

Composition structure of fish assemblage in Al-Auda marsh southern Iraq

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Abstract:

The aim of the present study is to determine the species composition, the structure of the fish assemblages, and to develop ecological indices in the restored Al-Auda Marsh. A total of 19 fish species belonging to 9 families were collected from the restored Al-Auda marsh from November 2012 to July 2013 using electrofishing gear, fixed gill net at six sites. Fish samples contained Eleven freshwater species, and eight alien species. Native species numbered 11 (59.95 %), alien species 8 (40.05 %). Resident species formed 99.67 % , seasonal species 0.21 % and occasional species 0.12 % of the fauna. The abundance of species varied, Liza abu being the most dominant species, with Carassius gibelio ranking second and Tilapia zillii ranking third, comprising 34.60 %, 23.27 % and 8.39% respectively. Ecological indices were as follows: diversity ranged from 1.75 in April to 2.19 in June, richness ranged from 1.65 in March to 2.38 was in May, and evenness ranged from 0.63 in April to 0.75 in January. The highest monthly similarity was 100 % between December 2012 and January 2013; May and June 2013 and lowest similarity 58.8% was between March 2013 and November 2012. Water temperature showed medium correlations ($r=0.582$ and $r=0.613$, $p \leq 0.05$) with both the number of species and the total catch respectively, while salinity exhibited weak positive correlations ($r = 0.262$ and 0.312 , $p \leq 0.05$) with both the number and the total catch of species, respectively. In addition to number of fish species and total catch of individuals in Al-Auda marsh showed a positive correlation significant with dissolved oxygen ($r=0.397$ and $r=0.494$, $P \leq 0.01$).

Keywords: Species composition, fish assemblage, ecological indices, Marshes, Native and alien species.

Introduction:

The Iraqi marshlands constitute the largest wetland ecosystem in the Middle East and Western Eurasia and covered more than 15,000 km². Mesopotamian Iraqi marshes often referred to as the “Garden of Eden” having been the cradle of Western civilization (Maltby, 1994; Nicholson and Clark, 2002; Richardson, 2008). The inland freshwater bodies in Iraq cover

between 600 000 and 700 000 ha, made up of marshes (44%), natural lakes (39%), dams and reservoirs (13.3%) and rivers and their branches (3.7%), in addition to a coastline of approximately 50 km along the NW Arabian Gulf (FAO (1999)). These marshes were a natural refuge for many aquatic organisms, especially fish and waterfowl, because of their environmental, hydrological and meteorological conditions they form a unique ecosystem, that allows aquatic biota to flourish (Mohamed *et al.*,2012). The marshes were also characterized by their productivity (Al-Zubaidi, 1985; Al-Mayah, 1994 and Al-Hillel *et al.*, 2009) and consequently were the richest and rarest biotope in the region. These marshes were considered as feeding, resting and nesting area for many residents and migratory water birds (Allouse, 1961; Scott and Carp, 1982). Several studies were conducted before drying of the marshes during the nineties dealt with the biology and environment of fish and fisheries, as compared with other southern of Iraqi marshes (Mohamed & Barak, 1988a; Hussain *et al.* 1992). In recent years, several studies (Mohamed *et al.* 2012; Hussain *et al.*,2008; Mohamed *et al.*,2009; Coad, 2010; Younis *et al.*,2011 and Mutlak, 2012) were focused on fish diversity in Iraqi marshes. After the partial re-flooding of marshes (Hussain *et al.*,2006) identified 25 fish species in freshwater of all marshes. In addition to described assemblage of fish in Al- Hawizeh marsh after three years of restoration marshes (Mohamed *et al.*,2008c), where recorded 15 species and divided into (Resident, Seasonal and Rare) groups. In Southeast Al-Hammar recorded 36 species of bony fish belonging to 32 genera and 17 families marsh by (AL-Shamary *et al.*,2011). However, conducted to assess to assemblage of fish in eastern Al-Hammar marsh, which recorded 47 species belonging to 35 genera of 20 families, as well as Cyprinidae was a dominant family on account of individuals Mutlak (2012). The aim of the present study is to determine the structure of the fish assemblage and the species composition in the restored Al-Auda Marsh. Previously, no studies were conducted on the diversity of the fishes, taking into consideration their relative abundance, the monthly changes in ecological indices, and the similarity between sampled months coupled with the effects of environmental factors like water temperature and salinity.

The study area

Al-Auda marsh is one of the water bodies located in Maysan province, southern Iraq, which lies approximately 35 km of Ammara city (Latitude/Longitude : 31°33'N, 46°51'E) and 5 km away from Al-Maymunah district. This marsh was considered one of the marshes that situated in the western side of the Tigris River in Maysan province, this marsh has suffered the drought for a long time.

The marsh bordered to the north Maysan province, central marshes to the south, Al-Maymunah district to the east and Saied Ahmed Al-Refay rural area to the west (Fig.1).

Al-Auda marsh covers an average area of about (7,500 hectare).The length marsh about 20 km, width 10 km and up area boundaries 105 km² CRIM(2012). However, depth of Al-Auda marsh was different were varied from (1.75m - 3.85 m) depending on the geographical nature of the marsh and quantities of providing water to marsh from five major branches of Al-Haddam River, as well as the average velocity of water in the marsh (0.05m/s).

Haur Auda was drained during 1990s and then returned water naturally after 2003 to inundated large a total area of marsh by (50%).Which one IBA site Important Bird Area (IBA: 034) as described by Evans(1994). However, Al-Auda marsh was listed as a wetland of international importance by Carp (1980).

Al-Auda marsh was surveyed as a station in the central marsh within Key Biodiversity Areas (KBA) project held by the Iraq Ministry Of The Environment (IMOE) and Nature Iraq Organization (NI) in 2005-2008 and was expressed by code CM 23Nature Iraq (2009).

Al-Haddam River is considered the main supply of water to this marsh. In general, the Rivers which feed Al-Auda marsh with water were five major branches including, Braidah River, Al-Adla River, Al-Auda River, Umm Al-Meshahef River and finely Umm Al-Mtabij River CRIM (2007).

However, upstream as Braidah River and downstream as Umm-Al-Mtabij River in Al-Haddam area, currently Al-Auda marsh associated with central marshes through linked with Al-Battat marsh and Al-Ezz canal Central for Restoration of Iraqi Marshes CRIM (2012).

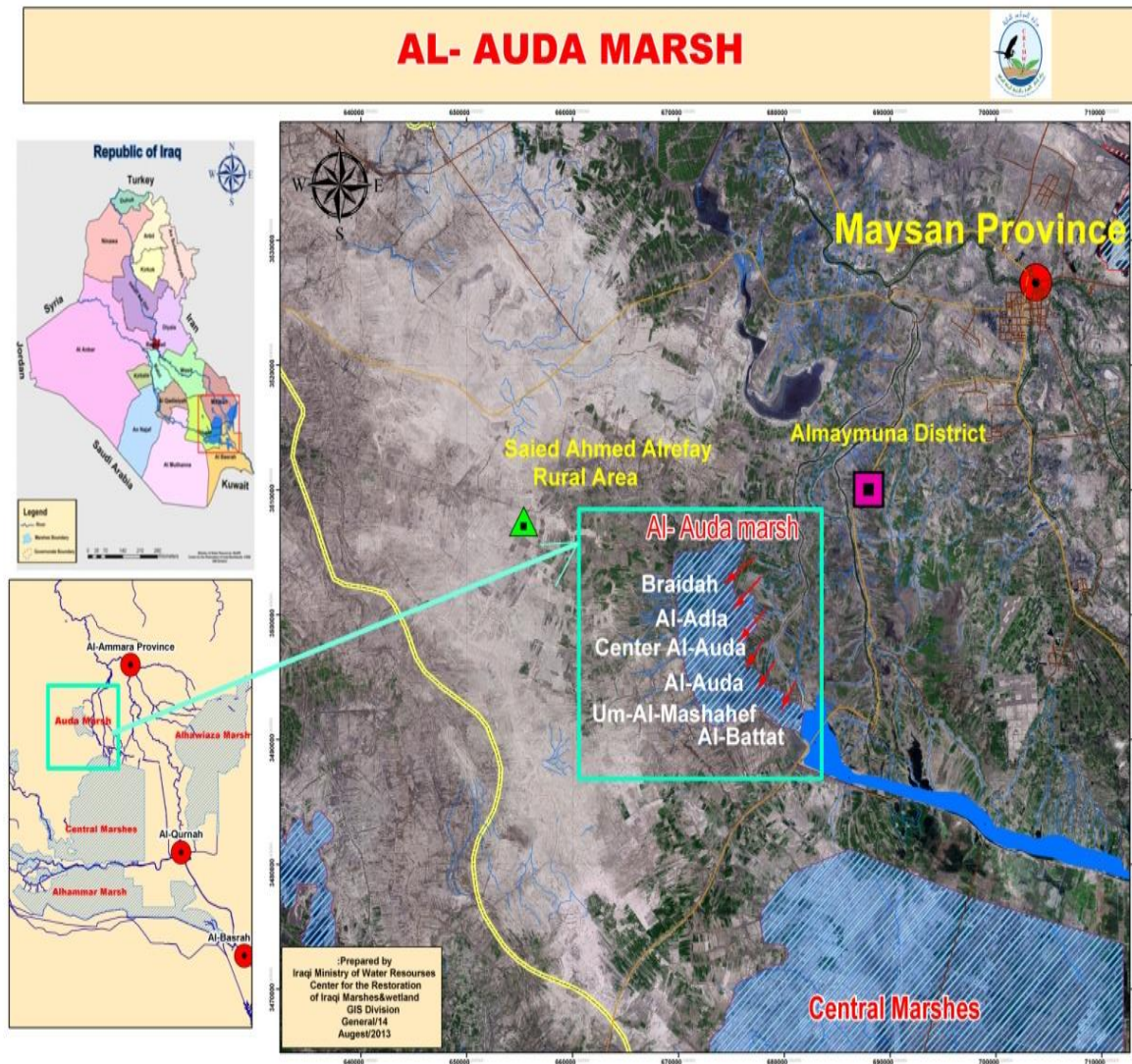


Figure 1 - Al-Auda Marsh in Maysan province southern Iraq. Source CRIM, (2013).

Materials and methods:

Fishes were collected monthly sampling from six selected sites in Al-Auda marsh (Fig. 1) from November 2012 to July 2013.

Station	GPS	Environment	Status
Braidah	N 31° 36' 25" E 46° 50' 10"	Openness marsh	Natural station
Al-Adla	N 31° 35' 22" E 46° 50' 25"	Dense Vegetation marsh	Natural station
Center Al-Auda	N 31° 35' 22" E 46° 49' 47"	Channel marsh	Desiccated station
Al-Auda	N 31° 34' 33" E 46° 51' 13"	Openness marsh	Natural station

Umm Al- Meshahef	N 31° 33' 49" E 46° 52' 07"	Openness marsh	Natural station
Al Battat	N 31° 32' 55" E 46° 54' 09"	Openness marsh	Desiccated station

During daylight the electrofishing boat was equipped with a generator engine (providing 220 V and 10 A). During the evening hours, fixed gill nets (50 to 100 m long with 2.5 cm to 10 cm mesh size) were placed in the open water and left overnight. The fish preserved in cold ice box until reaching to the laboratory. Small fish preserved in 4% formaldehyde and bigger fishes in deep freeze. The net was removed the following morning after approximately 10 h by local fishermen. Water temperature and salinity were measured by YSI 556 MPS instrument, to determine the relationships of these two factors with the number of species and total catch of species.

Fishes were identified to species by using Beckman (1962) ; Al-Daham (1977) and Coad (2010) in Marine Science Center at University of Basrah , where a record number individuals each species separately, placed in plastic bags and preserved and marked by freezing. Fish species were divided into three groups based on existence of monthly samples. The division of a species into resident, seasonal and rare, according to Tyler (1971) and based on number study months (study period).

The similarity among fish based on their species was calculated according to Jaccard similarity Index (ISJ %), using SPSS software (ver. 11, 2001) statistical package. The ecological indices of fish assemblage i.e. relative abundance, diversity(H), evenness(J), richness(D) and similarity Jaccard (ISJ %) were calculated monthly.

Relative abundance

Relative abundance % = $(n_i / N) * 100$ Krebs (1974).

n_i = number of individuals of species in the sample.

N = total number of individuals of all species.

Diversity index (H)

$H = -\sum p_i \ln p_i$ (Shanon and Weaver, 1949; Ludwig & Reynolds, 1988)

P_i = the proportion of individuals in the p_i the species of the whole sample.

Richness index (D)

$$D = S-1/ \ln N \quad (\text{Margalef, 1968; Ludwig \& Reynolds, 1988})$$

S= the number of species in the sample.

N= the number of individuals in the sample.

Evenness index (J)

$$J = H/ \ln S \quad (\text{pielou, 1977; Ludwig \& Reynolds, 1988})$$

H= diversity index.

S= the total number of species.

Jaccard similarity index (Ss%)

$$Ss\% = [a/(a+b+c)] \times 100 \quad \text{Boesch (1977)}$$

a= sum of species occurred in sample A and B.

b= sum of species occurred in sample A not in B.

Results and discussion

A total of 18860 individuals of fish were collected of Al-Auda Marsh from six orders Cypriniformes; Mugiliformes; Siluriformes; Synbranchiformes; Perciformes and Cyprinodontiformes, nine families belong to nineteen genera and nineteen species which were of osteichthyes class .

Groups of freshwater fish in Al-Auda marsh

The fish fauna of Al-Auda Marsh may be broadly classified into two groups, Native and Alien freshwater fish species.

Native freshwater fish

This group included 5 orders located in 6 families, 11 genera, 11 species and 11307 individuals, forming 59.95 % of the total number caught individuals, giving the highest number of 1869 individuals recorded in November and lowest number 444 found in February. Mugilidae family recorded highest relative abundance 57.71 %, while Cyprinodontidae family recorded lowest relative abundance 0.35 % of the total number individuals fish Native in Al-Auda marsh (Fig. 2).

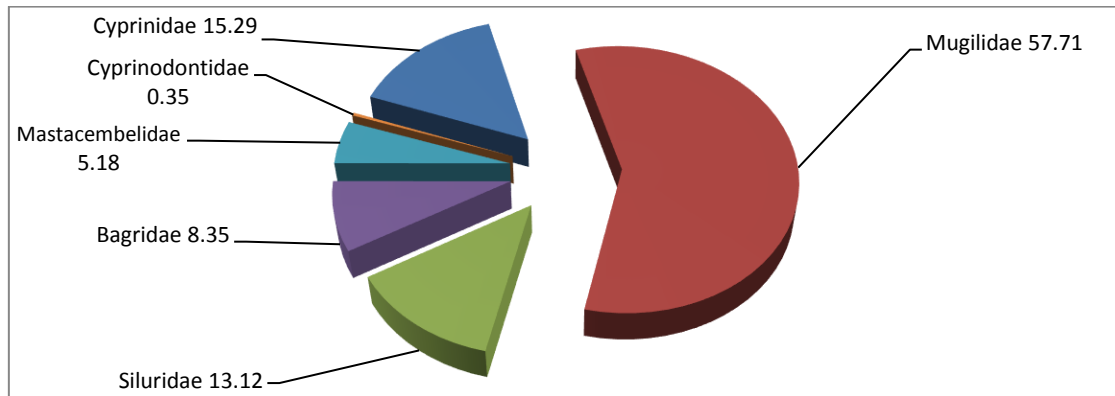


Figure 2: The Relative abundance (%) of Native fish family recorded in Al-Auda marsh

The species *Liza abu* was recorded highest relative abundance formed 57.71 % and the lowest abundance of species *Luciobarbus xanthopterus* formed 0.02% of the total number individuals Native freshwater fish species .

Alien freshwater fish

This group included 4 orders located in 4 families, 8 genera, 8 species and 7553 individuals, forming 40.05 % of the total number caught individuals, again highest number 1098 and lowest number 355 individual were found during November and February, respectively. Cyprinidae family recorded highest relative abundance 65.02 %, while Poeciliidae family recorded lowest relative abundance 5.04% of the total number individuals fish Alien in Al-Auda marsh (Fig. 3).

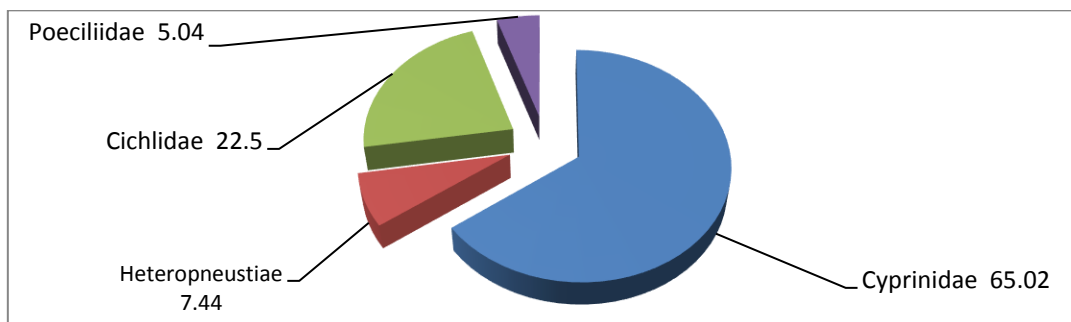


Figure 3: The relative abundance (%) of Alien fish family was recorded in Al-Auda marsh

The species *Carassius gibelio* was recorded highest relative abundance, giving a percentage 65.02 % and lowest abundance of species *Ctenopharyngodon Idella* has 0.26 % of the total number individual Alien freshwater fish species.

In similar study of Al-Hawizeh marsh (Younis *et al.*,2011) found a total of 13 species of freshwater fish was (10 native and 3 of the alien) species, while (Mohamed *et al.*,2012) found 14 species of freshwater fish in Al-

Chybaish marsh were (10 native and 4 alien species), in East Al-Hammar marsh recorded 24 species of freshwater fish (16 native and 8 alien) species by Mutlak (2012) whilst the alien species did not seen in old survey by Mahdi (1962) but recorded in recently by Coad (1991).

However, entry Alien species and human modification of aquatic environment might affect seriously on native fauna and flora (Gozlan *et al.*,2010 and Tarkan *et al.*,2012b) similar to the worldwide pattern (Hermoso and Clavero 2011). Furthermore, the inland waters of Iraq have clearly faced several drastic changes which included habitat alterations, entry alien species and declines in native fish (Coad, 2010 and Jawad, 2003). In other work (Hussain *et al.*,2000) showed the ability of alien species in influencing on composition the fish community through competition, predation and interference with resident local fish.

The variations in the composition of fish community

Cyprinidae as a dominant family in terms of a number species, was represented by 10 species within 10 genera. Individuals of Cyprinidae family were in first rank having the species of *Alburnus mossulensis*, *Acanthobrama marmid*, *Aspius vorax*, *Carasobarbus luteus*, *Mesopotamichthys sharpeyi*, *Luciobarbus xanthopterus*, *Carassius gibelio*, *Cyprinus carpio*, *Ctenopharyngodon idella*, *Hemiculter leucisculus*. The species *Carassius gibelio* had highest relative abundance 66.1 %, while *Luciobarbus xanthopterus* gave lowest relative abundance 0.03 %. However, these data were found to be significantly ($P \leq 0.05$) among different species of Cyprinidae family during all study periods.

Figure (4) shows the relative abundance (%) for nine fish families collected from Al-Auda marsh during the study period. The highest value 35.21 % was found in the Cyprinidae family followed by the value of 34.60 % for Mugilidae, while the lowest value 0.21% was recorded for Cyprinodontidae family, whereas the remaining families were varied from 2.02 % for Poeciliidae to 9.01 % for Cichlidae.

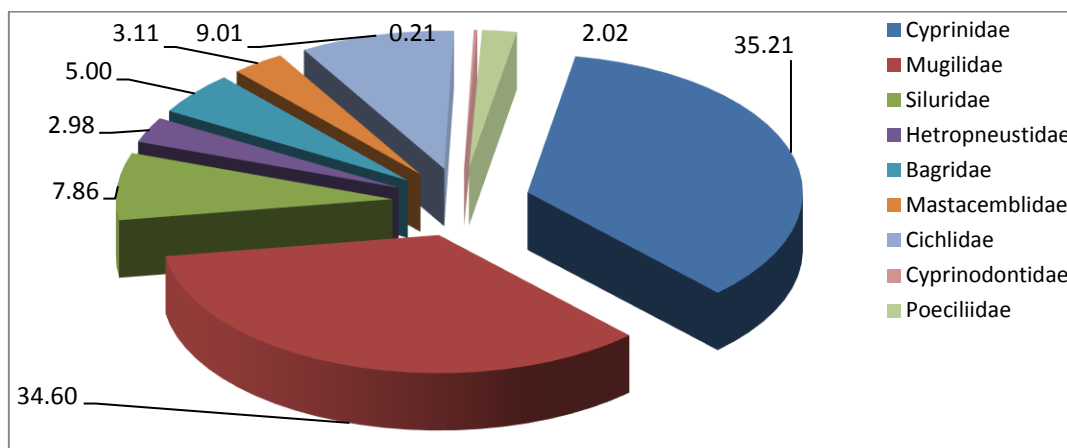


Figure 4: Percentage (%) of nine fish families collected from Al-Auda marsh

The Cyprinidae family occupied the first rank with 6640 individual having a percentage of 35.21 %. The highest number 1213 was recorded in February while the lowest number 339 in March gives a percentage of 38.92 % and 42.43%, respectively. Cyprinidae family dominant in five months (January, February, March, May and June) as a number of individuals and percentages contributions monthly, while Mugilidae family were dominated in four months (November, December, April and July).

The highest number of Mugilidae family of 1301 individuals was recorded in November, while lowest number 294 found in March giving a percentage 43.98% and 36.8%, respectively. This is due to the shallowness of the water and presence large numbers of this family in fishermen's nets. However, the species *Liza abu* recorded as a highest number of 6525 individuals with 34.60 % from among all identified species which collected in all examined sites (Table 1).

Table (1): Numerical and relative abundance (%) for individuals of fish caught in Al-Auda marsh

Family	No. individuals	Rel. abun (Ra). %	Fish species	No. Individuals	Rel. abun.(Ra)
Cyprinidae	6640	35.21	<i>Acanthobrama marmid</i>	258	1.37
			<i>Alburnus mossulensis</i>	714	3.78
			<i>Aspius vorax</i>	54	0.29
			<i>Carasobarbus luteus</i>	656	3.48
			<i>Mesopotamichthys sharpeyi</i>	45	0.24
			<i>Luciobarbus xanthopterus</i>	2	0.01
			<i>Carassius gibelio</i>	4389	23.27
			<i>Cyprinus carpio</i>	379	2.01
			<i>Ctenopharyngodon idella</i>	20	0.11
			<i>Hemiculter leucisculus</i>	123	0.65
Mugilidae	6525	34.60	<i>Liza abu</i>	6525	34.60
Siluridae	1483	7.86	<i>Silurus triostegus</i>	1483	7.86
Heteropneustidae	562	2.98	<i>Heteropneustes fossilis</i>	562	2.98
Bagridae	944	5.0	<i>Mystus pelusius</i>	944	5.0
Mastacemblida	586	3.11	<i>Mastacembelus mastacembelus</i>	586	3.11
	1583	8.39	<i>Tilapia zillii</i>	1583	8.39

Cichlidae	116	0.62	<i>Oreochromis aureus</i>	116	0.62
Cyprinodontida	40	0.21	<i>Aphanius dispar</i>	40	0.21
Poeciliidae	381	2.02	<i>Gambusia holbrooki</i>	381	2.02
9	18860	100	19	18860	100

Apparently, *Liza abu* species occupied the first rank in numerical dominance and relative abundance among caught species in all six studied sites during the study period, that may due to the ability of *Liza abu* species to adapt for different environmental factors and their high resistance to ecological variations as suggested (Wahab,1986 and Younis,2005), whilst came *Carassius gibelio* came in second rank by numerical dominance.

The high percentages for *Liza abu* and *Carassius giebilo* in the present study may be due to the availability of food sources, as well as the abundance of crumbs that led to increasing numbers of *Liza abu* as suggested by (Younis *et al.*,2001 and ARDI, 2006) also, this may be related to the consider these species know being tolerant such harsh environmental factors as reported by Younis (2005). These two species had an overall numerical dominance of 57.87% of a total fish number examined in this study.

The results of the present study showed four species of fish *Liza abu* , *Carassius gibelio*, *Tilapia zillii* and *Silurus triostegus* seen in all monthly fishing samples in all six studied sites in Al-Auda marsh.The numerical abundance to these species were of 14694 individuals forming 74.12% of the total number of fish catches, while *Luciobarbus xanthopterus* species recorded only 2 individuals giving percentage 0.01% only once time in site 2 during June. The occurrence being due to the changing in environment marshes in terms of prosperity species at the expense of other species, as well as dominant species to another, available species instead of them and get competition among these species, in addition to overfishing processes practiced by fishermen used toxins and electricity shock led to the destruction nests these species and lower its stores Salman (1994).

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Table 2 : Shown the total and monthly variations in the numerical and relative abundance of individuals caught fish of species by two means fishing in Al-Auda marsh during the study period

Month	Nov.2012		Dec.2012		Jan.2013		Feb.2013		Mar.2013		April 2013		May 2013		June 2013		July 2013		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
<i>A. marmid</i>	16	0.54	36	1.35	38	1.68	52	1.67	8	1.0	17	1.53	23	1.8	32	1.47	36	1.44	258	1.37
<i>A. mossulensis</i>	69	2.33	85	3.18	88	3.89	114	3.66	49	6.13	53	4.77	69	5.42	104	4.78	83	3.33	714	3.78
<i>A. vorax</i>	4	0.13	7	0.26	5	0.22	8	0.26	2	0.25	5	0.45	4	0.31	8	0.37	11	0.44	54	0.29
<i>C. luteus</i>	47	1.59	53	1.99	51	2.25	91	2.92	19	2.38	21	1.89	32	2.51	147	6.76	195	7.83	656	3.48
<i>M. sharpey</i>	5	0.17	5	0.19	6	0.27	8	0.26	-	-	-	-	6	0.47	8	0.37	7	0.28	45	0.24
<i>L. xanthopterus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.09	-	-	2	0.01
<i>C. gibelio</i>	714	24.14	566	21.2	660	29.15	857	27.49	232	29.04	300	26.98	259	20.36	387	17.78	414	16.61	4389	23.27
<i>C. carpio</i>	36	1.22	41	1.53	49	2.16	64	2.05	16	2	29	2.61	34	2.68	62	2.85	48	1.93	379	2.01
<i>C. idella</i>	-	-	-	-	-	-	-	-	-	-	-	-	5	0.4	6	0.28	9	0.36	20	0.11
<i>H. leucisculus</i>	-	-	27	1.01	6	0.26	19	0.61	13	1.62	5	0.45	14	1.1	22	1.01	17	0.68	123	0.65
<i>L. abu</i>	1301	43.99	945	35.4	582	25.71	904	29.0	294	36.8	482	43.34	445	34.99	705	32.40	867	34.79	6525	34.60
<i>S. triostegus</i>	225	7.6	239	8.95	197	8.70	252	8.08	66	8.26	57	5.12	101	7.94	166	7.63	180	7.22	1483	7.86
<i>H. fossilis</i>	113	3.82	106	3.97	63	2.78	122	3.91	-	-	13	1.17	37	2.91	56	2.57	52	2.09	562	2.98
<i>M. pelusius</i>	106	3.58	148	5.54	129	5.7	125	4.01	-	-	31	2.79	60	4.72	148	6.80	197	7.9	944	5.0
<i>M. mastacembelus</i>	96	3.24	110	4.12	86	3.8	99	3.18	-	-	5	0.45	41	3.22	75	3.45	74	2.97	586	3.11
<i>T. zillii</i>	150	5.07	206	7.71	224	9.89	330	10.59	66	8.26	68	6.11	104	8.17	196	9.0	239	9.59	1583	8.39
<i>O. aureus</i>	16	0.54	30	1.12	22	0.97	18	0.58	-	-	4	0.36	5	0.4	11	0.5	10	0.4	116	0.62
<i>A. dispar</i>	-	-	-	-	-	-	3	0.09	6	0.75	2	0.18	8	0.63	10	0.46	11	0.44	40	0.21
<i>G. holbrooki</i>	60	2.03	66	2.47	58	2.56	51	1.64	28	3.5	20	1.8	25	1.96	31	1.42	42	1.69	381	2.02
No.of species	15		16		16		17		12		16		18		19		18		19	
Total No .of individuals	2958	15.68	2670	14.16	2264	12.0	3117	16.53	799	4.24	1112	5.9	1272	6.74	2176	11.54	2492	13.21	18860	100

Varied number of fish species were detected in the remaining months. In November recorded 15 species with 2958 individuals, but 16 species were found in each of December, January and April giving 2670, 2264 and 1112 individuals, respectively. However, the monthly changes in the number of fish species were caught in Al-Auda marsh shows in (Fig. 4).

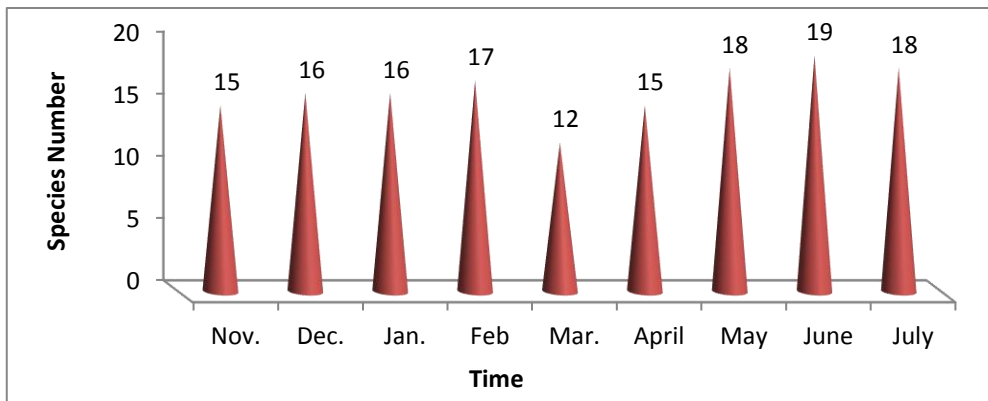


Figure 4: Monthly changes in the number of fish species caught in Al-Auda marsh

The results of the present study showed the Maximum number of 19 species was recorded in June by giving of 2176 individuals forming 11.54 % of the total number of fish catches, while minimum number 12 species was recorded having of 799 individuals in March to giving 4.24% of the total number of fish catches (Table 2).

In general, the number of species during the months was positively related to water temperatures compared to other months relating to the environmental changes. The results of the present study showed the highest number was catches of 3117 individuals during February giving a percentage 16.53%, while the lowest number of 799 individuals was found in March forming 4.24 % (Fig. 5).

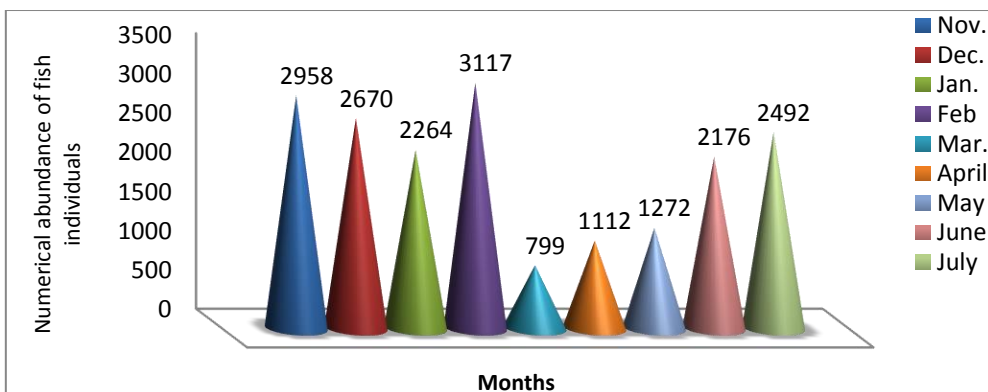


Figure 5: Monthly variations in the count of fish individuals caught during the study period

Species composition and temporal occurrence

The occurrence examined species were classified into three main groups according to collection period and the found in monthly caught samples. In the other hand altered division the species into resident, seasonal and rare species according to Tyler (1971) and based on number the study months as follows:-

- 1- Resident species: - This group had been the highest number of species among other groups and these species were found during 7-9 months being have 16 species and giving of 18798 individuals forming 99.67 % of the total number of fish catches including: *A. marmid* , *A. mossulensis* , *A. vorax* , *C. luteus* , *C. gibelio* , *C. carpio* , *M. sharpey*, *H. leucisculus* , *G. holbrooki* , *L. abu* , *S. triostegus*, *M. pelusius* , *M. mastacembelus* , *H. fossilis* , *T. zilili* and *O. aureus*.
- 2- Seasonal species :- This group had one species seen from 5 to 6 months, and the total number was 40 individuals had a percentage formed 0.21 % of the total number of fish catches include: *A. dispar* species was recorded in six months.
- 3- Rare species: - This group had only two species forming 0.12 % of the total number of fish catches. The species was found in 1- 4 months, giving of 22 individuals include: *C. idella* species was found in 3 months while *L. xanthopterus* seen in June only .

In general, the highest numerical abundance of 3749 individuals giving a percentage 19.88% was recorded through existence 18 species on site 5, while lowest numerical abundant of 2042 individuals forming 10.83% were recorded from through seen 15 species of fish in site 3 in Al-Auda marsh.

In the other hand, in site 1 low existence of *A. vorax* species being found only once during July while the occurrence of *L. xanthopterus* species was found only once in site 2 during May. Again occurred *A. dispar* only once in same site through July. But in site 3 had a similar existence of *A. vorax* in July while *O. aureus* species occurred only once in January, In site 6 low existence of *H. leucisculus* species only one individual through December, and fish *A. dispar* appeared was found only once in July. Again occurred *A. dispar* only once in same site through July .

Table (2): List of fish species in three restored southern of Iraqi marshes compared with the present study (+) Presence species, (-)Absence species, * Marine species, + alien species.

Family	Species	Hawizeh marsh [53]	Hammar marsh [52]	Chybaish marsh [6]	Al-Auda marsh (present study)
Cyprinidae	<i>Acanthobrama marmid</i>	+	+	+	+
	<i>Acanthobrama lissneri</i>	-	+	-	-
	<i>Acanthopagrus latus</i> *	-	+	-	-
	<i>Alburnus mossulensis</i>	+	+	+	+
	<i>Aspius vorax</i>	+	+	+	+
	<i>Barbus grypus</i>	+	+	-	-
	<i>Carasobarbus luteus</i>	+	+	+	+
	<i>Mesopotamichthys sharpeyi</i>	+	+	+	+
	<i>Luciobarbus xanthopterus</i>	+	+	-	+
	<i>Carassius gibelio</i> +	+	+	+	+
	<i>Cyprinus carpio</i> +	+	+	+	+
	<i>Cyprinion microstium</i>	+	+	+	-
	<i>Ctenopharyngodon idella</i> +	-	+	-	+
	<i>Hemiculter leucisculus</i>	+	-	-	+
<i>Sparidentex hasta</i> *	-	+	-	-	
Mugilidae	<i>Liza abu</i>	+	+	+	+
	<i>Liza klunzingri</i> *	-	+	-	-
	<i>Liza subviridis</i> *	-	+	-	-
Siluridae	<i>Silurus triostegus</i>	+	+	+	+
Mastacembelidae	<i>Mastacembelus mastacembelus</i>	+	+	+	+
Heteropneustidae	<i>Heteropneustus fossilis</i> +	+	+	+	+
Bagridae	<i>Mystus pelusius</i>	-	-	-	+
Cyprinodontidae	<i>Aphinus dispar</i>	-	+	+	+
Poecillidae	<i>Gambusia holbrooki</i> +	-	+	+	+
Clupeidae	<i>Tenualosa ilisha</i> *	-	+	-	-
Engraulidae	<i>Thryssa mystax</i> *	-	+	-	-
Scatophagidae	<i>Scatophagus arqus</i> *	-	+	-	-
Gobiidae	<i>Bathygobies fuscus</i> *	-	+	-	-
Hemiramphidae	<i>Hemiramphus georgii</i> *	+	+	-	-
Solidae	<i>Synaptura orientalis</i> *		+		
Cichlidae	<i>Tilapia zillii</i> +	-	-	-	+
Total number		15	34	14	19

Ecological indices

The monthly variations in the Richness index value (D), Diversity index (H) and Evenness indices (J) of fish examined from November 2012 to July 2013 are shown in (Fig.6). The overall value of (D) that calculated for 18860 individuals from 19 species was found 1.83. However, Highest D value 2.38 was recorded in May while the lowest D value 1.65 in March. The D values recorded widely variations when description a fish community of Al-Auda marsh comparison with other studies which carried out in different ecosystems in southern Iraq. Table (3) shows the results of some indices in an assessment fish community of the southern Iraq marsh.

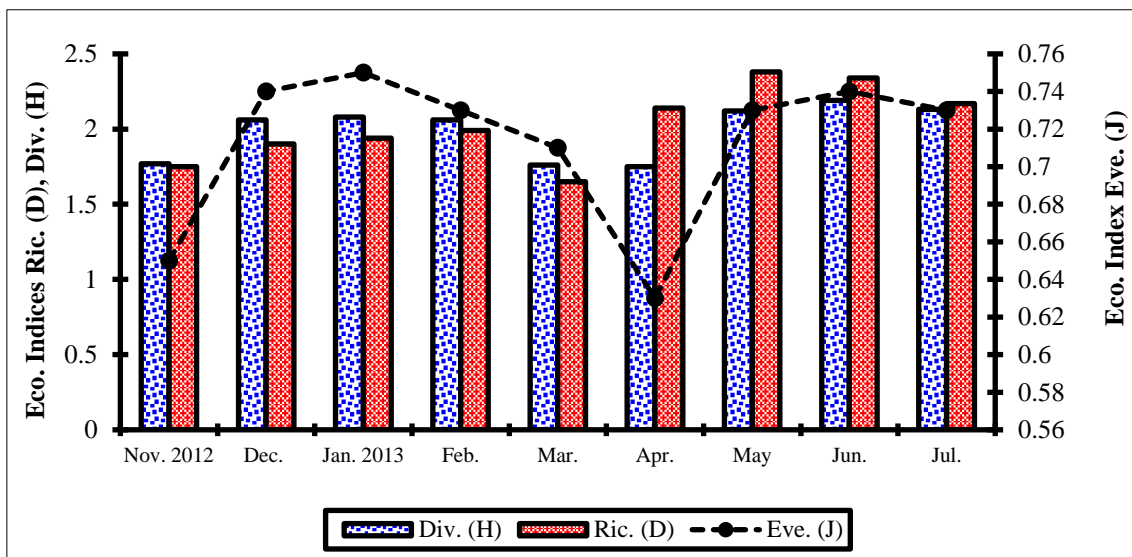


Figure 6: Monthly variations in values indices of assessment life for fish community in Al-Auda marsh

The results of the present study showed higher H and D value in Al-Auda marsh in the period June - July that related to resident species and brought individuals in spring with flooding Tigris river (Mohamed *et al.*,2008b and Jasim, 1988) that led to higher (J) values. However, the D value in Al-Auda marsh was higher in May, that due to the existence higher number of freshwater fish by 18 species. This result similar study (Hussain *et al.*,2006; Mohamed *et al.*,2007 and Mohamed *et al.*,2008b).

For H value, the overall value was found 2.05 and ranged from 1.75 in April to 2.19 in June. The H values recorded identical with study (Younis *et al.*, 2008) in Al-Saffia sanctuary of Al-Hawizeh marsh (1.58-2.24), while it is higher than the reported values in Al-Chybaish Marsh (Mohamed *et al.*,2012 and Hussain *et al.*,2007) in Al-Hawizeh Marsh (Hussain *et al.*,2008) and in East Al-Hammar Marsh by Mutlak (2012).

On the other hand, (Karve *et al.*,2008) has indicated that the H value influenced by environmental factors, as well as the suitability of the

environment for the presence fish and spread, also the movement fish, whether they for nutrition or breeding it's had a large impact on the variation values for this index.

However, the rising discharge water Tigris River shares in existence variation in composition fish community of Al-Auda marsh, therefore this result reflected on Richness index value which express on the extent fertility for water body and healthy in terms of numerical abundant and fish quality Rathertm (1999).The monthly variation for ecological indices in Al-Auda marsh showed the superiority these D, H and J indices 1.83, 2.05 and 0.7, respectively, that identical to the results were recorded by (Younia *etal.*,2008) was 1.95, 2.12 and 0.76 in his study of Al-Hawizeh marsh, this due to the high values of diversity, accompanied with stable ecosystem that might change by other factors as pollution and harsh environmental variables (Bechtel and Copeland, 1970).

In case of (J) value, the current study found the overall value 0.7 varying from 0.63 in April and 0.75 in January. The (J) values were affected by H values. However, as stated by Birch (1981) that (J) represents the ratio between the real diversity and maximum possible diversity for species theoretically, and that we get it if all species were present with numerical abundance, whilst (Routledge,1983).noticed that the (J) value remains constant if non maintained all species on its abundance ratios even if changes total abundance, because the (J) value depends on extent ratios change and abundance of each species and not on the total abundance, it seems that clear in February, May and July as equal values (0.73), therefore J values varied in the current study among the values of other studies .

Degree of similarity in the qualitative composition among different months

Cluster analysis of similarity degree of composition qualitative among different study months showed three different main groups (Fig. 7).

The first main group (I) includes two of subgroups, the first subgroup formed in May and July and the second subgroup had only June, whilst the second main group (II) formed of three subgroups, the first include February, April and the second include December 2012, January 2013 while third subgroup had only November 2012, whereas the third main group (III) consisted of March 2013.

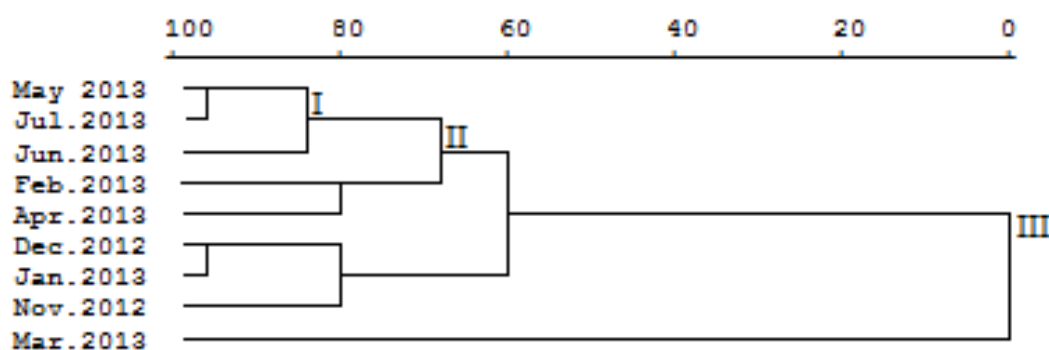


Figure 7: Cluster analysis of similarity degree among samples fishing monthly using (ISJ %).

In general, the data of this work showed the highest similarity of fish species 100 % was recorded between December 2012 and January 2013; May and June 2013 for these months, while lowest similarity 58.8% was found between March 2013 and November 2012. This may be due to the high numbers of caught species in these months as a result of provides food sources available for some species, as well as abundance the crumbs that lead to increasing in counts *Liza abu* species which is main food to it Younis (2005), in addition to a preference for environmental factors in marsh during that period, slow flow water and richness of nutrients.

However, February was the peak in terms total number of 3117 individuals, that due to an increase in number of *Liza abu* fishes, the prosperity and activity of fishing led to the diversity of species and caught high numbers of fish individuals at this time, while March was low in total number of 799 individuals. This may be due to decline activity of fishermen and the lower numbers of fish caught as a result of fishing prevention processes in fish breeding season .

Environmental variables

The monthly fluctuations in water temperatures and salinity in Al-Auda Marsh showed water temperature changed from 13°C in January to 35.6°C in July. The minimum value of salinity was 0.9 mg/l in February and the maximum value was 3.1 mg/l in June. The relationships of water temperature and salinity with the number of fish species and the total catch of individuals in Al-Auda Marsh are showing a significant positive correlation ($r = 0.582$ and 0.613 , $p \leq 0.05$) with the number of fish species and the total catch of individuals, while salinity showed very weak positive correlations with both of them ($r = 0.262$ and 0.312 , $p \leq 0.05$), respectively. Regarding the number of fish species and total catch of individuals in Al-Auda marsh showed a

positive correlation significant with dissolved oxygen ($r=0.397$ and $r=0.494$, $P\leq 0.01$).

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الخصائص التركيبية لمجتمع الأسماك في هور العودة جنوب العراق

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المستخلص:

الهدف من هذه الدراسة هو تحديد تكوين الأنواع، وتركيبية تجمع الأسماك، ووضع المؤشرات البيئية في استعادة هور العودة. تم تسجيل ما مجموعه 19 نوعا من الأسماك تنتمي إلى 9 عوائل من هور العودة للفترة من تشرين الثاني 2012 وحتى تموز 2013 باستخدام جهاز النقال الكهربائي ، شباك الصيد الثابتة في ستة مواقع . احتوت عينات الأسماك المصادة على احد عشر نوع من أسماك المياه العذبة ، وثمانية انواع من الاسماك الغريبة. بلغ عدد الأنواع المتوطنة 11 نوع (59.95%)، والغريبة 8 انواع (40.05%). شكلت الأنواع المقيمة (99.67%)، والأنواع الموسمية (0.21%) والأنواع النادرة (0.12%). تباينت وفرة الانواع حيث كان النوع *Liza abu* اكثر سيادة من الأنواع الاخرى كونها أكثر الأنواع المهيمنة، بينما احتل النوع *Carassius gibelio* المرتبة الثانية واحتلت اسماك البلطي *Tilapia zillii* المرتبة الثالثة، التي شكلت 34.60%، و 23.27% و 8.39% على التوالي. كانت المؤشرات البيئية على النحو التالي: دليل التنوع من 1.75 في نيسان إلى 2.19 في شهر حزيران، وتراوحت قيم الغنى من 1.65 في اذار إلى 2.38 في شهر ايار، ودليل التوزيع المتساوي تراوحت قيمه من 0.63 في نيسان إلى 0.75 في كانون الثاني. أعلى نسبة تشابه شهرية كانت 100% بين كانون الاول 2012 وكانون الثاني 2013؛ كذلك بين ايار وحزيران 2013، وكانت أدنى نسبة تشابه 58.8% بين اذار 2013 وتشرين الثاني 2012. أظهرت درجة حرارة الماء ارتباطا "متوسطا" ($r=0.582$ and $r=0.613$, $p \leq 0.05$) مع كل من عدد الأنواع ومجموع المصيد من الاسماك على التوالي، في حين اظهرت الملوحة ارتباطا "ضعيفا" موجبا" ($r = 0.262$ and 0.312 , $p \leq 0.05$) مع كل من عدد الانواع ومجموع المصيد من الاسماك، على التوالي. بالإضافة إلى ان عدد من أنواع الأسماك ومجموع المصيد في هور العودة أظهرت وجود علاقة إيجابية مع الأوكسجين المذاب ($r=0.397$ and $r=0.494$ $P \leq 0.01$).