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Building of Fish Assemblage Structure of the Shatt- Al-Arab River, Southern Iraq

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Abstract: The hydrological system plays a vital role in ecosystem functions that reflects on organism species populations. The study of fish species populations and ecological factors was carried in three sites in the northern part of Shatt Al-Arab River, during the period October 2018 to September 2019. A total of 35 species of fish were captured from the area of the sites which included 30 genera and belong to 17 families. In total of 2731 individuals were caught from site one and varied from 45 individuals in September to 420 in June and the number of species differed from ten species in October, January, and September to 15 species in December. The total number of 5631 individuals was recorded from site two it recorded 272 individuals in March to 928 in December, while the number of species ranged from eight species in September to 17 species in March. Site three included 5381 individual and varied from 297 in January to 617 individual in April and most of the fish species recorded in this site and ranged between 11 species in May and November to 19 species in March. The number of fish members in the study sites was 13743 individuals, the minimum number (908) was caught in August and the maximum (1800) in December, the number of species differed from 17 in November to 22 in December and February, the relative abundance varied from 24.62% to 0.01%. The values ranged of ecological indices in the study area; Shannon and Weaver diversity index (H) 0.43 in September to 1.99 in March, the values varied of Evenness (E) 0.15 in August and September to 0.65 in March and the minimum of Margalef richness (D) 2.30 in November to the highest 3.02 in February. Three fish species (*C. gibelio, P. abu,* and *O.aureus)* which included 70.21% of the total number according to dominance index (D_3). Fish species were classified into three groups according to their presence in the monthly samples, the common fish species were formed 16 species and in proportion 98.741270% of the total number. The seasonal fish contain five species and represented 0. 93 % of the catch, the occasional fishes comprised 14 species and formed 0.320163% from the catch.

Keywords**:** Ecological properties, Shatt-Al-Arab River, Hydrological system, Fish Assemblage Structure

Most disturbing of the ecosystem at the rivers are one of the by different human activities and have significant effects in the river fauna (Abdullah et al 2019). For a long time, as a result of considering watercourses as a mere physical way of taking water and not a biological system, only the river structure was restored and not the river function. Recently this situation seems to be changing with an increasing interest in river restoration studies (Oscoz et al 2005). The understanding water bodies a shape the structure of fish and is valuable in habitat assessment, stream restoration, management and conservation of fish populations (Pease et al 2011). Records of fishery catches provide a primary source of data for the study of fish ecology and the status of stocks as well as information on the structure, size and the number of fish harvested, fluctuations related to alterations in the environment. The fish community considered a biological complementarity unit use as indicators of the effect of habitat retro gradation, the productivity of an ecosystem, fixity of fisheries and climate variations (Cagauan 2007). The dynamics of fisheries parameters allows discussion of factors and analyzing the behavior of fishers and their selection of desired species are very necessary to maintenance fisheries stock (Salas and Gaertner 2004). Composition of fish is an important component of the aquatic ecosystem and provides a good biological indicator for the quality of water ecosystems due to its sensitivity to the range of stresses that caused by external influences, such as human activities and others, which effected of the aquatic environment (Oberdorff et al 2002, Mohamed and Al-Jubouri 2017). Pyron et al (2019) indicated that fluctuations in water bodies and discharge rates strongly correlated with fish species composition and nature of fish populations. Habitat of the river environment, such as pool dimensions, and the amount of available cover, can correlate strongly with the structure of fish species (Diana et al 2006). River water provides services for ecosystems from local to global and works as ecological refuges as well as supply water for human and agricultural activities (Lehner et al 2011). Headwater streams and rivers provide ecosystem services from local to global and serve as ecological refuges and

supply water for human activities (Roa-Fuentes and Casatti 2017). Many studies were conducted earlier in different Iraqi environments on the quality of water and relationship to fish populations (Hameed and Aljorany 2011, Moyel and Hussain 2015, Mohamed and Abood 2017, Abduallh et al 2018). The current study aims to evaluate the fish population in selected sites of the Shatt Al-Arab River after fluctuating in the amount of water during the year of study and its relationship to some physical and chemical properties.

MATERIAL AND METHODS

The Shatt Al-Arab River is the one of major rivers in Iraq, consists of a convergence of the Tigris and Euphrates rivers of Qurna city northern Basrah Province, and flows to southeastern towards the Arabian Gulf (Fig. 1) and is about 204 km and with width from 250 m at Al-Qurna to more than 1,500 m (Mohamed and Abood 2017). Three sites on the Shatt Al-Arab River was selected, the first site was located between latitude 30° 52' 58" N and longitude 47° 31' 26" at the southeast of Qurna city in Sayed Nour Bridge, the second site was stretches between 30° 44' 52" N and 47° 41' 59"E in Saad Bridge and the third site were located between latitude 30° 40' 25" N and longitude 47° 45' 33" E in front of Al-Hartha power station (Fig. 1). Fishes and water samples were monthly collected from each site from October 2018 to September 2019. The water sample was in the middle of the river and a depth of 20 cm from the water surface. Some physical and chemical properties were measured, namely water temperature (°C), salinity estimated by YSI 556 MPS models 2005 and expressed in g/l, hydrogen ion (pH) estimated by Hanna instruments (a waterproof HI-9146). The dissolved oxygen, biological oxygen demand (BOD_5) were determined and turbidity with a turbid meter HI- 93703C in Nephelometric turbidity units (NTU). Fish samples were collected from each site; different fishing methods were adopted to collect such as, gill nets, fixed gill nets, seine nets and cast nets as well as observations from fishermen. Fishes were identified (Iwatsuki et al 2013, Freyhof et al 2017). Freshwater fishes and both groups were used to update the names of new families of Cypriniformes, the analysis of fish structure in the study sites was carried by the following methods and indices: relative abundance (Odum 1970), diversity index (H), evenness (E), richness index (D), dominance (D3) by (Kwak and Peterson 2007) and occurrence (Tyler 1971). Statistical program (SPSS) (ver. 17, 2011) (was used for analysis).

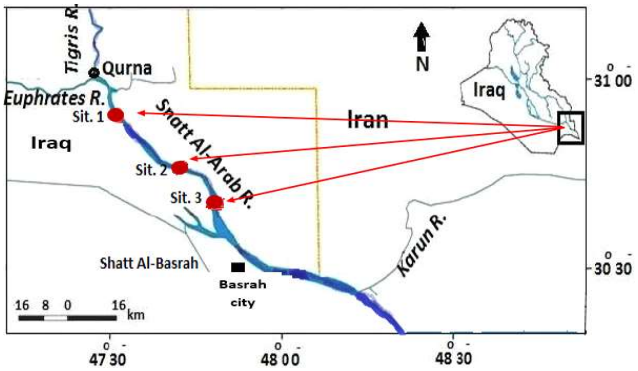

Fig. 1. Studying site

RESULTS AND DISCUSSION

Ecological properties: The lowest values of water temperature in three sites (11.2°C, 15.5°C and 12.5°C) recorded in January and the highest (30. 4°C, 31.8°C and 32°C) in the July and August (23.58°C, 25.40°C and 25.72°, respectively) and annual mean value 25°C (Table 1). The temperature of water effects on solubility and exchange of dissolved gases in the water samples in the three sites and the difference in temperature between sites may be due to the difference in the time of samples collection. Minimum values of salinity (1.5 g l^{-1}, 2.2 g l^{-1}, and 3.2 g l^{-1}) were in November in site one and October in sites 2and 3. Maximum salinity (3.8g l^{-1}, 6.3g l^{-1}) were in in April, August and July of sites one, two, and three respectively, and mean value 3.56 in all sites. Salinity fluctuated due to high water levels in the study sites, the relative higher salinity was observed in third site because anthropogenic activities, domestic effluent discharges and run-off with high suspended matter.

Table 1. Monthly variables in some environmental properties of sites study

Variables	Site 1		Site 2		Site 3		Study area
	Range	Mean+ SD	Range	Mean+ STDEV	Range	Mean+ STDEV	Mean+ STDEV
Water temperature	11.2 - 30.4	23.58 ± 4.60	15.5 - 31.8	25.40 ± 3.92	12.5 - 32	25.72 ±5.03	25 ± 5.4
Salinity	1.5 - 3.8	2.83 ± 0.52	2.2 - 3.8	2.88 ± 0.38	3.2 - 6.3	4.97 ± 0.71	3.56 ± 0.58
pH	7.3 - 8.2	7.8 ± 0.26	7.4 - 8.4	7.74 ± 0.24	7.1 - 8.6	7.81 ± 0.39	7.8 ± 0.2
Dissolved oxygen	6.6 - 8.3	7.86 ± 0.32	7.5 - 8.9	7.88 ± 0.51	6.5 - 8.6	7.64 ± 0.58	7.8 ± 0.56
BOD5	0.6 - 1.5	0.93 ± 0.22	0.4 - 1.3	0.83 ± 0.20	0.5 - 1.4	0.98 ± 0.25	0.91 ± 0.27
Turbidity	6.6 - 88	35.56 ± 26.74	5.6 - 43	15.67 ± 10.95	10.5 - 123	46.69 ± 44.8	32.36 ± 23.9

Hydrogen ion varied from 7.1 in July to 8.6 in October of site three with an average of 7.8. The hydrogen ion (pH) in the water at the study sites was within range of Iraqi inland water surfaces. The lowest values of dissolved oxygen (6.6 mg l^{-1}, 7.5 mg l^{-1} and 6.5 mg l^{-1}) in July of site one and August in sites two and three, the was8.3 mg l^{-1}, 8.9 mg l^{-1} and 8,6 mg l^{-1} in March and February of site one, two and three with mean value 7.8 mg l^{-1} in all sites. The lowest value of dissolved oxygen (DO) has indicated on the first site may be as result to receiving the sewage water, human activities, and animal waste into the river without treatment, which affects the exhaustion of dissolved oxygen, concentration of dissolved oxygen values within limited to the Standard Specification. The range values of biological oxygen demand (BOD_5) were recorded 0.4mg l^{-1} in February from site 2 to 1.5 mg l^{-1} in August at site one and the annual mean of twelve months 0.91 mg l^{-1}. The biological oxygen demand values in all sites of study are below 5mg l^{-1}. The observed turbidity value ranged from 5.6 NTU in June to 123.NTU in January for sites two and three respectively with mean value 32.36 ± 23.91. Results showed that values of turbidity in the study area above guideline of World Health Organization. Water temperature exhibited negatively correlated with dissolved oxygen (r = -0.79) and positively with salinity and biological oxygen demand ((r = 0.49, r= 0.73) respectively. The results of hydrogen ion values (pH) that noted weakly correlated (r = -0.08) with salinity. Dissolved oxygen (DO) was strong negatively correlated with the biological oxygen demand (r = -0.975). The physicochemical properties of water are one of the factors that effecting of water quality and have a role in the distribution and spread of living fauna especially the spread of fish in water bodies (Diana et al 2006).

Fish assemblage: A total of 35 species of fish were captured from the area of the sites of Shatt Al-Arab River which included 30 genera and 17 families (Table 2) (Al-Faisal and Mutlak 2012). A total of 2731 fishes caught from site one and ranged between 45 individuals in September for 420 to June, and the number of species differed from ten species in October, January, and September to 15 species in November (Table 2). The total number of 5631 individuals were recorded from site two, 256 individuals in May to 928 in December, while the number of species varied from eight in September to 17 species in March. Site three included 5381 individual and varied from 297 in January to 617 individual in April, and most of the fish species recorded in this site (34 species) and ranged between 11 species in May and November to 19 species in March. The difference was significant between the number of species in site two and three. There was significant difference in fish number at the three sites, also there are significant differences between the number of species in site two and three, the third site was characterized by an increase in the number of species compared to site one and two of the total catch, this result is agreed with (Abdullah et al 2017).

Water temperature was positively correlated with a number of species (r = 0.014314) and weak negatively to individuals (r = -0.31) (Fig 3). The number of fish species and an individual number are influenced by the rate of water

Table 2. The families' name, scientific name and habitat, which collected during the study period

Families	Scientific name	Habitat
Clupeidae	*Tenualosa ilisha*	M
	Nematalosa nasus	M
Engraulidae	*Thryssa whiteheadi*	M
	T. hamiltonii	M
Cyprinidae	*Carassius gibelio* +	F
	Carasobarbus luteus	F
	Cyprinus carpio +	F
	C. kais	F
	Garra rufa	F
	Luciobarbus xanthopterus	F
	Mesopotamichthys sharpeyi	F
Xenocyprididae	*Ctenopharyngodon idella* +	F
	Hemiculter leucisculus +	F
	Hypophthalmichthys molitrix	F
	H. nobilis	F
Leuciscidae	*Acanthobrama marmid*	F
	Alburnus sellal	F
	Leuciscus vorax	F
Bagridae	*Mystus pelusius*	F
Sisoridae	*Glyptothorax* sp.	F
Siluridae	*Silurus triostegus*	F
Heteropneustidae	*Heteropneustes fossilis* +	F
Mastacembelidae	*Mastacembelus mastacembelus*	F
Cichlidae	*Oreochromis aureus* +	F
	Coptodon zillii +	F
	Oreochromis niloticus +	F
Cyprinodontidae	*Aphanius dispar*	F
Poeciliidae	*Gambusia holbrooki* +	F
	Poecilia latipinna +	F
Mugilidae	*Planiliza abu*	F
	P. subviridis	M
	P. klunzingeri	M
Hemiramphidae	*Hyporhamphus limbatus*	M
Sillaginidae	*Silago sihama*	M
Sparidae	*Acanthopagrus arabicus*	M

Freshwater fish = F, Marine fish = M, Alien species = +

temperature (Al-Helli et al 2019). The correlation of salinity was positively and negatively, with the species and individuals number (r = 0.641, r = -0.427) respectively (Mohamed and Abood 2017). Hydrogen ion was positively correlated with species and individuals number (r = 0.140, r = 0.169), Simlar trend was indicated by (Lazem and Attee 2016). Dissolved oxygen was weak negatively correlated with the total number of species, (r = -0.01) and positively with the number of individuals (r = 0.17). The biological oxygen demand was a weakly positive correlation (r = 0.017) with the number of species and negatively (r = -0.079) with the number of individuals respectively, that conformed by (Hussein et al 2015). The values of turbidity was weakly positive correlation (r = 0.057) and negatively (r = -0.22) with species and individuals number, this was recorded of waters Iraqi inland (Hussein and Atte 2000, Younis et al 2001).

Relative abundance: The total number of individuals' fish in the study area was 13743 individuals; the lowest number of individuals' fish (908) was caught in August and the highest (1800) in December. The number of species differed from 17 in November to 22 in December and February and varied 0.01to 24.62 to %. Results explained that the fish was dominated by *C. gibelio* and range from 13% in April to 33.8% in February of total catch. *P.abu* including 23.79% of the individual total number and ranged from 13.9 in February to 31% in July. *O. aureus* was 21.81% of the total catch in study site with a range of 7.7% in October to 33.4 in November. *C. zillii* comprised 20.12% and varied from 13.8% in July to 31.4% in February, followed by *L. vorax* in the rate of 1.86% and differed from 0.2% in February to 4.7% in August of the total catch in the study area. Other species ranged from 1.22% (*C.luteus*) to 0.02% (*G. holbrooki*) were explained in Table 2. The minimum of relative abundance were recorded for each of the following fish species *Glyptothorax sp., L.klunzingeri, A. dispar, T. hamiltonii, S. sihama, C. kais* and *H. nobilis* as it formed 0.01% of the total number of individuals in the study sites. The most relative abundance species (*C. gibelio, P. abu*, *O. aureus,* and *C. zillii*) were dominated of the catch of individuals in all sites that previously mentioned by (Abdullah 2017), but it differs in the order of species of the total number and the rest species were varied from *L. vorax* to *A. dispar, T. hamiltonii, S. sihama, C. kais* and *H. nobilis*, these fish species were recorded by (Al-Noor and Abdullah 2015, Mohamed et al 2012).

The number of native species was 13 ranged from six species in September to 11 in February and April and the total number of individual 9409 and in proportion 68.46% (Table 2 & 3). A number of alien species differ between six in November and April to nine in December of total 13 species and total number 4092 and represented 29.77%, while the number of marine species was nine varied from two in January, April and May to seven in September and a total number of individual 242 and included 1.76%. The fish species number of native, alien, and marine agreed with (Al-Faisal et al 2014) in the presence of alien species.

Ecological indices: The value rate and standard division of diversity status during the months of the study area (Fig. 3). The values mean and standard deviations of the diversity indices 1.53 ± 0.50, 0.51 ± 0.12 and 2.66 ± 0.17 respectively. The values ranged of Shannon and Weaver diversity index (H) 0.43 in September to 1.99 in March. The values varied of Evenness (E) 0.15 in August and September to 0.65 in March and the minimum of Margalef richness (D) 2.30 in November and the highest 3.02 in February. The result correlation of diversity index showed that weak positively (r = 0.007), and the correlation was negative (r = -0.07) of Evenness (E) with species number, on anther hand there was a strong positive correlation (r = 0.93) between a number in species of Margalef richness (D). Three species of fish (*C.* gibelio), *P. abu* and *O. aureus*) which included 70.2175% of the total

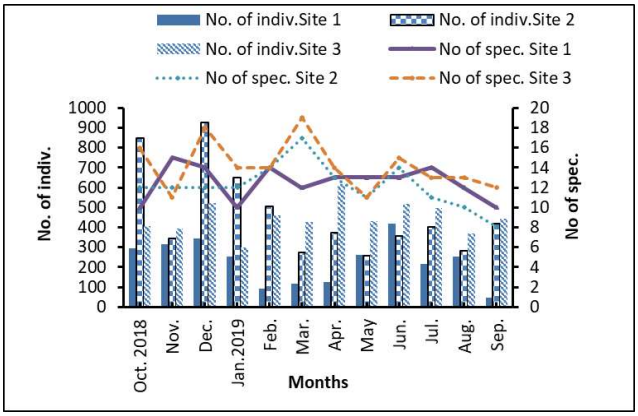

Fig. 2. Monthly variations in the number individuals and fish species in three sites

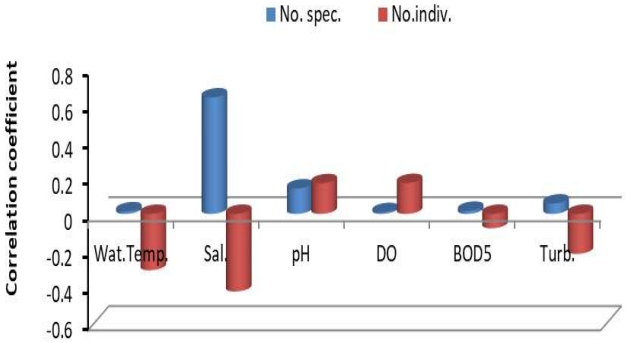

Fig. 3. Relationship of some ecological factors with the number of fish spices and individual in three sites (2018 to 2019)

Table 2. Relative abundance in a number of fish individuals of the Shatt- Al-Arab River from October 2018 to September 2019

Species	Oct.2018		November		December		Jan.2019		February		March		April		May		June		July		August		September			
	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Total	%
C. gibelio +	521	33.6	177	16.7	508	28.2	384	32.0	356	33.8	197	24.6	144	13.0	169	17.8	284	22.1	238	21.4	168	18.5	238	25.9	3384	24.62
P. abu *	443	28.6	307	29.0	433	24.1	182	15.2	147	13.9	140	17.5	297	26.9	184	19.4	339	26.4	345	31.0	218	24.0	234	25.4	3269	23.79
O. aureus +	120	7.7	353	33.4	302	16.8	354	29.5	140	13.3	171	21.4	310	28.1	263	27.7	318	24.7	277	24.9	230	25.3	159	17.3	2997	21.81
C. Zillii +	381	24.6	149	14.1	359	19.9	198	16.5	331	31.4	164	20.5	236	21.4	191	20.1	230	17.9	153	13.8	171	18.8	202	22.0	2765	20.12
L. vorax *	21	1.4	9	0.9	36	2.0	18	1.5	2	0.2	21	2.6	16	1.4	9	0.9	32	2.5	24	2.2	43	4.7	25	2.7	256	1.86
C. luteus *					42	2.3	12	1.0	7	0.7	25	3.1	19	1.7	36	3.8	5	0.4	12	1.1	9	1.0			167	1.22
A. sellal *	10	0.6	3	0.3	41	2.3	13	1.1	19	1.8	15	1.9	9	0.8	7	0.7	6	0.5	6	0.5	9	1.0			138	1.00
T. ilisha #			3	0.3	4	0.2	6	0.5	3	0.3	18	2.3	38	3.4	53	5.6	1	0.1			3	0.3	3	0.3	132	0.96
C.carpio +	14	0.9	13	1.2	11	0.6	10	0.8	2	0.2	8	1.0	5	0.5	6	0.6	14	1.1	3	0.3	13	1.4	22	2.4	121	0.88
S. triostegus *	9	0.6	8	0.8	12	0.7	5	0.4	3	0.3	3	0.4	5	0.5	6	0.6	13	1.0	3	0.3	5	0.6	10	1.1	82	0.60
*M. mastacemblus**	1	0.1	7	0.7	9	0.5	2	0.2	2	0.2	6	0.8	8	0.7	4	0.4	6	0.5	8	0.7	10	1.1	6	0.7	69	0.50
O.niloticus +	5	0.3	6	0.6	14	0.8	5	0.4	2	0.2	6	0.8	3	0.3			6	0.5			3	0.3	6	0.7	56	0.41
A. marmid *	1	0.1	1	0.1	10	0.6	1	0.1	15	1.4	7	0.9	4	0.4					3	0.3			1	0.1	43	0.31
H.leucisculus +	6	0.4	5	0.5	4	0.2	2	0.2	9	0.9	2	0.3			4	0.4	3	0.2	3	0.3					38	0.28
P. subviridis #	4	0.3	6	0.6	2	0.1					5	0.6					7	0.5	3	0.3	5	0.6	1	0.1	33	0.24
G.rufa *	9	0.6	6	0.6	1	0.1	2	0.2	4	0.4	2	0.3	2	0.2	4	0.4	1	0.1			1	0.1			32	0.23
P. latipnnia +					2	0.1	3	0.3	1	0.1					3	0.3	11	0.9	9	0.8	3	0.3			32	0.23
T. whiteheadi #	1	0.1							4	0.4	2	0.3			6	0.6			9	0.8	8	0.9			30	0.22
A. arabicus #	2	0.1			2	0.1			3	0.3							4	0.3	8	0.7	4	0.4	1	0.1	24	0.17
M. pelusius *			4	0.4	4	0.2			1	0.1	3	0.4	2	0.2	1	0.1			4	0.4	1	0.1	2	0.2	22	0.16
H. limbatus #							1	0.1			2	0.3	2	0.2			2	0.2	1	0.1			2	0.2	10	0.07
N. nasus #					2	0.1					2	0.3									2	0.2	3	0.3	9	0.07
M. Sharpyi *													3	0.3	**2**	0.2	3	0.2							8	0.06
C. idella +					1	0.1			1	0.1			1	0.1					2	0.2					5	0.04
L.xanthopterus *									1	0.1			1	0.1			1	0.1							3	0.02
H.fossilis +					1	0.1					1	0.1									1	0.1			3	0.02
H. molitrix +																							3	0.3	3	0.02
G. holbrooki +	2	0.1													1	0.1									3	0.02
Glyptothorax sp. *	1	0.1							1	0.1															2	0.01
L. klunzingeri #			1	0.1																			1	0.1	2	0.01

Cont...

Table 2. Relative abundance in a number of fish individuals of the Shatt- Al-Arab River from October 2018 to September 2019

Species	Oct.2018		November		December		Jan.2019		February		March		April		May		June		July		August		September		
	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Num.	%	Total	%
A. dispar *																					1	0.1			1	0.01
T. hamiltonii #																							1	0.1	1	0.01
S. sihama #																			1	0.1					1	0.01
C. kais +																							1	0.1	1	0.01
H. noblis +							1	0.1																	1	0.01
No. of individuals	1551		1058		1800		1199		1054		800		1105		949		1286		1112		908		921		13743	
No of species	18		17		22		18		22		21		19		18		20		20		21		20			
No. of native specis	8		8		9		8		11		9		11		9		9		8		9		6			
No. of alien specis	7		6		9		8		8		7		6		7		7		7		7		7			
No.of marine specis	3		3		4		2		3		5		2		2		4		5		5		7			

Alien species, (*) native species, (#) marine species (+)

species number according to dominance index. The biodiversity indices of the water bodies are affected by the abundance of fish species. The values of the diversity index, Evenness and Margalef richness indicated that they are poor, unbalanced and troubled respectively in the study area, and this may be due to correlation of fish species with the values of physicochemical factors of study sites (Hussain et al 2009).

Occurrence: The species of fish that catch during the study period can be classified, into three groups (Table 2, Fig. 4). The common fish were 16 species and consisted of *C.* gibelio, *P.abu, O. aureus, C. Zillii, L. vorax, C. carpio, S. triostegus, M. mastacemblus, C. luteus, A.* sellal, *A. marmid, H. leucisculus*, *O. niloticus*, *T. ilisha, G. rufa* and *M. pelusius*,

Table 3. Monthly variation of the native, alien and marine species number in three sites from 2018 to 2019

Months	No. of native sp.	No of alien sp.	No. of marine sp.	No. of individuals
October 2018	8	7	3	1551
November	8	6	3	1058
December	9	9	4	1800
January 2019	8	8	2	1199
February	11	8	3	1054
March	9	7	5	800
April	11	6	2	1105
May	9	7	2	949
June	9	7	4	1286
July	8	7	5	1112
August	9	7	5	908
September	6	7	7	921
Total	9409	4092	242	13743
Relative abundance	68.46%	29.77%	1.76%	100%

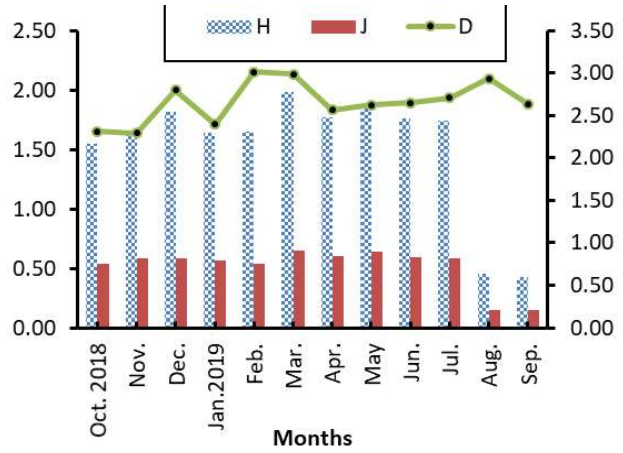

Fig. 3. Monthly variations of ecological indices in study sites from 2018 to 2019

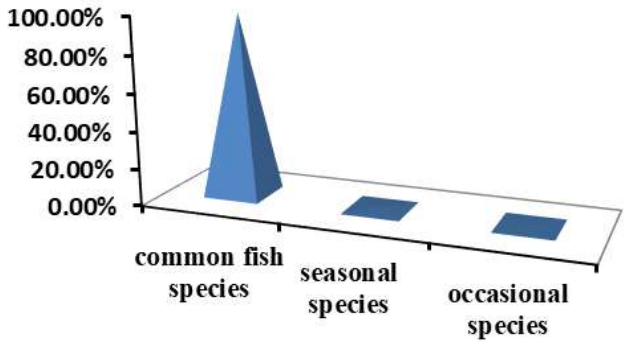

Fig. 4. Fish presence ratios according to their appearance in the monthly samples of study sites

and in proportion 98.74% of the total number catch. These species appeared in 9 to12 months during the study period, this result is compatible with (Abdullah 2017) but it differed in the presence of some species of fish in different months of the study period. The seasonal of fish species contain five species (*P. subviridis, P. latipnnia, T. whiteheadi, A. arabicus, H. limbatus*) and represented 0.93% of the total catch. The occasional species comprised 14 species belongs to the *N. nasus* species and *H. nobilis*, and included 0.32% of the total catch. The seasonal and occasional fish species was compatible with (Mohamed et al 2015) in some species that appeared during the study period.

CONCLUSIONS

Three fish species (*C. gibelio, P. abu,* and *O.aureus*) which included 70.21% of the total number of catch. Fish species were classified into three groups according to their presence in the monthly samples, the common fish species were 16 species. The seasonal fish contain five species and represented 0. 93 % of the catch, while, the occasional fishes comprised 14 species and formed 0.32% from the catch. This study indicates that the number of fish species caught was 35 species, and this may be attributed to the low and high levels of water during the study period.

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