CMFRI
bulletin 36

JUNE 1985

TUNA FISHERIES OF THE EXCLUSIVE ECONOMIC ZONE OF INDIA: Biology and Stock Assessment

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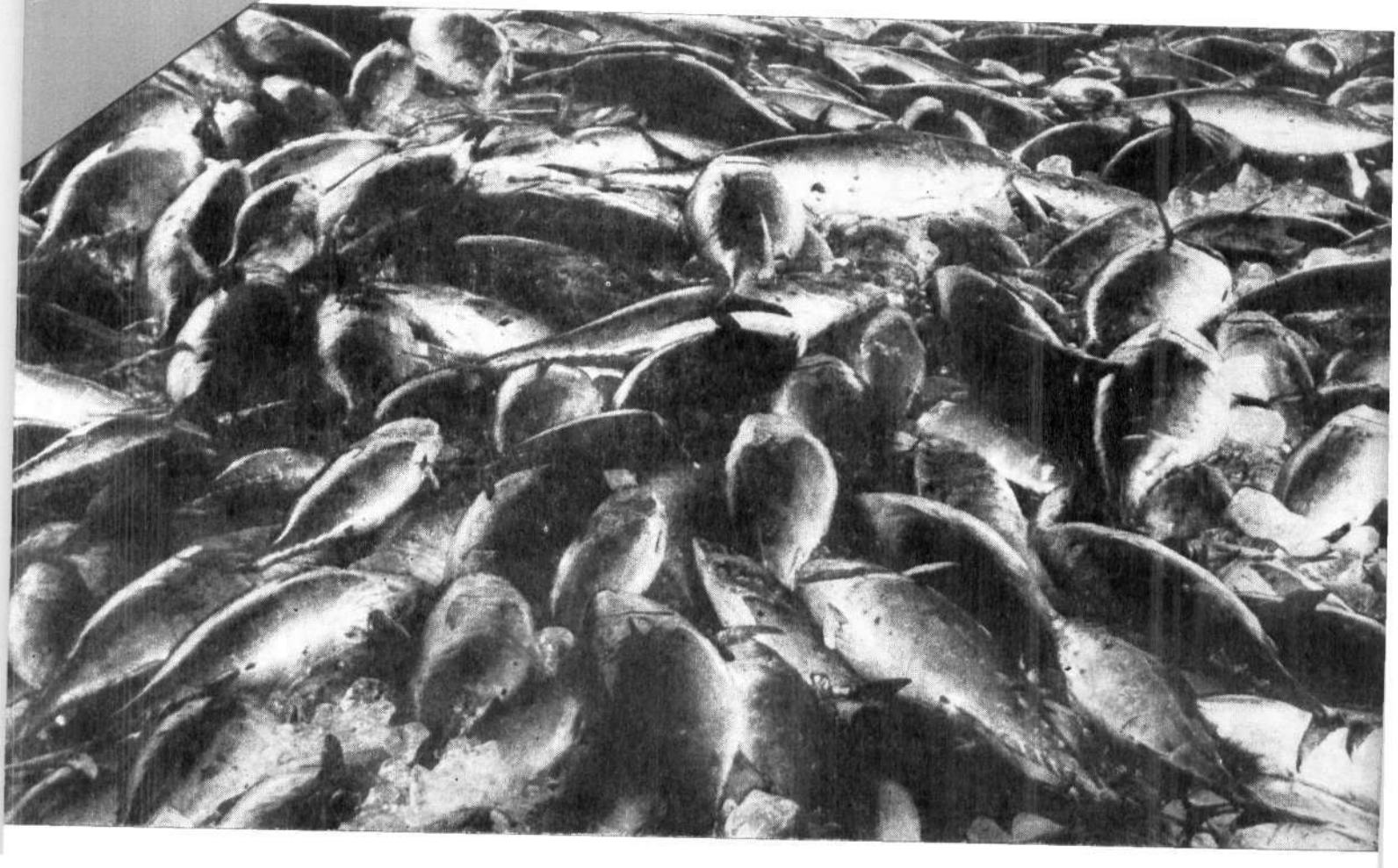

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TUNA FISHERIES OF THE EEZ OF INDIA—AN INTRODUCTORY STATEMENT

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The tuna fisheries in India is still predominantly an artisanal activity with marginal inputs from the commercial sector. As part of the National Policy for the judicious exploitation of the fishery resources of the Exclusive Economic Zone (EEZ) of India, further emphasis is to be given to the development of tuna fisheries, both in the coastal waters and in the high seas. Despite the fact that there has been a noticeable increase in the landings of coastal tunas during the last two decades, the tuna stocks remain to be one of the least exploited pelagic resource from the EEZ of India. The impact of modern technology was mainly by way of introduction of synthetic fibres for the gear and mechanisation of the crafts which enabled the traditional fishermen to develop their fishing practices in a steady state condition, but the developments in the post harvest technology, especially in the processing of products for internal markets and for exports are still lagging behind (Silas *et al.*, 1979 ; Silas and Pillai, 1982 ; 1983 ; 1984).

The present state of affairs of the tuna fishery in the Indian Ocean are indicative that a major international effort is needed for the development of tuna fisheries for the coastal and island states and to effectively manage the tuna resources of the Indian Ocean, without generating conflicts/developing protective interests and exclusive attitudes. Except for the longline tuna fishery by Japan, Taiwan and the Republic of Korea, and purse seine fishery for tuna by Seychelles there is no organised high seas tuna fisheries in the Indian Ocean. There is the possibility of unlimited entry into the tuna fishery, and added to this, estimates of catch and effort expended and information for biological follow up studies are not always available. The major factors to contend with this fishery are the complex nature of the tuna fishery itself, which employs different techniques for harvesting the resources at surface and sub-surface combined with the need for greater mobility of the fishing fleets. Due to the highly migratory habit of tuna the question of standing stocks become important. All these would necessitate a centralised monitoring Agency to estimate the levels of abundance, catch rate and effort expended and to advice the fishing industry. It is in this context that Silas and Pillai (1982) proposed the establishment of the 'ICCIOT' (International Commission for the Conservation and Management of Indian Ocean Tunas) which could design and implement a coherent policy for the Indian Ocean tuna fishery.

An updated picture of the tuna fisheries of the Indian Ocean as for 1983 shows about 105,000 tonnes increase in production from 207,897 tonnes in 1973 to 312,986 tonnes in 1983, a 51% jump. The catch details for 1983 are given in the following Table.

TABLE 1. *Catch details of tunas, tuna-like fishes and billfishes: Indian Ocean* (1983) (MT).

(Source : *IPTP Data Summary No.* 3, March, 1985)

	Total for Indian Ocean	Total for Western Indian Ocean	Total for Easetrn Indian Ocean
Tunas and tuna-like fishes ..	303,616	187,989	115,627
Billfishes ..	9,370	5,889	3,481
	312,986	193,878	119,108

Inspite of the fact that the last two decades have witnessed the augumentation of production of coastal species of tunas and tuna-like fishes in the small scale fishery sector, through mechanisation of the existing crafts, increasing effort through drift gillnet fishery, pole and line (live-bait) fishery and purse seining, tunas remain to be one of the least exploited resources of the Indian seas, and in 1983 it formed only 1.1% of the total marine fish landings in India. Except in the Lakshadweep Islands where there exists pole and line

Gear-wise and species-wise catch details (MT)—1983

Species	Longline Bait	Bait Boat	Purse Seine	Unclassified (Coastal gears ?)
Yellowfin tuna ..	26,568	6,451	10,773	12,935
Bigeye tuna ..	40,536	1	295	328
Albacore tuna ..	16,890	..	..	..
Southern bluefin tuna ..	10,918	..	..	15,938
Skipjack ..	21	21,646	13,462	28,620
Longtail tuna ..	295	..	..	8,605
Little tuna ..	131	993	..	11,139
Frigate tuna ..	..	3,189	..	851
Tuna-like fishes ..	260	938	15	71,818
Blue marlin ..	2,729	..	..	2
Black marlin ..	294	..	1	..
Striped marlin ..	1,693	..	..	..
Sailfish ..	125	..	..	3
Swordfish ..	1,780	..	..	241
Billfishes ..	1,868	..	..	634
Total ..	104,108	33,218	24,546	151,114
% ..	33.26	10.61	7.84	48.29

surface fishery mainly aimed at tunas; there is no organised fishery for tunas in vogue along the mainland of India. Tuna fishery is currently limited to the small scale sector and very little attempt has hitherto been made to exploit the tuna resources of the EEZ of India.

One of the areas where little information is available is on the se. sonal occurrence in different areas of surface species such as skipjack and young yellowfin tuna which support a surface fishery. Further, there exists scope for the augmentation of production in the pole and line fishery in the Lakshadweep Islands by developing a steady source of bait through bait-fish culture and by attracting tunas by fish aggregating devices (FADs). Vast areas of the Andaman Sea is highly productive for the surface species of tunas. *Inter-alia*, if the environmental data such as temperature, thermocline distribution and its seasonal fluctuations in our waters are made known, these would help considerably in the purse seine operations.

It is to be considered that tuna fishing involves operations not only within our EEZ, but also in the contiguous high seas and if necessary under bilateral arrangements with the other nations. For the Indian Ocean area, the projected figure of potential yield for skipjack tuna is 2 25,000 to 400,000 tonnes and for smaller tunas such as *Auxis* spp. 100,000 to 200,000 tonnes (IOFC 1977). In recent years, the production of tunas, tuna-like fishes and billfishes mainly from the longline fishery and fishing from coastal and oceanic sectors is about 312,986 tonnes (1983). The percentage composition of tuna production from the coastal and island waters through pole and line (bait boat) fishing is 10.61%, surrounding nets (purse seining) 7.84%, coastal fishing (drift gillnetting, hooks and lines and trolling) 48.29% and from the high seas by longlining is 33.26%. The recent development of purse seining by the Republic of Seychelles has been a pointer to the resource potential of skipjack that could be exploited from the Indian Ocean.

Mr. Ranjan Misra (Personal communication) informs me that in March-1985 as many as 46 purse seiners are in operation in Seychelles. Of these 27 belong to five companies from France and 19 to five companies from Spain. The operations are on payment of licence fee as well as royalty and other charges such as fixed amount per tonne of catch as transhipment. Concurrently, another system of joint venture with 51% in favour of Seychelles Government and 49% for French companies is under contemplation. The ' total tonnage being taken from the EEZ of Seychelles and immediately surrounding international waters is estimated to be 150,000 tonnes (tunas) per year'. The purse seiners are 50 and 70 meter vessels of 600 and 1100 MT. That this should happen from virtually a zero base in 1981 should be on eye-opener for our planners.

Mr. Misra further informs me that Thailand in 1984 canned about 100,000 MT of tunas and its 1985 target is about 150,000 MT.

These two are extremely significant developments within the last three to four years which we should take note of.

Silas and Pillai (1982) suggested that the production tempo of tuna fisheries development programmes in India should achieve the commercial production target in terms of quantity and value by 1990 as follows :

Groups	Areas of fishery	Proposed production by 1990 (Tons)	Commercial target (million Rs.)
Coastal species of tunas and skipjack	Small scale fishery sector (Drift gillnets, pole and line and others)	45,000	202.50
Young yellowfin and skipjack	Surface fishing (purse seining)	50,000	450.00
Large oceanic tunas and billfishes	Sub-surface fishing (ordinary & deep longlining)	20,000	270.00
	Total	1,15,000	922.50

During the three year period April, 1982 to April, 1985, India has added hardly anything to tuna production, while Seychelles has developed a base for harvesting over 150,000 MT during this period. In the light of this, the target of achieving 115,000 tonnes production in 1990 given by Silas and Pillai (1982) appears to be very modest, but quite feasible with planned development.

By 1990 I feel that, as indicated by Silas and Pillai (1982) the major component that will contribute to this increase will be skipjack tuna which could easily account for about 40,000 tonnes plus from the present level of artisanal fishery at the Lakshadweep of about 3,000 tonnes.

Bulk of the targeted production of skipjack tuna and young yellowfin in the surface fishery by purse seining and the large oceanic species of tunas and billfishes in the sub-surface fishery by longlining will thus have to be achieved through joint venture or chartering arrangements. As may be envisaged, this would be predominently an export oriented development (Silas, 1982).

In this report, three distinct but complementary components or modules were selected for study

(1) Species-wise catch, effort and c/f ;

(2) Biological aspects such as size distribution, length-weight relationship and growth parameters , and

(3) Population dynamics (stock assessment of selected species of coastal and oceanic tunas).

The specific objectives of these modules were to understand the status of the fishery resources, performance of the various parts of the fishery and to estimate the possibilities of expansion of tuna fishery.

The Central Marine Fisheries Research Institute (CMFRI) furnishes the historical data of various species of marine fishes based on a multi-stage stratified random sampling techniques after classifying important groups of fishes (CMFRI, 1983). For detailed biological investigations involving aspects of species composition, size, age, maturity, spawning, food and feeding habits and other parameters, the Project has selected certain centres along the mainland coast and at Minicoy in the Lakshadweep for tuna investigations which would help in monitoring the resources. Basic data used in the present investigations were collected from :

(1) Publications of the Central Marine Fisheries Research Institute on the trends in the marine fish production in India from 1965-1983 (*Mar. Fish. Infor. Serv. T & E Ser.*, Nos. 22 1980), 32 (1981), 41 (1982) and 52 (1983);

(2) Data collected from selected centres by the scientists on the fishery and biology of different species under the Institute Research Project ' Resources of tunas and billfishes ' (FB/PR/3.1) ;

(3) Data on the landings by coastal purse seine vessels ;

(4) Information on the results of exploratory longlining operations by the vessels of the Central Institute of Fisheries, Nautical and Engineering Training and the Fishery Survey of India ; and

(5) Results of exploratory oceanic drift gillnetting and purse seining conducted in the late sixties by CMFRI and the erstwhile Indo-Norwegian Project.

Although for assessing the total catch and to study the trend of production in the different maritime states of India and the country as a whole, the data have been utilised from 1965-83, for estimating parameters of population dynamics, the data from 5 centres collected during the period 1979-82 in the mainland of India and during 1976-82 from the Minicoy Island were taken into consideration.

New Areas for Research and Development

It is also appropriate to indicate in this introductory statement some new areas for R and D programmes. Of those outlined below, some may have to have a national perspective while others have to be dealt with at organisational level. I could think of the following areas needing immediate attention :

1. *Tunas and billfishes as game fishes*

In some parts of the world tunas and billfishes form a lucrative base for tourism and sport fishing. While our priorities in these matters differ from some of the developed countries, in view of our emphasis on the development of tourism, the importance of ocean sport fishing cannot be minimised. There are excellent opportunities along the west coast of India, Gulf of Mannar, the Lakshadweep Sea and Andaman and Nicobar waters where tunas, sailfishes, marlins and swordfish could be taken in rod and tackle. It is important that we also pay some attention to this area and initiate development of facilities such as boats and gear at selected centres such as Port Blair and Mayabundar in the Andamans, Agathi and Minicoy in the Lakshadweep and at some of the mainland centres such as Ratnagiri, Karwar, Cochin and Tuticorin. A beginning has to be made and both Government of

India and State Tourism Department and Port and Fisheries Departments could evolve a suitable strategy for the development of this activity. Along the east African Coast sport fishing activity has been developed in Malindi and it is understood that the island states such as Seychelles and Mauritius are keenly interested in large scale development of sport fishing in the sea. In our waters the most suitable sport fishing grounds would be :

(i) *Andaman Sea* (Between Port Blair and Diglipur) —excellent area for tunas, seerfishes, sailfish, marlins and barracudas.

(ii) *Gulf of Mannar* (Along Tuticorin—Cape Comorin Coast)—excellent area for seerfishes, sailfishes tunas and marlins.

(iii) *Cochin-Mangalore Area*—good area for tunas, sailfish and seerfishes.

(iv) *Lakshadweep* (Agathi, Minicoy and other islands) —good areas for tunas, sailfish, marlin, swordfish and pelagic sharks.

Besides this, other oceanic gamefishes such as the rainbow runner (*Elagatis bipinnulatus*), dolphin fish (*Coryphaena hippurus*), seerfishes or spanish mackerels (*Scomberomorus commerson, S. guttatus, S. lineolatus* and *S. koreanus*), wahoo (*Acanthocybium solandri*) telang queenfish (*Scomberoides commersonianus*), etc. are excellent game fishes and also occur in the aforesaid areas.

2. *Tuna genetics*

Considerable amount of work on the sub-populations of skipjack tuna in the Central Pacific Ocean has been carried out in the past, in order to understand their migratory patterns and localised concentrations. The need for identifying sub-populations of tunas and their genetic differences through serological studies and observations on sperm morphology and other techniques is a prerequisite for delineating stocks and connected management problems.

3. *Satellite tracking and remote sensing*

Telemetric tagging and tracking of tunas by satellite is a new area which needs further study. Migratory pattern of tunas and their areas of concentrations are to a certain extent dependent on the pattern of se. surface temperature differences, chlorophyll distribution, current boundaries, areas of convergence and divergence, ocean fronts, concentration of flotsams and slicks which could be detected in satellite imagery. Scientifically planned data acquisition and mapping out of these features would help us to a greater extent to understand the likely areas of concentration of tunas especially skipjack and young yellowfin tuna.

4. *Magnetic crystals and migration of tunas*

Investigations are being carried out at present for studying the possibility of whether tunas synthesize internal 'magnets' to enable them to navigate accurately over long distances. It has been observed that millions of 'magnetic crystals' occur in the head of tunas (located in the frontal bone in the case of yellowfin, skipjack and little tunas) with 'accurate magnetic map sense'. Intensive studies on this characteristic feature of tunas should be undertaken since they have far reaching implications in understanding the migratory behaviour of tunas.

5. *Tuna culture*

In Japan, bluefin tuna (*Thunnus thynnus*) is being cultured and harvested. The culture is species specific and the product is aimed at supplying choice markets. This species occurs in temperate waters and to what extent tuna could be cultured economically in tropical waters needs to be seen. Perhaps, an attempt should be made in view of the fact that (*a*) faster growth rates are normally achieved in warmer waters and (*b*) possibility of using the by-catch in fishing operations as feed. This could be motivation enough to carry out some trials in India.

6. *Young fish surveys*

Larval and young fish surveys of tunas are of paramount importance to understand the occurrence and distribution of the '*lost year*' group (post-larvae to early juveniles) which would help in demarcating the spawning ground and season of different species. Further, a species-wise knowledge of the swimming layer of early juveniles, young and adults of tunas would contribute in effective management of operation of fishing gears.

7. *Pollution*

It is necessary that the levels of PCBs, organo-chlorine compounds, radio activity and heavy metals be monitored in the meat of tunas and tuna-like fishes. This is important as these fishes are at the apex of the food chain and obtain and accumulate such pollutants through the different trophic levels.

8. *Floating objects*

Little information is available on the destructive role of damaged plastics, floating tar balls and other flotsam on tunas. With intensive fishing operations good quantities of webbing which have been cut off from the nets may also add to the hazard. A critical study about these objects which negatively affect tuna aggregation and their fishery is called for.

9. *Detection of tuna shoals*

While more sophisticated methods of scouting for tuna shoals and the areas of their concentration by the use of sonar and under water acoustics, aerial spotting and satellite imageries may be undertaken, visual sighting particularly with the help of the movement and behaviour of sea birds should not be discounted. It is very necessary that proper logs of sea bird sightings, their concentration and behaviour is entered in the fishing logs so that accumulated data on their occurrence, distribution and behaviour could also help in the scouting of tuna shoals.

10. *Dolphin-tuna association*

In the Pacific, tuna purse seining is also involved with heavy mortality among dolphins, especially the spinner dolphin (*Stenella longirostris*) and spotted dolphin (*S. attenuata*). Available information indicate that so far the dolphin-tuna association as in the Pacific is not present in the Indian Ocean. However, it is an aspect which needs a careful watch so that in the event of such association in any geographical area in the Indian Ocean, precautionary measures should be taken. The conservation and management practices adopted in the Pacific in purse seine net designs for escape of dolphins should be considered in such an eventuality. Relationship between tunas and other fish associates such as the whale shark need study.

11. *Data acquisition and management of tuna fishery*

One of the important aspects in the management of tuna fisheries is the development of a strong data base for resource information, particularly acquisition of fishery data, its processing and dissemination. Special attention should be given for the monitoring and data acquisition of capture by surface and sub-surface gears for assessing and understanding the stock position of young yellowfin, albacore and skipjack tunas vulnerable to purse seine gear. Any increase in the purse seine fishery and its impact on the longline fishery especially for yellowfin and albacore should be properly assessed. The need is to determine the year classes and magnitude of fish available for a viable longline fishery. Regulation is necessary, but it cannot be implemented without an ocean wide data acquisition system and a co-operative management mechanism and data dissemination system.

12. *Utilisation of tunas*

Silas and Pillai (1982) dealt with in detail the post-harvest storage, processing and marketing of tunas both for export and internal marketing. Development of one or more tuna canneries which can each handle 6,000—10,000 tonnes of tunas per annum is an area which requires immediate attention. The financial assistance for building up infrastructure for such canneries and freezing plants may be provided by government agencies such as the Marine Products Export Development Authority and NABARD.

Frozen tuna products consist mainly of frozen whole body, frozen semi-dress, frozen dress and frozen fillets. Production of such frozen products would involve freezing of captured tunas in fish holds capable of holding the fish below -20° or -40°C.

For internal marketing, the quality and shelf life of dried tuna products such as 'Masmin' should be improved. Canned products should find a good market demand in the country. Better quality salted, smoked or sundried tuna meat would find good market demand in the interior and tribal areas. Future development of processing of tuna meat for internal market should be mainly aimed at developing the technology of fresh and frozen products, canned tuna products and other acceptable items such as fish sausage and fish ham.

Conclusion

In summing up I would like to mention that the international market for tunas which was depressed during the last three years, creating a crisis and vagaries in further expansion of this industry is now picking up. The future is bright and 1986 should usher in an era of demand for tunas. Such a positive trend is bound to accelerate global production and marketing efforts. This is one more time for positive action and let us not miss the bus.

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