Feeding Ecology of Zero Group Fish Community from Shatt Al-Arab River in Basrah, Iraq

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Zero group fish, stomach content, feeding habit, dietary overlap, Shatt Al-Arab River, Iraq.

ABSTRACT

The food and feeding adaptations of 0-group fishes in the water of Shatt Al-Arab River were studied during the period between March 2011 to December 2012. A total of 1851 fish samples of were collected. The stomach fullness and contents were observed and analyzed using frequency of occurrence, numerical and point methods. The non-empty stomach recorded during the study could be attributed to food abundance and good feeding habits. Four major food groups Bacillariophyta, Chlorophyta, Cynophyta, Copepods, Amphipods and Shrimp) were recorded. The result showed that *Liza subviridis* is herbivores and the remaining of the fish are omnivores feeders. The degree dietary overlap among the species investigated was in the region of 51.1% . Diet Similarity Index between each pair species was also calculated .The results indicate that these fish might be in direct competition for food.

بيئة تغذية مجتمع الاسماك الفئة العمرية صفر المُصطَادة من مياه شط العَرب في البصرة، العِراق

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الكلمات الدالة

مجموعة اسماك عمر الصفر، محتويات المعدة، العادات الغذائية، التداخل الغذائي، شط العرب،ألعراق

المُستلخص

تم دراسة التكيفات الغذائية لمجاميع الأسماك عمر صفر في مياه شط العرب للفترة ما بين اذار (مارس) 20 إلى كانون الاول (ديسمبر) 2012. اذ تم جمع 1851عينة من الأسماك قيد الدراسة. لوحظ الاختلاف في مستويات امتلاء المعدة وفحص انواع الغذاء وتحليلها باستخدام التكرارات المتوالية الحدوث وطريقة النقاط ويمكن أن يعزى وجود الغذاء في المعدة خلال الدراسة إلى وفرة الغذاء والعادات الغذائية الجيدة. وسجلت أربع مجاميع غذائية رئيسية وهي الدياتومات والطحالب الخضراء والطحالب الخضراء المزرقة والقشريات (مجدافيات ومزدوجات الأرجل والروبيان). وأظهرت النتائج أن البياح الاخضرمن اسماك نباتية التغذية والباقي من الاسماك مختلطة التغذية. ووجد درجة التداخل الغذائي بين انواع الاسماك المدروسة في حدود 51.1 % . وتم قياس دليل التشابه لأنواع النظام الغذائي لكل زوج من انواع الاسماك, واشارت النتائج إلى أن هذه الأسماك قد تكون في منافسة مباشرة للغذاء.

Introduction

There is a huge demand in Iraq for the fish as a main source for the protein (Nasir and Khalid, 2013). The study food and feeding habits of the fish have an important benefit in fishery biology and fish farming. Studies of diets and feeding patterns of fishes can add significant benefits to an understanding of ecological interactions and community structure (Nasir, 2000) ; (Hammerschlag *et al.,* 2010). Study the stomach composition could also supply useful information in positioning of the fishes in a food web in their environment and in making management strategy

decision in multi species fisheries (Joseph and Djama, 1994). However, (Pius and Benedicta, 2002) stated that the employ of stomach content results to decrease intra and inter specific competition for ecological niche is necessary. In fact, the information on stomach composition of fish is essential in providing models of stomach content dynamics (Palmores *et al*., 1991).

This work is designed to give detailed data about the food and feeding habits of the fishes, and diet similarity for the fish species living together at part of Shatt Al-Arab River. These data may be useful for developing the future research and trophic models as tools for understanding multi-species fisheries (Christensen and Pauly, 1992); (Walters *et al*., 1997).

Materials and Methods

(1) Study Area

The study was conducted Southern part of Shatt Al- Arab River (figure I) from March 2011 to December 2012. This river formed by joining Tigris with Euphrates rivers in Basrah , about 160 kilometers North of the Arabian Gulf. Other details of this river were stated by (Al-Hassan , 1999).

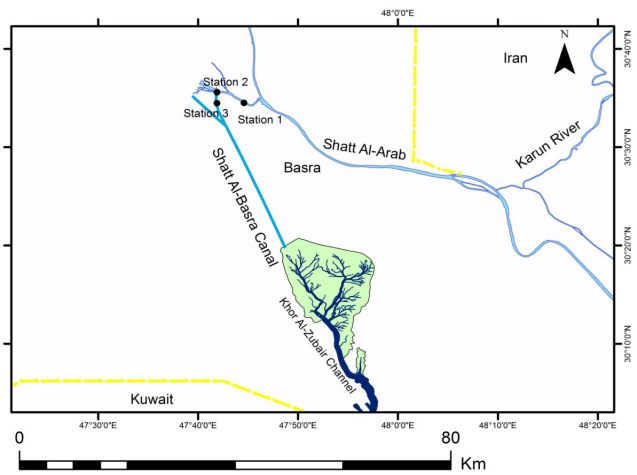

Figure I: Location of Sampling site of the Fishes in Shatt Al-Arab River, Iraq. (*Sampling site*)

Monthly sampling was carried out using seine netting along three 120 m long transects that extended perpendicularly from shore**.** Water temperature, Dissolved Oxygen, Salinity and pH were measured during the sampling using field Lovibond meter. All samples were done during the day time. All sampled fishes were identified to species, their length were measured to the nearest mm. 1/3 of the alimentary track for stomachless fish (*Cyprinus carpio*) and the stomachs for other fishes were removed and opened using fine scissors. Food contents were examined and identified using compound and dissection microscope.

The diet of the fish was then assessed using points (%P) (Hyslop, 1980); (Nasir, *et,al*.,1988) and Occurrence frequency (%F) **(**Hyslop, 1980; (Mantelatto and Christofoletti, 2001). The percentage of points method (%P) was used to give a determined quantity of points based in the volume of each food item as: % Pi = (Σaij/A) x 100 (Mantelatto and Christofoletti, 2001) , where as: % Pi = points percentage of the food item "i"; aij = 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 food items were described using the index of relative importance. The frequency of occurrence of each item was assessed by following equation %FO = *e*i x 100 / E, where: *e*i = number of stomachs with occurrence of food item *i*; E = total stomachs analyzed.

The Index of Relative Importance (IRI) modified (Pinkas *et,al.,* 1971), was calculated from %FO and %P: IRI = %FO x %P / Σ (%FO x %P).

(2) Food Overlap

Dietary similarity (Cλ) between fish species was calculated 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 groups; X_i= total proportion of the diet of the food group (i) in the diet of species X; Y_i= proportion (i) in the diet of species Y. The value greater than 0.60 represent a significant overlap (Zaret and Rand, 1971); (Nasir, 2000).

Results

Summaries of abiotic data collected during the study period are shown in Table I. Water temperature ranged from 9.3 to 31.2°C , O2 from 3.8 to 7.4, salinity ranged from 8.6 to 12.4 and pH ranged from 6.8 to 8.3 during the period of the study (table 1).

Table 1: Environmental parameters of Shatt Al-Arab River

Environ. Parameters	Temp. C°		O2. Mg/L		Sal.		Ph	
Seasons	Mini.	Max.	Mini.	Max.	Mini.	Max.	M.ini	Max.
Winter	9.3	12.8	4.6	6.2	8.6	9.5	7.2	8.1
Spring	11.6	16.4	5.1	7.4	9	11.9	6.8	8.2
Summer	22.1	28.9	3.8	5.2	11.3	12.4	7.8	8.1
Autumn	19.7	31.2	4.8	5.9	9.2	11.3	7.7	8.3

Seven fish species belonging to six families were collected during the this study (Table 2). The total number of the 0- group fish catch was 1851. The fish collected are based mainly on *Thryssa whiteheadi* with 42.36% of total' The minimum catch was presented by *Aspius vorax* (8.54%) and *Tenualosa illisha* (8.27%) as seen in table 2

(1) Stomach Fullness

The percentage empty stomach % are given in table 2. Of the 1294 stomachs of 0-group fish analyzed, 268 were empty (20.7%). The percentage of empty stomach changed significantly among the fish species investigated ($X^2 = 17.9$, $p<0.05$).

(2) Food Composition and Food Overlap

A total of 11 different taxa: Bacillariophyta, Chlorophyta, Cynophyta, Aquatic plants, Copepods, Amphipods, shrimps, Crabs , Bivalves, Insects and fishes were recorded in stomach of the fishes. The frequency of occurrence, and point composition are shown in table 3.

Table 2: Total length (T.L.) , Total Catch and Percentage of Empty Stomach for the Fishes Collected from Southern Part of Shatt Al-Arab River.

Species	Family	TL Range (mm)	No. of Caught	% of Total Catch	No. of Stomach Examined	Empty Stomach %
Thryssa whiteheadi	Engraulidiae	32-72	784	42.36	243	48.6
Tilapia Zilli	Cichlidae	43 - 85	202	10.91	201	28.9
Cyprinus carpio	Cyprinidae	37 -72	192	10.37	191	9.95
Gumbusia affinis	Poeciliidae	29 -59	188	10.17	185	3.7
Liza subviridis	Mugilidae	35 -71	171	9.24	169	18.1
Aspius vorax	Clupeidae	49 -72	158	8.54	154	12.0
Tenualosa illisha	Clupeidae	39 -73	153	8.27	151	11.8
Total			1851		1294	20.7 %

Table 3: Percentage of Occurrence (F%) and Percentage of Total Point Composition (P%) of the Common Food Items of Fishes Collected from Shatt Al-Arab River

Type	*Tenualosa illisha*		*Aspius Vorax*		*Cyprinus Carpio*		*Gumbusia affinis*		*Thryssa whiteheadi*		*Liza Subviridis*		*Tilapia Zilli*	
	F	P	F	P	F	P	F	F	F	P	F	P	F	P
Bacillariophyta	40	10.6	73	23.6	56	9.9	80	20.7	90	19.1	33	12.3	73	17.4
Chlorophyta	8	8.16	70	14.8	86	26.6	86	10.9	83	13.5	36	11.1	60	12.6
Cynophyta	-	-	86	26.6	-	-	-	-	36	6.6	6	3.2	23	5.32
Aqua plants	22	6.7	93	16.3	26	12.3	-	-	36	7.9	-	-	-	-
Copepods	86	20.6	-	-	30	3.4	33	23.4	73	15.1	23	10.7	96	19.4
Amphipods	30	11.6	-	-	30	3.4	30	6.8	46	12.2	-	-	30	11.4
Shrimps	36	9.1	-	-	-	-	-	-	23	6.3	76	17.9	80	16.4
Crabs	73	18.8	-	-	-	-	-	-	-	-	60	15.1	-	-
Bivalves	-	-	-	-	15	15.8	-	-	30	7.3	-	-	33	9.1
Aqua Insects	-	-	-	-	30	3.4	86	24.2	-	-	-	-	-	-
Fishes	1	8.2	1	-	-	-	80	12.5	-	-	80	21.8	-	-
Detritus	5	5.7	9	18.7	7	10.8	6	1.5	5	11.9	4	7.9	9	8.4

Bacillariophyta, Chlorophyta, Cynophyta, copepods, amphipods, and ahrimps were considered as a six major group food recorded in the fish diets .While other groups such as shrimps, Bivalves and fishes were considered as a minor importance diet and then Crabs and Insects were considered as occasional diet. Chlorophyta formed 16.64% of the total IRI, followed by Copepods and Bacillariophyta (%IRI= 12.24 and 11.72 respectively). Other taxa recorded in stomach contents such as Cynophyta

(7.34), Aquatic plant (7.34), Amphipods (7.34) , digestive food (6.83), Bivalves (4.45), Insects (4.13) Shrimps (6.29), fishes (6.23) and Crabs (3.43) were less important (see table 4) .

The index of Relative Importance (IRI) of different prey groups found in the stomach of the fishes are given in Table 4.

Table 4: Index of Relative Importance (%IRI) of the Common Food Items in the Diets of Seven Different Zero Group Fish Species from Shatt- Al-Arab River.

Type	*Tilapia Zilli*	*Liza Subviridis*	*Thryssa whiteheadi*	*Gumbusia affinis*	*Cyprinus Carpio*	*Aspius Vorax*	*Tenualosa illisha*
Bacillariophyta	13.56	32.13	14.67	3.20	31.27	11.46	21.03
Chlorophyta	2.08	19.32	60.51	18.13	20.38	11.29	12.52
Cynophyta	-	42.66	-	-	4.98	0.54	2.02
Aqua plants	4.70	2.75	8.46	-	5.16	-	-
Copepods	56.69	-	2.70	14.94	20.11	6.94	30.83
Amphipods	11.13	-	2.70	3.95	10.20	-	5.5
Shrimps	0.26	-	-	-	2.65	38.39	21.72
Crabs	10.49	-	-	-	-	25.57	-
Bivalves	-	-	6.26	-	3.98	-	4.97
Aqua Insects	-	-	2.70	40.26	-	-	-
Fishes	0.03	-	-	19.34	-	4.91	-
Detritus	0.93	2.75	2.00	0.17	1.27	0.90	1.25

(3) Diet Similarity

The diet similarity indices for the food groups between each two fish species are given in Table 5. Of the 21 fish species pairs 13 (70%) showed high overlaps (> 60) and 2 pairs (10%) with low overlap (< 34). High overlap values were found for the species pairs of similar feeding guild but low dietary overlap values were noticed in species pairs of far different feeding guild. *Liza subviridis* clearly shows the highest significant overlap (Cλ = 0.87) with *Gumbusia affinis*. High overlap (Cλ = 0.83) also occurs between *Cyprinus carpio and Tenualosa illisha* (Table 5). Fish pairs of *Tilapia zilli - Thryssa whiteheadi and Liza subviridis – Aspius Vorax* showed the lowest dietary overlap as 0.23 and 0.35 respectively (table 5).

Table 5: Food Similarity Calculation Comparing the Proportion of Common Food Groups Recorded in the Diet of Seven Fish Species from Shatt Al –Arab River.

Species	*Liza subviridis*	*Thryssa whiteheadi*	*Gumbusia affinis*	*Cyprinus Carpio*	*Aspius Vorax*	*Tenualosa illisha*
Tilapia Zilli	0.64	0.23	0.63	0.65	0.28	0.76
Liza subviridis	-	0.62	0.87	0.67	0.35	0.53
Thryssa whiteheadi.	-	-	0.47	0.64	0.41	0.40
Gumbusia affinis	-	-	-	0.64	0.69	0.72
Cyprinus carpio	-	-	-	-	0.46	0.83
Aspius vorax	-	-	-	-	-	0.75

Discussion

The higher occurrence of non-empty stomach , recorded in this study, were due to good feeding strategy of species and food abundance in most part of the year (Fagade, 1978); (Nasir, 1985;) or to sampling method that permitted rapid removal of fish from gear and immediate preservation, which minimized post-capture digestion (Bowen,1996). The differences in the percentage of empty stomachs and the stomach with food might be also related to light intensity, food quantity availability, season and tidal condition (Bowman & Bowman, 1980); (Nasir, 2000); (Shinkafi, & Ipinjolu, 2001). The differences in temperature and/or salinity during the study period can have an effect on fish feeding and metabolic rates. (Winemiller,1989) reported that the fish niche breadth increased seasonally when fish population densities were highest and availability of invertebrate prey was reduced. (Bolnick *et,al.,* 2003) stated that the seasonal changes in population niche breadth may be achieved through changes in individual diet specialization. However, the reasons for individual specialization might be related to the morphological, behavioral or physiological aspects, such as learning in avoiding predation risk searching and handling prey, or in searching and handling prey (Nasir, 1985), (Bolnick *et,al.,* 2003), (Svanback and Bolnick 2005).

The result also indicated from table 3 (see table 3) that *Liza subviridis* is herbivores feeding on Bacillariophyta , Chlorophyta , Cynophyta. On other hand, the other fish species are omnivores feeding on Bacillariophyta , Chlorophyta , Cynophyta, Aqua plants, copepods, Amphipods, shrimps, crabs, Insects and fishes. Infact, the animal food material had higher occurrences during the course of this study. (Malami *et,al.,* 2004) suggested that diversify food habit of the species due to it possesses well equipped canal and bony-ridge teeth for manipulating animal substances. The present work suggests that the fish tend to have preference for some items they eat as food. Earlier, (Ofujekwu & Ejike 1992) suggested that there is preference for a particular food organism in the diet of most species. However, analysis of variance showed that there was no significant difference ($P > 0.05$) in the stomach content based on the method used.

Dietary similarity calculations (table 5) indicate that in 12 out of a total of 21 comparisons the index equal or exceeds 0.60. This suggests that more than half of the fish used similar proportions of the food available. Therefore, It could be concluded from this suggestion that those fish species might be in competition. (Kislalioglu & Gibson ,1977), (Nasir ,1985) and (Nasir ,2000) stated that the fish size , fish behavior, seasonal changes in the proportion of food taken, food abundance , prey size and depth may reduce the diet similarity between fish species.

As seen in table 3 (see table 3), that eleven food groups were recorded in the stomachs examined. Several of these groups were more predominant in the stomach than others and some were only taken by small number of the fish. However, the food groups considered as principal food groups if they occur in 10.0% or more of the fish stomachs examined (Kislalioglu & Gibson, 1977; Nasir, 1985 ; Nasir, 2000). The principal food groups of this study made up 87.79 to 99.82 of the total RII in each fish species (mean 78.9) . The number of the principle food groups used by the fish species ranged from 4 to 8 with a mean value of 6.4 (table 6), suggesting that most of the fish depended on several food groups, such as *Cyprinus carpio* depended on eight groups. *Thryssa whiteheadi*, *Aspius vorax* and *Tenualosa illisha* depended on seven food groups, *Tilapia zilli* and *Gumbusia affinis* depended on six food groups and *Liza subviridis* depend on four food groups. This phenomenon might reduce the feeding competition to some extent between the fish species, which may reflect the food abundance (Piank, 1976); (Langton, 1982); (Nasir 2000).

Table 6: Principal Food Items (*PFI) Which Occurred in Seven Fish Stomach Examined form Shatt Al-Arab River.

Type	*Tilapia zilli*	*Liza subviridis*	*Thryssa whiteheadi*	*Gumbusia affinis*	*Cyprinus carpio*	*Aspius vorax*	*Tenualosa illisha*	N0. of occurrence
Bacillariophyta	13.56	32.13	14.67	3.20	31.27	11.46	21.03	7
Chlorophyta	-	19.32	60.51	18.13	20.38	11.29	12.52	6
Cynophyta	-	42.66	-	-	4.98	0.54	2.02	4
Aqua plants	4.70	2.75	8.46	-	5.16	-	-	4
Copepods	56.69	-	2.70	14.94	20.11	6.94	30.83	6
Amphipods	11.13	-	2.70	3,95	10.20	-	5.5	5
Shrimps	0.26	-	-	-	2.65	38.39	21.72	4
Crabs	10.49	-	-	-	-	25.57	-	2
Bivalves	-	-	6.26	-	3.98	-	4.97	3
Aquatic Insects	-	-	2.70	40.26	-	-	-	2
Fishes	-	-	-	19.34	-	4.91	-	2
No. Principal food	6	4	7	6	8	7	7	45
Total Principal Rll	95.83	96.86	98.00	99.82	98.73	87.79	98.59	

(*PFI *Which Occurred in 10.0 % or More of the Fish Stomach Examined*)

The degree of food overlap between fish species among all the fish species studied was determined according to (Tyler, 1972);(Kislalioglu and Gibson, 1977); (Nasir, 2000). The value was in the region of 51.5%. This work consider calculation of this degree as a first attempt to estimate such degree in the Shatt Al-Arab river. Certainly, it might be has a significant contribution in the future ecological studies in this area.

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