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THE BIOLOGY OF GREY MULLETS IN A TROPICAL LAGOON IN SRI LANKA. I — AGE AND GROWTH

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ABSTRACT

The age and growth, coefficients of condition and length-weight relationships of seven species of grey mullet viz. *Liza subviridis* (Valenciennes), *L. macrolepis* (Smith), *L. tade* (Forskal), *L. vaigiensis* Quoy and Gaimard, *Mugil cephalus* Linnaeus, *Valamugil buchanani* (Bleeker) and *V. cunnesius* (Valenciennes) were studied in Negombo lagoon, Sri Lanka. *M. cephalus* showed the highest asymptotic length of 897mm while the lowest value of 300mm was calculated for *V. cunnesius*. Allometric growth was evident in all species except in *M. cephalus* and the females of *L. tade*. Statistically, significant differences in the length weight relationship of the two sexes were observed in the case of *L. subviridis*, *L. macrolepsis*, *L. tade*, *M. cephalus* and *V. cunnesius*. In these species, the coefficient of condition of the females were found to be significantly higher than those of the males.

Key words: length-weight relationship, grey mullets, Lagoon, Sri Lanka.

INTRODUCTION

Grey mullets have constituted important fishery in the brackishwater areas and are considered as candidate species for aquaculture (Pillay, 1972; Pruginin, Shilo and Mires, 1975; Oren, 1981). Although grey mullets form an important component in the lagoon fishery of Sri Lanka (Pillai, 1965: Wijeyaratne, 1984), the biology of the common species of grey mullets is still more or less completely unknown. This paper presents the results of the investigations carried out on age and growth, coefficient of condition and length-weight relationships of seven species of grey mullets namely *Liza subviridis* (Valenciennes), *L. macrolepis* (Smith), *L. tade* (Forskal), *L. vaigiensis* Quoy and Gaimard, *Mugil cephalus* Linnaeus, *Valamugil buchanani* (Bleeker) and *V. cunnesius* (Valenciennes) collected from the Negombo lagoon which is situated in the west coast of Sri Lanka.

MATERIALS AND METHODS

The samples of grey mullets for this study were collected biweekly from the commercial catch at the three main fish landing sites in Negombo lagoon

(7°10′N and 79°50′E) for a period of three years. The fish were identified to the species and the total length (cm) and weight (g) of each fish were measured on the site. The total number of fish analysed in each species ranged from 167 individuals in *L. vaigiensis* to 3456 in *L. tade*. Total length of the fish ranged from 6 to 48cm. By grouping the fish into 2cm size groups, the modal length at each age was determined for each species using Petersen's method as described by Pauly (1980). The asymptotic lengths and the growth coefficients were calculated by means of the Ford Walford Plot as described by Gulland (1969). The length-weight relationship was expressed as $W = aL^b$ where W is the weight in grams and L is the total length in cm. The coefficient of condition was calculated by considering the value of 'b' to be 3. The length-weight relationships and coefficients of condition were calculated separately for two sexes when the sex of the fish was identifiable. The length-weight relationships of males and females were statistically compared using the procedure described by Sokal and Rohlf (1969). Further, using the procedure described by Bailey (1965), the slope of equation $\ln W = b \ln L + \ln a$, where W and L are the weight in gm and total length in cm respectively, was compared with 3 to determine whether fish show isometric or allometric growth.

RESULTS

The length frequency polygons of grey mullet species studied are shown in Fig. 1. The modal lengths at each age are listed in Table I. The lowest growth during the first year of life, which was 93mm was observed in *L. subviridis* while the highest growth of 113mm occurred in *L. macrolepis* and *M. cephalus*.

The Ford Walford plots used to calculate the asymptotic length ($L \infty$) and growth coefficients (K) are shown in Fig. 2. Calculated values for $L \infty$ and K are given in Table *I. M. cephauls* showed the highest asymptotic length of 897mm while *V. cunnesius* had the lowest value of 300mm. The highest and the lowest values for growth coefficient were obtained for *L. tade* an *V. cunnesius* respectively.

Length weight relationships of the grey mullets studied are shown in Fig. 3. The weight was found to increase exponentially with length. The regression equations calculated for length weight relationship are given in Table II. In *M. cephalus* and the females of *L. tade*, value for the exponent 'b' in the length-weight relationship, $W = aL^b$, was not significantly different from 3, at 5% level. In others it was significantly lower than 3 ($p<0.05$). The lowest value for 'a' was observed in the males of *M. cephalus* and the highest value was obtained for the males of *L. macrolepis*. Length-weight relationship for the sexes were calculated separately only for five species as sex identifiable individuals of *L. vaigiensis* and *V. buchanani* were not found in the samples. In *L. subviridis*,

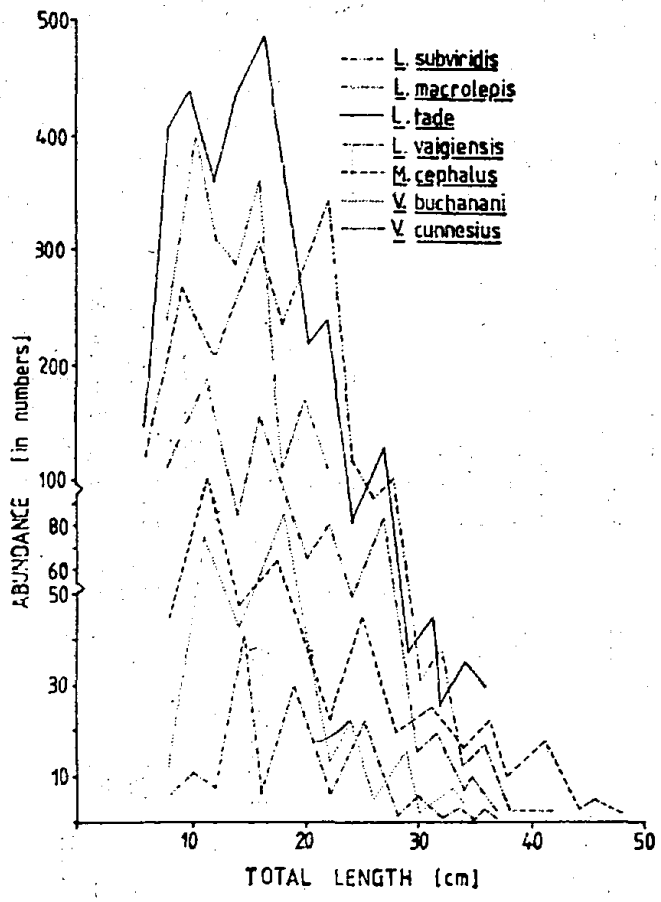


Fig. 1. Length frequency distribution of the grey mullets in Negombo lagoon.

L. macrolepis and *M. cephalus*, values for both 'a' and 'b' were significantly different in the two sexes ($p<0.05$). In the other two species only the values for 'a' were significantly different in the two sexes ($p<0.05$).

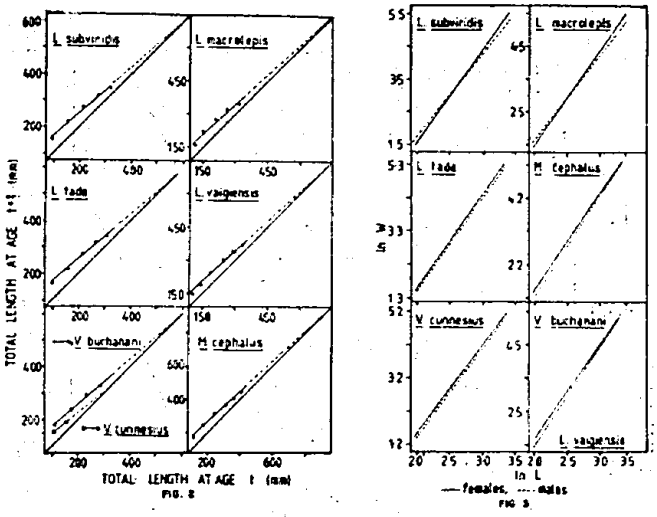
In all species where coefficients of condition were calculated separately for the two sexes, the mean values for the females were found to be significantly higher than those of the males ($p<0.05$). Seasonal variation of the coefficient of condition of all species other than *L. vaigiensis* is shown in Fig. 4. *L. vaigiensis* was not found in the samples in sufficient numbers every month. The coefficient of condition of *L. subviridis* increased from May to July and from September to November. In *L. macrolepis* these values varied over a relatively narrow range and high values were recorded in December and July. In *L. tade* these were high in April, November and December. Relatively higher values for *M. cephalus* were observed in March and April. In the case of *V. buchanani* and *V. cunnesius*, these values were high from November to January. In *V. cunnesius*, higher value was observed in August too.

Table I - Length at each age, asymptotic length, growth coefficient and coefficient of condition of the grey mullets in Negombo lagoon.

Species	Mean length (mm) at each age (Years)							Asymptotic length (mm)	Growth coefficient	Coefficient of Condition	
	I	II	III	IV	V	VI	VII			males	females
Liza subviridis	93	160	220	275	320	353		581	0.1526	0.0091	0.0103
L. macrolepis	113	160	220	270	320	348		723	0.0969	0.0091	0.0101
L. tade	100	163	220	270	313	340		515	0.1734	0.0099	0.0106
L. vaigiensis	100	145	190	250	300	335	360	748	0.0856		
Mugil cephalus	113	173	247	316	363	410	452	897	0.0943	0.0096	0.0108
Valamugil buchanani	110	180	240	288	333			586	0.1582		
V. cunnesius	104	160	200					300	0.0365	0.0088	0.0107

Table II - Length weight relationship of the grey mullets in Negombo lagoon (W = Weight in g, L = Total length in cm.)

Species	Males	Females	All individuals
Liza subviridis	$W = 0.0178\ L^{2.6657}$	$W = 0.0278\ L^{2.6574}$	$W = 0.0133\ L^{2.9022}$
L. macrolepis	$W = 0.0324\ L^{2.5655}$	$W = 0.0169\ L^{2.8336}$	$W = 0.0136\ L^{2.8848}$
L. tade	$W = 0.0133\ L^{2.8917}$	$W = 0.0118\ L^{2.9564}$	$W = 0.0128\ L^{2.9200}$
L. vaigiensis			$W = 0.0199\ L^{2.8109}$
Mugil cephalus	$W = 0.0081\ L^{3.0276}$	$W = 0.0134\ L^{2.9122}$	$W = 0.0110\ L^{2.9022}$
Valamugil buchanani			$W = 0.0139\ L^{2.9203}$
V. cunnesius	$W = 0.0122\ L^{2.8716}$	$W = 0.0233\ L^{2.6952}$	$W = 0.0203\ L^{2.7849}$



Figs 2 & 3. Ford Walford plots and length weight relationships of the grey mullets in Negombo lagoon respectively.

DISCUSSION

The size of grey mullets at each age has been observed to vary with localities (Quignard and Farrugio, 1981). The growth of *M. cephalus* during the first year of life in Australian waters (Grant and Spain, 1975a) appears to be very close to that of the same species in Negombo lagoon. Rather higher values, however, have been recorded from Italy, Mexico, Tunisia, France (Quignard and Farrugio, 1981) and India (Devasundaram, 1952; Gopalakrishnan, 1972). In the case of *L. vaigiensis,* the lengths recorded at all ages except for one year old fish are higher in Australian waters (Grant and Spain, 1975b) than those observed in the present study. The length of one year old *L. tade* in India (Pillay, 1954) is very much higher than that of the same species from Negombo lagoon. However, in the case of *V. cunnesius,* lengths recorded at all ages in Indian waters (Sarojini, 1958) are lower than those observed in the present study.

M. cephalus, having the highest asymptotic length could attain the largest size of all grey mullets in Negombo lagoon. *V. cunnesius* having the lowest value could therefore be the smallest. Asymptotic lengths of grey mullet species have also found to vary from region to region (Quignard and Farrugio, 1981). Closer values to that of *M. cepahlus* in Negombo lagoon have been recorded from India (Thakur, 1967) and Australia (Thomson, 1951). Lower values have been recorded from U.S.A. (Cech and Wohlshlag, 1975) while higher values have been observed in India (Devasundaram, 1952) and Australia (Kesteven, 1942). The values for asymptotic lengths calculated *for L. tade* and *V. cunnesius* in Negombo lagoon were found to be smaller than those recorded for these species in India (Pillay, 1954; Sarojini, 1958).

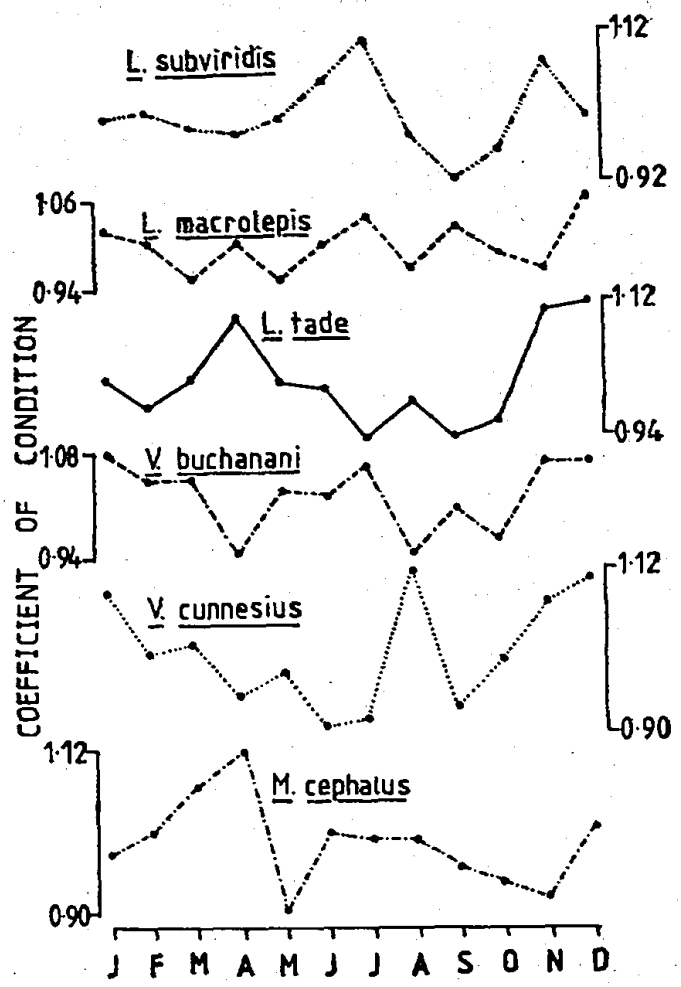


Fig. 4. Seasonal variation of the coefficient of condition of grey mullets in Negombo lagoon (values x 100).

Growth coefficient is considered as a measure of rate of approaching asymptotic length (Ricker, 1975). Closer values to the growth coefficient of *M. cephalus* in Negombo lagoon have been recorded for the same species in Australia (Kesteven, 1942). However, higher values have been recorded from U.S.A. (Cech and Wohlschlag, 1975) and India (Devasundaram, 1952; Thakur, 1967). The growth coefficient calculated in the present study for *L. vaigiensis* was smaller than the value obtained for the same species from Australia (Grant and Spain, 1975b). Growth coefficients for *L. tade* and *V. cunnesius* in India (Pillay, 1954; Sarojini, 1958) were smaller than the respective values of the same species in Negombo lagoon.

Since the value of 'b' in the length-weight relationship is not significantly different from 3, isometric growth is evident in *M. cephalus* and female *L. tade* In other individuals where this value is significantly less than 3, growth pattern

appears to be negatively allometric. None of the grey mullets studied, showed a value significantly higher than 3; therefore, these fish may not become heavier for their lengths as they grow (Ricker, 1975).

Significantly higher values for the coefficient of condition in females indicate that the female grey mullets at a given length are heavier than the males having the same length. This may be due to the presence of ovaries in females which are generally heavier than the testes. Seasonal variation in the coefficient of condition is considered as an index to determine the spawning season of fish (Pillay, 1954; Sarojini, 1958). Generally in most species of fish the increase in the coefficient of condition is attributed to the gain in weight accompained by the maturation of gonads during the pre-spawning period and when the fish become spent, the values decline due to the lowering of gonad weight. However, it was evident that the fluctuation of the coefficient of condition could not always be attributed to the maturation of gonads as observed in the freshwater grey mullet, *Rhinomugil corsula,* in India (Ranganathan and Natarajan, 1970). Among other factors which influence the coefficient of condition are intensity of feeding, age and sex of the individuals (Everhart, Eiper and Young, 1975), abundance and the types of food available and physico-chemical characteristics of the environment (Ranganathan and Natarajan, 1970).

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