ECOSYSTEM AND ITS BIODIVERSITY ASSESSMENT OF INTERTIDAL ZONE

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BIODIVERSITY

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Biodiversity is a modern term which simple means "the variety of life on Earth". The variety can be measured on several different levels. Biodiversity is the variation of life forms within a given ecosystem, biome or for the entire Earth. "Biological diversity" means the full range of variety and variability within and among living organisms and the ecological complexes in which they occur and encompasses ecosystem or community diversity, species diversityand genetic diversity.

DIFFRTENT LEVELS OF BIODIVERSITY

Biodiversity is usually considered at different levels :-

- **Genetic diversity**
- **Species diversity**
- **Ecosystem diversity**

GENETIC DIVERSITY:

It refers to the variety of genetic information contained in all of the individual plants, animals and microorganisms.

- ✓ Genetic diversity occurs within and between populations of species as well as between species, such as the four varieties of white-cheeked rosella, *Platycercus eximius* and three species of Eucalyptus, such as *Eucalyptus cloeziana*, *E. delegatensis*, *E. saligna*.

SPECIES DIVERSITY:

It refers to the variety of living species. Aspects of species diversity can be measured in three ways. Richness, Species abundance and taxonomic or phylogenetic diversity.

Richness means number of species in a different area.

ECOSYSTEM DIVERSITY:

Ecosystem diversity describes the number of trophic levels, ecological richness and other ecological processes that sustain energy flow, food web and recycling of nutrients.

It has further three levels:

- ✓ Alpha diversity
- ✓ Beta diversity
- ✓ Gamma diversity.

MULTIPLE QUANTIFIABLE FACTS OF BIODIVERSITY

To proceed very fast with the study of biodiversity, we need to pin concept down. We cannot even begin to look how biodiversity is distributed or how fast it is disappearing. Unless we can put units on it. However any attempt to measure biodiversity quickly runs into the problem that is a fundamentally multinational concept; knowing the diversity (however measured) of one place, group or times is in itself more or less meaningless. Let us take a sample example which shows that it (biodiversity) cannot be reduced sensibly to a single number.

Biodiversity had a multitude of facts that can be quantified. Here we classify some commonly used measures into three conceptually different although not orthogonal, approaches.

NUMBERS

The most commonly considered facet of biodiversity is species richness the number of species in a site, habitat or clade. Species are an obvious choice of unit when trying to measure diversity. Most species have an idea what 'species' means and although their idea differ considerably (Bisby 1995), there even less things in common about other levels of taxonomic hierarchy (Avise & John, 1999). Many other measures are less intuitive, & have arisen only through appreciation of limitation of measures of species richness. Species are also sensible units to choose from a biological perspective; they keep their genes more or less themselves, & to that extend have independent evolutionary trajectories and unique histories. The current ‘best guess’ (Hawksworth & Kalin-Arroyo, 1985) figure. Region with many species, especially endemic species are sometimes called biological hotspots (Mayer’s et all. 2000).

Species and regions differ in the number of population. Population of a given species is defined on the basis of limited gene flow among them, will evolve to an extend independently. Each population contributes additional diversity. The number of genetic population in the world, taking all these into account, has been estimated to lie between 1.1 & 6.6 billion (Hughes et al., 1997).

Manydiversity have been develop to cover the extend to which individuals are distributed among species(Magnum,1998). Most authorize combine 'evenness' with 'SPECIES RICHNESS'.

DIFFERENCE

Some pair of species (or alleles or populations) is very alike, whereas others are very different. Disparity and character diversity are measures of phenotypic differences among the species in the sample & can be made independent of species number. some phenotypic characteristics might be more considered more important than others. Ecological diversity among species may be crucial for ecosystem for ecosystem functioning genetic variability among population within species management unit or evolutionary significant units. All these kind of difference are likely to be at least partly reflected by the phylogenetic diversity (Faith, 1994) among organisms which is estimated as the sum total of the branch lengths in the phylogeny (evolution tree) that link them together.

EXPLORING BIODIVERSITY

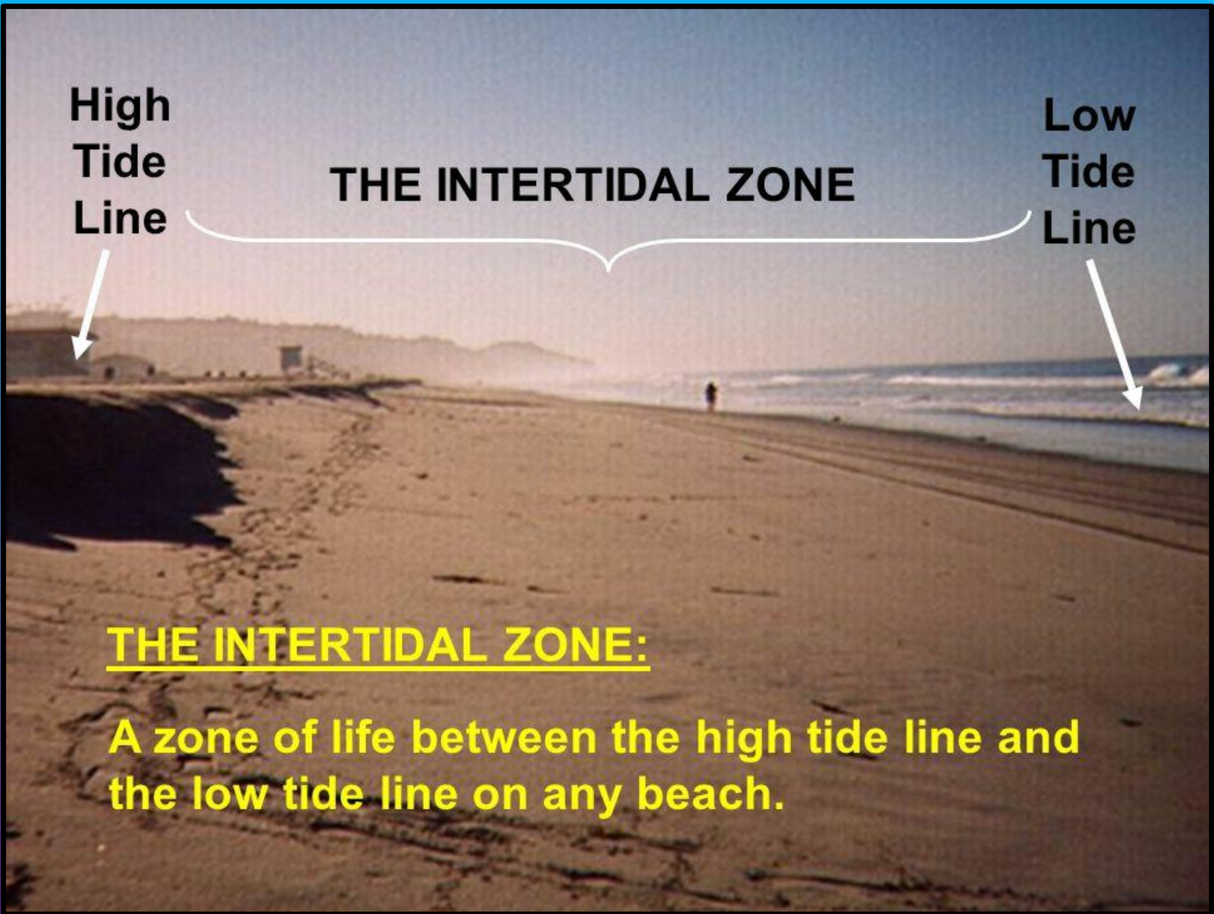
Biodiversity is fundamentally multidimensional concept, the exploring of which requires in the depth studies on the hand, and skill full evolution, vis-a-vis interpretation of gathered information.

Since biodiversity is sum total of all biotic variation from the level of genes to ecosystem (Purvis and Hector, 2000) knowing biodiversity of one place, group and time in itself meaningless.

We can realize that biodiversity cannot sensible be reduce to a single number alone. For a much comprehensive understanding aspect such as number evenness and different must be suitable quantified. After a sensible lecture delivered by our teacher as part of upstream programme (to zoological excursion) we realized while in the field learner must be aware of the following features that bear a direct relationship to our sustainable existence of Earth:

1. Biodiversity is growing as indicated by ongoing exploration of phylogenetic studies.
2. Biodiversity pattern change with time and space.
3. Biodiversity is shrinking by both natural process and human activities.

BIODIVERSITY OF INTERTIDAL ZONE



belongs to the terrestrial environment, with its extremes in temperature,moisture, and solar radiation. Despite these changes, seashore inhabitants are essentially marine organisms adapted to withstand some degree of exposure to the air for varying periods of time.

At ebb tide, the uppermost layers of intertidal life are exposed to air, wide temperature fluctuations, intense solar radiation, and desiccation for a considerable period, whereas the lowest fringes on the intertidal shore may be exposed only briefly before the rising tide submerges them again. These varying conditions result in one of the most striking features of the coastal shoreline: the zonation of life.

for the same niche. More essential nutrients are acquired from the water and they are buffered from extreme changes in temperature.

SIMPSON'S DIVERSITY INDEX :-

Simpson's diversity index is simple mathematical measures that characterize species diversity in a community.

Simpson's index (D) is a measure of the species diversity of an ecosystem based on the concept of dominance. It measures the probability that two individuals randomly selected from a sample will belong to the same species. It is actually a measurement of dominance.

For a finite community, this is

$$D = \sum \frac{n(n-1)}{N(N-1)}$$

Where,

n = total number of individuals of a particular species in the sample.

N = total number of individuals of all species present in the sample.

D is a measure of dominance, so as D increases, diversity (in the sense of evenness) decreases. The value of D ranges between 0 and 1, with this index, 0 represents an infinite diversity and 1, no diversity. That is, the bigger the value of D,the lower the diversity.

Simpson's index is usually reported as its complement (1-D) called, Simpson's index of diversity. The value of this index also ranges between 0 and 1, but now, the greater the value, the greater the sample diversity. In this case, the index represents the probability that two individuals randomly selected from a sample will belong to different species.

SHANNON DIVERSITY INDEX :-

Shannon diversity index (or Shannon-Wiener index) is another index that is commonly used to characterize species diversity in a community. It is a measure of the species diversity of a community based on information theory i.e., on the idea that greater diversity corresponds to a greater uncertainty in picking at random an individual of a particular species. Like Simpson's index, Shannon's diversity index accounts for both richness and evenness of the species present. As the Shannon diversity index increases, both the richness and the evenness of the community increase.

$$H = -\sum_{i=1}^{s}(P_i . \ln P_i)$$

Where:

H= the Shannon diversity index

P_i = fraction of the entire population madeup of species i

s = numbers of species encountered

∑ = sum from species 1 to species n

For real communities the value is between 1.5 and 3.5 with higher the value greater the diversity. The minimum value of Shannon-Wiener index is 0 when only a single species is present.The index is rarely greater than 4.

ADVANTAGES OVER SIMPSON'S INDEX

If a community had many such rare species,their contribution wouldaccumulate.This makes the Shannon's diversity index very valuable to conservation biologists,who often study rare species and their importance to the community.

MEMBERS OF OUR FIELD TRIP

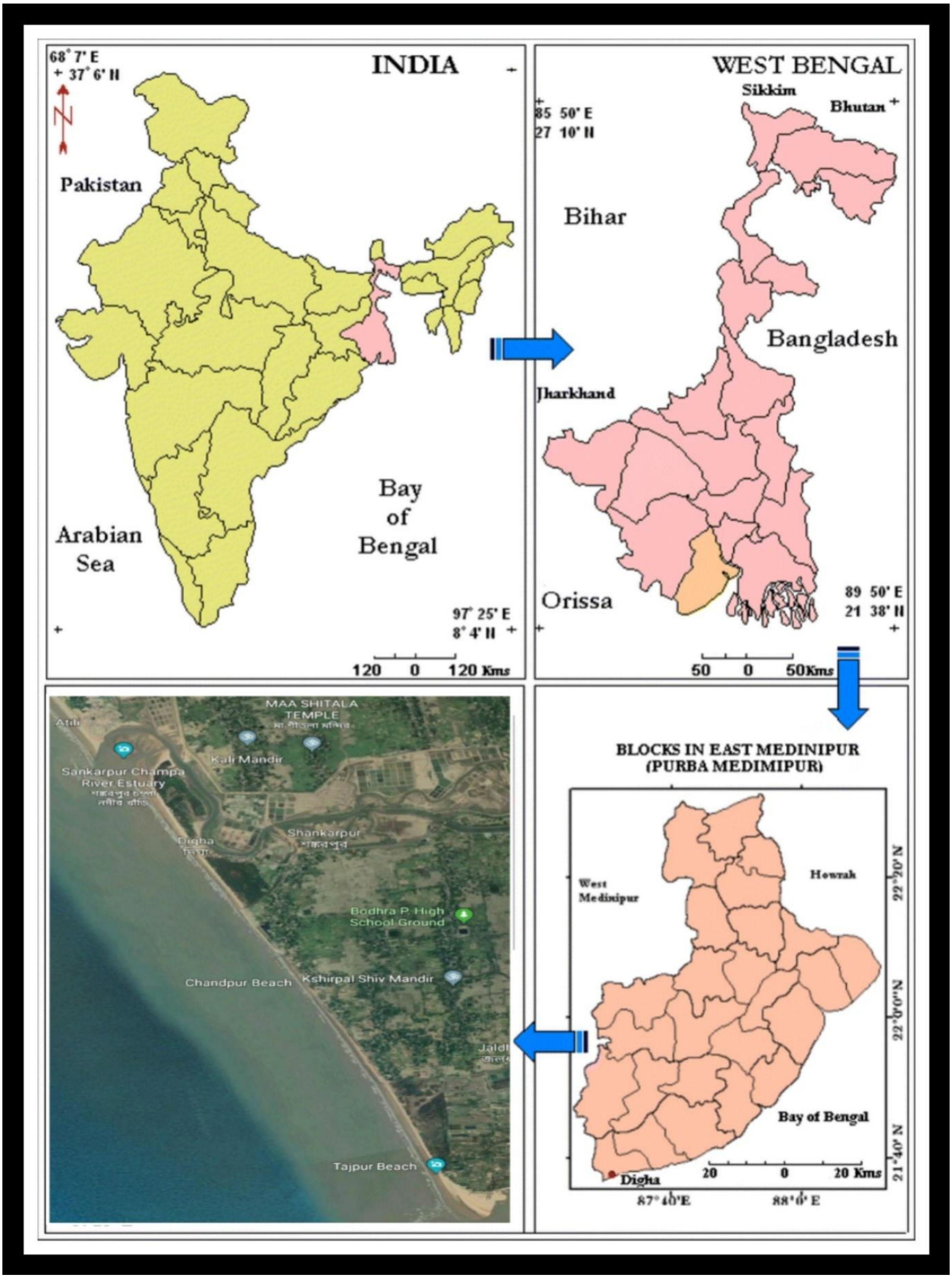
Teacher:	**Dr. Sudipta Bhowmick**	**Mr.Santu Paria**
Lab Attendant:	**Mrs. Debi Porel**	
Students:	**1. Priya Bhowmick** **2. Priti Maity** **3. Sheya Parvin** **4. Manimohan Pal** **5. Dipan Khamaru** **6. Sumona Dey** **7. Piyali Malik** **8. Chandrani Das** **9. Sukonna Maity** **10. Rituparna Bhattacharya** **11. Sudeshna Dhara** **12. Shilpa Nandy**	

Fig: Group Photo at Chandpur Sea Beach

ACTIVITIES

DATE	PLACE
18.10.2019	➢ Departure from Dharmatala at 7:30 am by bus and arrival at 12:45 pm in Chandpur. ➢ Visit to Tajpur beach for specimen collection.
19.10.2019	➢ Study of ecosystem at Shankarpur beach.
	➢ Quadrate sampling and Line-Transect method at Tajpur Sea Beach
20.10.2019	➢ Plankton collection and local biodiversity study at Chandpur sea beach. ➢ Departure from Chandpur at 1:30 pm by bus and arrival at 6:30 pm.

LOCATION MAP OF OUR STUDY AREA



LINE TRANSECT METHOD FOR COUNTING OF BIRDS AND BUTTERFLIES

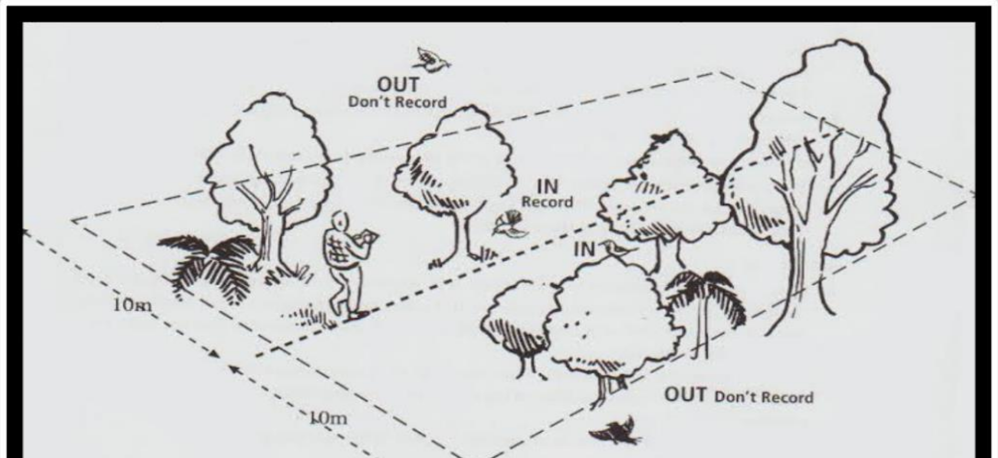


Fig: Line Transect Method

Line transects (Polland, 1975; Morre and Corbrt, 1990; Brooks, 1993). are used for birds of extensive open habits, e.g.- shrub-steppe and moorland, offshore seabirds and water birds.

METHOD :

A line transect involves an observer moving along a predetermined route through the study area, recording the distances at which everyone is seen (either exactly or in birds). Line transects are often used for birds especially in open habits, where it is relatively easy to record birds while walking. The observer should move sufficiently slowly to detect all the animals on the transect line and most of those nearby.

Transect lines should ideally be straight. Animals are usually recorded on both sides of the line but may be recorded on one side only. To cover an area properly, several independent transects should be walked.

Total length of transect route will depending upon the study in question.

✐ ADVANTAGES :

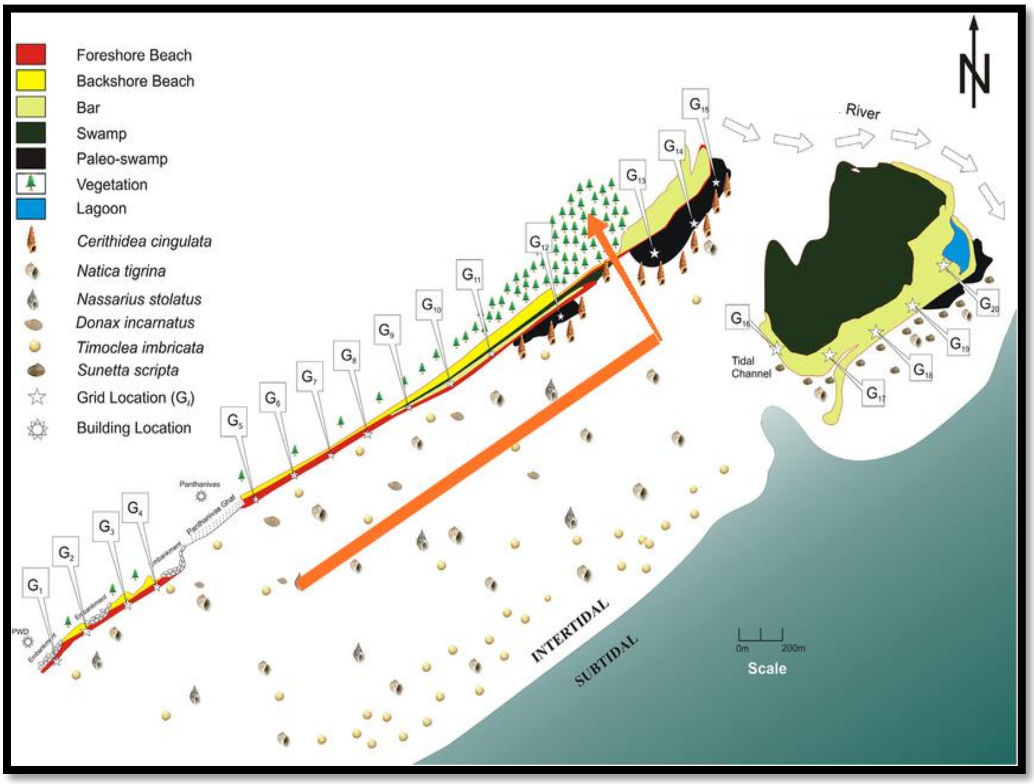
I. Line transects can be undertaken at any time of the year, on land, on sea or in the air.

II. Line transects suited to large areas of homogenous habitat and are particularly useful where bird populations are at low density.

✐ DISADVANTAGES :

I. Because of the observer is continually on the move, identification can be difficult and cryptic birds can easily be missed.

II. A high level of observer experience is required.



QUADRATES

Quadrates are for measuring abundances of species in any vegetation, including aquatic macrophytes.

METHODS :

Quadrates can be used to measure density, frequency, cover or biomass. They are used to define sample areas within the study area and are usually four strips of wood, metal or rigid plastic which are fixed together to form a square. Corners are marked by posts and it is important to keep a constant quadrate shape. For certain purposes the quadrate can be divided into a grid of equal-sized squares using regularly spaced lengths of string or wire. The sizes most often used are 0.01-0.25m^2 bryophyte,lichen,0.25-16m^2 for grassland,25-100m^2 for tall*shrub communities.

To get a good estimate of species abundances multiple quadrates should be used in each study area according to sampling design and various measures can be used to survey the vegetation.

Density is measure by counting the number of individual each species within the quadrate.

$$\text{Density} = \frac{Total\ no.of\ individuals\ of\ the\ species\ in\ all\ quadrates}{No.of\ quadrates\ in\ which\ that\ surveyed}$$

Abundance is measured by counting the number of individuals of each species within the quadrates in which that species is observed.

$$\text{Abundance} = \frac{Total\ no.of\ individuals\ in\ all\ quadrates}{No.of\ quadrates\ in\ which\ the\ particular\ species\ is\ found}$$

Frequency can be measured in two ways. One is to use the quadrate as the sampling unit. A large number of quadrate is placed in the study area and the proportion of quadrate

Purple sunbird (Male)

Little ring plover

containing the species is counted. A more load measure of frequency can be derived if the quadrate is subdivided into grid and the percentage of grid squares containing the species is calculated.

$$\text{Frequency} = \frac{No.of\ quadrates\ in\ which\ the\ species\ occured}{Total\ no.of\ quadrates\ studied} \times 100$$

✎ ADVANTAGES :

- Very easy to use and can be employed in a wide range in studies.
- Frequency is a very quick method to use.

✎ DISADVANTAGES :

- Time consuming to measure and very large quadrates.
- The estimate of frequency will always be influenced by quadrate or subdivision size.

QUADRATE AT TAJPUR BEACH

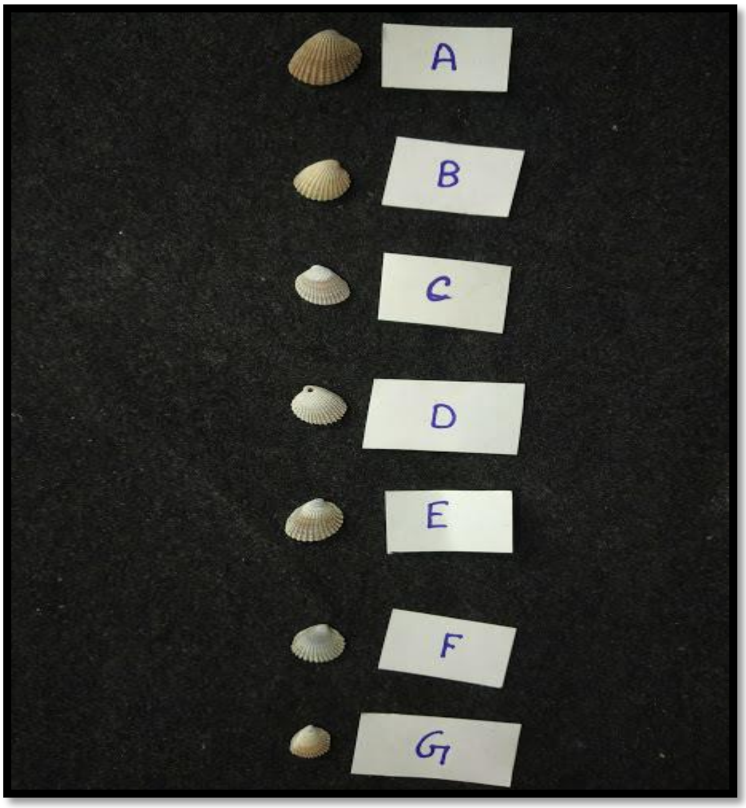


Fig: Collection of Bivalve shells observed during quadrate study

Name of the species	Quadrate 1	Quadrate 2	Quadrate 3	Quadrate 4	Quadrate 5	Quadrate 6	Total no. Of individual Per species	Total no. of individual
Sp. A	3	8	15	11	20	16	73	221
Sp. B	3	4	22	5	12	8	54	
Sp. C	6	2	7	6	14	2	37	
Sp. D	11	2	3	9	0	15	40	
Sp. E	6	4	0	4	0	0	14	
Sp. F	0	2	0	0	0	0	2	
Sp. G	0	1	0	0	0	0	1	

DENSITY :

For sp. A = $\frac{73}{6}$= 12.166

For sp. B = $\frac{54}{6}$ = 9

For sp. C = $\frac{37}{6}$ = 6.166

For sp. D = $\frac{40}{6}$ = 6.666

For sp. E = $\frac{14}{6}$ = 2.33

For sp. F = $\frac{2}{6}$ = 0.333

For sp. G = $\frac{1}{6}$ = 0.166

ABUNDANCE :

A = $\frac{73}{6}$ = 12.166

B = $\frac{54}{6}$ = 9

C = $\frac{37}{6}$ = 6.166

D = $\frac{40}{5}$ = 8

E = $\frac{14}{3}$ = 4.666

F = $\frac{2}{1}$ = 2

G = $\frac{1}{1}$ = 1

FREQUENCY :

A = $\frac{6}{6}$ ×100 = 100%

B = $\frac{6}{6}$ ×100 = 100%

C = $\frac{6}{6}$ ×100 = 100%

D = $\frac{5}{6}$ ×100 = 83.33%

E = $\frac{3}{6}$ ×100 = 50%

F = $\frac{1}{6}$ ×100 = 16.666%

G = $\frac{1}{6}$ ×100 = 16.666%

Simpson's index

Name of Species	Total no of individual per species(n)	Total no of individual (N)	n(n−1)
Sp. A	73	221	5256
Sp. B	54	221	2862
Sp. C	37	221	1332
Sp. D	40	221	1560
Sp. E	14	221	182
Sp. F	2	221	2
Sp. G	1	221	0

$\sum n(n-1)$ = 5256 + 2862 + 1332 +1560 + 182 + 2 + 0

= 11194

N(N−1) = 221(221−1) = 48620

Simpson's index $(D) = \sum \frac{n(n-1)}{N(N-1)}$

D = $\frac{11194}{48620}$ **= 0.23**

Hence, **Simpson's index of Diversity** = 1 – D

= 1 – 0.23

= **0.77**

Comment: In our study Simpson's index of diversity is 0.77, that shows the presence of **fair amount of diversity** among the specimens collected from the quadrate.In this case, the index represents the probability that two individuals randomly selected from thecommunity will belong to different species.

Shannon-Wiener index

Name of species	Total no of individual per species(n)	Total no of individual(N)	$n/N = P_i$	lnP_i	$P_i lnP_i$
Sp. A	73	221	73/221=0.330	-1.108	-0.365
Sp. B	54	221	54/221=0.244	-1.41	-0.344
Sp. C	37	221	37/221=0.167	-1.789	-0.298
Sp. D	40	221	40/221=0.180	-1.714	-0.308
Sp. E	14	221	14/221=0.06	-2.813	-0.168
Sp. F	2	221	2/221=0.009	-4.710	-0.042
Sp. G	1	221	1/221=0.0045	-5.403	-0.024

$$H = -\sum_{i=1}^{s} Pi.lnPi$$

H= [-{-(0.365+0.334+0.298+0.308+0.168+0.042+0.024)}]

H= [-{-1.549}]

H= 1.549

Comment: In our study Shannon-Wiener index of the community is 1.549. This shows the presence of **low diversity** among the bivalvian specimens in the community.

Evenness or Shannon's equitability(E_H)

Shannon's equitability (E_H), also called evenness, can be calculated by dividing Hby H_{max}.Here,**H_{max}= lnS& S = total number of species in the community or richness**. Equitability assumes a value between 0 and 1, with 0 signifying no evenness and 1 being complete evenness.

Here S = 7. Therefore, ln(S) = ln(7) = 1.945

$$E_H = H / H_{max}$$

$= H / \ln S = 1.549 / 1.945 = 0.79$

Comment: Here, E_H for the quadrate is 0.79, that indicatescomparatively high evenness i.e.individuals in the community are distributed more equitably among these species.

QUADRATE AT TAJPUR BEACH
(FOR CRAB HOLES)

Method:

I. The quadrate was formed by the help of rope, measuring tape.
II. The quadrate having $6m^2$ area total, which were divided 6 equal sub quadrates which had the area of $1m^2$.
III. Then the species variety of the faunal diversity is recorded.

Date-19/10/2019
Temp.:24°C

Fig: Quadrate study at Tajpur (Quadrate 3)

	Quadrate 1	Quadrate2	Quadrate3	Quadrate4	Quadrate5	Quadrate6	Total number
Number of crab holes	21	33	9	9	14	16	102

- **Density** $= \frac{Total\ number\ of\ individual\ of\ the\ species}{Total\ number\ of\ quadrate\ studied}$

$= \frac{102}{6} =$ **17**(so, 17 individual per sq. m or m^2)

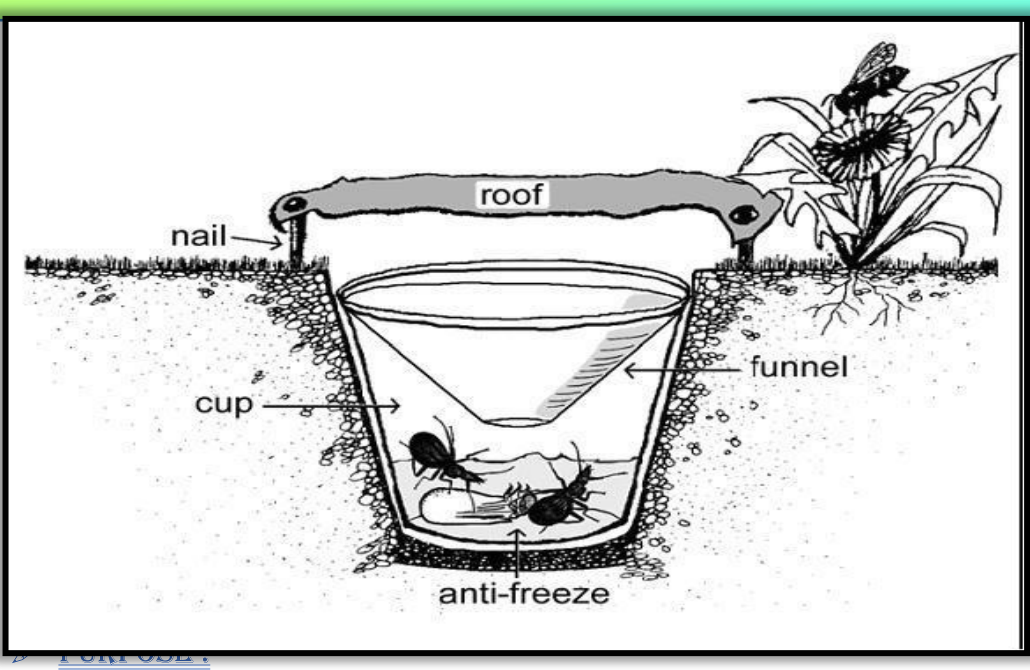
- **<u>Abundance</u>** = $\frac{Total\ number\ of\ individual\ of\ the\ species}{Total\ number\ of\ quadrate\ in\ which\ species\ at\ occur}$

= $\frac{102}{6}$= **17**

- **<u>Frequency</u>** = $\frac{Total\ number\ of\ quadrate\ in\ which\ species\ has\ occur}{Total\ number\ of\ quadrate\ studied}$

= $\frac{6}{6}$ **×100 = 100%**

PITFALL TRAPS AT CHANDPUR BEACH



PURPOSE:

These traps are used for active, surface-living invertebrates in low vegetation and bare ground, particularly larger beetle, spiders and ants.

METHODS:

Pitfall traps consist of straight-sided containers sunk level with the surface of the ground into which invertebrates inadvertently fall. Any size or type of containers with smooth sides can be used, but tough polythene tubs about 8 cm in diameter and 10 cm deep with fitting lids have been found to work well and have advantages that they are less easily crushed by stock, do not crumple when pushed into stony ground.

Preservative solutions are usually put in the trap to arrest decay and prevent invertebrates from eating each other. The most reliable preservative is neat can antifreeze (ethylene glycol or propylene glycol).

A tip made up of hardboard is used sometimes to prevent the trap from blocking up with leaves, overflowed with rain water and to drive away large animals from the trap. It is fitted on the top of the trap leaving a small gap (about 10 mm).

Pitfall traps can also be baited with raw meat, fish, cheese or fermenting fruit to attract beetles. Preservation should not be used in baited traps, since these may mask the smell of the bait.

If traps are to be emptied repeatedly, then a quick way to do this is to empty the trap contents through muslin. The trap liquid can be then reused.

I.

✎ ADVANTAGES :

I. Pitfall trapping is probably the most commonly used trapping method for studying invertebrates and is a cheap, quick and easy method of catching very large numbers of specimens.

II. Pitfall traps catch a range of animals that are rarely, if ever caught using other standard methods. There is almost no substitute for this method.

✎ DISADVANTAGES :

I. In common with often active trapping techniques, catches reflect relative activity and vary with weather conditions.

II. Catch rates also vary with the nature of the surrounding vegetation, because taller vegetation in the vicinity of the trap impedes invertebrate's movement.

III. Other animals may also interfere with pitfall traps.

Fig: Setup of pitfall trap

Fig: Installation of the pitfall traps

Fig: Sorting of specimens from a pitfall trap

Fig: Result obtained from pitfall trapping

COLLECTION OF PLANKTON SPECIES FROM FRESH WATERAT BODIES NEAR CHANDPUR SEA BEACH

Organisms of relatively small size, mostly microscopic, which have either relatively small power of locomotion or not at all and which drift in water subject to action of waves and current and other forms of water motion are termed plankton.

PLANKTON COLLECTION

✐ EQUIPMENTS:

1. Plankton net
2. 5% formaline solution
3. Measuring cylinder
4. Distilled water

✐ PROCEDURE:

1. Plankton samples are collected preferably early in the morning before 8 a.m. These are collected from different parts of the same pond randomly.
2. Each time 50 Liters of water is collected and the sample is sieved by plankton net.
3. After sieving water plankton net is repeatedly washed by splashing water from outside and in this way plankton is collected and taken in the sample bottle.
4. It is difficult to separate microscopic organisms in live state. They are killed by slow addition of formaldehyde in water, and separated later.
5. The specimens are collected in a watch glass containing distilled water and identified under a field microscope.

✐ SIGNIFICANCE:

1. Plankters represent the first and the second and sometime third tropic level represent the main autotrophs of the water body.
2. Plankton gives idea about the productivity of aquatic systems.

<u>CHECKLIST OF PLANKTON SPECIES</u>

Ditch Jewel

SL NO.	NAME OF THE PLANKTON	IDENTIFYING CHARACTERISTICS
1.	*Daphnia sp.*	• Antennae biramous. • Bivalve carapace encloses body & appendages. • Caudal spine present.
2.	*Asplanchna sp.*	• Ovoviviparous. • No foot. • No hindgut/anus.
3.	*Branchionus sp.*	• Anteriomedian spines have broad base. • Posterior spines are often present. • Lorica is smooth and transparent.
4.	*Cyclops sp.*	• Elongate, pear-shaped body. • Body with a pair of antennules & apair of antennae. • In mature females two lateral ovisacs hang from the abdomen.

LIST OF SOME BIRD SPECIES OBSERVED AT SHANKARPUR

SL No.	COMMON NAME	SCIENTIFIC NAME	ORDER	NUMBER OF OBSERVATION OF SPECIES (n)	RELATIVE ABUNDANCE [(n/N)×100]%
1)	Black Hooded Oriole	*Oriolus xanthornus*	Passeriformes	1	3.84%
2)	Jungle Babbler	*Turdoides striata*	Passeriformes	5	19.23%
3)	Rofous Treepie	*Dendrocitta vagabubda*	Passeriformes	2	7.69%
4)	Common Myna	*Acridotheres tristis*	Passeriformes	8	30.76%
5)	Spotted Dove	*Spilopelia chinensis*	Columbiformes	4	15.38%
6)	Eurasian Collared Dove	*Streptopelia decaocto*	Columbiformes	2	7.69%
7)	House Sparrow	*Passer domesticus*	Passeriformes	3	11.53%
8)	Lesser Coucal	*Centrops benghalensis*	Cuculiformes	1	3.84%

Long Spine Sea Bream

Yellow Fin Tuna

Japanese Silver Bream

CONCLUSION

Population grows and as more people lives at higher standard there is a greater demand for resources. The resources must be conserved to assume that these will be enough for the future.

To save our biodiversity following conservation are to be taken up.

- To maintain essential ecological process and life support system.
- To make protected wildlife and it's genetic diversity.
- To make sustainable utilization of genes, species and ecosystem.
- It is very important to protect and conserve wild animals, as once they are gone, they will be gone forever.
- To emphasize on the basic role of nature ecological process, biodiversity and sustainable utilization at all levels of decision making.
- To identify conservation priorities with attainable goals.
- To promote establishment of protected area network, biosphere reserve management another conservation initiative for preservation of the natural habit.
- To provide facilities for conservation education and community development programme.
- To establish efficient scientific information and decision support for needs driven research and conservation planning.
- To implement regulations prohibiting hunting of wildlife under Indian Wildlife (protection) Act, 1972. To engage many national and international Agencies, Government and non-Government. Agencies (NGO) like IUCN, WWF, WTI, UNDP etc. for conservation of wildlife in it's natural environment.
- Many research projects are going on by Government and non-Government Agencies Awareness programme.