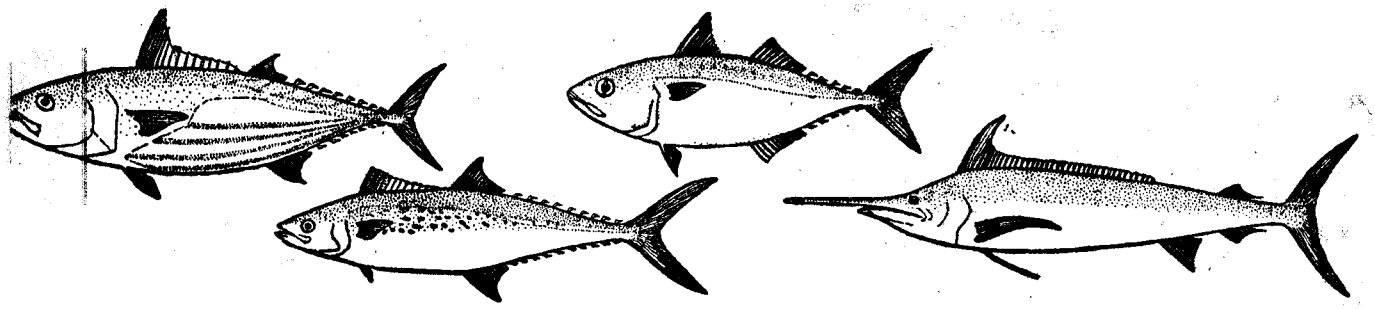
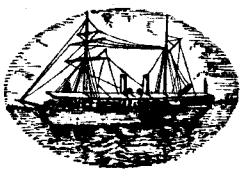


SYMPOSIUM ON SCOMBROID FISHES

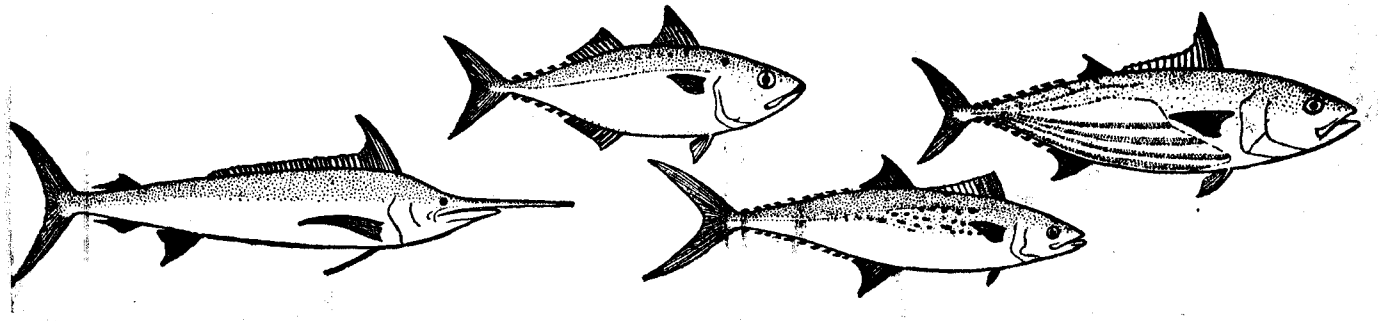
PART II



MARINE BIOLOGICAL ASSOCIATION OF INDIA

MANDAPAM CAMP

S. INDIA

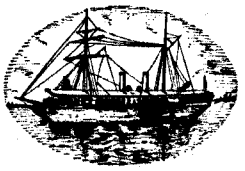


PROCEEDINGS OF THE

SYMPOSIUM
ON
SCOMBROID FISHES

HELD AT MANDAPAM CAMP FROM JAN. 12-15, 1962

PART II



SYMPOSIUM SERIES I

MARINE BIOLOGICAL ASSOCIATION OF INDIA

MANDAPAM CAMP

S. INDIA

PRINTED IN INDIA
AT THE DIOCESAN PRESS, MADRAS—1964. C8787

PRELIMINARY OBSERVATIONS ON THE PRODUCTIVITY OF CERTAIN TUNA WATERS OFF THE WEST COAST OF INDIA*

By R. Raghu Prasad and P. V. Ramachandran Nair
Central Marine Fisheries Research Institute, Mandapam Camp, India

Introduction

It is well-known that in dealing with major oceanic fisheries like that of tunas, billfishes, etc., we have to take into account a very complex ecological system. Researches and surveys hitherto carried out with regard to the tuna fisheries have had as their main object the extension of present fishing grounds and discovery of new ones. Though it could be noted that some variations take place from year to year in the position of the centres of good fishing and in their relative importance, the geographical patterns of catch distribution seem to be rather permanent features. It has been found often that some particular areas have been consistently yielding good catches of tuna though the reasons are not known in detail. In support of the hypothesis that tunas aggregate in localities where a favourable food supply is available, the observational data from the *Shellback* and *Eastropic* expeditions of the Scripps Institution of Oceanography have indicated that some of the areas of high tuna production are characterised by high organic production and high standing crops of zooplankton (Homes *et. al.*, 1957 ; Shimada, 1958). These in turn are associated with oceanic circulation which brings nutrient rich water near to the surface. Hence the measurement of primary productivity in these waters, apart from confirming our understanding of physical, chemical and biological phenomena, could indicate the basis on which successively higher trophic levels would be built and thereby give useful information on the possibilities of large scale exploitation.

The rich tuna fishery potential of the western sector of the Indian Ocean has been recently discussed by Jones (1958). As part of the programme of investigations of the Central Marine Fisheries Research Institute on the tuna fisheries of these waters, the study of the productivity was also undertaken. The experiments were conducted during April-May, 1961. Though the data collected may suffice to venture a preliminary comparison with other regions where similar investigations have been conducted, more comprehensive work both spatial and temporal will have to be carried out in order to assess the fisheries potential.

Methods

Owing to lack of a research vessel, experiments had to be carried out from *M. V. SEA FOX*, a cargo-*cum*-passenger vessel. The facilities on board were by no means adequate to conduct any detailed or extensive work and samplings had necessarily to be limited to places of anchorage of the ship (Fig. 1) especially near Andorth and Kalpeni Islands. Off Minicoy the ship was not anchored, as the depth exceeds 1500 metres. Because of her constant motion with the country crafts in tow, it was not possible to conduct the experiments through the entire photosynthetic zone which may extend beyond 75 metres.

The authors have been collecting fairly extensive data on the organic production of the inshore waters off Mandapam using the oxygen method. Subsequently with a consignment of standardized ^{14}C ampoules obtained from the International Agency for ^{14}C determination at Charlottenlund,

* Published with the permission of the Director, Central Marine Fisheries Research Institute, Mandapam Camp.

concurrent experiments have also been carried out. Both methods have been applied in the present investigations. Excepting in the shallow waters of the lagoons near the islands O_2—technique, as is to be expected, was not sensitive.

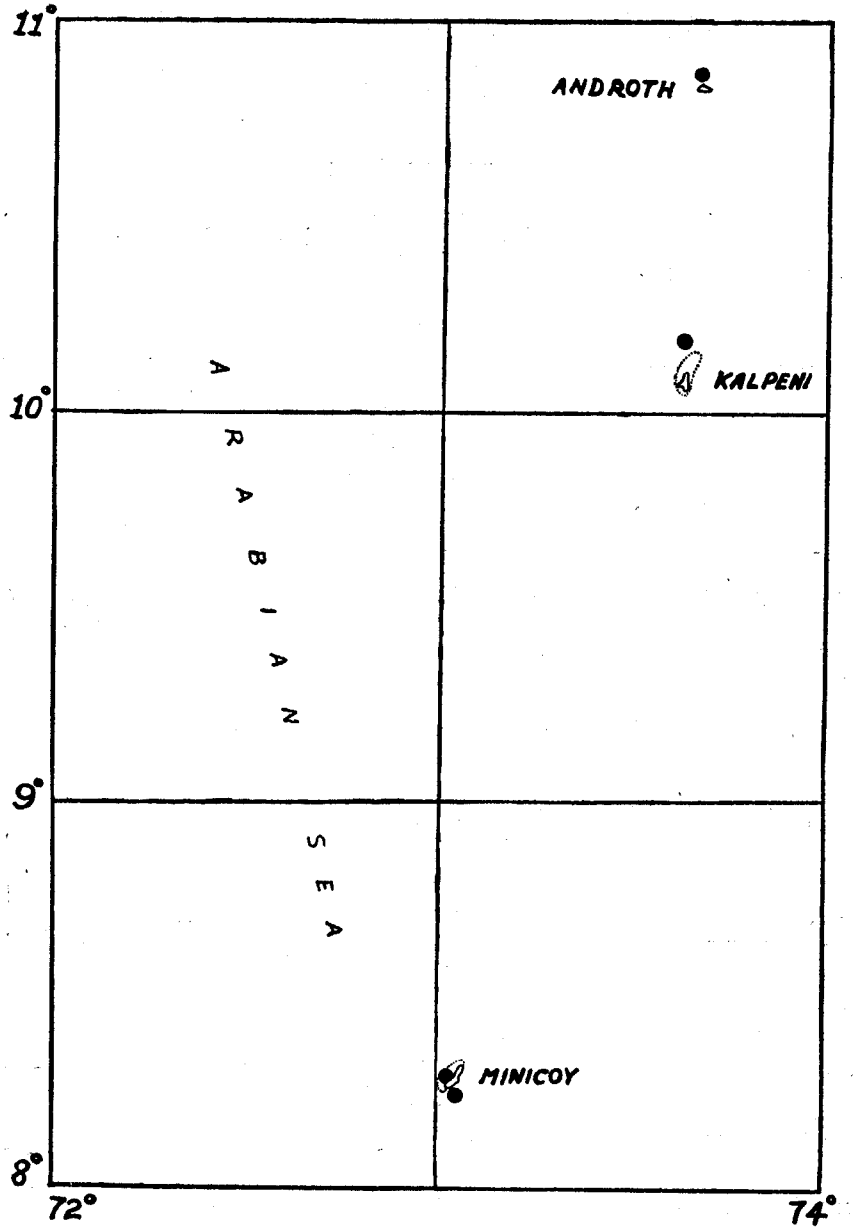


Fig. 1. Showing location of Stations where ^{14}C experiments were conducted.

For ^{14}C experiments, water samples were collected with a glass bottle having a 'snatch' mechanism and later on with an insulated water bottle with inner cylinder of plexiglass. 60 ml. clear-glass bottles were filled with the sea-water to which the contents of the ampoules were also

added (strength 0.004 mC per ampoule). These bottles were then suspended at the same depth from a float or from the side of the ship for six hours either from sunrise to noon or noon to sunset. Salinity and temperature were also recorded for the respective samples. At the end of the experiment samples were filtered through membrane filters, and the filters were dried in special holders in a desiccator with calcium chloride to which a little soda lime was added. The computing of the photosynthetic rate was done by the International Agency for ^{14}C determination. The ' light ' and ' dark ' bottle method applied was essentially the same as given in Prasad and Nair (1960) except that oxygen estimations were made with winkler technique.

Discussion of Results

The following table gives the results of ^{14}C experiments conducted in the Laccadive waters together with certain data from the *Galathea* and *Vitiaz* expeditions from the adjacent waters and that of the tropical eastern Pacific Ocean.

Table 1

Station	Production in mgC/m³/day	Production for the column mgC/m²/day	Remarks
California current, North Equatorial current (offshore from Baja California & Central Mexico)	0.40	..	Low concentration
'Dome' off Central America 115°W. longitude (Holmes *et al.*, 1957)	25	414 to 779	High value
Galathea stations at middle latitudes in the western part of the Indian Ocean outside the Continental shelf. (Steemann Nielsen & Jensen, 1957)		100 to 200	Normal production rate in tropical & sub-tropical regions where there is no admixture of bottom water
Vitiaz (Kabanova, 1961) Arabian Sea Stations.			
4708	1.51		
4712	0.58		
4718	2.74		
Androth—surface	11.136	..	
middle layer	8.546		Low
bottom layer	5.249		
Minicoy lagoon surface	38.224		
bottom	29.552		High
Minicoy deep region-surface	6.446	300	-do-
Kalpeni—surface	33.524		
middle layer	23.618		
bottom	10.121	..	-do-
Inshore waters of Mandapam	25 to 435	..	Very high

It may be seen, from the experiments conducted so far, that the waters around Androth are having the lowest rates of production with an average of 8.31 mg C/m³/day. The waters of Minicoy were found to have the highest production rates with an average value of 33.89 mg C/m³/day and at Kalpeni it was 22.42 mg C/m³/day. The surface samples of the deeper waters off

Minicoy where active tuna fishing was going on, the value was 6.446 mg C/m^3/day. But in view of the depth of the photosynthetic zone as revealed by Secchi disc readings, the production for the entire water column would amount to about 300 mg C/m^2/day which is a fairly high rate. Holmes *et al.* (*l.c.*) observed values of 0.40 mg C/m^3/ day for the surface waters of the California current and North Equatorial current in the offshore regions of Baja California and Central Mexico. This is a very low concentration whereas off Central America 115° W longitude and northern boundary of Peru Current, a production rate of 25 mg C/m^3/ day has been observed, which is a very high concentration amounting to values over 414 mg C/m^2/day.

Galathea stations at middle latitudes in the western part of the Indian Ocean outside the continental shelf showed a production rate of 100 to 200 mg. C/m^2/day. According to Steemann Nielsen and Jensen (1957) that is the value normally found in tropical and sub-tropical oceanic regions in the absence of any admixture of nutrient-rich water from below, whereas a daily organic production of about 200-500 mg C/m^2/day is found in regions with a fairly steady admixture of new water to the photosynthetic zone. The same authors noted in the stations on the *Galathea* section from Mombasa to Ceylon a pronounced maximum of production between 57° to 72°E longitude. Quite recently *Vitiaz* expedition (Kabanova, 1961) observed in the Arabian Sea-water, high production rates in regions of deep water ascent. Though based on entirely different technique, calculations of phytoplankton production in eight stations between latitudes 6° and 9° N and longitudes 50° and 70°.E made during the John Murray Expedition, showed that the production is 14.4 gm/m^2/day (wet weight) or 345.6 mg C/m^2/day, which is of a high order. The influx of cold Antarctic bottom water and the influence on the organic productivity of these waters have been discussed by Prasad (1951). The physico-chemical observations conducted by Jayaraman *et al.* (1959 & 1960) in the Laccadive offshore waters have yielded very interesting results regarding the water movements and the productivity of these regions. According to these authors, the vertical distribution of oxygen which shows an oxygen-minimum layer of several metres thickness with the upper layer at 150 metres is closely related to the high organic productivity of these waters and apart from this the geostrophic pattern of circulation helps to maintain the highly productive waters around the islands for a considerable length of time. Thus all the evidences point to the fact that the rate of production is quite high in the Laccadive waters with very high production rates in certain localised areas.

According to Nakamura (1952), in the East Philippine Sea, South Sea, Celebes, North Guinea, Solomon Islands, etc., the catch rate of tunas was higher during the south west monsoon. On the west coast of India, the phytoplankton standing crop (Subrahmanyan, 1959) and organic productivity (Sarma — personal communication) are at the maximum during the south west monsoon months. If this is the case for the offshore regions also a much higher production rate could be expected when the seasonal maxima are taken into account as well. Hence it may be observed that intensive investigations on the productivity of these waters together with the data on water temperature, salinity, etc., which offer favourable conditions for the habitation of tunas would give useful information for the exploitation of this valuable resource.

Summary

A preliminary account of the organic productivity of the tuna fishing grounds of Laccadive waters has been given based on some ^{14}C experiments conducted in this region and also from the data collected by *Galathea* and *Vitiaz* expeditions from the adjacent waters. The available data indicate a high productivity. Detailed investigations both spatial and temporal will have to be conducted for obtaining a comprehensive view of the fisheries potential.

Acknowledgements

The authors are grateful to Dr. S. Jones, Director, Central Marine Fisheries Research Institute, Mandapam Camp, for his keen interest and encouragement in these investigations. The

authors are also thankful to Mr. P. T. Thomas and other members of the staff of the Central Marine Fisheries Research Centre, Minicoy for their help in conducting the experiments, to the Captain and crew of *M. V. SEA FOX* for their co-operation, and to Mr. Mohammed Moideen for assistance in field-work.

REFERENCES

HOLMES, R. W., M. B. SCHAEFER AND B. M. SHIMADA 1957. Primary production, chlorophyll and zooplankton volumes in the tropical eastern Pacific Ocean. *Bull. Inter-Amer. Trop. Tuna Comm.*, **2** : 129-156.

JAYARAMAN, R., C. P. RAMAMIRTHAM AND K. V. SUNDARARAMAN 1959. The vertical distribution of dissolved oxygen in the deeper waters of the Arabian sea in the neighbourhood of the Laccadives during the summer of 1959. *J. Mar. biol. Ass. India*, **1** : 206-211.

JAYARAMAN, R., C. P. RAMAMIRTHAM, K. V. SUNDARARAMAN AND C. P. ARAVINDAKSHAN NAIR 1960. Hydrography of the Laccadive offshore waters. *Ibid.*, **2** : 24-34.

JONES, S. 1958. The tuna live-bait fishery of Minicoy. *Indian J. Fish.*, **5** : 303-308.

KABANOVA, Y. G. 1961. Primary production and nutrients in the Indian Ocean. *Acad. des Sci. de l'URSS Comite de l'Annee Géophysique Internationale*, X section of the IGY program (Oceanology) No. 4, Moscow, 72-75.

NAKAMURA, H. 1952. The tunas and their fisheries. *Spec. Sci. Rep. U.S. Fish Wildl Serv.*, **82** : 1-115.

PRASAD, R. R. 1951. Geographical and climatic features of India and the hydrology of the surrounding seas. *Hand Book of Indian Fisheries, Govt. of India, Ministry of Agri., New Delhi*, 17-23.

PRASAD, R. R. AND P. V. R. NAIR 1960. A preliminary account of primary production and its relation to fisheries of the inshore waters of the Gulf of Mannar. *Indian J. Fish.*, **7** : 165-168.

SHIMADA, B. M. 1958. Geographical distribution of the annual catches of yellowfin and skipjack tuna from the eastern tropical Pacific ocean from vessel log-book records, 1952-1955. *Bull. Inter-Amer. Trop. Tuna Comm.*, **2** : 289-363.

STEEMANN NIELSEN, E. AND E. A. JENSEN 1957. Primary oceanic production. The autotrophic production of organic matter in the oceans. *Galathea Repts.*, **1** : 49-136.

SUBRAHMANYAN, R. 1959. Studies on the phytoplankton of the west coast of India. Part I. Quantitative and Qualitative fluctuation of the total phytoplankton crop and their inter-relationship, with remarks on the magnitude of the standing crop and production of matter and their relationship to fish landings. *Proc. Indian Acad. Sci.*, **50B** : 113-187.