

## Diversity, abundance and community structure of fishes in the lower part of the Euphrates River Southern Iraq

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**Abstract** - Diversity, abundance and community structure of fish species in the lower part of the Euphrates River was investigated during May 2016 to April 2017. Three stations were selected to conduct the work. Monthly variance of water temperature ranged from 11°C in January and February to 31°C in August, turbidity differs from 2.31 in June to 24.10 NTU in November. The overall values of hydrogen-ion differ from 7.52 in April to 8.27 in November and December. The overall values of salinity in the work area were 0.91 ‰ in October to 1.52 ‰ in May. Several fishing methods were used to collect the samples of fishes. A total of 4380 specimens' of fish were collected included 23 fish species belonging to 23 genera and 11 families, ten of them represented native fish species, eight alien fish species and five marine species. *Oreochromis aureus* was the most abundance species formed 34.27 % of the total number then *Liza abu* (24.66 %) of the total number of species and *Carassius gibelo* (14.36 %). Values of three dominate species ( $D_3$ ) was 73.29 %. The mean values of diversity index (H) in the study area ranged from 1.11 to 1.92, evenness index (J) from 0.53 to 0.90 and richness index (D) from 1.15 to 2.33. The study showed the dominance of small species of exotic and native fish in the study area and the scarcity of large economic species due to the overfishing.

**Key Words:** Diversity, Abundance, Community structure of fish and Euphrates River.

### Introduction

Fish community structures are known as responsive indicators of habitat degradation, natural condition distribution, environmental parameter and overall ecosystem status (Dwivedi *et al.*, 2016). Described a community structure based on expected species patterns and physical environmental parameters along the longitudinal continuum of the river, is indispensable to comprehension their apportionment, and emphasized on the external influences (Jackson *et al.*, 2001), may also affect fish distribution dynamics, such as the influences of river form (geomorphology), climate variability, presence of tributaries and floodplains, riparian vegetation, channel discontinuities and human disturbances (Benda *et al.*, 2004; Thorp *et al.*, 2006). Dudgeon *et al.* (2006) mentioned that there are five reasons affected by freshwater biodiversity and impacts on ecological indices introduce exotic species, water pollution, overexploitation, habitat degradation and modification of water flow. Ecological indices are important tools commonly used to measure, analysis and assessment communities of organisms quantitatively and qualitatively (Heip *et al.*, 1998).

Two studies were implemented that deal with the community structure of fish in the lower reaches of Euphrates River, (Al-Noor *et al.*, 2009), analysis fish

community structure, and recorded 21 species belong to 12 families, seven of them was marine, Hussein *et al.* (2015) investigated the ecology and fish structure in the Southern sector of the Euphrates River between Chibyaish and Mudyna districts North-West of Basrah, they found 24 species represented nine families, dominated by Cyprinidae which counting 12 species. Several studies were done in the areas adjacent to the end of the lower Euphrates River, Mohamed *et al.* (2006) obtained 22 fish species which represented 12 families, when they analytical study of the fisheries of the lower reaches of the Tigris River North of Qurna. Mohemad *et al.* (2012) focused on fish guilds in Chybaish Marsh collected 14 species belong to 7 families; they found *Carassius auratus* was dominated formed 24 %. Al-Noor and Abdullah (2015) recorded 32 species from the lower reach of the Shatt Al-Arab River, *Liza abu* and *C. auratus* prevailed were the most occurrence.

The present study was aimed to assess influences of some ecological factors, diversity, abundance and fish community structures of the lower part of Euphrates River to evaluate the changes in the fish guilds North and South of constructed an obstruction, and the reason which makes some species are existing and others absent and effects of hydrology modification.

## Materials and Methods

### Study Area:

The study area of the lower part of the Euphrates River extends 32 km, from the North of the constructed an obstruction between Chibyaish and Mudyna towns to the point of confluence the Tigris and Euphrates Rivers, the width ranged from 400 to 500 m, two tributaries branches and penetrating to adjacent marshes, Nahar Annter and Al-Aizz River (Fig. 1). Three stations were selected to conduct the work, in the lower part of Euphrates River. Station 1 is located directly North of the constructed an obstruction N 30° 57' 36", E 47° 13' 12", station 2 to the Southern about 13 km N 30° 55' 48", E 47° 17' 24", station 3 near Al-Qurna town at Pipe Bridge N 30° 59' 24", E 47° 24' 36", near the point of confluence the Tigris and Euphrates Rivers. The stations position were determined by GPS (Global position system), etrex type manufactured in Garmin Company Taiwan.

Samples were monthly collected from the three stations during the period from May 2016 to April 2017. Several tools were used to collect samples of fishes from the studied area, included seine net (80 to 100 m length, 4 to 6 m height), fixed and drift gill net (40 to 60 m, mesh size 15 to 57 mm), (80 to 100 m length, 25 mm mesh size), cast net (5 m diameter, 22 mm mesh size) and electrofishing used generator engines (500 V, 10 A). The species were classified according to (Boulenger, 1915; Carpenter *et al.*, 1997; Coad, 2010).

Some environmental factors were measured simultaneously with fishing operations, water temperature (°C) was measured by mercurial thermometer, turbidity (NTU) using a device Hanna HI-93703K (Italy). Hydrogen-ion and salinity (‰) measured by Lovibond-Sensor Direct 150 manufactured in Germany. Analysis nature of fish community structure was executed at three stations by the following: Relative abundance due to Odum (1970). Dominance ( $D_3$ ) according to Kwak and Peterson (2007) and occurrence Tyler (1971). Fish diversity by Shanon and Weaver (1949), evenness Pielou (1977) and richness Margalef (1968). SPSS Ver. 16 was used for an application the statistical analysis of variance (ANOVA) to assess ecological variations, number of species and individuals ( $P \leq 0.05$ ) among the stations and to execute the correlations of environmental factors.

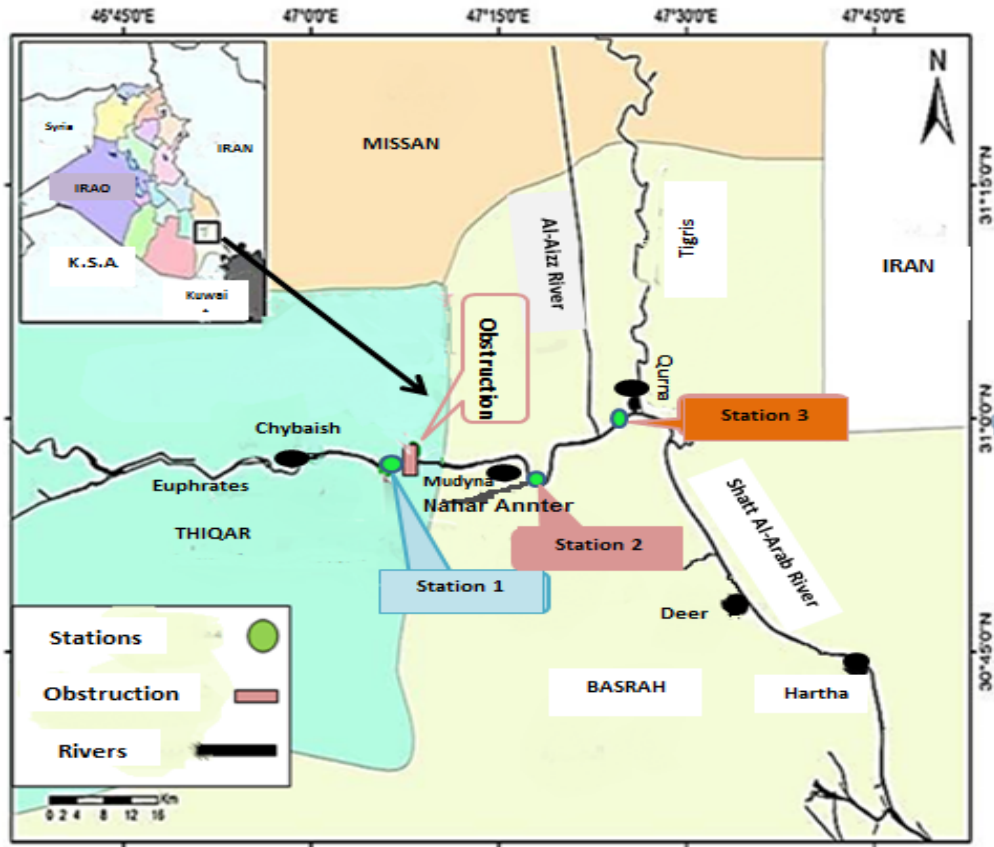


Figure 1. Map of the study area.

## Results

### Ecological Factors:

Monthly variance in the rates values of some ecological factors in the lower reaches of the Euphrates River were addressed (Fig. 2). The temperature of water, turbidity, and hydrogen-ion concentration, revealed no significant differences among the three represented stations ( $P > 0.05$ ). Water temperature rates values varied from 11°C in January and February to 30°C in August. Overall values of turbidity in the study area differ from 2.31 in June to 24.10 NTU in November. Hydrogen-ion concentrations values ranged from 7.62 in July to 8.30 in December in station (1), but in station (2) ranged from 7.18 in April to 8.30 in November and December, but 7.63 in March to 8.30 in October and November in station (3). The overall values differ from 7.52 in April to 8.27 in November and December.

Salinity concentrations in station (1) varied from 1.15 ‰ in October and November to 2.10 ‰ in May and July, but from 0.79 ‰ in October to 1.50 ‰ in January in station (2) then ranged between 0.79 ‰ in October to 1.25 ‰ in February in station (3). Significant differences ( $P \leq 0.05$ ) were detected between station (1) and other stations. The overall values of salinity in the work area were 0.91 ‰ in October to 1.52 ‰ in May (Fig. 2).

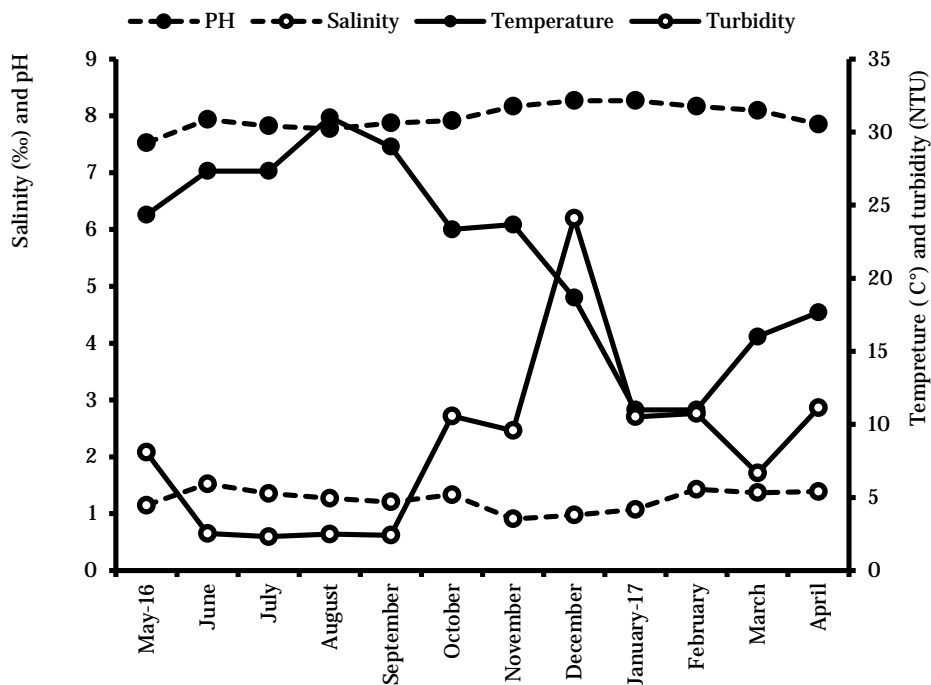


Figure 2. Monthly variations in the ecological factors in the lower reaches of the Euphrates River from May 2016 to April 2017.

#### Fish Community Structure:

A total of 4380 individuals represented 23 fish species belonging to 23 genera and 11 families, all of them affiliated Osteichthyes were caught from investigated area in the lower part of Euphrates River, ten species comprise native, eight aliens and five marine species. Cyprinidae was the most prevailing family shared 11 species and 11 genera (Table 1). The results showed *Oreochromis aureus* have the higher monthly density in all stations.

*Liza abu* was the most abundant fish in the North of constructed an obstruction (Station 1); formed 36.15 % of the total catch in station 1 followed by *Oreochromis aureus* 32.36% and *Carassius gibelo* 13.69 %. In station (2) *O. aureus* 43.67 % the most dominant fish then *C. gibelo* 20.28 % and *Coptodon zillii* 10.09 % of the total number of caught. Station (3) dominated by *O. aureus* 27.22 %, *L. abu* 11.79 % and *C. gibelo* 9.23 % of the total number of species (Table 1).

The number of species were varied monthly in the investigations stations. In station (1) 13 fish species were caught; they ranged from five in January to 11 species in November (Fig. 3). In station (2) 14 fish species were caught; they ranged from six in April to 10 species in September. Station (3) was shared in 22 species; they differ from seven in December to 12 in August and November. Significant differences ( $P \leq 0.05$ ) were found in the number of species between station (2) and (3). Weak positive correlated ( $r=0.225$ ) was shown between temperature and the number of species in the study area.

Table 1. Species of the fish sampled from the three stations and their abundance in the lower part of Euphrates River from May 2016 to April 2017.

Family	Species	Habitat	North the dam (Station 1) %	South Mudyna (Station 2) %	Pipe Bridge (Station 3) %
Cyprinidae	<i>Carassius gibelus</i> *	F	13.69	20.28	9.23
	<i>Alburnus mossulensis</i>	F	4.2	1.93	7.9
	<i>Carasobarbus luteus</i>	F	4.08	4.13	3.52
	<i>Leuciscus vorax</i>	F	1.73	3.58	1.94
	<i>Cyprinus carpio</i> *	F	1.24	1.1	1.09
	<i>Acanthobrama marmid</i>	F	0.21	0.09	1.34
	<i>Hemiculter leucisculus</i> *	F	0.25		0.73
	<i>Mesopotamichthys sharpeyi</i>	F	0.21		0.12
	<i>Hypophthalmichthys nobilis</i> *	F			0.36
	<i>Ctenopharyngodon idella</i> *	F			0.12
	<i>Garra rufa</i>	F			0.12
Cichlidae	<i>Oreochromis aureus</i> *	F	32.36	43.67	27.22
	<i>Coptodon zillii</i> *	F	4.12	10.09	8.87
Mugilidae	<i>Liza abu</i>	F	36.15	9.72	11.79
	<i>Chelon subviridis</i>	M			3.89
Clupeidae	<i>Tenuulosa ilisha</i>	M		2.75	8.38
Sparidae	<i>Acanthopagrus arabicus</i>	M			2.67
Engraulidae	<i>Thryssa whiteheadi</i>	M		0.28	8.02
Sillaginidae	<i>Sillago sihama</i>	M			0.24
Siluridae	<i>Silurus triostegus</i>	F	1.64	2.2	2.21
Heteropneustidae	<i>Heteropneustes fossilis</i> *	F		0.09	
Bagridae	<i>Mystus pelusius</i>	F			0.24
Mastacembelidae	<i>Mastacembelus mastacembelus</i>	F	0.12	0.09	

F= freshwater species, M= marine species, \*= Alien species.

Monthly variations in the number of individuals were detected from the represented stations (Fig. 3). A total of 2438 specimens of fish were collected in station (1), differ from 56 in March to 755 fish in November, station (2) shared in 1107 specimens ranged from 25 in the March to 252 fish in August, however, 835 individuals caught from station (3), varied from 37 in December to 92 fish in November.

Significant differences ( $P < 0.05$ ) in a number of individuals were recorded between station 1 and other sites. High positive correlation ( $r = 0.987$ ) was found between water temperature and number of individuals in the study area.

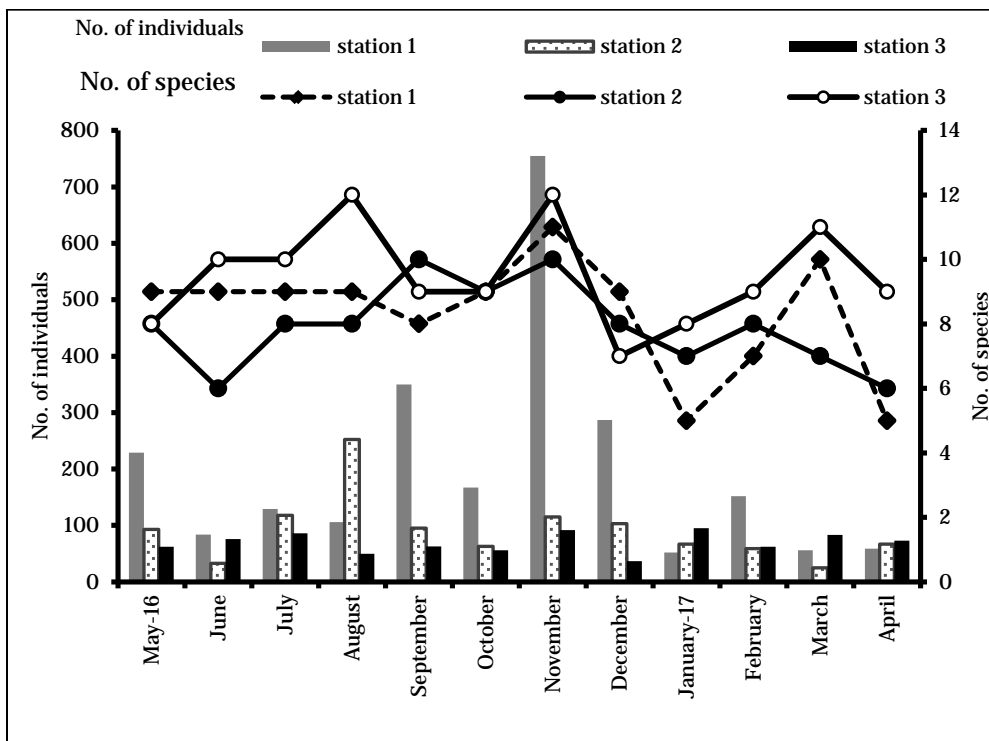


Figure 3. Monthly variations in number of species and individuals in the study stations.

#### Relative Abundance:

Three species topped up the first three positions in the numerical relative abundance of the three stations with the exchange of roles among them. *L. abu* was the most abundance species in station (1) constituting 36.15 % of the total number of species, followed by *O. aureus* 32.36 % then *C. gibelo* 13.69 %.

In station (2) *O. aureus* was the most abundance species to the total number formed 43.67 % after that *C. gibelo* 20.28 % and *C. zillii* 10.09 %, as well as *O. aureus* was the most dominant species in station (3) consisting 27.22 % of the total number of species followed by *L. abu* 11.79 % and *C. gibelo* 9.23 % (Table 1).

As in the stations, four species were the most abundance fish species in the lower reaches of Euphrates Rivers, during the period from May 2016 to April 2017 (Table 2).

*O. aureus* was formed 34.27 % ranged from 7.66 % in February to 57.22 % in November. *L. abu* 24.66 % it varied from 6.15 % in January to 62.40 % in September. *C. gibelo* was the third most dominant species in the study area it was composed 14.36 % differ from 4.17 % in May to 36.07 % in January.

Dominance index ( $D_3$ ), of the highest three dominated species during study period constituted 73.29 % of the abundant of a total number of species. The species *C. zillii* formed 6.87 % of the total number of species comprising 0.74 % in August to 29.52 % in March (Fig. 4).

Table 2. Monthly variations in relative abundance of species from lower parts of Euphrates River from May 2016 to April 2017.

Species	May 2016	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 2017	Feb.	Mar.	Apr.	Total
<i>Oreochromis aureus</i>	48.44	25.25	25.23	45.59	16.14	19.58	57.22	50.35	7.79	7.66	12.05	21.61	34.27
<i>Liza abu</i>	21.09	26.26	11.71	15.69	62.40	38.81	22.64	18.97	6.15	22.99	10.84	12.06	24.66
<i>Carassius gibelo</i>	4.17	19.19	18.62	20.10	10.04	15.73	7.79	11.94	36.07	17.62	14.46	25.63	14.36
<i>Coptodon zillii</i>	4.43	9.09	9.31	0.74	1.77	1.75	1.14	5.62	15.16	28.35	29.52	10.55	6.87
<i>Alburnus mossulensis</i>	3.91	1.52	7.81	1.23	0.98	3.50	1.87	4.92	22.13	6.51	4.22	2.01	4.32
<i>Carasobarbus luteus</i>	8.07	4.04	8.41	2.70	2.56	5.94	1.04	1.87	0.41	7.28	3.61	11.06	3.97
<i>Tenualosa ilisha</i>	2.86	4.04	0.30	3.19	0.98	2.80	0.93	1.64			7.83	12.06	2.26
<i>Leuciscus vorax</i>	3.39	1.52	2.40	5.15	0.79	2.45	2.18	0.94	3.28	1.53	1.81	0.50	2.21
<i>Silurus triostegus</i>	0.78	0.51		2.45	1.77	3.15	1.14	0.94	0.82	5.75	7.83	1.01	1.87
<i>Thryssa whiteheadi</i>		2.53	6.61	0.74	0.20	3.85	1.14	0.94			1.20	3.02	1.58
<i>Cyprinus carpio</i>	1.04	3.03	2.70	1.47	1.57	1.40	0.52	0.70	2.46	1.53	1.20		1.30
<i>Chelon subviridis</i>	1.56	2.02	0.90	0.25			0.83	0.47			4.82		0.73
<i>Acanthopagrus arabicus</i>		1.01	3.60	0.25	0.39		0.52						0.50
<i>Acanthobrama marmid</i>			1.50		0.20	0.35			4.10				0.39
<i>Hemiculter leucisculus</i>					0.20	0.35	0.52	0.47	1.23				0.27
<i>Mesopotamichthys sharpeyi</i>				0.25		0.35	0.31				0.60		0.14
<i>Hypophthalmichthys nobilis</i>			0.30							0.77			0.07
<i>Mastacembelus mastacembelus</i>			0.30										0.07
<i>Silago sihama</i>	0.26						0.21						0.07
<i>Heteropneustes fossilis</i>									0.41				0.02
<i>Ctenopharyngodon idella</i>			0.30										0.02
<i>Gara rufa</i>				0.25								0.50	0.02
<i>Mystus pelusius</i>								0.23					0.02
Number of Individuals	384	198	333	408	508	286	963	427	244	261	169	199	4380
Number of Species	12	13	16	15	14	14	16	14	12	10	13	11	23

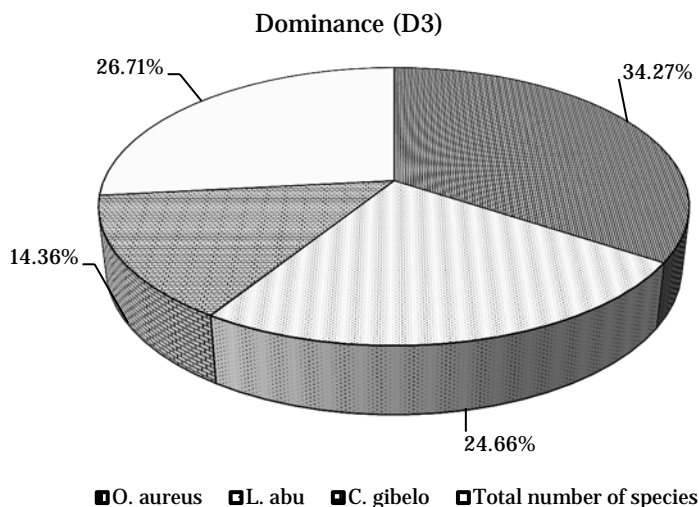


Figure 4. Dominance index (D<sub>3</sub>) of the highest three dominated species during study period.

#### Ecological Indices of Fish:

Ecological indices values revealed clear variable in the fish community structure due to the nature variations of each station. Monthly differences in diversity index (H) in station 1 ranged from 0.87 in September to 1.93 in July. In station (2) differ from 1.05 in August to 1.76 in October, while oscillated from 1.40 in May to 2.08 in November in station (3).

The range values of diversity index in the study area from 0.83 to 2.08 (Fig. 5). Significant differences ( $P < 0.05$ ) in diversity index values were detected between station (3) and both of stations (1) and (2).

Evenness index (J) values varied from 0.42 in September to 0.89 in January in station (1), but from 0.51 in August to 0.88 in March in station (2) while, differ from 0.67 in May to 0.92 in February in station (3).

Range of evenness index values in the investigated stations from 0.42 to 0.92 (Fig. 5). Significant differences ( $P < 0.05$ ) in evenness values were observed between stations (1) and (2).

Richness index values (D) fluctuated from 0.96 in January to 2.24 in March in station (1), after that from 0.95 in April to 1.93 in October in station (2), whereas ranged from 1.54 in January to 2.81 in August in station (3). The range values of richness index in the lower reaches of Euphrates River being from 0.96 to 2.81 (Fig. 5). Analysis values of richness index revealed a significant difference ( $P < 0.05$ ) between stations (1) and (3), stations (2) and (3).

#### Species Occurrence:

Fish species divided into three guilds according to their occurrence during the year (Fig. 6). The most common fish species included 11 species formed 98.40 % of the total number of species. Seasonal species represented one species participated in 0.73 % of the total catch, and occasional species were 11 species formed 0.87 % of the total number.



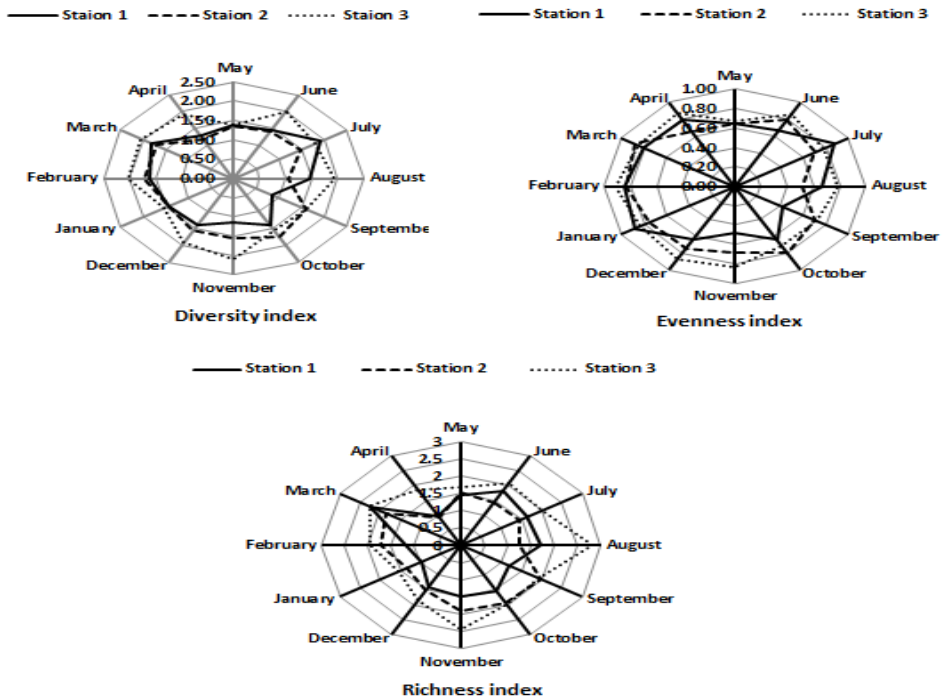


Figure 5. Monthly variations in ecological indices in the studied stations during May 2016 to April 2017 in lower parts of Euphrates River.

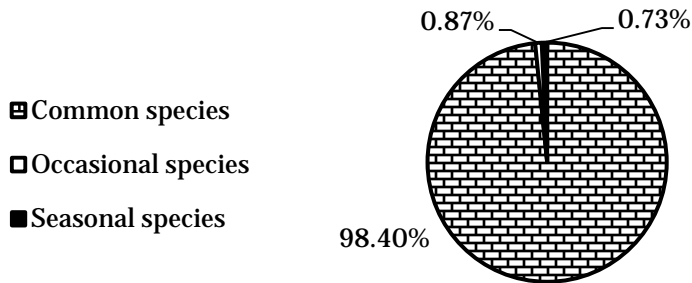


Figure 6. Species occurrence during period from May 2016 to April 2017 in the lower parts of Euphrates River.

Analysis of cluster structure to find out temporal changes of species composition in the three stations (Fig. 7). The figure shows three main groups in station (1), the first group contains two secondary groups. The first secondary group included October, December, May, July, August, and June. The second secondary group consists of March and November. The second main group represented by February and September.

The third main group contains two secondary groups. The first included January and April. Station (2) comprised of three main groups too, the first secondary contains August, December, February, May, and July, while the second group October only. The second main group consisted of two secondary groups, the first include April and June, but the other February and March. The third main group consists of September and November.

Also, station (3) contains three main groups, the first main group included two secondary groups, the first represented by August and November, whereas the other March only. The second main group contained two secondary groups, the first composed of January and May, whereas the other December. The third main group consists of two secondary groups, the first represented by June and July, but the others included September, October, February and April.

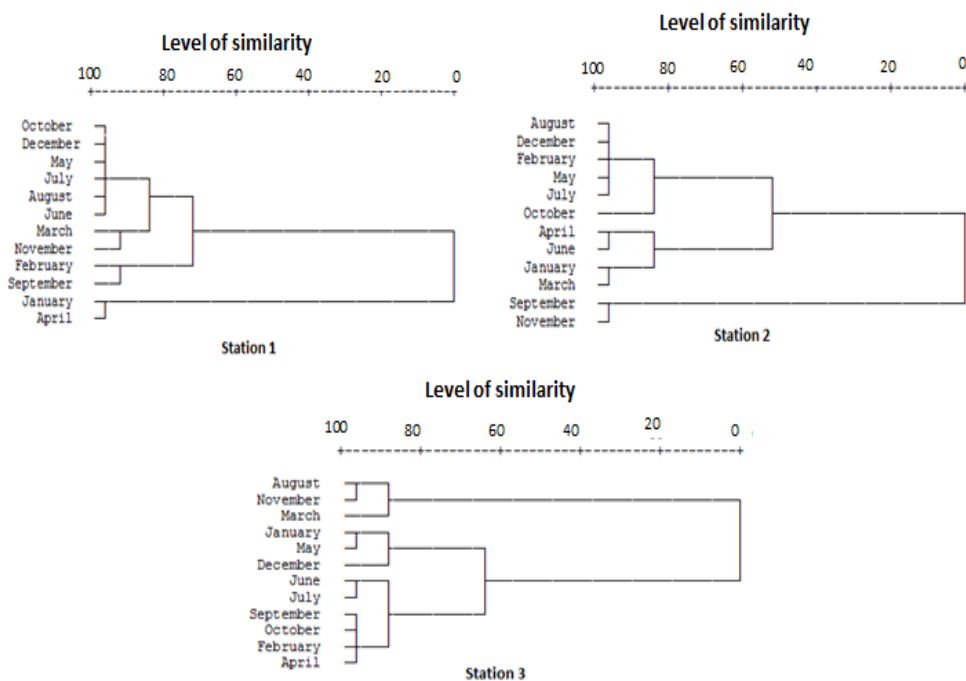


Figure 7. Cluster analysis of temporal changes of fish species in studied stations during the period from May 2016 to April 2017 of lower parts of Euphrates River.

## Discussion

Environmental template, hydrology and geography of three locations were variable, so fish assemblage diversity, abundance and distribution vary remarkably due to the differences among stations (Cattaneo *et al.*, 2003; Dodds *et al.*, 2012).

The three sites were exhibit evident variance in natural circumstances and water hydrology represented as the anthropogenic modification creates a new conditions altered guild of fish to worst status by dominant of a small size of alien species (Yang *et al.*, 2008).

Water temperature plays an important role in the control of behavior an organism such as reproduction, feeding, migration, metabolism process and activity (Holker, 2003). The turbidity of the water is a barometer to suspended and dissolved materials from mud, silt, Phyto and zooplankton. Turbidity values are relatively higher in station (3) than other stations and this belongs to high current, because narrow of river section across tubular bridge causing a stir up the bottom and sides of the river, this is compatible with the results Of Hussein *et al.* (2013).

Generally, Iraqi inland water tends to be toward the basic direction, according to the presence of carbonate and bicarbonate in the soil, increasing pH values and this showed in the present results coinciding with Hussein *et al.* (2015) when they explained by the increase of base ions with a relative decrease in the summer months due to the increased density of phytoplankton in the lower reaches of the Euphrates River.

The salinity influence in the distribution, abundance and community structure within the longitudinal section of the river, this is evident in the fish community composition at the three represented stations, noting increased the number of marine species in the station (3) near the upper end the Shatt Al-Arab River and this results correspondence with Bruno *et al.* (2013), when they noticed that fish abundance and distribution related to salinity and other environmental factors, also with Mohamed *et al.* (2015), when they investigated the spatiotemporal variability of fish assemblage in the Shatt Al-Arab River from Al-Dair to Abu Al-Khasib.

A number of individuals differ monthly among stations and this related in season and the differences in fishing tools and effort (Unlu *et al.*, 2000). Community structure of species is remarkably variable in the three stations due to variance among the selected locations. Presences of constructed an obstruction prevent marine species from penetrating to station (1), although they decrease toward the upper reaches of Shatt Al-Arab River Mohamed *et al.* (2015); however station (3) characterized by high values of diversity and species richness due to entry of marine species, to vicinity region from the upper reaches of Shatt Al-Arab River and present results corresponding with Hussein *et al.* (2015), when they recorded 24 species in the same area and Al-Noor *et al.* (2009) reported 21 fish species in the lower part of Euphrates River. The results showed presence some of the species in station (1) and absence or rare existence in other sites such as *M. sharpeyi*, the reason may be due to available their food and an occurrence of reproductive regions North of constructed an obstruction in Al-Chibyaish marsh. Al-Hassan *et al.* (1989) mentioned that an occurrence of marine species became fewer as we head towards the upper river, therefore station (2) included a low number of marine species compared than station (3) according to upriver contain few marine species than downriver.

In the present paper, Cyprinidae was the most dominant family participate in 11 species, and this result agrees with all previous works in the Southern inland water (Hussain *et al.*, 2009; Al-Noor and Abdullah, 2015; Hussein *et al.*, 2015).

The relative abundance results showing that the three stations occupied by *L. abu*, *O. aureus*, *C. gibelo* and *C. zillii* formed 80.16 % of the total number of species in the study area, with the differences in the serial arrangement among three locations. When we analyze the reasons that made *L. abu* the dominant, we found their food consist of organic detritus and diatoms, which are available in our habitat, and have a high tolerance, whereas *O. aureus* and *C. zillii* are alien species have large resistance to the bad conditions of low oxygen concentrations, salinity

and vegetarian feeding which available in subtropical habitat, they owning a wide reproductive potential, while *C. gibelo* has the same feature as well as it has been omnivores feeding, this result concurred with several of modern studies in the South of Iraq (Al-Noor and Abdullah, 2015; Hussein *et al.*, 2015).

Diversity index values were evident indicator that lower part of Euphrates River was poor according Jorgensen *et al.* (2005). The highest values of richness index were observed in station (3), and this attributed to presence large numbers of marine species increased diversity; the present results were similar to many of the recent studies conducted on the same or adjacent regions (Hussain *et al.*, 2012; Hussein *et al.*, 2015; Mohamed *et al.*, 2015). The results of evenness index indicate as semi-balanced in all stations with a relatively slightly raised in station (3), due to the existence of marine species penetrate from the upper part of Shatt Al-Arab River (Al-Noor *et al.*, 2009). Richness index values refer to half an integrated into three stations. The results showed that values of ecological indices in the lower sector of Euphrates River within the ranges of most previous studies on the present area and adjacent regions in the south of Iraq (Younis *et al.*, 2008; Hussain *et al.*, 2012; Hussein *et al.*, 2015).

## References

- Al-Hassan, L.A., Hussain, N.A. and Soud, K.D. 1989. A preliminary annotated checklist of the fishes of Shatt Al-Arab River, Basrah, Iraq. *Pol. Arch. Hydrobio.*, 36(2): 283-288.
- Al-Noor, S.S., Mohamed, A.R.M. and Faris, R.A.K. 2009. Structure of the fishery of the lower Euphrates River, Qurna, Iraq. *Iraqi J. Agric.*, 14(8): 157-169 (Special Issue) (In Arabic).
- Al-Noor, S.S. and Abdullah, A.H.J. 2015. Structural diversity of fish communities in the North part of Shatt Al-Arab River-North of Basrah-Qurna. *Basrah J. Agric. Sci.*, 28(2): 15-29 (In Arabic).
- Benda, L.E., Poff, N.L., Miller, D., Dunne, T., Reeves, G.H., Pess, G. and Pollock, M. 2004. The network dynamics hypothesis: How channel networks structure riverine habitats. *Bio. Sci.*, 54: 413-427.
- Boulenger, G.A. 1915. *Catalogue of the freshwater fishes of Africa in the British Museum (Natural History)*, 526 pp.
- Bruno, D.O., Barbini, S.A., Astario, J.M.D. and Martos, P. 2013. Fish abundance and distribution patterns to environmental factors in a choked temperate coastal lagoon (Argentina). *Brazilian J. Oceanography*, 61(1): 43-53.
- Carpenter, K.E., Krupp, F., Dones, D.A. and Zajonz, U. 1997. *Living marine resources of Kuwait, eastern Saudi Arabia, Bahrain, Qatar and The United Arab Emirates. Food and Agriculture Organization of the United Nations, Rome.*, 293 pp. and 17 pls.
- Cattaneo, F., Hugueny, B. and Lamouroux, N. 2003. Synchrony in brown trout (*Salmo trutta* L.) population dynamics: A 'Moran effect' on early-life stages. *Oikos.*, 100: 43-53.
- Coad, B.W. 2010. *Freshwater fishes of Iraq*. Pensoft Publishers, Sofia-Moscow, 294 pp.
- Dodds, W., Robinson, C., Gaiser, E.E., Hansen, G., Powell, H., Smith, J., Morse, N.B., Johnson, S.L., Gregory, S.V., Bell, T., Kratz, T.K. and McDowell, W.H. 2012. Surprises and insights from long-term aquatic datasets and experiments. *Bio. Sci.*, 62: 709-721.

- Dudgeon, D., Arthington, A.H., Gessner, M.O., Kawabata, Z., Knowler, D.J., Leveque, C., Naiman, R.J., Prieur-Richard, A.N., Soto, D., Stiassny, M.L. and Sullivan, C.A. 2006. Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biol. Rev.*, 81: 163-182.
- Dwivedi, A.C., Mishra, A.S., Mayank, P. and Tiwari, A. 2016. Persistence and structure of the fish assemblage from the Ganga River (Kanpur to Varanasi section), India. *J. Geogr. Natu. Disas.*, 6(1): 1-8.
- Heip, C.H.R., Herman, P.M.J. and Soetaert, K. 1998. Indices of diversity and evenness. *Ocea.*, 24(4): 61-87.
- Holker, F. 2003. The metabolic rate of roach in relation to body size and temperature. *J. fish Biol.*, 62: 565-579.
- Hussain, N.A., Mohamed, A.R.M., Al-Noor, S.S., Mutlak, F.M., Abed, M.I.M. and Coad, B.W. 2009. Structure and ecological indices of fish assemblage of the recently restored Al-Hammar Marsh, Southern Iraq. *Bio. Rask.*, 3: 173-186.
- Hussain, N.A., Ali, H. and Lazem, L.F. 2012. Ecological indices of key biological groups in southern Iraqi marshland during 2005-2007. *Mesopot. J. Mar. Sci.*, 27(2): 112-125.
- Hussein, S.A., Al-Sabochi, A.A. and Al-Haji, S.A. 2013. Monthly variation in density of attached algae on solid plates in two lentic lotic localities from Basrah Province. *Basrah J. Agric. Sci.*, 26(1): 15-26.
- Hussein, S.A., Abdullah, A.A.M. and Abdullah, S.A. 2015. Ecology and fish structure in the Southern sector of the Euphrates River, Iraq. *Basrah J. Agric. Sci.*, 28(1): 95-108 (In Arabic).
- Hussein, S.A., Abdullah, A.A.M. and Abdullah, S.A. 2015. An appraisal to lower reaches waters' of Euphrates River by applying CCME Water quality index. *Thi-Qar Univ. J. Agric. Res.*, 4(2): 36-52.
- Jackson, D.A., Peres-Neto, P.R. and Olden, J.D. 2001. What controls who is where in freshwater fish communities-the roles of biotic, abiotic, and spatial factors. *Can. J. Fish. Aquat. Sci.*, 58: 157-170.
- Jorgensen, S.E., Xu, E.F.L., Salas, F. and Marques, J.C. 2005. Application of indicators for the assessment of ecosystem health, pp: 5-65. In Jorgensen, S.E., Costanza, R. and F. L. Xu (Eds.). *Handbook of ecological indicators for assessment of ecosystem health*. CRC Press, 2000 N.W. Corporate Blvd., Boca Raton, Florida, 577 pp.
- Kwak, T.J. and Peterson, J.T. 2007. Community indices, parameters, and comparisons. In *Analysis and interpretation of freshwater fisheries data*, Edited by: Guy, C.S. and Brown, M.L., pp: 677-763. Bethesda, Maryland: American Fisheries Society.
- Margalefe, R. 1968. *Perspectives in ecology*. University of Chicago. Press Chicago, 111 pp.
- Mohamed, A.R.M., Al-Noor, S.S. and Faris, R.A. K. 2006. Analytical study of the fisheries in the lower reaches of the Tigris River, North Qurna, Basrah, Iraq. *Iraqi J. Aquau.*, 1: 57-73 (In Arabic).
- Mohamed, A.R.M., Hussein, S.A., Al-Noor, S.S., Mutlak, F.M., Al-Sudani, I.M. and Mojer, A.M. 2012. Ecological and biological aspects of fish assemblage in the Chybaish marsh, Southern Iraq. *Ecohydro. Hydrobio.*, 12(1): 65-74.
- Mohamed, A.R.M., Hussein, S.A. and Lazem, L.F. 2015. Spatiotemporal variability of fish assemblage in the Shatt Al-Arab River, Iraq. *J. Costal Life Medicine*, 3(1): 27-34.

- Odum, W.A. 1970. Insidious alternation of the estuarine environment Trans. Amer. Fish. Soc., 99: 836-847.
- Pielou, E.C. 1977. Mathematical ecology. John Wiley, New York, 385 pp.
- Shannon, C.E. and Weaver, W. 1949. The mathematical theory of communication, Univ. Illinois Press Urbane, 117 pp.
- Thorp, J.H., Thoms, M.C. and Delong, M.D. 2006. The riverine ecosystem synthesis? Biocomplexity in river networks across space and time. River Res. Appl., 22: 123-147.
- Tyler, A.V. 1971. Periodic and resident components in communities of Atlantic Fishes. J. Fish. Res. Bd. Can., 28(7): 935-946.
- Unlu, E., Balci, K. and Meric, N. 2000. Aspect of the biology of *Liza abu* (Mugilidae) in the Tigris River (Turkey). Cybm., 24: 27-43.
- Yang, T., Zhang, Q., Chen, Y.D., Tao, X., Xu, C. and Chen, X. 2008. A spatial assessment of hydrologic alteration caused by dam construction in the middle and lower Yellow River, China. Hydrological Processes, 22: 3829-3843.
- Younis, K.H., Al-Mukhtar, M.A., Al-Katrani, L.M., Abdullah, A.J. and Abdullah, S.A. 2008. The study of nature of fish assemblage in Al-Saffia Reservation, Al-Hawaizah marshes, Iraq. Iraqi J. Aquac., 28(2): 73-84 (In Arabic).

## تنوع ووفرة وتركيبية مجتمع الأسماك في الجزء الأسفل من نهر الفرات جنوبي العراق

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**المستخلص-** أجريت دراسة لمعرفة تنوع ووفرة وتركيبية مجتمع الأسماك في الجزء الأسفل من نهر الفرات للمدة من أيار 2016 لغاية نيسان 2017. أُختيرت ثلاث محطات لأجراء العمل. قيست التغيرات الشهرية في درجة الحرارة وكانت 11<sup>0</sup> م في كانون الثاني وشباط و 31<sup>0</sup> م في آب وتراوحت عكارة المياه بين 2.31 NTU في حزيران و 24.10 NTU في تشرين الثاني. سُجِّلَ أجمالي قيم الأس الهيدروجيني 7.52 في نيسان و 8.27 في تشرين الثاني وكانون الأول. تراوحت أجمالي قيم الملوحة في منطقة الدراسة بين 91 ‰ في تشرين الأول و 1.52 ‰ في حزيران. أُستخدمت العديد من الطرق لجمع عينات الأسماك. جُمعَ 4380 نموذجاً شملت 23 نوعاً تعود الى 23 جنساً مثلت 11 عائلة. شملت عشرة أنواع من الأسماك المحلية وثمانية من الأسماك الدخيلة وخمسة أنواع من الأسماك البحرية. كان النوع *Oreochmis aureus* الأكثر وفرة في منطقة الدراسة وشكل 34.27 % من العدد الكلي جاء بعده *Liza abu* وحقق 24.66 % من العدد الكلي واحتل *Carassius gibelio* المركز الثالث وشكل 14.36 % من العدد الكلي للأنواع في منطقة الدراسة. كانت قيمة أعلى ثلاثة أنواع سائدة (D3) 73.29 %. تراوح معدل قيم دليل التنوع (H) بين 1.11 إلى 1.92 ومعدل قيم دليل التكافؤ (J) بين 0.53 إلى 0.90 ومعدل قيم دليل الغنى (D) من 1.15 إلى 2.33. أظهرت الدراسة سيادة الأنواع صغيرة الحجم من الأسماك الدخيلة والمحلية في منطقة الدراسة وندرة الأنواع كبيرة الحجم بسبب ضغط الصيد الذي تتعرض له.