2. EXPERIMENTAL STUDY OF PREDATION BEHAVIOR OF THE SHRIMP MACHROBRACHIUM NIPPONENSE (DE HAAN, 1849) ON GRASS CARP CTENOPHARYGODON IDELLA VAL., 1844

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ABSTRACT

The results of the present study showed the behavior of the intruder shrimp Machrobrachium *nipponense,* which inter the marshy environments of south Iraq, that this species was predatory species on small and sick fish belong to the species *Ctenopharyngodon idella* Val., 1844 and this behavior depends mainly on the size and health status of prey fish and the degree of shrimp appetite. Also, the current study refer to the mechanisms of predation used by this kind of shrimp. So, we can be considered the present study at least the first trail in Iraq and the adjacent area regarding shrimp behavior toward fishes.

Introduction

There is a growing demand for shrimp consumption on world markets as a major source of animal protein. Wickins and Beard (1978) estimated the total global catches of the shrimp which can be exceeded 1.25 million tons. Hedgpeth (1949) stated that there are more than a thousand species of shrimp belong to the genus *Macrobrachium* in the world and he expected that the species *M. nipponense* occupied a large area of shrimp aquaculture around the world. Hanson, J.A. & Goodwin, H.L. (1978) were reported that the first culture of river shrimp *Macrobrachium rosembergii* was began in Malaysia in 1950.

In southern parts of Iraq the freshwater environment has four localized species of river shrimp i.e., *Caridina babaulti basrensis, Atyaephyra desmarestii mesopotamica*

Metapenaeus affinis and *Palaemon* sp. (Al-Maliky, 2013).

Abdullah (1989) mentioned that shrimp in Iraq have been overlooked with little interest. Up to date we can found a sporadic studies conducted on the diagnosed shrimp species in Iraq, including their: taxonomy (Al-Adhub and Hamzah, 1987 and Al-Adhub, 1987), life and environment (Hamzah, 1980 and Rashid, 1985), evolution (Salman, 1987), pathology (Al-Daraji, 2004), breeding (Al-Maliky, 2009), Propagation and breeding (Al-Maliky, 2015).

Recently, at the Marine Sciences Centre, a team of specialized researchers, Salman *et al.* (2006) noted in the past few years exactly since at the end of the 2002, the existence of a species of shrimp belonging to the genus *Macrobrachium* which have been found in their study that this intruder species has specifications and code or genetic characteristics that apply with the type of *M. nipponense*, this intruder species has invaded the freshwater aquatic environment of Iraq and this author instructed the reason of Its presence in Iraqi freshwater leads to its unintentional leak from Iranian shrimp farms to the Iraqi freshwater environment (Al-Maliky, 2010).

Ling (1969), Forster & Beard (1974) and Hanson & Goodwin (1978), showed that the shrimp M. rosenbergi possessed predatory status of Cannibalism, and we were also told by a group of fishermen. in several areas in south of Al-Hammar marsh that they are subjected to tingling on their submerged legs while fishing by M. nipponense, another witness, a local fish farmer stated that they are noticed M. nipponense was attacking their sick or inactive fishes. The present study was designed to study the predation behavior of the shrimp

M. nipponense experimentally and determine its potential to do this behavior and what factors affect this behavior in addition to the mechanisms used when performing these behaviors.

Materials and Methods

Sampling area

The sample area of the shrimp *M. nipponense* called Al-Mashab which is marshy area located at the southern parts of Al-Hammar marsh 15Km northwest Basrah province. This environment contains a variety of vertebrates, such as aquatic birds, reptiles, amphibians and mammals, in addition to several species of fish and aquatic plants.

Collection of shrimp samples:

A- Some shrimp samples were collected accidentally by using seine net during the fishing process in April 2006. The shrimp specimens were observed in different sizes (5.8-8.8 cm total length without arm and their arms lengths ranged from 3.2 to 9.9 cm). Then live shrimp with live fish were transported to the laboratory by plastic containers 30x30x45 cm equipped with a Aerator.

B) Some samples of shrimp were collected from the ponds of the experimental fish farming station at the Marine Science Centre, University of Basrah.

Collection of normal fish samples:

For the laboratory experiments on the predation behavior of *M. nipponense* oriented to fish in natural aquatic environment or in ponds in particular, grass carp *C. idella* was selected to complete these experiments because they represent one of the common type currently used in local inland fish farming. The fish samples were collected as follows:

A - Fish larvae (total length: less than 1.5 cm). It was collected from the experimental fish hatchery of the Marine Science Centre.

B - Fish larvae (total length: 1.5 to 6.0 cm) were collected from the experimental ponds of the Marine Science Centre.

C - Juveniles of fish (total length: 8 cm up). It was collected from the natural environment and from the aquariums of the Marine Science Centre.

D - Some samples of grass carp infected with malnutrition disease were collected from the experimental farm of the Marine Science Centre to study the behavior of this type of shrimp because they are illness fish and characterized by inactivity and debility.

Laboratory work

For the purpose of studying shrimp behavior towards the fish, live shrimp and fish samples were distributed in a glass aquarium (with dimensions of 30 x 30 x 80 cm) equipped with water from the natural environment in addition to aerator, as follows:

1 - Eight individuals of Shrimp were distributed in each aquariums.

2 - The larvae of the grass carp with a (total length less than 1.5 cm) and (total length from 1.5 to 6.0 cm) and the juveniles (total length: 8 cm upwards) were placed with the shrimps as a number of 8 fishes per each aquarium.

3 - Grass carp was infected with malnutrition disease, by feeding them with high fat contain food, and was also placed with shrimps as 4 fish individuals for each aquarium.

Shrimp samples used in the experiments were acclimatized and starved for ten days prior to the start of the experiment.

Shrimp were classified according to Holthuis (1980). A digital web camera connected to a computer was also used to depict the behavior of shrimp towards fish in the aquariums.

Results and Discussion

Shrimp behavior with the normal small fish larvae

The results showed that the shrimp *M. nipponense* began to attack the larvae of fish less than 1.5 cm in total length when it placed with him in the same aquarium, but he failed to catch them immediately at the first days of the experiment, but he managed to catch them after 10 days of starting the experiment.

Shrimp behavior towards fish juveniles

The results of the study showed that the shrimp *M. nipponense* immediately began attacking larvae of the grass carp of the total length (greater than 1.5 cm to 6.0 cm) and was able to catch them easily and eat them as a whole or as a part according to the degree of its hunger (after 10 days of starvation) as shown in the (Picture 1, 2).

Pic. 1. Showing how the shrimp (*M. nipponense*) catchs the fish larva of (*C. idella*) and began to eat it (4X).

Pic. 2. Showing the consuming of *M. nipponense* to a half of the fish larva of *C. idella*.(4X).

Shrimp behavior towards large fish (total length from 8.0 cm and above)

A- Large healthy fish

The results showed that the shrimp *M. nipponense* was immediately began attacking large healthy fish but he failed to catch them completely and this indicates that it cannot being a predatory shrimp towards the large fishes, but its hostile behavior may be resulted from the starvation period and this behavior disappears as soon as food is available, so such situation refers to an advantage to use a mixed farming of this type of shrimp with the fishes (Al-Maliky, 2017).

B - Diseased large fish

It was observed that the shrimp started attacking large, sick and inactive fish and hugged their arms at the abdominal side, and began to feeding on the mucous and epithelial layer of the skin, causing clear skin necrosis to the fish which may be accompanied with hemorrhage, further more in some cases a secondary infections with fungul disease caused by the fungus *Saprolegnia parasitica* may be occurred in areas and tissues that have been attacked by shrimp as shown in the Picture (3). This characteristic behavior of the shrimp is predominant among crustaceans that the stronger one eats the weak one even within its species.

Pic. 3. Show heavy infection in the skin of fish *C. carpio* which attach by *M. nipponense* and infected by aquatic *Saprolegnia parasitica*.(16X).

From these results we can conclude the following:

Table 1. Show the effects of fish total length and the degree of the starvation of the shrimp (10 days after commencement of the experiment) on the predation behavior of the shrimp.

Length (cm)		
Less than 1.5	greater than 1.5- 6.0	Above than 8.0
√	√	X

X: he cannot predate the fish; √: he managed to predation.

Predation mechanism used by the shrimp *M. nipponense*:

The predation mechanism which used by *M. nipponense* towards its prey will show as the following:

1 - According to the laboratory observations it seems that this type of shrimp has a high response to identify the presence of its prey, where once the fish is added to the aquarium it is moving from its place searching for the added fish using a touch in the process of sensitization in addition to its eyesight.

2 - It was noticed that in case of its sensitivity to the presence of fish, he will quickly attack it with the aid of its long arms.

3 - The predation process was begin by attacking shrimp to the caudal peduncle of the

fish and catch it using one of its long strong arms and butting the second arm in fish mouth and then start strangling the small prey fish by closing the mouth opening or close its operculum to stopping its breathing process and then push the prey towards his mouth, combining with this process it was also observed that the shrimp swim forward to fix the prey all the time in his mouth. Also in other times, when the prey fish was active and trying to escape from the shrimp arms, the shrimp tend to enters one of its arms through the operculum to damages the gill filaments as quickly as possible to control the prey by killing them by suffocation.

4 - In case of the size of the fish suitable for predation, but fails to capture them because of its speed and activity, which drains the power and activity of the shrimp in pursuit, the shrimp tend to be stagnate in one aspect using his thin and long tentacles by attracting the fish to him by moving them constantly in a way make that fish suggested that there is a kind of live food moving near it and if the fish moved towards the tentacles the shrimp will jumping quickly towards the fish to catch th8em and then starting to predation them (Pic. 4).

Pic. 4. Show the shrimp using its tentacles to attracting the larva of *C. idella*. (4X).

The reason why shrimp cannot prey on small-sized fish (larvae with a total length less than 1.5 cm) is that small fish sizes do not fit the size of its claws (chela) which located at the end of their long arm, but he can able to catch them after a few days because those fish larvae became somewhat bigger in their size and suitable to be captured.

The shrimp cannot predate the large and the healthy fish due to its speed and high activity and inadequate size. On the contrary, shrimp can attack large sick fish, but it cannot predate them as it works to embrace them.

The use of high and long tentacles of shrimp in the process of attracting fish is a common method for predators that cannot keep pace with their prey in speed and activity and thus attract and encourage them to approach a suitable distance where they can catch the prey, as in the predatory benthic fish which called Angle fish.

Through the results obtained in the current experimental study we can expect that this type of shrimp intruder on the freshwater environment of southern Iraq is in general harmful to both the neighborhoods organisms and the environment in which it exists because it will be a competitor to the local neighborhoods resident organisms on food and space, and its own harmful towards the other organisms was confirmed through the results of the current experiment when it is in a hunger state. Finally, the current study recommend to the need of further studies directed to this species of shrimps to determine its environmental and biological requirements and the kind of its relationships with the other neighborhood organisms in addition to the needs of knowledge's of the possibility to control it.

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