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COMPARATIVE GROWTH STUDIES ON LETHRINUS LENTJAN, LACEPEDE 1802 AND L. MAHSENA, FORSSKAL. 1775 (PISCES, LETHRINIDAE) IN THE RED SEA

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ABSTRACT

Growth characteristics for two lethrinids, Lethrinus lentjan and L. mahsena in the Red Sea off Jeddah waters were studied. With ages determined by scale readings, back calculated lengths up to the seventh year of life were obtained for each species. Regressions of fish length on scale radius were also computed. Growth in length appeared to be most rapid during the first year of life and slows down as age progresses. Growth in weight, on the other hand, was highest during the third and fourth years of life for L. lengtjan and L. mahsena respectively. Within each species, males and females gave virtually identical results in their growth rate. Three exponential equations were derived for each species to represent the length/weight relationship for separately males, females and sexes combined. Coefficient of condition (K) values were also determined and variation of these values with fish size and month of capture were studied. The parameters of VonBertalaffy's growth equation L , K & t were estimated for the two species under study.

INTRODUCTION

Fishes of family Lethrinidae or emperors constitute an important fishery in Saudi Arabia as well as in other areas. They are caught throughout the year and accounted for about 14.4 & 29% of the annual production of 1986, from the Saudi Red Sea coast and Arabia Gulf line respectively (Chakraborty et al., 1986). Emperors (locally known as 'Shaour or Sheiry', usually inhabit coastal coral reefs and rocky areas (Wray, 1979) where they are chiefly caught with handlines.

Despite the economic importance of emperors, few scientific work has been reported on their biology. Hashem and Shakour, 1981; Kedidi, 1984; Kedidi et al., 1984 and El-Dussary, 1987 have provided some information on the subject on the Red Sea and Arabian Gulf. In other regions, the study of Toor, 1968, Aldonov and Druzhinin, 1978, Loubens, 1980, and Bertrand, 1988 may be worthy mentioning.

The present work was undertaken to study the growth rate of two lethrinid species of considerable commercial importance namely: Lethrinus lentjan or redspot emperor and L. mahsena or mahsena. The former species is taken from both

Red Sea and Arabian Gulf as well, whereas the later is confined to the Red Sea only. It is hoped that such knowledge will be useful for the management of lethrinids fishery.

MATERIAL AND METHODS

Random samples of both species were obtained fresh from the commercial fishery operating in coastal waters off Jeddah. Sampling extended for a whole year, from December 1988 to November 1989, 400 & 323 specimens of **L. lentjan** and **L. mahsena** respectively were collected at almost monthly intervals and examined for total length (mm), total and gutted weights (g) sex and stage of maturity. Scale samples were also taken from the left side of the body just under the pectoral fin area for age determination. Examination and measurments of scales were conducted by means of a binocular microscope (magnification X 20). Line of measurment was made off focus towards the anterior field so as to intercept the successive annuli and margin at its point of maximum diameter.

Total length was used throughout this study and sexes were kept separate. Fish were classified to one-centimeter length groups considering all individuals that measured between (x-0.5) and (X+0.4) as belonging to (X) length group.

RESULTS

i- Scale Reading

Examination of more than 700 scale samples, of both species, showed various patterns of cyclical growth. Many fish were forming extra-checks in addition to the year marks or 'annuli'. Some fish were forming the so called 'fry rings' which are usually seen not far from the focus, or 'spawning rings' which often followed the true annulus by a short distance. Bias in accurate agening was likely to be greatest with the crowdness of annuli near the scale margin in older ages.

In the present study, true annuli are characterised by the criterion of crossing over of circuli along the lateral edges of the scale, and could be traced in the posterior field. Whereas the false rings were distinguishable when breaks in the circuli were not accompanied by crossing over.

ii- Size Composition

For **Lethrinus lentjan**, the most frequent sizes were from 23 to 33 cm, constituting about 75% of the fish examined, whereas the corresponding size for **L.mahsena** were from 26 to 37 cm representing about 76% of the fish investigated. The smallest fish observed were 15 & 20 cm and the largest were 42 & 47 cm for the former and later species in turn. For both species, sizes smaller than 20 cm were of rare occurrence within the catch or almost nonexisting. The few individuals (8-19 cm) listed for L. lentjan in Table I were obtained from a fishing-amateur friend of the author and never seen in the commercial catch.

iii- Length/Weight Relationship

Males of L. lentjan have always higher weights than females of the same size class, except for those size groups which are represented by few number of fish (Table I). As regards L. mahsena, males are also heavier than females up to size class 26 cm and the reverse is true for bigger sizes (Table II). Therefore, a length (L)/ weight (W) formula for separately males, females and sexes combined has been established by applying the general equation $W = c\ L^n$ (where c & n are constants) for the two species understudy. The following six equations were arrived at:

For L. lentjan

$W_m = 0.015\ L^{2.9709}$ .. (1) for males (r =0.9995)
$W_f = 0.0193\ L^{2.8949}$ .. (2) for females (r =0.9987)
$W_{mf} = 0.0165\ L^{2.9416}$ .. (3) for sexes combined (r =0.9992)

For L. mahsena

$W_m = 0.0387\ L^{2.716}$ .... (4) for males (r =0.9995)
$W_f = 0.0298\ L^{2.794}$ .... (5) for females (r =0.9935)
$W_{mf} = 0.351\ L^{2.742}$ .... (6) for sexes combined (r =0.9941)

It is obvious that the value of exponent "n" is little higher for males (2.97) than for females (2.89) of L. lentjan, and the reverse is true for L. mahsena (n = 2.72 for males & 2.79 for females).

These formulae can be used to estimate fish length or weight when only one parameter is known, and will be applicable in growth rate computations.

iv- Coefficient of Condition (K)

In this study, coefficient of condition or condition factor (K) is another expression for the total length against whole weight relationship. it measures the robustness or plumbness of fish and relative condition in different habitats Variations of average values of 'K' for males and females with the change in length is given in Table I & II for L. lenjan and L. mahsena respectively. For sexes combined, 'K' ranged between 1.30 & 1.58 (average 1.37) for L. lentjan and between 1.23 & 1.63 (av. 1.48) for L. mahsena, excluding the values that representing only one or two specimens. These estimates of condition are considered characteristic for each species in Jeddah waters of the Red Sea.

It is clear that, for a given size class 'K' value for L. mahsena was always higher than the corresponding for L. lentjan. The grand average value of 'K' for the former species (1.48), as expected, is also higher than that for the later (1.37). Tables I & II also showed no obvious trend of variation of 'K' values with the increase in fish length.

Monthly variations of average condition factor for L. lentjan (Fig. 1 a) illustrated two peaks in May and October (1.4) and one drop in April (1.21). When taking the seasonal fluctuation into account, a highest 'K' value was indicated in autumn (1.36) and a lowest in spring (1.58) with intermediate values in summer (1.32) and winter (1.3). For L. mahsena, on the other hand, maximum condition was attained in May (1.71)and minimum in March (1.15) (Fig. 1 b). As for seasonal variations, a relatively higher values were noticed in summer (1.6) and autumn (1.56) compared to those of winter (1.47) and spring (1.48). The month or season of highest condition signifies the best time for exploitation of the species.

v- Body/Scale Relationship

Using total length (L) in centimeters versus scale radius (S) in micrometer divisions (1m.d=0.5mm) produced a linear trend of variation for both species (Fig. 2). Therefore, the resulting regression estimates are as follows:

$L = -5.118 + 3.4117\ S$ .... (7) for L. lentjan
and $L = 10.4086 + 3.3681\ S$ .... (8) for L. mahsena

For L. mahsena, L/S ratio was found to increase with further increase in fish length, whereas an opposite trend of variation was noticed for L. lentjan, but to a lesser degree (Table III).

vi- Growth in Length

Mean lengths at age for fish aged 1-7 years were calculated for males, females and sexes combined for both species under investigation. In each case, T-test indicated insignificant differences in mean lengths at each age between males and females. Therefore, data were pooled and growth rate was estimated for sexes combined (Tables IV & V) for L. lentjan and L. mahsena respectively. Growth in length was highest during the first year of life (about 11.3 & 9.4 cm for L. lentjan and L. mahsena respectively), being comparatively higher for the former than for the later species. A graduall decrease in the annual increment was obvious for both species as fish gets older. For L. lentjan, increment of the fourth and fiveth years was almost the same (about 3.5 cm). For an illustration, comparative growth curves in length (Fig. 3) is also given for the two species understudy.

vii- Growth in Weight

In a similar way, calculated weights at each age were estimated (Table VI) by fitting the length/weight equations 3 & 6 each in turn to the mean lengths obtained in Tables IV & V for L. lentjan and L. mahsena respectively. Opposite to growth in length, growth in weight seems much slower during the first two years of life, for both species and considerably increased reaching a maximum during the third (about 140 g) or fourth (about 146 g) year of life for L. lentjan and L. mahsena respectively. After which, a remarkable drop in annual increment was noticed in the following years for both species. Fig (4) showed that percentage increase in weight, relative to the weight reached at seventh year of life, was rather constant during the fiveth and sixth years (about 18% for L. lentjan and slightly declined in the following year. Highest percentage increase (19.9%) was reached during the fourth year for L. mahsena (Fig. 4).

viii- Theoretical Growth

Following the procedure outline earlier, mean lengths at age were used to obtain the parameters of vonBetalanffy's growth equation $L_t = L \quad (1 - e^{-K(t-t_o)})$. This involved assuming values for L and undertaking linear regressions of $\log_e$ (1- (L_t/ L) against age to obtain corresponding values for K & t_o. Estimates were as follows: L = 43.9554 cm, K = 0.29085 & t_o= 0.00654 yr for L. lentjan and L = 49.4721 cm, K = 0.2076 & t_o = 0.01442 yr for L. mahsena. Infinity weights were also derived by converting the infinity length to weights using the length/weight equations each in turn: W = 1123.5 g for L. lentjan and W = 1552 g for L. mahsena. Theoretical lengths and weights at age, using vonBertalanffy equation, were then computed and compared with the back-calculated ones (Table VI). Both results, for the two species, showed well agreement (d values are small) and verify the findings arrived at.

ix - Sex Ratio

Within each monthly sample, the number of females always exceeds that of males for both species. However, sex ratio when related to age (Table VII) revealed that for L. lentjan percentage females was higher than that of males within the same age group up to the fourth year of life, and the reverse was true for older ages. The overall sex ratio thus constituted 2.3 female to one male. As regards L. mahsena, on the other hand, females always predominate at all ages, except for the oldest age VII, where males were equally presented as females (50%). Considering all data together, sex ratio of females to males accounted for 2.1:1.

DISCUSSION

L. lentjan, L. mahsena or both are among common lethrinid species in the Red Sea (Al-Kholy, 1972, Wray, 1979 & Randall, 1983); Gulf of Aden (Aldonov and Druzhinin, 1978); Arabian Gulf (El-Dussary, 1987); Indian waters (Toor, 1968) and Saya de Malha, Indian Ocean (Bertrand, 1988); New Caledonia (Loubens, 1980) and in other areas as well as (FAO, 1983). They live at depths of approximately 27- 50 m (AldonOv and Druzhinin, 1978). The most frequent sizes, as given in the present study, are 23-33 cm for L. lentjan. This range is little wider than that recorded by Kedidi et al., 1984 (24-30 cm) in the same area. Maximum length reached, 42 cm, is almost the same as indicated in earlier reports, 40 cm (Wray, 1979 & Randall, 1983) & 41 cm (Kedidi et al., 1984). On the other hand, L. mahsena attain 47 cm, as obtained in this study, which is also higher than postulated in previous reports, 40.5 cm (Aldonov and Druzhinin, 1978); 40 cm (Wray, 1979) & 43 cm (Hashem and Shakour, 1981) with the exception of that listed by Randall, 1983 (50 cm).

Previous trials for ageing the two species under study by scale interpretation have been carried out (Toor, 1968; Hashem and Shakour, 1981; Kedidi et al., 1984 and El-Dussary, 1987). The usefulness of other bony structures such as otoliths was also investigated (Toor, 1968). Earlier attempts for age determination indicated also a high frequency of extra-checks on the sclaes (Hashem and Shakour, 1981 & El-Dussary, 1987). Deposite there is only $10^{o}C$ annual range of variation in temperature at Jeddah waters, this study has confirmed earlier observations that an annulus is laid down annually on L. lentjan and L. mahsena scales. The similarity of growth rate results of the present work's with those previously reported verify the findings arrived at. Whereas, the work of Toor, 1968 based on reading both scales and otolights of L. lentjan in Indian waters indicated substantial faster growth than attained in the Red Sea. it is likely that the observed variability is merely a reflection of the different environmental conditions in the two habitats. It is equally possible that growth achieved in different years within the same locality vary for the same reasons.

The exceptional growth rate noticed in this study during the fourth year of life (Figs 3 & 4) may be a cause of sex reversal stage usually happened at this age. Data on sex ratio at ages (Table III) support this assumption. Evidance of sex reversal from female to male was shown by histological examination of the gonads (Bawazeer, personal communication). Further proof for protogynous hermaphroditism in L. lentjan was previously demonstrated by Young and Martin, (1982). The precise mechanism, in lethrinids, the control the onset of sex change is not yet known.

None of the previous length/weight formulae (Hashem and Shakour, 1981 and Kedidi et al., 1984) have given values for the constant 'n' for separate sexes as has done in the present work. The values for sexes combined as obtained herein (2.94 & 2.74 L. lentjan & L. mahsena respectively) are little lower than those given by Kedidi et al., 1984 for L. lentjan (about 3.0) or by Hashem and Shakour, 1981 for L. mahsena (3.15). Although the later authors interpreted this value as an indication to the good living conditions of these fishes at Jeddah waters, they also mentioned that their computation imposes strict limitations on its use since it was based on samples covering only part of the year (January-March).

Unfortunately, none of the previous reports gave values for condition factor 'K' except Hashem and Shakour, 1981. Whose calculations were based on standard length and gutted body weight, which couldn't be comparable to the present work's.

Only Kedidi et al., 1984 have obtained estimates to VonBertalanffy growth parameters for L. lentjan, which are higher (L= 51.1 cm)than the present study's (L=44 cm). The corresponding value of Toor, 1968 was L = 64.02 cm and he provides no value for t_o Kadidi et al., 1984 concluded that the stock of redspot emperor L. lentjan is fully exploited in Tuwwal waters (north Jeddah). Kedidi, 1984 stated that a more detailed biological study of the redspot emperor is needed to identify the appropriate characteristics of the stock along the total coast in order to dispose a management policy. Hopfully, the present study has provided some of the required information.

SUMMARY

1- Accessory annuli contributed some difficulty in age determination. However, the use of scale reading as an ageing technique for L. lentjan and L. **mahsena** has been validated.

2- Regressions of total fish length (L) on anterior scale radius (S) are described satisfactorily by the following equation: L = 5.118 + 3.4117 S., for L. lentjan & L = 10.409 + 3.368 S for L. **mahsenea**.

3- The highest increase in length generally occur during the first year of life, which is higher for L. lentjan (11.3 cm) than for L.mahsena (9.4 cm). The rate then gradually decreases with further increase in age.

4- Growth in weight is greatest during the third and fourth years for respectively L. lentjan and L. mahsena, then decreased thereafter.

5- The increse in fish weight with length for sexes combined is slightly higher for the former species (n = 2.94) than for the later (n = 2.74).

6- Grand average condition factor 'K' of L. mahsena (1.48) is little higher than that of L. lentjan (1.37). maximum condition was attained in May for both species.

7- The overall sex ratio revealed the predominance of females at earlier ages and males at older ones.

8- The parameters of vonBertalanffy's growth formula are estimated as follows: L = 44 & 49.5 cm; K = 0.29 & 0.21 ; t_o= 0.007 & 0.01 for L. lentjan & L. mahsena respectively, each in turn.

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Table (I) - Length/weight relationship and condition factor (K) for Lethrinus lentjan .

T. length (cm)	Av. wt. (g) Males ± s.d	FRQ	K	Av. wt (g) Females ± s.d	FRQ	K
8	7.00	1	1.36	-		
9	10.00 ± 0.0	2	1.37	-		
10	14.25 ± 0.8	6	1.43	-		
11	19.50	1	1.47	20.25 ± 2.3	2	1.52
13	-			31.00	1	1.41
16	-			64.00	1	1.56
17	-			73.00	1	1.49
18	-			85.00	2	1.46
19	-			101.33 ± 3.4	6	1.48
20	112. 0	1	1.40	108.67 ± 6.6	9	1.36
21	128.75 ± 7.4	6	1.39	129.56 ± 4.9	9	1.40
22	141.17 ± 10.0	[illegible]	1.33	140.67 ± 12.9	27	1.32
23	159.80 ± 8.7	8	1.31	160.59 ± 13.9	19	1.32
24	185.00 ± 0.0	5	1.34	184.00 ± 18.0	21	1.33
25	221.56 ± 20.6	10	1.42	206.80 ± 20.4	20	1.32
26	249.40 ± 11.0	8	1.42	238.67 ± 20.1	15	1.36
27	269.33 ± 9.9	5	1.37	265.83 ± 21.5	13	1.35
28	289.57 ± 13.1	8	1.32	294.77 ± 25.2	30	1.34
29	317.50 ± 16.3	9	1.30	319.77 ± 25.7	20	1.31
30	350.42 ± 19.5	13	1.30	354.71 ± 18.7	17	1.31
31	391.00 ± 20.1	8	1.31	398.14 ± 20.1	7	1.34
32	427.70 ± 25.0	11	1.31	427.83 ± 30.2	12	1.31
33	466.83 ± 30.0	15	1.30	470.38 ± 30.1	8	1.31
34	556.86 ± 20.2	8	1.42	556.67 ± 30.0	3	1.42
35	631.00 ± 5.0	2	1.47	641.67 ± 30.2	3	1.50
36	680.00 ± 30.0	[illegible]	1.46	680.00 ± 30.0	2	1.46
37	700.00 ± 25.5	[illegible]	1.38	710.00	1	1.64
38	760.00	1	1.39	784.00	1	1.43
39	806.50 ± 3.5	2	1.36	-		-
40	-		-	813.00	1	1.27
41	822.00	1	1.19	845.00 ±200	2	1.23
42	-		-	880.00	1	1.19
T. No. of fish		146	1.36		254	1.38

Table (II) - Length/weight relationship and condition factor (K) for <u>Lethrinus</u> <u>mahsena</u> .

T. length (cm)	Av. wt. (g) Males ± s.d	FRQ	K	Av. wt.(g) Fameles ± s.d	FRQ	K
15	56.00	1	1.66		-	-
17	-			75.00 ± 0.0	2	1.53
18	-			91.33 ± 1.9	3	1.57
19	-			102.50 ± 2.5	2	1.49
21	141.00 ± 10.1	4	1.52	137.00	1	1.48
22	165.0 ± 10.8	3	1.55	175.00	1	1.64
23	194.0 ± 7.1	4	1.59	186.50 ± 3.5	2	1.53
24	220.38 ± 10.[illegible]	8	1.59	215.86 ± 6.7	7	1.56
25	258.50 ± 20.1	4	1.65	247.5 ± 10.1	6	1.58
26	274.0 ± 25.4	6	1.56	268.40 ± 12.5	15	1.53
27	287.86 ± 21.7	7	1.46	288.75 ± 14.4	12	1.47
28	323.33 ± 22.2	6	1.47	331.52 ± 13.7	21	1.51
29	370.0 ± 24.9	5	1.52	378.71 ± 18.0	17	1.55
30	427.14 ± 25.[illegible]	3	1.58	428.27 ± 20.0	15	1.59
31	432.14 ± 15.3	7	1.45	455.90 ± 19.4	10	1.53
32	500.1 ± 20.2	12	1.53	530.80 ± 21.4	20	1.62
33	556.67 ± 23.6	6	1.55	582.86 ± 23.7	14	1.62
34	-			641.38 ± 29.1	13	1.63
35	671.17 ± 25.0	6	1.57	687.00 ± 30.6	15	1.60
36	704.50 ± 30.0	6	1.51	730.57 ± 28.4	7	1.57
37	741.67 ± 20.5	3	1.46	755.20 ± 30.0	21	1.49
38	817.50 ± 25.6	4	1.49	819.67 ± 30.0	3	1.49
39	83[illegible] ± 25.8	3	1.40	833.00 ± 31.0	4	1.40
40	850.0 ± 30.2	3	1.33	856.00 ± 0.0	2	1.34
41	780.0	1	1.26			-
42	906.0	1	1.22	913.33 ± 30.0	3	1.23
44	-			992.50 ± 20.0	2	1.17
46	-			1030.00	1	1.06
47	1090.0	1	1.05	-		
T. No. of fish		104	1.50		219	1.48

Table (III)- Relation between fish length and average scale radii (X20) for L.lentjan and L.mahsena .

T. length (cm)	L.lentjan FRQ	Av.S (m.d)	L/S	L.mahsena FRQ	Av.So (m.d)	L/So
15	-	-	-	1	7.20 + 0.0	2.08
17	-	-	-	2	7.65 ± 0.2	2.22
18	2	6.35 + 0.7	0.35	3	8.07 ± 0.3	2.23
19	6	6.88 ± 0.8	0.36	2	8.35 ± 0.7	2.28
20	7	7.17 + 0.6	0.36	2	8.50 ± 0.0	2.35
21	17	7.35 ± 0.6	0.36	4	9.30 ± 0.5	2.26
22	33	7.95 ± 0.6	0.36	5	10. 0 ± 0.6	2.20
23	27	8.24 ± 0.7	0.36	6	10.32 ± 0.3	2.23
24	27	8.75 ± 0.6	0.36	13	10.51 ± 0.9	2.28
25	32	8.95 ± 0.8	0.36	10	10.77 ± 0.5	2.32
26	25	9.26 ± 0.9	0.36	21	11.05 ± 0.5	2.35
27	14	9.58 ± 0.7	0.35	17	11.18 ± 0.6	2.42
28	31	9.87 ± 0.6	0.35	27	11.54 ± 1.0	2.43
29	18	10.17 ± 0.8	0.35	20	11.94 ± 0.7	2.43
30	18	10.62 ± 0.7	0.35	22	12.15 ± 0.9	2.47
31	15	10.69 ± 0.9	0.34	19	12.57 ± 0.7	2.47
32	21	11.07 ± 0.7	0.35	30	13.14 ± 0.8	2.44
33	25	11.30 ± 0.7	0.34	17	13.46 ± 0.9	2.45
34	9	11.80 ± 0.6	0.35	9	13.63 ± 0.6	2.49
35	3	11.87 ± 0.8	0.34	14	13.85 ± 1.0	2.53
36	4	11.97 ± 0.6	0.33	13	14.01 ± 1.0	2.57
37	6	12.12 ± 0.7	0.33	15	14.17 ± 0.9	2.61
38	2	12.65 ± 0.4	0.33	8	14.4 ± 1.0	2.64
39	2	12.85 ± 0.9	0.33	7	14.59 ± 1.0	2.67
40	3	13.00 ± 0.6	0.33	4	14.88 ± 0.9	2.69
41	3	13.15 ± 0.1	0.32	2	15.01 ± 0.5	2.73
42	1	13.50 ± 0.0	0.32	3	15.22 ± 1.0	2.76
44	-	-		2	15.60 ± 0.0	2.82
46	-	-		1	16.00 ± 0.0	2.88
47	-	-		1	16.50 ± 0.0	2.85
T.No. of fish	**351**		**0.35**	**300**		

Table (IV) - **Back-calculated lengths at the end of different ages for <u>Lethrinus lentjan</u>, (increment in parenthesis).**

Age Group	FRQ %	Av. L. at capt.	L_1	L_2	L_3	L_4	L_5	L_6	L_7
I	35 9.1	20.95	13.64						
II	12.9 33.6	23.46	11.15	19.66 (8.51)					
III	132 34.4	30.00	11.20	20.41 (9.21)	26.94 (6.53)				
IV	60 15.6	32.39	10.78	19.20 (8.42)	25.53 (6.33)	29.90 (4.37)			
V	25 6.5	36.00	10.35	17.77 (7.42)	24.49 (6.72)	29.51 (5.02)	33.35 (3.84)		
VI	2 0.5	39.15	10.04	17.58 (7.54)	24.03 (6.45)	28.28 (4.25)	32.37 (4.09)	36.47 (4.10)	
VII	1 0.3	41.50	10.29	18.37 (8.08)	24.0 (6.47)	28.76 (4.76)	32.07 (3.31)	35.57 (3.50)	38.50 (2.93)
grand av. calc. length			11.28	19.71	26.24	29.74	33.23	36.17	38.50
Increment			11.28	8.43	6.53	3.50	3.49	2.94	2.33

Table (V) - Back - calculated lengths at the end of different ages for *L.mahsena* (increment in parenthesis).

Age group	FRQ %	Av. L. at capt (cm)	L_1	L_2	L_3	L_4	L_5	L_6	L_7
I	6 2.0	17.18	10.45						
II	23 7.8	22.91	9.84	17.19 (7.35)					
III	76 25.8	26.39	9.73	16.06 (6.33)	23.26 (7.20)				
IV	101 34.2	30.62	8.98	16.57 (7.59)	23.70 (7.13)	29.10 (5.40)			
V	61 20.7	34.20	9.32	16.21 (6.89)	22.75 (6.54)	27.78 (5.83)	31.97 (4.19)		
VI	22 7.5	37.13	9.40	16.72 (7.32)	21.95 (5.23)	27.59 (5.64)	31.96 (4.37)	35.18 (3.22)	
VII	6 2.0	40.23	9.01	16.63 (7.62)	21.25 (4.62)	27.22 (5.97)	31.55 (4.33)	35.34 (3.79)	37.87 (2.53)
grand Av. calc.length	295		9.37	16.42	23.16	28.44	31.94	35.25	37.87
Increment			9.37	7.05	6.74	5.28	3.50	3.31	2.62

Table (VI) - Comparison between calculated and theoretical(Bertalanffy's equation) lengths and weights at different ages of <u>L. lentjan</u> and <u>L. mahsena</u>.

Age (yr)	L. Lentjan						L. mahsena					
	Av. Length (cm)			Av. Weight (g)			Av. Length (cm)			Av. Weight (g)		
	calc.	theor.	$\hat{d}$	calc.	theor.	$\hat{d}o$	calc.	theor.	$\hat{d}$	calc.	theor.	$\hat{d}o$
1	11.28	11.16	-0.12	50.56	19.92	-0.64	9.37	9.39	0.02	16.20	16.30	0.1
2	19.71	19.43	-0.28	106.15	101.78	-4.37	16.42	16.91	0.49	75.44	81.78	6.34
3	26.24	25.62	-0.62	246.32	229.59	-16.73	23.16	23.01	-0.15	193.71	190.29	-3.42
4	29.74	30.25	0.51	356.01	374.27	18.26	28.44	27.97	-0.47	340.17	324.97	-15.20
5	33.23	33.71	0.48	493.42	514.68	21.26	31.94	32.00	0.06	467.62	470.03	2.41
6	36.17	36.29	0.12	633.17	639.37	6.2	35.25	35.28	0.03	612.78	614.22	1.44
7	38.50	38.23	-0.27	760.81	745.22	-15.59	37.89	37.94	0.05	746.97	749.68	2.71

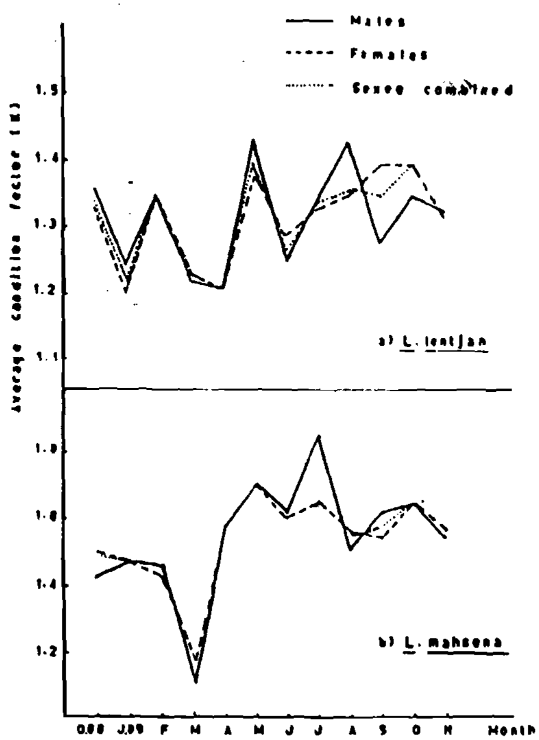

Fig. 1 : Monthly variations of average condition factor of Lethrinus lentjan and L. mahsena

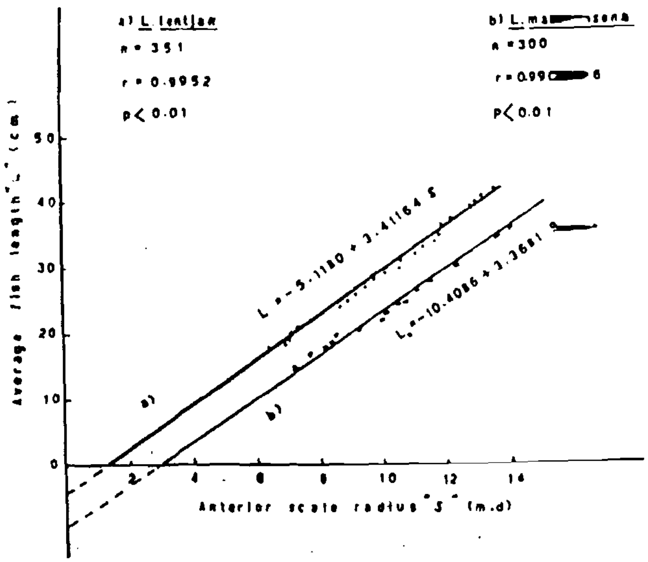

Fig. 2: Fish-length / scale radius relationship for Lethrinus lentjan and L. mahsena

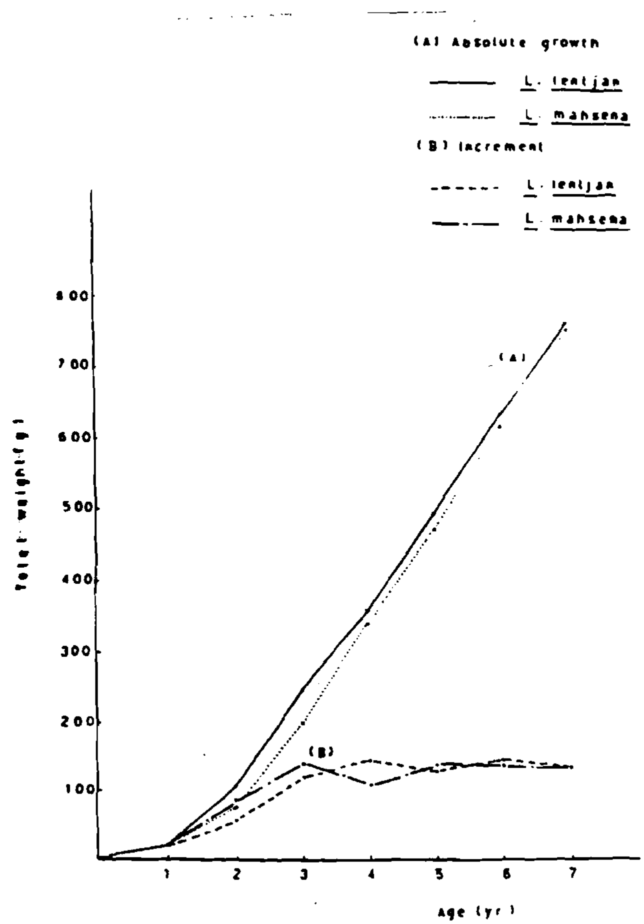

Fig. 3 : Growth in weight with age for *Lethrinus lentjan* and *L. mahsena*.

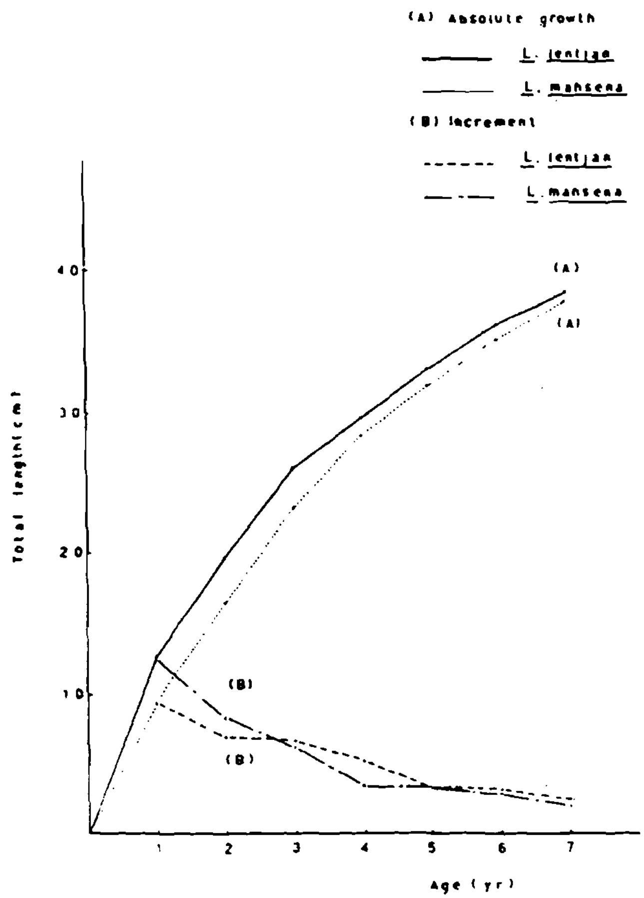

Fig. 4 : Growth in length with age for *Lethrinus lentjan* and *L. mahsena*.