Assessment of Fish Composition and Ecological Indices in the Southern Huwaiza Marsh, Iraq

Salman N.S.[1*]; Hassan S.S.[2]; Taher M.M.[3]

Received: July 2025 Accepted: September 2025

Abstract

This study aimed to assess fish species composition, dominance, and key ecological indices (diversity, evenness, richness, and similarity) in the southern part of Huwaiza Marsh, Iraq. Sampling was conducted at Al-Safya site, which is connected to Al-Suwaib River and Shatt Al-Arab River, during the dry season (June–August) and wet season (February–May). Fish were collected using fixed gill nets (2.5–10 cm mesh size) and electrofishing.

During the dry season, 10 species from five families were recorded, with native species representing 80% and alien species 20% of the total. Seven commercial species accounted for 70% of the catch. In the wet season, 11 species were recorded, with 72.7% native and 27.3% alien species; six commercial species made up 54.5% of the total. Cyprinidae was the dominant family in both seasons.

Ecological indices showed seasonal fluctuations. During the dry season, the Shannon diversity index (H) averaged 1.81, richness (D) 1.57, and evenness (J) 0.89. In the wet season, H averaged 1.39, D 1.30, and J 0.67. Higher diversity and evenness were observed in the dry season compared to the wet season. These results highlight seasonal variations in the fish community structure and provide baseline data for future conservation and management of the Huwaiza Marsh ecosystem.

Keywords: Fish composition; Ecological indices; Seasonal variation; Huwaiza Marsh; Iraq

1-Al-Warka University College
2- Al-Maqal University, Basra, Iraq
3- Department of Fisheries, University of Basra, Iraq
*Corresponding author's Email: ndrslmn1@gmail.com

Introduction

The marshes of southern Iraq are the largest wetlands in southwest Asia and covered more than 15,000 km2. These marshes were a natural refuge for many aquatic organisms, especially fish and birds. Because of environmental, hydrological and meteorological conditions a unique ecosystem formed, allows aquatic biota to flourish. These marshes play an important role as spawning grounds, nurseries and feeding areas for fish. The availability of food resources enhances the growth of fish within this ecosystem in comparison to other Iraqi water bodies (Mohamed and Ali, 1992). The vast area of marshes and dense macrophytes provide refuge from predators and wide dispersion throughout the entire area.

In 1990 FAO estimated that the total inland catch of fish in Iraq was 23,600 tones, with over 60% of this coming from the Mesopotamian marshes (UNEP, 2006). They represent the permanent habitat for millions of birds and a flyway for millions more migrating between Siberia and Africa (Maltby 1994; Evans 2002). Despite the fact that the southern marshes are considered as a major source of freshwater fishes in Iraq, no detailed studies have been conducted about the species composition, fish ecology and fisheries in the most important marshes such as Huwaiza Marsh. In this context no previous studies have traced the species composition, dominant species and fluctuation in ecological indices in this marsh.

Most of the previous published work about fishes in the marsh has dealt with various aspects of fish biology and few about fisheries. Neither checklist nor articles were traced concerning fish ecology. Several taxonomic accounts were published mostly in the sixties of the last century dealing with freshwater and marine fishes of Iraq such as those of Khalaf (1961), Mahdi (1962), Al-Daham (1982) and Coad (1991). They were tentatively refer to the marshes. Most of the species inhabited the marshes are freshwater with few marine species, including anadromous and estuarine ones which penetrate to the lower reaches of the southern marshes, especially in Hammar and Huwaiza marsh (Hussain *et al*., 1989, 2006).

Ecological indices are the basic tools to determine the status of the fish ecosystem monthly and seasonal, changes in number of species and number of individuals reflecting the status of the marsh, dominance in the assemblage and between species, changes in number of species in relation to the number of individuals. Species composition monthly and seasonally in attempt to recognized the marsh native species, marsh alien (introduce) and seasonal marine migratory species. The aim of the present survey is to provide a baseline information about the fish ecology of the Huwaiza marsh. Consequently, the major objectives are to gather data on fish composition, species dominance, fish sizes and ecological indices like diversity, evenness, richness and similarity, in the southern part of Huwaiza.

Materials and methods

Sampling sites

Al-Suwaib (Al-Safya) represents the southern part of Huwaiza marsh which is connected with Al-Suwaib river and then with Shatt Al-Arab river at 3 km before the point where Tigris and Euphrates meet (Latitude 31 7 58.7, Longitude 47 35 32.8) (Fig. 1).

Figure 1: Open waters and banks of Al-Suwaib at the southern part of Huwaiza Marsh.

Field work

Fish sample were collected from (Al Safya) during dry season (June, July and August) and wet season (February, March, April and May). Sampling was carried out by using fixed gill nets (150 to 1000 m long with 2.5 cm to 10 cm mesh size) and electro- fishing gear. Specimens were immediately kept in crushed ice then transported to the laboratory.

Laboratory work

Fishes were identified to species by using Coad (1991). Total length (T.L) and weight (w) were taken to all fish captured was recorded to the nearest (mm) and (0.01g) respectively.

Ecological indices

The analysis of the nature of the fish communities in the, Huwaiza marsh was carried out by using ecological indices of the fish in following methods:

Relative abundance (Odum, 1970):

Relative abundance (%)=i n/ N * 100

Where, i n=number of individuals of the species in the monthly sample, N=total number in the monthly sample.

Diversity Index (Shannon and Weaver, 1949),

H= - å Pi loge Pi

Where, H=the species diversity index, Pi=the proportion of the i^{th} species of the whole sample.

Evenness index (Pielou, 1977):

J=H / loge S

Where, J=the evenness index, H=the species diversity index, S=number of species.

Richness index (Margalef, 1968):

D = S-1 / loge N

Where, D=the richness index, S=number of species, N=number of individuals

Fish species were divided into three categories according to their occurrence in the monthly samples following Tyler (1971). They were divided also into commercial and non commercial species.

Results

Species composition

Dry season

A total of ten species belonging to five families were caught during dry season of 2007 from southern part of Huwaiza Marsh (Table 1). Cyprinidae is the dominant family in terms of number of species which is represented by six species (Barbus sharpeyi, *B. luteus, Cyprinus carpio*, *Aspius vorax*, *Carassius auratus*, and *Alburnus mossulensis*), while other species belonging to the families mugilidae (*Liza abu*), siluridae (*Silurus triostegus*), mastacembelidae (*Mastacembelus mastacembelus*) and sparidae (*Acanthopagrus latus*). There is a slight variation in the number of species during that period. The collected species comprised eight native species 80% of the total number of species and two alien species 20% of the total number of species, moreover the commercial species was represented by seven species (*B. sharpeyi, C. carpio, B. luteus, A. vorax, C. auratus, Acanthopagrus latus* and *L. abu*) and comprised 70% of total species number.

Table 1: Abundance of species caught during dry season from southern part of Huwaiza Marsh.

Species	Commercial	Noncommercial	Abundance (%)
Barbus sharpeyi	+		0.94
Barbus luteus	+		23.11
Aspius vorax	+		14.15
Cyprinus carpio	+		6.60
Carassius auratus	+		12.74
Liza abu	+		26.89
Acanthopagrus latus	+		2.36
Alburnus mossulensis		+	9.90
Silurus triostegus		+	1.89
Mastacembelus mastacembelus		+	1.42
Total	**7 species**	**2 species**	**1**

Wet season

The total number of species caught during wet season of 2008 from southern part of Huwaiza Marsh was eleven species belonging to five families (Table 2). Cyprinidae is the dominant family in terms of number of species and was represented by seven species (*Barbus sharpeyi, B. luteus*, *Cyprinus carpio, Aspius vorax, Carassius auratus, Alburnus mossulensis* and *Acanthobrama marmid)*, while other species belonging to the families mugilidae (*Liza abu), siluridae (Silurus triostegus), mastacembelidae (Mastacembelus mastacembelus*) and heteropneustidae (*Heteropneustus fossilis*). There is slight variation in the number of species during the whole season. The collected species comprised eight native species 72.73% of the total number of species and three alien species 27.27% of the total number of species. The commercial species were represented by six species (*B. sharpeyi, C. carpio, B. luteus, A. vorax, C. auratus* and *L. abu*) and comprised (54.54)% of the total number of species (Table 2).

Table 2: Relative abundance of species caught during wet season from southern part

Species	Commercial	Noncommercial	ndance (%)
Barbus sharpeyi	+		0.26
Barbus luteus	+		14.01
Aspius vorax	+		10.61
Cyprinus carpio	+		2.26
Carassius auratus	+		6.01
Liza abu	+		59.70
Alburnus mossulensis		+	2.96
Acanthopagrus latus		+	1.48
Silurus triostegus		+	0.69
Mastacembelus mastacembelus		+	0.96
Heteropneustus fossilis		+	1.04
Total	**92.86**	**7.14**	**100**

Fish size

Dry season

The monthly and overall length frequency distributions of commercial fish species are illustrated in Figure 2. The length frequency of *A. vorax* varied between total lengths 170-440 mm, and the dominant length group is 350 mm in July and August. The length frequency of *C. carpio* includes total lengths of (140-570) mm. *Barbus luteus* was very common and was regularly found in catch throughout the whole year, and length frequency of this species include total lengths of (110-280) mm, and the dominant length groups are (210, 210 and 200) mm during July, August and September respectively. *Liza abu* was the most abundant species in the catch throughout dry season, and length frequency of this species include total lengths of (80-220) mm, and the dominant length group is (130) mm in July. Length frequency of *Carassius auratus* include total lengths of (160-265) mm, and the dominant length groups is (180) mm in September.

Wet season

The monthly and overall length frequency distributions of commercial fish species are illustrated in Figure 3. The length frequency of *B. sharpeyi* include total lengths of (340-360) mm. The length frequency of *A. vorax* include total lengths of (180-450) mm, and the dominant length groups are (270, 330 and 250) during February, April and May respectively. The length frequency of *C. carpio* includes total lengths of (150-520) mm, and the dominant length groups are (250 and 270) mm in April. Barbus luteus was very common and regular found in catch throughout the year, and length frequency of this species include total lengths of (110-320) mm, and the dominant length groups are (210, 220 and 270, 230) mm during February, April and May, respectively.

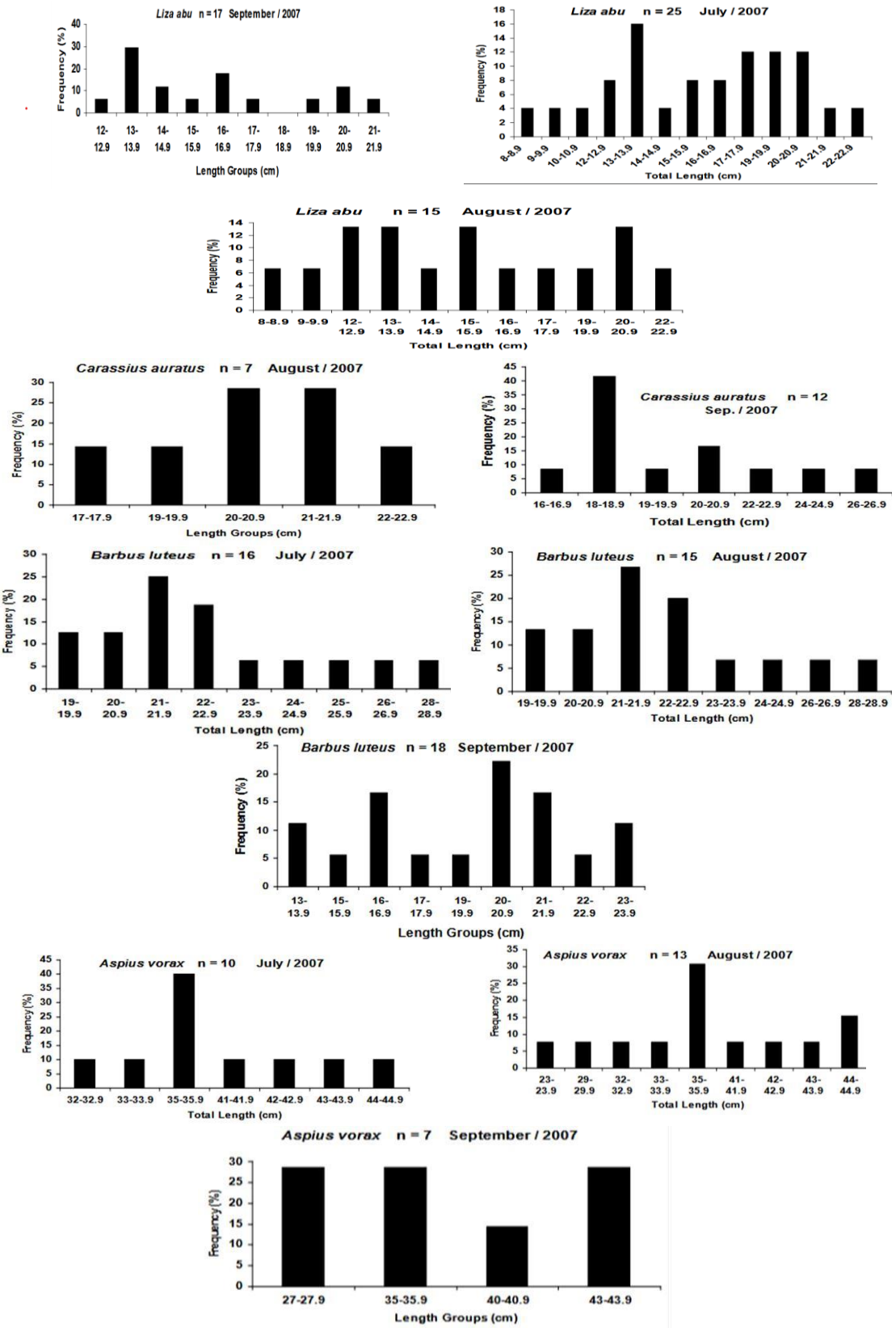

Figure 2: Length frequency distribution of fish caught from southern part of Huweza marsh (AL Safya) during dry season.

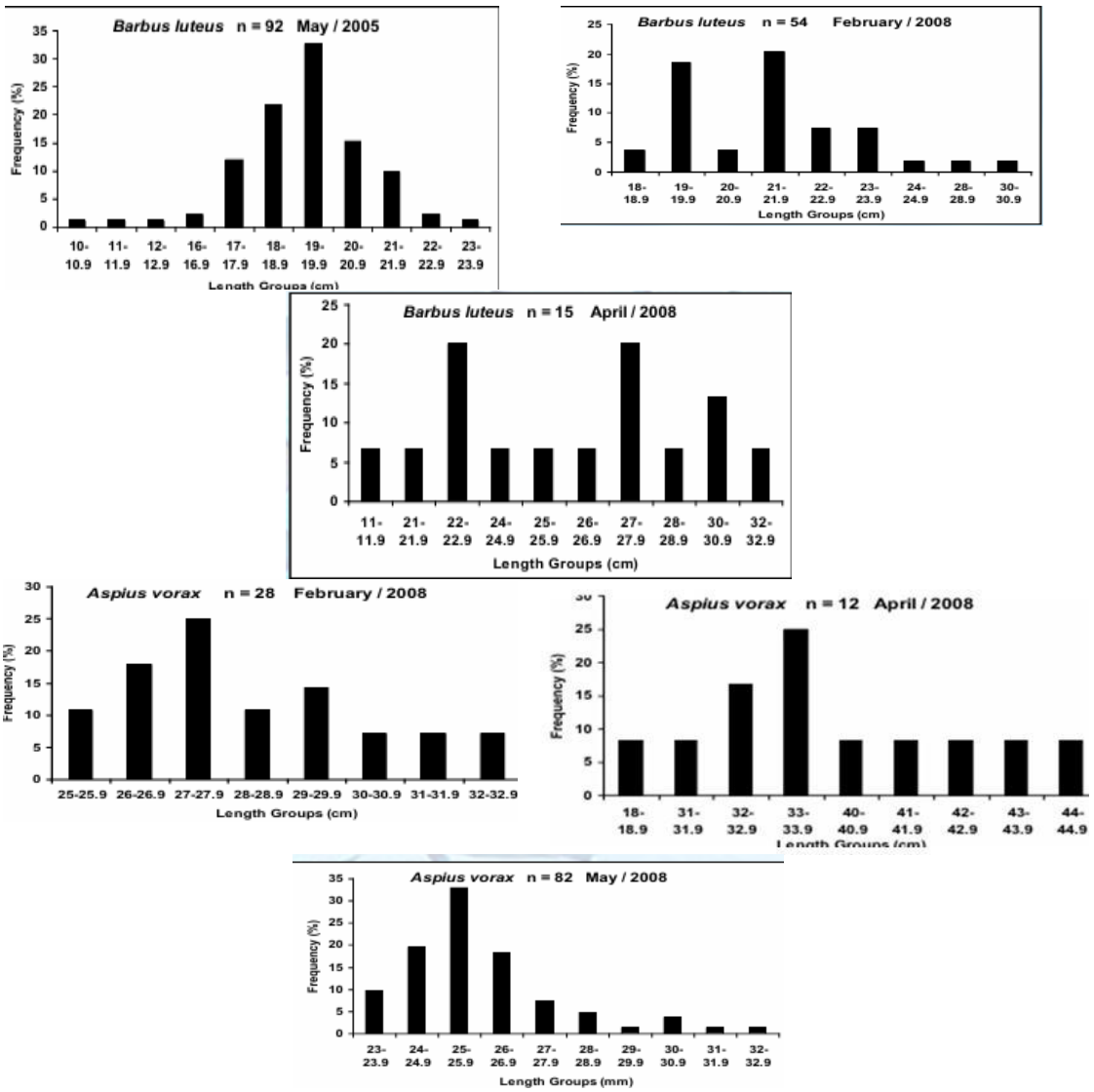

Figure 3: Length Frequencies for fish caught from southern part of Huweza Marsh (Al Safya) during wet season 2008.

Liza abu was the most abundant species in the catch throughout wet season, and length frequency of this species include total lengths of (40-130) mm, and the dominant length groups are (110, 90-110, and 70) mm at months of February, April and May, respectively. *Carassius auratus* is consider as the second most abundant species during the wet season, The length frequency of this species include total lengths of (110-300) mm, and the dominant length groups are (180-190 and 220) mm during February and April respectively.

Relative abundance and ecological indices

Dry season

Overall, 212 fishes from 10 species were caught from southern part of Huwaiza marsh during dry season. No significant differences could be detected in the number fishes caught at July, August and September. *Liza abu* was the dominant species comprising 57 individuals

(26.89 %) of the total catches followed by *B. luteus* 49 individuals (23.11 %), *A. vorax* 30 individuals (14.15%), and C. auratus 27 individuals (12.73 %) (Table 1). Ecological indices showed monthly variation pattern during dry season are shown in Figure 4. The diversity index (H) changed from 1.7998 in September to 1.8306 in August with overall average value of 1.8142. The richness index (D) fluctuated from 1.3732 in September to 1.6895 in August with overall average value of 1.5713. The evenness index (J) ranged from 0.8776 in July to 0.9249 in September with overall average value of 0.8943 (Fig. 4).

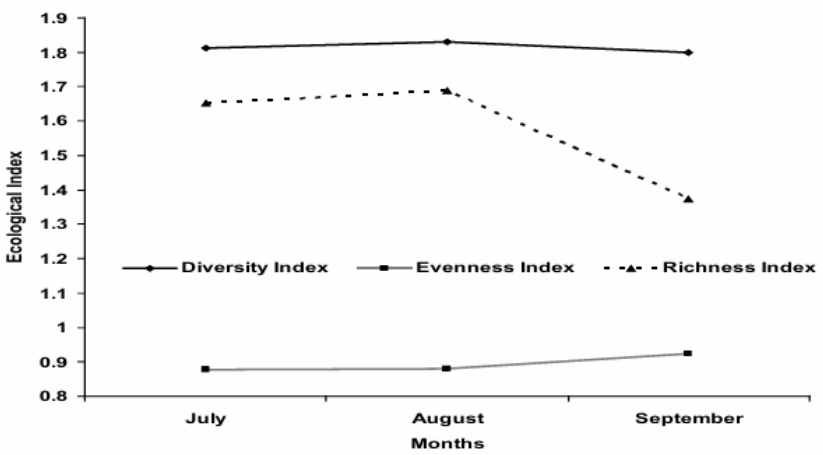

Figure 4: Monthly variation in ecological index of fish caught from southern part of Huwaiza Marsh (Al Safya) during dry season.

Wet season

Overall, 1149 fishes from 11 species were caught from southern part of Huwaiza marsh during wet season. The highest number was 695 in February and the lowest 140 in April. *Liza abu* was the most dominant species comprising 686 of the total catches followed by *B. luteus* 161 individuals, *A. vorax* 122 individuals and *C. auratus* 69 individuals (Table 2). Ecological indices also showed monthly variation pattern during wet season are shown in Figure 5. The diversity index (H) changed from 0.9033 in February to 1.9259 in April with overall average value of 1.3850. The richness index (D) fluctuated from 1.0697 in February to 1.6189 in April with overall average value of 1.3020. The evenness index (J) ranged from 0.4344in February to 0.9262 in April with overall average value of 0.6661.

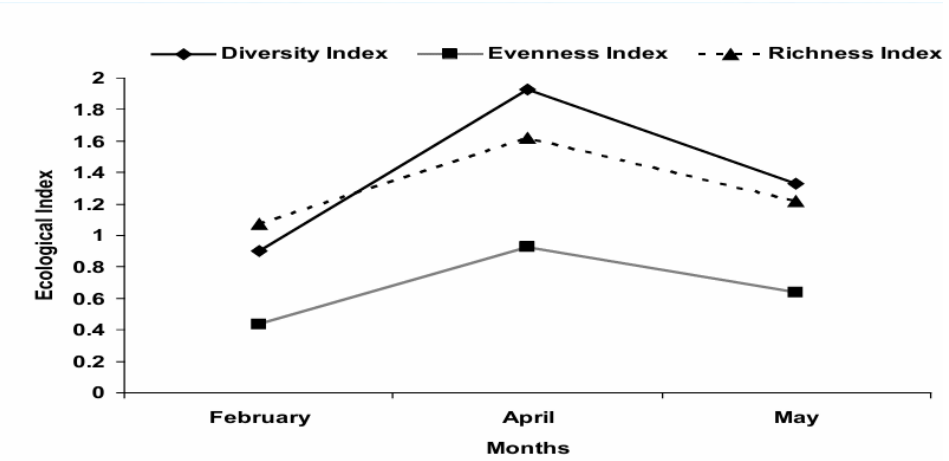

Figure 5: Monthly variation in ecological index of fish caught from southern part of Huwaiza Marsh (Al Safya) during wet season.

Discussion

Species composition and fish structures

The desiccation of the marshes altered the fish community and brought major changes to their structure due to the harsh environment that prevailed during this period and to changes to production especially primary production of aquatic plants and phytoplankton, leading consequently to changes in secondary productivity of zooplankton.

Results of the present investigationare in aggreement with those of Mohamed et al. (2008) who studied also the fish assemblage in Huwaiza marsh. They showed that there were wide variations in relative abundance of fish species inhabiting Huwaiza marsh. Part of such variation can be related to seasonal differences of water quality, plankton and aquatic vegetation availability. The other part is due to spatial reasons. The highest number of fish species (13) was recorded in the middle of Huwaiza at during the wet season. Lower numbers of species were recorded in other parts of the marsh. Hussein *et al*. (2006) found that the total number of species caught in the Huwaiza marshes between October 2005 and September 2006 was 15 fish species belonging to 5 families. Cyprinidae was the dominant family in terms of number of species and was represented by eleven species. Number of fish species recorded in the present investigation was slightly lower than that recorded by Hussein *et al*. (2006) and Mohamed et al. (2008). This may reflect a certain degree of unfavorable water characters due to shortage of discharge and limited movement of water masses from nearby water bodies.

The present decline of number of fish species and fish population structure in Huwaiza marsh has been pointed out by comparison with that recorded in other studies such as Al-Daham (1982), Coad (2010) and the inland fishery statistics of the FAO for the past period (1950-2001). A total of 65 fish species were recorded by Al-Daham (1982) with obvious dominance for the most commercial species such as Shabout *Barbus grypus* , Gattan *B. xanthopterus* and Biz *Barbus esocinus*. The same

observations were mentioned in the FAO statistics where Bunni Barbus sharpeyi and Gattan were also the dominant species. In the present investigation those valuable and favorable species composed only 1 % of the catch, while small size Khishni *Liza abu* stands first in the catch of all stations followed by another less demanded species Himri *Barbus luteus* and the alien species Crusin carp *Carassius auratus*. Similar observations were recorded by Mohamed et al. (2008) who stated that *Liza abu* was the most abundant species comprising 37.1% of the total numbers followed by *Barbus luteus* (29.4%), *Carassius auratus* (15.3%), *Alburnus mossulensis* (4.88%) and *Aspius vorax* (4.14%). The disappearance or decreased abundance of *B. sharpeyi* was due to the reduction of its food resources (mainly aquatic plants) and shelter (provided by these aquatic plants). These conditions led to the increase of *B. luteus*, which have mixed diet and *S. triostegus*, which reach larger sizes because of the availability of small fish upon which they need for feeding and due to the disappearance of their predators (aquatic birds and otters) (New Eden Master Plan, 2006).

These changes may be related to changes in the food basis which suited certain species. Species like *B. xanthopetrus and B. grypus* substantially decrease in their numbers due to scarcity of food resources (insects and annelids) or competition with alien species *C. carpio* (Al-Kanaani, 1989). Deterioration of water quality of the marshes such as the increase of salinity from 0.4 g/l in seventies (Al-Saadi et al., 1981) to 6.3 g/l in late eighties (Al-Rikabi, 1992) could be a crucial reason for changes in fish composition. More deterioration in water quality of the marshes which have been reported in recent years (Salman, 2011; Douabul et al., 2013; Salman et al., 2021) could also lead to the disappearance of several cyprinid species like B. sub-quicucitus and *B. scheich*. IMRP (2005) report on the restored marshes in 2004-2005, indicated that *L. abu* was the most dominant species followed by *C. carassius* except in Huwaiza by *B. luteus*. Similar findings have been reported by New Eden Master Plan (2006).

Seasonal variations

In all stations of the present survey, the highest number of species (11- 13) was recorded during the period between February to May and the lowest (10) during July - September. Slightly different observations were recorded by Hussein *et al*. (2006). They found that the number of species captured from Huwaiza marsh increased in summer (July) and spring (February-May), and sharply decreased in winter (December). Generally there is an agreement that number of species and individuals in Huwaiza marsh increase in spring to summer months and decrease in winter, as it is in all other southern marshes of Iraq. Similar observations were illustrated by IMRP (2005) in their monitoring program (2004-2005). It seems that a relation existed between productivity cycle of aquatic plants and

phytoplankton and increase in number of species and individuals. It coincides with the second peak of phytoplankton productivity cycle which occurred in such period and also the peak of productivity of dominant submerge plant (*Ceratophyllum demersum*) as documented by IMRP report (2005). There are many species remain during dry season as refuge. These species are considered of low commercial value. They include *Liza abu* which is the most abundant species followed by *Barbus luteus, carassius carassius, Acanthobrama mossulensis* and *silurus triostegus.*

Fish grouping

The fish fauna of the Huwaiza marsh may be classified as native and alien fish species and also as commercial and noncommercial species. Ten native species (*Barbus luteus, B. sharpeyi, B. xanthopterus, Aspius vorax, Acanthopagrus marmid, Alburnus mossulensis,, Liza abu, Heteropnuestus fossillis, Mastacembelus mastacembelus* and *Silurus triostegus*) constituted 75–80% of the total number of species. Four aliened species (*C. carpio, H. fossilis, Hemiculter leucisculus* and *C. carassius*) comprised 20-25% of the total number of species. No marine species was recorded in this marsh. Twelve native and three aliened species were mentioned by Hussein *et al*. (2006) in Huwaiza marsh. The commercial species were represented by six to seven species (*B. sharpeyi, C. carpio, B. luteus, A. vorax, C. auratus, A. marmid* and *L. abu*) and comprised between 55–70% of the total number of species. The above dominant species can be considered commercial as far as poor people are concerned. Those cheap-priced species (2000 ID) comprise a cheap source of animal protein for the nutrition of marsh arabs and low-income inhabitants in the cities and villages of southern Iraq. According to Eden Master Plan (2006) the distribution of some non-economic species such as *Bathygopius fuscus, Alburnus mossulensis, Acanthobrama marmid,* and *Mystus pelusius* were different from the others. The accompanied distribution for the economic species such as *Barbus sharpeyi, Barbus xanthopterus, Carassius carassius* and non-economic predator species such as *Silurus triostegus and Mastacembelus mastacembelus*, were one of the most important problems causing disturbance of the food web in southern Iraqi marshes.

Ecological indices

Ecological indices recorded in the present study revealed slight variations during all seasons. This might be due to the low number of caught fish and to their similar contribution to the total monthly catch. Nevertheless, values of all ecological indices are slightly higher during the dry season (July September) than wet season (February –May). Higher diversity and richness in Huwaiza marsh in July-September period, could be related to joining of recruits of resident species after spring spawning and individuals brought with spring flood of Tigris River tributaries.

Similar observations have been stated by Mohamed et al. (2008). They have recorded nearly similar indices such as diversity index ranged from 0.88 to 2.1, richness from 0.73 to 2.42 and evenness from 0.49 to 0.85. Higher values of ecological indices however were obtained from Hammar mainly due to the higher number of species, higher number of individuals collected and invasion of marine species, which take place more in summer than winter (Hussein *et al*., 2006). These values were comparable to that of Shatt Al- Arab river (H=3.01) as showed in by Hussain *et al*. (1989).

References

Al-Daham, N.K., 1982. The ichthyofauna of Iraq and the Arab Gulf. *Bulletin of Basrah Natural History Museum*, 4, 102P. (Arabic).

Al-Kanaani, S.M., 1989. Diet overlap among the common carp *Cyprinus carpio L*. and three native species in Al-Hammar marshes, Southern Iraq. MSc. thesis, Coll. Agric., Basrah Univ. 118P. (Arabic).

Al-Rikabi, H.U.K., 1992. An Ecological and physiological study for some aquatic plants in AlHammar Marsh. MSc thesis. Basrah University.124P. (Arabic).

Al-Saadi, H. A., Antoine, S. R. and Nurl Islam, A. K. M. 1981. Limnological investigation in Al-Hammar marsh area in Southern Iraq. Nova Hedwig Cramer. xxxv: 157-166.

Coad, B.W., 2010. Freshwater fishes of Iraq. Pensoft Series Faunistica No. 93 Sofia, Bulgaria. ISBN 978-954-642-530-0.

Coad, B.W., 1991. Fishes of the Tigris–Euphrates Basin: A Critical-List. *Syllogeus*, 68, 1-49.

Douabul A.A., Al-Saad H.T., Abdullah D.S., and Salman N.A., 2013. Designated protected marsh within Mesopotamia: Water Quality. *American Journal of Water Resources*, 1, 39-44. DOI:10.12691/ajwr-1-3-4.

Evans, M.l., 2002. The ecosystem. Pages 201-219 in Nicholson E, Clark P, eds. The Iraqi Marshlands: A Human and Environment study. London: Politico's.

Hussain, N.A., Ali, T.S. and Saud, K.D., 1989. Seasonal fluctuations and composition of fish assemblage in Shatt Al Arab River at Basrah. *J. Biol. Sci. Res.,* 20(**1**), 139-150.

Hussain, N.A., Mohamed, A.M., Al Noor, S.H., Coad, B., Mutlak, F.M., Al- Sudani, I.M., Mojer, A.M., Toman, A.J. and Abdad, M.A., 2006. Species composition, ecological indices, length frequencies and food habits of fish assemblages of the restored Southern Iraqi Marshes. Report of University of Basrah, Iraq, October, 2006.

Iraqi Marshes Restoration Program (IMRP), 2005. Monitor Marsh Ecosystem Recovery. Chapter six 167-214 Final Report, 400P.

Khalaf, K.T., 1961. The marine and fresh water fishes of Iraq. Al-Rabitta Press, Baghdad, Iraq. 164P.

Mahdi, N., 1962. Fishes of Iraq. Ministry of Education, Baghdad.Iraq. 82P.

Maltby, E., 1994. An Environmental and Ecological Study of the Marshlands of Mesopotamia. Draft Consultative Bulletin. Wetland Ecosystems Research Group, University of Exeter. The AMAR Appeal Trust, London. 222P.

Margalef, R., 1968. Perspectives in ecology. University of Chicago press. Chicago. 111 P.

Mohamed, A.R.M. and Ali, T.S., 1992. The biological importance of Iraqi marshes in fish growth (pp: 205-215). In: N.A. Hussain (ed.) Ahwar of Iraq environmental approach. *Marine Science Center,* 18, 299P.

Mohamed, A.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 Hydrobiology*, 8(**2**), 4375-384 https://doi.org:10.2478/v10104-009-0029-5

New Eden Master Plan, 2006. New Eden master plan for integrated water resources management in the marshland area. Volume I, overview of present conditions and current use of the water in the Marshland Area, Book 4, Marshland. The Italian Ministry for the environment and territory and free Iraq Foundation, Italy – Iraq. 256P.

Odum, W.A., 1970. Insidious alternation of the estuarine environment. *Transactions of the American Fisheries Society*, 99, 836-847. https://doi.org/10.1577/1548-8659(1970)99<836:IAOTEE>2.0.CO;2

Pielou, E.C., 1977. Mathematical ecology. John Wiely, NewYork. 385

Salman N.A., 2011. Assessment of environmental toxicity in Iraqi Southern marshes using fish as bio-indicators. Ekologija 57(**1**), 21-29. https://doi.org:10.6001/*ekologija*

Salman, N.A., Al-Saad, H.T. and Al-Imarah, F.J., 2021. The Status of Pollution in the Southern Chapter 27. In: Marshes of Iraq: A Short Review 3. In: © Springer Nature Switzerland AG 2021. L. A. Jawad (ed.), Southern Iraq's Marshes, Coastal Research Library 37, https://doi.org/10.1007/978-3-030-66238-7_27

Shanon,C.E. and Weaver, W., 1949. The mathematical theory of communication, Univ. Illionis. Press Urbane. 117 P.

Tyler, A.V., 1971. Periodic and resident component communities of the Atlantic fishes. *Journal of the Fisheries Research Board of Canada*, 28(**7**), 935-946.

United Nations Environmental Program (UNEP), 2005. Back to Life: Environmental management of Iraqi marshland. DTI/0722/PA 16 P. www.unep.org