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SOME ASPECTS OF BIOLOGY OF *STOLEPHORUS BATAVIENSIS* HARDENBERG, FROM MANGALORE AREA, DAKSHINA KANNADA

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ABSTRACT

The growth parameters of *S. bataviensis* are estimated by Gulland and Holt method. The parameters are $L\infty = 116$ mm, $k = 0.0054$/day and $t_o = -20$ days. This species reaches a length of 77 mm at six months and 101 mm at the end of one year. The length-weight regression equations of the males and females differ significantly. The sexes are uniformly distributed over most of the study period. The length at first maturity is estimated as 77 mm. The major spawning period is from November to March. Mature fish are found through out the year. Juveniles occur abundantly from April to June. Fecundity estimates are poorly correlated to the total length of the species. Fluctuating K_n values beyond the length at first matuity may be due to protracted spawning season of the species. *S. bataviensis* mainly feeds on zooplankton dominated by copepods.

INTRODUCTION

STOLEPHORUS BATAVIENSIS ranks second in importance to *S. devisi* among the whitebait species occurring in Mangalore area. On an average it forms only about 4% of the whitebait landings at Mangalore. This species is caught mostly by trawls as bycatch. During October-November, however, it is also caught by purse-seines, along with *S. devisi*. Very little information is available on the biology of this species. There is no published account on this species from this area.

Thanks are due to Dr. P. S. B. R. James, Director, CMFRI for encouragement and Dr. G. Luther for going through the manuscript and suggesting improvements.

MATERIAL AND METHODS

This study is based on the samples collected mainly from trawls at weekly intervals during 1979-'85. Classification of maturity stages are given in the account on *S. devisi* (Rao, 1988) which will hold good even to this species although there is slight variation in the shape of ova. The fish that were in stage III and above were considered adults and those below that stage were treated as juveniles. The methods followed are already described in the account on *S. devisi* (Rao, 1988).

BIOLOGY

Length-weight relationship

The total length was measured in mm and weight in grams with an accuracy of 0.1 gm. This study was based on 676 specimens in the total length range of 50 - 104 mm.

Scatter diagram of weight on total length indicated that the relation conforms to the general allometric growth formula, $W = al^b$.

The regression equations fitted on the data separately for males and females are as follows

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(Fig. 1). The parabolic equations are given in parenthesis.

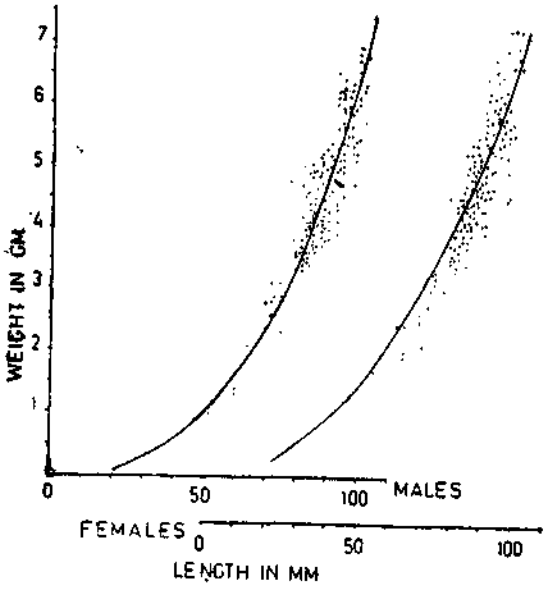

FIG. 1. Length-weight relationship of *Stolephorus bataviensis*.

MALES : Log $W = -4.3914 + 2.5945 \log L$

$(0.000040607\ L^{2.5945})$

FEMALES : Log $W = -3.72162.2556$ Log L

$(0.000189802\ L^{2.2554})$

The above regression equations differ from eath other significantly as shown by the analysis of co-variance (Table 1).

The length-weight regression equations of *S. bataviensis* reveals that the weight of fish increases at a rate lower than the cube of length.

Sex ratio

The monthly sex. ratios of *S. bataviensis* during the years 1979-1985 are presented in the Table 2. The Chi-square analysis of the monthly sex ratio shows that females out numbered males, in January 1980, May 1981 June 1983, December 1983 and May 1984. However in January, April and December 1984, and January and December 1985, the reverse situation was observed. In the remaining months the sex ratio conformed to 1 : 1 ratio. The Chi-square test revealed that on an annual basis, except during 1984, the sexes were equally distributed. However during 1984 the proportion of males was significantly higher than that of females.

Maturity and spawning

Mature fish were dominant and were found to constitute more than 50% of adults examined during November-March (Fig. 2 a). This period may be considered as the major spawning season for the species. It may be seen that juveniles were abundant during April-January period, whereas they were completely absent during the post-monsoon period (Fig. 2 b). The picture during the southwest monsoon period (June-September) is not quite clear due to the cessation of fishing. As in

TABLE 1. *Analysis of covariance to test the significance of difference between regression lines of sexes in length weight relationship of* S. bataviensis

Source of variation	d.f.	Deviation from regression sum of squares	mean square
Due to regression within sexes ..	63	0.060063	0.000953
Difference between regression co-efficients ..	1	0.006807	0.006807
Residuals due to regression pooled data ..	64	0.066870	0.001045
Difference between means ..	1	0.010371	0.010371

Comparison of slopes	F=7.142707,	d.f.=1,63	Significant at 5%
Comparison of elevation	F=9.924402,	d.f.=1,64,	,,

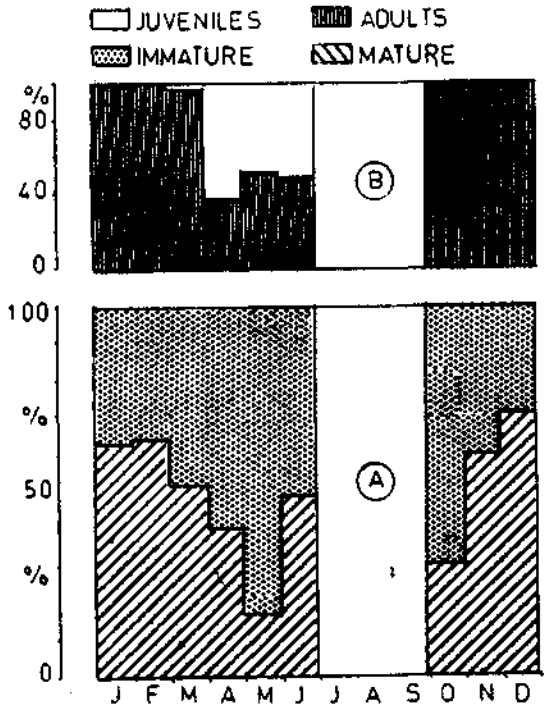

FIG. 2. a. Distribution of mature and immature *Stolephorus bataviensis* in different months and b. abundance of juveniles and adults of *S. bataviensis* in different months. No fishing during July and August (data pooled for the years 1979-85).

S. devisi, in this species also mature fish were observed almost throughout the year, indicating the protracted nature of spawning. Length frequency distribution of intra-ovarian eggs reveales that *S. bataviensis* spawns more than once during the spawning season (Fig. 3).

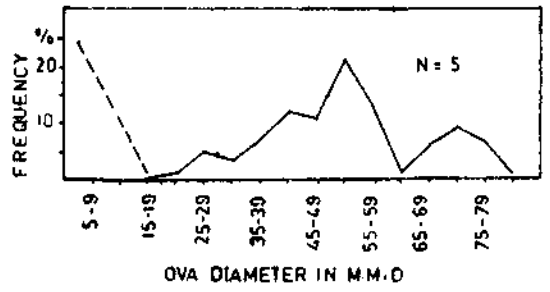

FIG. 3. Ova diameter frequency distribution of mature *S. bataviensis*.

Size at first maturity

For determining the size at first maturity, all the fish in and above stage III of maturity were taken into consideration. A plot of frequency distribution of the total length showed that at the length group 75-79 mm, more than 50% were mature (Fig. 4). Hence the mid point of this group, 77 mm can be taken as the length at first maturity. Both males and females attain maturity at the same length. For this species along the southwest coast of India, the size at first maturity was given as 80 mm (Anon., 1975).

Fecundity

The total number of ripe ova found in the mature ovaries of *S. bataviensis* varied from 970 to 2571 (Table 3). An attempt was made to study the relation between the number of ova and total length of mature fish. A regression equation was fitted as below :

$$\text{Fecundity} = 2.10788592\ L^{1.4836}$$

$$(r = 0.2273)$$

$$d.f = 8$$

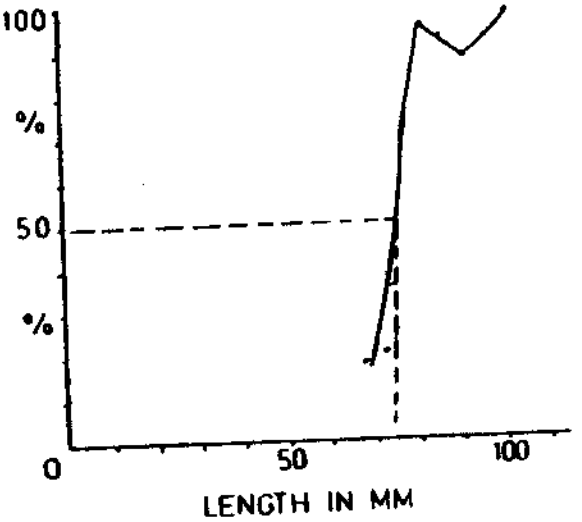

FIG. 4. Size at sexual maturity of *Stolephorus bataviensis*.

TABLE 2. *Distribution of males and females of*

	1979				1980				1981				1982			
	M	F	T	χ^2	M	F	T	χ^2	M	F	T	χ^2	M	F	T	χ^2
Jan.	—	—	—	—	9	20	29	4.17*	45	35	80	1.25	52	49	101	0.09
Feb.	—	—	—	—	31	29	60	0.06	73	63	136	0.73	13	12	25	0.04
Mar.	—	—	—	—	25	20	45	0.55	43	37	80	0.45	11	11	22	0
Apr.	—	—	—	—	18	12	30	1.20	29	26	55	0.16	20	10	30	3.33
May	31	29	60	0.06	5	4	9	0.11	17	38	55	8.01*	2	4	6	0.66
Jun.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jul.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sep.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Oct.	—	—	—	—	63	62	125	0.008	44	32	76	1.89	—	——	—	—
Nov.	26	19	45	1.08	23	16	39	1.25	67	47	114	3.50	55	45	100	1.0
Dec.	72	56	128	2.00	45	35	80	1.25	19	19	38	0	16	9	25	1.96
Total	129	104	233	2.68	219	198	417	1.05	337	297	634	2.52	169	140	309	2.72

* Significant at 5%. M=Males, F=Females, T=Total.

TABLE 3. *Fecundity of* S. bataviensis (*Stage V*)

Length (mm)	Weight (gm)	No. of ova
88	4.3	1192
90	5.2	1167
83	5.3	2571
87	3.8	970
91	4.7	1454
84	3.6	1213
97	5.7	1526
94	5.1	1449
90	5.1	1569
91	4.2	1635

The correlation coefficient between the parameters studied is not significant indicating poor relationship between length and fecundity.

Food and feeding

The feeding habit of *S. bataviensis* appears to be diverse. It is seen from Table 4 that a

TABLE 4. *Seasonal variation in the stomach contents of* S. bataviensis (*occurrence*)

Month	Composition	%
Jan.	Copepods, Ostracods, fish larvae *Coscinodiscus*,	20
Feb.	Copepod, Amphipods	5
	Digested crustacean matter	95
Mar.	*Acetes*, Copepods, *Lucifer*, Ambhipods	
	Coscinodiscus and mollusc.	23
	Digestes crustacean matter	77
Apr.	Copepods	15
	Digested crustacean matter	85
May	Copepods	25
	Digested crustacean matter	75
June	————	
July	————	
Aug.	————	
Sep.	————	
Oct.	Copepod appandages and crustacean matter	100
Nov.	Acetes, algal filaments	48
	Copepod apandages and digested matter	52
Dec.	*Lucifer*, *Acetes*, copepods and *Cladocera*	20
	Digested matter	80

S. bataviensis *in monthly samples during* 1979

1983				1984				1985				Pooled			
M	F	T	χ^2	M	F	T	x^2	M	F	T	x^2	M	F	T	χ^2
52	48	100	0.16	254	131	385	39.25*	63	37	100	6.76*	475	320	995	2.03
—	—	—		112	88	200	2.88	—	—	—		229	192	421	3.25
59	40	99	3.64	—	—	—		—	—	—		138	108	249	3.66
—	—	—		64	36	100	7.84*	76	94	170	1.91	2071	178	385	2.18
—	—	—		28	72	100	19.30*	71	80	151	0.54	154	227	381	13.98*
27	54	81	9.0*	—	—	—		—	—	—		27	54	81	9.00
—	—	—		—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—		107	94	201	0.84
62	38	100	5.76*	74	83	157	0.52	71	73	144	0.94	378	321	699	4.65
40	60	100	4.0*	62	38	100	5.76*	196	140	336	9.33*	450	387	807	10.71
240	240	480		594	448	1042	20.45	477	424	901	3.12	2165	1851	4016	24.55

wide variety of organisms formed the food of this species. Zooplankton dominated by copepods formed the major source of food for almost throughout the year. There does not appear any specific preference exercised by *S. bataviensis* in selecting its prey, rather it preys upon whatever planktonic animals are available within its environment. Large sized *S. bataviensis* is able to prey on larger sized plankton such as *Acetes* sp. which almost exclusively formed the food, when they were abundant in the environment.

Relative condition factor (Kn)

The values of relative condition factor (Kn) of adult *S. bataviensis* (Fig. 5 a) were generally high and above unity during the major part of the year, except in May. The peak was observed during April. In the case of juveniles, which were available from March to June, the Kn values were less than unity during March and June. The Kn values were less than unity between 50-70 mm length and were consistently above unity beyond

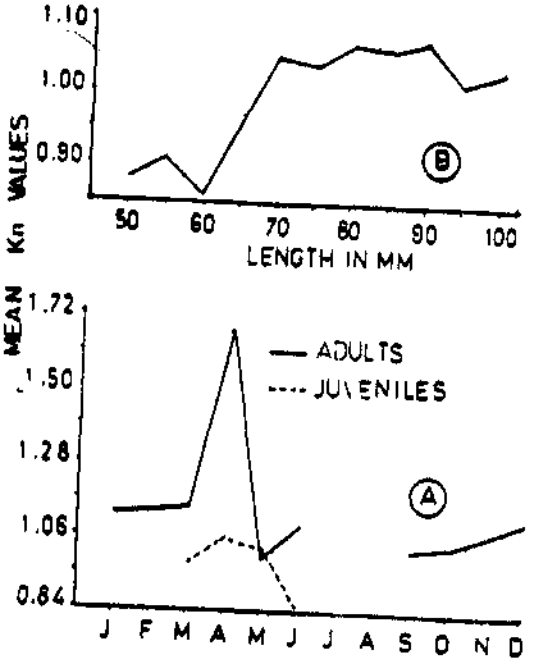

FIG. 5. (a) Mean Kn values of *Stolephorus bataviensis* in different months and (b) Mean Kn values at different lengths of *S. bataviensis*.

70 mm (Fig. 5 b). After 70 mm length, the first trough is noticed at 77 mm which happens to be length at first maturity.

Age and growth

Samples of *Stolephorus bataviensis* were collected from trawls at weekly intervals, depending on the availability. Methods employed for the study of this aspect have been outlined in the account on *S. devisi* by the author (Rao, 1988).

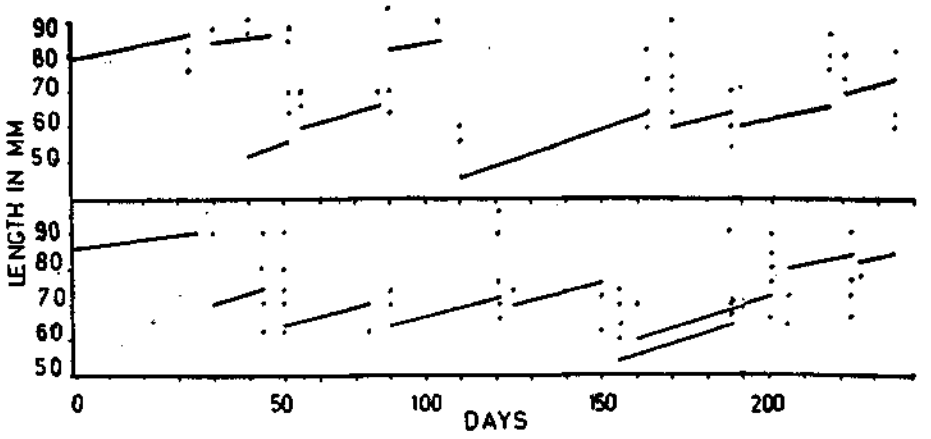

FIG. 6. Mode — Chains considered for estimating age and growth of *Stolephorus bataviensis*. The dots indicate the untraced modes.

The growth rates derived at different mean lengths (Fig. 6) were utilized to get the regression equation (Fig. 7) by the least squares method as under :

Growth rate (Y) = 0.6256 − 0.0054

Length (x) ($r = 0.8730$)

The intercept a and slope b provide values of K and L_∞ through the relationships :

$K = -b$; 0.0054/day

$L_\infty = \frac{a}{K}$; 116 mm

t_0 was calculated by following the emperical relationship derived by Pauly (1979). This relationship gave to value as −20 days.

Hence the von Bertalanffy growth equation for *S. bataviensis* may be expressed as

$$L_t = 116\,(1 - e^{-0.0054\,(t + 20)})$$

It may be mantioned here that Tham (1967) fitted the following growth equation for *S. insularis* (= *S. bataviensis*)

$$L_t = 99\,(1 - e^{-0.0057\,(t + 29)})$$

In this equation the length considered was standard length. According to equation now

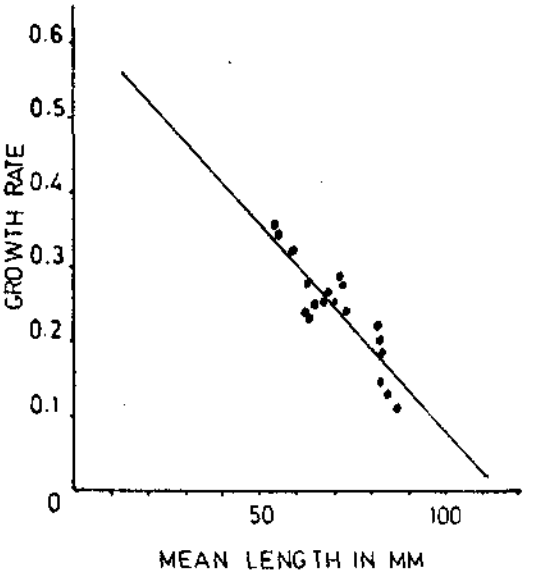

FIG. 7. Regression of instantaneous growth rates on mean lengths of *Stolephorus bataviensis*.

obtained *S. bataviensis* attains 52 mm at the age of 3 months, 77 mm at six months, 92 mm at 9 months and 101 mm at the completion of one year (Fig. 8).

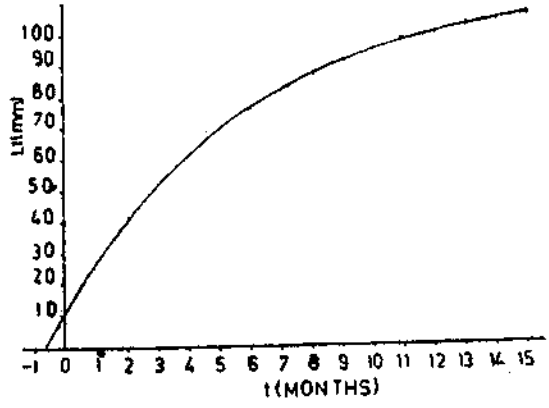

FIG. 8. Growth curve of *Stolephorus bataviensis* obtained by fitting von Bertalanffy equation.

DISCUSSION

From the von Bertalanffy growth equation, it is evident that *S. bataviensis* reaches a length of 101 mm at the end of one year of its life. The growth parameters obtained in the present study are $L\infty$=116 mm, K=0.0054 (daily basis) and to= —20 days. Tham (1967) estimated K at 0.0057 (daily basis) and t_o at —29 days for *S. insularis* (=*S. bataviensis*) from Singapore. These values are very close to the values obtained in the present study. An earlier estimate (Anon., 1970) indicate that *A. bataviensis* (=*S. bataviensis*) grows to an average length of 80 mm within six months, which is quite close to the estimated value of 77 mm obtained in the present study.

S. bataviensis attains first maturity at 77 mm length at the age of six months. When compared with *S. devisi* this species attains first maturity at a higher length. As the mature fish are available throughout the year, with a well marked peak during November-March (Fig. 2 a), it may be inferred that *S. bataviensis*, as observed in its congener *S. devisi*, spawns at frequent intervals (Fig. 3).

In *S. bataviensis*, study of the seasonal variations in the Kn values showed that low Kn values were obtained during the peak spawning period. The Kn values were low, at length below 70 mm and the first trough after this length coincided with the length at first maturity. The fluctuating Kn values in the fish beyond size at first maturity may be indicative of the multiple spawning habit of the species.

In many aspects of its biology *S. bataviensis* shows similarity to *S. devisi*.

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