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Length-Weight Relationship and Spawning Season of *Sphyraena jello* C., from Persian Gulf

[1]A. Hosseini, [2]P. Kochanian, [3]J. Marammazi, [2]V. Yavari, [4]A. Savari and [4]M.A. Salari-Aliabadi
[1]Department of Fisheries, Faculty of Agriculture and Natural Resources,
Persian Gulf University, Boushehr, Iran
[2]Department of Fisheries, Faculty of Natural Resources,
Khorramshahr University of Marine Science and Technology,
P.O. Box 669, Khorramshahr, Khuzestan, Iran
[3]Khuzestan Fisheries Research Institute, Khuzestan, Iran
[4]Department of Marine Biology, Faculty of Marine Science,
Khorramshahr University of Marine Science and Technology,
P.O. Box 669, Khorramshahr, Khuzestan, Iran

Abstract: Length-weight relationship and spawning season of *Pickhandle barracuda*, *Sphyraena jello* (C.) were studied for one year in Boushehr waters of the Persian Gulf. In the present study, 311 specimens were collected during November 2006 to October 2007. The samples composed of 151 (48.55%) male, 160 (51.45%) female; the sex ratio was M: F = 1: 1.06. The b value ranged between 2.77 to 2.87 for male and female fishes, respectively. The relationship between body weight and length in total specimens was 2.82, indicating that this species show negative allometric growth. The peak spawning season of these fishes occur around spring, from April to June. The lowest Gonadosomatic Index recorded in August. The present study is the first record on length-weight relationship and spawning season of this species in the Persian Gulf region.

Key words: *Sphyraena jello*, Pickhandle barracuda, reproductive, GSI, Persian Gulf

INTRODUCTION

The waters of the Persian Gulf are environmentally unique with an unusual faunal assemblage (Carpenter *et al*., 1997). The Persian Gulf is a semi-closed water body connected to the Oman Sea through narrow Strait of Hormuz. The maximum width is 640 km with the average depth of 35 m (Reynolds, 1993). The Persian Gulf is in the subtropical zone lying almost entirely between the latitudes of 24° and 30° N and longitudes of 49° to 61° 25' E. The entire water column is well mixed and lies within the photic zone. However, primary productivity for the Persian Gulf is apparently only in average, being higher than most the Red Sea but lower than the Arabian Sea (Sheppard *et al*., 1992).

The Persian Gulf possesses various commercially important fish species. Pickhandle barracuda, *Sphyraena jello* Cuvier, 1829 locally called Dewolmy is one of the valuable commercial fishes in the south coasts of Iran and has been classified at the top level of commercial categorization, so owing to its economic importance. Pickhandle barracudas are migratory pelagic predators that are distributed over continental shelves, estuaries and also in open oceans of tropical, subtropical and warm temperate seas (Bachok *et al*., 2004). The *Pickhandle Barracuda* (*S. jello*) is a long, slender schooling fish. It is silvery with variable darker bars on the body and a deeply forked, yellowish tail (Ramachandran *et al*., 2007). This species is of importance to fisheries in many countries and is considered a good table fish due to its excellent flesh qualities. *S. jello* is a commercially important pelagic fish and is caught with different types of fishing gears such as of trawls, long line and gill nets in coastal waters of Boushehr Province (Hosseini *et al*., 2008). Barracuda (*S. jello*) a trash fish of yester years is gaining importance as a potential source for product development in recent times with a landing of about 7011 ton in 2004 (MPEDA News Letter, 2006).

Length-Weight Relationship (LWR) is of great importance in fishery assessments (Garcia *et al*., 1989; Haimovici and Velasco, 2000). Fish length-weight relationships, which describe mathematically the

Corresponding Author: Mohammad Ali Salari-Aliabadi, Department of Marine Biology, College of Marine Science, Khorramshahr University of Marine Science and Technology, P.O. Box 669, Khorramshahr, Khuzestan, Iran Tel: +989133555872 Fax: +986324230551

correlation between fish length and weight, are useful for converting length observations into weight estimates to provide some measure of biomass (Froese, 1998). Length and weight measurements in conjunction with age data can give information on the stock composition, age at maturity, life span, mortality, growth and production (Beyer, 1987; Bolger and Connoly, 1989; King, 1996a, b; Diaz *et al*., 2000). Method to estimate the length-weight relationship was described by Biswas (1993) and King (2007).

There are only a limited number of studies on the LWR of this commercially important fishes worldwide and there are no studies that describe length-weight relationship and spawning season of this pelagic marine fish. Therefore, a biological investigation on *S. jello* in coastal waters of Boushehr Province was taken up. The aim of the present study was to determine the length-weight relationship parameters and basic information on the spawning season of *S. jello* from Boushehr waters (the Northeast Persian Gulf).

MATERIALS AND METHODS

The fishes used for the study were collected during November 2006 to October 2007 from the Bandargah and Jofreh harbors, two important landing centers on the Boushehr coastal. The fishing gears used in this region include gill net and trawl. At least 20-30 specimens were randomly collected per month. The randomly selected samples were transported in ice box to laboratory for further biological measurement. Identification of species was made based on Smith *et al*. (2003) and FAO Species identification sheets (Fischer and Bianchi, 1984). Total length (TL) was measured from the tip of the snout to the extended tip of the caudal fin. Body weight of individual fish was measured to the nearest 0.01 g with an electronic balance. Then the gonads were removed and weighed (0.001 g).

The relationship between the total length and total weight were determined by fitting the data to a potential relationship in the form of:

$$W = aL^b$$

where, W is the weight in grams, L the total length in centimeters, a and b are the parameters to be estimated, with b being the coefficient of allometry (Pauly, 1984). A logarithmic transformation was used to make the relationship linear (Bagenal and Tesch, 1978):

$$\text{Log } w = \log a + b \log L$$

For this species a regression was used to estimate the intercept (Log a) and the regression coefficient or slope (b), using Microsoft Excel. For species with sufficient data the LWR was determined separately for each sex in addition to total fishes (311 specimens). Sex was determined by examination of the gonad tissue either with eye or with the aid of a binocular (25-40×). The overall sex ratio was assessed using Chi-square test (Zar, 1984). Statistical analyses were performed with SPSS 11.5 software package and a significance level of 0.05 was adopted. Gonadosomatic index (GSI %) = (gonad weight/total body weight)×100 was calculated for each fish and all values were averaged for each sampling date (Biswas, 1993). The gonadosomatic index or maturity index is an indirect method for estimating spawning season of a species (Biswas, 1993).

RESULTS

Based on descriptive statistics size of males ranged from 37.5 to 93.5 cm and that of females from 39.5 to 80 cm, respectively. Minimum and maximum weights of males were between 200.15 to 2850 g, respectively and that of females 235.10 and 2310.17 g, respectively. Mean values of length and weight for males and females were 58.20±7.79 cm, 891.26±357.87 g and 58.13±7.90 cm, 867.22±372.47 g, respectively. All the length data was classified into 5 cm groups and the analysis of total length distribution frequency of all individuals is shown in Fig. 1. High abundance of this species was observed in 52.5-57.5 cm length. The relationship between somatic weight and total length of the fish (Fig. 2a, b) were calculated separately for male and females. Significant differences were obtained between the b exponents and 3 for isometric growth in the sexes separately (t_{test}, t_{male} = 5.22, t_{female}= 3.98, $p<0.05$), indicating negative allometric nature of growth ($b<3$) in the population. Moreover, there was a significant difference in the b exponent between males and females (ANCOVA, $F = 8.34$, $p<0.05$).

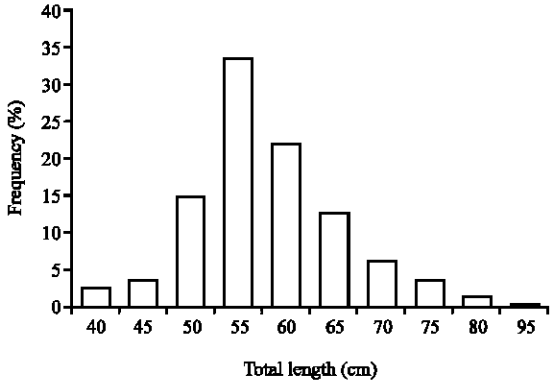

Fig. 1: Length frequency distribution for *S. jello* from Boushehr waters (the Northeast Persian Gulf)

Table 1: Month wise sex ratio of *S. jello* from Boushehr waters (the Northeast Persian Gulf)

Month	No. of Females	No. of Males	Total	Female (%)	Male (%)	Sex ratio(M:F)	χ^2 value	p-values
Nov.	17	11	28	0.607	0.393	0.647	1.280	>0.05
Dec.	13	17	30	0.433	0.567	1.308	0.530	>0.05
Jan.	16	9	25	0.640	0.360	0.563	1.960	>0.05
Feb.	13	11	24	0.542	0.458	0.846	0.166	>0.05
Mar.	13	15	28	0.464	0.536	1.154	0.142	>0.05
Apr.	13	15	28	0.464	0.536	1.154	0.142	>0.05
May	16	7	23	0.696	0.304	0.438	3.520	<0.05
Jun.	10	20	30	0.333	0.667	2.000	3.330	<0.05
Jul.	13	14	27	0.481	0.519	1.077	0.037	>0.05
Aug.	11	14	25	0.440	0.560	1.273	0.360	>0.05
Sep.	13	7	20	0.650	0.350	0.538	1.800	>0.05
Oct.	12	11	23	0.522	0.478	0.917	0.043	>0.05

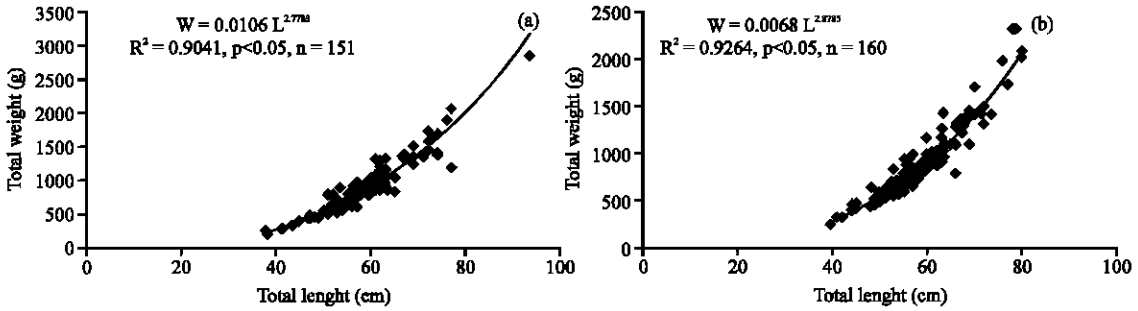

Fig. 2: Length-weight relationship curves for (a) males and (b) females of *S. jello* from Boushehr waters (the Northeast Persian Gulf)

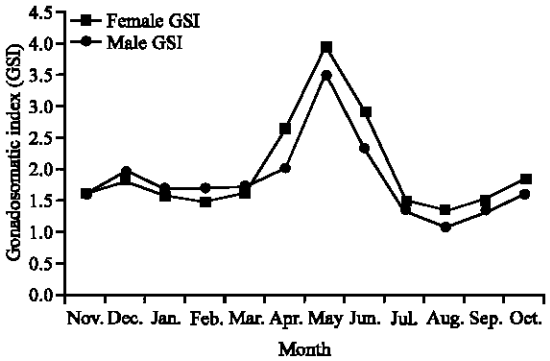

Fig. 3: Monthly mean GSI distribution of *S. jello* from Boushehr waters (the Northeast Persian Gulf) during Nov. 2006 to Oct. 2007.

Also determination and correlation coefficients show a high relationship between these two morphometric characteristics ($p<0.05$).

The sex ratio and GSI (Gonadosomatic Index) were calculated during the study period. Table 1 shows the sex ratio observed in different months. The results of the Chi-squire test showed that there was no significant difference in sex ratio in all months except May and June. Monthly fluctuations in the GSI of both males and females are shown in Fig. 3. The highest GSI for both males and females was observed in May, which declined gradually in the following months up to August. From September onwards an increasing trend in GSI was observed in males and females indicating growth of gonads. This observation also corresponds with the gonad maturity stages. In October-November period gonads were found to be in the early maturing stage and highest numbers of fish with fully developed gonads were observed during April-May. This fish is, therefore, assumed to be a spring spawner.

As shown, the GSI for both male and female remained low (<1.5-2) from July to March. They increased gradually from April to May, but rapidly to reach a peak in May (testes and ovaries). The indices then decreased, falling to pre-spawning level by August. It could be stated that *S. jello* spawns once a year in Bousher waters during the period between April to June, with a spawning peak in May.

DISCUSSION

Due to selectivity of fishing gear, samples don't include juveniles or very small individuals. In this context and according to Petrakis and Stergiou (1995), the use of W-L relationship should be rigorously limited to the size ranges applied in the estimation of the linear regression parameters. For this reason, it is particularly difficulty to extrapolate data to fish larvae (Pepin, 1995), juveniles (Safran, 1992) or immature stage (Bagenal, 1978).

Additionally, since samples were collected over an extended period of time, this data is not representative of a particular season or time of the years and for comparison purpose it should be considered only as mean annual values, as suggested by Petrakis and Stergionu (1995). In fact, W-L relationship isn't constant over the whole year, varying according to factor such as food availability, feeding rate, gonad development and spawning period. However, the parameter b is characteristic of the species and generally doesn't vary significantly through out the year, unlike the parameter a, which may vary daily, seasonally and or between different habitats (King, 1996b). The numerical value of b is nearly always between 2.5 and 3.5 and is often close to 3 (Bagenal, 1978). When b = 3, the body is increasing in all dimensions in the same proportions as it grows (Hart and Reynolds, 2002).

In a study carried out by Al-sakaff and Essen (1999) in Gulf of Eden, b value was 2.721 and 2.706 for male and female fishes of this species, respectively. The observations made in the present study (b = 2.778-2.878) also was comparable with the work of Vander-Elst (1981), where b value was estimated to be 2.81 for this species from South African waters. In a study by Abdurahiman *et al.* (2004) in Southern coast of Karnataka state, b values obtained for male and female fishes were 3.059 and 3.170, respectively. The difference between the results of this study and the present investigation can be attributed to difference in latitude, ecological condition and length ranges in the studied fishes in two regions. Because firstly, fishes mature earlier in tropical regions compared to temperate region and secondly, the fishes studied in India belonged to lower length range and hence had higher growth rates.

Sexual ratio had no significant differences in various months except May and June; because during spawning time, females remind in spawning area more than males (Arcand-Hoy and Benson, 1998a, b). Bachok *et al.* (2004) reported a sex ratio of 0.86 in Malaysian waters. Al-sakaff and Esseen (1999) reported a sex ratio of 1.187 for this fish in Gulf of Eden. The results obtained from these two studies and present investigation is in agreement. Richard *et al.* (1993) has stated that spawning season for this species in water of Fiji is in summer and in the regions from the coast. Related to differences in the GSI between reproductively active males and females, in reviewing the reproductive biology of the *S. jello* it is noted that values of males are commonly lower than those of females. Buxton (1990) pointed out that the cost of producing sperm is thought to be less than for producing eggs. The difference in male and female gondosomatic indices suggests that energy invested in gamete production by male is probably less than that invested by females.

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