Assessment of the Diversity and Spatial Distribution Patterns of Marine Bivalve Molluscs in the Intertidal Zone of Digha Coast

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ABSTRACT

This study aims to analyze the diversity of different conflict species in the intertidal zone of the coastal area, thereby understanding the role of environmental factors in the formation of marine populations. The study was conducted for three months from March 2023 to May 2023 in three remote areas of the coastal region namely New Digha, Mohan and Talsari. These sites were selected based on contrasting environmental conditions. Our study compares the abundance of bivalve mollusks from differently analyzed and intermediate zones depending on the selected environmental conditions. In the present study, we found that Mohana beach (S1), New Digha beach (S2) and Talsari beach (S3) showed the highest species richness and diversity than other sites. Shannon's diversity index was observed in Mohana Beach (H = 27.6), New Digha Beach (H = 17.56) and Talsari Beach (H = 18.34). The study of Mohana beach (S1) shows the highest species richness and diversity than New Digha beach (S2) and Talsari beach (S3). Based on my collection and identification of species, I sorted them quantitatively into different study areas (Mohana, New Digha, Talsari) to assess their diversity and relevance and abundance to construct the Shannon index. Bivalve species are important components of coastal ecosystems around the world, playing an important ecological role in sediment stability, nutrient cycling, and energy flow. Bivalves are distributed in the intertidal and subtidal zones of coastal areas with different morphological, physiological and behavioral adaptations that allow them to survive and thrive in different areas. Studying biodiversity in the intertidal zone is very important because this area is frequently affected by the tidal cycle and environmental changes, and inundation can affect the different layering of the sea and its condition.

1. INTRODUCTION

The transitional area separating the sea and terrestrial environment is the intertidal zone or the littoral zone. This zone will be submerged with water at high tide and remains uncovered at low tide. The environmental conditions of littoral zones are frequently changing and challenging, organisms that are adapted to such conditions are found in intertidal zones. Organisms living in an intertidal area are inherently tolerant to a wide range of natural conditions (Halim et al., 2019). The intertidal zone is characterized by extreme changes in salinity, desiccation, temperature, cur-rents, and predators. Hence, many organisms possess special adaptive features to overcome these challenges.

Bivalve Molluscan are one of the phyla that form an important component of intertidal fauna (Chapman, 2012). Bivalve Molluscan play a significant role in the ecosystem by providing food sources to aquatic animals, migratory birds, and humans (Halim et al. 2019). Bivalve Molluscs feed on algal matter, other snails, and detritus(Ramesh and Ravichandran, 2008). bivalve Molluscs form a key link in the food chain and have a high soci-oeconomic value for coastal fisheries. Coastal Karnataka, comprises sandy and rocky shorelines which are with rich faunal communities with distinctive morphological characters forming the benthic/pelagic realm of the marine ecosystem. The sandy beaches lying adjacent to the rocky stretch includes pebbles, boulders, and small rock submerged in seawater during high tide. The studies on the diversity of bivalve molluscs in intertidal habitats of coastal Karnataka are limited (Haragi and Naik, 2012; Tenjing, et al., 2018). The factors governing the distribution of mollusca on the coast are not known.

2. MATERIALS AND METHODS

2.1) Study area

Digha was selected for the study based on an initial pilot survey of Bivalve species from different parts of the coastal belt.

Important learning points and a good understanding of the hydro-biology of benthic Molluscs as a unique model. For details, coastal sea belt ofDigha was selected to study availability and use of competitors. Coastal belt Midnapore District (East) West Bengal, India 870 5 'E to 880 5' E and 200 30 'N longitude 220 2' N. Three areas of study contrast in the present work.

Digda Mohana, New Digha and Talshari Ecotone Interval Zone, Bay of Bangladesh, West Bangladesh - Odisha Coast, India, Dubda was selected at the inlet of Bangladesh Bay. It is geographically located at the foot of Digha Bay. It is located very close to the mouth of the Ganges. East coast of India up to Bay of Bengal, 21' latitude 36'30" N and longitude 87° 30'E. It is a fishing and fishing center as well as a tourist center in Western Bangladesh. The climate is tropical and humid most of the season. It rains all year round. 1000 mm to 1300 mm. It varies from 16ºC to 35.5ºC and the relative humidity varies. From 50% in December to 78% in July. The average wind speed is 30 km/hour. The average wave amplitude is about 2 m per total cycle of the Moon. Beautiful rivers divide the common coast of West Bengal.

2.1.1) Coastal Zone:

i) Digha - Medinipur ancient Rasulpur beach and

ii) The Delta area of 24 South Parganas District of West Bangla has a total coastline of 158.2 km. Offshore Digha - Rasulpur occupies the delta area of ??the 24 Parganas Kidul district, about 55.2 km and 103 km from the coast.

The bivalve species were collected at low tide from the dry seashore by hand, knife and dust.

2.2) Sampling method

The bivalve species composition was documented by placing 25 random sampling quadrats (1 m × 1 m). Location of three study sites (Digha Mohana, New Digha Beach, Talsari Beach) from March to May 2023. For the current study, I used three examples of each site (Digha Mohana, New Digha Beach and Talsari Beach) for comparison, to assess the disparity between the three different habitats in physico-chemical parameters. This type of Bivalve is available at every site. Sampling units are hand-picked at low flow. identified in situ and fixed in 4% formalin and transported to the Laboratory for identification using species identification guidelines (Dey, 2006; Modayil, 2007).Soil Sample Each sample was collected using a soil corer at a depth of 0-10 cm from the soil surface and stored in a plastic bag. Soil and water samples were taken from each site and taken to the laboratory for further analysis. In the laboratory, the soil samples were air-dried, homogenized, and sieved through a 2-mm mesh to remove rock fragments and larger root particles. Composite soil samples were used for detailed analysis of soil salinity, pH, temperature, soil texture, and organic carbon.

2.3) Data Analysis:

The study of environmental abiotic parameters and water physicochemical parameters is important in understanding the diversity of marine species in coastal areas, especially in the intertidal zone. In this research project, we will discuss the importance of data analysis in studying the diversity of species and the factors that affect their population.

Abiotic environmental parameters are non-living environmental factors. These include factors such as temperature, salinity and pH. Physicochemical water parameters refer to the physical and chemical properties of water, such as dissolved oxygen, nitrate concentration, and ammonia concentration. These parameters play an important role in shaping the ecology of the intertidal zone.

The diversity of the intermediate zone is conditioned by the unique physical and chemical conditions of the environment. Organisms that live in the intertidal zone are adapted to changing water conditions.

Bivalve species are important components of coastal ecosystems, contributing to productivity, nutrient cycling, and habitat creation. However, their population is exposed to environmental changes, especially changes in temperature, salinity, and dissolved oxygen levels. Therefore, accurate monitoring and analysis of abiotic and physicochemical parameters of the environment is important for understanding the distribution, abundance and diversity of marine species in coastal areas.

2.3.1) Physicochemical parameter analysis method:

Monthly samples of soil and interstitial water and soil were prepared from three study sites at different levels of inundation to evaluate different physico-chemical parameters of soil and water using standard methods (Strickland and Parsons, 1968; Jackson, 1973; FAO, 1976; & APHA, 2005) and using a water quality tester (Water Analyzer 371).

2.3.2) Intermediate water sample analysis:

2.3.2.1) Temperature: The interstitial water temperature in each study location at three tide levels was measured using a mercury thermometer with a resolution of 0.1 °C.

2.3.2.2) pH: The interstitial water pH is measured using a portable pH meter as well as an automatic water quality tester (Water Analyzer 371).

2.3.2.3) Salinity (ppm): Water salinity is measured by an automatic water quality tester (Water Analyzer 371).

2.3.2.4) Dissolved oxygen (mL): The level of dissolved oxygen in water is measured using the Winkler titrimetric method (Strickland & Parsons, 1968) as well as a water quality tester (Water Analyzer 371).

2.3.2.5) Turbidity (NTU): Turbidity is measured using an automatic water analyzer (Water Analyzer 371).

2.3.2.6) Conductivity (s/m): Water conductivity is measured by water quality tester (Water Analyzer 371).

2.3.2.7) Nutrients-Nitrogen, Phosphate, Potassium (mg/l): Nutrients are measured using the standard method of (Strickland and Parsons, 1968) and APHA (2005).

2.3.3) Soil Sample Analysis: a metal knife was used to collect soil samples from the three study areas mentioned above and transported to the laboratory in airtight polyethylene bags. Samples were collected from sun-dried powder with a standard sieve (BSS 40 40, mesh size 0.42mm) and the following parameters were recorded.

2.3.3.1) Temperature (T): The soil temperature in each study location of the three tide levels was measured using a mercury thermometer with a resolution of 0.1 degrees Celsius.

2.3.3.2) pH: Measure the pH below the site b electronic pH meter.

2.3.3.3) Organic Carbon (%) : Organic carbon content of three study areas were measured by using Wakeel & Riley (1956), Walkley and Black (1934) wet designation method using 0.5 N ferrous Ammonium sulphate.

2.3.3.4) Salinity (ppm): Fresh soil suspension is prepared in distilled water at a ratio of 1:5 and the suspension is kept mechanically for one hour and filtered through 42 filter paper. The salinity of the filter was then measured using the standard method described by Strickland and Parsons in 1968.

2.3.3.5) Nutrients - Nitrogen, Potassium, Phosphorus (mg/100gm): Measured by the standard method prescribed by Hesse, (1971); Jackson, 1967 and FAO, 1976.

2.3.3.6) Soil texture (sand%, silt% and silt%): Soil texture constituents were evaluated by mechanical analysis using the international tube method as described by Banerjee and Chattopadhyay, 1980.

3. Result

3.1) Physiography of the study area: Digha is a type of sandy beach that can be defined as a sandy beach along the coast known as the land and sea interaction zone. These interactions are further complicated by additional processes such as waves and winds and boundary conditions such as antecedent morphology, geology, sediment characteristics, and biota (Short and Jackson, 2013). The three sandy beaches are i) beaches made up of sandy sediments, ii) beaches made up of land-water interaction zones, iii) gravity waves. The distribution of marine sediment texture and waves control the profile and shape of beaches and consequently their dynamic behavior (Trindade et al., 2009).

The three study areas are humid and warm in nature.

Tidal intervals are classified by Davis (1964) as micro- (<2 m), meso- (24 m) or macro-tidal (> 6 m) (Masselink and Short, 1993). 4 m. Therefore, the average width of this meso wave Digha Beach varies between 190 - 210 m. At the highest level, Digha Beach has approximately 5,286.78 meters of concrete beach. , with an average width of 150-170 meters, 2) another part of the concrete dam, with an average width of 30-40 meters. The width of the beach between low tide and high tide is 180 meters. The steep seaward edge of a marsh is called a bank or berm or bar. These bars develop in different hydrodynamic conditions and assume different configurations whose morphology can vary in shape, size, and number over space and time (King and Williams, 1949; Orford and Wright, 1978; Greenwood and Davidson) - Arnott, 1979; Aagaard et al., 1998; Wijnberg and Kroon, 2002; Sedrati et al., 2009). It can also grow due to sediment transport by upstream water. The coast plays a role in producing different types of currents in other parts of the coast.

3.2) Physicochemical perspective:

During the time of species collection, the physiochemical parameters of water and soil of the three respective study sites in three respective months (March, April and May) are given below in the table 1 & table 2 below. Where s1 is study site 1 which is Mohana; s2 consists study site 2, which is new Digha beach and s3 stands for study site 3 which is none other than talsari beach.

3.2.1) In study area Mohana beach: The average temperature recorded for water and soil samples were 31.75 ±1.76°C and 32.33 ±0.69°C, respectively. The average pH recorded for water and soil samples were 8.17 ±0.06 and 8.63 ±0.46, respectively. The average dissolved O2 and salinity recorded for water samples were 3.77 ±0.81 (mg) and 22.95 ±1.71ppm, respectively. Average nitrogen contains recorded in water and soil samples were 2.15 ±0.48mg/L and 9.48 ±5.30mg/100g. Average phosphorus contains recorded for the water and soil samples were 1.94 ±0.88mg/L and 0.53 ±0.28mg/100g. The average potassium contains recorded for water and soil samples were 14.30 ±0.48mg/L and 0.42 ±0.32mg/100g. Average conductivity and turbidity recorded for water samples were 2.40 ±0.47m/s and 286.67± 40.41ntu, respectively. Average sand, silt and clay percentage in the study area were 86.86 ±7.71%, 21.57 ±8.47, and 3.87 ±3.25, respectively.

3.2.2) In Study area New Digha Beach: The average temperature recorded for water and soil samples were 32.00 ±1.65°C and 29.27 ±3.76°C, respectively. The average pH recorded for water and soil samples were 8.13 ±0.06 and 8.11 ±0.66, respectively. The average dissolved O2 and salinity recorded for water samples were 5.02 ±1.18 ppm and 8.98 ±0.49ppm, respectively. Average nitrogen contains recorded in water and soil samples were 2.37 ±0.51mg/L and 17.19 ±6.21mg/100g. Average phosphorus contains recorded for the water and soil samples were 2.25 ±0.57mg/L and 0.53 ±0.30mg/100g. The average potassium contains recorded for water and soil samples were 14.37 ±0.54mg/L and 0.38 ±0.30mg/100g. Average conductivity and turbidity recorded for water samples were 2.37 ±0.49m/s and 323.33± 45.09ntu, respectively. Average sand, silt and clay percentage in the study area were 75.77 ±8.52%, 21.57 ±8.13, and 13.92 ±8.96, respectively.

Table1: Physicochemical measures of water.

Parameters	MOHANA	DIGHA	TALSARI
Temperature (°)	31.75±1.76	32.00±1.65	32.00±1.49
pH	8.17±0.06	8.13±0.06	8.00±0.10
Dissolved O2(ml)	3.77±0.81	5.02±1.18	3.83±0.55
Salinity(ppm)	22.95±1.71	25.58±0.74	19.87±11.70
Nitrogen(mg/100g)	2.15±0.48	2.37±0.51	2.28±0.33
Phosphorus(mg/100g)	1.94±0.88	2.25±0.57	2.17±0.36
Potassium(mg/100g)	14.30±0.48	14.37±0.54	14.46±1.69
Conductivity	2.40±0.47	2.37±0.49	2.21±0.15
Turbidity	286.67±40.41	323.33±45.09	260.00±20.00

Table2: physicochemical measures of soil:

Parameters	MOHANA	DIGHA	TALSARI
Soil Temp.(C)	32.33±0.69	29.27±3.76	32.70±0.92
Soil pH	8.63±0.46	8.11±0.66	8.24±0.06
Salinity (ppm)	8.28±0.21	8.98±0.49	7.97±0.13
Carbon (%)	0.45±0.11	0.52±0.13	0.54±0.21
Potassium (mg/100g)	0.42±0.32	0.38±0.30	0.44±0.19
Phosphorus (mg/100g)	0.53±0.28	0.53±0.30	0.53±0.18
Nitrogen (mg/100g)	9.48±5.30	17.19±6.21	13.12±11.06
Sand (%)	86.86±7.71	75.77±8.52	55.51±47.50
Silt (%)	21.57±8.47	21.57±8.13	22.17±19.30
Clay (%)	3.87±3.25	13.92±8.96	8.51±7.34

3.2.3) In study area Talsari Beach:

The average temperature recorded for water and soil samples were 32.00 ±1.49°C and 32.70 ±0.92C, respectively. The average pH recorded for water and soil samples were 8.00 ±0.10 and 8.24 ±0.06, respectively. The average dissolved O2 and salinity recorded for water samples were 3.83 ±0.55 ppm and 19.87 ±11.70 ppm, respectively. Average nitrogen contains recorded in water and soil samples were 2.28 ±0.33mg/L and 13.12 ±11.06mg/100g. Average phosphorus contains recorded for the water and soil samples were 12.17±0.36mg/L and 0.53 ±0.18mg/100g. The average potassium contains recorded for water and soil samples were 14.46 ±1.69mg/L and 0.44 ±0.19mg/100g. Average conductivity and turbidity recorded for water samples were 2.21 ±0.15m/s and 260.00± 20.00ntu, respectively. Average sand, silt and clay percentage in the study area were 55.51 ±47.50%, 22.17 ±19.30, and 8.51 ±7.34, respectively.

3.3) Population Dynamics :

In Study sites Mohana, the individual population size and their diversity changes due to the tempo-spatial variation during the study periods. Here, in this study sites total 9 types of intertidal bivalve mollusks species were found during the study periods.Identification of bivalve species done by morphological characters. The diversity indices indicate the ecological status of the particular species in specified area. From the current results it was concluded that the highly abundant species was H3 (Ab= 0.407; RA= 40.729) followed by the species H6 (Ab= 0.295; RA= 29.44) and H5 (Ab= 0.109; RA= 10.94). Shannon Wiener diversity index takes this study sites (H=27.6). Evenness refers to uniformity in species distribution of that study area. In this study area the nearest uniformly diverse species are H3 (E= 0.044) and H6 (E=0.043), where species H8 (E= 0.011) and H9 (E=0.011) were co-exit at same habitat and uniformly distributed (Table- 3).

Table 3: Ecological status of the bivalve species at Mohana sites during the study time.

Species	Population (Ni)	Abundance (Ab) [Pi=(Ni/N)]	Relative Abundance (RA) [RA=Pi*100]	Shannon Diversity (H) [-Pi*ln (Pi)]	Evenness (E) [E=H/ln (Max Ni)
H1	66	0.006	0.63	0.032	0.0034
H2	55	0.005	0.54	0.028	0.003
H3	4277	0.407	40.72	0.366	0.044
H4	772	0.074	7.352	0.192	0.023
H5	1149	0.109	10.94	0.242	0.029
H6	3092	0.295	29.44	0.360	0.043
H7	581	0.055	5.53	0.160	0.019
H8	261	0.025	2.49	0.092	0.011
H9	248	0.024	2.36	0.088	0.011
Sum	N= 10501	1	100	Pi*ln(Pi)=1.560	0.19

In Study sites New Digha, the individual population size and their diversity changes due to the tempo-spatial variation during the study periods. Here, in this study sites total 7 types of intertidal bivalve mollusks species were found during the study periods.Identification of bivalve species done by morphological characters. The diversity indices indicate the ecological status of the particular species in specified area. From the current results it was concluded that the highly abundant species was H5 (Ab= 0.41; RA= 40.70) followed by the species H6 (Ab= 0.14; RA= 13.93) and H4 (Ab= 0.23; RA= 22.68). Shannon Wiener diversity index takes this study sites (H=17.56). Evenness refers to uniformity in species distribution of that study area. In this study area the nearest uniformly diverse species are H5 (E= 0.04) and H6 (E=0.03), where species H7 (E= 0.03) and H4 (E=0.04) were co-exit at same habitat and uniformly distributed (Table-4).

Table- 4:Ecological status of the bivalve species at New Digha sites during the study time.

Species	Population (Ni)	Abundance (Ab) [Pi=(Ni/N)]	Relative Abundance (RA) [RA=Pi*100]	Shannon Diversity (H) [-Pi*ln(Pi)]	Evenness (E) [E=H/ln(Max Ni)
H1	21	0.02	1.78	0.07	0.01
H2	13	0.01	1.10	0.05	0.01
H3	91	0.08	7.73	0.20	0.03
H4	267	0.23	22.68	0.34	0.05
H5	479	0.41	40.70	0.37	0.06
H6	164	0.14	13.93	0.27	0.04
H7	142	0.12	12.06	0.26	0.04
Sum	1177	1	100	Pi*ln (Pi)=1.552	0.25

In Study sites Talsari, the individual population size and their diversity changes due to the tempo-spatial variation during the study periods. Here, in this study sites total 8 types of intertidal bivalve mollusks species were found during the study periods.Identification of bivalve species done by morphological characters. The diversity indices indicate the ecological status of the particular species in specified area. From the current results it was concluded that the highly abundant species was H4 (Ab= 0.289194; RA= 28.91945) followed by the species H6 (Ab= o.130845; RA= 13.08448) and H5 (Ab= 0.156778; RA= 15.6778). Shannon Wiener diversity index takes into this site, (H= 18.34). In our study the highly Evenness refers to uniformity in species distribution of that study area. In this study area the nearest uniformly diverse species are H4 (E= 0.042912) and H5 (E=0.034744), where species H7 (E= 0.033575) and H8 (E=0.031631) were co-exit at same habitat and uniformly distributed (Table-5).

Table 5: Ecological status of the bivalve species at Talsari sites during the study time.

Species	Population (Ni)	Abundance (Ab) [Pi=(Ni/N)]	Relative Abundance (RA) [RA=Pi*100]	Shannon Diversity (H) [-Pi*ln(Pi)]	Evenness (E) [E=H/ln(Max Ni)
H1	99	0.039	3.89	0.126	0.02
H2	82	0.032	3.22	0.111	0.02
H3	196	0.077	7.70	0.197	0.03
H4	736	0.289	28.91	0.359	0.05
H5	399	0.157	15.68	0.290	0.04
H6	333	0.131	13.08	0.266	0.04
H7	371	0.146	14.57	0.281	0.04
H8	329	0.129	12.93	0.264	0.04
Sum	2545	1	100	Pi*ln(Pi)=1.895	0.29

3.4) Species Diversity:

Shannon Wiener diversity index takes into account species richness, in our study the highly species richness was found in the Mohana Beach (H= 27.6) Evenness refers to uniformity in species distribution of that study area.

The species composition at three different study areas may be compared and differentiate by suitable indices or quotients. Similarity index is a simple measure at the extent to which different habitats have species in common. Most commonly used quotients of similarity procedure is produced which has developed by "Sorrenson's Index" ranges from '0' indicating total dissimilarity to '1', meaning total similarity and value '>0.5' is indicative of similarity and '<0.5' is indicative of de-similarity.

In case of S1 and S2, "Sorrenson's Index" is 0.87.

In case of S2 and S3, the "Sorrenson's Index" is 0.93.

In case of S1 anS3, the "Sorrenson's Index" is 0.94.

Hence, according to the scale of similarity can be concluded that the S1 and S3 is strongly similar, the S2 and S3 is strongly similar and S1 and S3 is also strongly similar. But S1 and S3 more similar than S1 and S2 & S2 and S3 (Fig-1).

Fig-1: Population diversity found in study area A) Meretrix casta B) Anadara inequivalvisC8) Donax scortum D) Anadara antiquata E) Unidentified F) Unidentified G) Unidentified H) Unidentified I) Unidentified

4. Discussion:

A total of nine intermediate molluscan species were identified during the survey at the Mohana study site. Identify contrasts based on morphological features. The diversity index reflects the ecological status of species in an area. From the current results, it can be concluded that the most common type is H3 (Ab = 0.407; RA = 40.729), followed by H6 (Ab = 0.295; RA = 29.44) and H5 (Ab = 0.109; RA = 10.94). Shannon Wiener diversity index, Mohana index (H) = 27.6 measures species richness in our study area. Evenness indicates the homogeneity of species distribution in the study area. The closest species differences in the study area are H3 (E = 0.044) and H6 (E = 0.043), where H8 (E = 0.011) and H9 (E = 0.011) species coexist with the same distribution. This is a top view of the species found on this page.

A total of 7 conflicting mollusk species were identified during the survey in the New Digha research area. Identify contrasts based on morphological features. The diversity index reflects the ecological status of species in an area. From the current results, it can be concluded that the most common strain is H5 (Ab = 0.0).41; RA = 40.70), followed by H6 (Ab = 0.14; RA = 13.93) and H4 (Ab = 0.23; RA = 22).68) Shannon Wiener's diversity index, which measures species richness in our new Digha Beach study site (H) = 17.56, Flatness indicates the homogeneity of species distribution in the study area. The closest different species in the study area are H5 (E = 0.04) and H6 (E = 0.03), where H7 (E = 0.03) and H4 (E = 0.04) species coexist and are the same in the area the same.

In the study area, Talsari, a total of 8 conflicting mollusk species were identified during the survey. Identify contrasts based on morphological features. The diversity index reflects the ecological status of species in an area. From the present results, it can be concluded that the most common strain is H4 (Ab = 0.289194; RA = 28.91945), followed by H6 (Ab = o.130845; RA = 13.08448) and H5 (Ab = 0.156778; RA = 15.67). Shannon Wiener's diversity index (H) = 18.34 for species richness in our New Digha Beach study site, Homogeneity refers to the homogeneity of species distribution in the study area. The closest different species in the study area are H4 (E = 0.042912) and H5 (E = 0.034744), where H7 (E = 0.033575) and H8 (E = 0.031631) species coexist and are in the area the same. is equally distributed.

Our study compared the abundance of bivalve molluscs from different analyzes and intermediate bands depending on the selected environmental conditions. In the current study, we found that the Mohana beach survey (S1) showed the highest species richness and diversity from other sites, while New Digha beach (S2) and Talsari beach (S3) confirmed that even a small change in salinity causes change. in the distribution and abundance of benthic organisms (Sandilyan et al., 2010). The presence of a large number of molluscs at the bottom of the intertidal profile may be due to a stable environment, low desiccation, and increased feeding time compared to the high intertidal zone (McLachlan, 1990). Similarly, high Shannon diversity index values ??indicate a more diverse marine mollusk community at S1 (Talsari Beach) compared to other sites (S2, S3). The lower parity index in S3 indicates that this site is more homogeneous than others. Differences in diversity and gathering of these species may be due to differences in environmental parameters between different zones. A wide distribution of mollusk diversity by environmental factors has been suggested by many researchers (Hedgpeth, 1983; Ysebart et al., 2003; Rueda & Salas, 2008; Itsukushima et al., 2017; Chen et al., 2019).The monthly variation in abundance for the total study area indicates that the fruiting mollusk fauna varies seasonally. Due to salinity and temperature, the lowest density is in May, but the low dissolved oxygen and high turbidity in S1 ??(Mohana Beach) make it difficult for the species to crawl and survival.

Overexploitation of some mollusk species as a commercial resource has led to a gradual decline of the species. The lack of species in this study may be due to sea water pollution and environmental disturbances. Therefore, the decrease in the abundance of molluscs can be another reason for the registration of fewer species compared to previous workers and changes in the structure of society in the form of continuous exploitation.

Plot 2 PCA analysis is done based on the first component (component 1 and component 2), which shows that the eigenvalue of component 1 is 9.415 and 57.154% variable coverage, while the eigenvalue of component 2 is 6.855. and 42.846% variation (Fig-2). According to the rotated component matrix, water parameters such as pH (-0.806), dissolved oxygen (-0.775), salinity (-0.997), conductivity (-0.851) and turbidity (-0.978) are closely related with a negative relationship overall. types, namely Sp1 (0.475), Sp2 (0.507), Sp3 (0.927), Sp4 (0.838), Sp5 (0.876), Sp6 (0.938) and Sp7 (0.990).

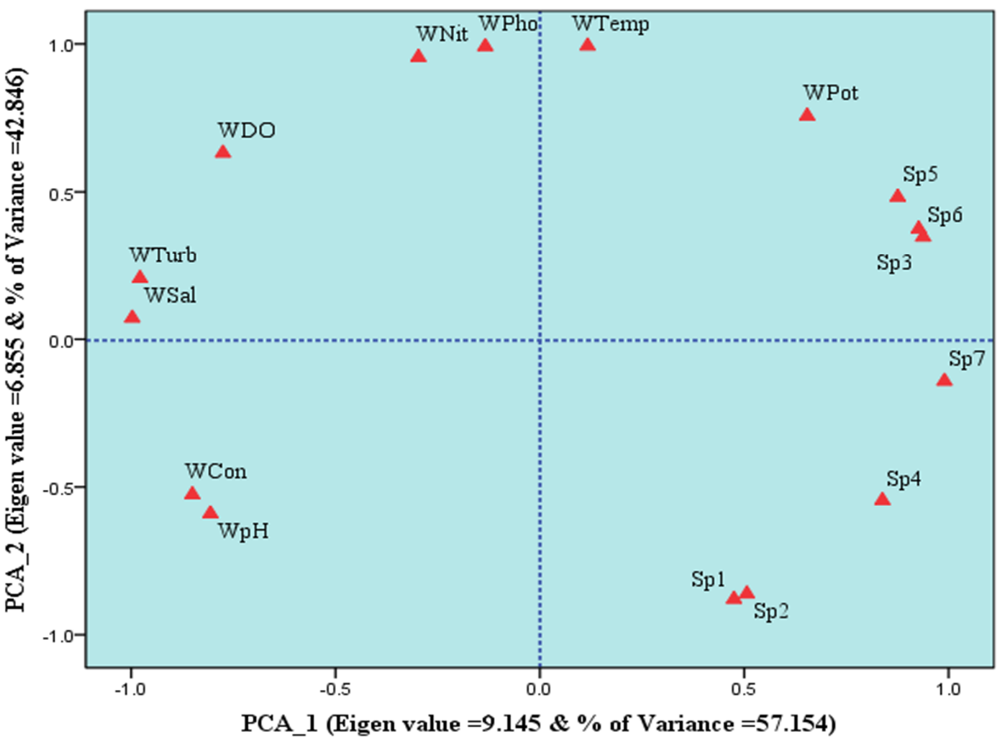

Fig-2:Principal component analysis (PCA) showing the relationship between bivalve species with water physiochemical parameter. Where, WTemp.-Water temperature, WpH- Water pH, WDO- Water dissolve oxygen, WSal- Water salinity,WNit- Water nitrogen, WPho- Water phosphate, WPot- Water potassium, WCon- Water conductivity, WTurb- Water turbidity and Sp- Species.

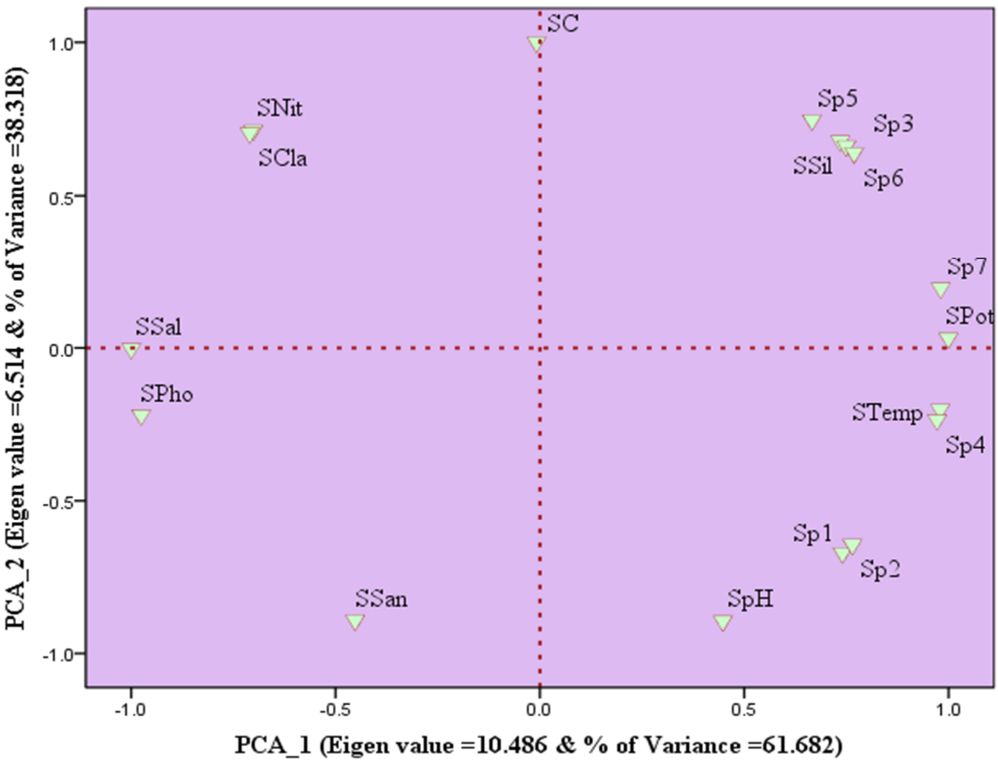

Fig-3:Principal component analysis (PCA) showing the relationship between bivalve species with soil physiochemical parameter. Where, STemp. -Soil temperature, SpH- Soil pH, SSal- Soil salinity,SC- Soil carbon, SNit- Soil nitrogen, SPho-Soil phosphate, SPot- Soil potassium, SSan- Soil sand, SSil- Soil silt, SCla- Soil clay and Sp- Species.

Plot 2 of PCA analysis was made based on the first two components (component 1 and component 2), which shows that the eigenvalue of component 1 has variable coverage of 10.486 and 61.682%, while the eigenvalue of component 2 is 5.514. and 38.318% variability (Fig-3). According to the rotated component matrix, soil parameters such as salinity (-1.000), phosphorus (-0.976), nitrogen (-0.701) and soil clay (-0.710) are closely related and have a negative relationship with Sp1 (0.741), Sp2 (0.764), Sp3 (0.750), Sp4 (0.972), Sp5 (0.666), Sp6 (0.769) and Sp7 (0.981).

5. Conclusion

Conclusions drawn from this study indicate that, within the surveyed locations, Mohana Beach exhibits a noteworthy abundance of marine mollusc diversity, while New Digha and Talsari beaches display comparatively lower mollusc diversity than their counterparts. The diminished diversity at Talsari and New Digha can be attributed to the influx of tourists, who contribute to beach pollution. Notably, Mohana Beach experiences a higher density of visitors; however, their impact on the beach environment is mitigated as most tourists do not venture far into Mohana Beach. Additionally, the population density of protected bivalve mollusc species is found to be significantly higher at Mohana Beach compared to the other two beaches.

Ethical approval: NA

Consent of the participant: In this research, no living participant is involved. Therefore, this is not applicable.

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