

Helminths and crustaceans copepod parasites of silver carp (*Hypophthalmichthys molitrix* (Valenciennes, 1844)): Population of the lak of Fouarate, Kenitra (Morocco)

Latifa El Harrak^{1,2}, Kaoutar Hourri¹, Hafida Jaghror¹, Mohammed Izougarhane¹,
Ahmed Omar Touhami Ahami², Mohamed Fadli^{1*}

¹Laboratory of Biodiversity and Natural Resources, Department of Biology, University Ibn Tofail,
Faculty Of Science Kenitra, PO Box 1400, (MOROCCO)

²UFR «Human Biology and Population Health (BHSP)». Department of Biology Ibn Tofail University Kenitra,
PO Box 1400, (MOROCCO)

³Laboratory of Zoology and General Biology. Team of Sustainable Development of Ecosystems,
Faculty of Sciences. 4A. Ibn Battouta B.P. 1014 RP Rabat; 10090, (MOROCCO)

ABSTRACT

In Asian, Asian carp has been introduced in different water accumulations in the world for the production of animal protein or for environmental objectives. However, many parasites have benefited from the operation to conquer many countries and continue to threaten the species itself, and be a risk to humans.

In this work, we determined the parasitic species Helminths and Copepod (Crustacean) infesting a population of silver carp of the lake Fouarate nearby the city of Kenitra (Morocco).

The results show that four helminths (*Clonorchis sinensis*, *Diplostomum spathaceum*, *Bothriocephalus acheilognathi*, *Anisakis simplex*, *Dactylogyrus Sp*) and a copepod crustacean (*Lerneae Sp*) parasitize the muscle, the intestine, the skin, the eyes or the gills of the studied fish. The contamination of the lake by sewage and the important diversity of the parasitized body parts can be two main causes of the specific wealth of the parasite population.

A. simplex has the highest prevalence (19.33%) followed by that of *Lerneae* (16 %). The prevalence of other parasites varies from 7.33% to 10%. Similarly, the fishes having a large size were more attacked by parasites except for *Lerneae* which has shown an inverse phenomenon.

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KEYWORDS

Silver carp;
Parasites;
Helminths;
Copepod prevalence
Fouarate lake;
Morocco.

INTRODUCTION

In Asia, the silver carp is very integrated in the farming agricultural practices such as in the rice fields which it is used to increase yield 19% by decreasing the pest

infestations and by reducing weeds^[1]. Moreover, the silver carp is often introduced for fighting against eutrophication of the water accumulations. Thus, in addition to its beneficial effect on the quality of water, the carp culture has had a perceptible economic interest to

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the extent that culture can provide the professional sinners bordering the deductions taken a significant amount of fish sold on the local market at a remunerative price. However, as has been reported by Hoglund^[2] parasitological the infestation of fish led to his stress and reduces its reproductive capacity.

In addition, the Gharb plan is located in the north-west area of Morocco and represents the most threatened water reserves by urban sprawl and industrial and agricultural development of the studied area. The lake Fouarate, which is part of the urban area of the city "Kenitra", is one case. Indeed, this lake is in a marshy and unhealthy area and receives wastewater issued by the surrounding habitats and industrial units.

However, the waters of Lake Fouarate are used for irrigation of crops that grow north of the lake and as a watering source of cattle, and as a living environment of silver carp which is caught and marketed in the riparian zone.

Moreover, various conditions favoring the infestation of the carp in the lake by pathogens such as the contamination of the water by the fecal bacteria. So, the transmission to humans of various parasitic through the marketing of the undercooked fish is very possible. Thus, in this work we have identified the helminth species and copepod crustaceans parasitizing the silver carp in the studied lake and determined their frequencies.

MATERIALS AND METHODS

Studied sites

With a total area of 2.16 km² and a variable depth from 0 to 4 m, the Fouarate lake lies northeast of the city of Kenitra. It is located between 34 ° 15' north latitude and 6 ° 30' longitude, and it is limited by agglomerations Saknia Labita and on the south by the Fouarat-Mgadid the north by the main road from Kenitra-Tangier in the west, and the neighborhood of the common "Haddada" east.

From the point of view of the lake pedology, the soil is hydromorphic little or moderately humus^[3] having a profile showing a dark surface with gray but the soil structure becomes gray missive to depth.

The impoundment of the lake is mainly due by the natural water, groundwater, the reports of Fouarate River, the wastewater of peripheral areas,

and the precipitations. In September the rains are quickly absorbed by the shrinkage cracks. This percolation continues until the arrival of abundant rainfall causing floods. It is followed by the impoundment of winter that causing the outcrop of the aquifer. After the spring rains, the water level reached quickly a height which remains more or less constant. Then, by the dry season, the losses of water by evaporation increases progressively.

For the vegetation of the lake, according to the temporality of the different water areas of the lake, there are

- Vegetation that grows in the temporary part. It consists mainly *Scirpus maritimus*, *Mentha ratundifolia*, *Cyandon* sp, *Thypha angustifolia*, *Phragmites communis*, *Isoetes*, *Velata* and *Scrofularia aquatiqua*.
- A vegetation of temporary or semi-perm zone, it contains mainly: *Glyceria fluitans*, *Ranunculus aquatilis*, *Isoetes velata*, *Aritidia pungens* and *Iris pseudcorus*.

About pollution, the lake poses serious problems related to pollution and environmental degradation, including pollution of groundwater and the transport of pollutants to the estuary of Sebou, then to the Atlantic Ocean. Many hydratoses and pests to humans may appear in the nearby area.

Systematics and ecology of silver carp

Scientific name: *Hypophthalmic molitrix* (Valenciennes, 1844).

It is in the family Cyprinidae, the minnow and carp family. The genus *Hypophthalmic* is made up of the Greek word "hypo" meaning "under", the Greek word "ophthalmos" meaning "eye" and the Greek word "Ichthys" meaning "fish". The silver carp was first named by Valenciennes in 1844.

In its native range it occurs when the water temperature stabilizes above 20 ° C (period of Asian monsoon rainfall). After three days, it feeds on lower groups of zooplankton such as rotifers and protozoa. But, during the second week the fry diet evolves to include Copepods and cladocerans. When the fry reach a size of 2 cm the phytoplankton is added to their diet, and the consumption of algae occurs at a size of 3-4 cm^[4].

Today, the carp is a very common fish both in

TABLE 1 : Parasites species and parasitism frequencies

Zoological groups	Pest species	Attacked parts of the body	--	Size 1	Size 2	Size 3
Trematoda (Platyhelminthes)	<i>Clonorchis sinensis</i> Looss, 1907	Muscle	Infected fish (%)	8	10	12
			Overall infection rate (%)		10	
	<i>Diplostomum spathaceum</i> (Rudolphi, 1819)	Œil	Infected fish (%)	6	6	10
			Overall infection rate (%)		7,33	
Cestoda (Helminth)	<i>Bothriocephalus acheilognathi</i> Yamaguti, 1934	Intestin	Infected fish (%)	6	8	14
			Overall infection rate (%)		9,33	
Nematoda (Helminth)	<i>Anisakis simplex</i> Dujardin, 1845	Intestin Muscle	Infected fish (%)	18	18	22
			Overall infection rate (%)		19,33	
Monogenea (Platyhelminthes)	<i>Dactylogyrus sp</i> Diesing, 1850	Branchies	Infected fish (%)	10	6	14
			Overall infection rate (%)		10	
Copepoda (Crustacea)	<i>Lerneae sp</i> Linnaeus, 1758	Peau	Infected fish (%)	20	14	14
			Overall infection rate (%)		16	

rivers, ponds, and lakes. It likes the calm and warm waters having abundant vegetation. Growth is optimal at 20-25°C. The duration of larval life is 40-50 years for the wild strains of the order of 12-15 years for the selected strains for breeding. Sexual maturity is reached at 2-3 years. Breeding occurs between May and July, according to the temperature.

Technical study methods

150 fishes were sampled and analyzed. Selected individuals belong to both sexes and fall into three size classes (so, hence three classes of ages): 10 and 15cm and 16 and 20 cm, and 21 and 25 cm. The protocol for sampling and detection of parasites were carried out according to "The sampling protocol of fish parasites" that was reported by CCME^[5].

The studied parasites

In order to contribute to the study of parasites of silver carp in the studied lake we have limited ourselves to the study of Helminths (Nematoda, Trematoda, Cestoda, Monogenea) et Crustacea (Copepoda). The choice of these groups is the result of the adverse effect that may cause these pathogens on fish studied such as the stress. So, the activity of these parasites is a determining component of productivity. In this respect, the development of any research of knowledge of these parasites is very important for a better control of the productivity and mortality of the fish. Notice too that the parasite rates assessed in this subject field are equally defined by Bush et al. (1997)^[6]: Prevalence, intensity of infection and abundance.

RESULTS AND DISCUSSION

Results

The TABLE I shows the parasites, their systematic classification, the attacked body parts by the parasite, and the frequency of parasitic infestation of fish examined.

Discussion

The results show that five species of helminths and one species of crustacean parasite the studied population of silver carp. The species belong to different taxonomic classes. Also, five parts of the body of the fish are affected by the parasitism, the muscle, the intestine, the skin, the eyes and the gills. The high contamination of the lake by sewage and the diversity the affected body parts explain the wealth of the population of parasites that attack the studied fish population.

About the comparative prevalence of the observed parasites, *A. simplex* has the highest value (19.33%), but it appears that, this value varies according to the size of the fish. The possibility of this species to occupy both the muscle and intestine may explain its high prevalence.

With a prevalence of 16%, *Lerneae sp* is very common in the population of silver carp in the medium studied. Furthermore, the results indicate that the more young fishes are more infected by this ectoparasite.

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For the other parasites, the medium prevalence was ranging from 7.33% to 10%, and it was the fishes having larger sizes that were more attacked. Note too, that according to many authors, for the same parasite the prevalence may depend on many environmental components. Thus, the prevalence of infection in *Dactylogyrus* varies according to season. Indeed, it was found that for this species the infections are in their late in the fall or in early winter^[7]. Likewise, a correlation has been found between the urine temperature and the strength of the parasitic infection^[8]. And, it is broadly accepted that *Dactylogyrus* is more exposed to infections during its reproductive period^[8].

Moreover, it was mentioned that, for the riparian human population consuming the studied fish, the hazard of pollution by the parasite remains low because Moroccans use the fishes very cooked.

Furthermore, the parasite species are characterized as follows:

***Clonorchis sinensis* Looss, 1907**

Clonorchis sinensis is a trematode *Platheminthe* very common in most regions of the globe; it parasitizes the human and it settles in the liver and feeds by the bile^[9]. Indeed, 200 million people are at hazard of contamination by this species, especially in Asia. It is even classified as a Group 1 of the organic carcinogens in 2009^[10-12]. Moreover, in its life cycle, the second intermediate host is constituted by a fish; once in his flesh, cercariae of the parasite metacercaria create a cyst. Thus, once the fish is eaten raw or not cooked by human, the human will be infected, being so the definitive host of *Clonorchis sinensis*.

***Diplostomum spathaceum* (Rudolphi, 1819)**

D. spathaceum is a species having a very complex cycle of life; it is common in the world by the migration of its definitive hosts, fish-eating birds^[13]. It is the stage of its metacercaria that develops in many species of fish host by piercing firstly their epithelium and migrating to the eye for to persist, there until its development in the lens, the retina or the humor.

Moreover, infection of fish by *D. spathaceum* can cause several pathological consequences that can lead to high levels of mortality in particular, local hemorrhage, blindness, reduced growth, weight

loss^[2].

***Bothriocephalus acheilognathi* Yamaguti, 1934**

Acheilognathi is a tapeworm infecting fish species belonging to the families Cyprinidae, Poeciliidae, cichlids and Centrarchidae^[14,15]. It adjusts its size to that of its host^[16]. In the fish, this parasite fixed near the front part of the intestine, just back of the bile duct causes inflammations and perforations of the bowel. Therefore, it can cause in the infected individual, especially in young, weight loss, anemia and even death especially in young fish^[16].

***Anisakis simplex* Dujardin, 1845**

Anisakis spp. is a parasite with a complex life cycle where the second intermediate host may be a fish. He digs and encysted in the wall of the intestine, but sometimes, this is done in the muscle or under the skin.

Note that the consumption of raw fish infected with this parasite leads to an anisakiasis, a disease causing a reaction with anaphylactic shock in sensitized individuals whose body produces specific immunoglobulin E (IgE)^[17,18].

***Dactylogyrus* sp Diesing, 1850**

It is a parasite of gills or the oral cavity of fish, especially those of freshwater fish such as carp^[19]. It delivers a direct life cycle no intermediate server. Infected fishes scrape their gills on the rocks^[20]. Their appetite decreases, the rate of respiration is accelerated, and gills inflamed with excessive mucous secretions^[21],

***Lerneae* sp Linnaeus, 1758**

It is a Copepod crustacean affecting a large number of fresh or brackish water fish. After mating, the female burrows into the flesh of the infected fish and turns into an unsegmented worm body, usually in a suspended part of the fish's body. According Jithendran et al.^[22], it appears to have an affinity for the heart region of small fish that it kills by piercing the center or other critical organs. It can contribute to a hemorrhage of the host fish, and ulcerated lesions favoring so many secondary infections such as anemia, stunted growth, weight loss and loss of equilibrium.

CONCLUSION

The population of silver carp studied is infected with various parasites belong to six systematic taxa attacking various parts of the fish cops. This parasitic attack can certainly lead a decreased productivity of the fish and even with a high rate of mortality in the population. In fact, all the parasitized parts of the fish's body have a very vital role in the animal. Furthermore, many parasitic species could combine their effects on the same fish. The highest prevalence was noted at *Anisakis simplex*, which it parasites, both muscle and skin of the fish. Then the *Lerneae* prevalence is also high. Moreover, the aged individuals have the highest prevalence, but the phenomenon was reversed for *Lerneae* sp.

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