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Fishery and population dynamics of silverbellies off Visakhapatnam

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Abstract

The annual average catch of silverbellies was 453 t in small-mechanized boats operating off Visakhapatnam during 1990-2001. Silverbellies contributed 4.2 % to the total landings. Maximum landings were during April-June. Ten species of silverbellies were recorded of which *Leiognathus bindus* (51%) was the dominant species. The growth parameters, L_α and K for *L. bindus* and *Secutor insidiator* were 148 mm & 0.88 yr^{-1} and 140 mm & 0.96 yr^{-1}, respectively. The estimated mortality rates, Z, M and F were 6.36, 1.97 and 4.39 for *L. bindus* and 6.03, 2.12 and 3.91 for *S. insidiator*. The exploitation rates for the species were 0.69 and 0.65 respectively.

Keywords: Fishery, population dynamics, silverbellies, Visakhapatnam

Introduction

The fishes of the family Leiognathidae, commonly known as silverbellies, pony fishes and slipmouths form a major fishery along the east coast of India and they are abundantly available in Indo-Pacific region. These are shallow water fishes distributed in the depth range of 1-40 m (James, 1973; Pauly, 1977). Eventhough silverbellies have less demand in fresh condition, there is considerable market for dry fish and also as fishmeal especially in poultry industry. Fishery, distribution, biology and population dynamics of silverbellies have been studied in detail (James *et al.*, 1987 and 1992; James, 1973, 1975 and 1986; James and Badruddin, 1975, 1981, 1986; Jayabalan and Ramamoorthi, 1985a & b; Murty, 1983, 1985, 1986a, 1986b, 1989, 1991; Reuben *et al.*, 1989). The present study deals with the fishery and population dynamics for *L. bindus* and *S. insidiator* off Visakhapatnam.

Materials and methods

Field observations were made twice a week to collect the data on catch, effort, length, weight and species composition from the commercial small-mechanized units (small trawlers: 1990-01 and *sona* boats: 1997-01) landed at Visakhapatnam. These are wooden boats (small trawlers: 9.2-11.3 m OAL, 63-93 Hp engine and 3-5 days voyage; *sona* boats: 13.1m OAL, 102 Hp engine and 8-15 days voyage), which operate four-seam shrimp trawl with 15-25 mm cod end mesh size. The monthly and annual estimates of catches were made using the methodology adopted by Fishery Resource Assessment Division of Central Marine Fisheries Research Institute.

The length frequency data for the period 1997-01 was pooled and subjected to ELEFAN module of FiSAT for estimation of von Bertalanffy's Growth Parameters, L_∞ and K (Gayanilo *et al.*, 1995). A total of 3000 and 1450 fishes of *L. bindus* and *S.insidiator*, were used for estimation of growth parameters, respectively. The t_0 was considered as '0' (Sparre *et al.*, 1989). The total mortality rate (Z) was estimated from the length converted catch curve method (Pauly, 1983a) and natural mortality rate (M) was estimated from Pauly's empirical formula (Pauly, 1983b). Surface sea water temperature was taken as 27 ^{0}C.

The fishing mortality rate F was estimated from Z - M. The exploitation rate was estimated from the ratio of fishing mortality / total mortality.

$$E = F / F + M$$

Yield/recruit was estimated from the relative yield / recruit model of Beverton and Holt (1957).

Results and discussion

Fishery: The average annual estimated landing of silverbellies was 453 t during 1990-2001(Table 1). The landings showed wide fluctuations ranging from a maximum of 753 t in 2000 to a minimum of 166 t in 1999. The trend of fishery over the period indicated a decline till 1995; revived up to 1998 followed by a decline to 166 t in 1999, the lowest landings during the period. The last two years recorded highest landings but the catch rate was lower compared to the earlier period 1990-96. The possible reasons for the increased landings may be the result

Table 1. *Catch and effort data of silverbellies off Visakhapatnam during 1990-2001 in small-mechanized units*

Years	Units	Hours	Catch (t)	CPUE (kg/unit)	Cph (kg/hour)	Percent in total catch
1990	19699	314519	255	12.9	0.8	5.2
1991	21188	306836	309	14.6	1.0	5.9
1992	14180	220867	217	15.3	1.0	5.7
1993	14089	191701	274	19.4	1.4	7.2
1994	14232	205933	250	17.6	1.2	6.0
1995	10170	176454	187	18.4	1.1	5.6
1996	8998	146893	221	24.6	1.5	7.9
1997	14937	436550	250	16.7	0.6	3.2
1998*	14759	530044	298	20.2	0.6	3.5
1999*	10934	503455	166	15.2	0.3	3.7
2000*	18825	1155035	753	40.0	0.7	4.4
2001*	14837	770279	653	44.0	0.8	3.6
Average	16972	642926	453	26.7	0.7	4.2

* The data for the year is for 11 months since May is declared as closed season from 1999 onwards

of increased effort in hours (Table 1) and also due to the introduction of *sona* boats in 1997, which might have become fully functional by the year 2000.

The trawl ban (1999-2001) has not helped in reduction in fishing effort. On the other hand, the effort has increased from 5 million hours (1998) to 12 million hours (2000) due to introduction of more efficient *sona* boats and increase in sea endurance (up to 15 days).

The average catch rate, cph and CPUE of silverbellies off Visakhapatnam ranged from 0.3 kg/hr (1999) to 1.5 kg/hr (1996) and 13 kg/unit (1990) to 44 kg/unit (2001) with an average of 0.7 kg/hr and 26.7 kg/unit, respectively. The cph was fairly better in first half (1990-96) compared to the later half indicating the increased effort in hours because of voyage fishing lasting for 8-15 days since introduction of *sona* boats (Table 1). The CPUE showed an increasing trend with exceptions in the years 1997 and 1999. Though the catch has increased in 2000 & 01, the cph has decreased compared to 1990-96 indicating the increased effort in hours. The percentage contribution of silverbellies to the total landings of small-mechanized units ranged from 3.2 (1997) to 7.9 (1996) with an average contribution of 4.2.

Silverbellies are one of the major resources that were discarded regularly in the sea as well as at landing centers. They formed 3.8 % of the total discards and 1.3% of the total landings. The major species recorded in discards were *L.bindus* and *S.insidiator*.

Seasonal landings: Silverbellies formed reasonably good fishery in all the months. The cph ranged from 0.5 kg (February-March) to 2.1 in May. Though the catches were higher during July to December, the catch rate was lower because of target fishing for shrimps. The percentage contribution of silverbellies to the total landings varied between 2.8 in March and 6.6 in May (Fig. 1). April and May are the favourable months for silverbellies landings. Similar seasonal periods, April - June (Murty *et al.*, 1992) and May - June (Luther *et al.*, 1998) have been reported.

Species composition: A total of 21 species of silverbellies were reported from Indian waters (Murty *et al.*, 2003). Ten species were recorded during the period 1997-2001, of which *L. bindus* (51.3%) dominated the fishery (Fig. 2). *S. insidiator* (14.4%), *Gazza minuta* (12.8%), *L. equulus* (7.7%), *L. leuciscus* (4.1%), , *L. splendens*

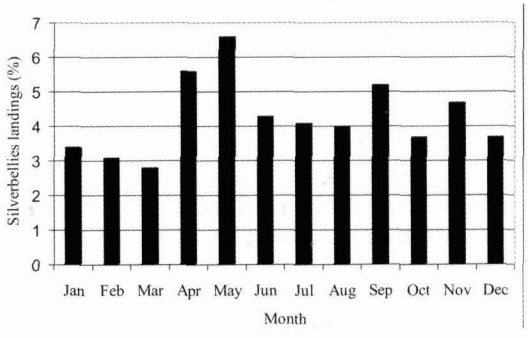


Fig. 1. Seasonal landings of silverbellies at Visakhapatnam

(3.9%) *S. ruconius* (3.3%) and *L. dussumieri* (2.5%) formed the fishery. Apart from the above *L. brevirostris* and *L. daura* were observed in less quantities, which do not form a fishery. Nine to twelve species of silverbellies were recorded by Murty *et al.* (1992) along North Andhra and Tamil Nadu coasts and reported the dominance of *L. bindus*.

Population dynamics: *L. bindus* and *S. insidiator,* the economically important species which formed a regular fishery along the Visakhapatnam coast were considered for estimation of growth parameters.

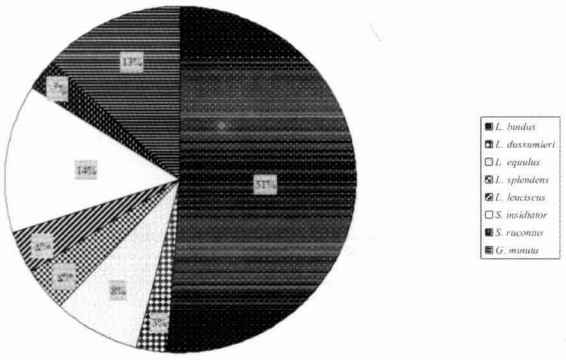


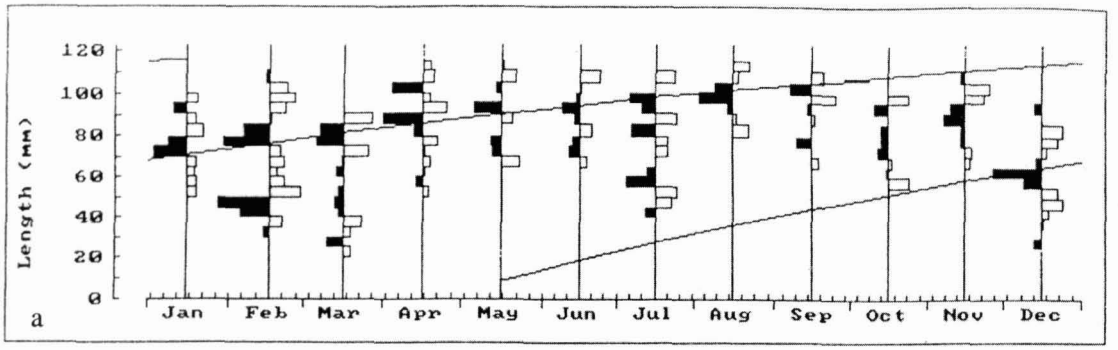
Fig. 2. Species composition of silverbellies off Visakhapatnam

Age and growth: *L. bindus*: A total of 3000 specimens with length range of 25-117 mm were used for estimation of growth parameters. The estimated L_∞ and K were 148 mm and 0.88 yr^{-1}, respectively (Fig. 3a). The fish attains a length of 87 mm and 123 mm at the end of 1st and 2nd year. The growth and mortality rates of the two species published in the literature are presented in Table 2. Murty *et al.* (1992) reported L_∞ and K as 151-163 mm and 0.95 off Visakhapatnam, 154-165 and 0.77-0.70 off Kakinada and 153-167 and 0.90-0.96 off Madras coast for *L. bindus*, respectively, which is slightly higher than the present estimates. Murty (1986) observed higher L_∞ 158.4 mm and lower K 0.58 yr^{-1} for *L. bindus* off Kakinada coast. Lower L_∞ and higher K estimates (121 & 0.98 and 125 & 1.38) were also reported by Silvestre (1986) and Dwipanggo *et al.* (1986) off Samara Sea and Java, respectively

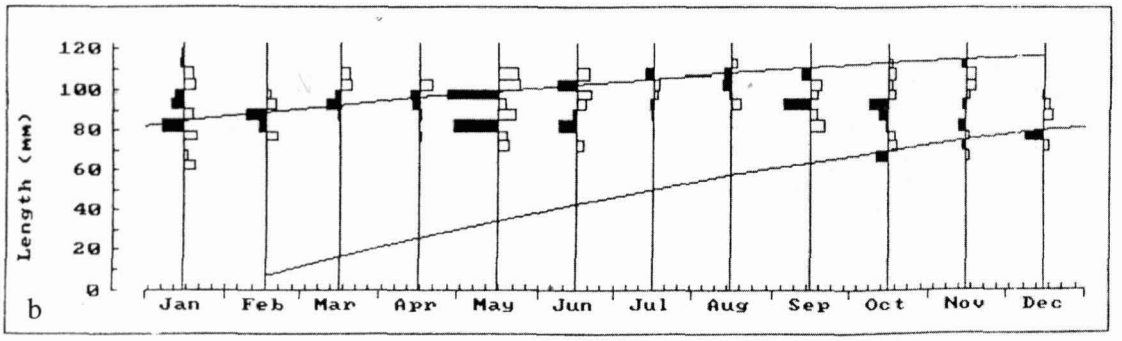
S. insidiator: A total of 1450 fishes in the length range of 55-117 mm were used for estimation of VBG parameters. The L_∞ and K are 140 mm and 0.96 yr^{-1},

Table 2. *Estimates of population parameters of silverbellies*

S. No	Species	Area	L_α (mm)	K	Z	M	F	E	Author
1	*L. bindus*	Visakhapatnam	151-163	0.95-0.95	4.14-4.72	2.05-2.01	2.09-2.61	0.51-0.55	Murty *et al.* (1992)
		Kakinada	154-165	0.77-0.70	5.26-5.43	1.78-1.67	3.48-3.79	0.66-0.70	do
		Madras	153-167	0.90-0.96	5.22-7.44	1.98-2.01	3.24-5.43	0.62-0.73	do
		Kakinada	158.4	0.58	5.20	1.5	3.7	0.71	Murty (1986)
		Samara Sea	121	0.98	4.28	2.21	2.07	0.48	Silvestre (1986)
		Java	125	1.38	8.84	2.83	6.01	0.68	Dwipongga *et al.*, (1981)
		Visakhapatnam	148	0.88	6.36	1.97	4.39	0.69	Present study
2	*S. insidiator*	Kakinada	123	1.20	6.10	2.60	3.5	0.57	Murty (1991)
		Visakhapatnam	120-130	1.20-0.85	4.88-5.28	2.55-1.99	2.33-3.29	0.48-0.62	Murty (1992)
		Kakinada	125-130	1.06-0.85	4.69-4.36	2.33-1.99	2.36-2.37	0.50-0.54	do
		Madras	125.5-138	1.22-1.30	5.67-8.72	2.55-2.59	5.43-6.13	0.96-0.70	do
		Visakhapatnam	140	0.96	6.03	2.12	3.91	0.65	Present study



$L\infty = 148$ K = 0.88 Rn = 0.31

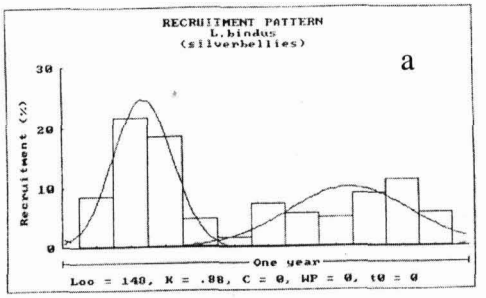


$L\infty = 140$ K = 0.96 Rn = 0.34

Fig.3. Growth curves of silverbellies using ELEFAN, a. *L.bindus* and b. *S.insidiator*

respectively (Fig. 3b). The fish grows to 86 mm at the end of the first year and 119 mm at the end of the second year. Murty *et al.* (1992) reported lower L_∞ and K estimates for *S. insidiator,* 130 and 0.85 yr^{-1} (Visakhapatnam and Kakinada) and 138 and 130 yr^{-1} (Madras), respectively. Murty (1991) reported lower L_∞ (123 mm) and higher growth rate 1.20 for *S. insidiator* off Kakinada coast. Pauly and David (1981) reported lower L_∞ and higher K estimates for *L. bindus* (122 mm and 1.3 yr^{-1}). The slight variation in the growth rate for both the species may be because of environmental factors, availability food and predators.

Recruitment: Continuous recruitment throughout the year was observed for both the species with two peaks (Fig. 4). The major peak was in February and March for *L. bindus* and March and April for *S. insidiator* and the minor peak was in October for *L. bindus* and August for *S. insidiator*. The recruitment to the fishery occurs at the age of 2-3 months (25-30 mm) in *L. bindus*. However, *S. insidiator* juveniles (<55 mm) are not represented in the samples, and hence it was difficult to estimate the age/ size of the recruitment in the species.



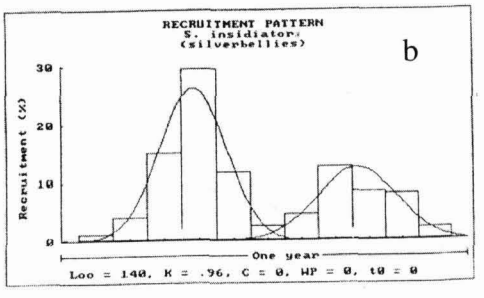


Fig. 4. Recruitment patterns, a. *L.bindus* and b. *S.insidiator*

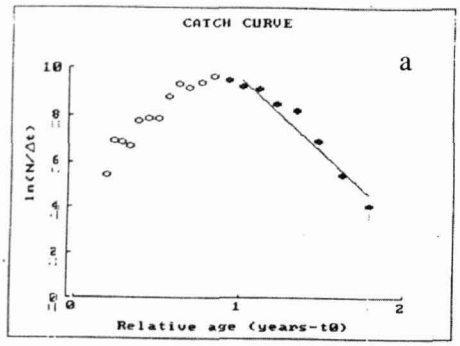


Fig. 5. Length converted catch curves, a. *L.bindus* and b. *S.insidiator*

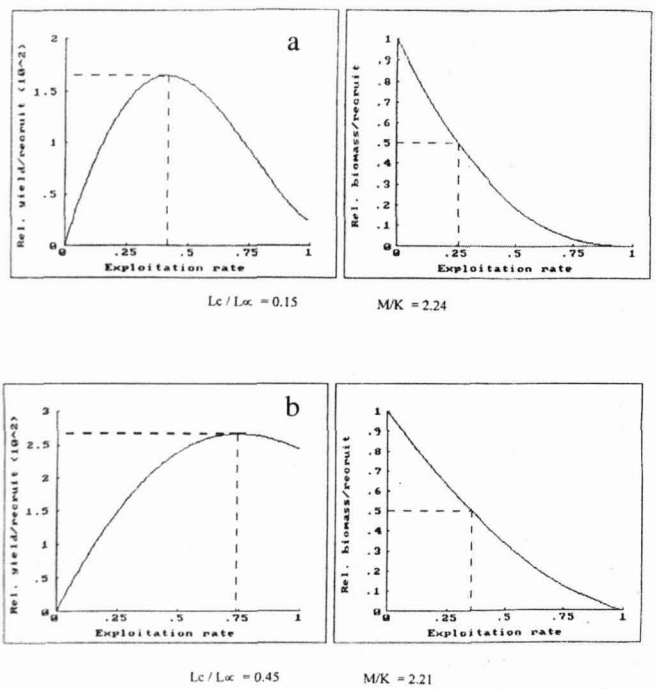


Fig. 6. Yeild/recruit and biomass/recruit a. *L.bindus* and b. *S.insidiator*

Mortality: The mortality rates i.e., the total mortality (Z), natural mortality (M) and fishing mortality (F) were 6.36, 1.97 and 4.39 for *L. bindus* and 6.03, 2.12 and 3.91 for *S.insidiator*, respectively (Fig. 5). Murty *et al.* (1992) reported lower Z for *L. bindus* and *S.insidiator* off Visakhapatnam and Kakinada and higher Z off Madras for both the species. Though the values are lower than the present estimates, are on higher side ranging from 4.14 to 8.84 (*L.bindus*) and 4.36 to 8.72 (*S.insidiator*), which is well justified by the short life span of the species. The natural mortality ranged from 1.5 to 2.83 for *L. bindus* and 1.99-2.60 for *S. insidiator*. The fishing mortalities are also lower for both the species except for *S. insidiator* (6.13) off Madras.

Yield/ Recruit: The exploitation of the resource is measured in terms of exploitation rate (E). The 'E' for *L. bindus* and *S. insidiator* is 0.69 and 0.65 respectively. The present exploitation rate was more than the ideal E value of 0.5 for desirable fishing effort indicating the overexploitation of the two species. *L.bindus* was overfished by 66% with respect to its $E_{max.}$ The lower E_{max} of the resource supports the over exploitated state of the resource. At the present level of exploitation rate the yield is 1.2 g and biomass is 0.15 g (Fig. 6a). The exploitation rate of *S. insidiator* was below the E_{max} (0.74) for the species (Fig.6 b). At present 'E' the yield/recruit is about 2.5 g but the biomass is low, only 0.2 g/ recruit. At present though the yield is good the biomass is affected. The E values reported by earlier authors ranged from 0.48 to 0.73 for *L.bindus* and 0.48 to 0.96 for *S.insidiator* (Table 2). The present exploitation rates off Visakhapatnam were higher than that reported by Murty *et al.* (1992) for the two species during 1980s; 0.51 to 0.55 for *L. bindus* and 0.48 to 0.62 for *S.insidiator* indicating the increased exploitation of the resources over the period.

The reduction in the effort and increase in mesh size are suggested to improve the status of the resource for an optimum and sustainable production.

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