Checklists of Fish Hosts of Species of *Neoechinorhynchus* Stiles & Hassall, 1905 (Acanthocephala: Neoechinorhynchidae) Recorded in Iraq

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Received 27/09/2023 Accepted 07/11/2023 Published 25/06/2024

Abstract

A survey of 145 literature concerning the occurrence of the acanthocephalan genus *Neoechinorhynchus* parasitizing fishes of Iraq, indicated that there are 12 identified species of *Neoechinorhynchus* as well as some unidentified species of this genus infecting 34 fish species. The infections were distributed in fishes from Tigris, Euphrates and Shatt Al-Arab rivers and some of their tributaries, as well as in some lakes, marshes, depressions, drainage networks, many fishponds and floating cages in different parts of Iraq, in addition to marine territorial waters of the Arab Gulf. Among the infected fishes, the mugilid fish *Planiliza abu* was infected with the highest number of *Neoechinorhynchus* species (ten parasite species), followed by *Silurus triostegus* (five parasite species), while 17 fish species were infected with only one *Neoechinorhynchus* species each. Among such acanthocephalans, *N. iraqensis* was infecting a total of 25 different fish species, followed by *N. rutili* (16 fish species), while *N. australis*, *N. macronucleatus* and *N. miniovalis* were detected from one fish host species each.

Keywords: Acanthocephala, *Neoechinorhynchus*, Fishes, Iraq.

Introduction

Neoechinorhynchus Stiles & Hassall, 1905 of the family Neoechinorhynchiae, order Neoechinorhynchida, class Eoacantho-cephala of the phylum Acanthocephala, represents the type and most speciose genus with 143 species worldwide (GBIF.org, 2023), while WoRMS (2023) enlisted 129 extant species.

P-ISSN: 1812-237X, E-ISSN: 2788-5720, https://ijaqua.uobasrah.edu.iq/index.pip/iaqua

The acanthocephalans live in the intestine of vertebrates attached to the wall by a retractable proboscis usually covered with recurved hooks. No alimentary canal is present at any stage in their life cycle and food being absorbed through body surface. The sexes are separate and reproductive systems are complex (Hegner, 1956).

There are many reports of the effects of parasitism by *Neoechinorhynchus* species on fishes such as desquamation of the intestinal epithelium, hyperplasia, goblet cell hypertrophy and submucosal inflammatory reaction around the point of proboscis attachment (Virgilio *et al*., 2021). However, acanthocephalans are very seldom the cause of any serious damage or death to man or his domestic animals (Kennedy, 2006).

Neoechinorhynchus species have indirect life cycle between the final host where the adult worms live in the intestine, and their intermediate hosts (ostracods and other crustaceans). The following diagram, extracted from Sousa Lourenço *et al*. (2018) demonstrates the life cycle stages of *N. buttnerae*.

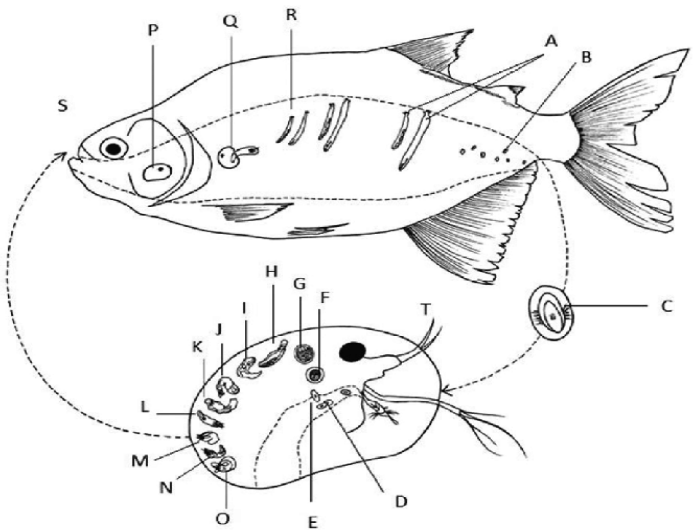

Figure 1: Illustration of the life cycle of *Neoechinorhynchus buttnerae* Golvan, 1956. A: Adult parasites inside the fish gut, B: Free eggs in the fish gut, C: Egg expulsed to the water with fish faeces, D: Acanthor hatching in the gut of the ostracod, E-M: Young acanthella, N: Male acanthella, O: Cystacanth (infective stage), P: Ostracod inside the fish gut, Q: Juvenile leaving the ostracod, R: *N. buttnerae* inside the fish gut, S: The infected fish *Colossoma macropomum*, T: The infected ostracod *Cypridopsis vidua* (From Sousa Lourenço *et al*., 2018).

Herzog (1969) was the first one to report the first *Neoechinorhynchus* species (*N. rutili*) from *Luciobarbus xanthopterus* (as *Barbus xanthopterus*) and *Planiliza abu* (as *Mugil abu*) of Iraq. Mhaisen (2002) gave the first review on the acanthocephalans infecting fishes of Iraq, which indicated the occurrence 11 acanthocephalan species inclusive of six *Neoechinorhynchus* species, one synonymous species and some unidentified species of that genus. After that, extensive work was done on the occurrence of different *Neoechinorhynchus* species from different water bodies of Iraq (a total of 141 references were encountered). Among such records, six species were considered as new species to science. These are *N. iraqensis* by Amin *et al.* (2001), *N. zabensis* by Amin *et al.* (2003), *N. barbi*, *N. planilizai* and *N. tigrisensis* by Al-Ayash *et al.* (2021) as well as *N. miniovalis* by Amin *et al.* (2023).

The present article aims to revise all records on *Neoechinorhynchus* species from fishes of Iraq and provide updated lists of them and their host species. It is a continuation of some recent checklists on some groups of fish parasites in Iraq, such as 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, 2023a) and *Ergasilus* species (Mhaisen and Al-Daraji, 2023).

Sources and Methods

Depending on the Index-Catalogue of parasites and disease agents of fishes of Iraq (Mhaisen, 2023b), a total of 145 references (91 published research papers, 38 unpublished M. Sc. theses, one M. Tech. theses, 14 unpublished Ph. D. theses and one abstract) dealing with records on *Neoechinorhynchus* species from fishes of Iraq 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 and fish farms in Iraq as well as the fish-*Neoechinorhynchus* list. For fishes, the scientific names were reported as they appeared in their original references. Fish valid scientific names and their authorities were corrected according to Fricke *et al.* (2023), Froese and Pauly (2023), GBIF.org (2023) and WoRMS (2023). For each alphabetically listed *Neoechinorhynchus* 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 *Neoechinorhynchus* Species in Iraq

The following list includes the scientific names of all Iraqi fish species infected with *Neoechinorhynchus* species, their full authorities and their orders and families, based on Fricke *et al*. (2023) and Froese and Pauly (2023).

Class Actinopteri
- Order Cypriniformes
  - Family Cyprinidae
    - *Arabibarbus grypus* (Heckel, 1843)
    - *Capoeta barroisi* Lortet, 1894[1]
    - *Capoeta damascina* (Valenciennes, 1842)
    - *Capoeta trutta* (Heckel, 1843)[2]
    - *Capoeta umbla* (Heckel, 1843)
    - *Carasobarbus luteus* (Heckel, 1843)
    - *Carassius auratus* (Linnaeus, 1758)
    - *Carassius carassius* (Linnaeus, 1758)
    - *Cyprinion kais* Heckel, 1843
    - *Cyprinion macrostomus* Heckel, 1843[3]
    - *Cyprinus carpio* Linnaeus, 1758
    - *Luciobarbus esocinus* Heckel, 1843
    - *Luciobarbus xanthopterus* Heckel, 1843
    - *Mesopotamichthys sharpeyi* (Günther, 1874)
  - Family Xenocyprididae[4]
    - *Ctenopharyngodon idella* (Valenciennes, 1844)
    - *Hypophthalmichthys molitrix* (Valenciennes, 1844)
  - Family Leuciscidae
    - *Acanthobrama marmid* Heckel, 1843
    - *Alburnus caeruleus* Heckel, 1843
    - *Alburnus sellal* Heckel, 1843
    - *Chondrostoma regium* (Heckel, 1843)
    - *Leuciscus vorax* (Heckel, 1843)
- Order Siluriformes
  - Family Bagridae
    - *Mystus pelusius* (Solander, 1794)
  - Family Siluridae
    - *Silurus triostegus* Heckel, 1843
  - Family Heteropneustidae
    - *Heteropneustes fossilis* (Bloch, 1794)
- Order Gobiiformes

Family Gobiidae
Boleophthalmus dussumieri Valenciennes, 1837
Periophthalmus waltoni Koumans, 1941[5]
Order Synbranchiformes
Family Mastacembelidae
Mastacembelus mastacembelus (Banks & Solander, 1794)
Order Cyprinodontiformes
Family Poeciliidae
Gambusia holbrooki Girard, 1859
Poecilia latipinna (Lesueur 1821)
Order Pleuronectiformes
Family Soleidae
Brachirus orientalis (Bloch & Schneider, 1801)
Order Mugiliformes
Family Mugilidae
Planiliza abu (Heckel, 1843)
Planiliza klunzingeri (Day, 1888)
Planiliza subviridis (Valenciennes, 1836)
Order Perciformes
Family Sparidae
Acanthopagrus arabicus Iwatsuki, 2013

In addition to the above fish list, some unspecified fish hosts were reported by both Al-Amura *et al.* (2012) and Mansor *et al.* (2012).

[1] According to Fricke *et al.* (2023), *Capoeta barroisi* is considered now as a synonym of *Paracapoeta barrioisi* (Lortet, 1894).

[2] According to Fricke *et al.* (2023), *Capoeta trutta* is considered now as a synonym of *Paracapoeta trutta* (Lortet, 1894).

[3] The specific name of *Cyprinion macrostomus* is spelled as *macrostomus* according to Fricke *et al.* (2023), Froese and Pauly (2023) and WoRMS (2023), but as *macrostomum* according to GBIF.org (2023) and Al-Jadoaa (2002) in this article.

[4] Both *C. idella* and *H. molitrix* are considered within the family Xenocyprididae according to Fricke *et al.* (2023) and Froese and Pauly (2023), but to the family Cyprinidae by both GBIF.org (2023) and WoRMS (2023). According to the phylogenetic classification of extant genera of fishes of the order Cypriniformes by Tan and Armbruster (2018), both *Ctenopharyngodon* and *Hypophthalmichthys* belong to the family Xenocyprididae. In all the

concerned Iraqi references in this article, the name of this family was reported as Cyprinidae.

[5] According to Fricke *et al.* (2023), *Periophthalmus waltoni* belongs to the family Oxudercidae but to the family Gobiidae by Fricke *et al.* (2023), GBIF.org (2023) and WoRMS (2023). In addition, its order is considered as Gobiiformes according to Fricke *et al.* (2023), Froese and Pauly (2023) and WoRMS (2023), but the order Perciformes according to GBIF.org (2023).

Localities of Collection of Fishes of Iraq infected with *Neoechino-rhynchus* Species

The record of available literature concerning the occurrence of different *Neoechinorhynchus* species from fishes of Iraq can be grouped into eight major categories according to localities of collection of the infected fishes. These are:

1- Tigris River at Nineveh Province (Fattohy, 1975; Rahemo and Ami., 1991; Mustafa, 2005; Mustafa *et al.*, 2006; Zangana, 2008), Salah Al-Din Province (Abdul-Ameer, 1989; Al-Jawda *et al.*, 2000; Al-Ayash, 2011; Al-Ayash *et al.*, 2011; Al-Tikrity *et al.*, 2012; Al-Jubori, 2013; Saleh, 2016; Abdullah *et al.*, 2017; Hamdan, 2018; Jasim *et al.*, 2018; Taha *et al.*, 2018; Jasim, 2019; Al-Ayash, 2020; Al-Ayash *et al.*, 2021; Jasim, 2022), Kirkuk Province (Rahemo and Nawwab Al-Deen, 2008) and Baghdad Province (Herzog, 1969; Balasem *et al.*, 1993; Al-Moussawi, 1997; Adday *et al.*, 1999; Asmar *et al.*, 2003; Mansor *et al.*, 2012; Atwan, 2016; Rasheed, 2016; Hammood, 2017; Abbas, 2019), Greater Zab River (Rashed and Hussain, 1988; Ali, 1989; Abdullah, 2002; Amin *et al.*, 2003; Abdullah, 2009; Hashim, 2014; Hashim *et al.*, 2015), Lesser Zab River (Rashid *et al.*, 1989; Abdullah, 2002; Rahemo and Nawwab Al-Deen, 2008; Al-Obaidy, 2019; Hathal *et al.*, 2020; Hathal, 2021), Bahdinan River at Erbil Province (Bilal, 2006; Bilal and Abdullah, 2009), Sirwan River at Sulaimaniya Province (Ali, 2020) and Diyala River (Ali *et al.*, 1987; Al-Shaikh *et al.*, 1995; Balasem *et al.*, 2001; Mhaisen *et al.*, 2002; Al-Rubaie *et al.*, 2003; Mohammed, 2017).

2- Euphrates River and its branches at Al-Anbar Province (Herzog, 1969; Al-Alusi, 1998; Al-Sady, 2000; Amin *et al.*, 2001; Al-Sady *et al.*, 2003; Al-Alusi, 2011; Al-Salmany, 2015, 2022), Babylon Province (Al-Sa'adi, 2007; Mhaisen *et al.*, 2015), Al-Diwaniah Province (Al-Jadoaa, 2002; Al-Waaly, 2005; Yassin, 2010; Karawan *et al.*, 2012; Al-Mahi, 2014; Al-Mahi and Al-Mayali, 2016, 2017), Al-Najaf Al-Ashraf Province (Taher *et al.*, 2009), Thi Qar Province (Rahemo and Al-Abbadie, 1994; Al-Abbadie, 2006; Al-Kinanny and

Al-Ubaydi, 2017) and Al-Muthanna Province (Al-Asadiy *et al*., 2012; Al-Helli, 2019).

3- Shatt Al-Arab River (Habash and Daoud, 1979; Al-Hadithi *et al*., 1980; Mhaisen, 1986) Garmat Ali River (Jori, 1998; Abdul-Rahman, 1999; Al-Niaeem, 1999, 2002; Al-Niaeem and Al-Azizz, 2002; Al-Salim and Al-Niaeem, 2002a. b, c; Al-Salim and Jori, 2002; Al-Niaeem, 2006; Al-Salim *et al*., 2007; Al-Saboonchi *et al*., 2009; Al-Janae'e, 2010), Al-Majidiah River (Mehdi, 1989; Al-Hadithi *et al*., 1990; Khudhair *et al*., 1992; Mehdi *et al*., 2009), Al-Salihiya River (Al-Janae'e, 2010), Kuritrad River (Al-Saboonchi *et al*., 2009) and Mehaijeran creek (Khamees, 1983; Mhaisen *et al*., 1986; Khamees and Mhaisen, 1988; Mhaisen *et al*., 1988).

4- Some lakes, depressions and marshes: These included Darbandikhan Lake (Abdullah, 2013, Abdullah and Abdullah, 2015a, b, c), Dokan Lake (Abdullah, 1990; Abdullah and Ali, 1999; Abdullah and Rasheed, 2004; Abdullah, 2009; Ali, 2020), Al-Tharthar Lke (Al-Saadi, 1986; Al-Sady *et al*., 2009), Al-Qadisiya Dam Lake (Al-Alusi, 1989; Asmar *et al*., 1999; Balasem *et al*., 2003), Al-Habbaniyah Lake (Mhaisen *et al*., 1999), Al-Husainia creek in Karbala Province (Al-Saadi, 2007; Al-Saadi *et al*., 2010, 2011), Al-Razzaza Lake in Kerbala Province (Hussain, 2010), Bahr Al-Najaf Depression in Al-Najaf Al-Ashraf Province (Al-Awadi, 1997; Al-Awadi *et al*., 2010), Al-Dalmaj Marsh of Al-Diwaniyah Province (Al-Khenifsawy, 2022; Al-Khenifsawy and Al-Mayli, 2022), Huwazah Marsh at Maysan Province (Al-Musaedi, 2020), Umm an Ni`aj Marsh at Maysan Province (Al-Musaedi and Alsaady, 2022) and Al-Hammar Marsh in Basrah Province (Al-Daraji, 1986; Jori, 2006).

5- Some drainage networks at Baghdad Province (Balasem *et al*., 2002; Asmar *et al*., 2003; Mhaisen *et al*., 2003), Al-Diwaniyah Province (Al-Jadoaa, 2008) and Shatt Al-Basrah Canal (Amin *et al*., 2023).

6- Fish ponds and farms which included some at Kirkuk Province (Al-Obaidy, 2019), Baghdad Province (Mohammad-Ali *et al*., 1999; Al-Nasiri, 2000; Al-Nasiri *et al*., 2003), Babylon Province (Ali and Shaaban, 1984; Ali *et al*., 1989; Al-Zubaidy, 1998; Al-Jadoaa, 2002) and Basrah Province (Al-Niaeem, 2006; Al-Salim *et al*., 2007) in addition to some from floating cages at Basrah Province (Eassa *et al*., 2014).

7- Fish markets at Erbil Province (Abdullah, 2000), Kirkuk Province (Hashim, 2014; Hassan *et al*., 2016), Baghdad Province (Hasan,

2004; Al-Sady, 2009; Hasan *et al*., 2015a, b) and Basrah Province (Mhaisen, 1986).

8- Marine waters of Iraq, which included those from north of Shatt Al-Arab Estuary, near Fao City (Amin *et al*., 2015), Khor Al-Zubair Lagoon (Mhaisen and Al-Maliki, 1996) and Khor Abdullah (Bannai, 2002).

It is reliable to state here that Al-Amura *et al*. (2012) gave no scientific names for the infected fishes with *N. iraqensis*, while their investigating on staining this parasite with red beet (*Beta vulgaris*) extract.

List of *Neoechinorhynchus* Species from Fishes of Iraq

The following is an alphabetical listing of valid species of *Neoechinorhynchus* so far recorded from fish species of Iraq with their authorities according to GBIF.org (2023).

1-*Neoechinorhynchus australis* Van Cleave, 1931
2-*Neoechinorhynchus barbi* Al-Ayash, Gustinelli, Al-Nasiri & Caffara, 2021
3-*Neoechinorhynchus chilkaensis* Podder, 1937
4-*Neoechinorhynchus cristatus* Lynch, 1936
5-*Neoechinorhynchus dimorphospinus* Amin & Sey, 1996
6-*Neoechinorhynchus iraqensis* Amin, Al-Sady, Mhaisen & Bassat, 2001
7-*Neoechinorhynchus macronucleatus* Machado-Filho, 1954
8-*Neoechinorhynchus miniovalis* Amin, Ali & Adday, 2023
9-*Neoechinorhynchus planilizai* Al-Ayash, Gustinelli, Al-Nasiri & Caffara, 2021
10-*Neoechinorhynchus rutili* (Müller, 1780) Hamann, in Stiles & Hassal 1892
11-*Neoechinorhynchus tigrisensis* Al-Ayash, Gustinelli, Al-Nasiri & Caffara, 2021
12-*Neoechinorhynchus zabensis* Amin, Abdullah & Mhaisen, 2003
13-Unidentified *Neoechinorhynchus* species.

***Neoechinorhynchus*-Fish Host List**

The different *Neoechinorhynchus* species infecting fishes of Iraq are here alphabetically arranged. To avoid repetition, the authorities of such parasites are not given here as such authorities are given above. Valid fish host species (and their synonyms when applicable) for each *Neoechinorhynchus* species are alphabetically listed. Concerned references on records from each host species are chronologically arranged. The reference of the first record of each *Neoechinorhynchus* species in Iraq is underlined here.

Neoechinorhynchus australis was reported only from *Planiliza abu* (as *Liza abu*) by Abdul-Rahman (1999) and Al-Salmany (2022).

Neoechinorhynchus barbi was reported from two fish species: *Capoeta damascina* by Al-Ayash (2020) and Al-Ayash *et al.* (2021) and *Planiliza abu* by Al-Salmany (2022).

Neoechinorhynchus chilkaensis was reported from two fish species: *Leuciscus vorax* (as *Aspius vorax*) by Al-Sady *et al.* (2009) and from *Luciobarbus xanthopterus* (as *Barbus xanthopterus*) by Al-Sady *et al.* (2009). This parasite was reported in the above reference as *N. elongates*, which is a synonym of *N. chilkaensis* according to both GBIF.org (2023) and WoRMS (2023).

Neoechinorhynchus cristatus was reported from two fish species: *Capoeta trutta* (also as *Varicorhinus trutta*) by Abdul-Ameer (1989), Zangana (2008) and Al-Jubori (2013) and *Planiliza abu* (as *Liza abu*) by Mohammad-Ali *et al.* (1999), Balasem *et al.* (2003), Al-Saadi (2007), Al-Saadi *et al.* (2010, 2011), Al-Jubori (2013) and Hammood (2017). In addition, this species was reported from unspecified host by Mansor *et al.* (2012).

Neoechinorhynchus dimorphospinus was reported from three mugilid species: *Planiliza abu* (as *Liza abu*) by Abdul-Rahman (1999), *Planiliza klunzingeri* (as *Liza klunzingeri*) by Amin *et al.* (2015) and *Planiliza subviridis* (as *Liza subviridis*) by Bannai (2002).

Neoechinorhynchus iraqensis was erroneously identified as *Neoechinorhynchus agilis* (Rud., 1819) for the first time in Iraq by Habash and Daoud (1979). The following is a list of the 25 host species of *N. iraqensis* together with its records as *N. agilis* (which are shown here by an asterisk above the concerned mention as *N. agilis*): *Acanthobrama marmid* by Al-Janae'e (2010), *Acanthopagrus arabicus* (as *Acantho-pagrus latus*) by Al-Janae'e (2010), *Alburnus caeruleus* by Al-Saadi (1986)*, *Alburnus sellal* (as *Alburnus mossulensis* by Al-Janae'e, and as *Chalcalburnus sellal* by Abdul-Rahman, 1999) by Abdul-Rahman (1999)* and Al-Janae'e (2010), *Arabibarbus grypus* (as *Barbus grypus*) by Al-Janae'e (2010), Al-Mahi (2014) and Al-Mahi and Al-Mayali (2016, 2017), *Brachirus orientalis* (as *Euryglossa orientalis*) by Al-Janae'e (2010), *Carasobarbus luteus* (as *Barbus luteus*) by Khamees (1983)*, Mhaisen *et al.* (1986)*, Khamees and Mhaisen (1988)*, Abdul-Rahman (1999)*, Al-Jadoaa (2002), Al-Waaly (2005) and Al-Janae'e (2010), *Carassius auratus* by Al-Janae'e (2010), *Carassius carassius* by Abdul-Rahman (1999)*, *Ctenopharyngodon idella* by Abdul-Rahman (1999)*, *Cyprinion kais* by Jasim (2022), *Cyprinion macrostomus* by Al-

Jadoaa (2002), *Cyprinus carpio* by Al-Zubaidy (1998)*, Abdul-Rahman (1999)*, Al-Niaeem (2006), Al-Salim *et al.* (2007), Al-Janae'e (2010), Eassa *et al.* (2014), Hussain (2010)* and Jasim (2019, 2022), *Gambusia holbrooki* (as *Gambusia affinis*) by Al-Niaeem (2006) and Al-Salim *et al.* (2007), *Heteropneustes fossilis* by Abdul-Rahman (1999)*, *Leuciscus vorax* (also as *Aspius vorax*) by Al-Alusi (1989)*, Abdul-Rahman (1999)*, Al-Saadi (2007), Al-Janae'e (2010), Al-Saadi *et al.* (2010), Al-Alusi (2011), Saleh (2016) and Abdullah *et al.* (2017), *Luciobarbus xanthopterus* (as *Barbus xanthopterus*) by Al-Awadi (1997)* and Al-Awadi *et al.* (2010), *Mastacembelus mastacembelus* by Abdul-Rahman (1999)* and Hammood (2017), *Mesopotamichthys sharpeyi* (as *Barbus sharpeyi*) by Abdul-Rahman (1999)* and Al-Niaeem and Al-Azizz (2002), *Mystus pelusius* by Abdul-Rahman (1999)*, *Planiliza abu* (also as *Liza abu* and *M. hishni*) by Habash and Daoud (1979)*, Al-Hadithi *et al.* (1980)*, Khamees (1983)*, Ali and Shaaban (1984)*, Al-Daraji (1986)*, Al-Saadi (1986)*, Mhaisen (1986)*, Mhaisen *et al.* (1986)*, Ali *et al.* (1987)*, Mhaisen *et al.* (1988)*, Abdul-Ameer (1989)*, Al-Alusi (1989)*, Ali *et al.* (1989)*, Mehdi (1989)*, Al-Hadithi *et al.* (1990)*, Khudhair *et al.* (1992)*, Balasem *et al.* (1993)*, Al-Shaikh *et al.* (1995)*, Al-Awadi (1997)*, Al-Alusi (1998)*, Jori (1998)*, Abdul-Rahman (1999)*, Adday *et al.* (1999)*, Al-Niaeem (1999)*, Asmar *et al.* (1999)*, Mhaisen *et al.* (1999)*, Mohammad-Ali *et al.* (1999)*, Al-Jawda *et al.* (2000)*, Al-Sady (2000), Al-Nasiri (2000), Amin *et al.* (2001), Abdullah (2002), Al-Jadoaa (2002), Al-Niaeem (2002)*, Al-Salim and Al-Niaeem (2002a, b, c)*, Al-Salim and Jori (2002)*, Balasem *et al.* (2002)*, Mhaisen *et al.* (2002), Al-Nasiri *et al.* (2003), Al-Rubaie *et al.* (2003), Al-Sady *et al.* (2003), Asmar *et al.* (2003), Balasem *et al.* (2003), Mhaisen *et al.* (2003), Hasan (2004), Mustafa (2005), Al-Niaeem (2006), Mustafa *et al.* (2006), Al-Saadi (2007), Al-Sa'adi (2007), Al-Salim *et al.* (2007), Al-Jadoaa (2008) as *N. aglis* in the table and as *N. iraqensis* in the remaining text, Rahemo and Nawwab Al-Deen (2008), Al-Sady (2009), Mehdi *et al.* (2009)*, Taher *et al.* (2009), Al-Awadi *et al.* (2010), Al-Janae'e (2010), Al-Saadi *et al.* (2010), Al-Ayash (2011), Al-Ayash *et al.* (2011), Al-Saadi *et al.* (2011), Al-Asadiy *et al.* (2012), Al-Tikrity *et al.* (2012), Karawan *et al.* (2012), Mansor *et al.* (2012) p.35, Al-Jubori (2013), Al-Mahi (2014), Hashim (2014), Al-Salmany (2015), Hasan *et al.* (2015a, b), Hashim *et al.* (2015), Mhaisen *et al.* (2015), Al-Mahi and Al-Mayali (2016), Atwan (2016), Hassan *et al.* (2016), Rasheed (2016), Saleh (2016), Abdullah *et al.*

(2017), Al-Kinanny and Al-Ubaydi (2017), Al-Mahi and Al-Mayali (2017), Hammood (2017), Mohammed (2017), Hamdan (2018), Taha *et al*. (2018), Al-Helli (2019), Ali (2020), Al-Musaedi (2020), Al-Khenifsawy (2022), Al-Khenifsawy and Al-Mayli (2022), Al-Musaedi and Alsaady (2022) and Al-Salmany (2022), *Planiliza subviridis* (as *Liza subviridis*) by Abdul-Rahman (1999)* and Al-Janae'e (2010), *Poecilia latipinna* by Al-Janae'e (2010), *Silurus triostegus* by Abdul-Rahman (1999)*, Jori (2006), Al-Janae'e (2010), Hashim (2014), Hashim *et al*. (2015), Al-Ayash (2020), Al-Musaedi (2020) and Al-Musaedi and Alsaady (2022) in addition to Unspecified host by Al-Amura *et al*. (2012) and Mansor *et al*. (2012).

Neoechinorhynchus macronucleatus was reported only from *Planiliza abu* (as *Liza abu*) by Abdul-Rahman (1999).

Neoechinorhynchus miniovalis was reported only from the intestine of *Boleophthalmus dussumieri* by Amin *et al*. (2023).

Neoechinorhynchus planilizai was reported from two fish species: *Planiliza abu* by Al-Ayash (2020), who erroneously reported it as *N. lizai* and Al-Ayash *et al*. (2021) and from *Silurus triostegus* by Al-Ayash (2020) and Al-Ayash *et al*. (2021).

Neoechinorhynchus rutili was reported from 16 fish species. These were: *Arabibarbus grypus* (as *Barbus grypus*) by Al-Moussawi (1997), *Capoeta barroisi* (as *Varicorhinus barroisi*) by Al-Alusi (1989), *Capoeta damascina* (as *Barbus belayewi*) by Ali *et al*. (1987), *Capoeta trutta* (as *Varicorhinus trutta*) by Fattohy (1975), Abdul-Ameer (1989), Rahemo and Ami (1991), Rahemo and Nawwab Al-Deen (2008) and Zangana (2008), *Carasobarbus luteus* (as *Barbus luteus*) by Al-Jadoaa (2002) and Rahemo and Nawwab Al-Deen (2008), *Chondrostoma regium* by Rahemo and Nawwab Al-Deen (2008), *Ctenopharyngodon idella* by Al-Jadoaa (2002), *Cyprinus carpio* by Al-Zubaidy (1998), Abdul-Rahman (1999), Al-Jadoaa (2002), Rahemo and Nawwab Al-Deen (2008) and Yassin (2010), *Heteropneustes fossilis* by Abdul-Rahman (1999), *Hypophthalmichthys molitrix* by Al-Jadoaa (2002), *Leuciscus vorax* (as *Aspius vorax*) by Abdul-Rahman (1999), Al-Saadi (2007), Al-Saadi *et al*. (2010) and Al-Alusi (2011), *Luciobarbus esocinus* (as *Barbus esocinus*) by Rashed and Hussian (1988), Ali (1989), Rashid *et al*. (1989), Abdullah (1990), Abdullah and Ali (1999), Abdullah (2000) and Abdullah and Rasheed (2004), *Luciobarbus xanthopterus* (as *Barbus xanthopterus*) by Herzog (1969), Al-Jadoaa (2002), Al-Abbadie (2006) and Al-Alusi (2011), *Mastacembelus mastacembelus* by Abdul-Rahman (1999), *Planiliza abu* (also as *Liza abu* and *Mugul*

abu) by Herzog (1969), Rahemo and Al-Abbadie (1994), Abdul-Rahman (1999), Al-Sady (2000), Balasem *et al*. (2001), Al-Jadoaa (2002), Balasem *et al*. (2002), Asmar *et al*. (2003), Al-Abbadie (2006), Al-Saadi (2007), Al-Saadi *et al*. (2010), Yassin (2010), Al-Saadi *et al*. (2011), Rasheed (2016), Abbas (2019), Al-Khenifsawy (2022) and Al-Khenifsawy and Al-Mayli (2022) and from *Silurus triostegus* by Abdul-Rahman (1999).

Neoechinorhynchus tigrisensis was reported from two fish species: *Chondrostoma regium* and *Leuciscus vorax* both by Al-Ayash (2020) and Al-Ayash *et al*. (2021).

Neoechinorhynchus zabensis was reported from 12 fish species: *Acanthobrama marmid* by Jasim (2022), *Arabibarbus grypus* by Jasim *et al*. (2018), *Capoeta damascina* (also as *Barbus belayewi*) by Amin *et al*. (2003), Abdullah (2009), Al-Ayash (2011), Al-Ayash *et al*. (2011), Al-Tikrity *et al*. (2012), Hashim (2014), Hashim *et al*. (2015) and Hassan *et al*. (2016), *Capoeta trutta* (also as *Varicorhinus trutta*) by Amin *et al*. (2003), Bilal (2006), Zangana (2008), Abdullah (2009), Bilal and Abdullah (2009), Abdullah (2013), Al-Jubori (2013), Abdullah and Abdullah (2015a, b, c) and Ali (2020), *Capoeta umbla* (as *Varicorhinus umbla*) by Bilal (2006) and Bilal and Abdullah (2009), *Carasobarbus luteus* (also as *Barbus luteus*) by Jasim *et al*. (2018) and Al-Obaidy (2019), *Carassius auratus* by Al-Ayash (2011) and Al-Ayash *et al*. (2011), *Cyprinus carpio* by Al-Obaidy (2019), *Luciobarbus xanthopterus* (also as *Barbus xanthopterus*) by Al-Obaidy (2019), Hathal *et al*. (2020) and Hathal (2021), *Mesopotamichthys sharpeyi* (as *Barbus sharpeyi*) by Al-Obaidy (2019), *Planiliza abu* (as *Liza abu*) by Al-Ayash (2011), Al-Ayash *et al*. (2011), Al-Tikrity *et al*. (2012), Al-Jubori (2013), Al-Salmany (2015) and Al-Ayash (2020) and from *Silurus triostegus* by Al-Ayash (2011), Al-Ayash *et al*. (2011), Hathal *et al*. (2020) and Hathal (2021).

Unidentified *Neoechinorhynchus* species were reported from three fish species: *Cyprinus carpio* by Al-Saboonchi *et al*. (2009), *Periophthalmus waltoni* by Mhaisen and Al-Maliki (1996) and *Silurus triostegus* by Rahemo and Ami (1991).

Finally, according to Amin *et al*. (2001), it is appropriate to mention that here that the marine *Neoechinorhynchus agilis* (Rud., 1819) Van Cleave, 1916, erroneously identified for the first time in Iraq by Habash and Daoud (1979), is considered as *N. iraqensis*. Also, *Neoechinorhynchus elongatus* Tripathi, 1956 was considered as a synonym of *Neoechinorhynchus chilkaensis* Podder, 1937 according to both GBIF.org (2023) and WoRMS (2023).

Host-Parasite List

The following list of infected fishes with *Neoechinorhynchus* species is alphabetically listed. For each fish species, names of *Neoechinorhynchus* species are also alphabetically listed.

Acanthobrama marmid: *Neoechinorhynchus iraqensis*, *N. zabensis*.
Acanthopagrus arabicus: *Neoechinorhynchus iraqensis*.
Alburnus caeruleus: *Neoechinorhynchus iraqensis*.
Alburnus sellal: *Neoechinorhynchus iraqensis*.
Arabibarbus grypus: *Neoechinorhynchus iraqensis*, *N. rutili*, *N. zabensis*.
Boleophthalmus dussumieri: *Neoechinorhynchus miniovalis*.
Brachirus orientalis: *Neoechinorhynchus iraqensis*.
Capoeta barroisi: *Neoechinorhynchus rutili*.
Capoeta damascina: *Neoechinorhynchus barbi*, *N. rutili*, *N. zabensis*.
Capoeta trutta: *Neoechinorhynchus cristatus*, *N. rutili*, *N. zabensis*.
Capoeta umbla: *Neoechinorhynchus zabensis*.
Carasobarbus luteus: *Neoechinorhynchus iraqensis*, *N. rutili*, *N. zabensis*.
Carassius auratus: *Neoechinorhynchus iraqensis*, *N. zabensis*.
Carassius carassius: *Neoechinorhynchus iraqensis*.
Chondrostoma regium: *Neoechinorhynchus rutili*, *N. tigrisensis*.
Ctenopharyngodon idella: *Neoechinorhynchus iraqensis*, *N. rutili*.
Cyprinion kais: *Neoechinorhynchus iraqensis*.
Cyprinion macrostomus: *Neoechinorhynchus iraqensis*.
Cyprinus carpio: *Neoechinorhynchus iraqensis*, *N. rutili*, *N. zabensis*, *Neoechinorhynchus* sp.
Gambusia holbrooki: *Neoechinorhynchus iraqensis*.
Heteropneustes fossilis: *Neoechinorhynchus iraqensis*, *N. rutili*.
Hypophthalmichthys molitrix: *Neoechinorhynchus rutili*.
Leuciscus vorax: *Neoechinorhynchus chilkaensis*, *N. iraqensis*, *N. rutili*, *N. tigrisensis*.
Luciobarbus esocinus: *Neoechinorhynchus rutili*.
Luciobarbus xanthopterus: *Neoechinorhynchus chilkaensis*, *N. iraqensis*, *N. rutili*, *N. zabensis*.
Mastacembelus mastacembelus: *Neoechinorhynchus iraqensis*, *N. rutili*.
Mesopotamichthys sharpeyi: *Neoechinorhynchus iraqensis*, *N. zabensis*.
Mystus pelusius: *Neoechinorhynchus iraqensis*.
Periophthalmus waltoni: *Neoechinorhynchus* sp.

Planiliza abu: *Neoechinorhynchus australis*, *N. barbi*, *N. cristatus*, *N. dimorphospinus*, *N. iraqensis*, *N. macronucleatus*, *N. planilizai*, *N. rutili*, *N. tigrisensis*, *N. zabensis*.
Planiliza klunzingeri: *Neoechinorhynchus dimorphospinus*.
Planiliza subviridis: *Neoechinorhynchus dimorphospinus*, *N. iraqensis*.
Poecilia latipinna: *Neoechinorhynchus iraqensis*.
Silurus triostegus: *Neoechinorhynchus iraqensis*, *N. planilizai*, *N. rutili*, *N. zabensis*, *Neoechinorhynchus* sp.
Unspecified host: *Neoechinorhynchus cristatus*, *N. iraqensis*.

It is apparent from the above list that the three fish farm species (*C. idella*, *C. carpio* and *H. molitrix*), although abundant in different fish farms in Iraq, but they were infected with only two, four and two *Neoechinorhynchus* species, respectively, while some wild fishes like *P. abu* and *S. triostegus* were infected with ten and five *Neoechinorhynchus* species, respectively. As demonstrated by Mhaisen (1993), the occurrence of *Neoechinorhynchus* species in farm fishes of Iraq comes as a result of the entrance of some wild fishes, especially *P. abu* and *S. triostegus*, to fish ponds via the inlet water. As *P. abu* is so abundant in different water bodies of Iraq and easy to catch, hence 102 out of 145 Iraqi references in this article were concerned with *Neoechinorhynchus* species from this fish alone.

Acknowledgements

Thanks are due to Dr. Hayder Ali Al-Hasson of Basrah Education Directorate, Iraq for his help in providing the figure of this article. Sincere thanks are due to Dr. Atheer H. Ali for forwarding his correspondence with Jörg Freyhof of Leibniz Institute for Evolution and Biodiversity Science, Berlin for ascertaining the specific name of the fish *C. macrostomum* as *C. macrostomus*.

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قوائم مرجعية لأنواع الأسماك المصابة بطفيليات الجنس *Neoechinorhynchus* Stiles & Hassall, 1905 (شوكية الرأس: عائلة نيوأكينورنجدي) المسجلة في العراق

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تاريخ الاستلام: 2023/09/27 تاريخ القبول: 2023/11/07 تاريخ النشر: 2024/06/25

المستخلص

أظهر مسح 145 مصدرا معنيا بظهور الديدان شوكية الرأس العائدة للجنس *Neoechinorhynchus* المتطفلة في الأسماك في العراق، وجود 12 نوعا مشخّصا من هذا الجنس بالإضافة لبعض الأنواع غير المشخّصة من هذا الجنس تصيب 34 نوعا من الأسماك. توزعت الإصابات في أسماك من أنهار دجلة، الفرات وشط العرب وبعض روافدها، كذلك بعض البحيرات، الأهوار، المنخفضات، شبكات البزل، العديد من أحواض الأسماك والأقفاص العائمة في مختلف أنحاء العراق، فضلا عن المياه الإقليمية البحرية في الخليج العربي. من بين الأسماك المصابة، كانت أسماك الخشني مصابة بأعلى عدد من أنواع الجنس *Neoechinorhynchus* (عشرة أنواع من الطفيليات)، أعقبتها أسماك الجري الآسيوي (خمسة أنواع من الطفيليات) في حين كان 16 نوعا من هذه الأسماك كل منها مصاب فقط بنوع واحد من الجنس *Neoechinorhynchus*. من بين هذه الديدان شوكية الرأس، كان النوع *N. iraqensis* قد أصاب ما مجموعه 25 نوعا مختلفا من الأسماك، أعقبه النوع *N. rutili* (16 نوعا من الأسماك)، في حين تبيّن أن كل من النوع *N. australis* والنوع *N. macronucleatus* والنوع *N. miniovalis* قد حصلت إصابة كل منها لنوع واحد فقط من الأسماك.

الكلمات المفتاحية: شوكية الرأس، الجنس *Neoechinorhynchus*، الأسماك، العراق.

P-ISSN: 1812-237X, E-ISSN: 2788-5720, https://ijaqua.uobasrah.edu.iq/index.pip/iaqua