International Journal for Modern Trends in Science and Technology, 9(07): 23-29, 2023

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0907005
Available online at: http://www.ijmtst.com/vol9issue07.html

Exploring the Influence of Changing Environmental Factors and Water Parameters on Epibiont Parasites of *Macrobrachium rosenbergii*

[1]Monjit Paul, [1]Joydeep Das, [1]Sudip Mondal, [1]Subhasis Acherya, [2]Mukti Chanda, [3]Asim Kumar Giri

[1]Department of Biological Science, Fishery Science, Midnapore City College, Midnapore-721129, West Bengal, India
[2]Department of Industrial Aquaculture and Fisheries, Asutosh College, Kolkata-700026, West Bengal, India
[3]Project Coordinator, District Mineral Foundation (DMF), Keonjhar-758001, Odisha, India

To Cite this Article
Monjit Paul, Joydeep Das, Sudip Mondal, Subhasis Acherya, Mukti Chanda and Asim Kumar Giri. Exploring the Influence of Changing Environmental Factors and Water Parameters on Epibiont Parasites of Macrobrachium rosenbergii. International Journal for Modern Trends in Science and Technology 2023, 9(07), pp. 23-29. https://doi.org/10.46501/IJMTST0907005

Article Info
Received: 30 May 2023; Accepted: 29 June 2023; Published: 02 July 2023.

ABSTRACT

Recently, the culture of the giant freshwater prawn,Macrobrachium rosenbergii is growing in India and also West Bengalinspecific, owing to its comparatively fast growth rate, great market, and export demand. The currentresearch on parasitic diseases in freshwater prawns has got less consideration compared topenaeid prawns. The present study on Macrobrachium rosenbergii from coastal West Bengalencountered 14 species of parasites. Among the protozoan parasites, Zoothamniumsp., Epistylissp., Vorticellasp,and a suctorian Acinetasp., the most commonly observed were ciliate infections which occurred as epibiont on gills and appendages of the host.The invasion of peritrich ciliate infestations in prawnscan affect normal physiological behavior like respiration, feeding, growth, and even the survival rate. In the currentstudy, parasitic infections were pragmaticduring the year (2022-23), we also concentrated on some physical parameters like pH, Temperature (˚C), and salinity (ppt), variations of these parameters will affect the larval growth rate and survival rate in hatchery system.Developing the right kind of intervention andmanagement practice can prevent the adverse impact of diseases and assist poor farmers in sustainableproduction.

Keywords: *Macrobrachium rosenbergii, pathogens, parasites, seasonal influence, Purba Medinipur.*

1. INTRODUCTION

The aquatic ecosystemis incredibly dynamic, subject to constant changes in environmental conditions that can significantly impact the health and survival of its inhabitants. Among these inhabitants, *Macrobrachium rosenbergii*,known as the giant freshwater prawn, thrives in a wide range of aquatic habitats. However, like all organisms, the prawns are not immune toeffects of the environmental fluctuations, especially when it comes to the presence of epibiont parasites.

Epibiont parasites commonly *Zoothamniumsp*., *Epistylissp*., *Vorticellasp*,and *Acinetasp*(a suctorian) are organisms that live on the external surfaces of other organisms, often forming symbiotic or parasitic relationships with their hosts. *Macrobrachium rosenbergii* serves as an ideal model organism for studying the dynamics between epibiont parasites and their host due to their ecological importance and commercial value in aquaculture.

As the environment and water parameters change, the delicate balance between epibiont parasites and *Macrobrachium rosenbergii*can be disrupted. Fluctuations in temperature, pH, alkalinity and dissolved oxygen levels, and water quality can all exert significant stress on the prawns, making them more susceptible to parasitic infestations. Understanding the interaction between the prawns, their environment, and the epibiont parasites is crucial for ensuring the sustainability and success of prawn aquaculture, as well as the overall health of freshwater ecosystems.

This article aims to explore the impact of water parameters andchanging environmental conditions on the prevalence, diversity, and virulence of epibiont parasites. By examining recent research findings and current trends, we will delve into the mechanisms by which environmental stressors influence the interaction between prawns and their parasites. Furthermore, we will discuss the potential implications of these interactions for prawn aquaculture practices, highlighting the importance of implementing effective management strategies to mitigate the negative effects of epibiont parasites in a rapidly changing aquatic environment.

In conclusion, as global environmental changes continue to unfold, it is crucial to deepen our understanding of the intricate relationships between *Macrobrachium rosenbergii*, epibiont parasites, and their surrounding environment. By shedding light on the dynamics of this intricate interplay, we can pave the way for the development of innovative approaches and strategies that ensure the sustainability and resilience of prawn aquaculture, while preserving the delicate balance of freshwater ecosystems for generations to come.

An investigation of the epibiont parasites will be undertaken in the present study, with a view to identifying the various species in the parasite assemblage infecting the freshwater prawns of Purba Medinipur District of West Bengal and monitoring the seasonal changes in the occurrence of common species of parasites and their relationship to the environmental factors.

2. MATERIALS & METHODS:

Areas of Collection:

Samples were collected from different culture sites (Contai 1, 2, and 3 Block, Ramnagar, Khejuri) of Purba Medinipur District of West Bengal, India, monthly during the period of August 2022 to July 2023.

Collections of Samples:

Sufficient numbers of *Macrobrachium rosenbergii* were collected throughout the year. Although per month 30 samples were collected for anatomical study, monthly prevalence of parasites, and mean intensity of the parasites during two years (size range 2.8cm to 14cm). The live crustaceans were packed in 50% pond water where they live and 50% groundwater in double plastic bags with the airspace in the bag filled with oxygen. The bags were sealed tightly with rubber bands or rubber rings and packed inside a foam box/thermocol box. A small amount of ice was added to keep the water cool, especially when a long transport time was expected.

Examination of Prawns for Parasites:

Skin, exoskeleton, and gills were examined thoroughly with the naked eye to find any discoloration or dark spots, and thenthe gills of prawns were removed by fine scissors. If the prawn was small, the whole gills were removed and examined. In the case of the larger specimen, the part of the gills or a few filaments were taken to the slide for examination. The gills of the infected prawns were observed with a magnification of 100X of the microscope (Magnus Mag Master 201). If any particular parasites were seen, they had been further examined under 400X and 1000X magnification also. Simultaneously the photographs and videos were recorded through the camera (Tuscen™) attached to the microscope. Likewise, other preferred sites of the specimen attachment were methodicallyscannedlikethe exoskeleton, mouth, and appendages. The prawn with weighty infestations of the parasites had an ambiguous-looking mat on the superficialarea of gills, appendages scrapings of these areas show the parasites mostly in the colonial form.

Data Analysis of Monthly Samples:

Water and soil samples from the ponds were collected, for the analysis of the physicochemical parameters including dissolved oxygen (DO), pH of water and soil, and organic carbon of the soil. Dissolve oxygen was estimated by Winkler’s method, while pH is measured by pH meter/pH paper, ammonia and nitrite concentration of pond water was measured by test kit available in the market. The temperature was recorded in the field by digital thermometer or pH meter. Organic carbon was estimated by Walkley-Black Method. Sufficient numbers of specimens were obtained throughout the year from different ponds or nearby markets of study areas. The month-wise data of parasites from the prawns were recorded from the samples. Recorded data were analyzed monthly to find out the month-wise parasitic intensity of the cultured prawns with temperature, pH, and dissolve oxygen concentration (DO) of culture pond water. Month-wise temperature data were collected from the Meteorological Departments of Kolkata.

Statistical Analysis, Tables, and Graphs

The data were statistically analyzed by statistical package SPSS version 21 and QP30 at a 95% confidence interval.

3. RESULTS:

Total Parasites and Soil-Water Quality Parameters

Months	Total Parasites	WATER QUALITY				SOIL QUALITY	
		DO	pH	ALKALINITY	TEMPERATURE	pH	OC (%)
AUGUST	562	4.21	7.89	110	27.9	6.80	2.10
SEPTEMBER	622	4.09	7.56	99	27.6	6.50	1.50
OCTOBER	725	3.79	7.25	85	26.3	6.20	1.60
NOVEMBER	722	3.85	7.22	75	23.3	6.20	1.70
DECEMBER	445	4.95	8.01	125	20.2	7.00	2.20
JANUARY	321	5.26	7.96	112	19.4	6.91	2.50
FEBRUARY	469	4.81	7.96	110	22.7	6.91	2.40
MARCH	225	5.78	8.09	129	27.7	7.00	2.60
APRIL	123	5.98	8.22	145	30.2	7.17	2.00
MAY	65	6.33	8.46	171	31.6	7.39	1.80

Table – 6: Parametric Correlation with Parasites and Soil-Water Quality Parameters:

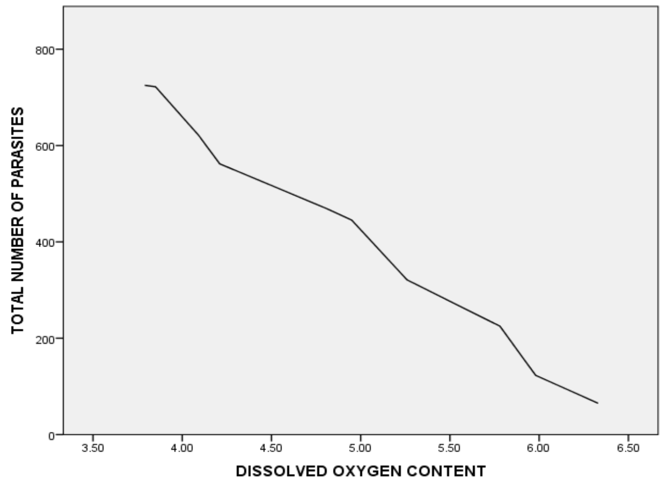
Correlations

		TOTAL NUMBER OF PARASITES	DISSOLVED OXYGEN CONTENT	pH	ALKALINITY	TEMPERATURE	pH OF THE SOIL	ORGANIC CARBON CONTENT
TOTAL NUMBER OF PARASITES	Pearson Correlation	1	-.995**	-.930**	-.937**	-.377	-.929**	-.451
	Sig. (2-tailed)		.000	.000	.000	.283	.000	.191
	N	10	10	10	10	10	10	10
DISSOLVED OXYGEN CONTENT	Pearson Correlation	-.995**	1	.918**	.929**	.340	.920**	.466
	Sig. (2-tailed)	.000		.000	.000	.336	.000	.175
	N	10	10	10	10	10	10	10
pH	Pearson Correlation	-.930**	.918**	1	.950**	.304	.998**	.519
	Sig. (2-tailed)	.000	.000		.000	.393	.000	.124
	N	10	10	10	10	10	10	10
ALKALINITY	Pearson Correlation	-.937**	.929**	.950**	1	.488	.949**	.273

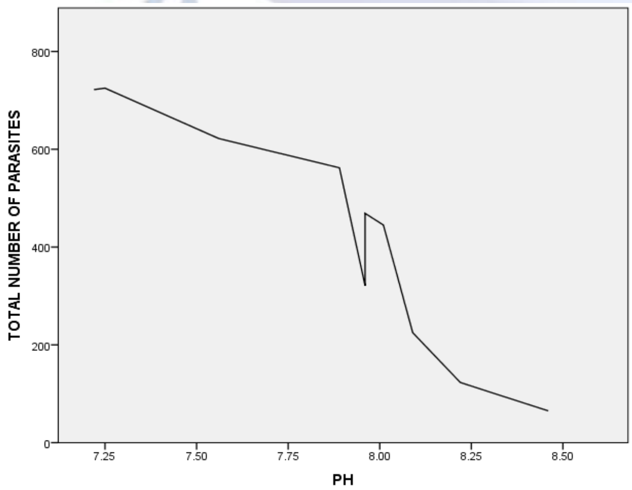
	Sig. (2-tailed)	.000	.000	.000		.153	.000	.445
	N	10	10	10	10	10	10	10
TEMPERATURE	Pearson Correlation	-.377	.340	.304	.488	1	.269	-.396
	Sig. (2-tailed)	.283	.336	.393	.153		.452	.257
	N	10	10	10	10	10	10	10
pH OF THE SOIL	Pearson Correlation	-.929**	.920**	.998**	.949**	.269	1	.516
	Sig. (2-tailed)	.000	.000	.000	.000	.452		.127
	N	10	10	10	10	10	10	10
ORGANIC CARBON CONTENT	Pearson Correlation	-.451	.466	.519	.273	-.396	.516	1
	Sig. (2-tailed)	.191	.175	.124	.445	.257	.127	
	N	10	10	10	10	10	10	10

**. Significant at the 0.01 level (2-tailed).

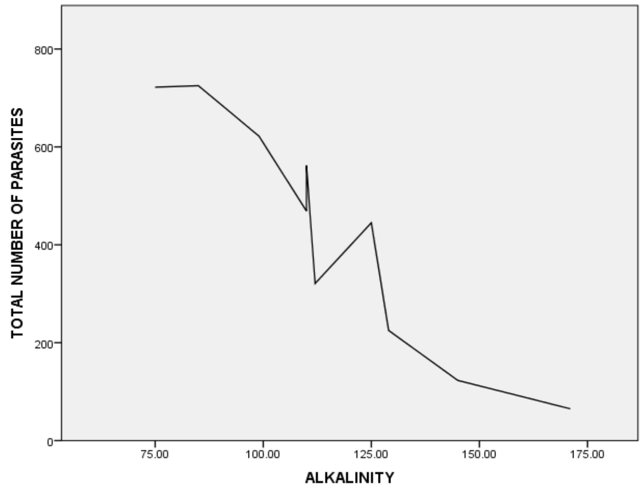
Graph - 1: Pearson's Correlation graph on the Total Number of Parasites& Dissolved Oxygen Content.



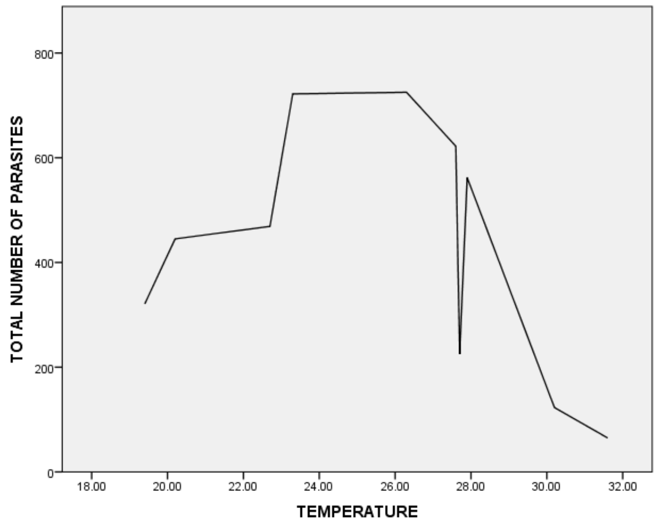
Graph - 2:Pearson's Correlation graph on the Total Number of Parasite and pH of Water.



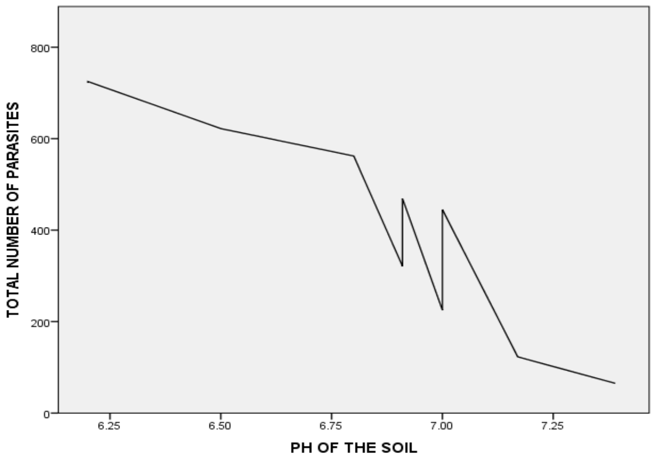
Graph -3: Pearson's Correlation graph on the Total Number of Parasites& Alkalinity of Water.



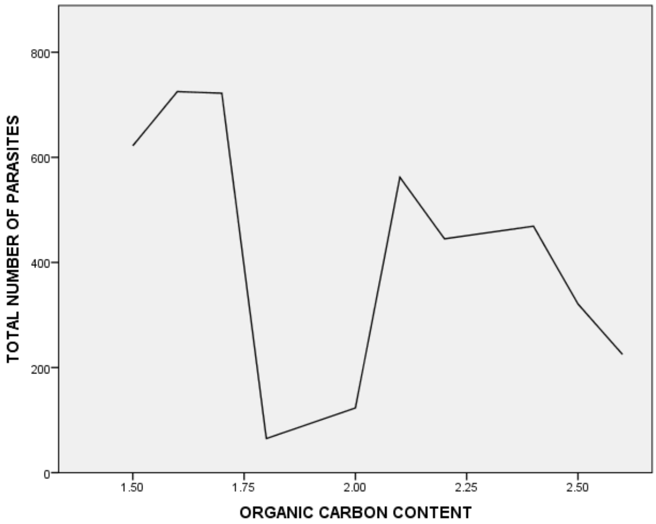
Graph – 4: Pearson's Correlation graph in the Total Number of Parasite & Temperature of Water.

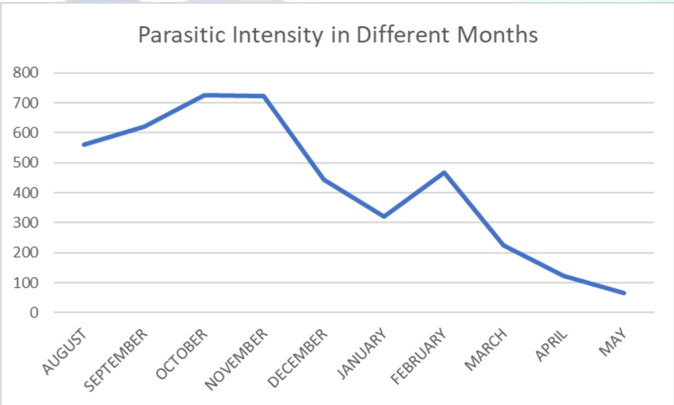


Graph – 5: Pearson's Correlation graph on the Total Number of Parasite & PH of the Soil of Water.



Graph -6: Pearson's Correlation graph on the Total Number of Parasites& Organic Carbon Content of Water.





Correlation of Parasites with Water-Soil Parameters:

Table – 1 show that total parasites found in each month of 2022-2023 were negatively correlated (r = -0.995; P<0.01) with the DO average content of water recorded monthly from the culturable pond. When the D.O. level of the water became low, the parasitic intensity was high.

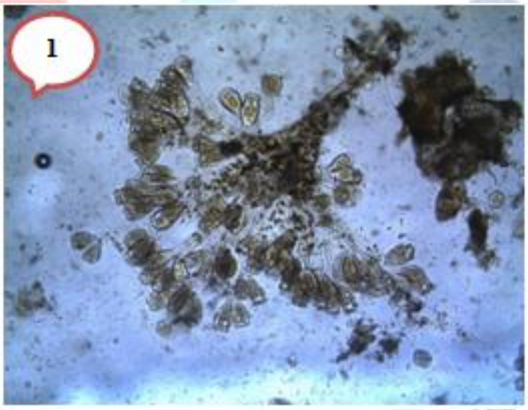
Besides, alkalinity and pH levelsare also responsible for the parasitic invasion of the *Macrobrachium rosenbergii* as both parameters are negatively correlated. The parasitic invasion was high in lower pH conditions (r = -0.930; P<0.01) and alkalinity conditions (r = -0.937; P<0.01).

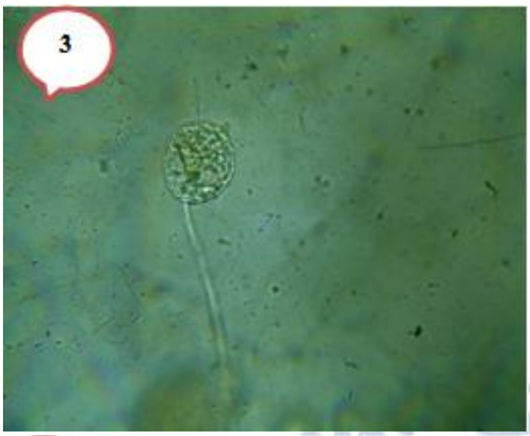
pH of the soil (r = -0.929; P<0.01) is crucial as the parameter is negatively correlated to total parasites found in each month of the study periods.

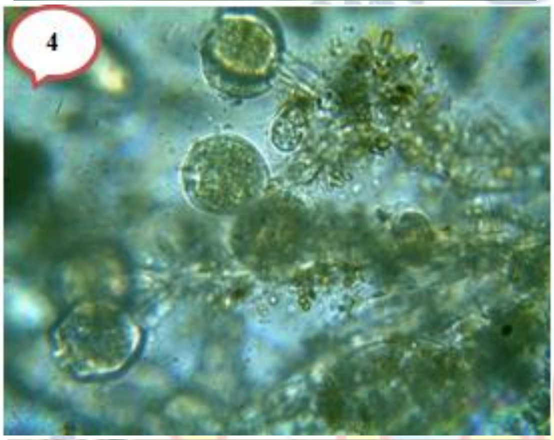
The organic carbon (OC) contents of the soil did not show any correlation with the total parasites found each month.

Seasonal Influence:

Observed that no significant correlation was found between the fluctuation of temperature in different months and the total number of parasites. Though the parasitic intensity was high from August to October, and sharply decreased from November to January, in colder months. But when the temperature increased again in February, the sudden increase of the parasites was recorded, but in hotter climates from March to May, the intensity became low gradually.







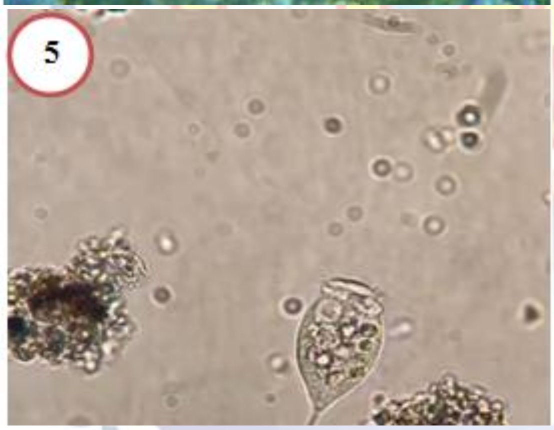


Figure-1: *Epistylis* sp.**(**Colony) 100X**Figure-2:***Epistylis* sp. (Stocks)400X, **Figure-3:***Zoothamnium* sp. (a Single Stock)400X **Figure-4:***Zoothamnium* sp. (Branches)400X**Figure-5:** A Single Stock of *Vorticella* sp. 400X **Figure-6:** Stocks of *Acineta* sp. 400X

4. DISCUSSIONS:

Commonly, sessile peritrich ciliates are observedattach tovarious non-living and living objects in fresh, brackish, and marine water habitats. The living of hosts (i.e., basibionts) often establishanappropriate attachment site for the parasites and other sessile organisms as the crusade of the organism can be the source nutrients to the epibionts and facilitate removal of waste material (Jayasree et al., 2001 and Mariappan et al., 2003). *Macrobrachium rosenbergii* are the most common bastions in West Bengal, for various species of peritrich, and several studies have been focused on this relationship (e.g., Green and Shiel, 2000; Jayasree et al., 2001; Paul et al., 2010; Mandal et al., 2015; Farook et al., 2019). Despite the well-documented occurrence of peritrich as epibionts on planktonic crustaceans in a variety of aquatic environments (Hanamura, 2000; Jayasree et al., 2001), only a few studies have identified epibionts to species level (Jayasree et al., 2001; Paul et al., 2010; Mandal et al., 2015; Farook et al., 2019). Identification of peritrichs ciliates can be difficult and time-consuming because of superficial original descriptions or incomplete descriptions, as pointed out by Leitner & Foissner (1997). Also, most of the available species' descriptions of non-loricate peritrichs are based on live observations only, although studies have shown that characters like oral infraciliature are diagnostic across genus/species boundaries, and are useful for identification (Paul et al., 2010; Chu et al., 2011; Mandal et al., 2015; Farook et al., 2019).

The general body surface of the prawn can serve as a substrate for epibionts – single or colonial protozoans. Shedding the exoskeleton, during ecdysis temporarily frees the prawn from those fouling microorganisms. Large animals and blue-claw males, which molt less often, are frequently seen with excessive burdens of the epibionts. The presence of epibionts, nonetheless can be deleterious. Fouling by various microorganisms can provoke respiratory and feeding impairments during the larval and post-larval phases. Heavy infestation on the gills can significantly reduce the efficacy of gas exchange or may cause death in juvenile and adult prawns by suffocation even when the D.O. level is not critical.

All individuals of the prawn were examinedwhich included epibiont parasites. Peritrichous ciliates belonging to the genera *Zoothamnium* sp., *Vorticella* sp., *Epistylis* sp., and the suctorian *Acineta* sp. were found infecting the prawns. Among those, *Zoothamnium* was most dominant, occurring on the appendages and gills of the hosts. However, the appendages were more frequently and heavily infected than the gills. Infections with *Epistylis* sp., *Vorticella* sp.,and *Acineta* sp. were mostly found in the appendages and less frequently found gill of the host. Deposition of pigment, melanin, was also noted thattissue-infected gills, indicating that the presence of the parasites was causing some cellular reactions. In non-living substances (glass slides), the attachments of peritrichous ciliates – *Zoothamnium*, *Vorticella*, and *Epistylis*sp were found, but no suctorian *Acineta*was recovered from the test slides placed on the infected ponds. Peritrichous did not form any colony after 7 days in glass slides.

5. CONCLUSION:

The production of this prawn is less likely to have a harmfuleffectasthe animal cannot be reared with high stocking density as those commonly used in Brackish and marine watershrimp farming. Productivity is generally lower, management is less labor intensive, and the potentiality of abuse or waste of resources is minimal, and (unlike the inland culture of marine shrimp) the grow-out of Macrobrachium does not make agricultural land saline and can be cultured with polyculture systems of carps in Indian sub-continent. The prawn culture in the freshwater pond is compatiblewith small enduring family businesses, can be proficient by relatively amateurish fishing and rural people, and produces products that can be consumed by all social classes with high market prices.

This study was designed to investigate the parasitic infection in *Macrobrachiumrosenbergii* cultured in Purba Midnapore. The up-to-date study found four chief genera of parasites –*Epistylis* sp.,*Zoothamnium* sp., *Vorticella* sp., and *Acineta* sp. The information provideda detailed description of the parasites and their prevalence in different monthsin freshwater wetlands.

From this current study, we come to the conclusion that a considerable number of these prawns,*Macrobrachium rosenbergii*, which are cultured or reared in Bengal are in a state of danger by infestation of parasites. This calls for immediate intervention to prevent the undesired decline of the potentially marketable Macrobrachium rosenbergii. This can be done fruitfully with the active participation of the local populations in culturing, marketing, or awareness of the parasites and their control of soil and water quality management.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] Chu, KB., Choong, FC., Hazreen Nita MK., Muhd Faizul, HAH., Bhassu, S., Imelda, RR., and Mohammed, M., (2011). Screening of parasitic and IHHNV infections in wild giant freshwater prawn *Macrobrachium rosenbergii* from Rejang River at Kuching, Sarawak. Trop. Biomed. 28(1):85-89.

[2] Farook, M.A., Muthu Mohamed, H.S., Mohammed Tariq, N.P.M., Muhammed Shariq, K., (2019). Giant Freshwater Prawn, Macrobrachium rosenbergii, a review. International Journal of Research and Analytical Reviews. 6 (1), 574-584.

[3] Green, J. D., and Shiel, R.J., (2000). Mobilize peritrich riders on Australian calanoid copepods. *Hydrobiologia*. 437, 203-212.

[4] Hanamura, Y., (2000). Seasonality and infestation pattern of epibiotic in the beach mysid Archaeomysis. *Hydrobiologia*. 427, 121-127.

[5] Jayasree, L., Janakiram, P., and Madhavi, R., (2001). Epibionts and parasites of Macrobrachium rosenbergii and Metapenaeus dobsoni from Gosthani estuary, Journal of Natural History, 35:2, 157-167.

[6] Mandal, B., Dubey, S.K., Ghosh, S.K., and Dash, G., (2015). Parasitic occurrence in the giant freshwater prawn Macrobrachium rosenbergii from coastal West Bengal, India, Vol. 7(6), pp. 115-119

[7] Mariappan, P., Balasundaram, C., and Trilles JP., (2003). Infection of the isopod Tachaea spongillicola on freshwater prawns Macrobrachium sp. in southern India. Dis. Aquat. Organ. 55:259-260.

[8] Paul, M., Chanda, M., Maity, J., Gupta, S., Patra, B.C., and Dash, G., (2010). Parasitic prevalence in freshwater prawn Macrobrachium rosenbergii in the north and south 24 Parganas districts of West Bengal. *Chron Young Sci.* 1, 48-50.

[9] Paul, M., Chanda, M., Das, J., and Giri, AK., (2023). Epibiont parasites of freshwater prawn Macrobrachium rosenbergii in relation to the water quality parameters, West Bengal, India.International Journal for Research Trends and Innovation. Vol.8(3), pp.310-313.