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COMMUNITY ECOLOGY

The group of organisms that live together in a particular ecosystem are known as a **community**. With due course of time different species have made many complex adaptations for community living, evolving together and forging relationships that give the community its features and stability.

What is a Community?

- It is an assemblage of individuals of different species living close enough together for prospective interaction.
- A community differ in its species richness, the number of species it have, and in evenness of different species.

Communities differ from each other

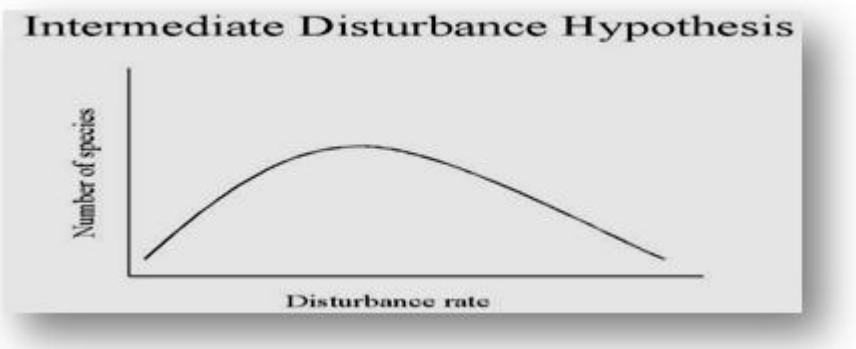
- In species diversity
- In species richness
- In relative abundance of different species.

The factors which shape community structure

The structure of a community is because of many interacting factors, both in abiotic and in biotic world. There are many important factors that influence community structure:

- **The climate of community's location.**
- **Geography of the community's location.**
- **The heterogeneity or patchiness of the environment**
  Each part of environment varies in its resources composition
- **Rate of disturbances, or disruptive events.**
- **Relationship between organisms.**
- **Opportunities for migration of pioneer communities**
  Far and smaller island have lower biodiversity
- **Behaviour of predators**
  A predator helps in reduction of competition by eating competitive dominants
- **Level of disturbance**

According to intermediate **disturbance hypothesis (IDH)** species diversity is maximum when ecological disturbance is neither too high nor too low.



The chance events during the history of community can also influence community's composition. Let's suppose a single seed immigrate into the soil of a particular area. If this seed is going to take root there, then this species may establish itself. Then after some time this species will become a dominant species by excluding other species. But if this seed is going unsuccessful in sprouting, than many other potential species can establish their self and can become dominant species of that area.

Ecological Characteristics of a community:

Species diversity

The species composition of a community is dependent on its locality. The complexity of a community is majored by its species composition. It is majored by its **species richness** and by **species evenness.** Greater the numbers of species it have and more even abundances of these species leads to a greater species diversity.

Species diversity has two components:

(i) **Species richness**: it refers to the number of species in a community.

(ii) **Species evenness**: it refers to the abundance of different species in a community. Evenness is highest when species are present in almost equal proportion.

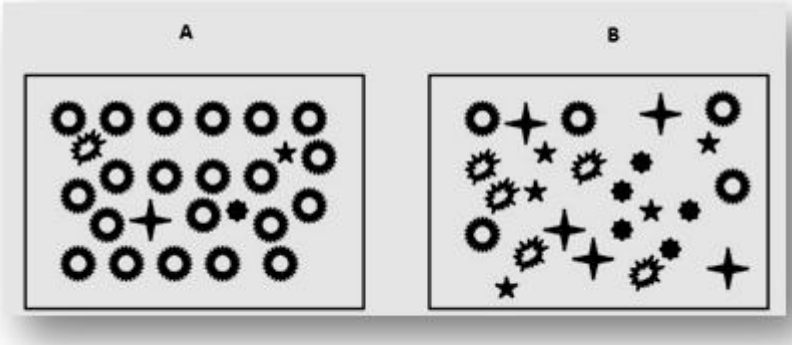


Fig. : Both communities A and B contain 5 species each. That means both have the samedegree of species richness. But in community A, one species is present in large number andthe others are few in number. Whereas, in community B, all the five species are present in thesame proportion. As a result, species evenness of community B is higher than that ofcommunity A. Communities which have higher evenness have higher species diversity.

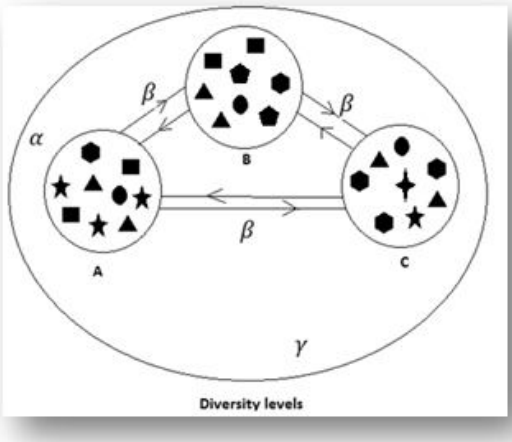
Species diversity can be studied at 3 levels:

(i) Alpha diversity: Refers to the number of species within a habitat or a local site.

(ii) Beta diversity: Refers to total number of different species present between 2 habitats.

(iii) Gamma diversity: Refers to the total number of different species present in all habitats within a region.

- **These term were introduced by <u>R. H. Whittaker</u>**



Community	■	⬢	▲	●	★	✦	⬟
A	2	1	2	1	3	-	-
B	2	1	2	1	-	-	1
C	-	3	2	1	1	1	-

Diversity			
Alpha	A = 5	B = 5	C = 5
Beta	A—B = 6	B—C = 7	C—A = 6
Gamma	A—B—C = 7		

Diversity index

It is a quantitative measure that reflects how many different types of species are there in a community and at the same time it also takes into account how evenly the individuals of different species distributed.

OR

It can also be defined as a numerical measurement of species diversity in a community. Diversity index gives us important information about community composition than simply species richness; it also takes the relative abundances of different species into consideration.

In this way diversity index becomes an important tool for biologists in understanding community structure and function.

How to measure diversity index?

Simpson index and Shannon diversity index are two ways to calculate the diversity of a particular community.

1. **Simpson index**

- **Formula for Simpson diversity index**

$$\text{Simpson Index (D)} = \frac{1}{\sum_{i=1}^{s} p_i^{\,2}}$$

or

$$D = 1 - \left(\frac{\Sigma\, n(n-1)}{N(N-1)} \right)$$

Where:

- **n = it is the total number of organisms of a particular species**
- **N = it is the total number of organisms of all species**

Here, value of D ranges between 0 and 1. In this index, 1 represents infinite diversity and 0, no diversity.

Example:

	Number (n)	n(n-1)
rabbit	2	2
snails	8	56
Inland typan	1	0
fox	1	0
rhino	3	6
Total	15	64
	N = 15	n(n-1) = 64

After putting the values into the formula for Simpson's Index:

$$D = 1 - \left(\frac{\Sigma\, n(n-1)}{N(N-1)}\right)$$

$$D = 1 - \left(\frac{64}{15(14)}\right)$$

Simpson's Index of Diversity comes out 0.7.

Shannon diversity index (H)

As like Simpson index, the Shannon diversity index (H) is also used to characterize species diversity of a community. Shannon's index also accounts for both abundance and evenness of the species present in a community.

How to calculate Shannon index:

- The proportion of species (i) relative to the total number of species (pi) is calculated
- And then it is multiplied by the natural logarithm of this proportion (lnpi).
- The resulting product is summed across species, and multiplied by -1:]

$$\text{Shannon Index (H)} = -\sum_{i=1}^{s} p_i \ln p_i$$

Where:

- H = the Shannon diversity index
- Pi = fraction of the entire population made up of species i
- S = numbers of species encountered
- " = sum from species 1 to species S

To calculate the index:

1. Divide the number of individuals of species 1 which you have to find in your sample by the total number of individuals of all species. And this is known **as Pi.**
2. Then multiply this Pi by its natural log (Pi * ln Pi)
3. Again repeat this for all of the different species that you have in your sample.
4. Sum all the - (Pi * ln Pi) products to get the value of H

For example;

Birds	N_i	P_i	$\ln P_i$	$-(P_i * \ln P_i)$
Robin bird	96	.96	-.041	**.039**
Eagle	1	.01	-4.61	**.046**
vulture	1	.01	-4.61	**.046**
Crow	1	.01	-4.61	**.046**
sparrow	**1**	**.01**	**-4.61**	**.046**

H = 0.223

If there is high values of H, it means more diverse the communities is. "0" value of h means that that this community only bears a single species. Because in this case Pi will be equal to 1 and when it will multiplied by ln Pi which would be equal to zero? An even distribution of species cause high value of **"H"**. So high value of h not only means that there is species richness in a particular community, it also means that this species are also more evenly distributed in this community.

Ecotone