

Growth, Mortality and Recruitment Patterns of *Amblyrhynchthys truncatus* (Bleeker) in Paya Bungor, Pahang

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RINGKASAN

Kertas ini bermaksud untuk mendapatkan parameter-parameter pertumbuhan, kematian dan corak rekrutmen *Amblyrhynchthys truncatus* dengan menggunakan kaedah komputer untuk penganalisan data frekuensi panjang (ELEFAN I & II). Didapati bahawa spesies ini boleh mencapai usia empat tahun dengan parameter-parameter pertumbuhan berikut: $L_{\infty}=29.5\text{cm}$, $K=0.425$ dan $t_0 = -0.41989$. Walaupun kadar kematian semulajadi adalah sama dengan spesies lain di dalam tasik tersebut, tetapi kadar kematian penangkapan dan kadar eksploitasi adalah agak tinggi. Ikan ini senang ditangkap dengan menggunakan pukat tiga lapis dan penangkapan penuh berlaku pada saiz 18cm (panjang) dan purata panjang tangkapan pertama ialah 17.8cm. Terdapat satu musim rekrutmen yang kemuncaknya ialah pada bulan Januari.

SUMMARY

This paper attempts to determine the growth, mortality and recruitment patterns of *Amblyrhynchthys truncatus* by using a computer-based method for the analysis of length-frequency data (ELEFAN I & II). It is shown that this species has an approximate life span of four years with the following growth parameters; $L_{\infty}=29.5\text{cm}$, $K=0.425$ and -0.41989 . While natural mortality ($M = 1.04$) is comparable to other species in the lake, fishing mortality ($F = 4.15$) and exploitation rates are found to be relatively high. This fish is highly susceptible to trammel nets with full retention occurring at 18cm length while the mean length at first capture is 17.8cm. There appears to be a single recruitment season with a peak in January.

INTRODUCTION

In many countries, freshwater bodies are being exploited for domestic and industrial purposes, i.e. mainly irrigation and power supply. In Malaysia, besides water and power supply, greater emphasis is now being placed on further development and utilization of the water bodies for fisheries related purposes such as aquaculture and recreational fishing.

One of the areas being proposed for recreation and cages culture is Paya Bungor, a lake in Pahang. Its development will be undertaken by the Pahang State Economic Planning Unit under the project "Rancangan Projek Pelancongan Paya Bungor". Before the actual development takes place, it was thought that suitable studies should be carried out especially on limnology and fish population dynamics so that adequate management and

development strategies can be proposed. Thus a study was conducted by a research team from UPM from January to December 1982. With the exception of 2 papers published by the team recently (Ambak *et al.*, 1983; Fatimah *et al.*, 1983), no other information is available.

Ambak *et al.* (1983) found that the most dominant fish species in Paya Bungor is *Amblyrhynchthys truncatus*. This paper describes the state of this stock and its population dynamics.

METHODS AND MATERIALS

Samples were taken twice a month for 12 months at 2 stations using gill nets and trammel nets which were set overnight. Catches from gill nets and trammel nets were treated differently. For the purpose of this paper, only catches from

trammel nets are considered* and since the sample size is small, catches for the 2 stations have been pooled. The analysis of the population is made on a quantitative, mathematical basis.

Estimation of Growth Parameters from Length-Frequency Data

Growth is assumed to conform to the Von Bertalanffy Growth Formula (VBGF) ie

$$L_t = L_\infty(1 - e^{-K(t-t_0)}) \quad (1)$$

where L_t = length at age t

- L_∞ = theoretical asymptotic length
- K = growth coefficient
- t_0 = theoretical age at length zero

According to Gulland (1983), this formula fits most of the observed data on fish growth.

Only length data grouped in class intervals for each month are used. Since there are 2 sampling dates for every month, the monthly dates are set on the 15th. Analysis of the length frequency date for growth was done using a computer programme, ELEFAN I (Pauly *et al.*, 1980). This programme is basically a modification of the "Petersen method" which is based on modal progression in consecutive length-frequency histograms.

Estimation of Mortality Parameters from Length-Frequency Data

Using the growth parameters extracted from ELEFAN I, the length frequency data was analysed for estimation of total mortality and related parameters using ELEFAN II (Pauly *et al.*, 1981). This programme converts the data into a catch curve with the relationship:

$$\log_e (N/\Delta t) = a + bt^1 \quad (2)$$

Where N = number of fishes in a given length class

Δt = time needed to grow through a length class

and t^1 = relative age (ie when $t_0 = 0$)

Equation (2) has the form of a liner regression where the slope, b with sign changed, represents the total mortality, Z . Natural mortality M , can

be estimated from the empirical equation developed by Pauly (1980):

$$\begin{aligned} \log_{10} M = & - 0.0066 - 0.279 \log_{10} L_\infty \\ & + 0.6543 \log_{10} K \\ & + 0.4634 \log_{10} T \end{aligned} \quad (3)$$

where L_∞ = the maximum length in cm

T = Annual mean environmental temperature in °C

Using the estimate of Z and M , values of the fishing mortality, F and the exploitation rate, E are automatically computed using the formula:

$$F = Z - M \quad (4)$$

$$E = \frac{F}{Z} \quad (5)$$

Selection Patterns

Every fishing gear has its own selectivity. The selection pattern for trammel net can be obtained by plotting the proportion of fish at each length entering the net and are retained, against length. Thus, selection patterns can be generated from the length-converted catch curves. In the original "ELEFAN II programme", selection patterns were constructed by assuming total mortality, Z to be constant throughout the whole size or lifespan of the fish (i.e. the straight descending portion of the catch curve can be projected backwards).

This gives biased estimates since fishing mortality, and therefore total mortality, is not constant. Pauly (pers. comm) has modified the ELEFAN II programme to give a more realistic selection pattern. This modified programme was used to construct the selection pattern.

Recruitment Patterns

Recruitment patterns were also derived from the ELEFAN II, using a set of growth parameters. The peaks and troughs of the length frequency data will reflect the seasonality of recruitment pattern (see Pauly *et al.*, (1981) for actual derivation of recruitment pattern).

RESULTS AND DISCUSSION

Growth

Length frequency data is shown in Fig. 1 and the restructured version is presented in Fig. 2.

*Gill net data are misleading since there is size selection; samples are therefore not truly representative of the population.

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When seeded values of K, L_{∞} and starting points are entered, the programme provides the quantitative assessment of the growth parameters as follows:

$$L_{\infty} = 29.5 \text{ cm, and } K = 0.425$$

The estimate of longevity is 3.95 years. The goodness of fit is 64.5%*. The growth curve is shown in Fig. 2. Following equation (1), the growth formula for *A. truncatus* is

$$L_t = 29.5 (1 - e^{-0.425(t + 0.4199)}) \dots (6)$$

* this refers to the ESP/ASP ratio (see Pauly *et. al.*, (1980)

where ESP = explained sum of peaks
ASP = available sum of peaks

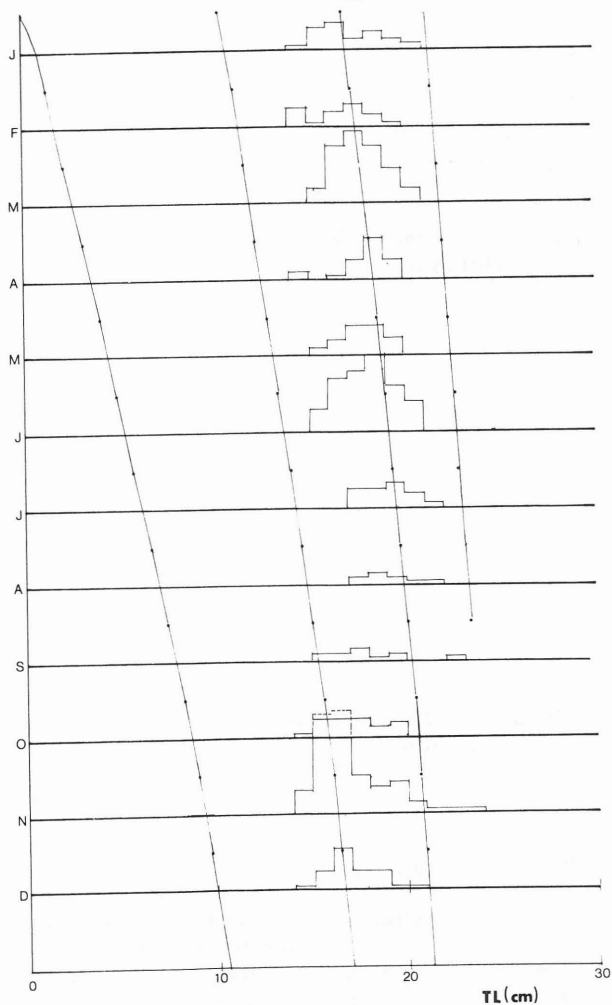


Fig. 1. Length-frequency of *Amblyrhynchichthys truncatus* showing growth curves.

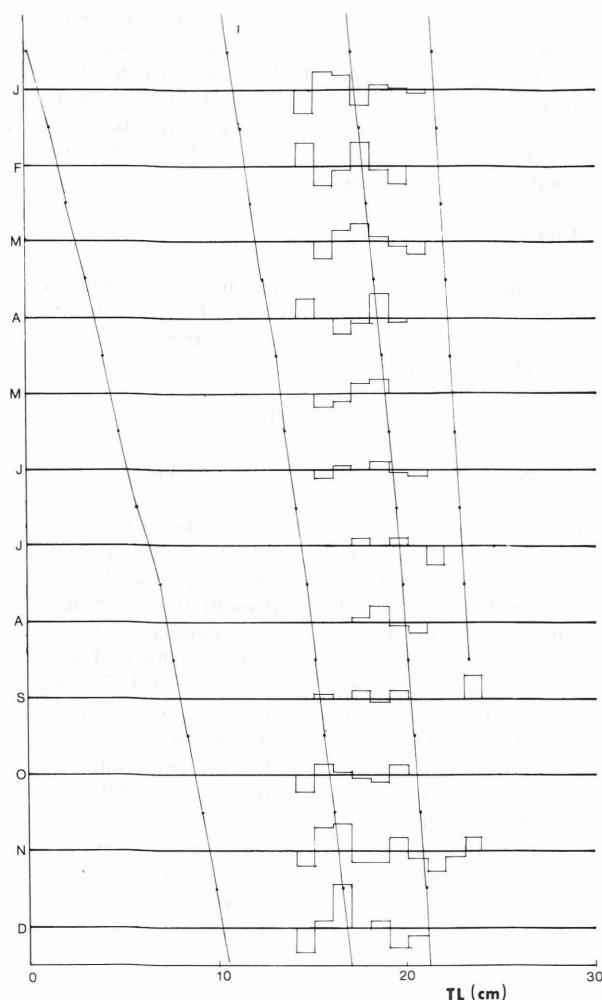


Fig. 2. Restructured length-frequency for *Amblyrhynchichthys truncatus* showing growth curves.

The growth variables computed are just estimated and therefore not exact. There is no opportunity to compare them with tagging and recapture data or results from other workers. The asymptotic size (L_{∞}) estimated is quite reasonable since the largest fish encountered, L_{max} is 24cm.

The average instantaneous rate of growth, K, estimated by ELEFAN I depends on set values of L_{∞} . Ricker (1975) and Pauly (1979) noted the inverse relationship between L_{∞} and K i.e. K increases as asymptotic size (L_{∞}) decreases.

The negative value of t_0 ($T_0 = -0.4199$) which is defined by Ricker (1975) as the hypothetical age the fish would have had at zero length if it always grows in the manner described by VBCF, is biologically sound but looks unrealistic. A better estimate could have been obtained from larval development studies.

Mortality

The length converted catch curve derived by ELEFAN II is presented in Fig. 3. Points 5 to 9 were used in computing the regression line which is as follows:

$$\ln(N/\Delta t) = 21.3 - 5.19458 t \quad \dots (7)$$

coeff. of determination, $r^2 = 0.974436$

From (7), total mortality, Z is found to be 5.195 (Point 10 was not used in the computation since it falls within 5% of L_∞ and points 1 to 4 were not used since they represent the ascending portion of the curve). This is equivalent to an annual mortality rate of almost 100%. Using equation (3) with $L_\infty = 29.5\text{cm}$, $K = 0.425$ and $T = 29^\circ\text{C}$, the natural mortality M was found to be 1.04. From equation (4), fishing mortality, F was found to be 4.15 and from equation (5), exploitation rate, E was found to be 0.80. The extremely high total mortality rate is mainly composed of a very high fishing mortality rate. The result also suggests that 80% of *A. truncatus* stock are exploited, which may indicate over-fishing. This might also explain why L_{\max}

observed earlier is less than that obtained by Taylor's rule of thumb. i.e. $L_{\max} = 0.95 L_\infty$ (Taylor, 1962).

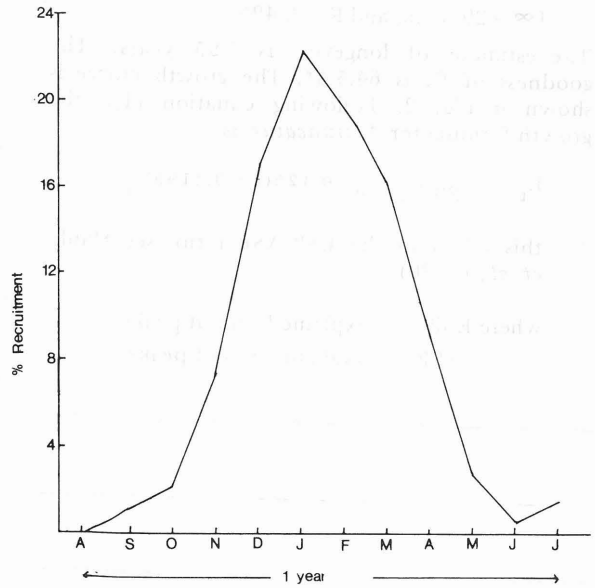


Fig. 4. Recruitment patterns for *Amblyrhynchichthys truncatus*

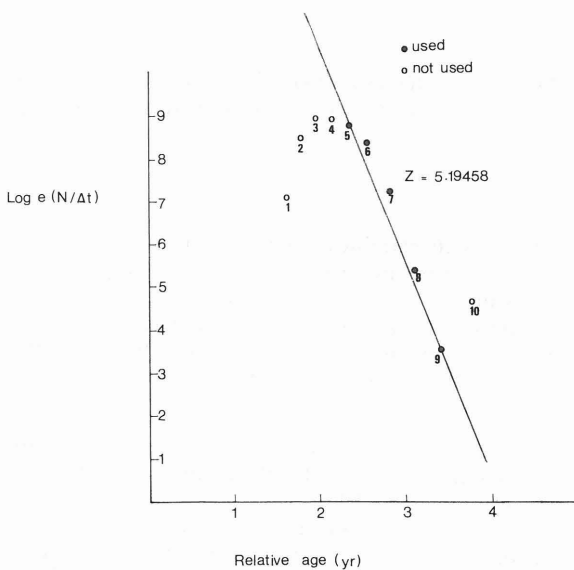


Fig. 3. Catch curve for *Amblyrhynchichthys truncatus*

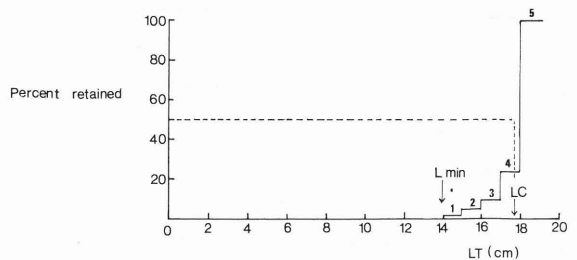


Fig. 5. Selection patterns of *Amblyrhynchichthys truncatus*

Recruitment Pattern

The recruitment pattern for *A. truncatus* is illustrated in Fig. 4. The recruitment pattern seems to have a normal distribution starting from October and reaching a peak in January. This suggests that the wet season may facilitate production of young fish. The rise in water level will certainly increase the availability of food and will induce the fish to mature and breed.

Selection Patterns

The selection pattern for *A. truncatus* is illustrated in Fig. 5. The minimum length retained is 14.0 cm while full retention is at $L^1 = 18.0$ cm. Mean Length at first capture is 17.8 cm.

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