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Distribution of Fish Species Infested by *Livoneca redmanii* (Isopoda, Cymothoidae) in Lake Manzala, Egypt during Dredging Operations

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ABSTRACT

This study concentrated on the distribution of fish species infested by isopods during dredging operations in Manzala Lake. Samples were collected by using different fishing gears and methods from different sites of the lake during the period from 2019 to 2021. Species infested by isopods were identified and recorded. Most of the infestations were found in the western and El- Boughaz (Northeastern) regions. *Livoneca redmanii* (Isopoda, Cymothoidae) was observed in all seasons infesting fish of great economic importance. The most infested fish species by *L.redmanii* in Lake Manzala during the period of study were *D. labrax* and *D. punctate*, followed by *C. ramada*, while *C. zillii* was the least. Infestation of gills in different fish species by *L. redmanii* was detected on one or both sides of the gills. Sometimes two *L. redmanii* were noticed, one of which was recorded on one side and the other on the other side. In addition, different stages of growth of *L. redmanii* were observed in *D. labrax*. We suggest biological control by scientific researcher specialists to prevent the further spread of this parasite and protect the fisheries development in the lake.

INTRODUCTION

Lake Manzala is one of the Egyptian Mediterranean wetlands along the Nile Delta coast **(Abd Ellah, 2021)**. It contributes to about 14% of the total annual Egyptian fisheries production **(Mostafa *et al.*, 2019)** and represents 32% of the lake's fish production in Egypt and 44% of the northern lakes. The lake is exposed to high levels of pollutants from industrial, domestic and agricultural resources **(Ibrahim *et al.*, 1999)**.

Lake Manzala used to receive about 7500 million cubic meters of untreated industrial, domestic, and agricultural drainage water that is discharged annually through six main drains; Bahr El-Baqer, Hadous, Ramsis, El-Serw, Matariya and Faraskour Drains. This amount of wastewater was reduced to about 4000 million cubic meters after the construction of El-Salam Canal **(Abdel-Baky *et al.*, 1998; El-Ghazali *et al.*, 2015; Ismail & Hettiarachchi, 2017)**.

Crustaceans are spread in all types of aquatic ecosystems, and most species are adapted to severe temperatures, salinity as well as anoxia. It was found that about 25% of

parasites infesting fish are crustaceans belonging to three main groups: brachiura, copepod and isopod **(Eiras *et al*., 2000** & **Öktener & Sezgin, 2000**). Isopods were considered as the largest ectoparasites infesting fishes worldwide **(Rhode, 2005)** and causing significant economic losses to fisheries through mortalities, stunting growth or damaging tissues of the fish **(Bunkley- Williams *et al*., 2006; Toksen, 2007**). Not only these, but also via acting as a vector for the transmission of other fish pathogenic organisms **(Horton & Okamura, 2001**). Isopods of the family Cymothoidae inhabit tropical marine environments; however, several species have also been recorded in freshwater habitats. All species of the family Cymothoidae are obligate fish parasites, attaching to exterior body surfaces of fish, the buccal or opercular cavities, or burrowing into abdominal muscle tissue **(Poore & Bruce, 2012; Hata *et al*., 2017; Smit *et al*., 2019)**. Most members of Cymothoidae are protandrous hermaphrodites, which begin life as males and turn into females. They are unable to leave their hosts after developing into females **(Purivirojkul & Songsuk, 2020)**.

Cymothoids cause mortality, stimulate the deterioration of condition factor and growth, behavioral changes, severe morbidity and tissue damage for the infected fish **(Raissy & Ansari, 2011; Rameshkumar & Ravichandran, 2014; Purivirojkul & Songsuk, 2020)**.

Lake Manzala is one of the most important economic pillars in Egypt, with respect to their fish production for it is characterized by shallow depths, calm water movement and high fertility. A national project for the purification and development of Lake Manzala has taken place since 2017. Since some infections with isopods were recorded in many species of commercially important fishes causing significant economic losses to fisheries (**Rameshkumar *et al*., 2013)**, the present work aimed to study the distributaion of fish species infested by isopods in Lake Manzala during dredging operations to suggest proper management of this vital sector.

MATERIALS AND METHODS

Study area and sampling

Lake Manzala is located between latitudes 31°05`N and 31°25`N and longitudes 31°47`E and 32°17`E. The sampling sites were selected to cover and represent the whole water body of the lake (Figure 1). Five different surveys were carried out during the period from 2019 to 2021. Fish samples were collected from different commercial fishing gears and methods used at different sites of the lake. The most common fishing gears and methods in Lake Manzala during dredging operations were trammel nets (Balla and Kaffaya), basket traps (Gawabi), trawl nets, spiral traps (Tahaweet- Dorra), noodling (i.e. fishing with bare hands) (Kadamat), longline (Sinnar), and other methods. The morphometric study including measurement of total length; total weight was done using measuring scales and electronic balance. All fish species infested with the isopod parasite were recorded. The crustacean isopod parasite, *Livoneca redmanii* was morphologically

identified according to **Brusca (1981); Mahmoud *et al*., (2017)** and **Abdallah & Hamouda, (2022).** *L. redmanii's* physical characteristics described by **Sandifer and Kerby (1983)** as generally light brown with black chromatophores. It has an ovate body, with an average width of 13 mm and an average length of 21 mm. The head is as wide as long, usually 3 mm, and has indistinct eyes situated post-laterally and two pairs of antennae. The thorax contains seven segments. The abdomen is not set in the thorax. It is slightly narrower than the thorax and has six segments, which gradually decrease in width. The uropoda are equal in length. The inner branch is larger than the outer one by about one half. The legs, which are the most pertinent feature for this parasite's lifestyle, have curved dactyli for grasping on to the fish.

Its classification is :

Kingdom: Animalia (Animals)
Phylum: Arthropoda (Arthropods)
Subphylum : Crustacea (Crustaceans)
Class : Malacostraca
Order : Isopoda (Isopods)
Family: Cymothoidae
Genus: *Livoneca*
Species*: Livoneca redmanii*

RESULTS

Infested fish species by *Livoneca redmanii* (Isopoda):

Most of the infestation by *Livoneca redmanii* (Isopoda, Cymothoidae) during the period of study (2019- 2021) was found in the Western and El- Boughaz (Northeastern) regions in all seasons (Figure 1 & Table 1).Data in Table 1 shows that the most infested fish species in Lake Manzala were *D. labrax* and *D. punctate* followed by *C. ramada. C. zillii* was the lowest one.

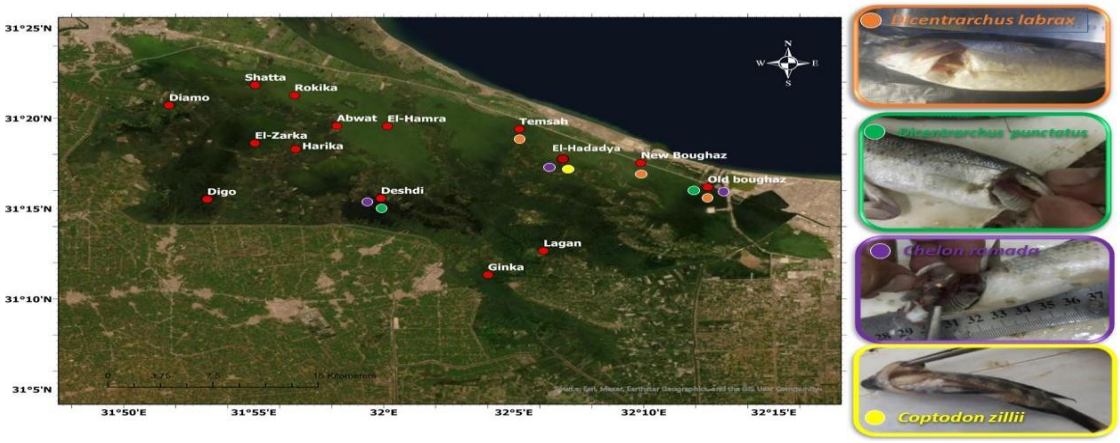

Figure1. A map of Lake Manzala showing sampling sites and the distribution of infested fish species

L. redmanii (Isopoda, Cymothoidae) has been observed in all seasons, Table 1. *L. redmanii* which infested different fish species was observed on one side or both sides of the gills. Sometimes two *L. redmanii* were noticed on one side (Figure 2). Figure (3) shows various fish species infested by *L. redmanii* collected from Lake Manzala during the period of study. Different stages of growth of *L. redmanii* were observed also in *D. labrax*(Figure 4).

Table 1. Spatial and temporal distribution of infested fish species during dredging operations in Lake Manzala (2019- 2021).

Season	Area	Infested fish sp.	% infected fish of the same species in the same area
Autumn 2019	New Boughaz of El-Gamil	*D. labrax*	31.3
Summer 2020	Old Boughaz of El-Gamil	*D. labrax*	100
		D. punctata	100
Winter 2021	Deshdy	*C. ramada*	8.7
		D. punctata	100
Spring 2021	Old Boughaz of El-Gamil	*C. ramada*	23.5
	El- Hadadya	*C. ramada*	7.4
		C. zillii	12.5
Autumn 2021	Old Boughaz of El-Gamil	*D. labrax*	20
		D. punctata	53
		C. ramada	12.2
	Temsah	*D. labrax*	100

Figure 2.Two parasites on the gills of the infested *C. ramada*, *D. labrax* and *C. zillii* and the parasite protruded outside the gills of *D. punctate*

Temporally, infested *D. labrax* samples were recorded during all survey trips except for Winter 2021 which makes it the most frequent infected species, while infected *C. zillii* was the least frequent infected species as its samples were only detected during Spring 2021. Spatially, infected *D. labrax* and *C. ramada* were recorded in three different locations, (Old Boughaz of El-Gamil, New Boughaz of El-Gamil, and Temsah for *D. labrax*, and Deshdy, Old Boughaz of El-Gamil, and El- Hadadya for *C. ramada)*, which makes them the most distributed infected species while *C. zillii* was the least distributed infected species as its infested samples were only detected in one location (El- Hadadya) (Table 1).

Figure 3. Different fish species Infested by *Livoneca redmanii* (Isopoda, Cymothoidae) collected from Lake Manzala during dredging operations (2019- 2021)

Figure 4. Different stages of growth of *Livoneca redmanii* (Isopoda, Cymothoidae) in gills of *D. labrax* in Lake Manzala during dredging operations (2019- 2021)

DISCUSSION

Lake Manzala is considered a new area where fish infected by the isopod *Livoneca redmani* were detected. **Fahmy *et al*. (2022)** mentioned that Lake Manzala and its corresponding fish farms considered new localities for the detected crustacean and monogenean species. Most infected species were found in the Western and El- Boughaz (Northeastern) regions. The lake has been classified as being eutrophic by various researchers including **El- Wakeel and Wahby (1970) and El-Sherif & Gharib (2001).** The lake is highly eutrophic with both macrophytes and planktonic algae contributing to extensive carbon fixation. **Mahmoud *et al*., (2019)** mentioned that, there was strong relationship between parasitic infestation and water pollution. Infestation by isopod *Livoneca redmani* in Lake Manzala may be due to the entrance of infected species from the Mediterranean to the lake through Boughaz El- Gamil opening, due to eutrophication of water's lake, or translocation of the infected fry from the fish farms. Since the lakes are relatively shallow, climate change can lead to an increase in water temperature, which could result in changes in the lake ecosystems as well as changes in its yield. Changes in the salinity of Lake Manzala, for example, may lead to impacts on lake ecology and fisheries (**Shaltout *et al*., 2017). Mahmoud *et al*., (2023)** reported that, the close molecular relation between *L. redmanii* in Qarun Lake and that isolated from the Mediterranean Sea supported the introduction of this isopod to the lake during wild fry transmission. Using hatchery-reared fry instead of wild ones for supplying lakes and fish farms is recommended.

In the present study, the most infested fish species in Lake Manzala during the period of the study were *D. labrax* and *D. punctata* followed by *C. ramada. C. zillii* was the lowest one. This agrees with **Fahmy *et al*. (2022)** who reported that the rates of parasitic infestation of fish species in Lake Manzalah during 2019 were 84.44; 70.37 and 55.00 for D. *labrax (*Moronidae*), Mugil spp.* (Mugilidae) and *Tilapia spp.* (Cichlidae), respectively. A 23% prevalence rate of isopods was reported in *D. labrax* from Egyptian Mediterranean waters(**Abdallah and Hamouda, 2022).**

This study shows different stages of growth of *L. redmanii* in *D. labrax.* **Helal and Yousef (2018)** reported that the intensity of infestation of *Mugil cephalus* in Lake Qarun by *Livoneca redmanii* was one or two parasites per hosted fish in the gills region or attached on the skin causing atrophy and hemorrhage at the site of attachment. These may be attributed to the low respired oxygen of destructed gill epithelium which is caused by feeding activity, fixation, attachment, and locomotion of crustaceans. These results agree with those reported by **Eissa *et al.* (2012) and Kayiş and Ceylan (2011).**Cymothoid isopod, *Livoneca redmanii* in Lake Qarun causes economic loss associated with reduced fish growth, high mortality and a marked drop in fish production in the lake (**Helal and Yousef, 2018**). **Fahmy *et al*. (2022)** recommended periodically checking Manzala Lake's water. Also, the regular and sanitary disposal of the waste left over from the government's clearing and dredging operations in the lake.

CONCLUSION

In conclusion, the current reporting of the presence and spread of the isopod parasite in Lake Manzala is a red flag, since it has been observed in all seasons and

infests fish of great economic importance such as *D. labrax, D. punctate, C. ramada* and *C. zillii.* To achieve proper fisheries management of Lake Manzala concerned with infection by isopods, reduce different sources of pollution pouring into Lake Manzala to improve habitats of fish and other aquatic species. Also, biological control, by specialist scientific researchers to prevent its further spread and to preserve different fish species in Lake Manzala in good health, is recommended.

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