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Feeding habits of the Atlantic stargazer fish *Uranoscopus scaber* Linnaeus, 1758 (Family: Uranoscopidae) in Egyptian Mediterranean waters

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ABSTRACT

The examination of 418 stomachs of *Uranoscopus scaber* in the Egyptian Mediterranean waters showed that the feeding intensity had a maximum value during April (85%). Analysis of food contents revealed that this species is mostly carnivorous fish, that feeds on a broad food items including pisces, crustaceans, molluscs, echinoderms, annelids, algae and higher plants. *Spicara smaris* and *S. flexuosa* (Family: Centracanthidae) were the main fish prey in the diet of stargazers. The test of seasonal diversity index of food items exhibited high value during spring (H' = 1.43) than in other seasons, due to wide diversity of food. Regarding the feeding diversity according to size groups, it was found to be high for fishes of large size groups of more than 20.0 cm (H' = 1.41). The test of food overlap according to seasons showed significant overlapping among all seasons with exception between autumn and winter. Significant overlapping was found between all size groups (<15.0 cm, 15.0–20.0 cm and > 20 cm).

Key words: Feeding habits, *Uranoscopus scaber*, Family Uranoscopidae, Mediterranean waters, Egypt.

INTRODUCTION

The stargazers (Family: Uranoscopidae) are represented in the Mediterranean basin, Black sea, Atlantic coasts of Europe and Africa by one genus and one species (*Uranoscopus scaber* Linnaeus, 1758). These are benthic fishes occurring in littoral waters and on the continental shelf and upper slope (Hureau, 1986; Fischer *et al.*, 1987; Roux, 1990; Demestre *et al.*, 2000).

The aim of the present study is to declare the food habits of this species in the Egyptian Mediterranean waters.

MATERIAL AND METHODS

Samples of *Uranoscopus scaber* were collected monthly from the trawling nets operated in the Egyptian Mediterranean waters of Alexandria during the period from July 2005 to June 2006. A total of 418 fish were taken and

measured to nearest mm, while their stomachs were preserved in 10% formalin for food content analysis. The numbers of full and empty stomachs were recorded. The food from each stomach was identified and sorted into main taxonomic groups.

Analysis of the data was carried out according to Windell and Bowen (1978) as follows: The percentage frequency of occurrence 0% (percentage of stomachs with a certain food item in relation to number of stomachs with food average number N% (total number of certain food item in relation to number of stomachs containing this item) and gravimetric percentage G% (total weight of certain food item in relation to total weight of all food items).

For comparing the seasonal or size variations of food items of *U. scaber*, the modified equation given by Rodriguez (1996) was applied as follows:

$$MFI = G\% \sqrt{\frac{O\% + N\%}{2}}$$

Where MFI: modified food index, G% percentage of weight of one item to total weight of all items, O%: frequency of an item to total examined stomachs, N%: percentage of number of an item to total number of all prey.

The diet amplitude (diversity) was studied by performing the Shanon diversity index H' (Shanon and Weaver, 1963) using the following equation:

$H' = -\sum_{i}^{S} (ni/N) \ln (ni/N)$, where ni is the total number of the prey species, N is the total number of all food items and s is the number of different food items.

The overlapping of different food items was tested according to fish size (< 15.0cm, 15.0-20.0 cm and >20 cm) and seasons. The following formula given by Schoener (1970) was applied: $T = 1 - 0.5 \sum_{i=1}^{n} |P_{xi} - P_{yi}|$, where P_{xi} and P_{yi} are the properties by number of the food item i respectively in fish x and fish y. When the index of overlap (T) equals to zero, this indicates that there is no overlapping between fish x and fish y and when the value of this index reaches one, this indicates that both fish x and fish y used the same food items in the same proportionality. Values higher than 0.6 are considered to be significant (Macpherson, 1979).

RESULTS

I- Feeding intensity

The examination of 418 stomachs of *U. scaber* showed that 148 stomachs (35.4%) were completely empty and the feeding intensity reached its maximum value in April (85.0%), (Table 1).

II– Food spectrum:

As presented in Table (2), it is clear that the major food items eaten by *U. scaber* were pisces, crustaceans, molluscs, echinoderms, annelids, algae and higher plants.

Table (1): Monthly empty and full stomachs in *Uranoscopus scaber* in the Egyptian Mediterranean waters

Month	No. of stomach examined	Empty stomach		Full stomach	
		No.	%	No.	%
July 2005	43	14	32.6	29	67.4
August	41	12	29.3	29	70.7
September	41	14	34.1	27	65.9
October	39	19	48.7	20	51.3
November	19	4	21.1	15	78.9
December	38	17	44.7	21	55.3
January 2006	47	24	51.1	23	48.9
February	36	13	36.1	23	63.5
March	30	9	30.0	21	70.0
April	20	3	15.0	17	85
May	21	7	33.3	14	66.7
June	43	12	27.9	31	72.1
Total No. of stomachs	418	148	35.4	270	64.6

A- Pisces

These were the main food items, occurring in 44.07% of all examined fishes and constituting by number and weight 34.79% and 90.58% of the total (main) food items respectively. This category included 16 fish species: *Spicara smaris, Spicara flexuosa, Labrid* species, *Saurida undosquamis, Uranoscopus scaber, Mullus surmuletus, Pagrus pagrus, Serranus cabrilla, Serranus hepatus, Conger* species, *Trichiurus* species, *Bothus podas, Leognathus klunzingeri, Gobius niger, Atherina* species and fish fry. The digested food of fishes occurred in 23.7% of all stomachs examined representing 27.7% by weight.

It was observed that *S. smaris* and *S. flexuosa* (Family: Centracanthidae) occupied in the first rank of importance in the diet of stargazer forming about 30% by weight of all weights of ingested food of fishes. *Labrid* species, *Bothus podas* and *Conger* species followed Centracanthidae in importance forming 6.77, 5.16 and 5.15% by weight respectively.

B- Crustacea

The crustacean category was represented by adult decapods and digested ones occurring in 10.37% of all stomachs examined and constituting 3.27% of all diet weight.

C- Mollusca

Members of this class were represented by cephalopods and gastropods occurring in 1.85% of all examined fishes and contributing 2.72% by weight.

D- Echinodermata

Members of this category occurred in 10.37% of the total examined stomachs forming 0.22% by weight.

Table (2): The general food spectrum in stomachs of *Uranosecopus scaber* in the Egyptian Mediterranean waters

Food items	Occurrence O%	Number N%	Gravimetric G%
A- 1- Pisces	44.07	34.79	90.58
Spicara smaris	3.70	11.43	18.78
Spicara flexuosa	2.22	3.81	10.99
Fish fry	2.96	4.28	0.96
Labrid sp.	3.7	4.28	6.77
Conger sp.	1.48	1.90	5.15
Bothus podas	1.85	2.38	5.16
Leognathus klunzingeri	0.74	0.96	1.44
Saurida undosquamis	0.74	0.96	3.26
Uranoscopus scaber	1.11	1.43	2.68
Mullus surmuletus	0.37	0.48	2.94
Trichiurus sp.	0.37	0.48	0.82
Pagrus pagrus	0.37	0.48	0.31
Gobius niger	0.37	0.48	1.82
Serranus cabrilla	0.37	0.48	0.65
Serranus hepatus	0.37	0.48	0.40
Atherina sp.	0.37	0.48	0.75
2- Digested fish	23.70	8.0	27.7
B- Crustacea	10.37	8.57	3.27
Decapoda	5.93	8.40	3.15
Digested decapoda	4.44	0.11	0.12
C- Mollusca	1.85	1.86	2.72
Cephalopoda	1.48	1.38	1.12
Gastropoda	0.37	0.48	1.60
D- Algae	14.74	20.95	3.00
Brown algae	4.81	8.57	1.25
Sea grass	4.44	5.71	0.83
Red algae	2.90	4.29	0.62
Green algae	1.85	2.38	0.30
E-Echinodermata	10.37	32.38	0.22
F- Annelida	0.74	—	0.21
G- Higher plant	0.74	0.95	0.20
Total No. of all prey		423	
Total weight (g)			612

E- Algae

The recorded items of this category were: brown algae, red algae, green algae and sea grass. They occurred in 14.74% of total examined stomachs constituting 3.0% by weight.

Other food categories such as annelids and higher plants were of minor importance forming negligable percentage of occurrence and weights.

III- Seasonal feeding variation (Table 3)

It was clear that the modified food index for pisces diet in the stomachs of *U. scaber* reached a maximum value in winter (24.9), whereas it was minimal in autumn (5.0). *Spicara smaris* was found to be the main food item in winter having modified food index equal to 11.3. In addition to that *Serranus cabrilla, Serranus hepatus* and *Atherina* species were markedly observed during this season and completely missing in the other seasons. Individuals of decapods, echinoderms, brown algae and sea grass were found to be eaten during all seasons having values of modified food index less than 0.75.

The test of seasonal diversity index exhibited high value during spring (H' = 1.43) compared to the other seasons. This can be attributed to the wide diversity of food items during this season.

The test of food items overlap according to season declared that the stomach niche that overlap between summer and autumn seemed to be higher than that between spring and summer and between winter and spring (T= 0.81, T= 0.79 and T= 0.76 respectively). These values revealed that there is significant overlapping between these seasons i.e. fishes in each pair of seasons feed more or less on the same food items. The overlap index (T) between autumn and winter seasons showed an insignificant value (0.53) which revealed that the food items eaten during these successive seasons were quantitatively and qualitatively different.

IV- Feeding variation according to fish size

The specimens of stargazer were divided into three size groups: <15.0 cm, 15.0 – 20.0 cm and > 20.0 cm (Table 4). From above, it was shown that the diet of small fishes (less than 15.0 cm) constituted of pisces namely *Spicara samris, Labrid* spp., *Canger* spp. and Fish fry. These fishes occurred in 4.81% of all examined stomachs and formed 4.93% by weight. Crustacea echinoderms and algae came next in importance, occurring in 3.33, 2.22 and 1.85% respectively. The highest value of modified food index for small size group of fishes was only observed for pisces diet (4.49).

For fishes of medium size group (15.0 – 20 cm) twelve species of pisces diet were identified occurring in 16.29% of all examined stomachs and constituted by weight 30.4%. This diet of fishes has high value of modified food

(19.46). Other diets such as echinoderms, crustaceans and algae came next in importance, occurring in 4.45, 3.70 and 2.96% respectively.

For fishes of large size groups (>20.0 cm), pisces diet occurred in 22.96% of all examined stomachs forming 55.17% by weight of all food weights. The main identified taxon of this diet were: *Spicara smaris, S. flexuosa, Labrid* spp. and *Bothus podas*. The estimated modified food index (MFI) was found to reach 35.55. Algae came next of importance in the diet of this size group occurring in 9.93% of all examined stomachs and having MFI equal to 4.56.

Table (3): Seasonal variation of food items in stomach of *U. scaber* (O%= occurrence percentage, N%= number percentage, G%= gravimetric percentage, MFI= modified food index)

Food items	Summer				Autumn				Winter				Spring			
	O %	N %	G %	MFI	O %	N %	G %	MFI	O %	N %	G %	MFI	O %	N %	G %	MFI
A- 1- Pisces	2.96	3.82	13.87	6.86	2.9	4.29	6.89	5.0	14.43	20.48	35.68	24.95	4.44	6.2	34.4	13.48
Spicara smaris	0.37	0.48	0.82	0.59	—	—	—	—	3.33	10.95	17.96	11.32	—	—	—	—
Spicara flexuosa	—	—	—	—	—	—	—	—	0.74	1.43	0.25	0.52	1.48	2.38	10.74	4.55
Fish fry	0.37	0.48	0.48	0.45	1.11	1.90	0.22	0.57	1.48	1.90	0.26	0.66	—	—	—	—
Labrid sp.	0.74	0.95	0.52	0.66	—	—	—	—	1.85	1.90	3.46	2.55	1.11	1.43	2.79	1.85
Conger sp.	—	—	—	—	—	—	—	—	0.74	0.95	3.37	1.69	0.74	0.95	1.78	1.64
Bothus podas	0.37	0.48	1.90	0.90	0.74	0.95	1.99	1.30	0.74	0.95	1.27	1.03	—	—	—	—
Leognathus klunzingeri	—	—	—	—	0.37	0.48	0.72	0.55	0.37	0.48	0.72	0.55	—	—	—	—
Saurida undosquamis	—	—	—	—	0.37	0.48	0.87	0.61	—	—	—	—	0.37	0.48	2.39	1.01
Uranoscopus scaber	0.74	0.95	2.04	1.31	—	—	—	—	—	—	—	—	0.37	0.48	0.64	0.52
Mullus surmuletus	—	—	—	—	—	—	—	—	0.37	0.48	2.94	1.12	—	—	—	—
Trichiurus sp.	—	—	—	—	—	—	—	—	—	—	—	—	0.37	0.48	0.82	0.59
Pagrus pagrus	—	—	—	—	0.37	0.48	1.82	0.88	—	—	—	—	—	—	—	—
Gobius niger	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Serranus cabrilla	—	—	—	—	—	—	—	—	0.37	0.48	0.65	0.53	—	—	—	—
Serranus hepatus	—	—	—	—	—	—	—	—	0.37	0.48	0.40	0.41	—	—	—	—
Atherina sp.	—	—	—	—	—	—	—	—	0.37	0.48	0.75	0.56	—	—	—	—
2- Digested fish	11.11	0.30	7.80	6.67	3.33	0.05	1.27	1.46	3.70	0.75	3.65	2.85	5.56	0.92	14.97	6.96
B- Crustacea	1.85	0.48	0.23	0.52	2.22	5.09	2.34	2.92	2.59	1.20	1.04	1.40	3.33	1.80	0.25	0.80
Decapoda	0.37	0.48	0.19	0.26	1.85	5.09	2.34	2.65	1.48	1.20	1.00	1.16	1.80	1.80	0.21	0.62
Digested decapoda	1.48	0.11	0.04	0.18	0.37	0.11	0.04	0.10	1.11	0.11	0.04	0.16	0.11	0.11	0.04	0.18
C- Mollusca	0.37	0.48	0.06	0.16	—	—	—	—	0.74	0.60	0.29	0.44	0.37	0.78	2.37	1.80
Cephalopoda	0.37	0.48	0.06	0.16	—	—	—	—	0.74	0.60	0.29	0.44	0.37	0.30	0.77	0.51
Gastropoda	—	—	—	—	—	—	—	—	—	—	—	—	0.37	0.48	1.60	0.82
D- Algae	2.22	8.58	0.72	1.97	2.59	8.08	0.61	1.80	1.11	0.90	0.49	0.70	2.59	3.33	0.34	1.00
Brown algae	1.11	3.38	0.21	0.69	2.22	3.39	0.16	0.67	0.37	0.30	0.01	0.06	0.74	0.95	0.04	0.18
Sea grass	1.11	1.43	0.05	0.25	1.11	2.38	0.22	0.62	—	—	—	—	0.74	0.95	0.03	0.16
Red algae	0.74	1.42	0.60	0.60	0.37	0.48	0.03	0.17	—	—	—	—	0.37	0.48	0.02	0.09
Green algae	1.48	2.35	0.52	0.52	1.11	1.83	0.20	0.54	0.74	0.60	0.28	0.43	0.74	0.95	0.25	0.46
E-Echinodermata	2.96	8.57	0.06	0.59	2.96	6.19	0.04	0.93	2.59	11.43	0.08	0.75	1.85	6.19	0.04	0.40
F- Annelida	0.37	0.20	0.07	0.14	—	—	—	—	—	—	—	—	0.37	0.40	0.14	0.20
G- Higher plant	—	—	—	—	—	—	—	—	0.74	0.95	0.20	0.40	—	—	—	—
Diversity Index (H')	1.20				1.36				1.07				1.43			

Regarding the feeding diversity (H'), it was found that the maximum value (1.41) was found for large size group suggesting that fishes of older ages seem to be more active for capturing different food items compared to those of small and medium size group.

The test of food overlap according to size groups showed significant overlapping between all sizes (<15.0 cm & 15.0 – 20.0 cm), (<15.0 cm & > 20.0 cm) and (<15.0 – 20.0 cm & > 20.0 cm) having the values of 0.86, 0.80 and 0.70 respectively.

Table (4): Variation of food items in stomach of *U. scaber* in relation to size groups (O%= occurrence percentage, N%= number percentage, G%= gravimetric percentage, MFI= modified food index)

Food items	Size groups (cm)											
	< 15.0				15.0 – 20.0				> 20.0			
	O %	N %	G %	MFI	O %	N %	G %	MFI	O %	N %	G %	MFI
A- 1- Pisces	4.81	3.36	4.93	4.49	16.29	8.63	30.37	19.46	22.96	22.85	55.17	35.55
Spicara smaris	0.74	0.48	0.72	0.66	0.37	0.48	0.49	0.46	2.59	10.47	17.57	10.75
Spicara flexmosa	---	---	---	---	0.37	0.48	2.04	1.43	1.11	3.38	8.95	4.48
Fish fry	0.74	0.95	0.24	0.45	---	---	---	---	2.22	3.33	0.76	1.39
Labrid sp.	0.37	0.48	1.26	0.73	1.48	1.90	0.91	1.24	1.85	1.90	4.0	2.94
Conger sp.	0.74	1.45	0.51	0.75	0.74	1.45	4.65	2.25	---	---	---	---
Bothus podas	---	---	---	---	0.37	0.48	0.82	0.59	1.48	1.90	4.34	2.71
Leognathus kimzingeri	---	---	---	---	0.74	0.96	1.44	1.11	---	---	---	---
Saurida undosquamis	---	---	---	---	0.37	0.48	2.39	1.01	0.37	0.48	0.87	0.61
Uranoscopus scaber	---	---	---	---	0.37	0.48	1.25	0.73	0.74	0.95	1.43	1.10
Mullus surmuletus	---	---	---	---	---	---	---	---	0.37	0.48	2.94	1.12
Trichiurus sp.	---	---	---	---	0.37	0.48	0.82	0.59	---	---	---	---
Pagrus pagrus	---	---	---	---	---	---	---	---	0.37	0.48	0.31	0.36
Gobius niger	---	---	---	---	0.37	0.48	1.82	0.88	---	---	---	---
Serranus cabrilla	---	---	---	---	0.37	0.48	0.65	0.53	---	---	---	---
Serranus hepatus	---	---	---	---	0.37	0.48	0.40	0.41	---	---	---	---
Atherina sp.	---	---	---	---	---	---	---	---	0.37	0.48	0.75	0.56
2- Digested fish	2.22	0.07	2.20	0.56	10.00	1.10	12.7	8.39	11.5	2.99	13.1	9.74
B- Crustacea	3.33	1.38	0.16	0.61	3.70	1.38	0.57	1.20	3.34	5.81	3.14	3.79
Decapoda	1.85	1.38	0.12	0.35	1.85	1.38	0.52	0.92	2.23	5.81	3.11	3.54
Digested decapoda	1.48	0.00	0.04	0.17	1.85	0.00	0.05	0.21	1.11	0.00	0.03	0.13
C- Mollusca	---	---	---	---	1.11	1.43	1.95	1.57	3.70	12.51	0.85	0.67
Cephalopoda	---	---	---	---	0.74	0.95	0.35	0.54	0.74	0.43	0.77	0.67
Gastropoda	---	---	---	---	0.37	0.48	1.60	0.82	---	---	---	---
D- Algae	1.85	2.85	0.16	0.40	2.96	2.93	0.28	0.91	9.93	15.17	2.75	4.56
Brown algae	0.74	0.95	0.03	1.17	1.11	1.43	0.02	0.16	2.96	6.19	0.42	1.39
Sea grass	0.74	0.95	0.04	0.17	0.37	0.48	0.15	0.25	3.33	4.28	0.63	1.55
Red algae	0.37	0.95	0.03	0.17	0.74	0.48	0.07	0.21	1.79	2.86	0.20	0.68
Green algae	---	---	---	---	0.74	0.54	0.04	0.16	1.11	1.84	0.39	0.76
E-Echinodermata	2.22	5.71	0.03	0.34	4.45	14.29	0.10	0.97	0.70	12.36	0.08	0.86
F- Annelida	---	---	---	---	0.37	0.00	0.14	0.16	0.37	0.00	0.07	0.11
G- Higher plant	---	---	---	---	---	---	---	---	0.95	0.95	0.20	0.40
Diversity index (H')	1.28				1.28				1.41			

DISCUSSION

The stargazer *Uranoscopus scaber* is a demersal fish that feeds by lying in wait for its prey, buried in the sand almost to its eyes. It attracts its prey by means of protractile appendix attached to the mandible waved like a lure (Bauchot and Pras, 1980; Pietsch, 1989). Huet *et al.* (1999) showed that the fish captures its prey by bending its vertebral column which causes its head to rotate upward and the mouth to open just beneath the prey.

From studying the feeding habits of this species in the Egyptian Mediterranean waters, it was found that it is a carnivorous one which feeds on a broad food items: including pisces, crustaceans, molluscs, algae and echinoderms. Sixteen fish species were identified in its diet of which *Spicara smaris* and *Spicara flexuosa* (Family: Centracanthidae) are the main fish prey. Rizkalla (1992) and Faltas (1993) declared that picarels (Family: Centracanthidae) constitute a remarkable percentage in the catch of Egyptian bottom trawlers. The present result shows that *S. smaris* is eaten in large number during winter. This fact is found to be in accordance with that given by Rizkalla (1995) who declared that this species constitutes a high percentage in trash fish catch obtained by Egyptian bottom trawlers (94% of total catch).

The high diversity of food items in the stomach of this species in Egyptian Mediterranean waters was found in spring. This coincides with the peak of gonadosomatic and hepatsomatic indices during this season (Samia, 2003).

By comparing the present results with those given in other localities, it is found that the main fish diet of *U. scaber* in Spain were *Atherina boyeri, Callionymus occulatus* and *Trachurus trachurus* (Sanz, 1985), while in Greece, it was *Mullus surmuletus* (Kyrtatos, 1982). Boundka and Katari (1996) declared that the stargazer inhabiting the Tunisian coast feeds on benthic animals particularly fishes, crustaceans and molluscs. For those inhabiting the western Mediterranean from Portugal to Gulf of Guinea, it was found that the diet constitute mainly of fishes (*Callionymus maculatus, Alpheus glaber, Solenocera membramacea*) and decapod crustaceans (Sanz, 1985).

From the above finding it is clear that there is variation of fish species in the diet of *U. scaber* in different areas of the Mediterranean sea and east of Atlantic ocean. This can be attributed to the difference in the biodiversity of these areas.

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