

## The Monogenean *Paradiplozoon zeller* (Gyntovt, 1967): First Record in Iraq from Gills of *Alburnus mossulensis* Heckel, 1843

Younis S. Abdullah

Medical Laboratory Department, College of Health and Medical Technology,  
Sulaimani Polytechnic University, Iraq

Corresponding author: [younis.abdullah@spu.edu.iq](mailto:younis.abdullah@spu.edu.iq)

**Abstract:** The monogenean *Paradiplozoon zeller* (Gyntovt, 1967) (Monogenea: Diplozoidae) was recorded and described in the present study for the first time in Iraq on gills of leuciscid fish *Alburnus mossulensis* Heckel, 1843 which was collected from Aw-e Shiler River in Sharbazher Region, north of Sulaimani City in Iraq. This is the first *Paradiplozoon* species recorded on *A. mossulensis* in Iraq and it's the twentieth *Paradiplozoon* species so far recorded from Iraqi fishes. The description and measurements of this parasite are given.

**Keywords:** Diplozoidae, *Paradiplozoon zeller*, *Alburnus mossulensis*, Aw-e Shiler River, Sulaimani City, Iraq

### Introduction

The genus *Paradiplozoon* (Monogenea: Diplozoidae) includes monogenean ectoparasites that live on the gills of fishes. Such parasites occur as two jointed hermaphroditic individual worms in permanent cross copula (Le Brun et al., 1988). The life cycle of this worm is direct and including egg, free-swimming oncomiracidium, the larval stage (diporpa), and adult. Adult of this worm is unique; the two larvae permanently fuse into a pair to form a sexually matured adult (Civáňová et al., 2013). According to GBIF (2021) and WoRMS (2021), this parasite belongs to the family Diplozoidae, order Mazocraeidea of the class Monogenea.

The subfamily Diplozoinae Palombi, 1949 contains five genera: *Diplozoon* Nordmann, 1832, *Eudiplozoon* Khotenovsky, 1985, *Paradiplozoon* Akhmerov, 1974, *Sindiplozoon* Khotenovsky, 1981 and *Inustiatus* Khotenovsky, 1978 (Pugachev et al., 2010).

The genus *Paradiplozoon* Akhmerov, 1974 includes blood-feeding parasites that infect the gills of fishes, mainly cyprinid fishes (Konstanzová et al., 2015). This directly transmitted worm possesses the attachment apparatus (sclerotized parts) which consists of four pairs of clamps and one pair of small central hooks on the ventral side of the opisthaptor (Khotenovsky, 1985). The identification of diplozoid members at the species level, commonly depends on the size and shape of the sclerotized parts; central hooks and clamps (Matějusová et al., 2002, 2004).

In Iraq, the first *Paradiplozoon* species: *Paradiplozoon kasimii* (reported as *Diplozoon kasimii*) was recorded from the gills of *Cyprinion macrostomum* by Rahemo (1980). After that, several species were recorded from different fish species in different parts of Iraq. Here is the first report of each of these *Paradiplozoon* species from fishes of Iraq: Khamees (1983), Rasheed (1989), Al-Saadi (2007), Al-Nasiri (2009), Al-Nasiri & Mhaisen (2009), Al-Nasiri (2010), Abdullah (2013), Al-Jubori (2013), Al-Salmany (2015), Abdullah & Abdullah (2016), Al-Nasiri & Balbuena (2016), Al-Nasiri (2017) and Hameed (2019).

In Kurdistan Region, Iraq, some *Paradiplozoon* species were recorded. These included those of Ali (1989), Rasheed (1989), Abdullah (1990, 2002), Abdullah & Mhaisen (2004), Abdullah & Rasheed (2004), Mama (2012), Mama & Abdullah (2012a, b), Abdullah (2013), Muhammad et al. (2013), Nasraddin (2013), Abdullah & Abdullah (2015a, b, c), Abdullah & Nasraddin (2015), Abdullah & Abdullah (2016) and Bilal (2016).

The aim of the present study is to report *Paradiplozoon zeller* (Gyntovt, 1967) on gills of *Alburnus mossulensis* Heckel, 1843 which was collected from Aw-e Shiler River at Sharbazher Region north of Sulaimani City of Kurdistan, Iraq.

## **Materials and Methods**

### **Sampling Area**

Aw-e Shiler River is one of the major rivers which passes through the Sharbazher Region from east to the west. It is mixed with Lesser Zab River and feeds Dokan Lake in Sulaimani Province, Kurdistan Region, Iraq.

### **Specimen Collection**

Thirty specimens of Mossul bleak *Alburnus mossulensis* of the family Leuciscidae were collected from Aw-e Shiler River near Khewata Village (N 35<sup>0</sup>.75'11", E 45<sup>0</sup>.47'92") in Sulaimani Province, Kurdistan Region, Iraq by Pulse electro-shock device (SAMUS 1000, made in Poland). The specimens were placed in a cool box with a few amounts of river water and transported to the parasitology laboratory, Medical Laboratory Department, College of Health and Medical Technology, Sulaimani Polytechnic University and immediately examined for parasites. Identification of the fishes was done based on morphometric and meristic characters, according to Coad (2010), and the scientific name was taken according to Froese & Pauly (2021).

### **Preparation of Specimens of *Paradiplozoon***

Gills of the fishes were removed and placed in a separated Petri dish. A small amount of normal saline was added, directly examined under a dissecting microscope and searched for a large monogenean parasite (*Paradiplozoon*). The parasites were separated from the gills, washed with normal saline solution and then placed on a clean slide. Few drops of normal saline were added and examined under stereoscopic microscope.

For light microscopy, the worms were fixed in glycerin-alcohol, transferred into clean glycerin, covered with a cover slide and gently pressed (Lucky, 1981).

The *Paradiplozoon* measurements were done with the aid of an ocular micrometer. The identification of the parasite was done based on Pugachev et al. (2010). Photos were taken by Sony camera, 16.1 megapixels.

The infestation was evaluated in terms of prevalence (percentage of infested fishes) and intensity (number of parasites in individual infested fishes).

## Results and Discussion

Four diplozoid monogeneans were recorded on the gill of two Mossul bleak, *Alburnus mossulensis* (family Leuciscidae) from Aw-e Shiler River in Sulaimani Province, Kurdistan Region, Iraq. The study revealed that two out of 30 *A. mossulensis* were infested with *Paradiplozoon zeller* (Gyntovt, 1967) which were found on gills of the infected fishes with a prevalence of 6.7% and mean intensity of 2.

The following is a brief account and measurements (in millimeters) based on the four specimens of this parasite. The adult parasite is X-shaped, consists of two worms (Figure 1A) which that fused to each other. Each worm included anterior and posterior parts. The anterior part contains vitellaria and digestive tract, while the posterior part (Figure 1B) contains reproductive organs, the terminal part of the digestive tract, four pairs of adhesive clamps and one pair of anchors. The gonads lie in the first half of the posterior part of the body. Each egg (Figure 1C) has a filament on its top.

Body length is 2-3 mm, anterior part is 1-2 mm and posterior part is 0.6-1 mm. The posterior part has 10-14 folds. Size of clamps (Figure 1D): I: 0.04-0.07 x 0.04-0.11 mm, II: 0.04-0.07 x 0.08-0.14 mm, III: 0.04-0.07 x 0.08-0.12 mm, IV: 0.04-0.07 x 0.08-0.15 mm. The anterior end of the median sclerite is broadened as fishtail-shaped and connected to the clamp jaws by two short sclerites. The lateral edges of the posterior end of the median sclerite are rounded. Anchor (Figure 1E) length is 0.019-0.020 mm, handles are 0.036-0.047 mm. The diameter of suckers is 0.04-0.05 mm, the pharynx is 0.04-0.07 mm. The testis is lobed. Egg size is 0.21-0.22 x 0.08-0.09 mm.

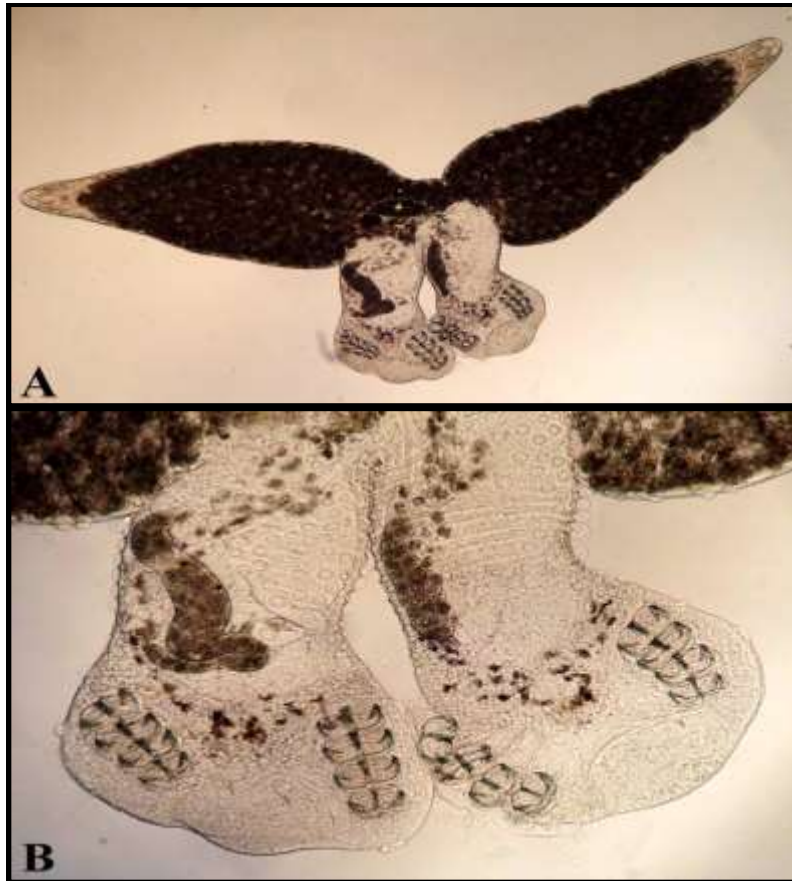


Figure 1: A- Photomicrograph of *Paradiplozoon zeller* (40X).

B- Photomicrograph of posterior part of *Paradiplozoon zeller* (100X).

The description and measurements of the present *Paradiplozoon* are closely similar to *Paradiplozoon zeller* which was showed by Pugachev et al. (2010) on gills of *Phoxinus phoxinus*, *Rutilus rutilus*, *Scardinius erythrophthalmus*, *Gobio gobio*, *Barbus barbus*, *Rhodeus amarus* and *Cyprinus carpio* from rivers of the Baltic, Black and Caspian seas.

This parasite (*P. zeller*) was never been reported previously from any fish species in Iraq before. Therefore, the present report is considered as its first record in Iraq.

According to Mhaisen (2021), the Iraqi diplozoid fauna now includes 22 species: 20 species of *Paradiplozoon*: *P. amurense*, *P. barbi*, *P. bingolense*, *P. bliccae*, *P. cyprini*, *P. ergensi*, *P. homoion*, *P. iraqensis*, *P. kasimii*, *P. leucisci*, *P. magnum*, *P. megalobramae*, *P. megan*, *P. minutum*, *P. pavlovskii*, *P. rutili*, *P. skrjabini*, *P. tadjhikistanicum*, *P. vojteki* and *P. zeller*, as well as one species for both *Diplozoon* and *Eudiplozoon* (*D. paradoxum* and *E. nipponicum*, respectively).

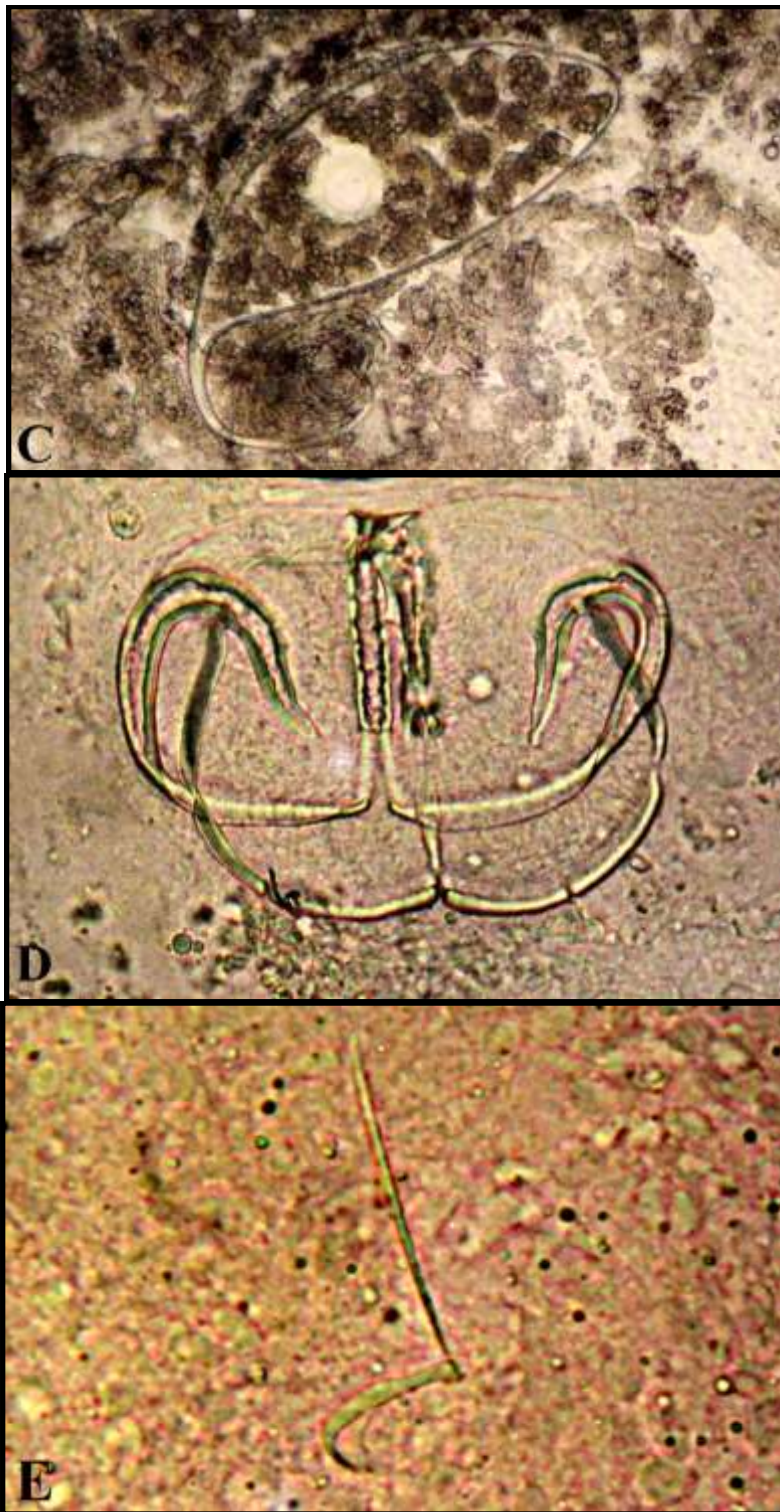


Figure 1: C- Photomicrograph of the egg of *Paradiplozoon zeller* (300X).  
D- Photomicrograph of the clamp (400X).  
E- Photomicrograph of the median hook (1000X).

According to previous checklists on parasites of fishes of Kurdistan Region, Iraq (Mhaisen & Abdullah, 2017) and the latest checklists of parasites of fishes of Iraq (Mhaisen, 2021), the family Diplozoidae in Kurdistan Region, Iraq, so far includes only 11 species of *Paradiplozoon*: *P. amurense*, *P. barbi*, *P. bingolense*, *P. cyprini*, *P. homoion*, *P. kasimii*, *P. leucisci*, *P. pavlovskii*, *P. tadjikistanicum*, *P. vojteki* and *P. zeller*.

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