OBSERVATIONS ON SOME ASPECTS OF BIOLOGY OF SILVERBELLY *LEIOGNATHUS BINDUS* (VALENCIENNES) FROM KAKINADA

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ABSTRACT

The length-weight relationship of *Leiognathus bindus* can be described by the equation log W = —4.77709 + 2.96182 log L. The length at first maturity is estimated as 80 mm. This species is a fractional spawner and appears to release the ova in at least two spawning acts during the course of one year; it appears to spawn in almost all months, with a peak during December-February. Based on length-frequency distribution, the species attain 65 and 90 mm at the completion of first and second year respectively.

INTRODUCTION

Along the Andhra coast, an estimated annual average of 4073 tonnes of silverbellies landed during the 11-year period 1969-79 (CMFRI 1980), forming 9.5% of all India silverbelly catches. The studies on the resource characteristics of silverbellies were taken up at Kakinada in 1979, as part of investigations on the major demersal fisheries resources, and the present paper deals with some aspects of the biology of *Leiognathus bindus*, which is one of the important species in regard to abundance, in the trawl catches at Kakinada. Reports dealing with biology of silverbellies in general are a few from India (Arora 1951; Kuthalingam 1958; James and Badrudeen 1975) and, but for the paper of Balan (1967), there is no information on the biology of *L. bindus*.

MATERIAL AND METHODS

The study is based on the data collected during the years 1979 and 1980. Samples were obtained at weekly intervals from the catches of commercial trawlers. On each observation day, samples of all silverbellies were collected from 3-4 boats for species composition and biology. The length data on *L. bindus* obtained on each observation day were raised to the day's catch and these were further raised to get monthly length composition of the estimated catch. It is only on the basis of these data that the estimation of age and growth rate were made. For detailed biology the specimens were examined in fresh condition; the data on weight of each fish were taken to 0.5 g accuracy. The various maturation

stages were fixed arbitrarily following those fixed for *L. brevirostris* by James and Badrudeen (1975). Ova-diameter measurments were made from ovaries fixed in 4% formalin, following the procedure of Clark (1934). From each ovary about 300 ova were measured at a magnification, at which 10 md equals 0.097 mm. The length-weight relationship was calculated by the method of least squares using the formula $W = aL^n$ or $\log W = \log a + n \log L$, where W = weight in grams, L = length in mm, a = a constant and n = exponent.

Length-Weight Relationship

The study is based on 183 males ranging from 54 to 113 mm length and from 2 to 24 g weight and 182 females ranging from 56 to 122 mm length and from 2 to 38 g weight. The relationship was calculated separately for sexes and the equations are:

Males: $\log W = -4.74861 + 2.94179 \log L$
Females: $\log W + -4.81952 + 2.98912 \log L$

The significance of difference between the regression coefficients of sexes was tested by analysis of covariance foliowing Snedecor and Cochran (1967), and the results are given in Table 1. It is observed that the difference is not signicant at 5% level. Hence the data of sexes were pooled and a single equation was calculated for the species from Kakinada which is:

$$\log W = -4.77709 + 2.96182 \log L$$

In the parabolic form the equation can be written as $W = 0.0000167 L^{2.96182}$. According to Balan (1967), the equation for the length-weight relationship of this species from Calicut is $W = 0.00002452 L^{2.8641}$.

TABLE 1. *Comparison of regression lines of length-weight relationship of males and females of* L. bindus *from Kakinada.*

	df	Σx^2	Σxy	Σy^2	Reg. coefficient	Deviation from Reg. df	SS	MSS
Within								
Males	182	0.99866	2.93786	11.44379	2.94179	181	2.80119	
Females	181	0.70836	2.11739	8.76149	2.98912	180	2.43230	
						361	5.23349	0.01449
Pooled	363	1.70702	5.05525	20.20528	2.96144	362	5.23442	0.01445
		Difference between slopes				1	0.00093	0.00093
Between	1	0.00002	0.00072	0.04198				
Total	364	1.70704	5.05597	20.24726	2.96182	363	5.27231	
		Between adjusted means				1	0.03789	0.03789

Comparison of slopes F = 0.1449/0.00093 = 15.58, Df = 361,1
Comparison of elvation F = 0.0389/0.01445 = 2.622, Df = 1,362

Maturation and Spawning

The study is based on 540 specimens (288 males and 252 females) ranging from 60 to 122 mm total length.

Length at first maturity: For the purpose of determining the minimum length at first maturity only females were considered, and fishes in stages III-VI of maturation were considered as mature. The data of the two years were pooled. The percentage of the mature fish in relation to immature fish in different lengths are given in figure 1. It is observed that mature fish occur from 72 mm and that until a length of 102 mm the percentage of mature individuals show gradual increase. Above 102 mm all are mature. It may be seen that at a length of 80 mm, 50% of the fish are mature and this length is taken as the length at first maturity of *L. bindus* from the sea off Kakinada. It may be stated in this connection that according to Balan (1967), the length at fiirst maturity of this species at Calicut is 87 mm, almost the same.

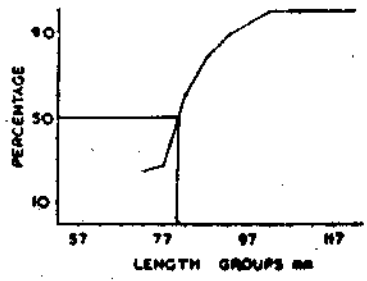

FIG. 1. Percentage-frequency distribution of mature female. *L. bindus* in relation to immature females in different length groups.

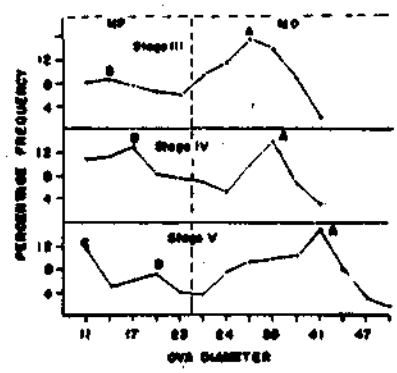

FIG. 2 *L. bindus*: ova-diameter-frequency distribution in ovaries of Stages III-V of maturation. MP : Maturing partially opaque ova, MO = Mature opaque ova.

Spawning: For purpose of detremining the spawning season only females above the length at first maturity were taken into account. The frequency distribution of females in stages II-VI of maturation during 1979 and 80 and in the data of two years pooled are shown in Table 2. It is observed that fishes in stage IV of maturation occurred during March, May, September, November and December 1979 and January, March, July and August 1980.. StageVI females occurred only in small numbers in January and July 1980. On the basis of the occurrence of fishes in stages IV-VI of maturation in different months, it appears that in the sea off Kakinada *L. bindus* spawns in almost all months with a peak during December-February. Supporting evidence is obtained from the length-frequency distribution: smaller fishes in the length range 15-34 mm occur in the catches in almost all months (fig. 3).

It may be stated in this connection that mature *L. bindus* were recorded throughout the year wih peak during February-April at Madras (CMFRI 1978).

TABLE 2. L. bindus: *frequency disritibution of adult females in different stages of maturation* (Data of 1979 and 1980 pooled).

Months	No. of females examined	No of females above length at Ist maturity.	% of maturation stages				
			II	III	IV	V	VI
January	43	33	—	33.3	51.5	9.1	6.1
February	49	33	18.2	66.7	15.1	—	—
March	19	5	20.0	20.0	50.0	—	—
April	7	5	100.0	—	—	—	—
May	11	6	16.7	50.0	33.3	—	—
June	4	3	100.0	—	—	—	—
July	10	9	—	55.5	33.3	—	11.1
August	12	12	16.7	58.3	16.7	8.3	—
September	32	31	9.7	45.2	45.2	—	—
October	23	17	52.9	47.1	—	—	—
November	7	7	—	—	14.3	85.7	—
December	35	25	12.0	44.0	20.0	24.0	—

According to Balan (1967) the spawning season of *L. bindus* at Calicut is very short, extending from December to February only.

The ova-diameter frequency in ovaries of stages III-V of maturation are presented in figure 2. Three types of ova are present in the ovaries of stages III-V: one representing immature stock with the diameter extending up to 9 md; these ova are translucent with irregular shapes with the nucleus clearly visible and with yolk in some only. These ova were not considered for measurement of diameters. The second group represents the maturing ova, the diameter ranging from 10 to 24 md; these ova are more or less spherical and partially opaque heavily yolked and nucleus not visible. The third group represents the mature ova with diameter ranging from 25 to 51 md; these are spherical and opaque with yolk deposition complete. These ova in stage V show the distinct peri-vitelline space.

It is observed (fig. 2) that there are two modes in the diameter-frequency dstribution in stage III: one at 32 md (mode a) and the other at 14 md (mode b). These modes show progression to 35 md and 17 md in stage IV respectively and 41 md and 20 md in stage V ovary. The ova forming a mode at 41 md in stage V may be released in one batch after a short time since they are already mature. The ova forming a mode at 20 md in stage V have already undergone about half the maturation process, and they may take only less than

half the time required for the immature ova to undergo the process of maturation and release, since it is generally known that the growth of ova in maturing condition is faster than those in immature condition.

In stage V, a new mode appeared (mode c) at 11md; these ova forming the early maturing. This mode is almost the same as that at 14 md (mode b) in stage III, which indicates that this mode reaches to about 20 md by the time the ova forming a mode at 20 md in the same ovary reach about 32 md. This situation indicates a possibility that once the ovary reaches stage VI (ripe) it may revert back to stage III and again undergo ripening and reach stage VI. It may be mentioned in this connection that James and Baragi (1980) have indicated that in some fishes the ovary after attaining stage VI (ripe) and releasing a batch of ova may revert to stage V, IV or III. It may be questioned as to how stage VI ovary reverts back to stage III after releasing a batch of ova instead of to stage II as is genearlly known in fishes. The ova forming a mode at 41 md in stage V may further increase in size by the time the ovary passes on to stage VI and the ova forming a mode at 20 md in stage V may grow further and pass on to a modal size of 32 md — the modal diameter of mature opaque ova in stage III (fig 2) — judging from the progression of ova in different modes in stages III-V. Thus, it appears that *L. bindus* in Kakinada is a fractional spawner releasing the ripe ova in at least two batches in the course of one year. Balan (1967), however, states that each adult female releases the ripe ova in one spawning act during a short spawning season at Calicut. The conclusions made here get support from the occurrence of stage IV females in almost all months (Table 2) and also from the similar observations made at Madras (CMFRI 1978).

Length-Frequency Distribution

Data on length-frequency distribution collected during the years 1979 and 1980 were used. A total of 5626 specimens ranging from 17 to 122 mm were measured. The monthly length-frequency distribution is presented in figure 3. It is observed that the modes in the length-frequency ditribution do not show regular monthly progression and in some consecutive months the distribution shows modes at the same length. There are, however, some modes whose progression could be traced for shorter periods ranging from one to five months. An attempt is made to estimate the growth rate and age on the basis of the progression of these modes. It may be seen from figure 3 that there is a mode (a) at 32 mm in December 1979 which can be traced to 37 mm in January 80. This can be further traced to 57 mm in May 80. Thus a growth of 25 mm is obtained in 5 months from December 79 to May 80 at a rate of 5 mm per month. The modes at 47 mm (b & c) in September 79 and February 80 can be traced to 52 mm in October 79 and March 80 respectively, which also give a monthly growth of 5 mm. There is a mode (d) at 52 mm in August 79 which can be traced to 57 mm in September 79; this mode can be further traced to

62 mm in November 70. Thus a monthly growth of 5 mm is observed between 52 and 57 mm and 2.5 mm between 57 mm and 62 mm. The mode (e) at 57 mm in September 80 can be traced to 62 mm in November 80 which gives a growth of 5 mm in two months. Similarly the mode (f) at 57 mm in March 79 has shown a growth of 5 mm in months and reached 62 mm in May 79. The progression of

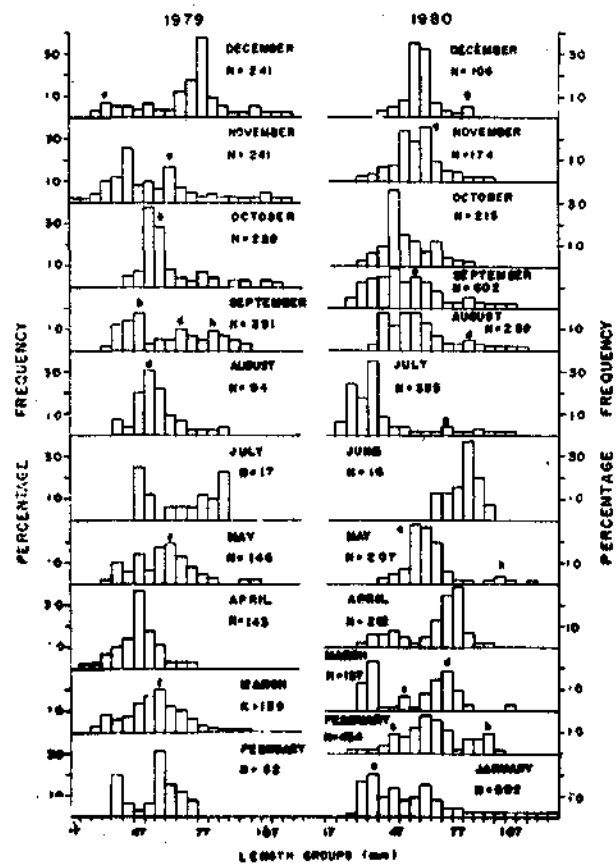

FIG. 3. Monthly length-frequency distribution of *L. bindus* during 1979 and 1980.

mode at 62 mm (d) in November 79 can be traced to 72 mm in March 80 (4 months) giving a monthly growth of 2. 5 mm; this can be further traced to 82 mm in August 80 (5 months from March) which shows an average growth of 2 mm per month. Similarly the mode (g) at 72 mm in July 80 can be traced to 82 mm in December 80 giving a growth of 10 mm in five months with an average monthly growth of 2 mm. The mode at 82 mm in September 79 (h) can be traced to 92 mm in February 80 which gives a monthly growth rate of 2 mm; this mode can be further traced to 97 mm in May 1980 with a growth of 5 mm (1.66 mm|month) in three months.

It can be inferred from the above observations that in the sea off Kakinada *L. bindus* grows at an average monthy rate of 5 mm between 32 and 57 mm length, 2.5 mm between 57 and 72 mm length, 2 mm between 72 and 92 mm length and 1.7 mm between 92 and 97 mm. The growth is not traceable beyond 97 mm though fishes up to 122 mm length are recorded in the catches. Since a growth rate of 5 mm per month is obtained from 32 to 57 mm and since a reduced growth rate is observed from 57 mm onwards, the smallest modal length obtained in the present study at 32 mm (from which growth rate could be traced) can be reasonably taken as 4 months old with an average growth of 8 mm per month. It may thus be stated that *L. bindus* attains average length of 65 mm at the completion of first year and 90 mm at the completion of second year in the sea off Kakinada. It may be mentioned here that the catches of *L. bindus* at Madras range from 33 to 124 mm length and it appears that the species attains 70 mm at the completion of first year (CMFRI 1978). Balan (1967) studied the length-frequency distribution of *L. bindus* in the catches obtained at Calicut during 1956-1959. Though he did not arrive at any conclusion regarding growth rate and age he stated that ".... there is an overall increase in the size of the fish from 50 mm in April to 90 mm in November i.e., showing a growth of 40 mm in the course of 7 months each year (in 1957 and 1958) in general."

James and Badrudeen (1975) studied the length-frequency disribution of *Leiognathus brevirostris* from southeast coast of India. According to them the fish grows at a uniform rate of 5 mm per month throughout its life and attains 60 mm and 120 mm at the completion of first and second years respectively. It is possible that the longevity of *L. bindus* is more than two years because the estimated average length at the completion of second year of life at Kakinada is 90 mm and because the maximum length recorded is 120 mm. In view of these observations and also since growth rate could not be traced beyond 97 mm (which is 28 months old), the estimation of growth parameters has not been attempted for fear of getting erroneous results.

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