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Study of Fish Assemblages in Two Selected Stations in the Shatt al-Arab River After the Decline of Salt Incursion

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ABSTRACT

Forty-eight species of the Osteichthyes fish were obtained in two selected stations in the Shatt al-Arab River (Sindbad and Abu -Al-Khaseeb) after the decline of salt incursion during the study period extending from January 2019 to December 2019, with all species present in the first station and 34 species at the second station. The number of native species in the first station was 11 species, and 8 species in the second, as well as, the number of alien species reached eight species in each station, while the number of marine species reached 29 and 18 species for the first and second stations, respectively. 4189 fish were caught from the study area, including 2879 in the first station and 1310 fish in the second station. The results of the numerical abundance showed that two species constituted 61.65% of the number of individuals of the species caught from the first station; these are *P. abu* (1090) fish, equivalent to 37.86% and *C. auratus* (685) fish, with a percentage of 23.79%. Additionally, four species comprised 56.3% of the total number of fish caught at the second station: *C. auratus* (240 fish, 18.3%), *P. latipinna* (193 fish, 14.7%), *P. abu* (167 fish, 12.7%), and *O. aureus* (139 fish, 10.6%). The overall diversity, richness, and evenness index value of the first station were 2.1 (0.88- 2.13), 5.9 (1.47- 3.65), and 0.54 (0.33-0.79) and for the second station were 2.6 (1.81- 2.48), 4.6 (1.33- 3.53) and 0.72 (0.77- 0.93), respectively.

INTRODUCTION

The Shatt al-Arab River is the primary source of surface water in Iraq, extending from the North of Basrah to the South, where it flows into the gulf. The water source of the Shatt al-Arab River comes from the Tigris and the Euphrates rivers flow within Iraq, and the rivers of Karkheh and Karon flow within the Iranian lands. Because of the scarcity of water, the Euphrates River was cut as a feeder for the Shatt al-Arab River, and the water was used for feeding the Al-Hammar marshes, as Iran cut off the waters of Karkheh and Karon rivers to reach the Shatt al-Arab. Hence, the Tigris River becomes the only source of freshwater feeding **(Al-Asadi, 2017)**.

Shatt al-Arab River is affected by many factors, natural and human **(Al-Asadi *et al*, 2019)**. The salinity coming from marine water is the most crucial cause of the salinity of the Shatt al-

Arab River, as well as salty water from sewage and drainage channels. In addition Shatt al-Arab water suffers from organic pollution, resulting from the discharge of the domestic sewage **(Al-Asadi & Alhello, 2019)**.

Fish community literature are characterized by their importance in giving the nature and composition of fish stocks, in addition to the fact that the fish caught in these studies from several locations provide an accurate information about commercial and non-commercial fish, and about the distribution of fish according to the total length of the different species, and an estimate of their stocks, growth, and mortality, as well as determining the breeding seasons **(Carlsoon *et al,* 2000, Korsbrekke *et al.,* 2001; Pennington *et al*., 2002)**.

Studies have been conducted on the fish assemblages in the Shatt al-Arab River, including **Yaseen (2016)**, **Mohamed and Hameed (2019)**, **Aldoghachi and Abdullah (2021)** and **Yaseen *et al*. (2024)**. The current study aimed to investigate the nature of the fish assemblage in two selected stations in the Shatt al-Arab River after the decline of salt incursion.

MATERIALS AND METHODS

The study was conducted in the central part of the Shatt al-Arab River, and samples were monthly gathered from two locations in this part (Fig. 1) from January to December 2019. The first is the Abu Al-Khasseb (station 1), south of the Abu Al-Khasseb region (30 ° 46′ 37″ N, 47 ° 77′ 11″ E). This site is affected by the water coming from the city center of Basrah during the tidal period and the water coming from the Arabian Gulf during the tidal period. The second is Sinbad (station 2) north of Sinbad Island (30° 58′16″N, 47°77′11″E), where the water level is affected by the movement of tides and many small boats passing through this station. There are agricultural lands from the east, so large quantities of agricultural drainage water flow into this area. The area is also affected by sewage and water from the electric power station of Najibiyah. *Phragmites australis, Vallisneria spiralis, Typha domingensis,* and *Ceratophyllum demersum* were widespread and predominant on the banks of both sites, both locations abound in fishing operations using different fishing gear.

Fish samples were collected from both sites using drift gill nets (200– 500m long with a mesh size of 25 × 25mm) and cast nets (8m diameter with a mesh size of 15 × 15mm). Moreover, electro-fishing by generator engine (provides 500V and 10A), is especially used in areas where aquatic plants abound and where the use of nets is difficult.

Fish were counted and classified according to their species following **Al-Faisal (2020)**, **Fricke *et al*. (2021)** and **Coad (2017)**. In addition, water and air temperature (°C) and salinity (‰) in each site were measured using YSI portable instrument model 556 MPS, and water hydrogen ion concentration (pH), water electrical conductivity (EC), and water salinity (‰) were measured directly in the field by using digital portable WTW Multi-meter model (Multi 350i meter). The light penetration (Cm) was determined using a Secchi disc with a diameter of 20cm and dyed in black and white colors, and the total dissolved solids (TDS) were measured in the field using a US-made YSI device from Kalbuneh Company.

The analysis of fish assemblage followed the method of **Huang *et al*. (2019)** for measuring fish diversity index and Shannon index. This method was described by **Walag *et al.* (2016)** for calculating relative abundance. Evenness and richness indices were calculated according to **Nyitrai *et al.* (2012)**. The jaccared similarity index of fish species between both sites was calculated according to the equation of jaccard **(Augsten & Bohlen, 2022)**.

Fish species were categorized according to their occurrence in the monthly samples following the guidelines of **Vieser *et al*. (2018)**.

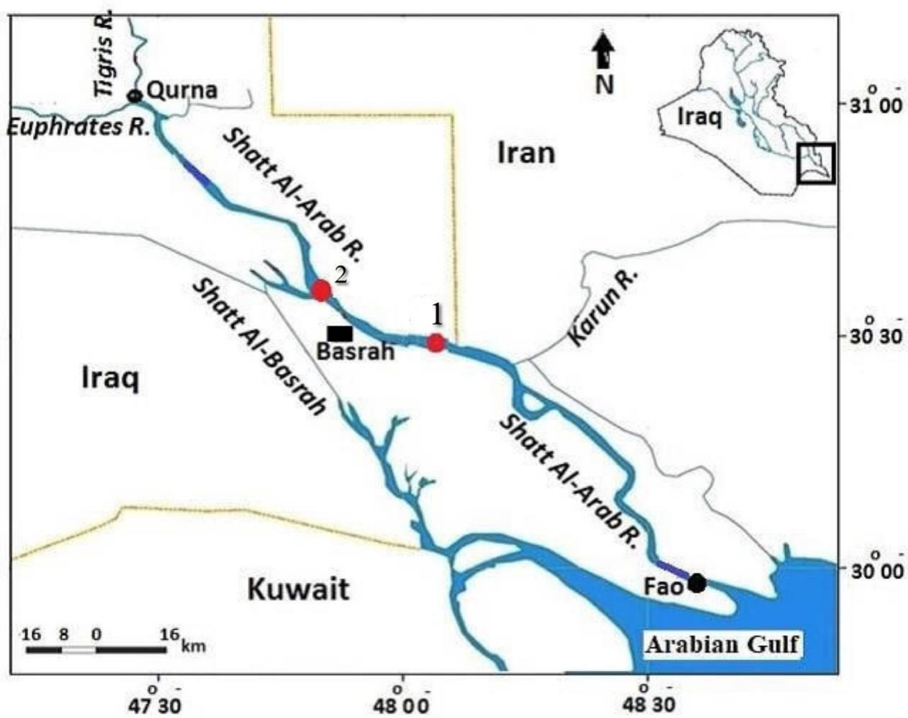

Fig. 1. Map of Shatt al-Arab with locations of study sites

1. Abu -Al-Khasseb station 2. Sindbad station

RESULTS

Air Temperature (A.T)

Monthly variations in air temperature were examined in the study areas. Air temperature changed during the studied period, with a minimum value of 17.0°C measured in January at stations 1 and 2, while the maximum value was 42.0°C examined in June at station 2 (Fig. 2).

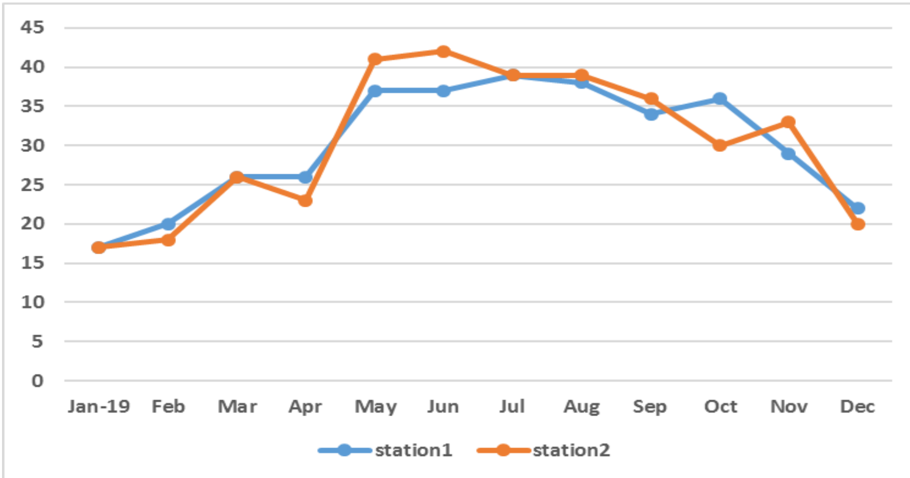

Fig. 2. Monthly variations in air temperature (°C) of two studied stations in Shatt al-Arab River from the period January to December 2019

Water temperature (W.T)

Water temperature varied during the study period; the minimum value of 18.0°C was recorded in December in stations 1 and 2 and in January at station 2, and the maximum value of 32.0°C was tested in May and June at station 2 (Fig. 3).

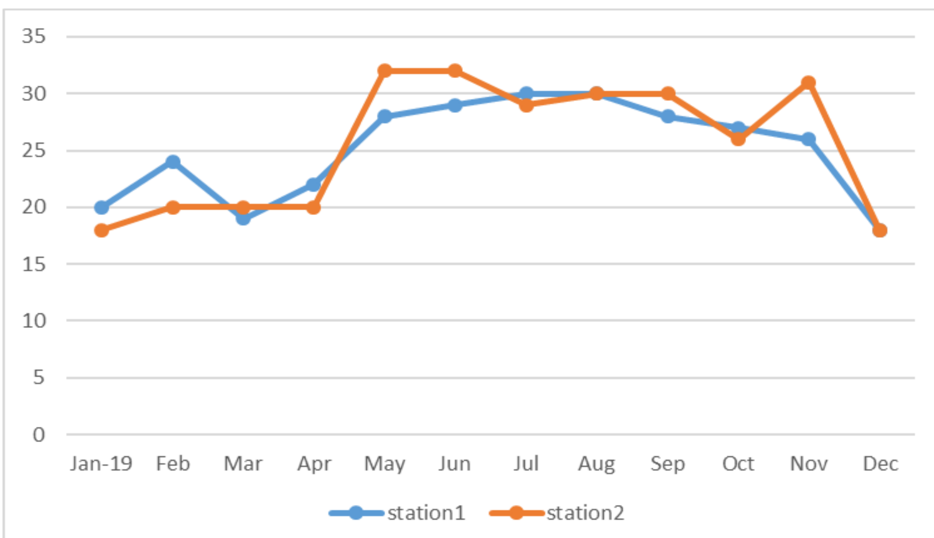

Fig. 3. Monthly variations in water temperature (°C) of Abu-Al-Khaseeb and Sindbad stations

Salinity (‰)

Monthly variations in water salinity were tested; the present study showed that the variances in water salinity values ranged from 1.1% in March at station 1 to 2.6% in February at station 2 (Fig. 4).

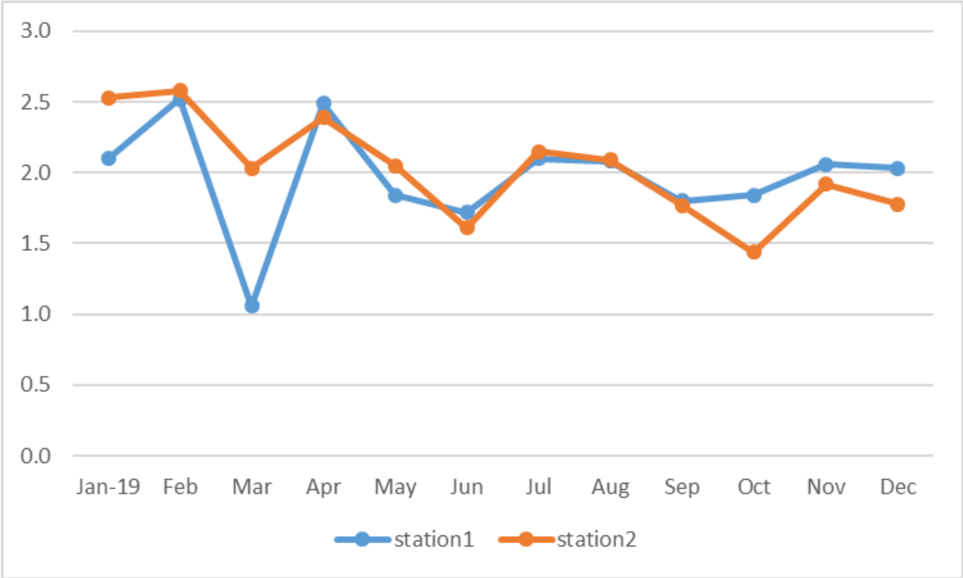

Fig. 4. Monthly variations in salinity (‰) of two studied stations

Hydrogen ion concentration (pH)

The monthly fluctuations in the pH values are shown in Fig. (5). The minimum value of 8.1 was recorded in April at station 2, while the maximum value of 9.2 was recorded in July at stations 1 and 2.

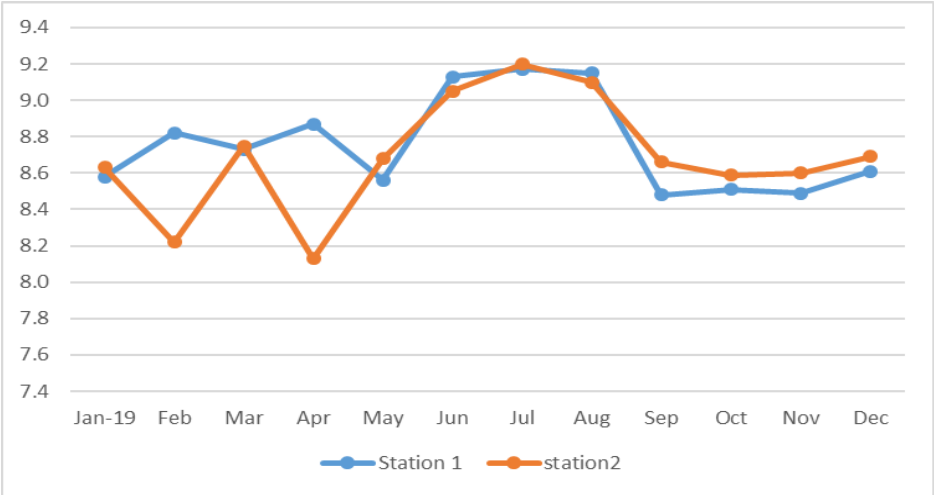

Fig. 5. Monthly variations in pH of two studied stations of Shatt al-Arab River from January 2019 to December 2019

Electrical conductivity (EC)

The minimum value of EC was 2.0, tested in March at station 1, while the maximum value was 5.0, recorded in January at station 2 (Fig. 6).

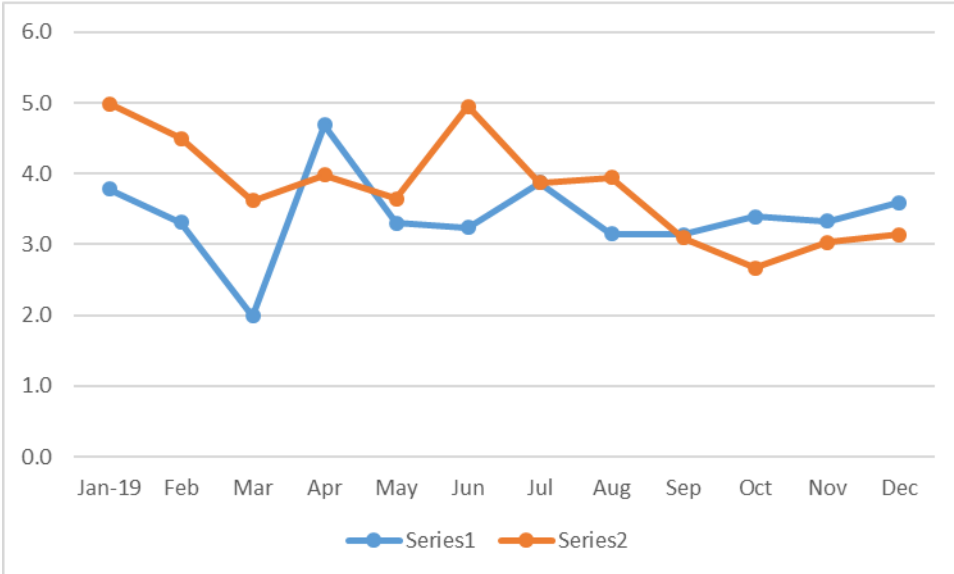

Fig. 6. Monthly variations in electrical conductivity (EC) of Abu-Al-Khaseeb and Sindbad stations

Light penetration (Cm)

The results of light penetration showed that the highest values were obtained at station 2 and reached 78cm in March, while the lowest values of 30cm were obtained in October at station 1 and May at station 2 (Fig. 7).

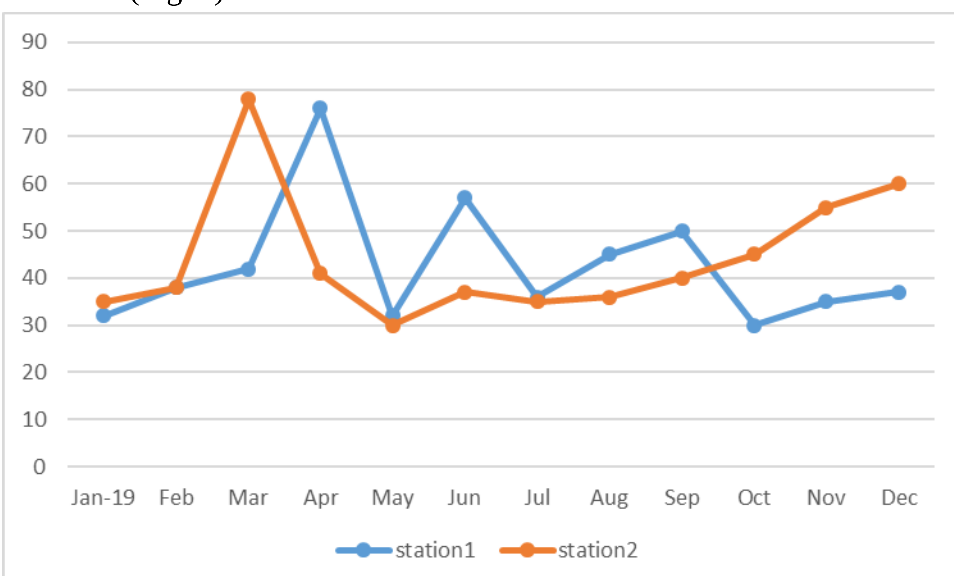

Fig. 7. Monthly variations in light penetration (cm) of two studied stations

Total dissolved solids TDS

Fig. (8) exhibits the monthly changes in the TDS values during the study, as the lowest values were recorded (1.3) in March at station 1, while the highest values (3.17) were recorded in June at station 2.

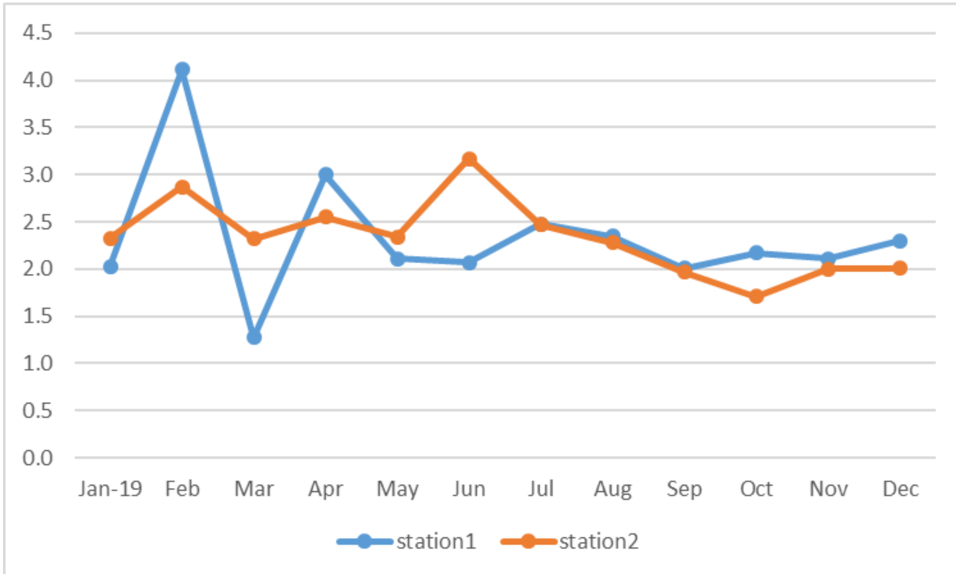

Fig. 8. Monthly variations in TDS of two studied stations of the Shatt al-Arab River

The composition of the species and number of fish

Forty-eight species of the Osteichthyes fish were obtained during the study period extending from January 2019 to December 2019, all of which appeared at the first station (Abu -Al-Khaseeb), and 34 species were present at the second station (Sinbad). Fourteen species appeared at the first station and did not appear at the second station, including *Triacanthus biaculeatus*, *Solea stanalandi*, *Otolithes ruber*, *Cynoglossus kopsii*, *Johnius belangerii*, *Platycephalus indicus*, *Plicofollis dussumieri*, *Solea elongta*, *Strongylura strongylura*, *Cynoglossus arel*, *Plicofollis layavdi*, *Luciobarbus xanthopterus*, *Luciobarbus pectoralis*, and *Arabibarbus grypus*. The results of the similarity coefficient in the qualitative composition using the Jaccared similarity coefficient showed that the similarity rate between the two stations was 70.8%. The highest similarity percentage (80%) was between January and February at the first station (92.3%), and between August and September at the second station, and the lowest were (24%) between July and February and (29.4%) between January and April in addition to January and July for the first and second stations.

Fig. (9) shows the cluster analysis of the degree of similarity between the months in the fishing samples using the Jaccard similarity index, as the evidence relied on the presence or absence of the species, as the figure shows the presence of four main groups of months in the first station at a similarity level of 98%. The first major group included August at a similar level of 80%. The second main group consisted of two secondary groups, the first secondary group included September and October at a similar level of 60%, the second secondary group included November only at a similar level of 70%, while the third main group included two secondary groups, the first included May and June at a similar level of 50% and second secondary of July at a similar level of 65%. In contrast, the fourth main group included three secondary groups, the first secondary group included February only at a similar level of 50%; the second secondary group included March and April at a similar level of 40%, and the third secondary group included January only at the similarity level of 70%.

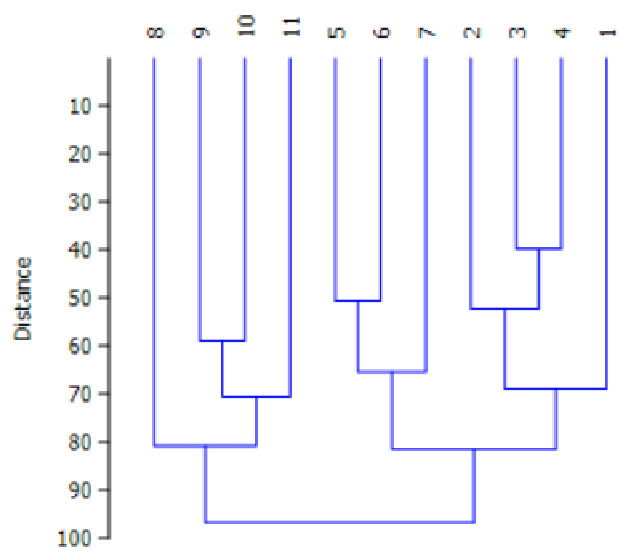

Fig. 9. Cluster analysis of similarity degree in the species composition for fish samples at station 1 using Jaccard similarity index (%)

There were four main groups found at station 2 at a similarity level of 80%. The first major group included two secondary groups; the first included September and October at a similar level of 67%, and the second secondary group included August only. The second main group included June and July at a similar level of 60%, the third main group included November only, and the fourth main group of December at a similar level of 85%. In contrast, the fourth main group included three secondary groups, the first secondary group had April and May at a similar level of 48%, the second secondary included March only at a similar level of 35%, and the third secondary of January and February at a similar level of 30% (Fig. 10).

Fig. (11) shows the monthly changes in the number of species of fish caught from the study stations. The first station ranged between 9 in January and February 2019, twenty-two species were recorded in July, and the second station was distributed among seven species in January and 18 in May.

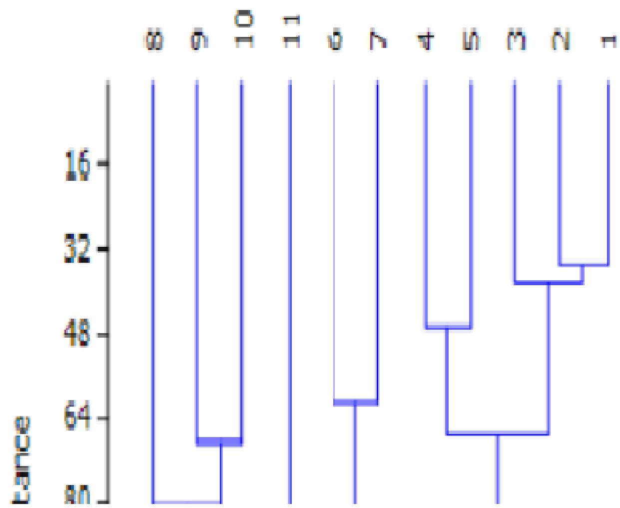

Fig. 10. Cluster analysis of similarity degree in the species composition for fish samples at station2 using Jaccard similarity index (%)

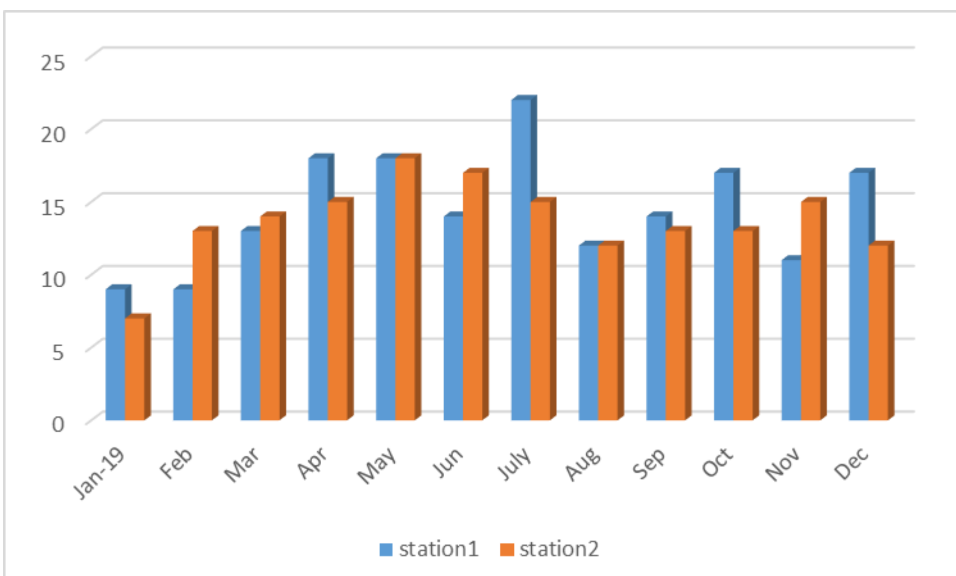

Fig. 11. Monthly variations in the total number of captured fish species at two studied stations

The number of native species at the first station was 11 species; their highest appearance was (8) in July, while no species of this group were recorded in March, and (8) species at the second station ranged between 4 species in June and one species in January and April, August and September, while the number of alien species reached eight species at the two stations, ranging between 6 species in January, April, August, September and December, and 5 species in the remaining months at the first station, and also ranged between 6 also in February, May, June, August, September, and December to 3 species in April at the second station, and the number of marine species reached 29 and 18 species for the first and second stations, respectively, ranging from 10 in April and October to one species in January and February at the first station, and 11 species in April to two species in January at the second station (Table 1).

According to **Vieser *et al*. (2018)**, the fish catch at Abu -al-Khaseeb and Sindbad stations is divided into three categories, including eight common species, two seasonal species, and thirty-eight rare species at the first station and eight common species, five seasonal species, and twenty-one rare species at the second station. At station 1, the common species recorded eight species where two species in all study months which included *C. auratus* and *O. aureus,* and the presence of only two species of *P.latipinna* and *C. zilli* during 11 months. Hence, *P. abu, O. niloticus and T. illisha* species appeared in 10 months, while only one species *C. carpio* was found throughout 9 months. The seasonal species at station 1 included two species, *T. whiteheadi* and *T. vitriastrsis* that appeared in eight months, as well as the rare species, including thirty-eight species, appeared in 1- 5 months (Table 2).

For station 2, the common species revealed eight species that appeared, four species in all study months, including *C. auratus* , *P. latipinna* , *O. aureus,* and *T. illisha.* The presence of four species of *P. abu, C. zilli, T. whiteheadi,* and *T. vitriastrsis* was recorded throughout 11 months. At station 2, the seasonal species included two species, *C. carpio* and *O. niloticus*, which appeared for 8 months. Additionally, *B. fuscus* was observed for 7 months, and *P. bindus* for 6 months. In addition, the rare species at station 2 were observed with twenty-one species covering 1- 5 months (Table 2). 2520,150, and 209 fish of common, seasonal, and rare species were caught at the first station, and 1087, 127, and 96 fish were caught in the second station, which is equivalent to 87.5, 5.2, 7.3, 83, 9.7 and 7.3% of the total number of fish caught at the first, second stations, respectively.

The results of the correlation coefficient (r) showed that the degree of pH, EC, transparency, water, and air temperature has a positive correlation with the number of species, where the value of r was .204, .358, .136, .540 and .248, respectively, while TDS and salinity values showed a negative correlation with the number of species and reached -.111 and -.035, respectively.

Number of fish and their numerical abundance

Four thousand one hundred eighty-nine fish were caught from the study area, including 2879 at the first station. Their number ranged between 85 in November and 572 in September, and 1310 fish at the second station, and it varied between 85 also in October and a maximum of 134 in September (Fig. 12).

The total number of individuals of native species was 1136 and 197 fish, equivalent to 39.5 and 15.0% of the total fish caught for the first and second stations, respectively. It ranged between

422 fish in September, while no individuals of this group were recorded in March for the first station and between 33 fish in July to two fish in January at the second station, while the total number of individuals of alien species reached 1482 fish, equivalent to 51.5%, and ranged from 38 fish in November to 224 fish in July at the first station, and 751 fish, or 57.3% at the second station and ranged between 49 fish in October to 83 fish in March and May. Regarding the marine fish, the total number reached 623 fish, of which 261 fish were at the first station and 363 fish at the second station, which is equivalent to 9.1 and 27.6% of the total number of fish caught at the first and second stations, respectively, and ranged between eight fish in June, August, and November to 43 fish in March for the first station, and twelve fish in November to 64 fish in April for the second station.

The results of the numerical abundance showed that two species constituted 61.65% of the number of individuals of the species caught at the first station. They are in the order as follows: The species *P. abu* (1090 fish), equivalent to 37.86% of the total number of fish caught, and its relative abundance varied between 73.4% in September, indicating the disappearance of this species in March and October, and the species *C. auratus* (685 fish), with a percentage of 23.79%, and its relative abundance ranged between 42.7% in February to 6.8% in June, and four species formed 56.3% of the total number of fish caught in the second station are: *C. auratus* (240 fish), with a percentage of 18.3%, and its relative abundance ranged between 38.1% in November to 10.6% in April, and *P. latipinna* (193 fish), with a percentage of 14.7%, and its relative abundance ranged from 33.0% in February to 3.16% in August, and *P.abu* (167 fish) reached 12.7%. Its relative abundance ranged from 26.8% in November to the disappearance of this species in January and October. The species *O. aureus* (139 fish), equivalent to 10.6% of the total number of fish caught at the second station, and its relative abundance ranged between 21.74% in January to 3.23% in June (Table 1).

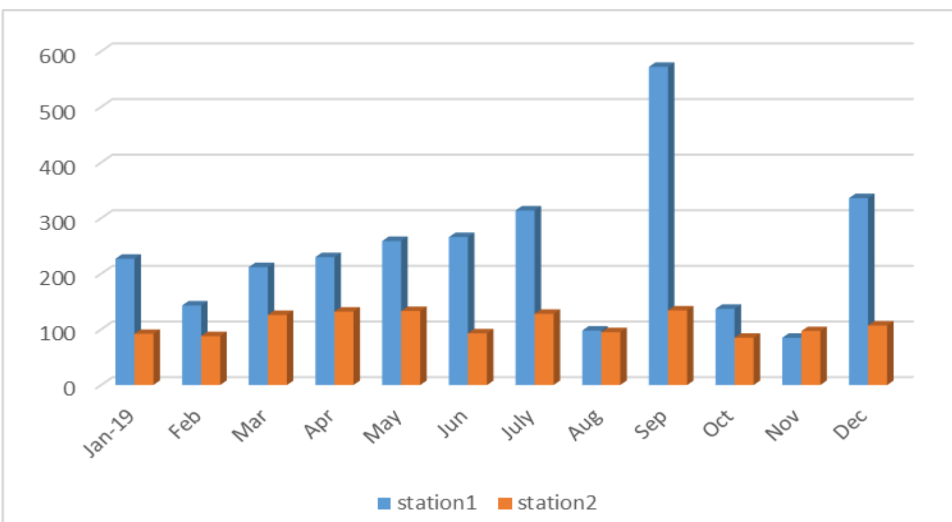

Fig. 12. Monthly variations in the total number of catch individuals at two stations

The results of the correlation coefficient (r) showed that the degree of EC, transparency, water, and air temperature has a positive correlation with the number of individuals, where the value of r was .043, .209, .110 and .023, respectively, while PH, TDS, and salinity values showed a negative correlation with the number of species and reached -.162, -.209 and -.183, respectively.

Ecological indices

The overall value of the Shannon (H) index at Abu -Al-Khaseeb and Sindbad stations was recorded at 2.1 and 2.6, respectively. The monthly variations in Shannon index values at station 1 varied from 0.88 in June to 2.13 in April, while at station 2, it ranged between 1.81 in January and 2.48 in May (Fig. 13).

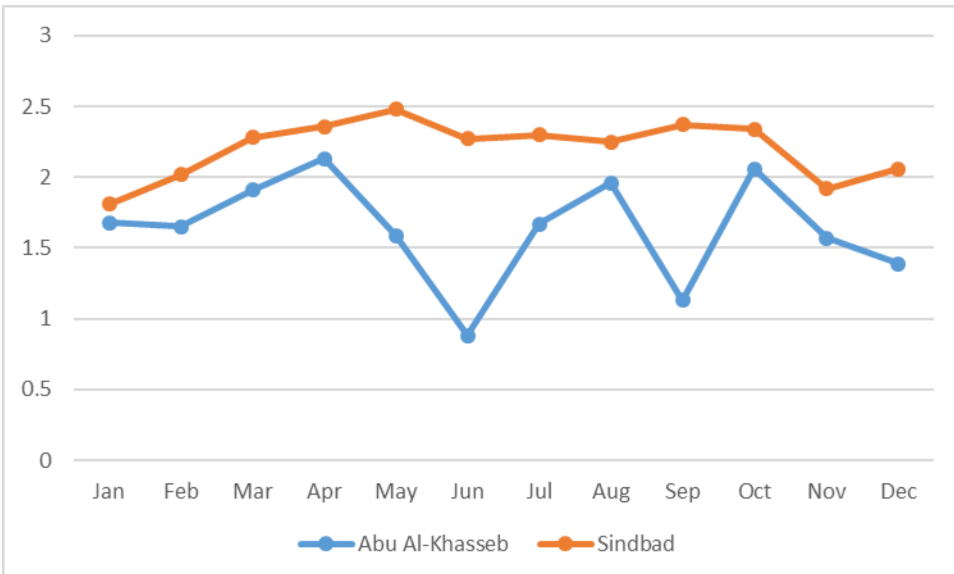

Fig. 13. Monthly variations in the diversity (H) index values of two stations during the study period

The results of the correlation coefficient (r) showed that the degree of EC, TDS, and salinity has a positive correlation with the diversity index (H), where the value of r was .163, .140, and .173, respectively, while PH, transparency, water, and air temperature showed a negative correlation with the number of species and reached -.001, -.023, -.125 and -.211, respectively.

The results of the present study showed that the overall value richness (D) index value achieved 5.9 and 4.6 for the first and second stations, respectively. The results showed different richness (D) index values among the current study's two stations. In station 1, the lowest richness index (D) value, 1.47, was in January, while the highest value, 3.65, was found in July. In station 2 lowest (D) value, 1.33, was reocrded in January, while the highest value, 3.53, was recorded in June (Fig. 14).

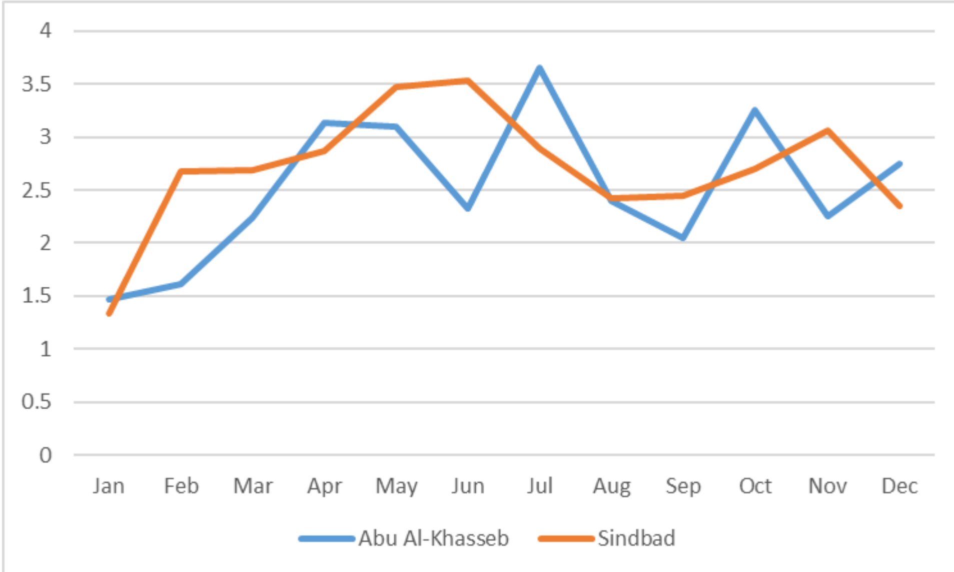

Fig. 14. Monthly variations in the Richness index (D) values of Abu Al-khaseeb and Sindbad stations

The correlation coefficient (r) showed that the degree of PH, EC, salinity, transparency, water, and air temperature has a positive correlation with the richness index (D), where the value of r was .218, .345, .005, .075, .601and .318, respectively, while TDS only showed a negative correlation with the number of species and reached -.085.

In the present study, the evenness (J) index value was valued at 0.54 and 0.72 for both stations, respectively. The richness (D) index values among the two studied stations varied in the present study. At station 1, the lowest evenness (J) index value of 0.33 was recorded in June, while the highest value, 0.79, was found in August. Whereas at station 2, the lowest index (J) value was 0.77 in November, while the highest value, 0.93, was tested in January (Fig. 15).

The results of the correlation coefficient (r) showed that the degree of EC, TDS, salinity has a positive correlation with the evenness index (J), where the value of r was .21, .233, and .229, respectively, while PH, transparency, water, and air temperature showed a negative correlation with the number of species and reached -.068, -.132, -.389 and -.307, respectively.

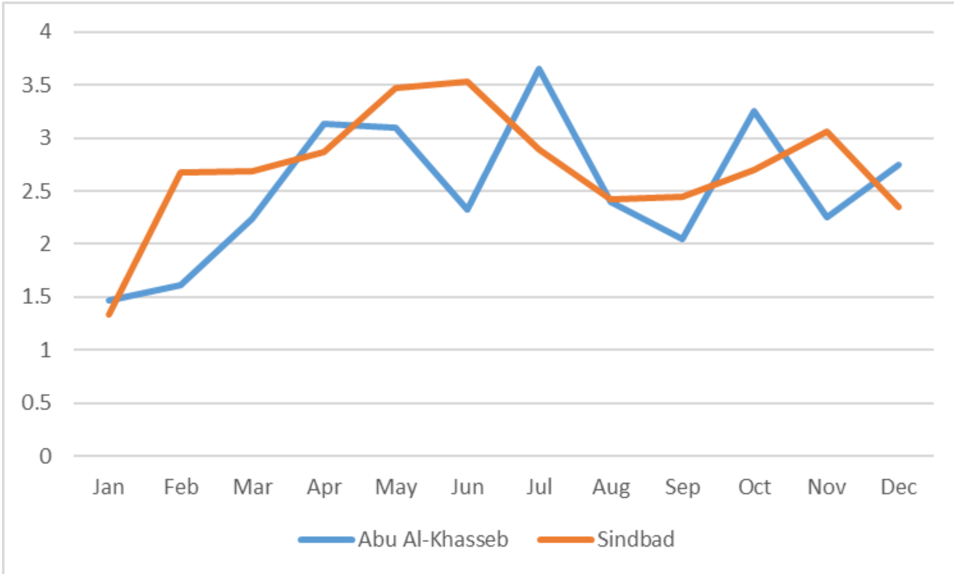

Fig. 15. Monthly variations in the Evenness index (J) values of two stations during the study period

Table 1. The numbers and relative abundance (%) of fish caught in the Abu-Al-Khasseb station from the period January-December 2019

The Species	January		February		March		April		May		June		July		August		September		October		November		December		[	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Planliza abu	3	1.32	3	2.1	3	1.42	49	21.3	125	48.3	212	79.7	58	18.5	17	0.51			1	0.25	4	0.54			134	0.46
Carassius auratus	82	36.1	61	42.7	44	20.8	25	10.9	67	25.9	18	6.77	132	42	90	2.71	12	1.89	10	2.52	20	2.69	20	1.87	670	2.31
Poecilia latipinna	37	16.3	29	20.3	24	11.3	3	1.3	1	0.39	1	0.38			22	0.66	6	0.95							144	0.49
Coptodon zillii	53	23.3	17	11.9	56	26.4	9	3.91	10	3.86			7	2.23	178	5.37	6	0.95					47	4.38	888	3.07
Oreochomis nilotics	26	11.5	15	10.5			1	0.43	20	7.72	3	1.13	2	0.64	87	2.62							17	1.58	321	1.11
Cyprinus carpio	2	0.88			42	19.8	2	0.87			18	6.77	80	25.5	202	6.1	62	9.78	46	11.59	81	10.9	97	9.05	1926	6.65
Oreochromis aureus	13	5.73	6	4.2	22	10.4	3	1.3	16	6.18	2	0.75	3	0.96	558	16.82	135	21.29	60	15.11	135	18.17	165	15.4	8516	29.41
Thryssa whiteheadi					11	5.19	65	28.3	1	0.39	2	0.75	1	0.32	12	0.36	6	0.95			17	2.28	18	1.68	161	0.56
Thryssa vitriastris					4	1.89	33	14.3	1	0.39	1	0.38	1	0.32	5	0.15	1	0.16			3	0.4	3	0.28	100	0.34

Teunalosa ilisha	9	3.96	10	6.99			3	1.3	6	2.32	1	0.38	4	1.27	25	0.75	7	1.1	4	1.01	10	1.35	13	1.21	273	0.94
Scatophagus argus															94	2.83	27	4.26	49	12.34	67	9.02	69	6.44	680	2.35
Silurus triostegus													6	1.91	81	2.44							26	2.43	608	2.1
Photopectoralis bindus							9	3.91							52	1.57									127	0.44
Bathygobius fuscus							15	6.52					1	0.32	8	0.24									45	0.16
Hyporhamhus limbatus							4	1.74	2	0.77	1	0.38			66	1.99	12	1.89	27	6.8	73	9.83	55	5.13	272	0.94
Triacanthus biaculeatus															145	4.37	47	7.41	35	8.82	58	7.81	86	8.02	1077	3.72
Alburnus mossulensis	2	0.88	1	0.7	1	0.47			1	0.39					79	2.38	11	1.74			7	0.94	12	1.12	356	1.23
Planiliza subviridis							1	0.43					5	1.59	1356	40.87	249	39.27	132	33.25	218	29.34	385	35.91	11063	38.2
Carasobarbus luteus							1	0.43			3	1.13	2	0.64	241	7.26	53	8.36	33	8.31	50	6.73	59	5.5	1598	5.52
Solea stanalandi													1	0.32												
Boleophthalmus dussumieri							4	1.74			1	0.38														

Otolithes ruber																										
Acanthopagrus arabicus									**1**	**0.39**			**4**	**1.27**												
Cynoglossus kopsii																										
Leuciscus vorax									**1**	**0.39**	**1**	**0.38**	**1**	**0.32**												
Johnius belangerii																										
Platycephalus indicus					**2**	**0.94**																				
Planiliza caranata					**1**	**0.47**			**1**	**0.39**																
Thryssa dussumeri							**2**	**0.87**																		
Plicofollis dussumieri																										
Solea elongta													**1**	**0.32**												
Planiliza klunzingeri									**2**	**0.77**																
Strongylura strongylura							**1**	**0.43**																		
Brachirus orientalis													**1**	**0.32**												

Aphanus dispar									**2**	**0.77**																
Gambusia holbrooki											**2**	**0.75**														
Cynoglossus arel																										
Alburnus marmid					**1**	**0.47**							**1**	**0.32**												
Sillago Arabica					**1**	**0.47**																				
Sillago sihama																										
Mystus pluseius			**1**	**0.7**																						
Nematalosa nasus									**1**	**0.39**																
Sillago attenuate									**1**	**0.39**																
Plicofollis layavdi																										
Luciobarbus xanthopterus													**1**	**0.32**												
Luciobarbus pectoralis													**1**	**0.32**												
Arabibarbus grypus													**1**	**0.32**												

Hemicultre leucisculus					**3**	**1.42**																				
No. of species	**9**		**9**		**13**		**18**		**18**		**14**		**22**		**12**		**14**		**17**		**11**		**17**		**48**	
Total	**227**	**100%**	**143**	**100%**	**212**	**100%**	**230**	**100%**	**259**	**100%**	**266**	**100%**	**314**	**100%**	**98**	**100%**	**572**	**100%**	**137**	**100%**	**85**	**100%**	**336**	**100%**	**2879**	**100%**

Table 2. Categorization of fish species according to their occurrence at two stations of Shatt al-Arab River from the period January -December 2019

Station	Category		
	Common species (9-12 months)	Seasonal species (6-8 months)	Occasional species (1- 5 months)
Station 1	*C. auratus, C. zillii, O.aureus, P.abu , C. carpio , O.niloticus, P. latipinna, T. ilisha*	*T. whiteheadi, T. vitriastris*	*S. argus, S. triostegus, P. bindus, B. fuscus, H. limbatus, T. biaculeatus, A. mossulensis, P.subviridis, C. luteus, S.stanalandi, B. dussumieri, O. ruber, A. arabicus, C. kopsii, L. vorax, J. belangerii, P. indicus, P. caranata, T. dussumeri, P. dussumieri, S. elongta, P. klunzingeri, S. strongylura, B. orientalis, B.orientalis, G. holbrooki , A. marmid, S. Arabica, S. sihama, M. pluseius, N. nasus, S. attenuate, P. layavdi, L. xanthopterus, L. pectoralis, A. grypus, C. arel*
Station 2	*C. auratus, C. zillii, O. aureus, P.abu , P.latipinna, T. ilisha, T. whiteheadi, T. vitriastris*	*C.carpio, O.niloticus, P. bindus, B. fuscus*	*S. argus, S. triostegus, P. bindus, , H. limbatus, A. mossulensis, P.subviridis, C. luteus B. dussumieri, A. arabicusL. vorax, P. caranata, T. dussumeriP. klunzingeri, B. orientalis, B.orientalis, G. holbrooki , A. marmid, S. Arabica, S. sihama, M. pluseius, N. nasus, S. attenuate,*

DISCUSSION

The composition of fish differed in terms of the number and nature of species at the two study stations. The lowest number of species (34) was recorded at the second station (Sinbad), while all species (48) were recorded at the first station (Abu Al-Khasseb). This difference results from environmental conditions and the number of introduced marine species. This finding aligns with **Abood's (2018)** study, which noted that marine species are predominantly found in the middle and lower reaches of the Shatt al-Arab River, with their presence decreasing toward the north.

The current study showed apparent differences in the number of native and alien species compared to previous studies. The number of native species in the current study reached 11 and 8 species for the first and second stations, respectively, and eight alien species at both stations. These numbers are less than what was obtained in the study of **Hussein *et al.* (1997)** and **Abood (2018)**, where 13 and 14 native species were recorded, respectively. While, the alien species showed an increase, reaching eight species at both stations, which is somewhat less than what was recorded in studies conducted on the fish population in the Shatt al-Arab, where **Mohamed *et al*. (2015)** recorded ten species, **Al-Noor and Abdullah (2015)** recorded eleven species, and **Abood (2018)** recorded twelve exotic species. These alien species were not present or were present in small numbers in previous studies in the Shatt Al-Arab, where **Mohamed *et al*. (2015)** recorded four species in the Hamdan region, as well as five species in the Dair region, and **Hussain *et al.* (1997)**, where three species were recorded in the Jabasi region.

The results of numerical abundance in the current study showed the dominance of tolerant species represented by the native species *L. abu* and the alien species *C. auratus*, constituting 61.65% of the total fish caught at the first station. The same situation was repeated at the second station, where three alien species *C.auratus, P. latipinna, O. aureus,* and one native *L. abu* species constituted 56.3% of the total number of caught fish; this is the same thing that **Al-Thahaibawi (2019)** found in his study on the Al-Huwaizah Marshes, and he stated that the reason is due to the ability of these species to tolerate changes in the water levels, high salinity, and acidity compared with native species that were absent at different periods of occurrence within the monthly catch samples. This result is also indicated by some researchers, such as **Mohamed *et al.* (2012)** and **Abdullah (2017)**.

Biodiversity indices are essential in knowing fish populations in different river locations. Diversity index values also show the degree of stability of those populations at a very high rate, and they are of a great importance in knowing the number of living species that grow naturally and can be observed in the river section and constitute a high percentage of productivity **(Sandu & Oprea, 2013)**. The results of the current study showed that the overall diversity, richness, and evenness index value of the first station was 2.1 (0.88- 2.13), 5.9 (1.47- 3.65), and 0.54 (0.33- 0.79) and for the first station was 2.6 (1.81- 2.48), 4.6 (1.33- 3.53) and 0.72 (0.77- 0.93), respectively. The results recorded in this study are somewhat close to what was obtained in studies conducted on the Shatt al-Arab River and the marshes of the Southern region **(Mohamed *et al*., 2012; Al-Thahaibawi *et al*., 2015; Mohamed *et al*., 2015; Yaseen, 2016; Abood, 2018; Al-Thahaibawi, 2019)**.

The abundance of alien and marine species has increased the richness, evenness, and diversity indices and created seasonal fluctuation in the relative abundance **(Hussain *et al.*, 1989)**. This is comparable to the previous studies on the east Al-Hammar marsh and the Shatt al-Arab River **(Mohamed *et al*., 2009; Younis *et al.*, 2010; Mohamed *et al.*, 2017)** on the Garmat Ali River.

CONCLUSION

Forty-eight species of the Osteichthyes fish were obtained at two selected stations in the Shatt al-Arab River after the decline of salt incursion, all of which appeared at the first station (Abu-Al-Khaseeb) and 34 species at the second station (Sinbad). The number of marine species reached 29 and 18 species for the first and second stations, respectively. The overall diversity, richness, and evenness index values of the first station were 2.1 (0.88- 2.13), 5.9 (1.47- 3.65), and 0.54 (0.33- 0.79) and for the second station, values recorded were 2.6 (1.81- 2.48), 4.6 (1.33- 3.53) and 0.72 (0.77- 0.93), respectively.

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