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TROPHIC BREADTH AND DIETARY OVERLAP FOR SEVEN FISH SPECIES CAUGHT FROM SHATT AL-ARAB RIVER, SOUTHERN IRAQ

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ABSTRACT A total of 290 fishes of seven species were caught since July 2010 to March 2011, using coastal seine net from Shatt Al-Arab River at Hamdan and Dair districts. The importance of food items in the diet of seven species assessed by index of relative importance. Most fishes depend upon two main food items where the all fishes eat 15 food items of which six were animal items, another six of plant origin and three organic and non-organic detritus. Six species considered as herbivores where plant ratios in their diets were 100, 96.9, 95.8, 85.2, 75.4, and 73.1% for *Poecilial latipinna, Acanthobrama marmid, Carassius auratus, Tenualosa ilisha, Planiliza subviridis and Anodontostoma chacunda* respectively. One species (*Planiliza abu*) were consider as detrivores where ratio of detritus was 62.6%.The Morisita indexes of feeding overlap showed significant overlap between studied species except *P. abu*. Results appeared that *A. marmid and T. ilisha* were high specialized feeders, *P. abu, A. chacunda, C. auratus and P. latipinna* were low specialized feeders and *P. subviridis was* generalized feeder.

KEYWORDS : Shat Al-Arab River, Feeding interaction, Morisita indexes, IRI

INTRODUCTION

Distribution of fish food are affected fish distribution in a certain water body in addition to restricted environmental factors. The competition on food and place considered as important factor in abundance of animal communities (Hahn *et al*., 2004). Major challenges in the environments is understanding ecological mechanisms by which large numbers of species are able to coexist in the same community and how they can shared food resources (Olurin *et al*., 1991). The same food resource may be shared by numerous freshwater fish species and each species may successively exploit several different sources around the year (Olurin *et al*., 1991; Pouilly *et al*., 2003; Hahn, *et al*., 2004; Mérona and Mérona, 2004; Pouilly *et al*., 2006). Fishes occupy different food niches in order to reduce food overlap by different mechanisms such as taking different portions of the same prey groups and feeding on different organisms along a vertical distributional axis (Casaux and Barrera-Oro, 2013).

Study of food and feeding habits is useful in determining the population level, in as much as the number of individuals in fish population depends on the amount of food available, and it is also determine growth rate of fish species, as well as revealing the status of the foraging fish species. It is important to understanding the relationship between body structures and fish diet to predicting the diet of, how they feed and the mechanics of feeding, so studies on stomach composition could provide useful information in positioning of the fishes in the food web. Many benefits can be reached from studying of fish feeding for assemblages such as recognizing distinctive trophic guilds, and make inferences about their structure, the degree of importance of the different trophic levels and the relationships among their components (Novakowski *et al.*, 2008).

Several studies deal with food competition and resource partitioning among fishes in fresh and marine waters in south Iraq (Al-Dubakel, 1986; Al-Daham, and Yousif, 1990; Hussain *et al*., 1993; Hussain *et al*., 2007; Taher, 2010; Al-Lamy *et al*., 2012; Mohamed *et al.,* 2015; Taher *et al*., 2016; Mohamed and Abood, 2018 and 2019; Abood and Mohamed, 2019). The aim of this study was to highlight on the feeding habits and feeding overlap of fish species in the central and northern parts of Shatt Al-Arab River.

MATERIALS AND METHODS

Fishes were collected seasonally from Shatt Al-Arab River at Hamdan and Dair districts during July 2010 to March 2011 (Figure, 1). Sampling carried out using coastal seine net of 100 meters length and 8 meters height with a mesh sizes 10×10 mm, in addition to coastal cast net. The fish preserved in cold icebox until reaching the laboratory to put in deep freeze. Fishes identified after (Coad, 2010). Total lengths and weights of fishes measured and the digestive canals removed and give the degree of fullness, then opened in Petri dish to identified different food items. Frequency and points methods were used to analysis different food items (Hynes, 1950). Foods were identified according to Hadi *et al*. (1984) and Wehr and Sheath (2003).

Index of relative important (IRI) was calculated according to the following formula of (Stergiou, 1988):

$IRI = Cw \times F$

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

$B = 1/\Sigma Pi2$

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 (Krebs, 1989) 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 (Krebs, 1989):

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

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).

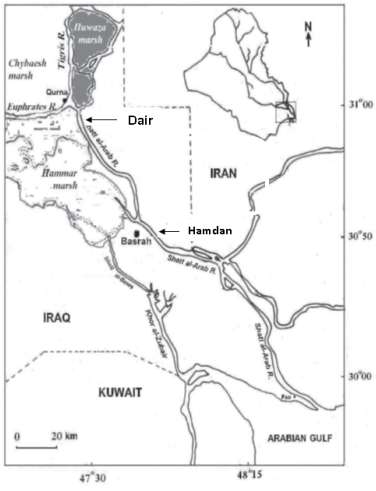

Figure (1) Map of the Shatt Al-Arab River showing the sampling areas.

RESULTS

Seasonal changes in some ecological factors in the study sites (Hamdan and Dair) 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 seven fish species caught during sampling period from two stations, where largest total number (68) for *Carassius auratus* and smallest number (15) for *Anodontostoma chacunda.*

Table (3) showed mean and range of total length and weight of fish species caught during sampling period from two stations, where largest species was *Liza subviridi* with mean total length of 16.64 cm and mean weight 56.23 g. Table (4) show frequency percentage of the seven studied fish species in Shatt Al-Arab River. Highest frequency percentage (100%) was recorded to diatom in *A. chacunda* followed (93.75%) by green algae in *A. marmid,* while lowest frequency percentage (1.16%) recorded to crustacean, eggs and shrimp in *C. auratus.*

Table 1. Seasonal variations in the ecological factors at the studied stations in Shatt Al-Arab River during 2010-2011.

Environmental Factors	Hamdan Station				Dair Station			
	Sum.	Aut.	Win.	Spr.	Sum.	Aut.	Win.	Spr.
Temperature (0C)	26.7	22	15.4	21.4	28.26	23	15.2	22.2
pH	7.7	7.9	8.1	7.9	8.3	8.2	8.0	8.2
Salinity (ppt)	1.4	2.3	3.8	2.5	1.2	0.8	1.8	1.3
Dissolved O2 (mg/l)	7.5	8.6	12.5	9.5	8.5	9.5	12.5	10.2
Transparency (cm)	47	42.5	48	45.8	47	56	55	52.7

Table (2) Numbers of fish species collected from the two studied stations in Shatt Al-Arab River during 2010-2011.

No.	Fish species	Total	Dair	Hamdan
1	*Planiliza subviridis*	56	0	56
2	*Carassius auratus*	68	19	49
3	*Planiliza abu*	67	23	44
4	*Tenualosa ilisha*	43	28	15
5	*Poecilia latipinna*	17	9	8
6	*Acanthobrama marmid*	24	24	0
7	*Anodontostoma chacunda*	15	0	15

Table (3) Total length and weight of fish species collected from the studied stations in Shatt Al-Arab River during 2010-2011.

No.	Fish species	Mean total length (cm)	Range of total length (cm)	Mean total weight (g)	Range of total weight (g)
1	P. subviridis	16.64	14.0-22.5	56.23	34.07-132.9
2	C. auratus	12.17	6.5-20.2	33.49	3.83-136.34
3	P. abu	13.82	10.8-17.0	32.66	13.22-54.62
4	T. ilisha	16.48	12.5-23.3	41.89	14.07-110.33
5	P. latipinna	6.37	5.5-7.3	4.12	2.41-6.48
6	A. marmid	12.63	11.2-14.5	19.95	11.17-39.86
7	A. chacunda	11.99	10.8-13.4	22.69	18.2-31.6

Table (4) Frequency percentage values of food items for fish species collected from Shatt Al-Arab estuary during 2010-2011.

Fish species	P. subviridis	C. auratus	P. abu	T. ilisha	P. latipinna	A. marmid	A. chacunda
Diatom	89.29	46.51	23.44	44.44	88.24	50.00	100.00
Green Algae	66.07	81.40	28.13	84.44	58.82	96.15	93.75
Phytoplankton	30.36	32.56	10.94	17.78	23.53	0.00	31.25
Plant	3.57	65.12	12.50	44.44	11.76	3.85	0.00
Spirogyra	28.57	10.47	7.81	0.00	17.65	3.85	6.25
Eggs	50.00	1.16	9.38	2.22	0.00	3.85	87.50
Clay	10.71	0.00	54.69	0.00	0.00	3.85	0.00
Silt	37.50	0.00	21.88	0.00	0.00	0.00	31.25
Crustacean	0.00	1.16	1.56	2.22	0.00	3.85	0.00
Shrimp	0.00	1.16	0.00	0.00	0.00	0.00	0.00
Worms	7.14	0.00	0.00	0.00	0.00	0.00	0.00
Insects	0.00	0.00	7.81	0.00	0.00	3.85	0.00
Detritus	0.00	2.33	18.75	22.22	0.00	0.00	0.00
Filament Algae	0.00	20.93	4.69	0.00	23.53	0.00	31.25
Zooplankton	0.00	0.00	0.00	11.11	0.00	0.00	0.00

Table (5) showed ratio percentages of different food items of fishes. Green algae was the main food item (90.59%) for *C. marmid* and for *T. ilisha* (56.30%) and *P. latipinna* (46.21%), while diatoms was the main food item (51.68%) for *A. chacunda*. Zooplanktoon was found only in the diet of *T. ilisha* with very low ratio (1.57%). Six species were considered as herbivores where plant ratios in their diets were 100, 96.9, 95.8, 85.2, 75.4, and 73.1% for *P. latipinna, A. marmid, C. auratus, T. ilisha, P. subviridis and A. chacunda* respectively. One species (*P. abu*) were consider as detrivores where ratio of detritus was 62.6%, ratio of plant materials was 32.3% and ratio of animal materials was 5.1%.

Table (6) show feeding habits of the seven studied fish species in 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 six were animal items (eggs, crustacean, shrimp, worms, insects, and zooplankton), six of plant origin (diatom, green algae, phytoplankton, plant, *Spirogyra* and filament algae) and three of organic and non-organic matters (silt, clay and detritus). Diatoms and green algae were found in all fish species, while phytoplankton, plant, *Spirogyra*, eggs found in six species. The highest IRI values (8710.4 and 4753.8) of green algae between all food materials was found in *A. marmid.*

Table (ʏ) and figure (2) showed diet overlap between seven species cached from the studied stations in Shatt Al-Arab estuary during 2010-2011. The Morisita indexes of feeding overlap showed significant overlap between studied species except *P. abu*. The highest overlap (0.99) was between *T. ilisha* and *A. marmid* followed by *P. latippinna* and *P. subviridis* where overlap was 0.95. Overlap values was 0.91, 0.88 and 0.80 between *A. chacunda* and *P. subviridis*, between *C. auratus* and both *T. ilisha* and *A. marmid* respectively.

Figure (3) showed standardized niche breadth values for seven fish species occurred in Shat Al Arab River estuary. Fish species having breadth values 0.25 or less were considered as high specialized feeders (*A. marmid and T. ilisha*). Fish species having breadth values between 0.26-0.49 were considered as low specialized feeders (*P. abu, A. chacunda, C. auratus and P. latipinna*), while fish species having breadth values ≥0.50 were considered as generalized feeders (*P. subviridis*).

Table (5) Ratio percentage of food items for fish species collected from the studied stations in Shatt Al-Arab estuary during 2010-2011.

Fish species	P. subviridis	C. auratus	P. abu	T. ilisha	P. latipinna	A. marmid	A. chacunda
Diatom	28.11	7.82	21.02	4.60	29.24	3.92	51.68
Green Algae	26.51	33.07	6.77	56.30	46.21	90.59	15.77
Phytoplankton	5.42	17.96	0.94	8.35	9.39	0.00	2.01
Plant	0.60	27.91	1.02	15.98	2.17	0.39	0.00
Spirogyra	14.26	1.16	0.71	0.00	5.05	1.96	0.67
Eggs	9.64	0.13	1.65	0.36	0.00	0.78	22.48
Clay	6.63	0.00	41.50	0.00	0.00	0.40	0.00
Silt	6.83	0.00	6.69	0.00	0.00	0.00	4.36
Crustacean	0.00	0.39	0.31	1.21	0.00	0.78	0.00
Shrimp	0.00	0.26	0.00	0.00	0.00	0.00	0.00
Worms	2.01	0.00	0.00	0.00	0.00	0.00	0.00
Insects	0.00	0.00	3.15	0.00	0.00	1.18	0.00
Detritus	0.00	1.29	14.41	11.62	0.00	0.00	0.00
Filament Algae	0.00	10.01	1.81	0.00	7.94	0.00	3.03
Zooplankton	0.00	0.00	0.00	1.57	0.00	0.00	0.00

Table (7) Diet overlap of fish species collected from the studied stations in Shatt Al-Arab estuary during 2010-2011.

Fish Species	P. subviridis	C. auratus	P. abu	T. ilisha	P. latipinna	A. marmid	A. chacunda
P. subviridis	1.00	0.43	0.08	0.52	0.95	0.53	0.91
C. auratus	0.43	1.00	0.09	0.88	0.61	0.80	0.16
P. abu	0.08	0.09	1.00	0.03	0.06	0.02	0.07
T. ilisha	0.52	0.88	0.03	1.00	0.71	0.99	0.19
P. latipinna	0.95	0.61	0.06	0.71	1.00	0.72	0.77
A. marmid	0.53	0.80	0.02	0.99	0.72	1.00	0.20
A. chacunda	0.91	0.16	0.07	0.19	0.77	0.20	1.00

Table (6) IRI values of food items of fish species collected from the studied stations in Shatt Al-Arab estuary during 2010-2011.

Fish species	P. subviridis	C. auratus	P. abu	T. ilisha	P. latipinna	A. marmid	A. chacunda
Diatom	2510.0	363.6	492.7	204.5	2580.2	196.1	5167.8
Green algae	1751.3	2692.1	190.5	4753.8	2718.2	8710.4	1478.6
Phytoplankton	164.6	584.7	10.3	148.5	220.9	0.0	62.9
Plant	2.2	1817.2	12.8	710.3	25.5	1.5	0.0
Spirogyra	407.3	12.2	5.5	0.0	89.2	7.5	4.2
Eggs	481.9	0.2	15.5	0.8	0.0	3.0	1967.3
Clay	71.0	0.0	2269.3	0.0	0.0	1.5	0.0
Silt	256.0	0.0	146.4	0.0	0.0	0.0	136.3
Crustacean	0.0	0.5	0.5	2.7	0.0	3.0	0.0
Shrimp	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Worm	14.3	0.0	0.0	0.0	0.0	0.0	0.0
Insects	0.0	0.0	24.6	0.0	0.0	4.5	0.0
Detritus	0.0	3.0	270.2	258.3	0.0	0.0	0.0
Filament Algae	0.0	209.6	8.5	0.0	186.9	0.0	94.4
Zooplankton	0.0	0.0	0.0	17.5	0.0	0.0	0.0
Total items no.	9	10	12	8	6	8	7

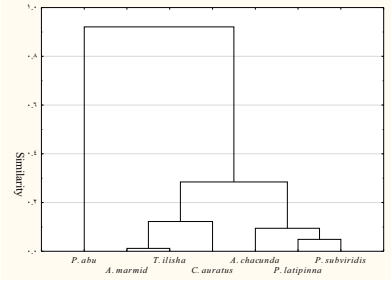

Figure (2) Average linkage of statistica analysis of proportional diet overlap between seven fish species collected from Shatt Al-Arab estuary during 2010-2011.

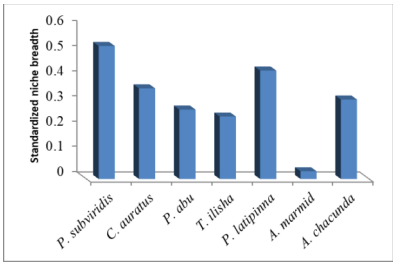

Figure (3) Standardized niche breadth values for seven species cached from Shatt Al-Arab River estuary during 2010-2011.

DISCUSSION

Studying food and feeding habits of fishes is necessary to evaluate stock assessment. Food consumption provides helpful information deciphering some of higher level trophic relationships in an ecosystem. Food materials found in the stomachs *of P. subviridis* in current study were diatom (28.1%), green algae (25.5%), *Spirogyra* (14.3%), eggs (9.6), silt (6.8) and clay (6.6%). Taher *et al.* (2016) stated that food materials found in the stomachs of *P. subviridis* in Shatt Al-Arab River- Fao were plant (52.3%) and detritus (40.3%), while the diet of *P. subviridis* in Shatt Al-Arab River consisted mainly from diatoms (42.2%), high plants (20.9%), detritus (17.7%) and algae (15.9%) (Mohamed and Abood, 2019). Food materials found in the stomachs of this species in Shatt Al-Basrah Canal were plant (58%), detritus (27%) and eggs (13%) (Taher, 2010).

Food items found in the stomachs of *C. auratus* in current study were green algae (33.1%), plant (27.9%), phytoplankton (18.0), filament algae (10.0%) and diatom (7.8%). Mohamed and Abood (2018) stated that *C. auratus* in Shatt Al-Arab River fed on aquatic insects (28.9%), followed by macrophytes (26.2%), algae (12.8%), detritus (12.4%), zooplankton (6.0%), diatoms (5.8%) and snails (5.5%). Seven food items found in the diet of *C. auratus* in East Hammar Marsh, the most important item was filament algae (90%) followed by higher plants (5.77%) (Al-Lamy *et al*., 2012).

Food materials in the stomachs of *P. abu* in current study consisted mainly from clay (41.5%), diatom (21%), detritus (14.4%), silt (7.0%) and green algae (6.8%). Mohamed and Abood (2019) stated that food

materials found in the stomach of *P. abu* fished from Shatt Al-Arab River were diatoms (38.6%), high plants (21.7%), algae (15.9%), detritus (15.3%), fish eggs (6.9%) and zooplankton (1.6%). Mohamed *et al.* (2015) pointed diatoms (42.1%) as important food items of *P. abu* in East Hammar Marsh followed by algae (26.5%), organic detritus (15.6%), rotifers (6.5%) and copepods (5.0%).

The main food items of *T. ilisha* in current study were green algae (56.3%), plant (16.0%), detritus (11.62%), phytoplankton (8.3%) and diatom (4.6%). Abood and Mohamed (2019) stated that food items of *T. ilisha* in Shat Al-Arab River consist mainly from zooplankton (55.0%), algae (13.9%), organic detritus (12.6%) and higher plant (10.0%). Mohamed *et al.* (2008) recorded filament algae (40%) and diatom (34%) as two main food items for this fish in the three southern restored marshes, While Mohamed *et al.* (2015) recorded algae (20.3%), rotifers (18.0%), cirripedia (17.2%) and copepods (16.3%) as main food items for this fish in East Hammar Marsh.

The main food materials of *P. latipinna* in current study were green algae (46.2%), diatom (29.2%), phytoplankton (9.4%) and filament algae (7.9%). Yamamoto and Tagawa (2000) stated that this fish fed mainly on algae, while Hassan-Williams *et al*. (2007) stated that this fish also consumed animal materials such as rotifers, small crustacean and aquatic insects.

The main food items of *A. chacunda* in current study were diatom (51.7%), eggs (22.5) and green algae (15.8%). Whitehead (1985) stated that this fish fed on zooplankton, zoobenthos, worms and polychaetes, while Monkolprasit (1994) recorded many food items of this fish such as detritus, debris, plants, zoobenthose and benthic algae. The Morisita indexes of feeding overlap in current study showed significant overlap between studied species except *P. abu*. Taher *et al.* (2016) pointed five significant overlap between four carnivores species in Shat Al-Arab River. Taher (2010) recorded one high overlap between *P. subviridis* and *Boleophtalmus dussumieri in* Shat Al-Basrah Canal, while Hussain *et al.* (2007) recorded much occasions of high overlap between 13 carnivorous species in Iraqi marine waters, Northwest Arabian Gulf, and Hussain *et al.* (1993) recorded high overlap between 12 marine species in subtropical coastal water of Khor Al-Zubair.

Levins standardized niche breadth values of current study stated that *A. Marmid* and *T. ilisha* were high specialized feeders, *P. subviridis* generalized feeder and other species were low specialized feeders. It seemed that index of Levins standardized niche breadth depend largely on the ratio of different feeding materials rather than on numbers of feeding materials. Mohamed *et al.* (2005), Taher (2010), Taher *et al.* (2016) and Mohamed and Abood (2019) reported that *P. subviridis* as low specialized feeders. Mohamed and Abood (2019) stated that *P. abu* was non-specialized feeder in Shat Al-Arab River, while Mohamed *et al.* (2005) stated that this fish was low specialized feeder. Mohamed *et al.* (2015) and Mohamed and Abood (2018) stated that *C. auratus* was generalized feeder. Mohamed *et al.* (2015) stated that *T. ilisha* was generalized feeder in East Hammar Marsh, while Abood and Mohamed (2019) stated that *T. ilisha* was low specialized feeder.

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