Indian J. Fish., 36 (2) : 103 - 106 (1989)

POPULATION DYNAMICS OF SILVERBELLY *LEIOGNATHUS JONESI* JAMES IN THE TRAWLING GROUNDS OF RAMESWARAM

M. KARTHIKEYAN, N. GOPALAKRISHNA PILLAI AND M. BADRUDEEN *
Central Marine Fisheries Research Institute, Cochin - 682 031, India

ABSTRACT

The Von Bertalanffy growth parameters for *Leiognathus jonesi* are estimated as : L_∞ = 146.617 mm and K = 0.917 per year. The coefficient of total mortality (Z) , natural mortality (M) and fishing mortality (F) rates are estimated. The length-weight relationship of the fish is $W = 0.000030335\ _{L}\ 2.887$. Beverton and Holt yield per recruit analysis shows that an increase in Lc results in better yield per recruit. The estimated average annual stock ranges between 8,800-9,100 tonnes and the average standing stock between 1,700-1,900 tonnes.

INTRODUCTION

The fishes of the family Leiognathidae, popularly called silverbellies contribute an important fishery along the coasts of Andhra Pradesh, Tamil Nadu and Kerala. Among these states Tamil Nadu contributes the bulk of the catch of silverbellies. The southeast coast comprising Palk Bay and Gulf of Mannar regions yields very high catch rates of silverbellies. Of the 16 species of silverbellies occurring in the area, *Leiognathus jonesi* form the dominant species accounting for 85% of the catch. The fishery is continuous round the year with a peak season from April to October along the Palk Bay and from November to March along the Gulf of Mannar coasts.

Silverbellies have been subjected to heavy exploitation off Rameswaram after introduction of mechanised trawling and the total catch increased from 4,900 tonnes in 1977 to 9,300 tonnes in 1982 . In view of its importance in the fishery at Rameswaram Island, an attempt was made to study the dynamics of the fishery to determine the effect of intensive fishing on the abundance of the stock. The present paper deals with the growth parameters and mortality rates of *L. jonesi* on the basis of the data collected from private trawlers during 1981-'83. An attermpt was also made at estimating the yield per recruit and stock assessment of this species.

DATA BASE

Samples were collected once a week from Rameswaram fish landing centre to get data on species composition of silverbellies as well as catch and effort data of commercial trawlers. Lengths of *L. jonesi* were obtained on each observation day. The length, catch and effort data thus obtained were raised to the day's catch and these were further raised to get the monthly estimates forming primary data base.

Length-weight relationship

To obtain the length-weight relationship, a sample of 240 specimens representing all

* Present adress : Regional Centre of CMFRI, Mandapam Camp, India.

length groups collected during 1980 was used. By fitting the equation of the form

$$W = a.L^b$$

to the observed data, the length-weight relationship was obtained as

$$W = 0.000030335\ L^{2.887}$$

Growth parameters

Assuming that the growth in length of the species follows Von Bertalanffy's (1938) equation, the growth parameters were obtained. A total of 7,979 specimen of *L.jonesi* in the length range of 15 and 135 mm were measured during 1981- '83. The estimates of successive monthly length compositions were pooled to get quarterly length composition of the catch and subsequently quarterly modes were obtained by Bhattacharya's (1967) method. These modes were plotted (Fig.1) and then modal progression analysis was carried out. The growth parameters L_∞ and K were estimated at L_∞ = 146.617 mm and K = 0.917 per year.

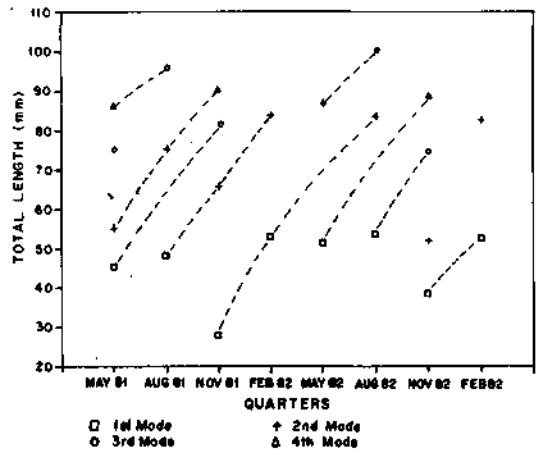

FIG. 1. Modal length in *Leiognathus jonesi* in different quarters during 1981-'83

Mortality rates

For the estimation of mortality rates, average annual length-frequency distribution was considered. Then using Beverton and Holt (1956) equation, total mortality (Z) was estimated at Z=5.26. Alagaraja (1984) method gave Z= 4.78. Natural mortality (M) was estimated at M=1.41 by using the equation.

$$M = -\ln (0.01)/Tmax$$

Where Tmax = 3/K = 3.27. M was also estimated at M=1.25 using Sekharan (1975) method. Venkataraman, Badrudeen and Thiagarajan (1981) stated that the life span of *L. jonesi* was less than three years only whereas James (1986) stated that the life span of the species (*L. jonesi*) was found to be more than four years. Among the different estimates of M, the estimate M=1.25 (where T max = 3.68) gave an Lmax (=142mm) close to L_∞ and hence M was taken as M=1.25. Based on the estimate of average annual landings (Y) of *L. jonesi* (6,657 tonnes), average annual stock and average standing stock were estimated along with the annual rate of exploitation U (Beverton and Holt, 1957; Ricker, 1975) (See Table 1.)

TABLE 1. *Estimates of Z obtained by different methods along with average annual stock and average standing stock*

Method of	Z	F	U	Ave. annual stock (Y/U) (in tonnes)	Ave. standing stock (Y/F) (in tonnes)
Beverton and Holt (1956)	5.26	4.01	0.758	8,800	1,700
Alagaraja (1984)	4.78	3.53	0.732	9,100	1,900

Yield per recruit analysis

To study the effect of fishing on yield, Beverton and Holt (1957) yield per recruit analysis was carried out for three values of M/K (viz. M/K = 1, M/K=1.5 and M/K=2) and at three different values of Lc (Lc = 42.5 mm, Lc = 72.5 mm and Lc = 82.5 mm). Other

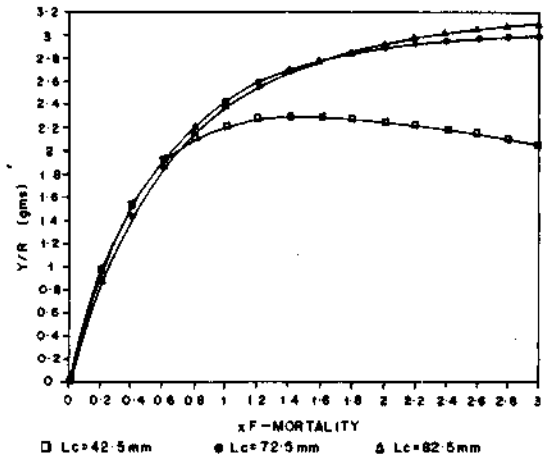

FIG. 2. Beverton & Holt Y/R analysis (M/K=1.5) *Leiognathus jonesi* Rameswaram 1981-'83.

inputs were Fp = 4.01, L_∞ = 146.617 mm and Lr = 15 mm. The yield per recruit (in g) was estimated at different levels which were multiples of the present fishing mortality (Fp). In Fig. 2 and Fig. 3 the xF = 1 denotes Fp, xF = 1.2 denotes 20% increase in Fp, xF = 0.8 denotes 20% decrease in Fp *etc.*

The results of yield per recruit analysis are given in Table 2.

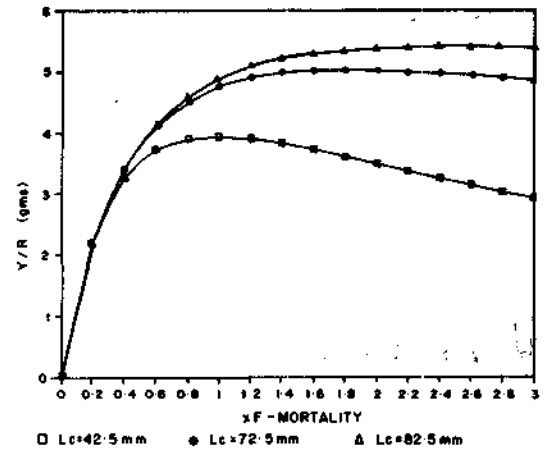

FIG. 3. Beverton & Holt Y/R analysis (M/K=1) *Leiognathus jonesi* Rameswaram 1981-'83.

For M/K = 1.5 yield per recruit was calculated at different Lc's and it was observed that the Y/R at present Lc of 72.5 mm was the highest (2.44 g) as compared to Y/R at other levels with the present fishing mortality (Fig. 2). When M/K = 1 the Y/R analysis showed that with the present fishing mortlaity, Y/R at Lc = 82.5 mm was the highest (4.91g) as compared to Y/R at other levels (Fig. 3) whereas M/K = 2, Y/R at Lc = 72.5 mm was the highest (1.476 g) (Fig. 4).

TABLE 2. *Yield per recruit (in g) and maximum sustainable yield per recruit (in g) at different Lc's of* L. jonesi

		Length at first capture (in mm)		
		Lc = 42.5	Lc =72.5	Lc=82.5
M/K=1	Y/R AT FP	3.965	4.780	4.911
	MSY/R	3.967	5.030	5.417
M/K=1.5	Y/R AT FP	2.215	2.441	2.376
	MSY/R	2.295	2.998	3.193
M/K = 2	Y/R AT FP	1.457	1.476	1.368
	MSY/R	1.618	2.115	2.207

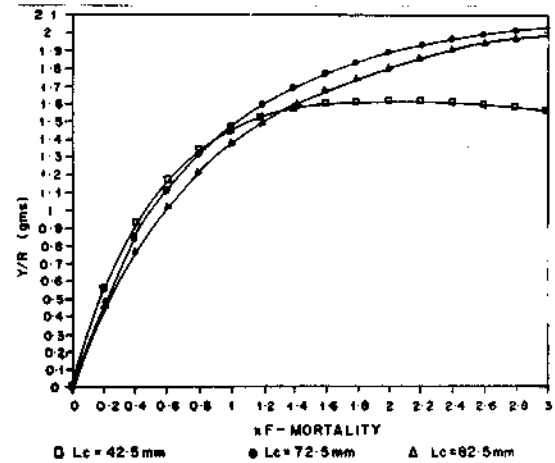

FIG. 4. Beverton & Holt Y/R analysis (M/K=2) *Leiognathus jonesi* Rameswaram 1981-'83.

DISCUSSION

As the fishery being a multi-species one, the effective effort expended for the species under consideration could not be obtained and hence estimation of natural mortality (M)

rate by regression of Z on effort was not possible.

For many species, it appears that the ratio (M/K) is considerably less variable than the individual values of either M or K (Beverton and Holt, 1957; Pauly, 1978). For example, Beverton and Holt, 1959 show that (M/K) lies largely in the range 0.8-2.5. Hence in this paper Y/R analysis has been carried out for three values of (M/K) = viz. M/K=1, M/K=1.5 and M/K = 2. When M/K = 1.5 the yield per recruit curve at Lc = 72.5 mm shows an ever increasing Y/R for increases in F. This is not practical as constraints are many for increasing F indefinitely (i.e. by introducing more fishing units) to get more yield. The same constraint is confronted when M/K = 2. When M/K = 1, with the constraints to increase F in view, the Y/R can be enhanced from 4.78 to 4.91 g by increasing Lc from 72.5 to 82.5 mm at the present F itself.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. P.S.B.R. James, Director, C.M.F.R.I. for encouragements and to Mr. M. Srinath for valuable suggestions. Thanks are also due to Dr. K. Alagaraja for critically going through the manuscript.

REFERENCES

ALAGARAJA, K. 1984. Simple methods for estimation of parameters for assessing exploited fish stocks. *Indian J. Fish.*, 31(2) : 177-208.

BERTALANFFY, L, VON 1938. A quantitative theory of organic growth. *Hum. Biol.*, 10(2): 181-213.

BEVERTON, R.J.H. AND S.J. HOLT 1956. A review of methods for estimating mortality rates in fish populations, with special reference to sources of bias in catch sampling. *Rapp. P-V. Reun. Perm. int. Explor. Mer.*, 140 (1):67-83.

BEVERTON, R.J.H. AND S.J. HOLT 1957. On the dynamics of exploited fish populations. *Fish. invest., Ser.* II, 19 : 533 pp.

BEVERTON, R.J.H. AND S.J. HOLT, 1959. A review of the lifespans and mortality rates of fish in nature and their relation to growth and other physiological characteristics. *In: CIBA Colloquia on Ageing*. Vol. 5. The Lifespan of Animals, G.E.W. Wolstenholme and M.O. Connor (Eds.), London, Churchill.

BHATTACHARRYA, C.C. 1967. A simple method of resolution of a distribution into Gaussian Components. *Biometrics*, 23 : 115-135.

JAMES, P.S.B.R. 1986. Biology and fishery of *Leiognathus jonesi* James from the Palk Bay and Gulf of Mannar. In: *Recent Advances in Marine Biology*. P.S.B.R. James (Ed.). Today and Tomorrow's Printers and Publishers, New Delhi : 29-94.

PAULY, D. 1978. A discussion of the potential use in population dynamics of the inter-relationships between natural mortality, growth parameters and mean environmental temperatures in 122 fish stock. *ICES CM* 1978/ G:21 (mimeo).

PAULY, D. 1980. On the inter-relationships between natural mortality, growth parameters and mean environmental temperatures in 175 fish stocks. *J. Cons. int. Explor. Mer.*, 39: 175-192.

RICKER, W.E. 1975. Computations and interpretation of biological statistics of populations. *Bull. Fish. Res. Bd. Canada*, 191 : 382 pp.

SEKHARAN, K.V. 1975. Estimates of the stocks of oil sardine and mackerel in the present fishing off west coast of India. *Indian J. fish.*, 21(1): 177-182.

VENKATARAMAN, G., M. BADRUDEEN AND R. THIAGARAJAN 1981. Population dynamics of silverbelly *Leiognathus jonesi* in Palk Bay. *Indian J. Fish.*, 28: 65-86.