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TROPHIC RELATIONS OF SEPIA OFFICINALIS AND LOLIGO VULGARIS (MOLLUSCA: CEPHALOPODA) IN ALEXANDRIA WATERS.

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ABSTRACT

Sepia officinalis and Loligo vulgaris specimens were collected monthly from the commercial trawl catches and the fish markets of (Anfoushy) Alexandria, Abu Qir, Maadiya and Rosetta during the period from September 1989 to August 1990. The stomach content of 646 and 466 specimens for S. officinalis and L. vulgaris, respectively were examined. Among the examined samples; about 68% (439 specimen) and 50% (234 specimen), were containing food respective to the mentioned species. The principle diet item for S. officinalis was crustacea followed by fish; while for L. vulgaris, the principle food item was fishes followed by crustacea. Remains of cephalopods also appeared in the stomach content of both species, which suggests that cannibalism may play a role in the ecology of the two species.

INTRODUCTION

Cephalopods play an important role in the food chain in the sea. They belong to the third trophic level in the food chain and progress one or two stages with age. They are active predators, but adaptive opportunist. The focus of the newly hatched cephalopods is on crustacea. They prey upon shrimps, crabs, fishes, other cephalopods (including cephalopods), and in the case of octopuses, on bivalved molluscs. Preys are caught by the tentacles or arms of the cuttlefish , then relaxed and harmless prey is bitten by the beak and reduced to a size suitable for ingestion, including the exoskeleton which is almost wholly devoured (Wilson, 1946; Messenger, 1968). In turn, cephalopods are major food items in the diets of toothed whales, seals, pelagic birds (Penguins, Petrels, Albatrosses, etc.), and both benthic and pelagic fishes (e.g., sea basses, lancet fishes, tunas, bill fishes, sharks and rays). (Roper et al., 1984). It is reported that more than 100 million ton of oceanic squids are consumed per year by the humpback whales (Clarke, 1966).

Diet of the squid appears to be varied; with mysids constituting the principle item for Loligo pealei. The second most abundant dietary item for this species is squids, which suggests that cannibalism may play an important role in the ecology of the squid. (Haefner, 1959).

The present paper provides some data on the variability of food and feeding patterns of the commercially important squids L. vulgaris and S. officinalis in Alexandria waters of Egypt.

MATERIAL AND METHODS

A sum of 1112 cephalopod specimens were collected from September 1989 to August 1990 from commercial trawl catches and from the fish markets. The samples were collected monthly from Alexandria (Anfoushy), Abu Qir, Maadiya and Rosetta. Of these there were 464 and 466 specimens for S. officinalis and L. vulgaris, respectively.

The stomachs of these specimens were examined and the prey components were studied qualitatively and quantitatively. The food content was removed from each stomach and placed in a clean petri dish and the material was covered with water. For identification of the food constituents a stereoscopic microscope was used. From the examination of stomach contents, cephalopod preys can be identified from the debris which includes pieces of exoskeleton from crustaceans, lenses, bones, otoliths and scales from fish, and lenses, beaks and sucker rings from sepoid cephalopods (Guerra, 1985). Food items were identified to the lowest possible taxonomic level. The various degrees of stomach fullness with food were also recorded and divided subjectively into 6 main degrees after Wiborg (1978) as follows: 0-empty; I-traces; II- little; III-half full; IV-Full and V- distended.

RESULTS

During the present work, the fish and cephalopod catch of a number of trawlers based at the Eastern Harbour of Alexandria were recorded for a period of one year. Most of the cephalopod catch was fished during the period from September to January. Cephalopods represented about 9.8% of the total landings. Statistical data records of Alexandria Mediterranean Waters from 1986 to 1989 (Anon., 1986-1989) also showed that the annual cephalopod catch did not exceed 8% of the total catch.

The identification of stomach food contents for the two species was sometimes difficult since the material was badly mutilated due to the active feeding habits of cuttlefish and squids and also due to the biting action of the beaks while the animal is feeding. Only broken fragments of the hard parts remained. Regardless of structure and composition; all skeletal fragments present in the gut were soft and translucent. Such material included parts of antennae, legs, rostral extensions, vertebrae, fish scales, statocysts and various other structures such as chaetae, or spines by which the organisms represented in the diet were identified.

The species recorded in the stomach of both S. officinalis and L. vulgaris are given in table (1). The quantitative analysis of the stomach content for both species are given in tables 2 and 4 respectively. The data show the frequency of occurrence of the particular food items during the different months and seasons of the year. It is to be noted that the food material present in the stomach of every analyzed specimen was found to belong to a single type, but in very few cases two types were found together. The degree of stomach fullness for S. officinalis and L. vulgaris are given in tables 3 and 5.

For S. officinalis, 646 stomachs were examined, of which 439 (68%) contained food in various amounts and the rest (32%) were empty (109; 52.7% males and 98; 47.3% females). The percentage of food items was also determined and descending rated in the following manner: 45.6% crustacea; 36% fish; 16.6% unidentified, and 1.8% cephalopods (Table 2 and Fig. 1). Spring and summer were the seasons of maximum and minimum stomach fullness, attaining 72.5% and 54.7%. Respectively concerning the degree of stomach fullness, about 33.4% were distended, 32% were empty, 13.2 were half full, 10.8% were with little food, 6.8% were full and lately 3.7% contained traces of food (Table 3 and Fig. 2).

For Loligo vulgaris, the stomach content of 466 specimens was analyzed. Of these 234 (50.2%) contained food material and the rest (49.8%) were empty (104; (44.8%) males and 128; (55.2%) females). The percentage occurrence of the food items are desendingly ranked as follows: 47.4% fish, 25.6%. crustacea, 23.1% unidentified, and lastly 3.9% cephalopods (Table 4 and Fig. 1). Autumn and winter were the seasons of higher (55.6%) and lower (45.1%) stomach fullness. Concerning the degree of stomach fullness, 49.8% were empty, 19.1% distended, 10.1% with little food, 9.7% half full, 7.5% with traces of food, and finally 3.9% were full stomachs (table 5 and Fig. 2).

Table (1): A list of species identified from the stomachs of Sepia officinalis and loligo vulgaris.

Fish :
Sardina pilchardus
Sardinella aurita
Mullus spp.
Gobius spp.
Boops boops
Pagellus erythrinus
Pagrus pagrus
Lithognathus mormyrus
Spicara spp.
Pleuronectidae
Scorpion spp.
Serranus cabrilla (grouper)
Sphyraena chrysotaena
Terapon spp.
Diplodus sargus
Engraulis encrasicholus
Unidentified cephalopods :
Mostly arms, tentacles, suckers, flesh, beaks of cephalopods.
Crustacea :
Squilla spp. and legs, skeletal parts, flesh of unidentified crabs and shrimps.

Table (2): Stomach contents monthly analyses of 646 samples of *Sepia officinalis*.

Month	Sample Size	% Empty	% Total with food	% Fish	% Crustacea	% Cephalopods	% Unidentified
September, 1989	92	21.74	78.26	27.78	47.22	-	25
October	50	56	44	27.27	63.64	-	9.09
November	55	30.91	69.09	47.37	39.47	2.63	10.53
Autumn	197	32.99	67.01	33.33	47.73	0.76	18.18
December	53	32.08	67.92	55.56	36.11	-	8.33
January, 1990	70	22.86	77.14	18.52	72.22	1.85	7.41
February	62	33.87	66.13	39.02	36.59	-	24.39
Winter	185	29.19	70.81	35.11	51.15	0.76	12.98
March	62	41.94	58.06	33.33	38.89	8.33	19.44
April	64	18.75	81.25	51.92	25	1.92	21.15
May	52	21.15	78.85	46.34	36.59	-	17.07
Spring	178	27.53	72.47	44.96	32.56	3.10	19.38
June	44	29.55	70.45	22.58	51.61	6.45	19.36
July	17	47.06	52.94	22.22	66.67	-	11.11
August	25	72	28	14.29	85.71	-	-
Summer	86	45.35	54.65	21.28	59.57	4.26	14.89
All year	646	32.04	67.96	35.99	45.56	1.82	16.63

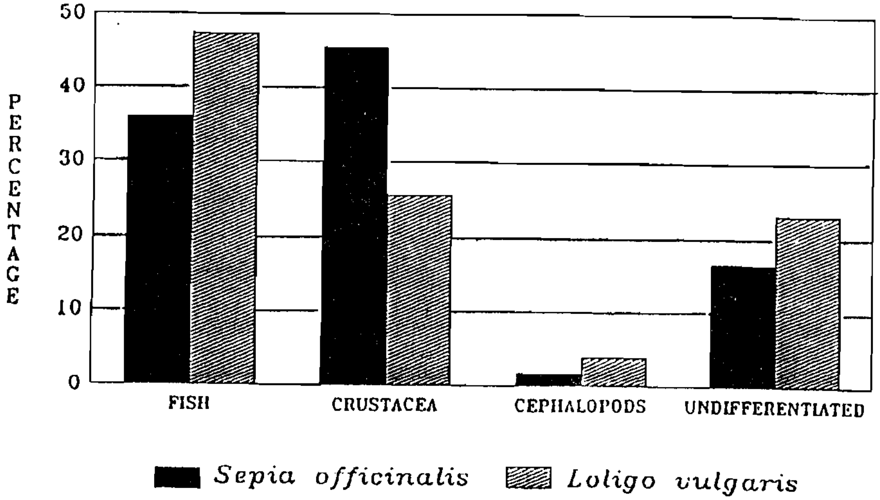

Fig.(1) Comparative composition of the diet for *Sepia officinalis* and *Loligo vulgaris*.

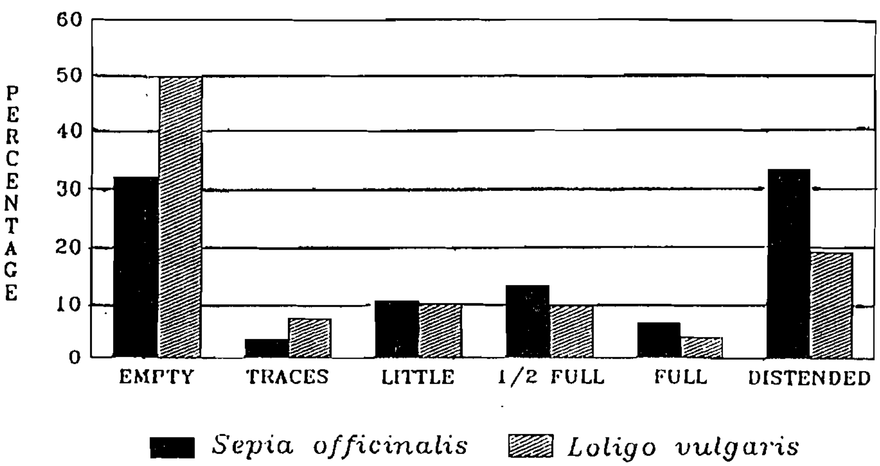

Fig.(2) Distribution of degree of fullness of stomachs for *Sepia officinalis* and *Loligo vulgaris*.

Table (3): Monthly distribution of degree of fullness of 646 stomachs of *Sepia officindis*.

Month	Sample Size	% Empty	% Traces	% Little	% Half ful	% Full	% Distended
September, 1989	92	21.7	8.7	15.2	16.3	2.2	35.9
October	50	56	2	2	12	-	28
November	55	30.9	5.5	-	21.9	-	41.8
Autumn	197	33	6.1	7.6	16.8	1	35.5
December	53	32.1	1.9	3.8	13.2	-	49.1
January, 1990	70	22.9	1.4	11.4	10	12.9	41.4
February	62	33.9	11.3	-	12.9	-	41.9
Winter	185	29.2	4.9	5.4	11.9	4.9	43.8
March	62	41.9	4.8	9.7	6.5	8.1	29
April	64	18.8	-	20.3	18.8	14.1	28.1
May	52	21.2	-	26.9	7.7	13.5	30.8
Spring	178	27.5	1.7	18.5	11.2	11.8	29.2
June	44	29.6	-	9.1	13.6	22.7	25
July	17	47.1	-	17.7	23.5	-	11.8
August	25	72	-	20	-	8	-
Summer	86	45.4	-	14	11.6	14	15.1
All year	646	32	3.7	10.8	13.2	6.8	33.4

Table (4): Stomach contents monthly analyses of 646 samples of *Loligo vulgaris*.

Month	Sample Size	% Empty	% Total with food	% Fish	% Crustacea	% Cephalopods	% Unidentified
September, 1989	72	40.28	59.72	51.16	32.56	4.65	11.63
October	34	55.88	44.12	46.67	26.67	-	26.67
November	38	42.11	57.89	31.82	22.73	13.64	31.82
Autumn	144	44.44	55.56	45	28.75	6.25	20
December	67	56.72	43.28	51.72	20.69	-	27.59
January, 1990	58	55.17	44.83	34.62	11.54	3.85	50
February	48	52.08	47.92	30.43	21.74	8.70	39.13
Winter	173	54.91	45.09	39.74	17.95	3.85	38.46
March	52	44.23	55.77	48.28	37.93	-	13.79
April	38	60.53	39.47	66.67	26.67	-	6.67
Spring	90	51.11	48.89	54.55	34.09	-	11.36
July	16	31.25	68.75	72.73	-	-	27.27
August	43	51.16	48.84	57.14	38.10	4.76	-
Summer	59	45.76	54.24	62.50	25	3.13	9.38
All year	466	49.79	50.21	47.44	25.64	3.85	23.08

Table (5): **Monthly distribution of degree of fullness of 466 stomachs of *Loligo vulgaris*.**

Month	Sample Size	% Empty	% Traces	% Little	% Half full	% Full	% Distended
September, 1989	72	40.3	4.2	16.7	13.9	1.4	23.6
October	34	55.9	-	11.8	11.8	8.8	11.8
November	38	42.1	23.7	2.6	5.3	-	26.3
Autumn	144	44.4	8.3	11.8	11.1	2.8	21.5
December	67	56.7	16.4	-	10.5	-	16.4
January, 1990	58	55.2	15.5	5.2	5.2	1.7	17.2
February	48	52.1	6.3	10.4	10.4	4.2	16.7
Winter	173	54.9	13.3	4.6	8.7	1.7	16.8
March	52	44.2	-	19.2	7.7	5.8	23.1
April	38	60.5	-	7.9	-	2.6	29
Spring	90	51.1	-	14.4	4.4	4.4	25.6
July	16	31.3	-	12.5	6.3	25	25
August	43	51.2	-	16.3	20.9	7	4.7
Summer	59	45.8	-	15.3	17	11.9	10.2
All year	466	49.8	7.5	10.1	9.7	3.9	19.1

DISCUSSION

It appears from the present data that a relatively large number of Sepia officinalis and Loligo vulgaris stomachs were empty (about 32% and 50% respectively). This can probably be attributed to the habit of cuttlefish and squid to reduce their feeding activity during the final weeks or days before spawning time. This was also observed by Fields (1965) and Augustyn (1990) for Loligo opalescens. According to Ehrhardt et al., (1983), the large percentage of empty stomachs observed could possibly also indicate very high digestion rate, or a low abundance of available food. The non-feeding phenomena in the opinion of August (1990) is probably not caused by physiological factors, but rather by shortage of food in the spawning areas. In the present study, the results showed a high percentage of full stomachs during the spawning season spring, summer, for S. officinalis and winter, spring summer for L. vulgaris (Abdalla, 1993), which means high abundance of available food in the spawning areas during the spawning season. It also shows that feeding activity does not stop during spawning.

Crustaceans were the principle food item for S. officinalis, while fishes were the dominant food item of L. vulgaris. The second most abundant category for S. officinalis was fish while for L. vulgaris it was crustacea. Penaeidae (Crustacea) represented the highest percent of occurrence in the diet of the cuttlefish, as S. officinalis feeds mainly on crustaceans (Guerra et al., 1988). This can be attributed to their feeding near the bottom during the day and nearer to the surface at nigh (Hulburt, 1957).

Crustaceans are caught by the cuttlefish tentacles or arms, then relaxed and harmless prey is bitten by the beak and reduced to a size suitable for ingestion, including the exoskeleton which is almost wholly devoured (Wilson, 1946; Messenger, 1968).

The comparatively high percentage of stomachs with fish content for L. vulgaris appears to confirm previous studies by Lipinski (1987) and Augustyn (1989) who stated that ordinarily young or adult small ocean squids eat fish and crustaceans. Squires (1957) found That the large squid Illex illecebrosus feeds mostly on fish. Karpov and Cailliet (1978) pointed out the preference of the squid L. opalescens for a crustacean diet besides scarce occurrence of fish eye lenses, mandibles and otoliths within the stomach. Mccay (1980) in his study on L. pealie, mentioned that crustaceans are the most frequent food item for this species followed by squids and fish (only bones and scales). Palmer (1985) stated that Loligo can catch fast swimming mackerel fish, and the giant squid Ommastrophes gigas attack tiny fish and eats every thing except the head. Baddyr (1991) showed that L. vulgaris fed mainly on fishes, crustaceans and its own species. In general small squids tend to feed on crustaceans and larger squids on fish and cephalopods, therefore, selection of prey seems to be a function of size and not adulthood or maturity. This could be related to faster swimming ability, aggressiveness, and greater strength of the larger squids.

The present study shows that there is a cannibalistic tendency in both species studied, since a percentage of the stomachs (1.8 % S. officinalis and 3.9 % L. vulgaris) contained remnants of cephalopods. Cannibalism may play an important role in the ecology of cuttlefish and squids. Cannibalized cephalopods were always smaller than their attackers. There was also a difference in the ratio of cannibalistic males and females, males more frequently attacking other cephalopods. The higher incidence of cannibalism in squid may possibly be attributed to feeding on dying squids as well as to the shortage of other food during the post-spawning period where a high mortality occurs in many cephalopod species (Arnold & Williams, 1977). In terms of the overall sample: however, the incidence of cannibalism as mentioned was 1.8 % for S. officinalis and 3.9 % for L. vulgaris, which is not likely to have a major impact on natural mortality.

Although more data would be useful, the information already recorded indicates that cuttlefish and squids form an important link in the food chain in near shore Alexandria waters. They feed on a variety of smaller species and they constitute themselves a major food item, (especially during their schooling for spawning), in the diet of the larger commercial fishes in Alexandria waters. According to Rizkalla (1992), the cephalopods are one of the main food items for fishes of the Genus Pagellus and represent 10 % of Pagellus erythrinus diet in Alexandria waters. Faltas (1993) also stated that cuttlefish and squid constituted the second food item for lizard fish in Egyptian Mediterranean waters, constituting 0.54 % and 3.2 % by weight for Synodus saurus & Saurida undosquamis, respectively.

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