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Fish biology

**THE EFFECT OF A HEAVY RIVER FLOOD ON THE FISH ASSEMBLAGE
STRUCTURE IN KHOR AL-ZUBAIR, NORTHWESTERN ARABIAN GULF,
IRAQ**

**WPŁYW WLEWU WÓD RZECZNYCH NA SKŁAD GATUNKOWY RYB
W AKWENIE KHOR AL-ZUBAIR PÓŁNOCNO-ZACHODNIEJ CZĘŚCI
ZATOKI PERSKIEJ, IRAK**

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The effect of heavy river flood during 1987/88 on fish population was studied in Khor al-Zubair, northwestern Arabian Gulf. The fish structure in the Khor changed dramatically due to the intrusion of freshwater species. Six freshwater species (*Heteropneustus fossilus*, *Liza abu*, *Alburnus capito*, *Barbus luteus*, *Parasilurus triostegus*, *Cyprinus carpio*) comprised 38.8% during the heavy flood at the northern part of the Khor (Junction station), while only the first five species contributed 17.8% the total number at the middle of the Khor (Port station).

INTRODUCTION

Every twenty years the Shatt al-Arab river basin experienced a heavy river flood, so in order to reduce the damage of the flood, a diversion channel (Shatt al-Basrah) was constructed to by-pass part of the flood directly to the Arabian Gulf through Khor al-Zubair (Fig. 1).

Riverine fish fauna of Basrah province was studied by several workers; Al-Nasiri and Shamsul-Hoda (1975), Al-Hassan and Hussain (1985), Hussain et al., (1989) - Shatt al-Arab, and Al-Daham and Yousif (1990) - Shatt al-Basrah. Inshore fish assemblage of the most northern Arabian Gulf was investigated by Dames and Moore (1983) - Kuwait Bay and Khor al-Sabiya, Wright (1988) - Sulaibikhat Bay, Hussain and Naama (1989) and Ali

and Hussain (1990) - Khor al-Zubair, Younis (1990) - Khor Abdullah, Mohamed (1992) and Ali (1992) - Iraq marine waters.

The severity of the river flood of fish assemblage structure in estuaries taken a little attention except that of estuaries of South Africa (Marais, 1982, 1983a, 1983b, 1988).

In the course of continuous monitoring of the dynamic changes of fish composition in Khor al Zubair, a heavy unexpected river flood occurred in 1987-1988. The effort was then directed toward the effect of that incidence on the fish assemblage in Khor al-Zubair.

MATERIAL AND METHODS

The study area:

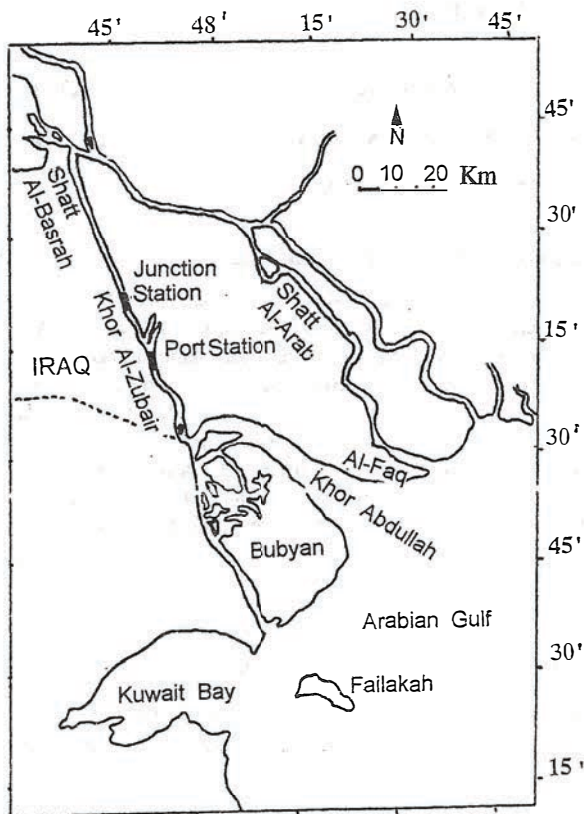


Fig. 1. Location map showing the study area and sampling stations

Khor al-Zubair is an extension of the marine water of the Arabian Gulf inside the Iraqi land (Fig. 1). During 1983, the lower Mesopotamia was connected with the Khor al-Zubair by Shatt al-Basrah channel. Such connection changed the nature of the Khor from a high saline lagoon to a moderately saline one. The length of the Khor is about 46 km with an average width of 1 km and a depth range of 15-20 m. In order to get an idea of the effect of the river flood on the composition of the fish assemblage in Khor al-Zubair, two stations were chosen. The first station near the junction

of Shatt al-Basrah channel with the Khor (Junction station) and the second in the middle of the Khor opposite the Khor al-Zubair port (Port station), about 9 km from the Junction station.

Fish collection:

Fish were sampled once a month from August 1987 to June 1988, using a beam trawl net of mouth width 2 m, lined with 13 mm stretched mesh. The trawling was fished for 30 minutes at speed of 3 knots. The fishing operation was carried out during the high tide. The sampling programme covering both intertidal and tidal zones. Temperature and salinity were measured before and at the end of each sampling using a Water Quality Monitor (TSK, model 1).

Data analysis:

The similarity of species composition was calculated according to the formula applied by Bray and Curtis (1957):

$$S = \frac{2X_{ij}}{X_i + X_j}$$

where S is similarity level, X_{ij} is number of species in both stations, X_i and X_j are total numbers of species in station A and station B respectively.

RESULTS

Abiotic factors:

Similar trend of monthly fluctuations of water temperature could be noticed at both stations (Fig. 2). The maximum temperature was recorded in August 1987 (31.5 and 30.5°C at the Junction and Port stations respectively) and the minimum was in January 1988 (11.5 and 10.5°C at the Junction and Port stations respectively).

The flood began in January 1988 and continued for six months according to the fresh-water discharged through the dam between Shatt al-Basrah and Khor al-Zubair (Fig. 2). Consequently low salinity values were recorded at the Junction station and ranged from 2.0‰ in March to 8.8‰ in October. At the Port station, a pronounced monthly fluctuation in salinity existed and ranged from 2.2‰ in March 1988 to 26.0‰ in October and December 1987. Generally sharp salinity decrease seem to be coincide with the beginning of the heavy flood.

Species composition:

The overall number of species caught in the Junction and Port stations were 32 and 37 respectively. Six of them were freshwater species recorded in the Junction station (*Heteropneustus fossilus*, *Liza abu*, *Alburnus capito*, *Barbus luteus*, *Parasilurus triostegus* and *Cyprinus carpio*). Of these only *C. carpio* was not recorded at the Port station. A clear fluctuation in the number of species was observed at both stations (Fig. 2). In the Junction station, the highest number of species was observed in December (18 species) while the

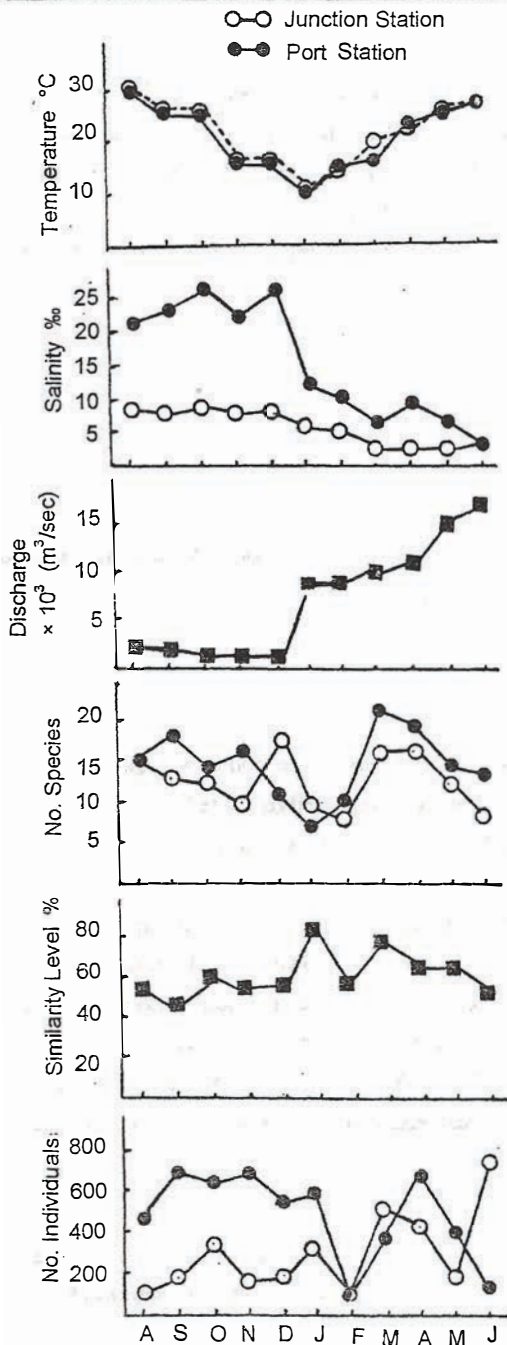


Fig. 2. Monthly variations in water temperature, salinity, freshwater discharge, number of fish species, similarity level of species composition and number of fish individuals in Khor Al-Zubair, Northwest Arabian Gulf during August 1987 - June 1988.

lowest was obtained in February (8 species). However, in the Port station the number of species fluctuated between 7 species in January and 21 species in March.

A test of similarity of species composition by months between the two stations indicated that the highest similarity level was found during January (82.0%) and the lowest was during September and November (45.0%), (Fig. 2). However, the overall similarity values between the lists of species in the two stations was 78.0%.

Number of individuals:

The total number of individuals captured at the Junction and Port stations were 3 286 and 5 256 respectively, with the exception of June, a similar trend of monthly fluctuations in number of individuals in both stations was noticed (Fig. 2).

Four species viz, *H. fossilus*, *Johnius belangerii*, *Acanthopagrus latus*, and *Liza subviridis* formed about 75% of the total catch at the Junction station (Tab. 1), while at the Port station only three species namely *Thryssa mystix*, *T. hamiltoni* and *L. subviridis* formed about 68.7% of the total catch (Tab. 2).

Table 1

Monthly total number of fish individuals collected from Junction station in Khor Al-Zubair
Northwest Arabian Gulf from August 1987 to June 1988

Species	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Total
<i>Heteropneustus fossilus</i> *	-	-	-	-	-	-	7	360	165	100	318	950
<i>Jhonijs belangerii</i>	25	100	97	59	58	5	-	-	25	3	272	644
<i>Acanthopagrus latus</i>	20	37	31	24	34	23	1	49	142	12	105	478
<i>Liza subviridis</i>	13	2	13	6	24	263	33	42	9	1	-	406
<i>Thryssa mystax</i>	10	3	69	29	19	12	2	20	29	23	3	219
<i>Thryssa hamiltoni</i>	9	5	57	25	15	13	-	15	27	20	-	186
<i>Ilisha megaloptera</i>	6	6	57	6	3	-	-	-	2	7	-	87
<i>Jhonijs elongata</i>	-	-	-	-	22	-	-	43	-	-	-	65
<i>Jhonijs sina</i>	2	14	4	-	4	-	-	1	1	3	18	47
<i>Alburnus capito</i> *	-	-	-	-	-	-	8	11	3	1	-	23
<i>Hilsa ilisha</i>	12	4	5	-	1	-	-	-	-	-	-	22
<i>Leiognathus bindus</i>	-	-	3	5	6	3	-	1	1	-	-	19
<i>Sillago sihama</i>	-	-	-	-	1	1	2	8	4	3	-	19
<i>Arius thalassinus</i>	1	7	-	-	-	-	-	9	1	-	-	18
<i>Euryglossus orientalis</i>	3	1	-	2	-	-	-	4	2	3	2	17
<i>Liza abu</i> *	-	-	-	-	-	12	1	2	-	-	-	15
<i>Parasilurus triostigus</i> *	-	-	-	-	-	-	-	-	-	-	10	10
<i>Cyprinus carpio</i> *	-	-	-	-	-	-	-	-	-	-	10	10
<i>Bathygobius fuscus</i>	-	-	-	-	-	-	3	3	2	-	-	8
<i>Cynoglossus arel</i>	1	1	-	3	3	-	-	-	-	-	-	8
<i>Chirocentrus dorab</i>	7	-	1	-	-	-	-	-	-	-	-	8
<i>Ilisha melastoma</i>	-	-	4	-	-	-	-	-	-	-	-	4
<i>Trichiurus lepturus</i>	2	-	1	-	1	-	-	-	-	-	-	4
<i>Barbus luteus</i> *	-	-	-	-	-	-	-	1	1	2	-	4
<i>Protonebea diacanthus</i>	-	1	-	-	1	-	-	-	1	-	-	3
<i>Sparidentex hasta</i>	-	-	1	2	-	-	-	-	-	-	-	3
<i>Strongylura strongylura</i>	1	-	-	-	-	-	-	1	-	-	-	2
<i>Scatophagus argus</i>	1	-	-	-	1	-	-	-	-	-	-	2
<i>Nematolosa nasus</i>	-	-	-	-	1	1	-	-	-	-	-	2
<i>Upeneus sulphurus</i>	-	-	-	-	1	-	-	-	-	-	-	1
<i>Eleutheronema tetradactylum</i>	-	-	-	-	1	-	-	-	-	-	-	1
<i>Pomadasys argenteus</i>	-	1	-	-	-	-	-	-	-	-	-	1
Total	113	182	343	161	196	333	57	570	415	178	738	3286

* Freshwater species.

No freshwater species have been recorded before the heavy river flood (from August to December 1987) in both stations, however out of 2291 fish individuals collected in the Junction station during the flood (from January to June 1988), 1012 were freshwater fish individuals, i.e. 15.0% of the total catch (Tab. 3). In Port station the total freshwater fish individuals was 421 forming 18.7% of the total catch during the flood.

Table 2

Monthly total number of fish individuals collected from Port station in Khor Al-Zubair
Northwest Arabian Gulf from August 1987 to June 1988

Species	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Total
<i>Thryssa mystax</i>	198	131	207	289	232	31	14	44	199	108	17	1470
<i>Thryssa hamiltoni</i>	163	108	170	237	190	27	13	37	163	89	14	1211
<i>Liza subviridis</i>	21	70	103	71	7	460	36	110	30	20	3	931
<i>Heteropneustus fossilus*</i>	-	-	-	-	-	-	-	83	120	100	75	378
<i>Nematolosa nasus</i>	20	118	117	6	37	35	-	3	2	2	4	344
<i>Leiognathus bindus</i>	12	81	26	43	23	8	1	1	25	19	-	239
<i>Ilisha megaloptera</i>	40	10	6	3	11	-	-	-	56	30	2	158
<i>Ilisha melastoma</i>	-	60	-	2	11	-	-	-	45	30	-	148
<i>Cynoglossus arel</i>	-	-	3	2	10	-	-	37	-	-	-	52
<i>Hilsa ilisha</i>	-	35	-	2	-	-	-	-	-	-	-	37
<i>Jhonijs belangerii</i>	-	-	-	-	-	-	1	26	6	1	1	35
<i>Anodontostoma chacunda</i>	-	30	-	-	-	-	-	-	-	-	-	30
<i>Liza abu*</i>	-	-	-	-	-	22	2	5	1	-	-	30
<i>Euryglossus orientalis</i>	-	13	1	4	3	-	-	6	-	1	2	30
<i>Sillago sihama</i>	1	2	-	2	9	1	1	11	1	-	-	28
<i>Jhonijs sina</i>	1	-	5	-	-	-	1	11	-	1	1	20
<i>Trichiurus lepturus</i>	1	7	1	-	-	-	-	1	1	1	2	14
<i>Hemirhamphus marginatus</i>	4	-	2	6	-	-	-	-	-	-	-	12
<i>Upeneus sulphurus</i>	1	3	1	6	-	-	-	-	-	-	-	11
<i>Pseudosynanceja melanostigma</i>	-	-	1	-	-	-	1	5	2	-	-	9
<i>Periophthalmus dentatus</i>	-	-	-	1	-	-	-	5	3	-	-	9
<i>Alburnus capito*</i>	-	-	-	-	-	-	5	3	-	-	-	8
<i>Eleutheronema tetradactylum</i>	2	5	-	1	-	-	-	-	-	-	-	8
<i>Otolithes ruber</i>	1	-	-	-	3	-	-	-	-	1	3	8
<i>Arius thalassinus</i>	-	-	-	-	-	-	-	1	5	2	-	8
<i>Chirocentrus dorab</i>	1	3	2	-	-	-	-	-	-	-	-	6
<i>Acanthopagrus latus</i>	-	1	-	-	-	-	-	2	2	-	-	5
<i>Barbus luteus*</i>	-	-	-	-	-	-	-	1	3	-	-	4
<i>Sardinella albella</i>	-	-	-	-	-	-	-	-	1	-	3	4
<i>Scatophagus argus</i>	2	-	-	-	-	-	-	-	-	-	-	2
<i>Jhonijs elongata</i>	-	-	-	-	-	-	-	1	-	-	-	1
<i>Parasilurus triostigus*</i>	-	-	-	-	-	-	-	1	-	-	-	1
<i>Polydactylus sextarius</i>	-	-	-	-	-	-	-	1	-	-	-	1
<i>Bathygobius fuscus</i>	-	-	-	-	-	-	-	-	1	-	-	1
<i>Caranx para</i>	-	-	-	1	-	-	-	-	-	-	-	1
<i>Platycephalus indicus</i>	-	1	-	-	-	-	-	-	-	-	-	1
<i>Strongylura strongylura</i>	-	1	-	-	-	-	-	-	-	-	-	1
	-	-	-	-	-	-	-	-	-	-	1	1
Total	468	679	645	676	536	584	75	394	666	405	128	5256

* Freshwater species

Table 3

Number of marine and freshwater fish collected before and during the heavy river flood

Station	Number of marine fish		Number of freshwater fish	
	before	during	before	during
Junction	995	1279	0	1012
Port	3004	1831	0	421

The relationship of temperature and salinity with the number of freshwater, marine and total fish individuals were reflected as correlation coefficient (r) values as illustrated in Tab. 4.

Table 4

Correlation coefficient (r) of freshwater, marine and total number of fish individuals with temperature and salinity

Group	Temperature (°C)		Salinity (‰)	
	Junction	Port	Junction	Port
Freshwater fish	+0.12	+0.15	-0.81**	-0.76**
Marine fish	+0.06	-0.07	+0.07	+0.76**
Total	+0.11	-0.01	-0.59*	+0.64*

* significant at 0.05 level

** significant at 0.01 level

Significant negative correlation was obtained between salinity and number of freshwater fish individual in both station.

However, marine fish individual in the Port station exhibited significant correlation with salinity. The total number of fish individual showed significant negative correlation with salinity in the Junction station and significant positive correlation with salinity in Port station.

Table 5

Salinity gradient (‰) of Khor Al-Zubair waters during 1987 -1988
(Baker and Salman, 1989)

Month	Surface	Bottom
June 1987	20.05	20.11
July	22.25	22.50
August	22.80	23.07
September	25.32	25.45
October	30.80	31.15
November	26.40	27.25
December	29.30	30.05
January 1988	12.71	18.62
February	10.60	17.92
March	6.39	11.08
April	5.75	11.00
May	4.25	9.35
June	4.01	9.11

DISCUSSION

All the freshwater species recorded in the present study were not recorded before in Khor al-Zubair, except *L. abu* which confined to the upper part of the Khor and represented only by few individuals (Hussain and Naama, 1989). However several marine species have been recorded in the Shatt al-Arab river, Al-Nasiri and Shamsul-Hoda (1975) reported 15 marine species, while Al-Hassan and Hussain (1985) recorded 16 marine species. Those marine species might be either estuarine species tolerate wide range of salinity such as *Liza macrolepis*, *Liza subviridis*, *Aphanius* spp, *Scatophagus argus* and *Ilisha* spp. or they spend their spawning period in Shatt al-Arab river such as *Hilsa ilisha*, *Nematolosa nasus* and *Acanthopagrus latus*. The occurrence of other marine species in Khor al-Zubair, especially in Port station, even the salinity decreased to not more than 5‰ could be explained due to the substantial differences in salinity concentration between the surface and bottom layers in the Khor during the heavy flood as mentioned by Baker and Salman (1989) (Tab. 5).

The highest similarity level of species composition between the two stations in January (the beginning of the heavy flood) may be caused firstly by the disappearance and / or decrease in the abundance of some marine species from Port station, however these species were of highly abundance during August-December (before the flood) and secondly by the invasion of *L. abu*, freshwater species (Kuronuma and Abe, 1986) to the area.

We could conclude that both temperature and salinity play an important role in the drastic changes of fish assemblage structure of Khor al-Zubair.

The previous studies in the Port station mentioned that temperature was the major factor regulating the occurrence of fish species seasonal (Hussain and Naama, 1989; Ali and Hussain, 1990). Due to the high discharge of fresh water during the heavy river flood, salinity was the major factor influencing the occurrence and abundance of both marine and total fish individuals in the Port station.

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WPŁYW WLEWU WÓD RZECZNYCH NA SKŁAD GATUNKOWY RYB
W AKWENIE KHOR AL-ZUBAIR W PÓŁNOCNO-ZACHODNIEJ CZĘŚCI
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STRESZCZENIE

Analizowano zmiany w składzie gatunkowym ryb w akwenie Khor Al-Zubair w okresie wlewu wód rzecznych od sierpnia 1987 do czerwca 1988 roku. Stwierdzono duże zmiany w strukturze gatunkowej ryb w obrębie badanego akwenu będące wynikiem pojawiania się gatunków słodkowodnych. Sześć słodkowodnych gatunków ryb (*Heteropneustus fossilus*, *Liza abu*, *Alburnus capito*, *Barbus luteus*, *Parasilurus triostegus*, *Cyprinus carpio*) stanowiło 38.8% w północnej części akwenu Khor (stanowisko Junction) w czasie wlewu wód rzecznych, podczas gdy pierwszych pięć gatunków stanowiło 17.8% w środkowej części akwenu Khor (stanowisko Port).

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