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Nematodes and Acanthocephalans of Fishes from the Euphrates River at Al-Musaib City, Mid Iraq

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Abstract

Due to the importance of the nematodes and acanthocephalans in fish life and as no previous work was done on both nematodes and acanthocephalans of fishes of Euphrates River at Al-Musaib city, mid Iraq, the present study was undertaken. A total of 472 fish specimens belonging to 24 species were inspected for parasites during the period from July 2006 till the end of June 2007. All fish specimens were externally examined for ectoparasites and then were dissected out to reveal any internal parasites in their body cavity, musculature and internal organs. Four nematode species and two acanthocephalan species were recorded from the intestine of 12 species of these fishes. These nematodes were *Contracaecum* spp. from nine fish species (*Alburnus orontis*, *Arabibarbus grypus*, *Carasobarbus luteus*, *Coptodon zillii*, *Leuciscus vorax*, *Luciobarbus xanthopterus*, *Mastacembelus mastacembelus*, *Mystus pelusius* and *Silurus triostegus*), *Camallanus lacustris* from three fish species (*A. orontis*, *Glyptothorax steindachneri* and *M. pelusius*), *Philometra* sp. from *Alburnus sellal* and *Rhabdochona denudata* from both *A. grypus* and *L. xanthopterus*. The acanthocephalans included both *Neoechinorhynchus iraqensis* and *Paulisentis fractus* from *Liza abu.* All these worms were adults except for *Contracaecum* spp. which occurred as a larval stage (third stage larva). In addition, seven new host records in Iraq were reported for four species of these nematodes. Number of fish hosts reported for these worms fluctuated from one host in case of three worm species to a maximum of nine hosts in case of *Contracaecum* spp. Among the inspected fishes, number of worm species fluctuated from a minimum of one worm species in seven fish species to a maximum of two worm species in case of five fish species, while 12 fish species showed no any worm infection.

Keywords

Nematoda, Acanthocephala, Freshwater Fishes, Euphrates River, Al-Musaib City, Babylon Province, Iraq

1. Introduction

The round worms or thread worms (nematodes) and the spiny- headed or thorny- headed worms (acanthocephalans) are among the important internal parasites that affect fishes both in natural waters and in aquaculture. As both groups have indirect life cycles, they utilize fishes as intermediate or final hosts (Hoffman, 1999).

The nematodes have a cylindrical body with an outer cuticle that gives their body structural rigidity. The gut begins with a mouth and ends with an anus. There is a pseudocoelom between the gut and the body wall muscles. Nematodes have separate sexes- males and females. Nematodes are common parasites in freshwater and marine fishes (Berland, 2006).

Most adult nematodes that parasitize fishes live in their intestinal tract. Larval nematodes of fishes may be found in almost every organ but are most common in the mesenteries, liver and musculature (Hoffman, 1999). So, fishes are either intermediate or final hosts for nematodes (Noga, 2010). Detailed information on the life cycles of nematodes can be obtained from Olsen (1974), Hoffman (1999), Berland (2006), Molnár *et al.* (2006) and Noga (2010).

Fish nematodes might harm their hosts in a variety of ways. They can cause mechanical injuries, atrophy of tissues, occlusion of the alimentary canal, blood vessels and other ducts and intoxication from their metabolic products, and they can deprive the host of food, enzymes and vitamins

(Molnár *et al.*, 2006). More information on nematode pathogenesis is explained by Noga (2010) and Levsen and Berland (2012). Detailed pathological effects of larvae of *Contracaecum* species on some freshwater fishes in Iraq, especially *Liza abu* were given by Shamsuddin *et al.* (1971) and Habish (1977).

The acanthocephalans are easily recognized because of their proboscis, which bears chitinoid hooks. The proboscis may become withdrawn when the worm is removed from the host (Hoffman, 1999). These elongated worms with non-segmented bodies have neither alimentary canal nor circulatory system. They are of separated sexes, males being shorter than females and characterized by their cement glands and copulatory bursa (Duijn, 1973). Detailed account on acanthocephalan morphology is demonstrated by Nickol (2006). The adult acanthocephalans suck host digested food directly through their teguments, may block host intestine in cases of heavy infection (Khamees, 1983) and cause diverse pathological changes in the intestine of their hosts (Hasan, 2004; Lefebvre *et al.*, 2012; Amin *et al.*, 2015).

Acanthocephalans require vertebrate animals as definitive hosts and arthropods (amphipods, copepods, isopods or ostracods) as intermediate hosts (Nickol, 2006). Detailed account on the life cycles of these worms is given by Hoffman (1999) and Noga (2010). Number of acanthocephalan taxa reached 26 families, 157 genera and 1298 species (Amin, 2013).

The presence of nematode larvae in fish may present a risk for humans. Third-stage larvae of genera *Anisakis*, *Pseudoterranova*, *Phocascaris* and *Contracaecum* occur in fish musculature and their adult stage is in homoeothermic animals such as whales and seals (Molnár *et al.*, 2006). Some nematodes cause important public health problems such as capillariasis, anisakidosis, gnathostomosis or paracapillariosis (McCarthy and Moore, 2000; Ko, 2006; Moravec, 2007). Some larval nematodes are serious public health problems and can cause larva migrans when ingested by humans such as *Anisakis* and *Pseudoterranova* (Noga, 2010). On the other hand, infection of human and other terrestrial vertebrates with the acanthocephalans occurred through the insects (Olsen, 1974).

Among parasitological investigations achieved on nematodes and/ or acanthocephalans of fishes from Euphrates River within the Iraqi territory are those of Al-Alusi (1989), Mhaisen *et al.* (1997), Al-Alusi (1998), Asmar *et al.* (1999), Al-Jadoaa (2002), Balasem *et al.* (2003), Al-Saadi (2007), Al-Alusi (2011), Al-Karboly (2012) and Al-Salmany (2015). The present article was aimed to contribute on the nematodes and acanthocephalans of fishes from the Euphrates River at Al-Musaib city as no previous study was done on fishes of this area.

2. Materials and Methods

Fish specimens were collected from the Euphrates River at Al-Musaib city (32°47'N, 44°17'E), mid Iraq during the period from July 2006 till the end of June 2007. They were caught with the aid of a cast net and were directly transported to the laboratory where they were measured, weighed and sexed. Fishes were freshly examined for parasites according to Amlacher (1970). Prevalence of infection was calculated according to Margolis *et al.* (1982). Parasite identification was done according to Bykhovskaya-Pavlovskaya *et al.* (1962) and Amin *et al.* (2001).

Names and authorities of the concerned nematodes were checked in accordance with some relevant literature (Moravec, 2006; Anderson *et al.*, 2009; Gibbons, 2010) and those of acanthocephalans with a recent account by Amin (2013).

The valid scientific names of the studied fishes were based on Froese and Pauly (2015). Such names are similar to those reported by Eschmeyer (2015), except for both *Barbus grypus* and *Tilapia zillii* which were considered as synonyms of *Arabibarbus grypus* and *Coptodon zillii*, respectively by the latter reference.

3. Results and Discussion

During the period of this investigation, a total of 472 fish specimens belonging to 24 species and eight families were inspected for parasites. The updated scientific names of these fishes as well as their examined numbers are demonstrated below according to their respective families.

Family Cyprinidae
16 *Alburnus caeruleus* Heckel, 1843
10 *Alburnus orontis* Sauvage, 1882
24 *Alburnus sellal* Heckel, 1843
9 *Arabibarbus grypus* (Heckel, 1843)
12 *Barbus barbulus* Heckel, 1847
2 *Capoeta damascina* (Valenciennes, 1842)
77 *Carasobarbus luteus* (Heckel, 1843)
4 *Carassius carassius* (Linnaeus, 1758)
3 *Chondrostoma regium* (Heckel, 1843)
2 *Ctenopharyngodon idella* (Valenciennes, 1844)
60 *Cyprinion kais* Heckel, 1843
15 *Cyprinion macrostomum* Heckel, 1843
7 *Cyprinus carpio* Linnaeus, 1758
22 *Garra rufa* (Heckel, 1843)
33 *Leuciscus vorax* (Heckel, 1843)
11 *Luciobarbus xanthopterus* Heckel, 1843
2 *Mesopotamichthys sharpeyi* (Günther, 1874)
Family Bagridae
18 *Mystus pelusius* (Solander, 1794)
Family Siluridae
5 *Silurus triostegus* Heckel, 1843
Family Sisoridae
13 *Glyptothorax steindachneri* (Pietschmann, 1913)
Family Heteropneustidae
12 *Heteropneustes fossilis* (Bloch, 1794)
Family Cichlidae
29 *Coptodon zillii* (Gervais, 1848)
Family Mugilidae
48 *Liza abu* (Heckel, 1843)
Family Mastacembelidae

38 *Mastacembelus mastacembelus* (Banks & Solander, 1794)

The inspection of these fishes revealed the occurrence of four species of nematodes which belong to two orders and four families as well as two species of acanthocephalans which belong to one order and one family as demonstrated below.

Phylum Nemathelminthes
Class Secernentea
Order Ascaridida
Family Anisakidae
Contracaecum spp.
Order Spirurida
Family Camallanidae
Camallanus lacustris (Zoega, 1776)
Family Philometridae
Philometra sp.
Family Rhabdochonidae
Rhabdochona denudata (Dujardin, 1845)
Phylum Acanthocephala
Class Eoacanthocephala
Order Neoechinorhynchida
Family Neoechinorhynchidae
Neoechinorhynchus iraqensis Amin, Al-Sady, Mhaisen *et* Bassat, 2001
Paulisentis fractus Van Cleave *et* Bangham, 1949

The following is a brief account on the occurrence of these nematodes and acanthocephalans with emphasis on the previous concerned records in fishes of Iraq.

3.1. Phylum Nemathelminthes

Four species of nematodes were detected from the intestine of 11 fish species. These were *Contracaecum* spp., *Rhabdochona denudata*, *Camallanus lacustris* and *Philometra* sp. The following is a brief account on the occurrence of these nematodes with emphasis on the previous concerned records in fishes of Iraq.

3.1.1. *Contracaecum* spp.

Third stage larvae of *Contracaecum* spp. were recorded from the intestine of *Alburnus orontis*, *Arabibarbus grypus*, *Carasobarbus luteus*, *Coptodon zillii*, *Leuciscus vorax*, *Luciobarbus xanthopterus*, *Mastacembelus mastacembelus*, *Mystus pelusius* and *Silurus triostegus* with an incidence of 20%, 11.1%, 5.2%, 17.2%, 9.1%, 19.2%, 5.3%, 11.1% and 20%, respectively. The first report of *Contracaecum* spp. larvae in Iraq was from the body cavity and different viscera of *L. vorax* (reported as *A. vorax*), *Luciobarbus esocinus* (reported as *Barbus esocinus*), *A. grypus* (reported as *B. grypus*), *C. luteus* (reported as *B. luteus*), *Heteropneustis fossilis*, *Liza abu* (reported as *Mugil abu*), *L. xanthopterus* (reported as *B. xanthopterus*), *Mesopotamichthys sharpeyi* (reported as *B. sharpeyi*), *M. pelusius* and *S. triostegus* from different inland waters of Iraq (Herzog, 1969). Later on, they were reported from 25 other freshwater fishes as well as some marine fishes entering freshwater habitats in Iraq. These records did not include *A. orontis* and *C. zillii* (Mhaisen, 2015). So, *A. orontis* and *C. zillii* of the present investigation represent two new host records for this worm in Iraq. As *Contracaecum* spp. larvae differ in lengths of caecum to appendage, caecum to esophagus and appendage to esophagus (Moravec, 1994), Ali (2008) believed that two types of *Contracaecum* species are found in fishes of Basrah. These are *Contracaecum* sp. 1 which is found in all fishes of Basrah infected with *Contracaecum* spp. larvae, except *H. fossilis* by Ali (2001) and *Contracaecum* sp. 2 in *H. fossilis* only (Ali, 2001).

In addition to the record of larvae of *Contracaecum* spp. from freshwater habitats in Iraq, such larvae were also reported from some marine fishes of the Arab Gulf within the Iraqi territorial waters (Al-Daraji, 1995; Bannai, 2002). Ali (2008) is of the opinion that such records are in fact belonged to the genus *Hysterothylacium* as adult *Contracaecum* spp. are parasites of birds and mammals and they cannot mature in fishes.

Some adult *Contracaecum* species were recorded from some piscivorous birds in Basrah province. *C. microcephalum* was reported from the purple heron *Ardea purpurea* (Al-Hadithi and Habish, 1977; Habish, 1977; Awad *et al.*, 1994), from the pygmy cormorant *Phalocrocorax pygmeus*, from the little egret *Egretta grazetta* from Basrah marshes (Awad *et al.*, 1994) and from *E. grazetta*, the bittern *Ardeola ralloides* and the little bittern *Ixobrychus minutus* from Al-Hammar marsh (Ali, 2008). *C. micropapillatum* was reported from the grey heron *Ardea cinerea* and *A. ralloides* from Al-Hammar marsh (Ali, 2008). *C. multipapillatum* and *C. rudolphi* (reported as *C. spiculigerum*) were reported from *P. pygmeus* from Basrah marsh (Awad *et al.*, 1994). *C. ovale* was recorded from *A. purpurea* from Abu Zijri marsh north of Basrah province (Abdullah, 1988; Al-Hadithi and Abdullah, 1991) and from *A. ralloides* (Ali, 2008). Unidentified adult *Contracaecum* species were also reported from *Phalocrocorax carbo* from Basrah and Babylon provinces (Abed, 2005), from six species of aquatic birds: *E. alba*, *E. garzetta*, *A. ralloides*, *B. stellaris*, *A. purpurea*, and *C. rudis* from Bahr Al-Najaf depression (Al-Awadi *et al.*, 2010) and from ten bird species in Meshab marsh (Al-Tameemi, 2013).

3.1.2. *Camallanus lacustris* (Zoega, 1776)

This parasite was recorded from the intestine of *A. orontis*, *Glyptothorax steindachneri* and *M. pelusius* with an incidence of 10%, 15.4% and 16.7%, respectively. The first report of *C. lacustris* in Iraq was from the intestine of *L. xanthopterus* (reported as *B. xanthopterus*) from Al-Qadisia Dam Lake (Asmar *et al.*, 1999). No more records were demonstrated for this parasite in Iraq and hence *A. orontis*, *G. steindachneri* and *M. pelusius* are considered as three new hosts for *C. lacustris* in Iraq (Mhaisen, 2015).

In addition to *C. lacustris*, two other species of *Camallanus* were so far reported from fishes of Iraq. These included both *C. ancylodirus* Ward *et* Magath, 1916 and *C.*

kirandensis Baylis, 1928 from *S. triostegus* by Jori (2006). Some unspecified specimens of *Cucullanus* from a marine fish, *Cynoglossus arel*, were also reported by Ali (2008) and Al-Salim and Ali (2011).

3.1.3. *Philometra* sp.

This parasite was recorded from the intestine of *Alburnus sellal* with an incidence of 4.3%. The first report of *Philometra* sp. in Iraq was by Herzog (1969) from the liver and ovaries of *C. luteus* (reported as *B. luteus*). In Iraq, some unspecified specimens of *Philometra* were reported from *A. grypus* (reported as *B. grypus*) by Saleem (1991), *C. luteus* (reported as *B. luteus*) by Herzog (1969), *C. macrostomum* by Abubakr (2015), both *Netuma thalassina* and *Sphyraena jello* by Ali (2008) and both *Strongylura leiura* and *Tylosurus crocodilus* by Ali (2001). So, *A. sellal* is considered as a new host for *Philometra* sp. in Iraq (Mhaisen, 2015).

In addition to *Philometra* sp., eight species of *Rhabdochona* are so far known from fishes of Iraq. These included, 1- *R. abdominalis* Nybelin, 1928 which was firstly reported from *A. grypus* (reported as *B. grypus*) by Ali *et al.* (1987), 2- *P. brachiri* Moravec *et* Ali, 2014 from *Brachirus orientalis* by Moravec and Ali (2014), 3- *P. johni* Moravec *et* Ali, 2013 from *Johnius dussumieri* by Moravec and Ali (2013), 4- *P. otolithi* Moravec *et* Monoharan, 2013 from *Otolithes ruber* by Moravec and Ali (2014), 5- *P. piscaria* Moravec *et* Justine, 2014 from *Epinepheles coioides* by Moravec and Ali (2014), 6- *P. strongylurae* Moravec *et* Ali, 2005 from both *S. leiura* and *S. strongylura* by Moravec and Ali (2005), 7- *P. tricornuta* Moravec *et* Ali, 2014 from *Saurida tumbil* by Moravec and Ali (2014) and 8- *P. tylosuri* Moravec *et* Ali, 2005 from *T. crocodilus* by Moravec and Ali (2005). Apart from *P. abdominalis*, all the remaining above-named *Philometra* spp. were recorded from marine fishes of Iraq. In addition, *P. intestinalis* Dogiel *et* Bykhovsky, 1934, firstly reported from *C. luteus* (reported as *B. luteus*) by Al-Jadoaa (2002) was transferred to the genus *Molnaria* by Moravec (1968). However, the genus *Molnaria* was subsequently re-named as *Kalmanmolnaria* by Sokolov (2006), because the former proved to be a homonym to *Molnaria* Zalessky, 1926, a genus of fossil Foraminiptera (In litt. with Prof. F. Moravec of the Institute of Parasitology, Academy of Sciences of the Czech Republic, 25 May 2015).

3.1.4. *Rhabdochona denudata* (Dujardin, 1845)

This parasite was recorded from the intestine of both *A. grypus* and *Luciobarbus xanthopterus* with an incidence of 11.1% and 9.1%, respectively. The first report of *R. denudata* in Iraq was from the intestine of *C. luteus* (reported as *B. luteus*) and *Cyprinion macrostomum* from different parts of Iraq (Moravec *et al.*, 1991). No more records were demonstrated for this parasite in Iraq (Mhaisen, 2015). According to Moravec *et al.* (1991), *R. mesopotamica* which was firstly described from the intestine of *C. macrostomum* from Tigris River at Mosul city by Fattohy (1975) and published later by Rahemo and Kasim (1979), is considered as a synonym of *R. denudata*. *R. mesoptamica* has so far seven host species in Iraq which include *A. grypus* but not *L. xanthopterus* and hence *L. xanthopterus* is considered as a new host for *R. denudata* in Iraq (Mhaisen, 2015).

In addition to *R. denudata*, 11 other species of *Rhabdochona* were recorded from fishes of Iraq but unfortunately, most of such records were considered later either as synonyms with other species or misidentifications. These included, 1- *R. chodukini* from both *B. barbulus* and *B. kersin* by Bilal (2006) which according to Moravec *et al.* (2012) probably belongs to *R. kurdistanensis*, 2- *R. fortunatowi* from *C. macrostomum* by Saraiva *et al.* (2007) which according to Moravec *et al.* (2012) belongs to *R. tigridis*, 3- *R. garuai* from *S. triostegus* by Jori (2006) which according to a personal communication with Dr. Moravec is considered as misidentification of *R. garuai* and should be considered as *Rhabdochona* sp., 4- *R. genedini* from *Varicorhina damascina* and *V. umbla* by Bilal (2006) which according to Moravec *et al.* (2012) is considered to be questioned, 5- *R. grandipapillata* which was firstly reported from *C. macrostomum* by Rahemo and Kasim (1979) and then from *Garra rufa* by Abdul-Ameer (1989) and considered as a synonym of *R. tigridis* by Moravec *et al.* (2009), 6- *R. hellichi* which was firstly recorded from *H. fossilis*, *L. xanthopterus* (reported as *B. xanthopterus*) and *M. pelusius* by Moravec *et al.* (2009), 7- *R. khazirensis* from *A. capito* by Zangana (2008) which according to Moravec *et al.* (2012) was considered as allegedly new species, 8- *R. kurdistanensis* as a new species from *L. kersin* by Moravec *et al.* (2012), 9- *R. mesopotamica* from *C. macrostomum* by Rahemo and Kasim (1979) which according to Moravec *et al.* (2012) was considered as a junior synonym of *R. denudata*, 10- *R. similis* which was recorded as a new species from both *C. luteus* (reported as *B. luteus*) and *Glyptothorax* sp. by Moravec *et al.* (1991) and 11- *R. tigridis* from both *C. trutta* and *C. macrostomum* by Moravec *et al.* (2009) to which both *R. tigrae* firstly reported from *V. trutta* by Rahemo (1978) and *R. grandipapillata* are considered as two new synonyms of *R. tigridis* according to Moravec *et al.* (2012). In addition, some unspecified specimens of *Rhabdochona* were so far reported from seven fish species in Iraq (Mhaisen, 2015).

3.2. Phylum Acanthocephala

Two acanthocephalan species were detected from the intestine of *L. abu* only. These were *Neoechinorhynchus iraqensis* and *Paulisentis fractus* which both belong to the family Neoechinorhynchidae.

3.2.1. *Neoechinorhynchus iraqensis* Amin, Al-Sady, Mhaisen *et* Bassat, 2001

This parasite was recorded from the intestine of *L. abu* with an incidence of 37.5%. The first report of *N. iraqensis* in Iraq was as a new species from the intestine of *L. abu* from the Euphrates River at Al-Falooja region by Al-Sady (2000) and its description was given later by Amin *et al.* (2001). It is appropriate to mention here that this species was erroneously reported in many Iraqi literatures (Mhaisen, 2002) as *N. agilis* which is in fact a marine species. *N. iraqensis* and *N.*

agilis have so far 17 host fishes in Iraq (Mhaisen, 2015). In Iraq, Khamees (1983) showed that *N. iraqensis* (reported as *N. agilis*) may block the intestine of *L. abu*. Hasan (2004) showed that *N. iraqensis* causes diverse pathological changes (absence of goblet cells from the mucosal layer, hyalinization, oedma, necrosis and infiltration of all intestine layers with lymphocytes) in the intestine of *L. abu*.

In addition to *N. iraqensis*, seven other species of *Neoechinorhynchus* were so far reported from fishes of Iraq. These included, 1- *N. australis* Van Cleave, 1931 which was reported only from *L. abu* by Abdul-Rahman (1999), 2- *N. cristatus* Lynch, 1936 which was firstly reported from *Capoeta trutta* (reported as *Varicorhinus trutta*) by Abdul-Ameer (1989), 3- *N. dimorphospinosus* Amin *et* Sey, 1996 which was firstly reported from *L. abu* by Abdul-Rahman (1999), 4- *N. elongatus* Tripathi, 1956 which was recorded from both *L. vorax* (reported as *A. vorax*) and *L. xanthopterus* (reported as *B. xanthopterus*) by Al-Sady *et al.* (2009), 5- *N. macronucleatus* Machado Filho, 1954 which was recorded only from *L. abu* by Abdul-Rahman (1999), 6- *N. rutili* (Müller, 1780) which was firstly recorded from both *L. xanthopterus* (reported as *B. xanthopterus*) and *L. abu* (reported as *Mugil abu*) by Herzog (1969) and 7- *N. zabensis* Amin, Abdullah *et* Mhaisen, 2003 which was firstly described as a new species from both *Capoeta damascina* and *C. trutta* by Amin *et al.* (2003). In addition, some unspecified specimens of *Neoechinorhynchus* were so far reported from four fish species in Iraq (Mhaisen, 2015).

3.2.2. *Paulisentis fractus* Van Cleave *et* Bangham, 1949

This parasite was recorded from the intestine of *L. abu* with an incidence of 4.2%. The first report of *P. fractus* in Iraq was from the intestine of *B. barbulus* from Tigris River at Tikreet city (Al-Jawda *et al.*, 2000) Later on, it was reported from two other hosts, inclusive of *L. abu*, from mid and south Iraq (Mhaisen, 2015). *P. fractus* is the only species of *Paulisentis* so far recorded from fishes of Iraq (Mhaisen, 2015).

4. Conclusions

To conclude on the nematode and acanthocephalan infections of fishes from the Euphrates River at Al-Musaib city, only four nematode species and two acanthocephalan species were detected from 12 fish species (*A. orontos*, *A. sellal*, *A. grypus*, *C. luteus*, *C. zillii*, *G. steindachneri*, *L. xanthopterus*, *L. vorax*, *L. abu*, *M. mastacembelus*, *M. pelusius* and *S. triostegus*), while 12 fish species showed no any infection with nematodes and acanthocephalans (*A. caeruleus*, *B. barbulus*, *C. damascina*, *C. carassius*, *C. regium*, *C. idella*, *C. kais*, *C. macrostomum*, *C. carpio*, *G. rufa*, *H. fossilis* and *M. sharpeyi*). All these worm species were adults living in the intestine of their hosts except for *Contracaecum* spp. which appeared as a third larval stage.

In connection with fish richness with these worms, seven fish species (*A. sellal*, *C. luteus*, *C. zillii*, *G. steindachneri*, *L. vorax*, *M. mastacembelus*, and *S. triostegus*) harboured only one worm species each, while five fish species (*A. orontis*, *A. grypus*, *L. xanthopterus*, *L. abu* and *M. pelusius*) harboured two worm species each. Such richness is quite low when compared with the monogenean infections of the same fishes from the same area (Mhaisen *et al.*, 2015a) as 36 monogenean species were recorded from 19 fish species in the latter study. On the other hand, this richness is similar to that detected in the trematode infections of the same fishes of the same area (Mhaisen *et al.*, 2015b) as seven trematode species were recorded from 10 fish species in the latter study and is also similar to that detected in the cestode infection of the same fishes of the same area (Mhaisen *et al.*, 2015c) as seven cestode species were recorded from six fish species in the latter study. The similarity between trematodes, cestodes and both nematode and acanthocephalan infections is due to their indirect life cycles in comparison with the infection with the monogeneans which have direct life cycles (Ginetsinskaya, 1961; Olsen, 1974).

Number of fish hosts reported for these four nematode species and two acanthocephalan species was one host in case of all the three worm species (*Philometra* sp., *N. iraqensis* and *P. fractus*), two hosts in case of *R. denudata*, three hosts in case of *C. lacustris* and nine hosts in case of *Contracaecum* spp. Among the inspected fishes, number of worm species fluctuated from a minimum of one worm species in seven fish species to a maximum of two worm species in case of five fish hosts, while 12 fish species showed no any worm infection.

The present investigation also revealed the record of seven new fish hosts for four of the previously known worm species from Iraq. These were both *A. orontis* and *C. zillii* for *Contracaecum* spp. larvae, *L. xanthopterus* for *R. denudata*, *A. sellal* for *Philometra* sp. as well as *A. orontis*, *G. steindachneri* and *M. pelusius* for *C. lacustris*.

Generally, the percentage incidence of infection of the 12 infected fish species with the four nematode species and two acanthocephalan species was light as it ranged from a minimum of 4.2% in case of *P. fractus* in *L. abu* to a maximum of 20% in case of *Contracaecum* spp. larvae in both *A. orontis* and *S. triostegus*.

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