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Estimating some population parameters and stock assessment of Dark Sleeper *Odontobutis potamophila* in the Gaosha River, Wuyuan County, Jiangxi Province, China

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ABSTRACT

A study was conducted to investigate the growth parameters, mortality and recruitment pattern of *Odontobutis potamophila* collected in the Gaosha river fish landing site, west part of Wuyuan County (Latitude: 29° 14' 29" N, Longitude: 117° 45' 49" E). *O.potamophila* were collected from November, 2013 to October, 2014. Growth parameters, asymptotic length ($L\infty$ = 192mm and growth coefficient (k) = 0.22 year^{-1}. Growth performance index(Ø') =3.91, total mortality (Z) = 0.72 year^{-1}, natural mortality (M) = 0.32 year^{-1}, fishing mortality (F) = 0.40 year^{-1} and exploitation rate (E) = 0.55year^{-1}.The estimated exploitation rate (E) has slightly exceeded the optimum value of E indicating this species was sustainable exploitation in the study area. The exploitation ratios were computed as E_{max} = 0.61, E_{10} = 0.52, E_{50} = 0.34. The length at first capture at 50%, (L_c) was 77 mm. The recruitment pattern of the species was found continuous all-round the year with one peak. The observation of the annual recruitment of *O.potamophila* found to occur from May to July. Steady biomass also increased with length class until 121-125 mm, and the total steady state biomass was found to be 2240 kg.

Key words: Growth, Mortality, *Odontobutis potamophila*, Wuyuan county.

INTRODUCTION

Dark Sleeper *Odontobutis potamophila* is a freshwater bathypelagic fish that is widely distributed in the waters of China and Viet Nam (Wu *et al*., 1993). This species has been investigated for farming in recent years, and studies have been carried out on reproduction, larval rearing, and performance (Liu *et al*., 2008; Zhao *et al*., 2009). It is surprising how little we know about the population dynamics of *O.potamophila*. The objectives of this study was to assess four important parameters namely growth, natural and fishing mortality and recruitment of *O.potamophila* in the Gaosha River ,Wuyuan County, where it is relatively isolated and its culture history might date back 300 years.

MATERIALS AND METHODS

The study was carried out in the Gaosha river fish landing site, west part of Wuyuan County (Latitude: 29° 14' 29" N, Longitude: 117° 45' 49" E), from November, 2013 to October, 2014. Monthly random samples of *O.potamophila* were caught using cage net, and the length of the fishing area was about 2 kilometers. The annual average temperature was 18°C. The body length (BL, from the tip of the snout to the end of the caudal fin) was measured along the dorsal mid-line to the nearest 1mm. A total of 2659 *O.potamophila* were used in this study. The length frequency data of *O.potamophila* were analyzed using the FiSAT II program(FAO-ICLARM Stock Assessment Tools-Version 1.2.2). The FiSAT routines were followed thoroughly, based on the user's manual (Gayanilo *et al*. 2005) and reference manual (Gayanilo and Pauly, 1997). Bhattacharya's method (BM), implemented from the package FiSAT II (Gayanilo *et al*., 1996), was used to simulate the Von Bertalanffy equation: $L_t = L\infty * [1-\exp(-k*(t-t_0))]$ to calculate the asymptotic length $L\infty$ and the growth parameter k, where, Lt is the length at age t, $L\infty$ is asymptotic length (computed as L_{max} /0.95, where Lmax is the maximum recorded length), k is the curvature parameter, and t_0 is the initial condition parameter (Bertalanffy, 1938). Given a distribution in size classes, Bhattacharya's (1967) method allows for the iterative computation of regression lines up to the total decomposition of the overall size-frequency distribution.

RESULTS AND DISCUSSION

The length frequency data of *O.potamophila* was analyzed in FiSAT software using various methods to estimate the growth, mortality and recruitment. For commercially utilized fish species, growth parameters ($L\mu$ and k) have been estimated because these population parameters are important to describe the species and input data in several fishery production models (Hilborn and Walters, 1992). $L\infty$ is the largest theoretical mean length that a species could attain in its habitat where as k is related

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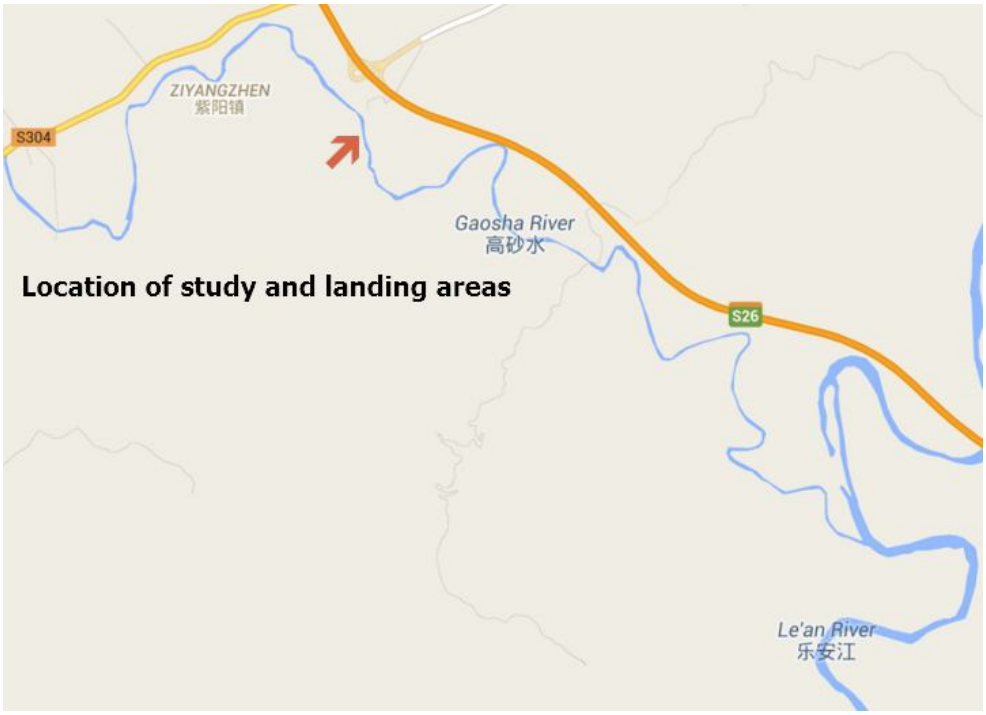

Fig 1: Location of study and landing areas for *O.potamophila*.

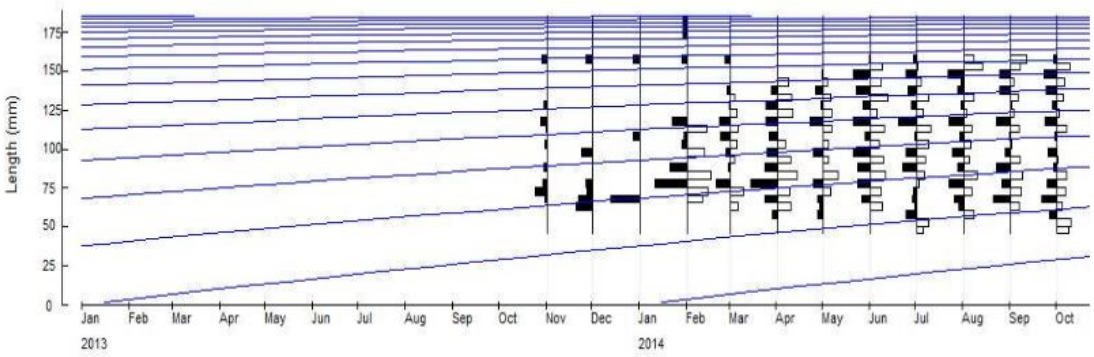

Fig 2: VBGF and Length Frequency Plot

to the speed it grows towards their final size.

Bhattacharya's plot: By using the Bhattacharya's method in FiSAT, *O.potamophila*, one group or cohort at modal length 120.5 ± 5.6 mm was obtained.

Growth parameters : A total of 2659 *O.potamophila* were examined and their length-mass relationships were computed as body mass = 0.032× body length$^{2.88}$(R=0.949;p<0.05). Length-mass relationship indicated isometric growth with b= 2.88. The parameters of the Von Bertalanffy growth equation (VBGF) L∞ and *k* were estimated by running the program Shepherd's method included in the FiSAT package. The monthly length-frequency distributions fitted with growth curves, are presented in fig. 2. This routine gave the L∞ = 192mm and *k* = 0.22 year^{-1}.

This value was found to be the best combination of L∞ and *k* with the score being 1.0. This value was further used to obtain the graph of von Bertalanffy Growth Function (VBGF). The VBGF of *O.potamophila* illustrated in Fig. 2 indicated that the origin of the growth curve starts in January for the group of *O.potamophila*. On annual basis, the growth of *O.potamophila* was described by the following Von Bertalanffy growth equations: $L= 192(1 - e^{-0.22(t +0.77)})$;$W = 158.9(1 - e^{-0.22(t +0.77)})^3$.

Pauly and Munro (1984) have indicated a method to compare the growth performance of various fish stock by computing a growth performance index(Ø')= log *k* + 2log L∞. Generally, the growth performance index(Ø') is a species specific parameters, which means that their values are usually

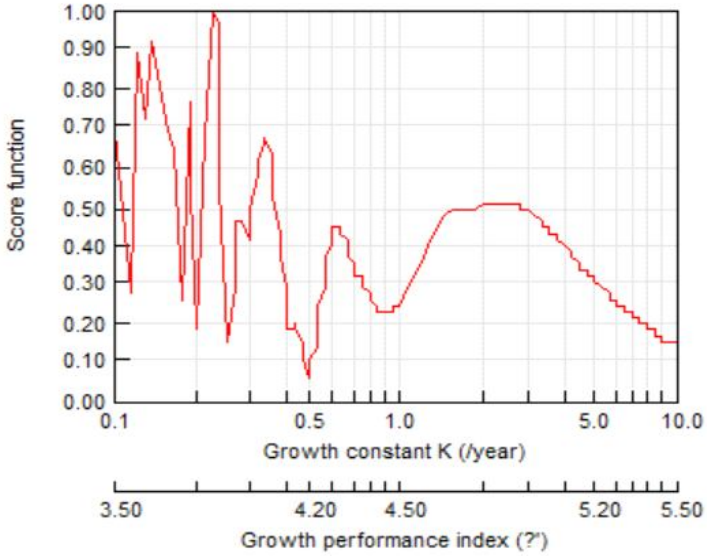

Fig 3: Non-parametric Scoring of VBGF Fit Using Shepherd's method

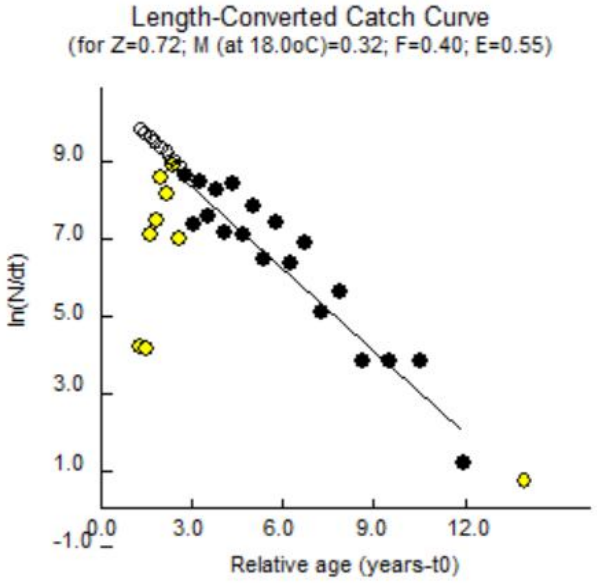

Fig 4: Length-Converted Catch Curve

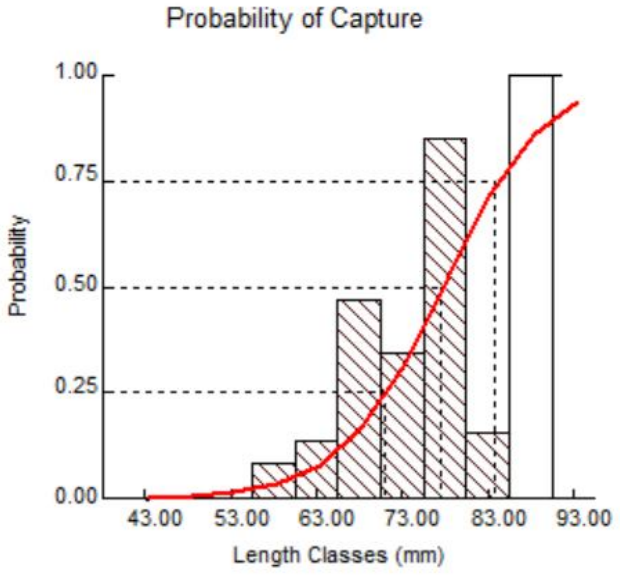

Fig 5: Probability of Capture

similar within related taxa and have narrow normal distributions.The growth performance index for *Odontobutis potamophila* was 3.91.

Mortality coefficients : The Z, M and F of *O.potamophila* were estimated as 0.72 year^{-1}, 0.32 year^{-1} and 0.40 year^{-1}, respectively, illustrated in Fig. 4. *O.potamophila* in the Gaosha river, west part of Wuyuan County showed low mortality rates which relates to fishing mortality and natural mortality. The exploitation rate was estimated to be 0.55 year^{-1}.

Length at first capture (Lc) : The length at first capture, L_c of *O.potamophila* was estimated at 77 mm (Fig. 5). The L_c was the length at which 50% of the fish are vulnerable to be captured by fishermen. This is the average size of fish vulnerable to fishing or enter the fishing ground, in the Gaosha river, west part of Wuyuan County.

Recruitment pattern: The recruitment patterns of *O.potamophila* suggested that there was one main pulse of annual recruitment, in agreement with the group separation using Bhattacharya's Plot. The major pulse appeared in July(Fig. 6).

Relative yield-per recruit (Y' /R) and relative biomass-per recruit (B' /R) : The exploitation ratios were computed as E_{max}= 0.61, E_{10}= 0.52, E_{50}= 0.34(Fig. 7). Here, E_{max} is the exploitation rate at which, maximum sustainable yield per

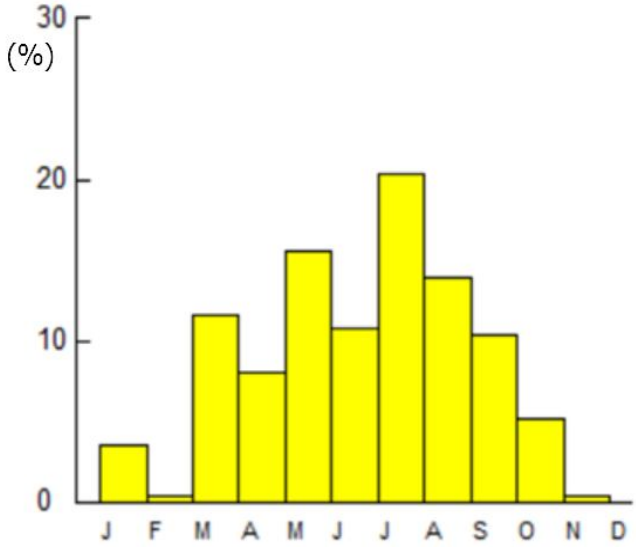

Fig 6: Recruitment Pattern

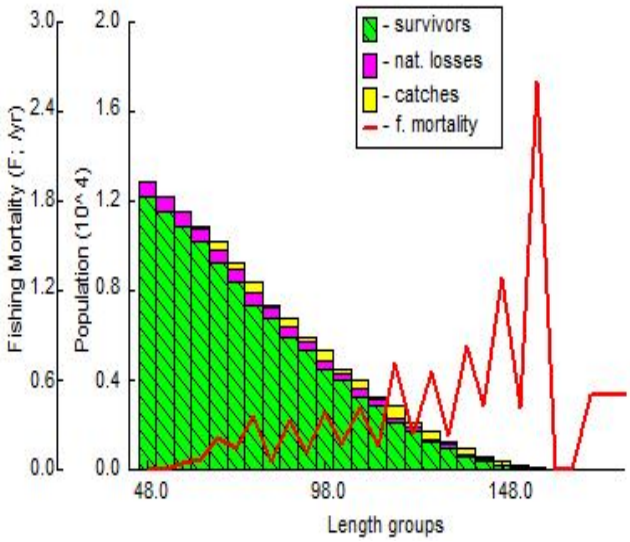

Fig 8: Virtual population analysis

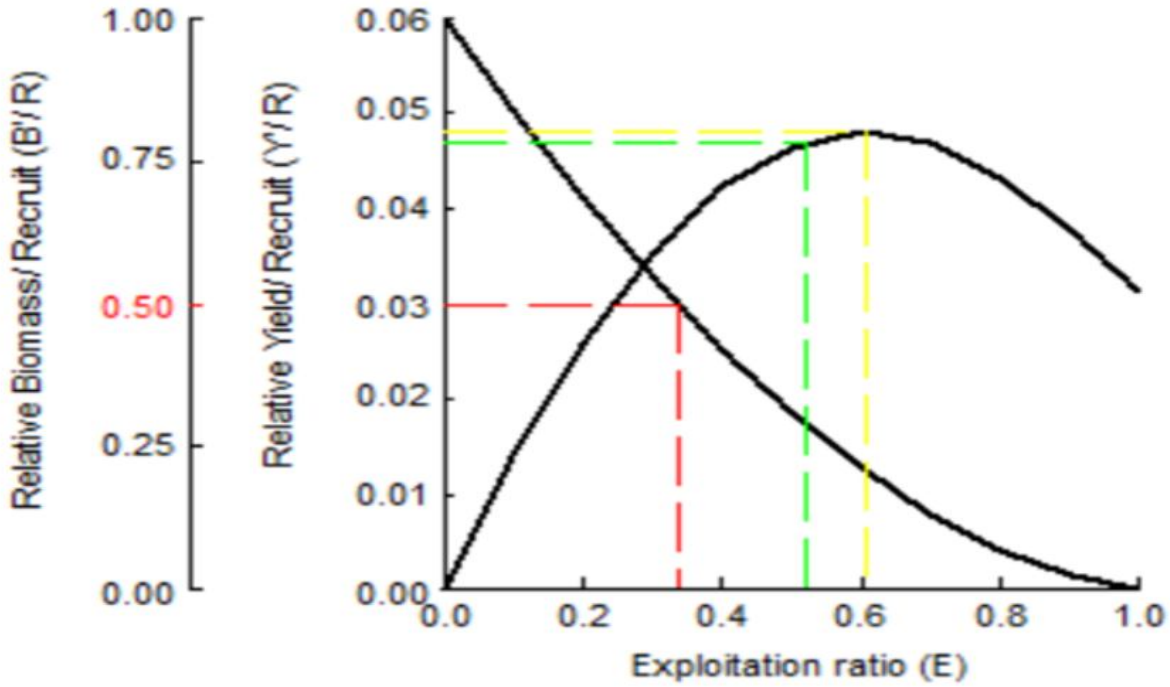

Fig 7: Relative Y'/R and B'/R(Knife-edge Selection)

recruit is obtained, E_{10} is the exploitation rate which was the marginal increase of relative yield per recruit was 1/10th and E_{50} is the value of E under which the stock had been reduced to 50% of its unexploited biomass.

Virtual Population Analysis: From virtual population analysis it was found that the maximum fishing mortality of *O.potamophila* occurred at the length range between 156 mm and 160 mm indicating low fishing mortality in the juvenile stage (Fig. 8). Steady biomass also increased with length class until 121-125 mm, and the total steady state biomass was found to be 2240 kg.

The "b" value of *O.potamophila* was found 2.88. The "b" value was estimated to be slightly <3 which indicates relatively lesser body mass in relation to increment in body length(Kannan *et al*., 2016). Estimate of $L\infty$ are similar whereas the *k* in current studies is substantially higher than their estimate. Sparre and Venema (1992) stated that the value of $k = 1.0$ is fast growth, $k = 0.5$ is medium growth and $k = 0.2$ is slow growth. Hence, k=0.22, for *O.potamophila* obtained from this study is considered as slow growth. Mortality means the death of fish from the stock due to fishing mortality or natural mortality including predation,disease and old age. Fishing mortality assumed to be associated with physical injury or physiological stress from being captured in the gear used during capture. Natural mortality (M) and fishing mortality (F) were additive instantaneous rates that sum up to total mortality (Z). The total mortality coefficient, Z= M + F (Gulland, 1971). When comparing mortality rates to the total births or recruits to the population, we can determine if a population is increasing or decreasing (Rahman *et. al.*, 2001). *O.potamophila* from study area had low total mortality 0.72 $year^{-1}$ and fishing mortality 0.40 $year^{-1}$. Gulland suggested that the optimum "E" should be 0.5, the exploitation rates 0.55 $year^{-1}$ indicated this species was sustainable exploitation in the study area. $E_{present}$ approximately equal E_{10} and $E_{present} > E_{50}$, indicating that, at the current rate of exploitation, there is the threat of over fishing as >50% of biomass-per recruit is fished,and fishing intensity is appropriate for the economy. The maximum fishing mortality of *O.potamophila* occurred at the length range between 156 mm and 160 mm and the total steady state biomass was found to be 2240 kg. The present study on this species is a preliminary study as it includes only one year of data. However, since no work about the population dynamics on this species has been done. This preliminary work covering growth, natural and fishing mortality and population parameters would help us understand the present status of species.Thus, all of this information would be the valuable sources for comparison in future, especially when the conservation and management of this fish stock is to be made.

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