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Evaluation composition of fish assemblage in the southern part of the Tigris River, Iraq

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Abstract:
The habitats of the southern part of the Tigris River in the north of Basrah province are going through impairment due to habitat modification and foundation of barriers, dams, and other human modifications in the last decades. The composition of assemblage of fishes in the southern river part was assessed from January to December 2018. A total of 8995 fish are affiliated to bony fishes included 13 families, 23 genera, and 26 fish species. The exotic fish species were nine; native species were twelve with five marine species. The small size Abu mullet *Planiliza abu* native species the highest abundant species in the study area formed 26.96% of the overall species number, and the Blue tilapia *Oreochromis aureus* formed 20.08% of overall collected fishes. Prussian carp *Carassius gibelio* included 19.86% of the total caught. The rate of diversity index in the study area assessed as poor fluctuated from 1.83 to 1.94. Values of richness index pointed as disturbed, varied from 1.83 to 2.84, rates of evenness index differ from 0.77 to 0.78 and expressed it as balanced. The occurrence of speciesinpresent study recoded twelve native fish species formed 94.89% of the total caught, and five seasonal fish species formed 3.76% of the total number of species and eight occasional fish species represented 1.35% of the total catch. The current study affirms the non-attendance or scarceness of some important native species that constituted the core building structure of the historical fish community as a result of anthropogenic activates caused habitat degradations and increased beta diversity.

Keywords: Fish populations, South part of the Tigris River, River habitats

Introduction

The losing of biodiversity in freshwater ecosystems causes negative impacts in the current direction for the endemic populations in neighboring areas on approaches streams, cause confusing functions of the ecosystem which rely on the organisms in the river ecosystem [1]. Challenges front by the biodiversity of fishes in the riverine ecosystems originate from anthropogenic alterations, habitat fractionation, river contamination, invasive fishes, and overfishing [2; 3]. Evaluation assemblage of fishrequire knowledge's in the permanence fundamentals andmaintenance, procreation,growth, recruitment, and growth of the communities likedynamic of fish assemblage[4; 5].Several indications verifying reduction of biodiversity and species dying out has inverse effects on earth [6], consequently diversity is important for determine fishes which subjected to threats and there is information about species allocation and spread to try to reduce the stress on river habitats originates from anthropogenic activities [7]. The populations of fishes in freshwater are exposed to dynamic changes in distribution, according to various stresses coming from human activities [8; 9].

Currently, collecting information about the biological composition of the assemblages longitudinal the river and streams presents a challenge for scientists in this field, however, many investigations affirm habitat variables perhaps effect on fish community structure, such as river template, climate, anthropogenic effluent, availability of tributaries and plant occurrence[10;11].The communities in freshwater fish are being be settled by the interactions of regional and territorial factors of ecosystem status synchronized with intra and interspecific correlations[12;13].Defining stream division systems as a habitat for fish gives good insight about the nature of the fish community's distribution and provides us aninformation about life in the river. The organisms' distribution in the aquatic habitats created a pattern of zonal (zonation), this term expresses the existence of a longitudinal sequence indicating the stability of the fish populations dwelling in the river with the longitudinal extension of the river, [14], the fish communities differ in the species composition and are severely related to a large degree with the environmental conditions of the river, especially with the lotic systems[12].In the riverine ecosystems fish assemblage perhaps be influenced by stability shifting of habitats due to human activities, which have a susceptibility to change the population composition providing opportunities to dominance and distribution of exotic fishes[15].

Several authors were dealt with an assemblage of fish composition in the south part of the Tigris River and neighboring areas [16], focused on the diversity of fishes in the lower section of the Tigris River found 27 species affiliated to twelve families [17], mentioned 23 species from the southern reaches of the Euphrates River. Mohamed and Abood [18] published a paper on the Shatt Al-Arab River from the Al-Dear region to Al-Fao at the north of the Arabian Gulf collected 111 species belonging to fifty families.

The objectives of the present work to evaluate fish assemblage building with insight on some environmental parameters and assess human activities impacts in the end part of the Tigris River according to scarcely or disappearance some of the native fish species from the river.

Materials and Methods

The study area description

The present investigated region in the end part of the Tigris River nearly extends 25 km, from Missan provinces boundary restricted to the northern borders of Qurna district Fig. (1). The range of river width about 75 m to 125 m. Three selected stations were determined, station 1 to the south of Al-Uzair region at the border of Missan provinces with the north of Basrah at location N 31˚ 17´ 58.04´ E 47˚ 25´ 55. 15", whereas station 2 at 10 km to the south of station 1 N 31º 14´57" E 47º 25´5" . Station 3 to

the north of Qurna district at location 31º 04´ E47º 27´7". Coordinates of stations were determined by GPS-126 manufactured by aGarmin company. The study was conducted from January 2018 To December, the samples were monthly collected from the three stations by many fishing tools including draft and fixed nets, seine nets, and cast nets. Measurements of some environmental parameters synchronized with fish sampling, the temperature of water (ºC) was calculated by glass thermometer, salinity PSU) by Lovibond-Sensor made in Germany, measurements of transparency (cm) used Secchi disk. Fish diversity analysis following [12].The relative abundance according to [19], and evenness and richness indices according [20]. CCA analysis to calculate the relationships between individuals' number and species and some of the habitat variables followed [21]. SPSS program used to showing the correlation of ANOVA to assess the vairance among individuals and species in selected stations. Fishes classified [22], and inserted other scientific names according to[23].

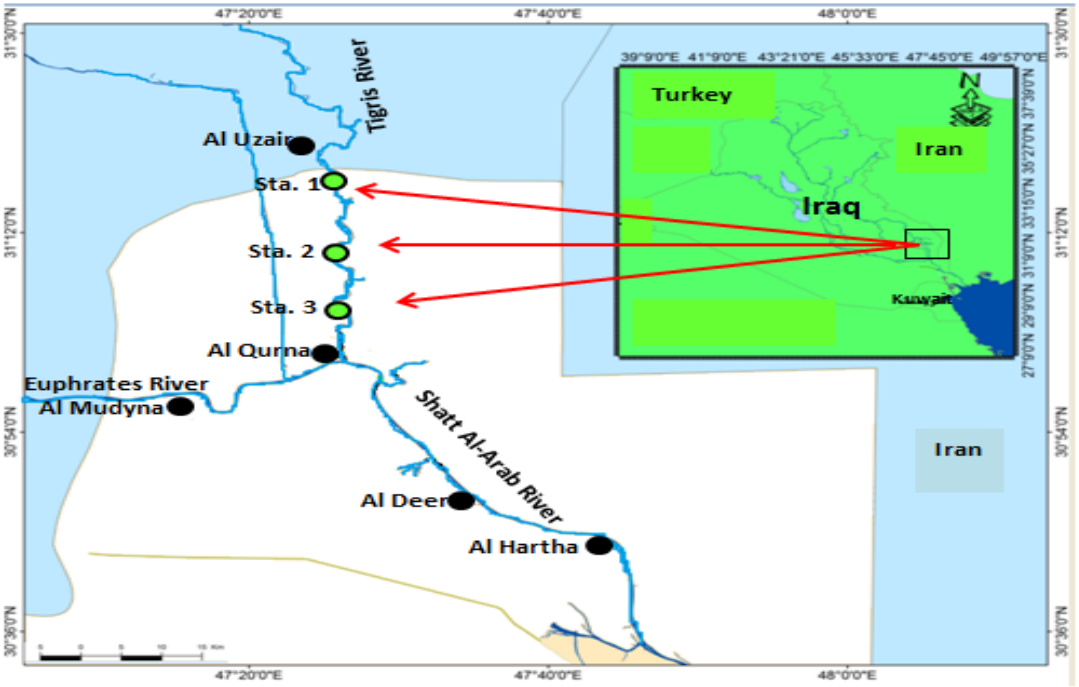

Fig. 1. Map of thethree stations in the southernpart of the Tigris River

Results and discussion

Ecological parameters

The average water temperature in the present investigated region varied from 13ºC in January to 33 ºC in July 2018, the mean and ±SD values 23.92 ± 6.61, whereas the salinity ranged from 1.16 in March to 1.75 psu in December, with the mean and ±SD values 1.49 ± 0.19psu. The transparency of water values, the mean 46.75 ± 6.88cmfluctuated between 41cm in February to 61cm in November (Fig. 2). Monthly changes in the average values of salinity, transparency and temperature, at the southern part of present section of the study showed no significant differences ANOVA (P>0.05) between the selected sites.

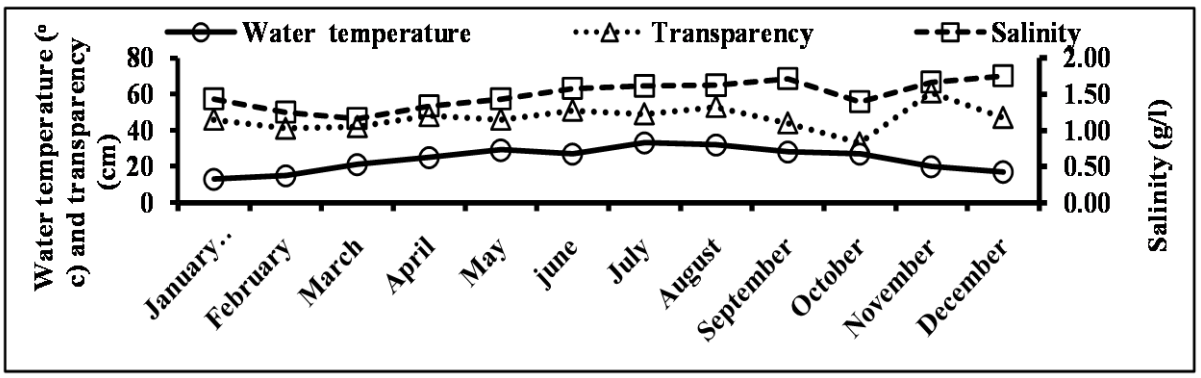

Fig.2.Monthlychanges in someenvironmentalparameters in the lower part of the Tigris River in the study region.

Rivers that extend for a great distance and which have a clear thermal and saline gradient across different river habitats, fish populations are composed bybothinteraction between local and regional parameters in the habitats represented river expandand river habitat downstream became more saline which exposes the aquatic organisms to increasing pressure from stress[10;24]. Temperature is one of the most important abiotic factors affecting the physiological, behavior, and distribution of organisms in the aquatic environment [25;26].The present study did not show significant differences between the present stations may be due to a small distance among the three stations. Salinity is a measure of ions dissolved in water and is considered one of the most important variables that play a fundamental role in the spread and distribution of organisms in the aquatic environment. The variations in salinity in the study area perhaps according to seasonal fluctuations and the changes in river discharge these results consisted with [16]. The penetration of light is necessary for sustaining the primary productivity that forms the base of the food pyramid in the aquatic environment and has an important role in growing aquatic plants [27]. The results in the present study showed a decrease average of transparency in October than other months, which indicated a decrease in the light penetration rates in these periods, due to the increased drainage that led to the stir the river bed by the water current [28].

Composition of fish species

The current study was collected 8995 fish specimens belonging to 26species, 23 genera, and 13 families, among them 12 resident species, nine alien fish species, with five marine species, all fish species affiliated bony fishes (Table 1). The most abundant family was Cyprinidae comprise seven species, whereas Leuciscidae, Xenocyprididae, and Cichlidae three species foreach. Mugilidae included two species, while Siluridae, Heteropneustidae, Engraulidae, Clupeidae, Bagridae, Mastacembelidae, Sparidae and Bagridae one speciesforeach.

Table 1. The species composition in the south part of Tigris River and theirrelative abundance in study area

Species	Family	Station 1 %	Station 2 %	Station 3 %	Total %
[N]*Carasobarbus luteus*	Cyprinidae	2.96±47.99	3.33± 32.35	2.00± 33.66	2.73± 45.77
[N]*Carasobarbus sublimulis*		0.10±11.54	0.22± 9.76	0.22± 14.23	0.18± 16. 89
[E]*Carassius gibelio*		19.78± 45.77	23.79± 32.35	16.51± 36.93	19.86± 37.64
[E]*Cyprinus carpio*		1.51± 2.89	2.34± 3.20	2.25± 2.10	2.02± 2.66
[N]*Mesopotamichthys sharpeyi*		0.10± 2.11	0.07±2.27	0.13± 2.91	0.10± 3.43
[N]*Luciobarbus xanthopterus*		0.06			0.021
[N]*Garra rufa*		0.32± 0.96	0.66± 1. 65	0.70± 1.52	0.56± 1.26
[N]*Alburnus mossulensis*	Leuciscidae	4.21± 11.90	4.50± 7.11	4.63± 20.02	4.45±13.34
[N]*Leuciscus vorax*		1.29± 3.12	1.75± 1.99	1.65± 2.09	1.56± 2.39
[N]*Acanthobrama marmid*		4.21± 2.04	4.64± 1.82	5.84± 2.00	4.91± 1.84
[E]*Ctenopharyngodon idella*	Xenocyprididae	0.06			0.02
[E]*Hypophthalmichthys nobilis*		0.10	0.04	0.03	0.06
[E]*Hemiculter leucisculus*		0.39± 1.87	0.26± 1.37	0.44± 1.56	0.37± 1.98
[N]*Silurus triostegus*	Siluridae	1.35± 3.02	1.21± 2.32	1.27± 3.24	1.28± 3.41
[E]*Heteropneustes fossilis*	Heteropneustidae	0.23	0.22	0.13	0.19
[M]*Thryssa whiteheadi*	Engraulidae	0.03	0.18	0.38	0.20
[M]*Tenualosa ilisha*	Clupeidae	0.13	0.58	1.02	0.58
[M]*Nematalosa nasus*	Bagridae	0.06	0.22	0.25	0.18
[N]*Mastacembelus mastacembelus*	Mastacembelidae	0.26	0.15	0.29	0.23
[N]*Planiliza abu*	Mugilidae	28.40± 59.28	22.70± 44.51	29.24± 57.46	26.96± 53.48
[M]*Planiliza subviridis*				0.35	0.12

[M]*Acanthopagrus arabicus*	Sparidae		0.11	0.19	0.10
[E]*Coptodon zillii*	Cichlidae	7.88± 17.09	7.57± 18.20	10.44± 21.05	8.68± 22.95
[E]*Oreochromis aureus*		22.13± 59.40	19.04± 38.13	18.95± 28.24	20.08± 43.17
[E]*Oreochromis niloticus*		4.37± 9.12	6.18± 6.16	2.76± 13.65	4.36± 10.76
[N]*Mystus pelusius*	Bagridae	0.06± 2. 40	0.26± 3.64	0.32± 6. 29	0.21± 5.14

N: Native fish species M: Marine species E: Exotic species

The current study noticed fundamental variations of the structure of assemblage in comparison with historical studies; in spite of the current area stretches for a short section of the river. The consequences showed clear changes in the salt and thermal gradient.

The results found there have been fundamental changesin the species structure in the river lotic habitat due to scarcity or absence of the major members of native species which represented the core of historical fish populations in the present section of the river (Table 2). These changes perhaps explained the construction of several obstacles and dams that caused habitat segregation and changed the nature of the river's flow and increased number of fishes preferred slow water running like exotic fish species [29], furthermore decline the number of native species lead to the negative impact on the stability of river ecosystem and the benefits it provides, however consolidation of the presence of local species enhances biodiversity and durability of the river habitats [5; 9].

Table 2. Fish community structure compared with historical previous studies in the south part of the Tigris River

Study location	Species number	species			The study
		resident	Exotic	Marine	
South section of the Tigris River	27	12	8	7	[16]
South section of Euphrates River	23	10	8	5	[17]
Shatt Al-Arab River	111	15	13	83	[18]
Shatt Al-Arab River	40	17	3	20	[30]
Shatt Al-Arab River	33	14	2	17	[31]
Shatt Al-Arab River	25	15	3	7	[32]
Shatt Al-Arab River estuary	34	7	1	26	[33]
Shatt Al-Arab River	40	9	6	25	[34]
Southern section of the Tigris River	26	12	9	5	Present study

Monthly variations in the structures of the exotic, native and marine speciesare shown in (Fig. 3). The appearance of the exotic fishes varied between 5 in January and December and 8 species in April formed 55.74%, while the native species in monthly samples clearlyvaried between 6 fish species in January, March, and April 2018 and 10 in October 2018 constitute 43.19% of the overall caught. The marine fishes disappear in fishing samples in January, October, November, and December, but collected 4 fish species in March, May and Junetheyformed 0.98% of the overall catch in the end parts of the Tigris River (Fig. 3). The current results exhibit a reduction in the number and abundance of local fish species communities in the south part of the river, however among the most major cases pointed to decline of local populations, environmental deterioration, modification of ecosystem, and shifting of fish assemblage by an increasing number of exotic species [35].

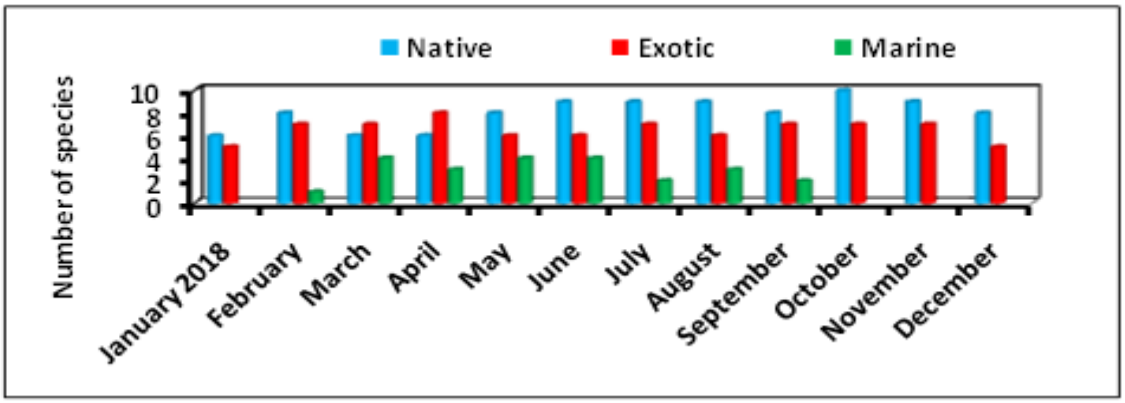

Fig.3.Monthly variations in the composition of local, exotic and marine fishesin the southern part of Tigris River.

Species abundance

Three species exhibit the highest abundance during the period of study formed 66.90% of the overall catch in the south part of the river. The native species *Planiliza abu* occupied the highest abundantfish in the present section of the rivergiven26.96%,*Oreochromis aureus* in the second rank constituted 20.08% of the total caught followed by *Carassius gibelio* recorded 19.86% of overall samples in the study area. There are slight differences in the abundance among the three selected stations, for instance in station 1 the species *P. abu* recorded the highest abundance 28.40% followed by *O. aureus* 22.13% and *C. gibelio* 19.78%, while in station 2 the species *C. gibelio* at the first rank formed 23.79% followed by *P. abu* 22.70% then *O. aureus* 19.04%, but in the station 3 the species *P. abu*, *O. aureus*, and *C. gibelio* formed 29.24%, 18.95%, 16.51% respectively (Table 1).

The consequences showed dominanceofthe small native species from Mugilidae (*P. abu*) and one species from Cichlidae (*O. aureus*) and Cyprinidae (*C. gibelio*), most recent paperswhich conducted in southern Iraq mention to presiding these species such as [17;18; 36]. The species *P. abu* was the most abundant species due to the small size body as adaption qualifies it to live under extreme conditions like small isolated poolswithlow oxygen concentration in the dried area, additional availableoftheir food that is constituted from organic detritus and diatoms in the muddy bottom [37], also the studied part of the river dominated by small size body exotic species that have a high tolerance to extremes conditions with a wide range of food elements. The present paper documented a large number of exotic species compared to the studies executed in the eighties and nineties of the last century which recorded the low number of exotic fishes and because of the development in transportation means and the spread of the phenomenon of raising ornamental fish [38].

Species and individualsnumber

Overall 26 fish species were captured from the south part of the Tigris River during the study period ranged between 11 fish species captured in January and 21 species in May. The overall species sampled from station 1 were 21 species fluctuated between 6 in January and 14 species in May, whereas in station 2 collected 21 species varied from 9 fish species in January, February, and December to fourteen species in May (Fig. 4), but in the station 3 twenty-six species were sampled differ from 10 fish species during January and December to 14 species caught in May. The ANOVA analysis showed no significant differences ($P>0.05$) among the three selected sites. A positive significant relationship (0.639*) appeared between the number of species and temperature in the present portion of the river.

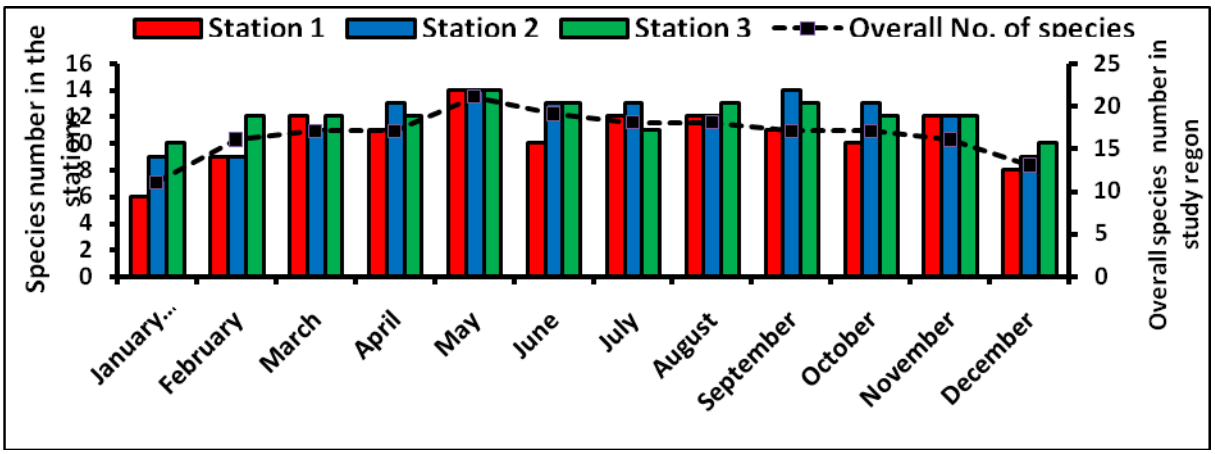

Fig.4.Monthly changes in the species number in the southern part of Tigris River.

Monthly changes in the number of specimens in the study chosen sites were addressed in (Fig. 5). Altogether 8995 specimens of fish were captured in the represented region of the river varied from 263 fish in March and 1409 in May. In station 1 the overall collection of individuals were 3216 ranged from 38 in January to 714 in May, while in station 2 the total number of collected fish 2608 fish specimens were caught fluctuated from 96 in January to 448 in August. The number of fish individuals in station 3 was 3171 specimens of fish ranged from 74 in March to 4751 in July. The ANOVA analysis showed no significant differences (P>0.05) in the number of fish specimens between the selected stations. Strong correlations (r= 803**) were detected in a relationship to the overall number of fish specimens and temperature of water in the south part of the Tigris River.

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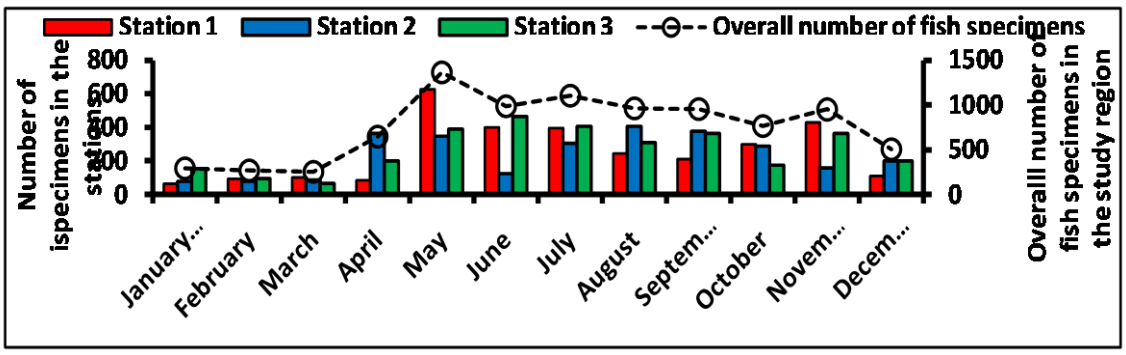

Fig.5.Monthly fluctuationsin the number of fish specimens in studied section of the Tigris River

The finding in this study regarding the number of species and fish specimens supports in general trend the result of [16;36] in the south section of the Tigris River and Al-Sweeb River north Basrah province respectively. declining number of native fish species from Cyprinidae that were the core of fish assemblage in the study area and verifying dominance of small local species (*P. abu*) and exotic species from Cichlidae as a result of habitats segregation by constructions of dams causing environmental degradation. The data in this document corroborate the finding of the most modern studies executed in southern Iraq such as [18; 17; 36]. A scarcity or absence of the core local fishesperhaps explained by reducing water flow which is important for reproducing these species and biotic factors like competition with exotic species and enhanced the stresses local species subjected [39].

Values of diversity indices

There are slight differences in monthly changes of fish assemblage diversity indices values among the three selected locations. Diversity index values varied between1.49 in May and 2.15 during March in site 1, butinsite 2 the values fluctuated from 1.62 in May to 2.16 in November. The values in site 3 ranged from 1.71 in June and2.31 in March. The meanofdiversity index values in study area differ from1.84 to1.96. The ANOVA analysis observed no significant differences (P>0.05) in the represent sites. The richness index values exhibit slight differences among sites and ranged from 1.21 in January to 2.39 inMarch in station 1, while station 2 varied from 1.52 to 2.53 in June. In site 3 oscillated between 1.20 in May to 2.64 in March. The overall values of this index in studied river section are ranged from 1.83 to 2.84.No significant differences (P>0.05) were found in the richness index values among the sites (Fig.6).Values of evenness index in site 1 ranged from 0.73 in June to 0.91 in January, whereas varies between 0.63 in May to 0.92 in January in site2. In station 3 the values differ between 0.70 in April to 0.91 in March, the mean values of the evenness index oscillated from 0.77 to 0.78 and no significant differences (P>0.05) were detected in the investigated sites.

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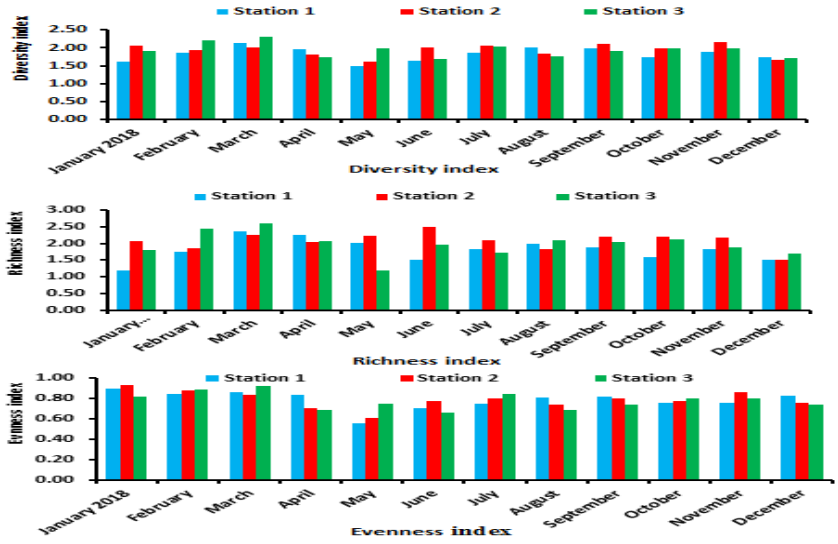

Fig.6. Monthly changes in the values ofdiversityindices in the studied section of the southern part of Tigris River

Diversity indices values showed the fish assemblage in the studied section of the river in a poor status due to the predominance of some small local species and alien tolerant species that have the ability to withstand extreme conditions. Richness index values exhibit that populations of fishes are in a confused state; the explanation for this phenomenon is that some dominant species follow an equilibrium strategy that makes them numerically superior due to the long reproductive period. The evenness index values seem as half balanced according to the presence of few numbers of species possesses obvious numerical abundance compared to most other fish species, this finding corroborates the results of [16;18;36], which pointed out dominance same species.

Occurrence of species

Twelve fish species represented native species were sampled from the studied part of the river formed 94.89% of overall species. The numbers of species caught in all months were 7 species included *C. gibelio*, *C. zillii*, *O. aureus*, *A. mossulensis*, *L. vorax*, *S. triostegus* and *P. abu*. Three fish species were sampled in eleven months *C. luteus*, *O. niloticus* and *C. carpio*. Two fish species captured in 9 months

G. rufa and *A. marmid*. Five fish species formed the seasonal species constituted 3. 76% of the total number of species two of them observed in 8 months *M. mastacembelus* and *H. leucisculus*, two species collected in 7 months *T. ilisha* and *H. fossilis*, whereas *T. whiteheadi* sampled 6months. The occasional species comprise eight species 1.35% of the overall species in the present study, *M. pelusius* captured in 5 months, *A. arabicus* recorded in for months, while the species *M. sharpeyi*, *H. nobilis* and *P. subviridis* sampled in two months. The species *N. nasus*, *C. idella* and *L. xanthopterus* caught in one month. These results corresponding with species occurrence that executed down of rivers like [29], while contradicting with the studies that done downstream near estuary such as [18; 40], due to existence of marine species.

Diversity of fishes andsome ecological variables

The CCA analysis explains the correlations between related species and some of the major habitat parameters in the studied section of the river (Fig. 7). The diagram shows a positive relationship (r= 0.768) detected in the number of species and water temperature rate, whereas a negative correlation (r=- 0.061) found between salinity and the number of species. A weak positive relationship (r=0547) was found in the number of species and average values of transparency. A positive robust relationship was observed between salinity and water temperature, while a negative correlation showed between transparency and water temperature. Conversely, the number of individuals' had astrong relationship (r=813) with temperature and a positive relationship (r=0.542) was observed between water salinity and the number of individuals while a positive relationship (r= 395) appeared between transparency and some individuals.The study diagnosed occurrence reduction of some local sensitive species from Cyprinidae such as *M. sharpeyi*, *A. grypus*, and *L. xanthopetrus* associated with rising in the number of introduced exotic species and dominance of small local species *P. abu*. The comparisonoffish assemblage structure with historical previous studies [30;31, 32; 33], remark fundamental variations in the fish assemblage structure due to the entry of new exotic species and decline in the abundanceofsome native species diversity [1]. The domination of small exotic species in the inland freshwater as a result of habitat deterioration attributed to anthropogenic activities [34; 18]. However, dams' construction changes river lotic ecosystems and fish populations' composition and may lose the reproductive ground of some local species and shifting fish community structure. Increased barriers and dams lose connectivity of the river and lead to habitat fragment with increased beta diversity and preventing species migratory to breeding or feeding places [41].

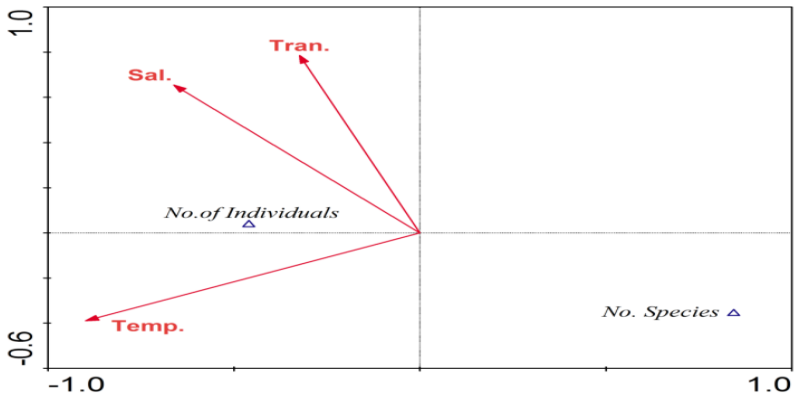

Fig. 7. CCA diagram illustrated the correlations among some ecological factors and fish individuals and species in the represent section of the Tigris River.: Sal. = Salinity, Temp. =Temperature, Tran. = Transparency.

Conclusions

The present study affirms that the fragmentation of river habitats, altering the river flow system and the introduction of more small-sized exotic fish species led to a decrease in the abundance and absence of some local species that represent the core of the historical fish communities and a change in the composition of the fish assemblage in the river.

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