



# Population characters of silverbelly *Photopectoralis bindus* (Valenciennes, 1835) along the Ratnagiri coast of India

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## Abstract

*Photopectoralis bindus* is one of the major species of pony fishes landed as bycatch from Ratnagiri coast. Given the fact that intrinsic relationship exists between major species and as each species has got its own stock size, it becomes imperative to study the fishing pressure exerted on each such species. In the present study, age and growth of pony fish *Photopectoralis bindus* (Valenciennes, 1835) was estimated from the length frequency data by using FISAT computer package. The growth parameters  $L_{\infty}$ ,  $K$  and  $t_0$  for *P. bindus* was estimated as 144.38 mm, 1.69 year<sup>-1</sup> and -0.0066 years respectively. The estimated mortality rates,  $Z$ ,  $M$  and  $F$  were 6.39, 1.59 and 4.80 respectively. This species attains a size of 89.5, 123.5 and 136 mm in total length at the end of six, twelve and eighteen months respectively. The exploitation ratio ( $E$ ) and  $E_{\max}$  obtained for the species was 0.75 and 0.89 respectively. Though the  $E_{\max}$  obtained at higher side, exploiting the fish up to that measures are certainly difficult.

**Keywords:** Growth, mortality, yield/recruit, *Photopectoralis bindus*, Ratnagiri

## Introduction

The fishes of the family Leiognathidae, commonly known as silverbellies, pony fishes and silpmouths are widely distributed in Indo Pacific region. They are one of the important demersal fishery resources of India. In Indian waters silverbellies are distributed in the depth range of 1-40 m (James, 1973 and Pauly, 1977), but are also known to occur up to depths of 100-150 m. Age and growth studies in fishes help to know the age and class structure of the stock and fluctuations in the fishery caused by the presence or absence of various year classes. Similarly age and growth studies help in understanding the life span of exploited fish stocks, age at sexual maturity, suitability of different environments for growth, age at recruitment, population dynamics and possible discrimination of stocks on the basis of differences in population parameters (Abraham *et al.*, 2011). The studies on *P. bindus* are very few and are carried out long ago (Murty, 1983; 1992). If the current fishing pressure on major species landed as bycatch is known, it would be helpful to recommend a generalized hike or decrease in the fishing effort. In this context, this study has been carried out to study growth and mortality parameters as well as yield per recruit.

## Material and methods

The catch and effort data was collected weekly from trawl catches from Mirkarwada landing centre (16.9800° N, 73.3000° E) of Ratnagiri in 2013-14. Total 2047 fish specimens were measured. The total length was measured to the nearest millimeter. The length frequency data were grouped into 10 mm class interval, then raised & pooled month wise (Sekharan, 1962). Asymptotic length ( $L_{\infty}$ ) and growth coefficient (K) of the von Bertalanffy equation for the growth in length were estimated by means of ELEFAN employing FiSAT (FAO-ICLARM Stock Assessment Tools) computer software package developed by Gayanilo *et al.* (1996). The total instantaneous mortality (Z) was calculated by the length-converted catch curve (Pauly, 1983; 1984) employing FiSAT programme. The natural mortality (M) was estimated from Pauly's empirical formula (Pauly, 1980) and fishing mortality (F) was estimated using the relationship,  $F = Z - M$ , where Z is the total mortality and M natural mortality.

The exploitation rate (U) is calculated as

$$U = (F/Z) * (1 - e^{-Z}) \text{ and exploitation ratio (E) by } F / Z.$$

Yield per recruit were estimated from the relative yield per recruit model of Beverton and Holt (1957) by employing FiSAT program by the equation:

$$(Y/R) = E * \frac{UM}{K} * \frac{1 - 3U + 3U^2 - U^3}{1 + m + 1 + 2m + 1 + 3m}$$

$$1 + m + 1 + 2m + 1 + 3m$$

where  $E = F/Z$  the exploitation ratio or the fraction of deaths caused by fishing:

$$M = F/Z$$

$U = 1 - L_c / L_{\infty}$ , the fraction of growth to be completed after entry into the exploited phase,  $(Y/R)$  is considered a fraction of U and E and the only parameters is M/K. Using different value of E on the X-axis and various sizes at first capture  $L_c / L_{\infty}$  ratios on Y-axis, the isovalues of relative yield per recruit were plotted to generate the yield isopleth diagram.

## Results and discussion

### Growth parameters

The growth parameters were also estimated by ELEFAN-I, taking length frequency of *P. bindus* employing FiSAT programme (Fig. 1). The parameters which were obtained by ELEFAN were  $L_{\infty}$  and K of 144.38 mm and 1.69 year<sup>-1</sup> respectively for *P. bindus* (Fig. 1).

The growth parameters  $L_{\infty}$  and K were noted by Murty (1983)

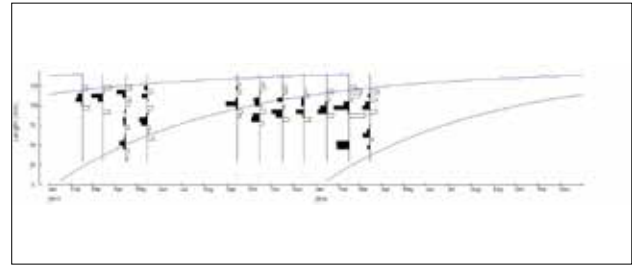


Fig. 1. VBGF plot by ELEFAN-1.

to be 148.4 mm and 0.58 year<sup>-1</sup> respectively from Kakinada coast. Similarly from Visakhapatnam coast the  $L_{\infty}$  and K have been estimated as 151-163 mm and 0.95 years<sup>-1</sup>, from Kakinada 154-165 mm and 0.77 year<sup>-1</sup> and from Madras 153-167 mm and 0.90-0.96 year<sup>-1</sup> for *P. bindus* (Murty, 1992). The values of  $L_{\infty}$  and K were reported to be 122 mm and 1.3 year<sup>-1</sup> for *P. bindus* from Calicut (Pauly and David, 1981). Silvestre (1986) reported  $L_{\infty}$  and K of *P. bindus* from Samara Sea to be 121 mm and 0.98 year<sup>-1</sup>. Similar findings have been reported by Murty (1992) for *S. insidiator* from Visakhapatnam and Madras.

The growth parameters estimated in the present study almost confirms to the values for  $L_{\infty}$  and K reported from Indian coast, thereby suggesting that *P. bindus* is a short lived fish with high growth rate. The  $t_0$  estimated by VBGF plot was (-0.0066) years. The  $t_0$  value for *P. bindus* was reported to be -0.024 years by Murty (1983). Similarly the value of  $t_0$  estimated by Murty (1990) for *S. insidiator* from Kakinada was -0.01 years. The  $t_0$  which has often got a small negative value is confirmed by the study.

Mean length estimated by Scattergram technique was considered for the calculation of age attained using the von Bertalanffy's Growth Formulae (VBGF). It was noted that *P. bindus* attains 89.5, 123.5 and 136 mm length at the end

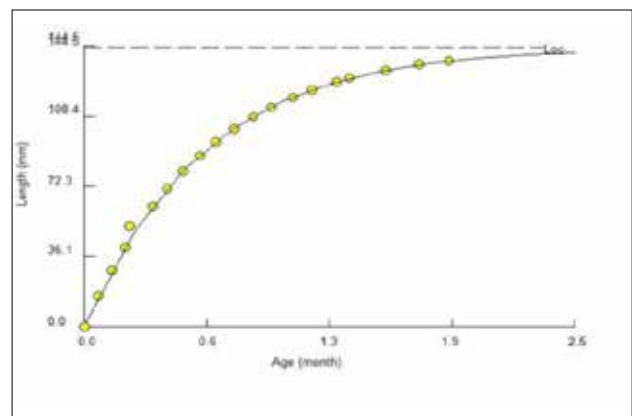


Fig. 2. Growth curve of *P. bindus* (Length at age).

of six, twelve and eighteen months respectively (Fig. 2). The longevity of *P. bindus* was estimated to be 2.65 and 1.90 years using K values obtained by scattergram and ELEFAN-1 methods respectively. Therefore it is concluded that *P. bindus* has a life span of 1.90 to 2.65 years.

Murty (1983) reported the length at age for *P. bindus* along the Kakinada coast of India, as 71 mm, 110 mm and 132 mm at the end of I to III years of growth respectively and also reported that the length at age for *P. bindus* along the Kakinada coast to be 65 mm and 90 mm at the completion of first and second year respectively.

### Mortality parameters

The mortality rates i.e., the total mortality ( $Z$ ), natural mortality ( $M$ ) and fishing mortality ( $F$ ) were 6.39, 1.59 and 4.80 respectively for *P. bindus* (Fig. 3). Murty (1983) reported the value of " $Z$ " along the Kakinada waters as 5.2. Murty *et al.* (1992) estimated " $Z$ " was 5.43 for *P. bindus* along the Visakhapatnam. Murty *et al.* (1992) reported the value of " $Z$ " along the Madras region as 7.44 for *P. bindus*. Rajkumar (2006) estimated the value of  $Z$  for *P. bindus* and *Secutor insidiator* as 6.36 and 6.03 respectively along Visakhapatnam coast. Silvestre (1986) calculated  $Z$  value for *P. bindus* from Samar Sea to be 4.28.

Karthikeyan *et al.* (1989) reported the value of  $M$  to be 1.25 for *L. jonesi* from Mandapam. Murty (1986) reported the value of  $M$  for *P. bindus* along the Kakinada region as 1.5. Murty *et al.* (1992) reported the value of  $M$  from Madras region as 1.98. Rajkumar (2006) reported the value of  $M$  as 1.97 for *P. bindus* along Visakhapatnam coast. According to Murty (1986) fishing mortality  $F$  along the Kakinada region was 3.7 for *P. bindus*. Murty *et al.* (1992) reported the value of  $F$  for *P. bindus* from Madras region was 5.43. Murty *et*

*al.* (1992) estimated the fishing mortality for *P. bindus* to be 3.48 from Kakinada.

The total mortality as well as fishing mortality estimated in the present studies is higher than above values except that reported by Murty *et al.*, 1992 from Madras. This may be attributed to the comparatively higher landings of the species in the region, its short life span and faster growth rate in the region. The natural mortality estimate is almost similar to the value of  $M$  reported from Kakinada by Murty (1983; 1992) for *P. bindus*.

### Relative yield per recruit and exploitation ratio

Relative yield per recruit show  $E_{max}$  at 0.89,  $E_{50}$  at 0.417 and  $E_{10}$  at 0.806. The values of  $L_c/L_{\infty}$  and  $M/K$  taken for estimation of  $Y/R$  and  $B/R$  are as 0.691 and 0.99 respectively (Fig. 4) in the present study. When  $L_c$ ,  $F$  and  $Z$  are known for a certain fishery the actual exploitation rate can be compared with the  $E_{max}$  level and management measures can be proposed if necessary. In the present study the exploitation ratio ( $E$ ) is estimated to be 0.75 for *P. bindus*. The relative yield per recruit study shows that MSY can be obtained at  $E$  of 0.891, where as the present exploitation ratio is 0.75. This suggests an increase in efforts by 15.7% to maximise the yield. Karthikeyan *et al.* (1989) estimated the exploitation rate for *L. jonesi* to be in the range of 0.732-0.758 from Rameswaram, which is almost similar to present study. Rajkumar (2006) reported the exploitation ratio for *P. bindus* and *S. insidiator* to be 0.69 and 0.65 respectively in Visakhapatnam region. Given the multigear and multispecies nature of Indian marine fisheries, it is difficult to implement the management recommendations coming out from the study of single species. Though the findings of the present study points to increase the fishing effort to maximise the yield of *P. bindus*,

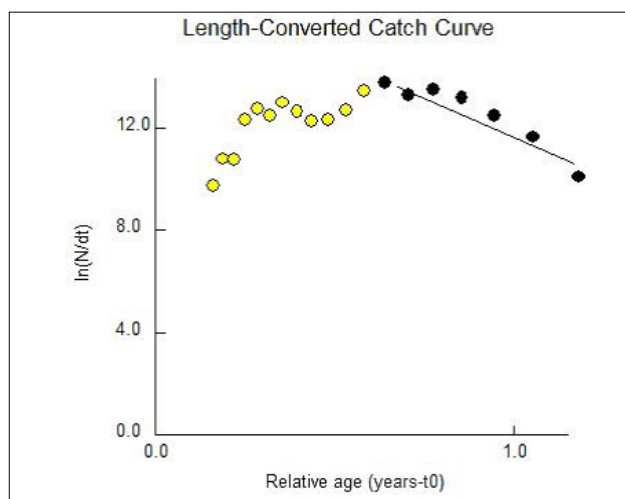


Fig. 3. Total mortality coefficient by length converted catch curve .

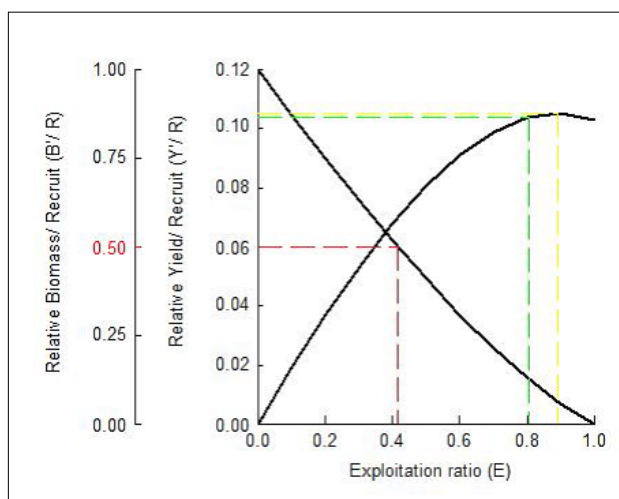


Fig. 4. Relative yield per recruit and biomass per recruit

to be on safer side and to avoid possible overfishing on other simultaneously landed species, it is recommended to maintain the fishing effort at present level of exploitation.

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