

Evaluation of fish assemblages' composition in the Euphrates River, southern Thi-Qar province, Iraq

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Abstract- Fish assemblage composition in the Euphrates River southern Thi-Qar province was assessed from January to December 2018. Various fishing methods were used to collect the samples. A total of 3010 specimens of bony fishes were caught represented 17 species, 17 genera, ten families and six orders. The species included ten native fish species and seven exotic fish species. The Abu mullet *Planiliza abu* was the most abundant species formed 26.21% of the total caught, blue tilapia *Oreochromis aureus* 19.30%, Prussian carp *Carassius gibelio* 17.48% and Redbelly tilapia *Coptidon zillii* 13.29% of the total number of species. The dominance index (D₃) value of the highest abundance represented by three fish species that preside the study area forming 62.99%, there are *P. abu*, *O. aureus* and *C. gibelio*. The occurrence of fish species contained seven fish species formed 92.03% of the total species caught. Seasonal fish species comprised of three fish species included 6.51% and occasional fish species contained seven species represented 1.46% of the total number of species. The diversity index values appear as poor ranged from 1.59 in December to 2.07 in April. Richness index values pointed to disturbing status, varied from 1.21 in September to 2.00 in May. Evenness index tends to be balanced, fluctuated from 0.79 in June to 0.91 in February and July. The present study verified the prevalence of the small-sized tolerance fish species represented by one native and three exotic species, with rarely or absence of the keystone native fish species of fish communities predominating the south of Iraq.

Keywords: Fish assemblage, Euphrates River, Southern Thi-Qar province, Keystone species.

Introduction

The Euphrates River is one of the longest rivers in Southwest Asia, passes during its path in many different habitats. Several dams were constructed along the section of the river, starting from its source to the place that confluence the Tigris River at Qurna town. The fragmentations of habitats cause the loss of spawning ground and migration routes of native local fish species and generally modify species composition (Benejam *et al.*, 2014). After the absence or rarity of some endemic species which substantially represent the historical core of fish assemblage like cyprinid species in the area (Mohamed and Abood, 2017).

Overexploitation is a common problem for fish communities around the world due to the use of effective fishing methods that cause a decrease in fish stocks (Priyanka and Dwivedi, 2015), in addition urbanization as a result of human activities represented by mineralogy and industrialization and reducing forest areas increased loss of biodiversity (Mgbemene *et al.*, 2016), also there are evidence indications revealed that extinction of species prejudicial to the stability and sustainability of the Earth's biosphere (Cardinale *et al.*, 2012; MacDougall *et al.*, 2013).

Fish populations composition are used as environmental indicators of response to habitat degradation, natural conditions, environmental pollution and ecosystem productivity, therefore freshwater fauna is one of the most vertebral groups vulnerable to extinction rates, of five times higher than terrestrial fauna and three times compared to marine mammals (Cooke *et al.*, 2005; Burkhead, 2012). However fish assemblages have a dynamic structure according to the nature of the interaction with biotic factors particularly competition, predation and aggressive behavior (Siqueira-Souza and Freitas, 2004). Moreover, abiotic variables have considerable effect on water criteria which directly related to the biodiversity in the river (Mondal *et al.*, 2010).

Li *et al.* (2010) pointed out that ecological indices are very important to measure the effect of contaminations on the biology of populations and their role to determine the efficiency in the monitoring of species abundance and temporal and spatial of hydrological variation on the assemblages of fishes in the rivers' ecosystems.

Several studies were carried out on Euphrates River southern Thi-Qar city evaluating fish community structure, Al-Noor *et al.* (2009), collected 23 fish species from the lower the Euphrates River, eight of them belonging to marine species. Abdullah (2017) collected 23 fish species, 23 genera belonging to 11 families, the diversity index ranged from 1.11 to 1.92 from the Euphrates River. Al-Helli *et al.* (2019), studied the fish assemblages in the Euphrates River at Al-Samawa City, Southern Iraq and recoded 24 fish species affiliated to ten families, 17 species of them were native species, whereas seven were alien fish species.

Abdullah *et al.* (2017) studied the fish community structure in the lower parts of the Euphrates River, in Thi-Qar southern province, collected 16 fish species. Abdullah (2019) investigated fish assemblage and impact of oscillation between drowning and drought on Fish size-spectrum in the Al-Chibyaish marsh and caught 15 fish species belonging to 15 genera and six families.

The objective of the present study is to evaluate the assemblage of fish with a highlight on some ecological factors on the Euphrates River southern Thi-Qar province.

Materials and Methods

The Euphrates River is the longest in Western Asia, its length extends to 2786 km, the river originates from southeastern Turkey and run to the south of Syria, then enters in Iraq, and join the Tigris River in southern Iraq at Qurna town (Al-Nasari *et al.*, 2018).

The study was conducted on the Euphrates River southeast Al-Nasiriya City in the area extending about 25 km, from west Al-Fuhud about 5km at the point of meeting of two branches of the river (N 30° 56' 24", E 46° 43' 48") to Al-Chibayish town (N 30° 57' 36", E 46° 58' 12"). The study area was determined by GPS. The samples were monthly collected from the area in the period from January to December 2018. Many types of nets were used in sampling, like seine nets (60 to 80 m length, 3 to 5 m height 22 to 44mm mesh size), drift gill nets (40 to 50m length mesh size 24 to 50mm), fixed gill nets (40 to 60m length mesh size 24 to 50mm) and cast nets (24mm mesh size) (Fig. 1).

Some environmental factors were measured at the same time of the sampling. These are: Water temperature, salinity (PSU), and Hydrogen ion (pH) concentration.

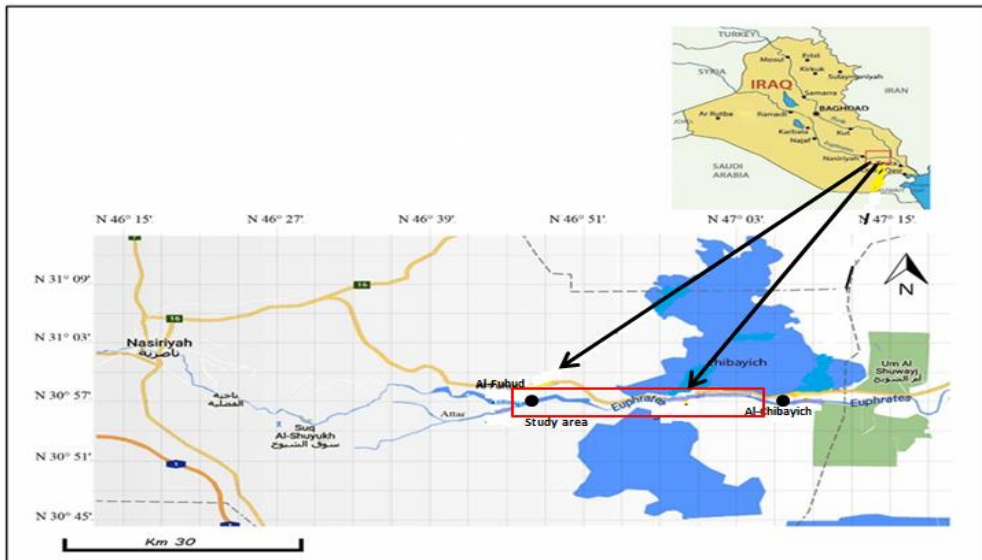


Figure 1. Map the study area of the Euphrates River from Al-Chibyaish to Al-Fuhud.

Fish Populations' Analysis:

Relative abundance was expressed according to Odum (1970), dominance (D_3) as in Kwak and Peterson (2007) and occurrence as in Tyler (1971). Fish diversity was calculated according to Shannon and Weaver (1949), richness as in Margalef (1968), and evenness as in Pielou (1977), and K-dominance is due to Lambhead (1983). Identification of fish was done according to Froese and Pauly (2020).

Statistical Analysis:

In order to identifying the statistical relationships the analysis of variance (ANOVA) used among the number of species and individuals ($P \leq 0.05$) in each month. A Statistical Package for Social Science-ver.20 program (SPSS) was used. The study period was divided into four-month groups according to temperature averages converge, the first group includes December, January and February, the second group March, April, May the third group June, July and August and September, October and November. The correlations among temperature, salinity and Hydrogen-ion with the number of species and individuals were done by the same program.

Canonical Correspondences Analyses program (CCA) was used to measure the relationships between the number of species and individuals and some of the environmental variables (Ter Braak, 1999).

Results

Ecological Factors:

The monthly variations in the values of water temperature, salinity and hydrogen-ion concentration in the Euphrates River south of Thi-Qar province were expressed in Figure (2). Water temperature ranged from 11°C in January to 34°C in July. Salinity varied from 1.38 PSU in March and 3.54 PSU in August, while the pH values fluctuated from 7.12 in August and 8.43 in December.

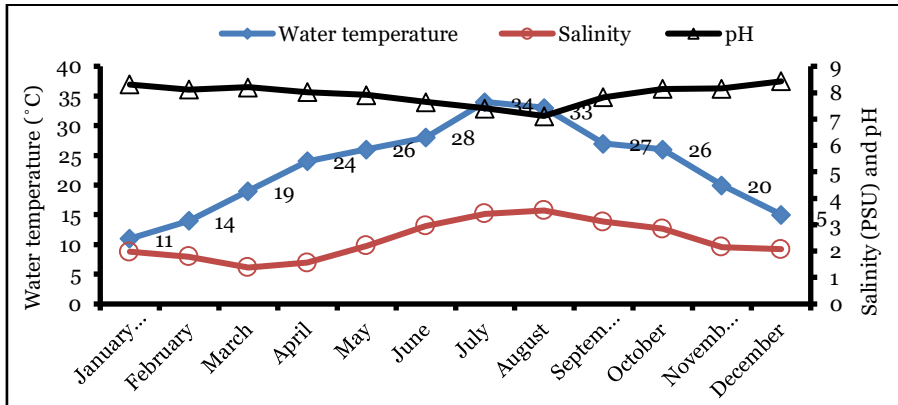


Figure 2. Monthly changes in some ecological variables in the Euphrates River southern Thi-Qar province.

Fish composition and some ecological variables:

Canonical correspondences Analysis (CCA) diagram highlights the correlation relationships as coefficient value (r) among the number of species, individuals, water temperature, salinity and pH (Fig. 3). Weak positive correlation relationship (0.277), (0.441) was found between temperature and the number of species and individuals respectively. Negative relationship (-0.297) was obtained between salinity and the number of species, while weak positive correlation (0.455) was detected between salinity and the number of individuals. Positive relationship (0.874) was shown between hydrogen-ion (pH) and the number of species, whereas a weak negative correlation (0.122) was recorded between hydrogen-ion and the number of individuals. A Strong significant correlation appeared between salinity and temperature (0.771**), whereas a significant negative relationship (-0.840**) was obtained between temperature and hydrogen-ion concentrations. A strong negative significant correlation (-0.777**) was found between salinity and hydrogen-ion concentration.

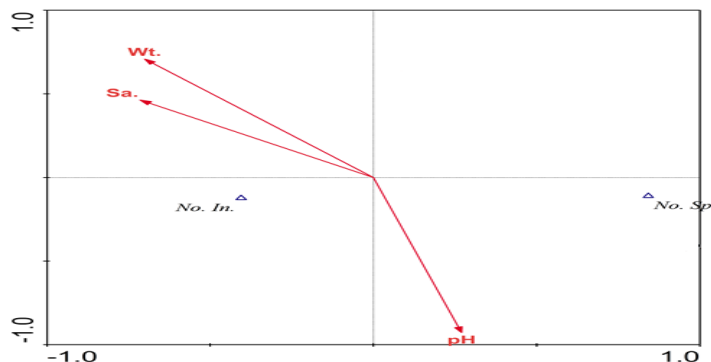


Figure 3. Canonical correspondences Analysis (CCA) expressing the relationships between temperature, salinity, pH and the number of species and individuals in the lower reaches of the Euphrates River. No. Sp.: Number of species, No. In.: Number of individuals, Wt.: Temperature, Sa.: Salinity, pH: Hydrogen ion.

Fish Species Composition:

Species Number:

Fish fauna collected through the period of the study comprised 17 species, 17 genera, ten families and six orders all of them were bony fishes collected from the Euphrates River south of Thi-Qar province (Table 1). The native species represented ten fish species and seven were exotic species. The number of species in the study area was varied from seven fish species in December (composing 41.18%) and 12 species in May (forming 70.59%) of the total species caught (Fig. 4). Significant differences ($P \leq 0.05$) were found among the number of species among the study months.

Number of Individuals:

Various differences in the number of individuals were found in the study area. A total of 3010 individuals of fish were caught from the river, the lowest number of individuals in December (97 fish) comprising 3.22% of the total, whereas the highest (607 specimens) was recorded in October (20.17% of the total number of fishes) (Fig. 4).

A Weak positive correlation (0.153) was detected between the number of species and individuals. The variance analysis showed significant differences ($P \leq 0.05$) between December, January and February group and September, October and November group.

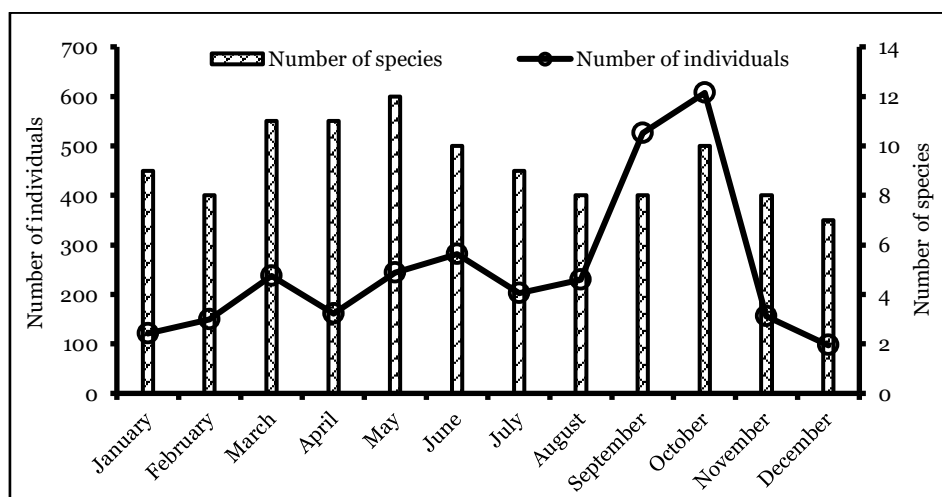


Figure 4. Monthly variations in the number of species and individuals in the Euphrates River southern Thi-Qar province.

Relative Abundance:

Four species presided the numerical relative abundance in the study area forming 76.28% of the total number of species during January to December 2018. *Planiliza abu* formed 26.21% of the total number of species, *Oreochromis aureus* 19.30%, *Carassius gibelio* 17.48% and *Coptidon zillii* 13.29%. Cichlidae the most abundant family formed 32.59% and contained two species followed by Mugilidae of one species (*P. abu*) composing 26.21% and Cyprinidae comprised of five species and constituted 21.88% (Table 1).

Table 1. The relative abundance of species and their Families and Orders in the Euphrates River southern Thi-Qar province from January to December 2018.

Family	%	species	%	Order
Cyprinidae	21.88	<i>Carassius gibelio</i> ^E	17.48	Cypriniformes
		<i>Carasobarbus luteus</i> ^N	3.26	
		<i>Cyprinus carpio</i> ^E	1.06	
		<i>Luciobarbus xanthopterus</i> ^N	0.07	
		<i>Mesopotamichthys sharpeyi</i> ^N	0.03	
Xenocyprididae	0.4	<i>Hemiculter leucisculus</i> ^E	0.40	
Leuciscidae	14.45	<i>Acanthobrama marmid</i> ^N	2.19	
		<i>Alburnus mossulensis</i> ^N	9.70	
		<i>Leuciscus vorax</i> ^N	2.56	
Siluridae	3.49	<i>Sihurus triostegus</i> ^N	3.49	
Heteropneustidae	0.30	<i>Heteropneustes fossilis</i> ^E	0.30	Synbranchiformes
Mastacembelidae	0.47	<i>Mastacembelus mastacembelus</i> ^N	0.47	
Cichlidae	32.59	<i>Coptodon zillii</i> ^E	13.29	Cichliformes
		<i>Oreochromis aureus</i> ^E	19.30	
Aphaniidae	0.07	<i>Aphanius dispar</i> ^N	0.07	Cyprinodontiformes
Poeciliidae	0.13	<i>Gambusia holbrooki</i> ^E	0.13	
Mugilidae	26.21	<i>Planiliza abu</i> ^N	26.21	Mugiliformes

N: Native

E: Exotic

The dominance index (D_3) of the three fish species that preside the study area formed 62.99% of the total are: *P. abu*, *O. aureus* and *C. gibelio*, whereas the rest of species constitute of 37.01% of the total (Fig. 5 & 6).

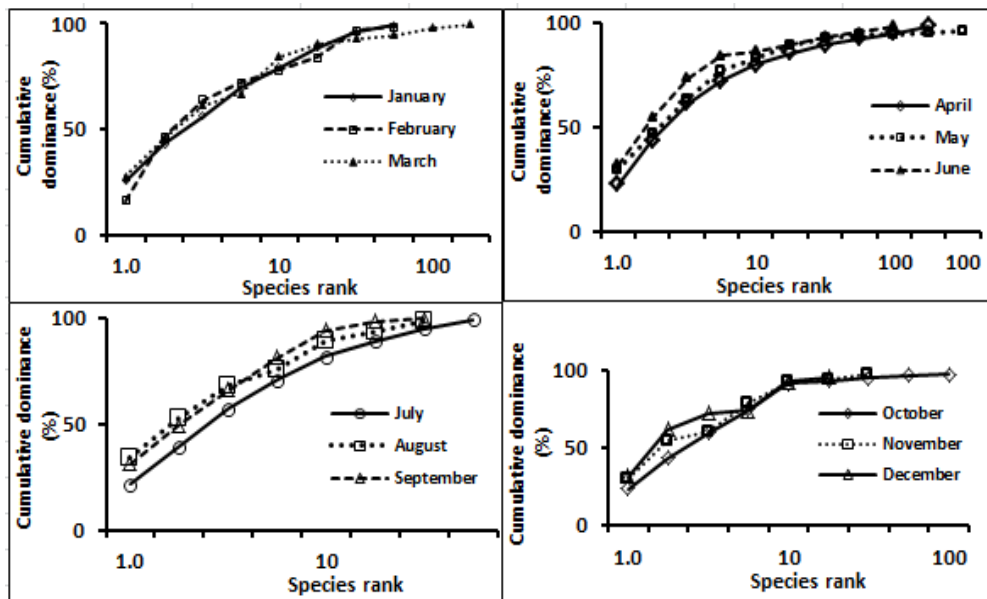


Figure 5. K-dominance to showing the cumulative abundance frequency in the study period.

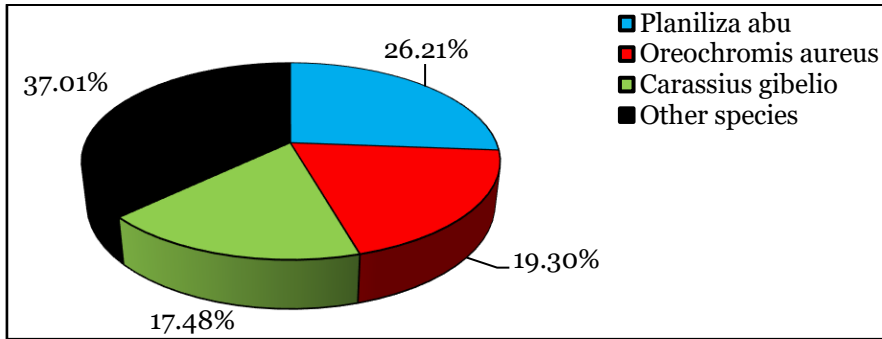


Figure 6. Dominance index (D3) of the three dominant species in the study area.

Occurrence of Species:

The monthly fish assemblage occurrence represented three groups. The common fish contained seven species (formed 92.03% of the total), three species of which appeared in 12 months (*C. gibelio*, *P. abu* and *O. aureus*), one species was present in 11 months (*S. triostegus*) two species (*C. zillii* and *L. vorax*) were caught in ten months and *A. mossulensis* was caught in nine months. On seasonal basis, the fish species comprised of three fish species forming 6.51% of the total species and occasional fish species contained seven species (1.46% of the total), *C. luteus*, and *A. marmid* appeared in seven months and *C. carpio* was collected in six months.

Occasional fish species included seven species forming 1.46% of the total, *H. leucisculus*, *M. mastacembelus* were collected in four months, *H. fossilis* in three months, and *L. xanthopterus*, *A. dispar*, *G. holbrooki* and *M. sharpeyi* occurred in one month (Table 2).

Table 2. The occurrence of fish species by groups and their monthly appearance in the Euphrates River southern Thi-Qar province.

Species	Group	Occurrence Months	%
<i>C. gibelio</i>	common fish species	12	92.03
<i>P. abu</i>		12	
<i>O. aureus</i>		12	
<i>S. triostegus</i>		11	
<i>C. zillii</i>		10	
<i>L. vorax</i>		10	
<i>A. mossulensis</i>		9	
<i>C. luteus</i>	Seasonal fish species	7	6.51
<i>A. marmid</i>		7	
<i>C. carpio</i>		6	
<i>H. leucisculus</i>	Occasional fish species	4	1.46
<i>M. mastacembelus</i>		4	
<i>H. fossilis</i>		3	
<i>L. xanthopterus</i>		1	
<i>A. dispar</i>		1	
<i>G. holbrooki</i>		1	
<i>M. sharpeyi</i>		1	

Ecological Indices:

The ecological indices exhibited remarkable monthly changes. The diversity index values ranged from 1.59 in December to 2.07 in April. Richness index values varied from 1.21 in September to 2.00 in May, while the evenness index fluctuated from 0.79 in June to 0.91 in February and July (Fig. 7).

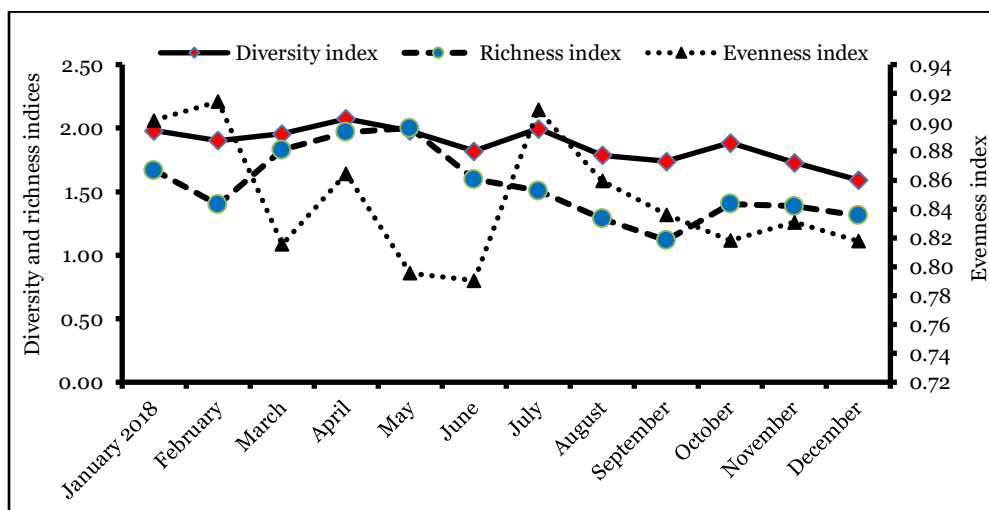


Figure 7. Monthly variations in the ecological indices in the Euphrates River, southern Thi-Qar province.

Discussion

The present results showed that the temperature commonly has an excessive range during cold and hot months, with this range the species *P. abu* still occupies the highest rank (26.21%) of the total species richness in the region due to it has high resistance to environmental conditions as well as the availability of its food components (organic detritus, diatoms, algae, and plants), in addition of having a small size, making it adapted to live under various difficult circumstances. The cichlid species: *O. aureus* and *C. zillii* have wide range of tolerance and can influenced on the local fish composition by predation, competition beside its impact on the carrying capacity of the habitat, aggressive behavior and rapid reproduction with that it can consume an extended range of food elements. *Carassius gibelio* had high abundance due to its possessing of high resistance to temperature, salinity and consumes a wide range of food items. However, most recent studies declare that habitat deterioration basically expedite mechanism displacement of local endemic species (Parks *et al.*, 2014).

The present study reported a negative correlation between the number of species and salinity, a weak relationship with temperature due to the absence or rarity of some native species that represented the keystone in the structure building of fish community, therefore increased temperature and salinity rates forced the sensitive fish species to disappear or leave the site. These results correspond with most studies that executed in southern Iraq (Mohamed *et al.*, 2015; Abdullah, 2017; Abdullah *et al.*, 2018), which corroborate the absence or rarity of some of the native species in this region such as *Arabibarbus grypus*, *Luciobarbus xanthopterus* and

Mesopotamichthys sharpeyi, whereas the positive correlation between salinity and number of individuals is due to increasing the number of individuals of tolerant native (*P. abu*) and alien species represented by *O. aureus*, *C. zillii*, *O. niloticus* and *C. gibelio*, these correlations confirm the validity of the present results, that representing the present situation of the deteriorating aquatic ecosystems in southern Iraq (Mohamed & Abood, 2017; Abdullah, 2019).

Increased temperature and salinity may alter fish assemblage structure; this may lead to an impact on all feeding levels of fish that feeding on phytoplankton and small fishes (Beaugrand, 2009). The variations in these parameters (temperature and salinity) will have strongly impact on small-sized fish communities which reinforce connective position in food webs (Souza *et al.*, 2018). The results revealed a noticeable rise in the concentrations of salinity from May to October due to low water levels, as well as higher temperatures which lead to increase evaporation rates (Abdullah *et al.*, 2017). The results showed that the pH values in the study area are within the basic direction and consonant with the criteria that recorded in the Iraqi inland waters, it tends to be with species tolerance (Hussain *et al.*, 2008; Abdullah *et al.*, 2017).

However a significant shifting in fish community structure was noticed in the last few years due to the entry of many exotic species, in addition to the absence or scarcity of some sensitive endemic fish species because of habitat degradation (Dudgeon *et al.*, 2006; Mohamed and Abood, 2017) (Table 3).

The native fish species formed the keystone species of fish populations in the inland waters, and despite of their low abundance rank, they become rare in southern Iraq. Generally, continued entry of exotic species, caused increase the numbers of their individuals over time, generated more stress on native fish species' and altered the composition of fish communities (Rahim *et al.*, 2013).

Table 3. Comparison of the composition of fish populations' in Euphrates River with those of adjacent regions.

No. of Species	Native sp.	Exotic sp.	Marine sp.	Sample Date	Reference
22	10	5	7	2005	Mohamed <i>et al.</i> (2006)
21	10	4	7	2005	Al-Noor <i>et al.</i> (2009)
23	10	8	5	2016	Abdullah (2017)
16	10	7	-	2016	Abdullah <i>et al.</i> (2017)
17	10	7	-	2018	The present study

The number of individuals is remarkably differed during the season, depending on the temperature, when it is moderate, the organisms exert their vital activities such as nutrition, reproduction, and migration, and therefore it is easy to catch. The recruitment is always the most important agent influencing the fish movement, so the difference in size and composition of fish affect the possibility of catch (Allen and Pine, 2000).

The present results revealed that the highest tolerant fish species were the highest abundant species such as *P. abu*, *O. aureus*, *C. zillii* and *C. gibelio*, these considerably correspond with the present result and the majority of recent studies that had been done in southern Iraq (Mohamed *et al.*, 2015; Abdullah, 2017; Abdullah *et al.*, 2018).

The present results verify the decline in numbers of some native species in southern Iraq, which represented the core of historical fish assemblage constituents that may results the deterioration of the ecosystem and increase the proportion of exotic species coincides with high number of individuals (Hughes *et al.*, 2005; Smith *et al.*, 2014).

Species distribution and occurrence as a result of species functions and specification such as size, resistance to difficult conditions, length of the breeding season, food availability and own high tolerance to anthropogenic and hydrological variations (Hoagstrom *et al.* 2011). These factors may explain the presence of *C. gibelio*, *P. abu* and *O. aureus* through the year. The present work trends concur with most recent investigations implemented in the southern regions which affirm the prevalence and occurrence of extremely tolerant species in the habitats. Warwick *et al.* (2008) pointed out that the plot of k-dominance visually depicts species richness and evenness, the species richness reflects the number of divers species represented in a short curve in the chart as July, September, December, but the steep gradient of the curve refer to low species evenness as shown in May, October and December.

Overall, diversity and richness indices values were low, due to the decrease in numbers of fish species in the river section, with slightly fluctuated among seasons, but there is a tendency of reduction in the values of diversity and richness indices from November to February these are probably to the migration of some species to deep areas when water temperature decline as the temperature is strongly correlated with the number of species and the total number of individuals (Hussain, *et al.*, 2009). However, the dominance of a few numbers of fish species caused shafting in the values of diversity and richness to be poor and disturbed, this finding is consistent with the general trend of the habitat in southern Iraq (Hussain *et al.*, 2012; Abdullah *et al.*, 2017). The evenness index ranged between 0.79 to 0.91 these results could be due to high relative abundance of five species (*P. abu*, *O. aureus*, *C. gibelio*, *C. zillii* and *A. mossulensis*) over the year which increase population stability and ultimately increase range value of evenness index (Hussain *et al.*, 2009). Ecological indices values in the present study correspond with the trends of previous studies conducted in the south of Iraq (Table 4).

Table 4. Comparison of diversity, evenness and richness indices with the previous studies.

Reference	Study Region	Diversity index	Richness index	Evenness index
Hussain <i>et al.</i> (2008)	Suq Al-Shuyukh	1.2-2.05	1.2-2.20	0.52-0.86
Hussein <i>et al.</i> (2015)	The southern sector of the Euphrates River	1.46-1.71	1.25-174	0.67-0.86
Abdullah <i>et al.</i> (2017)	The lower of the Euphrates River, Thi-Qar city	1.46-2.04	1.25-2.34	0.65-0.86
Abdullah (2019)	Al-Chibyaish marsh	1.38-196	0.96-1.96	0.68-0.85
Present Study	Southern Thi-Qar province	1.59-2.07	1.21-2.00	0.79-0.91

Conclusion

The study confirmed the prevalence of small and tolerant exotic fish species with the absence or scarcity of the main species representing the nucleus of the historical fish community.

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تقييم تركيبة التجمع السمكي في نهر الفرات، جنوبي محافظة ذي قار، العراق

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المستخلص - قِيمت تركيبة مجتمع الأسماك في نهر الفرات، جنوبي محافظة ذي قار جنوبي العراق للمدة من كانون الثاني إلى كانون الأول 2018. أتبعت طرق صيد متنوعة لجمع العينات. صيد 3010 نموذجاً من الأسماك العظمية مثلت 17 نوعاً و 17 جنساً وعشرة عوائل وست رتب. تضمنت عشرة أنواع مقيمة وسبعة أنواع دخيلة. كانت أسماك الخشني *Planiliza abu* الأكثر وفرة وشكلت 26.21% من الصيد الكلي و شكل البلطي الأزرق *Oreochromis aureus* 19.30% والكارب البروسي *Carassius gibelio* شكل 17.48% والبلطي أحمر البطن *Coptidon zillii* 13.29% من العدد الكلي للأنواع. كانت قيمة دليل السيادة الأعلى وفرة لثلاثة أنواع 62.99% ومثلت (*P. abu* و *O. aureus* و *C. gibelio*). تضمنت الأسماك السائدة سبعة أنواع شكلت 92.03% من الصيد الكلي للأنواع. وألفت الأنواع الفصلية ثلاثة أنواع مثلت 6.51% وضمت الأنواع النادرة سبعة أنواع مثلت 1.46% من المجموع الكلي. أستدل من قيم دليل التنوع أن البيئة فقيرة إذ تراوحت القيم من 1.59 في كانون الأول إلى 2.07 في نيسان. أشارت قيم

دليل الغنى إلى حالة إضطراب وأختلفت بين 1.21 في أيلول إلى 2.00 في آيار. بينت الدراسة أن مؤشر دليل التكافؤ متوازناً، إذ تراوح بين 0.79 في حزيران إلى 0.91 في شباط وتموز. أثبتت الدراسة الحالية سيادة الأنواع عالية التحمل صغيرة الحجم، التي قوامها نوع مقيم وثلاثة أنواع دخيلة مع ندرة أو غياب الأنواع المقيمة التي تمثل حجر الأساس للتجمع السمكي جنوبي العراق.