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Fish Assemblages in Iraqi Marine Waters, North West The Arabian Gulf

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Abstract

The composition of fish assemblages in Iraqi marine water was assessed. 91 species belonging to 71 genes and 47 families of Osteichthyes and 13 species of Conderchthyes were collected during the study period from January to December 2018, using trawl net fishing. Three stations were selected, where two new species *(Siganus javus* and *Gobiopsis sp*.) and reclassification of *Torpedo panther*a where identified and two species of freshwater fish (*Oreochromis niloticus* and *Oreochromis aureus*) were first recorded in marine waters. The highest numbers of species were 32 and 42 for the first and second stations, respectively, recorded in October , while 55 species were recorded in the third station during August. *Leiognathus bindus* was the dominant species in the first and second stations, while *Ilisha compressa* dominated the third station. Carangidae and Sciaenidae were the dominant families in number of species (7 and 5, respectively), whereas 4 species were recorded for Clupeidae, Sparidae, Mugilidae and Gobidiae.

Keywords: Iraqi marine waters, Fish assemblages, Arabian Gulf.

التجمع السمكي في المياه البحرية العراقية شمال غرب الخليج العربي

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الخلاصة

تم تسجيل 91 نوعا" تعود الى 71 جنسا" و47 عائلة من الاسماك العظمية و13 نوعا" من صنف الاسماك الغضروفية خلال مدة الدراسة لدراسة التجمع السمكي للفترة من كانون الثاني الى كانون الاول 2018 في المياه البحرية العراقية، باستعمال شباك الجر في الصيد، اذ تم اختيار ثلاثة محطات في المياه البحرية وتم تسجيل نوعين جديدين وهي *Siganus javus, Gobiopsis sp* واعادة تسجيل النوع *Torpedo panther* وسجل تواجد نوعين جديدين من اسماك المياه العذبة لأول مرة في المياه البحرية *Oreochromis niloticus, Oreochromis aureus*. سجل اعلى عدد من الانواع في تشرين الاول وبلغ 32 ،42 نوعا" في المحطة الاولى والثانية على التوالي و55 نوعا" في اب في المحطة الثالثة . ساد النوع *Photopectoralis bindus* في المحطتين الاولى والثانية على التوالي، بينما ساد النوع *Ilisha compressa* في المحطة الثالثة سادت العوائل Carangidae, Sciaenidae ب 7و5 انواع على التوالي وتمثلت العوائل التالية Clupeidae, Sparidae, Mugilidae, Gobidiae بأربعة انواع اثناء فترة الدراسة.

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Introduction

The marine ecosystem is characterized by considerable fluctuations in abundance and distribution of many species. One of the main tasks of fishery scientists is to determine the abundance of each species , their fluctuations and the factors controlling them [1]. The Arabian Gulf is a semi-enclosed shallow sea located in the subtropical climate [2]. The Gulf is considered biologically impoverished, due to its environmental characteristics in addition to its young age [3]. Recently, the discovery of the unique coral reef area (28 km^2) in the turbid coastal waters of Iraq will stimulate the interest of governmental agencies, environmental organizations, as well as international scientific community working on the fundamental understanding of current coral marine ecosystems and global climate [4]. Marine fish which live in deeper water and enter shallower intertidal and sub tidal zone, particularly during the growing season, play an important role as predators in coastal areas [5]. The fish community is influenced by a combination of physical and chemical factors, including river shape, bottom nature, pH, dissolved oxygen and salinity [6]. These factors provide a catalyst for interactions and life relationships among species[7]. The study of fish populations in Iraqi marine waters has been the focus of many studies. This includes the study of Mohamed [8] on the composition of fish in Iraqi marine waters, where the proportion of commercial families comprised 28.3% of the total catch and that of non-commercial families formed 59.1% . Abood [9] recorded 111 species belonging to 50 families and 3 species belonging to the cartilaginous fish class while studying the composition and distribution of the fish community in the mouth of the Shatt al-Arab estuary. The species of *Planiliza klunzingeri*, *Planiliza subviridis* and *Tenulosa ilisha* were more dominant. Al-Faisal [10] conducted a survey of marine fish species for the period from November 2014 to March 2018, recording 214 species belonging to 75 families.

The aim of this study is to determine the fish assemblages in the Iraqi marine waters and compare the results with previous studies.

Materials and Methods

Study Area

The Iraqi marine waters represent the most northwestern of the Arabian Gulf. Three study station were selected, with distance between one station and another is 15-20 km^2; the first station represents Shatt Al-Arab estuary and is limited by the coordinates (29 ° 54'15.93 "N; 48 ° 41'15.62" E), (29 ° 54'15.84 "N; 48 ° 37'24.24" E), (29 ° 50 ' 44.04 "N; 48 ° 41'15.51" E) and (29 ° 50'44.12 "N; 48 ° 37'24.38" E). This station has a bottom with alluvial mud deposits and a depth of 15m. The second stations includes the area between the impacts of Shatt Al-Arab estuary and the open marine waters, located at (29 ° 50'17.98 "N; 48 ° 43'53.28" E), (29 °; 48 ° 43'53.16 "E). This station is of a rocky bottom nature with depths of 15-20m, and (29 ° 46'48.99" N; 48 ° 49'43.90 "E). The third station of marine waters is defined by the coordinates (29 ° 43'33.41 "N; 48 ° 43'43.46" E), (29 ° 43'33.38 "N; 48 ° 49'34.85" E), (29 ° 40'04.13 "N ; 48 ° 43'43.39 "E) and (29 ° 40'04.02" N; 48 ° 49'34.96 "E). It has a depth of more than 20m, while the substratum is mainly of sandy –clay-silt texture;48.2% sand, 23.5% silt and 28.3% clay [11]. (Figure-1).

Fish Collection

Fish were collected from three study station as a part of the general fish survey of the region by using fishing-survey boats 2 (16 m length , 4.5 m wide and 2m draft) with a horsepower of 150 horses. Each boat is supplemented by trawl net of 5x5 cm mesh and a bag mesh of 3x3 cm. The length of the net pull rope ranges between 75-100 m. The time of pulling the net was three hours. Classification of fish was performed according to Kuronuma and Abe [12], Carpenter *et al*. [13] and Froese and Pauly [14].

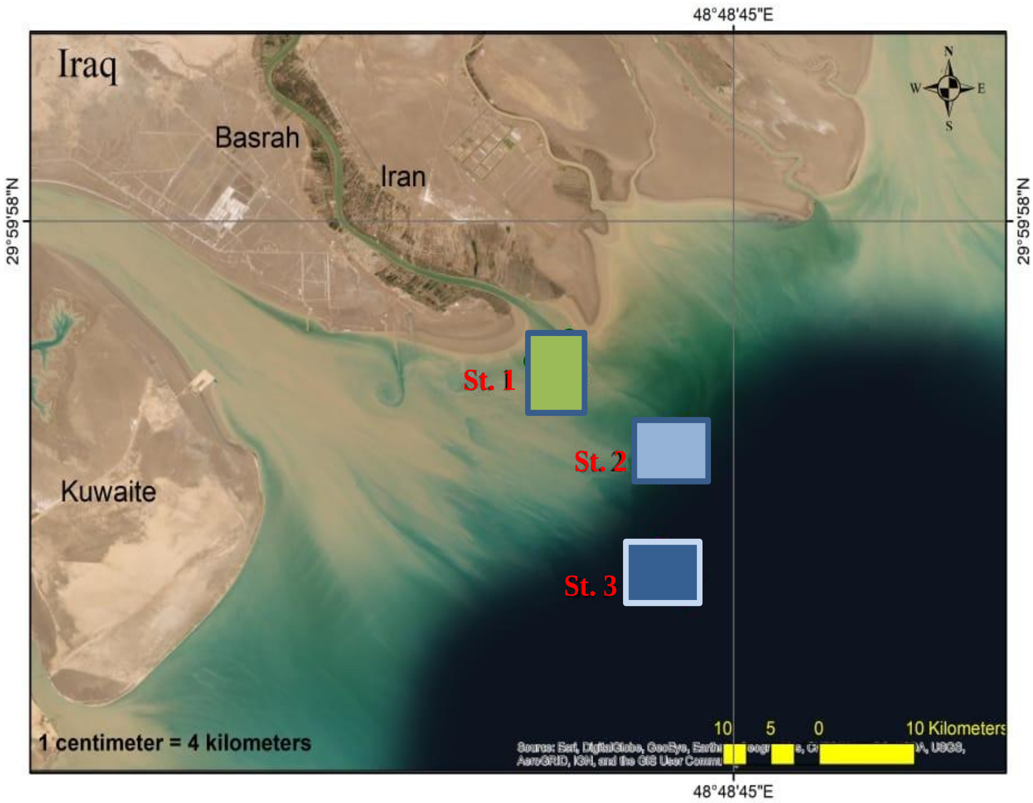

Figure 1-The location of the study stations in the Iraqi marine waters during the sampling period

Data Analyses

To calculate the biodiversity indices of the faunal community , a unilabiate analysis was applied using past з program. A number of diversity indices were calculated from the abundance in fauna raw data represented by a sum of triplicates for each species at each station, imported from Microsoft Excel into past 3 program. The following indices were calculated:

• Number of species (S): Total number of species in each replicate sample, indicating the number of species presented in an ecosystem. This index makes no use of relative abundances.

• Number of individuals (N): Total number of individuals in each replicate sample.

• Richness index (D): Margalef´s index [15].

D = S-1 / ln N

• Diversity index (H): Shannon-Weaver formula [16].

H = -[Σ (pi ln pi)]

where pi is the proportion of individuals found for each species , taking into account number of species (S) and number of individuals (N).

• Evenness index (J): Pielou index [17].

J=H/Lns

were H= diversity.

• Dominion Index (Dз): According to the evidence of the equation developed by Kwak and Peterson [18], as follows:

D3 = [∑i = 1pi] * 100

The numerical relative abundance of each fish species was calculated using the formula developed by Odum [19], as follows:

Relative abundance (%) = (ni / N) * 100

where

ni = number of species in the monthly sample

N = total number of individuals in the monthly sample

Result and Discussion

A total of 9772 fish were collected in Iraqi marine water, representing 91 species during the period of January to December 2018, belonging to 47 families. Thirteen species (4 sharks and 9 rays) represented the Conderchthyes, belonging to 10 genera and 10 families. Two species of *Siganus javus*, *Gobiopsis sp*, and reclassification of *Torpedo panthera* represented first records in present study (Table-1).

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Table 1-Families, species, number and relative abundance of fish caught in Iraqi marine waters during study period

Family	species	Number	Total%	S1%	S2%	S3%
Carangidae	*Alepes melanoptera*	65	0.66	0.07	0.66	0.65
	Alepes djedaba	137	1.40	0.63	1.58	1.72
	Alectis indica	120	1.22	1.71	1.12	0.97
	Atropus atropus	10	0.10	0.11	0.03	0.20
	Megalaspis cordyla	7	0.07	0	0	0.15
	Parastromateus niger	21	0.21	0	0.21	0.33
	Scomberoides commersonnianus	70	0.71	0.05	0.49	1.15
Sciaenidae	*Argyrosomus hololepidottus*	5	0.05	0	0	0.11
	Otolithes ruber	156	1.59	1.79	1.54	1.51
	Protonibea dicantha	6	0.06	0.03	0	0.11
	Johnius belangerii	809	8.28	10.65	9.56	6.11
	Johnius dussemeri	116	1.18	2.47	0.42	0.95
Clupeidae	*Anodontostoma chacunda*	3	0.03	0	0.03	0.04
	Nematlosa nasus	78	0.79	0.83	0.84	0.74
	Sardinella albella	227	2.32	2.15	1.89	2.69
	Tenulosa ilisha	146	1.49	2.11	1.72	0.9
Sparidae	*Acanthopagrus arabicus*	189	1.93	4.03	1.51	1.01
	Acanthopagrus berda	42	0.43	0.40	0	0.04
	Acanthopagrus bifasciatus	9	0.09	0	0	0.20
	Crenidens crenidens	22	0.22	0	0.17	0.38
Mugilidae	*Planliza subviridus*	227	2.32	1.19	4.25	1.72
	PlanLiza klunzingerii	33	0.33	0.31	0.28	0.38
	Liza carinata	36	0.36	0	0	0.81
	Mugil cephalus	222	2.27	5.18	1.96	0.81
Lutjanidae	*Lutjanus russellii*	33	0.33	0.09	0.52	0.20
	Lutjanus malabaricus	5	0.05	0	0	0.11
	Therapon puta	178	1.82	1.67	2.31	1.58
Gobiidae	*Baleophthalmus dussumierii*	62	0.63	0.59	1.12	0.33
	Cryptocentrus lutheri	1	0.01	0.03	0	0
	Trypauchen vagina	279	2.80	3.15	1.90	3.14
	Gobiopsis sp.	1	0.02	0	0	0.02
Soleidae	*Brachirus orientalis*	73	0.74	0.35	1.15	0.70
	Solea elongate	8	0.08	0	0.03	0.15
	Solea Stanalandi	424	4.34	1.43	5.69	5.11
Sillaginidae	*Sillago sihama*	213	2.18	0.45	1.86	3.07
	Sillago Arabica	2	0.02	0.07	0	0
	Sillago attenuate	6	0.06	0.03	0	0.11
Nemipterusdae	*Nemipterus japonicas*	26	0.26	0.11	0.35	0.29
	Nemipterus peronil	7	0.07	0	0.07	0.11
	Scolopsis taeniata	296	3.03	3.03	5.13	1.67
Pristigasteridae	*Ilisha melastoma*	806	8.25	0.55	3.23	15.8
	Ilisha compressa	232	2.37	2.63	2.14	2.37
Mullidae	*Upeneus sulphurens*	36	0.36	0	0.14	0.72

	Upeneus tragula	33	0.33	0.11	0.31	0.47
Sphyraemadae	*Sphyraena qenie*	27	0.27	0	0.35	0.38
	Sphyraena obtusata	198	2.02	3.63	1.79	1.26
Ariidae	*Netuma thalassina*	22	2.76	0.11	0.24	0.27
	Netuma bilineata	740	7.58	7.70	7.90	7.29
Engranlidae	*Thryssa whiteheadi*	91	0.93	1.31	0.45	1.01
	Thryssa mystax	33	0.33	0.99	0.17	0.06
Polynemidae	*Eleutheronema tetradactylum*	48	0.49	0.27	0.63	0.52
	Polydactylus sixtarus	5	0.05	0	0	0.11
Haemulidae	*Diagramma pictum*	10	0.10	0	0.07	0.18
	Pomadasys kaakan	722	7.39	7.78	7.27	7.24
Cynoglossidae	*Cynoglossus arel*	26	0.26	0	0.03	0.26
	Cynoglossus kopsii	21	0.21	0.07	0.35	0.20
Synancejidae	*Choridactylus multibarbus*	61	0.62	1.35	0.17	0.22
	Pseudosynanceia melanostigma	8	0.13	0.19	0.03	0.04
Serranidae	*Cephalopholis hemistiklos*	9	0.35	0.03	0	0.18
=	*Epinephelus coioides*	5	0.05	0	0.07	0.06
Siganidae	*Siganus canaliculatus*	13	0.13	0	0.07	0.24
	Siganus javus	31	0.31	0	0.35	0.47
Ephippidae	*Ephippus orbis*	11	0.11	0	0.07	0.20
=	*Platex teira*	1	0.01	0	0	0.02
Cichlidae	*Oreochromis niloticus*	1	0.01	0	0	0.02
=	*Oreochromis aureus*	1023	10.48	13.45	10.57	8.71
Leiognathidae	*Photopectoralis bindus*	177	1.81	1.19	1.72	2.21
Synodontidae	*Saurida tumbil*	19	0.19	0.15	0.17	0.22
Apogonidae	*Apogonichthoides taeniatus*	142	1.45	1.19	1.79	1.38
Stromnteidae	*Pampus orgenteus*	95	0.97	1.87	0.87	0.52
Chirocentridae	*Chirocentrus dorab*	108	1.10	1.15	1.30	0.95
Platycephalidae	*Platycephalus indicus*	7	0.07	0.15	0.07	0.02
Scatophagidae	*Scatophagus argus*	89	0.91	0.99	1.30	0.61
Trichiuridae	*Trichiurus lepturus*	4	0.04	0.04	0	0.06
Lethrinidae	*Lethrinus borbonicus*	42	0.43	0.31	1.05	0.09
Muraenesocidae	*Muraenesox cinereus*	76	0.77	0.83	1.30	0.40
Plotosidae	*Plotosus lineatus*	8	0.08	0.07	0.07	0.09
Tetraodontidae	*Lagocephalus lunaris*	14	0.14	0.19	0.10	0.13
Drepaneidae	*Drepana longimana*	19	0.19	0	0.45	0.13
Batrachoididae	*Allenbatrachus grunniens*	6	0.06	0	0.10	0.06
Scombridae	*Euthymus affinis*	10	0.10	0	0	0.22
Monacanthidae	*Paramonacanthus Choirocephalus*	2	0.02	0	0.03	0.02
Pamacanthidae	*Pamacanthus maculosus*	10	0.10	0	0.07	0.18
Chaetodontidae	*Heniochus acuminatus*	10	0.10	0	0.17	0.11
Priacanthidae	*Priacanthus tayenus*	3	0.03	0	0.07	0.02
Scorpaenidae	*Pterios russellii*	1	0.01	0.03	0	0
Hemiramphidae	*Rhynchorhamphus georgii*	1	0.01	0	0	0.02
Acanthuridae	*Acanthurus sohal*	1	0.01	0	0	0.02
Bothudiae	*Arnoglossus aspilos*	5	0.05	0	0	0.11
syngnathidae	*Hippichthys penicillus*	36	0.36	0.63	0.28	0.27

The present study showed that the highest number of species was recorded in the third station, which reached 86 species. Perhaps the reason is that the third station was characterized by high

transparency of 240cm , greater water depth of 20m , highest salinity concentration of 40ppt, and greater species diversity compared to the other two stations. The results of this study agreed with those of Younis [20] on Khor Abdullah, who noted a greater diversity in this station , where the catch was 4418 fish, with two newly recorded species (Ooctchthyes *G. sp* and *S. Javus*). This station is probably deeper, larger and more connected. The appearance of the two species *O. niloticus* and *O. aureus* for the first time in the third station during November is possibly due to the high salinity and temperature. This is in agreement with the results of Al-Dubaikel [21] who pointed out during his study on Shatt Al-Basrah that freshwater fish enter the zone when decreases. During the study period, we collected 198 specimens including 13 species belonging to the Conderchthyes, representing 12 genes and 8 families. Table-2 shows that the largest number was recorded for the Chonderchthyes of the two species *Brevitrygon walga* and *Brevitrygon imbricate* which reached 23 individual in the three catching stations, while the lowest number was for the species *Torpedo panthera*. In addition, the largest number of species appeared in July (38 species), while the lowest (6 species) was in February.
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Table 2-Species**,** families, genera and orders of Chonderchthyes catch in Iraqi marine waters during the catching period

Species	**genera**	**families**	**orders**
Carcharhinus leucas	Carcharhinus	Carcharhinidae	Carcharhiniformes
Rhizoprionodon acutus	Rhizoprionodon	=	=
Chiloscyllium arabicum	Chiloscyllium	Hemiscylliidae	Orectolobiformes
Sphyrna mokarran	Sphyrna	Sphyrnaidae	Carcharhiniformes
Aetobatus flagellum	Aetobatus	Myliobatidae	Myliobatiformes
Brevitrygon walga	Brevitrygon	Dasyatidae	=
Brevitrygon imbricate	=	=	=
Glacostegus granulatus	Glacostegus	Glaucostegidae	Rhinopristiformes
Gymnura poecilura	Gymnura	Gymnuridae	Myliobatiformes
Maculabatis gerradi	Maculabatis	Dasyatidae	=
Pastinachus sephen	Pastinachus	=	=
Himantura uarnak	Himantura	=	=
Torpedo panthera	Torpedo	Torpedinidae	Torpediniformes

The occurrence of Chonderchthyes in the three study stations and their abundance in the third station is likely due to the availability of food and the presence of these fish at a certain depth of water surface. . These results disagree with those of a previous study [8], which recorded 12 species in Iraqi marine waters. However, the results agree with those of Hussain *et al*. [22] and Hussain and Namma [23] who recorded 13 species in their study on Khor Al-Zubair. They attributed the presence of these species to high salinity , increased temperature, and increased marine productivity. As noted in the present study, the highest presence of Chonderchthyes was recorded in July (38 fish). It seems that Chonderchthyes in the summer months are increasing as compared to Osteichthyes, possibly due to increased food and appropriate heat. This is in line with Mohamed *et al.* [24] Who reported, during the assessment of marine water in the period 1995-1999 in terms of the presence of Chonderchthyes, an increased number in the summer months. The total number of species (91) indicated various appearance patterns over the year. The total number of species in the first (58 species) and in the second (73 species) stations reflected highest numbers during October (31 and 42, species respectively), while the lowest number was recorded in May (13 and 15 species, respectively).. Within the total recorded number of species in the third station (86 species), the highest appearance was during August (57 species), while the lowest was in January and October (25 species). The results also indicated that *P .bindus* prevailed, with a percentage of 13.43% of the total number of fish caught in the first station. The same species also prevailed with 33.7% in the second station, whereas *I .compressa* comprised 15.8% of the total number of fish caught in the third station (Figure-2).

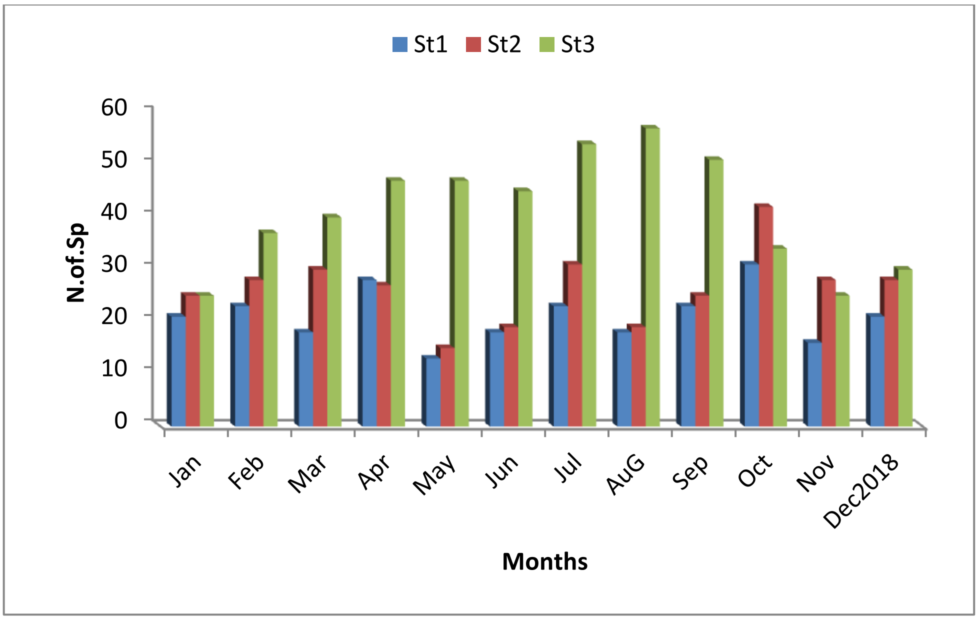

Figure 2-Monthly changes in the number of species catch in the three study stations

Spring and autumn are the seasons of mild heat in the study area. The absence of heat certainly affects the number of species and the weight of fishing samples, as explained by Ali [25] during his study on the composition of fish assemblages in Khor Al-Zubair. It seems that the northwestern Arabian Gulf zone is similar to the rest of the temperate zone, despite the extremes of temperature, and that the Arabian Gulf zone is unique to high temperatures and high salinity compared to Gulfs and seas of the world [26]. Al-Ghunaim *et al*. [27] reported that diversity of marine species in the environment of Gulf and marine water comes from the availability and durability of biomass primary productivity as main source of existing nutrients for the diversity of resident and migratory species. It is noted that studying monthly changes in the number of fish individuals in the first station, which reached a total of 2508 fish, that the number ranged from 40 fish in May to 347 fish in July. While among 2846 fish recorded in the second station, the lowest number of fish reached 96 in May and the highest was 500 fish in March. The total number of individuals in the third station was 4418 fish, with lowest appearance in January (213) and highest in June (500) (Figure-3).

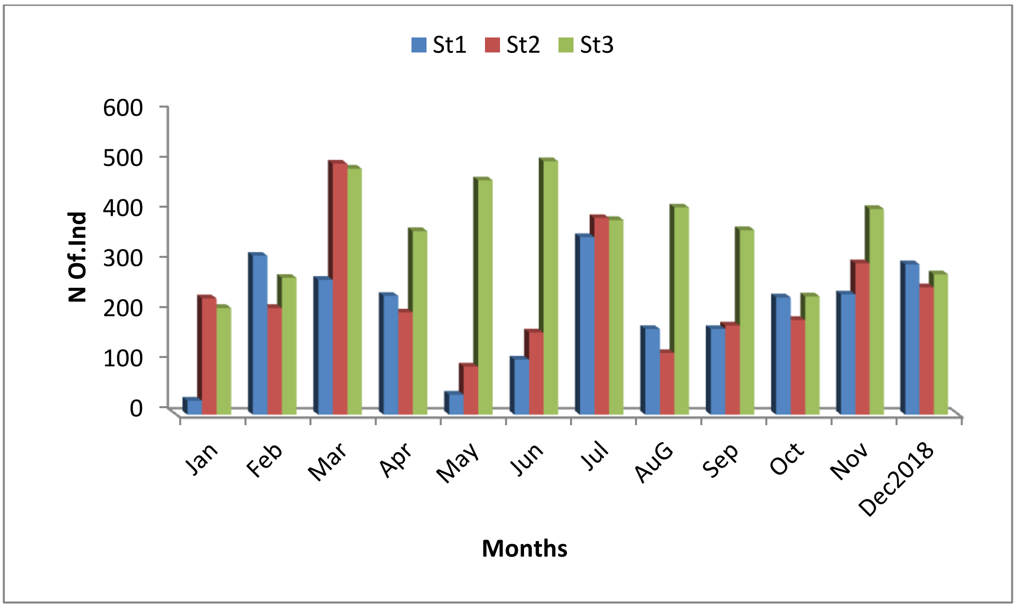

Figure 3-Monthly changes in the number of individuals catch in three study stations

According to Hussain and Namma [23], the number of individuals and species is increased in the temperate months of the long spring period and the short autumn, when fish progress to coastal zones from deep zones . This study agreed with a previous report [28] on the environment of the Arabian Gulf. The present study showed that the composition of fish assemblages in a state larger changes in Shadow differences of aquatic environment, resulting from several environmental factors that include changes in temperature and salinity as a result of the closure and opening of some tributaries of Shatt Al-Arab and loss of certain levels of water coming to the sea due to dams and lock up of water Lily tanks in Turkey and Iran [29]. Although the number of species and individuals showed obvious spatial and temporal variations, no real variation was observed for the evenness. Ninety one species of Osteichtheyes were recorded , several of them were previously recorded in the Iraqi marine waters. Carangidae and Sciaenidae dominated the catch in number of species consisting of 7,5 and 4 with Clupeidae, Sparidae, Mugilidae and Gobidiae respectively.

Five species, namely *C.arel, T. whiteheadii, I.compressa, J.belangerii, P. bindus* formed 41 % of the total relative abundance (10.48, 8.28, 8.25, 7.58, 7.39 %, respectively) . This study showed the highest numerical abundance of *P.bindus* (1023 specimen) , *J. belangerii* (809), *I. copressa* (806), *T. whiteheadi* (740) specimen *C. arel* (722) specimen. The above mentioned species comprised a numerical abundance of 4100 from the total number of fish catch. While the lowest abundance recorded was represented by the catch of only one fish of the species *E. coides, P. diacantha, N. japanicas, L. borbonica,* and *C. lutheri* in first station, *A. chacan, C. hemistici, A. atropos, C. kopsii, P. maculo, S. stanalan,* and *R. gerogii* in the second station, and *S. argus, p. maculosus, P. russeilli, G.sp,* and *A. sohal* in the third station. Also, we recorded for the first time the species *G.sp* in Iraqi marine waters, with a ratio of 0.01% of the total number of fish catch. The dominance of *P. bindus* to the total relative abundance on assemblages in the study stations may be due to their resistance to environmental conditions such as heat, salinity, etc. and their occurrence in all months of the year and more number of other fish catch in the assemblages and all stages from larvae to adult, the largest relative abundance for species *P. bandus* (13.45, 10.57)% of the total number of tolerance for circumstances high ecological populations were present during the study period and the presence of the occurrence species in the first and second stations. These results agree with those of Mohamed *et al*., [30] on catching in Iraqi marine waters. The dominance of *I. compressa* in the third station may be because it grazes in the deep zones and that open water provides the appropriate environmental conditions for its occurrence. The geographical distribution of this species starts from Khor Al-Amiya to the Arabian Gulf, where it is considered as a commercial species. This is in agreement with Mohamed *et al*. [24] who studied the Iraqi marine waters and Ahmed and Hussain [31] who studied Shatt Al-Arab estuary. It seems that the genus *Ilisha* who certain [32] is an adult that depends on swimming more in the deep water than from Iraqi marine waters, and its feeding on fishs and shrimp and provides climatic conditions. This was confirmed by Younis [20] during his study on the species *I. megaloptera* in Shatt Al – Arab estuary, as well as by Allen [33]. the change in the values of the evidence of diversity and differences in the exploitation of the estuary by fish on seasonal basis. Low values of diversity reflect the dominance of few species especially in the cold months, caused with that the dominance loss from ratio the values of other species, which rely[34] which to make the index degrees sensitive to any simple change whether numerical or weight. It is noted in the present study that the diversity index in the selected study stations reached the maximum value in April and October (3) in the first and second stations, respectively, while the value in the third station reached 3.3 in August. These results confirm those reported previously [35]. The increase in the diversity index is due to the overall weight of the dominant species less than their numbers and therefore less impact on the values of the index. The values of the diversity in the present study are nearest to many of the previous studies as they have a relatively wide range and reflect the use of the zone by fish on seasonal bases. This is consistent with the notion of Allen [33] and confirmed by Younis and Al-Shamary [36] in their study of fish assemblages in Shatt Al-Basra Canal. contrast the values of environmental indexes, including diversity, evenness, richness and Dominants, during the period of sampling to highest and lowest in this figures

Figure-4 presents the spatial and temporal variations for stations . The highest value of diversity index (3.3) was recorded in station 3 during August, whereas the lowest value (1.73) was in station 1 during May. Also, the ranges of the richness index were 2.7-6, 3.1-7.8 and 4-9.3 in stations one, two and three, respectively (Figure-5). This study revealed a reduction in biodiversity , richness and evenness of fish, possibly due to an increase in organic enrichment, mainly by ammonia and phosphates.

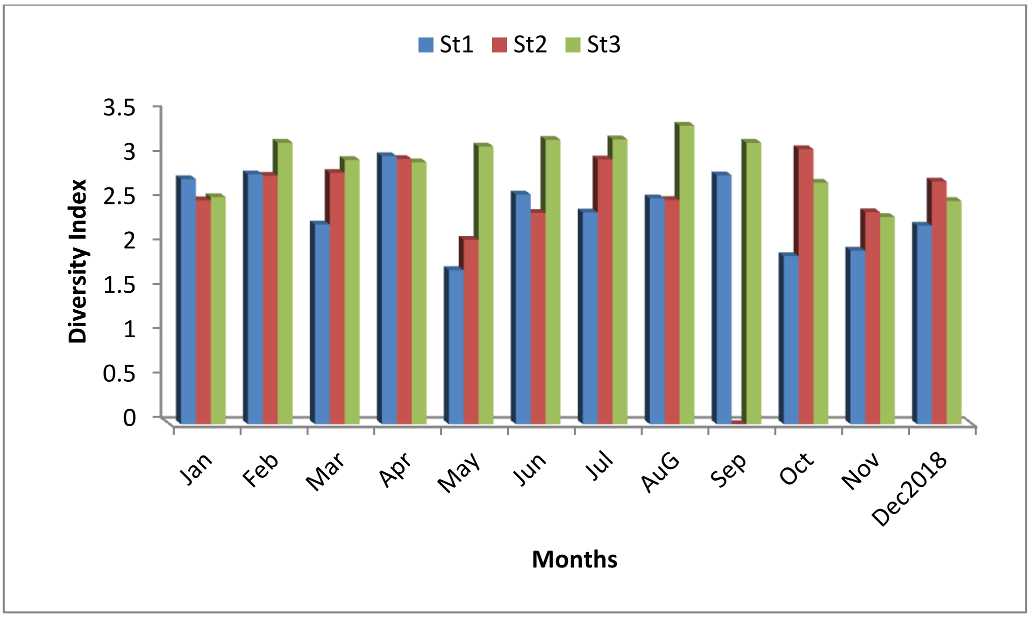

Figure 4-Values of diversity index in the three study stations during sampling period

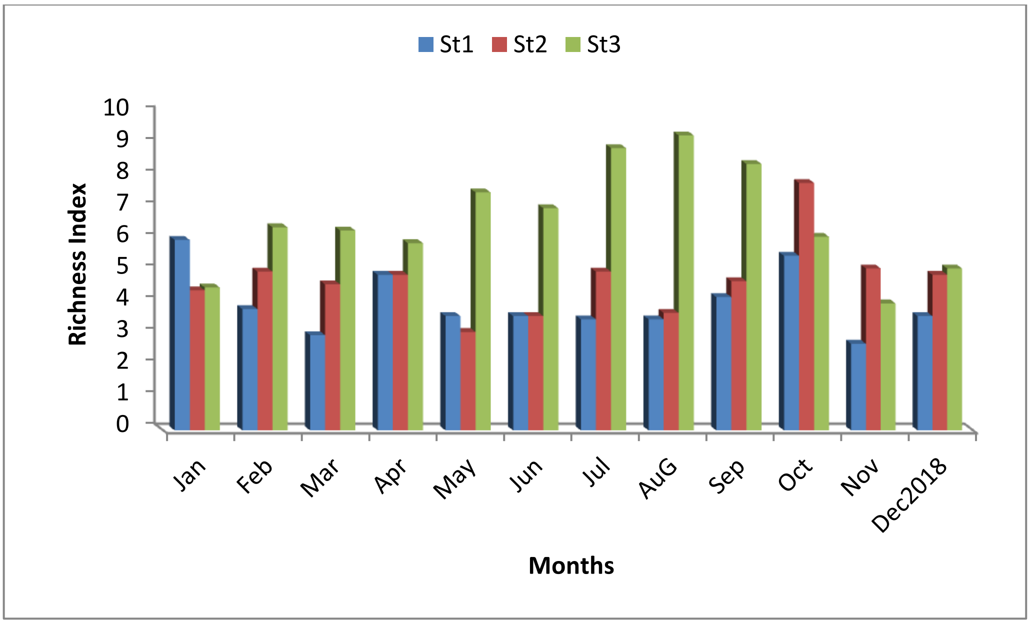

Figure 5-Richness Index value in three study stations during sampling period

Figure-6 demonstrates the results of the evenness index, where the highest value for station one was recorded in January (0.9) . In addition, the highest value for station two reached 0.9 in April. The highest value for station three was 0.87 in February. The lowest value was 0.7 in November for all the three stations.

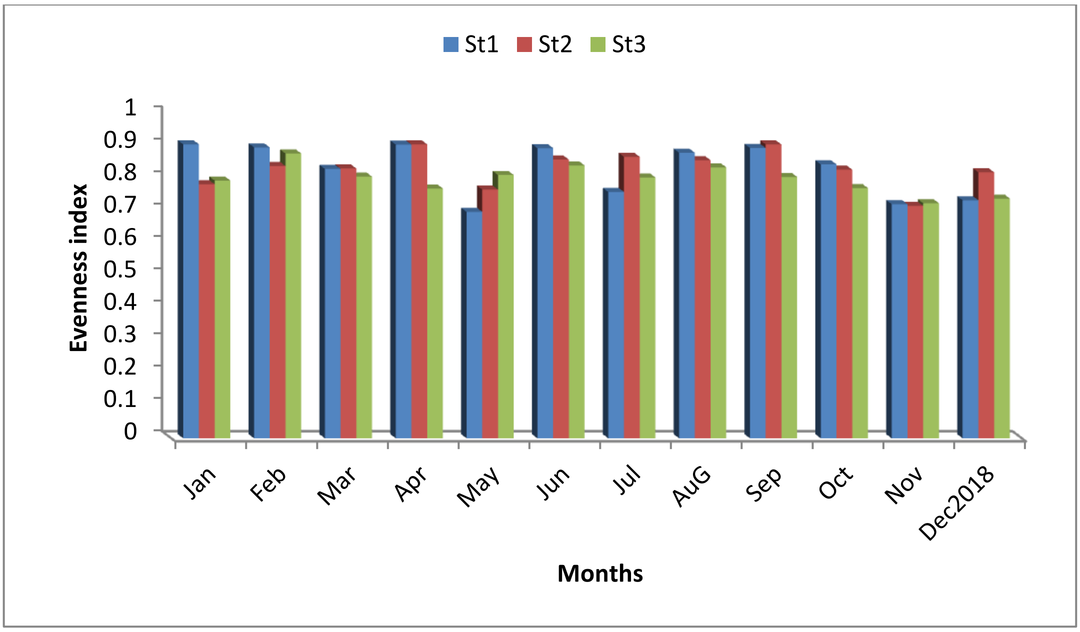

Figure 6-Evenness index value in three studded stations during sampling period

The utilization of the niche for different successive biological purposes by broad scale species enhances the occurrence of the species composition with less proportional variation and high evenness level [37].

Figure-7 shows the monthly changes in the values of the numerical dominance index in the study stations during the collection of samples. The lowest values were recorded during February in the first and second stations (47 and 44, respectively), and during January in the third station (71). The highest values were during April (75 and 80) in the first and second stations, respectively, and during July (87) in the third station.

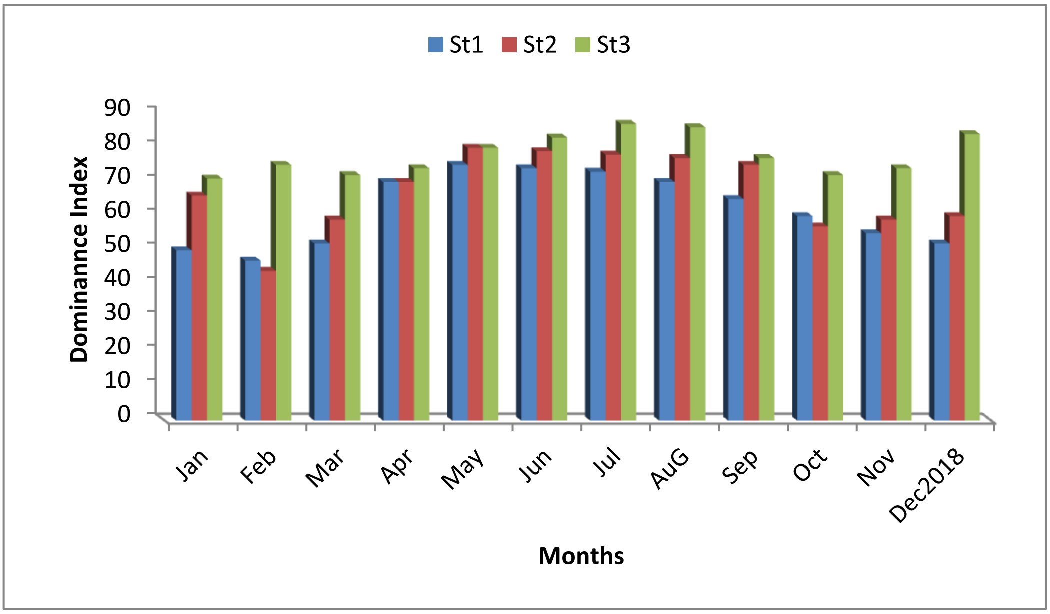

Figure 7-Values of dominance index in three studied stations during sampling period

The highest values recorded in the three stations were in the months when there was clear dominance of one species over the remaining of the species, while the lower values indicated the presence of all species with almost the same numerical abundance and the absence of sovereignty and do not dominance occurrence.

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