JKAU: Mar. Sci., **Vol. 31** No. 1 pp: 1-12 (1442 A.H. / 2021 A.D.)
DOI :10.4197/Mar.31-1.1

Feeding Habits and Relative Condition Factor of *Crenidens crenidens* in Jeddah Fisheries, Saudi Arabia

Mohamed H. Gabr[1,2], Ohoud M. Almohlbadi[1] and **Lafi S. Al Solami[1]**

[1] Marine Biology Department, Faculty of Marine Science, King Abdulaziz University, P.O. Box 80207, Jeddah 21589 Saudi Arabia, and [2] National Institute of Oceanography and Fisheries, Suez, Egypt

mgabr@kau.edu.sa

Abstract. The present study investigates the gut contents and feeding habits of *Crenidens crenidens* in the Red Sea coast of Jeddah, Saudi Arabia. Gonadosomatic index, length-weight relationship and relative condition factor were also determined. Samples were collected monthly during the period from November 2018 to October 2019. Stomach contents were identified and assessed by the frequency of occurrence, numerical and gravimetric methods. The total number of specimens collected was 375, of which 139 were having empty stomachs. Feeding intensity was the highest between April (80.0%) and September (90.9%) and the lowest from November (27.8%) to January (16.7%) and February (41.2%). The maximum value of Fullness index (FI%) was found in Summer (88.11%) and lowest in Winter (26.42%). Whereas the maximum value of Vacuity index (VI%) in Winter (73.56%) and lowest in Summer (11.89%). The results showed that *C. crenidens* mainly feeds on seaweeds, seagrasses, small mollusks and nematodes, and thus it is omnivorous fish. Seaweeds were the most important food items (IRI%, 38.33), then seagrasses (IRI%, 29.9) and unidentified small plant parts (IRI%, 22.0). The length-weight relationship could be described by the power equation: W = 0.0173 L3.00 (R2 = 0.96) where the slope 'b' equal to '3' indicating that the growth of this species is isometric. The relative condition factor Kn was found affected by the feeding intensity and spawning activity.

Keywords: Crenidens crenidens, Food composition, Index of relative importance, Length-weight relationship, Relative condition factor, Jeddah fisheries, Red Sea.

1. Introduction

The Karanteen seabream *Crenidens crenidens* is a species of the family Sparidae which currently consists of 39 valid genera containing 164 valid species (Fricke *et al.*, 2020). Sparids are demersal fish and inhabit the continental shelf and the slope in the tropical and temperate coastal waters. They are very important commercial fishes around the Middle East where they are commonly caught (Bauchot and Smith, 1983; Smith and Smith, 1986). *Crenidens crenidens* is found near the shore in shallow lagoons and bays; it is omnivorous species feeding mainly on algae and small invertebrates (Iwatsuki and Maclaine, 2013).

Information on the diet composition and feeding habits of fish species is a cornerstone to understand the trophic interactions (prey-predator relationship) within and between species. Moreover, the selection and development of successful farming of any given species depends mainly on the knowledge of the food items and feeding habits of this species (Manon and Hossain, 2011).

Although this species is a popular sparid species in the Red Sea coast of Jeddah and has high price value when sold fresh because of its favored flesh, there is no available studies concerning the food and feeding habits of *Crenidens crenidens* in the Red Sea. Ahmed (2012) studied only the reproductive biology of this species in the Libyan eastern coast. Thus, the present study aims to describe the feeding habits and diet composition of *Crenidens crenidens*, for the first time, in the Red Sea coast of Jeddah, Saudi Arabia.

2. Materials and Methods

Monthly fish samples of *Crenidens crenidens* were collected randomly from November 2018 to October 2019. Fish were caught by artisanal fishermen using gillnets in Jeddah fisheries. A total of 375 specimens were collected and the total length was measured to the nearest 0.1 cm, the total weight was recorded to the nearest 0.1 g using a digital scale. Specimens were dissected and their stomach having food items were removed and preserved in 10% formalin for further analysis. Stomach fullness was categorized based on the quantity of foodstuff present in the gut as gorged, full, 3/4th full, 1/2 full, 1/4th full, trace and empty. The stomach contents were placed in a clean petri-dish for determining the food composition visually and under microscope. Prey items were photographed using 'Amscope' 18 MP digital camera connected to the computer.

The feeding intensity was assessed using the following equations:

The equation given by Euzen (1987) and applied in Shilta *et al*. (2018) and Sumon *et al*. (2020) was used to estimate the vacuity index (VI%) as follows:

$$\% \text{ VI} = \frac{\text{Number of empty stomachs}}{\text{Number of examined stomachs}} x\ 100$$

Feeding or Fullness index (FI%),

$$\% \text{ FI} = \frac{\text{Number of stomach containing food}}{\text{Number of examined stomachs}} x\ 100$$

Food items were quantified by the frequency of occurrence (% Fi), points numerical percentage (% N) and gravimetric estimations (% W) (Hyslop, 1980) which are the most commonly used methods.

The percentage frequency of occurrence (%Fi) was estimated using the method of Dewan and Shaha (1979):

$$\% \text{ Fi} = \frac{\text{number of stomachs containing the food item (ni)}}{\text{total number of stomachs with food (NT)}} \text{ x } 100$$

Points numerical percentage (N%),

$$\% \text{ N} = \frac{\text{number of points allocated for the food item}}{\text{total number of points for all food items}} \text{ x } 100$$

Points are allocated for each food item relative to the gastropod size which is considered as one point (Zacharia and Abdulrahman, 2004).

Weight Percentage (W%),

$$\% \text{ W} = \frac{\text{Weight of food item}}{\text{total weight of all food items}} \text{ x } 100$$

To assess the importance of each food item in the stomach contents, the index of relative importance (IRI) formula (Pinkas *et al.* 1971), as modified by (Hacunda, 1981) and applied by Sumon *et al*. (2020), was calculated as follows:

$$\text{IRI} = (\% \text{ N} + \% \text{ W}) \times \% \text{ Fi}$$

The percentage of IRI of each food item has been expressed by following equation:

$$\% \text{ IRI} = (\text{IRI} / \Sigma \text{ IRI}) \times 100$$

The Gonado-Somatic Index (GSI) was estimated by the following equation:

$$\text{GSI} = \frac{\text{Gonad weight}}{\text{Total weight} - \text{Gonad weight}} \text{ x } 100$$

The length - weight relationship was described by the power equation, $W = a L^b$, (Le Cren, 1951) which gives a straight-line relationship by a logarithmic transformation as follows: Loge W = Ln a + b Ln L, Where W is the observed body weight in gram, L is the total fish length in centimeter, a & b are the intercept and slope of the regression line. From the equation of length -weight relationship, the relative condition factor (Kn) was calculated by using the equation: $Kn = W / a L^b$ (Le Cren, 1951) where 'a L^b 'is the calculated body weight from the length - weight relationship.

Seasonal variations in the food composition percentage (Fc%) of the different food items were tested using the analysis of variance (ANOVA). Heterogeneity of seasonal and sex-based vacuity index (VI) values was tested using a chi-square test. A two-sample proportion test was applied to check for the difference between each two seasonal vacuity ratios. The 'Statistix 8.1' software was used to carry out these statistical analyses.

3. Results and Discussion

3.1 Food Composition

Gut contents of the Karanteen seabream *Crenidens crenidens* consisted of algae, aquatic plants, nematodes, gastropods, bivalves, sand grains and others (detritus) (Fig. 1). Algae (seaweeds) and aquatic plants (seagrasses) represented the most important components of all the food items (Fig. 2), but mollusks and invertebrates such as gastropods, bivalves, and nematodes were in small quantities.

3.2 Gut Content Analysis

This study represented the first analysis of the gut contents of *C. crenidens* in the Red Sea coast of Jeddah. To reveal the food and feeding habits of *Crenidens crenidens* in Jeddah fisheries, the monthly percentage composition of each food item (Fc %, based on frequency of occurrence) was estimated, and the results are listed in Table 1 and represented in Fig. 2. There was no significant seasonal variability in food composition percentage (ANOVA, $F = 0.0$, $P > 0.05$). A significant difference was found between the overall percentage composition of each food item (ANOVA, $F = 12.4$, $P < 0.05$).

Seaweeds, seagrasses and small unidentified plant parts were the most frequent food items. Their highest percentage composition was found in February (74.73% collectively) while the lowest was found in April (42.86% collectively). The percentage composition of Nematodes was highest (16.28%) in July and lowest (3.37%) in March. The percentage composition of gastropods was highest (15.12%) in July and lowest (3.30%) in February, while the percentage composition of bivalves as food item was highest (14.29%) in April and lowest (3.30%) in February (Table 1).

Iwatsuki & Maclaine (2013) reported that the species of the family sparidae are typically carnivores feeding on benthic invertebrates, while the *Crenidens species* are omnivorous fishes (mainly consuming algae and small invertebrates). However, the results of the present study confirmed that *Crenidens crenidens* in Jeddah fisheries is omnivorous fish, where its diet consisted mainly of seaweeds, seagrasses, and small benthic invertebrates like mollusks and nematodes.

3.3 Feeding Intensity and Spawning Season

Results of the present study showed that the percentages of empty stomachs were higher between November and February. The highest percentage of stomachs having food items was noticed in June, July and August with the lowest percentage of empty stomachs (Table 2). However, the breeding season of this species in the Mediterranean Sea has been recorded to extend from November till February (Ahmed,

2012), and the same was found in the present study, where the highest value of the gonado-somatic index was found in February (GSI=8.78). Thus, the feeding intensity of this species is associated with the spawning period. A poor feeding intensity was observed from November to March and a moderate feeding intensity started in February and increased in April through October associated with high feeding intensity between May and August. However, these changes in the feeding intensity in relation to the gonadal development during the reproductive period was reported in many studies on various fish species (Ozyurt *et al*., 2012; Kadharsha *et al*., 2013; Vahabnezhad *et al*., 2016; Daghoogi *et al*., 2019).

3.4 Seasonal Variability in the Feeding Intensity

Results listed in Table 3 show the monthly mean total length, total weight, vacuity index, fullness index, gonadosomatic index and relative condition factor of *Crenidens crenidens* in Jeddah fisheries. It is clear that this species exhibits lower feeding intensity during November, December, January, and February where 72.2%, 78.6%, 83.3% and 58.8% of the total examined stomachs were empty in these four months, respectively. A seasonal variability was evident among the vacuity index values during the different seasons ($\chi^2 = 11.35$, $P < 0.05$), reflecting a seasonal variability in the feeding intensity of this species in Jeddah fisheries, as given in Table 4 and shown in Fig. 3. Whereas this species feeds intensively in spring (FI% = 78.62%), and summer (FI% = 88.11%), its ability for feeding decreased through autumn (FI% = 63.3%) to winter (FI% = 26.42%). The vacuity index in winter was significantly higher than that in all other seasons (Fisher's Exact: $P < 0.05$), whereas the lowest was in summer (Fisher's Exact: $P < 0.05$) These results indicate that the feeding intensity of *Crenidens crenidens* in Jeddah fisheries goes down during the gonadal development period (December to February) and start to increase after spawning. A similar pattern of feeding intensity changes affected by the reproductive cycle was reported by Ozyurt *et. al*. (2012) on the pikeperch *Sander lucioperca,* and by Daghoogi *et al*., (2019) on the Indian mackerel *Rastrelliger kanagurta*. However, males and females exhibited similar seasonal variability in the feeding intensity, where no significant difference was found between males and females in their seasonal vacuity index ($\chi^2 = 2.47$, $P > 0.05$).

Fig. 1. Pictures of few identified food items in the gut of Crenidens crenidens in Jeddah fisheries.

Table 1. Frequency of occurrence and percentage composition of different food items in *Crenidens crenidens* in Jeddah fisheries.

Month / Food		Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019
Seaweeds	ni	3	2	4	28	30	3	21	6	14	30	9	17
	NT	5	3	5	28	52	4	33	6	17	41	10	32
	Fi	0.600	0.667	0.800	1.000	0.577	0.750	0.636	1.000	0.824	0.732	0.900	0.531
	Fc%	18.75	20.00	26.67	**30.77**	17.24	**14.29**	17.36	19.35	16.28	22.73	16.98	23.29
Seagrasses	ni	4	2	4	25	35	3	18	5	13	27	7	15
	NT	5	3	5	28	52	4	33	6	17	41	10	32
	Fi	0.800	0.667	0.800	0.893	0.673	0.750	0.545	0.833	0.765	0.659	0.700	0.469
	Fc%	25.00	20.00	26.67	**27.47**	20.11	14.29	14.88	16.13	15.12	20.45	**13.21**	20.55
Plant parts (unidentified)	Ni	2	1	2	15	45	3	27	4	10	22	8	15
	NT	5	3	5	28	52	4	33	6	17	41	10	32
	Fi	0.400	0.333	0.400	0.536	0.865	0.750	0.818	0.667	0.588	0.537	0.800	0.469
	Fc%	12.50	**10.00**	13.33	16.48	**25.86**	14.29	22.31	12.90	11.63	16.67	15.09	20.55
Nematodes	ni	1	1	1	3	15	3	16	4	14	16	8	6
	NT	5	3	5	28	52	4	33	6	17	41	10	32
	Fi	0.200	0.333	0.200	0.107	0.288	0.750	0.485	0.667	0.824	0.390	0.800	0.188
	Fc%	6.25	10.00	6.67	**3.30**	8.62	14.29	13.22	12.90	**16.28**	12.12	15.09	8.22
Gastropods	ni	1	1	1	3	14	3	13	4	13	16	8	5
	NT	5	3	5	28	52	4	33	6	17	41	10	32
	Fi	0.200	0.333	0.200	0.107	0.269	0.750	0.394	0.667	0.765	0.390	0.800	0.156
	Fc%	6.25	10.00	6.67	**3.30**	8.05	14.29	10.74	12.90	**15.12**	12.12	15.09	6.85
Bivalves	ni	1	1	1	3	12	3	13	2	8	10	7	3
	NT	5	3	5	28	52	4	33	6	17	41	10	32
	Fi	0.200	0.333	0.200	0.107	0.231	0.750	0.394	0.333	0.471	0.244	0.700	0.094
	Fc%	6.25	10.00	6.67	**3.30**	6.90	**14.29**	10.74	6.45	9.30	7.58	13.21	4.11
Sand grains	ni	2	1	1	10	15	2	7	4	11	4	4	7
	NT	5	3	5	28	52	4	33	6	17	41	10	32
	Fi	0.400	0.333	0.200	0.357	0.288	0.500	0.212	0.667	0.647	0.098	0.400	0.219
	Fc%	12.50	10.00	6.67	10.99	8.62	9.52	5.79	**12.90**	12.79	**3.03**	7.55	9.59
Others	ni	2	1	1	4	8	1	6	2	3	7	2	5
	NT	5	3	5	28	52	4	33	6	17	41	10	32
	Fi	0.400	0.333	0.200	0.143	0.154	0.250	0.182	0.333	0.176	0.171	0.200	0.156
	Fc%	**12.50**	10.00	6.67	4.40	4.60	4.76	4.96	6.45	**3.49**	5.30	3.77	6.85

Table 2. Monthly variations in the percentages of feeding intensity of *Crenidens crenidens.*

Months	Active feeding		Moderate feeding		Poor feeding		Empty
	Gorged	Full	¾ full	½ full	¼ full	Trace	
Nov	-	-	-	-	-	27.8	72.2
Dec	-	-	-	-	-	21.4	78.6
Jan	-	-	-	-	5.7	8.6	85.7
Feb	-	-	-	14.7	16.2	10.3	58.8
March	-	-	-	5.5	8.2	57.5	28.8
April	-	-	-	60.0	-	20.0	20.0
May	-	15.4	33.3	17.9	7.7	10.3	15.4
June	-	42.9	28.6	14.3	-	-	14.3
July	-	36.8	15.8	10.5	21.1	5.3	10.5
Aug	-	28.3	43.5	15.2	2.2	-	10.9
Sep	-	9.1	18.2	36.4	18.2	9.1	9.1
Oct	-	4.4	24.4	33.3	6.7	2.2	28.9

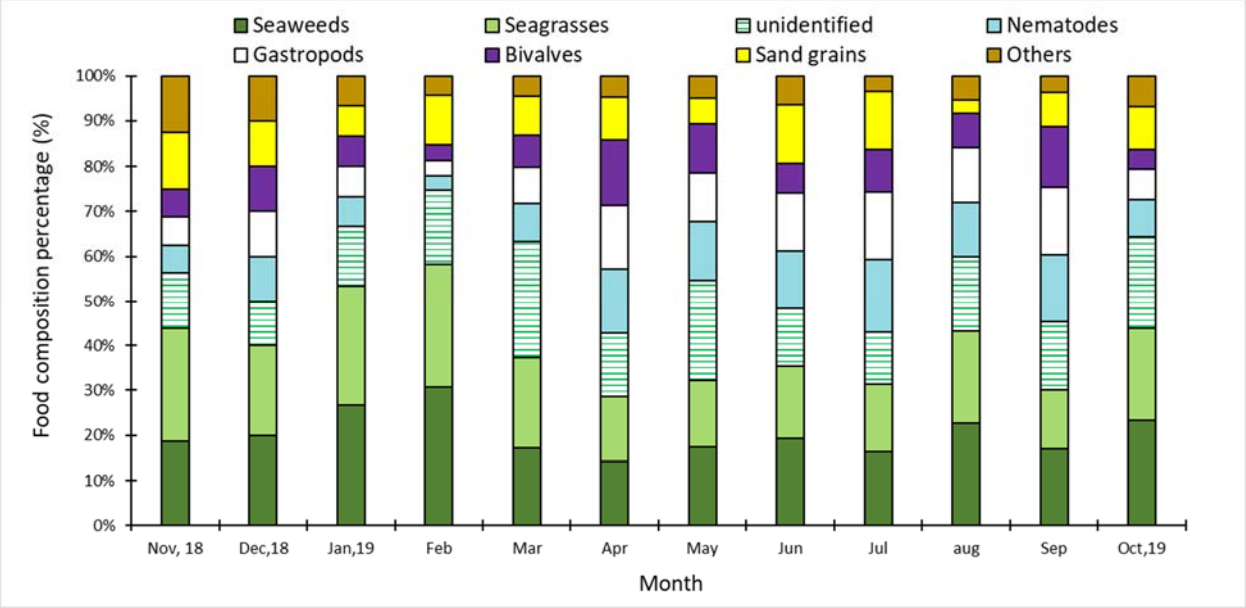

Fig. 2. Composition of different food items in gut contents of *Crenidens crenidens* in Jeddah Fisheries (based on frequency of occurrence).

Table 3. Monthly mean total length, total weight, vacuity index (VI%), fullness index (FI%), gonadosomatic index (GSI) and relative condition factor (Kn) of *Crenidens crenidens* in Jeddah fisheries.

Month	Number of examined fish	Total Length (cm) (Mean±SD)	Total Weight (gm) (Mean±SD)	FI (%)	VI (%)	GSI	Kn
Nov	18	16.4 ± 1.6	78.6 ± 24.6	27.8	72.2	1.62	0.99
Dec	14	16.5 ± 1.1	78.1 ± 17.6	21.4	78.6	3.48	1.00
Jan	30	19.2 ± 1.4	126.0±26.7	16.7	83.3	6.17	1.00
Feb	68	16.4 ± 1.5	79.6 ± 22.7	41.2	58.8	8.78	1.02
March	73	15.6 ± 1.2	66.0 ± 14.8	71.2	28.8	4.49	0.99
April	5	14.4 ± 1.7	52.6 ± 16.8	80.0	20.0	2.57	0.96
May	39	16.5 ± 1.4	78.5 ± 22.0	84.6	15.4	1.15	0.98
June	7	16.1 ± 0.8	72.3 ± 11.3	85.7	14.3	1.00	0.99
July	19	15.9 ± 0.9	66.5 ± 11.5	89.5	10.5	0.43	0.99
Aug	46	16.3 ± 1.4	77.3 ± 20.0	89.1	10.9	0.36	1.01
Sep	11	15.5 ± 0.7	64.8 ± 9.20	90.9	9.1	0.78	0.98
Oct	45	16.1 ± 1.6	76.5 ± 22.3	71.1	28.9	1.49	1.02

Table 4. Seasonal variation in vacuity index (VI%), fullness index (FI), gonadosomatic index (GSI) and relative condition factor (Kn) of *Crenidens crenidens* in Jeddah fisheries.

Season	N (total)	VI %	FI%	Males		Females		GSI	Kn
				N	VI	N	VI		
Autumn	74	36.7	63.3	33	27.3	41	43.9	1.30	0.998
Winter	112	73.6	26.4	10	60.0	102	68.6	6.14	1.006
Spring	117	21.4	78.6	32	25.0	85	23.5	2.73	0.977
Summer	72	11.9	88.1	42	9.5	30	13.3	0.60	1.000

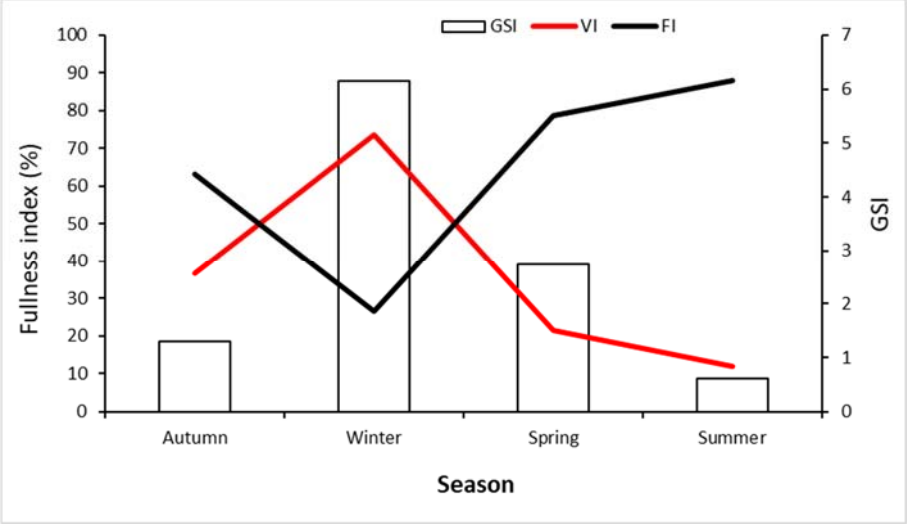

Fig. 3. Seasonal variability of Vacuity index (%), Fullness index (%) and Gonado-somatic index (GSI) of *C. crenidens* in Jeddah fisheries.

3.5 Length- Weight Relationship

In the present study, as shown in Fig. 4, for fish ranging in total length from 12.7 to 22.0 cm, the relationship between the fish total length and total weight could be described by the following power equation:

$$W = 0.0173\ L^{3.00}$$

($r^2 = 0.96$, N = 375, sexes combined)

It is clear that the 'b' value equal to the value '3' of the isometric growth, which means that this species does not change the body shape with growth (age). However, the only available study concerning the length-weight relationship for the karanteen seabream in northern Jeddah fisheries was that of Mal (2006) who indicated that, for fish (sexes combined) ranging in size from 2.0 – 20.0 cm, the b value was 2.77, reflecting a negative allometric growth for this species. Since the length range of fish used in the regression analysis is one of the factors that contribute to the differences in the b values (Tesch, 1971; Pitcher and Hart, 1982; Mal and Gabr, 2020), the inclusion of very small fish (juveniles) in the total length range (2.0 – 20.0 cm) used in the regression analyses by Mal (2006) might lead to lower b value than that recorded in the present study.

3.6 The Condition Factor in Relation to Feeding Intensity and GSI

From the equation of the length -weight relationship described in the present study; the relative condition factor (Kn) was calculated by using the equation: $Kn = W / a L^b$. The monthly changes of the feeding intensity (FI% and VI%), gonadosomatic index and relative condition factor of *Crenidens crenidens* are presented in Table 3. The results showed that the Kn values ranged from 0.96 in April to 1.02 in February and October. Le Cren (1951) indicated that high Kn values during the spawning season of fish may result from using observed fish weight plus gonad weight in estimating the Kn values. Thus, although the poor feeding intensity that found in winter, the value of Kn was high (1.02) in February (winter season) because of the advanced maturity stages with the peak in February (GSI=8.78). The lowest value (0.96) was found in April (spring season) which might be due to the end of the spawning season. In Summer and Autumn (Fig. 5), the Kn values were high due to the high feeding intensity

during these two seasons. However, variations of Kn value may be due to spawning season or stress, feeding patterns (Hile, 1948; Bal and Jones, 1960) or environmental factors (Wahabeb, 1992). The results obtained in the present study are in agreement with the findings of many previous published works on different fish species by many authors (Le Cren, 1951; Chakraborty *et al*., 2017; Abidin *et al*., 2019; Daghoogi *et al*., 2019).

3.7 Index of relative importance 'IRI%'

Results of the relative importance of the different food items in the stomach of *Crenidens crenidens* in Jeddah fisheries are listed in Table 5 and represented in Fig. 6. It is clear from these results that seaweeds were the most important food items (IRI%, 38.33), then seagrasses (IRI%, 29.90). And unidentified small plant parts (IRI%, 22.00). Nematodes (IRI%, 3.48), gastropods (IRI%, 1.89), bivalves (IRI%, 0.81), sand grains (IRI%, 2.33) and others 'detritus' (IRI%, 1.26%) were also important food stuff for *Crenidens crenidens* in Jeddah fisheries, where they represented collectively 9.76% of the total index of relative importance percentage (IRI%). However, many authors have attributed the presence of sand grains and detritus in fish stomachs to the bottom feeding habit that lead to the accidental ingestion of sand grains and detritus along with other food items (Kutty, 1965; Fagbenro *et al*. 2000; Sivan & Radhakrishnan, 2011; Nath *et al*. 2015; Hashim *et al*. 2017).

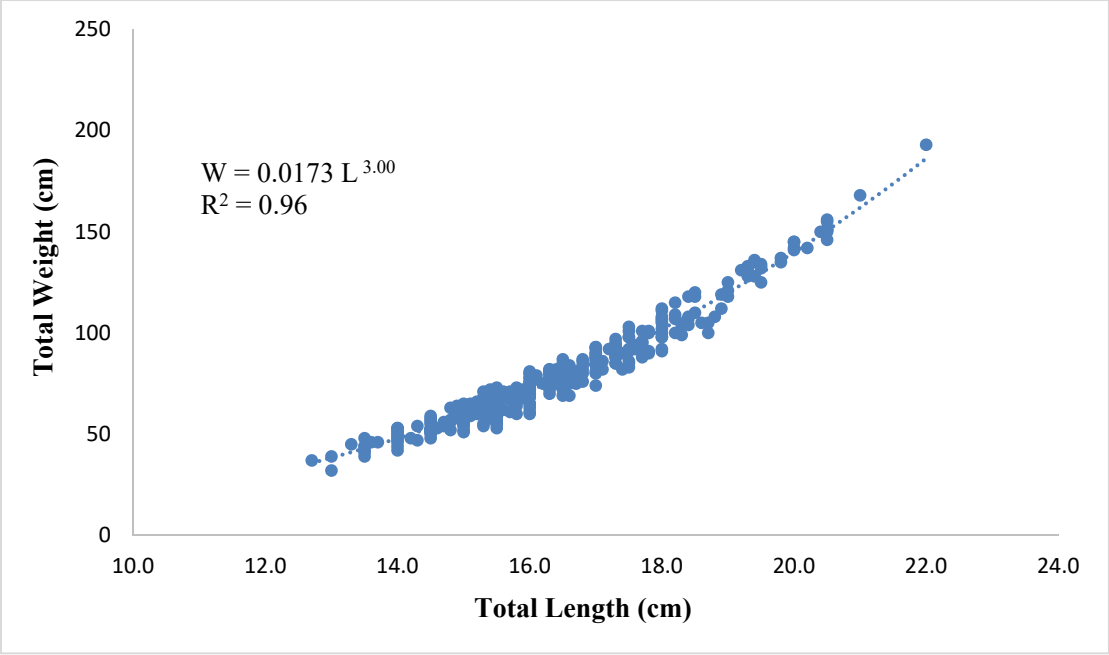

Fig. 4. Length-weight relationship (LWR) of *Crenidens crenidens* (sexes combined) in Jeddah fisheries.

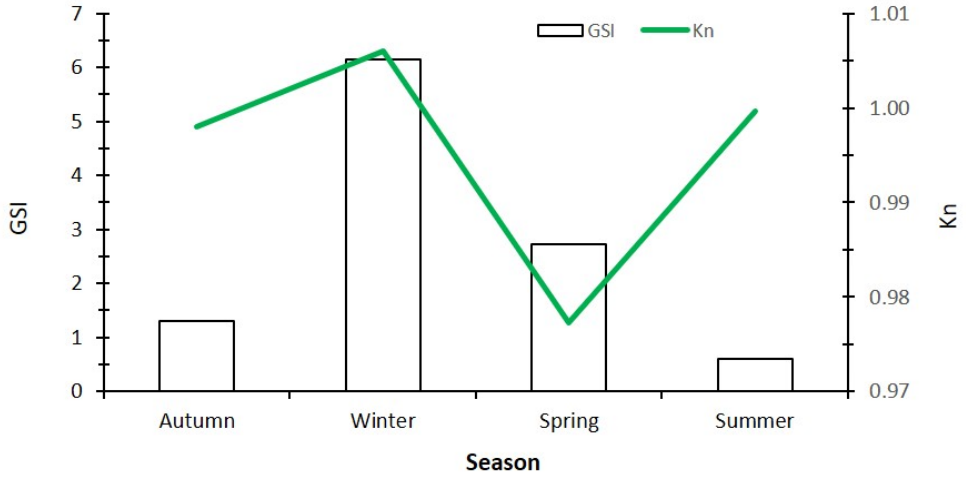

Fig. 5. Seasonal variability of the relative condition factor (Kn) and Gonado-somatic index (GSI) of *C. crenidens* in Jeddah fisheries.

Table 5. Index of relative importance of *Crenidens crenidens* in Jeddah fisheries.

Food items	n	N%	W	W%	O	Fi%	IRI	IRI%
Seaweeds	1350	31.75	20.0	33.73	167	70.8	4633.1	38.33
Seagrasses	1220	28.69	15.0	25.30	158	67.0	3614.5	29.91
Unidentified plant	800	18.81	13.0	21.92	154	65.3	2658.1	21.99
Nematodes	300	7.06	2.5	4.22	88	37.3	420.3	3.48
Gastropods	150	3.53	1.8	3.04	82	34.7	228.0	1.89
Bivalves	82	1.93	1.0	1.69	64	27.1	98.0	0.81
Sands	200	4.70	3.0	5.06	68	28.8	281.3	2.33
Others	150	3.53	3.0	5.06	42	17.8	152.8	1.26
Total	4252	100.0	59.3	100.0			12036.2	100.0
No. of examined stomachs		375						
No. of stomachs with foods		236	(62.9%)					
No. of empty stomachs		139	(37.1%)					

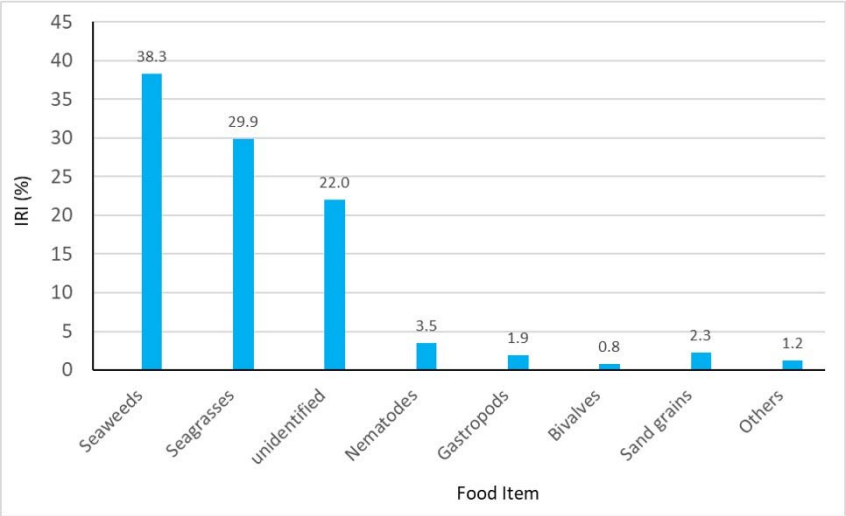

Fig. 6. Index of Relative Importance percentage (IRI%) of the different food items in the stomachs of *Crenidens crenidens* in Jeddah fisheries

4. Conclusions

In conclusion, the Karanteen seabream *Crenidens crenidens* is an omnivorous fish feeding mainly on algae (seaweeds) and aquatic plants (seagrasses and unidentified) which represent the most important components of all the food items (collective IRI% is 90.23). *Crenidens crenidens* also feeds on small mollusks and invertebrates such as gastropods, bivalves, and nematodes but in small quantity. This species feeds intensively in spring (78.62%), and summer (88.11%), then its ability to take food decreases through autumn (64.1%) to winter (26.42%). Thus, the feeding intensity of *Crenidens crenidens* in Jeddah fisheries goes down during the spawning season (December to February) where the majority of examined stomachs were empty reflecting the highest (73.56%) vacuity index in winter. The described length-weight relationship indicated that the growth of this species is isometric, where the slope 'b' value equal to '3', which means that this species does not change the body shape with growth (age). The Kn values ranged from 0.96 in April to 1.02 in October and February. Kn value was high (1.02) in February (winter season) which may be due to advanced maturity stages with a peak in February (GSI=8.78). The lowest value (0.96) was found in April (spring season) which might be due to the end of the spawning season, where the GSI value decreased to be 2.57, associated with a poor feeding intensity. In Summer and Autumn, the Kn values were high due to the high feeding intensity during these two seasons.

Acknowledgments

This study is a part of the second author M. Sc. project. The authors, therefore, acknowledge with thanks the Deanship of Graduate Studies, King Abdulaziz university, Ministry of Education for accepting Ohoud M. Almohlbadi as a postgraduate student in the M.Sc. Program in Marine Biology Department, Faculty of Marine Sciences.

References

Abidin, D.A.Z., Das, S.K. and **Abd Ghaffar, M.** (2019). Length-weight relationship, condition factors and trophic level of Buffon's river-garfish *Zenarchopterus buffonis* from the coastal waters of Malaysia. *Songklanakarin J. Sci. Technol*., **41** (5): 1162-1170.

Ahmed, A.I. (2012). Reproductive biology of the Egyptian sabaraus *Crenidens crenidens* (Forsskal, 1775) in the Libyan eastern coast, Libya. *Journal of Life Sciences*, **6:** 418-427.

Bal, J.N. and **Jones, J.W.** (1960). On the growth of brown trout of CYN Tegid. *Proc. Zool. Soc. London,* **134**: 1-4.

Bauchot, M.L. and **Smith, J.L.B.** (1983). Sparidae, in: W. Fisher, G. Bianchi (Eds.), *FAO Species Identification Sheets for Fishery Purposes (Western Indian Ocean Fishing Area 51), Vol. 4, FAO, Rome.*

Chakraborty, R., **Das, S.K**. and **Bhakta, D**. (2017). Length-Weight Relationship, Relative Condition Factor, Food and Feeding Habits of *Channa striata* from wetlands of Nadia District, West Bengal. J. Inland Fish. Soc. India, **49** (2): 22-26, 2017.

Daghooghi, B., **Kaymaram, F**., **Vosoughi**, A., **Valinassab, T**. and **Moradi, M**. (2019). Evaluation of some feeding habits of *Rastrelliger kanagurta* (Cuvier, 1817) in the Persian Gulf (Hormozgan Province). *Iranian Journal of Fisheries Sciences*, **18**(2): 319-331.

Dewan, S. and **Shaha, S.N.** (1979). Food and feeding habits of *Tilapia nilotica* (L.) (Perciformes: Cichlidae). *Bangladesh J. Zool.,* **7**(2): 75-80.

Euzen, O. (1987). Food habits and diet composition of some fish of Kuwait. *Kuwait Bulletin of Marine Science*, 9, 65- 85.

Fagbenro, O., **Adedire, C.O., Ayotunde, E.O.** and **Faminu, E.O.** (2000). Haematological profile, food composition and digestive enzyme assay in the gut of the African bony tongue, *Heterotis (Clupisudis) niloticus* (Cuvier 1829) (Osteoglossidae). *Trop. Zool*., **13**: 1-9.

Fricke, R., Eschmeyer, W.N. and **Van der Laan, R.** (eds) (2020). Eschmeyer's Catalog of Fishes: Genera, Species, References. *Electronic version accessed 11 Dec. 2020.*

Hacunda J.S. (1981). Trophic relationships among demersal fishes in coastal area of the Gulf of Maine. *Fish. Bull.,* **79**: 775- 788.

Hashim M., **Abidin D. A. Z**., **Das S. K**. and **Mazlan A.G**. (2017). Length-weight relationship, condition factor and TROPH of Scatophagus argus in Malaysian coastal waters. *AACL Bioflux,* **10** (2): 297-307.

Hile, R. (1948). Standardization of method of expressing length and weight of fish. *Trans. Am. Fish. Soc.,* **75**: 157-164.

Hyslop, E.J. (1980). Stomach contents analysis- a review of methods and their application. *Journal of Fish Biology*, **17:** 411-429.

Iwatsuki, Y. and **Maclaine, J.** (2013). Validity of *Crenidens macracanthus* Günther 1874 (Pisces: Sparidae) from Chennai (Madras), India, with taxonomic statuses of the congeners. *Ichthyological Research,* **60**(3), 241–248. doi:10.1007/s10228-013-0342-2.

Kadharsha, K., **Mohanchander, P.**, **Lyla, P.S**. and **Khan, S.A**. (2013). Feeding and Reproductive Biology of *Saurida undosquamis* (Richardson, 1848) from Parangipettai Coast, Southeast Coast of India. *Pakistan Journal of Biological Sciences*, **16** (22): 1479-1487.

Kutty, M.N. (1965). Observations on the Indian mackerel *Rastrelliger kanagurta* (Cuvier) from the trawl catch along the Bombay Coast. *Indian J. Fish.,* **9**(2) A: 590-603.

Le Cren, E.D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the Perch (*Perca fluviatilis*). *The Journal of Animal Ecology,* **20**(2): 201-219.

Mal, A.O. (2006). Length-Weight Relationships of Two Sea Bream Fish Species in Saudi Arabian Coastal Fisheries of the Red Sea. *JKAU: Met., Env. & Arid Land Agric. Sci.,* **17** (1): 69-74.

Mal, A.O. and **Gabr, M.H.** (2020). Stock assessment of two Parrotfish, *Hipposcarus harid* and *Scarus ferrugineus* in Jeddah fisheries, Saudi Arabia. *Pakistan J. Zool.,* **52**(5): 1709-1722.

Manon, M.R. and **Hossain, M.D.** (2011). Food and feeding habit of *cyprinus carpio* var. specularis. *Journal of Science Foundation*, **9**(1&2): 163-181.

Nath, S.R., **Beraki, T**., **Abraha, A.**, **Abraham, K**. and **Berhane, Y**. (2015). Gut Content Analysis of Indian Mackerel (*Rastrelliger kanagurta*). *J. Aquac. Mar. Biol.* **3**(10): 00052. DOI: 10.15406/jamb.2015.03.00052.

Ozyurt, E.C., Mavruk, E. and **Kiyağa, V.B.** (2012). Effects of predator size and gonad maturation on food preference and feeding intensity of *Sander lucioperca* (Linnaeus, 1758). *Turkish Journal of Fisheries and Aquatic Sciences*, **12**, 315-322.

Pinkas, L., Oliphant, M.S. and **Iverson, I.L.K.** (1971). Food habits of albacore, bluefin tuna, and bonito in California waters. *The Fishery Bulletin,* **152**: 1-105.

Pitcher, T.J. and **Hart, P.J.** (1982). Fisheries Ecology. UK, Croom Helm, London, p. 414.

Shilta, M.T., Narinder, K.C., Suresh, B.P.P., Asokan, P.K., Vinod, K.I.J., Paramita, B.S.R. and **Ramya, A.** (2018) The Food and Feeding Habits of Goldsilk Seabream, *Acanthopagrus berda* (Forsskal, 1775)**.** *Turk. J. Fish. & Aquat. Sci.,* **19**(7): 605-614.

Sivan, G. and **Radhakrishnan, C.K**. (2011). Food, Feeding Habits and Biochemical Composition of Scatophagus argus. *Turk. J. Fisher. Aquat. Sci*., **11**: 603-608.

Smith, J.L.B. and **Smith, M.M.** (1986). Family no. 183: Sparidae. In: Smith MM, Heemstra PC (eds) Smiths' sea fishes. Macmillan South Africa, Johannesburg.

Sumon, M.A.A., Gabr, M.H. and **Al-Harbi, M.A.** (2020). Analysis of food and feeding habits of *Gerres longirostris* in the Red sea coast of Jeddah, Saudi Arabia. *Egyptian Journal of Aquatic Biology and Fisheries*, **24**(7): 471-484.

Tesch, F.W. (1971). *Age and Growth*. In: Ricker, W.E. (Ed.), Methods for Assessment of Fish Production in Fresh Waters. Blackwell Scientific Publications, Oxford, pp. 99-130.

Vahabnezhad, A.; **Kaymaram, F**.; **Taghavi Motlagh, S.A.**; **Valinassab, T**. and **Fatemi, S.M.R**. (2016). The reproductive biology and feeding habits of yellow fin seabream, *Acanthopagrus latus* (Houttuyn, 1782), in the Northern Persian Gulf. *Iranian Journal of Fisheries Sciences*, **15**(1): 16-30.

Wahabeb, M.I. (1992). Aspects of the reproductive band growth of two species of goat fishes (Mugillidae) from Aqaba Red Sea. *Senekenb. Marit.,* **22:** 255-264.

Zacharia, P. U. and **Abdurahiman, K.P.** (2004). Methods of stomach content analysis of fishes- in Mohamed, K.S. (ed) Winter School on Towards Ecosystem Based Management of Marine Fisheries- Building Mass Balance Trophic and Simulation Models. *Technical Notes, Central Marine Fisheries Research Institute, Mangalore,* 148-158.

العادات الغذائية ومعامل الحالة النسبي لأسماك الحفار *Crenidens crenidens* في مصايد جدة، المملكة العربية السعودية

محمد حسنى جبر، وعهود مطلق المحلبدى، ولافي ساعد السلمي

كلية العلوم، جامعة الملك عبدالعزيز، ص. ب. ٨٠٢٠٧ جدة 21589، المملكة العربية السعودية

المستخلص. يقوم هذا البحث على دراسة العادات الغذائية لأسماك الحفار *Crenidens crenidens* في ساحل البحر الأحمر في جدة، المملكة العربية السعودية. وتم حساب الدليل المنسلى Gonadosomatic index، وعلاقة الطول بالوزن Length-weight relationship ومعامل الحالة النسبي Relative condition factor. تم جمع العينات شهريًا خلال الفترة من نوفمبر 2018 إلى أكتوبر 2019. وتم التعرف على محتويات المعدة وتقييمها من خلال تكرار التواجد، والطريقة العددية numerical والوزنية gravimetric. وبلغ العدد الإجمالي للعينات التي تم جمعها 375 عينة، منها 139 عينة كانت بطونها خاوية. وكانت كثافة التغذية هي الأعلى بين أبريل (80,0٪) وسبتمبر (90,9٪)، وأدنى المعدلات من نوفمبر (27,8٪) إلى فبراير (41,2٪). وكانت أعلى قيمة لمؤشر امتلاء المعدة (%FI) في فصل الصيف (88.11٪)، وأدنى قيمة في فصل الشتاء (26,42٪). بينما كانت أعلى قيمة لمؤشر فراغ المعدة (%VI) في فصل الشتاء (73,56٪)، وأدنى قيمة في فصل الصيف (11.89٪). وأظهرت النتائج أن أسماك الحفار تتغذى أساسًا على الأعشاب والحشائش البحرية والرخويات الصغيرة والديدان، وبالتالي فهذه الأسماك متعددة التغذية. وكانت الأعشاب البحرية هي أهم المواد الغذائية (IRI، 38,33٪)، ثم الحشائش البحرية (IRI، 29,9٪) وقطع النباتات الصغيرة غير المعرفة (IRI، 22,0٪). وأمكن وصف علاقة الطول بالوزن بمعادلة القوة: الوزن = 0,0173 * الطول^{3,0} (معامل الارتباط R^2 = 0,96)، حيث معامل الانحدار 'b' يساوي القيمة '3' لقانون التكعيب الذي يشير إلى أن نمو هذا النوع فى مصايد جدة هو نمو مثالي. ولقد وجد أن معامل الحالة النسبي لهذا النوع Kn يتأثر بكثافة التغذية وموسم التكاثر.

الكلمات المفتاحية: *Crenidens crenidens*، مكونات الغذاء، مؤشر الأهمية النسبية، علاقة الطول بالوزن، معامل الحالة النسبي، مصايد جدة، البحر الأحمر.