J. mar. biol. Ass. India, 1994, **36** (1 & 2) : 188 - 193

TUNA RESOURCES OF THE MADRAS COAST WITH A NOTE ON THE GROWTH PARAMETERS OF *EUTHYNNUS AFFINIS* (CANTOR)*

S. SRINIVASARENGAN, M. D. K. KUTHALINGAM AND E. VIVEKANANDAN

Central Marine Fisheries Research Institute, Cochin 682 014

ABSTRACT

During the years 1981-1986, an estimated annual average catch of 25 tonnes of tunas were landed by gill nets operated from commercial mechanised vessels from the Kasimedu landing centre, Madras, where all the catches from mechanised vessels land. This catch was obtained by expending annual average of 18,209 fishing hours with a catch rate of 1.4 kg/hr. It was observed that the maximum catch and catch rate were during April. Of the five species that constituted the fishery, *Euthynnus affinis* (79.9%) dominated the catch followed by *Katsuwonus pelamis* (12.4%); *Thunnus albacares, Auxis thazard* and *Sarda orientalis* formed the rest of the catch. The von Bertalanffy parameters of growth were calculated for *E. affinis* by length frequency method and the values were compared with those obtained for the species from other regions.

Based on the data collected during the 6 year period, Maximum Sustainable Yield and Optimum fishing effort were estimated for tunas in the commercial fishing grounds off Madras (12.80/4C, 5C and 6C, 13.80/1C, 2C, 3C and 4C). The MSY was 27 tonnes and the optimum fishing effort was 17,826 hours. These estimations reveal that the tuna stock of the inshore area off Madras may not stand to any further increase in fishing effort.

INTRODUCTION

TUNA forms one of the important fishery resources of Madras Coast. Recently the tuna fishery resources along the east and west coasts of India have been reviewed in detail by different workers (Tuticorin : Siraimeetan, 1985; Vizhinjam : Pillai and Sarma, 1985; Cochin : Silas *et al.*, 1985 a; Calicut : Balan and Yohannan, 1985; Mangalore : Muthiah, 1985; Ratnagiri : Silas *et al.*, 1985 b; Minicoy : Madan Mohan *et al.*, 1985). However, there is no report so far on the tuna resources of Madras Coast. The present paper deals with the fishery as well as Maximum Sustainable Yield (MSY) of tuna along the Madras Coast with an objective to suggest the optimum fishing effort.

The growth parameters of the little tunny, *Euthynnus affinis* have been estimated in five centres along the Indian Coast (Silas *et al.*, 1985 c). In the present paper, the growth parameters for *E. affinis* off Madras are estimated in order to compare the growth with that of the same species from other centres.

The authors are thankful to Dr. P. S. B. R. James, Director, CMFRI, Cochin for help and encouragement.

* Presented at the 'Symposium on Tropical Marine Living Resources' held by the Marine Biological Association of India at Cochin from January 12 to 16, 1988.

MATERIAL AND METHODS

In Madras, tuna is landed by gill net operated from mechanised vessels; tuna landings from other gears is meagre. Data on tuna catch and effort of commercial mechanised boats operating gill net from Kasimedu landing centre, Madras were recorded during the years 1981-1986 twice a week and weighted for monthly values. Each gill net operation in Madras Coast lasts for 6-8 hours and hence, fishing effort (in hours) was calculated by multiplying the estimated number of units by 7. For length frequency estimates, samples of *E. affinis* were collected every week from April 1981 to June 1986 and the length data obtained on each day were raised to the day's catch and these were further raised to get monthly length composition of catch.

The parameters of growth were estimated using von Bertalanffy equation :

$$lt = L_{\infty} [1 - e^{-k(t-t_0)}]$$

where L_{∞} is the asymptotic length; K the growth coefficient, t_0 the theoretical age when length is zero and lt the length at age t. The L_{∞} was estimated from the Ford-Walford plot (Ford, 1933; Walford, 1946) of lt + 1 against lt on the basis of lengths attained at intervals of 6 months.

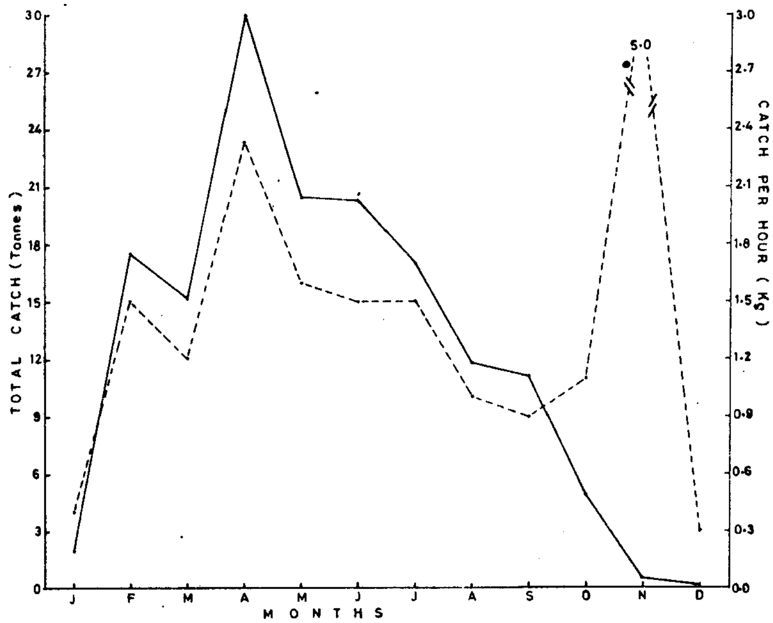

Fig. 1. Monthwise (Average) catch (—) and catch rate (....) of tuna for 1981-1986 at Madras.

For estimating Maximum Sustainable Yield, the 'Surplus yield' model of Schaefer (1954) and its variants were used. When fishing is conducted over a large number of years, there exists a relationship between the yield per unit effort (C/E) and fishing effort (E) (hrs), such as, C/E = a - bE, where a and b are constants of least square estimates (Graham, 1935; Schaefer, 1953, 1954; Ricker, 1975; Pauly, 1980). From differentiation, it follows that Maximum Sustainable Yield = $a^2/4b$ for a corresponding fishing intensity of f = a/2b. It also follows that

$$C = aE - bE^2.$$

Though the usual application of Schaefer's model is on a single species stock, it has been applied frequently to multispecies stock also (Lord, 1971; Krishnamoorthi, 1977).

To understand seasonal variations in catch and catch rate, the data obtained on monthwise tuna landings during the years 1981-1986 were pooled for respective months and plotted in

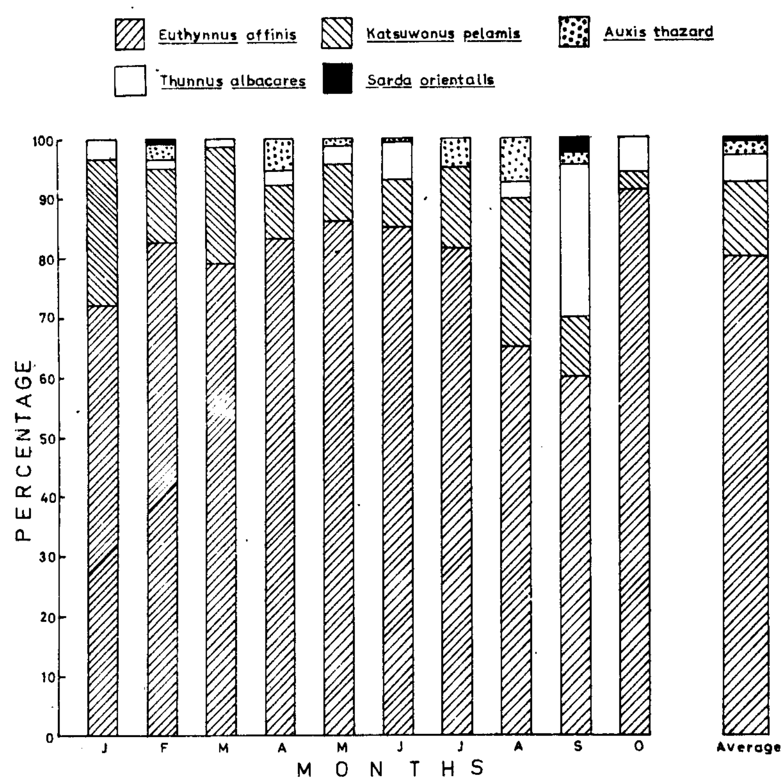

Fig. 2. Monthwise (Average) species composition of tuna for 1982-1985 at Madras.

Fig. 1. The catch increased from 2,317 kg in January to 29,964 kg in April and decreased in the subsequent months. During the NE monsoon months of November and December, the operation of gill net was suspended during most of the years and hence, the catch was negligible during these two months. Barring these two months, the catch rate ranged from 0.9 kg/hr (September) to 2.3 kg/hr (April).

Monthwise species composition of tuna was estimated for years 1982-1985 and presented in Fig. 2. Of the five species that constituted the fishery, the little tunny *Euthynnus affinis* (79.9%) dominated the catch followed

RESULTS AND DISCUSSION

Fishery

The estimated catch and catch rates of tuna from commercial mechanised vessels operating gill net during 1981-1986 are presented in Table 1. The annual catch was lowest (14,812 kg) in 1985 and highest (37,545 kg) in 1986. The maximum catch rate of 3.2 kg/hr was obtained during 1981. The annual average catch and catch rate were 25,151 kg and 1.4 kg/hr respectively.

by the skipjack tuna *Katsuwonus pelamis* (12.4%), the yellowfin tuna *Thunnus albacares* (4.6%), the frigate tuna *Auxis thazard* (2.8%) and the oriental bonito *Sarda orientalis* (0.3%). *E. affinis* and *K. pelamis* were available from January to October, *T. albacares* from January to June and from August to October, *A. thazard* during February and from April to September and *S. orientalis* only during February and September.

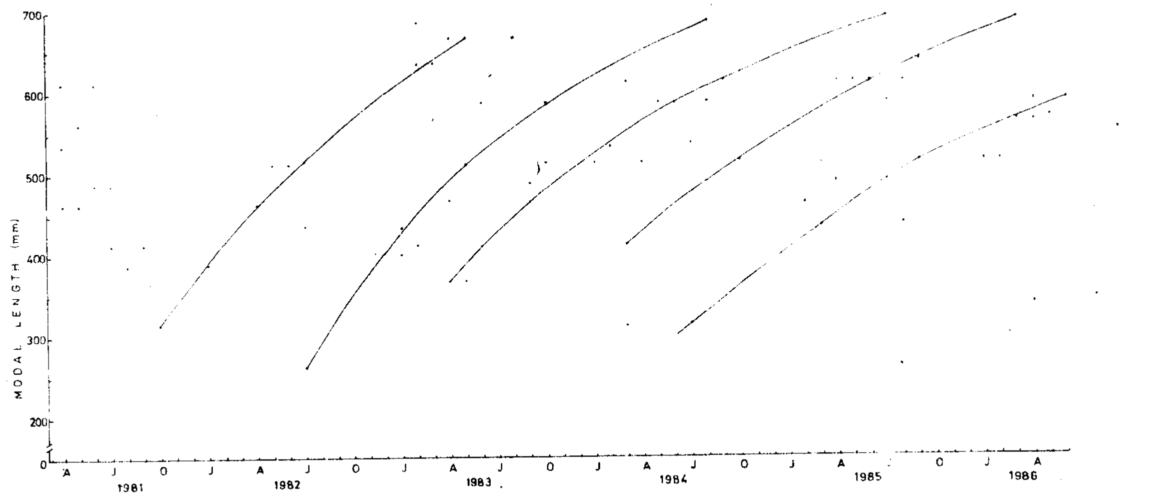

Fig. 3. Growth (in length) of *E. affinis* based on modal progression.

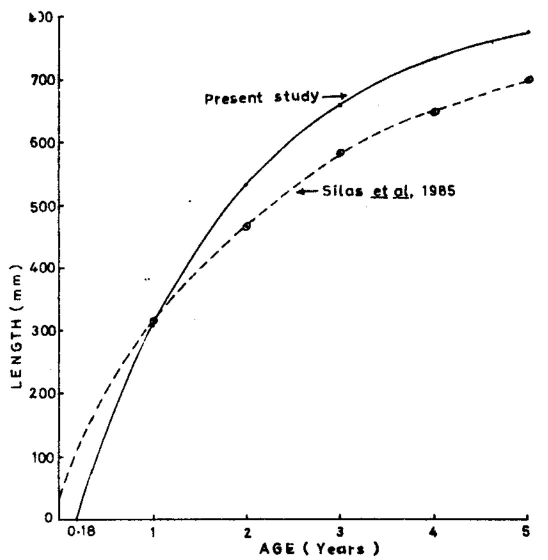

Fig. 4. von Bertalanffy growth curve for *E. affinis* of Madras Coast; the pooled growth curve for the same species from five different Indian centres (Silas *et al.*, 1985 c also given for comparison).

Growth of E. affinis

E. affinis ranging in total length from 250 to 699 mm were measured during the period from April 1981 to June 1986 and the modes in the length frequency distribution of each month were plotted (Fig. 3). By connecting the maximum number of modes, it was possible to obtain 5 growth curves with the available data. The lengths attained at half yearly intervals read off from each curve (starting from the minimum modal length) were used to estimate the von Bertalanffy parameters of growth (Vivekanandan and James, 1986). The 't_0' was calculated by using the following equation suggested by Pauly (1980) for fishes :

$$\log_{10} (-t_0) = -0.3922 - 0.2752 \log_{10} L_\infty - 1.038 \log_{10} K$$

The values of K, L_∞ and 't_0' thus estimated were 0.5638, 827 mm and 0.1807 year respectively. *E. affinis* attained the length of 306, 530, 658, 731 and 772 mm at the completion of 1, 2, 3, 4 and 5 years respectively (Fig. 4). The pooled values obtained for *E. affinis* from 5 different centres along the Indian Coast (Silas *et al.*, 1985 c), which closely compare with the present values, are also plotted in Fig. 4.

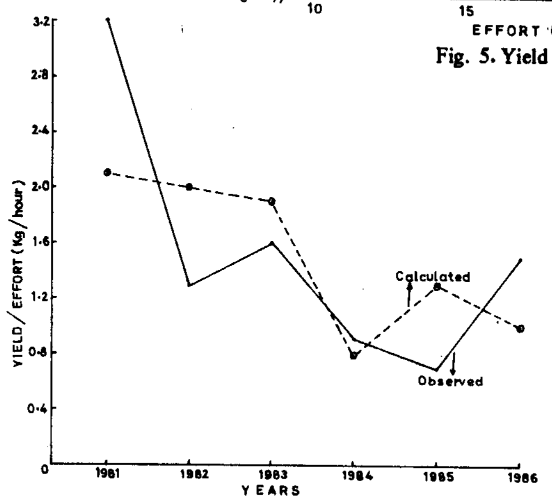

Fig. 6. Observed and calculated yield per effort of tuna for 1981-1986.

Maximum Sustainable Yield

The estimated values of MSY and optimum fishing intensity for tuna are plotted in Fig. 5

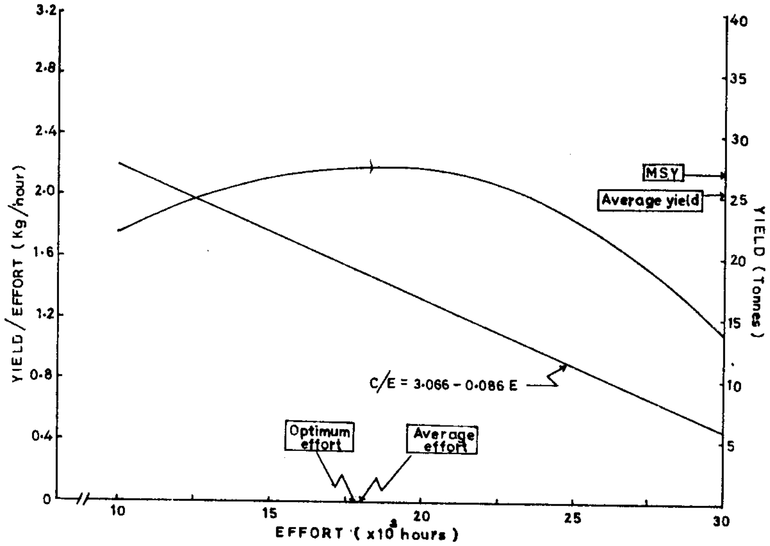

Fig. 5. Yield curve for tuna.

by using number of fishing hours (E) and yield (C) (total tuna catch is referred to as yield here). An analysis of relationship between E and C/E revealed the following equation with *r* value (coefficient of correlation) of 0.614.

$$C/E = 3.066 - 0.086 E.$$

TABLE 1. *Estimated catch and catch rate of tuna at Madras*

Year	Effort (hrs)	Catch (kg)	Catch rate (kg/hr)
1981	11133	35398	3.2
1982	12954	16932	1.3
1983	14073	22989	1.6
1984	26164	23229	0.9
1985	20632	14812	0.7
1986	24295	37545	1.5
Average	18209	25151	1.4

The estimated values of MSY and optimum fishing effort for tuna in Madras Coast are 27,326 kg and 17,826 hrs respectively. These estimated values are very close to the average yield of 25,151 kg and average fishing effort of 18,209 hrs for the years 1981-1986 (Table 1). It appears that there is no scope for increasing the effort for obtaining more tuna catch. The observed and calculated values of yield per effort over the 6 year period also suggest a decreasing trend (except the observed value in 1986) (Fig. 6). Hence, the tuna stock off Madras may not stand to further increase in fishing effort. However, the commercial gill netting off Madras is at present restricted to inshore waters in the areas 12.80/4C, 5C, 6C, 13.80/1C, 2C, 3C and 4C. Probably extension of fishing activity to offshore areas may increase the prospects of higher yield of tuna.

REFERENCES

BALAN, V. AND T. M. YOHANNAN 1985. Fishery and bionomics of tunas at Calicut. *Bull. Cent. Mar. Fish. Res. Inst.*, **36** : 115-121.

FORD, E. 1933. An account of herring investigations conducted at Plymouth during the years 1924-1933. *J. Mar. Biol. Ass. U.K.*, **19** : 305-384.

GRAHAM, M. 1935. Modern theory of exploiting a fishery and application to North Sea trawling. *J. Cons. Int. Explor. Nor.*, **10** : 264-274.

KRISHNAMOORTHI, B. 1977. Maximum equilibrium yields of demersal fisheries based on exploratory trawling. *Indian J. Fish.*, **24** : 76-82.

LORD, G. 1971. Optimum steady state exploitation of a multispecies population with prey-predator interaction. *Univ. Wash., Fish. Res. Cent. Quant. Sci. for Fish. Wildl. Quant. Sci. Pap.*, 29 pp.

MADAN MOHAN, P. LIVINGSTON AND K. K. KUNHIKOYA 1985. Fishery and bionomics of tunas at Minicoy Island. *Bull. Cent. Mar. Fish. Res. Inst.*, **36** : 122-137.

MUTHIAH, C. 1985. Fishery and bionomics of tunas at Mangalore. *Ibid.*, **36** : 51-70.

PAULY, D. 1980. A selection of simple methods for the assessment of tropical fish stocks. *FAO Fish. Circ.*, **729** : 54 pp.

PILLAI, P. P. AND P. S. S. SARMA 1985. Fishery and bionomics of tunas at Vizhinjam. *Bull. Cent. Mar. Fish. Res. Inst.*, **36** : 44-50.

RICKER, W. E. 1975. Computation and interpretation of biological statistics of fish population. *Bull. Fish. Res. Bd. Canada*, **191** : 382 pp.

SCHAEFER, M. B. 1953. Fisheries dynamics and the concept of maximum equilibrium catch. *Proc. Gulf & Carribean Fish. Inst., Annual Session VI, Miami.*

——— 1954. Some aspects of the dynamics of populations important to the management of commercial marine fisheries. *Bull. Inter-Amer. Trop. tuna Comm.*, **1** : 27-56.

SILAS, E. G., P. P. PILLAI, A. A. JAYAPRAKASH AND M. A. PILLAI 1985 a. Fishery and bionomics of tunas at Cochin. *Bull. Cent. Mar. Fish. Res. Inst.*, **36** : 28-43.

———, ——— AND PON. SIRAIMEETAN 1985b. Observations on the tuna fishery at Ratnagiri-Malwan area, Northwest coast of India. *Ibid.*, **36** : 184-187.

———, ———, M. SRINATH AND A. A. JAYAPRAKASH 1985 c. Population dynamics of tunas : stock assessment. *Ibid.*, **36** : 20-27.

SIRAIMEETAN, PON. 1985. Fishery and bionomics of tunas at Tuticorin. *Ibid.*, **36** : 86-103.

VIVEKANANDAN, E. AND D. B. JAMES 1986. Population dynamics of *Nemipterus japonicus* (Bloch) in the trawling grounds off Madras. *Indian J. Fish.*, **33** (2) : 145-154.

WALFORD, L. A. 1946. A new graphic method of describing the growth of animals. *Biol. Bull. Woods Hole.*, **90** : 141-147.