Entomology

Spinning secrets of *Dineutus sp* (Macleay, 1825) in Kangsabati River, West Bengal, India

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Received 22 Nov 2024; Accepted 3 Jan 2025; Published 10 Jan 2025

DOI: https://doi.org/10.64171/JAE.5.1.13-20

Abstract

A study was carried out on aquatic insect, *Dineutus sp*, of Kangsabati River at two sites, Kangsabati Rail bridge region (site-A), Dherua Bridge Region (site-B) of district Paschim Medinipur, West Bengal. The sampling was done monthly from January,2024 to January 2025. Due to its inclination to gyrate or skate in schools supported by surface tension, the Gyrinidae family is known as the "Whirligig Beetles." Their antennae are small and stout, and their middle and hind legs have been reshaped to seem more like paddles than legs. Their eyes are split into two sections, the lowest of which is below the water's surface and the top of which is above it. The female copulates on the water's surface and lays her eggs on emergent vegetation stems a few centimetres below the water's surface. They are one of the most well-known water beetle groups, and when handled, they emit a pleasant odour. When we were studied in river Kangsabati, we were found this species. The aim of this paper is to give interesting fact of this insect species.

Keywords: Whirligig beetle, *Dineutus sp*, Gyrinidae, Coleoptera, Kangsabati river

Introduction

Whirligig beetles are not hazardous or poisonous, and children playing with them because of their irregular, entertaining swimming patterns. They don't bite, and if you get too close or try to catch them, they'll simply flee. Dineutus is a whirligig beetle in the order Coleoptera and the family Gyrinidae. There are around 700 species of whirligig beetle. It is a cosmopolitan animal, which means that it may be found in almost every corner of the globe. Dineutus are 9 to 15 mm long, elytra are smooth, shallowly lined, or grooved. The name "whirligig" comes from the capacity of this little insect to spin swiftly on the water's surface as a survival strategy. Their incredibly effective ways of propulsion and mobility in water have been investigated and exploited to construct swimming machines and robots. Whirligig beetles are entirely aquatic and unable to walk on land due to the modification of their middle and hind legs into a flipper-like structure. While they prefer to stay on the surface, they will dive short if disturbed and carry a small air bubble under their elytra (beetles toughened outer wings) to prolong the dive. They can fly well when necessary to avoid predators such as fish or migrate to other areas. It is a bottom pond dweller during its larval stage. Adults frequently congregate in huge groups known as rafts, swarms, or schools. Hundreds of individuals of both sexes, and sometimes even numerous species, can be found in these swarms. A variety of things can influence an individual's place within the aggregation. Individuals hovering on the outskirts and in front of the swarm may have easier access to food due to reduced competition from other beetles, but they are also more vulnerable to predation by other animals. Aquatic insects were studied and recorded in river Kangsabati by Das J, Maity J. 2019; 2020; 2021; 2023 [3-6]. *Dineutus sp*. exhibit social behaviors that help in predator avoidance. Studies indicate that their group movements reduce individual predation risk by confusing predators (Nieser & Chen, 2012) [9]. Their rapid, synchronized swimming patterns make it difficult for predators to target a single individual (Holbrook *et al*., 2015) [8].

Scientific classification of *Dineutus sp*

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Coleoptera
Family	Gyrinidae
Genus	*Dineutus* (Macleay, 1825)

Brief information of Whirligig Beetle

Common Name	Whirligig beetle
Family Name	Gyrinidae
Insect Type	Aquatic invertebrate
Feeding Group	Predator
Diet Type	Insectivorous
Habitat Type	Slow parts of rivers, lakes, Ponds, swamps.
Average Life Span in Wild condition	2-3 years
Average Size	3-18 mm
IUCN Status	Most species have not been assessed

Materials and Methods

The study locations are the Kangsabati rail bridge region (22 ° 24 ' 32 " N to 87 °17 ' 43 " E) and the Dherua Bridge region (22 ° 19 ' 17 " N to 87 °05 ' 40 " E), both of which are in the Paschim Medinipur district. The investigation ranged from A1 (1.40 km) to A2 (0.83 km) in site A, and from B1 (1.25 km) to B2 (0.83 km) in site B. (1.01 km). Several aquatic weeds have colonised sampling locations, and these sites have numerous

anthropogenic activities. Many aquatic plants infest the Kangsabati river in Site A, including *Hydrilla sp., Azolla sp., Eichornia sp., Najas sp., Nymphoides sp., Lemna sp.*, and others. The Kangsabati River in Site B is primarily contaminated with *Salvinia sp.* Aquatic entomofauna samples were taken at weekly intervals between 7.00 and 9.00 a.m. A rectangular mouth shaped handnet with a mesh size of 250 m was used to gather samples. The netting was done at a rate of 10 hauls per site every 60 minutes with sampling sites being covered three days in a row every time. After labelling, the specimens were preserved in 4 percent formaldehyde in bottles. Only three or four specimens were taken, and only three or four were identified at the Aquaculture Research Laboratory, with the rest being released after counting. Stereo zoom microscopes by Magnus (MS-24). Standard keys were used to make the identifications. Water temperature, flow rates, and dissolved oxygen levels significantly impact the behavior of whirligig beetles. Higher temperatures correlate with increased activity levels, while rapid water flow can disrupt their aggregation and movement patterns (Voise & Casas, 2010) [11]. Whirligig beetles primarily feed on small invertebrates and organic matter, contributing to nutrient cycling within aquatic ecosystems. They employ specialized hunting techniques, using their forelegs to capture prey from the water surface (APHA, 2017) [1]. Their feeding habits play a crucial role in maintaining ecosystem balance.

Fig 1: Geographic location of sampling sites

Site -A

Site -B

Spin Swiftly on the Water's Surface

Rest on the Substance

Sample Searching in Site-A

Sample Searching in Site-B

Fig 2

Habitat

The whirligig beetle has evolved to the point where it may now be found on all continents except Antarctica. Ponds, streams, and lakes are ideal freshwater environments for it. Due to its benthic larval stage, it will also survive in a well-oxygenated environment. They will travel to larger, deeper bodies of water to overwinter in the northern ranges, where still bodies of water can become frozen through. They will hibernate in the mud until the spring, when they will return to their original location.

Dineutus indicus Aube, 1938

Body-length measures between 13.5 and 15.5 mm, with a somewhat-rounded, elongated, and slender-form. The specimen is predominantly-black, with punctuated-markings. The clypeus-exhibits a bronze-hue, while the lateral-sides display a green-iridescence, and reticulation is prominent. The antennae are black, consisting-of six segments. The pronotum is black-with oblique lateral-margins, and the elytra are-black with striations; displaying distinct reticulation and a slightly

matte surface-texture. Punctuation is double, and the ventral-surface is black. The legs vary from reddish to black in coloration. The median-lobe and paramere are of equal-length, with the median-lobe pointed and the paramere densely-setose and subparallel, rounding towards the apex.

Material examined

Male, 23.iii.2024, Kangsabati River, Paschim Medinipur District, West Bengal, India, Coll. J. Das, in wet preservation, Aquaculture dept. Vidyasagar University, West Bengal, India.

Morphological description

a) Body length: 13.7 mm.
b) The antennae are black, and 6 segments.
c) Dorsal and ventral compound eyes (1mm) widely separated.
d) The pronotum is black-with oblique lateral-margins.
e) The elytra are-black with striations (2mm).
f) Punctuation is double, and the ventral-surface is black.

Genital segments

Male, median-lobe and paramere are of equal-length. Median-lobe pointed and the paramere densely-setose and subparallel (rounding towards the apex).

Collection habitat

Kangsabati River, Paschim Medinipur, West Bengal, India.

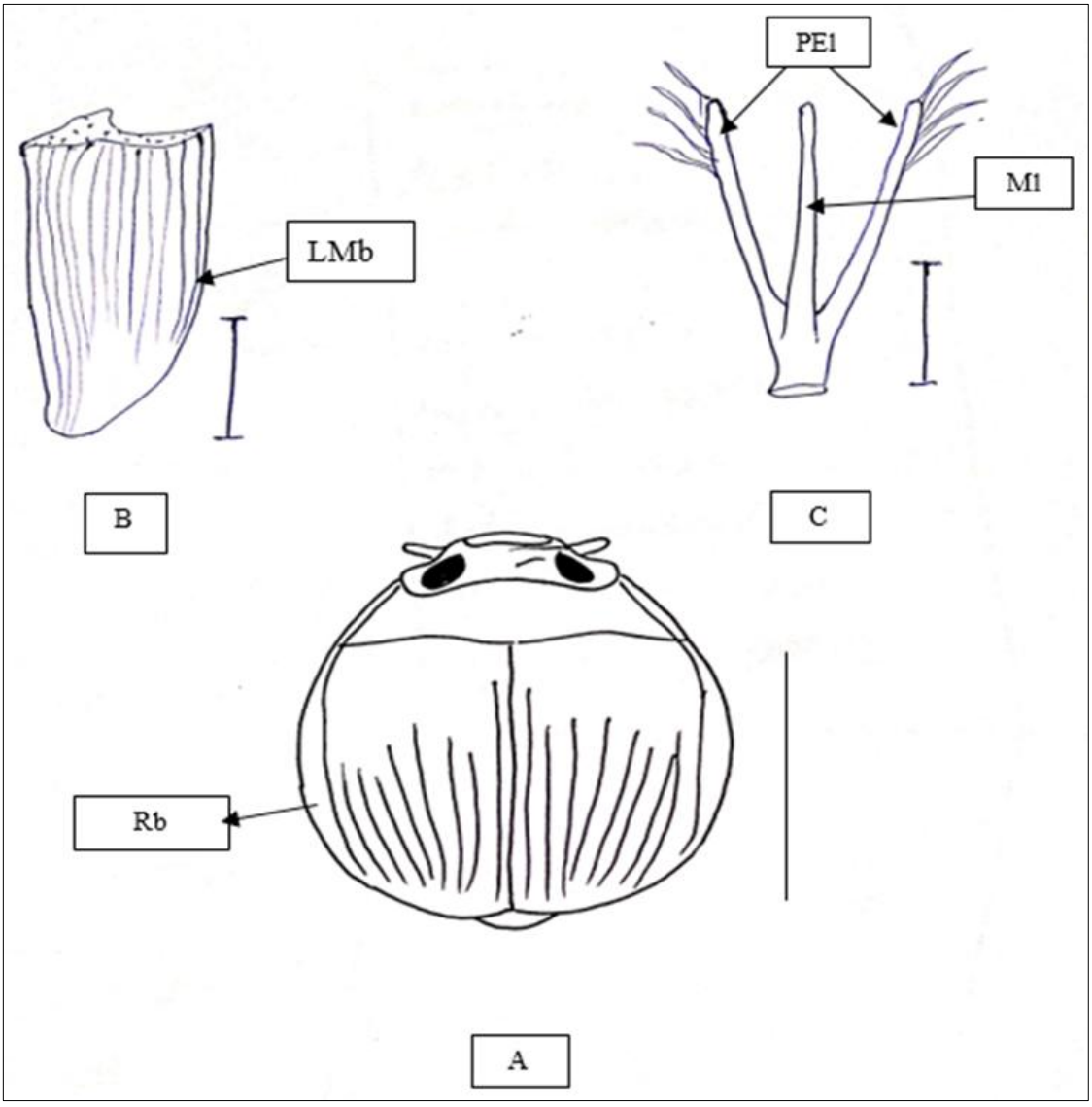


Fig 3: Diagrammatic representation of adult morphology of Dineutus indicus [Gyrinidae] Rb-Round body (A), LMb-Lateral Margin Black of Elytra (B), PEl-Paramere Equal Length, Md-Median length equal(C). Scales: 1mm, 2mm.

Physical features

Whirligig beetles have several physical characteristics that enable them to live in water.

Features of larvae

The larvae have slender, cylindrical bodies and can develop up to 30 mm in length. They have multiple pairs of feathery

abdominal gills that suck atmospheric oxygen, making them well adapted for life at the bottom of ponds.

Features of adult beetle

They have an ellipsoid body form, which is flattened and rounded. Predators find it difficult to grab their strong armour because it is smooth and secretes a waxy, water-repellent coating. They're also usually steel or bronze in colour, which helps them blend in with the water whether the weather is sunny or cloudy. The lengthy front legs are designed to catch prey, while the middle and back legs are designed to paddle through water. The whirligig beetle's short and thick antennae are highly sensitive to motion and can sense waves on the surface as small as a few micrometres in size, allowing it to excel at surface hunting. They will also generate their own surface waves to get feedback about their surroundings, like how other animals use echolocation. They have a Johnston's organ, which are sensory cells in the second segment of the antennae that detect motion, just as other adult insects. The Johnston's organ will be strategically positioned directly at the surface of the whirligig beetle. Whirligig beetles' compound eyes, which are divided horizontally into two portions and allow them to see both above and below water at the same time, are another remarkable characteristic that allows them to live on the surface. This enables these water beetles to be effective predators and avoid becoming prey for other creatures.

Predatory behaviour

Whirligig beetles are daytime carnivores, or insectivores as they are more properly known. The adult's diet consists primarily of surface terrestrial insects, particularly dead insects that have become entangled in the water. Lower in the water column, larvae feed on smaller aquatic insects such as snails, worms, and mites.

Defensive mechanism

It will exude a foul-smelling milky white substance as a protection mechanism to ward off predators. The odour has been likened to that of rotten apples. Fish, birds, and crayfish are common predators of the whirligig beetle.

Life cycle

The longevity of the beetle is determined by its reproductive activities, as it dies quickly after mating. They can live for about 2-3 years on average. Mating usually starts in the spring and lasts until the end of the summer. Each year, up to two new generations are born during this time. Although its sleek body makes it tough for predators to catch it, the male's front legs have suction cups that help him keep a better grip on the female during mating. The life cycle of the whirligig beetle includes complete metamorphosis and four stages: egg, larval, pupa, and adult. A single female will lay approximately 20-50 eggs in total. The incubation period is 5-17 days, and the eggs are placed in rows on submerged vegetation. Summer is when larvae develop, and they spend this time bottom feeding among rocks and flora. They will leave the water to pupate on the seashore or on aquatic plants, using mud and detritus to construct a pupal case. After 8-10 days, adults emerge from their pupal case. It takes roughly 6 weeks for an egg to develop into a fully developed adult.

Results and discussion

The water quality parameters indicate that the Kangsabati River maintains moderate ecological conditions during the wet season. The temperature and pH levels are suitable for aquatic life, while DO levels, although not critically low, suggest some degree of organic pollution. The moderate BOD values indicate the presence of organic matter, which could be a result of increased runoff during the wet season. Further monitoring of nutrient levels, turbidity, and microbial contaminants would provide a more comprehensive understanding of the river's health during different seasons.

Water quality of Kangsabati river in wet seasons

The assessment of water quality parameters in the Kangsabati River during the wet season at two different sites (Site A and Site B) provides insights into the river's ecological health and its ability to support aquatic life.

Temperature

The recorded water temperature at Site A was 26.5 ± 0.25°C, while at Site B, it was 26.6 ± 0.20°C. The temperature variations between the two sites were minimal, suggesting uniform thermal conditions in the river during the wet season. The observed temperature range is within the optimal limits for most freshwater aquatic organisms. However, higher temperatures in tropical rivers can accelerate microbial activity, influencing dissolved oxygen (DO) levels.

pH

The pH values at Site A (7.1 ± 0.08) and Site B (7.2 ± 0.12) indicate neutral to slightly alkaline conditions. This range suggests a well-buffered system, which is suitable for aquatic biodiversity. The slight variation in pH between sites may be due to differences in local geological formations, organic matter decomposition, or anthropogenic influences.

Dissolved Oxygen (DO)

DO levels were 4.1 ± 0.08 mg/L at Site A and 4.2 ± 0.08 mg/L at Site B. These values indicate moderate oxygen availability, which is essential for sustaining aquatic organisms. The slightly higher DO at Site B may be attributed to increased water turbulence, photosynthetic activity, or reduced organic pollution. However, these levels are relatively low, possibly due to organic matter decomposition and high microbial respiration during the wet season, when runoff carries more organic load into the river.

Biological Oxygen Demand (BOD)

BOD values were 2.4 ± 0.12 mg/L at Site A and 2.3 ± 0.20 mg/L at Site B. These moderate BOD levels suggest the presence of biodegradable organic matter, likely from runoff, agricultural discharge, or natural organic decomposition. The slight reduction in BOD at Site B could indicate better water quality conditions, possibly due to increased aeration or dilution effects.

Water quality of Kangsabati river in dry seasons

The water quality assessment of the Kangsabati River during the dry season indicates high temperatures, slightly alkaline pH, low dissolved oxygen levels, and moderate biological oxygen demand. The slight variations between Site A and Site

B suggest local influences such as organic matter input, microbial activity, and hydrological conditions. The relatively low DO and moderate BOD levels indicate potential stress on aquatic organisms, highlighting the need for continuous monitoring and sustainable management strategies to maintain ecological balance in the river.

Temperature

The recorded water temperature at Site A (34.3 ± 0.18°C) and Site B (34.4 ± 0.33°C) indicates relatively high temperatures, characteristic of the dry season. Elevated temperatures can influence aquatic life by reducing dissolved oxygen levels and accelerating biological and chemical reactions in the water body. The similarity in temperature between both sites suggests uniform environmental conditions.

pH

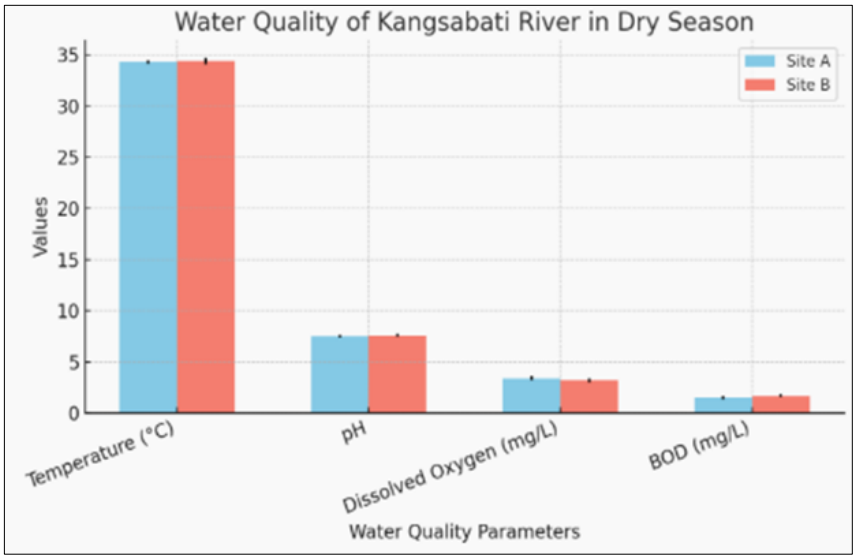
The pH values at Site A (7.5 ± 0.16) and Site B (7.6 ± 0.12) indicate that the river water is slightly alkaline. These values are within the permissible limits for aquatic life, suggesting favourable conditions for sustaining biological communities. A slightly alkaline pH is typical for freshwater ecosystems and can be attributed to the presence of bicarbonates and other buffering agents in the water.

Dissolved Oxygen (DO)

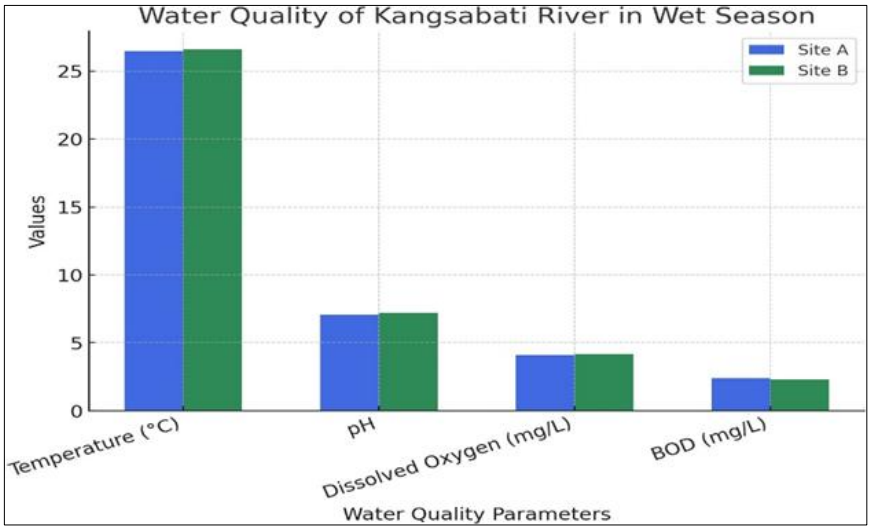
Dissolved oxygen levels were found to be 3.4 ± 0.18 mg/L at Site A and 3.2 ± 0.20 mg/L at Site B. These values indicate low oxygen availability, which may be attributed to high temperatures, reduced flow during the dry season, and organic matter decomposition. The slightly lower DO at Site B suggests higher organic pollution or increased microbial activity, leading to oxygen depletion. Low DO concentrations can have adverse effects on aquatic organisms, particularly sensitive species that require higher oxygen levels for survival.

Biological Oxygen Demand (BOD)

The BOD values were recorded as 1.5 ± 0.16 mg/L at Site A and 1.7 ± 0.12 mg/L at Site B. The slightly higher BOD at Site B suggests a marginally higher organic load, indicating microbial decomposition of organic matter. Though these values are within acceptable limits, an increase in BOD can further reduce DO levels, potentially impacting aquatic biodiversity.



Graph 1: Water quality of Kangsabati river in dry season



Graph 2: Water quality of Kangsabati river in wet season

Table 1: Water quality of Kangsabati river in wet season

Parameters	Site A	Site B
Temperature (℃)	26.5 ± 0.25	26.6 ± 0.20
pH	7.1 ± 0.08	7.2 ± 0.12
Dissolved oxygen(mg/L)	4.1 ± 0.08	4.2 ± 0.08
Biological oxygen demand (mg/L)	2.4 ± 0.12	2.3 ± 0.20

Table 2: Water quality of Kangsabati river in dry season

Parameters	Site A	Site B
Temperature (℃)	34.3 ± 0.18	34.4 ± 0.33
pH	7.5 ± 0.16	7.6 ± 0.12
Dissolved oxygen(mg/L)	3.4 ± 0.18	3.2 ± 0.20
Biological oxygen demand (mg/L)	1.5 ± 0.16	1.7 ± 0.12

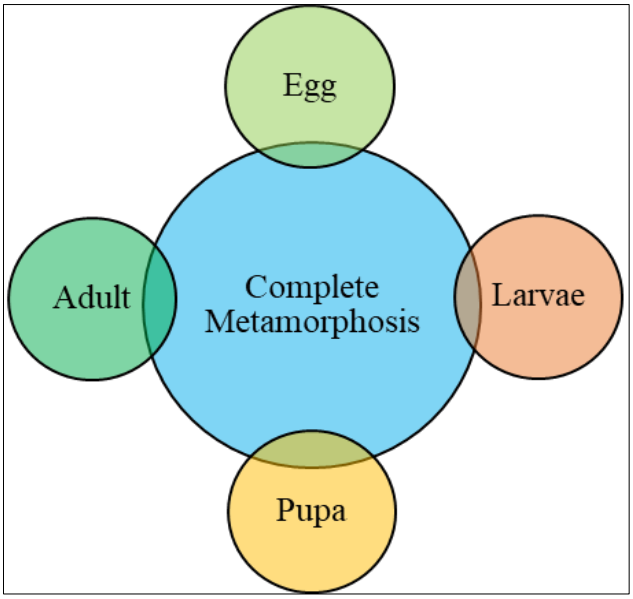


Fig 4: Diagrammatic representation of the life cycle of *Dineutus sp.*

Conclusions

Whirligig beetles are natural cleaners that can be advantageous to a home aquatic setup. The feeding pattern and diet of the whirligig beetle, which includes scavenging dead insects stranded on the surface, can help maintain a pond clean. They also aid in the control of populations of less desirable aquatic insects. They are appealing with some people, particularly youngsters, because of their unpredictable and continual movement during daytime hours, and they provide excitement to ponds. They are not at all dangerous to humans, and if you approach them or try to catch them, they will simply swim away. Maintaining generally clean water, with plenty of open spaces for swimming on the surface and some submerged aquatic vegetation, might attract them. The latter is necessary for these beetles to complete their life cycle. In fact, the presence of whirligig beetles can be a sign of good water quality because they are not pollutant-tolerant.

Acknowledgements

Authors thank the Higher Education Department, Government of West Bengal for the financial support.

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