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POPULATION CHARACTERISTICS OF THE SILVERBELLY *LEIOGNATHUS BINDUS* (VALENCIENNES) ALONG WEST BENGAL COAST

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ABSTRACT

Leiognathus bindus occurs 6-15 m above sea bottom during night time in areas of depths ranging from 21 to 35 m. There is good correlation between depth of occurrence and mean length of this species. The length-weight relationship in the sea off West Bengal can be described by the equation log W=-5.38217+ 3.28637 log L. The selection length for the 22 mm cod end mesh size is 42 mm. It appears that *L. bindus* in the sea off West Bengal belongs to a virgin stock and the estimated value of Z at 1.02 can be taken as M for the species. The yield per recruit analysis shows that higher yield can be obtained at a cod end mesh size of 42 mm with a maximum F of 3.2.

INTRODUCTION

IN FEBRUARY 1985, the Research Vessel *R. V. Skipjack* of the Central Marine Fisheries Research Institute conducted a survey in the region between 20°-21° 03'N and 87° 15' - 88° 55'E along the coast of West Bengal using a midwater trawl. *Leiognathus bindus* (family Leiognathidae) was one of the most dominant species in the catches. Since there is no information on this species from along West Bengal Coast, an account of biology and population dynamics of this species is given in this paper.

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MATERIAL AND METHODS

R. V. Skipjack operated a mid water trawl 141.5 m long (including the leg) with a cod end mesh size of 22 mm, in the sea off West Bengal during 21. 2. 1985 - 25. 2. 1985. One - hour hauls were taken at each station at a trawling speed of 3.5 kn in a total of 16 stations (Fig. 1). At each station, the depth (echo depth and year depth) was recorded along with all relevant particulars. Fishing was conducted both during day and night. The catch at each station was separated into constituent species and then all relevant data were recorded. In *L. bindus* all the specimens caught were measured: in cases where the catches were larger, a sample of fishes was measured and then weighted to the catch. Some specimens were preserved in formalin and brought to the laboratory for further studies. The length data were grouped into 5 mm- class intervals. For length-weight relationship the preserved specimens were measured to the nearest mm and 0.5 g and the relationship was calculated using the formula: log W=log a+b log L (Le Cren, 1951). Maturation stages were fixed following Murty (1984). The total mortality rate was estimated following Beverton and Holt (1956) method; for this purpose the data on length composition of catch at all stations were pooled. Natural mortality rate (M) was estimated assuming that 99% of the fish by numbers would die if there is no exploitation, by the time they attain maximum age (t_{max})

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and by taking t_{max} as corresponding to L_{max} in the catch (Sekharan, 1975) or to L_∞ - 0.50 cm (Alagaraja, 1984) or to 95% of L_∞ Pauly, 1983). Length at first capture (L_c) was estimated following Jones (1976): L_c = SF X MS where SF is the selection factor and MS the cod-end mesh size. SF was estimated using the depth ratio (standard length/maximum body depth) of the species and the nomogram given by Pauly (1983).

from 12 to 23 m (6-15 m above sea bottom having the depth range 21-35 m). Though fishing was conducted both during day and night, *L. bindus* was caught only during night time or during early morning time before dawn (Table 1). Only small quantities of another silverbelly (*Secutor ruconius*) were caught.

A plot of mean length (of all the fishes caught at each station) of *L. bindus* against the gear depth (Fig. 2) shows that there is a significant correlation between the two (n=6;

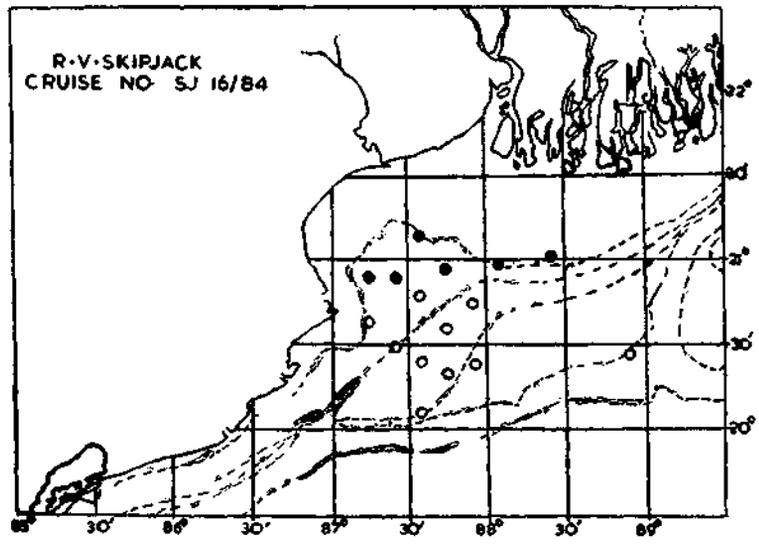

Fig. 1. Coast of West Bengal. Fishing stations are indicated by cricles and closed circles indicate stations where *L. bindus* was caught.

Distribution and Biology

Distribution: A total of 16 hauls was taken at 16 stations (Fig. 1). *Leiognathus bindus* was caught only in six stations and a total of 18.6 kg forming 13.5% of total catch in all 16 stations was obtained (Table 1). Fishing was conducted in areas having bottom depths ranging from 21 to 150 m and the depth of the gear ranging from 12 to 68 m. *L. bindus* occurred in the catches at gear depths ranging

r=0.79) suggesting that larger fishes live in relatively deeper waters. The relation can be described by the regression:

$$ML = -27.0428 + 5.8778\ D$$

Where ML is mean length in mm and D is gear depth in m.

Length composition of catch: A total of 1908 specimens was caught and 234 specimens

were measured. The total length at different stations varied from 20 to 135 mm (Fig. 3) with modal lengths at 47 and 102 mm.

Sex ratio and Maturity: A total of 163 specimens ranging from 87 mm to 118 mm was examined; of these 86 were females and the rest males. Among females 87.2% were in stage IV and 12.8% in stage V.

Length - weight relationship: Data of the 163 specimens mentioned above were used. The relationship was calculated separately for males and females and the regressions are:

males : $\log W = -4.69562 + 2.94611 \log L$; $r^2 = 0.80$

Females : $\log W = -5.70966 + 3.44844 \log L$; $r^2 = 0.83$

Analysis of covariance (Table 2) does not reject the identicality of regression lines at 5% level of significanc. The data of males

TABLE 1. *Details of fishing stations and catches*

St. No.	Depth (m) of bottom	gear	Time of fishing (Hrs)	Total catch (kg)	Silverbelly catch (kg)	Catch os *L. binduf* (kg)
1	21	12	0130–0230	25.86	1.00	0.10
5	150	60	1815–1915	1.00	–	–
11	25	18	0510–0610	13.19	2.00	1.35
12	53	32	0930–1030	1.25	–	–
13	98	45	1325–1425	0.05	–	–
15	94	50	1850–1950	0.66	–	–
16	58	36	2200–2300	0.65	–	–
17	35	20	0035–0135	2.28	2.10	2.10
18	26	20	0510–0610	27.39	0.13	0.13
19	35	25	0800–0900	3.78	–	–
20	53	35	1145–1245	0.10	–	–
21	89	68	1540–1640	–	–	–
22	44	32	1840–1940	34.10	0.20	–
23	33	23	2200–2300	17.33	15.00	15.00
24	27	21	0110–0210	8.20	0.28	0.08
25	34	29	0425–0525	2.70	–	–
			Total:	138.54	20.71	18.76

Note: The numbers of the stations where only hydrographic data were collected are not listed here.

and females were therefore pooled and regression for the species was fitted:

$$\log W = -5.38217 + 3.28637 \log L;\ r^2 = 0.82$$

The t-test (Pauly, 1984) was applied to test whether the regression coefficient is significantly different from 3. At df = n-2, the $\hat{t}$ value shows that the regression coefficient is not significantly different from 3 at 1% level.

Estimation of L_c: The depth ratio was calculated as 1.85 and using this value, the SF value was read as 1.9 from the nomogram of Pauly (1983). Taking the cod end mesh size of the gear at 22 mm, the L_c value was calculated as 42 mm. The L_c in the present study was taken as 40 mm being the lower limit of the length class 40-44 mm.

TABLE 2. *Analysis of Covariance to test the significance of difference between regression lines of sexes in the length-weight relationship of* L. bindus

Source of variation	Df	Deviation from Regression SS	MS
Due to regression within sexes	159	0.187204	0.001177
Due to difference between regression coefficients	1	0.004361	0.004361
Residual due to regression pooled within	160	0.191565	0.001197
Difference between adjusted means	1	0.000006	0.000006
Total	161	0.191571	

Comparison of slopes F=3.71, df=1,159; NS

Comparison of elevations F=0.005, df=1,160; NS.

TABLE 3. *Estimated values of M obtained by different methods along with the values of L_{max} and t_{max}* in L. bindus

Method of	L_{max} (mm)	t_{max} (year)	M	M/K
Sekharan (1975)	135	3.27	1.41	2.43
Pauly (1983)	150.48	5.14	0.90	1.55
Alagaraja (1984)	153.4	5.93	0.78	1.34
Pauly (1980)	–	–	1.50	2.59

Estimation of total mortality rate (Z): Murty (1986) estimated the von Bertalanffy growth parameters of this species as $L_\infty = 158.4$ mm, $K = 0.58$ per year and $t_0 = -0.024$ year from off Kakinada along the coast of Andhra Pradesh. Taking these values for the stock along West Bengal Coast and taking L_c as 40 mm ($\bar{L}$ value was calculated taking fishes above 40 mm TL), the value of Z was estimated as 1.02.

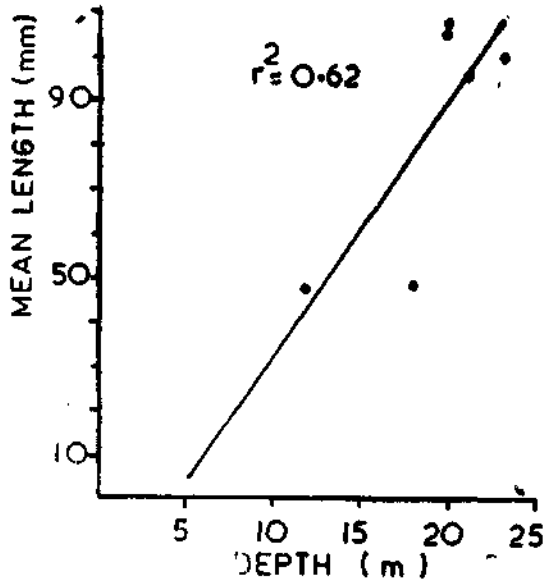

Fig. 2. Relationship between mean length of *L. binds* against fishing depth.

Estimation of natural mortality rate (M): The values of M obtained by different methods are shown in Table 3 along with the value obtained by Murty (1986) following Pauly's (1980) equation. In the present study M value was taken as 1.02 which is also the Z value.

Estimation of yield per recruit: The growth parameter estimates were taken from Murty (1986). The W_∞ value was calculated taking the L_∞ value and the length - weight relationship. The smallest length in the catch at 20 mm was taken as Lr and its age (t_r) is 0.2 year. Taking the value of M at 1.02 and taking different values of L_c corresponding to different

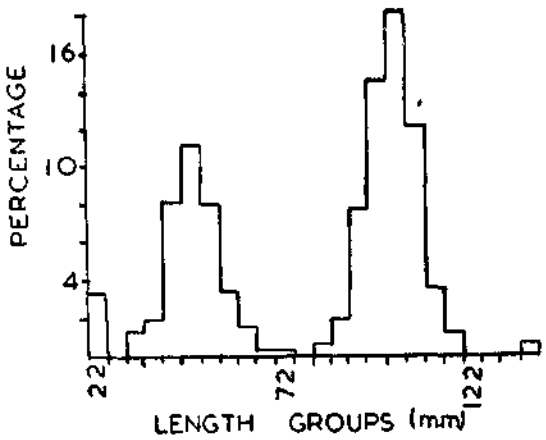

Fig. 3. Length frequency distribution of *L. bindus* (Data pooled from all stations).

cod end mesh sizes, the yield per recruit (Yw/R), was calculated. The Yw/R as a function of F (Fig. 4) shows that Yw/R is higher if t_c is higher and reaches maximum at greater values of F when t_c is greater. It is also clear that if t_c is 1.19 (cod - end mesh size 42 mm), maximum Yw/R is obtained at $F = 3.2$.

Discussion

Balan (1967) stated that in *L. bindus*, "very good catches are reported to be procured during foggy nights and also during the dark phase of the moon when the shoals reveal their presence by luminescence in the surface and sub-surface waters". Venkatraman and Badrudeen (1975) showed that silverbellies "stay at the bottom during day time and a good portion of these migrates from there and rises to surface and sub-surface waters

at night.". The present observations (Table 1) are in conformity with those of the above authors. There is justification, therefore, in using the present data from midwater trawl catches for a study of population dynamics of *L. bindus*.

Along the West Bengal Coast which has a length of 600 km, an average catch of 13,634 tonnes during 1976-'81 (CMFRI, 1982), of all fish forming 1.0% in the total marine fish catch of India, are landed annually. The annual average catch of siverbellies (during the above period) in this state was estimated at 110 tonnes (CMFRI, 1982) which forms 0.2% of all India silverbelly catch and 0.8% in total landings in West Bengal State. It is hus clear that marine fisheries resources in general are underexploited in West Bengal and *L. bindus* in the region can be treated as belonging to a virgin stock. This latter aspect is particularly clear from the estimate of instantaneous rate of total mortality : off Kakinada, the author (Murty, 1986) estimated the Z value of this species as 5.2 during 1979-'81 whereas in the present study (in 1985), it is estimated as 1.02 only. This latter value is much less than the value of M estimated by Sekharan's (1975) and Pauly's (1980) methods and is only slightly more than the M values obtained by Pauly's (1983) and Alagaraja's(1984) methods. It is thus clear that there is virtually no fishing mortality for this species off the West Bengal Coast. Since there is presently no way of obtaining an objective estimate of M particularly for the exploited stocks of

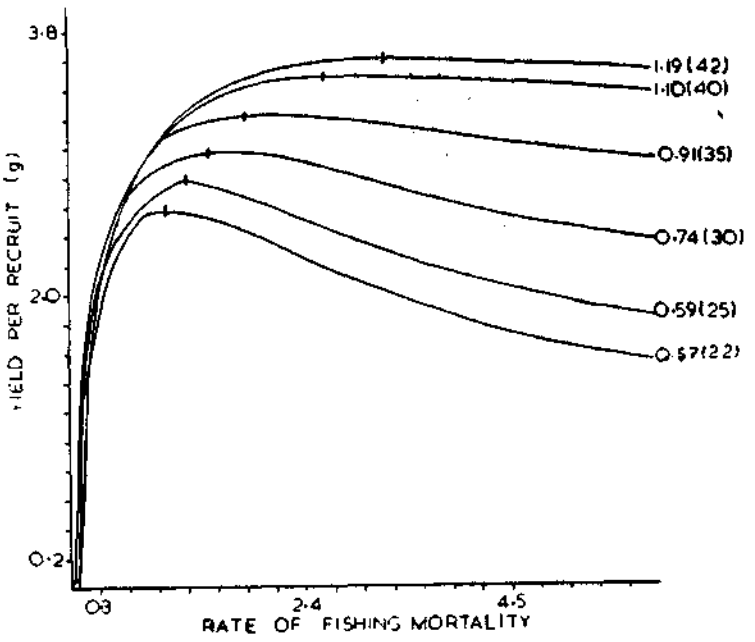

Fig. 4. Yield per recruit of *L. bindus* as a function of fishing mortality rate. Numerals indicate the values of age at first capture in years; those in parentheses are the corresponding values of cod end mesh size in millimetres.

tropical fishes (Cushing, 1981: Alagaraja, 1984), the present estimate of M = 1.02 for *L. bindus* can well be taken as the M value for those stocks of this species which are well-exploited.

The stock of *L. bindus* along West Bengal Coast, like any other species in tropical multispecies fisheries, can only be exploited along with several other demersal species in the region. The yield per recruit analysis (Fig. 4) of *L. bindus*, may therefore appear as having academic value only. While it may be so at present, the results of the analysis provide an idea of the best strategy for rational exploitation of the species and will be useful in future when similar information on all other demersal species in the region, becomes available.

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