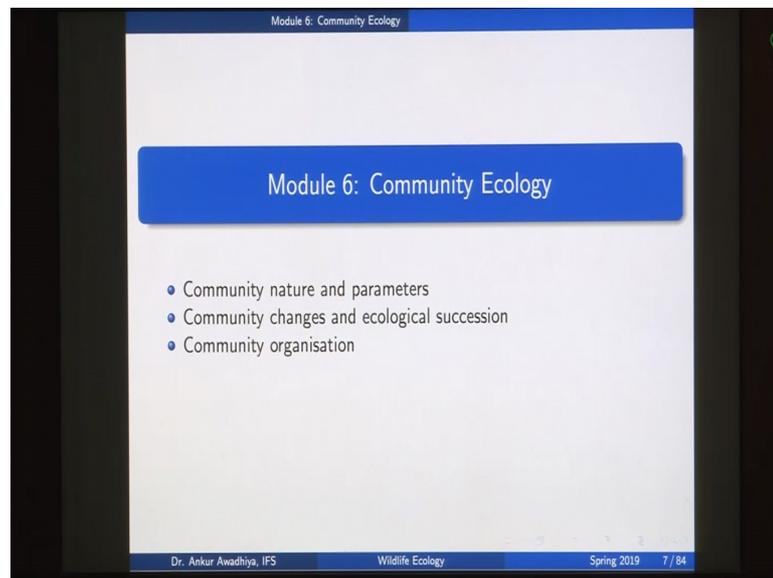


**Wild Life Ecology**  
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**Lecture – 16**  
**Community nature and parameters**

[FL]. Today, we begin a new module which is Community Ecology. Now, community ecology is the study of ecology at the level of the community or the application of the ecological principles to understand how a community works, in how a community functions? Now, in this module we will be having 3 lectures.

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The first one is community nature and parameters, what is the nature of a community? What are the specific traits that we can discern from a community? How is one community different from another community? What are the species that are found in a community is there any specific relationship between species and communities and so on.

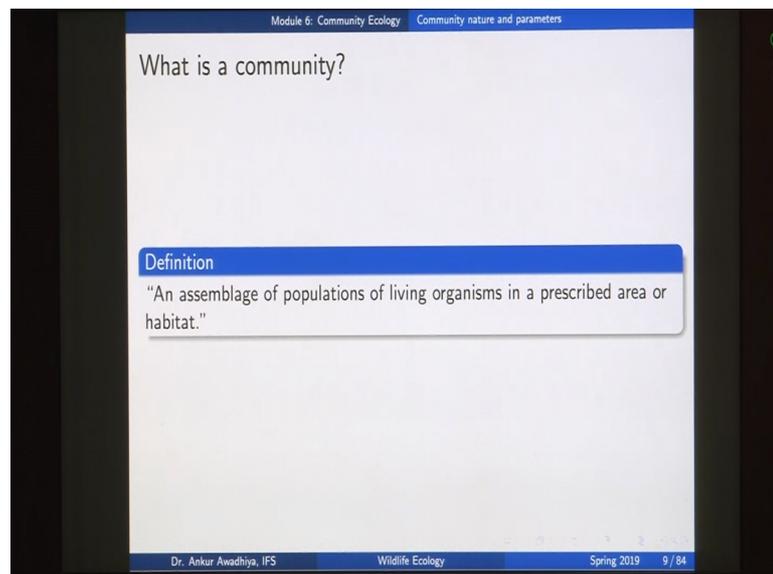
In the second lecture we will have community changes and ecological succession. Now, ecological succession is the process by which a community moves from being a certain kind of community to another kind of community. So, for instance if we have say a piece of rock. So, this piece of rock might get invaded by certain species they will form a community say a lichen community.

And then with time it will change, because these lichens will change the structure of the rock they will change the, chemical composition they will give out certain chemicals, certain enzymes, certain assets into the rock that might lead to the breakage of these rocks. And at the same time they will also produce a lot of organic material. When one of that happens you will have some amount of soil formation, which will make way for other species such as mosses, which will then out compete the lichens. And then from mosses will move to grasses and then 2 shrubs to trees to a final community, which we call is climax community, which remains stable and does not change.

Now, succession is the process in which these communities change with time. So, from a lichen community, you have a moss community then you have another community that is dominated by herbs, then another community that is dominated by shrubs and so on and this process is known as ecological succession.

So, to answer the question does a community change and if so, how does it change and what will be the final result of such a change. What will be the climax community that will be formed? And in the third lecture we will have a look at community organization. So, let us begin with the first lecture which is community nature and parameters.

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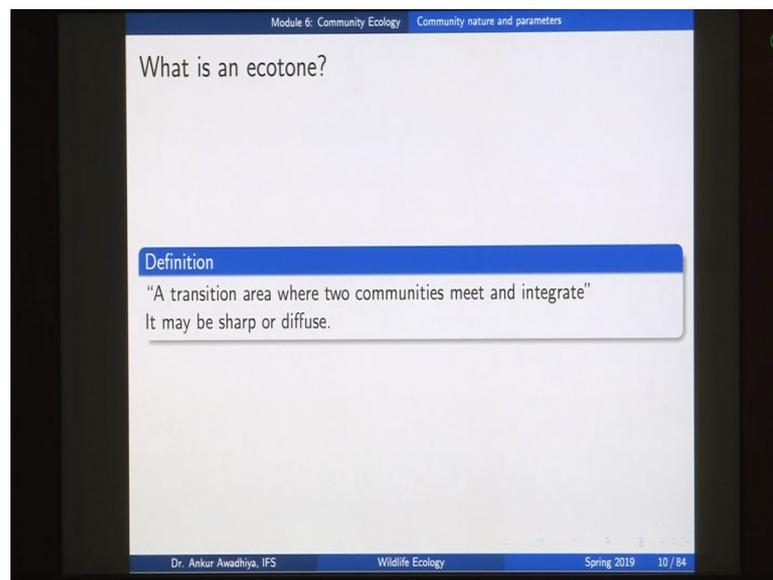


So, we begin with the definition of a community. "A community is an assemblage of populations of living organisms in a prescribed area or a habitat", that is it is a collection of populations of different species. So, here you have a number of species that are living

together they are living in a certain area. So, the aerial concept here is important, if you have certain species that are living in say Kanpur and there are certain species that are living in say Coimbatore.

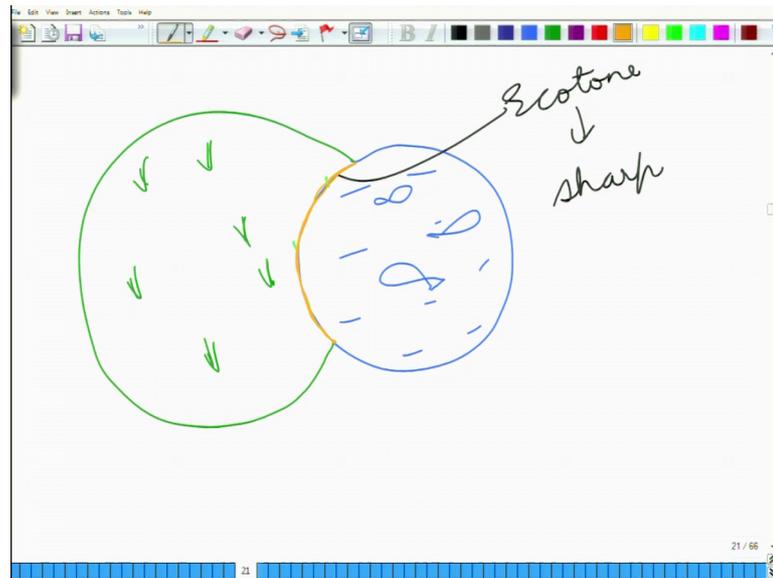
So, these 2 will not form a single community, but then if you have different species that are living together in say Kanha Tiger Reserve, we will say that it will form a community.

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And when you have 2 different communities the border between both of these communities is known as an ecotone. So, it has a transition area where 2 communities meet. And integrate and it may sharp or it may be diffused.

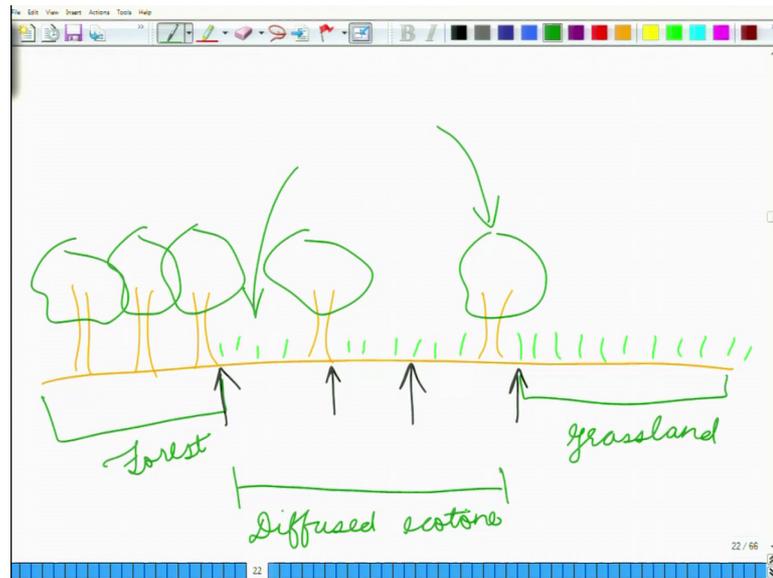
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So, essentially what we are saying is suppose here you have a water body and right next to the water body you have a grassland. So, the grassland will be having certain species, that are living together and the water body will be having certain species that are living together. So, if we talk about 2 different communities what is the border? So, this is this line is telling us the border and this is known as an ecotone.

Now, in this case the ecotone is a sharp ecotone, because we can very clearly see that anything that is on the right side of this line is a water body and anything on the left side of this water body is a grassland. So, in this case have sharp ecotone.

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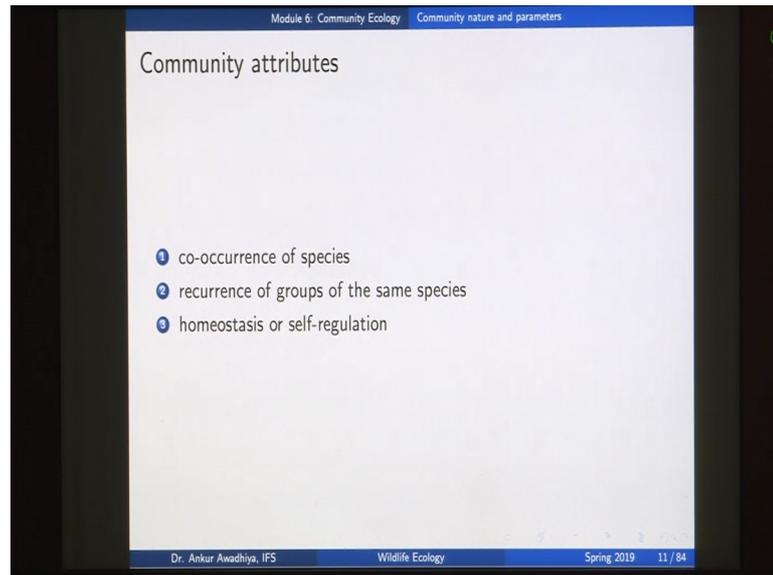
Now, let us consider another situation where we are considering a forest area and in this forest area we have certain trees and then after while you will see trees are a bit longer distances apart. And then you also have the grasslands.

Now, in such a scenario we can very clearly see that this is the forest region and this is a grassland region. So, we can say that this is a forest community on the left side and this is a grassing community on the right side. But, then where is exactly the border of the grassland, or the border between the forest and the grassland is it see here or is it here or is it here or is it here that is something that we do not know for sure. Because, we are seeing that the grassland has invaded into the forest and the grassland has come to this end or we can say that the forest has invaded into the grassland and we can see some trees species here in the grassland.

So, in this case the kind of ecotone that we are having is a diffused ecotone. So, it is a very wide ecotone and this is known as a diffused ecotone. So, coming back to the definition a transition area where two communities meet and integrate and it may be sharp or it may be diffuse that is an ecotone.

Now, when we are talking about any community, when we are talking about say a forest community or a grassland community, they will be certain attributes of that community certain characteristics of that community.

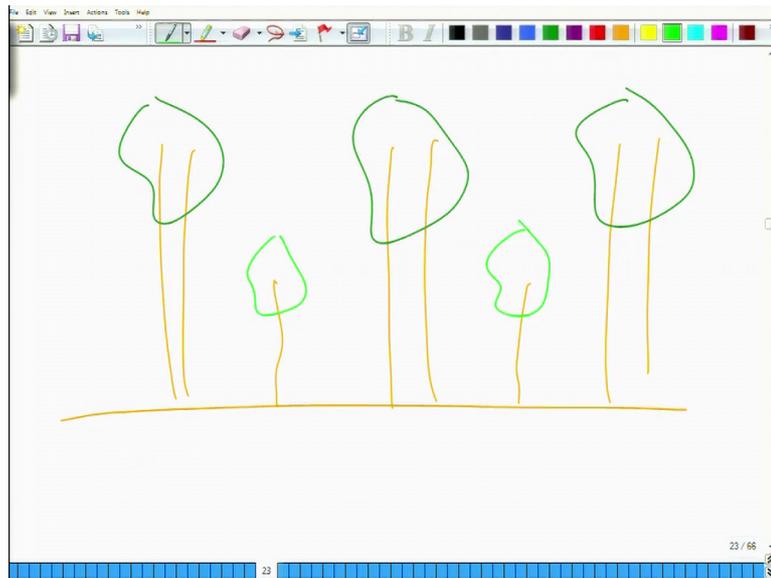
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So, let us now have a look the community attributes. The attributes of a community are co occurrence of certain species. Now, for instances if there is a forest and we say that there is a tiger that lives in the forest. So, we will we are talking about the co-occurrence of certain communities, where you have a forest you might have a tiger or we can talk about co-occurrence of species of plants that come up together.

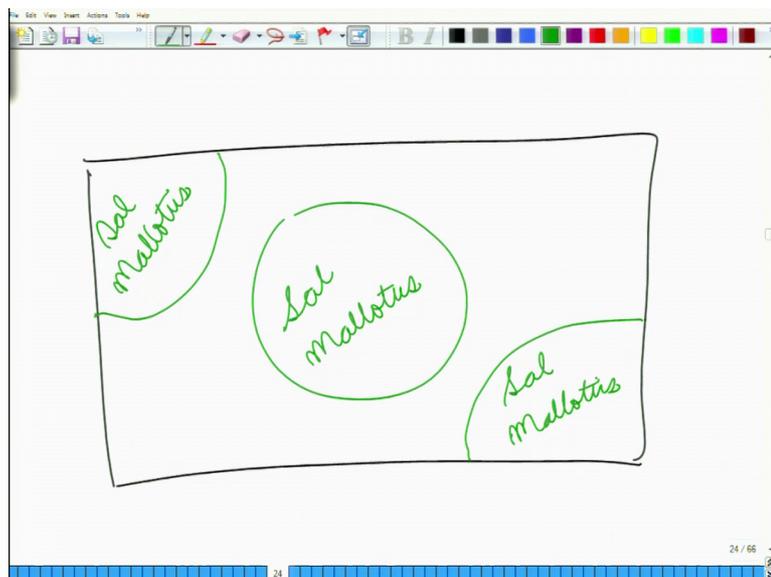
So, for instance in the case of a Sal forest, we have a number of associated species of Sal. So, there is a species that is known as a Sinduri species. So, in the case of Sinduri this tree will reside in the Sal forest.

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So, let us say that, here we have the tall trees of Sal and in the area in between you might have these small trees, they are known as Sindoori or Mallotus and their associated with the Sals. So, essentially where you have a Sal forest you will also find the Mallotus trees. So, here we are talking about the co-occurrence of certain species. So, these species are occurring together that is one attribute. So, we will call this a community of the Sal forest because you are seeing these tree that are always associated together. The second one is recurrence of groups of the same species.

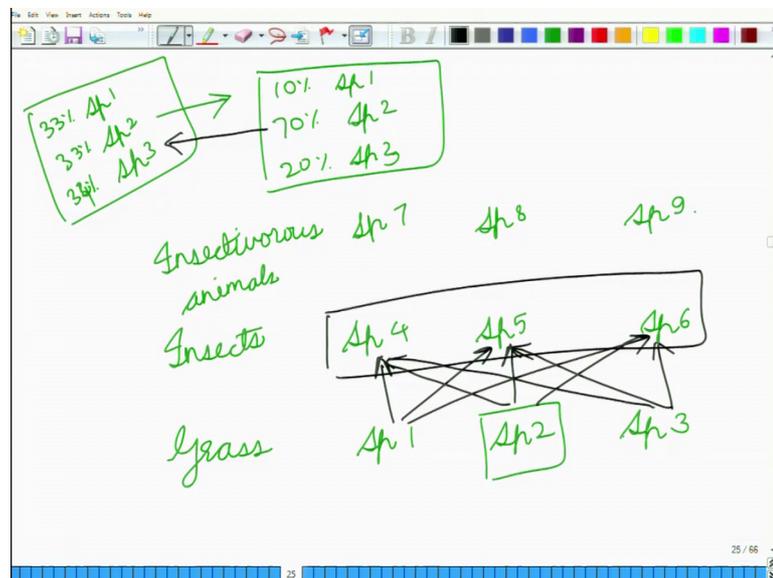
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Now, these groups tend to recur now when we say recur we mean that if you have say in a large landscape, if in this area you have a Sal forest and in this area you have another Sal forest, and in this area you have a third Sal forest. Now, in all three of these Sal forest you will find Sal trees and you will find Mallotus trees. So, tend to (Refer Time: 08:39) here also you have Sal here you also have the Mallotus, here also you will have Sal and Mallotus together. So, these groups of species they only occur together, but they also tend to recur whenever you have another community of the same type.

So, it is not like in one particular patch of Sal forest, you have Sal in Mallotus in another patch you do not have a Mallotus maybe you have some other species. So, that will not happen. So, it is a community because it has certain species that are occurring together and wherever you have a similar community you will find, the similar species that are coming together. The third attribute is that of homeostasis or self-regulation. So, in the case of a community because you have so, many different kinds of species that are living together, there is a certain amount of homeostasis or self-regulation that occurs in this community.

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So, for instance, if you say talk about grass we are talking about a grassland community. So, in this you will have grasses of different species let us say species 1, species 2, species 3, then maybe they you will have some insects and these are insects that are feeding on grass. So, here you have species 4, species 5, species 6, then maybe you have

some insectivorous animals. So, let us say you have species 7th, species 8 and species of 9.

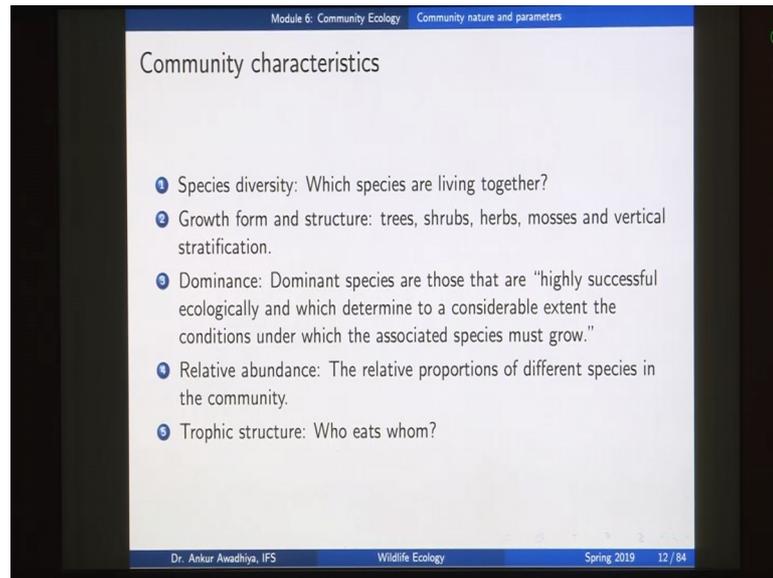
Now, what do we mean by homeostasis? Now, suppose this particular species of grass it, it has proliferated itself. So, essentially you have this particular grassland in which the earlier composition was let us say one-third was there for all the 3 species. So, you had for in any patch you will have 33 percent of species 1 33 percent of species 2 and 33 percent of species 3 or let us say 34 percent of species 3.

Now, suppose from this state this community changes in a way, that now you have let us say 10 percent of species 1, say 20 percent of species 2, species 3 and let us say you have 70 percent of species 2. So, in this situation what we are saying is that, the species 2 is tending to proliferate at the expense of species 1 and species 3. Now, ones that happens the situation is that you have species 1, that is eaten by all these 3 insects, you have species 2 that is eaten by all these 3 insects and you have the species 3 that is eaten by all these 3 species of insects.

Now, if a species 2 proliferates a lot. In that case the insect population will preferential will it is possible that the insect population will now tend to preferentially feed upon species 2, because it is now more commonly available. So, if you have certain species that are not having a very specific selectivity for the kind of food that they want to eat if any species tends to overshoot itself. So, they would be a number of other organisms that will regulated and they will bring the situation back to the status core. So, it will tend to bring it back to a situation where all these 3 species are together.

So, if there is any small perturbation in the community. The community tends to move back to the original state, which is known as homeostasis or self-regulation. So, it is self-regulate itself so, that the so; that the species composition remains the same.

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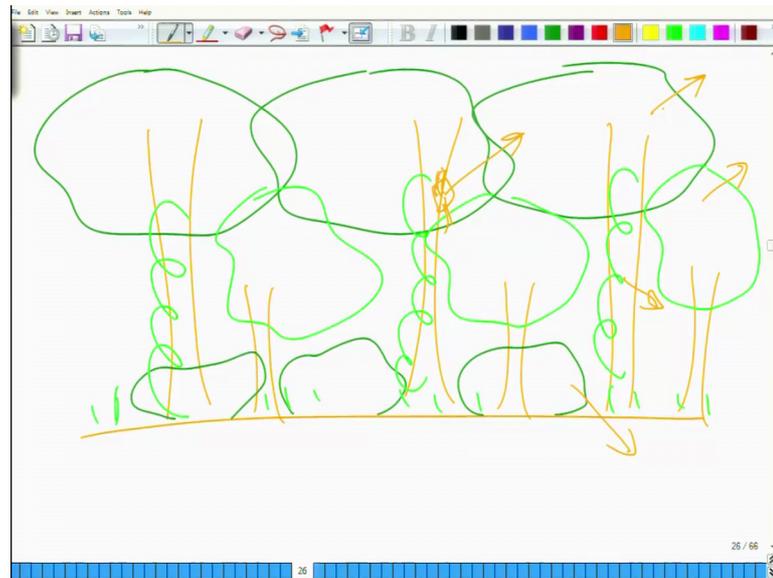
So, these are the 3 community attributes. Now, we will look at some community characteristics. Now, what are the different characteristics through which we can differentiate one community from another community? In the case of attributes we were asking the question, how do you define a community? What are the things that are common between different communities? And in the case of community characteristics we are asking, what are the things that are different in different communities?

So, if we say that there is a community of Sal forest and there is a community in teak forest, how are both of these communities different from each other is something that will ask in the case of community characteristics. So, the first characteristic is species diversity which species are living together. So, here you can ask which species and also how many different individuals are living in that particular area.

So, for instance in the case of a Sal forest, we will be having Sal, we will be having Mallotus. In the case of a teak forest, you will be having teak plants, maybe you will be having some mango trees, maybe you will be having some Jamun trees and so on.

So, species diversity is different in different communities, different species living different communities more or less. The second characteristic is the growth form and structure. What is the vertical stratification in a community? So, if we talk about an equatorial rainforest.

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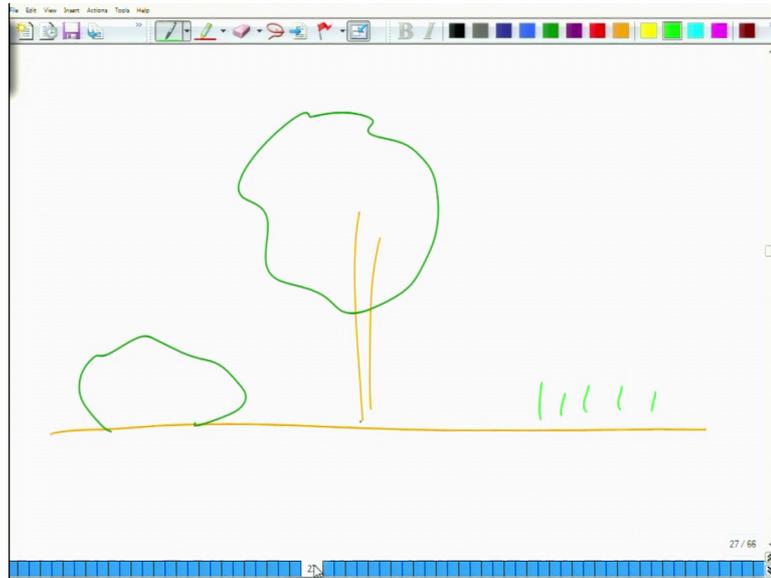
In the case of an equatorial rainforest, you will have a top community for a top canopy that is comprised of very tall trees. And these trees are practically covering up the whole of the canopy and then you will be having some trees that form a middle story. So, these are those species that are more shade tolerant.

So, they do not require a very great amount of sunlight, because of which they are able to survive below the first or the top canopy. Then you will be having some shrubs that are growing, you will be having some grasses that are growing, then you might be having some climbers on these trees, you might be having some other species that are living on these trees. So, such as you can have some orchids that are living on top of these trees.

So, this will lead to a vertical structure or a vertical stratification, where we can talk about the top canopy, we can talk about the middle canopy, we can talk about the ground cover, we can talk about the climbers or we can talk about the aphids that are living on these trees.

Now, such kind of a structure for such kind of a growth form is different in different communities, if for instance we go from this equatorial rainforest to say a shrub forest.

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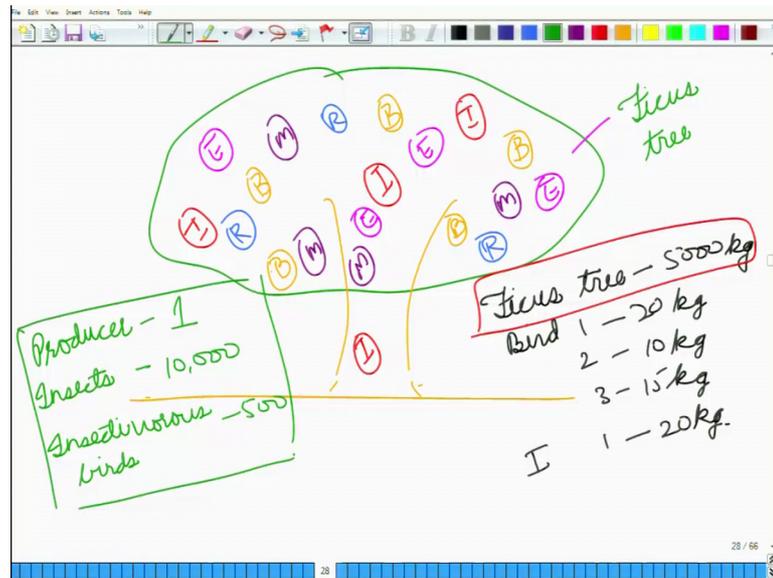
In the case of a shrub forest you will you would not be having this top middle canopies and all, but what will see is that you have a shrub here probably a tree somewhere and maybe some grasses somewhere. But, here we cannot talk about this vertical stratification. The vertical stratification is seen in the case of an equatorial rainforest then you have different layers. In this case you do not have different layers you just have species that are distributed here and there.

So, the growth form and the structure, that is the trees shrubs herbs mosses and the vertical stratification that is brought about by them is different in different communities. So, that is also a community characteristic. The third it is characteristics is which is the dominant species?

Now dominant species are those that are highly successful ecologically and which determine to a considerable extent the conditions under which the associated species must grow. Now, when we talk about a dominant species, if you go to a Sal forest you will say that Sal is a dominant species. Because, that is determining the characteristics of the Sal forest, because you have so, many tall Sal plants in that area.

So, the amount of moisture that is there available in the ground cover is very high, the amount of sunlight is very low essentially. So, the characteristics of that community are being determined by this particular species which is the Sal or Shorea Robusta or in the case of certain communities let us consider a community which is there on a ficus tree.

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So, you have a last sized ficus tree and in on that tree. Now this is a keystone species and it is giving rise to a number of fruits and various parts of the tree are edible the leaves are edible and so on. And so, you have a community of a number of birds that are living in this area.

So, you will have different species of birds that live on this particular tree you will have different species of insects that live on this tree, you will have certain mammals that live on this tree, say things like you are squirrels, that are living on the stream maybe you will be having some reptiles that live on this particular tree, you might also have some epiphytes that are living on this tree, epiphytes such as your orchids that live on this particular tree.

Now, all of these species dependent on this particular tree which is the ficus tree. Now, if you talk about this particular community of all these organisms that live together and whenever you have a ficus tree in the surroundings you will find all these different species that live together.

So, there is this consortium and there is also a recurrence that is seen in different areas in different Sal trees. And when we talk about such communities you have this ficus tree that is responsible for this congregation to occur. So, we will say that ficus tree in this case is the dominant species. Now, dominance can be there out of 2 different ways. The first thing is the numerical abundance if you have a tree that has their available in a very

vast numbers such as in the case of a Sal forestry, when we talk about Sal trees there in a vast number plus they are also determining the conditions under which the associated species will have to grow.

So, we will say that they are the dominant species or in the other case if there are any species that are keystone species, in which case you their impact on the whole community is much greater than their numerical abundance we will say that they are also the dominant species.

Now, in different communities we can have different species that are dominant. So, in a Sal forest, we have Sal that is a dominant species in a deep forests, we have teak that is a dominant species. In the case of a mixed forest you can have a situation where there is no dominance. So, dominance also varies between different communities and which is why we study it as part of community characteristics. Now, the fourth thing is relative abundance. Relative abundance is the relative proportion of different species in the community.

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Species	Community 1 Abundance	Community 2 Abundance
Sp1	1000	200
2	5	205
3	3	250
4	2	180
5	4	210
6	10	195
	1024	

So, you can have say a community where you are having species and their abundance.

So, you can have species 1 2 3 4 5 6. Let us say that we have this community of 6 species and the abundances see the species one has 1000 individuals 2 as 5, 3, 2, 4, 10. Now, that is one sort of a community. Let us talk about another community, where we have the

same species, but then their abundance is say 200 205 250 180 210 and let us say 195, if that is the abundance.

Now, in this case in the case of the first community this is community 2. In the case of the first community we will say that this species is species 1 dominates this community. So, much that it looks very much like a monoculture, if you go into this community you will say that you are only thing species 1, because species 2 3 4 5 and 6 are so, rare that will hardly find them. Whereas, in the case of the second community, you are saying that all of these species have roughly equal number of individuals so, wherever you go we will find probably all of these different species together. Now, here we are talking about the relative abundance.

Now, relative abundance is asking, the relative proportions of different species in the community. In this case in the case of community one the relative abundance of species 1 is very high, in the case of community 2, the relative abundance of all different species is roughly the same. So, now, this is a characteristic that will depend or that will differ between different communities and so, we studied it as under community characteristics.

And the 5th one is the trophic structure or who eats whom. So, this is something that we have dealt with in the case of energetics and that is also a community characteristic, because in different communities, you can have a different trophic structure, because you have different species they are having different roles and so on.

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Module 6: Community Ecology Community nature and parameters

### Community description

- 1 Species richness: number of species
- 2 Species abundance: in terms of number of individuals, biomass or cover
- 3 Species dominance: ranking as per abundance (number, basal area, etc.)

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Next we move to the description of a community. So, now, we have looked at the attributes of communities, when do we call something a community. So, what are the common features that you find in a community? We will look at community characteristics which is what are the things that are difference between one community to another community.

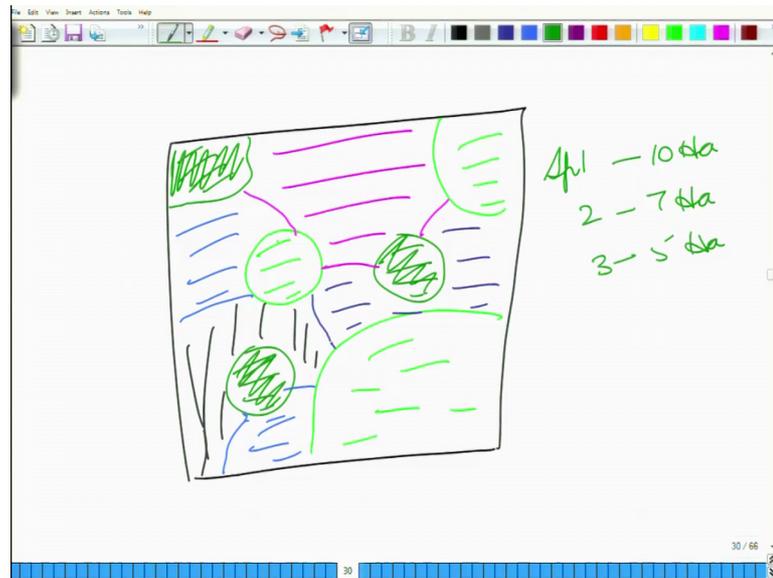
Now, how do you describe a community? So, let us say that we went to a Sal forest. So, how do we describe this community of a Sal forest? So, in this case we will define it using these 3 terms, the first point is species richness.

So, in any community we will define how many species are found in that particular community? Suppose, we are having so in this particular example that we were considering, here we were having 6 species. So, we will say that the community richness in this case is 6. Next, we talk about this species abundance in terms of number of individuals, biomass or cover that is being used by these different species. So, abundance is something that we already saw in this particular example. So, in the case of community 1, the species 1 was over abundant in the case of community 2 everybody was roughly equal in abundance.

Now, this is about the number of individuals that we found of different species, but in place of numbers we could go by see the biomass of different species that are found. So, for example, in the case of this particular community of the ficus tree, we can say consider that the ficus tree has a mass of say 5000 kgs, then your bird species one has say 20 kgs, your bird species 2 has say 10 kgs, bird species 3 has say 15 kgs, insect species 1 has say 20 kgs and so on.

So, in place of going with the numbers we could go with the masses or the biomass or the third way is to go by the cover.

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So, in the case of a cover if this is your area, or this is your community, you can say through for instance if there is a grassland, we could take a view from the top, and suppose the species 1 is found here, then it is found here, and then it is found here. So, this is the first species. The, second species is say found here, it is found here and maybe it is found here, in a big chunk.

Now, the third species is say found in this area only and then you can have a fourth species that is found in this area maybe a fifth species, that you find in this area and say this area. And let us say a sixth species that you are finding only in this area. Now, in if you are able to see all these species separately from a top view, in place of going with the numbers or going with the biomass, you can just take the area that is being used by these different species.

So, in the case of species 1, we will add up this area, along with this area, and along with this area. And let us see that species one is acquiring an area of say 10 hectares.

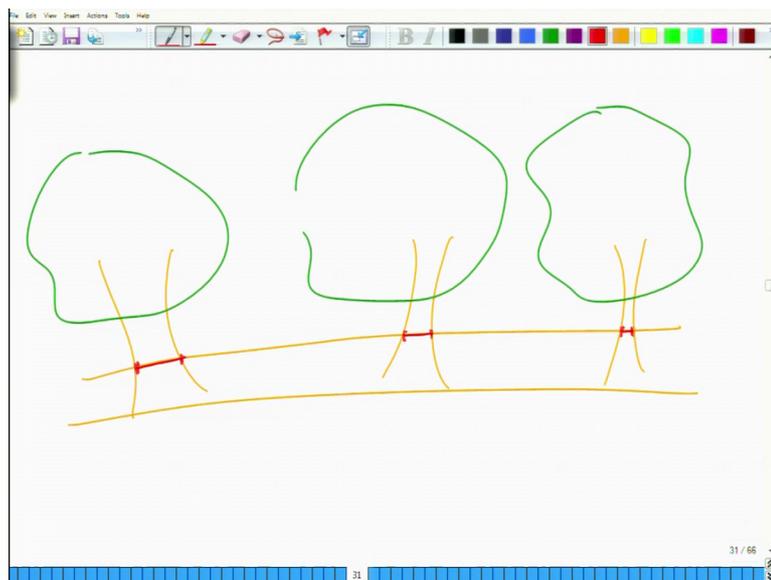
In case of species 2 let us see that it is 7 hectares, in the case of species 3 it is say 5 hectares and so on. So, we can come to our computation of abundance not just in terms of the number of individuals or the biomass, but also in terms of the covered that is being or the area that has been covered by these different species. So, while describing the community the first thing was how many in species are there, second is how much is this

abundance of these different species and then on the basis of the abundance we can talk about the species dominance.

So, in the case of dominance we can rank as per the abundance, that is the number basal area etcetera and then we can say that this is the species that is the most dominant species in this particular area. So, in this case we will say, that this is species the one is the dominant species. In the case of this example we will say that this species that is 7 250 individuals that is the dominant species. Here, we will say that the ficus tree that has the highest amount of biomass that is the dominant species. So, this is the way in which we describe the a community. So, you talk about species richness abundance and dominance.

Non dominance can also be in terms of the basal area.

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Now, what is basal area? Suppose you have a forest and in this forest you have these different trees. Now, when we are talking about of basal area, we can take same as standard height. So, we can take the best height and at this best height we can say that this is the area. Let us use another colour. So, this is the area that is used by these different trees.

So, in place of just the number or the cover we can also go with the basal area.

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Module 6: Community Ecology Community nature and parameters

### Some definitions

$$\text{Relative density} = \frac{\text{Number of individuals of species } x}{\text{Total individuals of all species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of species } x}{\text{Sum of frequency values for all species}} \times 100$$

where frequency is defined as the probability of finding the species in any one quadrat

$$\text{Relative dominance} = \frac{\text{Basal area of species } x}{\text{Total basal area of all species}} \times 100$$

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So, let us now look at some ways in which we find these different descriptive factors. So, the first one is relative density. Now, relative density is number of individuals of species  $x$ , divided by total number of individuals of all the different species into 100. So, when we are talking about the relative density what we are doing is? In this case we are totaling up the total number. So, here you have 5 6 7 8 9 10 14 24. So, here you have 1 0 2 4. So, that is the total number of individuals that you have in this particular community.

Now, the relative density of a species 1; so, let us now remove this.

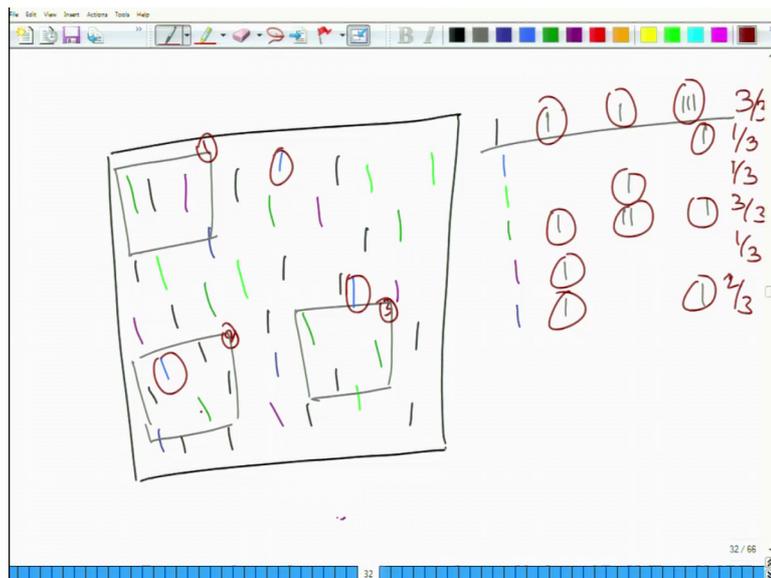
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Species	Community 1 Abundance	Relative density
1	1000	$\frac{1000}{1024} \times 100\%$
2	5	$\frac{5}{1024} \times 100\%$
3	3	$\frac{3}{1024} \times 100\%$
4	2	$\frac{2}{1024} \times 100\%$
5	4	$\frac{4}{1024} \times 100\%$
6	10	$\frac{10}{1024} \times 100\%$
	1024	

Now, relative density of species 1 will be given by 1000 divided by 1024 into 100 percent. Relative density of species 2 will be given by 5 divided by 1024 into 100 percent. Here, you have 3 divided by 1024 into 100 percent, 2 divided by 1024 into 100 percent 4 divided by 1024 into 100 percent and 10 divided by 1024 into 100 percent.

So, when we are talking about the relative density, we are asking this question what is the number of individuals that are present in a particular species, as a fraction of the total number of individuals of all the species that are there in this particular community. So, the second thing is relative frequency. Now, relative frequency  $x$  is frequency of a species  $x$  divided by sum of frequency values for all the species into 100, where frequency is defined as the probability of finding the species in any one quadrat. Now, what does that mean?

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Suppose, we have this forest or this community and in this community you have individuals of different species. So, let us say that this is species 1, 2, 3, 4 and let us say 5, then this is 6.

Now, this is a particular community that is comprised of 6 different species. So, you have the black species, you have the blue species, you have light green, you have dark green, you have purple, I think that we left out dark blue. So, these are the 6 different species that are found in this particular community. Now, let us take a quadrat. Now, when we

are talking about quadrates, we are taking a fixed size sample from this particular community.

So, let us that we are taking a quadrate here. Now, in this quadrate you found one of one of light green, one of black, one of purple and one dark blue. Let us take another quadrate of the same size. In this case you found one of black you found 2 of dark green, you found one of light green. Let us take a third quadrate here. So, here you found 3 of black, you found one of light blue, one of dark green and say one of dark blue.

Now, in this case when we are talking about the relative frequency, the question that we are asking is what is the frequency of a particular species?

Now, the frequency of a particular species this if you are taking this quadrates again and again, what is the probability that will find this particular species in that particular quadrate. So, in this particular example we took 3 quadrates. And in the case of species 1, we found that this species was found in 3 quadrates, it was found here, it was found here, and it was found here. So, the frequency of this particular species is 3 divided by 3.

In the case of the blue species we only found it once. So, the frequency is 1 by 3. In the case of light green it is 1 by 3, here it is 3 by 1, here again it is 1 by 3 and here it is 2 by 3. Now, this was a very simple example, but then when we do this quadrating sampling again and again we can come to a very precise value of the relative frequency. So, relative frequency says that if you are going into the field, you are drawing up a quadrate at any random location, what is the probability that we will find species 1.

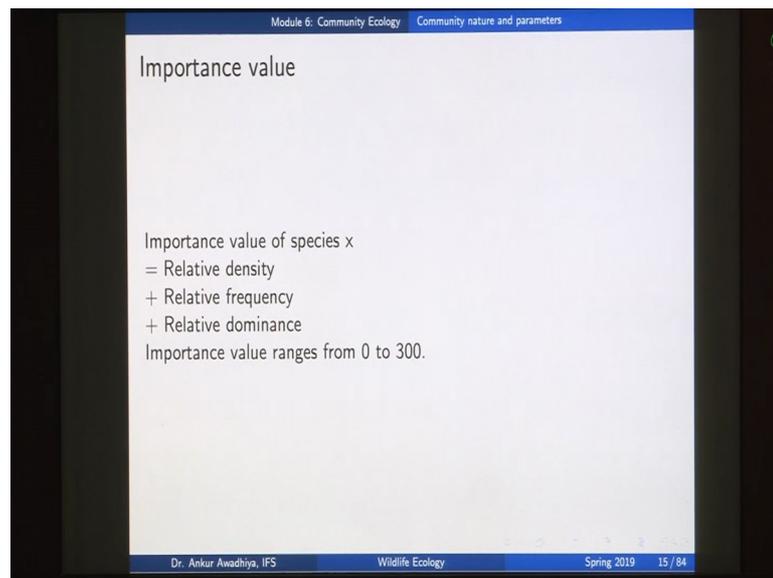
So, in the case of species 1 it is. So, common in this particular community, that wherever you draw a quadrate there is roughly a 100 percent chance that you will find the species 1, whereas, in the case of the species that is light blue in colour it is only found in one out of every 3 quadrates.

Because, the numbers of these individuals is very less. It is only 3 individuals that are there and this particular community. So, frequency also gives us in indication of how the a how different species are having different number of individuals. So, that is the relative frequency; frequency of species x divided by some of the frequency values of all the species into 100 percent. Now, the third thing is relative dominance. Now, we can define

dominance in terms of the basal area. So, we can say that it is basal area of species x divided by total basal area of all the species into 100 percent.

Now, when we add all these 3 values relative density so, relative density of species x plus relative frequency of species x plus relative dominance of species x, we get to a value that is known as the importance value.

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So, importance value for any species x is its relative density plus relative frequency plus relative dominance.

Now, in all these 3 we can see that the maximum values can be 100 percent. Now, suppose there is this community in which you only have 1 species. So, in that case you only have species x. So, total individuals and the number of individuals here is equal. So, you have a value of 100 percent. Similarly, the maximum value of relative frequency is 100 percent and the maximum value of relative dominance again is 100 percent. So, the importance value it varies from 0 to 300 and the higher the value a particular species has we say that that particular species is very important for this particular community.

So, that is about the importance value of any particular species any community. So, this is a way in which we can describe a community.

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Module 6: Community Ecology Community nature and parameters

Association between species:  $2 \times 2$  contingency table

Species y	Species x	
	PRESENT	ABSENT
PRESENT	type a	type b
ABSENT	type c	type d

If there is a positive association between species x and y, most of the sampled quadrats will have associations of type a or d.  
If there is a negative association between species x and y, most of the sampled quadrats will have associations of type b or c.

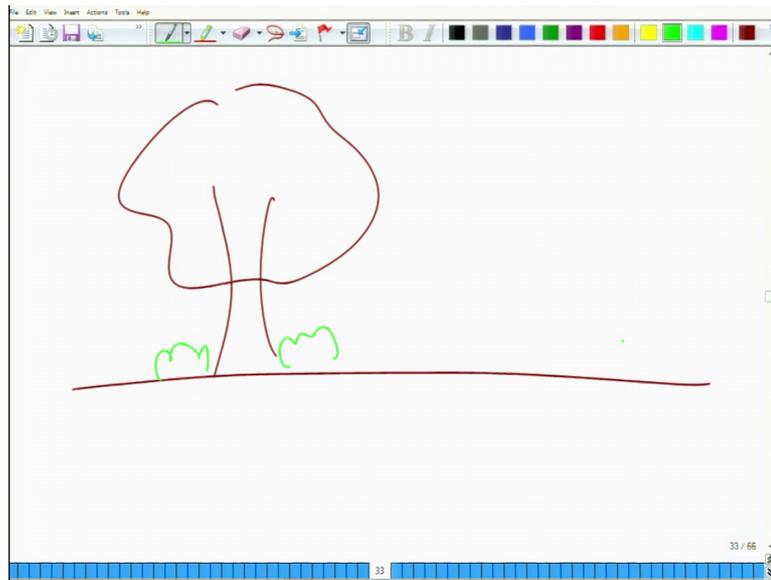
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Now, after description let us have a look at the associations between species. Now, suppose you look at a number of different quadrates. So, for instance here in this example we had taken 3 different quadrates. So, we have this first quadrate, we have the second quadrate and the third quadrate. Now, in the first quadrate we say that the green, the black, the purple and the blue are coming together. In the second one we say that the green the black and the line blue are coming together in the third one.

In the second when we are seeing that the black, the dark blue, light blue and the green are coming together. Now, similarly if we take n number of quadrates, we can say that between any 2 species we can have 4 different kinds of relations. So, the first relation is that if you have species y. So, species x is present in most of the situations. In which case we will say that there is a positive correlation, if y is present, x is present, if x is present, y is present or you can have another positive correlation in terms of absence.

So, if you do not have x you do not have y. In which case we can say that either both of these species are dependent on each other because of which they are found together in most of the cases or they are. So, dependent on each other that if one is not there the second will also not be there. So, they are interdependent on each other or maybe they are completely associated with each other. So, this kind of dependence can be say one way, in which you can have 1 species that is creating conditions for another species to thrive.

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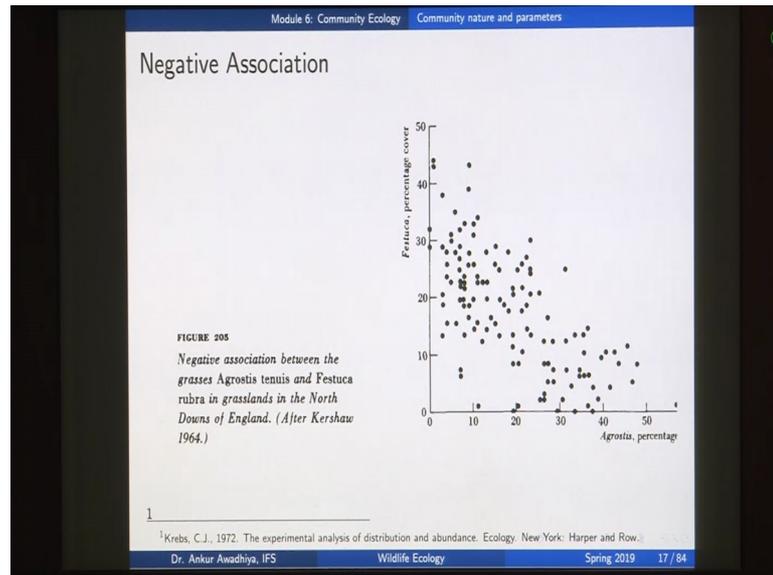


So, for instance you can have a situation where you have a very dry area and so, in this dry area, wherever you have a large size tree there only you will find this small shrub that is found because if you have this small shrub outside. So, because of the sun heat the shrub will die off. So, wherever you have this tree you will find the shrub and where you do not have the tree you will not find the shrub. So, if that is the kind of relationship we will say that both these species  $x$  and  $y$  are associated with each other, when one is present the second is also present and if one is absent the second will also not be found there.

On the other hand you can have a negative association. So, a negative association is if you have species  $x$  that is present. So, species  $y$  will be absent and where species  $y$  is present species  $x$  will be absent. So, you can have either  $x$  or  $y$ , but both of these will not come together. So, we say that this that any 2 species in a community can be positively associated or they can be negatively associated.

If there is a positive association between  $x$  and  $y$  most of the sample quadrates will have associations of type  $a$  or  $b$ , that is either both are present in the quadrate or none of them is presented in the quadrate. On the other hand if you have a negative association most of the sample quadrates will have associations of type  $b$  or  $c$  that is only  $x$  is present or only  $y$  is present.

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And if we look at the associations this is how we can see? So, in this example we are looking at 2 different species. And if you have very high association or very high presence of 1 species the second species is not found in that area, if you have a very high association of or presence of this particular species, the second one is not found in this area. So, you have a curve that goes like this. In the case of a positive association the curve will look like this. So, if you have less of a you will have less of b if you have less of if you have more of a you will have more of b. So, that is how you describe the associations between different species of a community.

Now, how does any particular community behave?

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Module 6: Community Ecology Community nature and parameters

### Community theories

- 1 Clements' organismic theory: the community was a superorganism or discrete unit, with sharp boundaries. Communities exhibit properties which are more than the sum of the individual parts. Species interactions are assumed to play a major role in the development and regulation of communities.
- 2 Hubbell's neutral theory: species are functionally equivalent, and the abundance of a population of a species changes by random births and deaths.
- 3 Gleason's individualistic / continuum theory: the abundance of a population of a species changing gradually along complex environmental gradients. According to this view communities are not tightly structured, but are merely coincidences resulting from chance dispersal, environmental sorting and species interactions. Communities are less predictable, and species interactions have a much reduced role in determining the structure of communities.

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So, in that to answer that question we have 3 different theories of community. The first one is Clements organismic theory which says that the community is a super organism or a discrete unit, which are boundaries; it exhibits properties that are more than the sum of the individual parts. Species interactions are assumed to play a major role in the development and regulation of the communities. So, but Clements thought was that these communities they behave like organisms. So, just like in our case we have different organ systems we have different organs that are working together.

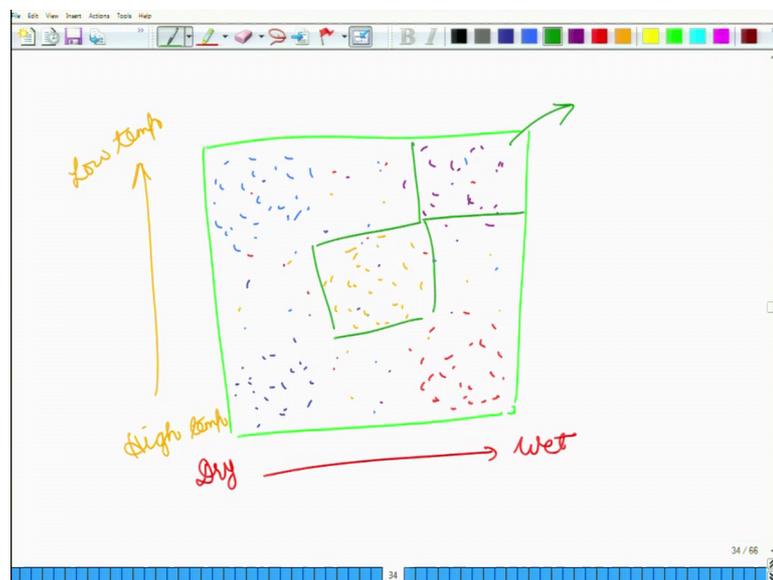
So, that we are able to survive and purses. Similarly, in the case of a community it behave like an organism and different species and different individuals that are there as part of this community, they are behaving like different organs and organ systems. So, once you have all of these organs and organ systems together then only the individual is able to function and once it starts functioning it is able to regulate itself.

Similarly, in the case of a community all these different populations and species and individuals must they have come together it becomes a self-contained unit. And once it is the self-contained unit it is able to regulate itself and it will behave like an organism. It will get properties that have very different from what are the properties of it is constituents. So, there are a number of emergent properties that a community will have on the other hand we have Hubbell's neutral theory which says that this species are

functionally equivalent and the abundance of a population of a species changes by random birth and death.

So, in Hubbell's view the associations and the population sizes are governed by random values of births and deaths. And then the third theory is Gleason's individualistic or continuum theory which says that the abundance of a population of a species changes, gradually along complex environmental gradients. And communities are not tightly structured, but are merely coincidences resulting from chance dispersal, environmental sorting and species interactions and communities are less predictable and species interactions have a much reduced role in determining the structure of the communities.

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So, essentially what it is saying is that suppose you have in an area, you have gradients of different environmental variables. So, let us say that this area is dry to wet and then you have high temperature to low temperature.

So, in this case you will have certain species that prefer high temperature and rains. So, they will more be found in this area and in other areas there the probability of finding them reduces. There is say another species that prefers this kind of an environment and in other areas it will be less found. Let us say that there is this third species that prefers this kind of an environment and in other areas it is found in very less numbers. And there is this fourth one that is found in this area and in other areas, it is found very less. And then

probably there is a fifth one that is found in these intermediate areas and in other areas it is found in less numbers.

Now, in terms of this individualistic theory or the continuum theory, what is happening is that different species are choosing the areas where they want depending on their own requirements? So, they are based on complex environmental gradients and because of this you have these species that are found in different areas now if you are talking about a community.

So, if say we are talking about this area and we are saying that, this is a community that is dominated by the yellow species, then that is not because all these species have come together to form a to perform a specific function, but it is just that every species is just looking for its own kind of atmosphere the best habitat that it can survive in and then just by chance it. So, happens that you have a predominance of the yellow individuals with some red, some purple, some blue and so on.

Whereas, if you talk about a community that is found in this area, we again have another community that we can describe as having a very high abundance or very high dominance of the purple species and very few number of individuals of blue and light blue and red individuals.

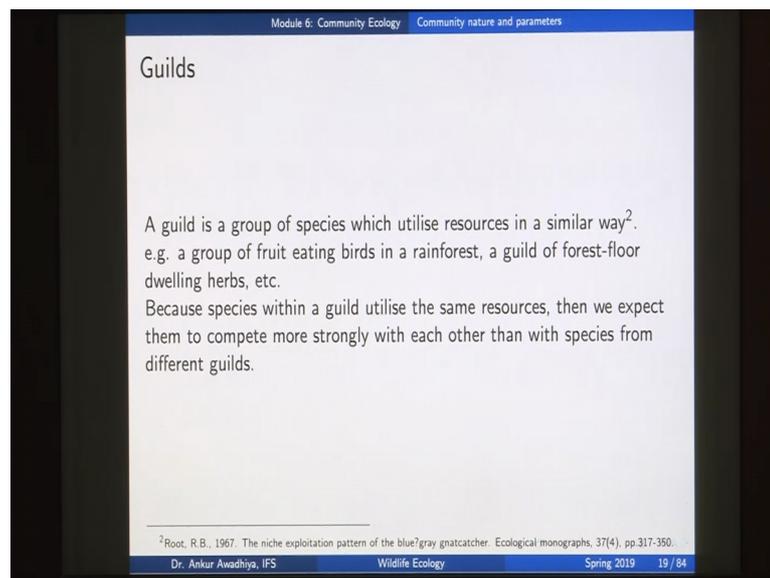
Now, the difference between these theories is that in the case of Clements theory will once these organisms have come together once they have formed this community, now this community is having its own emergent properties. So, it is self-regulating itself if there is an abundance of probability the death of a number of individuals of a particular species.

The community will function in a way that it will be able to bring that species back to the normal status. Whereas, if we talk about the individualistic theory it says that everything is coming up randomly and so, there is no emergent properties that is coming up. And essentially if there is any perturbation to this community, there is no way that this communities able to come back because there is no homeostasis that is working here, but just that every species is working based on its own requirements.

Now, we see both these extremes in the nature. So, for instance if we talk about a community that is living in a water body, then it will have some interactions and some

imagine properties that are coming up in terms of the organismic theory, but then if we look at individual species then we can also look at their properties based on the Gleason's theories. So, both these extremes are found and then depending on what is the kind of community that we are looking, or what are the kinds of interactions or what are the kinds of environments, that this community is surviving in we will find different kinds of characteristics.

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Now, let us have a look at guilds. Guild is a group of species which utilize resources in a similar way. Now, when we were talking about a community here we were saying that we have so, many individuals of species 1 so, many individuals of species 2. Now, there is another way to understand the structure of the community not just a species wise, but then we can group these species. So, probably both of these species are say produces. So, you have 2 species of grass that is there in this community. So, we can club both these species together.

Similarly, we can club those organisms that are feeding on grass together, we can club the insectivorous organisms together, when we look at these clubbed species together we are talking about the guilds.

So, a guild is a group of species which utilize resources in a similar way. Example a group of fruit eating birds in a rainforest, or a guild of forest-floor dwelling birds

etcetera. So, here we are talking about those species that are performing a similar function they are utilizing resources in a similar way.

Now, because species within a guild utilize the same resources, then we expect them to compete more strongly with each other than with species from different guilds. So, if you talk about birds that are insectivorous. So, we are grouping them together, because the amount of interspecific competition that they will have within a guild will be much greater than the interspecific competition that we have between 2 guilds.

So, the amount of competition between fruit eating birds and insects eating birds will be much less as compared to the amount of competition that we have between one fruit eating bird and another fruit eating bird. Now, the concept of guild is important, because in this case in place of just looking at the number of different species. We can say that you have the producer in this case is just 1 which is the ficus tree and then we can say that the insects, that are dependent on this particular tree are say 10,000 the insectivorous birds are say 500 and so on.

Now, once we group these species that are utilizing similar resources together. So, in that case we can bring out much easier way of understanding the functioning of this particular community. So, this community has bird producer that is supporting 10,000 organisms that are directly dependent on this particular tree and with [FL] further supporting 500 insectivorous birds that are dependent on these particular insects. So, the concept of guild enables us to simplify the understanding of the working of the community.

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Module 6: Community Ecology Community nature and parameters

## Niche

"The ecological niche of a species is a multidimensional description of its resource needs, habitat requirements and environmental tolerances."

### Fundamental niche

"the potential set of conditions which a species can occupy"  
It is determined experimentally. Also known as precompetitive niche.

### Realised niche

"the set of conditions which a species actually occupies due to effects of competition, predation, etc."  
It is determined through field observations. Also known as postcompetitive niche.

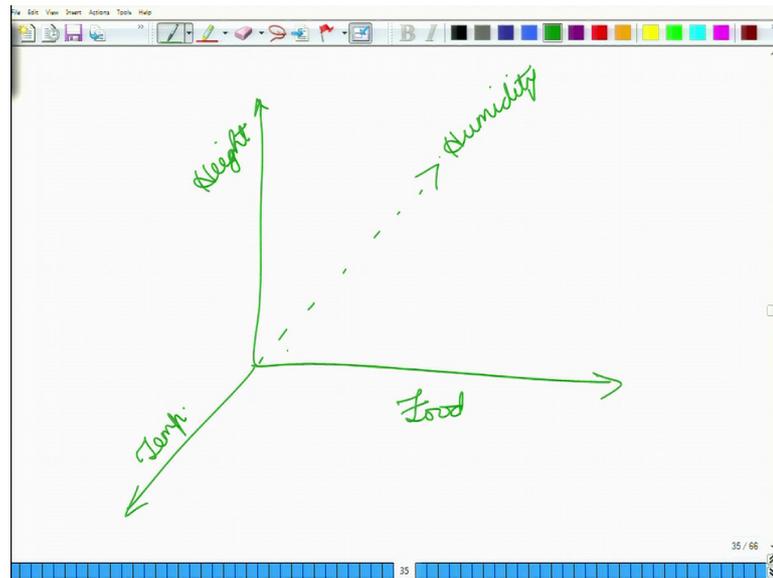
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From the guilds we can also move on to the niches, "the ecological niche of a species is the multidimensional description of its resource needs, habitat requirements and environmental tolerances".

So, essentially when we are talking about these different organisms that are living. So, in the case of guild we are looking at one particular resource which is the food if you bring in other resources such as the habitat. So, what are the species that live on the ground, what are the species that live on the branches, what are the species that live on the foliage or we look at other environmental characteristic? So, what are the species that require a very hot region, what are the species that require a cool region, what are the species that require a cold region?

So, in place of using just one particular set of characteristics, we can now look at multidimensional characteristics.

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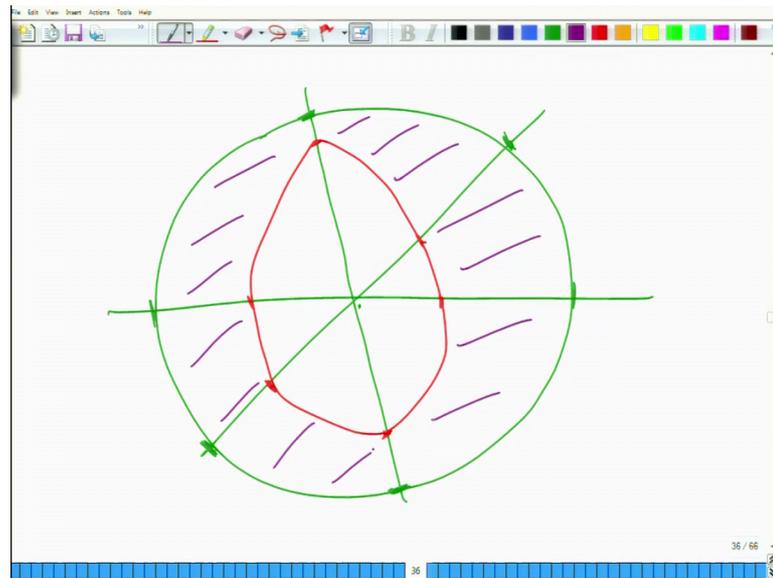


So, you have the first dimension which is the resource of food, you have another dimension which is talking about the height requirements, this yet another dimension that is talking about say the temperature requirements, this yet another dimension that is probably talking about the humidity requirements. And once you have this n dimensional structure and you try to fit in different species of a community into this structure, you can find those species that have very similar requirements. And, when you have species at a very similar requirements, we say that they are living in that particular niche.

So, niche is the multidimensional description of it is resource needs, habitat requirement and environmental tolerances. So, for 2 species that are occupying the same niche the competition will be much higher. So, in a community we can say a we can talk about the interspecies competition or we can talk about the interspecies competition in the case of guilds. Where they are using the same food resources, in which case the competition will be higher, or we can talk about the interspecies competition between organisms, that are occupying the same niche, in which the in which case the competition will be the extremely huge.

Now, niche is divided into 2 different categories, the first one is a fundamental niche and the second one is the realized niche. Now, fundamental niche tells you the answer to the potential set of conditions which a species can occupy. And it is determined experimentally and it is also known as a pre competitive niche.

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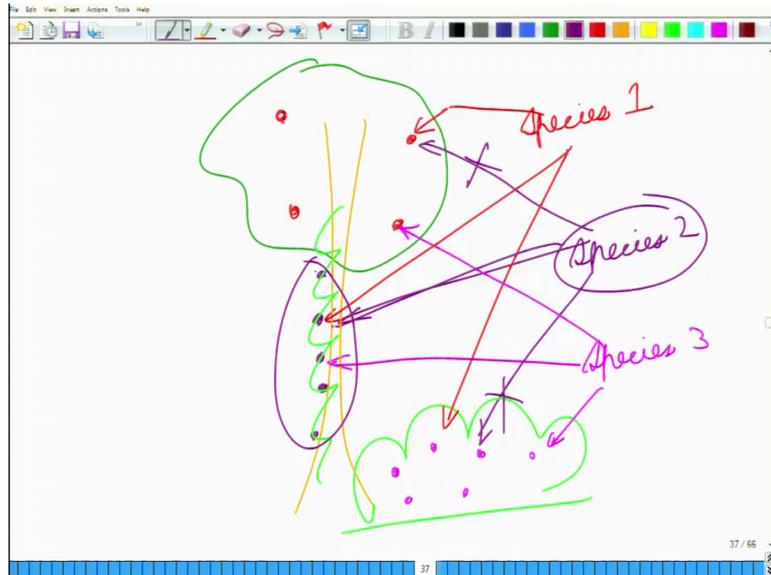


So, in this case we are saying that there is one particular species that can say occupy this much of environmental conditions. So, it can go from say this level of temperature to this level of temperature, it can go from this level of humidity to this level of humidity, it can go from say this much amount of food to this much amount of food and so on.

So, this is a fundamental niche. So, these are the set of conditions under which this particular organism can thrive or this particular species can thrive. If you do not have any other competition, but then when you put in competition so, for instance there is a frugivorous bird which is feeding on fruits.

So, that can (Refer Time: 53:28) these many areas in this particular tree. So, that will be the fundamental niche, but then when you put in another set of competitors. So, it is possible that the niche might change. So, now, the only areas where you can have these bird is this area, because in this case the other areas which are outside of the realized niche, they have been occupied by some other species that have a common fundamental niche.

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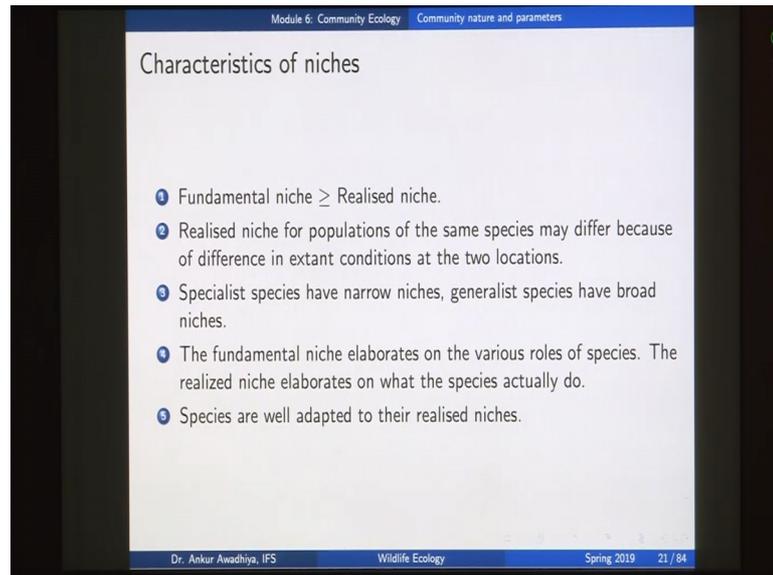
So, essentially because you had this tree so, probably you have this tree and this tree is having say fruits here. And then you also have a climber that is moving on this tree and this climber also gives rise to fruits and it is giving rise to fruits here. Now, in the case or probably you also have a shrub nearby. So, there is a shrub and this shrub also has some fruits.

Now, in the case of one species of birds you can have the species 1 that can feed on these fruits that can feed also on these fruits and that can also feed 1 these fruits. So, the fundamental niche would be all these 3 combined together. And then you can also have another species say species 2 that can also feed on these fruits, that can also feed on these fruits, and that can also feed on these fruits. And then say a third species 3 which can feed on these fruits and these fruits and these fruits .

So, in this case we will say that the fundamental niche of all these 3 birds are coinciding, because all can make use of all these different resources. And so, the multidimensional requirements of all these 3 species are one and the same, but then when they are competing against each other. So, it is possible that the species 2 will. So, this species 2 will preferentially feed on this particular area and it will not feed on these areas.

So, it will stop feeding on the fruits that are there on the canopy, because it is not able to compete with species 1 there. And it will not feed on these fruits that are growing in the shrub because it is not able to compete with species 3. So, the realized niche becomes much smaller than the fundamental niche.

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Module 6: Community Ecology Community nature and parameters

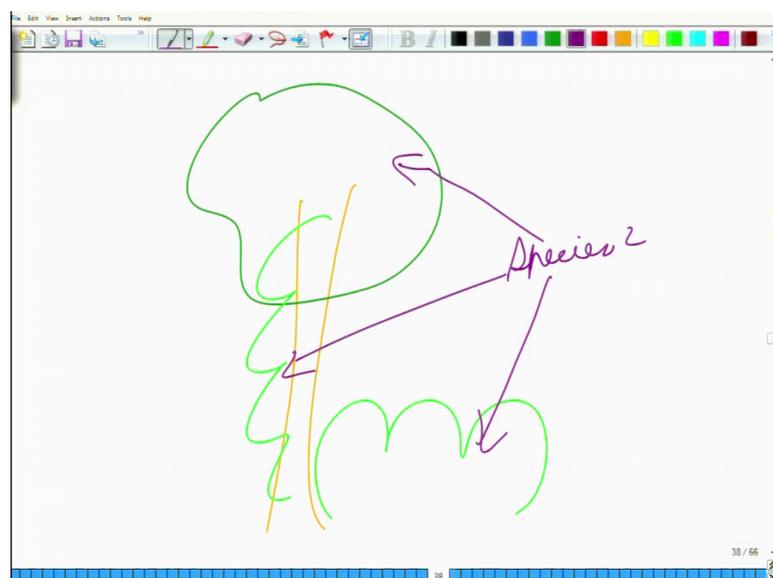
### Characteristics of niches

- 1 Fundamental niche  $\geq$  Realised niche.
- 2 Realised niche for populations of the same species may differ because of difference in extant conditions at the two locations.
- 3 Specialist species have narrow niches, generalist species have broad niches.
- 4 The fundamental niche elaborates on the various roles of species. The realized niche elaborates on what the species actually do.
- 5 Species are well adapted to their realised niches.

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So, if you look at the characteristics of the nations the fundamental niche is much greater than the realized niche or in some cases where the amount of competition is very less, you can have a situation where the fundamental niche and the realized niche are one and the same. Now, realized niche for populations of the same species made differ, because of the difference in extent conditions between the 2 locations. So, basically you have this populations of the same species you have this particular frugivorous bird species 2, that is living on this particular tree here.

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But, then it is also possible that at some other location, you also have this tree, and you also have the same climber and you also have the shrub, but then there is no other competitors. So, in this case the species 2 can feed on, the canopy fruits it can feed on, the climber fruits and it can feed on the shrub fruits.

So, the realized niche for populations of the same species made different areas because of the extent conditions and these 2 locations. Because of the amount of competition or maybe the availability of the food sources, specialist species have narrow niches, generalist species have broad niches. So, a species which a generalist can feed on a number of things, so, it will have a broad much broader niche. The fundamental niche elaborates on the various roles of the species and they realized niche elaborates on what the species actually do.

So, in the case of a fundamental niche we have talking about, the various roles of this species what it can do it can feed on these different a fruits and then it can lead to the dispersal of seeds of these particular fruits, but then the realized niche tells us what these species are actually doing. So, even though your species 2 can feed on these 3 different kinds of fruits and it can disperse the seeds of pulse these different kinds of fruits, but then probably it is dispersing the seeds of only 1 particular species. So, that is the realized niche and species are well adapted to their realized niches.

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### Index of similarity

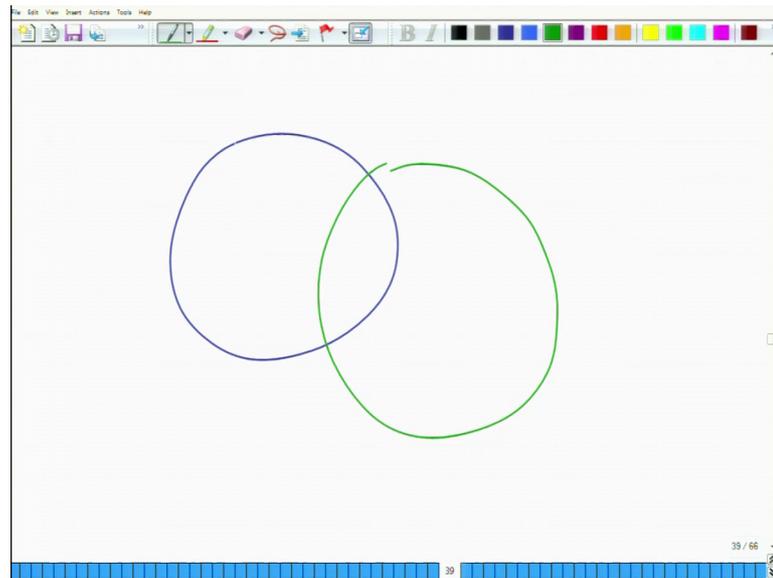
Consider two communities, one with  $a$  number of species, and another with  $b$  number of species. If there are  $c$  species that occur in both the communities, we have

$$\text{Index of similarity} = \frac{2c}{a + b}$$

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The next thing that we can look for is the index of similarity.

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So, if we have 2 different communities, you have this community, you can let us see you have the second community, we can ask the question how many species are there that are common between both of these species in terms of the total number of species that are found in these 2 communities. So, index of similarity is given by  $\frac{2c}{a+b}$ , where  $c$  is the number of species that occur in both the communities divided by  $a$  plus  $b$ , where  $a$  is the number of species and the first community and  $b$  is the number of species in the second community.

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Module 6: Community Ecology Community nature and parameters

### Association of a species with community<sup>3</sup>

- 1 Accidental species: rare species in the community, present either as chance invaders from another community or as relicts from a previous community
- 2 Indifferent species: a species with no real affinity for any particular community, but which is not rare
- 3 Preferential species: a species that is present with varying abundance in several communities, but is especially abundant and vigorous in one particular community
- 4 Selective species: a species found most frequently in a particular community, but also present occasionally in others
- 5 Exclusive species: a species that is confined completely or almost completely to a particular community

<sup>3</sup>Blanquet, B. and Pflanzensozioogie, J., 1964. Grudzuge der Vegetationskunde.

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So, on the basis of index of similarity we can ask the question how many species are there that are common between both of these communities. And depending on the association of different species with communities, we can have accidental species which are rare species which can be found in different communities. So, they are randomly found in different communities, or you can have in different species which are not rare species they are available in plenty, but still they do not have a preference for any particular community.

So, they can be found in any community. Then, we can have a greater amount of preference. So, you can have preferential species that prefer a certain community. So, they can be found in any community, then we can have a greater amount of preference. So, you can have preferential species that prefer a certain community. So, they will be found in different communities, but they will be found in more numbers in a preferential community. Or you can have selective species that are mostly found in one particular community, but randomly they can be found in some other communities as well. Or you can have exclusive species that are only found in some particular communities.

So, the association of a species with a community can show a very wide range of characteristics. So, it can vary from a species being in different to a species that is extremely dependent and completely exclusive to that particular community. So, in this lecture we started with the definition of a community, we looked at attributes how do we define any particular community, what are the characteristics of a particular community, and then we went on to the description of communities.

And, then we looked at certain concepts related to the niches of particular species or we will look at the guilds that are there in the community and we will build on these particular ideas in the next 2 lectures. So, that is all for today.

Thank you for your attention [FL].