

Research Article

Abundance and Biodiversity of Zooplankton in Salimpur Coast, Bangladesh

Mazharul Islam Sajeeb^{1*} and Deen Islam Bhuiyan MD²

¹Institute of Marine Sciences, University of Chittagong, Bangladesh

²Institute of Marine Sciences, Institute of Marine Sciences, University of Chittagong, Bangladesh

*Corresponding author: Mazharul Islam Sajeeb, Institute of Marine Sciences, University of Chittagong, Bangladesh; Email: sajeebmazharul@gmail.com

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Abstract

An investigation was carried out at three selected stations in Salimpur sea beach in the Bay of Bengal, Chittagong, with special reference to abundance, composition, and a taxonomic group of zooplankton. Samples were collected from three stations these are ship-breaking yard, Salimpur mangrove forest area, fishery ghat Salimpur during monsoon (15/10/2019), and post-monsoon (15/01/2020). A total of 7 groups of zooplankton were identified. Copepods were the most important constituents of the zooplankton in all areas. Copepods accounted for 30.71%, 32.81%, 34.05% during monsoon and 25.75%, 25.96%, 27.31% during post-monsoon of the total zooplankton population. The other dominant constituents were Fish larvae (20.71%), Shrimp larvae (20.18%), Crab larvae (16.84%), sagitta (5.14%) which are the maximum of the total zooplankton population. The minimum density of Copepod is (55.89 ind/m³) and the maximum density is (71.84 ind/m³) recorded in January. During October this transverse into (65.64 ind/m³) in minimum and (101.94 ind/m³) in maximum. The high density of copepods shows a significant relationship between zooplankton and the environmental condition that work as an indicator of pollution.

Keywords: Zooplankton; Mangrove; Post-monsoon; Abundance; Biodiversity

Introduction

Zooplankton is microscopic animals that act as primary and secondary links in the food webs of all aquatic ecosystems. They feed on phytoplankton which directly provides a food source for larval vertebrates and invertebrates as well as related to the growth of juvenile and larger fish. Zooplankton is a marine microorganism with a swimming pool against major currents. Though limited in their ability to swim, they move day and night at intervals of hundreds of feet. They prefer to feed at night on the surface of the water and successfully feed on phytoplankton, which is why they are called living organisms. They tend to represent important interactions between the parasitic particles and large grazers [1]. In the tropics lead to fish production from human exploitation. Natural marine life is linked to the abundance of zooplankton and biodiversity. The viability of pelagic marine fish directly or indirectly depends on the discovery of zooplankton. In aquatic waters, zooplankton is used as an indicator of physiological, chemical, and biological processes due to its widespread distribution, small size, and rapid growth rates [2], high density, short life span, ecological diversity, of various types and tolerances of stress [3]. In food webs, organisms of the zooplankton represent a link from autochthonous material to higher trophic levels, e.g. juvenile riverine fish, which use backwaters as feeding grounds [4].

FAO's survey report (1985) stated that Bangladesh's tidal areas are rich in zooplankton. The abundance of zooplankton and its ecosystems in Bangladesh's coast and harbors is rarely studied. [5] studied zooplankton in the northeastern part of the Bangladesh coast and found

18 genera and 18 species. [6] observed the macro-zooplankter of the continental shelf in the Bay of Bengal and reported on the occurrence and distribution of 18 calanoid copies. [7] recorded occasional variations of zooplankton in coastal waters in the southeastern part of Bangladesh. The major groups of zooplankton are copepods, Decapoda, Chaetognatha, cladocerans and fish, and shellfish. Zooplankton diversity of the saltwater area of the Bakkhali river, Cox's Bazar, Bangladesh was also studied by [8]. The coastal area contains sensitive land and aquatic areas, such as mangrove forests, wetlands, and wet flats. On the shores of Sitakunda in the Chittagong region, the northeastern part of the Bay of Bengal is located near the Sandwip Chanel, which has wave particles, shipwrecks, and a community of fishermen and an important source of fishery resources. The purpose of this study is to provide more information on the quantity and structure of the zooplankton community in the coastal waters of Salimpur coast, north of the city of Chittagong, currently involved in coastal shipping operations.

As an important link in the conversion of energy from producers to consumers, free-living zooplanktonic organisms are a fundamental element of the aquatic environment. Organic zooplanktonic organisms are indicators of water quality bio due to their growth and distribution are closely related to natural boundaries. Zooplankton communities are often used as important tools to find changes in water quality and to assess the health of rural aquatic bodies.

The Zooplankton site is a group of different heterotrophic species that consume phytoplankton that stimulate nutrients through their metabolism and transfer energy to higher trophic levels (Deborah et

al, 2010). Zooplanktons are playing a significant role in the ecosystem, as they are the second-largest food chain in the world. They play a key role in the transfer of power within their environment. They are found in the pelagic area of lakes, lakes, rivers, and the sea where light enters. Zooplankton releases much organic matter, which dissolves and converts into the biomass of various bacteria. The zooplankton community is made up of major and second-largest consumers. They provide a direct link between early producers and high trophic levels as almost all fish depend on zooplankton for food during their caterpillar phase, while other fish continue to consume zooplankton throughout their lives (Madin *et al.* 2001).

The purpose of this study is to provide more information on the quantity and structure of the zooplankton community in the coastal waters of Salimpur coast, north of the city of Chittagong, currently involved in coastal shipping operations, to identify critical issues affecting the potential of zooplankton community structures, and to provide a monitoring tool to improve the water quality of water for future studies.

Objectives of the Study

1. To identify and get an account of the zooplankton community of the Salimpur coast.
2. To determine the abundance and distribution of zooplankton along with some Physico-chemical parameters of the study area.

The Study Area

Zooplankton collection and finding the quantity of zooplankton assigned to be 3 areas selected. The stations were a Salimpur ship-breaking yard, the Salimpur mangrove area, and the Salimpur fishery ghat area.

Station 1: Sampling station 1 is Salimpur ship breaking yard. It is a polluted area with heavy metal and oil pollution.

Station 2: This station is salimpur mangrove forest area, highly vegetation with biologically enhanced site.

Station 3: Sampling station 3 is fishery ghat of salimpur.

Geological position of three stations (Figure 1 and Table 1).

Methods and Materials

Sampling Period

1. In Post Monsoon (October 15)
2. In monsoon (January 15)

Investigation in Salimpur was carried out during Post Monsoon (October) and Monsoon (January) periods. Samples are collected from three selected stations. All samples were taken during high tide.

The sample was collected from three stations Salimpur sea beach. From post-monsoon October 15 2019 to winter 15 January 2020, two sampling data were collected. In this data collection, 3 stations were under data collection. All samples were taken during high tide. We have used mechanized boats to collect samples and to measure the other parameters of seawater like water temperature, water pH, water salinity, water transparency, DO.

Table-1: GPS location of the study area

Station No.	GPS Coordinate
01.	22°21'26" N, 91°44'59" E
02.	22°22'39" N, 91°44'45" E
03.	22°23'42" N, 91°44'28" E

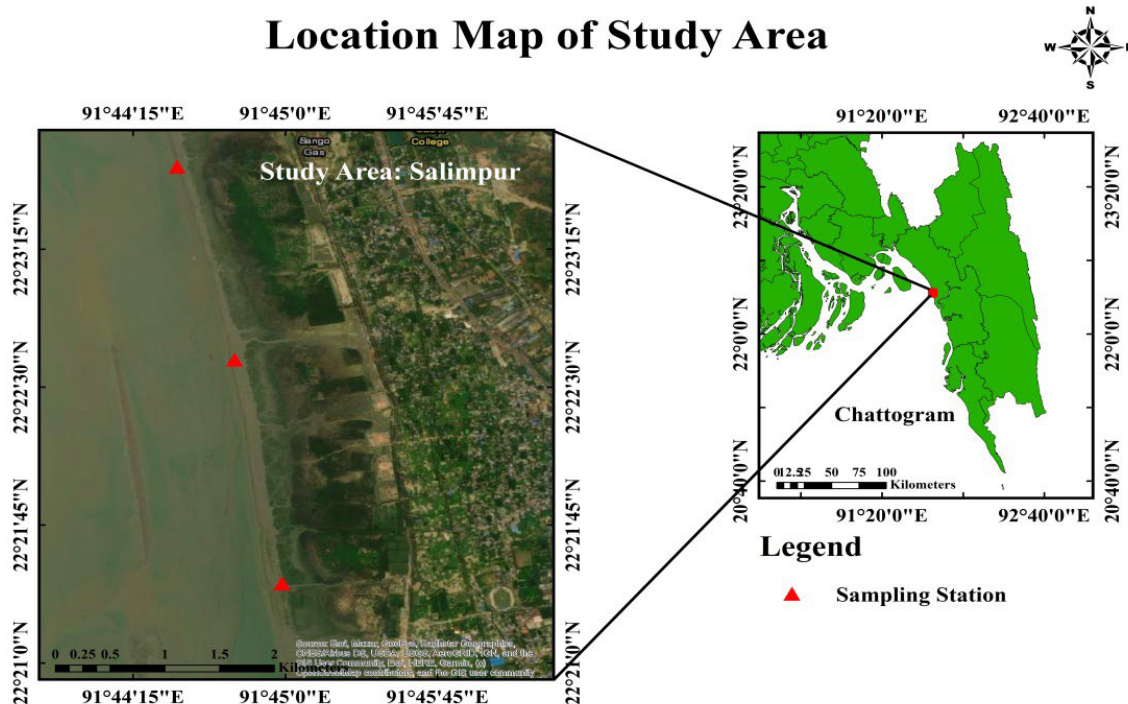


Figure 1: Study area

Collection and Preservation of Zooplankton

Zooplankton sampling was carried out with the help of a conical zooplankton net made of Nylon Silk of 335-micrometer mesh size and having 12 cm circular mouth opening fitted with a plastic bucket at the cod. A digital flow meter was set up at the mouth of the net to record the amount of water filtered through the net during sampling. Samples were collected at the three sampling stations from the surface water for 10 to 15 min. After collecting samples were preserved in 5% formalin.

Staining and Sorting

For efficient sorting, the samples were stained with eosin and left for over the night. All the zooplankton attained reddish color rendering easy identification. The stained plankton was stored out from debris with a fine brush, needle, forceps and low power microscope was used during sorting. The sorted organisms were preserved in 70% ethanol.

Identification and Counting

The sorted organisms were brought under microscope and identified following [9-14] etc. In each catch, the total number of the individual count was done either by complete counting or by sub-sampling.

Interpretation of Data

The zooplankton concentration was calculated at individuals/m³. Where the total volume of water (m³) filtered through the net was calculated by using the following equation:

$$\text{Total volume of water (m)} = \{(\text{FR} - \text{IR}) \times \text{coefficient}\} \times 2\pi r^2$$

Where,

FR=Final Reading

IR=Initial Reading

Co-efficient=0.3

$\pi=3.1416$

r=Radius of ring of used at plankton net=12 cm

The abundance of Zooplankton (individuals/m³)=Number of species in each group/volume of water.

Physicochemical Parameters

Sample Collection and Preservation

Water samples were taken from the surface with a bucket for the determination of different Physicochemical parameters. Data collection was collected by a different digital machine.

In situ Determination of Physicochemical Factor

Air and Water Temperature. Air and water temperature was measured by using a graduated centigrade thermometer.

Water Salinity. The water salinity was determined by using a Salinity Refractometer (tank new-100) and a digital salinity meter.

Hydrogen ion concentration of water (pH). For determining hydrogen ion concentration (pH), a digital pH meter was used.

Transparency. Water Transparency was determined by using a white Secchi disk of 30 cm diameter.

Determination of dissolved oxygen (DO). For determining dissolved oxygen (D.O), a digital DO meter was used.

Determination of TDS (mg/l). For determining Total Dissolved Solids (TDS), a digital TDS meter was used.

Determination of TSS (mg/l). At first, a filter paper was oven-dried for moisture-free at 60°C for 30 minutes. Then it will be kept into desiccators for cooling and then it will be weighted by an electric balance. Then a thoroughly mixed 100 ml samples will be filtered through the weighted filter paper. The filter paper will be allowed to dry completely and reweighted. The weight change will be multiplied by 10, thus total suspended solids (T.S.S) in 1L of water sample will be obtained.

Species Diversity Analysis

Zooplankton assemblage data were analyzed with the Plymouth Routines in Multivariate Ecological Research (PRIMER) statistical package version 6 (Clarke and Warwick, 06). Diversity of the species assemblage was analyzed by the Shannon-Wiener index (H') [15-21], species richness was measured by Margalef index (d) and evenness was measured by Pielou's index (J') (Pielou, 1966). The value of the Shannon-Wiener index, Margalef index, and Pielou's index calculated by the following formula:

Shannon-Wiener Diversity Index (H')

$$H' = -\sum P_i \times \ln(P_i)$$

Where,

H'=Shannon-Wiener diversity index;

P_i=n/N; [n=No. Of individuals of species]

N=Total individuals;

Margalef Richness Index (d):

$$d = (s-1)/\ln(n)$$

where,

S=Total species;

N=Total individuals;

Pielou's Evenness Index (J')

$$J' = H(s)/H(\text{max})$$

Where,

H(s)=Shannon-Wiener information function

H(max)=The theoretical maximum value for H(s), if all species in the samples are equally abundant.

Result

Data Collection of Monsoon

Data Collection of Monsoon is shown in Figures 2-5 and Tables 2-9.

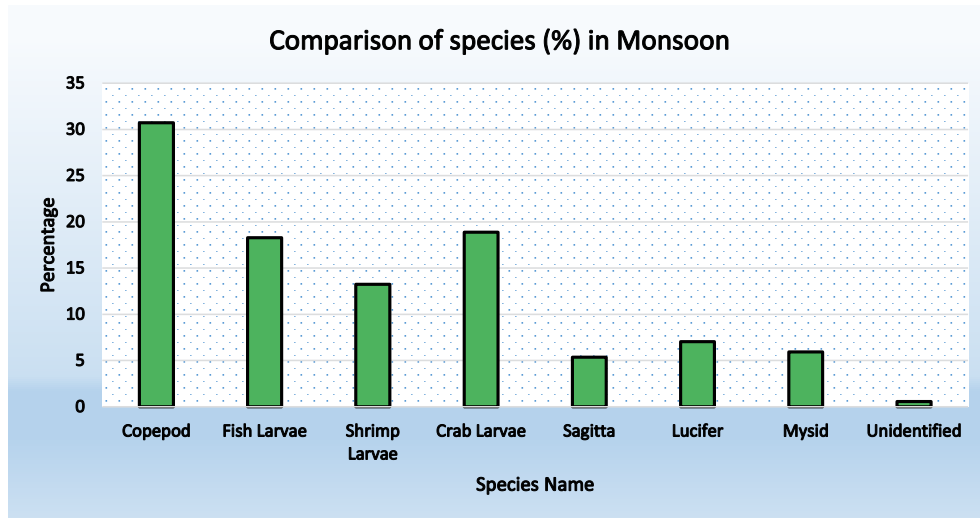


Figure 2: Abundance of zooplankton during Monsoon (Station-1)

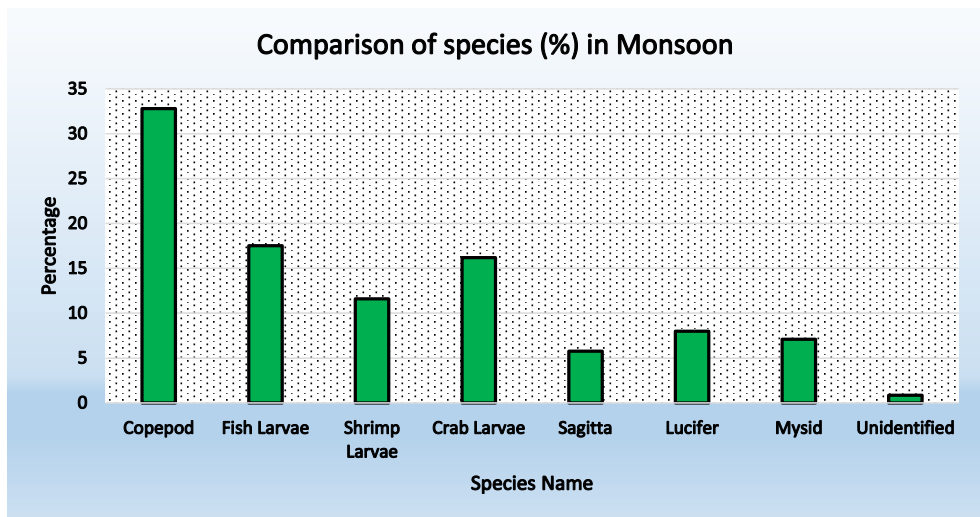


Figure 3: Abundance of zooplankton in Monsoon (Station-2)

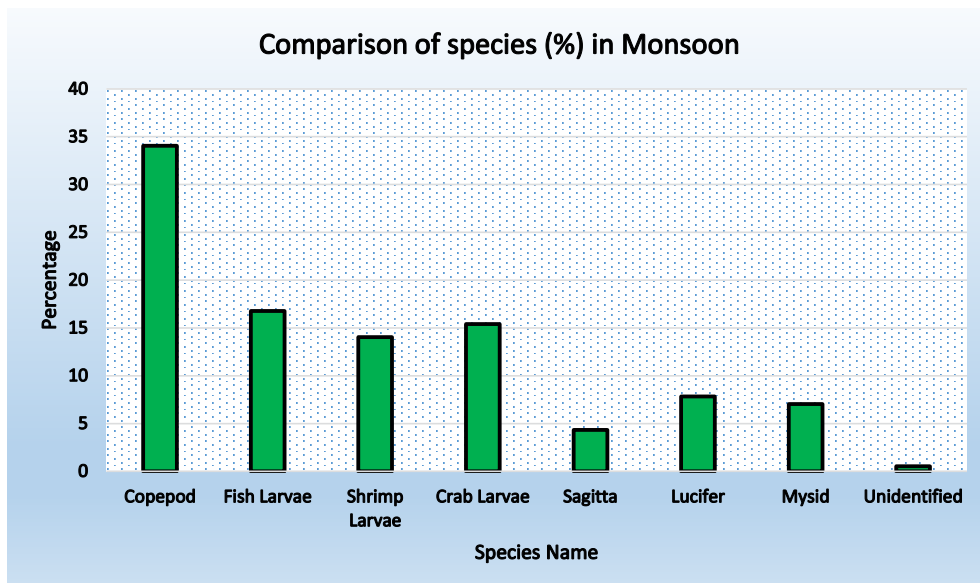


Figure 4: Abundance of zooplankton in Station-3 during Monsoon

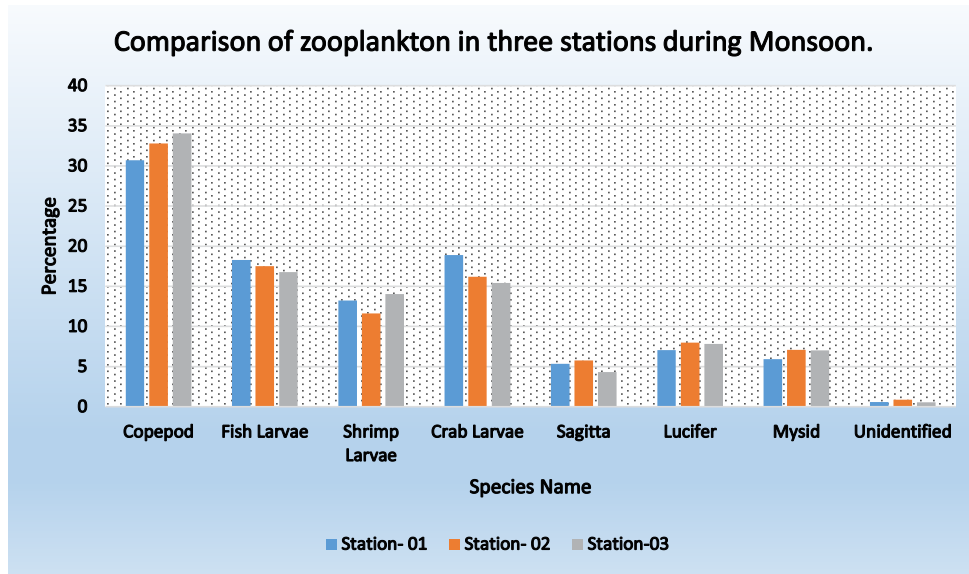


Figure 5: Comparison of species found in three stations during monsoon period

Table-2: Physiochemical parameters in Station- 1 during monsoon

Water temperature	22° c
Air temperature	25° c
Water transparency	6 cm
pH	7.9
Salinity	19 PPT
DO	2.48 mg/L
BOD	1.42 mg/L
TDS	21.88 g/L
TSS	276 mg/L
EC	33.68 ms/cm
PO ₄ -P	0.64 ug/L
NO ₂ -N	0.95 ug/L

Table 4: Physiochemical parameters in Station- 2 during monsoon

Water temperature	22 c
Air temperature	26 c
Water transparency	6 cm
pH	7.8
Salinity	21 PPT
DO	2.95 mg/L
BOD	1.2 mg/L
TDS	18.36 g/L
TSS	311 mg/L
EC	32.40 ms/cm
PO ₄ -P	0.81 ug/L
NO ₂ -N	1.12 ug/L

Table 3: Species composition in station-1 during monsoon

Station- 01			
Name of Species	Number of Individuals	Abundance (Ind/m ³)	Percentage (%)
Copepod	109	55.89	30.71
Fish Larvae	65	33.30	18.29
Shrimp Larvae	47	24.10	13.24
Crab Larvae	67	34.36	18.88
Sagitta	19	9.74	5.35
Lucifer	25	12.82	7.04
Mysid	21	10.77	5.92
Unidentified	2	1.03	0.57
	=265	=182.01	=100%

Table 5: Species composition in station- 2 during monsoon

Station- 02			
Name of Species	Number of Individuals	Abundance (Ind/m ³)	Percentage (%)
Copepod	148	71.84	32.81
Fish Larvae	79	38.35	17.52
Shrimp Larvae	53	25.73	11.61
Crab Larvae	73	35.44	16.19
Sagitta	26	12.62	5.76
Lucifer	36	17.48	7.98
Mysid	32	15.53	7.09
Unidentified	4	1.94	0.87
	=321	=218.93	=100%

Table 6: Physiochemical parameters at Station- 3 during monsoon

Water temperature	23 c
Air temperature	26 c
Water transparency	7 cm
pH	7.9
Salinity	22 PPT
DO	3.36 mg/L
BOD	1.18 mg/L
TDS	22.09 g/L
TSS	214 mg/L
EC	33.23 ms/cm
PO ₄ -P	0.92 ug/L
NO ₂ -N	1.45 ug/L

Table 7: Species composition in station- 3 during monsoon

Station- 03			
Name of Species	Number of Individuals	Abundance (Ind/m ³)	Percentage (%)
Copepod	126	62.69	34.05
Fish Larvae	62	30.85	16.76
Shrimp Larvae	52	25.87	14.05
Crab Larvae	57	28.36	15.41
Sagitta	16	7.96	4.32
Lucifer	29	14.43	7.84
Mysid	26	12.94	7.03
Unidentified	2	0.99	0.54
	=370	=184.09	=100%

Table 8: Comparison of physiochemical parameters in three stations during monsoon

Parameters	Station 1	Station 2	Station 3
Water temperature	22° c	22 c	23 c
Air temperature	25° c	26 c	26 c
Water transparency	6 cm	6 cm	7 cm
pH	7.9	7.8	7.9
Salinity	19 PPT	21 PPT	22 PPT
DO	2.48 mg/L	2.95 mg/L	3.36 mg/L
BOD	1.42 mg/L	1.2 mg/L	1.18 mg/L
TDS	21.88 g/L	18.36 g/L	22.09 g/L
TSS	276 mg/L	311 mg/L	214 mg/L
EC	33.68 ms/cm	32.40 ms/cm	33.23 ms/cm
PO ₄ P	0.64 ug/L	0.81 ug/L	0.92 ug/L
NO ₂ N	0.95 ug/L	1.12 ug/L	1.45 ug/L

Data Collection of Post-Monsoon

Data Collection of Post-Monsoon is shown in Figures 6-10 and Tables 10-17.

Biodiversity Index

Shannon-Wiener Diversity Index

Table 9: Comparison of species found in three stations during monsoon period

Name of Species	Percentage			Average
	Station- 01	Station- 02	Station- 03	
Copepod	30.71	32.81	34.05	32.52
Fish Larvae	18.29	17.52	16.76	17.52
Shrimp Larvae	13.24	11.61	14.05	12.96
Crab Larvae	18.88	16.19	15.41	16.83
Sagitta	5.35	5.76	4.32	5.14
Lucifer	7.04	7.98	7.84	7.62
Mysid	5.92	7.09	7.03	6.68
Unidentified	0.57	0.87	0.54	0.66

$$H' = -\sum p_i \times \ln(p_i)$$

Where,

H'=Shannon-Wiener diversity index;

P_i=n/N; [n=No. Of individuals of species]

N=Total individuals;

Shannon-Wiener Diversity Index

Station	Post Monsoon	Monsoon
01	1.7900	1.7956
02	1.7930	1.8131
03	1.7996	1.7797

Margalef Richness index (d):

$$d = (s-1)/\ln(n)$$

where:

S=Total species

N=Total individuals

Richness

Station	Post Monsoon	Monsoon
01	1.2885	1.3642
02	1.3441	1.6363
03	1.2357	1.3528

Pielou's Evenness Index (J')

$$J' = H(s)/H(\max)$$

Where,

H(s)=Shannon-Wiener information function;

H(max)=The theoretical maximum value for H(s), if all species in the samples are equally abundant.

Evenness

Station	Post Monsoon	Monsoon
01	0.8147	0.8172
02	0.7787	0.7561
03	0.8190	0.8099

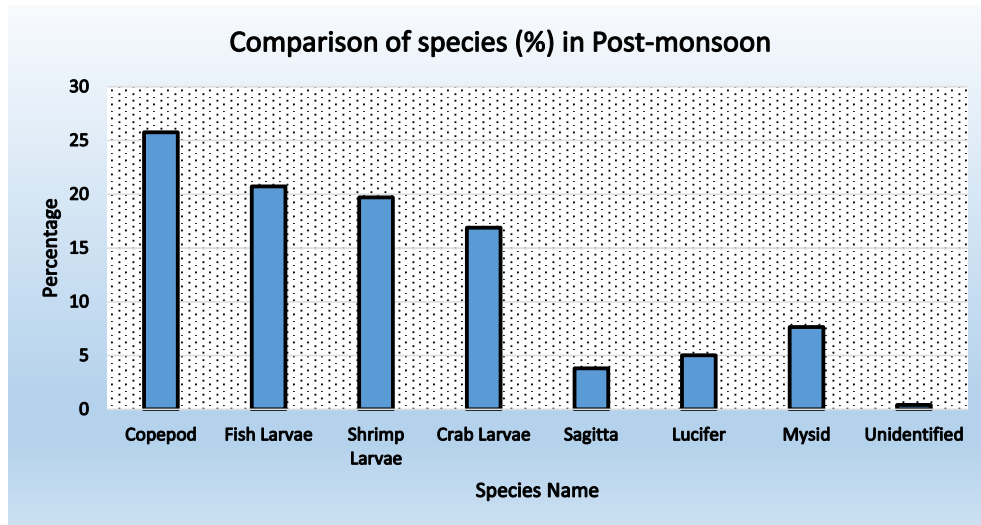


Figure 6: Abundance of zooplankton in station-1 during post-monsoon

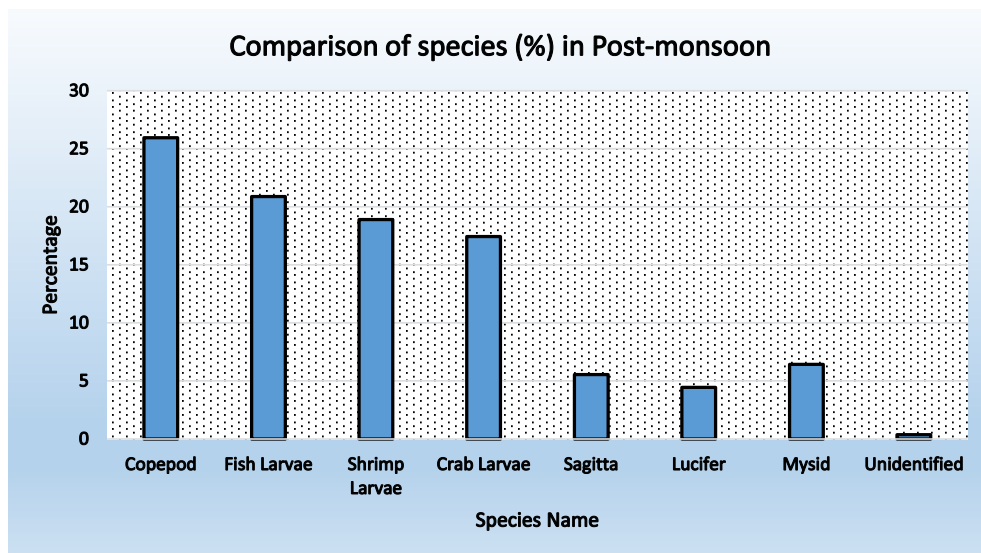


Figure 7: Abundance of zooplankton in Station-2 during post-monsoon

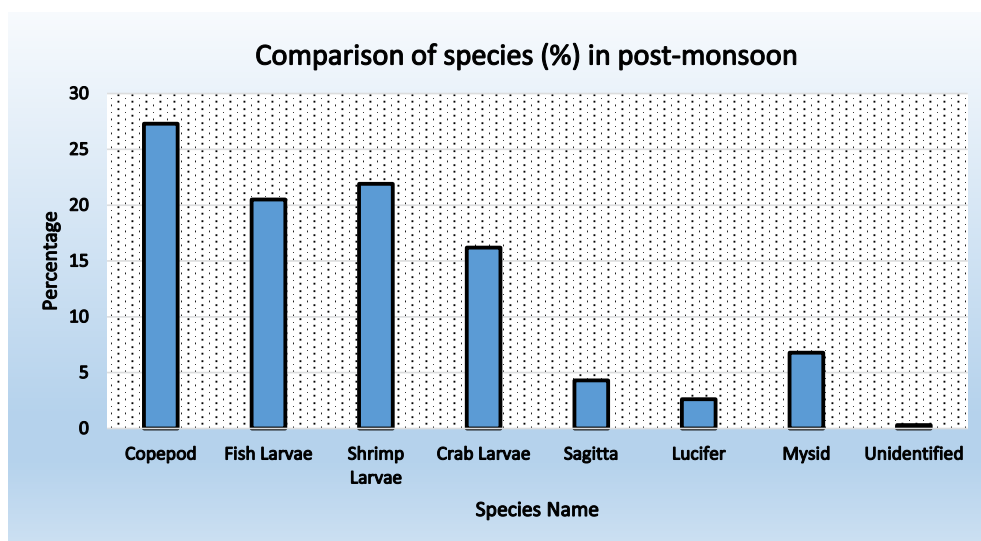


Figure 8: Abundance of zooplankton in station-3 during post-monsoon

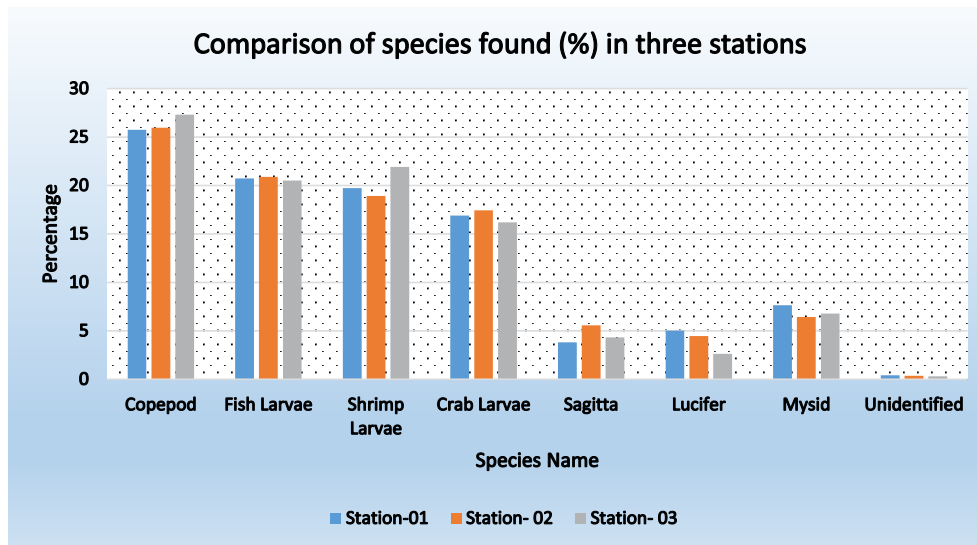


Figure 9: Comparison of species found (%) in three stations during Post-monsoon

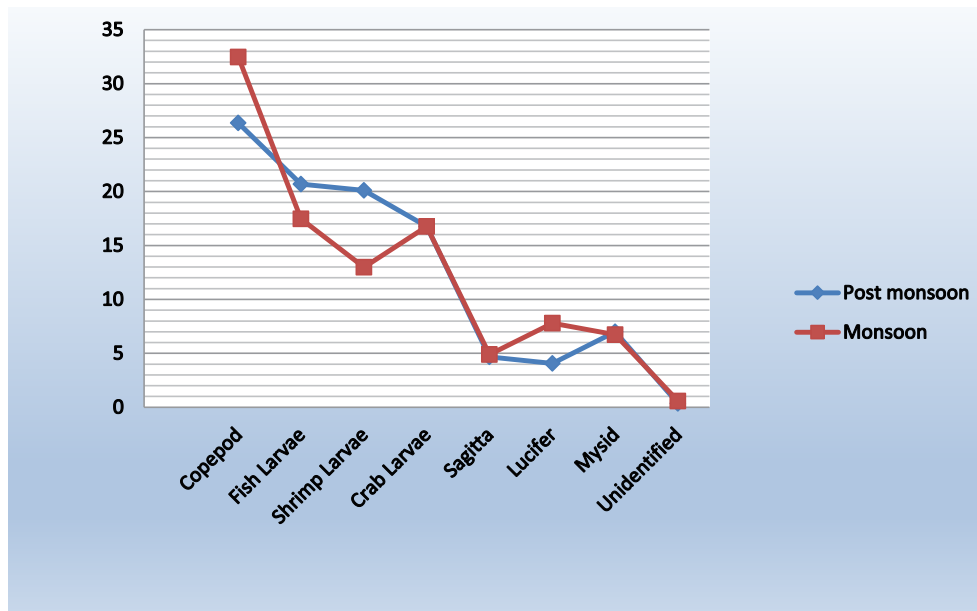


Figure 10: Abundance Variation of zooplankton between post-monsoon & monsoon

Table 10: Physiochemical parameters at Station-1 during post-monsoon

Water temperature	29° c
Air temperature	32° c
Water transparency	10 cm
pH	7.6
Salinity	14 PPT
DO	5.12 mg/L
BOD	2.90 mg/L
TDS	2.02 g/L
TSS	182 mg/L
EC	3.40 ms/cm
PO4-P	2.80 ug/L
NO2-N	2.58 ug/L

Table 11: Species found in station-1 during Post-monsoon

Station- 01			
Name of Species	Number of Individuals	Abundance (Ind/m ³)	Percentage (%)
Copepod	128	65.64	25.75
Fish Larvae	103	52.82	20.72
Shrimp Larvae	98	50.26	19.72
Crab Larvae	84	43.08	16.90
Sagitta	19	9.74	3.82
Lucifer	25	12.82	5.03
Mysid	38	19.49	7.65
Unidentified	2	1.03	0.40
	=497	=254.88	=100%

Table 12: Physiochemical parameters at Station-2 during post-monsoon

Water temperature	29 °c
Air temperature	32° c
Water transparency	12 cm
pH	7.4
Salinity	14 PPT
DO	5.71 mg/L
BOD	2.50 mg/L
TDS	2.42 g/L
TSS	114 mg/L
EC	4.56 ms/cm
PO4-P	2.36 ug/L
NO2-N	2.58 ug/L

Table 13: Species found in station-2 during post-monsoon

Station- 02			
Name of Species	Number of Individuals	Abundance (Ind/m ³)	Percentage (%)
Copepod	210	101.94	25.96
Fish Larvae	169	82.04	20.89
Shrimp Larvae	153	74.27	18.91
Crab Larvae	141	68.45	17.43
Sagitta	45	21.84	5.56
Lucifer	36	17.48	4.45
Mysid	52	25.24	6.43
Unidentified	3	1.46	0.37
	=809	=392.72	=100%

Table 14: Physicochemical parameters in station-3 during post monsoon

Water temperature	31° c
Air temperature	33° c
Water transparency	13 cm
pH	7.4
Salinity	15 PPT
DO	5.88 mg/L
BOD	2.32 mg/L
TDS	2.88 g/L
TSS	110 mg/L
EC	4.99 ms/cm
PO4-P	2.18 ug/L
NO2-N	1.92 ug/L

Table 15: Species found in station-3 during post-monsoon

Station- 03			
Name of Species	Number of Individuals	Abundance (Ind/m ³)	Percentage (%)
Copepod	177	88.06	27.31
Fish Larvae	133	66.17	20.52
Shrimp Larvae	142	70.65	21.91
Crab Larvae	105	52.24	16.20
Sagitta	28	13.93	4.32
Lucifer	17	8.46	2.62
Mysid	44	21.89	6.79
Unidentified	2	0.99	0.31
	=648	=322.39	=100%

Table 16: Comparison of physiochemical parameter during Post-monsoon

Post Monsoon			
Parameters	Station 1	Station 2	Station 3
Water temperature	29° c	29 °c	31° c
Air temperature	32° c	32° c	33° c
Water transparency	10 cm	12 cm	13 cm
pH	7.6	7.4	7.4
Salinity	14 PPT	14 PPT	15 PPT
DO	5.12 mg/L	5.71 mg/L	5.88 mg/L
BOD	2.90 mg/L	2.50 mg/L	2.32 mg/L
TDS	2.02 g/L	2.42 g/L	2.88 g/L
TSS	182 mg/L	114 mg/L	110 mg/L
EC	3.40 ms/cm	4.56 ms/cm	4.99 ms/cm
PO4-P	2.80 ug/L	2.36 ug/L	2.18 ug/L
NO2-N	2.58 ug/L	2.58 ug/L	1.92 ug/L

Table-17: Comparison of species found in three stations during Post-monsoon

Name of Species	Percentage			Average
	Station-01	Station- 02	Station- 03	
Copepod	25.75	25.96	27.31	26.34
Fish Larvae	20.72	20.89	20.52	20.71
Shrimp Larvae	19.72	18.91	21.91	20.18
Crab Larvae	16.90	17.43	16.20	16.84
Sagitta	3.82	5.56	4.32	4.56
Lucifer	5.03	4.45	2.62	4.03
Mysid	7.65	6.43	6.79	6.96
Unidentified	0.40	0.37	0.31	0.36

Discussion

Distribution and Abundance of Zooplankton

Zooplankton samples were sorted out into 7 major groups namely Copepod, Fish larvae, shrimp larvae, Crab larvae, Sagitta, Lucifer, mysid.

Total number of zooplankton varied from 182.01 Ind/m³ to 392.72 Ind/m³ in studied are throughout the research period.

Copepods

The number of Copepods during monsoon was recorded 34.05 % as the highest percentage. The lowest amount was found in post monsoon which is 26.34%. The abundance density was found 55.89 ind/m³, 71.84 ind/m³, 62.69 ind/m³ in monsoon and 65.64 ind/m³, 101.94 ind/m³, 88.06 ind/m³ in post monsoon.

Fish Larvae

From the recorded data, we saw that the percentage of fish larvae in post monsoon is higher than the percentage in monsoon. It is 20.71 % and 17.52 %. The abundance density in post monsoon was 52.82 ind/m³, 82.04 ind/ m³ and 66.17 ind/ m³. And 33.30 ind/ m³, 38.35 ind/ m³, 30.85 ind/ m³ in monsoon.

Shrimp Larvae

In monsoon, the amount of shrimp larvae was 12.96% and in post monsoon it increased to 20.18%. It was a little bit lower in monsoon than in post monsoon.

Crab Larvae

The percentages of crab larvae during post monsoon were 16.90% 17.43% 16.20% and in monsoon were 18.88%, 16.19%, 15.41%. That is the average is almost close in post monsoon and monsoon.

Sagitta

The amount of Sagitta in post monsoon was recorded 5.14% and in monsoon it was 4.56 %. That is in monsoon it was a little bit more than post monsoon. The abundance density was found 9.74 ind/ m³, 21.84 ind/ m³, 13.93 ind/ m³ in post monsoon and 9.74 ind/ m³, 12.62 ind/ m³, 7.96 ind/ m³ in monsoon.

Lucifer

From the recorded information, in monsoon it was quite a large amount of Lucifer then In post monsoon. 7.62 % in monsoon and 4.03% in post monsoon.

Mysid

Both in monsoon and post monsoon, percentages were almost the same. In monsoon it was 6.88 % and in post monsoon it was 6.96%. The abundance density was 19.49 ind/ m³, 25.24 ind/ m³ and 21.89 ind/ m³ in post monsoon. And in monsoon it was 10.77 ind/ m³, 15.53 ind/ m³ and 12.94 ind/ m³.

Shannon Diversity

In Shannon diversity index (H') the highest value was recorded 1.8131 at station-2 during Monsoon, and the lowest value was recorded 1.7797 at station-3 during monsoon. . As the value was higher in station-2 it is well diverse than others station.

In post-monsoon the highest value was recorded 1.7996 at station-3 and lowest value was 1.7900 at station-1. As the value was higher in station-3 it is well diverse than others station.

Pielou's Evenness Index

The evenness (J') was ranges between 0.7561 to 0.8172 during monsoon and 0.7787 to 0.8190 during post monsoon in the study area.

The highest value was found in Station 3 during post monsoon.

Margalef Richness Index

The richness (d) was found in a range of 1.35 to 1.63 at monsoon and 1.23 to 1.34 during post monsoon.

The highest value was found in Station 02 during monsoon.

Hydrological Parameters

Temperature

Water temperature is very important for aquatic organism. In the monsoon season the water temp was around 29-31°C and the air temperature was around 31-33°C. In winter season the water temperature was recorded 22-24°C and the air temperature was around 24-26°C.

PH

PH is one of the major factor for aquatic environment .The highest value was found 7.9 and lowest was recorded 7.4.

Water Transparency

The highest transparency of water was highest recorded 13 cm and lowest was 6 cm.

Dissolved Oxygen

In post monsoon season the dissolved oxygen (DO) was recorded 5.12-5.88 ml/L and in the monsoon 2.48-3.36 mg/L.

Salinity

In the post monsoon season the salinity was recorded around 14-16 PPT and in the monsoon season the salinity was recorded around 19-23 PPT.

BOD

In post monsoon season the Biological oxygen demand (BOD) was recorded 2.32-2.90 mg/L and In monsoon the Biological oxygen demand (BOD) was recorded 1.18-1.42 mg/L.

TDS

In post monsoon season the total dissolved solid (TDS) was recorded 2.02-2.88 mg/L and in monsoon, total dissolved solid was recorded 19.88-22.23 mg/L.

TSS

In post monsoon season total suspended solids (TSS) was recorded 110-182 mg/L and in monsoon season total suspended solids was recorded 214-311 mg/L.

Limitation of the Study

Currently in the current study on the inequality of sampling and disruption therefore due to the covid-19 pandemic condition. Further study is needed for a concrete conclusion

Conclusion

There are some differences between the three stations. The abundance of zooplankton is higher in station-02 which is mangrove forest area coast, Salimpur. Abundance is high here because of suitable parameters & nutrients, and it is a less polluted station than others. From the research, it is clear that the abundance in station-03 is a bit low and station-01 is the lowest. Station-03 is a fishery ghat and

station 01 is a ship breaking yard. Such an environment is risky for the abundance of zooplankton.

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