World Journal of Fish and Marine Sciences 3 (4): 346-350, 2011
ISSN 2078-4589
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Growth Parameters and Mortality Rates of Javelin Grunter, *Pomadasys kaakan*, in the Persian Gulf

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Abstract: The growth parameters and mortality rates were investigated for the Javelin grunter, *Pomadasys kaakan*. Samples were collected from different landings in north part of the Persian Gulf (Bushehr, Iran). Total length of the sampled 4735 fish ranged from 18 cm to 61cm. The Von-Bertalanffy growth parameters were estimated as L_8= 64.61 cm total length, k= 0.24 year^{-1} and t_0 = -0.39 year. The longevity was estimated to be 12.5 years. The total mortality rate (Z), fishing mortality (F) and natural mortality (M) were estimated to be 1.2 year^{-1}, 0.62 year^{-1} and 0.58 year^{-1}, respectively. The exploitation rate (E) was 0.516 indicating that the stock is not over-exploited. This study also provides the detailed estimates of growth and mortality rate for Javelin grunter in the north of Persian Gulf, which can be used as biological input parameters in further stock assessment in this region.

Key words: Growth · Mortality · Javelin grunter · *Pomadasys kaakan* · Persian Gulf

INTRODUCTION

The Javelin grunter, *Pomadasys kaakan*, is a member of the family Haemulidae, locally known as Sangsar. It is distributed from eastern Africa, the Red Sea and the Persian Gulf to Serilanka. This species is one of the prime commercial species throughout the Persian Gulf [1] and it is one of the most abundant commercial fish in the Persian Gulf [2]. *P. kaakan* occurs in coastal waters to a depth of approximately 75 meters [3].

The landing data from 1998 to 2007 in Bushehr's waters showed the annual catch of this fish has decreased from 1154 to 748 tons during these years [4]. Despite the commercial importance of this species, there are rare published studies on its biology. Lee *et al.* [5] studied stock assessment of *P. kaakan* in the southern Persian Gulf using length-based approach and aspects of population dynamics have been presented for this species [1]. Falahati Marvast *et al.* [6] studied reproductive biology of this species which collected from the north part of Persian Gulf (Iran). However, its population parameters have not been reported in northern Persian Gulf. In this context, the goal of this study was to evaluate the status of *P. kaakan* and to provide biological baseline information required for stock management in north part of the Persian Gulf, Iran.

MATERIALS AND METHODS

Size frequency data were collected from commercial catches of *P. kaakan* made off the Iranian coasts in the north part of the Persian Gulf between April 2007 and March 2008. Fish were selected randomly from tree major landings in the Boushehr province (Fig. 1). Lengths were taken using a measuring board and recorded to the nearest centimeter total length (TL). The FAO-ICLARM Stock Assessment Tools II (FiSAT II) was used to estimate growth parameters including L_8, K and t_0 for the von-Bertalanffy equation: $L_t=L_8 \{1 - \exp [-K (t - t_0)]\}$, where L_8 is the asymptotic length that an average fish would achieve if it continued to live and grow, K is the growth coefficient which determines how fast the fish approaches L_8 and t_0 is the hypothetical age for L_t=0 [7]. From the length–frequency distribution of the samples, growth parameters (L_8 and K) were estimated by the electronic frequency analysis (ELEFAN) method [8]. In order to compare different estimates of growth parameters, growth performance index (Φ'), phi prime was estimated by flowing formula [9, 10]:

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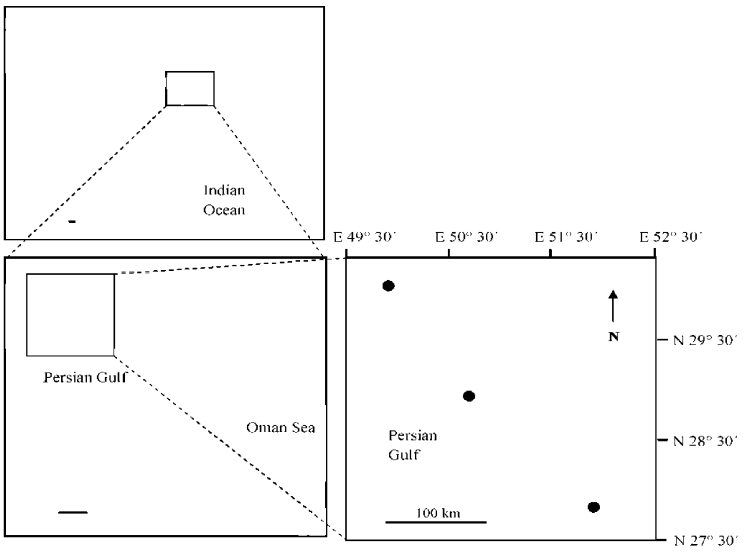

Fig. 1: Map showing the tree locations sampled in the Persian Gulf, Bushehr, Iran.

$$\Phi' = \ln K + 2 \ln L_\infty$$

The t_0 was estimated by employing Pauly's empirical equation [11]:

$$\log(-t_0) = -0.3922 - 0.275 \log L_\infty - 1.038 K$$

Longevity was calculated from Taylor's equation [12]:

$$t_{max} = 3/K.$$

Mortality was estimated for the total sampling period. Total mortality (Z) was estimated from the length-converted catch curve, using the program FiSAT [8]. Natural mortality (M) was obtained using Paulys empirical formula, from the estimate of growth parameters (L_∞, K) and the annual mean water temperature for the area (T) [11]:

$$\ln M = -0.0152 - 0.279 \ln L_\infty + 0.6543 \ln K + 0.463 \ln T$$

The total and natural mortality were used to calculate the fishing mortality (F=Z – M) and exploitation rate (E= F/Z).

RESULTS

This study covered a period of 12 consecutive months (April 2007- March 2008). Overall, 4735 specimens were collected and used for the growth analysis. The length of *P. kaakan* sampled ranged from 18 to 61 cm TL (Fig. 2).

Growth Parameters: The growth parameters estimated using ELEFAN I routine were as follow: L_∞= 64.61 cm total length, K=0.24 year^{-1} and Using Pauly's empirical equation the t_0 was estimated -0.39 year (Fig. 3).

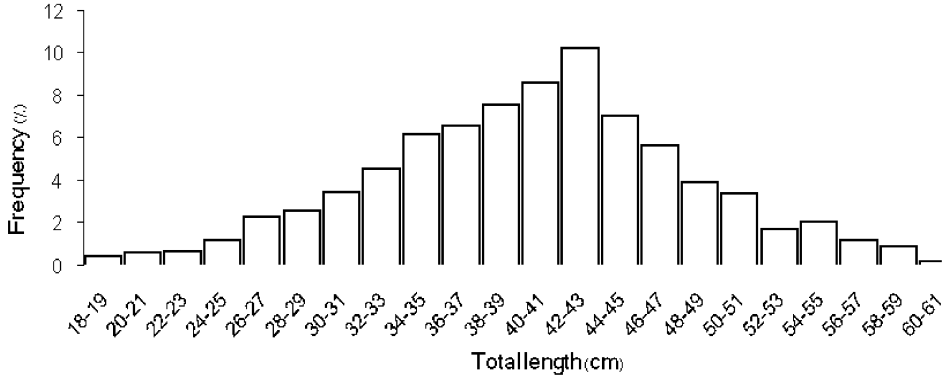

Fig. 2: Percentage frequency of length *P. kaakan* in Persian Gulf, Bushehr waters, (2007- 2008).

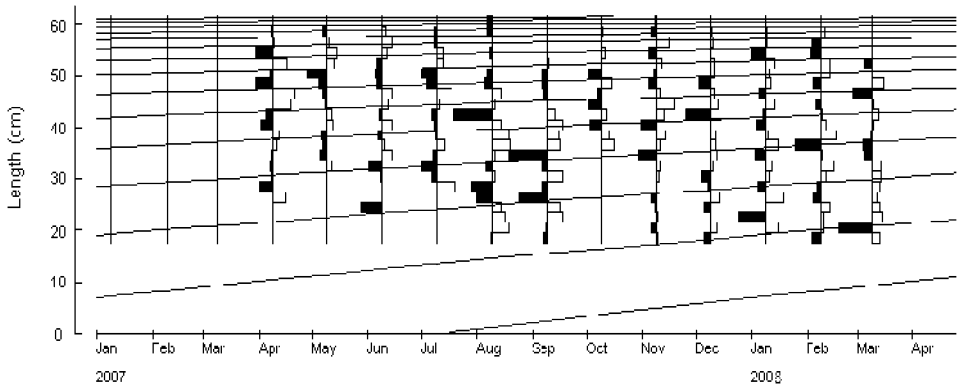

Fig. 3: Estimation of L_8 and K by employing ELEFAN method for *P. kaakan* in Persian Gulf, Bushehr waters, (2007- 2008).

Fig. 4: Growth curve of *P. kaakan* in Persian Gulf, Bushehr waters, (2007- 2008).

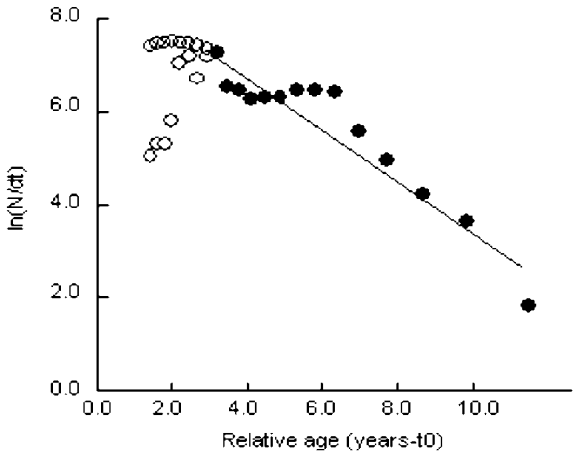

Fig. 5: Length-converted catch curve for *P. kaakan* collected in Persian Gulf, Bushehr waters, (2007-2008). Only black dots indicate the data refer to length classes under full exploitation.

The growth performance index (Φ') was 3. The longevity was estimated to be 12.5 years (Fig. 4).

Mortality Rates: The total mortality coefficient (Z), from length-converted catch curve was found to be Z=1.2 years^{-1} (Fig. 5). Using the empirical equation of Pauly, the growth parameters (L_8, K) estimated by the present work and the annual mean temperature of the surface sea (26 °C), M was found to be 0.58 years^{-1}. The estimation of fishing mortality gave F=0.62 years^{-1}. Using the values of Z and F, the exploitation ratio (E) estimated at 0.516. The value of M/K ratio was found to be 2.41.

DISCUSSION

Estimation of growth and mortality of exploitable species is very important since stock assessment and management rely on these population parameters. In this way, the specific objectives of this study were to estimate growth parameter and mortality rates of *P. kaakan* in north of Persian Gulf. The Length frequency analysis method is used widespread at the present time especially in the tropical and subtropical regions. These methods become important when aging techniques are either not possible or very expensive [13]. In this study L_8 was higher than the estimates given by some previous studies [1, 14] but lower than that by Lee *et al.* [5]. K value was higher than the estimate by Lee *et al.* [1], but in agreement with Majd and Imad [14] and Al-Husni *et al.* [1] (Table1). Growth comparison of fish based on a single parameter K or L_8 is misleading [15]. In order to compare the growth of *P. kaakan* from the study area with other studies, growth performance index (Φ') was compared. The growth performance index of 3 in the present study is in the same range with what reported by other studies [1, 5, 14]. Slight differences in growth patterns can be the result of differences in genetic structure and/or differences in

Table 1: Various growth parameters estimated for *P kaakan* from different locations at Persian Gulf

L_∞ (cm)	k (year^{-1})	Φ'	Locality	Reference
62.2	0.27	3.004	Persian Gulf (Kuwait)	Al-Husaini *et al.* (2002)
94	0.18	3.2	Persian Gulf (Kuwait)	Lee *et al.* (1992)
62.5	0.247	2.98	Coast of Pakistan	Majid and Imad(1991)
64.61	0.24	3	Persian Gulf (Iran)	Present study

temperature, density of food and diseases [16, 17]. The age at zero length was -0.39 indicates that juveniles grow is more quickly than the predicted growth curve for adults. Using the estimated value of the average growth coefficient "K", the longevity was found to be 12.5 yrs. This is in agreement with the longevity reported by Majid and Imad [14] (t_{max}=12). There was a contradiction between our result and Al- Husaini's [1], in which he found the longevity of approximately 36 years.

Our estimation of total mortality coefficient based on the catch curve method from length frequency data found to be 1.2 year^{-1} that was higher than those reported by Lee *et al.* [5] (Z=0.81–0.87). They used methods based on growth parameters estimated from length data. Based on the catch curve method with fish numbers at age, Al-Husni *et al.* [1] estimated the Z value of 0.25. In that study the probable bias may be related to the measurement of lengths and the insufficient number of fish investigated. According to Potts and Manooch [18], if number of samples used in aging studies are not representative of the entire population, model predictions can lead to faulty management decisions.

Unfortunately, it is difficult to estimate natural mortality directly because natural deaths are rarely observed [19]. The estimate of M from Pauly's empirical method (0.58 year^{-1}) was higher than other studies in Kuwait by Lee *et al.* [5] and Al-Husni *et al.* [1] that were 0.4 and 0.2 respectively. To verify the estimates of M or K, the M/K ratio was used because this ratio has been reported to be within the 1.12 – 2.50 range for most of the fish [20]. The value of M/K ratio was 2.41 in the present study which falls within the normal range of 1.12-2.50, therefore the M value can be considered as a reliable value.

The value of fishing mortality coefficient (F) in the present study was 0.62 year^{-1}. According to Gulland [21] in an optimally exploited stock, fishing mortality should be equal to natural mortality, resulting in an exploitation rate of 0.50 year^{-1}. In this study the exploitation rate was found to be 0.516 indicated that the stock is not over-exploited. This result conforms the previous reports that *P. kaakan* is one of the most abundant commercial fish in the Persian Gulf [2].

In conclusion, this study provides the first detailed estimates of growth and mortality rate for *P. kaakan* in the northern part of Persian Gulf, Bushehr, Iran. Furthermore the exploitation rate, leads to the suggestion that this species is moderately exploited in this part of the Persian Gulf.

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