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Original Article

Gonadosomatic and hepatosomatic indices, and condition factor of *Planiliza abu* (Heckel, 1843) in southern Al-Hammar Marshes, Iraq

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Abstract: Samples of *Planiliza abu* were monthly collected from Al-Mashab Marsh in the East Hammar Marsh of Iraq from January to December 2022 to study their Gonad-somatic index (GSI), hepatic index (HSI), and relative condition factor (K_n). GSI for both sexes was recorded. The highest value of GSI was 1.57 for males and 1.87 for females in March, and the lowest value was 0.27 for males and 0.70 for females in August. Based on the GSI, its spawning season is from March to April. Based on the results, the lowest value of HIS was recorded in July as 0.82 for females and in August as 0.60 for males, and the highest values were found as 1.65 in March for males and 1.87 in April for females. K_n ranged from 0.42-1.57 (males) and 0.70-1.87 (females).

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Introduction

The Mugilidae family is one of the widespread taxa in tropical, subtropical, and temperate regions. There were 304 available species in this family, but about 80 species are considered valid (Fricke et al., 2021). Freshwater mullet, *Planiliza abu* (Heckel, 1843) was previously placed in the *Liza* genus but recently became a member of the genus *Planiliza* (Durand et al., 2012; Eagderi et al., 2022). The fish of this family are among the most widespread commercial fish in global coastal waters and are an important component of aquatic ecosystems with commercial significance value (Coad, 2017; Mouludi-Saleh et al., 2021).

The gonadosomatic index (GSI), which quantifies gonad alterations through the ratio of gonad weight to fish weight (Wootton, 1991; Kamal et al., 2009), is used to determine gonad maturity and, consequently, the fish's spawning season. GSI and HSI functions are important indicators to determine the spawning season in fish in conjunction with other morphological and histological indications. Hardy and Keay (1972) showed that GSI is important in the study of reproduction as an indicator of the activity of fish's gonads and that it rises when the fish are mature and decreases after laying eggs (Desai, 1970). The hepatosomatic index (HIS) reveals useful details on the liver and body health, the effect of water quality, and the amount of energy stored in fish livers. The maturation of the ovaries is also associated with attrition uptake in the liver and muscle (Wootton and Mills, 1979).

The fish's general health is reflected by the condition factor, which is one of the significant factors influencing body composition (Fulton, 1904; Keivany et al., 2015; Eagderi et al., 2020). The relative condition factor (K_n) assesses the adequacy of a definite water environment for fish growth by measuring an organism's departure from the average weight in a sample (Yilmaz et al., 2012; Abodi, 2015). This study aimed to investigate the changes in the values of GSI, HSI, and condition factor of *P. abu* from the Iraqi Al-Hammar Marshes, as an economic importance food source.

Materials and Methods

The samples were monthly collected from January to December 2022 using gill nets with mesh sizes of 20×20 mm and electrofishing device from the

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Table 1. Minimum and maximum values of length, weight, GSI, HIS, and K_n of *Panaliza abu* in the Al-Hammar March.

Sex	N	TL (mm)		W(g)		GSI		HSI		K_n	
		min	max	min	max	min	max	min	max	min	max
Male	109	74	186	4.2	100.6	0.27	7.12	0.60	1.65	0.42	1.57
female	180	78	221	5.1	125.5	0.70	9.96	0.82	1.87	0.76	1.87
S.D.	-	0.32	0.27	0.12	0.54	0.05	0.31	0.08	0.09	0.23	0.16

Figure 1. The sampling area in the Alhammar Marsh.

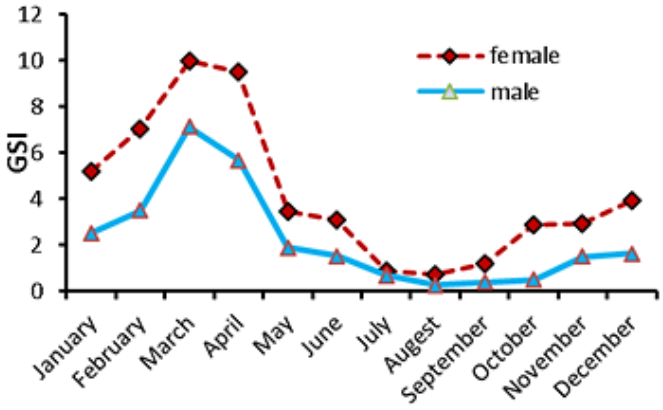

Figure 2. The changes of GSI of *Planiliza abu* in the Al-Hammar March.

brackish water of the Basrah region, Al-Mashab Marsh, East Hammar marsh (Fig. 1). Fishes were preserved in ice for transporting to the laboratory. The total length and body weight of the fish were measured to the nearest mm and 0.1 g, respectively. After that, fish were dissected to extract the liver and gonads, the weight of each organ was recorded, and the sex of each specimen was identified. GSI and HSI were calculated using equations of GSI = Weight of gonad / total body weight of fish *x* 100, and HSI = Liver weight (g) / total weight of fish (g) *x* 100, respectively (Htun-Ha, 1978). The relative condition factor (K_n) for both sexes was determined using the equation of $K_n = W/W'$ (Le Cren, 1951), where W is the observed weight, and W is the calculated weight.

Results

A total of 442 specimens (159 male and 283 female) of *P. abu* were collected during the study period. Total length ranged from 74-186 mm for males and 7.8-22.1 mm for females. The minimum and maximum weights were 4.2 and 100.6 g for males, and 5.1 and 125.5 g for females (Table 1).

The monthly variation of GSI is shown in Figure 2. Both sexes showed similar patterns in GSI values, but females displayed greater values than males. The highest GSI values for both sexes were 7.12 for males and 9.96 for females in March, and the lowest value in August was 0.27 for males and 0.70 for females. The GSI values indicated that the spawning season of this species is from March to April.

The results revealed that the HSI of males and females did not change clearly during the studying period (Fig. 3). The lowest values of HSI were recorded in July (0.82) for females and in August (0.60) for males, and the highest values of HSI for males were found 1.65 in March and1.87 in April for females.

Figure 4 represents monthly changes in the relative condition factor (K_n) for *P. abu*. The lowest value of k_n was observed in both sexes in August as 0.42 and 0.76 for males and females, respectively. The highest k_n values were found in January as 1.57 for males and 1.87 in December for females. There were no

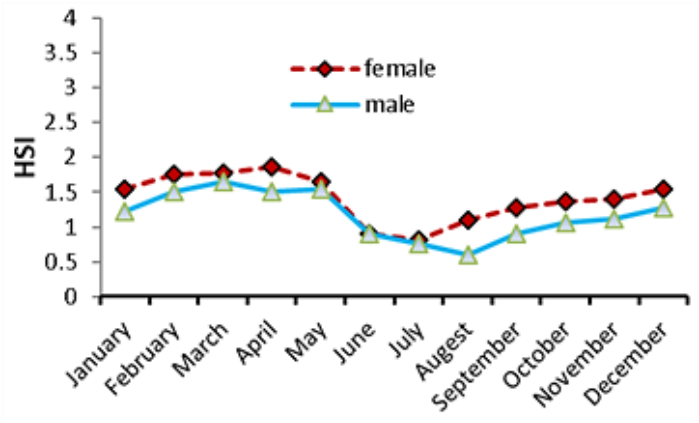

Figure 3. HIS variation of *Planiliza abu* in the Al-Hammar March.

significant variations between months or between males and females.

Discussions

GSI index is often used to examine spawning seasons since it is directly related to the development of the gonads (Yeldan and Avsar, 2000). Parameswarn et al. (1974) and Rheman et al. (2002) pointed out that the GSI represents the gonad's maturity, which increases with fish maturation. During this study, the GSI value of males continued to rise until reached its maximum value in March, and an identical pattern was observed in females. GSI values for males and females of *P. abu* indicate that the spawning season of *P. abu* occurred from March to April. Al-Shawi and Wahab (2008) recorded that the spawning period elongated from March to May in the Tuz-Chi tributary, in north Iraq. The spawning season of *P. abu i*n the East Hammar marsh extended from January to May (Mohamed et al., 2017). Mohamed and Al-Jubouri, (2021) found that the spawning period of this species is from April to May in the Al-Diwaniya River, Middle of Iraq. Jorfipour et al. (2021) pointed out that *P. abu* spent their gametes in the Karun River, Southwestern Iran from February to March. Şahinöz et al. (2011) reported the spawning season of *P. abu* between April and August in the Atatürk Dam Lake, Turkey. The variation in the spawning time may be associated with age, size, variations in the temperature of the water, spawning grounds, water currents, and photoperiods (Nikolsky,1963; Balik, 2004).

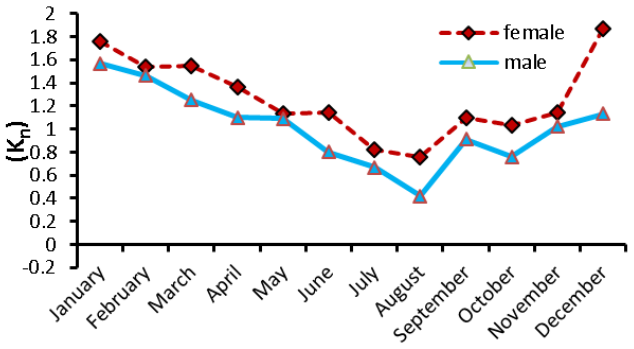

Figure 4. The relative condition factor *Planiliza abu* in the Al-Hammar March.

The hepato-somatic index (HSI) plays an essential role in knowing the physiological status of the fish, so it is an energy reserve indicator of the fish in different conditions of the environment (Tyler and Dunn, 1976). High values of HSI are due to the accumulation of energy reserves that are used in reproduction (Indira et al., 2013; Siami et al., 2017). Feeding activity plays a crucial role in raising the HSI, particularly during Spring (Yang and Baumann, 2006). In the current study, the highest values were in March and April for males and females, respectively, which might be due to food availability, proper environmental conditions, and quality of water. The monthly variation of HSI in males was found lower than in females. In the present study, HSI and GSI showed a similar trend, indicating the continuous feeding of the fish (Dopeikar et al., 2015). The combined effect of the feeding activity and the seasonal sexual maturity determined monthly changes in HSI, and Fish requirement to feed and reserve energy, especially in the liver for maturation of the gonads (Love, 1970; Medlford and Mackay, 1978).

Determining K_n is critical for understanding a fish's nutritional and biological cycle. If the value of K_n is bigger than one, it indicates good fish health, while a value less than one indicates poor fish health. When K_n values are close to or equal to one, it is assumed that fish species have an overall fitness (Le Cren, 1951). The physiological, environmental, dietary, and biological cycles can cause significant differences in fish conditions. Moreover, the condition factor indicates that variation occurs seasonally as a result of

sex and gonad development (Engdaw, 2014; Abbasi et al., 2019).

Based on our results, K_n of *P. abu* changed in a similar pattern for both sexes depending on months. In this study, the lowest values in K_n were found in August as 0.42 for males and 0.76 for females, while the highest value for males was 1.57 in January and 1.87 for females in December. Mohamed and Al-Jubouri (2021) recorded the highest value of K_n in February for both sexes, and the lowest value in October for females and in November for males in the Al-Diwaniya River, Middle of Iraq. Eabaid (2016) also found that the lowest values of the condition factor of *P. abu* in the Euphrates River, Al-Muthanna were in March and the highest values in October for both sexes. In the Ataturk Dam Lake of Turkey, the highest condition factor of *P. abu* was in August for males and females, and the lowest value for both sexes was in July (Doğu, 2014). Fish's condition factors fluctuate due to their reproductive cycle, dietary conditions, and other environmental and physiological factors (Wootton, 2011 Sharma, 2016; Radkhah and Eagderi, 2015). The physiological, environmental, dietary, and biological cycles can cause significant differences in a fish's health. Moreover, the condition factor demonstrates that variation occurs seasonally as a result of gonad development (Engdaw, 2014; Abera et al., 2014; Zamani Faradonbe et al., 2015).

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