Indian Journal ofFUheriesiX (2): 87-91, June 1994

Growth, maturity and mortality of *Upeneus sulphureus* from Andhra-Orissa coast

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Received: 22 December 1992

ABSTRACT

The length weight relationship, relative condition factor, growth, maturity, mortality and exploitation ratio of *Upeneus sulphureus* (cuv.) from Andhra-Orissa coast were studied. Growth parameters estimated from von Bertilanfly's growth function were: La, 20.22 cm; K, 0.65846/year; and to, —0.284 years. The fish attained maturity at 131 mm and had a longevity of 4.56 years. The total mortality Z and the fishing mortality F wore estimated as 2.318/year and 0.826/year respectively. The exploitation ratio E at 0.356 indicated under-exploited state of the stock.

Goat fishes of the Family Mullidae contribute an average of 640 tonnes (10%) to the annual small trawler landings at Visakhapatnam. The relative position of upeneids among the top 12 groups supporting the small trawler fishery has risen from the 11th (1982) to the first (1988, 1990 and 1991) during the last 10 years. *Upeneus sulphureus* (Cuv.) forms 52% (Luther *et al.* 1988) of the goat fish landings at Visakhapatnam followed by *U. vittatus* (33%). Ali (1984) studied the length-weight relationship of *U. sulphureus* from Maharashtra coast. Budihardjo (1987) studied its growth, mortality and biomass and Martasuganda *et al.* (1991) studied stock fluctuation from Java waters. This study deals with the length-weight relation, age and growth, maturation, mortality and exploitation ratio of *U. sulphureus* from Andhra-Orissa coast.

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MATERIALS AND METHODS

Total 4 837 specimens collected from Fishery Survey of India vessels MFV *Meena Shodak* and MFV *Meena Jawahar,* and from private trawlers, during 1976-78 were used. Length (mm) and weight (g) measurements of 240 males ranging from 91 to 177 mm, and 239 females ranging from 102 mm to 200 mm were used for estimating the length-weight relationship of the form W = aL by logarithmic transformation. ANOCOVA on the linearized length-weight regression, equations for males and females, t test on regression and correlation coefficients were carried out as per the standard procedures (Snedecor 1961). Relative condition factor Kn (LeCren 1951) at different body lengths as well as for different months was calculated for females using the formula: Kn = where W is observed weight and W is weight calculated using length-weight relationship. Size at first maturity was arrived at by plotting the percentage of mature specimen (stage IV and

above) against total length (Thomas 1969). The age at length data obtained by modal progression analysis were used in determining the parameters for von Bortalanffy's growth function (VBGF), i.e. L_a, K and to- The plot of $L_{I+|}$ against L_t (Ford Walford Plot) was used to estimate L_a as per Pauly (1983), while to was estimated by plotting -In (1 - $\frac{i+1}{7}$) against t (Sparre *et al.* 1989). Longevity was estimated from $t_{max} = 3/K$. (Pauly 1983). Pauly and Munro's (1984) length growth performance index PHI' was computed from:

$$PHP = \log K + 2\log L_a$$

where K and L_a are von Bertalanffy's growth parameters. Age at lengths calculated by the formula

$$i = t_{\text{„}} \frac{1}{K} \text{In} \quad (I \text{ -•-})$$

was used to estimate mean relative age. In $j\sim_t$ values were plotted against relative age and the slope of the resulting catch curve (with sign changed) was taken as estimate of total mortality Z. Value of Z was also computed from the mean size of the catch using the formula of Beverton and Holt (1956)

$$Z = \frac{K(L_a - E)}{L\text{--}V}$$

where L' is the smallest size of the fish fully represented in the catch and L is the mean length of the fish in the catch. Natural mortality M was estimated by Pauly's empirical formula:

$$\text{Log,}_0 M = -0.0066 - 0.279 \log,_0 L_a + 0.6543 \log|_0 K + 0.4634 \log,_0 T$$

T was taken as 27°C. Exploitation ratio was computed using the formula E = F/F + M (assuming F = Z — M).

RESULTS AND DISCUSSION

Length-weight relationship

The length-weight relationship for males and females was obtained as:

Males : $W = 0.00001173\ L^{3033455833}$ (r = 0.9909)
Females : $W = 0.00000920\ L^{30*76,816}$ (r = 0.9800)

where L is the total length (mm). ANOCOVA (Table 1) showed that the two regression lines have significantly (1%) different elevations

Table 1. Comparison of regression lines of female and male *Vpeneus sulphureus* by ANOCOVA

		df	Regression coefficient	Deviation from regression		
				df	SS	MS
Within	Male	239	3.03345833	238	1.26397970	0.00531084
	Female	238	3.08769816	237	0.79295669	0.00334581
				475	2.05693639	0.00433039
Pooled		477		476	2.06259007	0.00433317
Difference				1	0.00565368	0.00565368
Total		478		477	2.12414952	0.00445314
Between adjusted means				1	0.06155945	0.06155945

Comparison of slope F = (df 1,475): 1.30558218
Comparison of elevation F = (df 1,476): 14.20656240

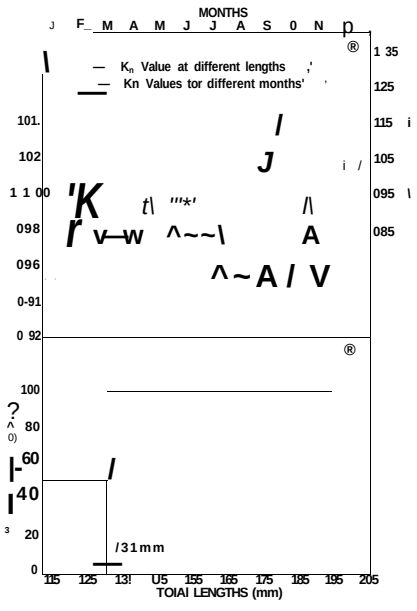

Fig. 1. (a) Relati\e Condition factor Kn for different body lengths and different months, (b) Size at maturity of *Upeneus sulphureus* from Andhra-Orissa coast.

but slopes do rot show any significant (5%) difference. The t test on correlation coefficient through Z conversion showed that the two V values are from a common population correlation. Though Ihe regression coefficient for male did not show any significant (1 %) departure from isometric value of 3, that of female was slightly higher than 3.

Condition factor

Relative condition factor Kn was less than 1 during January—August with lowest values during June (Fig. la), indicating a protracted per od of spawning. September-December, with higher Kn values, could be an intensive feeding period when the body condition improves. Kn was at a local maximum of 1 at about 122.5 mm body length followed by an inflexion. The values fluctuate widely after that but keep a general downward trend up to a length of 182.5 mm. If the inflexion after 122.5 mm is indicative of starting of sexual maturity (Hart 1946), it supports the finding that the fish attains first maturity at 131 mm. The fluctuating nature of Kn values after the inflexion at 122.5 mm could be an indication of the continuous nature of spawning of the fish. Thomas (1969) could not obtain any such relationship with Kn values of *U. tragula.*

Size at first maturity

The size at first maturity, the length at which 50% of the specimens are mature, was 131 mm (Fig. lb). This is in agreement with the earlier reported value of 130 mm for this species (Luther *et al.* 1988). The predominance of young fish (< 13 cm) during June to September also supports the fact that spawning occurs mostly during January to May.

Growth, mortality and exploitation

The maximum size of *U. sulphureus* encountered in this study (200 mm) was less than the maximum size reported earlier (235 mm) by Luther *et al.* (1988). The parameters of VBGF obtained (Fig. 2a, b) were: La, 20.22 cm; K = 0.65846/yr; and t_0, -0.284 years

Thus the von Bertalanffy growth function for *U. sulphureus* (Fig. 3a) can be written as:

$$L_t = 20.22(1-e)^{-0.65846(t+0.284)}$$

A mean of 8 independent estimates of ϕ' values for *U. sulphureus* from the Philippine and Indonesian waters was given by Budihardjo (1987) which agrees with the present ϕ' value (=logio0.65846 + 2 logio20.22) of 2.429.

The fishery is represented mostly by fishes of I to 3 years age. The longevity, t_{max}, obtained for this fish was 4.56 years.

The total mortality, Z obtained from mean size of the catch (Beverton and Holt

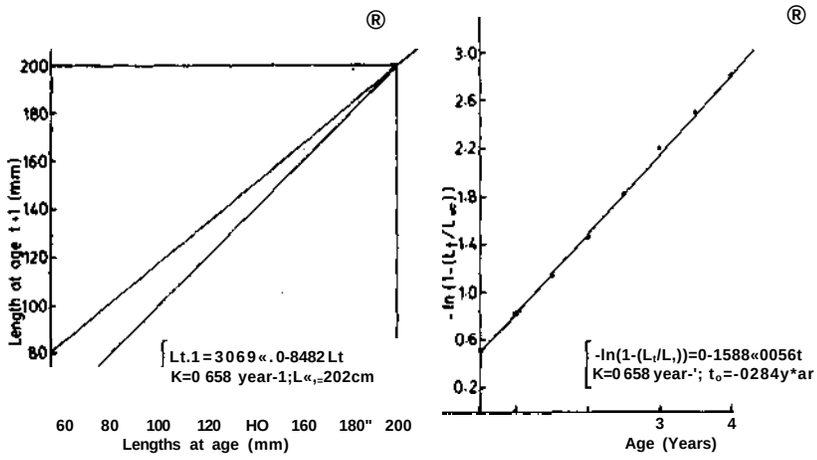

Fig. 2. (a) Ford-Walford plot for estimating L_a and K. and (b) plot for estimating to and K, at given L_{∞} of *Upeneus sulphureus* from Andhra-Orissa coast. g.

1956) was 2.098/year. By catch curve method a slightly higher value of 2.318/year was obtained (Fig. 3b) which was used for further calculations. The value of M obtained using Pauly's empirical formula was 1.492/year from which value of F (Z—M) was calculated as 0.826/year. The exploitation ratio E (0.826/2.318) of 0.356 obtained here indicated the underexploited condition of this stock. As the data pertain to a period when the mechanized trawling was still in the developing stage, the low exploitation ratio is quite justified. Further, the catch per effort has not shown any downward trend during the past 10 years. The fact that upeneids have come to occupy the first position during 1990-91 from the 11 th during the period of 1982-83 itself is indicative of the high exploitation potential of the stock of this species. It would be appropriate to undertake further investigation on this species and to estimate the stock, potential and maximum sustainable yield.

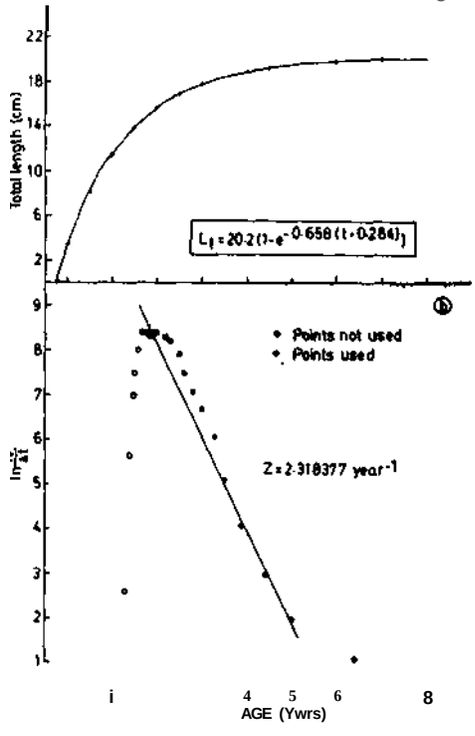

Fig. 3. (a) Estimated growth curve and (b) age structured catch curve of *Upeneus sulphureus* from Andhra-Orissa coast.

AC KNO W LEDG EM ENTS

The authors thank Dr G Luther, Principal Scientist, VRC of CMFRI, for suggestions; the Officer-in-charge, Visakhapatnam base of Fishery Survey of India and the Captain and Crew of M.F.V *Meena Shodak* and M.F.V. *Meena Jawahar* for the help; and Shri R V D Prabhakar for typing.

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