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Comparative monogenetic infections of some fish species in Greater and Lesser Zab rivers, Kurdistan Region, Iraq.

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ABSTRACT

A total of 953 fish specimens (521 females and 432 males), belonging to 19 species were collected from Greater Zab river at Aski-Kalak town and from Lesser Zab river at Kanibi village, Taqtaq town in north of Iraq, during the period of January to December 2022. only 11 fish species (842 specimens) were sympatric in both rivers, 2 species (14 specimens) were in Greater Zab and 6 species (97 specimens) were in Lesser Zab. The samples were examined for ecto-parasites. The study revealed the existence of 31 monogenean species, including twenty-one species of Dactylogyrus, three `species of Dogielius, two species of Diplozoon and one species of Solostaminides. During present study, it was found that, overall the prevalence of monogenean infection was 59.44 % for grater Zab river and 54.6% for the lesser Zab river. There were no significant differences in the percentage incidence in the overall of infection with this group of parasites from both rivers instead of there was obvious difference in the distribution and spread of parasitic fauna in both rivers.

1.Introduction

The important of fish parasites is strongly correlated with the important of the infected fish. The value of all food, including fish, rises as the global population rises. (Hoffman, 1998)

Helminths are an important and diverse group of parasites that infect fish. The Monogenea is the most abundant gill parasitic of fresh water fish in the world (Woo *et al.*, 2006), this parasitic group consisted as tiny worms that parasitized fish and frogs among other aquatic species (Mhaisen, 2019).

Despite the enormous difficulty of understanding the host-parasite system through the documentation and examination of the wide variety of factors that can impact the population of parasites (Kennedy, 1975), Dogiel provided numerous instances regarding the macro and microenvironment of fish parasites from the old Soviet Union (Dogiel, 1961).

In Kurdistan Region, although many surveys concerning the parasitic fauna of freshwater fishes were conducted in different parts. (Mhaisen, 2023). Only few of these surveys included more than one site for comparison, and were concerned with widely different habitats (Abdullah, 2002; Abdullah and Mhaisen, 2010; Mama and Abdullah, 2012). Due to the presence few information concerning the comparison of the parasitic fauna of fishes in two main rivers of Erbil province (Greater Zab and Lesser Zab rivers), the purpose of the present study was to compare the parasitic fish fauna of the fish in the two rivers in order to gather the fundamental data required for additional research on fishery management in both rivers.

2.Materials and Methods

2.1 Sample area description

Erbil Province is the capital of Iraqi Kurdistan Region, its boundaries extended from longitude 43° 15¯ E to 45° 14¯ E and from latitude 35° 27¯ N to 37° 24¯ N (Obaid, 1986 ; Bapeer *et al.,* 2006), Erbil basin is located at the northern part of Iraq, which lies between Greater-Zab at north-west and Lesser-Zab Rivers at South-east (Mustafa and Mawlood, 2023).

The Greater Zab river is situated between 36º-37º north latitude and 43º- 44º east longitude (Omar *et al*., 2023). The sampling area in this river is located near Aski-Kalak Districts, about 40 kilometers to the southwest of Erbil City.

Lesser Zab River is one of the greatest tributary of the Tigris River, it is located in the northeastern part of Iraq, between 34º and 36º north latitude and 43º and 46º east longitude (Saeedrashed and Guven, 2013; Abdullah and Nasraddin, 2020). This study was carried out on two sites of the Lesser Zab River: Kanibi River, 104 kilometres from Erbil Province; Taqtaq Zab, and is 90 kilometres from Erbil Province (Figure 1).

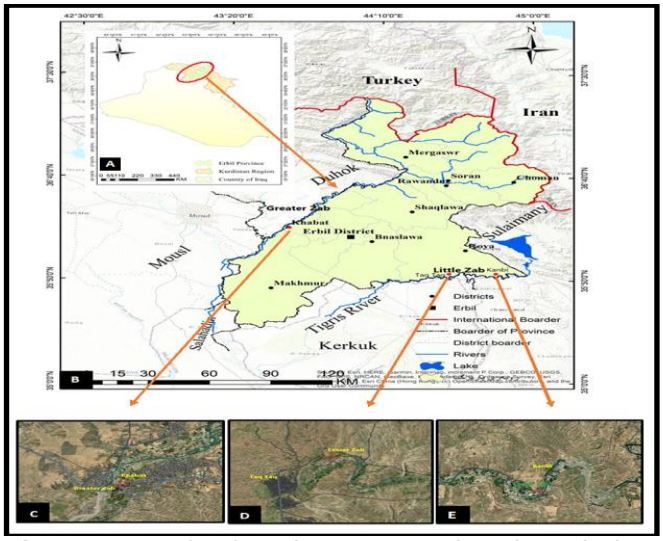

Figure 1: Study sites (Sources: Author through (DEM) 12m, using (ArcGIS)

A-Map of Iraq

B- Erbil Province map showing collecting sample sites (Greater Zab and Lesser Zab River)

C, D and E- Google-Earth Satellite maps of study sites.

2.2 Sample collection and analyzing

A total of 953 fish were randomly collected twice monthly, b y using gill nets from local commercial fisherman for a period started from January to December 2022. Fish specimens `were placed in plastic tanks supplied with local river water, and brought alive to the laboratory of Medical Laboratory Department at Koya Technical Institute, Erbil Polytechnic University, and dissected within 24 hours, all fishes were categorized into 19 species according to Coad (2010), and the scientific names followed those provided in Frose and Pauly (2023).

Fish were measured in the lab for both total and

standard length, each fish species weather male or female individuals were distinguished, and the fish were checked for parasites externally. Smears of the skin, fins, and buccal cavity were made by lightly scraping them and then examined. Gills were separated, kept wet in a Petri dish, and examined under a dissecting microscope. Wet mounts of gill filaments were prepared and examined under a light microscope. Parasite fixation and preservation was done according Kritsky *et al.* (2004).

The identified parasites were classified based on the measurements of their sclerotized hard structures, as detailed by Jarkovskỳ *et al*. (2004); Galli *et al.* (2010); Víllora-Montero *et al*. (2020). The terms employed in the ecological aspect corresponds to that of Margolis *et al.* (1982) and Bush *et al.* (1997). The prevalence, mean intensity, and abundance of the parasites were all studied in the study.

Chi-squared test was used for Statistical analysis and P value of < 0.05 at 95% interval was considered significant. All non-parametric data were transformed into natural logarithm (ln), analyzed and calculated by SPSS program (version 27).

3.Results and Discussion

During the study period, (953) fish specimens, belonging to 19 species, were collected (Table 1). Based on their occurrence in both rivers (Greater Zab and Lesser Zab), three categories are used for grouping these species

1- Fishes captured from Greater Zab river only. These belonged to two species, viz. *Alburnus mossulensis,* and *Luciobarbus barbulus*

2- Fishes captured from Lesser Zab river only. These belonged to six species, viz. *Barbus lacerta, Carassuis auratus C. carassius, Mesopotamichthys sharpeyi, Planiliza abu* and *Glyptothorax kurdistanicus.*

3- Fishes captured from both rivers. These belonged to 11 species, viz. *Arabiobarbus grypus, Cyprinus carpio, Carassobarbus luteus*, *Capoeta damacinus, C. trutta*, *C. umbla, Chondrostoma regium*, *Cyprinion macrostomum, Garra rufa*, *Luciobarbus kersin* and *Leuciscus cephalus.*

According to the parasitological examination on the fish species, the findings of the present study revealed that 19 fish hosts were infected by 31 monogeneans species, these included twenty-one species of *Dactylogyrus*, three species of *Dogielius*, two species of *Diplozoon* and one species of *Solostaminides.*

The present result showed, overall the prevalence of monogenean infection was 54.9% in both rivers (Lesser Zab River and Greater Zab River). While for each river separately the rate of infection was 59.44 % and 54.6% respectively, the statistical analysis indicated that no significant differences ($p<0.05$) were found between the rivers in the infection of examined fishes with this group of parasites.

This outcome agrees with observations of the other studies which were done by Abdullah (2002); Abdullah and Mhaisen (2010) in the same rivers. Since both rivers are located in the same geographic region, no more than 75 km is the distance between both rivers in Erbil province, and absence of any significant differences in the main physio- chemical features of waters in both rivers (water temperature, dissolved oxygen, pH, and turbidity, it is possible there were not any significant variations in the infection of examined fishes by this particular type of parasites. (Abdullah, 2002; Abdullah and Mhaisen, 2010; Nasraddin, 2024). With regarding of these, in the current study, there was an obvious difference in the distribution and spread of fish and parasitic fauna in both rivers.

Table (1) showed that the most common fish species in the Greater Zab river was *C. trutta* followed by *C. luteus* and *G. rufa*, whereas, in the Lesser Zab river, *C. regium* was the most common species, followed by *C. trutta*, and *C. carpio*.

Present results also showed the absence of some fish species in Greater Zab River and presence in Lesser Zab river and vice versa, may be due to fish activity and method of fishing in the two sites.

Table 1: Type and number of fishes collected from Greater Zab River and Lesser Zab River.

Fish family and scientific name	No. of fishes collected from:	
	Greater Zab river	Lesser Zab river
Family Cyprinidae		
Alburnus mossulensis (Heckel, 1843)	12	-
Arabiobarbus grypus Heckel, 1843	9	26
Barbus lacerta (Heckel, 1843)	-	10
Carassobarbus luteus (Heckel, 1843	65	31
Carassuis auratus (Linnaeus, 1758)	-	25
Carassuis carassius, (Linnaeus, 1758)	-	17
Capoeta damacinus (Heckle 1843	26	18
Capoeta trutta (Heckel, 1843)	115	70
Capoeta umbla (Heckel, 1843)	4	12
Chondrostoma regium (Heckel, 1843)	9	100
Cyprinion macrostomum Heckel, 1843	55	48
Cyprinus carpio Linnaeus, 1758	53	50
Garra rufa (Heckel, 1843)	65	8
Luciobarbus barbulus Heckel, 1847	2	-
Luciobarbus kersin (Heckel, 1843)	10	47
Mesopotamichthys sharpeyi (Gunther,1874)	-	18
Squalius cephalus (Linnaeus, 1758)	4	17
Family Mugilidae		
Planiliza abu (Heckel, 1843)	-	24
Family Sisoridae		
Glyptothorax kurdistanicus (Berg, 1931)	-	3
Total	429	524
	953	

Regarding the *D. carassobarbi* that infested *C. luteus* in both locations, it is clear from Table (2) that the prevalence of infection and the mean intensity of this parasite in Lesser Zab River were higher than that in Greater Zab River. But the infection rate of the same parasite species on *C. trutta* was slightly higher in Greater Zab than Lesser Zab, it may have related to tolerance ranges of both the parasites and hosts to different physical and chemical properties of the sites (Kennedy, 2009).

According to the Table (2), *C. carpio* was infected with five species of monogeneans (*D. dulkeiti*, *D. formosus, D. minutus, D. pulcher and G. sprostonae*) from Lesser Zab River only and with four species (*D. elegantis, D. extensus,* G. *elegans* and *P. homoion*) in Greater Zab River only, it means there were differences in their infection in both rivers. Moreover *C. carpio* was infected with each of *D. baueri, D. macrostomum* and *G. shulmani* in both rivers, since, the common carp's adaptation to a wide range of climatic and geographical condition, these differences may be related to range of compatibility between the parasites and this host species (Chappell and Owen, 1969).

According to the present results, each of D. microcirrus, D. mokhayeri and P. homoion parasitizing C. trutta in both rivers with slight differences in prevalence and intensity. This due to the relative adaptation of these species to the water characteristics, especially they are ectoparasites on the same host and the host factor not affecting the infestation (Dogiel, 1961; Rahn, 2018).

With regard to D. macrostomi, it is clear from Table (2) that this species parasitized five fish species including; C. trutta, C. macrostomum, C. carpio and G. rufa from both rivers, with inconsiderable differences in their infection rate and intensity. In addition, each of C. regium, S. cephalus infected with D. macrostomi in the Lesser Zab with very low different in their parasite intensity and abundance, it is possible related to compatibility range between this parasite and these hosts.

Furthermore, the results showed that Carassobarbus luteus infected with D. lenkoranoides in both rivers and their parasite intensity slightly higher in Lesser Zab River, may be related to water characteristics, that make Greater Zab more appropriate for this species.

Table 2: The distribution of isolated monogenean species on sympatric fishes according to collection sites (Greater Zab River and Lesser Zab River).

Parasite species	Host species	No. of fishes		Prevalence %	Individual parasite species richness	Mean intensity	Abundance (Relative density)	**Site of Collection**
		Examined	Infested					
Dactylogyrus achmerowi	Carassuis aurateus	25	3	12	20	6.67	0.8	Lesser Zab
	Cyprinus carpio	53	4	7.5	15	3.7	0.15	Greater Zab
		50	4	8	13	3.25	0.26	Lesser Zab
D. anchoratus	Carassuis aurateus	25	2	8	8	4	0.32	Lesser Zab
	Cyprinus carpio	53	4	11.3	20	5	0.264	Greater Zab
		50	3	6	10	2.5	0.2	Lesser Zab
D. barbuli	Luciobarbus kersin	47	17	36.2	70	4.1	1.09	Lesser Zab
D. baueri	Carassuis carassius	17	3	17.6	9	3	0.529	Lesser Zab
	Capoeta trutta	70	6	7.8	32	5.3	0.342	Lesser Zab
	Cyprinus carpio	53	19	35.8	96	5.05	1.792	Greater Zab
		50	25	50	78	3.12	1.56	Lesser Zab
	Garra rufa	65	7	10.7	12	1.9	0.184	Greater Zab
D. carassobarbi	Capoeta trutta	115	11	9.6	36	3.3	0.243	Greater Zab
		70	4	5.7	16	4	0.185	Lesser Zab
	Capoeta umbla	12	2	16.6	9	4.5	0.75	Lesser Zab
	Chondrostoma regium	100	7	9	80	10	0.55	Lesser Zab
	Garra rufa	65	3	7.7	18	6	0.2	Greater Zab
D. dulkeiti	Cyprinus carpio	50	4	8	19	4.75	0.38	Lesser Zab
D. elegantis	Capoeta trutta	115	4	3.5	28	7	0.243	Greater Zab
	Chondrostoma regium	100	4	4	7	1.75	0.07	Lesser Zab
	Cyprinus carpio	50	5	10	45	9	0.9	Lesser Zab
D. ergensi	Garra rufa	65	4	6.15	10	2.5	0.153	Greater Zab
D. extensus	Capoeta trutta	115	8	7	71	8.9	0.617	Greater Zab
	Cyprinion macrosto	55	4	7.2	44	11	0.8	Greater Zab

Table 2 Con

	mum							
	Cyprinus carpio	53	2	3.8	3	1.5	0.056	Greater Zab
D. lenkorani	Chondro stoma regium	100	2	2	8	4	0.08	Lesser Zab
D. lenkoran oides	Carassob arbus luteus	65	1	1.5	4	4	0.061	Greater Zab
		31	1	3.2	10	10	0.322	Lesser Zab
D.macro stomi	Capoeta trutta	115	1	0.9	6	6	0.052	Greater Zab
		70	2	2.85	8	4	0.114	Lesser Zab
D.macro stomi	Capoeta trutta	115	1	0.9	6	6	0.052	Greater Zab
		70	2	2.85	8	4	0.114	Lesser Zab
	Chondro stoma regium	100	5	5	27	5.4	0.27	Lesser Zab
	Cyprinion macrosto mum	55	4	7.2	21	5.25	0.381	Greater Zab
		48	5	10.4	25	5	0.52	Lesser Zab
	Cyprinus carpio	53	3	9.4	30	10	0.207	Greater Zab
		50	6	12	22	3.6	0.44	Lesser Zab
	Garra rufa	65	11	16.9	46	4.1	0.707	Greater Zab
		8	1	12.5	3	3	0.375	Lesser Zab
	Squalius cephalus	17	2	11.7	12	6	0.705	Lesser Zab
D. mascom ai	Capoeta trutta	70	3	4.28	12	4	0.171	Lesser Zab
D. microcirr us	Capoeta damacin us	18	1	5.6	5	5	0.277	Lesser Zab
	Capoeta trutta	115	41	35.6	189	4.6	1.643	Greater Zab
		70	33	47.1	89	2.7	1.271	Lesser Zab
	Chondro stoma regium	9	1	11.1	10	10	1.11	Greater Zab
		100	12	12	90	7.5	0.8	Lesser Zab
	Cyprinion macrosto	55	4	7.2	21	5.25	0.381	Greater Zab

Table 2 Continue…

	mum	48	2	4.2	8	4	0.166	Lesser Zab
	Luciobarbus kersin	10	2	20	8	4	0.8	Greater Zab
	Planiliza abu	24	4	16.6	14	3.6	0.583	Lesser Zab
D. minutus	Capoeta damacinus	26	1	3.84	5	5	0.192	Greater Zab
	Capoeta trutta	115	3	2.6	7	2.3	0.017	Greater Zab
		70	3	4.3	10	3.3	0.128	Lesser Zab
	Cyprinion macrostomum	48	1	2	5	5	1.02	Lesser Zab
D. persis	Carassobarbus luteus	65	6	9.2	9	1.5	0.138	Greater Zab
	Chondrostoma regium	100	2	2	9	4.5	0.09	Lesser Zab
D polylepidis	Chondrostoma regium	100	5	5	25	5	0.24	Lesser Zab
	Cyprinion macrostomum	48	1	2.1	5	5	0.104	Lesser Zab
D. pulcher	Capoeta trutta	115	7	6.1	19	2.7	0.165	Greater Zab
	Cyprinion macrostomum	55	22	40	80	3.6	1.454	Greater Zab
		48	27	56.2	70	2.6	1.458	Lesser Zab
	Cyprinus carpio	50	1	2	12	12	0.24	Lesser Zab
	Garra rufa	65	1	1.5	5	5	0.076	Greater Zab
	Planiliza abu	24	2	8.3	13	6.5	0.541	Lesser Zab
D. squameus	Capoeta trutta	115	1	0.9	2	2	0.017	Greater Zab
	Carassobarbus luteus	65	3	4.6	11	3.7	0.169	Greater Zab
D. vistulae	Alburnus mossulensis	12	2	23.5	10	5	0.5	Greater Zab
	Chondrostoma regium	100	1	1	6	6	0.06	Lesser Zab
	Garra rufa	8	1	12.5	3	3	0.375	Lesser Zab
	Mesopotamichthys	18	3	16.7	10	3.3	0.555	Lesser Zab

Table 2 Continue…

	sharpeyi							
Dogielius mokhayeri	Capoeta trutta	115	1	0.9	4	4	0.156	Greater Zab
		70	2	2.85	6	3	0.085	Lesser Zab
	Cyprinion macrostomum	55	1	1.8	12	12	0.218	Greater Zab
D. molnari	Capoeta damacinus	26	1	11.5	9	3	0.115	Greater Zab
		18	1	5.6	5	5	0.277	Lesser Zab
	Cyprinion macrostomum	55	3	16.3	39	4.3	0.709	Lesser Zab
D. persicus	Squalius cephalus	4	1	25	3	3	0.75	Greater Zab
Gyrodactylus elegans	Cyprinus carpio	53	2	3.8	10	5	0.094	Greater Zab
G. katharineri	Capoeta trutta	70	3	4.2	17	5.7	0.242	Lesser Zab
G. schulmani	Cyprinus carpio	53	1	1.9	5	5	0.094	Greater Zab
		50	3	6	8	2.3	0.16	Lesser Zab
G. sprostonae	Cyprinus carpio	50	2	4	16	8	0.32	Lesser Zab
Eudiplozoon sp	Chondrostoma regium	100	25	25	67	2.7	0.67	Lesser Zab
Paradiplozoon homoion	Capoeta trutta	70	3	4.2	13	4.3	0.18	Lesser Zab
Solostamenides mugillis	Capoeta trutta	70	6	7.8	11	1.8	0.157	Lesser Zab

The fish host *C. damacinus* infected with each *D. microcirrus* in Lesser Zab River, and *D. minutus* in Greater Zab river with the same mean intensity while infected with *D. molnari* in both rivers with variable values.

In relation to *P. abu,* Table (2) shown that this fish infected with *D. microcirrus* and *D. pulcher* in Lesser Zab river only with the prevalence of 16.6% and 8.3% respectively, this infestation did not appear in Greater Zab, because the fish host was not caught in there.

The present results showed that each of *D. lenkorani, D. pulcher, G. katharineri, Eudiplozoon* sp and *S. mugillis* were infecting fish hosts in the Lesser Zab only. This may due to the adaptation of these species to this locality only.

Another fish host *Al. mossulensis* infected by *D. vistulae* and *P. homoion* with infection rate 16.6% and 25% respectively in Greater Zab river only due to non-fishing this host in Lesser Zab river.

About *D. elegantis,* the results showed that it was infecting *C. regium and C. carpio* in Lesser Zab only with their severity 1.75 and 9 respectively. Whereas, *D. ergensi* was infected *G. rufa* in Greater Zab only. So it makes differences in their infection rate in both rivers. It possible related to the adaptation of these species with their locations.

Regarded to individual species richness of these parasites table (2 shows that the most richness species was D. *microcirrus (80)* on *C. regium,* and the lowest was *D. macrostomum* and *D. vistulae* on *G. rufa* from Lesser Zab river. While in the Greater Zab river *D. macrostomum* was the most richness and *D. squameus* was the lowest on *Capoeta trutta,* this may due to the range of adaptation between these parasites and their hosts.

Dogiel (1961) indicated that the relationship between the parasite fauna and the geographical position of the hosts habitat is governed not by a single factor, but by a complex of factors including climatic conditions, presence or absence of intermediate hosts, various features in the character of the water, the type of the bottom and current velocity.

Conclusions

The study revealed the existence of 31 monogenean species, and it's been concluded that there were no significant differences between the Greater Zab and Lesser Zab rivers in the overall infection of examined fishes with this group of parasites, instead of these, there was obvious difference in the distribution and spread of parasitic fauna in both rivers.

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