Spatial and temporal pattern of sympatric fish assemblage in the Al-Sweib River South of Iraq

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Abstract:

Spatial and temporal pattern of fish assemblages in the Al-Sweib River Southern Iraq was investigated from January to December 2017 to determine the nature of the fish community structure in the river. Two stations were chosen for the implementation of the work. Monthly variations in rates of water temperature were measured; it has been ranged from 11°C in December to 36°C in July and August. Salinity rates differ from 0.81ppt in February to 1.66 ppt in August. The value rates of dissolved oxygen in the studying area varied from 6.7 mg/l in August to 9.9 mg/l in January. The total alkalinity values rates in the work area differ from 115 mg/l in February to 156 mg/l in August. Several fishing methods were used to collect the samples of fishes: drift and fixed gill net, seine net and cast net.

A total of 6902 fish individuals collected from the Al-Sweib River included 27 species, represented 27 genera and 12 families, all of them belonging to Osteichthyes. The species were 11 native, ten alien and six marine. Four species topped the total numerical relative abundance in present the investigated area, formed 81.72% of the total number, *Planiliza abu* 35.34%, *Oreochromis aureus* 18.68%, *Carassius gibelio* 17.51% and *Coptodon zillii* 10.19%. The diversity index values classified as poor in the studying area, the values ranged from 1.48 in December to 2.07 in March at station 1, whereas station 2 from 1.33 in December to 2.17 in May. Values of richness index were between turbulent to half integrate, they ranged from 1.33 in December to 2.31 March in station1, while from 1.50 in November to 2.78 in June station 2. Evenness index between half balanced to balance varied from 0.65 in October and 0.89 in August station 1, but at station 2 it was between 0.56 in December and 0.87 in July. The total similarities between the stations formed 36.84% in June and 72.73% in November. The study showed that the composition of fish community in Al-Sweib River was similar to that of the northern part of Shatt Al-Arab River.

Key words: Temporal, Spatial, Fish assemblage, Al-Sweib River, South of Iraq

النمط المكاني والزماني للتجمع السمكي في نهر السويب جنوب العراق

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المستخلص:

درسَ النمط الزماني والمكاني للتجمع السمكي في نهر السويب جنوب العراق لتحديد طبيعة المجتمع السمكي في النهر للمدة من كانون الثاني إلى كانون الأول 2017. اختيرت محطتين لتنفيذ العمل. قيست التغيرات الشهرية لمعدلات درجات حرارة المياه، وتراوحت بين 11°م في كانون الاول و36°م في تموز وآب. إختلفت معدلات الملوحة بين 0.88 جزء بالالف في شباط إلى 1.66 جزء بالالف في آب. تباينت قيم معدلات الاوكسجين المذاب بين 6.7 ملغم.لتر$^{-1}$ في آب إلى 9.9 ملغم.لتر$^{-1}$ في كانون الثاني. تغايرت معدلات قيم القاعدية الكلية بين 115 ملغم.لتر$^{-1}$ في منطقة الدراسة في شباط إلى 156 ملغم.لتر$^{-1}$ في آب. أُستخدمت عدة طرائق لجمع عينات الأسماك منها شباك النصب الثابتة والمتحركة وشباك الكرفة والسلية. جمعت 6902 سمكة من نهر السويب تضمنت 27 نوعاً مثلت 27 جنساً و12 عائلة جميعها تعود لصنف الأسماك العظمية Osteichthyes. سجلَ 11 نوعاً محلياً وعشرة دخيلة وستة بحرية. تصدرت أربعة أنواع الوفرة العددية الكلية النسبية في منطقة الدراسة الحالية وشكلت 81.72 % من العدد الكلي وهي: *Planiliza abu* وشكلَ 35.34 % و *Oreochromis aureus* 18.68 % و *Carassius gibelio* 17.51% و *Coptodon zillii* 10.19%. صنفت قيم دليل التنوع كفقيرة وتراوحت القيم بين 1.48 في كانون الأول و 2.07 في آذار في المحطة الأولى، بينما كانت في المحطة الثانية بين 1.33 في كانون الأول و2.17 في آذار. تراوحت قيم دليل الغنى بين المضطرب إلى نصف متكامل وكانت بين 1.33 في كانون الأول و2.31 في آذار في المحطة الأولى، بينما في الثانية كانت بين 1.50 في تشرين الثاني و 2.78 في حزيران. قيم دليل التكافؤ بين النصف متوازن إلى متوازن وكانت في المحطة الأولى 0.65 في تشرين الأول و0.89 في آب، وفي المحطة الثانية 0.56 في كانون الأول و 0.87 في تموز. كان التشابه الكلي بين المحطتين 36.84% في حزيران و 72.73 % في تشرين الثاني. أظهرت الدراسة إنَّ تركيبة المجتمع السمكي في نهر السويب مشابهة لتلك في الجزء الشمالي من شط العرب.

Introduction:

There are various geological and historical factors contribute to the creation of the combination and structure of riverine fish populations. These factors run at a diversity of spatial and temporal scales. Many theories have suggested a priority sequence of agents that lead to clarifying the directions in the fish pools, first of this primacy length of evolutionary period and the geographical impression on animals may limited the existence of species in the ecosystem (18, 12).

Fish assemblage in Southern Iraq has been altered over the past few decades due to the introduction of many alien species. Anthropogenic activates the main source subjected inland water ecology to various types of stresses which reduce the species biodiversity by forcing the fauna to leave the region or create lethal conditions (29). River ecosystem segregation and hydrological change create a suitable environment to raise number of small invasions and native species that have a low economic value (2). The fish community considered a biological complementarity unit use as indicators of the effect of habitat retrogradation, productivity of ecosystem, fixity of fisheries and climate variations (8).

The present study was the first work deal with fish community structure in Al-Sweib River, but there were many studies have been done on fish community structure in neighboring regions of Al-Sweib River such as (15). Examing the seasonal fluctuations and composition of fish assemblage in the Shatt-Al-Arab River described 33 fish species, 14 were marine. (13) Found 25 species in Shatt Al-Arab River, seven were marine. (24) investigate spatial and temporal variability of fish assemblage in the Shatt Al-Arab River including 40 fish species, 25 marine species and nine native. (6) studied the structural diversity of fish communities in the North Part of Shatt Al-Arab River North of Basrah recorded 32 species eight species belonging were marine species. (2) assessed the diversity of fishes in the lower reaches of Tigris River, Northeast of Basrah province 27 fish species were collected belonging to 25 genera and 12 families.

The main goals to assess the spatial and temporal variability in fish assemblage in Al-Sweib River Southeast of Iraq and showed the effect of some environmental factors on fauna as the first work in the river.

Materials and methods:

Description of study area

Al-Sweib River is located in the Northeastern part of Basrah province, and extends along 30 km from the East to the West to meeting the Shatt Al-Arab River at 5 km South of Qurna town. In the past the river provided Shatt Al-Arab by water from Al-Huwaiza marsh when an Iranian side has seized the water that feeds the Huwaiza marsh, the river became received the water from Shatt Al-Arab River. The river's width varies between 80-200m (3). In the last few years, water gate was established on the riverbed after the point that Dead River confluence the river bed about 500m to the West to prevent the water of the Shatt Al-Arab River that entering during the tidal from returning, but the gates of regulator remained open during the study period (Figure 1).

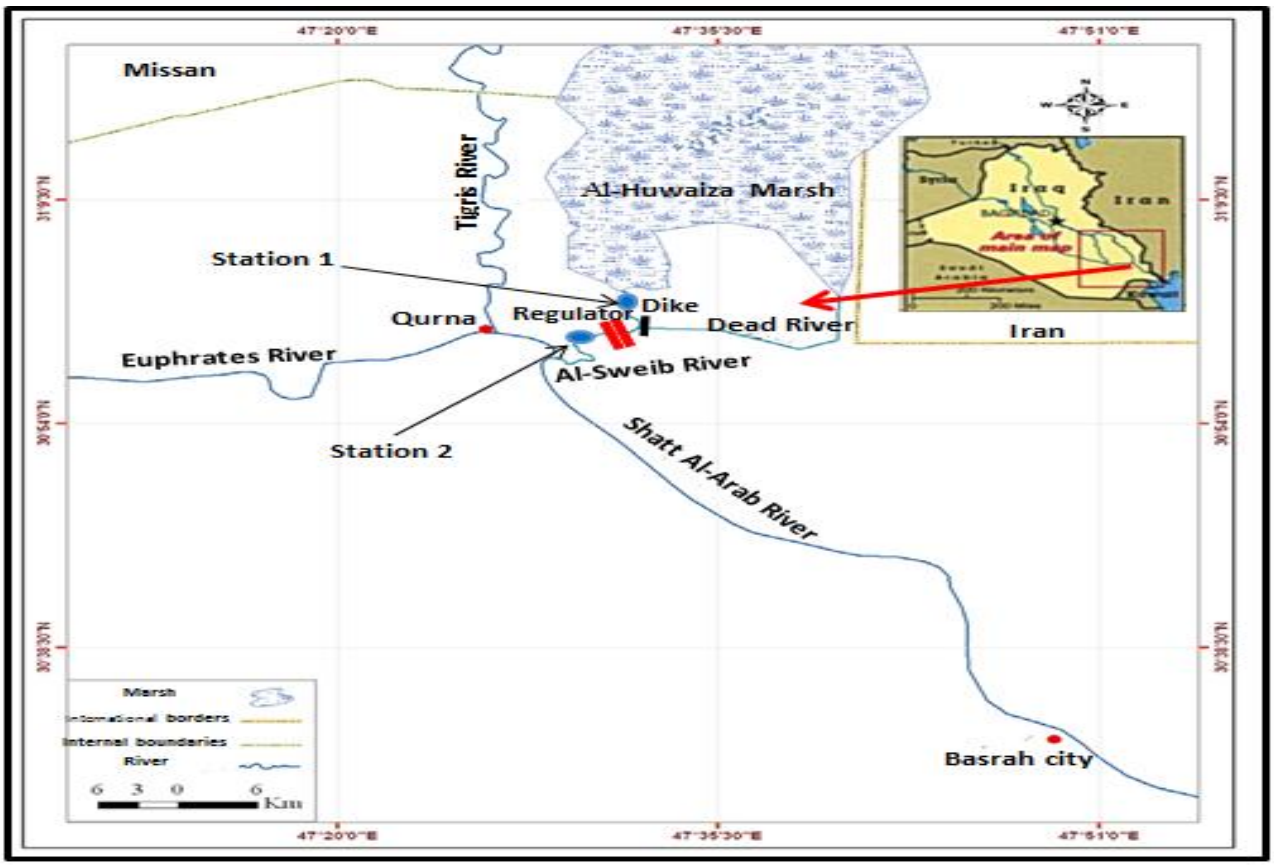

Figure 1: Map of studying area

Two stations were chosen to implement the work in the Al-Sweib River. The Positions of the stations were determined by GPS, Etrex type Taiwan production in the Garmin Company Taiwan. Station 1 N 31° 01′ 48″, E 47° 31′ 48 ″ located between Al- Huwaiza marsh and a meeting point with Dead River, while station, 2 N 30° 59′ 24 ″E 47° 29′ 24 ″toward the West on the other side of the water gate before the beginning of the meandering in the river.

The samples were monthly collected from the two stations during the period of the work from January to December 2017. Many fishing tools were used to collect the specimens of fishes, drift and fixed gill net (25 to 55mm) mesh size 60 to 80m length, seine net 22mm mesh size 60 to 80m length, cast net 22 mesh size 6m diameter. The classification of species was due to (7, 4, 6).

Four ecological factors were measured in Al-Sweib River, water temperature (°C) was measured by mercury Mercator (-10 to 100 °C), salinity concentrations (ppt) and dissolved oxygen (mg/l) estimated by YSI 556 MPS models 2005, total alkalinity (mg/l) was determined according to (1). Fish assemblage results estimation as:

Relative abundance was according to (28):

% = (ni / N) 100

Where ni= number of individuals for species in the sample N= Total number of specimens for all species collected.

Diversity index was due to (31):

H=-∑ pi lnpi

H= diversity index

Where; Pi = the ratio of individuals in the (i) the species

Evenness index according to (30):

J= H/lns

Where J= evenness index. S= where number of species

Richness index (22):

D= S-1/lnN

Where D= richness index N= number of individuals in samples and

Ecological indices used due to (20).

Similarity index was calculated to comparison the appearance difference for fish species between the two stations (Total differences) and between the months of the stations was expressed in the following equation (19):

Ss%= (a/ (a+b+c))*100

Where Ss= Similarity index a= number of conjoint species in the samples a and b b=Number of species occur in sample a and nonexistent in sample b, c= nnumber of species existent in sample b and absent in sample a.

The species were divided according to their occurrence in monthly caught samples into three categories according to (32).

The native fish species which appear in the fishing samples in 12-9 months. Seasonal fish species that occur in the samples from 8-6 months and occasional fish species which present in the catch samples from 5-1 months.

Statistical analysis was done to assess the fish assemblage depending on the SPSS program version 20 to know the differences (T-Test) in ecological conditions and the variability between species and individuals for the two stations. The correlation relationships were analyzed by the same program.

Results and discussion:

Physicochemical environmental factors

The results revealed no significant differences (P> 0.05) between the two stations in water temperature, salinity, pH and dissolved oxygen (Figure 2).

The monthly variations in averages of water temperature in the present studying area are shown in (Figure 2). The lowest value was 11°C in December, but the highest 36°C in July and August; these values were significantly correlated (P<0.05) with air temperature. The current values show clear changes among the seasons, in spite of the narrow ranges within the one season. The highest degrees of temperature, which was recorded during July and August (36°C), may cause some stresses on the fishes and other organisms. Data analysis shows a weak positive correlation (r= 0.42) between water temperature and the number of species in the studying area, whereas negative significant correlation (r= - 64) was found between water temperature and number of individuals. These findings may explain due to dominance of high tolerance alien species, available in all months of the year and this agrees with (6).

The study showed slightly oscillated salinity rate values with irregular pattern. It ranged between 0.81ppt in February to 1.66 ppt in August in studying area. No significant differences (P> 0.05) were noticed in salinity concentrations between station 1 and 2 (Figure 2). Salinity concentrations showed a marked decrease during the cold months and early spring months due to rise of precipitation amount and lack of evaporation processes, but the evident increase in July and August months is perhaps due to increase of evaporation processes in the hot months and reduce of water discharges, although the investigated river subject to the regular tidal (5, 6).

The value rates of dissolved oxygen in the investigating an area differ from 6.7mg/l in August to 9.9 mg/l in January; the highest value rates were recorded during the winter months due to increased oxygen dissolved capacity in low temperature through the cold months. The Values of dissolved oxygen were highly significant inversely correlated (r=-0.940) with water temperature. Values of dissolved oxygen concentrations were shown within the appropriate ranges for the presence and survival of fish in freshwater (21, 10).

Total alkalinity value rates in the area ranged from 115mg/l in February to 156mg/l in August. Usually alkalinity attributed to bicarbonate in the soil of the river bottom bead (17). Present data refer to increases of bicarbonates in the hot months due to rapid dissolution in warm water than cold; the present finding was within limits of (1).

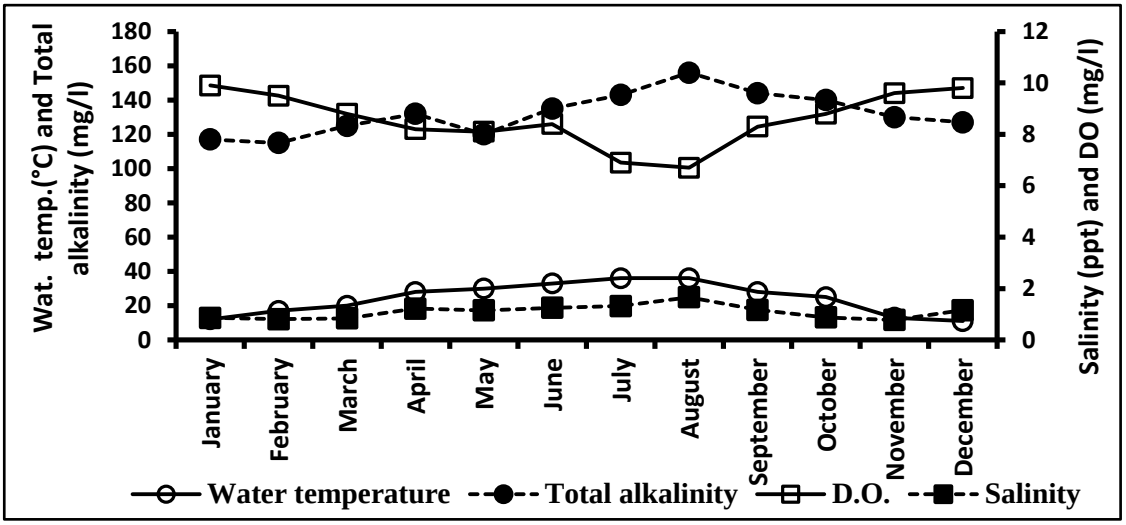

Figure 2: Monthly changes in ecological factors rates in Al - Sweib River from January to December 2017

Fish assemblage

A total of 6902 fish individuals collected from Al-Sweib River included 27 fish species, 27 genera and 12 families, all of them belonging to Osteichthyes (Table 1). The species were 11 native, ten alien and six marine. Cyprinidae was the most abundant; this is confirmed by many previous studies (6, 16, 2).

Species number

The total number of species was monthly different in studying area, it was 11 species in November, whereas 18 species in May and June. Station 1 contributed in 22 species, fluctuated between nine species in January, November and December and 12 fish species in March, whereas station 2 there were 27 species ranged from nine species in July and 14 in May (Figure 3). No significant differences ($P>0.05$) were found in a number of species between station 1 and 2. The results showed that the station 2 contained more species than station 1 may be due to its location near the Shatt Al-Arab River compared to the other station, and the existence of the gate that limit the entry of marine species, although it is always open over the year toward station 1. Many studies have been done neighboring regions of the Al-Sweib River recorded results close to the current study in the number of species such as (24) who captured 24 species from Al-Dayer sites which is nearest to locate of present studying area, and (6) found 32 species in the Sothern the Tigris River and North part of Shatt Al-Arab River. (13) Also recorded 36 fish species from the Al-Dayer station when they investigated the spatiotemporal variability of fish assemblages in the Shatt Al-Arab River, South of Iraq.

Table 1: Fish species collected from Al-Sweib River with their Families, abundance, occurrence months and habitat from January to December 2017

Species	Family	Total number	Abundance (%)	Occurrence months	Habitat
Carassius gibelio[a]	Cyprinidae	1208	17.50	12	F
Alburnus mossulensis[N]		363	5.26	12	F
Leuciscus vorax[N]		93	1.35	11	F
Carasobarbus luteus[N]		92	1.33	10	F
Cyprinus carpio[a]		110	1.59	12	F
Acanthobrama marmid[N]		107	1.55	7	F
Hemiculter leucisculus[a]		24	0.35	6	F
Garra rufa[N]		36	0.52	5	F
Hypophthalmichthys nobilis[a]		2	0.03	1	F
Mesopotamichthys sharpeyi		4	0.06	3	F
Ctenopharyngodon idella[a]		1	0.01	1	F
Luciobarbus xanthopterus[N]		1	0.01	1	F
Tenualosa ilisha[m]	Clupeidae	116	1.68	10	M
Nematalosa nasus[m]		2	0.03	1	M
Oreochromis aureus[a]	Cichlidae	1289	18.68	12	F
Coptodon zillii[a]		703	10.19	12	F
Planiliza abu[N]	Mugilidae	2439	35.34	12	F
Planiliza subviridis[m]		26	0.38	7	M
Thryssa whiteheadi[m]	Engraulidae	72	1.04	8	M
Acanthopagrus arabicus[m]	Sparidae	14	0.20	4	M
Silurus triostegus[N]	Siluridae	172	2.49	11	F
Mastacembelus mastacembelus[N]	Mastacembelidae	14	0.20	6	F
Poecilia latipinna[a]	Poeciliidae	4	0.06	1	F
Gambuzia holbrooki[a]		4	0.06	1	F
Silago sihama[m]	Sillaginidae	1	0.01	1	M
Mystus pelusius[N]	Bagridae	4	0.06	3	F
Heteropneustes fossilis[a]	Heteropneuetidae	1	0.01	1	F
		6902			

a=Alien species N=Native species M=Marine species

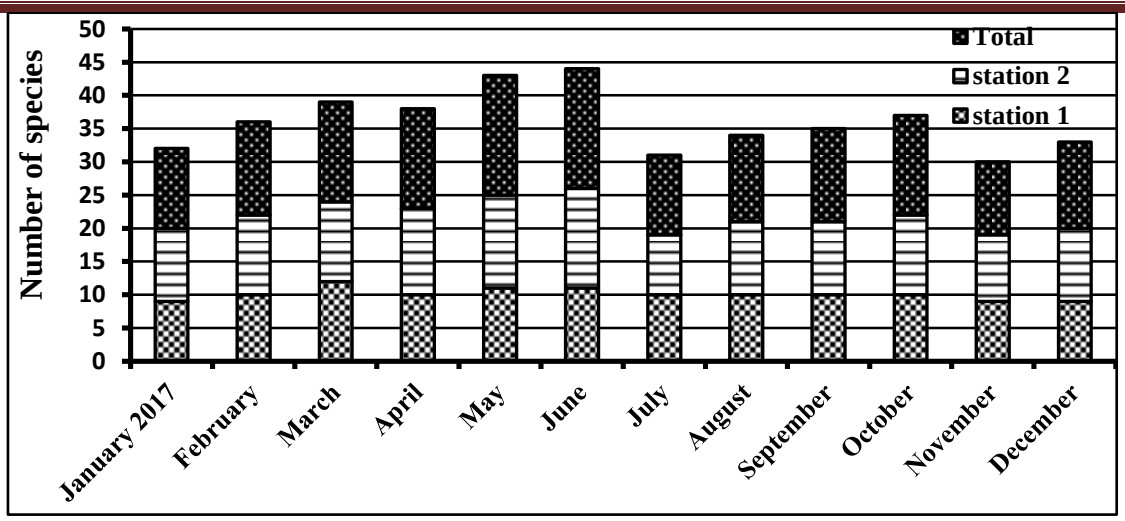

Figure 3: Monthly variations in the number of species in the studying area from January to December 2017

Individuals' number

There were large monthly variations in the number of individuals during studying period in Al-Sweib River, varied from 286 in July to 1038 specimens in October. The monthly variants in individuals number were very evident in station 1 ranged from 117 individuals in March to 471 in January, while the lowest 106 specimens in July and the highest 686 in October. Significant differences ($P \leq 0.05$) were observed between the number of individuals in station 1 and 2 (Figure 4).

Inversely correlation (r= - 0.257) was observed between the number of species and individuals, this explained by the dominance of some exotic species and their numerical superiority in all months of the year. This result corresponds with (2) who recoded dominance of the small alien species in the lower reaches of the Tigris River.

Catch-per-unit-effort and use of various means of fishing tools lead to an increase in the number of individuals, and the higher temperature throughout the year in the south of Iraq with the permanent occurrence of exotic species (26).

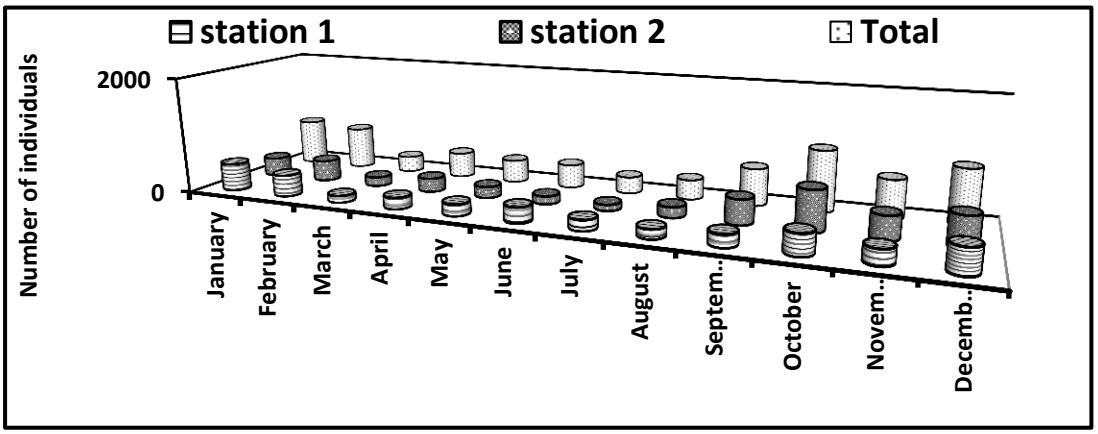

Figure 4: Monthly changes in the number of individuals in the Al-Sweib River from January to December 2017

Relative abundance

Small invasive and some local tolerance species represented high proportions in relative abundance in the Al-Sweib River (Table 1, 2).

Four species topped the total relative abundance in the present investigated area formed 81.72% of the total number, *P. abu* 35.34%, *O. aureus* 18.68%, *C. gibelio* 17.51% and *C. zillii* 10.19%. The most abundant species at station 1 was *P. abu* 35.21%, followed by *O. aureus* 19.61% then *C. gibelio* 17.50%, the same species were recorded in station 2 at close rates of *P. abu* 35.45%, *O. aureus* 17.87% and *C. gibelio* 17.50%. The ability of these species to rapidly adapt to the various environmental conditions and possession a high tolerance to environmental variations, with their rapidly reproduction and have a wide range of food items (33).

Table 2: Relative abundance and total number of species in investigated stations during the study period in Al-Sweib River

Species	Station 1		Station 2	
	Total number	%	Total number	%
C. gibelio	558	17.51	650	17.50
A. mossulensis	284	8.91	79	2.13
L. vorax	41	1.29	52	1.40
C. luteus	41	1.29	51	1.37
C. carpio	59	1.85	51	1.37
A. marmid	79	2.48	28	0.75
H. leucisculus	7	0.22	17	0.46
G. rufa	7	0.22	29	0.78
H. nobilis			2	0.05
M. sharpeyi	3	0.09	1	0.03
C. idella			1	0.03
L. xanthopterus			1	0.03
T. ilisha	29	0.91	87	2.34
N. nasus			2	0.05
O. aureus	625	19.61	664	17.87
C. zillii	214	6.71	489	13.16
P. abu	1122	35.21	1317	35.45
P. subviridis	12	0.38	14	0.38
T. whiteheadi	19	0.60	53	1.43
A. arabicus	6	0.19	8	0.22
S. triostegus	75	2.35	97	2.61
M. mastacembelus	4	0.13	10	0.27
P. latipinna			4	0.11
G. holbrooki			4	0.11
S. sihama			1	0.03
M. pelusius	1	0.03	3	0.08
H. fossilis	1	0.03		
	3187		3715	

Ecological indices

There was an evident fluctuation in the values of ecological indices in the study area between the two stations (Figure 5). The monthly shifting in diversity index was between 1.48 in December and 2.07 in March at station 1, whereas in station 2 it was 1.33 in December and 2.17 in May. Due to (20), the diversity index values classified as poor in the studying area. The results showed a decrease in diversity index values in the cold months may be to the reduction in the number of species which lead to loss in index values. The finding of the present index differed from the results of (14) in the Shatt Al-Arab River (1.19) and (24) in the Shatt Al-Arab River from Al- Dear to Al- Fao (1.91 to 2.56) and (23) from Al- Dear to Abu Al-Khsib (0.67 to 2.57). (4) pointed that number of species in downstream were more than those upstream due to entry of marine species, which increase values of diversity index.

Values of richness index were going down during cold months and had risen from March to August (Figure 5). Data of present this study differs from1.33 in December to 2.31 in March in station1, while from 1.50 in November to 2.78 in June at station 2 (Figure 5). High values of richness index indicate to an abundance of species, index values were strongly and significantly related (r= 873) with a number of species in both stations. The variance in values with the previous studies explained by differed number of species which is affected by the migration of species into and out of the river and it is one of the main reasons for the differences in the values of the diversity and richness indices (27).

Values of evenness index ranged from 0.65 in October to 0.89 in August in station 1, but in station 2 between 0.56 in December and 0.87 in July (Figure 5). These results indicate that there is no clear prevailing for a given species and the index values were between (zero to one), the criteria of index between turbulent to half integrated. These results within the range of the previous studies in the North part of Shatt Al-Arab River and adjacent regions that founded by several authors (16) from 0.66 to 0.85; (6) ranged between 0.39 to 0.78; (2) from 0.69 to 0.74, but (8) recoded variable values ranged from (0.1 to 0.75) may be due to the fauna structure in Shatt Al-Arab River variable upriver-mid river to downriver (24).

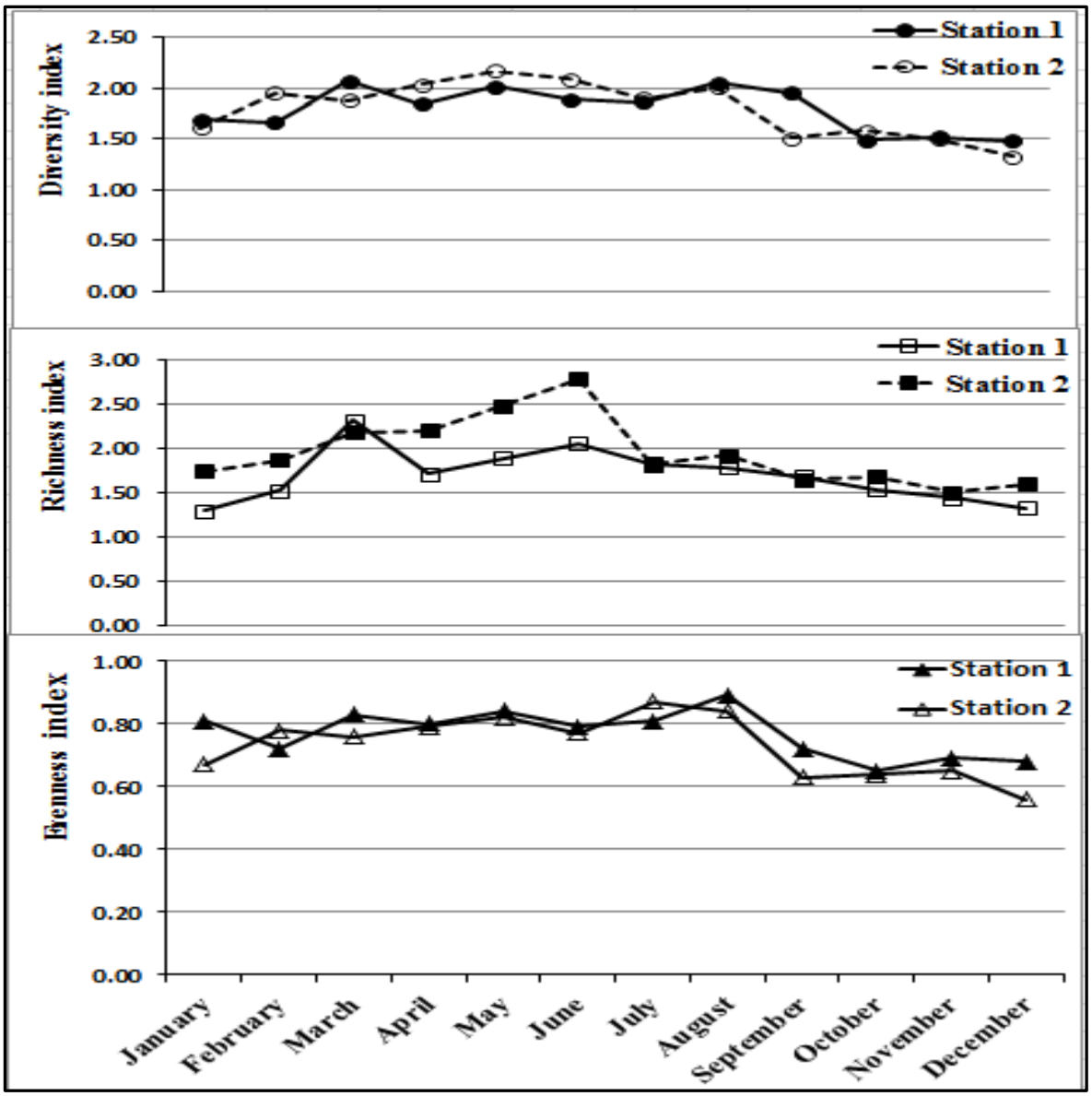

Figure 5: **Monthly variations in ecological indices in the two stations during studying periods**

Similarity index

The data of total similarity revealed the lowest ratio between the two stations was 36.84% in June, while the highest 72.73% in November, while the average of total similarity was 54.17% (Figure 6). The similarity among monthly total catch in the studied area varied from 38.10% between June and November and 84.62% between February and November (Table 3). The monthly differences in fishing tools and catch-per-unit-effort in the two stations reflect monthly number of species and individuals differences between the two stations, although presence of the water gate in the mid distance of the river, which were left open throughout the year allows the fish to pass in both directions toward the two stations. The present results are similar with the finding of (6) as both studies were done on the North part of Shatt Al-Arab River and were similar in fish community structure (24).

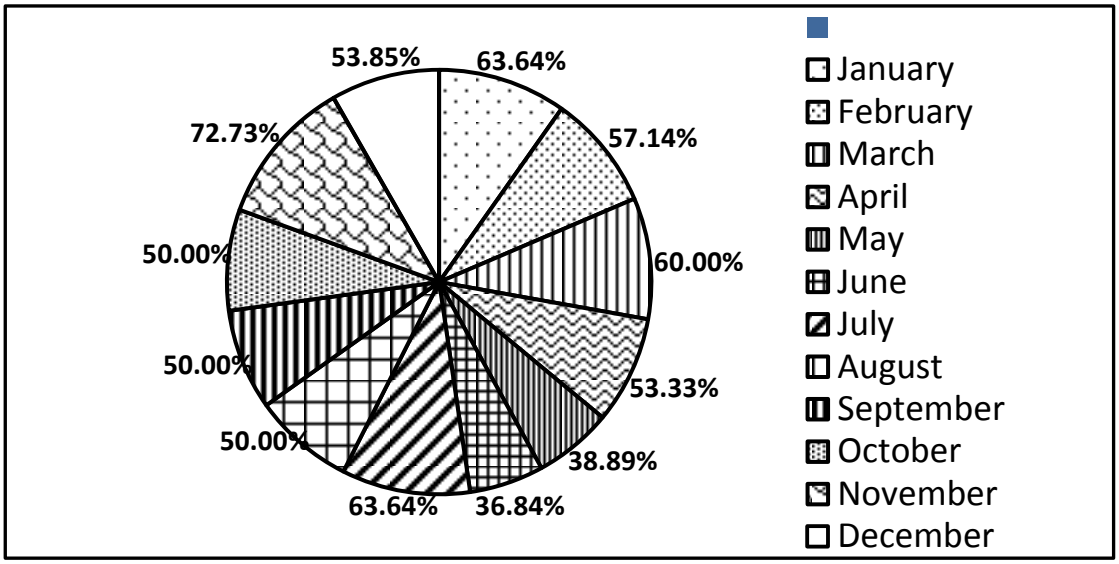

Figure 6: The monthly similarity between the two stations from January to December 2017

Table 3: The similarity among monthly total catch in Al-Sweib River

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Jan.	0											
Feb.	60.00	0										
Mar.	62.50	81.25	0									
Apr.	62.50	61.11	60.00	0								
May	50.00	68.42	77.78	68.42	0							
Jun.	55.56	55.00	50.00	63.16	50.00	0						
Jul.	50.00	52.94	62.50	56.25	57.89	52.63	0					
Aug.	44.44	73.33	68.75	55.56	63.16	61.11	57.89	0				
Sep.	56.25	75.00	70.59	70.59	63.16	50.00	62.50	44.44	0			
Oct.	58.82	76.47	76.47	55.56	65.00	50.00	58.82	55.56	81.25	0		
Nov.	53.33	84.62	62.50	52.94	50.00	38.10	50.00	50.00	66.67	73.33	0	
Dec.	56.25	68.75	55.56	62.50	47.62	50.00	71.43	44.44	80.00	78.57	73.33	0

Occurrence of species

Table (1) shows that the common species group included ten species formed 95.42% of the total number of species Figure (7), six of them appeared in all monthly catch samples *C. gibelio, A. mossulensis C. carpio, O. aureus, C. zillii* and *P. abu*, two species were found in 11 months *L. vorax* and *S. triostegus*, two species catch in ten months *C. luteus* and *T. ilisha*. The seasonal species group represented five species shared in 3.52% of the total number T. *whiteheade* observed in eight months, *A. marmid* and *P. subviridis* in seven months, both *H. leucisculus* and *M. mastacembelus* in six months. The occasional species included 12 species represented 1.06% of the total number of species included the rest fishes (Table 1).

The common or resident category was the most abundant group appeared in the most months. These result, are similar with findings of (25) when they studied fish

assemblage of Garmat Ali River, north of Basrah which recorded ten common species, seven for the seasonal and nine to the rare species, and agrees with (2) when he investigated diversity of fishes in the lower reaches of Tigris River, Northeast of Basrah province were found the common species represented the most abundant group forming 98.04%, seasonal species comprised 1.08% and occasional or rare species consisted eight species and represented 0.88% of the total number.

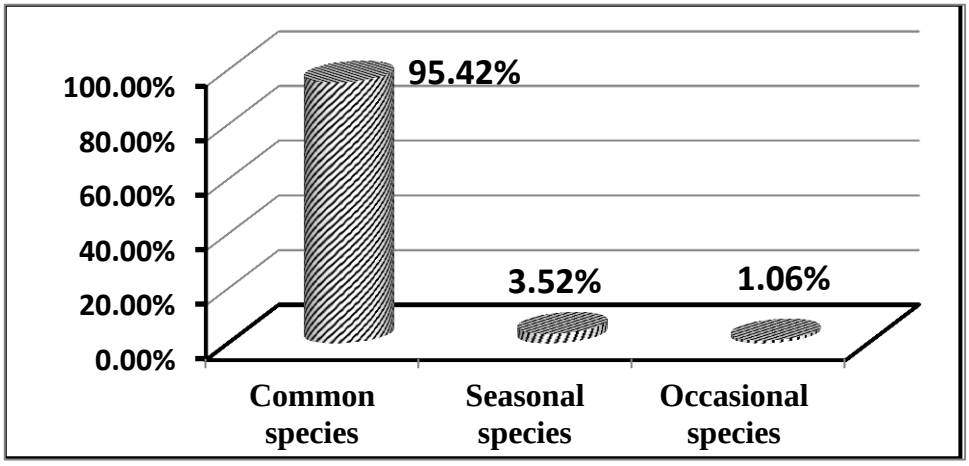

Figure 7: Occurrence of species in Al-Sweib River from January to December 2017

Conclusions

The present study was found that the fish assemblage in Al-Sweib River was relatively similar to the populations of the North part of Shatt Al-Arab River recorded by (vi) and (xxv) in Al-Dear station.

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