Spatial groups, occurrence, relative abundance and ecological indices of fish species from Lesser Zab river, Kurdistan region, Iraq

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Abstract:

The fish assemblages of Lesser Zab river was examined to establish a base line ecological data to be compare future situation and any present disturbance or anomaly from base line. The fish assemblages were divided according to their spatial occurrence to five groups. Generic and species names were revised to their current status. Synonym species were combined together and their numbers were added to the original. The most abundant species was *Alburnus mossulensis*, followed by *Acanthobrama marmid* and third class *Cyprinion macrostomum* but slightly different in the three river zones. Diversity, evenness and richness of Lesser Zab river in general were 2.40, 0.72 and 3.63 respectively, impaling a prosperous environment. Upper part of Zab was 1.89, 0.65; 2.72, Dokan 1.59, 0.89 and 1.08 lower part of Zab 2.25, 0.71 and 3.61. Similarity between Upper and Lower parts Zab 71% and 55.5% and lower values with Dokan reservoir was according Bray, Curits and Jaccard indices respectively, Indicating spatial species difference accordance with water current and bed nature of Lesser Zab, certain species were chosen as zone indictor, upper part of Zab *Barbus lacerta and Glyptothorax* spp., Dokan reservoir *Barbus escocinus* Lower part of Zab *Barbatula frenatus and Capoeta barrosis.*

Key word*:* Occurrence, relative abundance, ecological indices, fish, Lesser Zab river, Kurdistan region, Iraq

I. Introduction

Fish fauna of Iraqi inland waters received little attention by scientific media [16; 17; 1; 8; 11], moreover limited studies were published concerning the fish ecology of these waters, mostly dealt with species composition and other biological aspects of major lakes and reservoirs like, [2] on Dokan, [5; 6] on Habbinyea and Al-Qadisiya, [13] on Habbaniya, Tharthar and Razzazah and [12] on Dokan and Derbendikian. Few main rivers got certain interest in their riverien fish fauna and species ecology like Shatt Al Arab river [3; 14], others like Lesser Zab river [2; 4], central part of Euphrates river [7], Diyala river [6].

The aim of this study is to establish base line study about the fish ecology of river Lesser Zab depending on previous fish surveys in attempt to monitor any present or future disturbance in fish assemblage due to pollution or humans interventions.

II. Materials and Methods:

The data represented by [4] were used for numerical analysis to obtain the basic ecological indices [relative abundance, diversity, richness, evenness and similarity], again these data were incorporated with that of [2] to obtain the occurrence of species along the river Zab with it three different zones, according to the following:

A. Relative abundance:

Relative abundance [%] = ni / N * 100 [19] where, ni = number of individuals of the species in the monthly sample,

N = total number in the monthly sample.

B. Diversity Index:

$H = - \sum Pi \ln Pi$ [21]

where, H = the species diversity index, Pi = the proportion of the ith species of the whole sample.

C. Eveness index:

$J = H / \ln S$ [20]

where, J = the evenness index, H = the species diversity index, S = number of species.

D. Richness index:

$D = S-1 / \ln N$ [18]

where, D = the richness index, S = number of species, N = number of individuals.

E. Similarity indices:

Jaccard similarity index = [a / a + b + c] * 100 [9] where, a = sum of species occurred in samples A and B, b = sum of species occurred in samples A but not in B, c = sum of species occurred in samples B but not in A.

Bray-Curtis similarity index = 2Xij/Xi + Xj [10] where, Xij = number of common species in samples A and B, Xi = number of species in sample A, Xj = number of species in sample B

F. Occurrence percentage:

Occurrence of fish species according to their percentage of presence in sampling stations from total number of sampling stations.

G. Spatial Occurrence:

Fish species were divided into five groups according to their occurrence in the sampling stations, either in the upper, Dokan reservoir and lower part of Zab,

G1= comprised the species occurred a long the river ie in stations in upper and lower parts and Dokan reservoir.

G2= include species occurred in two geographical parts of the river either in the upper or lower and Dokan reservoir.

G3= Consisted of species occurred in upper part only.

G4= Consisted of species occurred in Dokan reservoir only .

G5= Formed of species occurred in lower part only.

Number of occurrence of species in the sampling stations [14] were described as common occurred in 14-9 stations, regular species 8-5. Occasional species appeared in

4-2 stations, and rare ones present only in one station.

H. Scientific names:

Generic and species were brought to their recent status according to [11]. Synonym were omitted and their number of individuals were added to the original species.

III. Results:

A. Relative abundance:

The most abundant species along river Lesser Zab was *Alburnus mossulensis* (18.8%) followed by *Acanthobrama marmid* (16.5%) in third rank, *Cyprinion macrostomum* (8.8%) and fourth *Barilius mesopotamicus* (8.5%) as displayed in table (I). Other species ranged from (8.1% - 0.07 %).

B. Upper part of Zab

The most abundant species in this part of the river is *A. marmid* (34.5%), followed by *C. macrostmum* (16.8%) and in third class *L. cephalus* (15.7%) as given in table (II).

C. Dokan reservoir

The most abundant species was *B. mesopotamicus* (38.8%) coming in second class *B. luteus* (24.0%) and then *C. macrostomum* (16.8%) in third rank. Table (III) Relative abundance of fish species in upper part of river Lesser Zab, as illustrated in table (IV).

D. Lower part of Zab

A. mossulensis was the most abundant species (27.9%), in second rank *C. macrostomum* (12.0%) and third *C. barrosis* (10.7%), as showed in table (V).

E. Occurrence percentage

The occurrence and spatial groups were showed in table (VI), three species were consider as common (*A. mossulensis, A. marmid* and *C. macrostomum*). Regular species were five (*C. kais, Cregium, L. cephalus, G. rufa* and *C. trutta*). Occasional species were ten and rare ones were twelve.

F. Spatial groups:

The biggest group (G1) was comprised of 13 species, followed by group (G2 %G5) consisted of six, groups (G4) formed of three species and group (G3) composed of two species.

G. Ecological indices:

Ecological indices were showed in table (VII), Diversity was higher (2.25) in lower part of Zab in comparison with other two parts. Evenness (0.81) was higher in Dokan reservoir than the other parts. Richness (3.61) was higher again in lower part than the other two zones.

H. Similarity indices:

Results of similarity between different parts of river Zab as illustrated in table [VIII], higher similarity (71.4%) existed between upper and lower parts according to [10] indices, again similar result but lower (55.5%) according to (15).

I. River Zones:

Table (IX) illustrated the fish species as indictor of the three zones in Lesser part of Zab. These species were distinct representative of zone.

Table. I: Relative Abundance of Fish Species Collected from Lesser Part of Zab River During 1971-1972.

Species	No. Zab River	Relative abundance	No. upper Zab	No. Dokan Reservoir	No. lower Zab
Acanthobrama marmid	223	16.5	178	10	35
Alburnus mossulensis	253	18.8	66	24	162
Cyprinion macrostomum	119	8.8	87	42	70
Barilius mesopotamicus	115	8.5	2	97	16
Leuciscus cephalus	110	8.1	81	-	29
Chondrostoma regium	72	5.3	26	-	44
Barbus luteus	69	5.1	7	60	2
Capoeta barrosis	62	4.6	-	-	62
Capoeta trutta	60	4.4	7	-	53
Garra rufa	45	3.3	8	8	29
Cyprinion kais	28	2.1	12	9	7
Liza abu	23	1.8	-	-	23
Barbatula frenatus	20	1.4	-	-	20
Barbus grypus	14	1.0	11	-	3
Barbatula panthera	13	0.9	13	-	-
Rutilus tricolor	12	0.8	-	-	12
Barbus lacerta	6	0.4	6	-	-
Leucicus lepidus	5	0.3	2	-	3
Barbus kersin	5	0.3	4	-	1
Barbus barbulus	3	0.2	2	-	1
Mastacembelus mastacembelus	3	0.1	2		1
Tylognathus nanus	2	0.1	-	-	2
Barbus pectoralis	1	0.07	1	-	-
Capoeta damascina	1	0.07	-	-	1
Barbatula tigris	1	0.07	-	-	1
Glyptothorax spp	1	0.07	-	-	1
Mystus pelusius	1	0.07	-	-	1
Total number	1345		516	251	578
No. Species	27				

Table. II: Relative Abundance of Fish Species in Upper Lesser Part of Zab River.

Species	No. Fish	%	Species	No. Fish	%
A. marmid	178	34.56311	*N. panthera*	13	2.524272
A. mossulensis	66	12.81553	*R. tricolor*	-	
C. macrostomum	87	16.8932	*B. lacerta*	6	1.165049
B. mesopotamicus	2	0.38835	*S. lepidus*	2	0.38835
L. cephalus	81	15.72816	*B. kersin*	4	0.776699
C. regium	26	5.048544	*B. barbulus*	2	0.38835
B. luteus	7	1.359223	*M. mastacemblus*	2	0.38835
C. barrosis	-		*T. nanus*	-	
C. trutta	7	1.359223	*B. pectoralis*	1	0.194175
G. rufa	8	1.553398	*C. damascius*		
C. kais	12	2.330097	*N. tigris*		
L. abu	-		*G. spp*		
N. frenatus	-		*M. pelusius*		
B. grypus	11	2.135922			

Table. III: Relative Abundance ofF Species Dokan Reservoir in Lesser Part of Zab River.

Species	No. Fish	%
A. marmid	10	4
A. mossulensis	24	9.6
C. macrostomum	42	16.8
B. mesopotamicus	97	38.8
L. cephalus	-	
C. regium	-	
B. luteus	60	24
C. barrosis	-	
C. trutta	-	
G. rufa	8	3.2
C. kais	9	3.6
L. abu	-	
N. frenatus	-	
B. grypus	-	
N. panthera	-	
R. tricolor	-	
B. lacerta	-	
S. lepidus	-	
B. kersin	-	
B. barbulus	-	
M. mastacemblus		
T. nanus	-	
B. pectoralis	-	
C. damascius	-	
N. tigris	-	
G. spp.	-	
M. pelusius	-	

Table. IV: Relative Abundance of Fish Species in Lower Lesser Part of Zab River.

Species	No. Fish	%
A. marmid	35	6.044905
A. mossulensis	162	27.97927
C. macrostomum	70	12.08981
B. mesopotamicus	16	2.763385
L. cephalus	29	5.008636
C. regium	44	7.599309
B. luteus	2	0.345423
C. barrosis	62	10.70812
C. trutta	53	9.153713
G. rufa	29	5.008636
C. kais	7	1.208981
L. abu	23	3.972366
N. frenatus	20	3.454231
B. grypus	3	0.518135
N. panthera	-	
R. tricolor	12	2.072539
B. lacerta	-	
S. lepidus	3	0.518135
B. kersin	1	0.172712
B. barbulus	1	0.172712
M. mastacemblus	1	0.172712
T. nanus	2	0.345423
B. pectoralis	-	
C. damascius	1	0.172712
N. tigris	1	0.172712
G. spp.	1	0.172712
M. pelusius	1	0.172712

Table. V: Occurrence and Spatial Groups of Fish Species in Different Parts of River Little Zab.

Species	Upper Zab	Dokan reservoir	Lower Zab	No. station	%	Spatial groups	Occurrence %
A.mossulensis	+	+	+	12	85.7	G1	Common
A.marmid	+	+	+	9	75.0	G1	=
C.macrostomum	+	+	+	10	75.0	G1	=
C.kais	+	+	+	8	50.0	G1	Regular
C.regium	+	+	+	8	50.0	G1	=
L.cephalus	+	+	+	6		G1	=
G.rufa	+	+	+	7	42.8	G1	=
C.trutta	+	+	+	5	28.5	G1	=
B.mesopotamicus	+	+	+	4	28.5	G1	Occasional
B.luteus	+	+	+	5	28.5	G1	=
B.barbulus	+	+	+	4		G1	=
B.grypus	+	+	+	3		G1	=
M.mas tacembulus	+	+	+	3		G1	=
L.lepidus	+	-	+	2		G2	=
B.lacerta	+	+	-	3		G2	=
C.damascina	-	+	+	2		G2	=
C.barrosis	-	+	+	4		G2	=
B.kersin	+	+	-	2		G2	Rare
B.pectoralis	+	+	-	1		G2	=
Glyptothorax spp.	+	-	-	1		G3	=
B.panthera	+	-	+	2		G3	=
B.escocinus	-	+	-	1		G4	=
B.xanthopterus	-	+	-	1		G4	=
B.subquinouctus	-	+	-	1		G4	=
L.abu	-	-	+	1		G5	=
B.frenatus	-	-	+	1		G5	=
R.tricolor	-	-	+	1		G5	=
T.nanus	-	-	+	1		G5	=
B.tigris	-	-	+	1		G5	=
M.pelusius	-	-	+	1		G5	=
Total species	31						
Total stations				14			

Table. VI: Fish Species as Indictor for River Zones.

River Zone	Indictor species
Upper Zab	*Barbus lacerta, Glyptothorax* spp.
Dokan Reservoir	*Barbus escocinus, Capoeta trutta*
Lower Zab	*Barbatula frenatus, Capoeta barrosis*

Table. VII: Similarity Indices Comparing Different Parts of Zab River.

Similarity indices - Bray & Curtis

	xjk	xj	xk	Ss%
Upper & Dokan	7	18	7	56.00
Upper & Lower	15	18	24	71.429
Lower & Dokan	7	7	24	45.161

Similarity indices - Jaccard

	a	b	c	Ss%
Upper & Dokan	7	11	0	38.8889
Upper & Lower	15	3	9	55.5556
Lower & Dokan	7	0	17	29.1667

Table. VIII: Ecological Indices (diversity, evenness and richness) of The Zab River and Different Parts of The River.

Region	Diversity	Evenness	Richness
Zab river	2.400434	0.728323	3.63921
Upper Zab	1.890166	0.653952	2.722541
Dokan Reservoir	1.593063	0.818672	1.086669
Lower Zab	2.259423	0.710945	3.615612

Table. IX: Habitat of Most Common Species in River Zab With Their Trophic Nature.

Species	Habitat	Trophic nature
A. mossulensis	benthopelagic	Omnivorous & insectovorous
A. marmid	benthopelagic	Insectovorous & Planktonovorous
C. macrostomum	benthopelagic	Planktonovorous & detritovorous
B. mesopotamicus	benthopelagic	Carivorous

IV. Discussion:

Even Iraq have many rivers like Tigris, Euphrates, Shatt Al Arab and their tributaries, just few got proper ecological studies, like Shatt Al-Arab river was studied thoroughly to be one of the best known river in middle east. Limited attention was paid to Euphrates except that [7], none was traced concern Tigris except one of its tributaries' Lesser Zab by [2] and [4].

The data displayed by [4] thoroughly cover most of river Zab but number of stations in Dokan reservoir were limited led to low number of species and individuals collected in comparison to upper and lower Zab and that of [2] and [12], single type of net was used by [4] to collect different species ,which could not be effected enough to all species and cope with all stations as appeared in data represent it seemed that the gear was more effected in upper and lower parts but not Dokan reservoir due to great depth of the reservoir which let a lot of species to escape consequently did not appear in Dokan stations, on contrary [2] collected several species did not collected by [4], the same is true for [12] have more detail sampling covering littoral and pelagic parts beside underwater observations, because their gear used were designed for investigation of fisheries resources of the Dokan and cover more depths and their gear more efficient. Similarity between upper and lower parts were moderate but low with Dokan reservoir, could be due to the velocity of currents in upper and lower in comparison to Dokan reservoir, as fact the reservoir have slower current in comparison to mountains river like the upper and lower parts beside the depth was different in upper and lower parts, the river relatively shallow while Dokan possess greater depths (80 meter). These limnological difference were reflected on the species composition for instance, the high relative abundance of *B. luteus* in Dokan, this species prefer slow current as in the southern marshes .Some species were more abundant in lower part than the upper part and Dokan, emphasis the role of physical and chemical conditions of the river on the occurrence, relative abundance of different species.

The occurrence of certain species in the three zones of the river, became tool to select certain species as indicator of the zones as displayed in table [6], the same could applied to other rivers like Tigris, Euphrates and their main tributaries. Modified river continuum concept (RCC) could be applied to Iraqi rivers which have enough limnological studies to incorporated with species relative abundance studies. The diversity and richness of lower part of Zab was higher than the upper part and Dokan reservoir could be related that limnological conditions were more suitable for the abundant species .The values of diversity and richness were higher than what had been recorded previously of other Iraqi rivers, like Shatt Al-Arab river [14], in other words the diversity and richness of Lesser part of Zab during the seventies were higher than the historical record for other Iraqi rivers. [12] categorized the fish of Dokan reservior into littoral species including *Glyptothorax* spp. (*G. kurdistanicus; G. steindachneri*), *B. frenatus*, *B. tigris*, *C. trutta*, *C. damascina* and *C. barroisi*. The pelagic species were mostly small in sizes comprised of *A. mossulensis* and *L. cephali*, were similar to other lakes and marshes as indicated by [5; 6] on Habbinyea and Al-Qadisiya, [16] on

Habbaniya, Tharthar and Razzazah. The habitat of the most common species in Zab river reviewed in table [9], all of them occupied the water column (benthopelagic) of the river as showed by [11] due to the shallowness while in Dokan reservoir inhabited the pelagic zone [12]. These species were mainly detritovorous or planktonvorous [23] except *B. mesopotamicus* to be carnivorous according to Whabe [in press]. commercial species were benthic such as *B. esocinus, B. xanthopterus* and *B. subquinounciatus* because they were bottom feeders. Other species were distributed according to the nature of their feeding, according *B.luteus* prefer the fringe of the reservoir colonized by aquatic plants with slow current much more than upper or lower parts, since this species occurred in the southern marshes characterized by slow currents [24].

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