



## **Species Composition and Ecological indices of Fishes in the restored marshes of Southern Mesopotamia**

**N.A. Hussain<sup>a</sup> ; H.A. Saoud<sup>b</sup> and E. j. Al shami<sup>b</sup>**

<sup>a</sup>*Dept. Biology, College Science. Basrah University*

<sup>b</sup>*Dept of Fisheries College Agriculture .Basrah University*

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### **Abstract**

Fish species composition and ecological indices were monitored in three restored southern marshes(Suq Al-Shuyukh, Al- Huwayzah and East Hammar ),during the period June 2004 to July 2005. 18 freshwater and seven marine species were collected in total from Al- Huwayza, Suq Al-Shuyuakh and East Hammar. The fish composition of each marsh exhibit certain differences . In Al- Huwayzah the fish assemblage dominated by native species formed of 70.6 % . In Suq Al-Shuyukh 64.7% ,in East Hammar consisted of 47.8%.The highest alien and marine constituents was in Al- Huwayzah and East Hammar 29.4% and 30.4%respectively. The dominant species in the three monitored marshes was *Liza abu* and in the second rank was *Carassius carassius*.

Diversity and Richness were higher in East Hammar than other marshes, Evenness generally the same in all marshes. Higher value of Similarity between Suq Al- Shuyukh and East Hammar 73.9%, between Al- Huwazah and Suq Al- Shuyukh 70%, in comparison with 68.1% between Al- Huwazah and East Hammar. The recovery index were higher in East Hammar( 71.8%), in compared with 69.5 % and 65.2 % in Suq Shuyukh and Huwazah respectively.

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### **1- Introduction**

The marshes of southern Iraq were the largest wetland in the Middle East .These marshes considered as natural refuge for aquatic organisms especially fish and birds . These marshes were characterized by their high primary productivity of aquatic plant and

phytoplankton (Al Hilli, 1977, Al-Zubaidy, 1985 and Al Mayah, 1992).consequently to be one of the richest and rarest bio-tops in the region.

During the 1990's these marshes faced a serious crisis through a planed desiccation led to reduce their original area by > 90%, and to

the disappearance of this bio-tops. After April 2003 these marshes were inundated, and the ecosystem start to flourish again.

Several taxonomic accounts were published concerning Iraqi fishes (Khalaf, 1961, Mahdi, 1962 Al-Daham, 1982 and Coad, 1991). Most of fishes existed in the marshes were fresh water with few intruder marine species including anadromous penetrate the

lower reaches of the southern marshes especially in Al-Hammar marsh (Fig.1), during certain period of the year (Al-Hassan and Naama, 1989).

The aim of this study to highlight on the fish composition and ecological indices in the restored Al-Huwayza, Suq Al-Shuyuakh and East Hammar marshes.

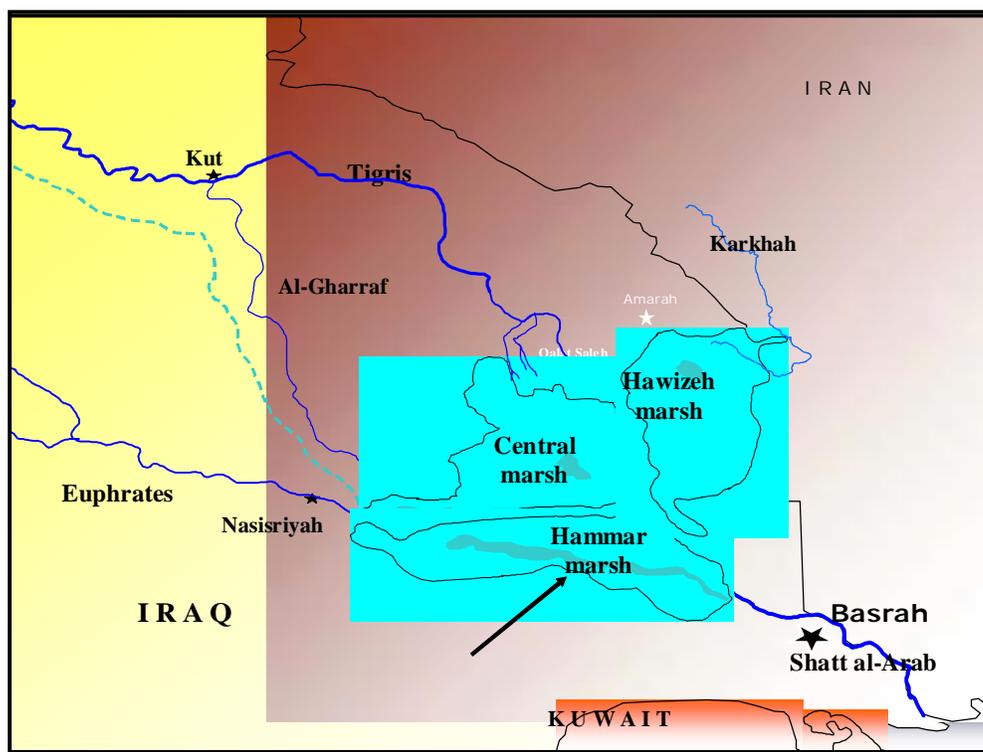


Fig. (1) Map showing Iraqi Southern Marshes

## 2-Materials and Methods

Monthly fish samples were collected from two stations as below from the three monitored marshes, during the period from June 2004 to July 2005. Nets with different mesh sizes, electrical fishing device and small dip net. Specimens were identified according to Khalaf (1961), Beckman (1962) and Coad (1991).

Ecological indices (abundance, diversity, evenness, richness and similarity) of pooled monthly samples were calculated according to Pearson and Rosenberg (1978), Shanon and Weaver (1949), Pielou (1977), Margalef, (1968) and Jaccard (1908) respectively.

Monthly temperatures and salinities for IMRP final report(2006).  
three monitored marshes were obtain from the

Marsh	Station	GPS	Environment	Status
Al-Huwaizah	Um Alnaaj	N 31 38 30 E 47 35 21	Open Water	Natural station
Al-Huwaizah	Taraba	N 31 29 48 E 47 31 48	Dense Vegetation	Desiccated station
Suq Al-Shuyuakh	Amia	N 30 51 41 E 46 38 13	Channel Water	Desiccated Station
Suq Al-Shuyuakh	Al-wineas	N 31 51 50 E 46 40 42	Open water	Desiccated Station
East Hammar	Saddah	N 30 40 32 E 47 37 21	Tidal Channel water	Desiccated station
East Hammar	Burkah	N 30 40 22 E 47 33 03	Tidal Open Water	Desiccated station

### 3-Results

#### Species Composition

The occurrence of different fish species collected after inundation of the desiccated marshes were displayed in table ( 1).

During the monitoring period a total of 18 freshwater and seven marine species were collected from Huwayza, Suq Al-Shuyuakh and East Hammar. The fish composition of each marsh exhibit certain differences .In Al-Huwayza 17 species were recorded all of them were freshwater .In Suq Al-Shuyuakh 15 freshwater species were censused in addition to two marine ones .In East Al- Hammar 23

species obtained in total ,16 of them were freshwater and seven marine .

In Suq Al-Shuyukh marsh, was dominated by freshwater species. The most abundant species was *Liza abu* (42.21%) followed by *Carassius carassius* (25.48%) and in the third rank *Barbus luteus* (13.42%). Two marine species were collected *Bathygoupius fuscus* and the anadromus species *Tenaulosa ilisha* ,(8 cm total length). In Huwayzah marsh ,all the fish assemblage consisted of freshwater species, *L.abu* coming first in abundance (36.22% )followed by *C. carassius* (23.04% ) than *Aspius vorax* (10.84%).

**Table (1): Numerical abundance (%) of fish species in Al-Huwayzah , Suq Al- Shuyukh and East Hammar marshes.**

species	category	Suq Al-Shuyukh	Al-Huwayzah	East Hammar
<i>Liza abu</i>	N	42.21	36.22	29.65
<i>C. carassius</i>	A	25.48	23.04	29.65
<i>Barbus luteus</i>	N	13.42	9.14	4.97
<i>Aspius vorax</i>	N	3.50	10.84	2.39
<i>Alburnus mossulensis</i>	N	3.20	0.42	2.94
<i>Acanthobrama marmid</i>	N	2.95	0.33	3.31
<i>Barbus sharpeyi</i>	N	2.65	9.20	1.10
<i>Cyprinus carpio</i>	A	2.65	6.15	0.92
<i>Silurus triostegus</i>	N	1.50	3.29	0.18
<i>Barbus xanthopterus</i>	N	0.45	0.04	0.36
<i>Cyprinion macrostomum</i>	N	0.35	-	0.18
<i>Ctenopharyngodon idella</i>	A	0.30	0.38	0.18
<i>Mastacembelus mastacembelus</i>	N	0.10	0.42	0.73
<i>Heteropneustus fossilis</i>	A	-	0.14	1.65
<i>Gambusia holbrooki</i>	A	0.40	0.14	0.36
<i>Aphanius dispar</i>	N	0.10	0.14	0.18
<i>Garra rufa</i>	N	-	0.14	-
<i>Mystus pelusius</i>	N	-	0.14	-
<i>Liza subviridis</i>	M	-	-	14.18
<i>Liza klunzingeri</i>	M	-	-	0.73
<i>Baleophallalmus boddarti</i>	M	-	-	0.73
<i>Thyrssa mystax</i>	M	-	-	0.55
<i>Acanthopagrus latus</i>	M	-	-	3.86
<i>Bathygobius fuscus</i>	M	0.10	-	0.36
<i>Tenaulosa ilisha</i>	M	0.10	-	0.73
Number of native species		11	12	11
Total number of species		17	17	23
Total number of individuals		1997	2099	543

N=Native species A=Alien species M=Marine species

In East Hammar marsh ,the situation was different to certain extent due to the existence of marine species, which had a pronounced abundance. The most abundant species were *L. abu* and *C. carassius* (29.65%) respectively, followed by marine species *L. subviridis* (14.73%) (table 1).

The highest number of native species were in Huwayzah (12) and lowest in both East Hammar and Suq Al-Shuyukh (11) . Marine species were higher in East Hammar (7) and none in Al- Huwayzah (table 1).

In Al- Huwayzah the fish assemblage dominated by native species formed of 70.6 % ,alien assemblage was constituted of 29.4% . In Suq Al-Shuyukh native assemblage consisted of 64.7% ,alien 23.5% and marine 11.7% In East Hammar the native assemblage consisted

47.8%, alien 21.7% and marine 30.4 % (table 2) .

#### **Percentage of Alien / Native species:**

In Suq-Shuyukh there were eleven native species and four alien =36.3%.

In Huwayzah there were twelve native and five alien = 41.6%.

In East Hammar there were eleven native species and five alien = 45.4%.

The highest percentage of alien species were in East Hammar and lowest in Suq Al-Shuyukh.

#### **Percentage of marine species/ freshwater species**

In Suq Al-Shuyukh only two marine species consisted 13.1% ,in Al Huwayzah 0.0% and in East Hammar seven marine species were recorded equal to 43.8%.

**Table (2) Percentages of abundance (%) of native ,alien and marine species of the fish assemblages in the Al-Huwayza, Suq Al-Shuyukh and East Hammar marshes.**

Species	Suq Al- Shuyukh %	Al-Huwayzah %	East Hammar %
Native	64.7	70.6	47.8
Alien	23.5	29.4	21.7
Marine	11.7	0.00	30.4

**Table (3): Ecological indices of the fish assemblage in Al-Huwayzah, Suq Al-Shuyukh and East Hammar marshes during monitored period**

Indices(range)	(Suq Al- Shuyukh)	(Al-Huwayzah)	East Hammar
Diversity	1.2-2.05	0.97-1.85	1.4-2.07
Richness	1.2- 2.2	0.8-1.75	1.3-2.6
Evenness	0.52-0.86	0.39-0.84	0.57-0.82
similarity	<b>Similarity between Suq. and Huw.</b>	<b>Similarity between Huw. and Ham.</b>	<b>Similarity Suq.and Ham.</b>
	73.6% *	78.9% *	94.1% *
	70.0%	60.0%	73.9%

(\*) Marine species were excluded.

**Table (4): The recovery index of restored marshes (Observed species / Historical species record).**

Stations	Observed species	Historical species	Recovery ratio %
Suq Al –Shuyukh	16	23*	69.5
Al-Huwayzah	17	23*	73.9
East Hammar	23	32**	71.8

\*only freshwater species reported

\*\* including freshwater and marine species

### Ecological Indices

Monthly fluctuations in diversity ,richness and evenness indices during the monitoring period were illustrated in figures (2), (3) and (4) .Diversity reach the peaks in November, December and July and the lowest values were in September, April and February at Al-Huwayza, East Hammar and Suq Al-Shuyuakh respectively (fig.2 and table 3) . Higher richness values recorded in November and April in Huwayza while at East Al Hammar and Suq Al-Shuyuakh in December and May respectively .The lowest were in September ,April and February in Al- Huwayza ,East Hammar and Suq Al-Shuyuakh (fig. 3 and table 3) .The peaks of evenness were noticed in

November , February and June and the lowest in May (2005) ,January and March at Al-Huwayza ,East Al Hammar and Suq Al-Shuyuakh (fig.4 and table 3) .

Similarity between the marshes was showed in table (3), the highest similarity existed between Suq Al-Shuyuakh and East Hammar 73.9% ,Al- Huwayza and Suq Al-Shuyuakh 70.0% and the lowest between Al-Huwayza and East Hammar 68.1%. In case marine species excluded the similarity increase to reach 93.7% between Suq Al-Shuyuakh and East Hammar, 83.3% between Al-Huwayza and East Hammar, 82.3% between Al-Huwayza and Suq Al-Shuyuakh .

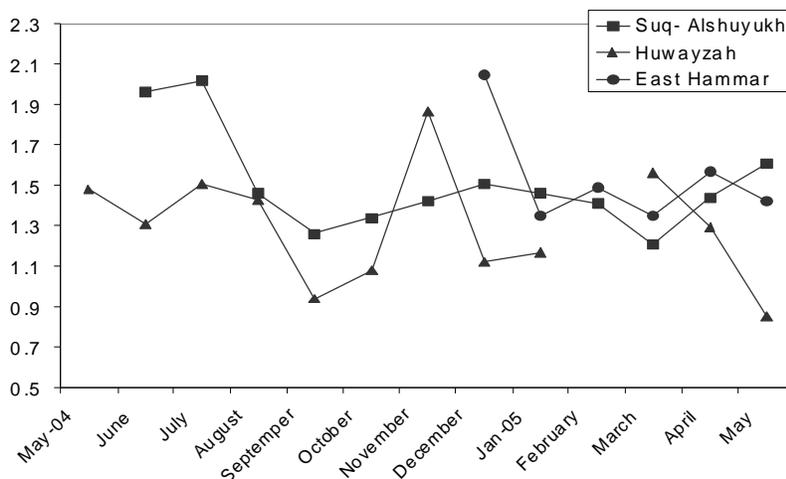


Fig. (1): Monthly variations of diversity for the three monitored marshes

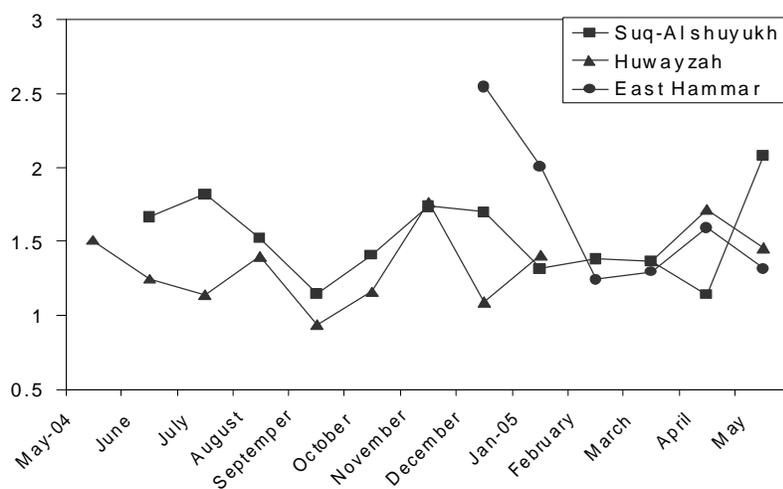


Fig.(2): Monthly variations of richness for the three monitored marshes

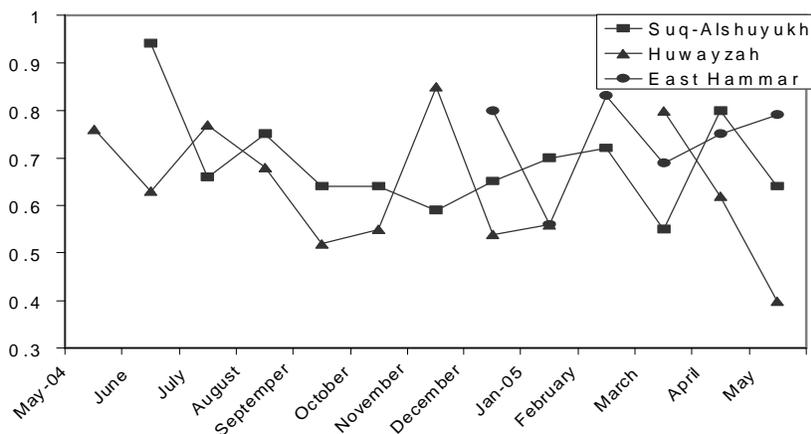


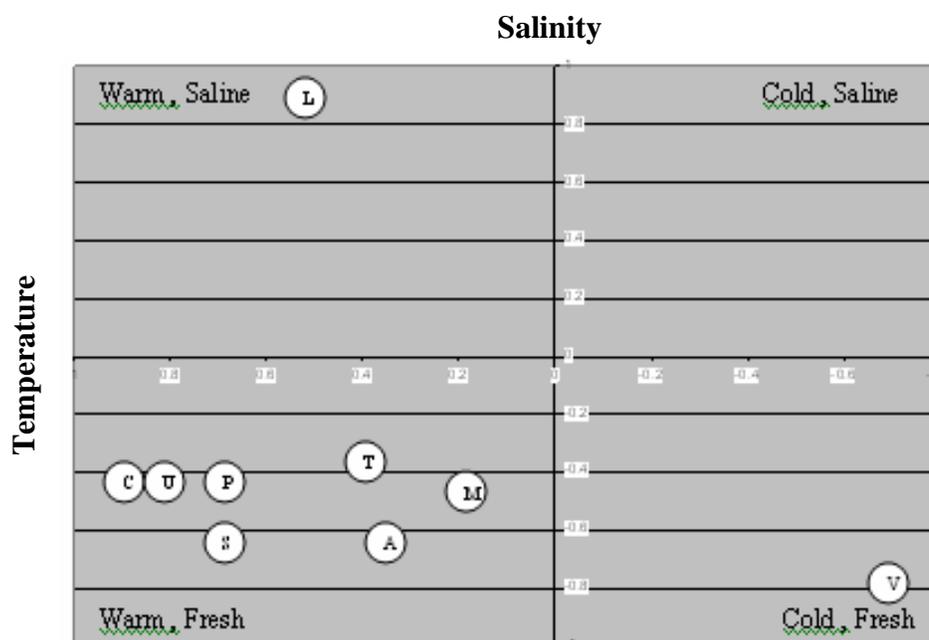
Fig. (3): Monthly variations of evenness for the three monitored marshes

**Abiotic factors:**

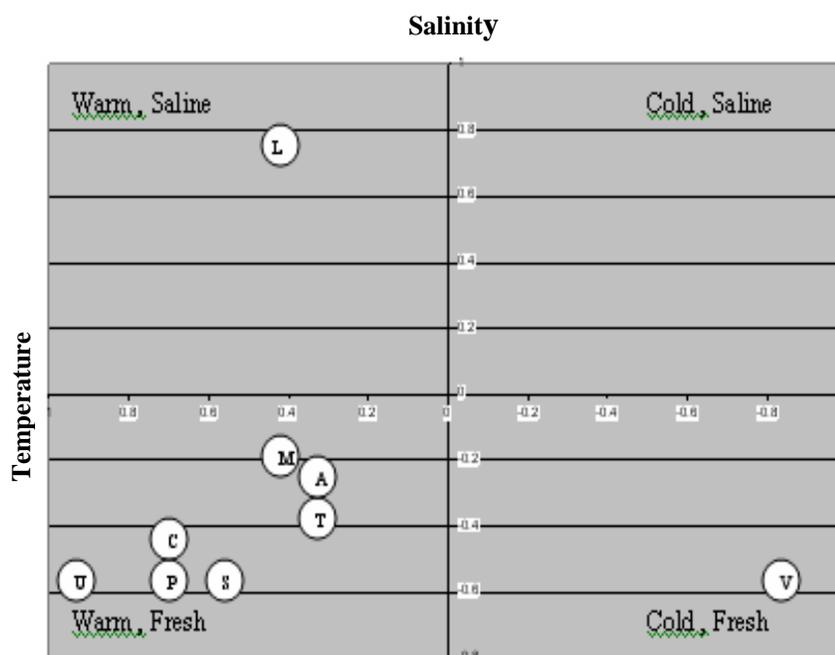
Water temperature ranged from 11C in January to 29 C in August. Salinity values were more stable. The relationship of temperature and salinity with number of species were established through the determination of correlation coefficients (r). The number of species were positively correlated with temperature ( $p < 0.05$ ). Salinity showed weak positive correlation ( $p < 0.05$ ). Nine species were coordinated along temperature and salinity axes as an indicator of the relative influence of these factors (Fig.4 a, b ; c), seven species are positioned in the lower left quadrant , these are correlated negatively with both temperature and salinity .One species was placed in the upper left quadrant indicating positive correlated with salinity negatively with

temperature (*L.abu*). One species (*A.vorax*) correlated negatively with salinity and positively with temperature in all studied marshes.

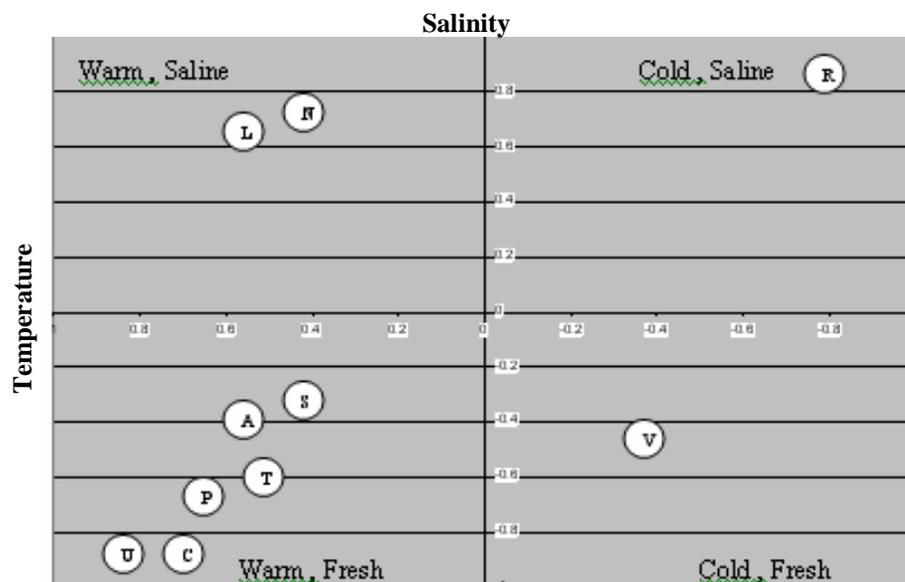
In Suq Al shuyuakh marsh , *Liza abu* appear as warm saline tolerant species , *Aspius vorax* was the only cold fresh lover. The other species were warm fresh tolerant ( *Acanthobrama marmid* , *Alburnus mossulensis* , *Silurus triostegus* , *Carassius carassius* , *Barbus luteus* , *Barbus sharpeyi* , *Cyprinus carpio* ) figure( 4a). The same pattern was exhibited in Al Huwayzah as illustrated in figure (4b). The situation was different in East Hammar due to occurrence of marine species *Liza subviridis* as warm saline and *Acanthopagrus latus* as cold saline species (fig.4c) .



Fig(4a) : The relationship between fish number and temperature and water salinity in Suq alshuyukh marsh ( L: *Liza abu* , A: *Acanthobrama marmid* , M: *Alburnus mossulensis* , T: *Silurus triostegus* , C: *Carassius carassius* , U: *Barbus luteus* , S : *Barbus sharpeyi* , P: *Cyprinus carpio* , V : *Aspius vorax* )



Fig( 4b) : The relationship between fish number and temperature and water salinity in Huwayzah marsh ( L: *Liza abu* , A: *Acanthobrama marmid* , M: *Alburnus mossulensis* ,T: *Silurus triostegus* , C: *Carassius carassius* , U: *Barbus luteus* , S : *Barbus sharpeyi* , P: *Cyprinus carpio* , V : *Aspius vorax* )



Fig(4c) : The relationship between fish number and temperature and water salinity in East Hammer marsh ( L: *Liza abu* , A: *Acanthobrama marmid* , M: *Alburnus mossulensis* ,T: *Silurus triostegus* , C: *Carassius carassius* , U: *Barbus luteus* , S : *Barbus sharpeyi* , P: *Cyprinus carpio* , V : *Aspius vorax* , N: *Liza subviridis* , R: *Acanthopagrus latus* )

#### 4- Discussion

Al-Daham (1988) stated that 65 species existed in the inland waters of Iraq, half of them occurred in the southern marshes. Coad (1991) put the total number of fishes in fresh water system of Iraq to be 58 consisting of 43 freshwater, 8 marine and 7 exotic species. Al-Shamaa (2005) collected 20 species from the marshes in Nasiriah, half of them were non-commercial. However no separate check list were published concerned with fish composition of the marshes before desiccation, but in any case they never exceed 35 species as compiled from different resources (Mahdi 1962, Al Daham 1982, Banister 1980, Al-Hassan and Naama, 1989 and Coad, 1991).

The number of species will increase depend on the development of the restoration and number of marine species penetrated to the marshes. After inundation of the marshes in April 2003, fishes start to return back gradually with improving of the environment.

Most of the species collected from the monitored marshes were fresh water derived originally from Tigris, Euphrates and Shatt Al-Arab rivers. Never the less, there were some difference which forced by the unique environmental situation in marshes like slow current, dense vegetation, relative shallowness and seasonal existence of marine species.

Marine species penetrate to the East Hammar were mostly juveniles for feeding and protection (ARDI 2006). These marine species were belong to marine families

inhabited Shatt Al-Arab estuary (Hussain et al. 1999).

The occurrence of different fish species in the marshes as reported by several authors Mahdi (1962), Al Daham (1982), Banister (1980) and Coad (1991) were compiled in table (6), estimated to be around 32. After restoration the number of species collected were 23 formed 71.8% from assumed original figure. The absent species were mostly of freshwater species belong to families cyprinidae (*B.grypus*, *B.scheich* and *B.subquincunciatus*), Cypriontidae (*A. mento* and *A sophiae*) and marine Hemiramphidae (*Hemiramphus* spp). Introduce species did not appear in old survey (Mahdi 1961) but occurred in recent one (Coad 1991).

The differences existed between the correlation of species with temperature and salinity in Al-Huwayza, Suq Al-Shuakh and East Hammar, could be due to different environmental setting, since East Hammar consider as tidal and oligohaline marsh (Hassain and Taher 2007).

The lesser abundant species especially *Barbus* spp. (family Cyprinidae), may be they were highly sensitive for environmental changes occurred in marshes like what happened in late eighties due to the increasing of salinity up to (2.8 ‰) as stated by Abed (1989) however, in late 1970's in particular, this parameter was about (0.4 ‰) as reported by Al-Saadi et al. (1981). Therefore, the decrease in abundance of those species may be related to such environmental changes beside other

feeding ecological factors like competition with *C. carpio*. (Hussein et al., 2000).

The desiccation of the marshes alter largely the fish community and brought major changes in the structure duo to harsh environment prevailing and to change in the ways of productions especially primary production of aquatic plants and phytoplankton, consequently change in secondary productivity of zooplankton and benthos .The dominant species previously were *L.abu* , *B.sharpeyi*, *C.carpio*, *B.luteus* and *S.triostegus* (Al-Daham 1988, Hussain et al. 1992) .After desiccation *L.abu*, *C. carassius* ; *B. luteus* were dominant by number and by weight was *S. triostegus*, beside the increase of abundance of small species like *Alburnus mossulensis* (ARDI, 2006) .

The disappearance or lesser abundant of *Garra rufa* and *Acanthobrama* marmaid because of scarcity of suitable food resources ( Younis et al. 2001) . These conditions could led to increase of *B.luteus* and *C. carassius* which had mixed diet i e. omnivorous.

Availability of detritus could led to increase in number of *L abu* since it is known as main food item (ARDI,2006) , on other hand increase in numbers the restored marshes of *S .triostegus* because of the availability of their preys in shape of small fishes and disappearance of their natural enemies ( aquatic birds ; river otters).

The decrease in number of individuals of *B. xanthopetrus* and *C. carpio* in comparison with previous record, could be related to the sacristry of benthic organisms ( IMRP 2006) .

The dominance species in Suq-Shuyukh, Huwayzah and East Hammar were *L. abu* , *B. luteus* and *C. carassius*,the first two were native , the third was alien appear during the nineties in Shatt Al-Arab river (Al-Shammaa et al. 2002), the abundance and dominance of these species could be related partly to their food availability and prevailing environmental factors .

Number of alien and marine species formed substantial percentage of the total number of species in the three monitored marshes consisting 40-50% of the assemblages, impaling that the original assemblage was distorted due to massive desiccation .Abundance of native species decrease in Al-Hammr marsh to less than 50% to be consider as mixed assemblage of fresh and marine species, while Al-Huwayzah was inhabited by freshwater fishes only.

The fish population occurred in restored marshes consisted of freshwater native species with few alien (introduced) and migratory marine species .

In general the fish assemblages in the three monitored marshes reflected the prevailing environmental factors after desiccation .

**Table (6) Reported occurrence of fish species before desiccation and after restoration (present) of southern Iraqi marshes .**

Family	Species	MAHDI 1962	Banister 1980	Al-Daham 1982	coad 1991	present
Clupeidae	<i>Tenulosa ilisha</i> **	+		+	+	+
Cyprinidae	<i>Acanthobrama marmid</i>	+		+	+	+
Cyprinidae	<i>Alburnus mossulensis</i>	+	+	+	+	+
Cyprinidae	<i>Aspius voras</i>	+	+	+	+	+
Cyprinidae	<i>Barbus grypus</i>	+	+	+	+	
Cyprinidae	<i>Barbus luteus</i>	+	+	+	+	+
Cyprinidae	<i>Cyprinion microstmmum</i>	+	+	+	+	+
Cyprinidae	<i>Barbus scheich</i>	+	+			
Cyprinidae	<i>Barbus sharpeyi</i>	+	+	+	+	+
Cyprinidae	<i>Barbus subquincunciatus</i>	+	+	+	+	
Cyprinidae	<i>Barbus xanthopterus</i>	+	+	+	+	+
Cyprinidae	<i>Carassius carassius</i> *				+	+
Cyprinidae	<i>Ctenophryngodon idella</i> *				+	+
Cyprinidae	<i>Cyprinus carpio</i> *			+	+	+
Cyprinidae	<i>Garra rufa</i>	+	+	+	+	+
Bagridae	<i>Mystus pelusius</i>	+	+	+	+	+
Siluridae	<i>Silurus triostegus</i>	+	+	+	+	+
Heteropneustidae	<i>Heteropneustes fossilis</i> *		+	+	+	+
Poeciliidae	<i>Gambusia holbrooki</i> *			+	+	+
Cyprinodontidae	<i>Aphanius dispar</i>	+		+	+	+
Cyprinodontidae	<i>Aphanius mento</i>	+		+	+	
Cyprinodontidae	<i>Aphanius sophiae</i>			+		
Mugilidae	<i>Liza abu</i>	+		+	+	+
Mugilidae	<i>Liza klunsiingeri</i> **	+		+		+
Mugilidae	<i>Liza subviridis</i> **	+			+	+
Sparidae	<i>Acatopagrus latus</i> **			+	+	+
Mastacembelidae	<i>Mastacembelus mastacembelus</i>	+			+	+
Hemiramphidae	<i>Hemiramphous</i> ** spp.				+	
Gobidae	<i>Boelophthalmus boddarti</i> **				+	+
Gobidae	<i>Bathygobius fuscus</i> **			+		+
Engraulidae	<i>Thryssa mystax</i> , ( <i>T.hamiltoni</i> )**	+		+	+	+
Sparidae	<i>Sparidentex hasta</i> **			+		

\* Alien (introduce) \*\*= marine

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## تركيب التجمع السمكي والدلائل البيئية في الاهوار المعادة في جنوب العراق

نجاح عبود حسين\* ، حسين عبد سعود\*\* والهام جبار الشامي\*\*

\*قسم علوم الحياة- كلية العلوم - جامعة البصرة

\*\*قسم الاسماك والثروة البحرية- كلية الزراعة - جامعة البصرة

### الملخص

درس التجمع السمكي في اهوار المنطقة الجنوبية ما بعد فترة التجفيف ( 2004-2005 ) ، وقد اظهرت نتائج الدراسة ان اسماك الخشني *L.abu* واسماك كارب الكارسين *Carassius carassius* سائدة في الاهوار الثلاثة المدروسة ( هور سوق الشيوخ وهور شرق الحمار وهور الحويزة ) . وسجلت خمسة انواع مدخلة وسبعة انواع بحرية . كان اعلى عدد لانواع الاسماك النهرية ( 17 ) في هور الحويزة ، بلغت الدلائل البيئية ( التنوع والغنى والسيادة ) والتشابه في المجتمعات السمكية الثلاثة اذ تراوح التنوع بين 0.87-2.07 والغنى 0.8-2.6 والسيادة بين 0.39-0.86 ، وكانت اعلى قيمة للتشابه بين هوري سوق الشيوخ و شرق الحمار (73% ) . اظهر دليل الاسترجاع اعلى قيمه في هور الحويزة اذ بلغ 73.9 % .