

Taxonomic Study of Monogenean Parasites Infesting *Cyprinus carpio* and *Liza abu* in Lake Balloran Dam -Syria (eastern Mediterranean).

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.

Three parasitic species belonging to the genus *Dactylogyrus* were isolated and identified from common carp: *D. dogieli*, *D. minutus*, and *D. extensus*. Additionally, two species from the genus *Gyrodactylus* were identified: *G. derjavini*, found in both common carp and Abu mullet, and *G. elegans*, isolated from common carp.

Dactylogyrus species were primarily isolated from the gills of the studied fish, whereas *Gyrodactylus* species were found on the skin and fins.

For the first time in Syrian freshwater, *D. dogieli* and *G. derjavini* were recorded 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. Salman H, [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.

2. MATERIALS AND METHODS

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. 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. 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].



Fig.1: Study location at Lake Balloran Dam.

3. RESULTS AND DISCUSSIONS

External examination of the body surface (skin, fins, gills, oral cavity, and nasal pits) 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

Dactylogyrus extensus (Müller & Van Cleave, 1932)

Dactylogyrus minutus (Kulwiec, 1927)

Dactylogyrus dogieli (Gussev, 1953)

Order: Gyrodactylidea

Family: Gyrodactylidae

Genus: Gyrodactylus

Gyrodactylus elegans (Nordmann, 1832)
Gyrodactylus derjavini (Mikailov, 1975)

First: Parasites of the Genus *Dactylogyus*

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

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).

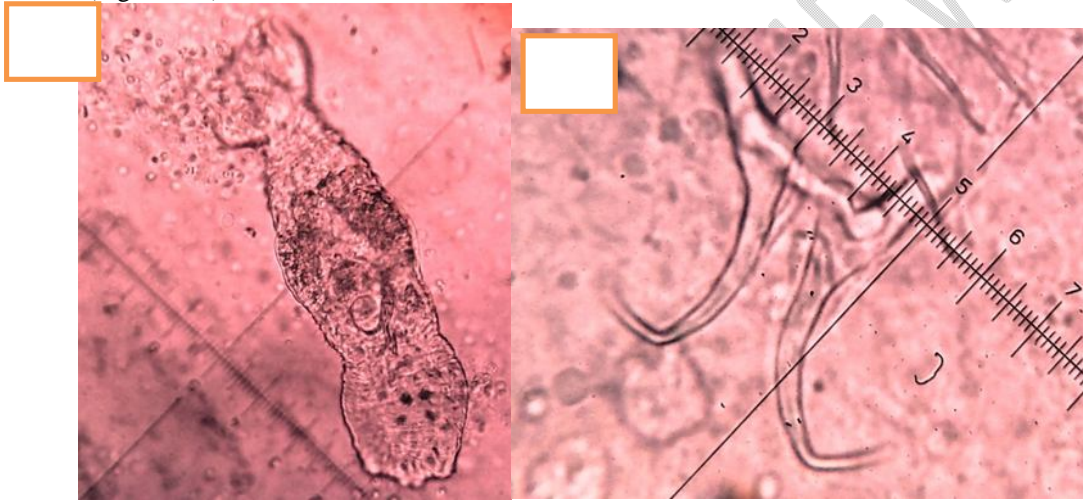


Fig. 2:(A) General appearance of *D. extensus* (×10); (B) Central hooks with the connecting piece (×40).

2. 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).

3. 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).

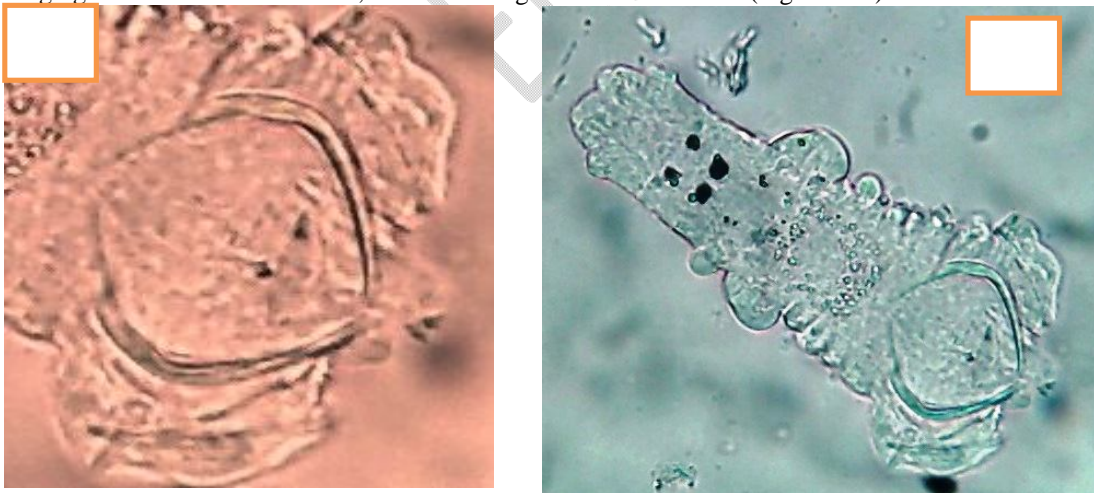


Fig. 4: (A) General appearance of *D. dogieli* (×10); (B) Central hooks with connecting piece (×40).

Species + Average		<i>D. extensus</i>		<i>D. minutus</i>		<i>D. dogieli</i>	
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

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

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.

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* ($\times 10$); (B) Central hooks with connecting piece ($\times 40$)

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		<i>G. elegans</i>	<i>G. derjavini</i>
Measurements(μm)			
Body	Length	430-680	520,30
	Width	128,60-180,40	149,05
Haptor	Length	54,80-63,70	58,30
	Width	47,15-58	51,25
Dorsal connecting bar	Length	21,90-27,50	24,90
	Width	2,80-3,90	3,45
Ventral connecting bar	Length	33,20-43,15	39,15
	Width	7,35-9,90	8,30
Marginal hooks		75,80-135,90	96,93
Median hooks		42-59	50,35

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. 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, [17] and Zidan M, [18], 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, [18] from common carp in Assad Lake.

The morphological and micrometric measurements of the registered *Dactylogyrus* species were consistent with those reported by Oztürk T, & Ozer A, [19] and Kearns GC, [20]. However, they partially differed from those found by Glaeser HJ, [21], 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. This finding is in agreement with Woo PTK, [22] and Al-Zubaidy A, [23]. *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, [24] from common carp in the Salah al-Din Dam (Safarqiya).

The morphological and micrometric characteristics of the registered *Gyrodactylus* species were consistent with measurements reported by Gussev AV, [25] and Malmberg G, [26]. However, they partially differed from those reported by Al-Zubaidy A, [23], 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-Zubaidy A, [23] isolated them from *Aspius vorax*.

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.

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