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MORTALITY ESTIMATES OF INDIAN RIBBON FISH *TRICHIURUS LEPTURUS* OFF MAHARASHTRA COAST

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ABSTRACT

In view of its new found status in export market, ribbon fish resources need to be continusly monitored. Mortality, one of the important parameter is reported for the Indian ribbon fish *Trichiurus lepturus* Linnaeus in the present communication. The average annual instantaneous rate of total (Z), natural (M) and fishing mortality coefficient (F) were estimated as 2.66, 0.77 and 1.89 respectively for the 1995 to 1997 period. The exploitation rate (U) and exploitation ratio (E) were estimated as 0.66 and 0.71 respectively, which is beyond the optimum Thursreduction in the fishing effort for this stock along the Maharashtra coast is necessary.

Keywords : Mortality, Exploitation rate, *Trichiurus lepturus*.

INTRODUCTION

Rribbon fishes were never the main focus of attention of Indian fishermen, and were primarily consumed locally in fresh/ sundried condition or used as popular baits for capturing larger fishes like seerfish. They were also regularly exported in sun dried or salt - cured condition to countries like Sri-Lanka, Malaysia etc. However, it is only during the last decade that ribbonfishes have been able to gradually attain the status of one of the major marine resource of India. Presently frozen ribbonfishes are exported to more than 30 countries around the world including China, Singapore, Republic of Korea, Japan etc. Recently, they have also been tried as a source of raw material for surimi processing in India. Further, there is an increasing demand for the cosmetics made from their skin and pearl essence obtained from their body. During the last 10 years, the Indian ribbonfishes have registered a three - fold increase in their annual landings (MPEDA 1990, 1996, 1998), including a record 10,000 tonnes hike along the Maharashtra State (west coast of India). It is in this context, during the course of the present study, an attempt has been made to analyse the trends in mortality over the years.

Mortality studies of the Indian ribbon fish *Trichiurus lepturus*, have been carried out by several workers like Narasimham (1983, 1994). Meenakshisundaram *et al.*

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(1986), Somvanshi and Antony (1989). Chakraborty (1990), Thiagarajan *et al.*, (1992), Reuben *et al.*, (1997) and Chakraborty *et al.*, (1997) along both coasts of India. The present investigation was carried out to estimate fishing and natural mortality coefficient of *Trichiurus lepturus* off Maharashtra coast specially on account of its new - found status as an important - sea - food export commodity.

MATERIAL AND METHODS

The catch and length composition data during the period October, 1995 to September, 1997 was collected by undertaking at least three monthly visits to each landing centre *viz.* Mirkarwada at Ratnagiri and New Ferry Wharf and Versova at Mumbai, representing southern and northern zones of the Maharashtra coast respectively. Length frequency data of total length in centimeters of *T. lepturus* thus obtained on each sampling day, was then pooled up month-wise by grouping it into four cm class interval. This month-wise data collected for the two years of study period was further pooled to one calendar year by taking average values of the corresponding months and was then converted to the percentage of sample total. Estimates of growth parameters *viz.* $L\alpha$ = 128 cm, K = 0.5 per year and t_0 = - 0.009 years thus obtained from this basic data (Mohite, 1999) have been used as inputs in the present analysis.

The mortality parameters were obtained by using FiSAT (FAO - ICLARM Stock Assessment Tools) computer software package developed by Gayanilo, *et. al.* (1996) comprising methods like Pauly's (1978) Rikhter and Efanov's (1976) and also Cushing (1968) and Srinath (1948) for natural mortality coefficient. Length converted catch curve (Pauly, 1983 b, 1984 a & b), Jones and van Zalinge plot (1981), Beverton and Holt (1956) and Ault and Ehrhardt (1991) for estimation of Z.

Table 1: Total Mortality Coefficient (Z) for *Trichiurus lepturus* off Maharashtra Coast (For $L\infty$ = 128 cm, K = 0.5 per year)

Method	Z	Remarks
Jones & van Zalinge (1981) Z plot	2.24	-
Length converted catch curve	2.25	-
Ault & Ehrhardt (1991) method	2.66	For L ' = 64.00 cm $\overline{L}$ = 74.103 cm and L max = 123.7 cm.
Beverton & Holt (1956) model	2.67	For L ' = 64.00 cm $\overline{L}$ = 74.103 cm

RESULTS AND DISCUSSION

The results of instantaneous rate of total and natural mortality coefficient of *Trichiurus lepturus* off Maharashtra, as estimated by different methods employed in the present investigation are given in Table 1 and 2 respectively. It is seen that annual "Z" varied from 2.24 to 2.67 while annual "M" varied from 0.77 to 1.61.

The "Z" as recorded by various authors for *T. lepturus* (Table 3) along the west coast of India varied from a minimum of 1.79 (Somvanshi and Antony 1989) to a maximum of off 3.82 Mumbai coast (Thiagarajan *et al.,* 1992). Similarly, along the east coast, the lowest "Z" value of 1.2 was observed by Narasimham (1983) off Kakinada and Meenakshisundaram *et al.,* (1986) off Andhra Pradesh coast, while the highest was 3.47 off Visakhapatnam coast by Ruben *et al.,* (1997).

The Ault and Ehrhardt (1991) method for the estimation of Z does not assume an infinite life span for the fish of the stock that is being analysed and is best suited for short lived tropical species (Gayanilo, *et al.,* 1996). During the present study, however, the annual "Z" values as obtained by Ault and Ehrhardt (1991) method and Beverton and Holt (1956) model are almost same. viz., 2.66 and 2.67 repectively (Table 1). Further, the annual "Z" as obtained by these two methods is close to the value obtained earlier by Chakraborty *et al.,* (1997) for the Maharashtra coast for *T. lepturus* (Table 3). Hence, the value of instantaneous total mortality coefficient "Z" = 2.66 as obtained by Ault and Ehrhardt (1991) method, had been selected for estimation of fishing mortality coefficient "F".

The instantaneous natural mortality coefficient "M" = 0.77 for *T. lepturus* off Maharashtra was the lowest estimate obtained by Pauly's (1978) method while the highest value of 1.61 was obtained by Rikhter and Efanov's (1976) method (Table 2). The natural mortality estimates of *T. lepturus* for different regions along the west

Table 2: Natural Mortality Coefficient (M) for *Trichiurus lepturus* off Maharashtra Coast (For L_∞ = 128 cm, K = 0.5 per year)

Method	M	Remarks
Pauly's (1978) method	0.77	For T = 28.72°C.
Srinath (1998) method	0.84	-
Cushing's (1968) method	0.92	For T max = 6 years and 95% of L_∞ = 121.6 cm.
Rikhter & Efanov's (1976) method	1.51	For t mass = 0.883 years. (females)
	1.61	t mass = 0.8125 years (males)

Table 3 : Mortality estimates for *Trichiurus lepturus* by different authors.

Indian Coast	Authors	Region	Annual Mortality Coefficients				
			M	Z	F	E	U
W E S T	Present Study	Maharashtra Coast	0.77 (Pauly's Method)	2.66 (Beverton & Holt method)	1.89	0.71	0.66
	Somvanshi & Antony (1989)	North West coast	0.80 (Pauly's method)	1.79 (Length Converted Catch Curve method)	0.99	0.55	0.46
	Chakraborty (1990)	Mumbai Coast	1.05 (Cushing's method)	1.96 (Beverton & Holt method)	0.91	0.46	0.39
	Thiagarajan *et al.*, (1992)	West Coast	1.00 and 1.07 (Calculated from Z & F)	3.71 and 3.77 (Catch Curve method and Cohort analysis)	2.71	0.730	0.70
	Chakraborty *et al.*, (1997)	Maharashtra Coast	0.75 (Pauly's method)	2.62 (Length Converted Curve method)	1.87	0.71	0.68
E A S T	Narasimham (1983)	Kakinada coast	0.90 (Sekharan's method)	1.20 (Average Catch curve (Ricker 1975)	0.30	0.25	0.17
	Meenakshisundaram *et al.*, (1986)	Andhra Pradesh coast	0.90 (method not mentioned)	1.20 (method not mentioned)	0.30	0.25	-
	Thiagarajan *et al.*, (1992)	East coast	0.95 and 1.12 (Calculated from Z & F)	3.15 and 3.32 (Catch Curve method and Cohort analysis)	2.20	0.70	0.84
	Narasimham (1994)	Kakinada coast	0.46 (Sekharan's method)	3.16 (Beverton & Holt method)	2.70	0.85	0.32
	Reuben *et al.*, (1997)	Visakhapatnam coast	0.89 (Pauly's method)	2.42 and 3.47 (Catch curve and Beverton & Holt method)	1.52	0.63	0.57

as well as east coast of India as computed by various authors is presented in Table 3. It can be seen that natural mortality estimates of *T. lepturus* along the west coast varied from a lowest of 0.75 off Maharashtra coast (Chakraborty *et al.*, 1997) to a highest of 1.07 off the entire west coast (Thiagarajan *et al.*, 1992). Similarly, along the east coast the minimum estimate was 0.46 off Kakinada coast (Narasimham, 1994) while the maximum of 1.12 was recorded by Thiagarajan *et al.*,(1992) for the entire east coast. The values of annual "M" of 0.77, 0.84 and 0.92 as estimated in the present investigation (Table 2) fall within the range of the estimates as obtained by (Table 2) appear to be on the higher side. Further, the value of instantaneous natural mortality coefficient "M" = 0.77 obtained in the present investigation for *T. lepturus* off Maharashtra coast using Pauly's (1978) method is quite close to the value obtained earlier by Chakraborty *et al.*,(1997) for the same region and hence, has been used in further analysis including estimation of fishing mortality coefficient "F".

The fishing mortality coefficient "F" obtained in the present investigation is 1.89 (i.e. after selecting "Z" = 2.66 and "M" = 0.77). The fishing mortality estimates of *T. lepturus* computed by various authors for different areas along both the coasts of India is given in Table 3. It can be observed that fishing mortality estimates of *T. lepturus* along the west coast varied from a minimum of 0.91 off Mumbai coast (Chakraborty, 1990) to a maximum of 2.71 off the entire west coast (Thiagarajan *et al.*, 1992). Similarly, along the east coast the lowest estimate of 0.3 was observed off Kakinada coast (Narasimham, 1994) and Andhra Pradesh coast (Meenakshisundaram, *et al.*, 1986) while the highest of 2.20 was recorded by Thiagarajan *et al.*, (1992) for the entire east coast. The value of instantaneous fishing mortality coefficient "F" =1.89 obtained in the present investigation is quite close to the value obtained earlier by Chakraborty *et al.* (1997) for Maharashtra coast.

The annual catchability coefficient "q" was derived by calculating "f' the average of trawler boat hours for the fishing seasons 1995-96 and 1996-97 and by using the value of "F" as 1.89. The average annual trawler boat hours during the period 1995 to 1997 was estimated to be 53,44,726 hours (Mohite, 1999). Further, it was estimated that out of the total *T. lepturus* landings of Maharashtra, for these two fishing seasons. 97 per cent was exclusively contributed by trawlers (Mohite, 1999). Hence, trawler boat hours have been used for the estimation of "q" in the present analysis. Further, assuming that the value of "q" & "M" remain the same over the years, fishing mortality and total mortality can be estimated if fishing effort 'f' is known.

The exploitation rate and exploitation ratio estimates of *T. lepturus,* as computed by various authors for different sectors along the Indian coast are presented in Table 3. It can be seen that the exploitation rate of *T. lepturus* along the west coast varied from a minimum of 0.39 off Mumbai coast (Chakraborty, 1990) to a maximum of 0.70 off the entire west coast. (Thiagarajan *et al.*, 1992). Similarly, along the east coast the lowest and the highest estimate of the exploitation rate of 0.17 and

0.82 both off Kakinada coast were recorded by Narasimham in 1983 and 1994, respectively. Like wise, the lowest value of the exploitation ratio was recorded as 0.25 off Kakinada coast (Narasimham, 1983) while the highest of 0.66 was observed for the entire east coast by Thiagarajan *et al.*, (1992).

Thus the exploitation rate as well as exploitation ratio as determined in the present investigation are quite similar to those obtained earlier by Chakarborty *et al.*, (1997) along the Maharashtra coast and Thiagarajan *et al.* (1992) along the entire west coast of India (Table 3) and are well beyond 0.5. Hence there is an urgent need to reduce fishing effort along Maharashtra coast for optimum exploitation of *T. lepturus*.

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REFERENCE

Ault, J. S. and Ehrhardt N. H., 1991. Correction to the Beverton and Holt Z - estimator for truncated catch length - frequency distributions. *ICLARM Fishbyte* **9**(1): 37-39.

Beverton, R. J. H. and **Holt S. J.,** 1956. A review of methods for estimating mortality rates in exploited fish populations, with special reference to sources of bias in catch sampling. *Rapp. P. - V. Reun. CIEM.* **140 :** 67 - 83.

Chakraborty, S.K., 1990. Fishery, age, growth and mortality estimates of *Trichiurus lepturus* Linnaeus from Bombay waters. *Indian J. Fish.,* **37** (1): 1-7.

Chakraborty, S.K., Deshmukh V.D., Khan M.Z., Kuber V. and Raje S.G., 1997. Estimates of growth, mortality, recruitment pattern and maximum sustainable yield of important fishery resources of Maharashtra coast. *Indian J. Mar. Sci.,* **26 :** 53-56.

Cushing, D.H., 1968. Fisheries biology. *A study in population dynamics.* Univ. Wisconsin Press, Madison, Wis., : 200pp.

Gayanilo, F.C. Jr., Sparre P. and Pauly P., 1996. FAO - ICLARM Stock assessment tools (FiSAT). Computer software package (ver. 1.1; September, 1995) & User's manual. *FAO Computerised information series. (Fisheries)* **8**: 126 pp.

Jones, R. and Zalinge van. N.P., 1981. Estimates of mortality rate and population size for shrimp in Kuwait waters. *Kuwait Bull. Mar. Sci.,* **2** : 273-288.

Marine Products Development Authority, India, 1990. *Statistics of Marine Products Exports*, 1989 : 115 pp.

Marine Products Development Authority, India, 1996. *Statistics of*

Marine Products Exports, 1994 : 254 pp.

Marine Products Development Authority, India, 1998. *Statistics of Marine Products Exports,* 1996 : 388 pp.

Meenakshisundaram, P.T., Narasimham K.A. and Sastry Y.A., 1986. The ribbonfish resources, *R & D series for marine fisheries resources management* CMFRI, Cochin, India.

Mohite, A.S., 1999. Stock assessment of *Trichiurus lepturus* (Linnaeus, 1758) and study of gears employed in its fishery of Maharashtra coast. Ph.D. Thesis submitted to the *Central Institute of Fisheries Education (Deemed University), Mumbai* : 219 pp.

Narasimham, K.A., 1983. On the fishery, mortality rates and yield per recruit of the ribbon fish, *Trichiurus lepturus Linnaeus, Indian J. Fish.,* **30** (1) : 99-101.

Narasimham, K.A., 1994 Fishery and population dynamics of the ribbonfish *Trichiurus lepturus* Linnaeus off *Kakinada. J. Mar. biol. Ass. India,* **36** (1&2) : 23-27.

Pauly, D., 1978. A discussion of the potential use in population dynamics of the interrelationships between natural mortality, growth parameters and mean environmental temperature in 122 stocks. *ICES, C.M., Demersal Fish* Committee 21 : 36 P.

Pauly, D., 1983 b. Length - converted catch curves. A powerful tool for fisheries research in the tropics. (Part I), *ICLARM Fishbyte,* **1** (2) : 9 - 13.

Pauly, D., 1984 a. Length - converted catch curves. A powerful tool for fisheries research in the tropics. (Part II). *ICLARM Fishbyte,* **2** (1) : 17-19.

Pauly, D., 1984 b. Length - converted catch curves. A powerful tool for fisheries research in the tropics. (Part III : Conclusion). *ICLARM Fishbyte,* **2** (3) : 9-10.

Reuben, S., Vijayakumaran K., Achayya P. and Prabhakar R.V.D, 1997. Biology and exploitation of *Trichiurus lepturus* Linnaeus from Visakhapatnam waters. *Indian J. Fish.,* **44** (2) : 101-110.

Rikhter, V.A. and Efanov V. N., 1976. On one of the approaches to estimation of natural mortality of fish populations. *ICNAF Res. Doc.,* **76/VI/8** : 12 pp.

Somvanshi, V. S. and Antony J., 1989. Population dynamics and assessment of *Trichiurus lepturus* Linnaeus stock in north - west coast of India. *In : Studies on Fish Stock Assessment in Indian Waters Spl. Publ.* ***No.2*** *(Fishery Survey of India)* : 1-32.

Srinath, M., 1998. Empirical relationships to estimate the instantaneous rate of natural mortality. *Indian J. Fish.,* **45** (1) : 7 - 11.

Thiagarajan, R., Lazarus S., Sastry Y.A., Khan M. Z., Kasim H.M. and Scariah K.S., 1992. Stock assessment of the ribbonfish, *Trichiurus lepturus* Linnaeus, from the Indian waters, *Indian J. Fish.,* **39** (3 & 4) : 182-194.