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The Effect of Organic Pollution on the Severed Limbs of *Namalycastis indica* (Southern 1921) in Shatt Al-Arab River - Iraq

Hussam M. Al-Kanani[1*], Entesar N. Sultan[1], Makia M. Al-Hejuje[2]
[1]Department of Fish and Marine Resources- College of Agriculture- University of Basra, Iraq
[2]Department of Ecology - College of Science - University of Basrah, Iraq
[*]Corresponding Author: hussammhmmd@gmail.com

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ABSTRACT

This study was designed to study the effect of organic pollution on Autotomy in one species of freshwater organism *Namalycastis indica* (Southern, 1921) which was collected during the study period (January 2022 to November 2022) from three sites in Shatt AL-Arab River. The organisms were exposed to different types of organic pollution in Shatt al-Arab River resulting from sewage, agricultural work, boat movement, and transport carrying oil derivatives and goods. The autotomy was after the tenth ring below the head. This study indicates that the cutting organisms have different signs as response to the parameters of the water quality affected by the oscillation. Also, growth was affected due to the increase in organic pollutants in the water, which leads to a long period of growth in the regenerated parts.

INTRODUCTION

Given that water is the basic component for the continuation of life on earth, so its abundance in quantity and quality is very necessary for human existence (**Chaudhury & Salahuddin, 2014)**. The process of preserving water quality from deterioration requires the application of efficient monitoring methods in delivering the necessary information about water quality in a simple and accurate manner to specialists and to decision makers, as it is based on that information in making appropriate decisions and drawing up policies that ensure the protection and preservation of water quality **(Ramakrishnaiah *et al*., 2009).** Water quality is related to the purpose of using water and evaluating its users. Water quality aims to describe the circumstance or condition of the water body depending on human use, and is usually described according to its biological, physical and chemical characteristics **(Al-Hejuje, 2014)**. The study **of Saleem *et al*., (2022)** showed that the waters of the Shatt al-Arab are affected by various human and industrial activities, which negatively affect living organisms and their ways of living, which are spread in that water body.

Invertebrates are animals that can be seen with the naked eye **(APHA, 2005)** and are found in sediments and bottom water bodies **(Ishaq & Khan, 2013)**. Invertebrates all live in different environments some terrestrial some aquatic and some have a life cycle in one environment **(Friberg *et al*., 2010)**. Macroinvertebrates are a tool in global biomonitoring programs and are widely recognized as important in water quality assessment **(Mamert *et al*., 2016).**

Environmental degradation and tolerance to pollution make macroinvertebrates diverse and good indicators of pollution. Other species are well adapted to polluted environments and can tolerate adverse conditions such as oxygen deprivation pollutant intrusion and increased water temperature **(Tachet *et al*., 2010).** The study aims to know the effect of some environmental factors (physical and chemical) and organic pollutants on the phenomenon of regeneration of developing ring in worms *N. indica*.

MATERIALS AND METHODS

Water and worm samples were collected monthly from the three study sites, from January to December 2022, randomly from intertidal zone of Shatt Al-Arab river (station 1 Sinbad Island), (station 2 Abu al-Khasib), and (station 3 Siba) Figer1. Water temperature, pH and salinity were recorded in field. Another water quality parameter Nitrates (NO_3^-), Phosphate (PO_4^{-3}), Ammonium ion ($NH_4^{+)}$ and Biological Oxygen Demand (BOD_5) were determined according to **APHA (2005).** The harvested animals were collected from the study stations with a part of the soil and water and followed up in the laboratory and the growth of the rings was calculated and the appropriate conditions were provided.

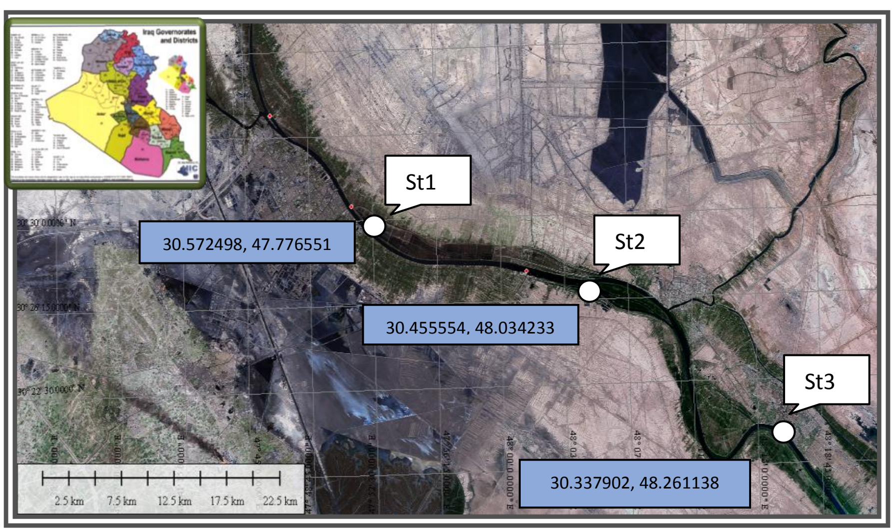

Fig. 1. A map of the study area

The total length of the worm *N. indica* animals was measured by a ruler, and the cutting process was carried out after the tenth ring below head. The worms that exposed to levels of organic pollutants in site throughout the study period. The number of rings produced per month was calculated after the cutting process. Use the organic pollution index and study the environmental variables. The lengths of the worms were divided into three categories: 4 cm, 8 cm, and 12 cm. Measuring the organic pollution index, and knowing the extent of organic pollution on the number of growing rings of *N. indica* the cuttings were made in a laboratory, exposing the organisms to organic pollution, and observing the effect of organic pollution on the number of developing rings of the cut organisms.

Calculation of organic pollution index (OPI):

Organic pollution index (OPI) was calculated according to the modified equation as a percentage scale to be more acceptable to decision makers and the general public, as shown in (**Saleem & Hussain ,2013**).

$$\mathbf{OPI = (\sum Ci / Cmi) / n \times 10}$$

where:

Ci: the experimental value for each variable analyzed

Cmi: the maximum allowed (Table 1)

n: the number of variables used to calculate the index

Table 1. The maximum limits allowed for the variables of organic pollution index.

Parameters	**The maximum allowable limits**				**Measuring unit**
	Saleem & Hussain (2013)	**EPA (2001)**	**EPA (2000)**	**Iraqi Standards and Metrology Organization (1976)**	
$\mathbf{BOD_5}$	4	-	-	<5	mg/l
$\mathbf{PO_4^{-3}}$	0.15	0.13*	0.04*	0.04	mg/l
$\mathbf{NH_4^{+}}$	0.4			1	mg/l
$\mathbf{NO_3^{-}}$	2	0.76**	0.9**	15	mg/l

* Total Phosphore
** Total Nitrogen

RESULTS

The organic pollution index (OPI) was calculated according to the Biological Oxygen Demand BOD_5, NH_4, PO_4^{-3} and NO_3 was measured. The highest value of organic pollution index ranged from (72) in November at the third station, and the lowest value (26) in October at the first station. Figure (2) shows the monthly changes in the organic pollution index values at the study stations The statistical analysis indicated that there were no significant differences ($P>0.05$) between the second and third stations, and there were significant differences ($P<0.05$) between the first station and the second and third stations. (Figure 2).

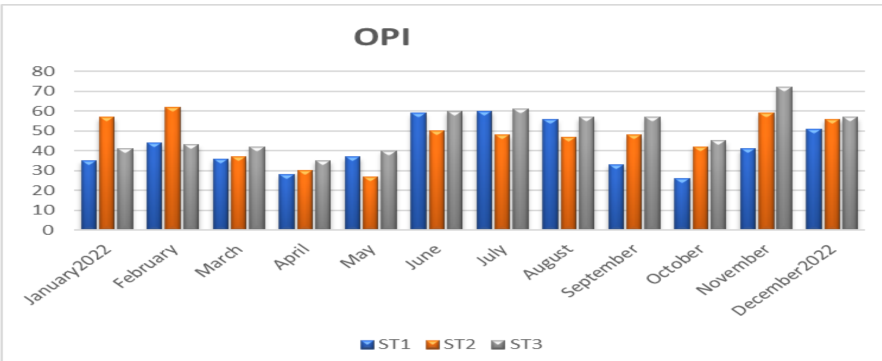

Fig 2. Organic pollution levels in the study areas

Figure (3) shows the number of growing rings per month for the type *N. indica* in the first station, as the highest growth rate for the (4) cm and (8) cm length category was (18) rings in the months of August, May and September, and for the (12) cm length category is (14) rings for the month of August.

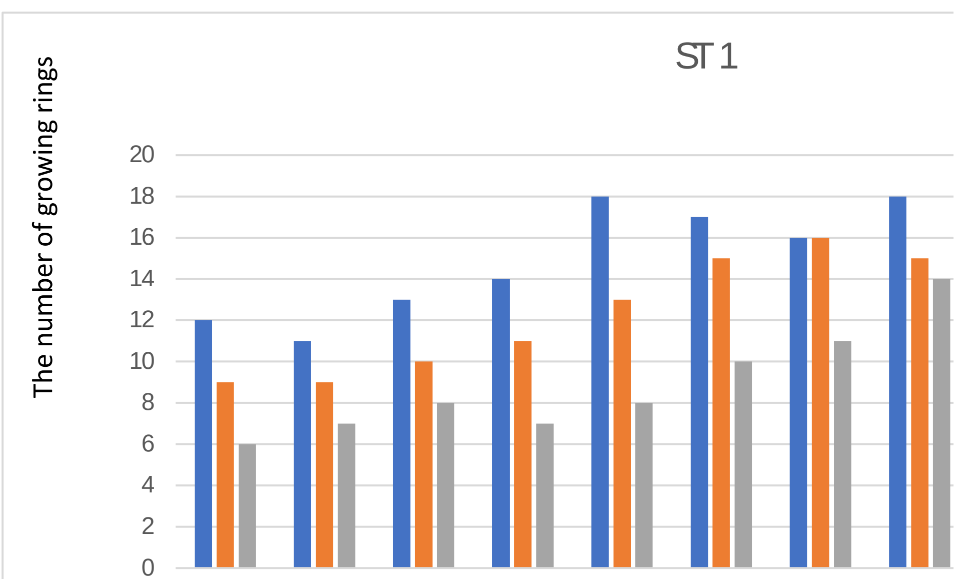

Fig 3. The monthly growth rings of the species *N. indica* at the first station

Figure (4) shows the number of growing rings per month for the species *N. indica* in the second station, as the highest growth rate for the (4) cm length category was (19) rings in July and for the (8) cm length category it was (13) rings for June and for the (12cm) length category it was (15) rings for the month of June.

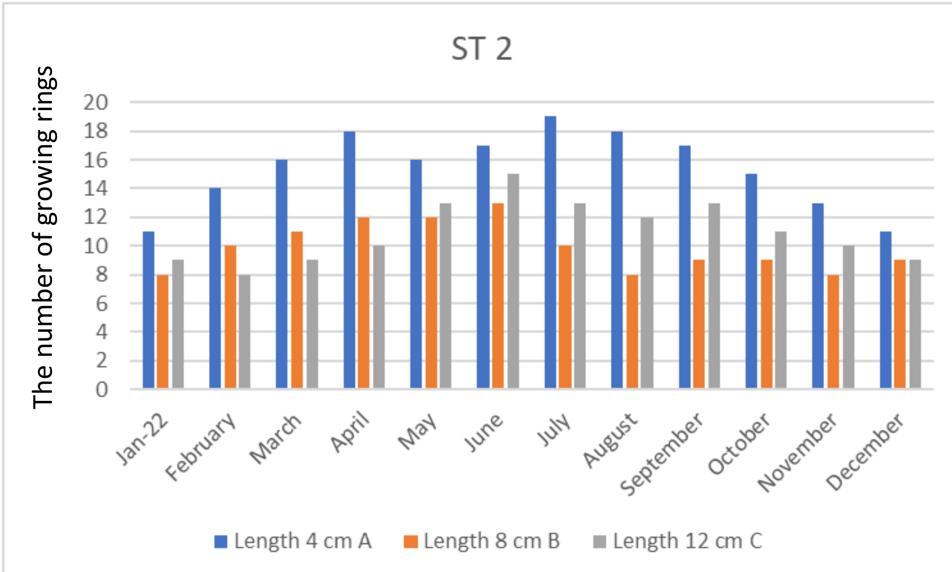

Fig 4. The monthly growth rings of the species *N. indica* at the sconed station

Figure (5) shows the number of growing rings per month for the species *N. indica* in the third station, as the highest growth rate for the (4) cm length category was (19) rings in June, for the (8) cm length category it was (16) rings for July, and for the length category (12 cm) was (13) rings for the month of August.

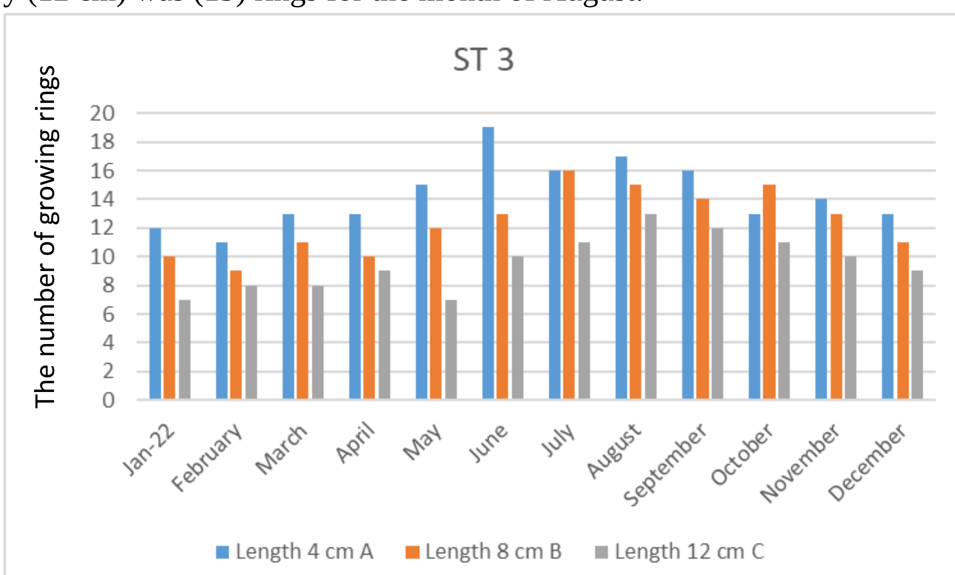

Fig 5. The monthly growth rings of the species *N. indica* at the third station

DISCUSSION

The results of the current study showed seasonal and local changes in the values of the organic pollution index (Figure 2), as the values showed that the second station is more polluted than the rest of the stations due to the high quantities of wastewater dumped into the Shatt al-Arab.

The Figures (3-5) showed an increasing in the growth rates of the rings in a worm due to the temperatures rise and the availability of organic matter in the summer season, as the worms feed on bacteria and decaying organic matter and are among the important factors for the abundance of ringworms, and this was in agreement with the study of Peralta ***et al.* (2002)**.

In addition to the station's proximity to residential areas and restaurants, and thus increasing its vulnerability to untreated sewage water, agricultural waste laden with chemical fertilizers, and livestock waste near the river. The values of the index decreased in the first station as a result of the dilution of the organic matter concentration due to the arrival of additional quantities of water from the east Al-Hammar Marsh through the Karmat Ali Chanel, which is characterized by low concentrations of organic pollutants **(Mitsch & Gooselink, 2000; Vander Valk, 2006).** As for the third station, it was within the presence of organic pollution due to the impact of ships and boats, as well as the area was affected by sewage and industrial water from the city of Muhammarah and Abadan refineries coming from Iran with tidal currents. The study showed high values of OPI in the Summer and low in the spring. The reason for the high values during the Summer is due to the increased consumption of nutrients by phytoplankton and aquatic plants, as well as the leakage of chemical fertilizers from the surrounding agricultural lands **Saleem & Hussain (2013)**. **Al- Baghdadi *et al.,* (2021)** showed that the studied environmental factors have an impact on the distribution and spread of this *N. indica* within the horizontal and vertical sections in the tidal zone. High temperatures that lead to an increase in the rate of decomposition of organic matter during Summer season, and the decrease in values in the spring season is attributed to the decrease in nutrient concentrations and the increase in phytoplankton consumption. Consequently, the values of OPI are low **(Twomey & John, 2001).**

The statistical analysis indicated that there were no significant differences ($P>0.05$) between the second and third stations, and there were significant differences ($P<0.05$) between the first station and each of the second and third stations.

It also recorded the lowest value of the index of organic pollution during the winter season due to the lack of activity of microorganisms and thus the reduction of organic matter, and this is consistent with the study of **Al-Hejuje, (2014).** The current study also agreed with the study of **Hassan & AL-Mansori (2018).** which indicated that the organic forms of phosphorous and nitrogen are dominant in some area of Shatt Al-Arab River, which confirms the presence of organic pollution in the Shatt al-Arab.

Polychaete worms belonging to the family Nerididae, represented by the type *N. indica*, appeared throughout the study in all stations with varying densities, noting that this type of worm was recorded for the first time in Shatt Al-Arab by **Jaweir (1987)**. Where the ability of worms to withstand different environmental conditions differs, and it may be due to several reasons, including respiratory performance, nutrition, movement, and the nature of living for this organism. These factors may be reflected in its phenotypic form. **Lafont (1984)** confirmed that worms that do not bear organic pollutants have a higher tolerance than worms that have hairlines.

One of the indicators of environmental damage due to the presence of pollutants is the absence of some species sensitive to pollution, and the absence or presence of polychaete worms in the sediment and mud is evidence of the benthic environmental state and an indicator of environmental damage **(Klavins *et al.*, 1998).**

Annalids worms decreased in the first station, compared to the second and third stations located in the Shatt al-Arab. The highest density of *N. indica* was recorded in the third station, this is attributed to the fact that worms can exist in environments with gradual pollution. Also *N.indica* prefer brackish water environments **(Alves & Santos, 2016).** These worms also differ in their degree of response to environmental pollutants, since the early stages of life (represented by eggs, embryos, larvae, early stages of development, and sexual development) are more sensitive to pollution than adult worms **(Dean, 2008)**. The presence of *N. indica* worms was recorded in the three study stations located on the Shatt al-Arab, as the high levels of organic carbon and the presence of nutrients helped the presence of this type of worm, which is characterized by its tolerance to environmental conditions **(Neves *et al*., 2003).** The relationship between worm densities, Each and water temperatures, salinity, and organic matter concentrations was positive, and the increase in worm densities is evidence of organic pollution of water and sediment. From the current study, it was found that the large volumetric groups are more tolerant of organic pollution and resistant than the small groups, according to a study (**Weis & Weis, 1991).**

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