

MORTALITY RATES AND YIELD PER RECRUIT OF CATFISH  
*TACHYSURUS TENUISPINIS* (DAY)

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ABSTRACT

The mortality rates and yield per recruit of the catfish, *Tachysurus tenuispinis* are estimated from mean sizes and age composition. The total instantaneous mortality rate ranges between 0.80 and 1.10. The natural mortality (M) was 0.51. The yield per recruit. YW/R was maximum when F = 0.3. As the fishing mortality (F) already generated is considerable, caution is indicated against stepping up the fishing effort any further to increase the catch of this species.

INTRODUCTION

The abundance and distribution of *Tachysurus tenuispinis* along the north-east coast of India, (Sekharan et al 1973, Sekharan 1973 a & b) and various aspects of its biology have been studied (Dan 1975, 1976, Dan and Mojumder 1976). The present paper deals with yield per recruit and mortality rates estimated from mean sizes and age composition of the species in the catches landed at Visakhapatnam.

MATERIAL AND METHODS

The instantaneous mortality rate (Z) was worked out by two methods:—

1. From the mean lengths suggested by Soentango and Larkin (1973), the equation being  $Z = K \left( \frac{y - y_c}{n + 1} \right)$  (=—) the quantities y and y<sub>c</sub> being defined respectively, as  $y = -1 \left( 1 - l_t \right)_{LoC}$  and  $y_c = l_n \left( 1 - l_c \right)_{LoF}$  where Z is total mortality coefficient, l<sub>n</sub> is nat. log., K \* a constant equal to 1/3 of oabolic coefficient in von Bertalanffy growth equation, l<sub>c</sub> is the length at capture and l<sub>t</sub> is the mean size of the fish caught, l<sub>t</sub> was obtained by measurements of the random samples from Govt, of India trawlers, small private trawlers and boat seines operating off Visakhapatnam.

2. By numerical method (Ricker 1958) which states,  $\frac{N_2}{N_1} = S =$  or

$-Z = \log N_2 - \log N_1$ , where  $N_j$  and  $N_2$  are the catch in numbers per 100 h trawling of a particular year class in two consecutive years;  $S$  = annual survival rate and  $(1-S)$  gives the annual mortality rate ( $a$ ). Length frequency data obtained at 2 cm interval from Govt, of India trawlers were raised to the total monthly catches and from this the number per 100 hours of trawling was worked out. This was then resferred to age structure on the basis of earlier study (Dan, MS) which showed that the fish grew to a size of 18, 30 and 40 cm at the end of I, II and III year respectively.

To find out instantaneous natural mortality rate ( $M$ ) the regression formula  $Z = M + qf$  (Gulland 1969), Where  $f$  is the fishing effort in 1000 h. of trawling, was used. The intercept  $M$  gave the instantaneous natural mortality rate and  $q$  the catchability coefficient for the unit effort of 1000 h of trawling.

Estimations of yield per recruit at different levels of fishing mortality were made using the formula of Beverton and Holt (1957) simplified by Ricker (1958).

$$R = \frac{F W_o c}{LF+M} \left( \frac{L - (L - L_o) e^{-K(t_p - t_o)}}{F+M+K} \right) + \frac{3 e^{-2K(t_p - t_o)}}{F+M+2K} - \frac{e^{-3K(t_p - t_o)}}{F+M+3K}$$

where  $F$  = instantaneous fishing mortality coefficient;  $M$  = instantaneous natural mortality coefficient;  $t_p$  = age of recruit (age at which the fish become vulnerable to trawl);  $W_o$  = average weight of the fish when its asymptotic length is  $L_a$ ;  $K$  = a constant equal to  $i$  of catabolic coefficient in von Bertalanffy growth equation;  $t_0$  = The age at which the fish would have zero length.

#### RESULTS

##### *Total instantaneous mortality rate (Z)*

(a) *From mean size:* The total instantaneous mortality rates ( $Z$ ) were worked out from the mean sizes of the samples for 1964, 1966 to 1969 and 1973 to 1976. Also worked out are the values of  $Z$  from mean sizes raised to the total catch for the years 1973 to 1976. The mortality rate was the highest (1.47) in 1974. In other years it varies from 0.80 to 1.17. The average rate for all the 9 years was 1.0. The values worked out from the mean sizes of the samples and the mean sizes raised to the total catch are comparable.

(b) *From numbers:* From the annual size composition of *T. tenuispinis* in terms of numbers per 100 hours of trawling for the years 1973, 1974, 1975 and 1976. It is found that the numbers of fish at age I in 1973, 1974 and 1975 are less than those of the age II fish in 1974, 1975 and 1976 respectively. This discrepancy observed during the three years consistently is perhaps due to fish at age I not being fully recruited to the fishery. The fish at age 3 are also not caught in sufficient numbers. The length rate at which the fish at age IV is caught by the net (41-45 cm) constitutes only half of the IV year span of life. The data

for catch per unit of effort in numbers for 1976 were scanty. Omitting the survival rates for age I/II fish and for age MI/IV fish  $a^*$  well as for the year 1975/76 the survival rates (S) during the years 1973/74 and 1974/75 are 0.4037 and 0.1404 respectively (Table 1). The annual mortality rates ( $a = 1-S$ ) were, therefore, 0.5963 and 0.8596 with corresponding Z values of 0.90 and 1.96 which were similar to those found from the estimates based on mean lengths reported in the earlier section.

TABLE 1. *Catch in numbers per 100 hours trawling (C/f) for T. tenuispinis during 1973, 74, 75 and 76 and the estimated survival rates (S).*

Age	1973 C/f	S	1974 C/f	S	1975 C/f	S	1976 C/f
I	90.7		984.57		61.47		726.09
		-54.5031		-2.7935		-19.6018	
II	5475.20		4943.43		2750.35		1204.92
		0.4037		0.1404		0.1209	
III	2456.36		2110.48		694.15		332.49
		0.0082		0.0013		0.0133	
IV	6.07		2.08		2.81		9.20

#### *Natural mortality rate (M)*

The values of Z and fishing effort (f) during different years are given in Table 2 and diagrammatically represented in Fig. 1. The least square estimate of M was 0.5124 and  $q = 0.3889$ .

#### *Yield per Recruit*

The values of the parameters  $t - (1.0 \text{ year})$   $t_0 (0.177 \text{ year})$   $L_a (82.0 \text{ cm})$  and  $K (0.2106)$  were estimated earlier (Dan, MS).  $W_0 (4.726)$  was calculated from length weight relationship.

TABLE 2. *Total instantaneous mortality rates (Z) and fishing effort (f) in 1000 hours during different years.*

Year	Z	f
1964	0.92	1.666
1966	1.10	1.720
1967	0.80	1.066
1968	0.83	1.010
1969	0.94	0.931
1973	0.86	0.882
1974	1.47	1.526
1975	1.17	1.462

The yield per recruit of *T. tenuispinis* at various rates of annual instantaneous fishing mortality is shown in Fig. 1, taking instantaneous rate of natural mortality as 0.51 (calculated earlier). The yield per recruit gradually increases up to a fishing mortality rate of 0.30 and falls thereafter.

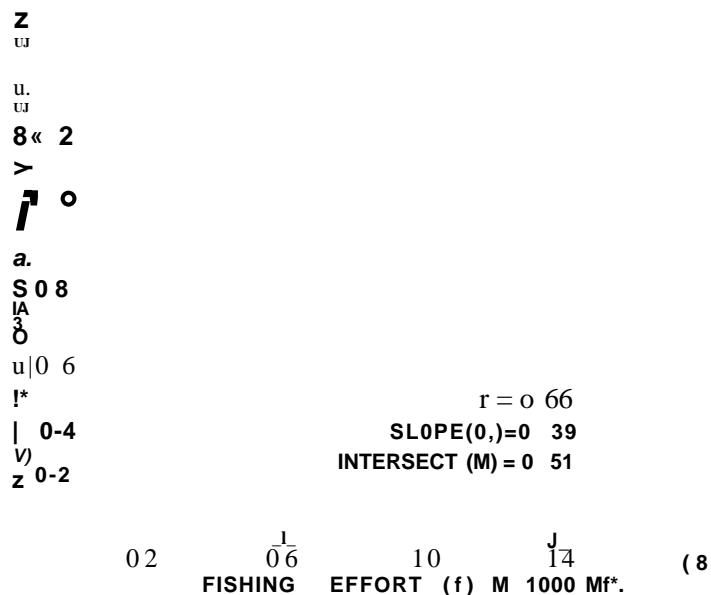


FIG. 1. Estimation of fishing mortality of *T. tenuispinis*

*Mortality and catch per effort*

The mortality rates and the oatch per unit of effort by Govt, of India trawlers during different years are given below:

	Total Instantaneous mortality rates (Z)	Instantaneous fishing mortality (F)	Oatch per hour (kg)
1964	0.92	0.41	8.87
1966	1.10	0.59	10.74
1967	0.80	0.29	9.53
1968	0.83	0.32	6.52
1969	0.94	0.43	3.57
1973	0.86	0.35	6.84
1974	1.47	0.96	3.57
1975	1.17	0.66	7.04
1976	1.09	0.58	

In general, fishing mortality rates have an inverse relation with the catch per effort. The maximum catch per effort (10.74) was obtained in 1967 when the fishing mortality rate (0.29) was close to the maximum yield per recruit (0.30) and the catch rates MI with the increase in fishing mortality.

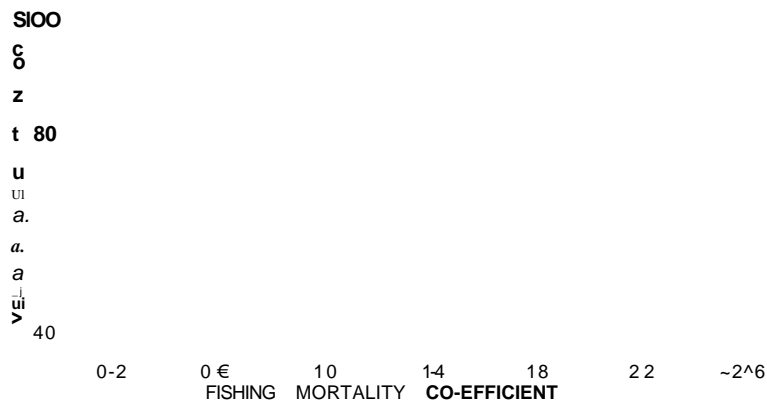


FIG. 2. Yield per recruit of *T. tenuispinis*.

#### REMARKS

*T. tenuispinis* is landed chiefly by trawl nets and bottom-set gill nets in the coast. A considerable quantity is caught by boat-seines and hook and line also. During the period from 1964 to 1976, it was found that the fishing mortality varied from 0.30 to 0.92. It was higher during the 1974-76 period and varied from 0.58 to 0.96 the maximum being in 1974. This higher rate in fishing mortality is probably due to the introduction of bottom set gill nets in 1972 and also small private trawlers, the number of which has gone as high as about 200. The prawn catch by bottom set gill nets having fallen, the intensity of operation of this net was drastically reduced from 1974. The fluctuations in the F values fairly coincides with the fluctuations in the intensity of gears catching cat-fish as well as catch per effort. The finding that the yield per recruit attains the maximum value at a fishing mortality rate of 0.3 and that the present fishing mortality rate is from 0.58 to 0.96 shows that any further attempt to step up the catch from the stock has to be exercised with caution.

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