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Original Article

Feeding Habits of The Thin Lip Grey Mullet *Liza Ramada* (Risso, 1810) (Pisces, Mugilidae) From Sousa Coast, Eastern Libya

Eman Rasheed[1]*, Hana Saleh[2], Hanen Hamed[2]

[1]Department of Zoology, Faculty of Science, Omar El-Mokhtar University, El -Beida-Libya.
2 Department of Marine science, Faculty of Science, Omar El-Mukhtar University, El-Beida, Libya.

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Corresponding Email. hana.khalefa85@gmail.com
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ABSTRACT

The feeding habits of Liza ramada (family: Mugilidae) inhabiting Sousa Mediterranean coast were studied using a total of 203 specimens collected monthly during April 2017 to March 2018. Stomach contents of each fish was studied by points of assessment to establish food and feeding habits of the fish, including annual diet composition, variation of diet composition and feeding intensity, during different months and seasons. Length of studied Liza ramada ranged from 19.4 to 50.8 cm. Liza ramada fed on a wide variety of prey types: sediment, algae (36%), polychaetes (35%), diatoms (16.2%), crustaceans "mainly small prawns, crabs, copepods, and amphipod" (6.2 %), sediment (3.4 %), foraminifera (2.3%) and fish parts (1%). In April, May and June, Liza ramada consumed Algae by values of 44%, 37% and 35.5% respectively, diatoms by 46% in April, sediment by 59.28% in October, polychaetes by 40% in December, crustaceans by 62.74% in January, foraminifera by 1.2% in November, and fish parts by 6.7 % and 18 % in February and March respectively. Algae were completely absent from the diet during January. Algae diatoms, Polychaetes and foraminifera were consumed by all length groups of Liza ramada. Contribution of sediment and polychaetes decreased as fish length increased, while that of Algae increased. The feeding activity of the Liza ramada was high during spring (58.33 %) and winter (35.59 %) and low during summer (14.96 %) and autumn (23.9 %).

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INTRODUCTION

Mullets (family Mugilidae) are mainly coastal marine fishes that are widely distributed in all tropical, subtropical and temperate seas. Mullets are generally considered to be ecologically important and forms major food resource for human populations in certain parts of the world [1].

The thin-lipped grey mullet, *Liza ramada* (Risso, 1826) is a catadromous pelagic species found in various habitats, from shallow brackish and marine waters to lagoons, estuaries and river deltas. It tolerates salinity extremes, as well as abrupt water-quality changes (Thomson, 1990). L. ramada is common in the shallow waters of the eastern Mediterranean and Black sea (El-Mor, 1993). It has a high-quality flesh, superior growth, large maximum size and wide salinity and temperature tolerances [2]. The trophic behavior of mullets has been reported by different authors using extensive terminology which categorized feeding patterns of these species [3]. Some examples include algae feeders [4], micro and meio-benthos feeders [5], interface-feeders [6], deposit feeders [7], benthic microphagous omnivores [8] and limnobenthofagous [9]. Food and feeding habits of the fish vary with time of the day, season of the year, size of the fish, environmental condition and with different food substances present in the water body. Changes in feeding habits of a fish species are a function of the interactions among several environmental factors that influence the selection of food item [10].

L. ramada is distributed along all coastlines, with especially high abundance found in river deltas [11]. Like most Mugilidae, this species reproduces at sea, after which fry undertake a trophic migration shoreward to continue their development [12] in food-rich lagoons, rivers, and even lakes [13]. Food and feeding of mullet fry of several species have been described by a number of authors, including: [14] and [15] in the Arno River and [16] in Haifa Bay. *L. ramada* feeding in the Gökova Bay in the southern Aegean Sea was studied by [17], the diet was comprised of different species. [18] in the Ain El_Ghazala lagoon eastern Libya; [19] in Wadi AL Hamsa – Dernah – Eastern Libya.

The trophic structure and feeding habits of L. ramada in eastern Libya Mediterranean Sea coast is poorly understood. Therefore, the aim of the present work is to investigate the feeding habits of this fish in Sosa cost, eastern Libya Mediterranean Sea. Results of the study may have direct implications for aquaculture.

METHODS

Study area

This work started at Susah harbor's (31°54' N 21°58' E) pavements, in the eastern region of Libya (Fig 1), to collect 203 of the thin lip grey mullet *Liza ramada* individuals, the specimens were taken monthly from artisanal catch of Susa coast obtained by trammel and gill nets, long line and spear fishing from April 2017 to March 2018 to study in the lab of Marine biology division, Zoology Department, Faculty of Science, Omar Al-Mukhtar University, El-Bayda, Fig (1).

Identification of specimens

Species identification was followed after [20]

Measurements and dissection

For each of 203 fish specimens, total length and weights were established to the merest 0.1cm and 0.1 gm. Then each fish was dissected and the alimentary tract removed by cutting at the point where the stomach entered the abdominal cavity and preserved in formalin. The degree of fullness of the stomach was assessed by visual estimation and classified as empty, trace, quarter full, hall full, three quarter full and completely full respectively as described by [21]. Then each stomach was cut, opened longitudinally, and its contents scraped off and transferred into a small Petri dish

containing a small amount of water. Food items were sorted out under a binocular microscope identified down to their groups. A list of general diet composition was made according to the numerical and frequency of occurrence methods of [22]. Obtained results were subjected to further statistical evaluation according to [23]. Food and feeding habit of the fish, diet composition and intensity by month and season, and its relation to fish length were established.

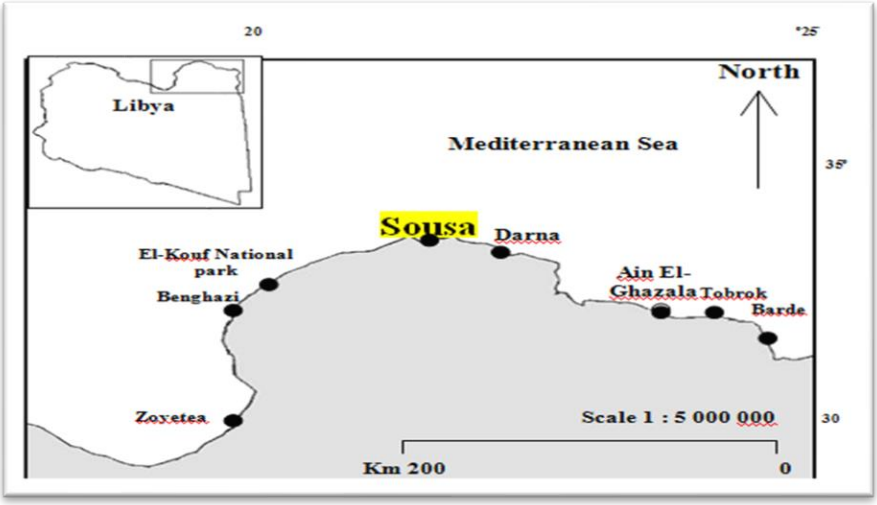

Figure 1: Sousa on the Mediterranean Sea, the site from which the studied *Liza ramada* were collected. (31°54' N 21°58' E)

RESULTS

Annual diet composition

The variety of food items consumed by the studied *Liza ramada* was large (Fig. 2). Algae such *Codium sp, Chladophora spp*. and Ulva spp. made up 36 % of the diet, Polychaetes 35%, diatoms 16.2 %, crustaceans, mainly small prawns, crabs, copepods, and amphipod 6.2%, sediments 3.4%, foraminifer 2.3% and fish parts 1%.

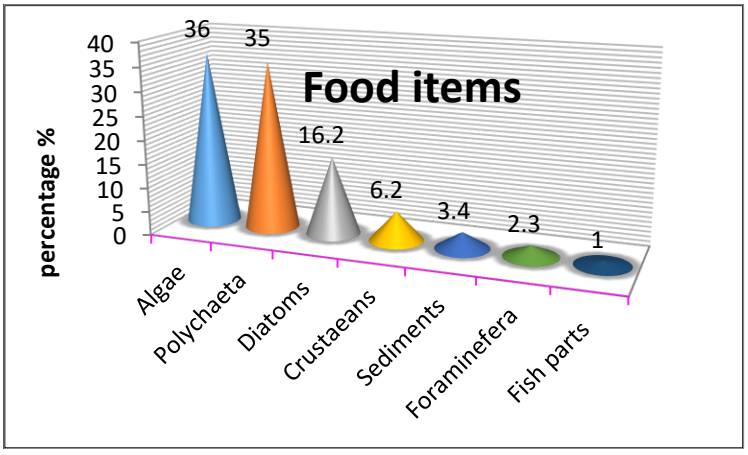

Figure 2: The diet composition of *liza ramada* from Sousa coast**.**

Monthly Diet Composition:

There was great variation in food items of *L. ramada* (Table 1 and Fig. 3): algae were consumed all year round, sediments completely disappeared from the diet during August and September. Maximum consumption of diatoms occurred in April (46%), crustaceans constituted 62.74% in January, polychaetes 40% in December, foraminifera 1.2% in November and of fish parts 18% in March.

Table (1): Monthly variations in diet composition of 203 *L. ramada* from Sosa coast, eastern Libya.

		Food item						
Months	**No.**	**Algae**	**Sediments**	**Diatoms**	**Polychaeta**	**Crustaceans**	**Foraminifera**	**fish part**
Apr-17	3	44	10	46	A	A	A	A
May-17	8	37	49	12	A	A	2	A
Jun-17	35	35.5	50.5	13.75	A	A	0.25	A
Jul-17	11	64.57	29.14	2.28	A	A	4	A
Aug-17	26	100	A	A	A	A	A	A
Sep-17	17	100	A	A	A	A	A	A
Oct-17	25	31.57	59.28	6.28	2.85	A	A	A
Nov-17	25	22.15	51.53	20.46	A	3.8	1.2	0.76
Dec-17	11	24	36	A	40	A	A	A
Jan-18	17	9.8	27.45	A	A	62.74	A	A
Feb-18	12	16.66	6.66	3.3	A	6.66	A	6.7
Mar-18	13	18	26	A	A	37.3	0.66	18
Mean		42.0	28.8	8.7	3.6	9.2	0.7	2.12

Remarks: Data expressed as percentage, (A) No food in month occurred

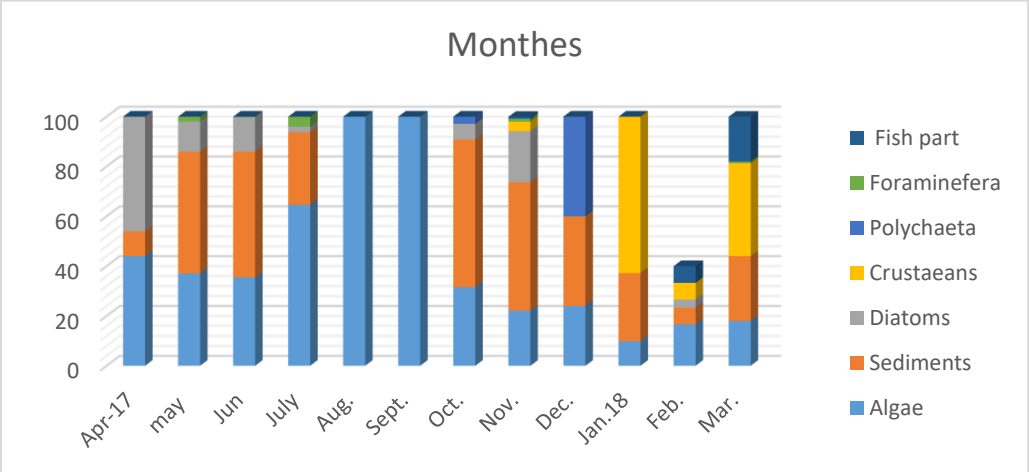

Figure 3. Monthly variations in diet composition of the studied *Liza ramada*

Seasonal variations in diet composition

The seasonal variations in diet composition of the studied *Liza ramada* are shown in Table 2 and Fig. 4. Algae were the main component of the diet during all seasons, diatoms were absent from the diet during August, and September. In spring, the fish preferred algae (33%), sediments (28.3%), diatoms (19.3 %) and polychaetes was absent, crustaceans (12.4%), foraminifera (0.88%) and fish part (6%). In summer, the fish ingested algae (66.69%), sediments (26.5%), diatoms (5.3%), while polychaetes, crustaceans and fish parts were absent. In autumn, algae (51.24 %), Sediments (36.9%), diatoms (8.91 %). In summer algae (16.82 %), Sediments (23.37%), crustaceans (27.57 %).

Table 2. Seasonal variations in diet composition of the *Liza ramada*

		Food item						
seasons	No.	Algae	Sediments	Diatoms	Polychaeta	Crustaceans	Foraminifera	fish part
spring	24	33	28.3	19.3	b	12.4	0.88	6
summer	72	66.69	26.5	5.3	b	b	1.3	b
autumn	67	51.24	36.9	8.91	0.95	1.26	0.4	0.25
winter	40	16.82	23.37	1.1	13.33	27.57	b	2.23

Remarks: Data expressed as percentage, (A): this item was not represented in the monthly diet

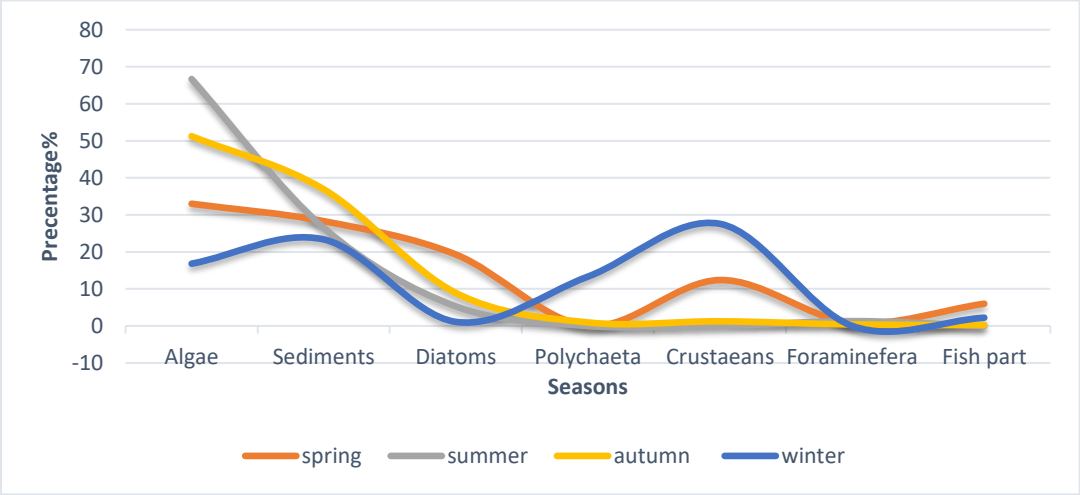

Figure 4. Seasonally variations in diet composition of the *Liza ramada*

Variations in diet composition with changes in Liza ramada length:

The length ranges of studied *L. ramada* (19.4cm to 50.8 cm) was subdivided into 5 classes having 6.2 cm intervals (Table 3and Fig. 5) to show diet composition per class. Algae, diatoms, polychaetes and foraminifera were found in all length classes. Consumption of algae increased as the fish length increased while, that of Polychaeta decreased. In the present study algae were found in all length groups, they increased from 30.68% in size class (19.4 - 25.6cm) to 43.35% in size class (44.6 - 50.8 cm). Polychaeta decreased from 40.1% in size class (19.4 - 25.6 cm) to 32.8% in size class (44.6 - 50.8 cm). Diatoms recorded the highest value of 27% in size class (38.3 - 44.5 cm) and

the lowest value of 7.46 % in size class (19.4 - 25.6 cm). Sediments were ingested in size class (19.4 - 25.6cm) by 4.01 %, increase in the following length groups, but recorded the lowest value of 1.1 % in size class (44.6 - 50.8 cm), then disappeared in size class (25.7- 31.9 cm). Crustaceans were ingested in size class (19.4 - 25.6cm) by 17.46 %, decrease in the following length groups and recorded the lowest value of 1. 42 % in size class (32.0 - 38.2 cm), then disappeared in size class (25.7- 31.9 cm) and (38.3 – 44.5 cm). Foraminifera recorded the highest value of 5.3 % in size class (25.7- 31.9 and 32.0 - 38.2 cm) and recorded the lowest value of 0.2 % in size class (44.6 - 50.8cm). Fish parts disappeared from the menu in size class (19.4 - 25.6cm) but recorded the highest value of 2% in size class (44.6 - 50.8 cm).

Table 3. Diet composition of different length classes of the 203 studied *Liza ramada*

	Food item							
Length groups (cm)	No.	Algae	Diatoms	Polychaeta	Sediments	Crustaceans	Foraminifera	Fish part
19.4 - 25.6	99	30.68	7.46	40.1	4.01	17.46	0.24	0
25.7- 31.9	79	32.7	24	36.7	0	0	5.3	1.3
32.0 - 38.2	10	36.67	14.01	34.2	6.6	1.42	5.3	1.8
38.3 - 44.5	10	36.4	27	31.2	5.1	0	0.3	0
44.6 - 50.8	5	43.35	8.6	32.8	1.1	12.1	0.2	2

Remarks: Data expressed as percentage, color for maximum value in the column color for minimum value (A): This item was not represented in the monthly diet.

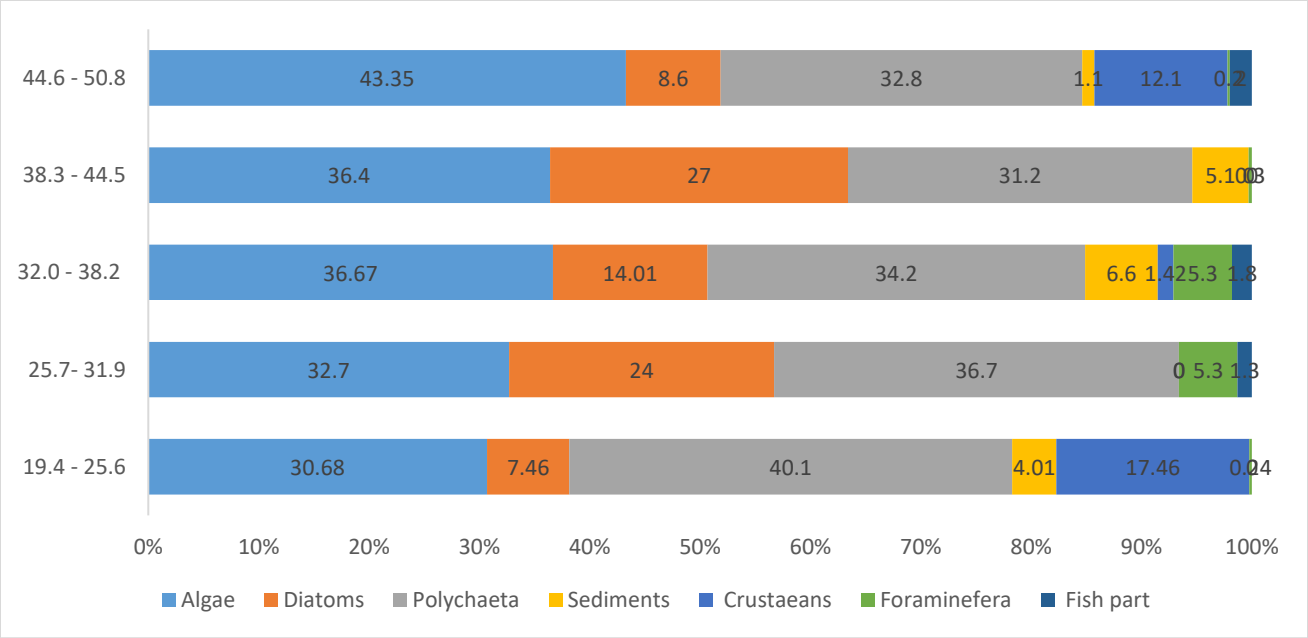

***Figure 5**. Diet composition of different length classes of the 203 studied Liza ramada.*

Feeding intensity

Monthly variations in feeding intensity of the studied *Liza ramada* are shown in Table 4 and Fig. 6. No clear regular trend was observed. *Liza ramada* (%) with stomach that were empty, with traces

of food and quarter full were summed together in the rank a%, they represented 66.75% of the studied *Liza ramada*. Those with stomach half full, almost full and full of food were summed together in the rank b% which included 33.25% of the Liza ramada.

Seasonal variations in feeding intensity

The feeding intensity (Table 5 and Fig 7) was quite high in spring (58.33%) and winter (35.59 %) and low in summer (14.96 %) and autumn (23. 9%).

Table 4. Monthly variations in feeding intensity of the studied *Liza ramada*

	Degree of distension of the stomach								
Months	No. of fish	Empty	Trace	1/4%	a %	1/2%	3/4 %	Full	b %
Apr-17	3	33.33	A	A	33.33	A	33.33	33.33	66.66
May-17	8	12.5	A	25	37.5	A	12.5	50	62.5
Jun-17	35	54.2	14.3	8.6	77.1	5.7	2.9	14.3	22.9
Jul-17	11	36.5	27.3	18.1	81.9	A	A	18.1	18.1
Aug-17	26	84.7	11.5	A	96.2	A	A	3.8	3.8
Sep-17	17	29.4	70.6	A	100	A	A	A	0
Oct-17	25	44	20	4	68	8	A	24	32
Nov-17	25	48	8	4	60	12	A	28	40
Dec-17	11	54.6	18.2	9.1	81.9	9	A	9.1	18.1
Jan-18	17	35.29	5.88	11.76	52.93	5.8	A	41.17	46.97
Feb-18	12	50	8.3	A	58.3	A	A	41.7	41.7
Mar-18	13	30.8	15.3	7.7	53.8	7.7	7.7	30.8	46.2
Average					66.75				33.25

Remarks: Data expressed as percentage A: This item was absent in this month.

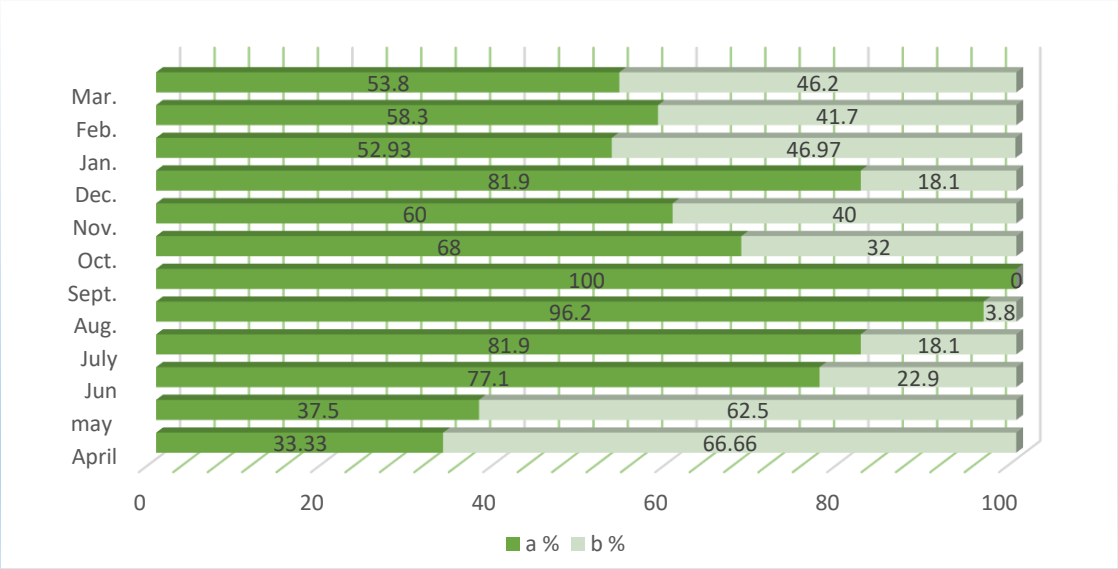

Figure 6. Monthly variations in feeding intensity of the studied *Liza ramada*. [a%: (empty + trace + ¼ stomachs), b% : (½ + ¾ + full stomachs)]

Table 5. Seasonal variations in feeding intensity of the studied *L. ramada*.

seasons	no.	Empty	trace	1/4%	a %	1/2%	3/4 %	full	b %
spring	24	25.5	5.1	10.9	41.5	2.5	17.8	38.03	58.33
summer	72	58.4	17.7	8.9	85	1.9	1	12.06	14.96
autumn	67	40.5	32.8	2.7	76	6.6	B	17.3	23.9
winter	40	46.63	10.79	6.95	64.37	4.93	B	30.65	35.59

Remarks: Data expressed as percentage color for maximum value color for minimum value

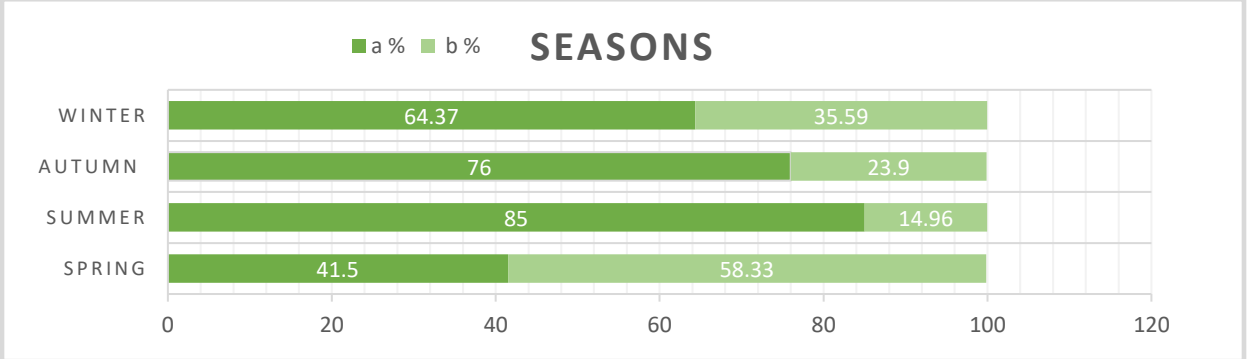

Figure 7. Seasonal variations in feeding intensity of the studied *Liza ramada*. [a%: (empty + trace + ¼ stomachs), b%: (½ + ¾ + full stomachs)].

DISCUSSION

The food and feeding habits of mullets were studied by many researchers [24-31,18-19]. The thin lip gray mullet *L. ramada* found over rock rubble or sand bottoms, young frequently found on algae, sea grasses beds and continual shelf [29], feeds on diatoms, polychaetes, crustaceans, algae, mollusks and sediments [27].

In the current study the *L. ramada* were found to consume a wide range of food items ranging from polychaetes supplemented by crustaceans, foraminifera, algae, diatoms, sediments and formed the major food group for the target species in spring, this is in agreement with [25] , [27], [29], [17] and [19]. Also, results of the present study were similar to that of [24] who studied the feeding biology for the L. ramada in Tunis Mediterranean Sea and found that the species feed on diatoms, crustacean, polychaetes, foraminifera, green algae with fragment quantities of sediments. Generally, the food extent demands and ability for food acquisition increase with fish development [32].

One of the studies [25] highlighted the feeding habits of Juvenile *Liza ramada* and displayed that the numbers and size prey taxa increased with size of the striped sea bream due to the ability of larger fishes to consume a wider range of prey sizes than smaller fishes, this phenomenon appeared to be done for the target species in the present work. In the current study, Liza ramada were found to consume a wide range of food items ranging from green algae, diatom, foraminifera, Polychaetes, crustacean and sediment this is in full agreement with [20].

The current study agrees with [18] that studied the food and feeding of *L. ramada* in in Ain El-Ghazala Lagoon in eastern Libya and showed that L. ramada feed on a wide variety of prey types: diatoms, polychaetes, green algae, crustacean, foraminifera and sediments.

The Diatoms, Polychaetes, Green algae and Crustacea, were the major food item all year round and it was found in all length groups. while in the present study algae found in all year round and it was algae, diatom, Polychaeta and foraminifera found in all length groups. Also, the attained results showed that diatoms, green algae and sediments increased as the fish size increased while, polychaetes, crustaceans and foraminifers decreased as the fish size increased, which is in agreement with [29, 18].

In the present work, the fish preferred diatoms in summer (19.3%) and autumn (8.41%). Where Polychaetes were taken by 13.33 % in winter and by 0.95% in autumn. In winter, green algae ingested by 16.82 % where cruastacea recorded (27.57 %). In summer the fish take foraminifera (1.3 %) and sediments (26.5 %), this is full agreement with [18]. Generally, the food extent demands and ability for food acquisition increase with fish development [32].

The monthly variation in the condition factors fish is affected by the feeding activity which may show their reflection on the body condition [33], this phenomenon appears to be correct for species in the present work. The highest condition factor values (Kf and Kc) were recorded in autumn and winter [29], these results coincide with the degree of stomach fullness in autumn and winter due to food availability. This supports observations for the target species in Tunis Mediterranean Sea [24], in the Egyptian Mediterranean waters [34], in Suez Canal, Egypt [29] and coastal waters of Sousa coast, Libya for *Mugil cephalus* [31].

CONCLUSION

L. ramada feed on a wide variety of prey types: algae, diatoms, crustaceans, foraminifera, polychaetes sediments and fish part. The green algae were the major food item all year round and it was found in all length groups. The feeding intensity was quite high during spring. In the present study is defining the trophic relationships between *L. ramada* with other invertebrates and fishes in this area, in order to understand the dynamic of this regional ecosystem. Beside results from feeding habits of *L. ramada* may have direct implications for aquaculture.

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