the areas over the past four decades have shown that the tuna resources in the area consists of Yellowfin tuna (Thunnus albacares), the Bigeye tuna (Thunnus obesus) and Skipjack tuna (Kastuwonus pelamis).In Lakshadweep islands, Skipjack tuna and a small fraction of juvenile Yellowfin tuna which enters the surface water are caught by pole and lines and troll lines.

The analysis of the average tuna catch during the 80's is 7,657 tons and also the survey result revealed that from September to March is the highly productive season.

In Indian waters for the last two decades, the oceanic tuna catch is in the increasing trend with minor fluctuations. The last three years from 2010 (21,215 tons) to 2012 (31,464 tons) there is an increase in trend observed. The highest catch of Yellowfin tuna was observed during 2012.

The present paper deals with exploration and exploitation of oceanic tuna resources in the Indian EEZ and contiguous oceanic water based on the oceanic resources survey carried out by Fishery Survey of India.

Keywords: EEZ, Exploration, Exploitation, Longlining, IOTC

Introduction

The contribution of the Indian ocean to the world tuna production of 2.8MT of 1984 is 12.4%. The production in general shows marked fluctuation in the last 30 years. Tuna is one of the least exploited resources of Indian seas, the average catch for 1970 to 1979 period being 11,542 tons. The peak production of 26,592 tons was recorded in 1979. Exploration and exploitation of the fishery resources in this area over the past 3 decades have shown that the oceanic tuna resources in this area consists of the Yellowfin tuna (*Thunnus albacares*) the Bigeye tuna (*Thunnus obesus*) and the Skipjack tuna (*Kastuwonus. pelamis*). The Indian EEZ is about 2.8% of the surface area of the Indian Ocean (73,556,000 km²)with nine maritime states and four union territories including Andaman &Nicobar group of Islands and Lakshadeep Islands. The fishery in India is confined to shallow inshore waters. In Lakshdweep island, the Skipjack Tuna and small fraction of juvenile Yellowfin tuna which enters the surface waters are caught by pole and line and troll lines.

Though the proximity of our country to the resources facilitates profitable exploitation of the fishery, the pace of development is rather unsatisfactory even after the enactment of the Law of the Sea (1976) and subsequent withdrawal of the foreign fleet from the sea. During September 1960 to Feb 1965 M.V.Pratap belongs to Fishery Survey of India (erstwhile deep sea fishing station and off shore fishing station) conducted six cruises of long lining in the Arabian sea. Later an indigenous trawler converted long liner M.V.Meena Prayas continued long lining during 1972. Though the results were encouraging, the programme would not be continued in the right perspective for want of adequate vessels and lack of infrastructure facilities. However FSI acquired two long liners from Japan under the Japanese aid programme during 1981 for training in tuna longlining and for survey of tuna resources, the activities gained considerable momentum. *Matsya Sugandhi*, the 31.5m Japanese built long liner based at Cochin base of Fishery Survey of India (1980 – 1988) has enormously expanded the area of investigation achieving spectacular results with respect to the landings of Yellowfin tuna. Subsequently the service undertaken by another Norwegian aided vessel, *Matsya Harini* (1980-1988) built in Goa Shipyard also made valuable contribution to enhance our information and viability of tuna fishing. Since these vessels could produce results covering only the limited area , the Government of India under India-Japan co operation introduced Japanese built tuna long line vessel M.V.Yellow Fin and M.V.Blue Marlin during the year 1989.With the acquisition of these two vessels ,the FSI could commence an organized and systematic survey of the tunas in the Indian EEZ. The vessel *M.V.Yellowfin* is deployed for survey along the north west coast of India while *M.V.Blue Marlin* is carrying our survey around Andaman and Nicobar Islands.

During 1989-90,a study was conducted wherein Vijayakumaran et.al.,(1992) stated that fourteen charter vessels (36m multifilament tuna longliners) operated 2000 hooks/day in the Indian EEZ and the estimated average catch per voyage of 30 days 28.78 tonnes which consists of 69.26% Yellowfin tuna ,0.85 % Bigeye tuna ,0.11%, Skipjack tuna 6.5% Bill fishes ,23.28% Sharks and other fishes.Until the year 2005 the tuna longline surveys were carried out using multifilament longline gears made out of tetron. With the objective of introducing and popularizing the monofilament long ling technology in the Indian waters and training the Indian fishermen on the modern fishing technique the FSI has acquired two monofilament long liners namely *Matsya Vrushti* and *Matsya Drushti* during Feb 2005 which are deployed for survey in Arabian sea along the West coast and in Bay of Bengal and Andaman Nicobar Waters along the East coast, within the Indian EEZ respectively.

Detailed accounts on the distribution of tuna resources in Indian ocean have been given by Suda (1974), Suzuki (1979), Sivasubramaniyan (1981), Silas and Pillai (1982), Silas (1983), Dwivedi and Devaraj (1983). The tuna fisheries in the Indian Ocean have observed that resources availability is never a constraint in its development as per Joseph (1972) Silas and Pillai (1979,1982), Haurata (1983)and Siva Subramanian (1985). Siva Subramanian (1985) has discussed the tuna fisheries in the EEZ of India, Maldives and Sri Lanka while Eapen (1964) and Joseph (1972) have given some aspects of developmental prospects of tuna fishing in Indian waters on the basis of exploratory survey conducted during the sixties. Varghese *et al* (1984) presented the results of survey conducted during April 1983 to March 1984. Sulochanan *et al (*1986) presented preliminary observation on the tuna resources with particular reference to Yellow fin tuna in the Arabian Sea for the period October 1983 to December 1985 corroborating the impressive hooking rate suggesting high commercial viability of tuna longlining. Sivaprakasam and Patil (1986) presented the data on distribution and abundance of tuna and tuna like fishes of South west coast of Indian during the period May 1985 to March 1986 based on the survey results carried out the *Matsya Sugandhi*. Anrose *et al* (2010) presented the data on distribution and abundance of oceanic fishery resources of Andaman and Nicobar waters. In order to evaluate the changes in the exploration and exploitation of oceanic tuna resources in the Indian EEZ from 1970's , an attempt has been made by analysing the results of Fishery Survey of India survey along the Indian EEZ.

Presently tuna fisheries are the one of the important fisheries in India. The Fishery Survey of India (FSI) has carried out exploratory resource surveys around Indian waters including Andaman and Nicobar Islands(A&N Islands) employing tuna long-liners since 1983 to understand the dynamics of these resources. Earlier studies based on the exploratory survey data provided the information on occurrence, spatial distribution and abundance of oceanic tuna resources around Arabian sea, Bay of Bengal and A&N Islands (Sudarsan *etal* 1993., ;John and Somvanshi, 2000; Somvanshi et al.,2003 John et al., 2005; Somvanshi et al.,2008,Anrose et al 2010). In the present study an attempt has been made to understand any changes in the seasonal abundance, distribution of the resources by comparing the results with historical data. The above information is vital for the conception of management strategies aimed at sustainable tuna fisheries in India.

Material and methods

The present study is based on the long line operations carried out by the survey vessels of Fishery Survey of India namely *Matsya Sugundhi* (OAL 31.5m and GRT 245.80), *M.V.Blue Marlin*(OAL 36m and GRT 310) and *M.V.Yellowfin* (OAL 36m and GRT 310) and *Matsya*

Vrushti (OAL 37.5m and GRT 465) in the west coast of Indian EEZ, *Matsya Harini* (OAL 32.5m and GRT 257.95)and *Matsya Drushti* (OAL 37.5m and GRT 465) in the east coast of Indian EEZ and *M.V.Yellowfin* (OAL 36m and GRT 310)and *M.V.Blue Marlin*(OAL 36m and GRT 310) in the Andaman and Nicobar Islands of Indian EEZ. The endurance of each voyage of these vessels was twenty days. The vessels *Matsya Drushti* and *MatsyaVrushti* are monofilament long liners and all other vessels are operated multifilament longline.

The monofilament longline gear ,one basket consists of , Main line: HDPE 3.6mm dia,continuous ,Branch line: 2.0mm dia 20m,Tuna hooks:16/0 Hiliner tuna circle hook x7 nos, Float:360mm dia Rigid plastic, Floatline : HDPE,3.6mm dia 20m. The multifilament longline gear one basket: Main line: Tetron 6.7mm dia continuous ,Branch line: Tetron 4.5mm diax20m, Sekiyama: SS wire No 30x4x3, 12 m, Leader wire: SS wire No 30x4x3,2.5m,Tuna hooks:3.6 sun with ring x5 nos,Float line : Tetron 6.7mm dia x24m .

The bait fishes used in these vessels for exploitation of tuna resources are Nemipterids, Sciaenids Mackerel, Sardine, Decapterids and Squid.

The data collected by Scientists onboard the vessels during the period 1985-2012 are considered for the studies. The month wise distribution and abundance of the oceanic tunas has been studied in the different geographical divisions by comparing the hooking rate (Number of fishes/100hooks).The data thus collected were pooled in 1^{o}N Lat. x 1^{o} E Long. on monthly basis for better understanding of the resources availability and the seasonal grouped under three geographic regions viz. West coast, East coast and Andaman waters.

The data on oceanic tuna landings submitted by the Government of India during 2008 – 2012 to the Indian Ocean Tuna Commission (IOTC) as National report has also been utilized in this paper for analyses. In addition, the Nominal catch data of oceanic tunas from Indian Ocean were used from the website of Indian Ocean Tuna Commission for trend analyses.

Exploration &Exploitation of oceanic tuna resources

The total oceanic tuna exploited during 1950-2011 showed an increasing trend from 1023 t in 1950 to 43,349 t in 2007 and thereafter fluctuated (Fig. 1) ,whereas in Indian ocean region the landings registered a steady increase from 15,150t in 1950 to 11,79,260 t in 2005 and thereafter declined to 8,21,770t during 2011 (Fig. 2) (source :IOTC). The average oceanic tuna landing in Indian seas during 2008-2012 was of 24,094t. This formed 2.8 % of the total oceanic tuna landings of Indian Ocean Countries. The Yellowfin tuna (*Thunnus albacares*),Skipjack tuna (*Kastuwonus pelamis*) and Big eye tuna (*Thunnus obesus*) are the

major species contributed to the oceanic tuna fishery in Indian seas. *Thunnus albacares* is the most dominant oceanic tuna species landed by coastal based and oceanic fishery. A landing over last five years shows that there was a decreasing trend till 2011 and thereafter registered an increasing trend with a highest landing of 16,507 t registered in 2012 (Table 1). Average catch of Yellowfin tuna during the period was 12,500 t. In India along the West and East coast, the Yellow fin tuna and Skipjack tuna were harvested by deploying drift gill net where as in recent years the traditional fishermen of Andhra Pradesh ventured into tuna fishing by deploying troll line in the territorial waters and contiguous zone so as to exploit the Yellow fin tuna resources. *Kastuwonus pelamis* is the second dominant oceanic tuna species landed in India .Landings exhibited a continuous decline from 22,060t in 2008 to 5,782t in 2012 with an average of 11,417t .Skipjack tuna formed target fishery along Lakshadweep islands and contributed a major share by operating Pole and lines. *Thunnus obesus* landings in India was very meagre .Average landing during the period was 177t.Bigeye tuna caught mainly in deeper waters of Nicobar waters of Indian EEZ (Between Lat.10^{o}N to 4^{o}N).

Survey results

(i) Trend in hooking rate

The survey results of tuna longliners of Fishery Survey of India viz., *Matsya Sugundhi, Matsya Harini, MFV Yellowfin, MFV Bluemarlin, Matsya Drushti and Matsya Vrushti* operated in Indian EEZ shows that Yellowfin tuna(YFT) *Thunnus albacares* is the dominant species caught by number in east coast(38.92%), west coast(48.4%) and Andaman and Nicobar waters(32.19%)during the survey period 1985-2012 whereas Skipjack tuna (SKJ)*Kastuwonus pelamis* caught by number in east coast was (2.4%), west coast (3.5%) and in Andaman and Nicobar waters(1.42%).The Bigeye tuna(BET) *Thunnus obesus* caught very few in number in Andaman and Nicobar waters(0.38%).

A total of 40,15,211 hooks operated during period out of which 44.36% operated in west coast, 31.46 % in Andaman and Nicobar waters and 24.17% in east coast of India. The trend in YFT hooking rate (%) in west coast indicate that 7.72% recorded in 1986 followed by 2.68% during 1985 and 2.50% during 1987 (Table- 2) ,whereas in east coast the highest hooking rate recorded in 1988 with 2% and in Andaman and Nicobar waters the highest YFT hooking rate was 1.54% in 1995.(Fig .3) . The hooking rate recorded for SKJ in west coast reveals that the highest hooking rate (0.22%) in 1999 followed by 0.18% in 2007 and 0.16 in 1986 (Fig. 4) .In east coast the highest hooking rate of 0.15% during 1993 and remaining years very low hooking rate was recorded (Table- 3). In Andaman and Nicobar waters very low SKJ hooking rate was observed during the period where are the highest SKJ hooking rate was 0.06% in 2002(Table- 4). The comparison of oceanic tuna hooking rate (%) during

1980's to 2012 indicates that in 80's the average hooking rate in Indian waters was 2.17% , in 90's it was 0.56%, in 2000's it was 0.27% and in 2010-2012 the average tuna hooking rate was 0.13% . The survey results of Fishery Survey of India in Indian waters shows that trend in hooking rate during 80's was highest (2.17%) and then declined to 0.13% in 2012.

ii) Seasonal abundance

In order to understand the seasonal abundance of the YFT and SKJ in the area, the hooking rate has been worked out for different months (Fig. 5 & 6). The month wise YFT hooking rate in west coast of India shows that the period October to March registered higher hooking rate varying from 0.73% in (October) to 1.32% (March). The hooking rate registered an increasing trend from January to March and declined thereafter up to August. The best fishing season for yellow fin tuna in the west coast of India could be predicted as December – March (Table-5). East coast of India reveals that the period November to January ,registered higher YFT hooking rate varying from 0.71% in (January) to 0.91% (November). The hooking rate registered an increasing trend from October to March and declined thereafter up to August. The best fishing season for yellow fin tuna in the east coast of India could be predicted as October to March(Table-6). In Andaman and Nicobar waters its shows that YFT hooking rate was higher in January (0.77%) and June (0.63%). The best fishing season for yellow fin tuna in Andaman and Nicobar waters of India could be predicted as May-August (Table-7) . The SKJ hooking in west coast revealed that highest SKJ hooking rate recorded in November (0.155%).From October to December SKJ was more in west coast, whereas in East coast shows that November and April higher SKJ hooking rate 0.081% and 0,027% respectively. In Andaman and Nicobar waters, the highest SKJ hooking rate recorded in the month of June (0.047%). May to July months are best season for SKJ in Andaman waters.

The comparison of the season wise oceanic tuna hooking rate (%) during 1980's to 2012 in the west coast ,east coast and Andaman and Nicobar waters of India is given in Fig 7,8 and 9. Its shows that in the west coast during 80's the hooking rate ranges between 0.20% to 6.63% and the best fishing season observed was the months between October to April with the peak in February (6.63%) whereas in 90's the hooking rate ranges between 0.04% to 1.21% and best fishing season was November to April with a peak in March (1.21%) , in 2000's the hooking rate ranges between 0.11% to 0.50% and the best fishing season observed was the months between November to April with the peak in December(0.50%) and in 2012 the hooking rate ranges between 0.001% to 0.53% and the best fishing season observed was the months between October to April with the peak in March (0.53%) .

In east coast during 80's the hooking rate ranges between 0.02% to 2.53% and the best fishing season observed was the months between November to June with the peak in January (2.53%) whereas in 90's the hooking rate ranges between 0.002% to 0.79% and best fishing season was November to February with a peak in January (0.79%) , in 2000's the hooking rate ranges between 0.06% to 1.59% and the best fishing season observed was the months between October to July with the peak in November (1.59%) and in 2012 the hooking rate ranges between 0.02% to 0.51% and the best fishing season observed was the months between September to February with the peak in November (0.51%).

In Andaman and Nicober waters, during 80's the hooking rate ranges between 0.10% to 1.00% and the best fishing season observed was the months between August to March with the peak in January (1.00%) whereas in 90's the hooking rate ranges between 0.23% to 1.82% and best fishing season was October to August with a peak in January (1.82%) , in 2000's the hooking rate ranges between 0.04% to 0.47% and the best fishing season observed was the months between October to August with the peak in January (0.47%) and in 2012 the hooking rate ranges between 0.001% to 0.14% with the peak in July (0.14%).

Discussion:

India being a peninsular country with two archipelagos, one each of east and west coasts and vast EEZ spread of 2.02million sq.kms given modern tuna fishing technology and vessels, has greater opportunity to harvest full potential of oceanic resources. India's oceanic tuna resources is pegged at 1.795lakh tons/annum (YFT-80,000t, SKJ-99,000t and BET-500t) as per present revalidation committee report submitted to Govt.of India during 2011. As the oceanic tuna's exhibits large scale migratory behavior, estimation of MSY of these stocks from any coastal states cannot be realistic. Only regional approaches will give valid estimates. The IOTC Working party on Tropical Tunas during 2012 estimated the MSY of oceanic tunas in Indian Ocean is 9,36,000t(YFT-3,44,000 t, SKJ-4,78,000t and BET-1,14,000t).The results of the commercial operation under different fishing schemes proved the abundance of tuna and allied fish stock in Indian EEZ, thereby indicating the feasibility of tuna fishery development in the Indian EEZ. It is worthy to mention here that the initial operations showed highest tuna hooking rate of 48% in a single set by the vessel *Matsya Sugundhi* during January, 1987 in the area Lat 14^{o}N/Long 72^{o}E, whereas at present the hooking rate though it is in the declining trend however in a single set in west coast 17.33% during August,2006 in the area Lat 22^{o}N/Long 67^{o}E . In the east coast during November 2010 in a single set 4.44% was recorded in the area Lat 14^{o}N/Long 80^{o}E and in Andaman and Nicobar waters in a single set 7.68% was registered during December 2006 in the area Lat 08^{o}N/Long 94^{o}E. After introduction of tuna liners by Fishery Survey of India many private

operators have converted their trawlers to tuna longliners for exploitation of tuna allied resources in the Indian EEZ. The comparison of hooking rates in the three areas of Indian EEZ viz, west coast, east coast and Andaman and Nicobar waters indicates that during October to May is the best season in west coast, whereas in east coast October to May is the best season and in Andaman and Nicobar waters there is two peak seasons observed between October to February and April to August. However the best fishing season for tuna fisheries in Indian EEZ is between the months of October to May as per the FSI survey results. Secondly west coast is more productive than east coast including Andaman and Nicobar waters. The comparison of oceanic tuna hooking rate during 1985-2012 reveals that in 80's the average hooking rate in Indian waters was 2.17% and declined to 0.56% in 1990's , 0.27% in 2000's and 0.13% in 2010-2012 .The declining of the hooking rate over the years may be due to various reasons such as global warming and migratory behavior of these species. The lack of Infrastructure facilities in the Island groups are the major hindrance for better utilization of these resources. The following suggestions will give a sustainable tuna fishery in India.

- Strengthen the mechanism to gather the data on exploited resources from Indian Ocean.
- Log book based data recording should be introduced in all mechanised longliners.
- A geographic effort and catch data are needed to plan for sustainable tuna fisheries
- The introduction of group fishing method and for the smaller mechanised crafts the mother ship concept to maintain the export quality tuna meat (sashimi grade) is the need of the hour.
- Awareness among fishermen to handle the tuna on board so as to get export quality fish for better earning.
- The vessel to be deployed should be designed for better utilisation of the space Onboard.
- The tuna resources in the Area Beyond Nation Jurisdiction (ABNJ) is also being exploited which is required to be monitored by the adjoining countries as it gives ample opportunities for the adjoining countries to exploit these resources along with other countries which are exploiting these resources.

Acknowledgement:

The authors are grateful to Dr. K. Vijayakumaran, Director General, Fishery Survey of India, Mumbai for consent support during the study. We acknowledge the efforts of all Scientists participants and Skippers of Fishery Survey of India for their effort during the data collection.

References :

Anon, 2011 .Report of the working group for revalidating the potential of fishery resources in the Indian EEZ submitted to Govt.of. India . pp 69

Anrose A,M.K.Sinha, A.B.Kar , S.K.Pattnayak and K.Govindaraj. 2010. Diversity and Potential of oceanic fishery resources in Andaman and Nicobar Islands. Recent trends in Biodiversity of Andaman and Nicobar Islands: 367-371 (Published by the Director ,Zool. Surv. India, Kolkata)

Dwivedi S.N and M.Devaraj 1983. Tuna fisheries of the Indian Ocean and development prospects in Indian EEZ. Tuna Update. 6-11

Eapen,P.K.1964. Tuna longline operation in west coast. Indian Sea Foods, II(I),13-19.

FAO,1967 .Report to the Govt. of India on exploratory tuna long lining fishing off South West Coast of India. Report FAO/UNDP (TA) 2274:1-46.

FAO,1972. Report to the Govt. of India on tuna long lining development in India Based on the 1972 work of Chi-Yun Pao, FAO/TA Master Fisherman Report FAO/UNDP(TA)3074:1-8.

Haruta,E .1983. Longline fishing. Industrial Fisheries Association Annual, Cochin: 31-38

John, M.E.,S.M.Patil and V.S.Somvanshi 1988. Tuna resources off the east coast of India as revealed by charter operation. Bull.Fish.Sur.India 17: 22-46

John ,M.E. and V.S.Somvanshi 2000. Atlas of tunas,billfishes and sharks in the Indian EEZ around Andaman and Nicobar Islands.FSI/FC(FA)/3/2000: 25pp

John, M. E., Bhargava, A. K., Varghese, S., Gulati, D. K.,Kadam, A. S. and Dwivedi. S. K. 2005. Fishery resources of the Indian EEZ around Andaman and Nicobar Islands.Bull. Fish. Survey India, 28: 1-38

John ,M.E,S.Varghese and V.S.Somvanshi,2006. Preliminary observations in comparison of CPUE indices obtained in conventional and monofilament longlining 2006.

Joseph K.M, 1972. Some observations on the exploitation of the Indian Ocean tuna resources. Sea Food Ex.Journal.4(8): 11-18

Suda. A 1974. Recent status of resources of tuna exploited by long line fishing in the Indian ocean. Bull. Far. Seas. Fish. Res. Lab. 10:29-64

Silas.E.G and P.P.Pillai, 1979. Tuna Fisheries in India. Recent trends. Marine. fish .

Information service T&E Ser.13: 1-10

Silas.E.G and P.P.Pillai, 1983. Tuna resources of the Indian seas-an overview. Proc.Sympos.Harvest and post-harvest Technol.Fish: Fish Techol.pp.20-27-

Sivasubramaniam.K,1981. The Tuna fishery in the EEZ's of the India Maldives and Srilanka BOBP/WP/31(RAS)81/O51)

Sivasubramaniam,K,1985. The tuna fishery in EEZs of India, Maldives and Srilanka.BOBP/WP/ 31:19-71

Sivaprakasam.T.E, and S.M.Patil 1986, Results of exploratory tuna-long line survey conducted in the Arabian Sea off South West Coast of India during 1985-86 Bull.Fish.Sur.India 17: 22-46

Somvanshi, V.S, S. Varghese and P. Sivaraj 2003. **T**rends in the abundance indices of Yellowfin and Skipjack tunas in the Indian EEZ. *IOTC Proceedings no. 6 (2003) pages-194-201*

Somvanshi, V. S., Varghese, S. and Varghese, S. P. 2008.Introduction of monofilament long-line technology for harvesting oceanic tuna and allied resources in the IndianEEZ. Bull. Fish. Survey India, 30: 1-36.

Sudarsan,D, T.E.Sivaprakasam,V.S.. Somvanshi and M.E. John 1993 Assessment of oceanic tuna and allied fish resources of the Indian Exclusive Economic Zone based on exploratory surveys.Proc.Nat.Conf. on Tunas: 44-66.

Sulochanan.P, M.E.John & K.N.V.Nair.1986. Preliminary observations on tuna resources of the Arabian Sea with particular reference to distribution pattern of Yellowfin tuna, Thunnus albacares (Bonnaterre). Bull.Fish.Surv.India,14:21-23

Varghese,K.K., M.E.John and V.Sivaji.1984. Some observations on the tuna resources of Indian OceanBull.Fish.Sur.India 13: 30-33

Vijayakumaran.K, A.Anrose and J.E.Prabhakar Raj 1992. Tuna resources, costs and earnings from tuna longliners . Bull.Fish.Sur.India 24: 61-78

	Oceanic tuna landing in India(t)					
Species	2008	2009	2010	2011	2012	Average
Big Eye Tuna	17	829	38	0	0	177

Skipjack tuna	22060	15591	4893	8759	5782	11417
Yellowfin tuna	13507	13228	9289	9971	16507	12500
Total	35584	29648	14220	18730	22289	24094

Table- 1: Species-wise Oceanic tuna catch in India during 2008-2012

Year	Efforts in Hooks	Aggregate hooking rate (%)	YFT	SKJ
1986	78500	9.78	7.72	0.13
1987	86100	3.92	2.50	0.05
1988	30840	1.26	0.29	0.05
1989	76110	2.62	0.48	0.03
1990	36835	3.82	0.89	0.05
1991	58050	0.71	0.13	0.00
1992	28450	1.44	0.45	0.02
1993	14280	0.56	0.07	0.01
1994	45110	0.53	0.03	0.00
1995	64765	0.68	0.10	0.00
1996	66900	0.60	0.18	0.00
1997	84325	1.60	0.89	0.01
1998	85235	1.00	0.29	0.04
1999	57525	1.72	0.59	0.22
2000	91700	0.81	0.18	0.14
2001	84050	0.63	0.07	0.07
2002	43300	0.60	0.26	0.03
2003	60125	0.78	0.37	0.09
2004	53075	0.82	0.25	0.07
2005	90540	0.80	0.37	0.03
2006	124678	0.53	0.15	0.03
2007	94058	0.90	0.15	0.18
2008	82755	0.60	0.11	0.07
2009	54117	0.43	0.06	0.02
2010	62218	0.43	0.07	0.00
2011	55085	0.52	0.09	0.01
2012	23074	0.81	0.42	0.00
Total	1781450	1.59	0.77	0.056

Table- 2: Year wise and species wise hooking rate (%) in west coast from 1985-2012

Year	Efforts in Hooks	Aggregate hooking rate (%)		
		ALL Fishes	YFT	SKJ
1985	12330	1.77	0.06	0.00
1986	55400	2.52	0.74	0.04
1987	76925	2.90	0.85	0.02
1988	24500	4.67	2.00	0.09
1989	30500	1.64	0.16	0.01
1990	45000	0.73	0.18	0.01
1991	27050	0.45	0.15	0.03
1992	39125	0.58	0.16	0.02
1993	8000	1.74	1.28	0.15
1994	4000	0.22	0.00	0.00
1995	0	0.00	0.00	0.00
1996	13530	0.80	0.24	0.03
1997	5000	0.55	0.18	0.02
1998	8710	0.83	0.22	0.05
1999	10111	1.18	0.65	0.02
2005	38323	1.07	0.51	0.04
2006	83825	0.53	0.29	0.02
2007	62140	1.03	0.85	0.02
2008	82680	0.62	0.31	0.03
2009	75075	0.21	0.12	0.01
2010	67130	0.37	0.21	0.06
2011	100135	0.20	0.06	0.00
2012	101010	0.29	0.17	0.01
Total	**970499**	**0.98**	**0.38**	**0.02**

Table- 3: Year wise and species wise hooking rate (%) in east coast from 1985-2012

Year	Effort in hooks	Aggregate hooking rate (%)			
		All fishes	YFT (%)	SKJ(%)	BET(%)

1989	30930	1.77	0.41	0.02	0.00
1990	37755	1.35	0.50	0.01	0.00
1991	15125	2.33	1.34	0.01	0.00
1992	92500	2.66	0.75	0.03	0.00
1993	50700	2.88	0.30	0.05	0.01
1994	93610	3.48	1.36	0.03	0.00
1995	62500	2.57	1.54	0.03	0.00
1996	57950	0.97	0.39	0.01	0.00
1997	27870	0.78	0.31	0.05	0.00
1998	63282	0.87	0.32	0.01	0.00
1999	37100	0.69	0.31	0.00	0.01
2000	46265	0.62	0.08	0.01	0.00
2001	38950	0.68	0.18	0.03	0.00
2002	71875	1.15	0.19	0.06	0.00
2003	51600	0.70	0.16	0.01	0.01
2004	56164	0.76	0.18	0.01	0.02
2005	59429	0.97	0.39	0.03	0.00
2006	57860	0.66	0.22	0.01	0.03
2007	75697	0.78	0.18	0.01	0.01
2008	57240	0.51	0.14	0.00	0.00
2009	63085	0.34	0.05	0.01	0.01
2010	85150	0.30	0.04	0.00	0.00
2011	23750	0.51	0.01	0.00	0.00
2012	6875	0.25	0.00	0.00	0.00
Total	**1263262**	**1.30**	**0.42**	**0.02**	**0.005**

Table- 4: Year wise and species wise hooking rate (%) in Andaman and Nicobar waters from 1989-2012

Month	Hooks	Hooking rate(%)		
		ALL fishes	YFT	SKJ
January	171626	2.59	1.32	0.07
February	147005	2.39	1.30	0.05
March	152778	2.13	1.32	0.04
April	142035	1.50	0.80	0.03
May	129247	1.52	0.41	0.01
June	113255	0.87	0.15	0.03
July	116374	0.72	0.19	0.03
August	150881	0.71	0.25	0.03
September	162818	1.08	0.49	0.04
October	154280	1.32	0.73	0.06
November	161672	1.68	0.85	0.15
December	179479	2.04	1.01	0.08
Total	**1781450**	**1.59**	**0.77**	**0.06**

Table- 5.Month-wise and species- wise hooking rate in west coast of India from 1989-2012

Month	Hooks	Hooking rate(%)		
		ALL fishes	YFT	SKJ
January	81710	1.42	0.71	0.04
February	81460	1.41	0.38	0.03

March	86653	1.38	0.60	0.02
April	87550	0.67	0.32	0.03
May	69505	0.69	0.21	0.02
June	78892	0.52	0.15	0.01
July	82095	0.70	0.12	0.01
August	100570	0.67	0.08	0.00
September	83150	1.14	0.13	0.01
October	79901	0.83	0.33	0.02
November	74675	1.21	0.91	0.08
December	64338	1.24	0.91	0.08
Total	**970499**	**0.984**	**0.383**	**0.024**

Table-6. Month wise and species wise hooking rate in east coast of India from 1989-2012

Month	Hooks	Hooking rate(%)			
		ALL fishes	YFT	SKJ	BET
January	98870	1.55	0.77	0.01	0.00
February	104076	1.37	0.41	0.02	0.01
March	145359	1.11	0.37	0.01	0.02
April	100500	1.18	0.37	0.02	0.00
May	89150	1.17	0.54	0.03	0.00
June	90192	1.35	0.63	0.05	0.00
July	88495	1.29	0.53	0.04	0.00
August	88505	1.75	0.56	0.02	0.00
September	93446	0.69	0.14	0.01	0.00
October	121573	1.09	0.20	0.01	0.00
November	125130	1.53	0.21	0.02	0.00
December	117966	1.52	0.45	0.01	0.00
Total	**1263262**	**1.30**	**0.42**	**0.02**	**0.005**

Table- 7. Month wise, species wise hooking rate in Andaman and Nicobar waters from 1989-2012

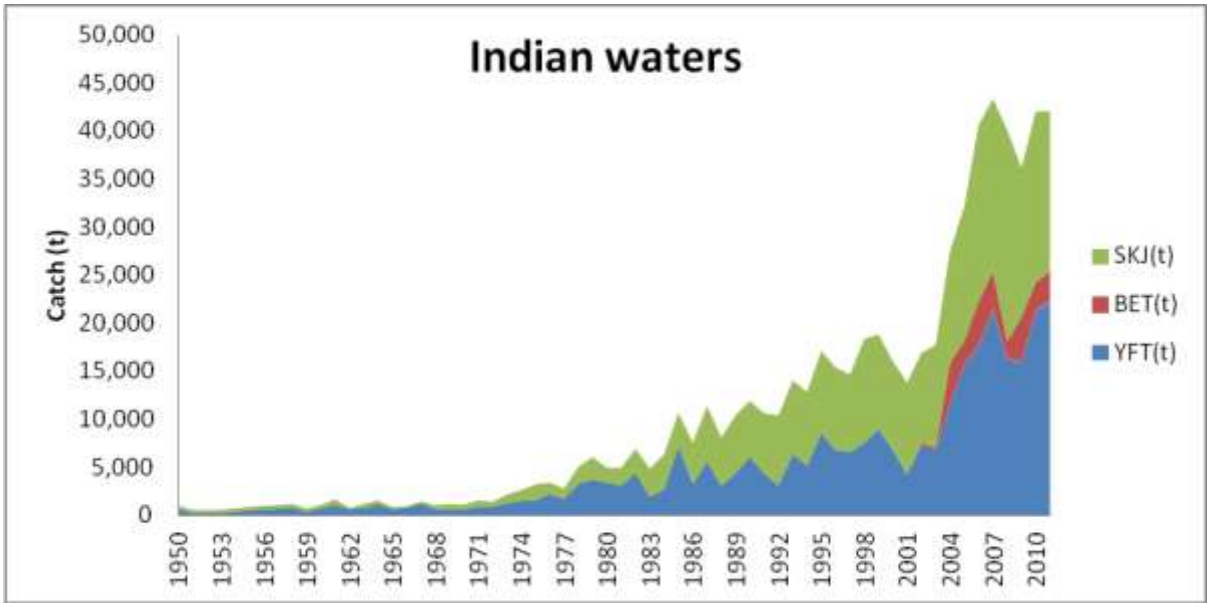

Fig.1 Trends in oceanic tuna catch in Indian seas from 1950-2011 (Source: IOTC data bank)

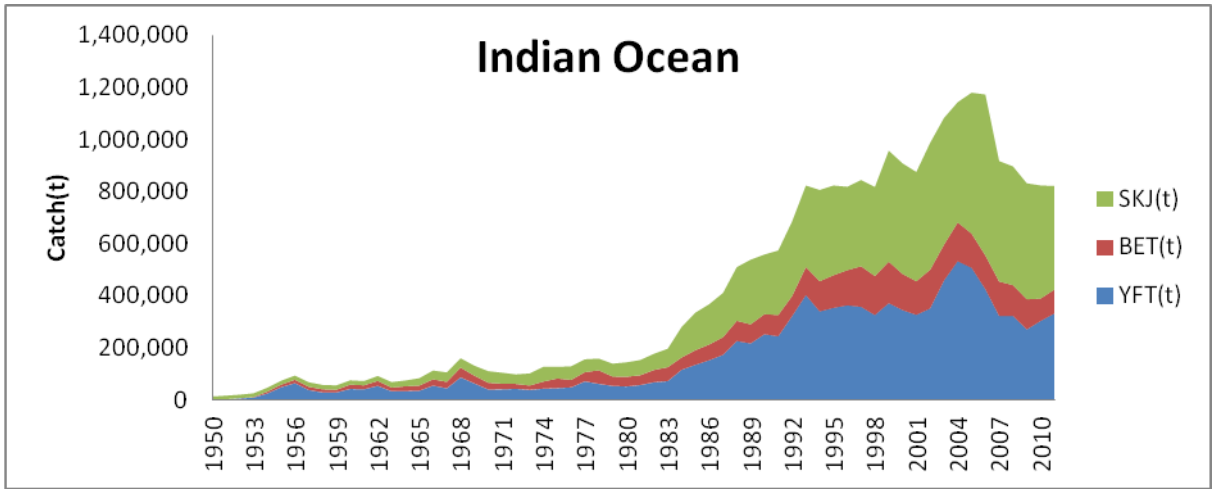

Fig.2 Trends in oceanic tuna catch in Indian Ocean from 1950-2011 (Source: IOTC data bank)

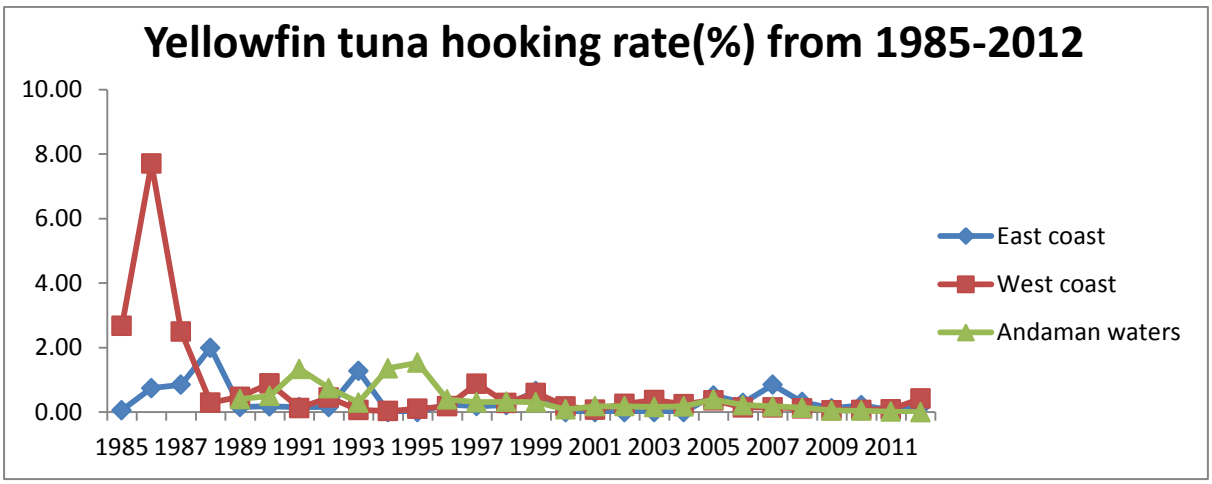

Fig.3: Year wise and area wise YFT hooking rate (%) from 1985-2012

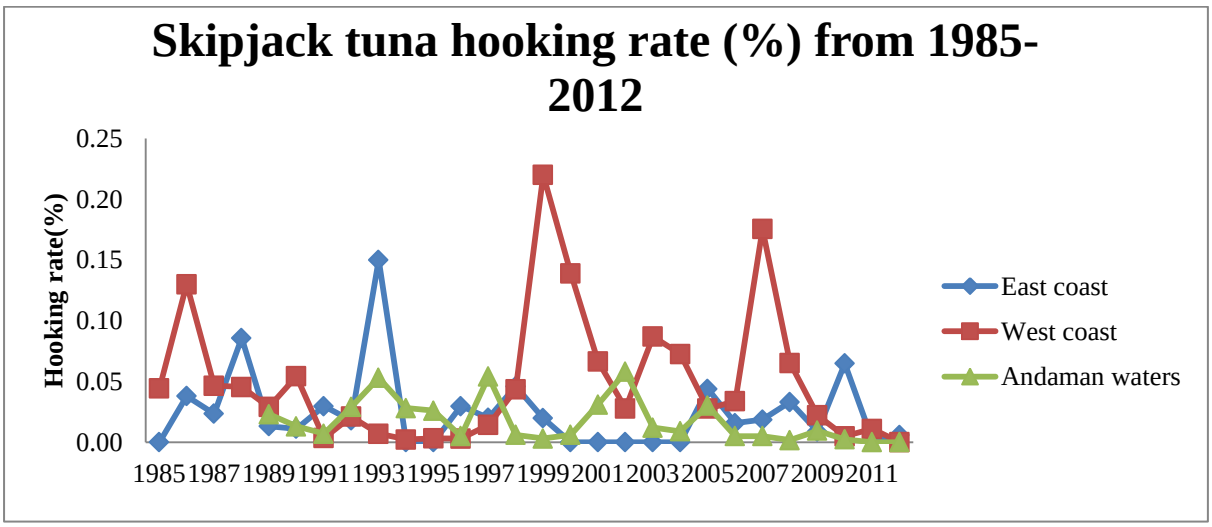

Fig.4: Year wise and area wise SKJ hooking rate (%) from 1985-2012

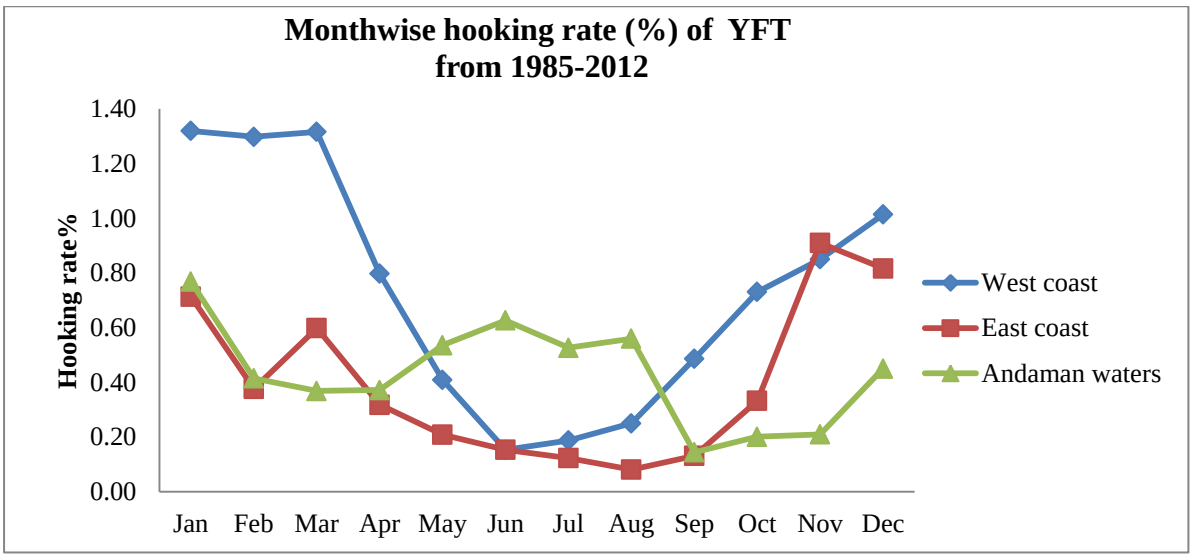

Fig.5 Month wise and area wise YFT hooking rate (%) from 1985-2012

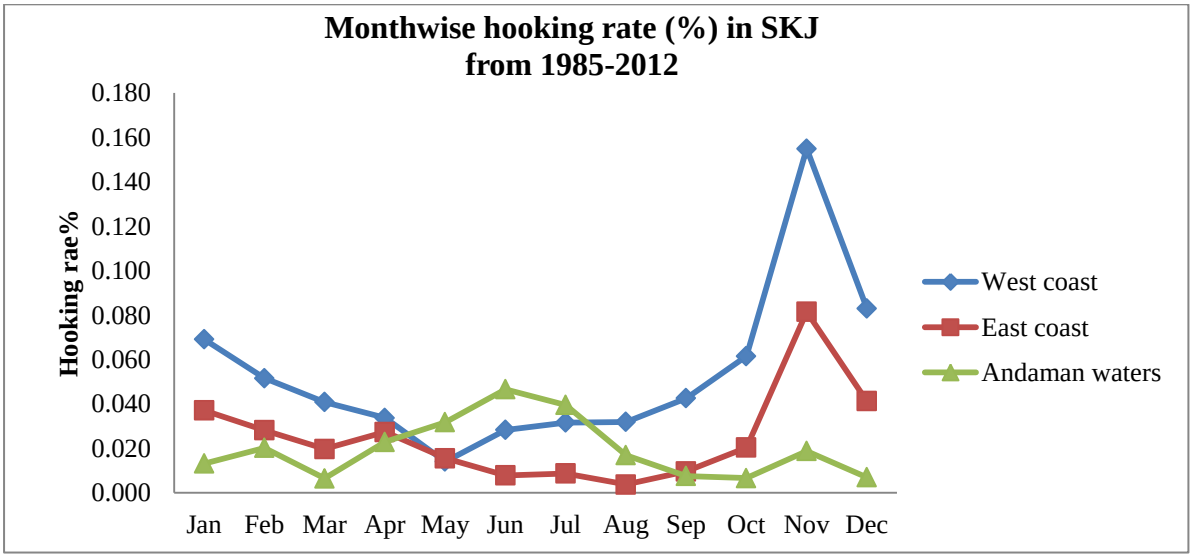

Fig.6 Month wise and area wise SKJ hooking rate (%) from 1985-2012

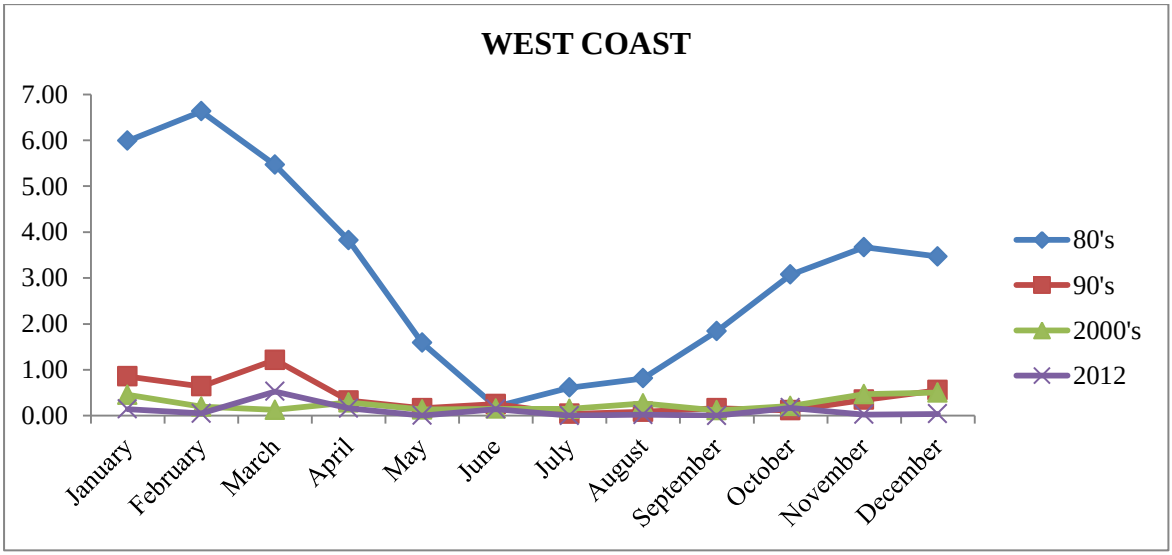

Fig.7. Month wise hooking rate during 1980's to 2012 in west coast of India

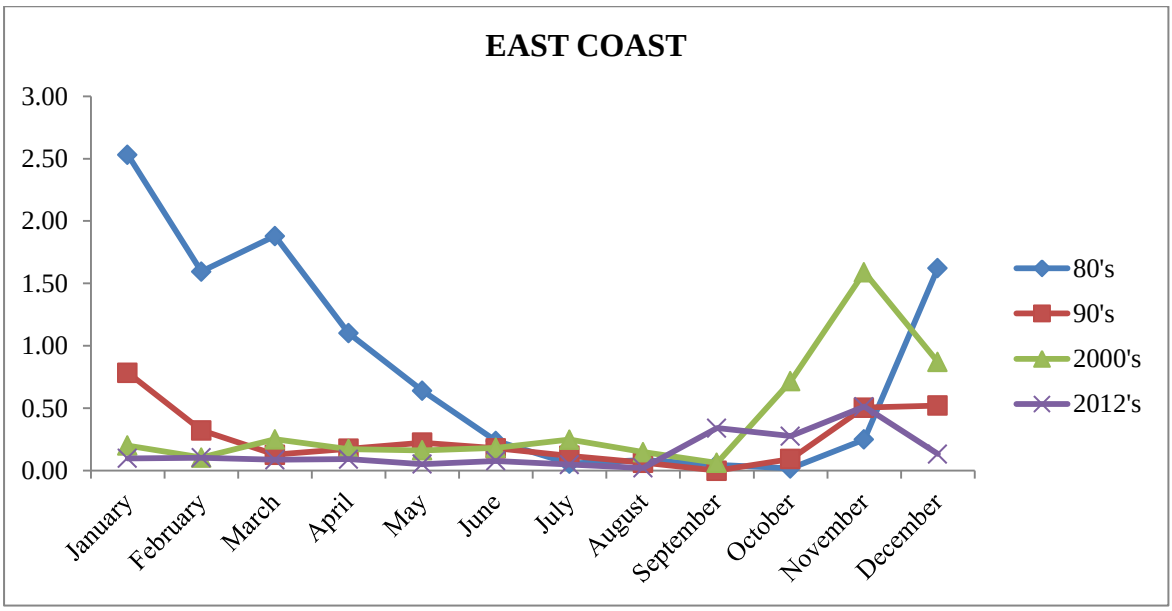

Fig.8. Month wise hooking rate during 1980's to 2012 in east coast of India

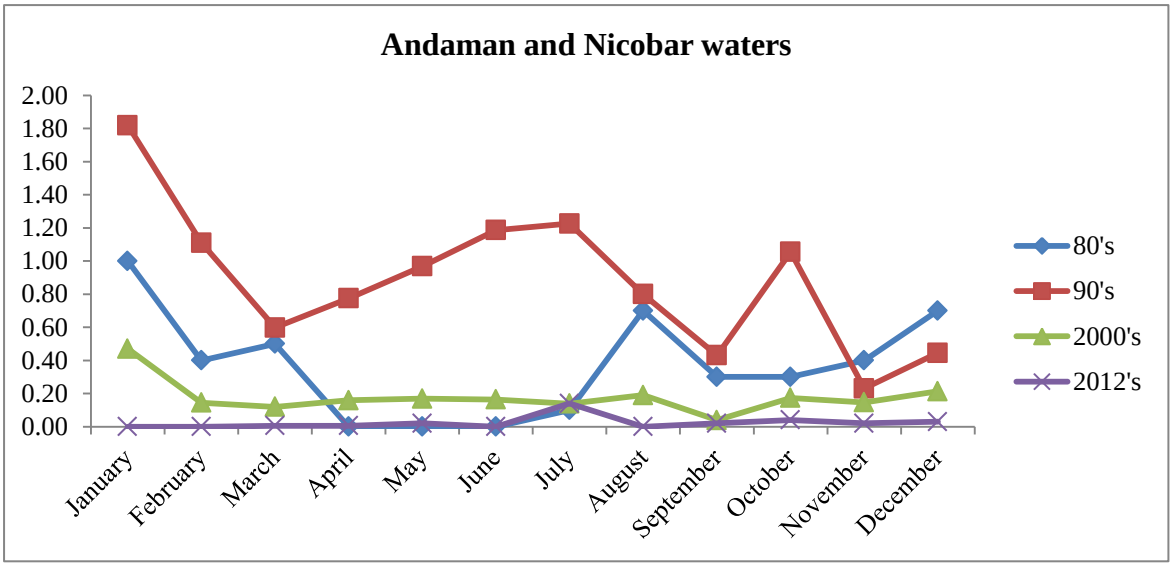

Fig.9. Month wise hooking rate during 1980's to 2012 in Andaman and Nicobar waters of India