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Silverbelly fishery of Palk Bay and Gulf of Mannar with special reference to *Leiognathus jonesi* (James, 1967)

REKHA J. NAIR

Central Marine Fisheries Research Institute, Kochi-18, India.

ABSTRACT

Silverbellies constitute an important group of demersal fishery resource along Tamilnadu coast. They are exploited by trawl and a variety of artisanal gears like shore seines, boat seines and gill nets. The southeast region contributed nearly 85 % of the silverbelly landings of India and Tamilnadu's share was 70%. Out of 20 species of silverbellies known from India, 15 species are found in varying proportions from the Palk Bay and Gulf of Mannar. Good fishery for silverbellies at Rameswaram was recorded from February to September and October to March at Pamban, during the years 1996–2000. The length–weight relationship of *L. jonesi* was $W = 0.000076197 L^{2.38}$. The growth parameters L_{∞} and K (annual) were 161 mm and 0.71 respectively. The MSY was estimated at 209.7 t.

Introduction

Fishes of the family Leiognathidae are small sized living in shallow coastal waters. They are exploited mainly by trawl and also by artisanal gears like shore seines, boat seines, gill nets etc. All India silverbelly landings increased from 15,000 t in 1961 to 52,450 t in 2003. Tamilnadu contributed nearly 57 % of the silverbelly landings during 2003.

Out of 20 species of silverbellies known from India, 15 species are found in varying proportions from the Palk Bay and Gulf of Mannar. Various aspects of the biology and fishery of these fishes are given in the two bibliographies exclusively on these fishes, (Pauly and Pauly, 1981; James *et al.* 1992). Published information on fishery and population dynamics of silverbellies of

Palk Bay and Gulf of Mannar include the works of Venkataraman *et al.* (1981), James (1986) and Karthikeyan *et al.* (1989). Since no major studies on this resource was done after 1989, an attempt was made to study the silverbelly fishery off Gulf of Mannar and Palk Bay with emphasis on *Leiognathus jonesi*.

Materials and methods

The study was based on trawl fishery landings at two main fish landing centres - Rameswaram and Pamban during 1996 to 2000. Weekly samples were collected and brought to the laboratory for taking data on species composition, length composition and biology. The data on species composition and length composition collected on each day of observation were first weighted respective to the estimated total catch

of the group and species obtained on that day and such estimates in a month were pooled and then raised to the estimated catch of the month as per Alagaraja (1984). To obtain estimates of total catch (weight) of each species as well as catch (numbers) at length of each species, the data obtained at the observation centre was suitably weighted to get estimates for each centre. The average catch per unit effort (kg/unit) was calculated for the estimated monthly values.

Samples of the dominant species, *Leiognathus jonesi* was collected from Rameswaram during the period April 1997 to March 2000. Length–weight relationship was calculated by the method of least squares using the formula :

$W = a L^n$ or $\text{Log } W = \log a + n \text{ Log } L$, where, W = weight in grams, L = length in mm, a = constant and n = exponent. W_{∞} was calculated taking the L_{∞} value and the length–weight relationship. The parameters of growth in length were estimated following the ELEFAN method (Pauly and David, 1981, Gayanilo *et al.* 1988) using the monthly length frequency data, during the period from 1997 to 1999.

The estimates of mortality were made using the combined data for the three years. Instantaneous mortality (Z) was estimated using length converted catch curve method (Pauly, 1983), natural mortality rate (M) using the empirical formula of Pauly (1980) and the fishing mortality F as $Z - M$. Value of temperature was taken as 27.2°C from Ganapati and Murty (1954) and La Fond (1958). The optimum length of exploitation (L_{opt}) was estimated from the empirical equation of Froese and Binohlan (2000) using the relationship :

$$L_{\text{opt}} = 3 \times L_{\infty} / (3 + M/K)$$

Life span was estimated using the equation $T_{\text{max}} = 3/K$

The exploitation ratio, E was estimated from the Gulland's (1973) equation $E = F / (F+M)$. Yield per recruit analysis (Y/R) was carried out to assess the long-term aspect of fishing and calculated from the equation of Beverton and Holt (1957). Standing crop was estimated as Y/F and total stock as :

$$U = \frac{F}{Z} (1 - e^{-Z})$$

Recruitment pattern is obtained by backward projection on the length axis of the set of length–frequency data (seasonally growth curve) according to the routine ELEFAN II.

Results

Trawl fishery

Trawlers fishing in the Palk Bay landed their catch at Rameswaram and Mandapam, while trawlers operating in the Gulf of Mannar landed the catch at Pamban. At Rameswaram, around 500 – 630 trawler units were operating daily. The boats operated at a distance of 15 – 25 km from the coast where the depth is 10 – 18 m. Mesh size of shrimp trawls and fish trawls are 15 – 20 mm and 20 – 25 mm respectively. During the period from January to March, pair trawling was conducted using fish trawls. At Pamban, mechanised trawlers are operated more in the Gulf of Mannar side (Thekkuvadi, Southern side).

Total fishing effort: Wide fluctuation was noticed in the number of units operated during different months at Rameswaram. Maximum number of units were operated between April and July, while August to October was the lean period at Rameswaram. However, at Pamban, a gradual increase was noticed in the number of units operated

TABLE 1: Estimated landings (t) by trawlers at Rameswaram and Pamban during 1996 - 2000.

Year	Rameswaram				Pamban			
	Total catch	Silverbelly landings	%	C/E	Total catch	Silverbelly landings	%	C/E
1996 -97	32127	12634	39.3	180	22660	4038	17.8	334.2
1997-98	38578	15349	39.8	194	3883	1347	30.2	189
1998-99	27087	11834	43.7	168	1791	376.5	20.96	88.5
1999-2000	13768	5316	38.6	67.2	714	145.3	20.4	45.3

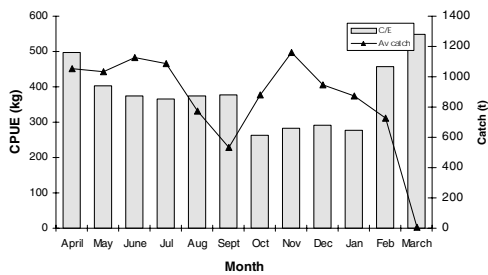


Fig.1 Monthly variations in catch and CPUE of silverbellies at Rameswaram during the period 1996-2000.

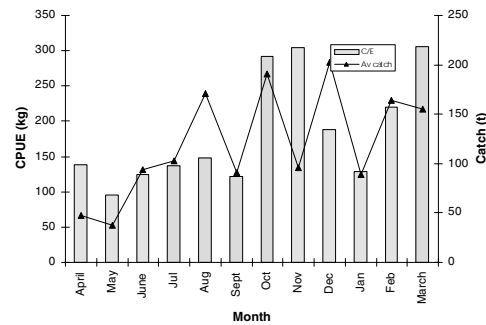


Fig.2 Monthly variations in catch and CPUE of silverbellies at Pamban during the period 1996-2000.

from April to August, with a peak in August. There was a drastic decline in the number of units operated in September. During December, there was two-fold increase in the effort as compared to November.

Silverbelly fishery: During 1996-97, 12634 tonnes of silverbellies were landed which formed 39.3 % of the total fish catch. Compared to the previous year, though the units under operation increased by 5029 numbers, catch decreased by 1387 tonnes (Table 1). Heavy fishery for silverbellies was observed at Rameswaram from February to September and at Pamban during October to March during the years 1996-2000 (Figs.1 & 2).

Species composition: Fifteen species represented the silverbelly fishery of Gulf of Mannar and Palk Bay; of these,

nine species contributed to fishery at Palk Bay. All the fifteen species were recorded in the Gulf of Mannar, of which eleven contributed to regular fishery. An estimated 5314 t (38 %) of *L. brevirostris* was landed during 1995-96 at Rameswaram, which increased to 51 % in 1996-97, 62 % in 1997-98 and fluctuated from 50-57% during 1998-99 and 1999-2000. Fishery was prevalent throughout the year with highest landings during March to August. Though fishery for *S. ruconius* was prevalent year round at Rameswaram, average annual production varied from 533 t in 1995-96 to 42 t in 1999-2000 (Fig. 3).

At Pamban, *L. dussumeiri* was the dominant species throughout the period showing a slight increase over the years and was available throughout the year along with *Gazza minuta* and *S.*

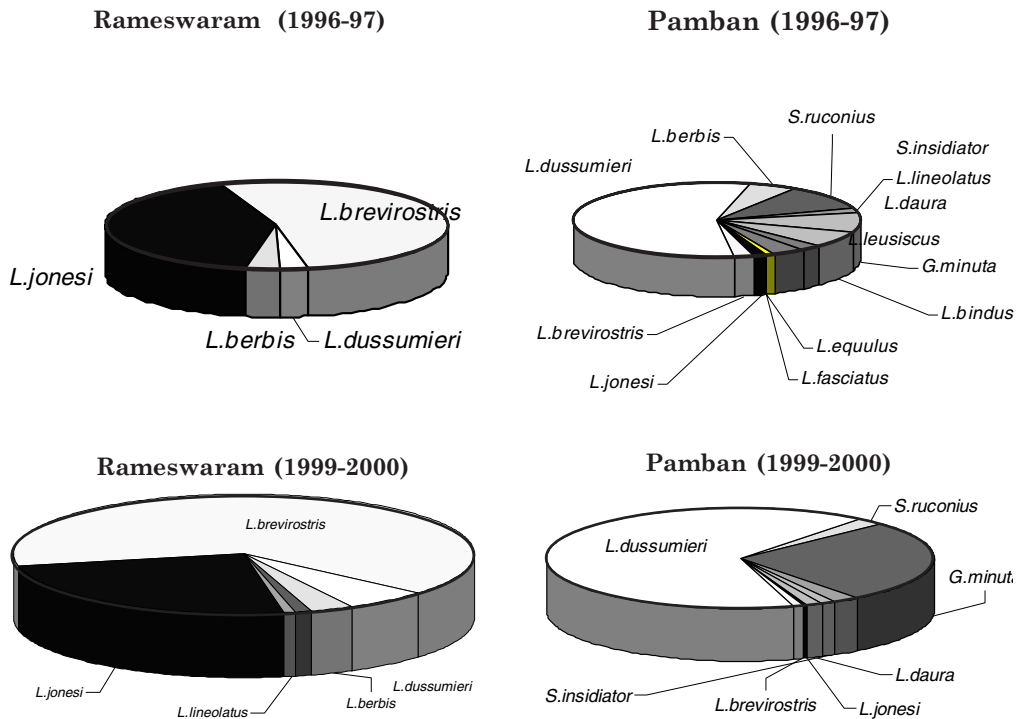


Fig. 3. Variations in the species composition of silverbellies at Rameswaram and Pamban during 1996 -2000.

ruconius. Percentage contribution of *L. breviostris* to fishery increased from 2.3 % to 8 % over the years 1996-99 and then showed a drastic decline to 0.8 % in 1999-2000. In 2000, fishery for *L. jonesi* was only occasional. Though fishery for *S. ruconius* existed year round at Pamban, landings decreased from 4430 t in 1996-97 to 3 t in 2000, while for *G. minuta*, percentage contribution to fishery increased from 8 % in 1996 to 27 % by 2000.

Biology of L. jonesi

Length – weight relationship: A total of 1829 specimens of *L. jonesi* in the length range of 30 to 125 mm were measured during 1997 – 99. By fitting the equation of the form $W = a * L^b$ to the observed data, the length –weight relationship was

obtained as :

$$W = 0.000076197 L^{2.38}$$

Assuming that the growth in length of the species follows von Bertalanffy’s equation, the growth parameters of *L. jonesi* were estimated. The growth curves produced with these parameters are shown over the restructured length distribution in Fig.4. The growth parameters L_{∞} and K (annual) were estimated as 161 mm and 0.71 respectively. Using the length–weight relationship, the weight of the fish measuring 161 mm total length was found to be 56.78 g (W_{∞}).

Mortality rate: Instantaneous total mortality rate (Z) estimated using length converted catch curve method was 7.05 (Fig. 5). Natural mortality (M) using

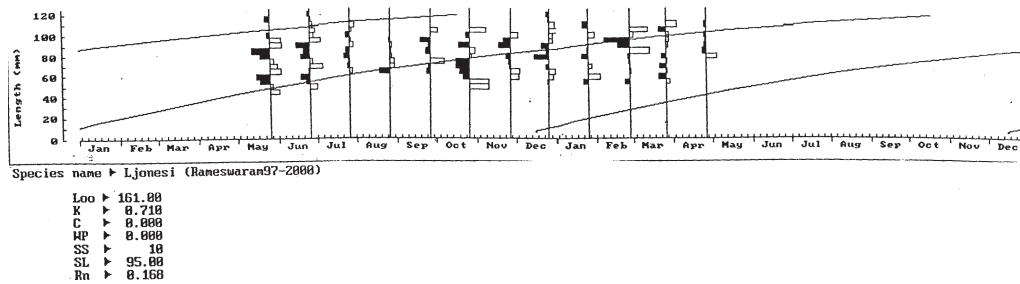


Fig. 4. ELEFAN growth curve of *L. jonesi* obtained for the year 1997 -1999 through FISAT programme at Rameswaram.

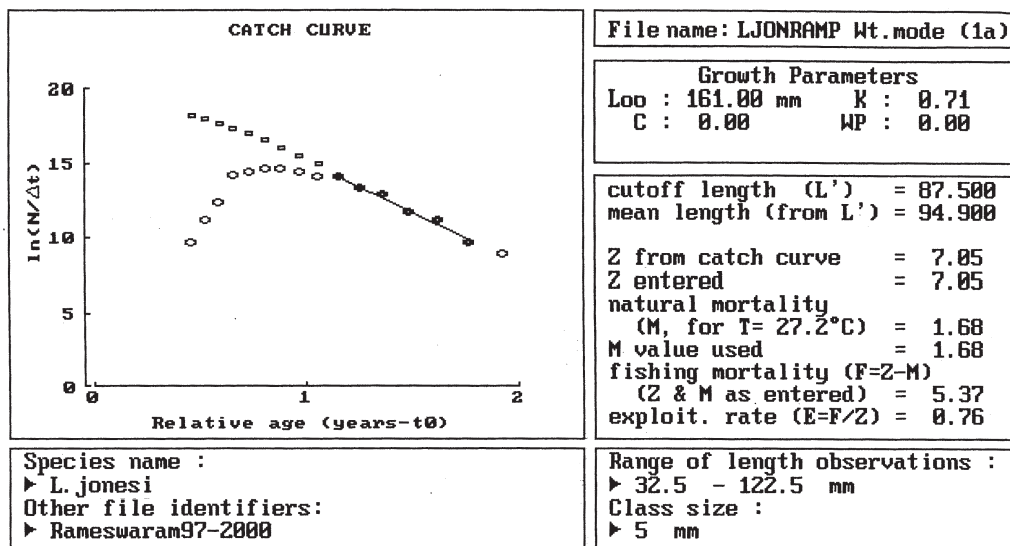


Fig. 5. Estimation of total mortality rate by catch curve method for *L. jonesi* exploited by trawlers during 1996 -2000 at Rameswaram.

Pauly's method (1980) was estimated at 1.67. Using Z and M, fishing mortality was estimated as 5.4. The optimum length of exploitation (L_{opt}) was estimated from the empirical equation of Froese and Binohlan (2000) was 82.85 mm. Life span of *L. jonesi* was estimated as 4.2 years.

The exploitation ratio (E) was estimated from the Gulland's (1973) equation,

$E = F / (F+M)$ as 0.76. The recruitment pattern determined through the ELEFAN II showed that this species

is recruited twice a year in the fishery during October and December.

Yield per recruit: The Y/R for *L. jonesi* has been drawn using the vital parameters already derived. (Fig 6). The MSY was estimated at 209.7 t. Standing crop and total stock estimated were 39 t and 276 t respectively.

Discussion

The decline noted in the landings during 2000 could possibly be due to fishery dependent factors. Heavy exploitation of silverbellies has been reported from the trawling grounds off

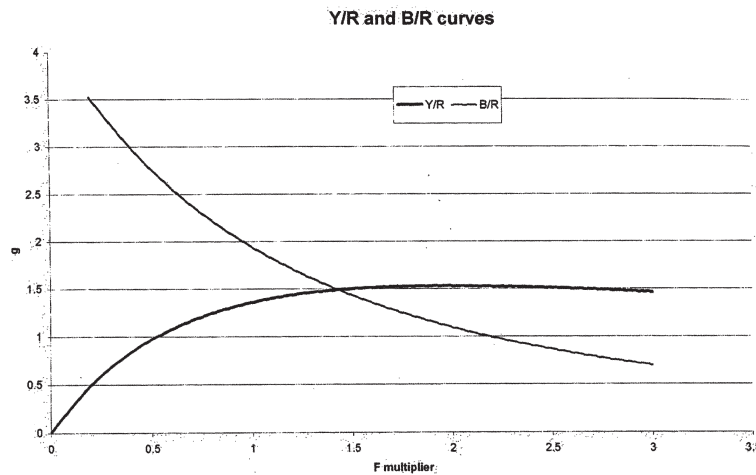


Fig. 6. Yield per recruit and biomass per recruit curves for *L. jonesi* at Rameswaram.

Rameswaram with *L. jonesi* as the dominant species (Karthikeyan *et al.*, 1989). The results of the present study point to the decline in the landings of *L. jonesi* from the same area. On the other hand, the landings of *L. brevisrostris* have increased. The dominance of *L. dussumieri* at Gulf of Mannar is in accordance with the observations made by James (1986) from this area. The fishery season of silverbellies in Palk Bay and Gulf of Mannar as per the Indo-Norwegian Project Report (1964) were September–October and November–March respectively. In the present study,

the fishery season was observed to be February to September in Palk Bay and October to March in Gulf of Mannar, which indicate the change in the fishing practices.

A comparative statement of the growth parameters estimated in the present study with that recorded earlier are given in Table 2. The

exploitation rate of *L. jonesi* in the present study indicated that the stock of *L. jonesi* is heavily fished. Though the current yield of silverbellies from Indian waters is well below the estimated potential yield (Anon, 2000), the exploitation rate of the south east coast is well above the optimum level. The optimum length of exploitation is also well above the length at first capture. From the yield per recruit study, it is clear that landings will not increase with increase in the number of units operated and the present effort is well above the

TABLE 2: Comparative statement of the results of the study on *L. jonesi* at Palk Bay and Gulf of Mannar.

Parameters	Venkataraman <i>et al.</i> (1981)	Karthikeyan <i>et al.</i> (1989)	Present study
L_{∞}	161.2 mm	146.6 mm	161 mm
K (annual)	0.528	0.917	0.71
W_{∞}	114.8 g	-	56.78 g
M		1.25 (Sekharan's method)	
M		1.41 ($M = -\ln(0.01)/T_{max}$)	1.67 (Pauly's method)
Z		5.26 (B & H)	7.05
		4.78 (Alagaraja)	
Life span	less than 3 years	more than 3 years	4.2 years

sustainable limits. The stock of *L. jonesi* along Tamilnadu coast, like any other species in tropical multispecies fisheries, can only be exploited along with several other demersal species in the region. However, the results will help to provide an idea of exploitation of this species along with other species of silverbellies.

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