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A PRELIMINARY ANALYSIS OF LENGTH FREQUENCY DATA OF *AMBLYGASTER SIRM* FROM NEGOMBO, SRI LANKA USING ELEFAN PROGRAMS

By

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ABSTRACT

ELEFAN programs were applied to length frequency data of *Amblygaster sirm* from gillnet fishery in Negombo. Fishing mortality showed a 70% increase from 1980/81 to 1983/84 while the Exploitation rate (F/Z) increased from 0.40 to 0.53 during the respective periods. The increase in fishing pressure, from about 200 boats in 1980/81 to 600 boats in 1983/84, is also reflected in catch per unit effort estimations, indicating an urgent meed for further investigations before the fishery is allowed to expand any further.

INTRODUCTION

The spotted sardine, *Amblygaster sirm* is a dominent species in the small mesh gillnet fishery conducted within the inshore waters of Sri Lanka. The gillnets, with mesh size ranging from 23 mm to 38 mm stretched mesh, are mostly operated from 17 to 23 ft. fibre glass boats powered by 6 to 15 HP out-board engines. A large concentration of these boats are at Negombo, where this species is caught year round in the gillnet fishery.

While there is hardly any information on *A. sirm* around Sri Lanka, studies off Vizhinjam in Indian coast (Radhakrishnan, 1973) indicate the possibility of two spawnings in an year. Pauly (1978) estimated the growth parameters of *A. sirm* from Indo-Pacific region using length frequency data.

In this paper, the growth, mortality, selectivity and recruitment patterns for *A. sirm* from Negombo have been estimated by applying ELEFAN programs to length frequency data for two different periods, April 1980 to March 1981 and Sept. 1983 to August 1984. The catch, effort and catch per unit effort of the fishery for the two periods are also analysed for possible indications on the status of the fishery.

MATERIALS AND METHODS

Sampling for the fishery and biology of *A. sirm* was attempted once a week and on four days per month as far as possible. Information was collected from ten boats, selected by systematic random sampling, on each sampling date. As the sardines are sold by numbers, the numbers of *A. sirm* caught by each boat was estimated first. This was then used, along with the mean weight of a fish, to estimate catch by weight. The monthly catch and effort values were estimated using catch and effort information obtained during sampling days.

Most of the crafts were observed to take 20 to 24 pieces of gillnets on board. The mesh size in these nets ranged from 23 mm to 38 mm, with 28.5 mm to 30 mm range being more popular. The fishing effort in this instance is therefore expressed in terms of number of boats operated as it would not introduce much bias in the estimation of the index of stock density.

Total lengths (from tip of the snout to the tip of upper lobe of the caudal fin) were measured to the nearest millimetre using a measuring board. Random samples of about 100 fish were taken for this purpose on each sampling day. Monthly length frequency distribution were prepared by pooling length data for each month and grouping them into 1 cm. length classes.

The use of ELEFAN programs for the estimation of population dynamic parameters of fish species has been described by Pauly et al (1980 b, 1981) and David et al (1982). ELEFAN (0, I and II) programs were used with an Apple II e microcomputer to estimate L_{∞}, K, total mortality (Z) and fishing mortality (F), Exploitation rate, Recruitment and Selectivity patterns of *A. sirm*, from the length frequency data.

RESULTS AND ANALYSIS

(i) Analysis of catch and effort data

The estimated production of *A. sirm* at Negombo on a monthly basis is shown in fig. 1. Production ranged from 2 tonnes to 1985 tonnes per month. The monthly production values showed peak production during April to June and November to January with corresponding increases in catch per unit effort values. The production during April to June period was high with comparatively small fish (average weight of a fish being 26.4 gm. in 1980/81) while the November to January period had larger fish (average weight of a fish being 53.0 gm. in 1983/84).

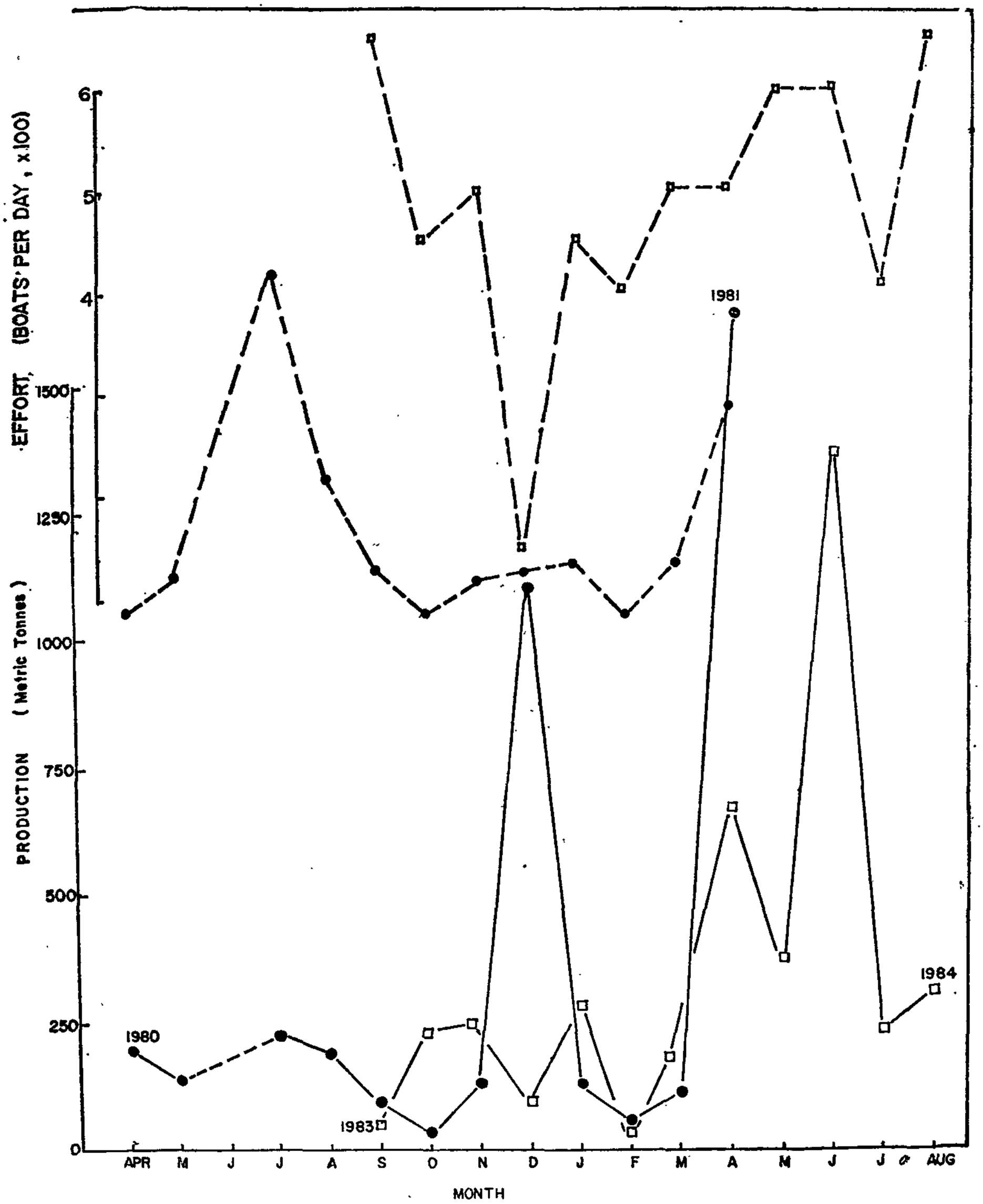


Figure 1: Monthly variation in effort (no. of boats) and production of A. sirm in gillnet fishery at Negombo.

Fishing effort index in terms of average number of boats operated per day is also given in fig. I for different months in 1980/81 and 1983/84 periods. The total number of boats operating at Negombo has increased from 200 in 1980/81 to 600 in 1983/84. The estimated mean catch per day for different months is shown in fig. 2 for the two periods. The mean catch per boat per day varied from 1.8 Kg. to 103.3 Kg. The catch per unit effort values in comparable months (September to March) were consistently higher during 1980/81 than in 1983/84, showing signs of excessive exploitation during 1983/84 period.

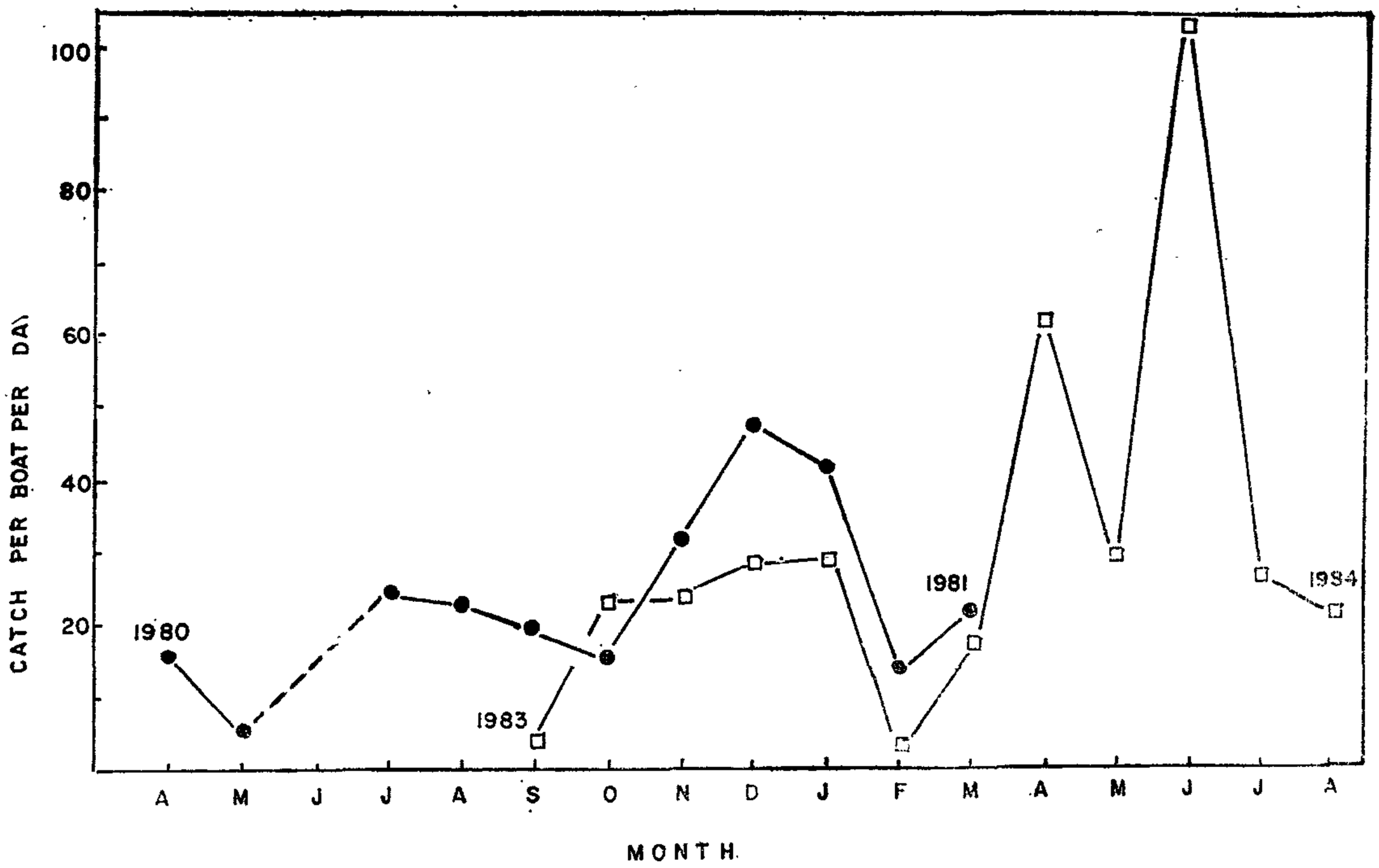


Figure 2 : Monthly variation in mean Catch Per Unit Eflort in the gillnet fishery at Negombo.

(b) Analysis of Length Frequency Data:

While ELEFAN 0 is a program designed primarily for creation, correction and modification of data files, ELEFAN I has been developed based on the integrated model progression analysis method, the optimization routine selecting the best curve passing through maximum number of peaks in a series of length frequency samples sequentially arranged in time, and in the process estimating the values of K and L_∞. The values of K and L_∞ obtained for length data of 1980/81 and 1983/84, together with the ESP/ASP ratios were;

	K	L_∞	*ESP/ASP*
1980/81	0.95	24.75 cm.	0.65
1983/84	0.95	24.80 cm.	0.89

The growth curves fitted, using the above K and L_∞ values, to the length data of 1980/81 and 1983/84, is shown in figure 3(a) and 3(b) respectively.

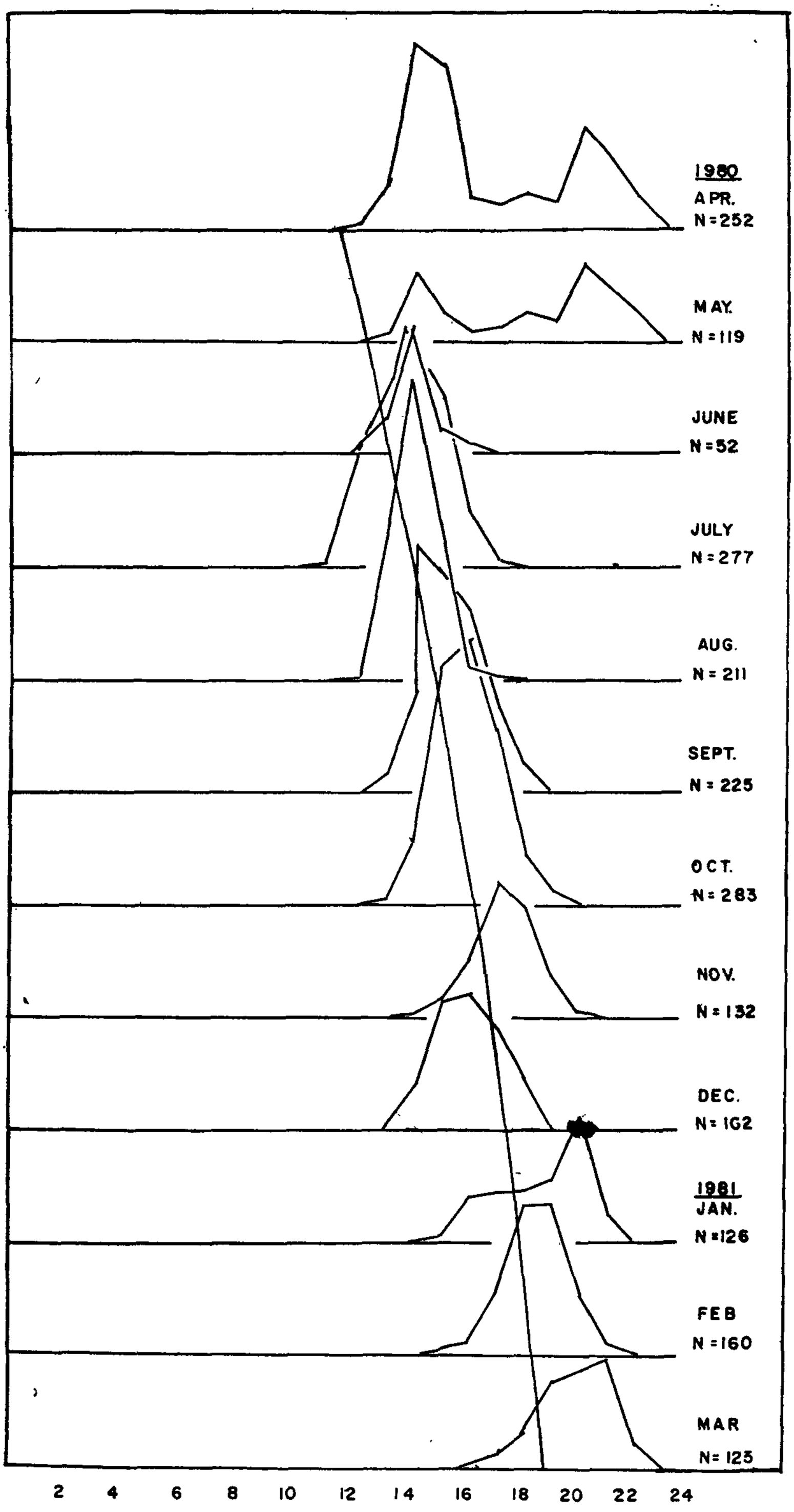


Figure 3: (a) Length frequency distribution of *Amblygaster sirm* — 1980/81 with growth curves fitted by ELEFAN I.

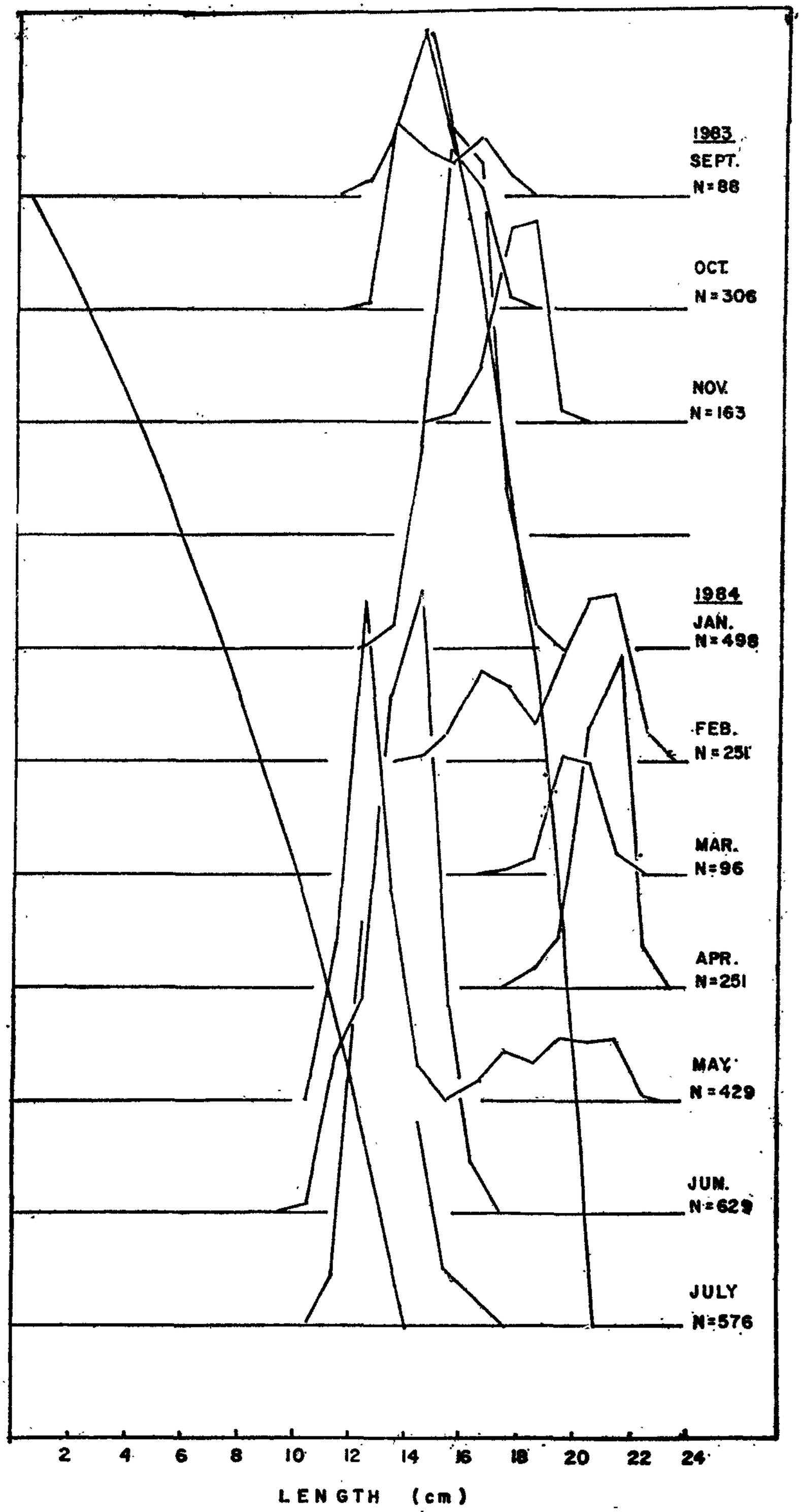
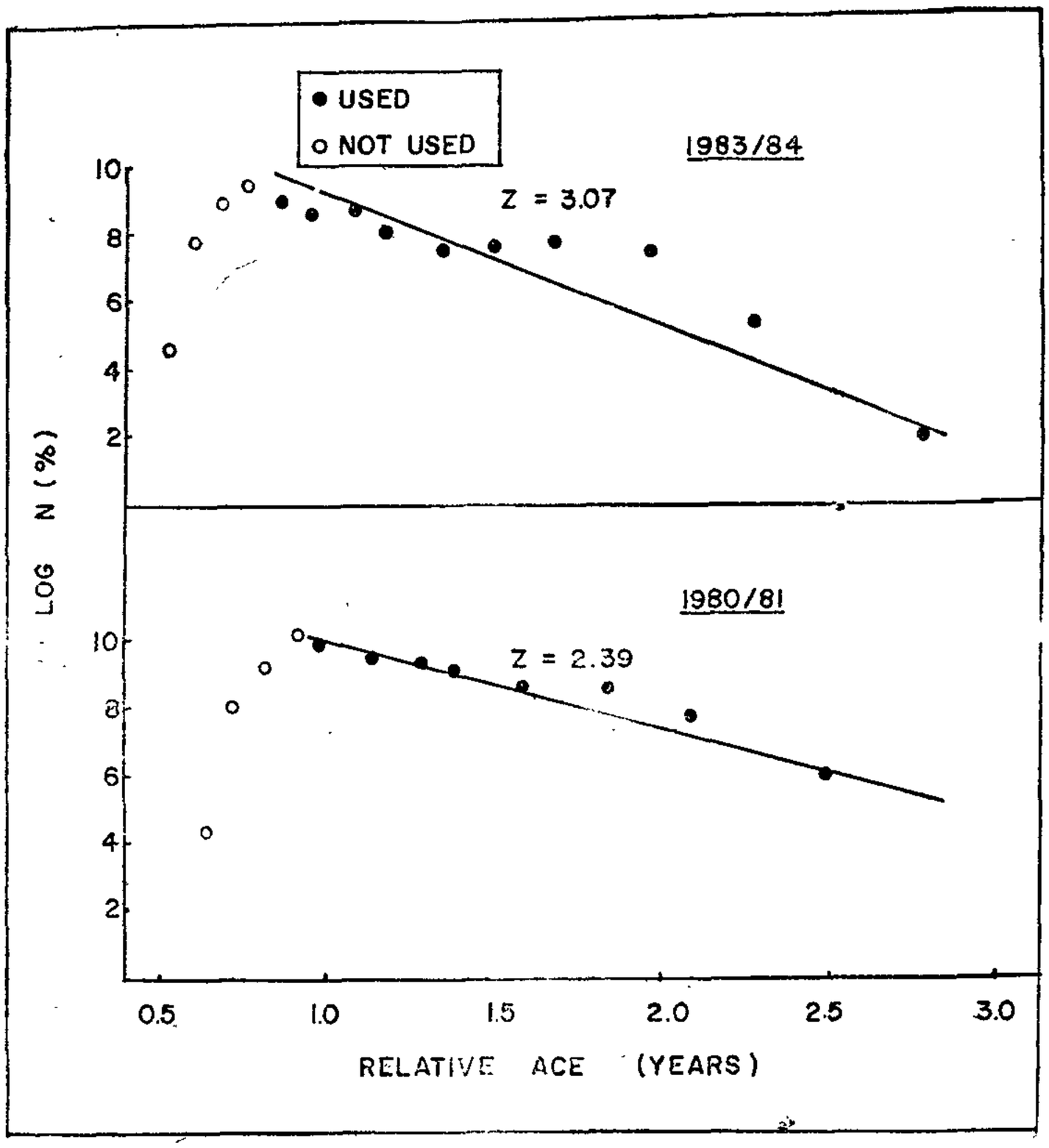


Figure 3 (b): Length frequency distribution of *Amblygaster sirm* — 1983/84 with growth curves fitted by ELEFAN I.

The length-converted catch curves, based on length frequency data shown in figures 3(a) and 3(b), and the growth parameters estimated above, are shown in figure 4.



Pig. 4: Length converted catch curves for *Amblygaster sirm* — based on growth parameters estimated by ELEFAN I.

The total mortality estimated from the catch curve and the fishing and natural mortalities from the multiple regression model are given below.

	Mortality			
Period	*Total* (*Z*)	*Fishing* (*F*)	*Natural* (*M*)	*Exploitation rate*
1980/81	2.39	0.96	1.43	0.40
1983/84	3.07	1.64	1.43	0.53

The selectivity pattern constructed from the catch curves is shown in fig. 5. L_{min}, L_c, and L' indicate the length at first capture; length at 50% probability of capture and length at complete recruitment to the fishery respectively. While L_{min} has remained at 11.0 cm, the length at 50% probability of capture has decreased from 14.0 cm. in 1980/81 to 12.8 cm. in 1983/84.

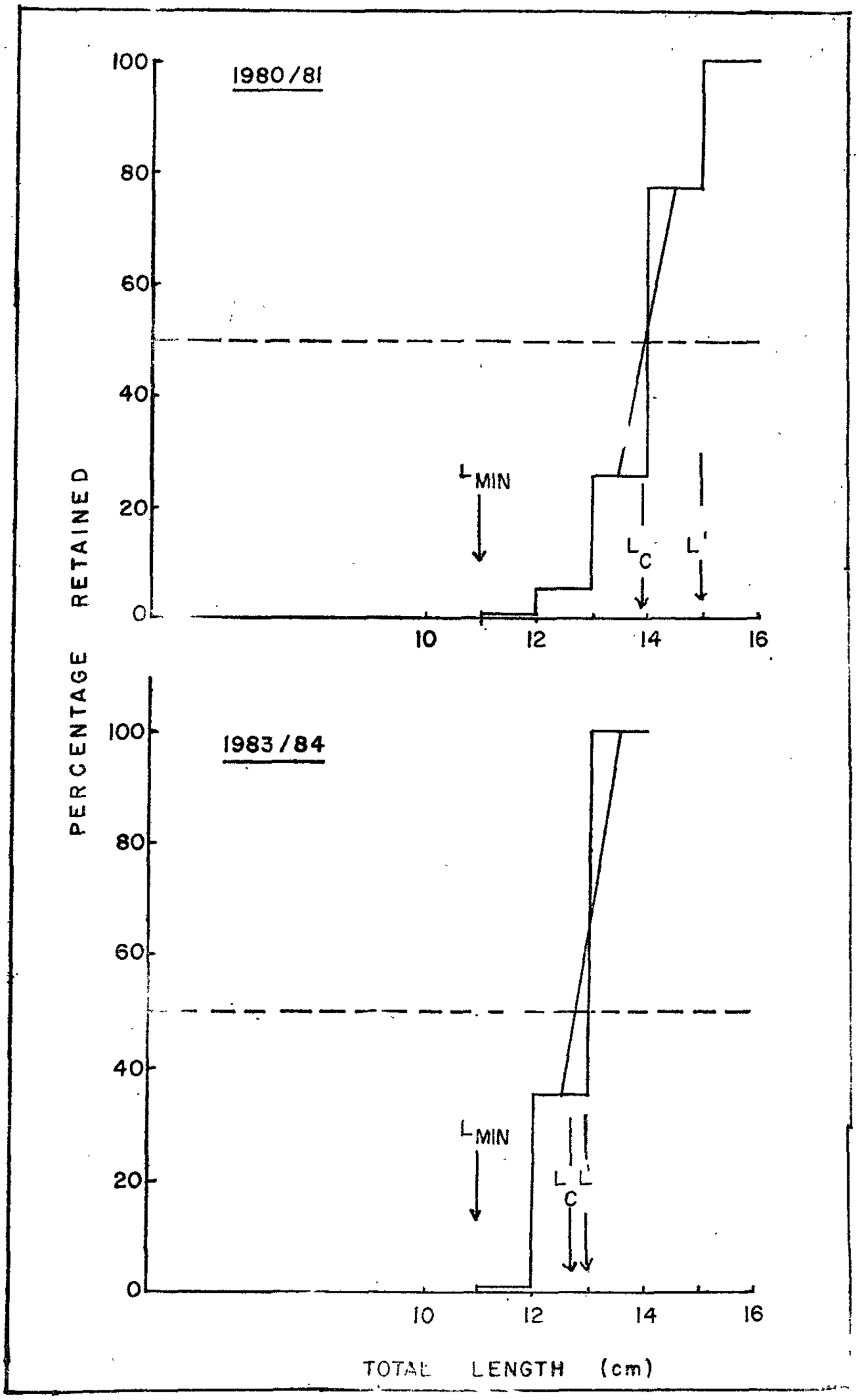


Figure 5 : Selection pattern of *Amblygaster sirm* as oblianed by ELEFAN II.

The recruitment patterns, derived from the length frequency data, for 1980/81 and 1983/84 is given in fig. 6. The separation of the recruitment pattern into their component distributions was done using NORMSEP. The recruitment pattern show possibility of two recruitments, separated by three months, in one year. The two pulses are of variable strength.

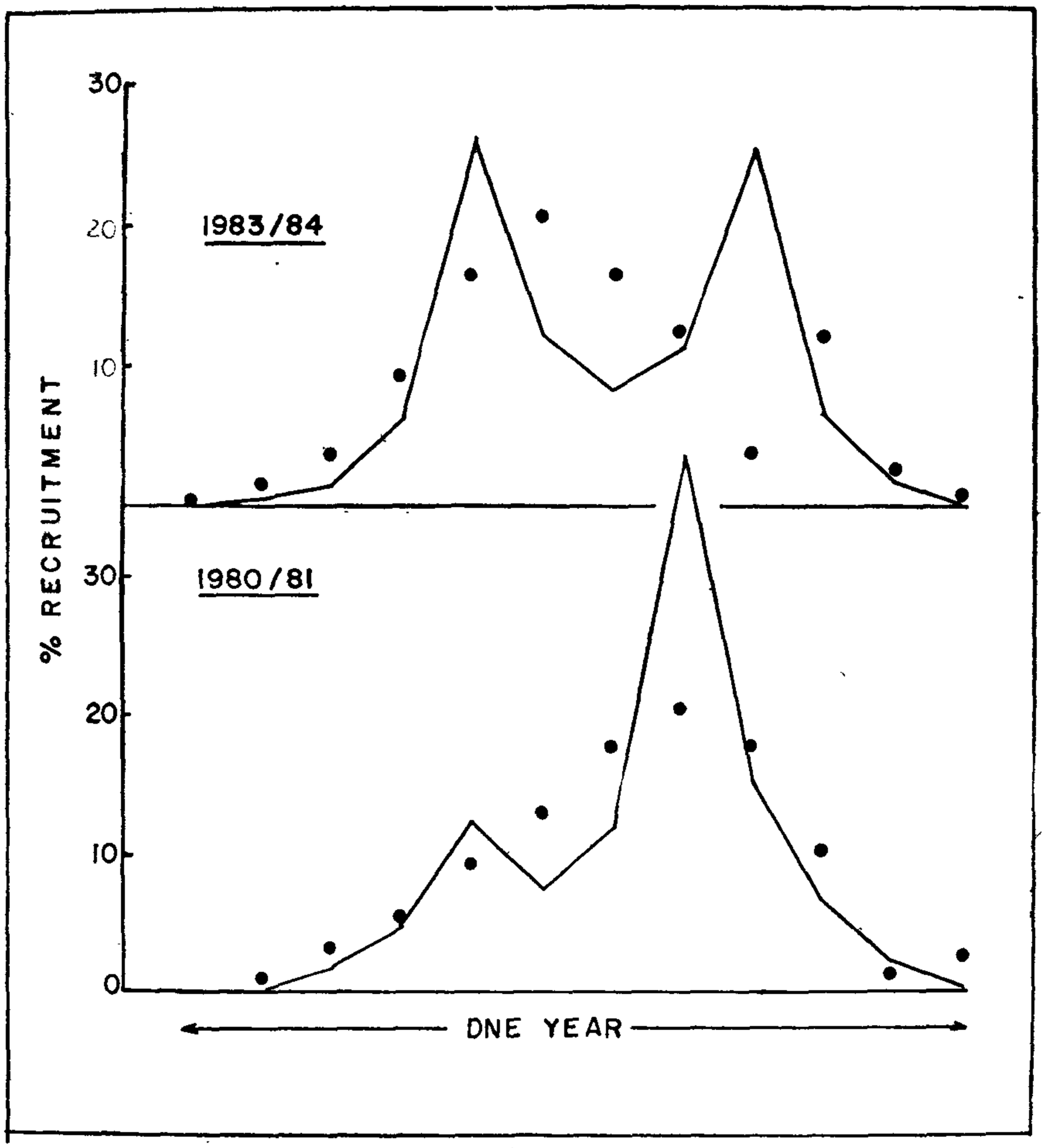


Figure 6 : Recruitment pattern for *Amblygaster sirm*, as estimated by ELEFAN II.

DISCUSSION

A comparison of catch and effort data in the fishery for the two periods show that an increase in fishing effort from 1980/81 to 1983/84 (200 boats in 1980/81 to 600 boats in 1983/84), has been accompanied by a decrease in catch per unit effort during most months. This indication of possible excessive or over exploitation of the resource is supported by the output from ELEFAN programs.

Values obtained for K and L_∞ of the von Bertlanffy growth equation were similar for both periods, 1980/81 and 1983/84. These values were higher than the values obtained by Pauly (1978) for *A. sirm* in the Indo-Pacific region, but can be considered reasonable since fish of total length 23 cm. have been sampled from the Negombo fishery. In gillnet fisheries where mesh size selects the size range of the population exploited, ELEFAN programs may fail to produce realistic and consistant results. The range of mesh sizes used in the gillnet fishery, at Negombo, 23 to 38 mm, has effectively sampled a wide length range of the exploited population to give good estimates for K and L_∞.

The natural mortality values obtained from ELEFAN II programs, based on Pauly's multiple regression model (Pauly, 1980) were considered to be over estimates for sardines (Pauly, personal communication). The computer output values of M were accordingly multiplied by 0.8 to obtain a value of 1.43 which is reasonable for a short lived species like *A. sirm*.

Fishing mortality has shown a 70% increase, from 0.96 in 1980/81 to 1.64 in 1983/84. While the total number of boats in the fishery has also increased from 200 in 1980/81 to 600 in 1983/84, fishing effort during different months was also much higher in 1983/84 period compared to 1980/81 period. The excessive fishing pressure is clearly indicated in the exploitation rate values obtained for the two periods, 0.40 in 1980/81 and 0.53 in 1983/84.

As the explcitation rate increases, the mean length at entry to the fishery decreases. The decrease in L_c value from 14.0 cm. in 1980/81 to 12.8 cm. in 1983/84, while there was no significant change in mesh sizes used validates the observations made on the changes in fishing mortality and exploitation rates during the two periods. The two recruitment pulses observed for *A. sirm* in Negombo has also been observed by Radhakrishnan (1973) for *A. sirm* off India and is considered normal for tropical fish (Pauly and Navaluna, 1983).

It is a general phenomena that the availability of small pelagic fish exhibit wide annual fluctuations, presumable due to variable recruitment levels in difierent years. Wide annual variation in recruitment may result in collapse of small pelagic fisheries when excessive fishing pressure is applied. Because of this, the level of exploitation in the case of small pelagic fish beyond 0.3 to 0.4 should be taken seriously.

In a multispecies fishery, the trends in the exploitation of the dominant varieties may also be indicative of the status of the whole fishery. In Negombo, as well as the whole coastal belt of Sri Lanka, gillnet fishery for small pelagic fish is confined to a narrow belt of 3 to 7 miles from the shore and concentrated closer to major fishing centres. This leads to the possibility of over exploitation of such resources in these areas. It is therefore important to carry out further investigations on the status of these resources before any expansion of the fishery is considered.

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