Management of Scombroid Fisheries

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Stock assessment of the oceanic skipjack, *Katsuwonus pelamis* in Minicoy, Lakshadweep

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ABSTRACT

The annual catch of skipjack tuna *Katsuwonus pelamis* at Minicoy fluctuated between 721.2 t and 1036.5 t during 1993-'98 with an average catch of 827.6 t which constituted about 89 % of the total tunas landed by pole and line (live bait) fishery and troll line fishery. The growth parameters estimated for skipjack tuna were L_∞= 92.6 cm and K= 0.98 (annual). Following VBGF this species is found to attain a length of 57.8, 79.6, 87.7 and 90.8 cm during the I,II,III and IV years respectively. Average monthly growth rate was 48.2, 18.1, 16.8 and 2.6 mm for the year classes I-IV respectively. Relatively higher total mortality rate (7.99) and fishing mortality (6.93) were recorded in the present study compared with the previous reports. Similarly the exploitation rate (E) of 0.87 derived during the present study indicates that skipjack tuna is commercially exploited from its distribution range in a relatively high rate when compared to previous studies. Relative yield per recruit is maximum at an F of 0.676 and optimum E is 0.367 indicating that the current level of exploitation is high. The recruitment to the fishery was observed to be at its peak during September- October.

INTRODUCTION

The oceanic skipjack *Katsuwonus pelamis* (Linnaeus) forms a significant fishery in the Lakshadweep islands constituting about 85% of the total pole and line tuna catch. Details of pole and line fishery, craft and gear, fishery and utilisation of skipjack tuna has been presented by Jones and Kumaran (1959), Silas and Pillai (1982), Madan Mohan *et al.* (1985), Varghese and Shanmugham (1989), Pillai (1991) and James and Pillai (1993). Studies on biological aspects like length frequency distribution, age and growth, spawning and recruitment, vital rates and stock assessment have been published by Appukuttan *et al.* (1977), Madan Mohan and Kunhikoya (1985a), Silas *et al.* (1985), James *et al.* (1993) and Yohannan *et al.* (1993). In the present paper, the fishery and biology of skipjack tuna at Minicoy island (08° 17' N –73° 04' E), UT Lakshadweep during the period 1993-'98 has been studied and results presented and critically discussed.

MATERIALS AND METHODS

Random samples of skipjack tuna landed by the pole and line units at Minicoy were collected and measured for fork length (cm) and grouped at 2 cm intervals. Data was analysed using FiSAT programme by pooling the length frequency data monthwise during the 1993-'98 period to obtain estimates of L_∞ (cm) and K (annual), mortality rates, recruitment patterns and yield per recruit(Y/R).

RESULTS

Fishery

The annual catch of skipjack tuna during 1993-'98 fluctuated between 721.2 t (1997) and 1036.5 t (1994) with an average catch of 827.6 t (Fig.1). Monthly variations in catch and CPUE was observed with peak landings during October- April. Quarter-wise, the fourth (October-December) and first (January to March) were most productive. Fishing activity is suspended by May/June as the lagoon becomes inaccessible to the mechanized boats during the monsoon and resumes only by August/September.

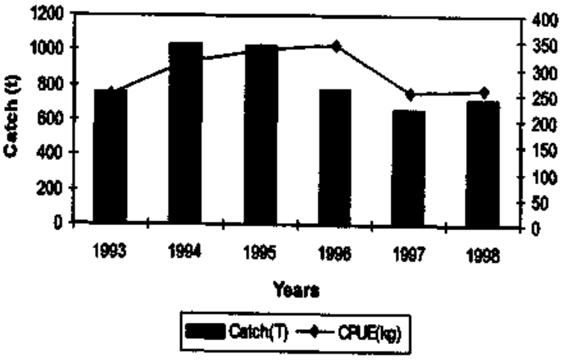

Fig. 1. Catch and CPUE of *K. pelamis* in the pole and line fishery at Minicoy during 1993-'98

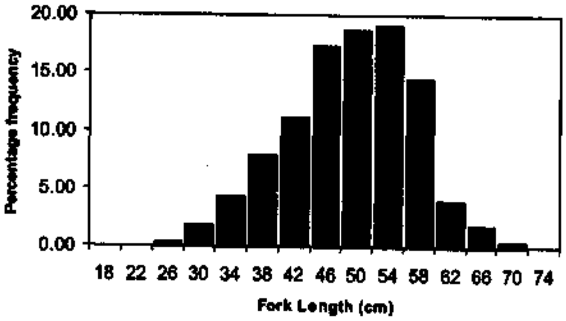

Fig. 2. Average percentage frequency of length groups of *K. pelamis* in pole and line fishery of Minicoy during 1993-'98

Length frequency distribution

The fishes ranged in size from 18-74 cm with the major fishery supporting group in the 46-54 cm range. Average percentage frequency of length groups of *K.pelamis* during the period 1993-'98 is presented in Fig.2.

Spawning and recruitment

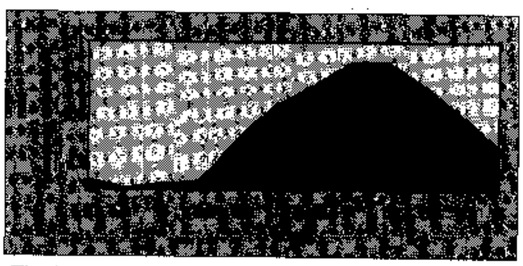

Fig. 3. Recruitment pattern of *K. pelamis* in the pole and line fishery at Minicoy during the period 1993-'98

The recruitment pattern of *K.pelamis* in the pole and line fishery at

Minicoy during the period is given in Fig. 3. In the present study recruitment to the fishery was observed to be at at its peak during August - October.

Growth studies

Length frequency analysis using the ELEFAN module of FiSAT (Fig.4) gave estimates of the growth parameters L_∞ = 92.6 cm and K = 0.98 (annual) according to which skipjack attains a length of 57.8, 79.6, 87.7 and 90.8 cm in the first, second, third and fourth years of life respectively. In the present study the average monthly growth rate was 48.2, 18.1, 16.8 and 2.6 mm during the first to fourth years of life respectively. A comparison of the growth parameters and length at age obtained by the species in the previous studies is given below:

L_∞(cm)	K(yr^{-1})	t_0	Length (cm) at age (years)				Author
			I	II	III	IV	
84.2	0.22	-1.93	40.6	49.3	56.2	60.4	Appukuttan *et al.* (1977)
90.0	0.49	-.06	36.7	57.3	69.0	77.7	Madanmohan & Kunhikoya (1985b)
66.0	1.1	0	44.0	58.7	63.6	65.2	Yohannan *et al.* (1993)
92.6	0.98	-.01	57.8	79.6	87.7	90.8	Present study

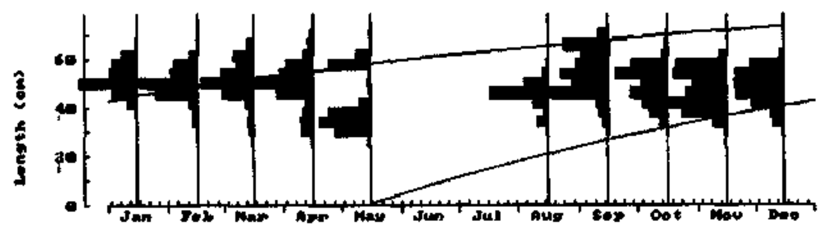

Fig.4. The growth curve of skipjack *Katsuwonus pelamis* occurring in the pole and line fishery of Minicoy estimated using the ELEFAN I module of FiSAT

Mortality estimates and relative yield per recruit:

The total mortality (Z), fishing mortality (F), natural mortality (M) and exploitation rate (E) were estimated (Fig. 5) as follows:

Z = 7.97
M = 1.04
F = 6.93
E = F/Z=0.87

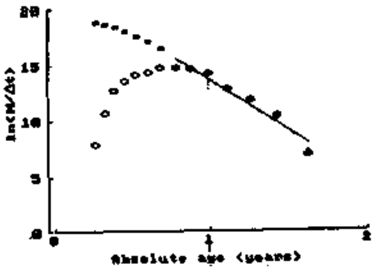

Fig. 5. Length converted Catch Curve Z=7.9, F=6.9, E=0.8

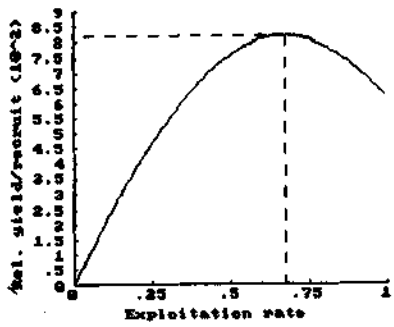

Fig. 6. Relative yield per recruit analysis. E_{max} = 0.68, E_{opt} = 0.4

The relative yield per recruit was found to be highest at an exploitation rate (E) of 0.676 while the present E was 0.87 (Fig.6).

DISCUSSION

Appukuttan *et al.* (1977) stated that month to month variation in the catch was very pronounced and the peak season for the fishery to be during November to March with a major peak in March and a minor one in December. Hunter (1986) observed that seasonal movements of skipjack tuna may be related more to changes in forage availability than to an inherent migratory cycle. Mathew and Gopakumar (1986) monitored the environment of skipjack tuna fishing grounds of Minicoy and observed higher secondary production during January/February which was followed by the appearance of baitfishes in March/April attracting tuna shoals. Pillai and Gopakumar (1987) summarised the probable factors controlling the migration of skipjack tuna around Lakshadweep based on the data collected both from the pole and line and troll line fisheries.Yohannan *et al.* (1993) observed that availability of skipjack schools is governed by forage availability (baitfishes like sprats and caesionids). While sprats are resident species in the Minicoy lagoon, caesionids are migratory species attracting large schools of skipjack tuna. These factors, namely, environmental conditions and the abundance / non- availability of baitfishes, may explain the temporal variations in skipjack abundance and their catches at Minicoy. Yohannan and Pillai (1993) have already observed that the artisanal skipjack fishery at Minicoy is not of much consequence to the skipjack stocks and decline in catches could be due to lack of efficiency of exploitation and also changes in pattern of the movement of fish chiefly due to certain environmental factors.

Earlier, Yohannan *et al.* (1993) have reported a size range of 20-70 cm with a major mode at 60 cm , and two secondary modes at 38 and 52 cm, while in the present study there was a single mode at 52 cm. Stequart and Marsac (1989) have reported that the size range of skipjack in the Central Indian Ocean ranges between 20-80 cm with variations according to the fishing techniques used.With improved fishing technologies, the area and season of fishing operations at Minicoy are expanding and this will be reflected in the representation of various size groups in the catches landed.

Jones and Silas (1963) have reported that skipjack tuna spawn from January-April and June- September with maximum activity in January and June. Madan Mohan and Kunhikoya (1985a) from their observations of mature females throughout the year and young fish of about 30 cm during January-May and September to December concluded that in Minicoy waters skipjack tuna spawns throughout the year. However, Yohannan *et al.* (1993) reanalysed the data presented by Madan Mohan and Kunhikoya (1985) and opined that the skipjack shows a spawning peak around March/ April period and probably a minor peak in December. In the present study, as observed from the recruits entering the pole and line fishery a prolonged spawning period with a peak during April - June period is indicated.

Based on the purse seine fishery data in the Western Indian Ocean (both in the float associated and free school fisheries), Marcille (1996) summarised the growth estimates of skipjack tuna. Only limited studies have been carried out on the age and growth of skipjack tuna in the Indian seas as by Appukuttan *et al.* (1977); Madan Mohan and Kunhikoya (1985); Pillai and Gopakumar (1987) and Yohannan *et al.* (1993).

Growth comparison of fish based on a single parameter K or L_∞ (W_∞) is misleading (Pauly,1979) and some authors like Pauly and Munro (1984), Moreau *et al.* (1986) and Moreau (1987) have proposed an indice of overall growth performance (ϕ') based on the two parameters L_∞ and K , because these are correlated and the growth curves themselves are produced by growth rates that are constantly changing with time and size. In the present study the average monthly growth rate was 48.2, 18.1, 16.8 and 2.6 mm during the first to fourth years of life respectively, while the monthly growth rate of skipjack from Pacific and elsewhere varies between 20.58 - 43.58, 12.5 -23.3 , 6.6 -13.91 and 4-11.58 mm during the first to fourth years of life respectively (Madan Mohan and Kunhikoya, 1985) which agrees with the results of the present study.

Yohannan and Pillai (1993) observed that in the case of an artisanal skipjack tuna fishery with restricted fishing area and seasons, depending on a migratory stock exploited by other countries also, the catches may not represent the true conditions of the stocks of skipjack available for exploitation and the population parameters estimated by sampling them can be biased. They also suggested that gears like drift gill nets and purse seines which do not depend on the availability of light, baitfishes or feeding condition of skipjack can improve the catches and help estimate more reliable population parameters. Stequert *et al.* (1993) has opined that the effect of environment on tuna stocks can be summarised at two levels: recruitment and availability to the gears. Therefore, a holistic approach , taking into consideration environmental factors has to be used to understand the annual variations in the fishery. Further, the recommendations of the 1993 Tuna Colloquium, for co-operative tagging programmes with countries in the Indian Ocean, fishing for tuna in the adjacent geographic realms and a critical review of existing production models for assessing the status of tuna stocks should be given priority.

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