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Trophic breadth and dietary overlap for ten fish species caught from Shatt Al-Arab River, Fao, southern Iraq

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Abstract

A total of 274 fishes of 10 species were caught since July 2010 to March 2011, using coastal seine net from Shatt Al-Arab River at Fao. The importance of food items in the diet of ten species were assessed by index of relative importance. Most fishes depend upon one or two main food items where the all fishes eat 15 food items of which seven were animal items, five of plant origin and three organic and non-organic detritus. Six species were considered as carnivores where animal ratios in their diets are 97.1, 89.1, 86.9, 81.5, 76.8 and 72.6 for *Johnius belangerii, J. dussumieri, Thryssa whitheadi, Ilisha compressa, Sparidentex hasta* and *T. hamiltoni* respectively. The Morisita indexes of feeding overlap showed only five significant overlap, three of them between *J. dussumieri* with *I. compressa* (0.869), *T. whitheadi* (0.866) *and T. hamiltoni* (0.675), while only two significant overlap were recorded between *T. whitheadi* with *I. compressa* (0.862) and *T. hamiltoni* (0.657). Five species were considered as high specialized feeders (*P. klunzegeri, J. dussumieri, J. belangeri, T. whithead* and *I. compressa*), four species were considered as low specialized feeders (*P. subviridis, A. arabicus, T. hamiltoni* and *T. Ilisha*), and *S. hasta* considered as generalized feeder.

Introduction

Studies of feeding in fish assemblages in a particular site allows us to recognize distinctive trophic guilds, and also make inferences about their structure, the degree of importance of the different trophic levels and the relationships among their components [1]. Also diet overlap may reflect competition under conditions of limited resource availability [2]. Studies in several freshwater environments [3, 4, 5, 6, 7, 8 and 9] have shown that the same food resource may be shared by numerous fish species, and that each species may successively exploit several different sources during the year. Fishes occupy different food niches to reduce food overlap by mechanisms that range from taking different portions of the same prey groups and feeding on different organisms along a vertical distributional axis, to specialized or generalized feeding [10 and 11].

Several studies deal with food competition and resource partitioning among fishes in the Shatt Al-Arab river estuary, Shatt Al-Basra Canal and Iraqi marine waters [12, 13, 14, 15 and 16], however most studies focused upon few specialized fish species during the last years. The Mesopotamian rivers were suffering from various problems amongst them new hydrological projects, several large dams in Turkey, Syria, Iran and Iraq have diverted water from the Tigris and Euphrates and their tributaries for irrigation, flood control, and hydroelectric power [17]. It is expect that this situation alter fish composition which might affect the trophic structure of the fish fauna in the estuary.

The aim of this study was to highlight on the feeding habits and feeding overlap of fish species in the estuarine part of Shatt Al-Arab River, Fao.

Materials and methods

Study area**:** The estuary of Shatt Al-Arab River represents the most northwestern end of the Gulf (Fig. 1). The substratum of this region differs from the other parts of the Gulf, due to terrigenous sediments brought by the river. The sediments are mostly composed of fine mud (clay and silt) with a percentage reach 80% [18]. There is no sandy or rocky or coral reef substratum. The hydrology of the region is influenced heavily by Shatt Al-Arab River [19].

Fish collection & identification**:** Fishes were collected seasonally from Shatt Al-Arab River at Fao during July 2010 to March 2011. Sampling was carried out using coastal seine net of 100 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 [20, 21 and 22]. 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 count different food items. Frequency and points methods were used to analysis different

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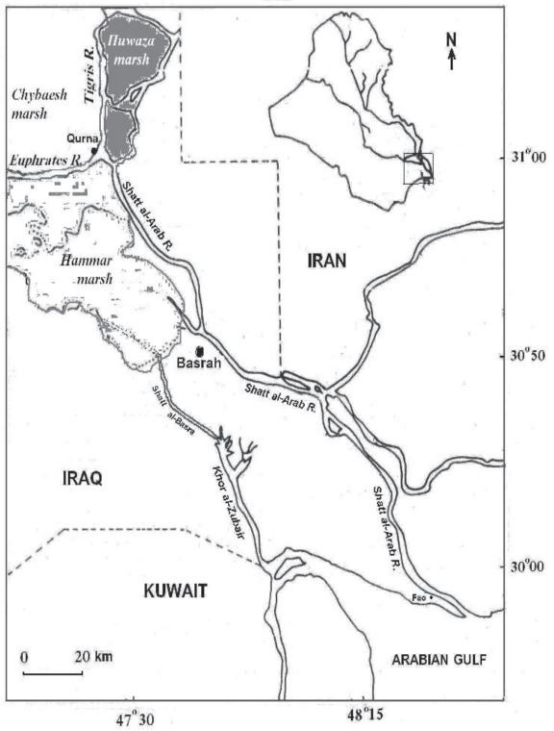

Figure (1) Map of the Shatt Al-Arab River showing the sampling area.

food items [23]. Foods were identified according to [24 and 25].

Index of relative important (IRI) was calculated according to the following formula of [26]: IRI = Cw× F

where Cw is proportion of food material and F is its frequency. Trophic niche breadth was calculated according to the following proposed formula of [27]: B = 1/Σ Pi2

where, B is Levins index of niche breadth and Pi is proportion of food group (i) in the diet. The modification to calculate standardized niche breadth (scale from 0-1) was estimated according to [28] as follow: BA = (B-1)/ (n-1)

where, BA 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 [28]:

$$C = (2\Sigma Py\,Pj)/(\Sigma Py+\Sigma Pj)$$

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).

Results

Seasonal changes in some ecological factors in the study site of Shatt Al-Arab river estuary are given in Table (1). Transparency, dissolved oxygen, salinity and water temperature exhibited obvious variation during different seasons, while pH showed alkaline trend in all sampling season. Table (2) show numbers and sizes of ten fish species caught during sampling period, where largest number (43) for *Tenualosa ilisha* and smallest number (15) for *Planiliza subviridis.*

Table (3) show feeding habits of the ten studied fish species in southern Shatt Al-Arab River. It was found that most fishes depend upon one or two main food items where all fishes eat 15 food items of which seven were animal items (shrimp, crab, other crustacean, snail, insects, egg and fishes) five of plant origin (plant, green algae, filament algae, diatom and phytoplankton) and three of organic and non-organic matters (silt, clay and detritus). Shrimp were found in nine fish species except *T. ilisha* with mostly of high frequency, while filament algae found only in the diet of *T. ilisha.*

Table (4) showed ratio percentages of different food items of fishes. Shrimp was the main food item (More than 70%) for three fish species (*J. dussumieri, T. whitheadi and I. compressa*), while detritus was the main food item (64%) for *P. klunzingeri* and crab was the main food item (58%) for *J. belangerii*. Filament algae was found only in the diet of *T. ilisha* with very low ratio (1.31%). Six species were considered as carnivores where animal ratios in their diets were 97.1, 96.5, 86.9, 81.5, 76.8 and 72.6 for *J. belangerii, J. dussumieri, T. whitheadi, I. compressa, S. hasta* and *T. hamiltoni* respectively. Two species were consider as omnivores, *A. arabicus* and *T. ilisha. P. klunzegeri* was detrivores where detritus consist 72.7% of its diet, while diets of *P. subviridis* consist of 52.3% plant and 40.3% detritus.

Table (5) Showed the values of IRI for food items of ten fish species. Highest IRI values were 7272.7, 6552.9, 5982.7, 4308.2, 1646.3 of shrimp for *I. compressa, T. whitheadi, J. dussumieri, T. hamiltoni and J. belangerii* respectively. Another highest values was 5533.8 of detritus for *P. klunzingeri*, 3894.7 of green algae for *P. subviridis* and 2628.5 of crustacae for *T. ilisha.*

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Table (6) and figure (2) showed diet overlap between ten species cached from southern Shatt Al-Arab river. The Morisita indexes of feeding overlap showed only five significant

Table (1) Seasonal variations in ecological factors at studied station in Shatt Al-Arab River during 2010-2011.

Season	Transparency (cm)	pH	Dissolved Oxygen (mg/l)	Salinity ppt	Water Temperature (°C)
Summer	12	8.3	7.2	7.6	27
Autumn	8	8	7.5	6.2	25
Winter	20	7.7	9.3	4.3	14.6
Spring	33	7.9	8.2	5.8	14.6
Mean	18.3	8.0	8.1	6.0	20.3

Table (2) Numbers, total length and weight of fish species collected from studied station in Shatt Al-Arab River

No.	Fish species	Number	Mean total	Mean total
1	*Planiliza subviridis*	15	14.94	47.13
2	*Planiliza klunzingeri*	20	12.22	24.62
3	*Acanthopagrus arabicus*	24	10.21	31.33
4	*Sparidentex hasta*	19	13.96	44.91
5	*Johnius dussumieri*	34	13.15	35.61
6	*Johnius belangerii*	41	14.02	34.28
7	*Thryssa whitheadi*	28	12.67	14.51
8	*Thryssa hamiltoni*	33	12.92	12.86
9	*Tenualosa ilisha*	43	15.27	32.33
10	*Ilisha compressa*	17	15.66	21.98

Table (3) Frequency percentage of food items for ten species cached from Shatt Al-Arab River.

Food items	Fish species									
	P. klunzegeri	*P. subviridis*	*A.. arabicus*	*S. hasta*	*J. dussumieri*	*J. belangerii*	*T. whitheadi*	*T. hamiltoni*	*T. ilisha*	*I. compressa*
Shrimp	73.3	10	4.2	47.4	82.3	51.2	89.3	81.8		100
Crab			41. 7	52.6	14.7	70.7				5.9
Crustacae			16.7		2.9	4.9	10.7		65.1	17.6
Snail			62.5			24.4			4.6	
Insect								6.1		
Egg	6. 7				2.9		17.9	42.4		
Fish			4.2	47.4	14.7	2.4		3		11.8
Green algae	13.3	80	58.3	68.4		2.4	32.1	42.4	34.9	23.5
Diatom	20	25	20.8	36.8			32.1	36.4	37.2	23.5
Phytoplanktoon							3.6	12.1		11.8
Plant	6. 7	5	12.5	5.3	8.8	2.4		3	39.5	17.6
Silt	6. 7	60								
Clay	46. 7	60							7	
Detritus	86. 7	25					3.6		13.9	5.9
Filament algae									2.3	

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Table (4) Percentage values of food items for ten species cached from Shatt Al-Arab River.

Food items	Fish species									
	P. klunzegeri	*P. subviridis*	*A. arabicus*	*S. hasta*	*J. dussumieri*	*J. belangerii*	*T. whitheadi*	*T. hamiltoni*	*T. ilisha*	*I. compressa*
Shrimp	18.9	7.4	3.3	27.7	72.7	32.1	73.4	52.6		72.7
Crab			14.2	20.5	13.5	58				1.1
Crustacae			8.3		0.3	1.3	6.4		40.4	4.3
Snail			36.3			5.7			1	
Insect								1.6		
Egg	2.03				2.6		7.1	18.1		
Fish			2.1	28.6	7.4	0.5		0.31		3.4
Green algae	3.4	48.7	31.2	17		0.3	7.5	15.2	17.8	6.8
Diatom	1.7	2.6	2.1	5.1			3.4	6.1	3.7	2.6
Phytoplanktoon							1.1	5.9		2.3
Plant	1.3	1	2.5	1	3.5	2.1		0.2	27.7	6.2
Silt	1.4	9.5								
Clay	7.4	13.4							1.6	
Detritus	63.9	17.4					1.1		6.5	0.6
Filament algae									1.3	

Table (5) IRI values of food items for ten species cached from Shatt Al-Arab River.

Food items	Fish species									
	P. klunzegeri	*P. subviridis*	*A.. arabicus*	*S. hasta*	*J. dussumieri*	*J. belangerii*	*T. whitheadi*	*T. hamiltoni*	*T. ilisha*	*I. compressa*
Shrimp	1387.4	73.7	13.9	1313.5	5982.7	1646.3	6552.9	4308.2		7272.7
Crab			590.3	1081.1	199	4105				6.7
Crustacae			138.9		0.9	6.22	68.9		2628.5	75.2
Snail			2265.6			140.0			4.9	
Insect								9.5		
Egg	13.5				7.8		127.6	768.9		
Fish			8.7	1355.8	108.1	1.2		1		40.1
Green algae	45.1	3894.7	1822.9	1159.5		0.6	241.1	643	621.8	160.4
Diatom	33.8	65.8	43.4	189.2			109.1	221.6	136.6	60.2
Ph.plankton							3.8	72		26.7
Plant	9	5.3	31.25	5.41	31.14	5		0.5	1093.3	110.3
Silt	9	568.4								
Clay	346.9	805.3							11	
Detritus	5533.8	434.2					3.83		91.4	3.3
Fil. algae									3.05	
Total items	8	7	8	6	6	7	7	8	8	9

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Table (6) Diet overlap of ten species cached from Shatt Al-Arab River.

Fish Species	*P. klunzegeri*	*P. subviridis*	*A. arabicus*	*S. hasta*	*J. dussumieri*	*J. belangerii*	*T. whitheadi*	*T. hamiltoni*	*T. ilisha*	*I. compressa*
P. klunzegeri	-	0.067	0.003	0.047	0.176	0.051	0.174	0.133	0.015	0.177
P. subviridis	0.067	-	0.243	0.153	0.012	0.004	0.004	0.034	0.080	0.090
A. arabicus	0.003	0.243	-	0.111	0.006	0.094	0.045	0.041	0.068	0.010
S. hasta	0.047	0.154	0.111	-	0.249	0.217	0.233	0.207	0.032	0.228
J. dussumieri	0.176	0.012	0.006	0.249	-	0.285	0.866	0.675	0.001	0.869
J. belangerii	0.051	0.004	0.094	0.217	0.285	-	0.253	0.199	0.001	0.253
T. whitheadi	0.174	0.004	0.045	0.233	0.866	0.253	-	0.657	0.01	0.862
T. hamiltoni	0.133	0.034	0.041	0.207	0.675	0.199	0.657	-	0.015	0.652
T. ilisha	0.015	0.08	0.068	0.032	0.001	0.001	0.01	0.015	-	0.011
I. compressa	0.177	0.09	0.01	0.228	0.869	0.253	0.862	0.652	0.011	-

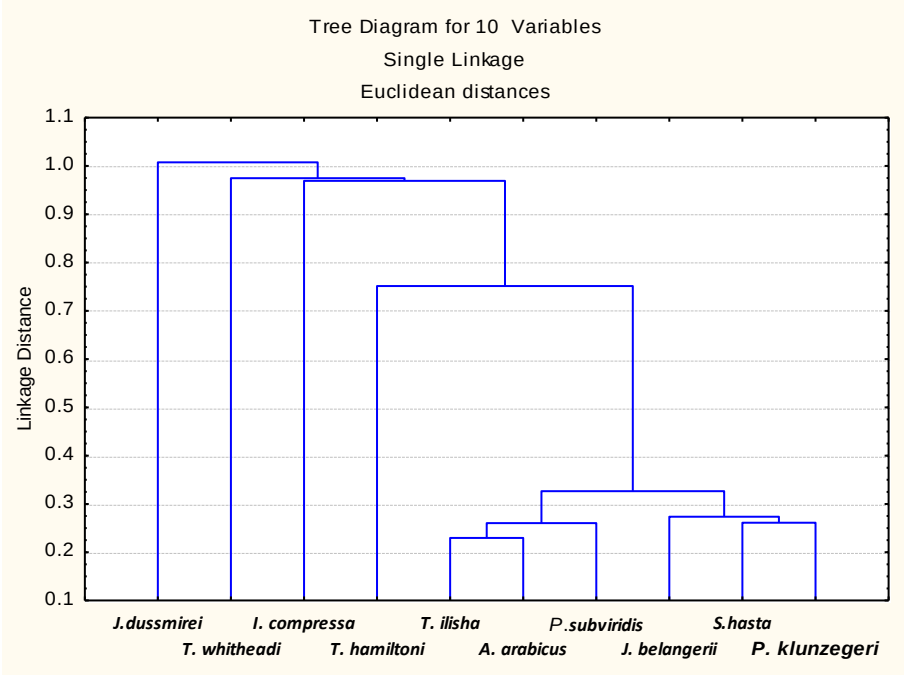

Figure (2) Average linkage of statistica analysis of proportional diet overlap between ten species cached from Shatt Al-Arab River.

Table (7) Standardized niche breadth values for ten species cached from Shatt Al-Arab River.

Species	Standardized niche breadth		
	High specialization	Low specialization	Generalized
P. klunzegeri	0.173746		
P. subviridis		0.388146	
A. arabicus		0.409396	
S. hasta			0.660349
J. dussumieri	0.161386		
J. belangerii	0.208677		
T. whitheadi	0.133692		
T. hamiltoni		0.276588	
T. ilisha		0.372195	
I. compressa	0.105717		

overlap, three of them between *J. dussumieri* with *I. compressa* (0.869), *T. whitheadi* (0.866*) and T. hamiltoni* (0.675), while only two significant overlap were recorded between *T. whitheadi* with *I. compressa* (0.862) and *T. hamiltoni* (0.657).

Table (7) showed standardized niche breadth values for ten fish species occurred in Shat Al Arab River. Fish species having breadth values 0.25 or less were considered as high specialized feeders (*P. klunzegeri, J. dussumieri, J. belangeri, T. whithead* and *I. compressa*). Fish species having breadth values between 0.26-0.49 were considered as low specialized feeders (*P. subviridis, A. arabicus, T. hamiltoni* and *T. Ilisha*), while fish species having breadth values ≥0.50 were considered as generalized feeders (*S. hasta*).

Discussion

It is necessary to study food and feeding habits of marine fishes to evaluate stock assessment, and consumption of food provides helpful information deciphering some of higher level trophic relationships in an ecosystem. Feeding habits of *A. arabicus* in current study differ greatly with results of [16], who recorded 77% filament algae in the diet of this species in Shatt Al-Basrah Canal. This result may be attributed to high abundance of filament algae in the coastal of Shatt Al-Basrah Canal comparing with very low abundance of filament algae in sampling area of Shatt Al-Arab in current study. Feeding habits of *A. arabicus* in this study (Animal diets comprise 64.2%) was similar to some extent to feeding habits recorded by other researchers [29,14, 30 and 31].

The main food item *of J. belangerii* in current study was crab that consist 58%, while shrimp consist 90% of the diet for this species in Shatt Al-Basrah Canal [16]. Shrimp comprise 22% of food materials for *J. belangeri* in Khor Al-Zubair [14], and comprise 12.5% and 25% of food materials for small and large fishes respectively in Shatt Al-Arab Estuary [32], while it comprise 64% of food materials in Northwest Arabian Gulf [15]. The main food item in current study of *J. dussumieri* was shrimp (76.7%) and it is the same main food item (72.7) recorded by [15] in Iraqi marine water. [33] stated that prawn was the main food item in Shatt Al-Arab Estuary, while [34] stated that prawn then crab were the main food items in Northwest Arabian Gulf.

The main food item of *T. whiteheadi* and *T. hamiltoni* in current study was shrimp that comprise 73.4% and 52.6% respectively. The main food item of *T. whiteheadi* in Shatt Al-Basrah Canal was egg which consist 47% then shrimp 38% of food items, while the main food item of *T. hamiltoni* was shrimp which consist 67% then eggs 21% of food items [16]. Previous studies of feeding habits of these fishes don't recorded any importance for eggs in the diet of them. [15] stated that shrimp was very important food material (99%) for *T. whiteheadi* in Northwest Arabian Gulf.

Food materials found in the stomachs *of P. klunzingeri* in current study were detritus (63.9%), shrimp (18.9%), clay (7.4%) and silt (1.4%), while food materials found in the stomachs

of this species in Shatt Al-Basrah Canal were green algae (39%), silt (36%), and clay (13%) [16]. The differences of clay and silt percentage may be attributed to high turbidity in Shatt Al-Basrah Canal because of high speed current especially in low tide comparing with low speed current and low turbidity in Shatt Al-Arab River at Fao. In Northwest Arabian Gulf food materials found in the stomachs of *P. kulengeri* are silt and clay (30%), organic matters (24%), diatom (16%), parts of plants (13%) and algae (13%) [38].

Food materials found in the stomachs of *P. subviridis* in current study were plant (52.3%) and detritus (40.3%), while food materials found in the stomachs of this species in Shatt Al-Basrah Canal were plant (58%), detritus (27%) and eggs (13%) [16]. [17] recorded Important materials (plants 29%, diatoms 23%, green and blue green algae 22%, silt and clay 15%) found in the stomachs of *P. subviridis* in Shatt Al-Basrah Canal. [35] found silt and clay 35%, organic matters 20%, diatom 17%, parts of plants 13% and algae 12% in the stomachs of *P. subviridis.*

Food materials found in the stomachs of *S. hasta* in current study were fish 28.6%, shrimp 27.7%, crab 20.5% and green algae 17%. [36] stated that this fish feed mainly on fishes and invertebrates in Kuwait's water. The main food items of *T. ilisha* in current study were crustacean (40%), plant (17.8%) and green algae (17.8%), while [37] recorded filament algae (40%) and diatom (34%) as main food items in the three southern restored marshes.

The Morisita indexes of feeding overlap in current study showed five significant overlap between four carnivores species, three of them between *J. dussumieri* with *I. compressa*, *T. whitheadi and T. hamiltoni*, while two of them between *T. whitheadi* with *I. compressa* and *T. hamiltoni*. [16] recorded only one high (0.97) overlap between *P. subviridis* and *Boleophtalmus dussumieri*. There were much occasions of high overlap between 13 carnivorous species studied by [15] in Iraqi marine waters, Northwest Arabian Gulf and between 12 marine species studied by [14] in subtropical coastal water of Khor Al-Zubair.

Levins standardized niche breadth values of current study differ slightly from the same six species studied by [16]. It seemed that index of Levins standardized niche breadth depend largely on the ratio of different feeding materials more than numbers of feeding materials. For example both of *S. hasta* and *J. dussumieri* in current study fed on six kinds of food, but they have very different niche breadth.

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