

## Feeding Ecology of 0-group fishes from Shatt al-Basrah , Basrah/Iraq

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### Abstract

The food and feeding of four species of the young (0-group) fishes in Shatt al-Basrah were studied from February 2011 to April 2012. Twelve food groups were recorded during this study. Crustaceans (copepods, amphipods, shrimps and crabs) were the most important prey for tilapia (*Tilapia zilli*) and mosquitofish (*Gumbosia affinis*) (Relative Importance indices (% RII) = 82.7 and 40.2 respectively). Plant was the most important food for mullet (*Liza subviridis*) (86.8%). Plant and fishes were considered most important food for whitehead's thryssa (*Thryssa white headi*) (32.3% and 32.7% of the total RII respectively). Tilapia (*T. zilli*) clearly shows only significant overlap with (*G. affinis*) ( $C\lambda = 0.76$ ). The overall degree of dietary overlap among all the species was 41.7%. This information is when the complex association between fishes and identifying groups of species using similar resources.

**Keywords;** Feeding ecology, 0-group fish, Shatt Al-Basrah, Iraq.

### Introduction

The studies of food and feeding habits of fishes have a significant advantage in fishery biology. However, such studies can describe the ecological interactions and community structure of the fishes [1, 2]. The dietary niche breadth of a fish population increase as preferred food resources become scarce [3, 4]. Moreover, [5] reported that the dietary niche breadth of a population can increase when each individual in the population may consume a large range of prey or they greater individual specialization. There are few studies that investigated the feeding habits among fishes in shallow waters of Iraqi marine waters (6, 7). The fishes in Shatt al-Basrah are economically important species and believed to be over fished . Species composition and diversity index were studied by [8]. There is no information available about the feeding ecology of 0- group fishes in this area. Therefore, the present study is designed to gives baseline data on

diet composition and niche breadth to compare against any possible future ecosystem changes at Shatt al-Basrah.

## Materials and methods

### Study Area:

Shatt Al-Basrah is an artificial canal, located on latitude between 30°15' N to 30° 45' N and longitude 47° 30' E and 48° 00' E, separated from the Iraqi Marine water by controlled, small, functional sluice, constructed to prevent flooding of the road and separated from Shatt-al-Arab (Freshwater) by artificial dune, on which the Mohammed Al-Kasim Bridge is built. Environmental factors such as temperature, salinity, PH and dissolved oxygen were measured during the period of the study using YSI Field Meters.

Fish samples were collected monthly from three localities (regulated gate, Al-Zubair station and Mohammed Al-Kasim Bridge station) in Shatt Al-Basrah (Figure 1). The field work started from February 2011 to April 2012 using beach seine net (100 X 3m) of different mesh sizes ranging between 6.35–12.7 mm laterally stretched mesh sizes. The fish samples were kept in ice and taken into the laboratory of Marine Science Center, Basrah University, while those that could not be handled were kept in a freezer until the next day. Fish length were measured to the nearest millimeter and weighed to the nearest 0.10 g. A total of specimens 825 with total length ranged from 1-9 to 6.9 cm. were investigated.

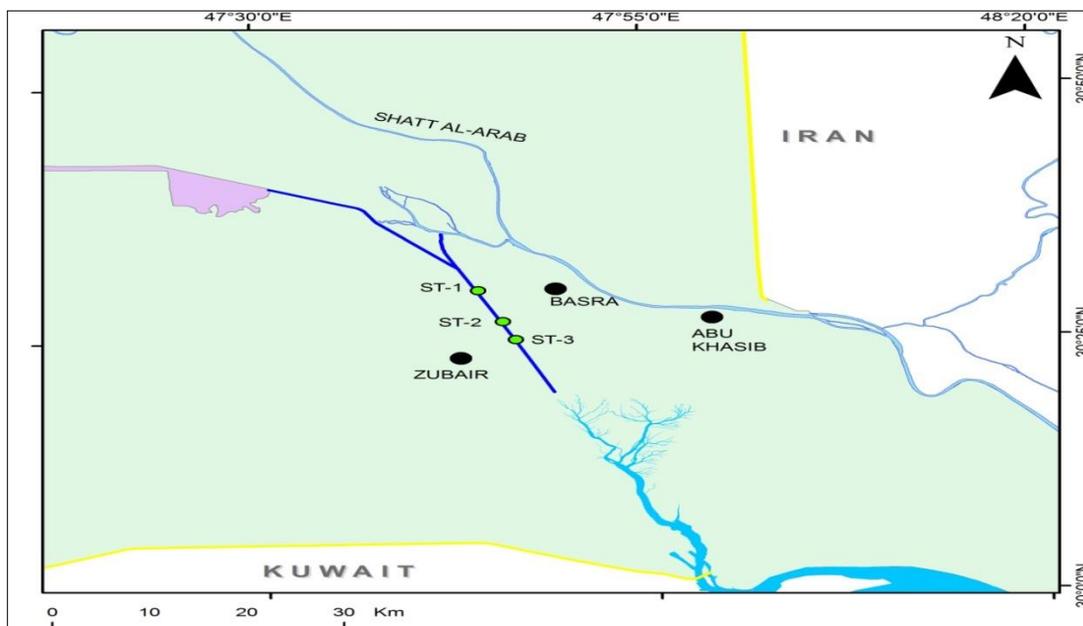


Figure 1. Locations of study area and sampling sites (ST-1, ST-2 & ST-3) in Shatt Al-Basrah

### Gut & Stomach contents analysis:

The gut and stomach of the four sampled fish was removed. The gut and stomach was opened and the contents emptied into a Petri-dish. The food materials were identified with using compound and dissection microscope. The stomach contents were assessed by frequency of occurrence method [7,9,10, 11] as:

%FO =  $e_i \times 100 / E$ , where:

$e_i$  = number of stomachs with occurrence of food item  $i$ ;  $E$  = total stomachs analyzed.

The diet of the fish was also assessed by using points (%P) [10, 11]. The percentage of points method (%P) was used to provide a determined quantity of points based in the volume of each food item as the following equation:

$\% P_i = (\sum a_{ij}/A) \times 100$  [10,12], where as:

$\% P_i$  = points percentage of the food item “ $i$ ”;  $a_{ij}$  = number of points of the food item “ $i$ ” in the stomach of predator “ $j$ ”;  $A$  = total number of points for all food items of all stomachs.

The Relative Importance indices (RII) [13, modified] were used to describe the food items using %FO and %P:

$RII = \%FO \times \%P / \sum (\%FO \times \%P)$ .

To evaluate the differences in diet breadth of the four fish species in this study , the Levins’ standardized index was used [14, 15,16] as the following:

$B_i = (1/n - 1) \times (1/\sum jP_{2ij} - 1)$

Where  $B_i$  is the Levins’ standardized index for predator  $i$ ;  $P$  is proportion of diet of predator  $i$  that is made up of prey  $j$ ,  $n$  is number of preycategories.

This index ranges from 0 to 1; low values suggest the diets dominated by few prey items (specialist predators), high values suggest the generalist diets[15] .

The number of empty guts and stomachs (Vacuity index (VI)) was recorded and expressed as a percentage of the total number of guts examined [17,18,19].

### Diet overlap:

Dietary similarity ( $C\lambda$ ) between fish species was estimated following [20,7] as:

$$C\lambda = \frac{2 \sum_{i=1}^s X_i Y_i}{\sum_{i=1}^s X_i^2 + \sum_{i=1}^s Y_i^2}$$

Where:  $S$ = total number of food group ;  $X_i$ = total proportion of the total diet of the food group ( $i$ ) in the diet of fish species  $X$ ;  $Y_i$ = proportion ( $i$ ) in the diet of fish species  $Y$ .

The value of  $C\lambda$  greater than 0.60 represent a significant overlap [7, 20, 21] .

Statistical differences ( $p < 0.05$ ) in diet composition were estimated by a chi-square test[22] applied on the frequency of a given prey. The variation of vacuity index was also assessed by a chi- square test.

## Results and discussions

The water temperature, salinity, pH, and dissolved oxygen ranged between 17 °C to 32 °C, 25 to 33‰, 7.2 to 8.7 and 4- 6 mg/L respectively. Four fish species belonging to four families were collected during this study (Table 1). In the total samples (n=825), whitehead's thryssa, *T. whiteheadi*, were the dominant fish species, representing 39.6 % of the total catches. The minimum catch was presented by mosquitofish, *Gumbusiaaffinis*, (13.6%) (Table 1).

**Table 1.** Total catch and % empty stomach of the fishes collected from Shatt Al- Basrah.

Species	Family	Length cm	Weight g	Total catch	% Total Catch	No. Stomachs Examined	Empty Stomachs	% Empty Stomachs
<i>Thryssawhite headi</i>	<i>Engraulidae</i>	3.6- 5.7	5.7-11.2	327	39.6	318	56	17.6
<i>Liza subviridis</i>	<i>Mugilidae</i>	4.6 –6.9	6.2-12.1	249	30.2	237	46	19.4
<i>Tilapia Zilli</i>	<i>Cichlidae</i>	2.4- 5.4	6.4-12.5	137	16.6	131	33	25.2
<i>Gumbosiaaffi nis</i>	<i>Poeciliidae</i>	1.9-4.8	3.1-8.8	112	13.6	102	14	13.7
Total				825		788	149	18.9

### Vacuity index (VI) :

The vacuity index (VI) of samples analyzed are given in Table1. The proportion of empty stomach changed significantly among fish species ( $X^2 = 31.1$ ,  $p < 0.05$ ). Their percentages were 17.6%, 19.4%, 25.2% and 13.7 % for whitehead's thryssa, *T. whiteheadi*, mullet, *L. subviridis*, *Tilapia*, *T. zilli*, and mosquitofish, *G. affinis*, respectively (Table 1).

### Food composition

Twelve food groups: Bacillariophyta, Chlorophyta, Cynophyta, Aquatic plants, copepods, amphipods, shrimp, crabs, bivalves, insects, fishes and detritus were recorded in the guts and stomachs of the fishes. The frequencies of occurrence and volumetric composition are given in Table 2.

Table 2 : Frequency of occurrence (O%) and points (P%) composition of the stomach contents of 0-group fishes collected monthly between February 2011 to April 2012 in three stations of the Shatt Al-Basrah.

Species	<i>Tilapia Zilil</i>		<i>Liza subviridis</i>		<i>Thryssawhiteheadi</i>		<i>Gumbusiaaffinis</i>	
	O%	P%	O%	P%	O%	P%	O%	P%
Bacillariophyta	13.3	8.8	19.1	24	<b>21.1</b>	5.4	15.8	8.1
Chlorophyta	7.4	11.2	13.7	12.3	17.9	11.3	11.9	9.5
<b>Cynophyta</b>	1.3	6.3	<b>28.5</b>	<b>40.8</b>	2.0	3.1	6.1	6.8
Aquatic Plants	12.1	3.9	22.5	10.4	1.2	2.0	-	-
<b>Copepods</b>	<b>62.8</b>	<b>26.9</b>	8.1	7.6	11.2	23.2	<b>18</b>	<b>18.2</b>
Amphipods	10.8	4.7	2.8	2.0	9.8	12.3	6.3	9.3
Shrimps	27.7	9.8	-	-	0.6	2.9	15.3	9.6
Crabs	1.3	8.1	-	-	1.6	3.4	1.3	5.8
Bivalves	2.7	9.5	2.5	1.4	2.0	3.9	5.4	9.5
<b>Aquatic</b>	-	-	-	-	17.7	7.4	11.7	10.3
<b>Fishes</b>	-	-	-	-	<b>14.7</b>	<b>22.4</b>	6.3	7.2
Detritus	4.0	10.8	2.5	1.5	0.9	3.0	1.9	5.7
Total	100	100	100	100	100	100	100	100

The indexes of relative importance of different prey groups found in the stomach of the fishes are given in Table 3. Crustacean (copepods,

amphipods, shrimps and crabs) composed the highest food item and Plant materials ( Bacillariophyta, Chlorophyta, Cynophyta and Aquatic plants) ranked as next important food groups in the diet of tilapia, T. zilli, and mosquitofish G. affinis respectively. Plant materials was the highest food in the diet of mullet, L. subviridis, and whitehead's thryssa, T. whiteheadi . Other taxa recorded in the stomach contents (bivalves, insects and fishes) were less important (Table 3).

**Table 3:** Relative Importance Indices (RII) of the common food items in the diets of four different fishes species from shatt Al-Basrah. \* Principal food items which occurred in 10% or more in the fish diet .

SPECIES	<i>Tilapia Zilli</i>	<i>Liza subviridis</i>	<i>Thryssawhiteheadi</i>	<i>Gumbusiaaffinis</i>	No. of occurrences
Bacillariophyta	8.2*	21.6*	11.3*	12.2*	4
Planktons	3.5*	8.1*	20.1*	10.8*	4
<b>Algae</b>	0.3	<b>54.6*</b>	0.6	5.1*	2
Aquatic Plants	2.1*	11.3*	0.3	0	2
<b>Copepods</b>	<b>67.5*</b>	2.9*	2.5*	<b>30.1*</b>	4
Amphipods	3.3*	0.2	13.6*	5.5*	3
Shrimps	11.4*	0	0.1	3.9*	2
Crabs	0.5*	0	0.5	0.7	1
Bivalves	1.4	0.1	1.3	4.8*	1
Aquatic Insects	0	0	16.8*	11.4*	2
<b>Fishes</b>	0	0	<b>32.7*</b>	4.3*	2
Detritus	1.8	1.2	0.2	1.2	0
No. of principal food	7	5	6	9	27
% total RII accounted for principal food items	96.5	98.5	97.0	88.1	

Species	<i>Liza subviridis</i>	<i>Thryssawhiteheadi</i>	<i>Gumbusiaaffinis</i>
<i>Tilapia zilli</i>	0.11	0.11	0.76
<i>Liza subviridis</i>	-	0.16	0.27
<i>Thryssawhiteheadi</i>	-	-	0.46

**Diet Overlap**

The diet similarity for the principal food groups between each two fish species is given in Table 4. According to Zaret and Rand, 1971; Wallace, 1981 and Nasir, 2000, any values of  $C\lambda$  greater than 0.60 represent a significant overlap. Therefore, it appears that *Tilapia, T. zilli*, clearly shows only significant overlap with *G. affinis* ( $C\lambda= 0.76$ ). The results indicate that the other fish species in this area do not take similar proportion of the food available (Table 4). The Levins' standardized index ( $B_i$ ) was 0.88, 0.90, 0.91 and 0.91 for Mullet, *L. subviridis*, *T. Zilli*, whitehead's thryssa, *T. whiteheadi*, and mosquito fish, *G. affinis*. These higher values indicate a wide trophic niche.

**Table 4.** Food similarity ( $C\lambda$ ) calculation comparing the proportion of principal food groups taken by four fish species from Shatt Al-Basrah.

The data from this study provide a first look at the diets of these marine fish species in Shatt Al-Basrah canal . It showed a relatively low percentage of fishes with empty stomachs. This may be due to sampling technique that allowed rapid removal of fish from gear and immediate preservation, which decrease post-capture digestion [23] .The higher occurrences of stomach with food were found in this

study. This finding might be due to good feeding strategy of species and food abundance in most part of the year [24]. The results from this work also indicate that the fish species are omnivores feeding on plant and animal. In fact, animal consistently formed an important food. This result could be related to the food habit of the species which possess well equipped canal and bony-ridge teeth for manipulating animal substances [25]. Good vision and prey attacking techniques considered essential when capturing very active swimming organisms such as shrimps and fishes. This study indicated that crustaceans and plant were the main item for tilapia, *T. zilli* and mosquitofish *G. affinis* and for mullet, *L. subviridis*, and whitehead's thryssa, *T. whiteheadi*. [26] stated that the prey group which present 50% or more of total RII, can be classified as main food. There is a common tendency for marine fishes to start as zooplankton feeders, using large number of calanoid copepods during their juvenile stages, and changing to other food sources when they grow [27]. However, the crustacean zooplankton was considered as the most important food for young marine fishes from different parts of the world [28,29,30].

Principal food groups were determined in this study if the food groups were occurred in 10 % or more of the fish stomachs studied [7,31]. The principal food groups of this study made up 88.1 to 98.5 of the total RII in each fish species (mean 93.3). The number of the principle food groups taken by the fish species ranged from 5 to 9 with a mean value of 7 (Table 3), suggesting that most of the fish depended on many food groups, such as mosquitofish, *G. affinis*, *T. zilli*, whitehead's thryssa, *T. whiteheadi*, and mullet, *L. subviridis*, tilapia, *T. zilli* depended on 9, 7, 6 and 5 food groups respectively. This phenomenon might reduce the feeding competition to some extent between the fish species, may reflect the food abundance [7, 32,33]. However, [7] reported that the principal food groups taken by fish species in Iraqi marine water, Khor Al-Zubair, ranged from 1 to 3, indicating that most of the fish depended on few food groups.

The degree of food overlap between fish species among all the fish studied was calculated according to [7, 31,34]. The value was 41.67% which is higher than other values found in another studies [7, 31, 34, 35,]. According to [34], the data from other marine fishes assemblages, when re-arranged as partitions could be directly compared with each other. However, this comparison could be affected by the degree of subdivision of food groups, food availability, seasonal changes in the food abundances [7,31].

Results from this work also show that fishes have high food intake and feed on a wide range of food types. It could be concluded that all the fish are generalist feeders, relying on different particular food, having different nutritional requirements and adopting different feeding strategies. In fact, gut and stomach contents used only during this study to assess individual specialization, which are only a snapshot of individual feeding habits. This type of information can be affected by sampling error and can cause overestimated levels of diet variation.

## **Conclusions**

The stomach fullness during the period of study could be attributed to food abundance and good feeding habits. The low vacuity emphasized the importance of the intertidal zone as a feeding ground for these fishes.

The food preference of the fishes in natural ecosystem as revealed by their diet content may be useful in multispecies fishery management as well as aqua feed. Better understanding of the ecology of these fishes should lead to improve their fisheries management.

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