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## DISTRIBUTION OF INTERTIDAL MALACOFUNA AT SAGAR ISLAND

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### INTRODUCTION

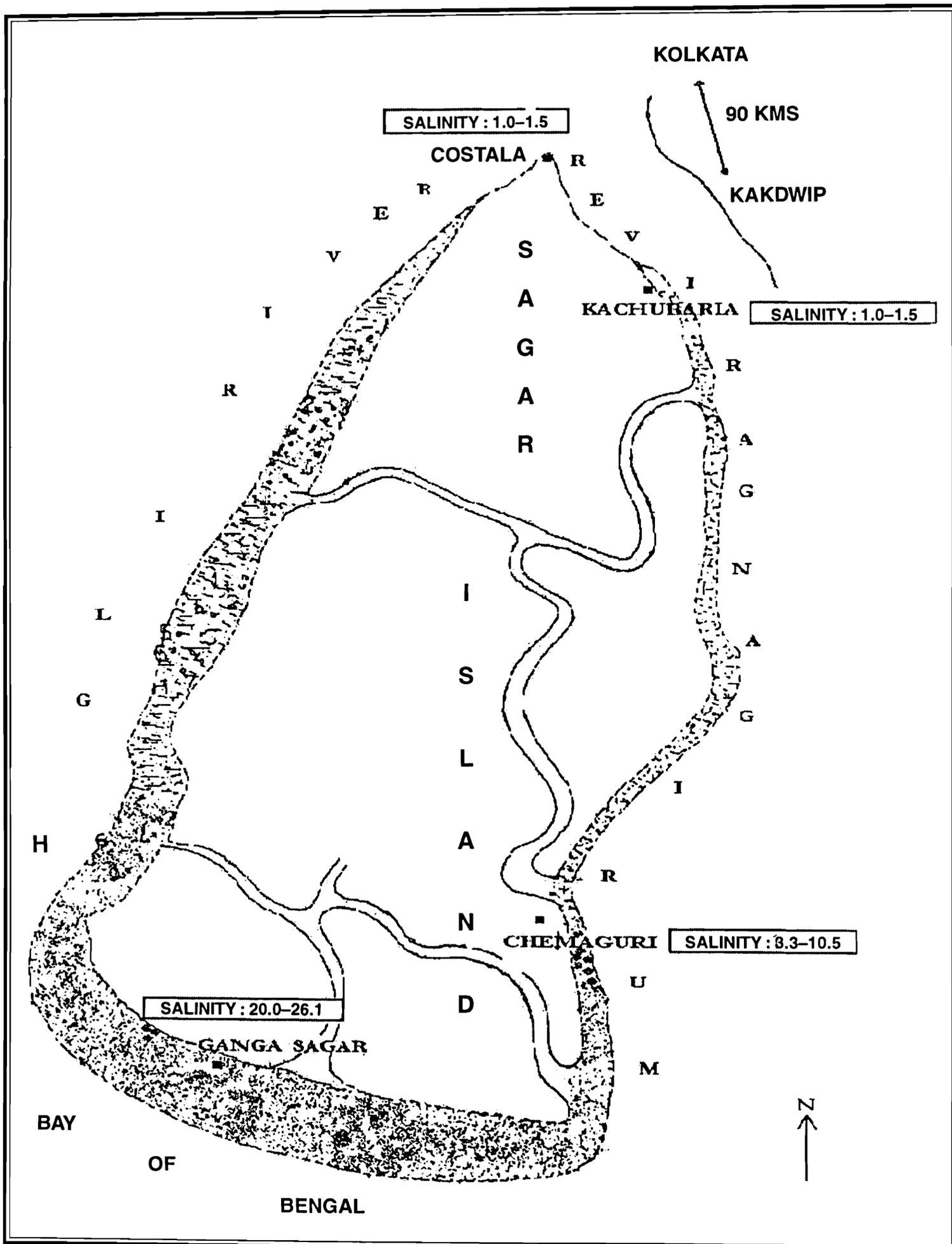
Sagar Island, the largest island of Indian Sunderban is about 105 kms south from the city of Kolkata. It is surrounded by the river Hugli on the north and north-western side and the river Muriganga on the eastern side. The southern part of the island faces the open sea, Bay of Bengal. Its geographical location is between 21°31' N to 21°53' N latitudes and 88°02' E to 88°15' E meridians.

The island has an area of about 300 sq km and is criss-crossed by twelve large and small tidal creeks strewn with mangrove vegetation, all connected with the principal estuarine water bodies, either on the east or on the west coast. Chemaguri creek is the principal creek in this island with flourishing mangrove vegetation at the bank. The island has an old light house on the south-west corner which offers settlement of a variety of bivalve and gastropod species. In addition, mangrove patches present on the southern part of the island are unique beds for *Telescopium telescopium*, *Cerithidea cingulata*, *Cerithidea obtusa* etc. The hard substrata of the broken light house also provide sites for attachment of various molluscan species like *Saccostrea cucullata*, *Thais lacera*, *Littorina scabra scabra* etc. The present article aims to throw light on the molluscan spectrum of the island with relation to major environmental variables like surface water salinity, pH and dilution factor during 2003. These parameters were collected from the data bank of Dept. of Marine Science, University of Calcutta.

### MORPHOLOGICAL FEATURES OF THE ISLAND

Sagar Island is the largest island of Indian Sunderban. With a considerable degree of marine characteristics in southern portion of the island, the important morphotype of the island are beaches,

### MAP OF SAGAR ISLAND (SHOWING FOUR SELECTED STATIONS)



mud flats, coastal dunes, sand flats, estuaries, creeks, inlets and mangrove swamps. The different morphological features of Sagar Island may be broadly divided into three headings :

- i. Marginal marshy areas above mean tide level.
- ii. Channel and tidal island with intertidal flats and dune areas.
- iii. Subtidal channel areas.

The marginal parts of the island are affected practically all times by wave and tidal currents and are best to depict the details of various morphological and structural characteristics. The sand and silt flats of these zones are sculptured complexly by different types of primary and secondary sedimentary structures. There exists considerable degree of variation of physico-chemical variables as one approach from southern to northern tip of the island (Table I). This is the main cause of malacofaunal diversity witnessed in Sagar Island (Table II).

Four stations were selected to study the distribution of molluscs. These are :

- I. **Kachuberia**
- II. **Costala**
- III. **Chemaguri**
- IV **Gangasagar**

#### STATION I : Kachuberia

The station is situated on the northern tip of the island. A passenger jetty present at this station offers the settlement of oysters (*Saccostrea cucullata.*) and gastropods like *Littorina scabra scabra*,

**Table I. : Mean seasonal variations of salinity, pH and dilution factor (df) at different sampling station in the Sagar Island during 2003.**

Station	Pre monsoon			Monsoon			Post monsoon		
	Salinity (%)	pH	df	Salinity (%)	pH	df	Salinity (%)	pH	df
Sagar light house area (south-western tip of the Sagar Island)	28.2	8.34	0.17	16.8	8.30	0.42	24.1	8.31	0.24
Chemaguri (south-eastern part of the Sagar Island)	23.7	8.21	0.30	10.1	8.20	0.65	19.6	8.22	0.39
Kachuberia (northern most tip of the Sagar Island)	12.8	8.01	0.62	2.5	8.00	0.91	8.8	8.10	0.73

TABLE II. : LIST OF SPECIES OCCURRING IN SAGAR ISLAND.

NAME OF THE SPECIES	STATION			
	I	II	III	IV
<b>Gastropoda</b>				
1. <i>Nerita articulata</i> (Gould)	+	-	-	+
2. <i>Pseudonerita sulculosa</i> (von Martens)	+	-	-	+
3. <i>Nerita (Dostia) violacea</i> (Gmelin)	+	+	+	-
4. <i>Littorina (Littorinopsis) scabra scabra</i> (Linnaeus)	+	-	-	+
5. <i>L.(Littoraria) melanostoma</i> Gray	+	+	+	+
6. <i>Stenothyra deltae</i> (Benson)	-	+	+	+
7. <i>Assimineia brevicula</i> Pfeiffer	+	+	+	+
8. <i>A. beddomeana</i> Nevill	+	+	+	+
9. <i>Cerithidea (Cerithideopsis) cingulata</i> (Gmelin)	-	-	+	+
10. <i>Cerithidea (Cerithidea) obtusa</i> (Lamarck)	-	-	+	+
11. <i>Telescopium telescopium</i> (Linnaeus)	-	+	+	+
12. <i>Acrilla acuminata</i> (Sowerby)	-	-	-	+
13. <i>Natica tigrina</i> (Roeding)	+	-	-	+
14. <i>N. gualteriana</i> Recluz	-	-	-	+
15. <i>Thais lacera</i> (Born)	+	-	+	+
16. <i>Nassarius stolatus</i> (Gmelin)	-	-	-	+
17. <i>N. foveolatus</i> (Reeve)	-	-	+	+
18. <i>Amalda ampla</i> (Gmelin)	-	-	-	+
19. <i>Haminea crocata</i> Pease	-	-	-	+
20. <i>Onchidium tenerum</i> (Stoliczka)	-	+	+	-
21. <i>O. tigrinum</i> Stoliczka	+	-	-	-
22. <i>Pythia plicata</i> (Gray)	-	-	-	+
23. <i>Larina burmana</i> Blanford	-	-	-	+
24. <i>Auricula translucens</i> Annandale and Prashad	-	-	-	+
<b>Bivalvia</b>				
1. <i>Crassostrea cuttackensis</i> (Newton and Smith)	-	-	-	+
2. <i>Saccostrea cucullata</i> (Born)	+	-	+	-
3. <i>Sanguinolaria (Soletellina) acuminata</i> (Philippi)	-	-	-	+
4. <i>Strigilla splendida</i> (Anton)	-	-	-	+
5. <i>Macoma birmanica</i> (Philippi)	-	-	+	-
6. <i>Theora opalina</i> (Hind)	-	-	+	+
7. <i>Siliqua albida</i> Dunker	-	+	-	-
8. <i>Meretrix meretrix</i> (Linnaeus)	-	-	-	+
9. <i>Glauconome sculpta</i> (Sowerby)	-	+	-	+
10. <i>Donax incarnatus</i> Gmelin	-	-	-	+
11. <i>Solen kempfi</i> Preston	-	-	-	+
12. <i>Barnea candida</i> (Linnaeus)	-	-	-	+
13. <i>Bankia rochi</i> Moll	-	-	-	+

*Nerita articulata* and *Thais lacera* (Pl. IV, figs. C, E). The first two species were dominant in the region. Occasionally empty shells of *Littorina melanostoma*, *Natica tigrina* and *Nerita articulata* inhabited by hermit crabs were also seen. The terrain on either side of the jetty is hard, interspersed with brick pieces, stones etc. and devoid of vegetation. *Onchidium tigrinum* was found crawling on the bricks of this terrain.

### STATION II : Costala

The station is situated 3 kms northwest of Kachuberia and the river bank is protected by mud bund. About 0.5 km of bed gets exposed during the low tide. Small patch of mangrove plants locally called as Baen (*Avicennia sp.*) and Haraguja, (*Acanthus illicifolius*) was observed. Most of the bed is covered with grass extending upto mid water mark and gradually decreases towards low water mark.

The terrain is hard to semi-hard between high to mid water mark and semi hard to soft mud between mid to low water mark, intersected by few small creeklets. At the high water mark large numbers of ditches are present, where the water comes only during spring tide.

The dominant malacofauna in this station are *Assiminea brevicula* (Pl. IV, fig. F) that extends from mid to low water mark with gradual increase in numbers and *Telescopium telescopium* found crawling on mud banks along the creeklets and ditches near the bed. The others are *Assiminea beddomeana*, *Stenothyra deltae* and *Onchidium tenerum*.

The mangrove plants often provide shelters to *Littorina melanostoma* which cling to their branches (Pl. IV, fig. B). Bivalve *Glaucanome sculpta*, *Siliqua altida* were collected from exposed bed during the low tide period.

### STATION III : Chemaguri

Chemaguri is situated 11 kms northeast of Gangasagar. A creek flowing through this station opens into the main river. The banks of the creek are studded with mangrove vegetation all along upto the river mouth, with salt marsh grass patches (*Porteratia coarctata*) from mid to low water mark. The terrain is hard to semi hard with loose slushy patches at the low water marks. The common malacofauna are *Assiminea brevicula*, *Assiminea beddomeana*, *Telescopium telescopium*, *Cerithidea cingulata*, *Cerithidea obtusa*, *Littorina melanostoma*, *Stenothyra deltae*, *Onchidium tenerum*. Among them *Cerithidea obtusa* and *Littoraria melanostoma* found clinging to the branches of mangrove trees.

The jetty pilers are thickly coated with sea anemones (*Metridium sp.*) barnacles, oysters (*Saccostrea cucullata*), *Littorina scabra scabra* and *Thais lacera*.

The mud flats of creek near the river mouth get exposed during the spring tides. The substratum consists of very loose mud with slushy pockets, criss-crossed by small creeklets. The slushy pockets are knee-deep to waist deep. The malacofauna on the mudflat in order of dominance are *Cerithidea cingulata* > *Telescopium telescopium* > *Theora opalina* > *Macoma birmanica* > *Nassarius foveolatus*. The first two species were concentrated in the centre of the mud flat, whereas the last three near the bank. The two bivalve species were found to occur at a depth of 10–30 cms in the slushy pockets. Presence of *Macoma birmanica* inside the burrows, were indicated by their protruding siphon that spread out on the slushy mud surface.

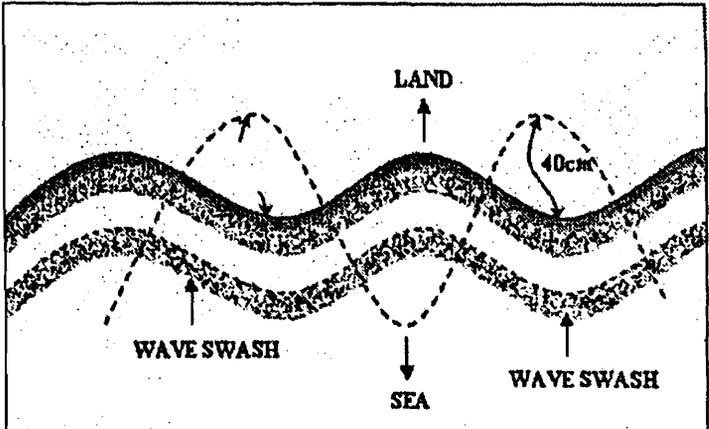
#### STATION IV : Gangasagar

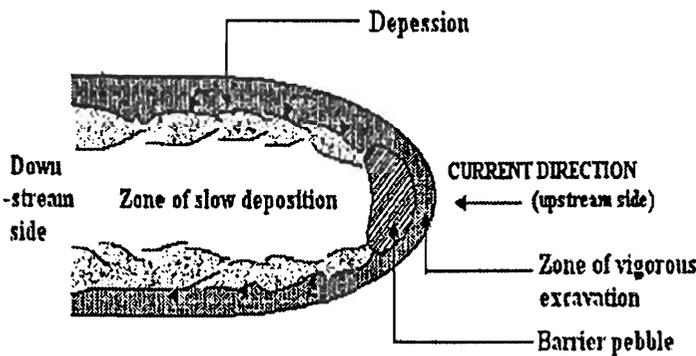
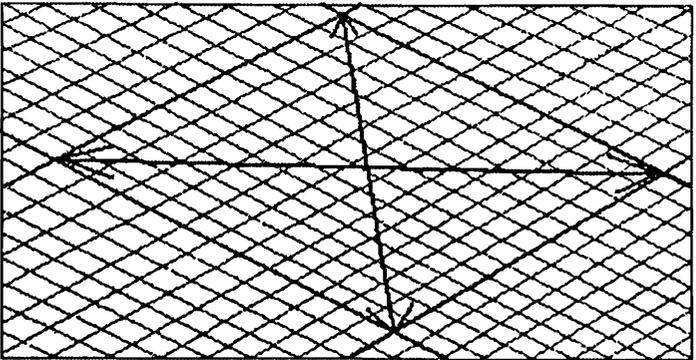
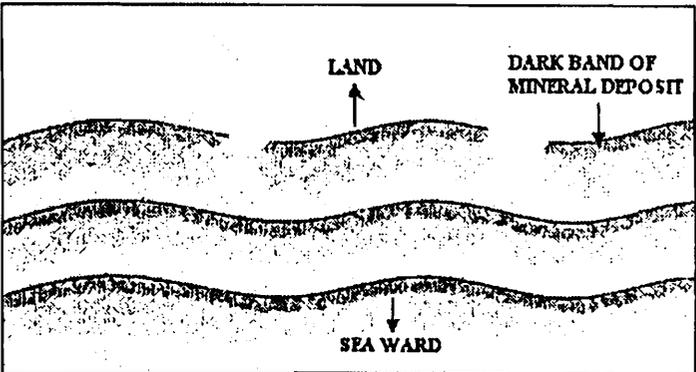
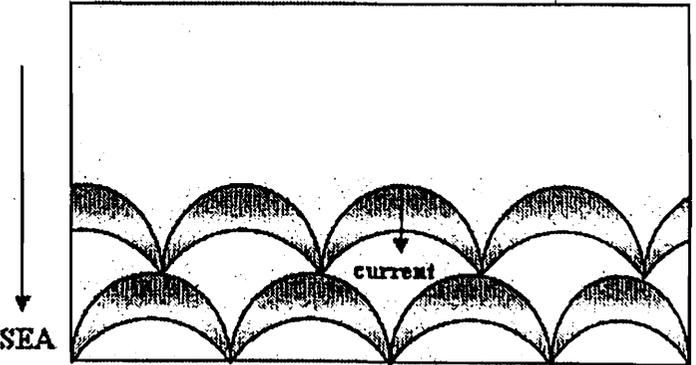
This is the southern tip of the island facing the Bay of Bengal. The beach is confined between two river mouths. A creek runs into the sea about 0.5 kms east of the Irrigation Bungalow, which flows north-west after separating in two branches. For a better scanning of the ambient environment, the area was grouped into three zones :

- A. Gangasagar beach
- B. The creek and their branches
- C. Mangrove forest

#### A. Gangasagar beach

The beach is mostly sandy admixed with fine mud and interspersed with mudflats. There are many surface structures recorded in the Gangasagar beach.

Surface structures in the Gangasagar beach	Description	Diagrammatic representation
Swash Mark	They are thin wavy ridge lines in the intertidal swash zone formed by upward movement of the wave swash. The forward edge of the wave tends to carry particles of sand and silt, sizes along with the caught up debris by the process of surface tension.	 <p style="text-align: center;"><b>SWASH MARK</b></p>

<p>Current crescent</p>	<p>They are V-shaped marks produced by currents against shell of organisms or clay pellets placed on the intertidal ridges. These broaden in the direction of flow and are produced by the back flow of tidal currents.</p>	 <p style="text-align: center;"><b>CURRENT CRESCENT</b></p>
<p>Rhombic ripple marks</p>	<p>These are diamond shaped structures that develop in the swash zone of the intertidal ridges. These structures are developed by backwash wave where the slope of the beach face is relatively steep.</p>	 <p style="text-align: center;"><b>RHOMBOID MARKS</b></p>
<p>Backwash ripples</p>	<p>They are symmetrical structures which migrate down slope by wave backwash. The crestal part of the ripples becomes flat by backwash.</p>	 <p style="text-align: center;"><b>BACKWASH RIPPLE</b></p>
<p>Crescentic ripples</p>	<p>These are cusped-shaped structure and lunate or linguoid in nature. The concave faces are toward the sea and convex sides are toward the land.</p>	 <p style="text-align: center;"><b>CRESCENTIC RIPPLE</b></p>

Besides these there are sand dykes of variable thickness, which are transgressive into parallel laminations in many areas of swash zone of the Gangasagar.

Air temperature : 25–36°C

Soil temperature : 26–35.5°C

Salinity : 18.6‰–29.2‰

Dissolve oxygen : 0.4–3.9 ml/l

For the study of the malacofauna three zones have been identified on the beach :

- a. **Supralittoral zone**
- b. **Littoral zone**
- c. **Eulittoral zone**

Supralittoral zone is mainly sandy with sand dunes extending upto the Kapilmuni temple. Beyond the temple there are hard mudflats. *Ipomoea pescaprae*, the common sand binders are found on the sand dunes and on the west of the mangrove forest. The region between high to mid water marks is sandy towards east and interspersed by mud flats in the west. The terrain is semi hard on sandy patches due to admixture of silt with sand. The mud flats are hard, slippery, corrugated and criss-crossed with small canals. Several dead shells are observed at mangrove vegetation and their roots. The mudflats near the mid water mark support few population of *Glaucanome sculpta*. Further down towards low water mark beach is hard to semi hard with patches of mudflats between. During spring tides a vast area of the beach is exposed, often extending for about a kilometer from supralittoral zone. The malacofauna observed are *Nassarius stolatus*, *Natica tigrina*, *Natica gualteriana*. Occasionally *Acrilla acuminata*, *Amalda ampla*, *Donax incarnatus* are also observed. The mudflats support rich population of *Barnea candida*, *Glaucanome sculpta*, *Solen kempfi*, *Strigilla splendida* and *Theora opalina*. The mangrove swamps on the mud flats are inhabited by *Littorina scabra scabra*, *Larina burmana* and oysters (*Saccostrea cucullata*).

## **B. The Creek and their branches at Gangasagar**

The creek has a wider mouth opening in the sea. The mouth is shallow and sandy; upstream the banks are steeper and muddy supporting mangrove vegetation.

The malacofauna near the mouth includes *Cerithidea cingulata*, *Nassarius stolatus*, *Meretrix meretrix*. The banks of the creek are inhabited by *Assiminea brevicula*, *Assiminea beddomeana* and *Haminea crocata*. Small population of *Littorina melanostoma* is found clinging to the plants on the bank. In the upper most part of creek where the water remains in ditches *Pseudonerita sulculosa* is also seen.

**Table III.** : Showing different ecological niches with dominant malacofauna

MUD BANKS AND MUD FLATS	MANGROVE FOREST	SANDY BEACH	MUD FLAT ON THE BEACH	JETTY, PILES, MANGROVE STEM AND DYKES
1. <i>Assimineia brevicula</i> Pfeiffer	1. <i>Cerithidea (Cerithidea) obtusa</i> Lamarck	1. <i>Nassarius stolatus</i> (Gmelin)	1. <i>Glauconome sculpta</i> (Sowerby)	1. <i>Littorina scabra scabra</i> (Linnaeus)
2. <i>A. beddomeana</i> Nevill	2. <i>Nerita articulata</i> (Gould)	2. <i>Natica tigrina</i> (Roeding)	2. <i>Barnea candida</i> (Linnaeus)	2. <i>Thais lacera</i> (Born)
3. <i>Telescopium telescopium</i> Linnaeus	3. <i>Littorina(Littorina) melanostoma</i> Gray	3. <i>N. gualteriana</i> Recluz	3. <i>Solen kempii</i> Preston	3. <i>Onchidium tigrinum</i> Stoliczka
4. <i>Cerithidea (Cerithideopsilla) cingulata</i> (Gmelin)	4. <i>Pythia plicata</i> (Gray)	4. <i>Acrilla acuminata</i> (Sowerby)		4. <i>O. tenerum</i> Stoliczka
5. <i>Stenothyra deltae</i> (Benson)	5. <i>Auricula translucens</i> Annandale and Prashad	5. <i>Amalda ampula</i> (Gmelin)		5. <i>Saccostrea cucullata</i> (Born)
6. <i>Onchidium tenerum</i> Stoliczka		6. <i>Donax incarnatus</i> Gmelin		
7. <i>O. tigrina</i> Stoliczka		7. <i>Meretrix meretrix</i> (Linnaeus)		
8. <i>Nassarius stolatus</i> (Gmelin)				
9. <i>Haminea crocata</i> Pease				
10. <i>Macoma birmanica</i> (Philippi)				
11. <i>Theora opalina</i> (Hind)				
12. <i>Strigilla splendida</i> (Anton)				

### C. Mangrove forest

The mangrove forest extends from the sides of the Irrigation Bungalow to west towards the mouth of the river Hugli. The major constituents are Hital (*Phoenix paludosa*). Others include Baen (*Avicennia* spp.), Genwa (*Excoecaria agallocha*) and Haraguja (*Acanthus illicifolius*)

The terrain is muddy with puddes and ditches. During the spring tide water enters in this region, but at other times it is semi dry. The ditches are with soft mud and small amount of water. The common malacofaunain this zone are *Telescopium telescopium* (Pl. IV; fig. A), *Cerithidia cingulata*, *Cerithidea obtusa* (Pl. IV fig. D), *Pythia plicata* and *Auricula translucens*.

## DISCUSSION

A total of 37 species of molluscs have been recorded from the intertidal zone of Sagar Island, of which 24 species are gastropods and 13 bivalves (Table II). 31 species have been recorded from Sagar South(Gangasagar), followed by 14 species from Chemaguri, 11 from Kachuberia and 9 species from Costala. Gangasagar is in the immediate vicinity of the sea thus having the maximum influence of marine species. Chemaguri is nearer to Gangasagar has more species than other stations which are not primarily marine in nature.

Depending upon the ecological niches the intertidal malacofauna of Sagar Island can be grouped into five categories : the fauna of mud banks and mud flats, mangrove forest, sandy beach, mudflat on the beach and the fauna of jetty pillars and mangrove swamps and dykes (Table III). Among these the maximum species recorded from the mud banks and mud flats. The species common on these areas are *Assiminea brevicula*, *Assiminia beddomeana*, *Telescopium telescopium*, *Cerithidea cingulata*, *Stenothyra deltae*, *Nassarius stolatus*, *Haminea crocata*, *Onchidium tenerum*, *Macoma birmanica*, *Theora opalina* and *Strigilla splendida*.

The malacofauna of mangrove area include *Cerithidea cingulata*, *Nerita articulata*, *Littorina melanostoma*, *Pythia plicata* and *Auricula translucens* occurs at the base of the plant or in the crevices or attached to the mangrove stems. *Nerita articulata* observed attached to mangrove plant up 1.5 meters height.

In the sandy beach the malacofauna observed from mid tidal zone to low tide mark and the common species were *Nassarius stolatus*, *Natica tigrina*, *Natica gualteriana*, *Acrilla acuminata*, *Amalda ampla*, *Donax incarnatus* and *Meretrix meretrix*. On the mudflat of the sea beaches the *Glaucanome sculpta* were observed as the dominant malacofauna. Others are *Barnea candida* and *Solen kempi*.

In the pillar of jetty, dykes *Littorina scabra scabra* was observed as the dominant malacofauna followed by *Saccostrea cucullata*, *Thais lacera*, *Onchidium* spp.

The malacofauna recorded show more or distinct zonations with maximum densities at certain levels. In the uppermost zone of mud and mud flats the *Telescopium telescopium*, *Cerithidea cingulata*, *Assiminea brevicula*, *Assiminea beddomeana* were very common. *Haminea crocata* is observed in the ditches with soft mud and grasses, on the bank. In the middle region *Assiminea brevicula*, *Nassarius stolatus*, *Natica tigrina* and in the lowest zone mainly the *Macoma birmanica*, *Theora opalina* and *Strigilla splendida* were recorded.

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