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Feeding Habits of the Common Pandora *Pagellus erthyrinus* (Linnaeus, 1758) from Benghazi Coasts, Libya

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Abstract: Aspects of feeding habits and diet of the common Pandora *Pagellus erthyrinus* are reported in this study. The feeding habits of 437 specimens of *Pagellus erthyrinus* (family: Sparidae), inhabiting Benghazi Mediterranean Coast, were studied monthly from January to December 2013. The annual diet composition, monthly variations in the diet composition, the variations of diet with length and the intensity of feeding were studied. Analysis of the stomach contents by points of assessment [9, 10] showed that, *Pagellus erthyrinus* feed on a wide variety of prey types: crustaceans (46.1%), mollusks (18.7 %), echinoderms (10.5%), polychaetes (7.1%), foraminifera (6.2%), fish parts (4.1%), sea grasses (3.1%) and sediments (4.2%). The crustacean and mollusks constituted the predominant food all year round and it was found in all length groups. In the present study crustaceans, mollusks, polychaetes, foraminifera, sea grasses and sediments increased as the size increased while, echinoderms and fish parts decreased as the fish size increased. The feeding intensity appeared to be relatively high during the winter, spring and autumn.

Key words: Feeding Habits · *Pagellus erthyrinus* · Libyan Eastern Coast · Mediterranean · Libya

INTRODUCTION

Sparid fishes inhabit tropical and temperate coastal water. Fish individuals are swimming near the shore in shallow inlet and bays at moderate depth. Family Sparidae comprise about 22 genera in four subfamilies containing 41 species [1-3]. Libya is known to be richly endowed with different species of Sparid fishes, 22 species were recorded in the Libyan coast, such as *Dentex dentex, Diplodus vulgaris, Lithognathus mormyrus, Oblada melanura, Sarpa salpa* and *Crenidens crenidens* [4]. The common pandora, *Pagellus erthyrinus* is one of the fishes in family Sparidae, is one of the most popular sparid fish species in the Mediterranean region and the Atlantic coast [5], the fish had been characterized by high price value, a highly appreciated flesh and good market perspectives. Although the common Pandora found in a wide variety of locations in Mediterranean, its status is considered endangered [6]. In Libya, the diet and feeding habits of only a few marine species of economic importance have been studied, from the available literature; it was found that few works have been published on the biology of Sparid fishes in the study area [7-10]. Laith [7] studied asymmetry in some morphological characters of four sparid fishes in Benghazi coast. El-Mor [10] studied the feeding habits of *Pagrus pagrus* in Benghazi coat, eastern Libya. There is no known record on *Pagellus erthyrinus* position in the trophic structure in this ecosystem. Therefore, the study, appear to be the first to give a detailed account of the food preference and feeding ecology of *Pagellus erthyrinus* (family Sparidae) in Libyan eastern coast. So the aim of the present study is defining the trophic relationships between *Pagellus erthyrinus* with other invertebrates and fishes in this area, in order to gather baseline information for a detailed investigation of the trophic structure of fish communities in this regional ecosystem. Beside results from feeding habits of *Pagellus erthyrinus* may have direct implications for aquaculture.

MATERIALS AND METHODS

Monthly samples of *Pagellus erthyrinus* were collected during the period from January to December 2013 by using gill and trammel nets from artisanal fishing in Benghazi fishing harbor 32°36'N and 20°03'E on the Mediterranean (Fig. 1). A total of 437 specimens of *Pagellus erthyrinus* were sampled for studying the feeding habits.

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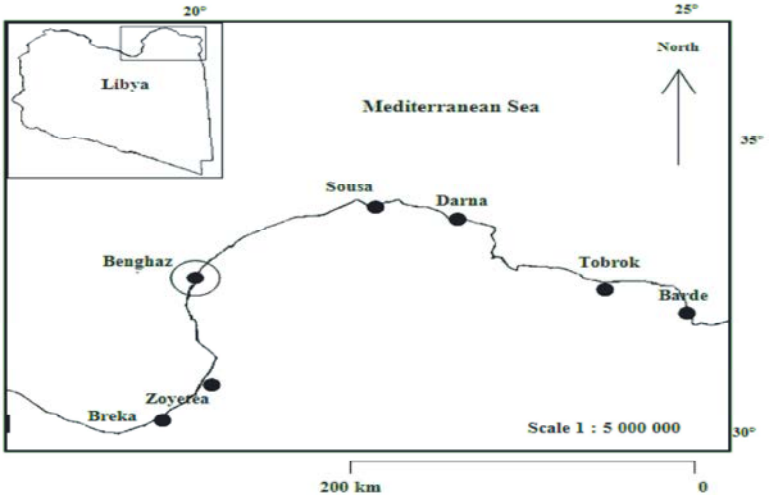

Fig. 1: Benghazi fishing harbor on the Mediterranean, Libya

Annual diet composition, seasonal variations of diet, variations of diet with lengths and feeding intensity were estimated in this study. Specimens were collected as fresh and immediately kept in ice containers to slow the digestion process of bacteria. Total length was measured to the nearest 0.1 cm by digital caliper and weights were measured with electronic balance. Each fish was dissected and the alimentary tract removed and preserved in 10% formalin for further analysis. The degree of fullness of the stomach was assessed by visual estimation and classified as empty, trace, quarter full, half full, three quarters full and completely full respectively as described in Ref [11]. The gut content was examined under binocular microscope and all food items were identified to their groups. A list of general diet composition was made. Food analysis was made by points of assessment [12]. The results were statistically analysis subjected to the further statistical treatment according to Godfriaux [13], in order to give more precise information about food and feeding habits of *Pagellus erthyrinus*. All data were tested for normality using a Kolmogorov–Smirnov test. One-way ANOVAs was used to the differences in diet composition among seasons and feeding habits in relation to body size.

RESULTS

Annual Diet Composition: Analysis of the stomach content data (Fig. 2) shows that the variety of food items in *Pagellus erthyrinus* diet was large. However, crustaceans supplemented by mollusks formed the major food groups for *Pagellus erthyrinus*. Crustaceans contributed (46.1%) of total volume,and consisting mainly of small prawns and crabs, whereas mollusks occurred in (18.7%) and were composed of bivalves and gastropods. The other food items were less significant, echinoderms

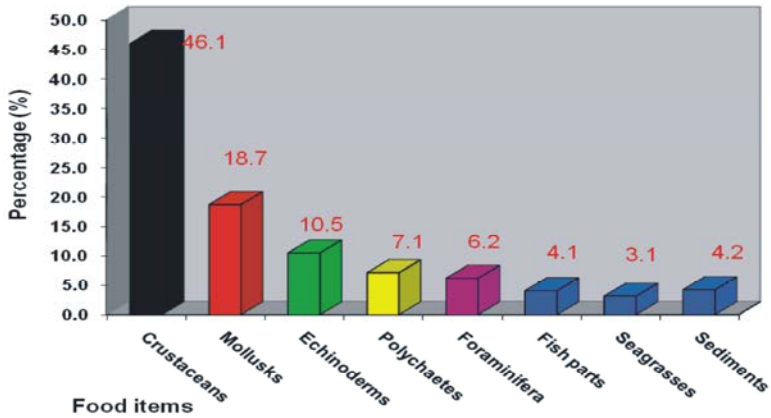

Fig. 2: Diet composition of Pagellus erthyrinus from Benghazi coast, eastern Libya during the period from January till December 2013

Table 1: Monthly variation in diet composition of *Pagellus erthyrinus* from Benghazi coast, Libya

		Food items							
Months	No.	Crustaceans	Mollusks	Echinoderms	Polychaetes	Foraminifera	Fish parts	Sea grasses	Sediments
Jan.	45	37.3	18.2	13.3	9.1	11.1	3.8	4.2	2.9
Feb.	52	44.2	16.3	10.6	8.1	5.2	5.6	3.7	6.3
Mar.	37	41.6	18.9	11.1	7.3	5.1	5.1	3.5	7.3
Apr.	39	45.1	20.5	9.2	8.5	4.9	2.6	3.3	5.9
May	35	48.6	20.9	11.7	3.1	6.0	3.1	2.6	4.0
Jun.	29	50.3	18.6	9.7	7.6	4.1	3.4	2.4	3.8
Jul.	29	49.3	18.6	9.3	6.2	5.2	4.5	2.8	4.1
Aug.	33	43.6	18.5	9.7	9.1	7.6	3.9	3.0	4.5
Sep.	32	48.8	20.0	10.0	5.3	5.9	3.1	3.1	3.8
Oct.	32	47.5	17.8	10.3	8.4	5.9	4.4	2.8	2.8
Nov.	32	48.8	17.8	10.6	5.6	6.6	5.0	3.1	2.5
Dec.	42	48.1	18.1	10.2	7.4	6.7	4.0	2.9	2.6
%	437	46.1	18.7	10.5	7.1	6.2	4.1	3.1	4.2

Data expressed as percentage.

constituting (10.5%), this followed by polychaetes (7.1%) and foraminifera (6.2%). Sediments (sand and clay) and the fish parts including fish scales and bones share the lower level of food composition with (4.2%) and (4.1) respectively. In addition, sea grasses which was mainly represented by *Halophila stipulacea* and *Halophila ovalis* occurred in (3.1%).

Monthly Variations in Diet Composition: Food items were occurred in all year round during the study (Table 1), crustaceans and mollusks constituted the major food item all year round during the study. Crustaceans increased from (37.3%) in January to (50.3%) in June, then decreased in the following months. Mollusks the second category in food items occurred in all months, reaching the maximum value in April (20.5%), in May (20.9%) and in September (20.0%) but the lowest value was observed in February (16.3). Echinoderms ingested showed the highest value in January (13.3%) and lowest value in April (9.2%). Polychaetes food item values decreased from (9.1%) in January to (7.4%) in December. Foraminifera attained the maximum value in January (11.1%) whereas the minimum value was in June (4.1%). Fish parts increased from (3.8%) in January to (5.0%) in November then decreased in the following months reaching (4.0%) in December. Sea grasses reaching the maximum values in January (4.2%) and the lowest value was observed in June (2.4%). Sediments ingested showed the highest values in March (7.3%) and the lowest value was observed in November (2.5%). There was no significant difference in seasonal variation of all food items; crustaceans, mollusks, echinoderms polychaetes, foraminifera, fish parts, seagrasses and sediments (ANOVA, $F_{3,433}$ =1.07, P = 0.360) (ANOVA, $F_{3,433}$ = 2.17, P= 0.091), (ANOVA, $F_{3,433}$ =0.64, P = 0.588) (ANOVA, $F_{3,433}$ = 1.45, P= 0.228), (ANOVA, $F_{3,433}$ =1.22, P = 0.301) (ANOVA, $F_{3,433}$ = 0.35, P= 0.787), (ANOVA, $F_{3,433}$=0.49, P = 0.688) and (ANOVA, $F_{3,433}$ = 2.51, P=0.058) respectively.

Seasonally Variations in Diet Composition: The diet of *Pagellus erthyrinus* mainly consisted of crustaceans' mollusks and echinoderms among seasons. Crustaceans were the dominant food components. It was recorded that the consumption of crustaceans was (48.3%) in autumn and (47.8%) in summer. It was also found that crustaceans formed (43.2%) during winter and (45.1%) in spring. Furthermore, mollusks and echinoderms ranked next to crustaceans and formed (17.6%) and (11.4%) during winter respectively. These were also present during spring and accounted (20.1) for mollusks and (10.7%) for echinoderms. It was recorded mollusks with (18.6%) and echinoderms with (9.6%) in summer as well as *Pagellus erthyrinus* ingested mollusks (18.5%) and echinoderms (10.3%) in autumn (Table 2).

Feeding Habits in Relation to Fish Size: The length groups of *Pagellus erthyrinus* population classified into fourteen classes ranged from 11.3 cm to 30.8 cm with 1.3 cm interval (Table 3). Prey size differed between large sizes fishes, which had ingested the large size, prey, whereas the small sized fishes ingested the small size prey. Crustaceans were found in all length groups of *Pagellus erthyrinus*, they increased from 45.3% in size class (11.3-12.6 cm) to 60.0% in size class (29.5-30.8 cm). Mollusks increased from 18.1% in size class (11.3-12.6 cm) to 30.0% in size class (29.5-30.8 cm). Echinoderms decreased from 11.1% in size class (11.3-12.6 cm) to 10.0% in size class (28.1-29.4 cm) and then the food item

Table 2: Seasonally variation in diet composition of *Pagellus erthyrinus* from Benghazi coast, Libya

Seasons	No.	Crustaceans	Mollusks	Echinoderms	Polychaetes	Foraminifera	Fish parts	Sea grasses	Sediments
Winter	139	43.2	17.6	11.4	8.2	7.7	4.5	3.6	4.0
Spring	111	45.1	20.1	10.7	6.3	5.3	3.6	3.1	5.7
Summer	91	47.8	18.6	9.6	7.6	5.6	4.0	2.7	4.2
Autumn	96	48.3	18.5	10.3	6.5	6.1	4.2	3.0	3.0

Data expressed as percentage.

Table 3: The diet composition of different size classes (cm) *Pagellus erthyrinus* Benghazi coast, Libya

	Food items								
Size groups (cm)	No.	Crustaceans	Mollusks	Echinoderms	Polychaetes	Foraminifera	Fish parts	Sea grasses	Sediments
11.3 - 12.6	97	45.3	18.1	11.1	6.2	7.7	4.0	3.4	4.1
12.7 - 14.0	90	46.0	18.3	11.3	7.6	6.4	3.7	2.4	4.2
14.1 - 15.4	30	38.3	17.0	12.7	6.3	9.3	6.7	4.3	5.3
15.5 - 16.8	23	54.8	17.4	8.7	4.8	5.7	4.8	1.7	2.2
16.9 - 18.2	35	47.1	18.0	10.6	7.4	6.9	4.3	2.3	3.4
18.3 - 19.6	31	46.1	19.7	9.4	5.2	6.8	4.8	3.5	4.5
19.7 - 21.0	6	46.7	23.3	10.0	8.3	6.7	B	3.3	1.7
21.1 - 22.4	59	44.4	19.2	11.0	6.4	8.8	3.1	3.2	3.9
22.5 - 23.8	22	50.0	18.6	7.7	5.0	4.5	5.0	3.6	5.5
23.9 - 25.2	13	40.8	17.7	8.5	7.7	7.7	5.4	4.6	7.7
25.3 - 26.6	2	50.0	30.0	5.0	B	5.0	B	5.0	5.0
26.7 - 28.0	13	45.4	20.8	10.0	5.4	6.2	3.8	3.8	4.6
28.1 - 29.4	15	44.7	20.0	10.0	2.0	8.7	3.3	4.7	6.7
29.5 - 30.8	1	60.0	30.0	B	10.0	10.0	B	B	B

Data expressed as percentage, (B) = no food in class occurred

Table 4: Monthly variation in the intensity of feeding of *Pagellus erthyrinus* from Benghazi coast, Libya

		The degree of distension of the stomach							
Months	No. of fish	Empty	Trace	1/4	a %	1/2	3/4	Full	b %
Jan.	45	6.7	20.0	11.1	37.8	6.7	40.0	15.6	62.2
Feb.	52	7.7	13.5	7.7	28.8	11.5	42.3	17.3	71.2
Mar.	37	2.7	16.2	5.4	24.3	10.8	48.6	16.2	75.7
Apr.	39	7.7	10.3	12.8	30.8	25.6	35.9	7.7	69.2
May	35	11.4	51.4	11.4	74.3	14.3	8.6	2.9	25.7
Jun.	29	A	24.1	48.3	72.4	6.9	17.2	3.4	27.6
Jul.	29	13.8	17.2	41.4	72.4	6.9	17.2	3.4	27.6
Aug.	33	9.1	18.2	6.1	33.3	A	39.4	27.3	66.7
Sep.	32	6.3	25.0	3.1	34.4	A	43.8	21.9	65.6
Oct.	32	6.3	28.1	A	34.4	A	43.8	21.9	65.6
Nov.	32	6.3	21.9	6.3	34.4	A	43.8	21.9	65.6
Dec.	42	4.8	16.7	4.8	26.2	4.8	40.5	28.6	73.8
Average	437				42.0				58.0

Data expressed as percentage, (A) = no food in month occurred.

disappeared in length group (29.5- 30.8 cm). Polychaetes increased from 6.2% in size class (11.3-12.6 cm) to 8.3% in size class (19.7-21.0 cm), to 10.0% in size class (29.5- 30.8 cm) and completely absent in length groups (25.3- 26.6 cm). Foraminifera increased from 7.7% in size class (11.3-12. cm) to 10.0% in size class (29.5-30.8 cm). Fish parts were completely absent in three length groups (19.7- 21.0 cm), (25.3- 26.6 cm) and (29.5- 30.8 cm). Sea grasses increased from 3.4% in size class (11.3-12.6 cm) to 5.0% in size class (25.3-26.6 cm) and completely absent in length group (29.5- 30.8 cm). Sediments increased from 4.1% in size class (11.3-12.6 cm) to 7.7% in size class (23.9-25.2 cm) and completely absent in length group (29.5- 30.8 cm).

There was no significant difference in the variation of all food items; crustaceans, mollusks, echinoderms, polychaetes, foraminifera, fish parts sea grasses and sediments among length groups of individuals (ANOVA, $F_{13,423} = 0.60$, $P = 0.856$) (ANOVA, $F_{13,423} = 0.98$, $P = 0.473$), (ANOVA, $F_{13,423} = 0.61$, $P = 0.850$) (ANOVA, $F_{13,423} = 0.69$, $P = 0.775$), (ANOVA, $F_{13,423} = 0.69$, $P = 0.777$) (ANOVA, $F_{13,423} = 0.74$, $P = 0.719$), (ANOVA, $F_{13,423} = 0.67$, $P = 0.791$) and (ANOVA, $F_{13,423} = 0.71$, $P = 0.753$) respectively.

Table 5: Seasonally variation in the intensity of feeding of *Pagellus erthyrinus* from Benghazi coast, Libya

		The degree of distension of the stomach							
Seasons	No. of fish	Empty	Trace	1/4	%	1/2	3/4	Full	%
Winter	139	6.4	16.7	7.9	30.9	7.7	40.9	20.5	69.1
Spring	111	7.3	26.0	9.9	43.1	16.9	31.0	8.9	56.9
Summer	91	7.6	19.9	31.9	59.4	4.6	24.6	11.4	40.6
Autumn	96	6.3	25.0	3.1	34.4	0.0	43.8	21.9	65.6

Data expressed as percentage

Feeding Intensity: Fishes with stomach half full, almost full and full of food ranked b% constituted 58.0% of all analyzed individuals, whereas those with stomachs that were empty or with traces of food ranked in a%, represented 42.0% of the total specimens (Table 4). The feeding activities were quite high during winter (69.1%), spring (56.9%) and autumn months (65.6%). There are minimal rate of feeding intensity in summer season (40.6%) (Table 5).

DISCUSSION

The aim of the present study was to provide a basis for understanding the dynamic of Libyan eastern coast ecosystem, through studying the trophic structure of the most known species common Pandora *Pagellus erthyrinus*. Many authors have been contributed to food and feeding habits studies of different species of sparidae [14-18]. The common Pandora, *Pagellus erthyrinus* from family Sparidae found over rock, rubble or sand bottoms young frequently found on seagrasses beds and continental shelf, feeds on crustaceans, fishes and mollusks [19]. In the present study, it was found that *Pagellus erthyrinus* feeds on a wide range of food items such as crustaceans, mollusks, echinoderms, polychaetes, foraminifera, fish parts, sea grasses and sediments; this observation consists with Papaconstantinou *et al.* [20] which studied the feeding habit of *Pagellus erthyrinus* in Greece coast, the Mediterranean. In the current study, various food items found in the gut of *Pagellus erthyrinus*, but crustaceans formed the main item in gut contents all year round and it was found in all length groups with echinoderms and fish parts. The results of this study are similar to the diet composition of *Pagellus erthyrinus* in the Thermatikos Gulf and the Thracian Sea, North Aegean Sea [20]. The stomach of study species contained sand particles and formed (2.7%) in the fish's diet. Generally, the food extent demands and ability for food acquisition increase with fish development [21]. It was found that the number and the size of prey taxa increased with size of *Pagellus erthyrinus* as larger animals can consume a wide range of prey sizes than small individuals, these finding match those for [14]. It was observed that small fishes significantly fed on crustaceans and then other items of diet and the size prey taxa (mollusks, echinoderms and fish parts) increased as the size of the target species increased. In the present study crustaceans, polychaetes, sea grasses and sediments decreased as the size increased while mollusks, echinoderms and fish parts increased as the fish size increased, which is in agreement with Wootton [15]. The monthly variation in the condition factor fish is affected by the feeding activities which may show their reflection on the body condition [22], this phenomenon appears to be correct for the species in the present work. The highest condition factor values (Kf and Kc) were recorded in winter, spring and autumn [6]. These results coincide with the degree of stomach fullness. This supports observations described in Ref [23] but for other species from the same family (*P. bagaraveo* and *P. acarne*) in Azores, Northeastern Atlantic. In the present study the feeding intensity were quite high during the end of each season possibly because of food availability. However, the minimum values in feeding intensity recorded in summer, these result coincide with spawning season for target species [19].

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