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GONADOSOMATIC INDEX (GSI) HEPATOSOMATIC INDEX (HSI), CONDITION FACTOR (K) AND LENGTH-WEIGHT RELATIONSHIP (LWR) IN EPINEPHELUS GUAZA INHABITING SUSA COAST, EL-GABAL AL-AKHADAR, LIBYA

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Abstract:-

A total of 207 specimens of Epinephelus guaza (Family: Serranidae) were collected from Catches by long line and spear fishing operating on Susa Coast on the Mediterranean sea , Libya were studied monthly from April 2010 to March 2011. hepatosomatic index (HSI), condition factor (K) and length-weight relationship (LWR) were evaluated. Monthly variations of GSI in both sexes showed the higher values during the period from June to September when HSI values were lower. Based on the values of GSI and HSI, the reproductive cycle of E. guaza is designated into prespawning period (April–May), spawning period (June-September), and posts pawning period (October-November). The correlation coefficient for length weight relationship was 0.99. The value of regression coefficient for both sexes was isometric (b = 2.969). The highest values of condition factors were recorded in summer (K 1.75) and autumn (K 1.63). The data revealed that E. guaza is a seasonal breeder and reproduction took a longer duration of time.

Keywords:-*Epinephelus guaza, Gonadosomatic index (GSI), Hepatosomatic index (HSI), Condition factor (K), Length-weight relationship (LWR).*

INTRODUCTION

The dusky grouper *Epinephelus guaza*, (Jordan and Evermam, 1896) lives in warm and temperate waters. It is present in the Mediterranean Sea and in the Atlantic Ocean [1];[2]. This particular species inhabits the irregular rocky bottoms, which offer many shelters (e.g., caves, holes, tunnels and crevices) along the continental shelf, but preferentially from the shore to a depth of 50 m in the Mediterranean Sea [3]. Dusky grouper, is a monandric protogynous hermaphrodite. Female maturity occurs when females are 5 years old and 380 mm long (sub-mature females can weight 2–3 Like other groupers, the dusky grouper Epinephelus excellent quality and it is highly valued. The knowledge of reproductive biology of fish is a prerequisite of fish production. Some of the parameters of fish biology include fecundity (F), gonadosomatic index (GSI), hepatosomatic index (HSI), condition factor (K), and length-weight relationship (LWR). These parameters are used to assess the reproductive condition of fish. A thorough knowledge of the fecundity of fish is essential for evaluating the commercial potentialities, stock study, life history study, particular culture and actual management of the fishery (Lagler *et al.*, 1956; cited by [4]. Fecundity is an important parameter in fishes for determining the reproductive potential of species. Monthly variations of GSI provide the reasonable indicator of reproductive seasonality for fish. The seasonal timing of reproduction, spawning time is often identified from changes in the gonadosomatic index which determines reproductive season [5]. The hepatosomatic index is the ratio of liver weight to body weight. The liver is a key organ in fish production of vitellogenin, the yolkprecursor (Koob and Callard, 1999; cited by [6]. Hepatosomatic index is important because it describes the fish's stored energy and is a good indicator of recent feeding activity [7]. Many researcher indicated ovary maturation based on gonadosomatic index (GSI), Hepatosomatic Index (HSI) [8]. Indexes of condition which can be determined easily and quickly are needed in routine fisheries surveys and are good predictors of the body composition and growth rate of fish [9]. Condition factor (K) is quantitative parameters of the well-being state of the fish and reflects feeding condition. This factor varies according to influences of physiologic factors, fluctuating according to different stages of the development. Differences in the condition factor have been interpreted as a measure of histological events such a fat reservation, adaptation to the environment and gonadal development [10]. Length-weight relationship is considered to be one of the important biological information in order to describe mathematical relationship between variances, length and weight. Because information about length and weight attributes of growth are essential in understanding this relation and length-weight relationship has been used in fish biology [11].

MATERIALS AND METHODS

Study area:

Epinephelus guaza specimens used in this study were taken from Catches by long line and spear fishing operating on Susa Coast on the Mediterranean Sea, Libya were studied monthly. Fig (I)

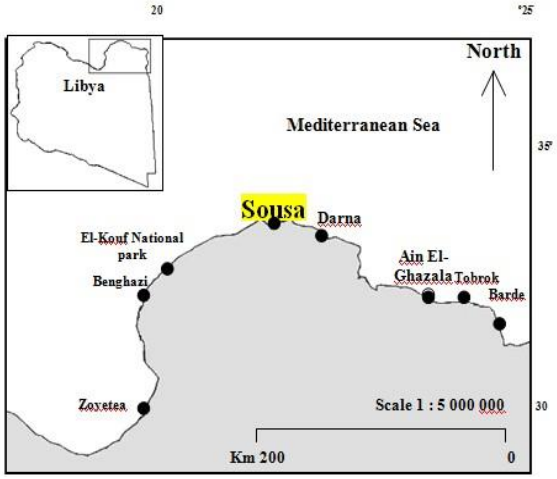

Figure I: Map showing the collection site: Sousa Coast on the Mediterranean Sea of eastern Libya 318

Study period:

The duration of the study period was from April 2010 to March 2011.

Collection of specimens:

A total of 207 (152 females and 55 males) *E. guaza* was collected and used in this study.

Identification of species:

Species identification was followed after [12]

Measurements and dissection:

The total length was measured to the nearest centimeter and weight to the nearest gram. Then ventro-lateral dissection was made and the sex noted. The gonads and liver were removed and weighed by digital balance.

Parameters employed:
The monthly changes in the gonadosomatic index (GSI) and hepatosomatic index (HSI) were calculated using the formulae given by [13].
Gonad weight

$$GSI = \frac{\text{Gonad weight}}{\text{Body weight}} \times 100$$

$$HSI = \frac{\text{Liver weight}}{\text{Body weight}} \times 100$$

The condition factor (K) was calculated according to formula stated by [14].

$$HSI = \frac{\text{Body weight}}{\text{Length}^3} \times 100$$

RESULTS

Condition factor (K):
Monthly variations of the condition factor in both male and female are shown in (Table I, Fig II). The lowest mean K values were observed in March (1.23±0.06). The highest mean values of K for both sexes were obtained (1.88±0.35) in July.

Hepatosomatic index (HSI):
Monthly changes of HSI values for both sexes are shown in (Table I, Fig III). The minimum mean values of HSI were found in October (0.31 ± 0.09). The maximum mean values of HSI were found in March (4.05 ±0.22) .

Gonadosomatic index (GSI):
Changes in monthly GSI values of both sexes are given in (Table 2, Fig IV) and 4. It is observed that the lowest mean GSI values were obtained in February 0.50 for males and in March 0.80 for females. The highest mean values occurred in September 2.01 for males and in September 8.97 for females.

Length-weight relationship (LWR):
Monthly means of the standard length and body weight for the males and females are given in (Table III). A highly correlation was observed between standard length and body weight for both sexes (Fig X) with correlation coefficient r = 0.99 An isometric (b = 2.969).

Table I: Monthly means of the HSI and K in *Epinephelus guaza* from April 2010 to March 2011.

Months	No. of fish examined	HIS	K
		Mean ± SD	Mean ± SD
Apr,10	15	3.03 ±0.11	1.39±0.06
May,10	12	3.88 ±0.15	1.41±0.11
June,10	22	1.11 ±0.06	1.63±0.23
July,10	25	0.45 ±0.05	1.88±0.35
Aug,10	18	0.40 ±0.08	1.73±0.41
Sept,10	14	0.36 ±0.07	1.70±0.22
Oct,10	20	0.31 ±0.09	1.65±0.19
Nov,10	22	0.87 ±0.08	1.55±0.13
Dece,10	22	1.12 ±0.07	1.42±0.12
Jan,11	12	1.56 ±0.15	1.37±0.11
Feb,11	13	1.77 ±0.14	1.33±0.09
Mar,11	12	4.05 ±0.22	1.23±0.06

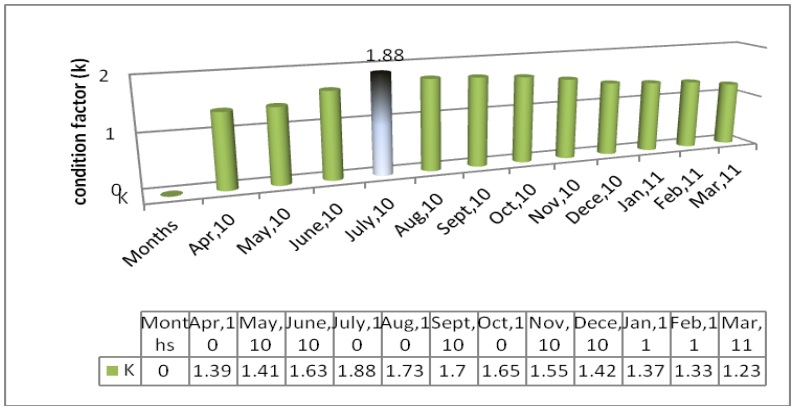

Figure II: Monthly means of the K in *Epinephelus guaza* from April 2010 to March 2011.

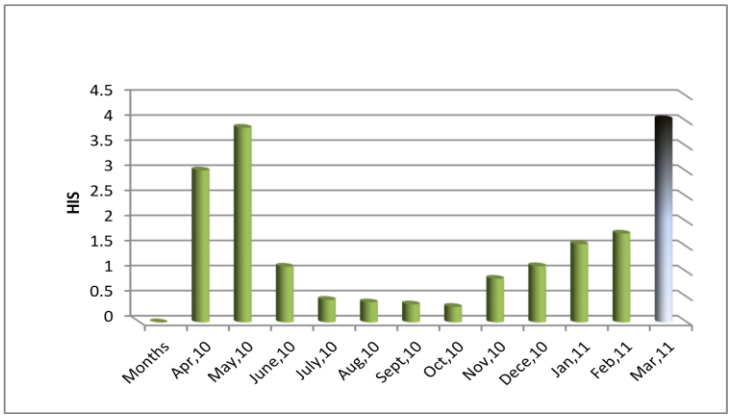

Figure III: Monthly means of the HSI in *Epinephelus guaza* from April 2010 to March 2011

Table II: Monthly means of the GSI in female and male *Epinephelus guaza* from April 2010 to March 2011.

Months	Female			Male		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
Apr,10	1.39	1.32	1.35	1.22	0.42	1.01
May,10	1.78	1.56	1.66	1.29	0.46	1.09
June,10	2.11	1.89	1.99	1.76	1.11	1.42
July,10	7.14	3.11	5.12	1.87	1.35	1.62
Aug,10	10.11	5.14	7.89	2.10	1.48	1.77
Sept,10	10.42	4.89	8.97	2.22	1.87	2.01
Oct,10	8.54	3.78	6.17	1.98	1.32	1.64
Nov,10	2.55	2.05	2.22	1.45	0.98	1.33
Dece,10	1.48	1.32	1.35	1.42	0.63	1.03
Jan,11	1.25	1.08	1.18	1.06	0.59	0.82
Feb,11	1.03	0.86	0.96	0.63	0.45	0.50
Mar,11	0.89	0.78	0.80	0.69	0.49	0.52

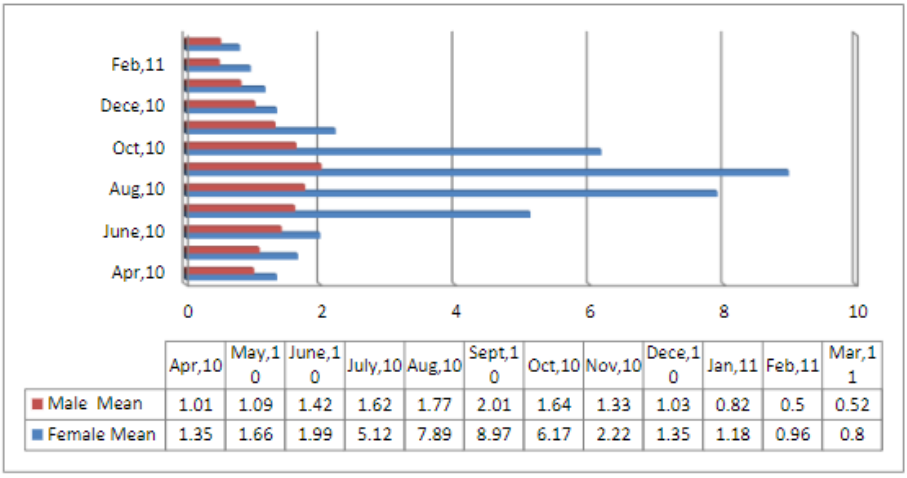

Figure IV: Monthly means of the GSI in female and male *Epinephelus guaza* from April 2010 to March 2011.

Table III: Monthly means of the total length and body weight in *Epinephelus guaza* from April 2010 to March 2011.

No. of fish examined	Total length		Body weight Mean ± SD
	Range	mean	
21	15.5-22.4	20.1	137.4 ± 22.3
52	22.5-29.4	26.2	302.1 ± 42.1
41	29.5-36.4	32.3	527.1 ± 62.3
15	36.5-43.4	39.9	1050.2 ± 121.1
13	43.5-50.4	48.2	1479.7 ± 132.6
11	50.5-57.4	53.6	2072.2 ± 103.9
11	57.5-64.4	60.6	3502.1 ± 135.6
11	64.5-71.4	66.7	4664.9 ± 157.9
13	71.5-78.4	75.4	6818.1 ± 188.2
14	78.5-85.4	82.3	8901.1 ± 175.5
4	85.5-92.4	88.4	12399.8 ± 325.6
1	92.5-99.4	98.8	14000.2 ± 0.00

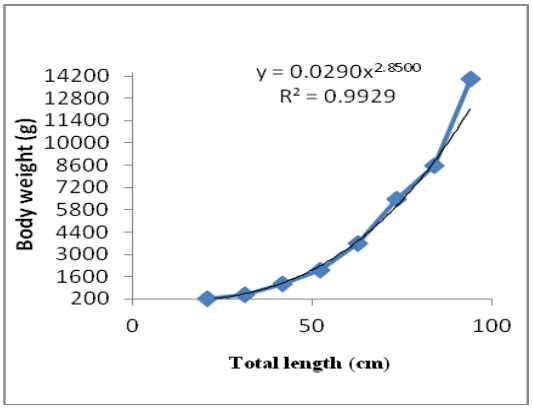

Figure X: Relationship between the standard length and body weight *Epinephelus guaza* from April 2010 to March 2011.

DISCUSSION

One hundred and fifty two female and 55 male *Epinephelus guaza* were collected during April 2010 to March 2011for the evaluation of gonadosomatic index (GSI), hepatosomatic index (HSI), condition factor (K), length-weight relationship (LWR). Gonadosomatic index (GSI) indicates the gonadal development and maturity of fish. It increased with the maturation of fish and declined thereafter (Parameswarn *et al.,* 1974; cited by [4]. [15] also reported that gonadosomatic index (GSI) is widely used especially for the bony fishes in order to examine the spawning period because its value is directly related to the development of the gonads.

In the present study, monthly variation in GSI revealed that both sexes followed nearly the same pattern. GSI showed higher values during the period from March – October, while the lower ones occurred during the period from November to February. In the present study, the stages of sexual maturity and the GSI, the fish showed a spawning season for males from June to October and females from July to October with the peak and peak of the spawning season of the two components in September. This result is consistent with the spawning season in Tunisia [16, 17 and18], in South-East Africa and in St. Maria, Spain for E. marginatus [19 and 20] Therefore, the period from June to October may be regarded as the spawning season. Due to the fact that the spawning time took for a long time, mature gonads were observed almost all of the study period. Based on the GSI values, the reproductive cycle of *Epinephelus marginatus* can be divided into prespawning period (April–May), spawning period (June-September), and postspawning period (October-November). Because of longer duration of reproductive period, the resting phase does not occur in this species. Normally, variations of hepatosomatic index (HSI) imply energy storage for reproduction [18]. Poor somatic condition during the spawning season is a common observation in many species of fish, and gives an indication that the somatic growth is limited due to the development of gonads. The decrease in condition has been ascribed to a depletion of body reserves during gonad maturation (Salgado-Ugarte, 1995; cited by [21]. This condition was observed in *E. marginatus* because minimal HSI values were obtained during the reproductive period. For both sexes, when the HSI values were at its minimal, the GSI values were highest and this condition suggesting the point that the liver has a weight loss during reproduction which may indicate the mobilization of hepatic reserves for gonads maturation. Condition factor (K) is one of the most important parameters, which throws light on the physiological state of the fish in relation to indication of the onset of the sexual maturity [22]. The condition factor also showed a minimum value in the spawning season in this work. Moddock and Burton (1999) who interpreted this condition as the result of mobilization of somatic energy reserves needed for reproductive development and energy in spawned fish, influenced by reduced feeding during this period (cited by [23]). In this study, such correlation was found in both sexes. However, a slight variation of K values for both sexes was shown during study period. [24] Demonstrated that the value of regression coefficient b = 3 indicated that the fish retains the same shape, it grows systematically (or) isometrically which means fish shape doesn't change as fish grows. A value significantly larger or smaller than 3 indicates allometric growth, if b is less than 3 showed that the fish becomes lighter (negative allometric), if b is greater than 3.0, it indicates that the fish becomes heavier (positive allometric) for its length as it increase in size (cited by [25]). In the present study the length of the fish ranged from 15.5 cm to 98.8 cm with mean weights from 137.4 g to 14000.2 g. In the study of the relationship between fish lengths and weights, b was found to be 2.969 and the correlation coefficient was strong (r^2= 0.99). This indicates that there is an isometric growth, for the region and its suitability for the growth of fish of various species. Previous studies of other species of fish [26, 27 and 28] show that the value of b is about 3 in all fish. prespawning period It is concluded that the reproductive cycle of *E. marginatus* is divided into prespawning (April – May spawning period (June - September), and postspawning period (October - November). periods and the species is a seasonal spawner.

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