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GROWTH AND MORTALITY PARAMETERS AND SOME ASPECTS OF BIOLOGY OF STRIPED EEL-CATFISH *PLOTOSUS LINEATUS* (THUNBERG) FROM NORTH ANDHRA PRADESH COAST

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ABSTRACT

Lengh-weight relationship, relative condition factor, food, growth, maturity, fecundity, breeding, mortality and exploitation of *Plotosus lineatus* (Thunberg) from Visakhapatnam waters were studied. The fish attained maturity at 159 mm total length and has a longevity of 2.19 years. The total mortality and fishing mortality were estimated as 2.3102 and 0.6462 respectively. The exploitation ratio, E = 0.2797 and exploitation rate, U = 0.2520 indicated underexploited state of the stock.

INTRODUCTION

THE STRIPED eel-catfish *Plotosus lineatus* (Family: Plotosidae) is an edible fish often landed in small quantities by trawlers at Visakhapatnam. Since no study has been made so far on *P. lineatus* in India, an attempt is made to study the length-weight relationship, relative condition factor, age and growth, maturity, fecundity, breeding, food, mortality and exploitation from Visakhapatnam waters.

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MATERIAL AND METHODS

1022 specimens collected from small mechanised boats operating from Visakhapatnam Fisheries Harbour, supplemented with samples from the Institute's research vessel *R. V. Cadalmin V,* during 1988-1990 were used in this study. A qualitative analysis of food was made by examining the gut of 119 specimens. Size at first maturity was arrived at by plotting the percentage of mature specimens (stages IV and above) against total length as given by Thomas (1969). Ovaries of 26 specimens were used for estimation of fecundity and ova diameter studies. Length (mm) and weight (g) measurements of 216 males ranging from 120 mm to 214 mm and 301 females ranging from 121 mm to 234 mm were used for arriving at the length-weight relationship of the form : $W = aL^b$, by logarithmic transformation. ANACOVA on the linearised length-weight regression equations and 't' test on correlation and regression coefficients were carried out as per standard procedures (Snedecor, 1961). Relative condition factor (Le Cren, 1951) K_n was calculated for both the sexes at different body lengths. Modal progression analysis was carried out to derive the length-at-age data as detailed by Pauly (1983). Ford-Walford plot and von Bertalanffy plot were used for estimating the VBGF parameters L_∞, K and t_o as detailed in Sparre *et al.*, (1989). Pauly and Munro's (1984) length growth performance index, PHI (ϕ) was computed using L_∞ and K and compared with the indices of related species. Total mortality Z was calculated using catch curve method of plotting ln ($N/\Delta t$) against relative age and also by using mean size of the catch as discussed by Pauly (1983). Natural mortality M was

calculated using Pauly's empirical formula (assuming average annual surface temperature = 27°C.) as given in Sparre *et al.*, (1989). Longevity t_{max}, exploitation ratio E and exploitation rate U were also computed as given in Pauly (1983).

Results and Discussion

Food and feeding

A qualitative analysis of the food of *P. lineatus* indicated that it is a voracious carnivore feeding mainly on benthic fauna. The food consisted of copepods, gastropods, crustacean larvae and most frequently crab juveniles. The guts of young and pre-adult specimens were mostly full, often bursting on slight pressure. However, the guts of specimens in advanced maturity and spent condition were either partially filled or empty. This indicated a probable slackening of feeding associated with breeding. In general, the fish showed affinity to hard shelled and less active organisms such as crabs, gastropods and bivalves which live on the substratum.

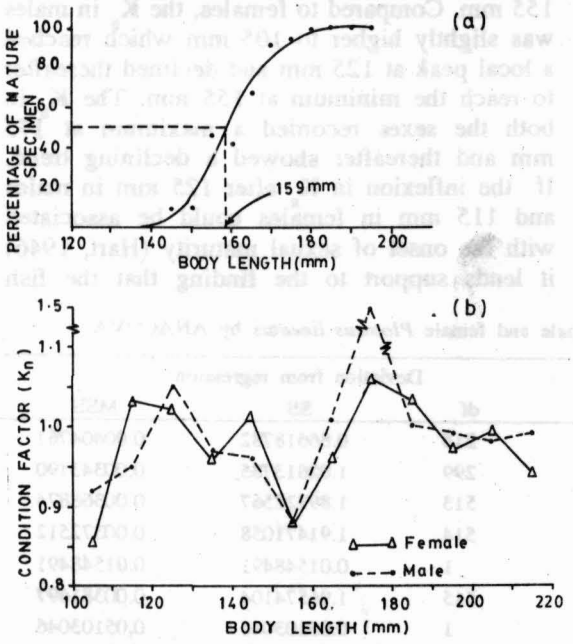

FIG. 1. (a) Size at maturity of *P. lineatus* from north Andhra Pradesh Coast. (b) Relative condition factor K_n at different body lengths of male and female *P. lineatus*

Maturity, Spawning and fecundity

The length at which 50% of the fish attain first maturity was estimated to be 159 mm (Fig. 1-a). This size is attained by the fish in about nine months. At about 185 mm length, which the fish attains in about 12 months, 100% of the fish are mature (Fig. 1-a). The ova diameter studies indicated progression of a single mode of maturing ova (Fig. 2). From

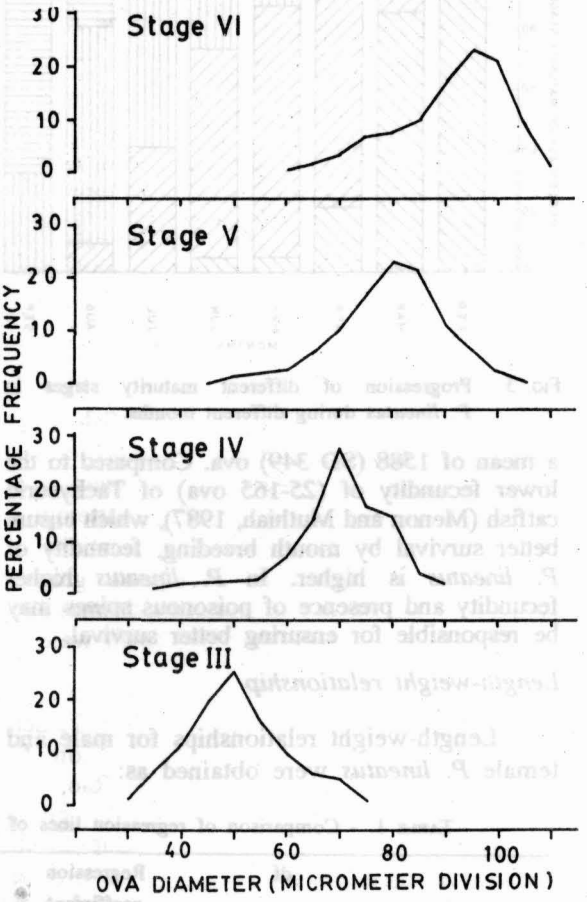

FIG. 2. Progression of ova diameter at different maturity stages of *P. lineatus*.

the above observations, it would appear that the spawning cycle in *P. lineatus* is annual as was observed in a related species, *P. canius* (Sinha, 1981). Tracing the progression of maturity stages and the recruitment of juveniles into the fishery and assuming that the fish move away from the fishing grounds during breeding, October-January period could be presumed as the breeding season for *P. lineatus*

(Fig. 3). The fecundity of this species was found to range between 913 and 2298 ova with

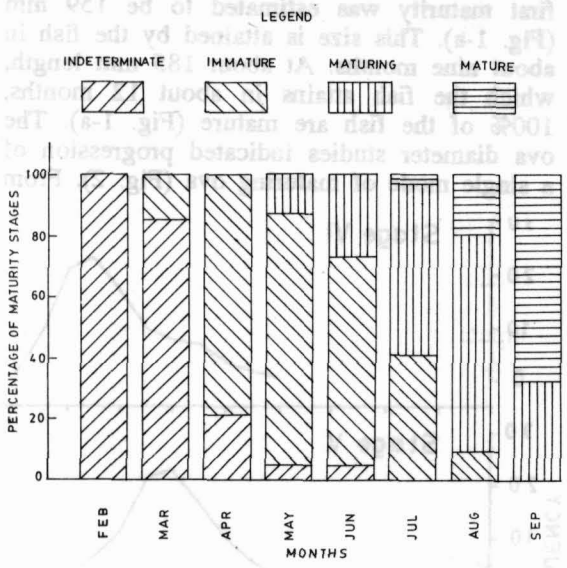

FIG. 3 Progression of different maturity stages in *P. lineatus* during different months.

a mean of 1588 (SD 349) ova. Compared to the lower fecundity of (25-165 ova) of Tachysurid catfish (Menon and Muthiah, 1987), which ensure better survival by mouth breeding, fecundity of *P. lineatus* is higher. In *P. lineatus* higher fecundity and presence of poisonous spines may be responsible for ensuring better survival.

Length-weight relationship

Length-weight relationships for male and female *P. lineatus* were obtained as:

$$Male : W = 0.00000121\ L^{3.347885}\ (r = 0.9930)$$

$$Female : W = 0.00000079\ L^{3.429552}\ (r = 0.9951).$$

ANACOVA showed that the two regression lines have significantly (5%) different slopes as well as elevations (Table-1). 't' test on correlation coefficient through z conversion showed at 5% level that the *'r'* values were not from a common population correlation. The regression coefficients for both male and female were significantly (5%) different (higher) from the isometric value three. Sinha (1981) reported that in *P. canius* the *'b'* value was significantly different (lower) from three.

Relative condition

The relative condition factor, K_n at different body lengths showed more or less similar trends for both male and female (Fig. 1-b). In females, the K_n value was lowest at 105 mm, reached a local peak at about 115 mm and thereafter showed a general declining trend till it reached the next lower value at 155 mm. Compared to females, the K_n in males was slightly higher to 105 mm which reached a local peak at 125 mm and declined thereafter to reach the minimum at 155 mm. The K_n in both the sexes recorded a maximum at 175 mm and thereafter showed a declining trend. If the inflexion in K_n after 125 mm in males and 115 mm in females could be associated with the onset of sexual maturity (Hart, 1946) it lends support to the finding that the fish

TABLE 1. - Comparison of regression lines of male and female *Plotosus lineatus* by ANACOVA

	df	Regression coefficient	Deviation from regression		
			df	SS	MSS
Males	215	3.347885	214	0.86618782	0.00404761
Females	300	3.429552	299	1.02613785	0.00343190
Pooled			513	1.89922567	0.00368874
Common	515	3.394847	514	1.91471058	0.00372512
Reg. Coeff.			1	0.01548491	0.01548491
Total	516		515	1.96574104	0.00381697
Adj. Means			1	0.05103046	0.05103046

Comparison of slope – F = (0.01548491) / (0.00368874) = 4.197886* (df 1,513).
Comparion of elevation- F = (0.05103046) / (0.00372512) = 13.699011 @ (df 1,514).
*Significant at 5% level, @ significant at 1% level

attains first maturity at about 159 mm. The decline in K_n after 175 mm, obviously due to intense spawning, also agrees with the size at 100% maturity.

Growth, mortality and exploitation

The minimum and maximum sizes of *P. lineatus* encountered in the present study were 37mm and 234 mm respectively. The tracing of growth curves from the progression of monthly modes is shown in Fig. 4. The parameters for von Bertalanffy's growth formula

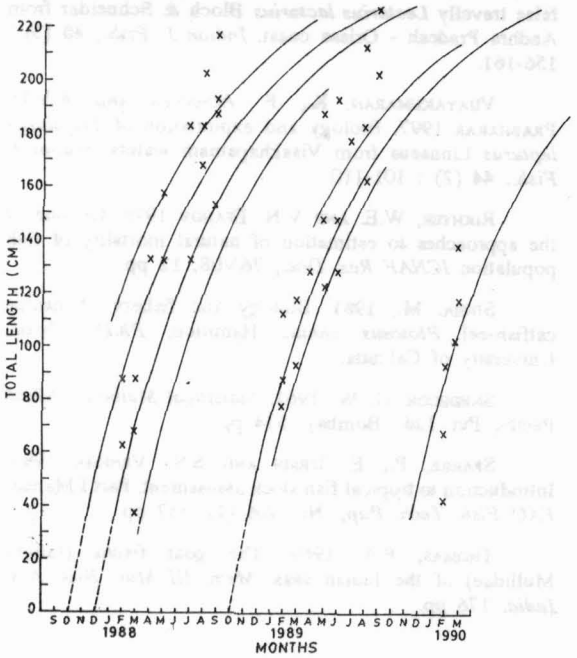

FIG. 4 Tracing of growth curves from progression of monthly modes of *P. lineatus*

(VBGF) obtained were: L_∞ = 243.73 mm, K = 1.3694 per year and t_o = 0.0085 year (Fig. 5-a). Thus the VBGF for *P. lineatus* can be written as:

$$L_t = 243.73\ (1 - e^{-1.3694\ (t-0.0085)})$$

The ϕ value obtained for *P. lineatus* was 2.9105, much closer to the ϕ value for *P. canius* (2.9855) derived from the parameters given by Sinha (1981). However, the ϕ value for *P. anguillaris* from Agoa Bay, Japan, derived from the parameters given by Pauly (1983), was 2.5159, much less than those of Indian species.

The fishery is represented by fishes of 1-2 years age and 3rd year class specimens were seldom observed during this study. Therefore, the longevity t_{max} of 2.1898 years obtained here is quite reasonable. The instantaneous total mortality coefficient *Z*, calculated using Beverton and Holt's (1956) formula was 2.5170, while the value of *Z* from catch curve method was 2.3102 (Fig. 5-b). The latter was arbitrarily chosen for further computations. The natural mortality coefficient, M obtained from Pauly's empirical formula was 2.2827. However, Rikhter and Efanov's formula for M yielded a lower value of 1.6640, which again was arbitrarily selected for further computations. As Rikhter and Efanov (1976) suggested, the higher natural mortality is compensated well by early maturation and reproduction in this case. The fishing mortality, F = (Z-M), was estimated as 0.6462 in this case. The ratio of natural mortality to growth coefficient (M/K) obtained in this study was 1.2151 which lies within the normal range of 1 - 2.5 suggested by Beverton and Holt (1959).

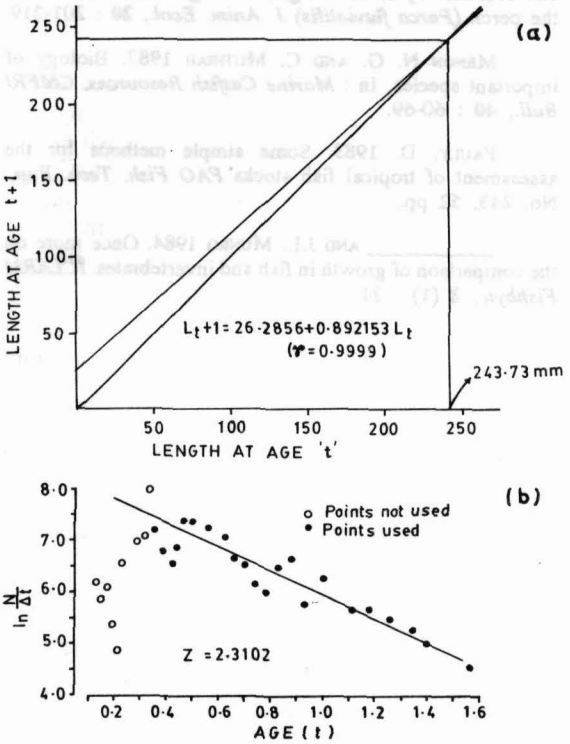

FIG. 5 (a) Ford-Walford plot for estimating L_∞ and K of *P. lineatus* (b) Age structured catch curve for estimating the total mortality coefficient of *P. lineatus*.

The present exploitation ratio of 0.2797 and exploitation rate of 0.2520 indicate the underexploited state of the fishery. However, the overexploited state of many stocks in the multispecies trawl fishery off Visakhapatnam (Rao, 1993; Reuben *et al.*, 1993 and 1997) will not permit to apply further effort to optimise the yield of this minor group.

REFERENCES

BEVERTON, R.J.H., AND S.J. HOLT 1956. A review of methods for estimating mortality rates in fish population, with special reference to sources of bias in catch sampling, *Rapp. et Process Verbaux des Reun. CIEM*, **140** (1) : 67-83.

_____ and _____ 1959. A review of the lifespans and mortality rates of fish in nature and their relation to growth and other physiological characteristics. In : *Ciba Foundation Colloquia on ageing*, edited by G.E.W. Wolsenholmy & M. O'Connor (CIBA) Vol. **5** : 142-180.

HART., T.J. 1946. Report on the trawling surveys on the Patagonian continental shelf. *Discovery Rep.*, **23** : 223-408.

LE CREN, E.D. 1951. The length-weight relationship and seasonal cycle in the gonad weight and condition in the perch (*Perca fluviatilis*) *J. Anim. Ecol.*, **20** : 201-219.

MENON N. G. AND C. MUTHIAH 1987. Biology of important species. In : *Marine Catfish Resources, CMFRI Bull.*, **40** : 60-69.

PAULY, D. 1983. Some simple methods for the assessment of tropical fish stocks' *FAO Fish. Tech. Pap,*. No. 243, 52 pp.

_____ AND J.L. MUNRO 1984. Once more on the comparison of growth in fish and invertebrates. *ICLARM Fishbyte*, **2** (1) : 21.

RAO, G. SUDHAKARA 1993. An appraisal o the marine fishery resources of Visakhapatnam coast. *Fishing Chimes*, **13** (1) : 81-87.

REUBEN. S., K. VIJAYAKUMARAN AND M. CHANDRASEKHAR 1993. Growth, maturity and mortality of false travelly *Lectarius lactarius* Bloch & Schneider from Andhra Pradesh - Orissa coast. *Indian J. Fish.*, **40** (3) : 156-161.

VIJAYAKUMARAN, K., P. ACHAYYA AND R.V.D. PRABHAKAR 1997. Biology and exploitation of *Trichiurus lepturus* Linnaeus from Visakhapatnam waters. *Indian J. Fish.*, **44** (2) : 101-110.

RIKHTER, W.E. AND V.N. EFANOV 1976. On one of the approaches to estimation of natural mortality of fish population *ICNAF Res. Doc.*, 76/vi/8, 12 pp.

SINHA, M., 1981. Biology and fishery of canine catfish-eel *Plotosus canius* Hamilton, *Ph.D. Thesis*, University of Calcutta.

SNEDECOR, G. W. 1961. *Statistical Methods.* Allied Pacific Pvt. Ltd., Bombay, 534 pp.

SPARRE, P., E. URSIN AND S.S. VENEMA 1989. Introduction to tropical fish stock assessment, Part I Manual *FAO Fish. Tech. Pap,*. No. 306 (1), 337 pp.

THOMAS, P.A. 1969. The goat fishes (family Mullidae) of the Indian seas. *Mem. III Mar. Biol. Ass. India*, 176 pp.