Food and nutrition for tow freshwater fish species at Tigris River near Al-Khalis Restriction / Dayalah Governorate, Iraq

Ramadan Meteab Hameed 1, Raaed Sami Attee2 and Luay Mohmad Abbas3
1Student at Diyala University - College of Agriculture - Department of Animal Production 2prof. Dept. Animal production – Agriculture of college-University of Diyala –Iraq
3Directorate of Agricultural Research, Ministry of Science and Technology, Iraq.
*Corresponding author's email: ramadantimimy86@gmail.com
Email addresses of coauthors Email addresses of coauthors: raaedsami@uodiyala.edu.iq,
Email addresses of coauthors dr.loay1972@gmail.com

Abstract :

A seasonal study was done of food and feeding habitat for Shaboot, Arabibarbus grypus and common carp, Cyprinus carpio Linnaeus, 1758 at three different sites (S1, S2 and S3) from a section of Tigris River in Al-Khalis District, Diyala Governorate for the period from winter 2022/2023 to autumn 2023. The present results showed slight changes in the food components for two fish species. Nine main groups of food components were recorded for fish stomach during the study period, represented by insects and their larvae, mollusca, zooplankton, algae, diatoms, aquatic plants, crustaceans, organic detritus, and finally sand and clay. The quarterly results of examining of food components indicated the

Shaboot was carnivorous. Food animal components were recorded highest total percentage of 69.1% at S1, whereas, decreased and similar at S1 and S3 with total percentages of 59.7% and 59.1%, respectively. Fish feeding intensity and activity were varied during different seasons, with the highest values of feeding intensity of 17.2 during winter, 15.6 during spring, and 16.2 during autumn with 100% feeding activity for sites S1, S2, and S3, respectively. While, these values were decrease during summer and recorded the lowest of feeding intensity and activity of 14.5 and 98% at S1, 13.8 and 92.3% at S2 and 14.3 and 96% at S3. Common carp was omnivorous, with fluctuating ratio of animal and plant food components at three sites. Fishes showed performance animal food components within total of 47.6% and 48.7% at S1 and S3 respectively. While, fishes at S2 tend to plant food within a total of 49.1%. Feeding intensity and activity values for fishes were decrease during winter at S1 of 13.5 with 95.3% and at S1of 14.0 with 96.5%. Whereas, increasing in values were showed during spring season and recorded of 16.5 with 100% at S1and 17.0 with 100% at S2. Fishes (both species?) at S3 showed a difference in feeding intensity and activity feeding and recorded the lowest values during summer for feeding intensity of 95.0 and activity was 98% whereas, these values increased during autumn season of 17.with 100% for feeding intensity and activity respectively.

Keywords: feeding intensity and activity, fish food habitat, freshwater fish.

ISSN 2072-3857

Introduction

Fishes are the largest group of animal kingdom including about 1,000 economic species related with food production [1] The nutritional value of fish is as important as other animal sources and present about 18.5% of animal protein, fish meat has nutritionally balanced cause its contains of unsaturated fatty acid, essential amino acids, vitamins, minerals, all of these play role on health as protecting against heart and arterial diseases in human [2]. There are multiple fish resources in Iraqi inland waters belonging to different families, the most important one are Cyprinidae and Mugilidae [3]. Water quality is the important impact factors on presence and distribution of fish species; as well as, the shape of the river, the nature of the bottom and the food available in the water are important factors that affect the life of fishes in water bodies [4]. Food items studies leads us to understand ecosystems productivity, available food, consumed food by fishes, and the activities of fish feeding during different seasons [5]. Cyprinidae is the largest freshwater fish, it includes 376 genera and 3148 species distributed around the world [6]. Of these fishes, more than 69 species belonged to 11 families were founded at Iraqi inland water {7}. Iraq has different water resources compared to Arab countries, within presence of fish that live and reproduce and reach highest in its weights, such as Bizz: Luciobarbus esocinus, Shabbot: Arabibarbus grypus and Guttan: Luciobarbus xanthopetrus [8]. These fishes constitute most of fish stocks at Iraqi water bodies, as they prefer warm and suitable waters which supported its life and physiology (9 .(

The aimed of the present study to support with information of food composition and quality, feeding habitat, feeding intensity and activity for two important tradition fish species at Tigris River in Al- Khalis District, Province, Iraq .

Materials and methods

Preparing fish samples

This study was conducted in the Tigris River with the aim of studying the food composition, feeding habitat, feeding intensity and activity of important traditional fish species in the Tigris River in Khalis District, Diyala Governorate, Iraq. A total of 120 fish samples of Arabibarbus grypus and 120 Cyprinus carpio were collected at three different sites (S1, S2 and S3) from a section of Tigris River in Al-Khalis District / Diyala Governorate, Iraq (33.8430542°N 44.5219807°E). Seasonally Food and feed habitat were studied from winter 2022/2023 to autumn 2023. Whereas, winter 2022/2023 represent by (December 2022, January and February 2023), spring season (March, April and May 2023), summer season (June, July and August 2023) and autumn season (September, October and November 2023). Fish samples were transferred to the laboratory of Animal and Fish Resource Center, Directorate of Agriculture, Ministry of Science and Technology for food components analyzing. Fish species were classified depending on [10] and verified according to Fishbase (Foese and Pauly, 2024.(

Fish feeding habitat

The anterior part of the intestine was cut to analyze the food content according to [11]. The degree of fullness was also determined and recorded for each stomach according to [12]. Food contents of the stomach (or fore intestine in carp) were examined using an anatomical and compound microscopes, and

ISSN 2072-3857

classified under groups according to [13]. For food habitat and feeding studies, using a methods of frequency for occurrence (% O) described [14], and calculated the Important Ranking Index (IRI %) for food components quarterly using the following equation [15] IRI % = O % x P %. To calculate feeding intensity and activity, the following two equations were used [16]: Feeding intensity (degrees/fish) = Total score obtained from the fullness index/ Number of fish fed. Feeding activity (%) = Number of fish fed/ Total number of fish examined x 100.

Results and Discussion

Knowing what fish eat in their environment helps stakeholders in developing the necessary plans for the development of the water body, and integrating them with other studies on the physical and chemical characteristics of the water body itself and the various living organisms available in it that fish may depend on for their food (17). The components of carp food in the study stations consist of nine main groups: Insects and their larvae: These include adult insects and their larvae in different growth stages belonging to the Chironomidae family, the Tabanidae horsefly, and the Dytiscidae family, Crustaceans: These include mollusks and snails, Soft-bodied organisms, including gastropods (Lymnaea megasoma) and mollusks Corbicula fluminalis, Zooplankton: These are represented by the Rotifera class, water fleas from the Clodocera family, and copepods, Algae: Represented by the green algae class of the Chlorophyceae family and the blue-green algae of the Cyanophyceae family, Diatoms: Represented by the Bacilli clas, Aquatic plants: Include parts of leaves, branches, seeds and fruits of plants, Sand and mud, Organic debris

.

Nature of food and nutrition of Arabibarbus grypus

Table (1) shows the nutritional components of carp fish in the three study sites, where fish tended to feed on carnivorous sources compared to other types of food. The percentages of the total importance level index for fish in site S1 reached 27.2% for insects and their larvae, 20.2% for soft food, 14.7% for zooplankton, and finally 3.0% for crustaceans. As for site S2, the percentage of insects and their larvae reached 22.8%, soft food 14.2%, zooplankton 17.5%, and crustaceans 5.2%. In the third site, the percentage of insects and their larvae reached 24.7%, soft food 15.5%, zooplankton 13.1%, and crustaceans 5.8%. The current results showed that this type of fish feeds on animal sources with total percentages of 65%, 59.7% and 59.1% for sites S1, S2 and S3, respectively, throughout the study period compared to the rest of the other food components. Table (2) shows the seasonal changes in feeding density and activity for these three sites throughout the study period. Fish at site S1 showed the highest feeding density of 17.2 during the winter of 2022/2023, and the lowest feeding density of 14.5 during the summer, while the highest values of fish feeding activity were recorded at 100% during the winter, spring and autumn. As for fish at site S2, they showed the highest feeding density of 15.6 and 15.5 during the winter and spring seasons and a feeding activity of 100% for the same two seasons. The lowest feeding density of 13.8 and a feeding activity of 92.3% were recorded during the summer of the same year. The fish at site S3 witnessed the lowest feeding density of 14 and its activity reached 96.8% during the summer, while the highest feeding density of fish was 16.2 and its activity was 100% during

ISSN 2072-3857

the fall. Tables (1 and 2) showed that fish that feed from animal sources witnessed the highest feeding density and activity during the winter and decreased during the summer at sites S1 and S2, while fish at site S3 witnessed the highest feeding density and activity during the fall compared to the lowest during the summer. Some local studies addressed the nature of the nutrition of this type of fish, and indicated the wide range of its feeding from different sources, as it was characterized by being mixed feeding and tending towards plant feeding in Lake Habbaniyah [18]. The current results agree with what was mentioned by [19] about the nature of mixed feeding, except that its tendency to consume plant or animal components in the hot months was associated with the difference in fertilization treatments for fish farming ponds in Zaafaraniya. The previous results show that the nature of feeding is directly related to the surrounding environmental conditions, and the current results are consistent with the study of [20], which explained the presence of different proportions of sand and mud to the nature of the feeding of bottom fish on molluscs, insects and their larvae, and oligochaetes at the bottom and top of the Qadisiyah Dam in the Euphrates River. It was observed that different species of fish in the Rhone River in France consumed high proportions of soft worms (Unionidae) and insect larvae (Chironomidae) during the winter, while oligochaetes (Tubificidae) constituted the highest proportions of food components for fish during the summer [21]. [22] It was suggested that oligochaetes be used as a natural high-protein food for several species of fish near hot streams in the United Kingdom, by raising and rearing members of the Tubificidae family during the hot months, and members of the Nididae family during the cold and warm months, due to their high ability to tolerate a rise in water temperature from 4 to 8 degrees Celsius above the natural environment. [23] He explained that these fish feed on animals in the Euphrates River. While [24] indicated that the nature of this type of fish is continental with a tendency towards animal food, as the original animal food constituted 62.89%. [25] He found that this type of fish feeds on plants at a rate of 71.1% in Lake Tharthar and on plant parts and seeds at a rate of 29.64%. [26] He indicated that insects, their larvae and higher plants constitute 24.8%, 17.7% and 32.4% respectively in Lake Hamrin. [27] He found that the carp in Daraa Tharthar was omnivorous, as plant food constituted 48.21% and animal food 17.37%. [28] He indicated that the nutrition of these fish is mixed feeding in similar proportions during the seasons. [29] He explained that aquatic plants accounted for the total percentage of food components, with the highest percentage reaching 41.7% in December, followed by aquatic insects at 14.8% in October. There are significant fluctuations and changes in fish nutrition and behavior due to different environments or different growth and life stages [30]. [31] He pointed out that organic matter occupied the main food list for carp, accounting for 43.91% of food components according to the point method, and plant parts and seeds came in second place with a percentage of 19.02%. [32] and [33] noted that animal food constituted 62.89% and 68.13% of the food components in the Euphrates River and the Tigris arm.

Nature of food and nutrition of Cyprinus carpio

Table (3) shows the nutritional components of common carp in the three study sites. The fish tended to feed on animal and plant components in a similar manner with their

tendency towards plant-based foods. The total percentages of the overall importance level index at site S1 for animal sources were 47.6% and 45.1% for plant sources. The total percentages of fish at site S2 for animal food components were 45.4% and 49% for plant sources, and the same percentages at site S3 for animal and plant sources were 48.7% and 45.1%, respectively. Table (4) indicates the feeding activity and intensity of fish for the three sites throughout the study period. Fish at site S1 recorded the lowest feeding intensity of 13.5 and its intensity of 95.3% during the winter and the highest feeding intensity of 16.5 and its activity of 100% during the spring. The fish of site S2 recorded the lowest feeding intensity of 15 and its intensity was 97% during the summer and the highest feeding intensity was 17.6 and its intensity was 100% during the fall. The current results showed that the common carp fish were omnivorous and the animal and plant sources were close at the three sites throughout the study period. Also, the fish had the lowest feeding intensity and activity during the winter and the highest during the spring at sites S1 and S2 and the above witnessed winter seasons, while the fish of the same species differed at site S3 and recorded the lowest feeding intensity during the summer and the highest during the fall .

Many studies in the world have been interested in the nutrition of common carp. [34] showed that the natural food of common carp in the Apatain-Plaeau rice fields in India is mixed feeding and the animal food form is 55%. [35] showed that common carp have a detrital feeding in the rice fields in Thailand. [36] explained that common carp have a mixed feeding and the animal food form is 63.46% in Hirfanh Lake. [37] indicated that common carp are mixed feeders with a tendency to consume animal components by 71% in Hamar Marsh, [38] indicated that the diet of common carp was mixed with the dominance of animal components in Habbaniyah Lake. [39] explained that organic materials constituted 39.60% of the diet of common carp, plants and their seeds 17.33%, sand and clay grains 11.83% by the point method, plant food constituted 35.84%, and animal food constituted 11.83% of the diet components. [40] and [41] stated that common carp are herbivorous, while [42]. stated that common carp are mixed feeders. [43] explained that the common carp in the first station south of Samarra Dam is a herbivore and in the second station north of Al-Dhuluiyah - Salah Al-Din, it has a mixed feeding. [44] found in the Tigris River that plant parts constituted the largest proportion of the common carp's food, at 45.10% of the food components. [45] showed that plant food constituted 51.70% of the common carp's food components in Lake Habbaniyah. Other researchers found that animal food constituted the largest proportion of the common carp's food components in the Euphrates River, Lake Al-Radwaniyah, where it constituted 73.38% and 43% of the food components [46]. [47]) found that organic matter is of great importance to the food of common carp in the eastern drain/Balad.

ISSN 2072-3857

Table .1 Seasonal changes in the IRI% index of nutritional components of carp in the Tigris River, Al-Khalis District, Diyala Governorate

Locations 1					
Total	autumn	summer	the spring	Winter	Nutritional components
27.2	26.6	28.5	25.4	28.1	Insects and their larvae
20.2	23.2	12.3	20.6	24.5	Soft-bodied animals
14.7	17.5	11.0	17.4	12.9	Zooplankton
3.0	-	-	7.1	4.7	Crustaceans
14.6	13.7	23.5	9.5	11.7	Algae
9.8	10.5	11.2	8.5	9.4	Diatoms
3.2	3.2	3.4	2.6	3.5	Aquatic plants
3.7	-	5.6	6.3	2.9	Organic detritus
3.6	5.3	4.5	2.6	2.3	Sand and mud
Locations 2					
Total	autumn	summer	the spring	winter	Nutritional components
22.8	21.5	24.4	21.6	23.7	Insects and their larvae
14.2	20.2	14.3	11.2	11.2	Soft-bodied animals
17.5	17.7	12.3	19.2	20.9	Zooplankton
5.2	8.4	-	8.0	4.2	Crustaceans
18.3	12.7	23.0	18.0	19.5	Algae
12.3	11.0	13.3	14.4	10.3	Diatoms
3.5	3.0	5.1	2.0	3.8	Aquatic plants
3.6	3.4	4.1	3.2	3.7	Organic detritus
2.6	2.1	3.5	2.4	2.7	Sand and mud
Locations 3					
Total	autumn	summer	the spring	winter	Nutritional components
24.7	22.6	32.2	20.5	23.6	Insects and their larvae
15.5	21.2	6.7	11.9	22.3	Soft-bodied animals
13.1	13.2	14.8	11.1	13.1	Zooplankton

ISSN 2072-3857

5.8	10.4	-	9.4	3.5	Crustaceans
18.5	12.3	30.2	19.2	12.2	Algae
12.0	11.3	8.0	17.3	11.3	Diatoms
3.5	3.8	4.0	3.4	2.6	Aquatic plants

Table .2 Seasonal changes in feeding intensity and activity of carp in the Tigris River, Al-Khalis District, Diyala

Locations 1			
Nutrition activity	Nutrition intensity	Temperature (°C)	Season
100	17.2	19.0	Winter
100	16.8	21.5	Spring
98.0	14.5	30.0	Summer
100	15.6	27.5	Autumn
Locations 2			
Nutrition activity	Nutrition intensity	Temperature (°C)	Season
100	15.5	19.5	Winter
100	15.6	21.5	Spring
92.3	13.8	30.2	Summer
98.0	14.3	28.0	Autumn
Locations 3			
Nutrition activity	Nutrition intensity	Temperature (°C)	Season
98.0	14.3	19.5	Winter
100	14.8	21.2	Spring
96.8	14.0	30.4	Summer
100	16.2	27.5	Autumn

ISSN 2072-3857

Table.3 Seasonal changes in the values of the importance level index (IRI%) of nutritional components of common carp in the Tigris River, Al-Khalis District, Diyala Governorate.

Locations 1					
Total	autumn	summer	the spring	Winter	Nutritional components
20.9	20.8	23.2	22.8	16.9	Aquatic plants
21.3	12.3	31.5	12.5	28.9	Algae
17.4	19.9	14.0	20.1	15.7	Zooplankton
14.0	11.4	12.6	17.5	14.5	Nanophytes
6.5	10.4	4.9	4.1	6.5	Diatoms
6.4	9.5	5.6	4.6	6.0	Crustaceans
6.2	8,5	-	10.8	5.4	Organic detritus
5.3	5.7	3.4	7.1	4.8	Sand and mud
2.0	1.5	4.8	0.3	1.3	Nutrients
Locations 2					
Total	autumn	summer	the spring	winter	Nutritional components
23.5	21.3	15.8	24.6	23.5	Aquatic plants
26.8	20.0	29.6	13.1	26.8	Algae
16.8	18.7	17.1	22.9	16.8	Zooplankton
13.4	11.6	14.5	14.2	13.4	Nanophytes
5.6	-	6.6	4.4	5.6	Diatoms
5.0	10.7	5.9	9.8	5.0	Crustaceans
3.3	9.8	5.3	7.7	3.3	Organic detritus
4.4	7.1	3.8	2.2	4.4	Sand and mud
1.2	0.8	1.4	1.1	1.2	Nutrients
Locations 3					
Total	autumn	summer	the spring	winter	Nutritional components
20.8	13.7	26.8	18.6	24.1	Aquatic plants
22.9	23.9	24.7	17.4	25.9	Algae
16.2	22.2	11.3	16.3	14.8	Zooplankton
11.4	12.5	10.3	9.3	13.6	Nanophytes
4.4	4.0	-	8.5	4.9	Diatoms
6.0	10.2	-	7.7	6.2	Crustaceans

ISSN 2072-3857

12.1	9.1	18.6	15.2	5.6	Organic detritus
4.4	2.8	6.2	5.4	3.1	Sand and mud
1.8	1.6	2.1	1.6	1.8	Nutrients

Table (4) Seasonal changes in the intensity and feeding activity of common carp in the Tigris River, Al-Khalis District, Diyala Governorate

Locations 1			
Nutrition activity	Nutrition intensity	Temperature (°C)	Season
95.3	13.5	19.0	Winter
100	16.5	21.5	Spring
97.0	15.5	30.0	Summer
99.5	16.2	27.5	Autumn
Locations 2			
Nutrition activity	Nutrition intensity	Temperature (°C)	Season
96.5	14.0	19.5	Winter
100	17.0	21.5	Spring
98.0	15.6	30.2	Summer
98.0	15.5	28.0	Autumn
Locations 3			
Nutrition activity	Nutrition intensity	Temperature (°C)	Season
99.0	16.3	19.5	Winter
98.5	15.5	21.2	Spring
97.0	15.0	30.4	Summer
100	17.6	27.5	Autumn

ISSN 2072-3857

According to the results obtained from a seasonal study of food and feeding habitats of carp Arabibarbus grypus and common carp Cyprinus carpio in three different locations (S1, S2 and S3) of the Tigris River section in Al-Khalis District/Diyala Governorate, there are slight changes in the food components of these two species of fish, as nine main groups of food components of the fish stomach were recorded during the study period, represented by insects and their larvae, molluscs, zooplankton, algae, diatoms, aquatic plants, crustaceans, organic remains, and finally sand and mud.

Reference

[30]Al-Amari, Mu'ayyad Jassim Yas .2011. A study of some biological and environmental aspects of the fish community in the Hilla River, Iraq. PhD thesis, College of Science, University of Babylon. 141 pages.

[45]Al-Ani, S. M. H. and Wahab, N. K. 2012. Nutritional habits of four species of eastern trocar fish – Balad /north of Baghdad. Tikrit University Journal of Agricultural Sciences, 12(2): 74-86.

[9]Kadhim, H. H., and Al-Khshali, M. S. 2020. Effect of stocking density on the survival rate and growth traits of common carp cultured in rice fields in iraq. Plant Archives, pp. 5773-5776

[38]Al-Hakim, A. W., Al-Mehdi, M. I. and Al-Salman, A. H. 1981. Determination of age, growth and sexual mortality of Barbus grypus (Heckel) in Dukan Reservoir of Iraq. Journal of Fish Biology, 18: 299 – 308.

[42]Al-Hamad, A.S.A. 2019. Fish biology of Tigris River within the districts of Tikrit, Al-Sharqat and Baiji / Salah al-Din Iraq - Baghdad. Ph.D. Thesis. College of Agriculture, University of Tikrit. 230 p.

[41]Al-Hamdani, R. I. Y. 2022. Some biological aspects of the Tigris River fish species found south of Samarra Dam and north of Dhuluiya - Salah al-Din/Iraq. M.Sc.. College of Agriculture. University of Saladin. 73 p.

[28]Al-Jubouri, M. A. and Abdullah, N.2019. Biological aspects of five species of fish in the Diwaniyah River in Al-Qadisiyah Governorate, Iraq, PhD thesis, College of Agriculture, University of Basra. 189 pages.

[46]Al-Kaabi, K. M.; Hussein, T. S.; Hassan, S. M.; Rahej, A.M.; Katee, A. J. and Mallah, S. 2017. Seasonal variations in the natural nutrition of the redfish Barbus luteus (Heckel) and the common carp Cyprinus Carpio in the Euphrates River at Musayib city, Iraq. Karbala University Journal, Fifth Scientific Conference: 48-55.

[27]Al-Kaabi, K. Mozan M., Hussein, T. S. and Rahej, A. M. 2018. Seasonal changes in the natural diet of carp Arabibaarbus grypus (Heckel, 1843) in the Euphrates River at Musayib, Iraq. Diyala Journal of Agricultural Sciences, 10(2): 15-25

[36]Al-Mashhadani, Ahmed Jassim and Al-Shamaa, Amer Ali .2002.. Food overlap of four species of Cyprinidae; Piesces in Lake Habbaniyah, Iraq. Fisheries Journal, 21 1:-7.

[18]Al-Rubaie, Raad Kamil 1989. Study of some biological aspects of two species of fish in Lake Habbaniyah: the redfish (Heckel) Barbus luteus and the carp (Heckel) Barbus grypus. Master's thesis. Ibn Al-Haitham College of Education. University of Baghdad 102 pages.

[39]Al-Rudaini, A. J.; Muhammad, A.M. and Abbas, L.M. 2006. Environment and life of the Barbus xanthopterus (Heckel) in the Euphrates River in central Iraq. Umm Salamah Journal of Science, 3(4): 595-603.

[11]Al-Shamaa, A.; Ali. M. and Ahmed J. A. 1999. Natural food for fish in Al-Qadisiyah Dam Reservoir 2: Barbus xanthopterus and

other species of the genus Barbus. Journal of Basic Sciences Studies, 26(1): 137-149.

[24]Al-Shawi, S. A. and Wahab, N. K. 2007. The nature of the fish community composition of the Tuzjay River Basin. Iraqi Journal of Agriculture, 12(4): 105-118.

[17]Al-Temimy, L. M. A. 2004. Environmental, biological and fish community assessment in the Euphrates River near the Musayb power station. PhD thesis, College of Agriculture. University of Basrah. 147 p.

[4]Al-Zuhairi, N. S. H. 2016. The efficiency of the Tigris River in exceptional drainage between the villages of Al-Dawjama and Al-Sindiyya in Al-Khalis District/ Diyala Governorate. M. Sc., College of Education for Human Sciences. University of Diyala. 177p

[31]Borkenhagen, K. 2014. A new genus and species of cyprinid fish (Actinopterygii, Cyprinidae) from the Arabian Peninsula, and its phylogenetic and zoogeographic affinities. Environment Biological Fish, 97 (10): 1179–1195.

[10]Coad, B.W. 2010. Freshwater fishes of Iraq. Pensoft Sofia, Bulgaria –Moscow, Russia , 94 p.

[6]Dantas, D.V.; Bessa E.; Santos, F.B.; Fernandez, W.S.; Santos, F.M.S. and Feijo, M.M. 2012. Life history of three catfish species (Siluriformes: Ariidae) from Southern Brazil. Biollogy Neotropic, 12(4): 74-83.

[13]Mohamed, A.M. and Hussain, N.A. 2012. Evaluation of fish assemblage environment in east Hammar using integrated index. Basrah Journal of Sciences, 30(2): 87-105

[43]Epler, P.; Bartel, R.; Chyb, J. and Szczerbowski, J.A. 2001. Diet of selected fish species from the Iraqi Lakes Tharthar, Habbaniya and Razzazah. Arch. Pol. Fish., 9(1): 211-223.

[7]Sediq, S. O..2023. Some Ecological Factors and Economic Fish Community of Greater Zab River in Aski-kalak, Kurdistan Region- Iraq. A Dissertation. College of Agricultural Engineering Sciences at Salahaddin University-Erbil

[1]FAO. Food and Agriculture Organization.2016. The State of World Fisheries and Aquaculture. Contributing to food security and nutrition for all. Rome, 200 p.

[22]Gordan, J. D. 1977. The Fish population in shore water of the West Costal Scotland. The food and feeding of the whiting (Merlanguis merlanguis L.). J. Fish Biol., 11 (6): 513-529

[19]Hamad, Amir Saud Alwan and Wahab, Nihad Khorshid 2020. The nature of the composition and presence of the fish community in the Mar River in the districts of Sharqat, Baiji and Tikrit / Salah al-Din / Iraq. The Eighth Scientific Conference and the Second International Conference of the College of Agriculture / Tikrit University (Part 3.(

[34]Hussain, N. A. Mohamed, A. R. M., Al-Noor, S. S., Mutlak, F. M., Abed, I. M. and Coad, B.W. 2009. Structure and ecological indices of fish assemblages in the recently restored Al-Hammar Marsh, Southern Iraq. Bio Risk, 3: 173-186 .

[22]Hussein, N. A.;Al-Taie, M. S. and Al-Ammari, M. J.Y. 2012. Some life aspects of the carp Barbus grypus (Heckel) in the Hilla River/Iraq. Iraqi Journal of Aquaculture, 9(2):39-58.

[44]Hussein, S. A.; Abdullah, A. M. and Abdullah, S. A. 2015. Ecology and composition of fish in the southern part of the Euphrates River. Basrah Journal of Agricultural Sciences.28 (1): 82-92.

[15]Al-Lamy, J.H. and Taher, M.M. 2016. Food and feeding habits of Common carp

ISSN 2072-3857

(Cyprinus carpio) larvae and juveniles in earthen ponds. Basrah Journal Agriculture, 29(1): 17-29.

[25]Jabr, A. Q. A. 2022. Some environmental and biological aspects of the catfish, Luciobarbus xanthopterus, in the Hamrin Dam Lake/Diyala-Iraq. M.Sc.. College of Agriculture. University of Diyala. 85 p.

[3]Kathem, H. H. and Al- Khashali, M. S. 2017. A survey of the reasons for the decline in the survival of fish larvae in hatcheries at the Tigris River in Waist Governorate. Iraqi Journal of Agricultural Research (IJAR). 22(2): 98-107.

[37]Khadiri, Maher Mohammed .2014. An environmental and biological study of the fish community in the Euphrates River, central Iraq, Master's thesis, College of Science, University of Babylon. 120 pages.

[29]Khodadadi, M., Arab, A. and Jaferian, A .2016. A Preliminary study on sperm morphology, motility and composition of seminal plasma of Shirbot, Barbus grypus. Turkish Journal of Fisheries and Aquatic Sciences, 16: 947-951.

[33]Mohamed, A. R. M. Hussain, N. A. AL-Noor, S. S. Mutlak, F. M. Al- Sudani, I. M., Mojer, A. M. Toman, A. J. and Abdad, M. A. 2008. Fish assemblage of restored Al-Hawizeh marsh, southern Iraq. Ecohydrology and Hydrobiology, 8 (2-4): 375-384.

[40]Mohammed, Abdul Qader Abdul Salam .2019. The impact of the Diyala River estuary on the environment and life of two species of local fish, Baghdad, Iraq. Master's thesis, College of Agriculture, University of Diyala. 84 pages.

[23]Mohammed, Abdul Razzaq Mahmoud, Al-Radini, Abdul Muttalib Jassim and Abbas, Luay Mohammed 2005. Some biological aspects of carp Barbus grypus near Al-Musayyab power station. Iraqi Journal of Agriculture, 1:53-69.

[14]Prescott. G. W. 1973. Algal of the western Great lakes area. Iowa. W. C. Brown comp., Pub. Dubuque, 348 p.

[20]Ramirez, L.V.; Navia, A.F. and Rubio, E. A. 2008. Food habits and feeding ecology of an estuarine fish assemblage of northern Pacific coast of Equator. Pan-American Journal of aquatic Science, 3(3): 361-372.

[5]Sakr, M. F. M. 2021. Fish community composition in Hamrin Dam Lake - Diyala. M.Sc.. College of Agriculture. University of Diyala. 86 p.

[32]Salman, A. H. 2006. Biodiversity of fish and the life of two species in Lake Tharthar - Tigris, PhD thesis, College of Science, University of Al-Mustansiriya . 102 p.

[12]Sinha, V. R. and jones, J. W. 1967. On the feed of the freshwater eels and their feeding relationship with salmonids. J. Zool. London, 153: 119-137 .

[2]Speedy, A. W. 2003. Global production and consumption of animal source foods. Animal production and health division, Food and agriculture organization of United Nations, Roma, Italy. 133(11):4048-4053.

[16]Stergion, k. I. 1988. Feeding of lessepian migrant Siganus luridus in Eastern Mediterranean, its new environment. J. Fish. Biol., 33: 531-543.

[35]Taher, M.M. 2010. Specialization, tropic breadth and diet overlap of thirteen small marine fish spices from Shatt Al-Arab Canal, Southern Iraq. Marsh Bulletin, 5(2): 118-131 .

[8]Abdullah, S. 2017. Diversity of fishes in the lower reaches of Tigris River, north east of Basrah province, Southern Iraq. Basrah Journal Agriculture Sciences, 30(1): 85-96.

[26]Wahab, Nihad Khorshid.2013. Some morphological and biological aspects of a

number of fishes of the Tigris River - Tikrit / Iraq. Tikrit University Journal of Agricultural Sciences 13(3):83-92.

[47]Yesser A. T.; AL-Taee M.A.J. and Abdul- Nebi , S. A. .S .2013. Determination of some toxic trace elements of fresh, frozen and canned fish species. Bas. j. vet. Res. Vol, 12(2): 139-148.

ISSN 2072-3857