

NATIONAL REPORT ON TUNA FISHERIES, RESEARCH AND DEVELOPMENT IN INDIA

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Introduction:

The magnitude of marine fish production in India is one among the major fish contributing coastal countries in the Indian Ocean. India has explored the seas around the country and estimated Maximum Sustainable Yield of the oceanic tuna and allied resources in the EEZ to be around 2.4 lakhs tonnes. The coastal tuna and allied resources also has add up substantially to the fish production. Currently, India has been prioritizing the tuna fisheries development through capacity building and encouraging the coastal fishermen in harvesting the tuna and allied resources. The Fishery Survey of India has initiated diversification in the exploratory surveys and research with directed effort for surveys in respect of Big Eye tuna, sword fishes and sail fishes. The small scale and pilot tuna tagging programme under the auspicious of IOTC is expected to commence from the Lakshadweep Islands during 2003-2004. Under the OFCF/IOTC project a Consultant has recently visited the major fishing centers in India. In connection with the preparation of a country paper on tunas and implementation of his suggestions/recommendations would help India to refine the tuna data collection and statistics. The Govt. of India, Ministry of Agriculture, Deptt. of Animal Husbandry & Dairying have also taken initiative in conducting marine census during 2003-2004 involving the field Institutions viz., CMFRI and FSI for enumerating the fishing crafts, fishing gears, fishermen population and their socio-economic conditions. The present paper reports the status of tuna fisheries, research and India's initiatives in relation to IOTC activities in the regional context.

Tuna production in India

India's production of tunas and tuna like fishes during 2002 was about 105795 tonnes from the coastal fishery. Of this, about 50 thousand tones were neritic tunas, four thousand tonnes of Billfishes, and 51.5 thousand tonnes of Seer fishes. The principal components of neritic tunas are skipjack, kawakawa, frigate mackerel and Yellowfin tuna while the main species of seerfishes were *Scomberomorus commerson*, *S. guttatus* and *S. lineolatus*. The main gears used were gillnets, pole and line, hook and line and longliners.

The longline catches by the survey vessels from the Indian EEZ during 2002 was 12.8 tonnes. Yellowfin tunas and Billfishes were the main components of the catches. Under the industrial fishing only one vessel was in operation with a catch of 48 tonnes. The oceanic tuna fishing activity is now revived by permitting 25 long line vessels under the scheme "The New Guidelines for Indian Owned Vessels". The voyage reports of these vessels are yet to be received.

a) Coastal fisheries

catch by species and gear

Drift Gill Net		Hooks and line	
Species local name	Catch(t)	Species local name	Catch (t)
Kawa kawa	12203	Kawa kawa	4555
Frigate tuna	7237	Frigate tuna	4672
Bullet tuna	349	Bullet tuna	692
Long tail tuna	1697	Long tail tuna	692
Skipjack tuna	175	Skipjack tuna	85
Yellowfin tuna	799	Yellowfin tuna	479
Indo-Pacific Bonito	0	Indo-Pacific Bonito	0
Total	22460	Total	11175
Pole and line		Purse seine	
Species local name	Catch(t)	Species local name	Catch(t)
Kawa kawa	0	Kawa kawa	1092
Frigate tuna	0	Frigate tuna	874
Bullet tuna	0	Bullet tuna	218
Long tail tuna	0	Long tail tuna	0
Skipjack tuna	5242	Skipjack tuna	0
Yellowfin tuna	582	Yellowfin tuna	0
Indo-Pacific Bonito	0	Indo-Pacific Bonito	0
Total	5824	Total	2184
Other gears		All gears	
Species local name	Catch(t)	Species local name	Catch(t)
Kawa kawa	2539	Kawa kawa	20389
Frigate tuna	2208	Frigate tuna	14991
Bullet tuna	0	Bullet tuna	1259
Long tail tuna	0	Long tail tuna	2389
Skipjack tuna	200	Skipjack tuna	5702
Yellowfin tuna	0	Yellowfin tuna	1860
Indo-Pacific Bonito	200	Indo-Pacific Bonito	200
Total	5147	Total	46790

Source: Central Marine Fisheries Research Institute

b) Oceanic fisheries

Industrial Long lining	Longlining by Survey vessels
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Species local name	Catch(t)	Species local name	Catch(t)
Yellowfin tuna	31.8	Yellowfin tuna	3.3
Bigeye tuna	13		
Skipjack tuna	2.6	Skipjack tuna	0.1
Sword fish	0.2	Sword fish	2.2
		Bill fishes	2.1
		Shark	9.6
		Others	0.8
Total	47.6	Total	18.1

Total	
Species local name	Catch(t)
Yellowfin tuna	35.1
Big Eye Tuna	13
Skipjack tuna	2.7
Sword fish	2.4
Bill fishes	2.1
Shark	9.6
Others	0.8
Total	65.7

Source: Fishery Survey of India

Fleet Structure

Type of craft	No. of crafts
Traditional crafts	181284
Motorised traditional crafts	44578
Mechanised boats	53684
Total	280491 (Including catamarans and beach landing crafts)

Source: Ministry of Agriculture, Govt. of India

Present system of data collection:

As there is no exclusive targeted tuna fishery, in the waters around mainland the data collection is one and the same for entire fishery, i.e., by adopting time-space multi-stage stratified random sampling by maritime states which was developed by CMFRI. All landing centres (large, medium and small) in a state are grouped into zones with geographical contiguity and sampling is being carried out in each zone by covering all landing centres

randomly by keeping their landings intensity. One zone and a calendar month are taken as time-space stratum. The coverage is for 16 to 20 calendar days in a month. Further, while collecting data, craft-wise and gear-wise stratification is followed and species wise classification is taken care of. While estimating the production figures, production is estimated for the specified sub-strata (craft and gear) in a strata (landing center) with appropriate raising factors like fishing days and active craft etc. In this context, methodology followed by Maharashtra maritime state is elaborated below:

Methodology followed by one of the maritime States (Provinces) :

- 1) Space-time multi-stage stratified random sampling with 25 zones consisting of 184 landing centers in five districts with geographical contiguity as space stratum and 5 cluster of 6 days each in a month as time stratum ;
- 2) In each zone, 10 fish landing centre days are sampled with a proportionate coverage of different landing centers (large, medium and small) basing on the total landings received in the previous years and each fish landing center day consists of 24 hours , i.e.,
 - 1) 12.00 to 18.00 hrs of first calendar day,
 - 2) 18.00 hrs to 6.00 hrs of intervening night (night landing)
 - 3) 6.00 hrs to 12.00 noon of second calendar day.
- 3) Fishing boats are selected on the sample basis for each net type basing on the arrival of the boats for the specific net in the following way;
 - 1) Up to 5 boats - all boats to be surveyed.
 - 2) 6-10 boats - every alternative boat
 - 3) 11-20 boats - one each from every four , i.e., 25%
 - 4) Above 20 - One each from every five, i.e., 20%
- 6) The overall sample coverage is about 4.5% (250 landing center days) of 5250 total landing center days with appropriate weightage to the large intensity centers.
- 7) The information collected by field staff is processed at head office and estimates of fish landings are obtained for each zone in each month by following formula:

$$C = \frac{D \cdot N}{n} \sum_{i=1}^n \frac{B_i}{b_i} \sum_{j=1}^{b_i} C_{ij}$$

Where C_{ij} = Catch of jth fishing unit observed at the ith center.

B_i = No. of fishing units landed during the sample day

b_i = No. of fishing units selected for observation

N = Total centers in the zone;

D = No of days in the month

n = No. of sample days

C = Estimated monthly catch of the zone.

Once the estimates are made for all the zones in the above manner, district wise estimates are calculated and also for the state. Similar type of exercise is being carried out by all other maritime states and all India production estimates are arrived basing the information provided by these states.

Strengthening of data collection system

Govt. of India has decided to strengthen data collection in its X plan on the following line.

a) Marine census covering various aspects of marine fisheries such as craft and gear, population distribution etc. in all the maritime states including islands.

b) As per the current proposal, collection of the landings data is being continued by state (provincial) fisheries and will be furnished to Fishery Survey of India for ensuring the validation and correctness of the data from scientific point of view. Later, the processed data will be transmitted to Ministry by FSI on quarterly and annual basis.

c) Fishery survey of India is also assigned the task of conducting sample surveys on biological aspects of marine fish species like length, weight etc; gear and craft specific surveys and market surveys which are not usually covered by maritime states. For example, collection of biological parameters of coastal tunas will be undertaken by visiting landing centers

d) In addition to the above tasks, Fishery Survey of India is assigned the task of providing training on taxonomical identification of species (including oceanic species) to the data enumerators and statistical staff for better identification of species and for its reporting in the landings.

Current scientific research in Fishery Survey of India

- ✓ Exploratory surveys have been continuing in the oceanic region of Indian EEZ to study distribution and abundance of oceanic tunas and allied resources.
- ✓ Biological studies including collection of L/F data with an eco-system approach.
- ✓ Research and development activities proposed for 2002-03 envisages Exploratory surveys beyond Indian EEZ and experimental fishing for targeted species using new gear and methods.
- ✓ Tagging programme for oceanic species like YFT and SKJ to be undertaken from different platforms under IOTC assistance as well as under inter-institutional projects.
- ✓ Collection of data on predation of longline caught tunas.
- ✓ Collection of data on L/F and biological observation of targeted species and by-catch species.

Research project undertaken by the Central Marine Fisheries Research Institute

The Central Marine Fisheries Research Institute, Kochi had undertaken a Research project on “Development of strategies for sustainable exploitation of tuna and billfish resources of Indian EEZ” for the period April 2002 to March 2007 with the following objectives:

Immediate objectives:

- To assess the magnitude and spatial/seasonal pattern exploitation of tunas and tuna live-baits by above mentioned gears and study impact of fishing pressure on three resource;
- Assessment of population parameters of major species for stock assessment studies;
- Interpret fluctuations in abundance with reference to oceanography and meteorological conditions;
- Model aggregation dynamics of tunas with FADs;
- Feeding habits of tunas associated with FADs;
- Stock assessment

Long term objectives :

- To maintain the tuna fishery at the Maximum Sustainable Yield level.

ANNUAL TUNA MEET 2003

As a follow-up to the discussions held in the IOTC meetings, Fishery Survey of India (FSI), and Central Marine Fisheries Research Institute (CMFRI) had organized the first national level meeting of the Tuna Scientists of India on 26th and 27th of September, 2003 at Kochi, Kerala. The theme of the Scientist Meet was to assess the present status of tuna and allied resources in the Indian EEZ and research being carried out towards assessment of measures for exploiting these resources by adopting modern eco-friendly methods for management and conservation of the stocks. Altogether 31 Scientists from CMFRI and FSI participated in the two day deliberations and contributed significantly by way of presentation of scientific papers and active discussions on the second day of the meeting. 23 papers were presented by the scientists in the three Sessions, Introductory Session, Coastal tunas Session and Oceanic tunas Session. A summary of the papers presented are given below:

SEER FISHES

Seer Fish production in India varied from 42,378 t in 2001 to 54,876 t in 1998 with an annual average of 48,378t, forming 1.9% of the total marine fish landings of the country. East coast contributed 40% of the catch while the contribution of west coast was 60%. About 66% the catch was taken by gill nets. Other gears employed for catching Seer fish were trawls, hook and lines. The king Seer, *Scomberomorus commerson* was the dominant species, which formed 66.3% of the catch while spotted Seer, *S. guttatus* formed 33% of the Seer fish catch. The size range of king seer in large mesh gill net was 30-140 cm along west coast and 14-154cm along east coast with mean length at 67 cm and 71 cm respectively. The Length at first maturity (L_m) and Length with optimum yield (L_{opt}) were estimated to be 93.9 cm and 72.1 cm respectively for west coast and 130.5 cm and 78.4 cm for east coast. For spotted seer, the length range in large mesh gill net was 14-58 cm along west coast and 10-70 cm along east coast with mean size at 40 cm at both coasts. The L_m and L_{opt} were 35.1 cm and 40.8 cm respectively for west coast and 39.1 cm and 46.1 cm for east coast. Analysis of pooled length

frequency data collected from different centers from west coast gave growth parameters as $L_{\infty} = 142$ cm, $K = 0.5/\text{year}$ and $t_0 = -0.0314$ year for *S. commerson* and as $L_{\infty} = 69$ cm, $K = 1.0/\text{year}$ and $t_0 = -0.0116$ year for *S. guttatus*. Using the length-frequency weighted to the west coast landings, the mortality parameters were estimated to be $M = 0.73$, $Z = 2.43$, $F = 1.69$ and $E = 0.70$ for *S. commerson* and $M = 1.41$, $Z = 6.17$, $F = 4.76$ and $E = 0.77$ for *S. guttatus*. Length-cohort analysis indicated higher fishing mortalities of young king seer (23-30 cm) by trawl and higher length groups (74-78 and 90-94 cm) by gill net. In the case of spotted seer above 38-40 cm were exposed to higher fishing pressure. The standing stock was estimated to be 9542 t against the present yield of 13169 t for king seer and 5142 t against the present yield of 9549t for spotted seer.

COASTAL TUNAS

All India tuna landings fluctuated from 39684 t in 1998 to 54001 t in 2000 with an average of 48043 t. The major species contributing the coastal tuna fishery were *Euthynnus affinis*, *Auxis thazard*, *Thunnus tonggol* and *A. rochei*. The dominant coastal tuna species from the Northwest coast of India is *T. tonggol*, which is landed by drift gill nets with peak fishery during September to January. Exploitation rate of this species has increased steadily for the years and is presently attained 0.81 compared to 0.35 during 1997-98 from this area. Thomson and Bell yield analysis indicated an annual yield of 7900 t for the northwest region. The fishery and population characteristics of the species *Auxis rochei* from the south Kerala coast indicates that the annual catch ranged from 721 to 2407 t. The length at first capture was found to be 25 cm while the length weight relationship was calculated as $W = 0.0031 L^{3.4718}$. The size at first maturity was 23.5 cm and the growth parameters estimated were $L_{\infty} = 34$ cm and $K = 1.1$ (annual). The estimated fork lengths for 0.5, 1, 1.5 and 2-year classes were 19.4, 22.8, 27.5 and 30.3 cm respectively. The Z was 4.81, $M = 1.85$, $F = 2.96$ and exploitation rate was 0.62. Tuna fishing around Lakshadweep seas is conducted by pole and line using live baits. There has been a steady and gradual increase in the catches from 1980 onwards the catch being 1760 t (1981) to 9343t (2001) with a bumper catch of 12300 t in 1998. Skipjack tuna, *Katsuwonus pelamis*, contributes about 80% of the catch.

OCEANIC TUNAS

The present status of the oceanic tuna resources is studied based on the data collected by exploratory survey by longlining. The potential estimates of oceanic species comprising YFT is about 108.9 thousand tones, SKJ 100.2 thousand tones, Big eye tuna about 0.3 thousand tones. The commercial operation through various schemes landed tunas to the tune of 12 thousand tonnes during 1991. The main species landed by these vessels were Yellow Fin Tuna, Big Eye Tuna, Skipjack Tuna, Marlins, Sword fishes, Sail fish and Sharks. Yellowfin tuna, *Thunnus albacares* contributes a major share of the tuna catches in the Indian EEZ including the waters around Andaman and Nicobar islands. Along north-west coast YFT was more abundant during Pre-monsoon period. The length-weight relationship of this species worked out $W = 0.00001727L^{2.9925}$. Gut content analysis indicates cephalopods and crustaceans as the preferred food items of YFT. The mean length of male and female YFT caught from Andaman islands is 121.93cm and 111.54cm respectively.

BILL FISHES

The Billfish production in India was about 55.6 t, which is mainly caught in troll line gear operating in Lakshadweep waters. The Marlins, comprising of *Makaira indica*, *Makaira mazara* and *Tetrapterus audax* are harvested mainly by long line gear. Modal length of *M. mazara* in Bay of Bengal observed is 181 cm and Arabian Sea is 201 cm respectively. The

Indo-pacific Sail fish, *I. platypterus*, is the major species hooked as a bycatch of tuna longline fishery. The abundance of the species along Northwest India indicates that the average catch rate obtained is 39.42 kg/1000 hooks constituting 15% of the total longline catches. The seasonal abundance shows that the second quarter (April-June) recorded highest catch rate for the species. The spawning period appear to be protractive extending from March to September. The size at first maturity is estimated to be 175 cm. The species feed mainly on cephalopods, bony fishes and crustaceans. The Length-weight relationship was calculated as $W = 0.0069L^{1.5596}$ for both sexes combined. The growth parameters estimated were $L_{\infty} = 316.5\text{cm}$, $K = 0.39/\text{year}$ and $t_0 = -0.512$ year.

The initiative taken in India as mentioned above, will help at national level to draw compatibility with the regional programmes on tuna and allied resources for sustainable fisheries and management and conservation of these fish stocks.
