Review Article

Speciesof Monogenean Parasites Infesting Cyprinus carpio and Planilizaabu in Lake Balloran Dam -Syria .

ABSTRACT

This study was conducted in Lake Balloran Dam and involved 68 fish specimens, including 23 common carp *(Cyprinus carpio*) and 45 Abu mullet (*Liza abu*). Sampling was carried out monthly and randomly from July 2020 to August 2021.The research addressed parasitic infections in these two important species of freshwater fish.
This work identifies five parasitic species of monogeneans, three of them were isolated from common carp and identified as species belonging to the genus Dactylogyrus: D. dogieli, D. minutus, and D. extensus. One species was isolated from both the common carp and Abu mullet, and identified as the species Gyrodactylusderjavini, and the other species, G. elegans, was isolated from only the common carp.
Dactylogyrus species were primarily isolated from the gills of the studied fish, whereas Gyrodactylus species were found on the skin and fins.
This study is of fundamental interest for the knowledge of parasitic biodiversity on the Asian continent that are widespread in vast bodies of water, and the species D. dogieli and G. derjavini were recorded for the first time in Syrian freshwater in this study.

Keywords: Monogenea, Common Carp, Abu Mullet, Lake Balloran Dam

1. INTRODUCTION

Fish are susceptible to various pathogenic agents such as fungi, viruses, bacteria, and parasites. These parasites can be classified into external parasites, which attach to the outer surface of the fish, and internal parasites, which infest internal organs and muscles, feeding on the fish's internal fluids. This can lead to increased mortality rates in infected fish, directly proportional to the severity of the infestation [1]. Monogenean worms are among the most significant and dangerous parasitic worms affecting freshwater fish, due to their direct impact on the tissues of infected fish or their indirect role in secondary bacterial and fungal infections [2]. These worms are unique in that they complete their entire life cycle on the fish, requiring no intermediate host, which means they have a direct life cycle. They are also host-specific and show a preference for particular attachment sites. Notable examples include Dactylogyrus species, which infest the gills of fish, and Gyrodactylus species, which parasitize the skin and fins [3].
Few studies have been conducted on wild fish parasites in Syria, with most focusing on parasites in farmed fish. One such study was conducted by Alsamman[4], which investigated the parasites of common carp from several fish farms in both Syria and Hungary. Salman H, and Dayoub, A,[5], and Salman H, Al-Samman A. Dayoub A, [6] conducted an ecological and taxonomic study on parasites of common carp in the Al-Sinn River fish farm, isolating and identifying six species of Monogenean worms, including *D. arquatus*, *G. cyprini*, and *G. medius*, which were recorded in Syria for the first time. SalmanH, [7] also studied parasitic

ciliates on the same farm. Further research by Alsamman A, Molnar K, Szekely C, [8] explored Monogenean infestations in both farmed and wild fish in Syria, while Salman H, Al-Samman A, Dayoub A, [9] identified various species of myxosporean parasites. Dayoub A, and Salman H, [10] conducted a study on the use of Monogenean parasites as bioindicators of environmental pollution in Lake 16 Tishreen Dam.

Regionally, several studies have focused on external parasites of mirror carp from the Seyhan River in Turkey [11]. Globally, Martins ML, Onaka EM, Morales FR, Bozzo F, Faro AD, Goncalves A,[12] conducted research on freshwater fish in various farms across Brazil, where they recorded heavy infestations of external parasites, including Monogenean species.

Based on the previous studies, the objective of this study was to isolate the parasites that are widespread in vast bodies of water in two host fish, the common carp and the Abu mullet, at Lake Balloran Dam which represents a very important freshwater source in the Syrian coastal region.

2. MATERIALS AND METHODS

2.1. Study area

Lake Balloran Dam is located in the northwestern part of Syria, near the village of Balloran, to the right of the Latakia-Kassab road, approximately 30 km north of Latakia (35°49'29"N, 35°57'6"E). The dam was built in the valley of the Shamerliya River.

2.2. Sample collection

A total of 68 fish specimens were collected monthly from various sites around the lake between July 20, 2020, and August 15, 2021 (Figure 1). The fish were captured using gill nets, cast nets, and standard hand fishing rods.

2.3. Species identification and parasites isolation

The samples were taken to the Graduate Research Laboratory in the Department of Animal Biology, Faculty of Science, where they were identified to the species level using international taxonomic keys [13, 14, 15, 16].External examination of the body surface (skin, fins, gills, oral cavity, and nasal pits) of the studied common carp and Abu mullet were studiedand the parasites were identified using classification and description studies [17, 18, 19].

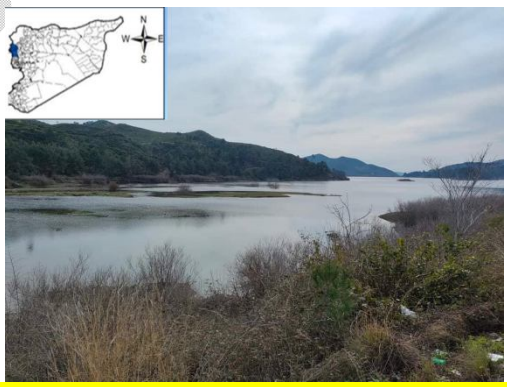

Fig.1: Study location at Lake Balloran Dam.

3. RESULTS AND DISCUSSIONS

3.1.Species identification and parasites isolation

External examination of the body surface of the studied common carp (*Cyprinus carpio*) and Abu mullet (*Liza abu*) revealed the presence of five species of Monogenean parasitic worms. The scientific classification of the isolated species is as follows:

Phylum: Platyhelminthes (Flatworms)
Class: Monogenea
Subclass: Polyonchoinea
Order: Dactylogyridea
Family: Dactylogyridae
Genus: Dactylogyrus
Dactylogyrusextensus (Müller & Van Cleave, 1932)
Dactylogyrus minutus (Kulwiec, 1927)
Dactylogyrusdogieli (Gussev, 1953)
Order: Gyrodactylidea
Family: Gyrodactylidae
Genus: Gyrodactylus
Gyrodactylus elegans (Nordmann, 1832)
Gyrodactylusderjavini (Mikailov, 1975)

3.1.1. Parasites of the Genus Dactylogyrus

Three species belonging to this genus were isolated and identified from the gills of common carp (*Cyprinus carpio*):

The species*: D. extensus*

This is a widespread parasite that infests the gills of carp species of various ages. It parasitizes the middle part of the gill lamellae and is relatively large, with a worm length ranging from 580.5 to 1750 microns, averaging 1350.55 microns, and a width ranging from 180 to 490 microns, with an average of 280.95 microns (Figure A-2).

The hard parts of the attachment disc consist of seven pairs of peripheral hooks, measuring 24-36 microns in length, and one pair of central hooks connected by a linking piece. The copulatory organ consists of a curved projection and a ring-shaped supporting structure, with an average length of 75.15 microns (Figure B-2).

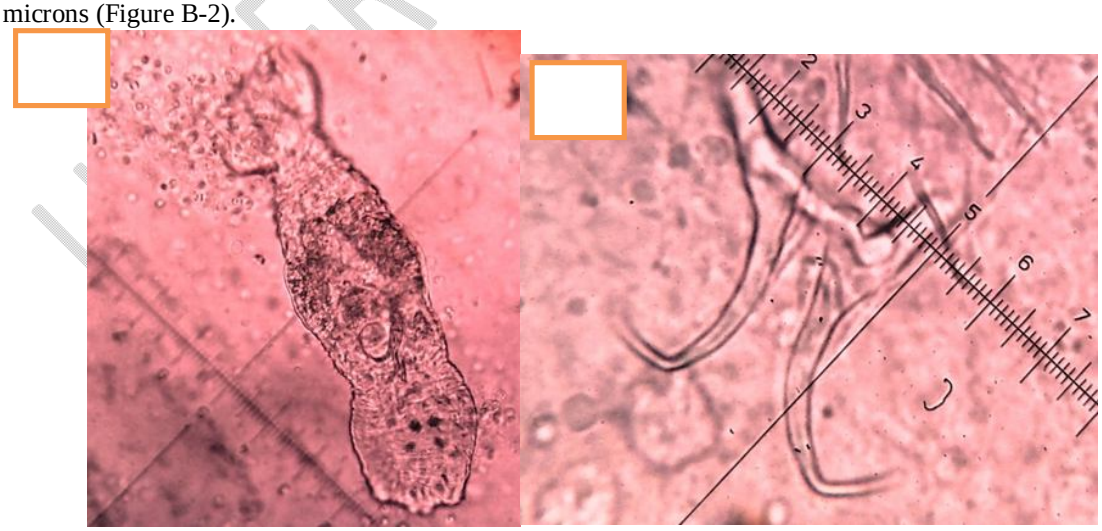

Fig. 2:(A) General appearance of *D. extensus* (×10); (B) Central hooks with the connecting piece (×40).

The species: *D. minutus*

This species consists of medium-sized worms, frequently isolated from the base of the gill filaments. The worm length ranges from 315 to 510.15 microns, with an average of 395.085 microns, and a width ranging from 85.90 to 125.50 microns, with an average of 94.80 microns.
The attachment disc is bell-shaped and consists of a pair of large central hooks connected by a dorsal linking piece, and seven pairs of smaller peripheral hooks around the disc's circumference, with an average length of 23.15 microns (Figure A-3).
The copulatory organ is composed of a long, slender projection, with a gradually tapering base towards the apex, averaging 34.58 microns in length (Figure B-3).

Fig.3:(A) General appearance of *D. minutus* (×10); (B) Central hooks with connecting piece (×40).

The species: *D. dogieli*

This species consists of flatworms that infest the gills of fish. The attachment disc is composed of seven pairs of small peripheral hooks and one pair of large central hooks connected by a linking piece. There are two pairs of ocular spots at the anterior part of the body (Figure B-4).
The worm length ranges from 800 to 1050 microns, with an average of 865.75 microns, and a width ranging from 280 to 300 microns, with an average of 283.15 microns (Figure A-4).

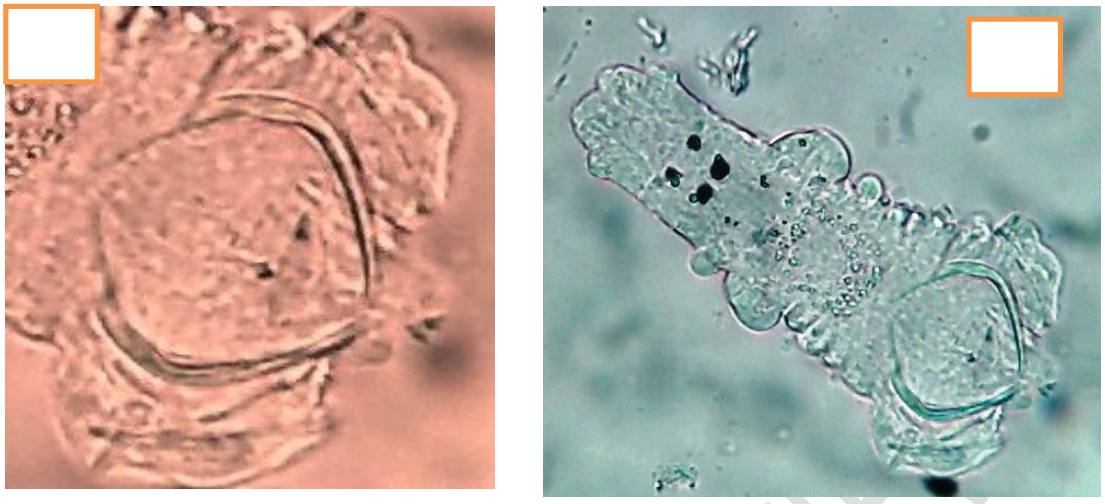

Fig. 4: (A) General appearance of *D. dogieli* (×10); (B) Central hooks with connecting piece (×40).

Species + Average		*D. extensus*		*D. minutus*		*D. dogieli*	
Measurements(µm)							
Body	Length	580,5-1750	1350,55	315-510,15	395,85	800-1050	865,75
	Width	180-490	280,95	85,90-125,50	94,80	280-300	283,15
Haptor	Length	80,90-133,65	98,80	58,93-67,22	61,85	47,50-80,95	66,65
	Width	130,15-185,30	95,45	84,50-105,90	93,45	83,16-100,50	97,95
Connecting bar	Length	40,20-51,20	26.10	24,98-26,50	25,81	49-62	56,80
	Width	12,60-15,95	13,75	4,50-5,15	4,95	6-8	7,5
Median hooks	Dorsal length	57,20-74	64,16	34,95-38,15	36,85	4-8	6
	Ventral length	71,80-80,90	73,80	38,90-45	42,80	29-40	35,16
Marginal hooks		31,50-33,60	31,96	18-24	23,15	27,56-34,30	30,25
Copulatory organ		73,50-83,14	75,15	34,15-38	36,58	55,10-72,50	61,35

The infested organ	common carp	the gills	the gills	the gills
	Abu mullet	-	-	-

Table 1:Measurements obtained with a micrometric lens of different body parts in Dactylogyrus species parasitic on common carp (*Cyprinus carpio*).

3.1.2. Parasites of the Genus Gyrodactylus

Two species belonging to this genus were isolated and identified from the skin and fins of common carp (*Cyprinus carpio*) and Abu mullet (*Liza abu*). These species differ in their morphological and anatomical characteristics, as well as in the micrometric (morphological) measurements of various body parts.

The species: *G. elegans*

Worms of this species were isolated from the skin of common carp and are relatively large, with a length ranging from 430 to 680 microns, averaging 520.30 microns, and a width ranging from 128.60 to 180.40 microns, with an average of 149.05 microns. The average length of the peripheral hooks is 50.35 microns, and the average total length of the central hooks is 96.93 microns (Figure A-5).

Fig. 5: (A) General appearance of *G. elegans* (×10); (B) Central hooks with connecting piece .(40×)

The species: *G. derjavini*

Worms of this species were isolated from the skin, fins, and gills of common carp (*Cyprinus carpio*) and Abu mullet *(Liza abu*). They are relatively large, with a length ranging from 540 to 590 microns,

averaging 556.43 microns, and a width ranging from 75.80 to 90.45 microns, with an average of 83.10 microns (Figure A-6).
The average length of the peripheral hooks is 31.33 microns, and the average total length of the central hooks is 59.83 microns (Figure B-6).

Fig. 6: (A) General appearance of *G. derjavini* (×10); (B) Peripheral hooks and central hooks with the connecting piece.(40×)

Table 2: Micrometric measurements of different body parts in isolated Gyrodactylus species

Species + Average Measurements(µm)		*G. elegans*		*G.derjavini*	
Body	Length	430-680	520,30	540-590	556,43
	Width	128,60-180,40	149,05	75,80-90,45	83,10
Haptor	Length	54,80-63,70	58,30	53,30-64,75	57,90
	Width	47,15-58	51,25	48,20-56,30	49,25
Dorsal connecting bar	Length	21,90-27,50	24,90	19,40-29,25	25,50
	Width	2,80-3,90	3,45	2,10-2,90	2,60
Ventral	Length	33,20-43,15	39,15	22,20-28,40	25,75

connecting bar	Width	7,35-9,90	8,30	7,5-9,30	7,80
Marginal hooks		75,80-135,90	96,93	55,20-63,80	59,83
Median hooks		42-59	50,35	29,50-32,20	31,33
The infested organ	common carp	the skin		the skin, the fins, and the gills	
	Abu mullet	-		the skin, the fins, and the gills	

Parasitic infections result from the interplay of several factors, including those related to the parasite, such as its type and number (severity of infection), and those related to the host, such as its type, sex, age, behavior, and feeding habits, in addition to other environmental factors. Parasitic infestation considers a serious threat for freshwater fishes in tropical and subtropical regions due to severe economic losses either directly or indirectly [20, 21].The diversity of parasites in freshwater fish can be attributed to the variation in fish species and the types of parasites present under the same conditions. The appearance of parasites on multiple host fish species indicates that the parasite is widespread, resistant to environmental changes, and adaptable.

Species of the genus Dactylogyrus are among the most common parasites of common carp (*Cyprinus carpio*). Our findings are consistent with those of Dayoub, A, [22] and Zidan M, [23], who isolated *D. extensus*, *D. minutus*, and *D. dogieli*from the gills of common carp only. The species *D. dogieli* was recorded for the first time in Syrian freshwater, while *D. extensus* and *D. minutus* were recorded by Salman H, and Dayoub, A, [5]from fish in the Al-San fish farm and Zidan M, [23]from common carp in Assad Lake.In Iran, more than 70 species of the genus Dactylogyrus have been reported from freshwater fishes [24].The frequency of occurrence of Dactylogyrus species which were found as parasites of carp fishes gills in Iran ranged from 2% for the species D. anchoratus to 29% to other species like D. extensus [21].

The morphological and micrometric measurements of the registered Dactylogyrus species were consistent with those reported by OztürkT, & Ozer A, [25] and Kearn GC, [26]. However, they partially differed from those found by Glaeser HJ, [27], which may be attributed to differences in surrounding environmental conditions such as temperature, humidity, and dissolved oxygen.

Species of the genus Gyrodactylus were primarily isolated from the skin and fins, occasionally from the oral cavity, and rarely from the gills. In general, Gyrodactylus species are the most common skin parasites infecting freshwater fishes all over the world and causing serious diseases to the common carp [28, 29].This finding is in agreement with Woo PTK, [30] and Al-ZubaidyA, [31]. G. derjavini was recorded for the first time in Syria in our study, while G. elegans was recorded by Salman H, Al-Samman A. Dayoub A, [6] from common carp in the Al-San fish farm and Safar G, [32] from common carp in the Salah al-Din Dam (Safarqiya).In Iraqi Kurdistan, several species of Gyrodactylus were recorded in the gills, fines, and skin of the common carp [29].

The morphological and micrometric characteristics of the registered Gyrodactylus species were consistent with measurements reported by GussevAV, [33] and Malmberg G, [34]. However, they partially differed from those reported by Al-ZubaidyA, [31], likely due to differences in the fish species from which the parasites were isolated; in our study, parasites were isolated from Abu mullet and common carp, whereas Al-ZubaidyA, [31] isolated them from Aspiusvorax.In other inventory in Iraqi Kurdistan, 10 species of the genus Dactylogyrus and 8 species of the genus Gyrodactylus were recorded parasiting on common carp,Dactylogyrus species were found in the gills andGyrodactylus species were found in the gills and skin [35].

4. CONCLUSIONS

The results of this study indicate that species of the genus Dactylogyrus primarily parasitize the gills of fish, while species of the genus Gyrodactylus are found on the skin and fins. Notably, *G. derjavini* and *D. dogieli* were recorded for the first time in the freshwater of the Syrian coast in this study.

Disclaimer (Artificial intelligence)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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