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Specialization, trophic breadth and diet overlap of thirteen small marine fish species from Shatt Al-Basrah Canal, Southern Iraq

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Abstract

Specialization, trophic breadth and diet overlap of thirteen marine fish species from Shatt Al-Basrah Canal had been studied from July 2008 to June 2009. Data obtained revealed that seven species (*Johnius belangerii, Platycephalus indicus, Silago arabica*, *Silago sihama*, *Thrysa hamiltoni*, *Thrysa mystex* and *Nematolosa nasus*) were carnivorous, three species (*Acanthopagrus latus, Leiognathus bindus* and *Boleophtalmus dussumieri*) were herbivorous and one species (*Scomberoides commersonnianus*) was a piscivorous. Data obtained also revealed that six species were high specialized feeders (*P. indicus, J. belangerii, B. dussumieri, T. hamiltoni, S. commersonnianus, A. latus*) having breadth range 0-0.25, five species were low specialized feeders (*T. mystex, N. Nasus, S. Sihama, Liza subviridis, Liza kulengeri*) having breadth range 0.26-0.49 and two species were generalized feeders (*S. arabica, L. bindus*) having breadth range 0.50-1.00. The Morisita indexes of feeding overlap showed high overlap (0.97) between *L. subviridis* and *B. dussumieri,* medium overlap (0.65, 0.60) between *J. belangeri, P. indicus* and between *J. belangerii*, *T. hamiltoni* respectively, low overlap (0.10-0.49) for 25 occasion (32%), very low overlap (less than 0.10) for 38 occasion (48.7%) and thirteen occasions (15.4%) of having any feeding overlaps.

1- Introduction:

Diversion canal (Shatt Al-Basrah) has been constructed due to several devastating floods and also to other purposes (Al-Ramadhan, 1988 and Al-Daham & Yousif, 1990). Shatt Al-Basrah Canal constructed to by-pass the excesses of water from Tigris and Euphrates to the Arabian Gulf through Khor Al-Zubair and to navigated canal between Um Qaser and Magel ports. Shatt

Al-Basrah Canal locate between (47°45-47°49) longitude and (18- 30° - 39- 30°) latitude. There is a regulating dam on this canal located about 24 km of its beginning. This dam regulates water current from the north brackish part of this canal and the south marine part. There were many side branches at marine part of the canal caused mainly by strong tidal current.

Much of our understanding for autecology, production and ecological rule of fish population were derived from studies of food habits of fishes (Hyslop, 1980). It is well known that fish species distribution in a certain water body depends on the distribution of its food in addition to restricted environmental factors. In regard to trophic relationships among fishes, one of the major challenges is to understand the ecological mechanisms by which a large number of species are able to coexist in the same community and the manner in which resources are shared (Esteves and Galetti,1994).

The competition on food and place considered as important factor in abundance of animal communities (Connell, 1975). The only study of feeding interaction between fish species of Shatt Al-Basrah Canal was conducted by Al-Dubakel (1986). There are many studies for food habits of Iraqi marine fishes such as (Yousif and Naama, 1992; Al-Daham *et al.,* 1993; Hussain *et al.,*1995, 1999, 2001; Mohamed *et al.,* 1998, 2000 and Ismael, 2008), but only the study of Hussain *et al.* (1993) was dealing with feeding overlap of twelve Iraqi marine fishes in Khor Al-Zubair, and the study of Hussain *et al.* (2007) dealing with feeding overlap of Iraqi marine carnivorous fishes. The aim of this work is to study the feeding overlap of small marine fishes occurred in marine part of Shatt Al-Basrah Canal.

2- Materials and Methods

There are only two fishing methods at the canal, the first was fixed and draft gillnets and the second was hooks and lines. Sampling area of this study was 3-5 km south the regulating dam. The bed of sampling area was very soft clay especially near the beginning of side branches. Monthly fish samples were collected from Shatt Al-Basrah Canal during the period from July 2008 to June 2009, using coastal seine net of 80 meters length and 8 meters height with a mesh sizes 10×10 mm. The fish preserved in cold ice box until reaching to the laboratory to put in deep freeze. Fishes were identified after ((FAO, 1984; Kuronuma & Abe, 1986 and Carpenter *et al.*, 1997). Total lengths and weights of fishes were measured and the digestive canals were removed and give the degree of fullness, then opened in Petri dish to counts

different food items. Frequency and points methods are used to analysis different food items (Hynes, 1950). Foods were identified according to Hadi *et al.* (1984) and Wehr & Sheath (2003). Index of relative important (IRI) was calculated according to the following formula of Stergiou (1988):

$IRI = C_w \times F$

where C_w is proportion of food material and F is its frequency. Trophic niche breadth was calculated according to the following proposed formula of Levins (1968):

$$B = 1/\sum Pi^2$$

where, B is Levins index of niche breadth and Pi is proportion of food group (i) in the diet. The modification to calculate standardize niche breadth (scale from 0-1) was estimated according to Krebs (1989) as follow:

$$B_A = (B-1)/ (n-1)$$

where, B_A is Levins standardized niche breadth and n is number of food items.

The following Morisita overlap index was used to quantify the dietary overlap between fish species (Krebs, 1989):

$$C = (2\sum Py\ Pj)/(\sum Py+\sum Pj)$$

where C is Morisita index of feeding overlap between species j and y. The similarity among fish species based on their diet was calculated according to Morisita similarity coefficient, using Statistica software (ver. 8, 2007).

3- Results

Total numbers of 614 fish belonging to thirteen species were fished during sampling period. Ranges of total lengths and weights of these fishes are shown in table (1). Data obtained revealed that *Scomberoides commersonnianus* was a piscivorous species fed mainly on fishes (76%). Seven fish species were carnivorous fed mainly on animal food. These species are *johnius belangerii* that fed mainly on shrimp (90%), *Platycephalus indicus* that fed mainly on shrimp (98%), *Silago arabica* that fed mainly on shrimp (36%), eggs (25%) and crustacean (22%), *Silago sihama* that fed mainly on shrimp (47%) and eggs (40%), *Thrysa hamiltoni* that fed mainly on shrimp (67%) and eggs (21%), *Thrysa mystex* that fed mainly on eggs (47%) and shrimp (38%) and *Nematolosa nasus* that fed mainly on eggs (46%). Three fish species were herbivorous fed mainly on plant food. These are *Acanthopagrus latus* that fed mainly on filament algae (77%), *Leiognathus bindus* that fed mainly on green algae (52%) and *Boleophtalmus dussumieri* that fed mainly on green algae (89%). Food of *Liza klunzingeri* contain 50% detritus, 47% plant materials and 3% animal materials, while the food of *Liza subviridis* consist of 58% plant materials, 27% detritus and 15% animal (mainly eggs) materials. Table (2) showed Index of relative importance (IRI) of different diet

items for thirteen species from Shatt Al-Basrah Canal. It seemed that shrimp considered as the first important food for carnivorous species except *N. nasus*, and eggs considered as the second important food. Three herbivorous species depend mainly on filament algae then on green algae.

Index of Levins standardized niche breadth for thirteen species from Shatt Al-Basrah Canal are given in table (3). The trophic niche breadth values are ranging from 0.06 for *P. indicus* to 0.57 for *L. Bindus*. Fish species having breadth values 0.25 or less were considered as high specialized feeders (*P. indicus, J. belangerii, B. dussumieri, T. hamiltoni, S. commersonnianus, A. latus*). Fish species having breadth values between 0.26-0.49 were considered as low specialized feeders (*T. mystex, N. Nasus, S. Sihama, L. subviridis, L. kulengeri*). Fish species having breadth values ≥0.50 were considered as generalized feeders (*S. arabica, L. bindus*).

The Morisita indexes of feeding overlap between each pair of the thirteen species are given in table (4). The index showed high overlap (0.97) between *L. subviridis* and *B. dussumieri,* and two medium overlap (0.65, 0.60) between *J. Belangeri, P. indicus* and between *J. belangerii*, *T. hamiltoni* respectively. The index also showed 25 occasion (32%) of low overlap (0.10-0.49) between these species and 38 occasion (48.7%) of very low overlap (less than 0.10). There aren't any feeding overlaps between species in twelve occasions (15.4%).

The Morisita's diet overlap index of all fish species were subjected to statistica software analysis (Fig. 1). The statistica analysis identified three major groups formed of two or more species and two groups of single species of different diets and degree of association. The first group includes two species (*L. subviridis* and *B. dussumieri*) of different feeding habits. Second group includes seven carnivorous species (*j. belangerii, P. indicus, S. arabica*, *S. sihama*, *T. hamiltoni, T. mystex* and *N. nasus*). Third group includes two species (*L. klunzingeri* and *L. bindus*) of different feeding habits. Fourth group formed of one high specialized piscivorous species (*S. commersonnianus*) and fifth group formed also of one high specialized herbivorous species (*A. latus*).

Table (1): Ranges of total lengths and body weights of thirteen species occurred in Shat Al-Basrah Canal.

Species	Fish No.	Range of T.L. (mm)	Range of W. (gm)
Liza subviridis	117	75-195	4.13-84.25
Liza klunzingeri	88	77-185	6.03-62.95
Johnius belangerii	76	74-212	3.75-136.36
Thrysa hamiltoni	55	81-215	4.11-63.52
Thrysa mystex	50	82-230	3.20-59.25
Silago sihama	42	60-155	1.24-29.36
Boleophthalmus dussumieri	40	103-215	7.64-49.07
Leiognathus bindus	38	47-77	1.28-7.25
Acanthopagrus latus	38	50-170	1.27-85.41
Silago arabica	20	66-115	1.71-9.5
Nematolosa nasus	19	71-124	3.45-14.61
Platycephalus indicus	16	97-225	3.61-74.30
Scomberoides commersonnianus	15	68-165	2.43-29.98

Table (2): Diets of thirteen species occurred in Shat Al-Basrah Canal expressed as index of relative importance (IRI).

Food Materials \ Species	*j. belangerii*	*P. indicus*	*S. commersonniamus*	*S. arabica*	*S. sihama*	*T. hamiltoni*	*T. mystex*	*A. latus*	*L. klunzingeri*	*L. subviridis*	*L. hindus*	*B. dussumieri*	*N. nasus*
Shrimp	3479	8700		862.1	1277	2296	1207	132.3		3.17	354.1		106.5
Snails	5.19						1.08	79.8					74.1
Polychaete	31.38			320.2		0.42	0.81				140.7		18.52
Worms	0.1							0.38					
Fish	1.29		4275	14.78		2.98	238.5	21.29					
Crabs	303.7			73.89	168.9			43.33					
Zooplankton	1.94		251.8	7.39	38.37	9.35	118.4	2.28		1.79	110		
Diatoms	11.04	64.29	369.4	12.31	17.44	173.4	110.3	3.04	202	334	306.4	339.5	270
Green Algae	1.51	38.09	547.4		58.14	165.8	1.62	3.8	1838	2030	2163.9	3342.2	21.6
Filament Algae	0.101	4.76			0.58	43.16	16.22	1220	71.79	168.8	424.8	2.65	
Egg	10.84	14.29		591.1	1109	710	1509	51.32	144	641.2	604	2.65	2006
Crustacean	0.43	14.29	142.3	509.8	31.98	21.69	0.54	2.28			82.099		213
Parts of Plants	0.87					0.42	2.16	18.2	74.19	14.77		33.16	3.089
Clay			2.74		1.74				615.5	80.48			185.2
Silt				2.46	10.18				1674	1087		12.38	61.7
Insects					0.58				1.35				
Organic Detritus									70.05			33.6	1361
Jellyfish												8.84	

Table (3): Degree of feeding specialization of thirteen species occurred in Shat Al-Basrah Canal expressed as index of Levins standardized niche breadth.

Species	High specialization 0.0-0.25	Low specialization 0.26-0.49	Generalized ≥0.50
Platycephalus indicus	0.06		
Johnius belangerii	0.09		
Boleophthalmus dussumieri	0.15		
Thrysa hamiltoni	0.21		
Scomberoides commersonnianus	0.23		
Acanthopagrus latus	0.24		
Thrysa mystex		0.29	
Nematolosa nasus		0.35	
Silago sihama		0.36	
Liza subviridis		0.36	
Liza klunzingeri		0.41	
Silago Arabica			0.52
Leiognathus bindus			0.57

Table (4) Degree of feeding overlaps between 13 species from Shat Al-Basrah Canal.

zFish species	*j. belangerii*	*P. indicus*	*S. commersonnianus*	*S. arabica*	*S. sihama*	*T. hamiltoni*	*T. mystex*	*L. klunzingeri*	*L. subviridis*	*A. s latus*	*L. bindus*	*B. dussumieri*	*N. nasus*
j. belangerii	0.00	0.65	0.00	0.30	0.41	0.60	0.34	0.00	0.00	0.05	0.08	0.00	0.02
P. indicus	0.65	0.00	0.00	0.18	0.26	0.45	0.24	0.00	0.00	0.03	0.07	0.00	0.02
S. commersonnianus	0.00	0.00	0.00	0.01	0.00	0.01	0.05	0.04	0.05	0.01	0.05	0.09	0.01
S. arabica	0.30	0.18	0.01	0.00	0.27	0.28	0.24	0.01	0.03	0.04	0.06	0.00	0.11
S. sihama	0.41	0.26	0.00	0.27	0.00	0.37	0.39	0.02	0.06	0.05	0.10	0.02	0.18
T. hamiltoni	0.60	0.45	0.01	0.28	0.37	0.00	0.35	0.03	0.06	0.06	0.11	0.05	0.11
T. mystex	0.34	0.24	0.05	0.24	0.39	0.35	0.00	0.02	0.07	0.04	0.10	0.00	0.22
L. klunzingeri	0.00	0.00	0.04	0.01	0.02	0.03	0.02	0.00	0.28	0.01	0.21	0.33	0.03
L. subviridis	0.00	0.00	0.05	0.03	0.06	0.06	0.07	0.28	0.00	0.02	0.27	0.97	0.08
A. latus	0.05	0.03	0.01	0.04	0.05	0.06	0.04	0.01	0.02	0.00	0.06	0.00	0.01
L. bindus	0.08	0.07	0.05	0.06	0.10	0.11	0.10	0.21	0.27	0.06	0.00	0.46	0.08
B. dussumieri	0.00	0.00	0.09	0.00	0.02	0.05	0.00	0.33	0.97	0.00	0.46	0.00	0.01
N. nasus	0.02	0.02	0.01	0.11	0.18	0.11	0.22	0.03	0.08	0.01	0.08	0.01	0.00

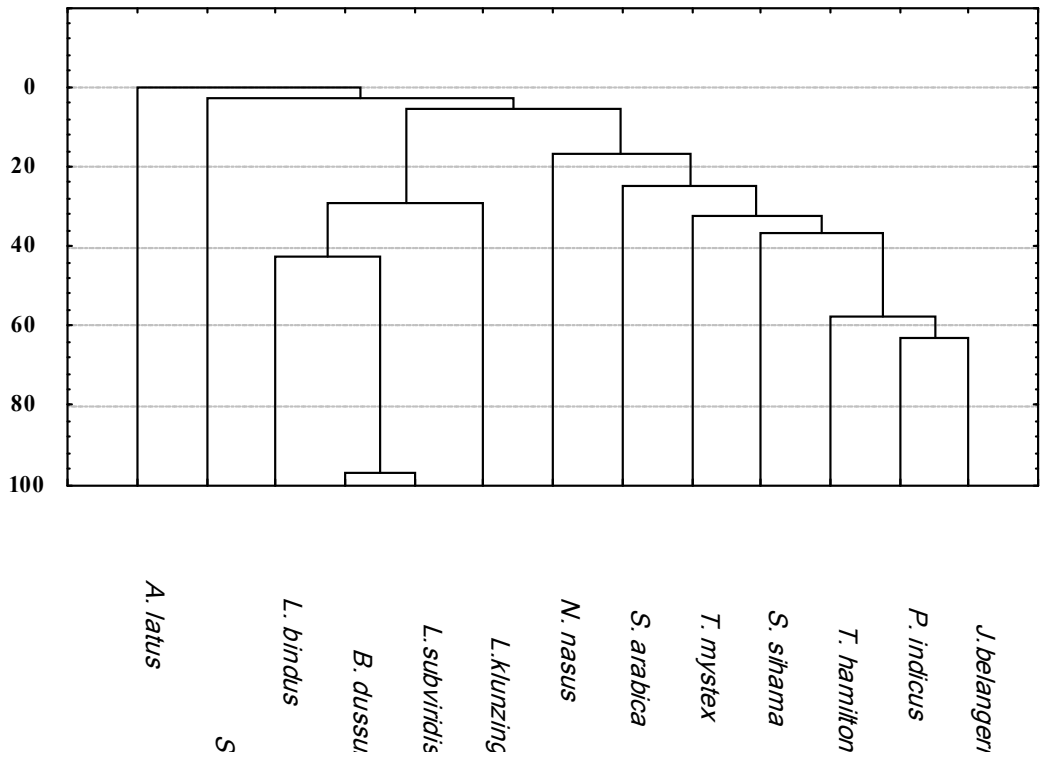

Figure (1) Average linkage of statistica analysis of proportional diet overlap between thirteen fish species occurred in Shat Al-Basrah Canal.

4-Discussion

Study of food and feeding habits of marine fishes is necessary in fish stock assessment and food consumption usually provides helpful information deciphering some of the higher level trophic relationships in an ecosystem. The highest feeding overlap (0.97) only between two species (*L. subviridis* and *B. dussumieri*) have different feeding habits, but they shared on green algae that consist 47% of food materials for *L. subviridis* and 88% for *B. dussumieri*. This result of only one occasion of high overlap is different from results of two much occasions of high overlap between 13 carnivorous species studied by Hussain *et al.* (2007) in Iraqi marine waters, Northwest Arabian Gulf and between 12 marine species studied by Hussain *et al.* (1993) in subtropical coastal

water of Khor Al-Zubair, Iraq. The result of only highest feeding overlap may be related to generally small sizes of fishes found in this area compared with sizes of fishes of Khor Al-Zubair and Northwest Arabian Gulf. This led to consider that the marine part of Shatt Al-Basrah Canal play as nursery ground more than other Iraqi marine waters. It is well known that small fishes consume different kinds of food materials comparing with more specialized large fishes.

It seemed that index of Levins standardized niche breadth depend largely on the ratio of different feeding materials more than numbers of feeding materials. As example the stomach of *J. belangeri* contain 13 food kinds with high specialized standardized niche breadth (0.09), while the stomach of *S. arabica* contain 9 food kinds with generalized standardized niche breadth (0.52). Shrimp comprise 90% of food contents of *J. belangeri,* while other 12 food kinds comprise only 10% of food contents.

Important food materials for *A. latus* are filament algae 77%, shrimp 8%, snails 5%, crabs 3% and eggs 3%. This proportion of filament algae in the diet was very high comparing with 9% in the diet of *A. latus* at three station of Shatt Al-Basrah Canal (Al-Daham *et al.,* 1993). Other studies don't recorded filament algae in the stomachs of *A. latus* such as (Hussain *et al.,* 2001; Ismael, 2008 and Hussain *et al.*, 1993). High proportion of filament algae may be due to small sizes of fishes (more than 80% of studying fish less than 10 cm in length) comparing with the size of fishes in other studies recorded above. Important food materials for *J. belangeri* are shrimp 90%, and then crab 8%. It seemed that shrimp in this study is more important food comparing with other studies. Shrimp comprise 64% of food materials for *J. belangeri* in Northwest Arabian Gulf (Hussain *et al.*, 2007), and comprise 22% of food materials for *J. belangeri* in Khor Al-Zubair (Hussain *et al.*, 1993), while it comprise 12.5% and 25% of food materials for small and large fishes respectively of *J. belangeri* in Shatt Al-Arab Estuary (Mahdi, 1996). Results of this study referred that shrimp comprise 47%, eggs comprise 40% and crabs comprise 6% from the diet of *S. sihama.* These three important food items didn't record in the diet of *S. sihama* in Shatt Al-Basrah Canal (Al-Dubakel, 1986), while Hussain *et al*. (1993) pointed that crabs comprise 64% and shrimp comprise only 3% of food materials for *S. sihama* in Khor Al-Zubair.

Results of this study pointed that shrimp (67%) was the first important food in the diet of *T. hamiltoni* and eggs (21%) was the second important food. Shrimp comprise 95% of food materials for *T. hamiltoni* in Northwest Arabian Gulf

(Hussain *et al.*, 2007), and comprise 35% of food materials for *T. hamiltoni* in Khor Al-Zubair (Hussain *et al.*, 1993), while eggs don't recorded in both studies. Important food materials for *T. mystex* are eggs 47%, shrimp 38% and fish 7%. These results are differing from the result of Hussain *et al.* (2007), where shrimp is very important food material (99%) for *T. mystex* in Northwest Arabian Gulf.

Food analysis for *N. nasus* showed that eggs comprise 46%, organic detritus comprise 31%, diatoms comprise 6% and crustacean comprise 5%. Diatoms and plants comprise 37% of the diets for *N. nasus* in Shatt Al-Basrah Canal (Al-Dubakel, 1986), organic detritus and crustacean comprise 29% and 13% respectively of the diet for *N. nasus* in Khor Al- Zubair (Majeed, 1989), while eggs don't record in both studies. Important materials found in the stomachs of herbivorous species *B. dussumieri* are green algae 89%, diatoms 9%. Diatoms and algae comprise 79% and 14% respectively of the diet for *B. bodarti* in Khor Al- Zubair, while *Priophthalmus waltoni* was carnivorous species fed mainly on crabs (67%) and insects (23%) (Al-Noor, 1994). Food materials found in the stomachs of *L. klunzingeri* were green algae 39%, silt 36%, and clay 13%, while food materials found in the stomachs of *L. subviridis* are green algae 46%, silt 25%, eggs 15% and diatom 8%. Important materials found in the stomachs of *L. carinata* in Shatt Al-Basrah Canal are green and blue green algae 36%, silt and clay 19% and diatoms 15%, while important materials found in the stomachs of *L. subviridis* in Shatt Al-Basrah Canal are parts of plants 29%, diatoms 23%, green and blue green algae 22%, silt and clay 15% (Wahab, 1986). In Northwest Arabian Gulf food materials found in the stomachs of *L. kulengeri* are silt and clay 30%, organic matters 24%, diatom 16%, parts of plants 13% and algae 13%, while food materials found in the stomachs of *L. subviridis* are silt and clay 35%, organic matters 20%, diatom 17%, parts of plants 13% and algae 12% (Saleh, 1997). It seems that the result of food habits of present study similar to some extent to the results of previous studies with one obvious difference (recording eggs in the diets of these two species at present study only).

Eggs recorded in all fish species studied in present study except the high specialized piscivorous species (*S. commersonnianus*). Eggs was the first important food in the diet of *T. mystex* and the second important food in the diet of *S. arabica, T. hamiltoni and B. dussumieri*. Previous studies of feeding habits for theses fishes in Iraqi marine waters don't record any importance for eggs in the diet of these

fishes. This result may be attributed to differences in size of fishes for this study and previous studies or to the availability of eggs in this canal, where many quantities of eggs appear in the plankton nets used at sampling area. This result lead us to conclude that some marine organisms spawn in Shatt Al-Basrah Canal or tidal current carry these big quantities of eggs from spawning areas of marine organisms to Shatt Al-Basrah Canal.

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التخصص والمدى والتداخل الغذائي لثلاثة عشر نوعاً من صغارالاسماك البحرية المصطادة من قناة شط البصرة، جنوب العراق

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الخلاصة

درس كل من التخصص والمدى والتداخل الغذائي لثلاثة عشر نوعا من الاسماك البحرية المصطادة من قناة شط البصرة للفترة من تموز 2008 ولغاية حزيران 2009. أظهرت البيانات وجود سبعة انواع حيوانية التغذية وهي أسماك الطعطوا *johnius belangerii* ، أسماك الوحرة *Platycephalus indicus* ، أسماك الحاسوم*Silago arabica and Silago sihama* ، أسماك الشيغة *Thrysa hamiltoni* and *Thrysa mystex* وأسماك الجفوتة الخيطية *Nematolosa nasus* ، كما اظهرت النتائج وجود ثلاثة انواع نباتية التغذية وهي أسماك الشانك *Acanthopagrus latus*، الأسماك الغروية *Leiognathus bindus* وأسماك أبوشلمبوا *Boleophtalmus dussumieri*، في حين وجد ان اسماك الضلع *Scomberoides commersonnianus* تتغذى حصرياً على الاسماك. بينت النتائج وجود ستة انواع عالية التخصص الغذائي (المدى الغذائي 0–0.25) وهي أسماك الوحرة، أسماك الطعطعو، أسماك ابو شلمبو، أسماك الشيغة *T. Hamiltoni*، أسماك الضلع وأسماك الشانك، ووجود خمسة أنواع منخفضة التخصص الغذائي (المدى الغذائي 0.26–0.49) وهي أسماك الشيغة *T. mystex*، أسماك الجفوتة الخيطية، أسماك الحاسوم *S. sihama* وأسماك البياح*Liza kulengeri* and *Liza subviridis* ، وكذلك وجود نوعان ذات تغذية عامة (المدى الغذائي 0.50–1.00) وهما الاسماك الغروية وأسماك الحاسوم *S. Arabica*. وجد تداخل غذائي كبير (0.97) بين أسماك البياح الأخضر *L. Subviridis* وأسماك أبو شلمبو، وتداخل متوسط (0.60، 0.65) بين أسماك الطعطعو وكل من اسماك الوحرة وأسماك الشيغة *T. Hamiltoni بالتعاقب*، وتداخل قليل (0.10–0.49) في 25 حالة (32%)، وتداخل قليل جدا (أقل من 0.10) في 38 حالة (48.7%)، بينما لم يسجل أي تداخل في 13 حالة.