Checklists of Fish Species Infected with Parasites of the Genera *Lamproglena* and *Pseudolamproglena* (Copepoda: Cyclopoida: Lernaeidae) in Iraq

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Abstract

A total of 51 references dealing with the occurrence of species of the genera *Lamproglena* and *Pseudolamproglena* infecting fish species in Iraq, until mid-2024 were consulted. A total of 22 fish species were found to be infected with two species of the genus *Lamproglena* (*L. chinensis* and *L. pulchella*) and two species of the genus *Pseudolamproglena* (*P. annulata* and *P. boxshalli*), in addition to some unidentified species of the genus *Lamproglena*. *L. chinensis* was recorded from two fish species, *L. pulchella* from 20 fish species, *P. annulata* from 12 fish species, *P. boxshalli* from five fish species and unspecified *Lamproglena* sp. from one fish species. Such parasites were recorded from their fish hosts from different water bodies (rivers, canals, lakes, marshes and drainage networks) as well as from some fishponds. Apart from *Cyprinion kais* and *Garra variabilis*, all the remaining fish species were infected with *L. pulchella*, and/ or other parasite species, with the maximum number of four parasite species was recorded only from *Leuciscus vorax*.

Keywords: Crustaceans, *Lamproglena*, *Pseudolamproglena*, Fish gills, Distribution, Iraq.

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Introduction

Members of the genus *Lamprogp.lena* von Nordmann, 1832 and the genus *Pseudolamproglena* Boxshall, 1976 belong to the subfamily Lamprogleninae, family Lernaeidae, order Cyclopoida, class Copepoda of the phylum Arthropoda (WoRMS, 2024). Walter and Boxshall (2024) also mentioned the subphylum Crustacea for both genera. According to GBIF.org (2024), the genus *Lamproglena* von Nordmann, 1832 includes 42 species, while the genus *Pseudolamproglena* Boxshall, 1976 includes only four species.

Members of the genus *Lamproglena* attach fish gills with their modified maxillae; usually, the attachment site is such that the egg sac extends beyond the gill filament so that the newly hatched nauplius larvae can escape without being entangled in the gill filaments (Van As and Van As, 2019). Sexual dimorphism is visible in all species of the family, with males retaining the cyclopoid form (Paperna, 1996) and dying soon after mating (Ho, 1998). The life cycle of *Lamproglena clariae* Fryer, 1956, extracted from Madanire-Moyo and Avenant-Oldewage (2013) is presented in Figure 1.

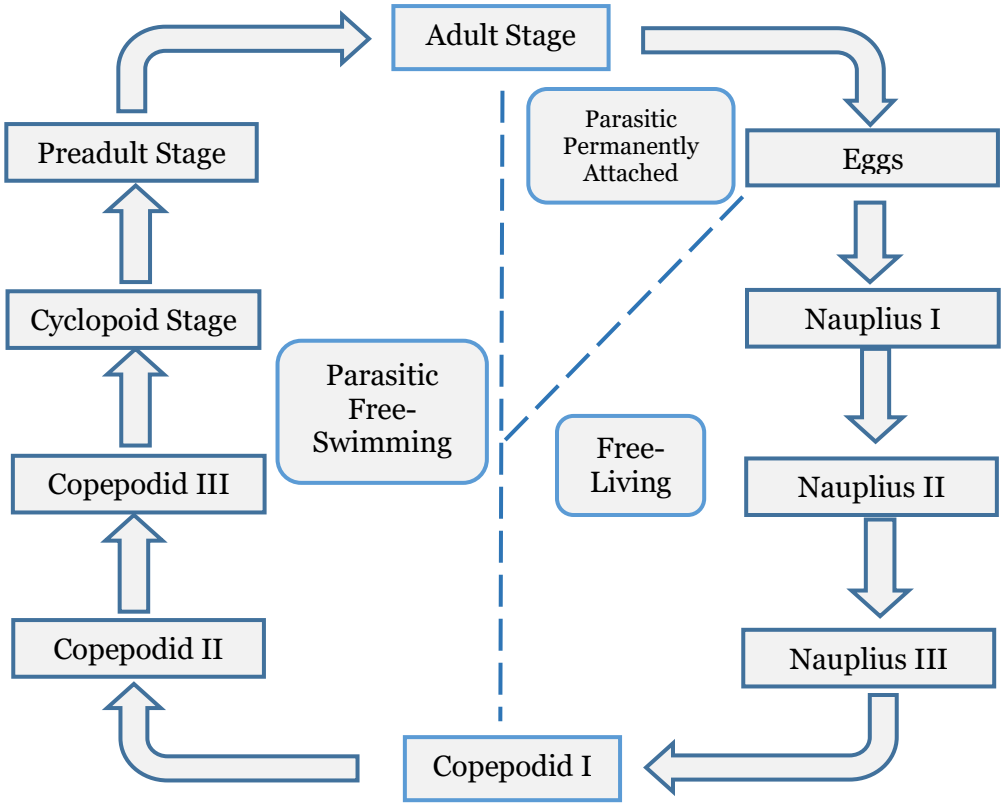

Figure 1: Diagrammatic presentation of the life cycle of *Lamproglena clariae* Fryer, 1956.

Copepods play major roles in pond ecosystems; serving as food for small fish, micro predators of fish and other organisms, fish parasites, intermediate hosts of fish parasites and hosts and vectors of human diseases (Piasecki *et al*., 2004). *Lamproglena* species were used as bio-indicators of environmental deterioration in regard to critical temperature levels and ammonia concentration (Jirsa *et al*., 2006). Sites that were found to be more polluted had lower mean intensity and mean abundance of *Lamproglena clariae* on *Clarias gariepinus* indicating pollution affects the survival of this ectoparasite along the Vaal River, South Africa (Pretorius and Avenant-Oldewage, 2022). Infection density of *Leuciscus cephalus* with *Lamproglena pulchella* from four different river reaches near Milan (northern Italy) increased in relation to fish length and age, suggests a dependence of infection intensity to the exposure time on the fish (Galli *et al*., 2001).

The gills of two Hungarian freshwater fishes were suffering from emaciation due to their infection with hundreds of *Lamproglena* specimens. Depression at the attachment sites, cell degenerations, local haemorrhages and host reaction were expressed by the proliferation of epithelioid cells, increase in number and size of goblet and mast cells and formation of giant cells (Molnár *et al*., 2018). Mass mortalities in two Turkish freshwater fishes with mean intensity ranged between 6.3 and 7.2 were noticed by Öktener *et al*. (2008). Different aspects of fish infestation with *Lamproglena* were covered by Elsaied and Elsheikha (2009).

Concerning the first records in Iraq, *Lamproglena pulchella* was reported from *Chondrostoma regium* and *Paracapoeta trutta* (reported as *Varicorhinus trutta*) by Rahemo (1977), while the second species (*L. chinensis*) was reported from the second above-named fish by Zangana (2008). In connection with *Pseudolamproglena*, *P. annulata* was recorded as a new genus and a species from *C. regium* by Boxshall (1976), while the second species (*P. boxshalli*) was also reported as a new species from *C. macrostomum* by Al-Nasiri *et al*. (2012). In addition, unidentified *Lamproglena* species was reported only from *Leuciscus vorax* by Al-Salmany (2022). Some more records were reported for the two species of each *Lamproglena* and *Pseudolamproglena*.

The present article aims to revise all records on *Lamproglena* and *Pseudolamproglena* species from fishes of Iraq. It is a continuation of some recent checklists on fish parasites in Iraq, which included those on *Trichodina* species (Mhaisen and Abdul-Ameer, 2020), *Myxobolus* species (Mhaisen and Al-Jawda, 2020), *Lernaea* species (Mhaisen and Abdul-Ameer, 2021a), *Contracaecum* species (Mhaisen and Abdul-Ameer, 2021b), fish parasites of floating cages (Mhaisen, 2022), *Ichthyophthirius multifiliis* (Mhaisen, 2023), *Ergasilus* species (Mhaisen and Al-Daraji, 2023), *Argulus* species (Mhaisen, 2024a) and *Neoechinorhynchus* species (Mhaisen and Abdul-Ameer, 2024).

Sources and Methods

A total of 51 references (29 published articles, 16 unpublished M. Sc. theses, two M. Technol. theses and four unpublished Ph. D. theses), dealing with the records of *Lamproglena* and *Pseudolamproglena* species from fishes of Iraq (Mhaisen, 2024b) were used to prepare the present article. Data from such references were gathered to provide reliable information on the distribution of such parasites in fishes from different water bodies as well as from some fish ponds in Iraq. A fish-host list was also prepared. The scientific names of fishes were reported as they appeared in their original references but their valid names were applied according to Fricke *et al*. (2024) and Froese and Pauly (2024). Parasite valid scientific names with their authorities were updated according to GBIF.org (2024). For each alphabetically listed *Lamproglena* and *Pseudolamproglena* species, valid fish host species are also alphabetically arranged together with their synonyms (if any) and their chronologically arranged references.

Results and Discussion

List of fish species infected with *Lamproglena* and *Pseudolamproglena* species in Iraq

The following list includes the scientific names of all Iraqi fish species infected with *Lamproglena* and *Pseudolamproglena* species with their full authorities and their orders and families, based on Fricke *et al*. (2024) and Froese and Pauly (2024).

Class Actinopteri

Order Cypriniformes

Family Cyprinidae

Arabibarbus grypus (Heckel, 1843)

Capoeta aculeata (Valencinnes, 1844)

Capoeta damascina (Valencinnes, 1842)

Capoeta umbla (Heckel, 1843)

Carasobarbus luteus (Heckel, 1843)

Chondrostoma regium (Heckel, 1843)

Cyprinion kais Heckel, 1843

Cyprinion macrostomus Heckel, 1843[1]

Cyprinus carpio Linnaeus, 1758

Garra rufa (Heckel, 1843)

Garra variabilis (Heckel, 1843)

Luciobarbus barbulus (Heckel, 1847)

Luciobarbus esocinus Heckel, 1843

Luciobarbus kersin (Heckel, 1843)

Luciobarbus xanthopterus Heckel, 1843

Mesopotamichthys sharpeyi (Günther, 1874)

Paracapoeta trutta (Heckel, 1843)

Family Leuciscidae

Leuciscus vorax (Heckel, 1843)

Squalius cephalus (Linnaeus, 1758)

Squalius lepidus Heckel, 1843

Squalius spurius Heckel, 1843

Order Mugiliformes

Family Mugilidae

Planiliza abu (Heckel, 1843)

[1]The specific name of this fish was spelled as *macrostomus* according to Fricke *et al.* (2024), Froese and Pauly (2024) and WoRMS (2024), but as *macrostomum* by all Iraqi references concerning *Lamproglena* and *Pseudolamproglena* species except Boxshall (1976), Kasim and Rahemo (1981), Abdul-Ameer (1989), Ali (1989) and Abdullah (1990).

Localities of collection of the infected fishes of Iraq with *Lamproglena* and *Pseudolamproglena* species

The records from available literature concerning the infection of different fish species in Iraq with parasite species of both *Lamproglena* and *Pseudolamproglena* can be grouped into six major categories according to localities of collection of the infected fishes. These are:

1- Tigris River at Nineveh Province (Boxshall, 1976; Rahemo, 1977; Kasim and Rahemo, 1981; Rahemo, 1995; Rahemo and Al-Kallak, 1998; Zangana, 2008), Salah Al-Din Province (Abdul-Ameer, 1989; Al-Jawda *et al.*, 2000; Al-Nasiri *et al.*, 2012; Al-Jubori, 2013; Esmaeel, 2018; Fahmy *et al.*, 2019; Kamil *et al.*, 2022; Esmaeel *et al.*, 2023) and Baghdad Province (Balasem *et al.*, 1993; Mhaisen *et al.*, 1995; Adday *et al.*, 1999;

Rasheed, 2016; Hendi, 2017; Abbood, 2022) as well as some tributaries of Tigris River which included Greater Zab River (Rashed and Hussain, 1988; Ali, 1989; Abdullah, 2002; Abdullah and Mhaisen, 2006, Muhammad *et al*., 2013), Lesser Zab River (Abdullah, 2002), Bahdinan River at Erbil Province (Bilal, 2006; Bilal and Abdullah, 2008) and Diyala River (Ali *et al*., 1987; Mohammed, 2017).
2- Euphrates River and its branches at Al-Anbar Province (Al-Salmany, 2015, 2022) and at Babylon Province (Al-Sa'adi, 2007; Mhaisen *et al*., 2015).
3- Shatt Al-Arab River: Mehaijeran Creek (Khamees, 1983; Mhaisen *et al*., 1986).
4- Some lakes, depressions and marshes: These included Mosul Dam Lake (Rahemo and Ami, 2013; Rahemo *et al*., 2013), Darbandikhan Lake (Abdullah, 2005; Abdullah, 2013, Abdullah and Abdullah, 2015a, b, c), Dokan Lake (Abdullah, 1990; Abdullah and Rasheed, 2004), Al-Husainia Creek in Karbala Province (Al-Saadi, 2007; Al-Saadi *et al*., 2010) and Al-Hammar Marsh in Basrah Province (Al-Daraji, 1986).
5- A drainage network at Babylon Province (Al-Sa'adi, 2022).
6- Fish ponds and farms which included some at Baghdad Province (Al-Nasiri, 2000) and Babylon Province (Al-Zubaidy, 1998; Al-Musawi, 2016).

Lamproglena and *Pseudolamproglena* species from fishes of Iraq

The following is an alphabetical list of parasite species of genera of *Lamproglena* and *Pseudolamproglena* infecting fish species of Iraq with their authorities, followed by a number of each host species in curly brackets.

1- *Lamproglena chinensis* Yü, 1937 {2}

2- *Lamproglena pulchella* von Nordmann, 1832 {20}

3- *Lamproglena* sp. {1}

4- *Pseudolamproglena annulata* Boxshall, 1976 {12}

5- *Pseudolamproglena boxshalli* Al-Nasiri, Ho & Mhaisen, 2012 {5}

Parasite-fish host list

Species of both *Lamproglena* and *Pseudolamproglena* are alphabetically arranged. The authorities of such parasites are not given here as they are given above. Valid fish host species (and their synonyms if applicable) for each parasite species are also alphabetically listed. References on records from each host species are chronologically arranged, with the reference of the first record of each of these parasite species in Iraq is underlined here.

Lamproglena chinensis: This parasite was recorded from *Leuciscus vorax* by Al-Sa'adi (2022) and from *Paracapoeta trutta* (as *Varicorhinus trutta*) by Zangana (2008). However, no illustrations were provided by Al-Sa'adi (2022) to ensure the exact identification. Zangana (2008) gave a poor-quality photo for parts of this parasite which could not explain the identification characteristics of the parasite.

Lamproglena pulchella: This parasite was so far recorded from 20 fish species in Iraq. These were *Arabibarbus grypus* (as *Barbus grypus*) by Mhaisen *et al.* (1995), *Capoeta aculeata* by Al-Salmany (2015), *Capoeta damascina* (as *Barbus belayewi*) by Abdullah (2002) and Abdullah and Mhaisen (2006), *Capoeta umbla* (as *Varicorhinus umbla*) by Ali (1989), Bilal (2006) and Bilal and Abdullah (2008), *Carasobarbus luteus* (also as *Barbus luteus*) by Ali (1989), Abdullah (2002, 2005), Abdullah and Mhaisen (2006), Al-Saadi (2007), Al-Saadi *et al.* (2010b), Esmaeel (2018), Kamil *et al.* (2022) and Esmaeel *et al.* (2023), *Chondrostoma regium* by Rahemo (1977), Ali *et al.* (1987), Adday *et al.* (1999), Abdullah (2002), Abdullah and Mhaisen (2006), Bilal (2006) and Bilal and Abdullah (2008), *Cyprinion macrostomum* by Bilal (2006) and Bilal and Abdullah (2008), *Cyprinus carpio* by Al-Zubaidy (1998), Mohammed (2017), Esmaeel (2018), Kamil *et al.* (2022) and Esmaeel *et al.* (2023), *Garra rufa* by Ali *et al.* (1987), Abdul-Ameer (1989), Mhaisen *et al.* (1995), Abdullah (2002) and Abdullah and Mhaisen (2006), *Leuciscus vorax* (also as *Aspius vorax*) by Khamees (1983), Al-Daraji (1986), Mhaisen *et al.* (1986), Rashed and Hussain (1988), Balasem *et al.* (1993), Adday *et al.* (1999), Al-Nasiri (2000), Al-Saadi (2007), Al-Saadi *et al.* (2010), Al-Sa'adi (2007), Al-Jubori (2013), Al-Salmany (2015), Mhaisen *et al.* (2015), Rasheed (2016), Hendi (2017), Fahmy *et al.* (2019) and Al-Salmany (2022), *Luciobarbus barbulus* (as *Barbus barbulus*) by Ali (1989), Bilal (2006) and Bilal and Abdullah (2008), *Luciobarbus esocinus* (as *Barbus esocinus*) by Rashed and Hussain (1988), Ali (1989), Abdullah (1990), Adday *et al.* (1999) and Abdullah and Rasheed (2004), *Luciobarbus kersin* (as *Barbus kersin*) by Bilal (2006) and Bilal and Abdullah (2008), *Luciobarbus xanthopterus* (also as *Barbus xanthopterus*) by Abdullah (1990), Abdullah and Rasheed (2004), Hendi (2017) and Abbood (2022), *Mesopotamichthys sharpeyi* by Al-Daraji (1986), *Paracapoeta trutta* (as *Capoeta trutta* and *Varicorhinus trutta*) by Rahemo (1977), Bilal (2006), Bilal and Abdullah (2008), Zangana (2008) and Al-Salmany (2015), *Planiliza abu* by Al-Musawi (2016), *Squalius cephalus* (as *Leuciscus cephalus*) by Ali (1989), *Squalius lepidus* (as *Leuciscus lepidus*) by Ali (1989), Abdullah (2002), Abdullah and Mhaisen (2006), Bilal (2006) and Bilal and Abdullah (2008) and *Squalius spurius* (as *Leuciscus spurius*) by Ali (1989).

Lamproglena sp.: The larva of this parasite was recorded only from *Leuciscus vorax* by Al-Salmany (2022).

Pseudolamproglena annulata: This parasite was recorded from 12 fish species. These were: *Capoeta umbla* (as *Varicorhinus umbla*) by Bilal (2006) and Bilal and Abdullah (2008), *Carasobarbus luteus* (also as *Barbus luteus*) by Abdul-Ameer (1989), Ali (1989), Abdullah (1990), Rahemo and Al-Kallak (1998), Al-Jawda *et al.* (2000), Abdullah (2002), Abdullah and Rasheed (2004), Abdullah (2005), Abdullah and Mhaisen (2006), Al-Jubori (2013), Muhammad *et al.* (2013), Al-Salmany (2015), Esmaeel (2018) and Esmaeel *et al.* (2023), *Chondrostoma regium* by Al-Salmany (2015), *Cyprinion kais* by

Al-Salmany (2015), *Cyprinion macrostomum* by Boxshall (1976), Kasim and Rahemo (1981), Abdul-Ameer (1989), Ali (1989), Abdullah (1990, 2002), Abdullah and Mhaisen (2006), Bilal (2006), Bilal and Abdullah (2008), Abdullah (2013), Abdullah and Abdullah (2015a, 2015b, 2015c) and Al-Salmany (2015), *Cyprinus carpio* by Abdullah (1990), Abdullah and Rasheed (2004), Esmaeel (2018), Kamil *et al*. (2022) and Esmaeel *et al*. (2023), *Garra rufa* by Rahemo (1995), *Garra variabilis* by Al-Salmany (2015), *Leuciscus vorax* (as *Aspius vorax*) by Adday *et al*. (1999), *Luciobarbus barbulus* (as *Barbus barbulus*) by Bilal (2006) and Bilal and Abdullah (2008), *Luciobarbus esocinus* (as *Barbus esocinus*) by Rahemo and Ami (2013) and Rahemo *et al*. (2013) and *Planiliza abu* by Esmaeel (2018) and Esmaeel *et al*. (2023).

Pseudolamproglena boxshalli: Five fish host species were recorded for this parasite: *Carasobarbus luteus* (as *Barbus luteus*) by Al-Jubori (2013) and Al-Salmany (2015), *Cyprinion macrostomum* by Al-Nasiri *et al*. (2012), Al-Jubori (2013) and Al-Salmany (2015), *Cyprinus carpio* by Al-Jubori (2013), *Luciobarbus xanthopterus* (as *Barbus xanthopterus*) by Al-Jubori (2013) and *Paracapoeta trutta* (as *Capoeta trutta*) by Al-Jubori (2013).

Host-parasite list

The following list of infected fishes with species of both *Lamproglena* and *Pseudolamproglena* is alphabetically arranged. For each fish species, names of parasites are also alphabetically listed.

Arabibarbus grypus: *L. pulchella*.

Capoeta aculeata: *L. pulchella*.

Capoeta damascina: *L. pulchella*.

Capota umbla: *L. pulchella*, *P. annulata*.

Carasobarbus luteus: *L. pulchella*, *P. annulata*, *P. boxshalli*.

Chondrostoma regium: *L. pulchella*, *P. annulata*.

Cyprinion kais: *P. annulata*.

Cyprinion macrostomus: *L. pulchella*, *P. annulata*, *P. boxshalli*.

Cyprinus carpio: *L. pulchella*, *P. annulata*, *P. boxshalli*.

Garra rufa: *L. pulchella*, *P. annulata*.

Garra variabilis: *P. annulata*.

Leuciscus vorax: *L. chinensis*, *L. pulchella*, *Lamproglena* sp., *P. annulata*.

Luciobarbus barbulus: *L. pulchella*, *P. annulata*.

Luciobarbus esocinus: *L. pulchella, P. annulata.*

Luciobarbus kersin: *L. pulchella*.

Luciobarbus xanthopterus: *L. pulchella*, *P. boxshalli*.

Mesopotamichthys sharpeyi: *L. pulchella*.

Paracapoeta trutta: *L. chinensis*, *L. pulchella*, *P. boxshalli*.

Planiliza abu: *L. pulchella*, *P. annulata*.

Squalius cephalus: *L. pulchella*.

Squalius lepidus: *L. pulchella*.

Squalius spurius: *L. pulchella*.

It is clear from the above list that, apart from both *C. kais* and *G. variabilis*, the remaining 20 fish species were infected by *L. pulchella* or/ with *P. annulata* and other parasite species. The number of parasite species ranged from one (in ten fish species) to a maximum of four parasite species in *L. vorax* only.

Finally, it is appropriate to mention here that the five crustacean species concerned in this checklist represent 5.3% of the whole crustacean species so far recorded from fishes of Iraq (Mhaisen, 2024b).

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قوائم مرجعية لأنواع الأسماك المصابة بطفيليات الجنسين *Lamproglena* و *Pseudolampoglena* (مجدافية الأقدام، دائرية الأقدام، عائلة ليرنيدي) في العراق

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المستخلص

تم الإعتماد على 51 مصدرا معنيا بظهور أنواع الجنسين *Lamproglena* و *Pseudolamproglena* التي تصيب أنواع الأسماك في العراق لغاية أواسط عام 2024. تبيّنت إصابة 22 نوعا من الأسماك بنوعين من الجنس *Lamproglena* هما *L. chinensis* و *L. pulchella* ونوعين من الجنس *Pseudolamproglena* هما *P. annulata* و*P. boxshalli* إضافة إلى بعض الأنواع غير المشخصة من الجنس *Lamproglena*. سجل النوع *L. chinensis* من نوعين من الأسماك، النوع *L. pulchella*من عشرين نوعا من الأسماك، النوع *P. annulata* من 12 نوعا، النوع *P. boxshalli* من خمسة أنواع وسجل النوع غير المشخص من الجنس *Lamproglena* من نوع واحد فقط من الأسماك. هذه الطفيليات سجلت من مضيّفاتها السمكية من مختلف المسطحات المائية (أنهار، قنوات، بحيرات، أهوار وشبكة مبازل) ومن بعض حقول الأسماك. ماعدا سمكة البنيني صغير الفم والكركور الملوّن، كانت جميع الأنواع السمكية المتبقية مصابة بالنوع *L. pulchella* و/ أو بأنواع طفيلية أخرى، في حين وصل أقصى عدد لأنواع الطفيليات، وهو أربعة فقط في سمكة الشلق.

الكلمات المفتاحية: قشريات، *Lamproglena*، *Pseudolamproglena*، غلاصم أسماك، إنتشار، العراق.

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