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SOME BIOLOGICAL CHARACTERS OF LETHRINUS NEBULOSUS (FORSKAL) IN THE ARABIAN GULF.

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ABSTRACT

The present investigation is concerned with age, growth and survival rates of **Lethrinus nebulosus** in the Arabian Gulf. Results of the present study can be summarized as follow:

1. The relationship between radius of scale (S) and total fish length (L) is shown by the following equation:

$$L = 2.3829\ (S) - 4.03$$

2. Growth rate in total length (L_t at age t) is given by the following von Bertalanffy's equation:

$$L_t = 61.22\ [1-e^{-0.138\ (t + 0.905)}]$$

3. The relationship between total body weight (W) and total length (L) is shown by the following equation:

$$W = 22.5940 \times 10^{-3}.\ L^{2.9985}$$

4. Survival rate was found to be 0.5520 i.e. about 55% of **Lethrinus nebulosus** could survive per year after two years of age.

INTRODUCTION

In fishery management it is necessary to consider the basic information on growth rates and the age composition of the commercial catch. In many fisheries it is desirable to restrict fishing during the period of rapid growth prior to attainment of sexual maturity, when the total increase in weight of fish exceeds the losses due to natural mortality. In other fisheries, natural losses exceeds the growth gains, and it is desirable to harvest the fish as soon as they reach marketable size.

It is therefore necessary to know the biology of the economically important fish species, especially those aspects related to production and growth in order to suggest the conservational lows in the fishery of such species.

Fishes of family **Lethrinidae** constitute very important part of the commercial catch of the Arabian Gulf. **Lethrinus nebulosus** is one of the common fish species of this family.

The present study deals with, growth and survival rates of **Lethrinus nebulosus** caught from the Arabian Gulf, near Qatar.

MATERIAL AND METHODS

The present study was based on monthly sampling of **Lethrinus nebulosus** collected from the catch of the fishing vessel "Gazal" operating in the water around Qatar. Bottom trawl net was usually used for fishing. Sampling was proceeded during 1981-1982 fishing season.

Total fish length was measured to the nearest millimeter and the fish sampled were grouped in 10 mm length classes. The weight of fish was also determined to the nearest gram using one ban balance.

Age determination was investigated from both the length frequency distribution, and examination of fish scales. The scales were taken from the left side of the fish below the lateral line and in the area of the pectoral fin. The location of the scales was constant throughout all the sampling procedure. This consistency was found to be necessary precaution to avoid all kinds of discrepancies that might arise during growth analysis. The scales were cleaned in 10% solution of amonia and mounted dry between glass slides, then examined and measured under a binocular stereoscopic microscope.

RESULTS AND DISCUSSION

Age Determination

I- The length frequency distribution is an accepted method, first suggested by Peterson (1895) for obtaining the year class composition of a fish population. It is to divide the length curve into its component parts.

The length distribution of **Lethrinus nebulosus** (Table 1) is graphically represented as shown in Fig. 1. This graphical representation may suggest that seven age groups are included in the population of that fish species.

Harding (1949) has described a method by which normal probability graph paper may be used to dissect bimodal and in some instances trimodal, frequency distributions of biological measurements into their component normally distribution parts. Cassie (1950, 1954 and 1962) has extended this method to include all polymodal normal distributions.

For propability paper analysis, the percentages of the length frequency frequencies and the cumulative percentages are given in Table 1.

The data are plotted as cumulative percentages on an arithmetically propability paper (Fig. 2). The plotted points lie on an assymmetrically placed eye fitted curve. There are five points of inflexion where the direction of the curvature changes. Five lines AB, CD, EF, GH and IJ are accordingly drawn to represent five size groups.

The average length was calculated for each size class, as given in Table 2. An estimate of X^2 for the difference between the calculated and observed

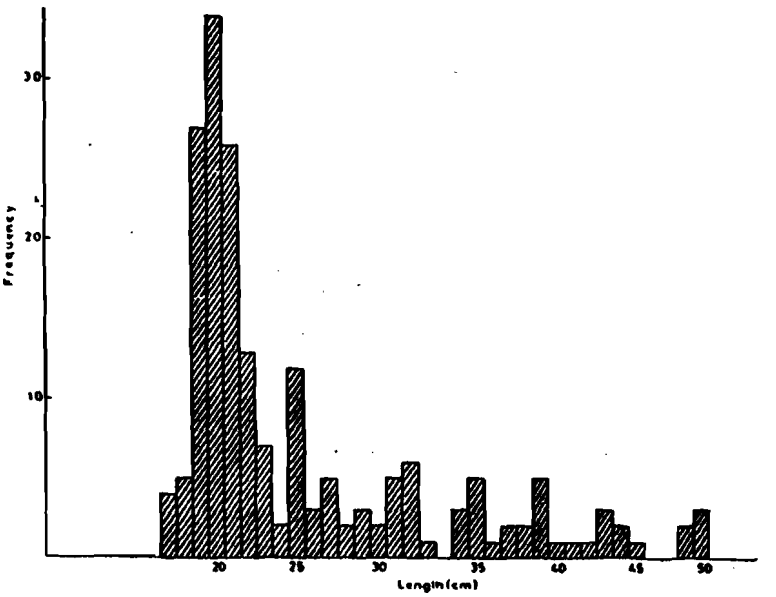

FIG. 1
Length distribution of Lethrinus nebulosus.

TABLE 1
Length frequency distribution of the examined sample of Lethrinus nebulosus in the Arabian Gulf.

Length	Frequency	Percentage frequency	Cumulative % frequency
17.5	4	2.14	6.96
18.5	9	4.81	6.96
19.5	27	14.44	21.39
20.5	34	18.18	39.57
21.5	25	13.37	52.94
22.5	13	6.95	59.89
23.5	7	3.74	63.63
24.5	2	1.07	64.70
25.6	7	3.74	68.44
26.5	3	1.60	70.04
27.5	5	2.67	72.71
28.5	2	1.07	73.78
29.5	3	1.60	75.38
30.5	2	1.07	76.45
31.5	5	2.67	79.12
32.5	6	3.21	82.33
33.5	1	0.53	82.86
33.5	3	1.60	84.46
36.5	5	2.67	87.13
37.5	1	0.53	87.66
38.5	2	1.07	88.73
39.5	2	1.07	89.80
40.5	5	2.67	92.47
41.5	1	0.53	93.00
42.5	1	0.53	93.53
43.5	1	0.53	94.06
44.5	3	1.60	95.66
45.5	2	1.07	96.73
46.5	1	0.53	97.26
49.5	2	1.07	98.33
50.5	3	1.60	99.93

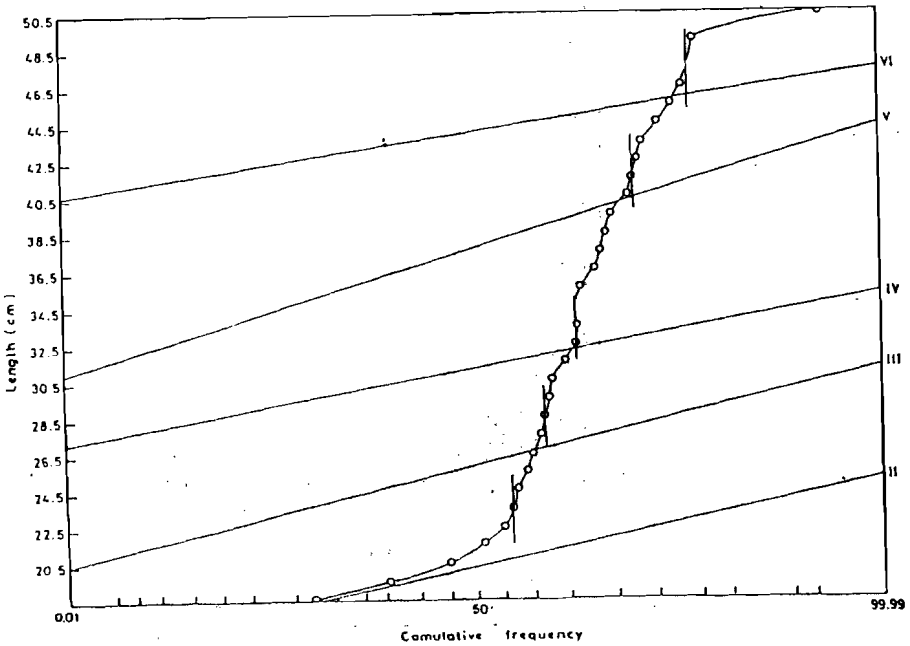

FIG. 2
Length distribution of Lethrinus nebulosus.

TABLE 2
The calculated average length of **Lethrinus nebuloses**
at various years of life according
to length frequency distribution method.

Year of age	II	III	IV	V	VI
Calculated length Length (cm	20.45	25.70	31.00	37.80	44.10

size frequency distributions indicated a satisfactory fit. P (X^2) was found to be 0.60 at 12 degrees of freedom.

II- The use of the scale method for age and growth studies of various fish was proved by several authors.

Annulii are usually formed as a result of drop in water temperature in winter season, or due to any other cause such as disease or starvation. In tropical and subtropical waters, such a drop is not sharp due to mild winters in such latitudes. So it might happen that no annulus is formed in one year, or on the contrary more than one annulus are formed in the same year due to various causes. However in such a case it is necessary to examine carefully a convenient number of scales so as to distinguish between the true and false annulus.

Microscopic examination of the scales of **Lethrinus nebulosus** revealed the presence of some difficulties in the interpretation of ages specially for old fish. Such difficulty was mentioned by Hashim and Shakour (1981) in their study on age determination and growth studies of **Lethrinus mahsena** and **Lethrinus xanthochilus** in the Red Sea.

A true annulus (or winter ring) on the scales of **Lethrinus nebulosus** was identified by the characters that a cutting over of the sclerites may occur. This cutting over is pronounced on the anterior sector of the scale. The second feature which helped in the location of the true annulus is the relatively narrow space between the sclerites of winter zones resulting in the formation of dark bands alternating with light zones of the fast growing summer zones. On the other hand the false annulus was characterised by the feature that it has no continuity on the two lateral sectors of the scale.

However, careful examination of the scales of this fish species, as carried out in the present study led to acceptable results concerning age determination and growth studies.

Body Scale Relationship

Growth calculations from sclae measurements require the establishment of a definite relationship between the growth of the scale and that of the body length.

The relation between the body length and anterior scale radius of **Lethrinus nebulosus** as shown in Table 3 was found to be nearly constant (with an average of S/L = 0.48). This fits a straight line relationship with the following equation:

$$L = 2.3819\ (S) - 4.03$$

where, L = total body length in cm, and
S = scale radius

TABLE 3
Body scale relationship of Lethrinus nebuloses from the Arabian Gulf water.

Average total length (cm)(L)	No. of fish	Average scale radius (S)	S/L
17.5	4	9.53	0.54
18.5	8	9.78	0.53
19.5	22	10.50	0.54
20.5	29	11.02	0.54
21.5	22	11.30	0.53
22.5	10	11.56	0.51
23.5	5	11.57	0.49
24.5	7	12.30	0.50
25.5	8	12.27	0.48
26.5	2	13.55	0.51
27.5	4	13.43	0.49
29.5	3	13.20	0.45
30.5	2	12.65	0.41
31.5	2	14.05	0.45
32.5	2	15.25	0.47
33.5	1	17.60	0.52
35.5	3	16.67	0.47
36.5	2	18.00	0.49
37.5	1	17.20	0.46
38.5	1	15.90	0.41
39.5	2	19.65	0.50
40.5	2	18.40	0.45
41.5	1	18.30	0.44
42.5	1	18.20	0.43
45.5	1	20.10	0.44
46.5	1	20.60	0.44
49.5	1	24.50	0.49

Growth in Length:

Since the body-scale equation has an intercept of (-4.03), so this has to be used as correction factor. Accordingly growth histories of **Lethrinus nebulosus** was computed according to the formula (Rosa Lee, 1920):

$$L_n = [(L_t + 4.03)/S_t] \times (S_n - 4.03)$$

where, L_n = Calculated length at the end of (n) years
L_t = total length at capture
S S_n = Scale radius to the (n) annulus
S_t = Total scale radius.

The calculated length attained at the end of each year of life and annual increment of growth in length for **Lethrinus nebulosus** are shown in Fig.3. From the curve it is obvious that the annual increment was high in the first year, while less increments were recorded during the following years of life.

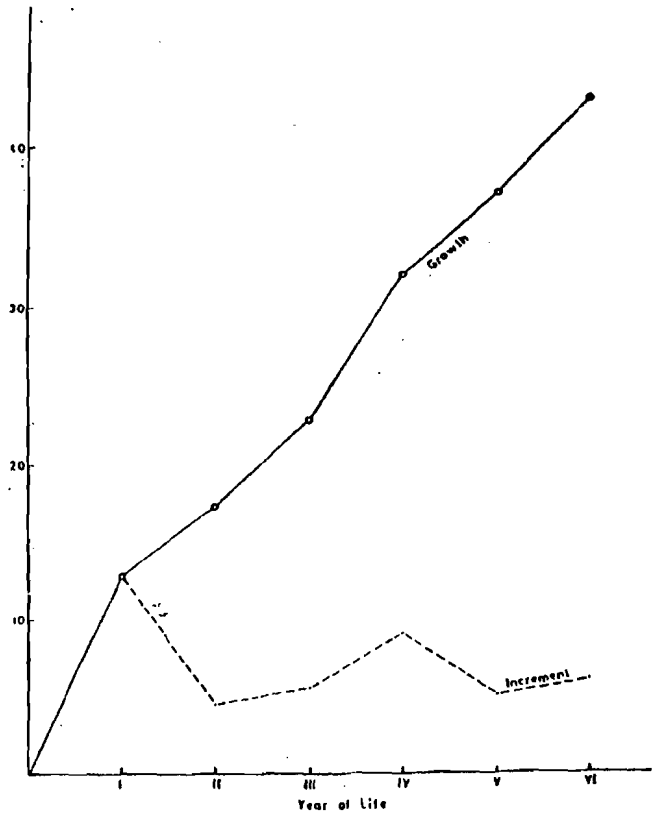

FIG. 3
General growth in length and annual increment in length of Lethrinus nebulosus.

Length/Weight Relationship:

The general equation ($W = a\ L^n$) has been proved to be the more satisfactory method of describing the length-weight relationship in fishes. The calculation of length-weight relation of **Lethrinus nebulosus** based on combined data from all fish regardless time of capture, sex and state of maturity, give the following equation:

$$\text{Log } W = -1.6460 + 2.9985 \text{ log } L$$

or

$$W = 22.5940 \times 10^{-3} \cdot L^{2.9985}$$

where, W = weight in grams
L = total length in centimeters

Since the value of the exponent (n = 2.9985) is close to 3, so it can be concluded that the weight of **Lethrinus nebulosus** increased approximately as the cube of its length. Therefore, the living condition of this fish species is expected to be good.

Growth in weight:

The calculated weights for each year of life for **Lethrinus nebulosus** are obtained from the calculated lengths at different years of life and the corresponding length-weight equation.

Figure 4 represents the calculated weights and the annual increment of growth in weight . It is clear that the increment in weight at the end of the first year of life is very small and has its maximum by the end of the 6 year of life.

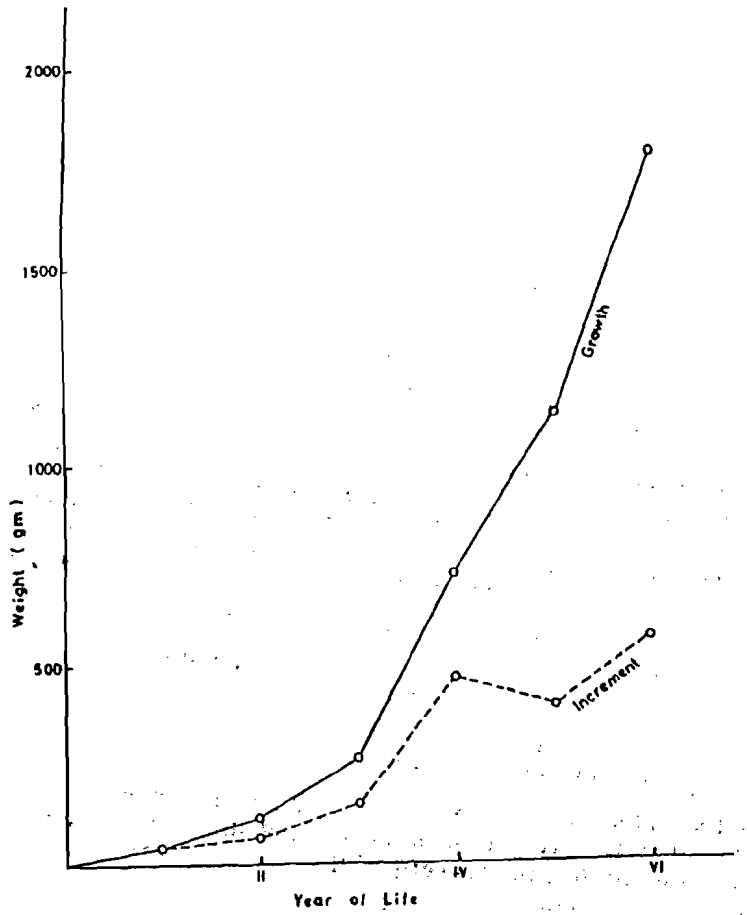

FIG. 4
General growth in weight and annual increment in weight for Lethrinus nebulosus.

Application of Von Bertalanffy Growth Model:

Growth models are usually used to study and follow up the growth of fish in various water bodies. The growth model used in the present study is that one described by von Bertalanffy (Beverton and Holt 1957) which is as follows:

$$L_t = L\,[1-e^{-K(t-t_\theta)}]$$

where, L_t =length at age t
L =ultimate length for the population
K =growth coefficient
t_θ =the time at which length would theoritically be zero.

Using the available data of **Lethrinus nebulosus,** the least square linear regression provides a relationship as follows:

$$L_{n+1} = 7.46305 + 0.8781\ L_n$$

where, L_n = length of fish at age (n)
L_{n+1}=length of fish at age (n+1)

TABLE 4
Length-weight relationship of
Lethrinus nebuloses in the Arabian Gulf.

Total fish length	Average emperical weight (gm)	Calculated weight (gm)
17.5	143.75	120.53
18.5	151.00	142.46
19.5	190.69	166.76
20.5	208.19	193.82.
21.5	226.00	223.46
22.5	240.85	256.21
23.5	246.92	291.88
24.5	327.50	330.75
25.5	367.50	372.73
26.5	390.00	418.31
27.5	434.29	467.41
28.5	472.50	520.23
29.5	533.33	577.03
30.5	585.00	637.82
31.5	620.00	702.59
32.5	680.00	771.61
33.5	980.00	844.70
35.5	1045.00	1005.31
36.5	1091.25	1092.95
37.5	1180.00	1184.67
38.5	1280.00	1282.63
39.5	1455.00	1384.84
40.5	1533.00	1483.88
41.5	1560.00	1605.46
42.5	1830.00	1723.85
43.5	1845.00	1849.27
44.5	2290.00	1980.16
45.5	2320.00	2115.92
46.5	2335.00	2258.92
49.5	2767.50	2724.58
50.5	2865.00	2892.68
51.5	2890.00	3067.61

The ultimate length (L) for this population is determined according to the formula

$$L = \text{intercept} / 1\text{-slope}$$

The von Bertalanfly equation as estimated for **Lethrinus nebulosus** is as follows:

Survival Rate: $L_t\ 61.22\ [1-e^{-0.138(t+0.905)}]$

The survival rate of the investigated species **Lethrinus nebulosus** has been studied from age distribution or age composition as shown by Ricker (1958). Thus the logarithms of number of fish are plotted against the corresponding ages (Fig. 5). the descending limb of the curve represents year classes which are captured in number proportional to their abundance in water mass. The straightness of this limb indicates a uniform survival with age.

The instantaneous total mortality was calculated as 0.803. On the other hand survival rate was found to be 0.55201 i.e about 55% of **Lethrinus nebulosus** survive per year after two years of age.

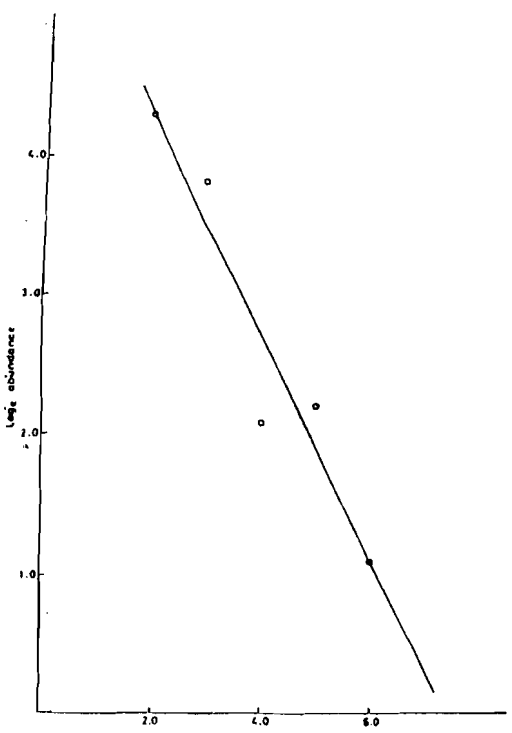

FIG. 5
Catch curve of Lethrinus nebulosus.

CONCLUSIONS

In the present study some difficulties were met when identifying the crowded annuli on the periphery of the scales of old fish. This was recorded by several authors, that in temperate latitudes annuli are sometimes not clear on the scales of fish or are not certainly recognizable during the season of slow growth.

To overcome this difficulty, the calculated lengths of **Lethrinus nebulosus** at different ages were adopted by two methods of caluclation.

It was found that there is an agreement between the calculated lengths of different age groups of fish, derived from frequency distribution and back calculation of scale measurements, which is a fair verification of the validity of the methods of age determination carried out in the present work.

The study shows that growth in length of **Lethrinus nebulosus** is fast during the first year of life, while less increments were recorded during the following years of life.

Using the von Bertalanffy equation, the theoritical rate of growth of **Lethrinus nebulosus** was calculated and the theoritical maximum length of fish was determined as 61.22 cm.

The survival rate of the fish in the Arabian Gulf has been estimated from data of age composition. It has been found that about 55% of **Lethrinus nebulosus** could survive per year after two years old.

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