Checklists of Fish Species Infected with Species of the Genus *Clinostomum* Leidy, 1856 (Platyhelminthes: Trematoda), the Causative Agents of the Yellow Grub Disease, in Iraq

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Abstract

A survey of 60 references concerning the occurrence of species of the trematode genus *Clinostomum* Leidy, 1856 parasitizing freshwater fishes and one marine fish of Iraq indicated that there are three identified species of this genus: *C. complanatum*, *C. dasi* and *C. tilapiae* as well as some unidentified species of this genus infecting 29 fish species. The infections were distributed mainly in fishes from different inland water bodies as well as in two fishponds in Baghdad and Babylon provinces. Among the infected fishes, *Carasobarbus luteus*, *Coptodon zillii*, *Cyprinus carpio* and *Heteropneustes fossilis* were infected with the highest number of *Clinostomum* species (two parasite species each), while the remaining fish species were each infected with only *C. complanatum*. Among such trematodes, *C. complanatum* was infecting all 29 fish species, followed by *C. dasi* and *C. tilapiae*, which infected two and one fish species, respectively.

Keywords: Trematoda, *Clinostomum*, Fishes, Distribution, Iraq.

Introduction

According to both GBIF.org (2024) and WoRMS (2025), the genus *Clinostomum* Leidy, 1856 belongs to the family Clinostomidae, order Diplostomida, class Trematoda of the phylum Platyhelminthes. This genus includes 65 valid species (GBIF.org, 2024), while WoRMS (2025) included only 61 valid species.

Platyhelminths belonging to the family Clinostomidae (Digenea) have a worldwide distribution and are known to infect piscivorous birds through their intermediate hosts, usually fish species (Choudhary *et al.*, 2022). They demonstrated the characterization of *Clinostomum* species from two fish species (*Channa punctata* and *Trichogaster fasciata*) and one bird species (*Bubulcus ibis*) in India. Maleki *et al.* (2018) identified the metacercariae of *C. complanatum* from four fish species from Gheshlagh basin, West of Iran by using molecular, Internal Transcribed Spacer (ITS), Scanning Electron Microscope (SEM) and morphological analysis. Lo *et al.* (1981) gave a full description, measurements and illustrations of the different life cycle stages of *C. complanatum* in the first intermediate host, the snail (*Radix auricularia*), the second intermediate host,

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the ayu sweetfish (*Plecoglossus altivelis*) and the final host, the aquatic heron birds (*Egretta garzetta* and *Nycticorax nycticorax*) in Taiwan, while Dias *et al.* (2003) demonstrated the life cycle of *C. complanatum* in Brazil. Kanev *et al.* (2002) elucidated that members of the Clinostomidae are adults parasitize the buccal cavity or oesophagus of birds, reptiles and mammals including humans. The first larval stage lives in gastropods and the second larval stage (metacercaria) encysts in the muscles, abdominal cavity, fins and gill cavity of freshwater fishes and amphibians (Figure 1).

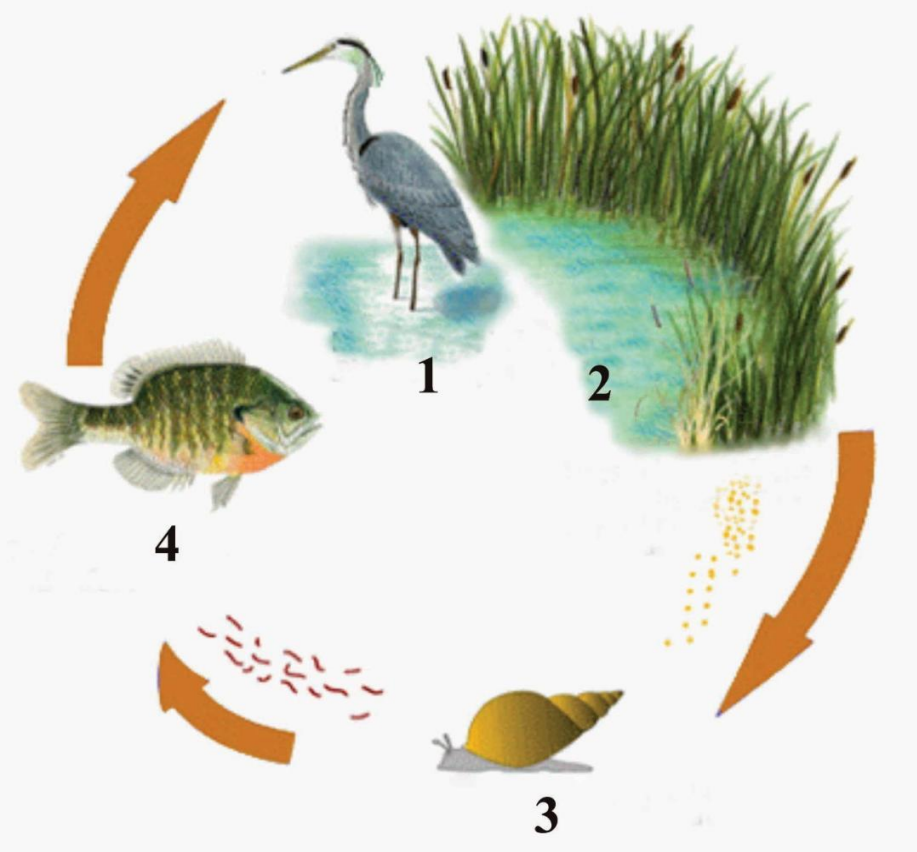

Figure 1: Life cycle of the yellow grub (Illustration courtesy North Central Regional Aquaculture Center, Iowa State University). 1- Birds ingest infected fish and develop adult worm, 2- Eggs released from adult flukes living in birds, 3- Eggs hatch into miracidia and infect snails, 4- Cercariae exit snails and infect fishes Kanev *et al.* (2002).

Micromorphology, oxidative stress, immunology and histopathology of *C. complanatum* in Nile tilapia (*Oreochromis niloticus*) were achieved by Mahdy *et al.* (2024). The inflammatory response in all organs of *Trigonectes aplocheiloides* and *Austrolebias monstrosus* (both of the family Rivulidae) showed dilated, congested vascular areas and infiltration of numerous inflammatory cells, mainly composed of lymphocytes, eosinophilic granular cells and macrophages (Di Cesare *et al.*, 2024).

C. complanatum (Rudolphi, 1814) Braun, 1899 is a fish-borne zoonotic parasite known to cause Halzoun syndrome, a rare condition transmitted through the consumption of raw or undercooked freshwater fish infected with *Clinostomum* (Park *et al.*, 2009). Sutili *et al.* (2014) published a review on the involvement of *C. complanatum* with zoonotic potential in southern Brazil.

In Iraq, Khamees (1983) was the first one to report the first *Clinostomum complanatum* from both *Carasobarbus luteus* and *Aspius vorax* (= *Leuciscus vorax*) from Mehaijeran Creek, one of the branches of Shatt Al-Arab River in Basrah. After that, this species was reported from other 27 fish species from different inland waters of Iraq. *C. dasi* was reported for the first time in Iraq by Ali *et al.* (1986) from *Heteropneustes fossilis* from Diyala River and then only from *C. luteus* by Al-Nasiri (2000) from a man-made lake, northwest of Baghdad City, while *C. tilapiae* (Ukoli, 1966) was reported from *Coptodon zillii* by Al-Maliki *et al.* (2015) from Tigris River, north of Qurna City, with no more other hosts in Iraq. In addition, an unidentified *Clinostomum* species was reported from *C. carpio* by Al-Saboonchi *et al.* (2009) from Garmat Ali River and Kuritrad River in Basrah.

The present article aims to revise all records on *Clinostomum* species from fishes of Iraq and provide updated lists of them and their host species. This article is a continuation of checklists, published during the last four years on some groups of fish parasites in Iraq. These included those on parasites of the redbelly tilapia *Coptodon zillii* (Mhaisen, 2021), *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 both *Lamproglena* and *Pseudolamproglena* (Mhaisen *et al.*, 2024).

Sources and Methods

Depending on the Index-Catalogue of parasites and disease agents of fishes of Iraq (Mhaisen, 2024b), a total of 60 references (30 published research papers, 18 unpublished M. Sc. theses, eight unpublished Ph. D. theses and four abstracts) dealing with records on *Clinostomum* 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 of Iraq as well as the fish- parasite list. Fish valid scientific names and their authorities were corrected according to Fricke *et al.* (2025), Froese and Pauly (2024) and GBIF.org (2024). For each alphabetically listed *Clinostomum* species, valid fish host species are also alphabetically arranged together with their synonyms (if any) and their chronologically arranged references. The reference of the first record of each *Clinostomum* species in Iraq is underlined here.

Results and Discussion

List of Fish Species Infected with *Clinostomum* Species in Iraq

The following list includes the scientific names of all Iraqi fish species infected with *Clinostomum* species, their full authorities as well as their orders and families, based on Fricke *et al*. (2025) and Froese and Pauly (2024).

Class Actinopteri
Order Cypriniformes
Family Cyprinidae
Arabibarbus grypus (Heckel, 1843)
Capoeta umbla (Heckel, 1843)
Carasobarbus kosswigi (Ladiges, 1960)
Carasobarbus luteus (Heckel, 1843)
Carassius auratus (Linnaeus, 1758)
Cyprinion kais Heckel, 1843
Cyprinion macrostomus Heckel, 1843[1]
Cyprinus carpio Linnaeus, 1758
Garra rufa (Heckel, 1843)
Luciobarbus esocinus Heckel, 1843
Luciobarbus xanthopterus Heckel, 1843
Paracapoeta trutta (Heckel, 1843) (as *Capoeta trutta*)[2]
Family Leuciscidae
Acanthobrama marmid Heckel, 1843
Alburnus caeruleus Heckel, 1843
Alburnus sellal Heckel, 1843[3]
Chondrostoma regium (Heckel, 1843)
Leuciscus vorax (Heckel, 1843)
Squalius lepidus Heckel, 1843
Order Siluriformes
Family Bagridae
Mystus pelusius (Solander, 1794)
Family Sisoridae
Glyptothorax kurdistanicus (Berg, 1931)
Family Siluridae
Silurus triostegus Heckel, 1843
Family Heteropneustidae
Heteropneustes fossilis (Bloch, 1794)
Order Synbranchiformes
Family Mastacembelidae
Mastacembelus mastacembelus (Banks & Solander, 1794)
Order Cichliformes
Family Cichlidae
Coptodon zillii (Gervais, 1848)

Order Cyprinodontiformes
Family Aphaniidae
Aphaniops stoliczkanus (Day, 1872)
Family Poeciliidae
Gambusia holbrooki Girard, 1859
Poecilia latipinna (Lesueur 1821)
Order Mugiliformes
Family Mugilidae
Planiliza abu (Heckel, 1843)
Planiliza subviridis (Valenciennes, 1836)

1- The specific name of *Cyprinion macrostomus* is spelled as *macrostomus* according to Fricke *et al.* (2025) and Froese and Pauly (2024), but as *macrostomum* according to GBIF.org (2024).
2- According to Fricke *et al.* (2025), *Capoeta trutta* is considered now as a synonym of *Paracapoeta trutta* (Heckel, 1843).
3- According to Fricke *et al.* (2025), *A. sellal* is considered as a valid name, while *A. mossulensis* as one of its synonymous names. However, in both Froese and Pauly (2024) and GBIF.org (2024), both *A. sellal* and *A. mossulensis* are regarded as valid species.

Localities of Collection of the Infected Fishes of Iraq

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

1- Tigris River at Nineveh Province (Mohammad *et al.*, 2000; Al-Salihi, 2002), Salah Al-Din Province (Al-Jubori, 2013) and Baghdad Province (Ali *et al.*, 1987b; Al-Jawda and Asmar, 2015; Bdair, 2018; Bdair and Al-Rudainy, 2018) as well as some tributaries of Tigris River which included Greater Zab River (Ali, 1989; Abdullah, 2002; Bashê, 2008; Abdullah and Mhaisen, 2010; Bashê and Abdullah, 2010a, b; Abdullah and Mhaisen, 2011; Abdullah *et al.*, 2017, 2018, 2019), Lesser Zab River (Abdullah *et al.*, 2023), Bahdinan River at Erbil Province (Bilal, 2006; Bilal and Abdullah, 2009), Sirwan River at Sulaimaniya Province (Abdullah *et al.*, 2023), watersheds of Sharbazher at Sulaimaniya Province (Abdullah *et al.*, 2017, 2018), Diyala River (Ali *et al.*, 1986, 1987a) and Tigris River north of Qurna (Al-Maliki *et al.*, 2015).
2- Euphrates River and its branches at Al-Anbar Province at Karbala Province (Al-Saadi, 2007; Al-Saadi *et al.*, 2010, 2011), Al-Diwaniah Province (Al-Jadoaa, 2002), Thi Qar Province (Al-Kinanny and Al-Ubaydi, 2017) and Al-Muthanna Province (Al-Helli, 2019).

3- Shatt Al-Arab River: (Mhaisen, 1986; Ali, 2001) and some of its branches at Basrah Province which included Garmat Ali River (Al-Ali, 1998; Jori, 1998; Abdul-Rahman, 1999; Al-Salim and Al-Ali, 2000; Al-Niaeem, 2006; Al-Saboonchi *et al.*, 2009; Al-Janae'e, 2010), Al-Majidiah River (Mehdi, 1989), Al-Salihiya River (Al-Janae'e, 2010), Kuritrad River (Al-Saboonchi *et al.*, 2009) and Mehaijeran Creek (Khamees, 1983; Mhaisen *et al.*, 1986).
4- Some lakes, depressions and marshes: These included Darbandikhan Lake (Abdullah, 2013, Abdullah and Abdullah, 2015a, b, c), Dokan Lake (Abdullah, 1990; Abdullah and Rasheed, 2004), Hemrin Dam Lake in Diyala Province (Al-Jawda and Ali, 2020), Bahr Al-Najaf depression in Al-Najaf Al-Ashraf Province (Al-Awadi, 1997; Al-Awadi *et al.*, 2010), Ibn-Najim Marsh in Al-Najaf Al-Ashraf Province (Al-Azebawe, 2010; Hamadi *et al.*, 2011) Huwayzah Marsh at Maysan Province (Al-Musaedi, 2020) and Al-Hammar Marsh in Basrah Province (Mohamad, 1989; Al-Salim and Mohamad, 1993a, b, 1995; Jori, 2006).
5- Fish ponds and farms which included some in Baghdad Province (Al-Nasiri, 2000) and Babylon Province (Al-Jadoaa, 2002).
6- Fish markets at Basrah Province (Mhaisen, 1986).

List of *Clinostomum* Species from Fishes of Iraq

The following is an alphabetical listing of valid species of *Clinostomum* so far recorded from fish species of Iraq with their authorities according to GBIF.org (2024).
Clinostomum complanatum (Rudolphi, 1814) Braun, 1899 {29}
Clinostomum dasi Bhalerao, 1942 {2}
Clinostomum tilapiae Ukoli, 1966 {1}
Clinostomum sp. {1}

Clinostomum Species- Host List

The following is an alphabetically arranged list of fish species so far known as hosts for *Clinostomum* species in Iraq with their concerned references. Fish synonymous names (when applicable) are given in parentheses, after the valid names. For each fish host, concerned references are chronologically arranged and the reference of the first record of each *Clinostomum* species in Iraq is underlined here.

Clinostomum complanatum: This parasite was reported from 29 fish species. These were: *Acanthobrama marmid* by Al-Janae'e (2010), *Alburnus caeruleus* by Bdair (2018) and Bdair and Al-Rudainy (2018), *Alburnus sellal* (as *Alburnus mossulensis* by Al-Janae'e, 2010 and *Chalcalburnus sellal* by Abdul-Rahman, 1999) by Abdul-Rahman (1999), Al-Janae'e (2010), Al-Jawda and Ali (2020) and Abdullah *et al.* (2023), *Aphaniops stoliczkanus* (misidentified as *Aphanius dispar*) by Mhaisen (1986), Al-Awadi (1997) and Al-Awadi *et al.* (2010), *Arabibarbus grypus* by Bdair (2018) and Bdair and Al-Rudainy (2018), *Capoeta umbla* (also as *Varicorhinus umbla*) by Abdullah (2002), Abdullah and Mhaisen (2010, 2011), Abdullah (2013), Abdullah and Abdullah (2015a, 2015b, 2015c) and Abdullah *et al.* (2023), *Carasobarbus kosswigi* by Abdullah

et al. (2023), *Carasobarbus luteus* (also as *Barbus luteus*) by Khamees (1983), Mhaisen (1986), Mhaisen *et al.* (1986), Ali (1989), Al-Awadi (1997), Al-Ali (1998), Abdul-Rahman (1999), Al-Nasiri (2000), Al-Salim and Al-Ali (2000), Mohammad *et al.* (2000), Abdullah (2002), Al-Salihi (2002), Al-Saadi (2007), Abdullah and Mhaisen (2010), Al-Awadi *et al.* (2010), Al-Saadi *et al.* (2010), Abdullah and Mhaisen (2011), Abdullah (2013), Abdullah and Abdullah (2015a, 2015b, 2015c), Al-Jawda and Asmar (2015), Bdair (2018), Bdair and Al-Rudainy (2018), Al-Jawda and Ali (2020) and Al-Musaedi (2020), *Carassius auratus* by Al-Azebawe (2010), Al-Janae'e (2010), Bdair (2018), Bdair and Al-Rudainy (2018) and Al-Jawda and Ali (2020), *Chondrostoma regium* by Bdair (2018), Bdair and Al-Rudainy (2018) and Al-Jawda and Ali (2020), *Coptodon zillii* (as *Tilapia zillii*) by Al-Azebawe (2010), Hamadi *et al.* (2011) and Al-Maliki *et al.* (2015), *Cyprinion kais* by Al-Azebawe (2010) and Al-Jawda and Ali (2020), *Cyprinion macrostomus* (misspelled as *C. macrostomum*) by Abdullah (2002), Bilal (2006), Bilal and Abdullah (2009), Abdullah and Mhaisen (2010), Al-Azebawe (2010), Abdullah and Mhaisen (2011), Al-Jubori (2013) and Abdullah *et al.* (2023), *Cyprinus carpio* by Abdul-Rahman (1999), Al-Jadoaa (2002), Al-Niaeem (2006) and Al-Jawda and Ali (2020), *Gambusia holbrooki* (as *Gambusia affinis*) by Mhaisen (1986), Al-Awadi (1997) and Al-Awadi *et al.* (2010), *Garra rufa* by Al-Jawda and Ali (2020) and Abdullah *et al.* (2023), *Glyptothorax kurdistanicus* by Abdullah *et al.* (2017, 2018, 2019), *Heteropneustes fossilis* by Mhaisen (1986), Mohamad (1989), Al-Salim and Mohamad (1993a, 1993b, 1995), Al-Awadi (1997), Abdul-Rahman (1999), Ali (2001), Al-Awadi *et al.* (2010) and Al-Jawda and Ali (2020), *Leuciscus vorax* (also as *Aspius vorax*) by Khamees (1983), Mhaisen (1986), Mhaisen *et al.* (1986), Abdul-Rahman (1999), Bdair (2018), Bdair and Al-Rudainy (2018) and Al-Helli (2019), *Luciobarbus esocinus* (as *Barbus esocinus*) by Ali (1989), *Luciobarbus xanthopterus* by Bdair (2018) and Bdair and Al-Rudainy (2018), *Mastacembelus mastacembelus* by Abdul-Rahman (1999), Bashê (2008) and Bashê and Abdullah (2010a, 2010b), *Mystus pelusius* by Abdul-Rahman (1999), *Paracapoeta trutta* (as *Capoeta trutta*) by Abdullah *et al.* (2023), *Planiliza abu* (also as *Liza abu*): Mehdi (1989), Al-Awadi (1997), Jori (1998), Abdul-Rahman (1999), Al-Niaeem (2006), Al-Saadi (2007), Al-Awadi *et al.* (2010), Al-Janae'e (2010), Al-Saadi *et al.* (2010, 2011), Al-Kinanny and Al-Ubaydi (2017), Bdair (2018), Bdair and Al-Rudainy (2018), Al-Jawda and Ali (2020) and Abdullah *et al.* (2023), *Planiliza subviridis* (as *Liza subviridis*) by Jori (1998) and Abdul-Rahman (1999), *Poecilia latipinna* by Al-Janae'e (2010), *Silurus triostegus* by Abdul-Rahman (1999) and Jori (2006), *Squalius lepidus* (as *Leuciscus lepidus*) by Abdullah (1990, 2002), Abdullah and Rasheed (2004), Abdullah and Mhaisen (2010, 2011) and Abdullah *et al.* (2023).

Clinostomum dasi: This parasite was reported from both *Carasobarbus luteus* (as *Barbus luteus*) by Al-Nasiri (2000) and *Heteropneustes fossilis* by Ali *et al.* (1986, 1987a, 1987b) and Ali (2001).

Clinostomum tilapiae: This parasite was reported only from *Coptodon zillii* (as *Tilapia zillii*) by Al-Maliki *et al.* (2015).

Clinostomum sp.: This parasite was reported only from *Cyprinus carpio* by Al-Saboonchi *et al.* (2009).

Finally, it is necessary to mention here that five references (Al-Daraji, 1986; Abbas, 2007; Awad and Abbas, 2009; Kadim, 2009 and Al-Azebawe, 2010), in which *Clinostomum phalacrocoracis* was reported, this species, according to GBIF.org (2004) is considered as a synonym of *Clinostomaopsis intermedialis* (Lamont, 1920) Lunaschi & Drago, 2009. *C. phalacrocoracis* was so far reported from nine fish species in Iraq (Mhaisen, 2024b). Therefore, there is no need to mention such records here, as they are not concerned with species of the *Clinostomum*.

Host-Parasite List

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

Acanthobrama marmid: *Clinostomum complanatum*.
Alburnus caeruleus: *Clinostomum complanatum*.
Alburnus sellal: *Clinostomum complanatum*.
Aphaniops stoliczkanus: *Clinostomum complanatum*.
Arabibarbus grypus: *Clinostomum complanatum*.
Capoeta umbla: *Clinostomum complanatum*.
Carasobarbus kosswigi: *Clinostomum complanatum*.
Carasobarbus luteus: *Clinostomum complanatum*, *C. dasi*.
Carassius auratus: *Clinostomum complanatum*.
Chondrostoma regium: *Clinostomum complanatum*.
Coptodon zillii (as *Tilapia zillii*): *Clinostomum complanatum*, *C. tilapiae*.
Cyprinion kais: *Clinostomum complanatum*.
Cyprinion macrostomus: *Clinostomum complanatum*.
Cyprinus carpio: *Clinostomum complanatum*, *Clinostomum* sp.
Gambusia holbrooki: *Clinostomum complanatum*.
Garra rufa: *Clinostomum complanatum*.
Glyptothorax kurdistanicus: *Clinostomum complanatum*.
Heteropneustes fossilis: *Clinostomum complanatum*, *C. dasi*.
Leuciscus vorax: *Clinostomum complanatum*.
Luciobarbus esocinus: *Clinostomum complanatum*.
Luciobarbus xanthopterus: *Clinostomum complanatum*.
Mastacembelus mastacembelus: *Clinostomum complanatum*.
Mystus pelusius: *Clinostomum complanatum*.
Paracapoeta trutta (as *Capoeta trutta*): *Clinostomum complanatum*.

Planiliza abu: *Clinostomum complanatum*.
Planiliza subviridis: *Clinostomum complanatum*.
Poecilia latipinna: *Clinostomum complanatum*.
Silurus triostegus: *Clinostomum complanatum*.
Squalius lepidus: *Clinostomum complanatum*.

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قوائم مرجعية لأنواع الأسماك المصابة بأنواع الجنس *Clinostomum* Leidy, 1856 (صنف المخرّمات) المتسببة بمرض اليرقة الصفراء في العراق

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المستخلص

أظهرت مراجعة مسح 60 من المصادر المعنية بظهور أنواع المخرّم جنس *Clinostomum* المتطفلة على أسماك العراق وجود ثلاثة أنواع مشخّصة من هذا الجنس وهي *C. complanatum*، *C. dasi* و *C. tilapiae* فضلا عن بعض النماذج غير المشخّصة من هذا الجنس التي تصيب 29 نوعا من الأسماك. كانت الإصابة منتشرة بالدرجة الأساسية في مختلف المسطحات الداخلية المائية في العراق، إضافة إلى مجموعتين من أحواض سمكية في محافظتي بغداد وبابل. من بين هذه الأسماك المصابة، كانت أسماك الحمري *Carasobarbus luteus*، البلطي أحمر البطن *Coptodon zillii*، الكارب الإعتيادي *Cyprinus carpio* والجري اللاسع *Heteropneustes fossilis* مصابة بأكبر عدد من أنواع هذا الجنس (نوعين لكل منها)، في حين كانت جميع الأنواع المتبقية مصاب كل منها بنوع واحد فقط هو *C. complanatum*. من بين هذه المخرّمات، أصاب النوع *C. complanatum* كل الأنواع السمكية وتبعه النوع *C. dasi* والنوع *C. tilapiae* حيث أصابا نوعين، ونوع واحد من الأسماك، على التوالي.

الكلمات المفتاحية: المخرّمات، *Clinostomum*، أسماك، التوزيع، العراق.