

Feeding Habits of Sea Breams (*Genus Pagellus*) in the Egyptian Mediterranean Waters

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ABSTRACT. Analysis of stomach content of *Pagellus erythrinus* showed that crustaceans, polychaetes and teleosts together with small amounts of cephalopods and brittle stars constitute the main food items. The empty coefficient of *Pagellus erythrinus* in the Egyptian Mediterranean waters is higher than in other regions which can be attributed to the less available food encountered by predators. Juveniles and adults of *P. erythrinus* differ to large extent in the mode of feeding. For immature individuals (less than 14.0 cm length) polychaetes are the most favourable food items, while for individuals having size more than 14.0 cm shrimp and crabs comprise the main food items. Results obtained revealed that polychaetes predominate in winter and spring, while crustaceans form the main group in summer and echinoderms are the essential food in autumn. Food items of *P. acarne* mainly consists of crustaceans, teleosts and echinoderms in addition to small quantities of cephalopods and polychaetes. Fishes with size less than 14.0 cm mainly feed on echinoderms and crustaceans, while shrimps, *Squilla mantis* and bony fishes comprise the most essential food items for individuals having length range 15.0-18.0 cm. For fishes with lengths more than 18.0 cm, bony fishes, shrimps and cephalopods constitute the main food. Crustaceans are found in all seasons but consumed in large quantities in summer, while during autumn and winter, bony fishes predominate. Such differences in the food items are attributed to the change in seasonal abundance of the above mentioned food items in the environment.

Introduction

Food habit studies are an important way to understand mechanism and processes which structure fish assemblages (Kotrschall & Thomson, 1986). Analyzing feeding patterns can contribute to an understanding of the interaction between members of these assemblages. In addition knowledge of prey selection enables assessment of the energy base and the trophic dynamics of the stream community. Food and feeding habits of *Pagellus* species have been discussed by Larraneta (1964); Jukic and Zupanovic (1965); Rijavec & Zupanovic (1965); Gurgel (1971); Ardizzone & Messina (1983); Roscchi (1983);

Ghannudi (1984); Andaloro & Giarritta (1985); Caragitsou & Papaconstantinou (1988); Andaloro (1982); Farranda *et al.* (1983) and Domanevskaya & Patokina (1984).

The objective of this work is to study the different food items found in stomachs of *Pagellus erythrinus* and *Pagellus acarne* in the Egyptian Mediterranean waters.

Material and Methods

Monthly samples of *Pagellus erythrinus* and *P. acarne* were randomly obtained from trawlers operating along the Egyptian Mediterranean coast from December, 1990 to January, 1992 for *P. acarne*. Guts were removed and preserved in 10% formalin solution. The different food items were identified to the major categories and data obtained were analyzed by using the occurrence and points methods.

A. The frequency of occurrence method

Number of fish stomach samples in which each of a given food item is listed as a percentage of the total number of fish examined [Godfriaux (1969); Hureau (1970); Al-Kholy & Abdel-Malek (1972) and Windell & Bowen (1978)].

B. The points method

This method is considered as the best approximation of the true volume of the food items consumed [Hynes (1950) and Pillay (1952)]. In such method, each food item is allowed as a number of points according to the volume of its presence in the stomach. All the points obtained are summed and dividing by the total number of food points awarded to all fish analyzed.

Results

1 – *Pagellus erythrinus*

a. Feeding intensity

The examination of 1479 stomachs of *P. erythrinus* showed that 68.56% were completely empty. The feeding intensity (number of stomachs containing different food items) is markedly increased during December and January reaching 80.00 and 72.22% respectively (Table 1).

b. Major food items

Examination of 131 stomachs of *P. erythrinus* containing different food items shows that members of Crustacea, Annelida, Mollusca, Echinodermata and Teleostei from the main food items. Crustacea constitutes an average percent of 27.95 by volume composition of diet. Members of this class are mainly shrimps, crabs, larvae and *Squilla mantis* which occurs in 29.77% of the total number of examined stomachs. Annelida (polychaetes) is considered as the second food item constituting 24.12% of composition and occurring in 33.59% of the total examined stomachs, whereas Teleostei represents the third major food item constituting 17.46% of the over all food bulk and occurring in

15.27% of the total examined samples. Mollusca is represented by cephalopods, gastropods and bivalves which occur in 27.485 of the total comprising 10.03%; 2.99% and 2.68% of the total diet respectively, constituting about 15.70% by volume composition of the ingested food. Echinodermata occurs in 13.74% of the total forming 9.11% of the total. The most common members of his phylum are the brittle stars, sea urchins and sea cucumber. They are arranged in descending position according to their importance. Urochordata is represented by genus *Ascidia* constituting 3.22% of the total. Algae and invertebrate eggs are not frequently eaten by *P. erythrinus* composing 0.99% and 1.45% of the total food items respectively (Table 2).

TABLE 1. Monthly percentage of empty stomachs and those containing food for *Pagellus erythrinus* in the Egyptian Mediterranean waters (1990-1991).

Month	Total number of stomachs examined	Empty stomachs		Stomachs containing food	
		No.	%	No.	%
December, 1990	205	41	20.00	164	80.00
January, 1991	162	45	27.78	117	72.22
February	136	99	72.79	37	27.21
March	85	69	81.18	16	18.82
April	87	63	72.41	24	27.59
May	140	122	87.14	18	12.86
June	104	99	95.19	5	4.81
July	93	68	73.12	25	26.88
August	96	68	70.83	28	29.17
September	99	85	85.86	14	14.14
October	116	114	98.28	2	1.72
November	156	141	90.38	15	9.62
Total number	1479	1014		465	
Total percentage			68.56		31.44

TABLE 2. Frequency occurrence and percentage composition of different food items in stomachs of *Pagellus erythrinus* according to their abundance.

Food items	% Occurrence	% Composition
Class Crustacea :	29.77	27.95
Shrimp	12.98	13.09
Crabs	6.87	8.50
Larvae	2.29	1.30
<i>Squilla mantis</i>	0.76	0.77
Others	8.40	4.29
Phylum Annelida :		
Polychaetes	33.59	24.12
Infra-class Teleostei :	15.27	17.46
Phylum Mollusca :	27.48	15.40

TABLE 2. Contd.

Food items	% Occurrence	% Composition
Cephalopod	8.40	10.03
Gastropod	7.63	2.99
Bivalves	6.87	2.68
Phylum Echinodermata :	13.74	9.11
Brittle star	7.63	4.36
Sea urchin	3.05	2.45
Others	0.76	0.23
Sub-phylum Urochordata:		
Ascidia	2.29	3.22
Algae :	0.76	0.99
Invertebrate eggs :	1.53	1.45

c. Food items in relation to size

Samples are arranged to three main groups: less than 14.0 cm (immature); 14.0-20.00 cm and more than 20.00 cm (Fig. 1). It has been observed that the most important food items for immature individuals are annelids (23.51%); crustaceans (22.48%); teleosts (21.35%); molluscs (15.88%) and echinoderms (13.59%). Ascidiaceans and invertebrate eggs comprise a rather minor portion of the diet.

As regards the second group (14.00-20.00 cm), crustaceans constituted (29.59%), while annelids (27.51%); teleosts (14.75%) and molluscs (14.35%).

For fishes with more than 20.00 cm in length, it was found that crustaceans constitute (32.45%); molluscs (20.41%); teleosts (14.90%) and annelids (12.65%). Brittle stars and sea urchins comprise 4.19% and 0.52% respectively.

d. Food items in relation to season

It was observed that crustaceans appear in the diet throughout the year, predominate in summer (29.95%). Polychaetes are generally prevailed during winter (27.43%), spring (28.86%) and summer (20.53%) but rarely found in autumn (3.25%). Teleosts are generally abundant from autumn (15.85%) to spring (26.56%) and absent in summer. Molluscs dominate in winter (20.91%). Gastropods are found only during autumn (9.35%) and winter (4.74%) (Fig. 2). The role of ascidians is gradually increased from spring (3.25%) to autumn (12.20%). Algae are only found during summer (6.28%). Invertebrate eggs are found in summer (9.18%), while they form a minor part in winter (0.08%) and completely disappear in spring and autumn.

2 – *Pagellus acarne*

a. Feeding intensity

Examination of 959 stomachs of *P. acarne* showed that 79.25% were completely empty. This species exhibits higher feeding activity during August where 84.44% of the

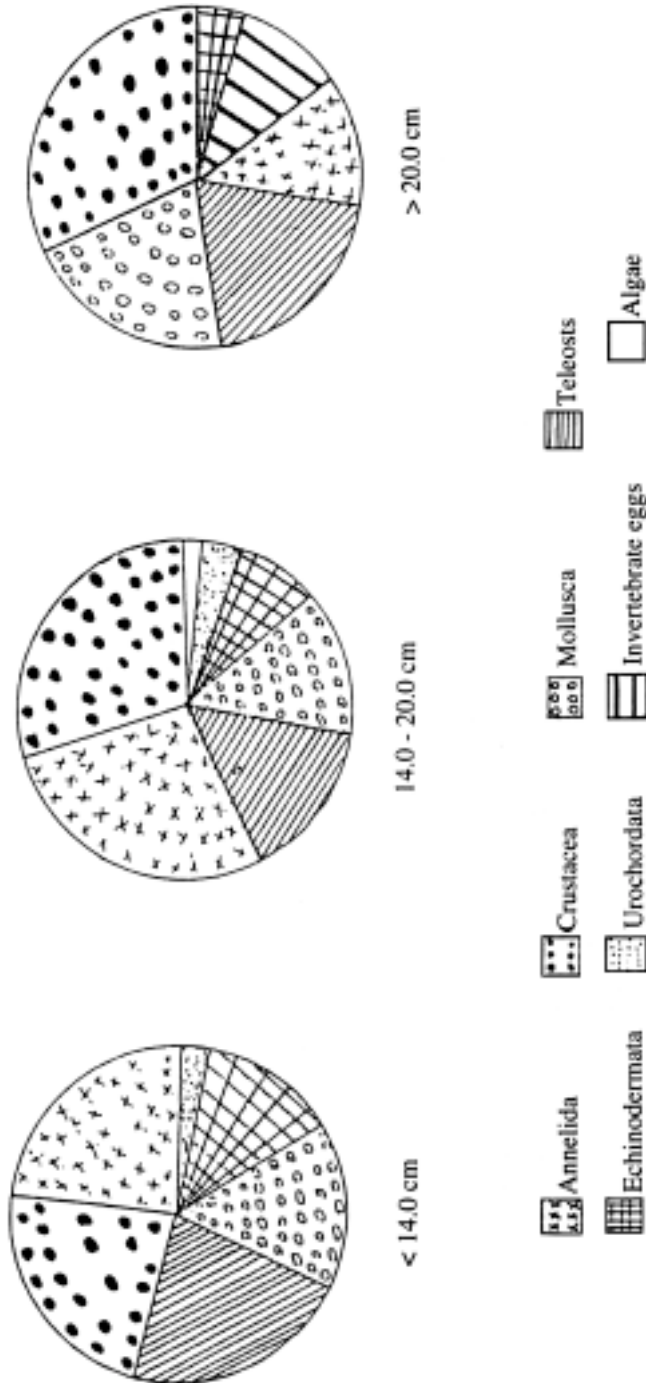


Fig. 1. Percentage composition of different food items in stomachs of *Pagellus erythrinus* in relation to different size groups.

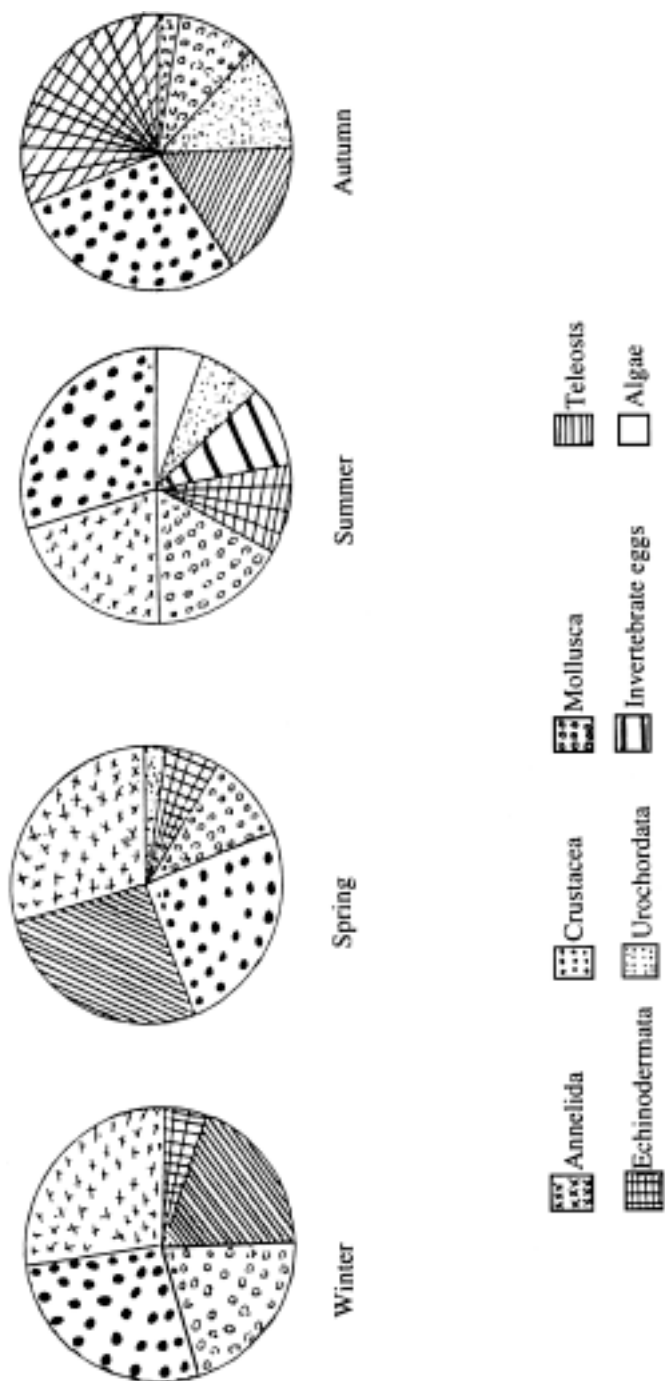


Fig. 2. Seasonal variation of diet composition in stomachs of *Pagellus erythrinus*.

total examined samples contain food. Such increase in feeding activity is observed before gonad maturation (Table 3).

TABLE 3. Monthly percentage of empty stomachs and those containing food for *Pagellus acarne* in the Egyptian Mediterranean waters (1991-1992).

Month	Total number of stomachs examined	Empty stomachs		Stomachs containing food	
		No.	%	No.	%
February, 1991	77	63	81.82	14	18.18
March	97	88	90.72	9	9.28
April	57	42	73.68	15	26.32
May	109	87	79.82	22	20.18
June	78	76	97.44	2	2.56
July	54	42	77.78	12	22.22
August	45	7	15.56	38	84.44
September	66	43	65.15	23	34.85
October	68	58	85.29	10	14.71
November	109	91	83.49	18	16.51
December	108	94	87.04	14	12.96
January, 1992	91	69	75.82	22	24.18
Total number	959	760		199	
Total percentage			79.25		20.75

b. Major food items

Crustaceans, teleosts and echinoderms constitute the main food items (Table 4). Crustaceans comprise 55.32% and occur in 68.14% of the total number of examined stomachs. Members of this class are arranged in descending order according to their percentage of volume composition; decapods (shrimps) constitute 25.69%; stomatopods (*Squilla mantis*) comprise 19.17%; amphipods (*Phitistica marina*; *Caprella* sp. and other) form 4.37%; isopods (3.03%) and other partially digested unidentified crustaceans (3.06%). Teleosts occur in 17.69% of the examined samples comprising 20.17% of the total. Echinoderms are represented by Ophiuroidea (brittle stars) occurring in 22.12% of the total examined stomachs which constitute 14.15% of the total. Molluscs are mainly represented by cephalopods and bivalves comprising minor portion (0.31 and 0.15% respectively). Annelids (polychaetes: *Sipunculus nudus* and invertebrate eggs form rather than low percentage (2.03%; 1.38% and 1.27% of the total diet respectively).

c. Food items in relation to size

As the same in *P. erythrinus*, sizes of *P. acarne* are arranged to three main groups: < 14.0 cm; 14.0-18.0 cm and > 18.0 cm (Fig. 3). The main food items for immature individuals (< 14.0 cm length) are Ophiuroidea (44.07%); Crustacea (28.19%) and Teleostei (19.68%). Crustacea is mainly represented by Decapoda (19.24%), Amphipoda (7.16%) and a minor portion of Isopoda (0.45%). Polychaetes (7.61%) and invertebrate eggs (0.45%) comprise relatively low percentage of food items.

TABLE 4. Percentage occurrence and percentage composition of different food items in stomachs of *Pagellus acarne*.

Food items	% Occurrence	% Composition
Class Crustacea :	68.14	55.32
Decapoda	30.97	25.69
Stomatopoda	15.93	19.17
Amphipoda	31.85	4.37
Isopoda	7.08	3.03
Others	12.38	3.06
Infra-class Teleostei :	17.69	20.17
Phylum Echinodermata :		
Ophiuroidea	22.12	14.15
Phylum Mollusca :	8.85	5.67
Cephalopod	4.42	5.21
Gastropod	3.54	0.31
Bivalves	2.65	0.15
Phylum Annelida :		
Polychaetes	10.62	2.03
<i>Sipunculus nudus</i> :	0.88	1.38
Invertebrate eggs :	1.77	1.27

For individual with size range 14.0-18.0 cm, it was observed that crustaceans; teleosts and echinoderms constitute 63.12%, 19.29% and 8.28% of the total food items respectively. Molluscs; polychaetes, *Sipunculus nudus* and invertebrate eggs comprise rather low values (5.25%, 0.73%, 1.75% and 1.56%) of the total respectively.

Teleosts; crustaceans and molluscs constitute the main bulk of food items for individuals having length > 18.0 cm. Bony fishes comprise 50.0% of the total followed by crustaceans (25.0%). Decapods; isopods and amphipods constitute 21.95%, 1.83% and 1.22% of the total food digested respectively. Mollusca is represented only by cephalopods comprising 21.95 of the total. Polychaetes and invertebrate eggs constitute 2.44% and 0.16% respectively.

d. Relation between food items and seasons

Analysis of the seasonal variation in different food items revealed that crustaceans dominate during the four seasons, they gradually increase from autumn (33.49% of the total) through the other successive seasons reaching maximum in summer (99.44%). The main members of crustacea are decapods; stomatopods; amphipods and isopods. Decapods (shrimps) and stomatopods (*Squilla mantis*) are abundant in summer forming 61.41% and 36.73% of the total food digested. Amphipods gradually increase their occurrence from summer through the other successive seasons reaching maximum value in spring. Isopods are absent in summer, they comprise 1.85% in autumn; 4.15% in winter and 4.58% in spring.

Teleosts reach maximum value during autumn and winter (30.48% and 27.29% respectively), while they are completely absent in summer.

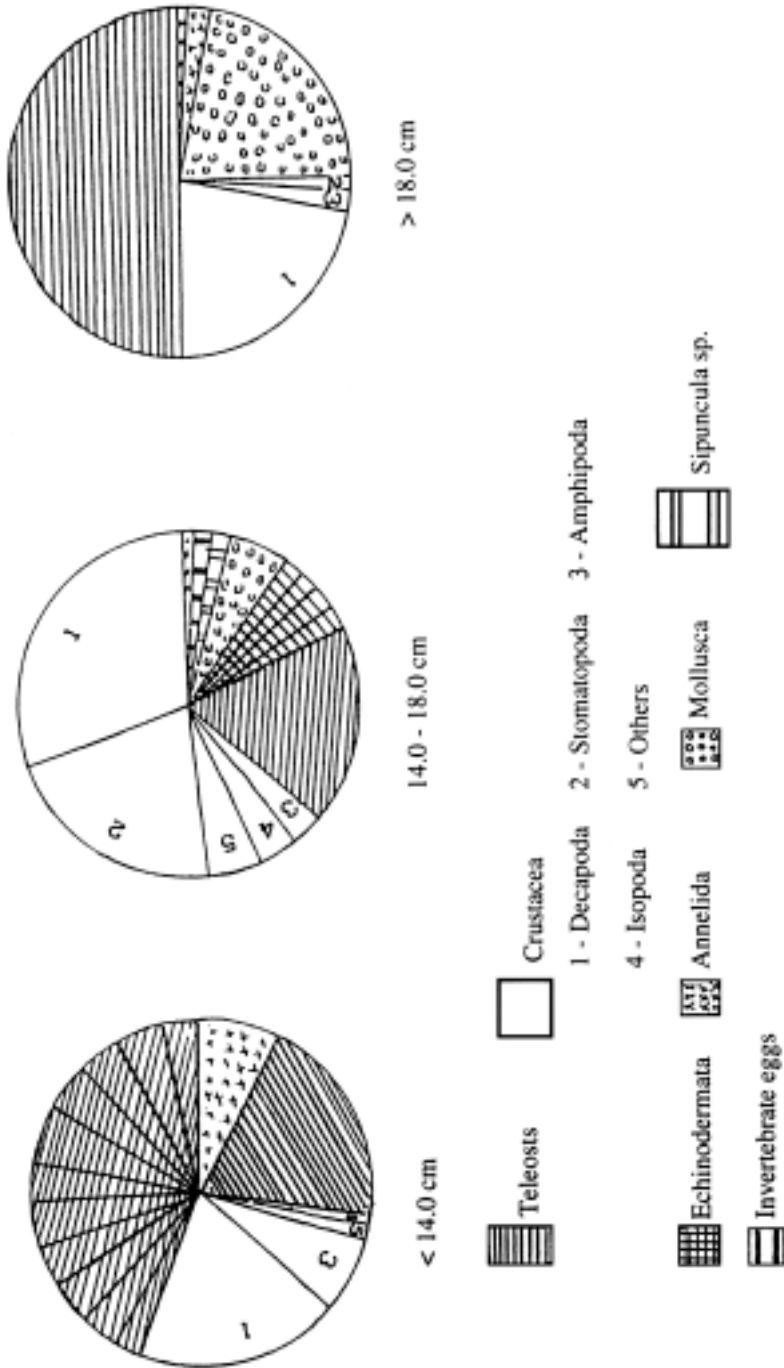


FIG. 3. Percentage composition of different food items in stomachs of *Pagellus acarne* in relation to size groups.

Brittle stars (Echinodermata) reach maximum in winter (28.28%). Cephalopods (Mollusca) comprise 26.79% of the total ingested food during autumn. The role of polychaetes increases from 0.37% in summer to 3.06% in winter. *Sipunculus nudus* constitutes 3.93% in winter, whereas invertebrate eggs are only observed in spring comprising 4.58% of the total food consumed (Fig. 4).

Discussion

Members of genus *Pagellus* inhabiting the Egyptian Mediterranean waters mainly feed on bottom fauna. The chief constituents of *Pagellus erythrinus* diet are crustaceans (shrimps and crabs); polychaetes and teleosts, they also feed on small quantities of cephalopods; brittle stars and other miscellaneous items. These results confirm those given by Larreneta (1964) for Castellon coast; Rijavec & Zupanovic (1965) for central Adriatic; Rosecchi (1983) for Gulf of Lion and Ardizzone & Messina (1983) for middle Tyrrhenian Sea (Table 5).

Gurgel (1971) and Caragitsou & Papaconstantinou (1988) found that polychaetes dominated diet of *P. erythrinus* in the Gulf of Marseille and Greece waters (Corinthiakos Gulf and Ionian Sea) respectively.

Analysis of data for *Pagellus acarne* revealed that it mainly feeds on benthic organisms which consist of crustaceans (shrimps and *Squilla mantis*); teleosts and echinoderms (Ophiuroidea). In addition, *P. acarne* consumes small amounts of molluscs, polychaetes and other different items.

Value of empty coefficients of *P. erythrinus* and *P. acarne* in the Egyptian Mediterranean waters is higher than in other regions (Table 6), this may be attributed to the less available food encountered by predators. Andaloro & Giarrita (1985) attributed the variations of the empty coefficient in stomachs of *P. erythrinus* in Sicilian channel to the possibilities of encounters between the predator and prey. Jukic & Zupanovic (1965) observed that the variation of temperature has a certain correlation with feeding intensity for *Mullus barbatus* and *Pagellus erythrinus* in Kastella Bay. They found that 14.2% of the maximum stomachs were empty during winter, while in summer none was found to be empty.

Changes in food composition with fish size are well known among fishes (Nikolsky, 1963; Al-Zahaby, 1973; Allam, 1979; Faltas, 1983 and El-Emary, 1987). In the present study, the mode of feeding patterns for *P. erythrinus* shows a significant difference between adult and juveniles. Polychaetes are one of the most favourable food items for individuals having length range less than 14.0 cm, while shrimps and crabs are the main food constituents for fishes with size more than 14.0 cm. This may be attributed to the mode of feeding related to the diameter of mouth opening and development of teeth (Al-Zahaby, 1973).

The present results are in accordance with those of Caragitsou & Papaconstantinou (1988) for *P. erythrinus* off the western coast of Greece, as they mentioned that polychaetes constituted the main bulk of diet for the individuals having small size and bra-

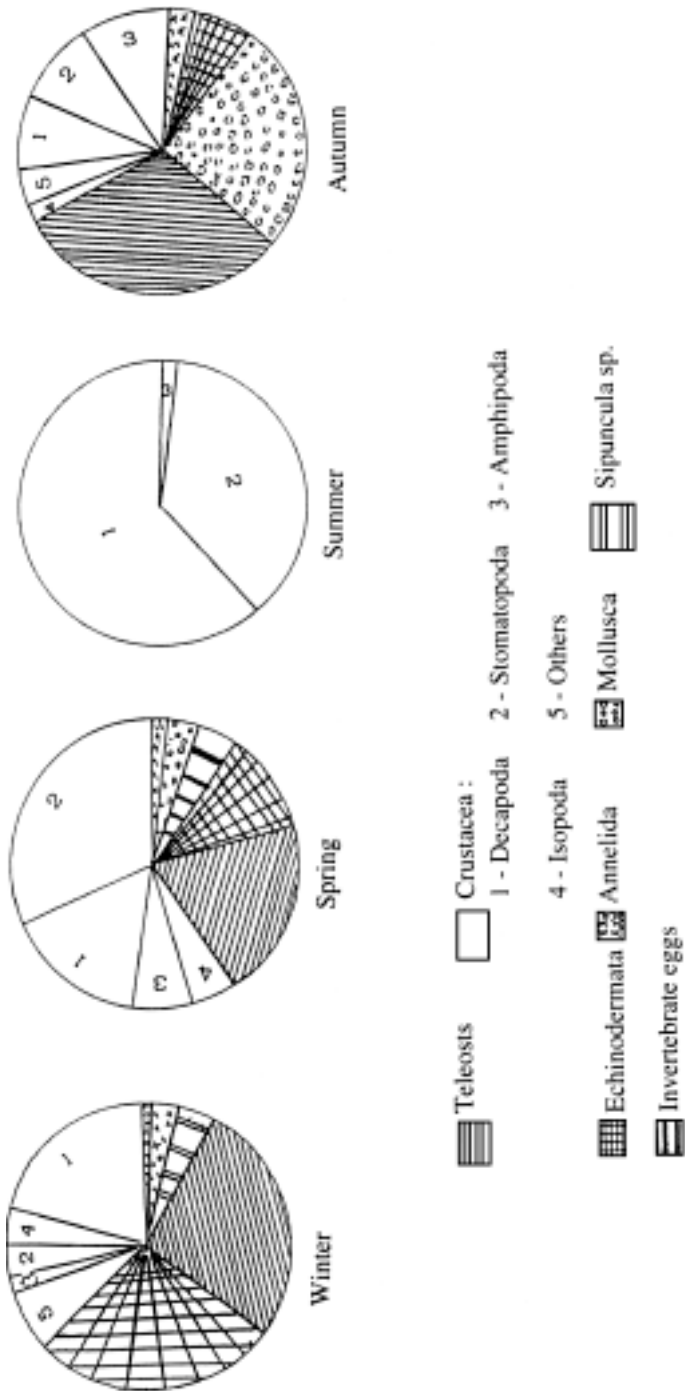


FIG. 4. Seasonal variation of diet composition in stomachs of *Pagellus acarne*.

TABLE 5. Percent composition of different food items in stomachs of *Pagellus erythrinus* in different localities given by different authors.

Food items	Author	Larraneta, 1964	Rijavic & Zupanovic, 1965	Gurgel, 1971*	Rosecchi, 1983	Ardizzone & Messina, 1983	Present study 1990-1991
	Area	Castellon coast	Middle Adriatic	Gulf of Marscille	Gulf of Lion	Middle Tyrrhenian sea	Off Alexandria
	No. of stomachs	70	93	83	225	-	131
Polychaetes		31	22.58	84.1	20	27.3	24.12
Crustaceans		38	22.58	4.9	54.6	50.6	27.95
Cephalopod		11	20.43	0.0	1.8	1.6	10.03
Teleosts		8	23.65	0.0	0.27	5.0	17.45
Gastropods		-	4.3	-	0.5	-	2.99
Bivalves		-	-	-	-	10.3	2.68
Brittle stars		4	-	2.0	6.0	4.7	4.36
Others		8	6.45	3.7	17	-	10.41

*Quoted from Rosecchi (1983).

chyuran (Crustacea) for the bigger ones. On the other hand, the present observation contradicts that given by Ghannudi (1984) who found that non significant differences were found in food taken by small and big individuals for *P. erythrinus* in Libyan waters. Concerning *P. acarne* it is clear that small fishes (< 14.0 cm) mainly feed on Ophiuroidea and Crustacea (amphipods and shrimps), whereas shrimps; *Squilla mantis* and teleosts are the most important items for individuals with length range 14.0-18.0 cm. For fishes bigger than 18.0 cm length, it was found that they mainly feed on bony fishes; shrimps and cephalopods. The presence of preys belonging to such different benthic communities in stomach content of *P. acarne* confirms its wide distribution along the coastal zone in the Egyptian Mediterranean waters.

TABLE 6. Comparison between empty coefficient for *Pagellus* species off Alexandria given in other localities of the Mediterranean Sea.

Author	Species	Area	Empty coefficient*
Jukic & Zupanovic (1965)	<i>Pagellus erythrinus</i>	Kastella Bay	14.20
Rijavec & Zopanovic (1965)	<i>Pagellus erythrinus</i>	Middle Adriatic	40.00
Ardizzone & Messina (1983)	<i>Pagellus erythrinus</i>	Middle Tyrrhenian Sea	48.00
Rosecchi (1983)	<i>Pagellus erythrinus</i>	Gulf of Lion	30.00
Andaloro & Giarrita (1985)	<i>Pagellus erythrinus</i>	Sicilian Channel	23.00
Present study (1990-1991)	<i>Pagellus erythrinus</i>	Off Alexandria	68.56
Present study (1991-1992)	<i>Pagellus acarne</i>	Off Alexandria	79.25

$$*\text{Empty coefficient} = \frac{\text{Number of empty stomachs}}{\text{Total number of stomachs}} \times 100$$

As regards the seasonal variations of food items ingested by studied fishes in the Egyptian Mediterranean waters, it has been found that polychaetes is the dominating food group for *P. erythrinus* in winter and spring, while crustaceans constitute the main food item in autumn. This shift in the diet composition is principally due to the change in seasonal abundance of these different food items in the habitat (Al-Zahaby, 1973). Ramadan (1979) observed that polychaetes dominated the benthic fauna of the Egyptian Mediterranean waters (Abu-Kir and Rosetta regions) during winter and spring at depth 50-70 meters. This observation is in agreement with that obtained during the present study which showed that polychaetes dominate the food items of *P. erythrinus* in winter and spring.

Crustaceans are found in the diet of *P. acarne* in all seasons and consumed in large quantities in summer, whereas teleosts dominated during autumn and winter. By comparing the present data with those given in available literature, it can be stated that the present results coincide with those given by Andaloro (1982) for Tyrrhenian and Ionian seas and Domanevskaya & Patokina (1984) for the central eastern Atlantic ocean. They mentioned that the Spanish bream or axillary bream (*Pagellus acarne*) mainly feeds on benthic organisms.

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العادات الغذائية لأسماك الغزيلة (جنس باجلص) في المياه المصرية للبحر المتوسط

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المستخلص . يوجد نوعين من أسماك الغزيلة في المياه المصرية للبحر المتوسط وهما الغزيلة الحمراء و الغزيلة البرونزية . وبتحليل المحتوى الغذائي لأمعاء الغزيلة الحمراء تبين أن المكونات الرئيسية لها هي القشريات ، الديدان عديدة الأشواك والأسماك العظيمة بالإضافة إلى كميات صغيرة من الرأسقدميات ونجوم البحر الهشة . وبمقارنة درجة امتلاء أمعاء تلك الأسماك بمشيلاتها في المناطق المختلفة من البحر المتوسط ، لوحظ انخفاضها في المياه المصرية ويرجع ذلك لعدم وفرة الغذاء اللازم . ولقد لوحظ أن الأسماك الكبيرة تختلف عن الأسماك الصغيرة في عاداتها الغذائية ، إذ تتغذى الأسماك الصغيرة ذات أطوال أقل من ١٤ سم أساساً على الديدان عديدة الأشواك بينما يمثل الجمبري و سرطان البحر الغذاء الرئيسي للأسماك الكبيرة ذات الأطوال أكثر من ١٥ سم . وبالنسبة للمتغيرات الموسمية للمحتوى الغذائي فلقد وجد أن الديدان عديدة الأشواك يكثر وجودها في الشتاء والربيع بينما القشريات في الصيف والجلدشوكيات في الخريف .

بالنسبة للنوع الثاني (الغزيلة البرونزية) فلقد وجد أن المحتوى الغذائي لأمعائها يشمل القشريات ، الأسماك العظمية ، جلدشوكيات بالإضافة إلى كميات صغيرة من الأصداف والديدان عديدة الأشواك . ولقد لوحظ أن الأسماك التي يقل طولها عن ١٤ سم تتغذى أساساً على الجلدشوكيات والقشريات أما الأسماك الكبيرة ذات أطوال من ١٥ - ١٧ سم فتتغذى على الجمبري والاسكويلا والأسماك العظمية والأسماك ذات أطوال أكثر من ١٨ سم فتتغذى أساساً على الأسماك العظمية

والجمبري والأسقميات . وتتواجد القشريات عموماً في أمعاء تلك الأسماك على مدار السنة وتستهلك بكميات كبيرة في الصيف بينما يكثر تواجد الأسماك العظمية في الخريف والشتاء .