



جامعة
بنغازي الحديثة



**مجلة جامعة بنغازي الحديثة للعلوم
والدراسات الإنسانية
مجلة علمية إلكترونية محكمة**

**العدد الخامس عشر
لسنة 2021**

حقوق الطبع محفوظة

شروط كتابة البحث العلمي في مجلة جامعة بنغازي الحديثة للعلوم والدراسات الإنسانية

- 1- الملخص باللغة العربية وباللغة الانجليزية (150 كلمة).
- 2- المقدمة، وتشمل التالي:
 - ❖ نبذة عن موضوع الدراسة (مدخل).
 - ❖ مشكلة الدراسة.
 - ❖ أهمية الدراسة.
 - ❖ أهداف الدراسة.
 - ❖ المنهج العلمي المتبع في الدراسة.
- 3- الخاتمة. (أهم نتائج البحث - التوصيات).
- 4- قائمة المصادر والمراجع.
- 5- عدد صفحات البحث لا تزيد عن (25) صفحة متضمنة الملاحق وقائمة المصادر والمراجع.

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3. تحتفظ مجلة جامعة بنغازي الحديثة بحقها في أسلوب إخراج البحث النهائي عند النشر.

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Food and Feeding Habits of The White Grouper, *Epinephelus aeneus* (saint-hilaire, 1817; Teleostei: Serranidae) From Telmetha Coast Eastern Benghazi, Libya

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Abstract.

Stomach contents of 128 specimens of *Epinephelus aeneus* caught in Mediterranean Sea were analysed in order to get information about the feeding habits of Telmetha coast, eastern Benghazi population of this important shallow water rocky reef predator fish, between May 2018 to April 2019. were examined by points of assessment to establish food and feeding habits of the *Epinephelus aeneus* including annual diet composition, variation of diet composition and feeding intensity during different months and seasons and with *Epinephelus aeneus* length. Length of studied *Epinephelus aeneus* ranged from 17.2 to 89.2 cm. *Epinephelus aeneus* fed on a wide variety of prey types: fish comprised 37.22 % of total diet by number, crustaceans (36.32 %), mollusks (12.49%), Polychaetes (10.67%) and Marine algae (2.59%) foraminifera (0.71%). Monthly variation in diet composition was as follows: In May, Jun and July the *Epinephelus aeneus* consumed crustaceans by values of 80 %, 65 % and 25 % respectively, mollusks by 59 % in January, fish by 100 % in October, polychaetes by 50 % in July, foraminifera by 8% in December and Marine algae was taken up in December by 6 %, and January by 6 %. Contribution of foraminifera, mollusks and Polychaeta decreased as fish length increased, while that of Fish and crustaceans increased. All length groups of *Epinephelus aeneus* consumed crustaceans, and fish. The feeding activity of the *Epinephelus aeneus* was high during spring (91.7 %) and winter (82.8 %) and low during summer (82.7 %) autumn (71.9 %). Fishes with stomachs half-full, almost full and full of food constituted 17.68% of all analyzed samples, whereas those with stomachs that were empty, had traces of food and quarter full represented 82.31%.

Keywords: Feeding habits, *Epinephelus aeneus*, Eastern Coast, Mediterranean Sea, Libya.

الملخص:

تم تحليل محتويات المعدة من 128 عينة من سمكة المناني (الفروج الأبيض *Epinephelus aeneus*) التي تم صيدها في البحر الأبيض المتوسط من أجل الحصول على معلومات حول عادات التغذية في ساحل طلميثة، شرق بنغازي من هذه الأسماك المفترسة الصخرية الهامة في المياه الضحلة، بين مايو 2018 وأبريل 2019. تم فحصها من خلال نقاط التقييم لتحديد عادات الغذاء والتغذية في *Epinephelus aeneus* بما في ذلك تكوين النظام الغذائي السنوي، وتنوع تكوين النظام الغذائي وكثافة التغذية خلال الأشهر والمواسم المختلفة ومع أطوال سمكة *Epinephelus aeneus*. يتراوح طول *Epinephelus aeneus* المدروس من 17.2 إلى 89.2 سم. يتغذى *Epinephelus aeneus* على مجموعة متنوعة من أنواع الفرائس: شكلت الأسماك حوالي 37.22% من إجمالي الغذاء من حيث العدد، القشريات (36.32%) الرخويات (12.49%) عديدات الأشواك (10.67%) الطحالب البحرية (2.59%) والمتقبات (0.71%). كان الاختلاف الشهري في تكوين النظام الغذائي على النحو التالي: في مايو ويونيو ويوليو، استهلك *Epinephelus aeneus* القشريات بنسبة 80% و65% و25% على التوالي، والرخويات بنسبة 59% في يناير، والأسماك بنسبة 100% في أكتوبر، وعديدات الأشواك بنسبة 50% في يوليو، المتقبات بنسبة 8% في ديسمبر، والطحالب البحرية بنسبة 6% في ديسمبر، ويناير 6% على التوالي. انخفضت مساهمة المتقبات والرخويات وعديدات الأشواك مع زيادة طول الأسماك، بينما زادت مساهمة الأسماك والقشريات. تم استهلاك القشريات والأسماك من قبل جميع مجموعات الطول من *Epinephelus aeneus*. كان نشاط تغذية *Epinephelus aeneus* مرتفعاً خلال الربيع (91.7%) والشتاء (82.8%) ومنخفضاً خلال الصيف (82.7%) والخريف (71.9%). شكلت الأسماك ذات المعدة نصف ممتلئة، شبه ممتلئة وممتلئة بالطعام 17.68% من جميع العينات التي تم تحليلها، في حين أن الأسماك التي كانت معدة فارغة لديها بقايا للطعام وربع ممتلئة تمثل 82.31%.

الكلمات المفتاحية: عادات التغذية، *Epinephelus aeneus* - الساحل الشرقي، البحر الأبيض المتوسط، ليبيا.

INTRODUCTION.

Serranidae (Perciformes) is a monophyletic group of fishes that includes about 475 species, which range from a few centimeters to 3 m long and 400 kg in weight.^{[1][2]} Most Serranids inhabit tropical marine ecosystems and live associated to rocky shores or coral shelves from shallow water to 200 m deep.^[3]

Serranidae is a large and important fish group, considering their diversity, biomass and role as top predators.^{[4]:[5]} Most serranid species have solitary and territorial habits and feed on fish and crustaceans, although the group also includes small-sized species that live in large schools and feed on plankton.^[6] *Epinephelus aeneus* [saint-hilaire, 1817] is present in the Mediterranean Sea and in the Atlantic Ocean.^{[7]:[8]} And can be found throughout the southern Mediterranean (up to 44°N in the Adriatic Sea) and along the west coast of Africa to southern Angola, including islands of the Gulf of Guinea.^[9] Adults are found on rocky or mud and sand bottoms in depths of 20 to 200 m; juveniles have been found in coastal lagoons and estuaries.^[10] *E. aeneus* is of considerable economic importance in fisheries and caught with hooks and lines and by trawls. The white grouper is listed as Near Threatened both in the Mediterranean Regional Red List and Global Red List of IUCN.^[11] This species is also reported to be an excellent candidate for mariculture because of the rapid growth rate and the potential for induced spawning in captivity and good results of aquaculture have been achieved in Israel^{[12]:[13]} and^[14] the maximum total length is reported as 120 cm and weight as 25 kg^[10]. It is a protogynous hermaphrodite species that is reported to be mature first at 5 to 7 years, as a female (total length 50-60 cm, weight about 4kg) and sex change occurs at 10 to 13 years (total length 80-110 cm, weight 6-15 kg) in Tunisia.^{[15]:[16]} Studied the gonad histology and spawning pattern of this species in Iskenderun Bay (Turkey) and reported that the spawning period started in the beginning of June and continued till the end of August.^[17] The length-weight relationship of fish is an important fishery management tool. Its importance is pronounced in estimating the average weight at a given length group and in assessing the relative wellbeing of a fish population.^[18] Consequently, length-weight studies on fish are extensive.^[19] Reported the importance of length-weight relationship in the calculation of an equation of growth in length into an equation of growth in weight.

In the West African waters,^[20] found that its diet comprises of fishes (58%), stomatopods (21%), crabs (10%), and cephalopods (10%). Examination of *E. aeneus* (400 to 900 mm TL; n=161) commercially-caught specimen from the Senegalese shore suggested that *Sardinella aurita* and *Octopus vulgaris* were the preferential and accessory preys during the cold season, respectively. During the warm season, teleosts were abundantly ingested while mollusks (esp. *Sepia officinalis*) were accessory preys with the crustacean *Callinectes amincola* be an occasional prey.^[21] The available data of grouper food habits demonstrate that they are similar to other large predatory fish, which feed throughout the day.^[22]

The available literature indicated that few works have been published on the biology of white grouper in Libyan coast. The present study is the first work on the feeding habits of *E. aeneus* in Telmatha Mediterranean coast, Eastern Benghazi.

MATERIALS AND METHODS.

Stomachs of 128 specimens of *Epinephelus aeneus* collected from the artisanal catch (long line and spear fishing) from Tellmatha Coast (32°42'53.86"N; 20°56'47.01"E) (Figure 1) during May 2018 to April 2019 were examined to study their food and feeding habits. Monthly and seasonal diet composition, variation of diet composition with fish length and the intensity of feeding were studied.

For each of 128 fish specimens, total length and weights were established to the nearest 0.1 cm 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, half full, three quarter full and completely full respectively as described by.^[23] 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.^[24] Obtained results were subjected to further statistical evaluation according to.^[25] In order to give more precise information about food and feeding habits of *E. aeneus*.

RESULTS.

Annual diet composition:

There was great variation in food items [Fig.2] of *E. aeneus*; however, fish supplemented by fish formed the major food groups of the fish. Fish made up 37.22 % composition of the bulk of the diet. They were represented by small fish such as, *Sardinella maderensis*, *sarp salpa*, *diplodus sp.*, *boops boops* and *Pagrus pagrus*. They were composed of shrimps, crabs (*cronies ruber* and not identified crabs from family *xanthidae*) and lobsters and mollusk (bivalves, gastropod and cephalopod). Crustaceans come in the second position of importance (36.32 %). The other food items were mollusk constituting (12.49%) followed by Polychaetes (10.67%) and Marine algae (2.59%). The minor food items were Foraminifers which constituted only (0.71%).

Figure [1]: Map showing the collection site: Telmatha Coast (32°42'53.86"N; 20°56'47.01"E) on the Mediterranean Sea of eastern Libya.

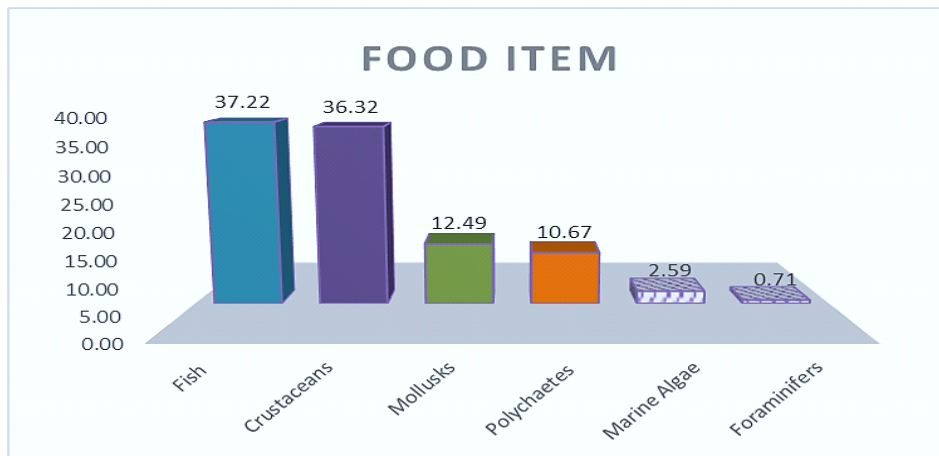


Figure [2]: The diet composition of 128 *Epinephelus aeneus* from Tellmatha Coast (32°42'53.86"N; 20°56'47.01"E), eastern Libya.

Monthly variations in diet composition.

There was great variation in food items of *Epinephelus aeneus* (Table 1 and Fig. 3): Crustaceans and fish were consumed all year round, sediments completely disappeared from the diet during August and September. Maximum consumption of Mollusks occurred in June (25%), crustaceans constituted 90% in April, polychaetes 50% in July, foraminifera 8% in December and of fish parts 100% in October.

Table (1): Monthly variations in diet composition of *Epinephelus aeneus* from Tellmatha Coast eastern Libya.

Months	N ^o of fish	Marine Algae	Crustaceans	Foraminifers	Fish	Mollusks	Polychaetes
May -18	4	0.0	80	6.7	13.3	0.0	0.0
Jun -18	5	0.0	65	0.0	10	25	0.0
July -18	10	0.0	25	0.0	0.0	25	50
Aug -18	17	0.0	25	0.0	75	0.0	0.0
Sep -18	16	11.7	73.3	0.0	11.7	0.0	3.3
Oct -18	2	0.0	0.0	0.0	100	0.0	0.0
Nov-18	13	0.0	16	0.0	60	24	0.0
Des -18	13	6	16	8	48	12	10
Jan -19	13	6	35	0.0	0.0	59	0.0
Feb -19	19	0.0	50.9	0.0	9.1	40	0.0
March-19	7	0.0	80	0.0	0.0	20	0.0
April -19	9	0.0	90	0.0	0.0	10	0.0
mean	128	1.97	46.35	1.23	27.25	17.92	5.28

Figure 3. Monthly variations in diet composition of the studied *Epinephelus aeneus*

Seasonal variations in diet composition.

The seasonal variations in diet composition of the studied *Epinephelus aeneus*. Are shown in (Table 2) (Fig 4). Fish, crustaceans and mollusks were the main component of the diet during all seasons, Marine Algae were absent from the diet during spring and summer. In summer, the fish ingested Crustaceans (38.3%), Fish (28.3%), mollusks (16.7%) and Polychaetes (16.7), while, Foraminifers and Marine Algae were absent. In autumn, algae (3.9 %), Crustaceans (29.8%), Fish (57.2 %) Foraminifers were absent. In winter Crustaceans (34.0 %), fish (19.0 %), mollusks (37 %), Polychaetes (3.3%) and Marine Algae (4%). In spring, the fish preferred Crustaceans (83.3%), Foraminifers (2.2%), fish (4.43 %), mollusks (10%) and Polychaetes was absent

Table 2. Seasonal variations in diet composition of the *Epinephelus aeneus*

Seasons	N ^o . of fish	Food item					
		Marine Algae	Crustaceans	Foraminifers	Fish	mollusks	Polychaetes
Summer	32	A	38.3	A	28.3	16.7	16.7
Autumn	31	3.9	29.8	A	57.2	8	1.1
Winter	45	4	34.0	2.7	19.0	37	3.3
Spring	20	A	83.3	2.2	4.43	10	A

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

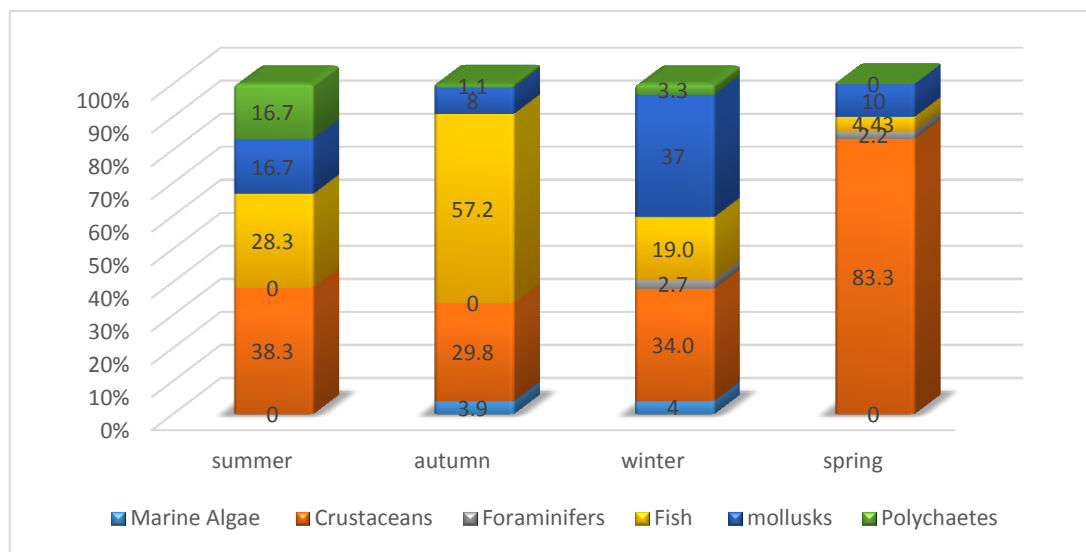


Figure [4]. Seasonally variations in diet composition of the *Epinephelus aeneus*

Feeding habit in relation to fish size:

The total length of *Epinephelus aeneus* population was segregated into 7 classes ranging from 17.2 cm to 89.2 cm with 10.2 cm interval (Table 3) (Fig 5). Prey size differed according to the size of the fish. Large fish ingested large size preys, whereas small sized fish ingested small size preys. Crustaceans, cephalopods and green algae were found in all length groups of *Epinephelus aeneus*.

In the present study, fish-preys increased as *E. aeneus* size increased while crustaceans, mollusks, foraminifera, polychaete and Algae decreased as *E. aeneus* size increased. Fish-preys were found in all length groups *E. aeneus*, they increased from 4.50 % in *E. aeneus* size class (22.7 - 37.7 cm) to 61.67 % in size class (48.1-58.3cm), increased in the following size classes to record 70% in size class 79.0 - 89.2cm, Fish parts disappeared from the menu in size class (37.8 - 48.0 cm). Crustaceans decreased from 56.09% in *E. aeneus* size class (17.2-27.4 cm) to 50.0 % in size class (37.8- 48.0), then recorded the lowest value of 30% in the size class (79.0 - 89.2cm). Foraminifera appeared 5% in size class (27.5 - 37.7cm), and disappeared in the other length groups. Recorded the highest value of Mollusks 36.9% of the food in

the size class (17.2 - 27.4). Algae Appeared in size class (17.2 - 27.4cm) and 6.67% in size class (58.4 - 68.6 cm).

Polychaetes recorded the lowest value of 8% in size class (27.5 - 37.7 cm) and the highest value of 50 % in size class (37.8 - 48.0).

Table (3). The diet composition of different size classes of *Epinephlus aeneus* from Tellmatha Coast, eastern Libya during May 2018 to April 2019

		FOOD ITEM					
length groups (cm)	No.of fish	Marine Algae	Crustaceans	Foraminifers	Fish	Mollusks	Polychaetes
17.2 - 27.4	43	3.48	56.09	A	4.35	36.09	A
27.5 - 37.7	48	3.00	51.50	5.00	4.50	28.00	8.00
37.8 - 48.0	12	A	50	A	A	A	50
48.1 - 58.3	8	5.00	A	A	61.67	16.67	16.67
58.4 - 68.6	8	6.67	26.67	A	60.00	6.67	A
68.7 - 78.9	7	A	40	A	60	A	A
79.0 - 89.2	2	A	30	A	70	A	A
	128	18.14	254.25	5.00	260.51	87.42	74.67
Mean		2.59	36.32	0.71	37.22	12.49	10.67

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

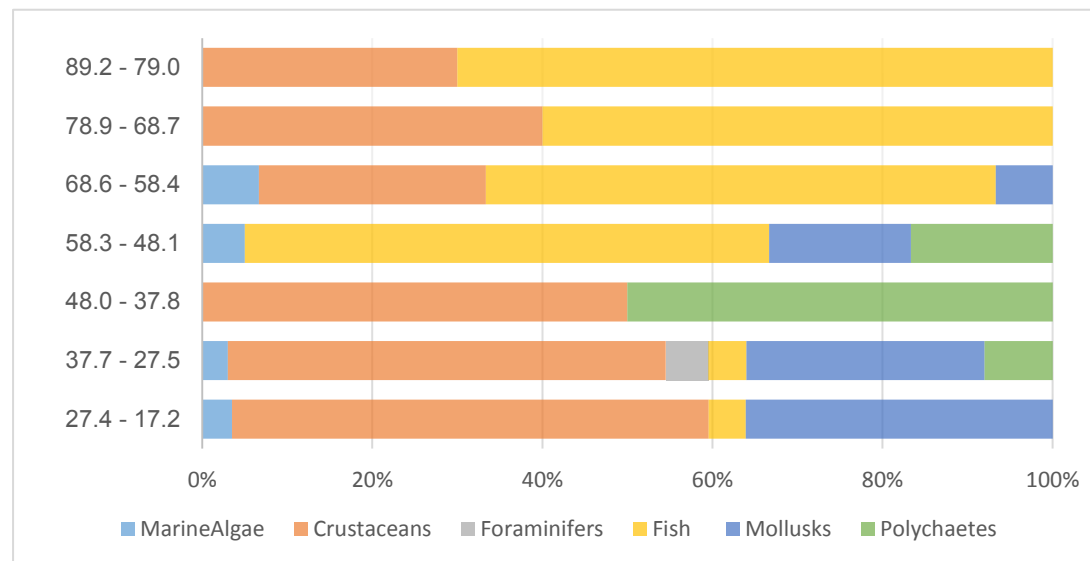


Figure [5]. Diet composition of different length classes of the 128 studied *Epinephlus aeneus*.

Feeding intensity.

Fishes with stomach half full, almost full and full of food were grouped together in the rank b%. They constituted 82.31% of all analyzed individual, whereas those with stomach that were empty or with traces of food and quarter full were ranked a percentage and represented 17.68 % of the total specimens.

Seasonal variations in feeding intensity:

The feeding intensity (Table 4 and Fig 6) was quite high in spring (91.7%), winter (82.8%) summer (82.7) and low autumn (71.92%).

Table (4). Seasonal variations in the intensity of feeding of *Epinephlus aeneus*, Tellmatha Coast, eastern Libya during May 2018 to April 2019

The degree of distension of the stomach								
Seasons	Empty	trace	1/4%	a %	1/2%	3/4 %	full	b %
Summer	A	6.7	10.6	17.3	52.1	28.6	2.0	82.7
Autumn	A	4.13	23.88	28.01	41.33	25.96	4.63	71.92
Winter	6.9	5.1	5.1	17.1	31.2	20.6	31.0	82.8
Spring	A	A	8.3	8.3	62.8	20.5	8.3	91.7

Remarks: Data expressed as percentage (A) = No food in season occurred



Figure [6]. Seasonal variations in feeding intensity of the studied *Epinephlus aeneus*. [a%: (empty + trace + 1/4 stomachs), b% : (1/2 + 3/4 + full stomachs)]

Discussion.

The studied area, Tellmatha Coast, eastern Libya. Libya is covered with a variety of marine algae, which accommodate abundant invertebrates such as Crustaceans, Foraminifers and Polychaetes [26]. In this study as well as in [20] study, fish and crustaceans, were identified as common food items for *E. aeneus*. Furthermore, similar percentages of preys (fish, crustaceans) were found inside the stomachs. These contrasts with some studies where groups themselves like crustaceans in study, [20] found that its diet comprises of fishes (58%), stomatopods (21%), crabs (10%), and cephalopods (10%) and were found to be the most frequent prey group. We believe that those findings are related to the small number of organisms sampled giving as a result diets composed primarily of fishes and crustaceans or just fishes. The majority of the preys found in the stomach contents were benthic species, with the exception of some pelagic species such as *Sardinella maderensis*, *sarp salpa*, *diplodus sp.*, *boops boops* and *Pagrus pagrus*. In the current study *E. aeneus* fed on a broad spectrum of food items. It fed predominantly on Crustaceans (36.32%) supplemented by fish (37.22%), mollusks (12.49%) Polychaetes with (10.67%), Foraminifers with (0.71%) and Marine Algae with (2.59%). This is agreement with [20]

Results of present and previous studies indicate that *E. aeneus* is a predator fish that feeds on a large number of different species of fishes, mollusks and

crustaceans. In conclusion, crustaceans are the smallest prey in relation to fish size and they are the most common prey of the small white grouper. As groupers increase in size, they consume higher amounts of development.^[27] In the present study, the ratio of composition of Crustaceans and Mollusks decreased as the fish size increased, whereas the ratio of Fish item increased. Personal observation and comments suggest that *E. aeneus* should be considered abenthic predator that feeds from species located at rocky site and sea grass beds. Since previous research indicates that these are their natural habitats.^{[10];[28]} We can that the weight grouper *E.aeneus* avoids large movements to catch their praise .Results of this study are similar to those reported by,^[22] who concluded that food habits of groupers change with size. In the current study, the feeding intensity of *E. aeneus* clearly indicates a high rate of feeding activity.

CONCLUSIONS

Result of present and previous Studies indicate that *E. aeneus* is a predator fish that feeds on large number of different species of fishes, mollusk and crustaceans .in conclusion, crustaceans are the smallest prey in relation to fish size and they are the most common prey of the small *E. aeneus*. As grouper, reach increase in size they consume higher amount of larger preys such as fishes and cephalopods. The fish, Crustaceans and mollusks 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 *E. aeneus* with other invertebrates and fishes in this area, in order to understand the dynamic of this regional ecosystem. Beside results from feeding habits of *E. aeneus* may have direct implications for aquaculture.

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