Forests and Their Management
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Module - 02
Basic of Silviculture
Lecture - 03
Ecological Succession

[FL]. In this lecture, we will have a look at "Ecological Succession" or how forest form in natural conditions?

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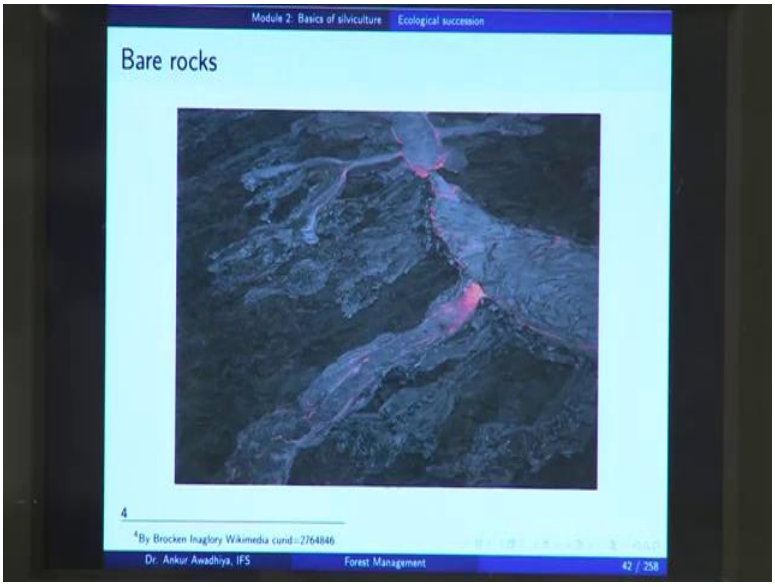

So, consider a situation in which a new island has formed, out of volcanic eruption. So, you have these lava flows that have constructed this rocky area. Now, in nature - how does this rocky area get converted into a forest? - is the question that we are going to study in ecological succession. Now evidently, these rocks because they are so hard, they are not able to support anything. Even though, these rocks have the minerals that can support plant life, but because these minerals are embedded inside these rocks, they are not made available to the trees.

So, if you think of growing a tree in this forest, if you say make a hole in this rock and put a seed inside, this seed will not turn into a tree and this will not form a forest. But

then, there are certain stages or certain phenomena that happen on to these rocks that convert this land which is a completely barren land into a forest. So, what will happen?

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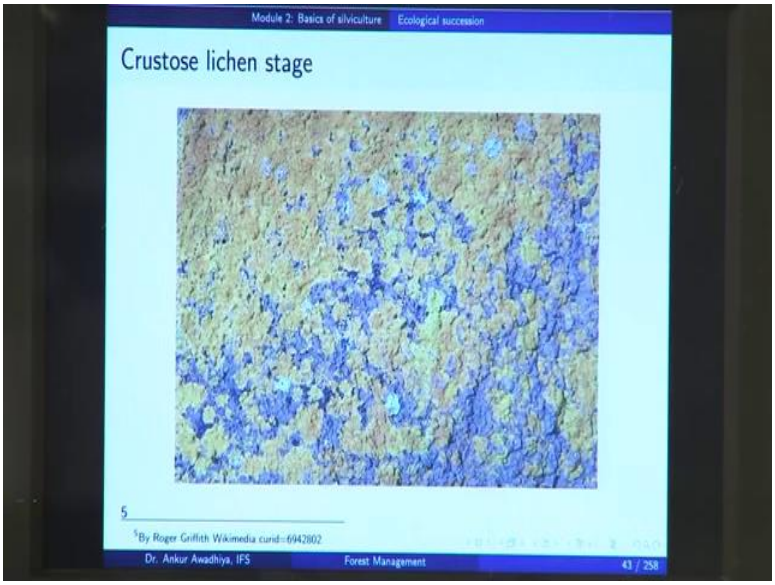

After a while, you will start seeing lichens. Now, lichens are small plants, and these are Crustose lichens. So, crustose is something that looks like a crust. So, these lichens, they look like crusts, and these form on these rocks. Now, even though these rocks are not able to support trees, but because they have the minerals; these minerals support these crustose lichens, and these lichens when they form here, after a while, they will die off when an organic matter dies, it gets converted into acids.

So, it will form some organic acids, and these acids will start to disintegrate this parent rock. So, what is happening here is that you have a rock that is full of minerals, but is unable to support your trees; but you have these small crustose lichens that got formed on these rocks, because they have a very less requirement of nutrients.

So, their requirement of nutrients can be met by the surface layer of this rock, or probably, the small amount of dust that is coming from the air. So, these crustose lichens will form a will form a layer on these rocks and they will start disintegrating these rocks. Now, when these rocks get slightly more disintegrates, so now, some other plants and also come and colonize these rocks.

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So, the next layer stage of plants, would be the Foliose lichens. Now, 'foliose' means 'leaves.' So, these lichens look like leaves. Now, they could not colonize the barren rock because their requirement of nutrients is a bit more than those of the crustose lichens, they require a bit more disintegrated rock; but once this rock has become a bit more disintegrated than the parent rock. Now, these species will be able to out compete the previous species of that of the crustose lichens.

So, what happens after a while? These foliose lichens; they have started growing on these rocks, and through their growth they will start to disintegrate the rock a bit more. So, when they also die, some acids form the that leads to a small amount of weathering, some leaching of minerals.

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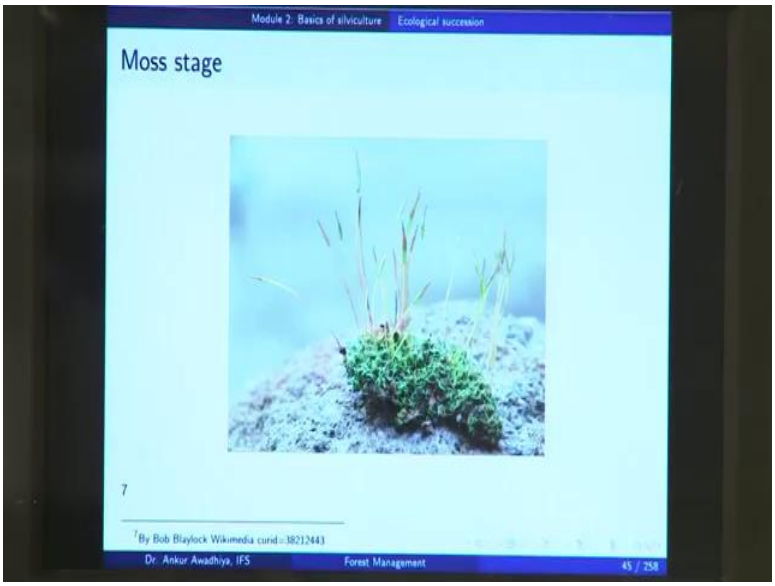

And after a while, we will start seeing mosses on these rocks. Now, the same process goes on and on, then mosses get replaced by herbs or grasses.

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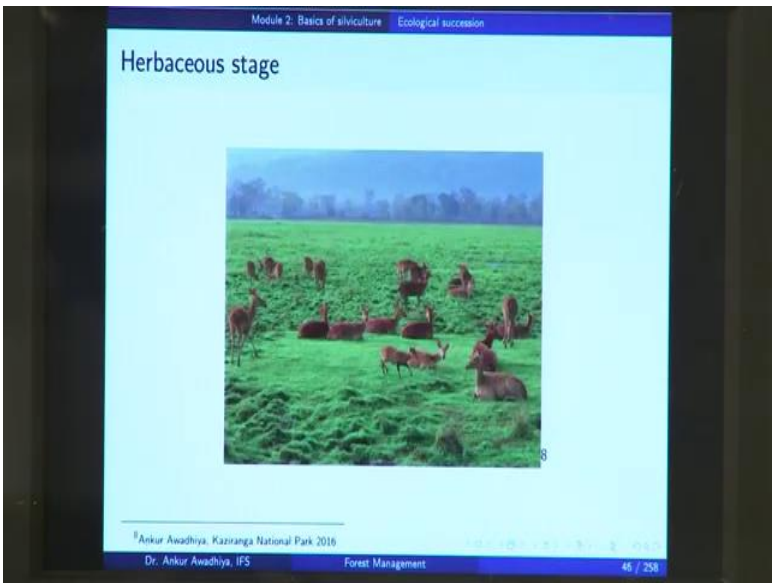

Now, once you have these herbs or even in the mosses stage, you will also start seeing some animals that have come on these rocks, because these mosses or these plants are now able to provide food to the animals, they are able to provide shelter do these animals. Obviously, you will not be seeing these mammals, but you will be seeing some

small animals, some insects that come into this area. Then, these grasses get replaced by the shrubs.

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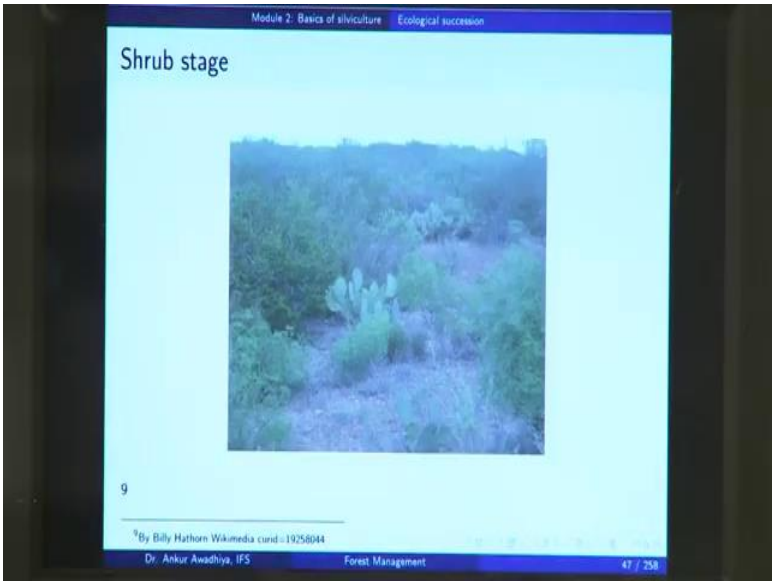

And then, these shrubs get replaced by the forests.

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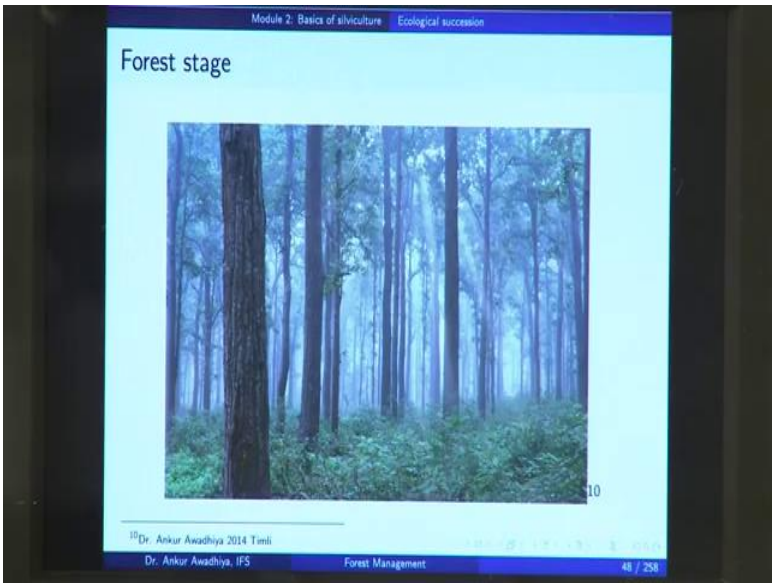

Now, at every stage, what these different plants, whether they are lichens, whether they are mosses, whether they are grasses, shrubs, or whether they are the trees, what they are doing is, with every stage, they are disintegrating the rocks a bit more.

Now, when we come to the plant stages of, say grasses, so, grasses have roots. What their roots will do is, they will start getting inside the rocks, and then, they will start disintegrating the rocks from a greater depth, and with all these different stages, we will see the formation of soils, and soils will then support the larger species.

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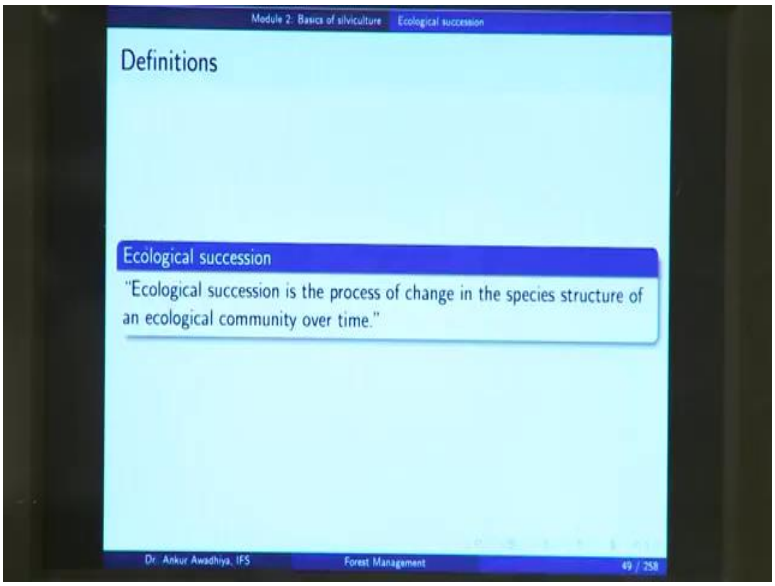

And, this whole process goes by the name of Ecological succession. So, ecological succession is the process of change in the species structure of an ecological community over time. What is happening here is, it is a process. So, it is something that takes place over some period of time, and it occurs in different stages. So, it is a process. It is a process of change.

So, in this process there are some changes that occur in your ecological community. What sort of changes? Changes in the species structure of the ecological community. So, changes in the species structure is from an ecological community that was dominated by lichens, it becomes an ecological community that is dominated by say – herbs, shrubs or the trees.

So, there is a change in the species structure of the ecological community and this whole change occurs over time. So, "Ecological succession" is the process of "change in the species structure of an ecological community over time."

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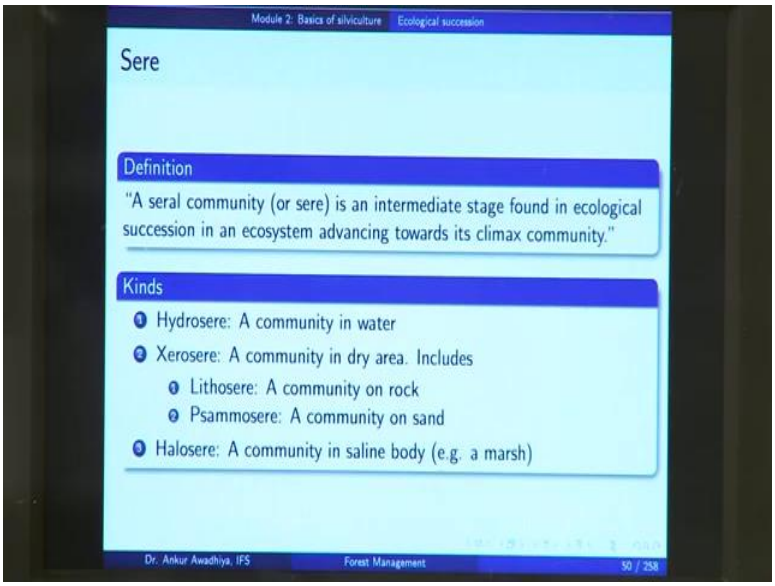

And these intermediate stages that we just saw are known as the Seres or a seral community. So, "a seral community or a sere is an intermediate stage found in ecological succession in an ecosystem advancing towards its climax community." So, what it says is that it is an intermediate stage found in the ecological succession. So, succession is the whole process from, in which you converted a bare rock into a forest. The forest is known as the climax community in this stage, or the climax is the final community that gets formed in this process, and seral community is an intermediate stage. So, for instance, of a stage of grasses will be a sere.

So, you will have a sere which is an intermediate stage found in the ecological succession in an ecosystem advancing towards its climax community. And, these seres can be of different kinds. So, you can have Hydrosere; so, hydrosere - hydro is water. So, hydrosere is a community that iss in water. Xerosere xero is dry. So, Xerosere is a community in a dry area. So, this community can be there on rocks, in which case we call it a Lithosere, or it can be on sand in which case we call it a Psammosere.

We can also have a stage of Halosere, in which you have a community in a saline body. Halo is salt. So, you have a community in a saline body; example, a marsh. So, this these are the different kinds of seres.

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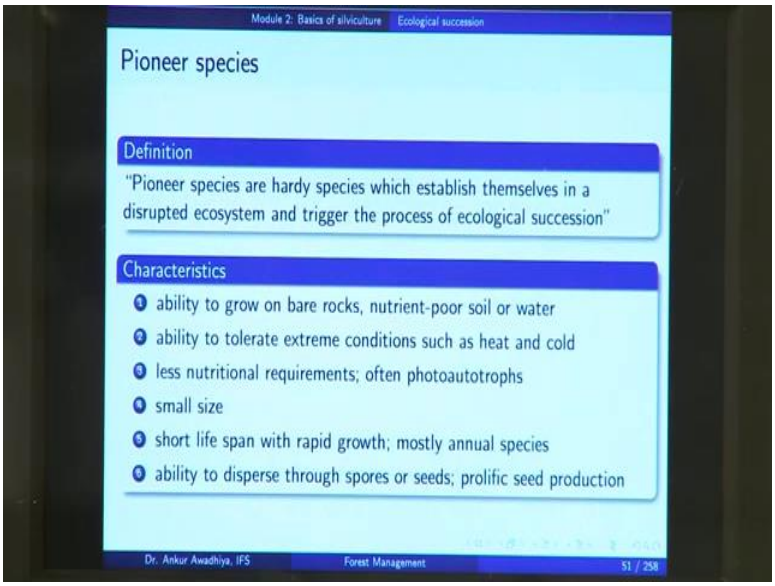

And in the process of ecological succession, you move from a pioneer species through different seers towards a climax community. Now, what is a pioneer species? "A pioneer species is a hardy species which establishes itself in a disrupted ecosystem and triggers the process of ecological succession". If you have a group of species, you will call them the Pioneer species.

So, all of these species will be hardy species, now why hardy species? Because the conditions that you have on a bare rock are the most stringest conditions that your plants could ever face. So, on the surface of a rock, there will be a huge amount of exposure of sunlight, there will be huge fluctuations of temperature. This is hardly anything to protect you. If there is any moisture, it gets evaporated in no time, but at the same time, if it is near a sea, then you can also be having some splashes of saltwater that are coming into this area.

So, all these situations are extremely – extreme - situations. So, a pioneer species has to be a hardy species that can tolerate all these conditions. Not only should it be able to tolerate these conditions, it should be able to establish itself in a disrupted ecosystem. So, a rock is an extremely disrupted ecosystem, and your pioneer species such as the crustose lichens are able to establish themselves on these rocks, and they triggered the process of ecological succession by making changes to these rocks.

Now, the characteristics of pioneer species are these. They are able to grow on bare rocks, or nutrient poor soil or water. So, they have very less nutritional requirements, and they are able to grow on these denuded areas or nutrient poor areas. Then, they are able to tolerate extreme conditions such as heat and cold, because in these bare rocks there is hardly anything to protect these plants.

So, they have to be hardly; they have to have the ability to tolerate extreme conditions. So, if there is a plant species that has a large nutritional requirement, it will not be able to grow on a bare rock and so, the things that row on the bare rocks should have less nutritional requirements, and often they should be photoautotrophic. So, 'trophy' is 'nutrition'; 'autotrophy' is 'self-nutrition' and photo-autotrophy is 'self-nutrition through light.'

So, what it says is that these pioneer species are often those species that are able to make their own food using light. So, if we have a species that is say a consumerist species. So, it is dependent on something else. So, if it is dependent on something else, it will not it cannot be a pioneer species because something else has to come before it comes.

So, pioneer species have less nutritional requirements and often are photoautotrophic. They are small in size because the conditions are so extreme, and the amount of nutrition that is available to these species is so less that they that a large size of individual cannot be supported. So, they have a small size.

They also have often a short life span with rapid growth and are mostly annual species. They have a short life span because if you have a species that has a very long-life span, if it is able to reproduce at a very late stage of life, probably the extreme conditions would have killed off those individuals before they get a chance to reproduce. So, they have to be individuals with short life span.

They should also have a rapid growth because the conditions are changing so fast that whenever you have a congenial situation, you should be able to show a rapid growth, and when the conditions become unfavorable, they die. So, before dying, they should be able to give out the next generation probably in the form of spores, and so, these are generally short life span species with rapid growth and mostly they are annual species.

There they also have the ability to disperse through spores or seeds, and have a prolific seed production. So, if you have a situation in which a bare rock is getting colonized by these plants, then in that situation, these plants to come there, they should they should be able to form the spores.

So, that the spores come through the air. So, these plants will - this pioneer species will be those plants that come that can colonize this these areas from large distances. So, often they are spore forming species, and often they have a very good amount of seed proliferation.

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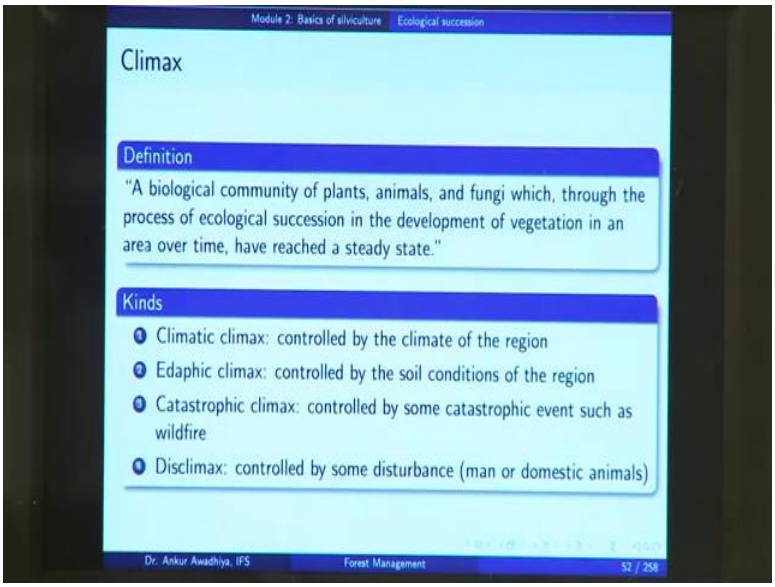

The other extreme are those species that form the climax communities. So, climax is a biological community of plants, animals and fungi, which through the process of ecological succession in the development of vegetation in an area over time have reached a steady state. So, a climax community is a steady state community; steady state because there is now no more change that is happening in that area. It is the final stage.

So, climax is a biological community of plants animals and fungi. So, if we looked at the earlier stages, so, for instance, in the case of a pioneer species, we only had a single species. But in the case of a climax community, we have a large number of species. So, you have plants, animals, fungi and so on.

So, these different individuals, they are forming a community - plants animals and fungi - which has reached a steady state. So, they are now able to support themselves in such a way that there is now no more change that is happening in this community, and they have reached this stage through the process of ecological succession in the development of vegetation in an area over time. So, this is the climax community and they can be different kinds of climaxes.

So, you can have a ‘climatic climax.’ So, a climatic climax is a climax that is controlled by the climate of the region. So, for instance, if you have a climax that is controlled by say temperature. So, you have a cold climax community, or you can have a dry or a warm climax community. So, these would be a climatic climax, but you can also have an ‘edaphic climate climax’ that is controlled by the soil conditions of the region. So, you can have a climax that is controlled by weather this area has sandy soil or whether it has alluvial soils for instance.

Or, you can have a ‘catastrophic climax,’ which is controlled by some catastrophic events such as wildfires. You can even have a ‘disclimax’ which is controlled by disturbances. So, disclimax is controlled by disturbances, such as man or domestic animals. So, you have a community in which you have some anthropogenic influences or you are having some cattle that are getting into this community, eating up the plants, and again and again, there are disturbing this climax. So, the community that gets formed in such a situation will be known as a disclimax.

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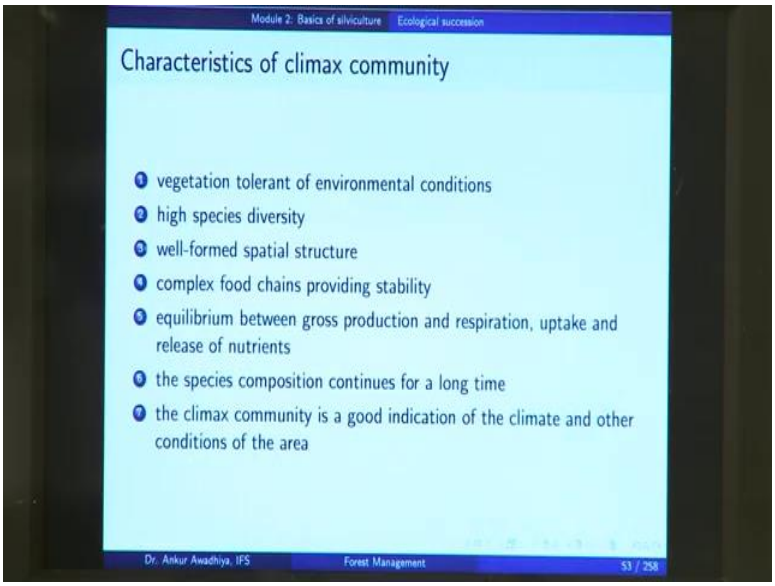

Now, the characteristics of the climax community will be roughly the opposite of the characteristics of the pioneer species. In the case of a pioneer species, you had the plants that could tolerate a very large range of environmental conditions. But here, you will have vegetation that is tolerant of the environmental conditions of the place, and they will not be able to tolerate very large disturbances.

It will have a high species diversity. So, as against a pioneer species that had only a single species, here you have a high species diversity. They have a well formed spatial. Another characteristic of the climax community is a well-formed spatial structure. Now, what is a spatial structure?

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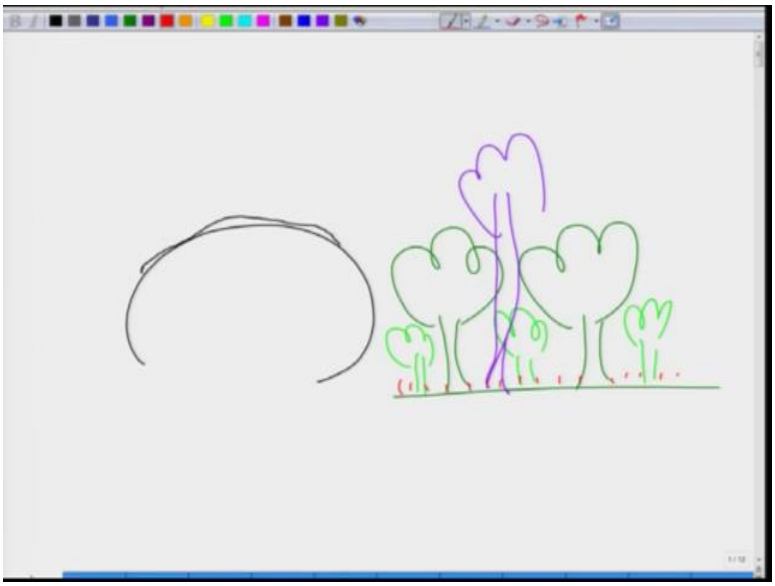

What we are saying here is that in the case of a pioneer species, why we had all the plants that were there on the surface of this rock. In the case of a climax community, you have a situation, in which you have a canopy, you have an understory, probably a few emergent trees and also the forest floor grasses. So, here you have a three-dimensional spatial structure or a well-formed spatial structure. You also have complex food chains that provide stability. Now, what does that mean?

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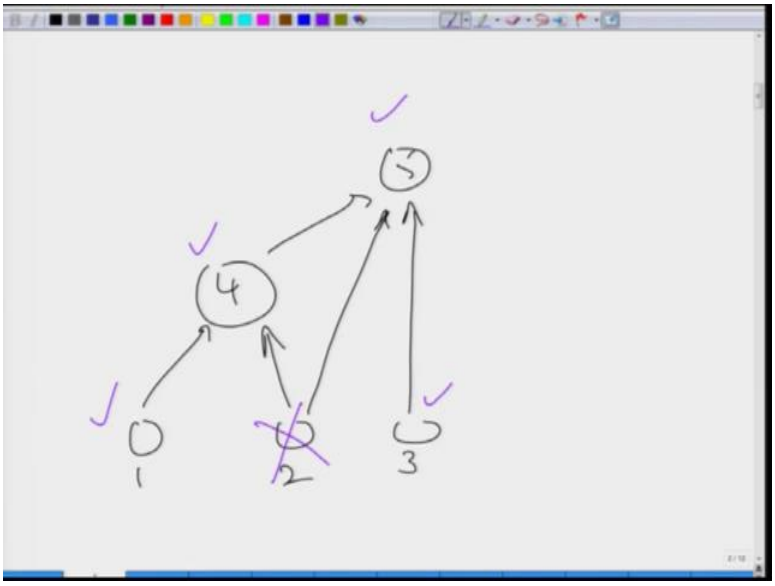

It means that you have species 1, 2 and 3. Now, this is species 4 can eat 1 or 2. Species 5 can eat either 4 or 2 or 3. So, it becomes a complex food chain. So, that even if you have the loss of one species, so if species two becomes extinct from this commune, from this climax community, still the other species will be able to survive.

So, it is a complex food chain in which there are species that are that are eating different species, which provides stability to this climax community. Then, there is equilibrium between gross production and respiration, uptake and release of nutrients. So, there is an equilibrium, the amount of gross production is equal to the amount of energy that is getting released because of respiration. The amount of uptake of nutrients from the soil is the same as the amount of nutrients that are released back into the soil because remember that a climax community is a stable community.

So, there are hardly any changes. So, everything is in equilibrium. So, the species composition continues for a long period of time, and the climax community is a good indication of the climate and other conditions of the area. So, if you see a community that is a climax community, you can make inferences about the climate of the area, the soil of the area, the rocks of that area, and so on. Because this is something that is constant over a long period of time, and it will, and it is reflective of the inherent conditions of that area.

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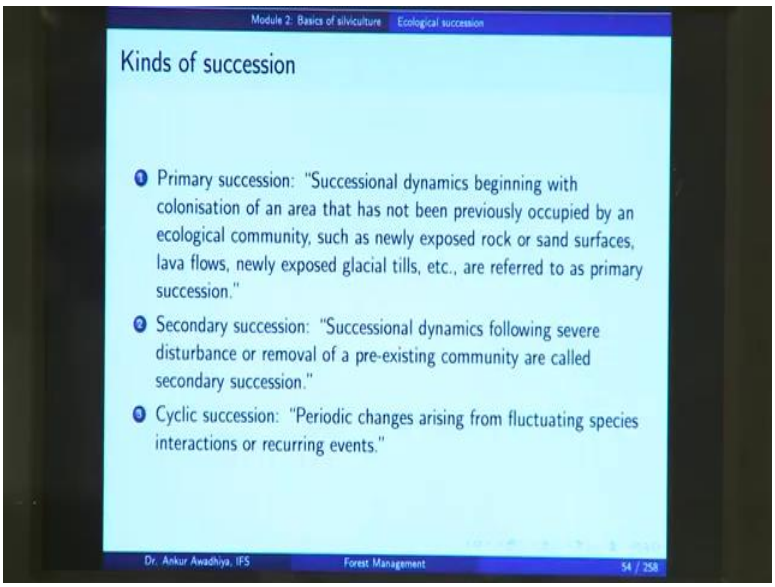

Now, let us have a look at the kinds of succession. So, we looked at ecological succession, but these this ecological succession is also of different kinds. So, you can have a primary succession, a secondary succession or a cyclic succession. A primary succession is the "successional dynamics beginning with colonization of an area that has not been previously occupied by an ecological community, such as newly exposed rock or sand surfaces, lava flows, newly exposed glacial tills etc., are referred to as primary succession."

So, in the case of a primary succession, you are witnessing succession in an area that was never colonized before. So, it is a *de novo* succession. On the other hand, a secondary succession is the "successional dynamics following severe disturbance or removal of a pre-existing community," and this is known as secondary succession. So, the basic difference is that in the case of a primary succession, you have lava flows that resulted in a new rock.

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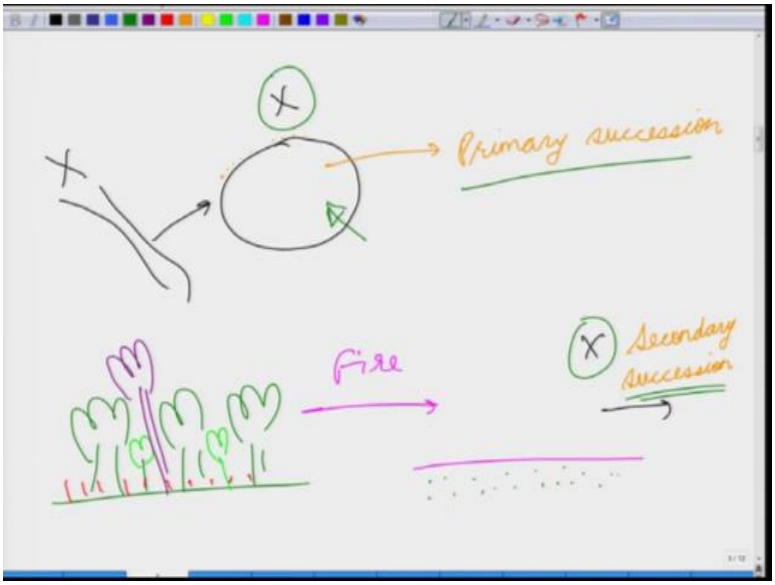

So, this there was no species in the lava flows, there are no species on these rocks, and then, you start seeing the crustose lichen, and the succession that happens here is the primary succession. Now, in the case of a secondary succession, you had a situation in which you had a well-developed forest with say different layers.

Now, what happened to this forest is that there was a forest fire, because of which you now have a barren land that does not have any species on it, and from this stage, you

have succession. So, this kind of a succession will be called a secondary succession. So, in both these - in both primary succession and secondary succession, you begin with a stage that does not have any species; but then, because, in the case of a primary succession, you had an area that was never colonized. So, here the conditions are much harsher than in a secondary succession, because at least in the case of secondary succession, you will be having some soil that has already been formed in this area. But in the case of a primary succession, you did not have any soil. So, this is a secondary succession, successional dynamics following severe disturbance or removal of preexisting community, are called secondary succession. Now, you can also have cyclic successions, which are "periodic changes arising from fluctuating species interactions or recurring events". Now, what is a cyclical succession?

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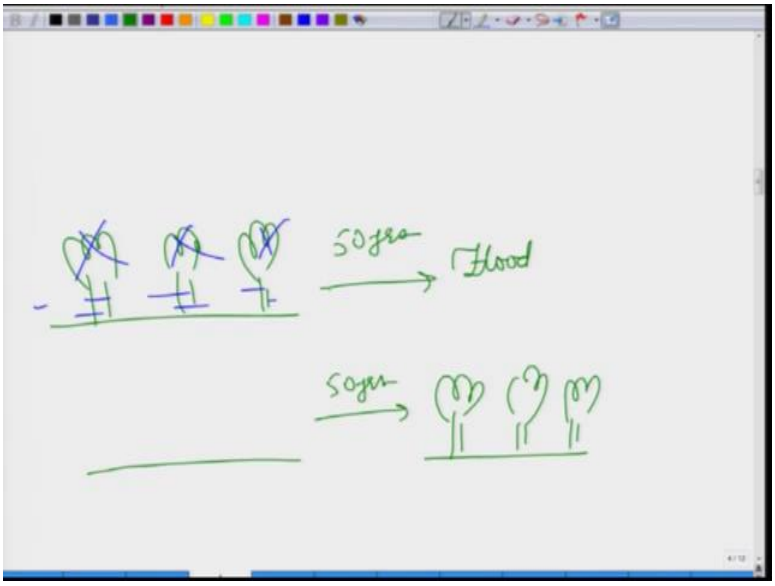

Suppose, you have an area with a well-developed forest, and say every around 50 years there is a flood. Now, during the flood, this whole area becomes inundated, and all the species die-out. Now, after this flood you again have a bare soil here, again you have a bare soil without any trees, because all of those trees died out during the inundation, and then, during these the next 50 years, they form a forest again, and then, after this forest has formed over a period of 50 years, you again have a flood.

So, if you have these cyclical changes, we will have a situation of a cyclical succession or a cyclic succession, which is periodic changes arising from fluctuating species

interactions or recurring events. So, there is a recurring event of flood which is leading to succession followed by another succession, followed by another succession and so on.

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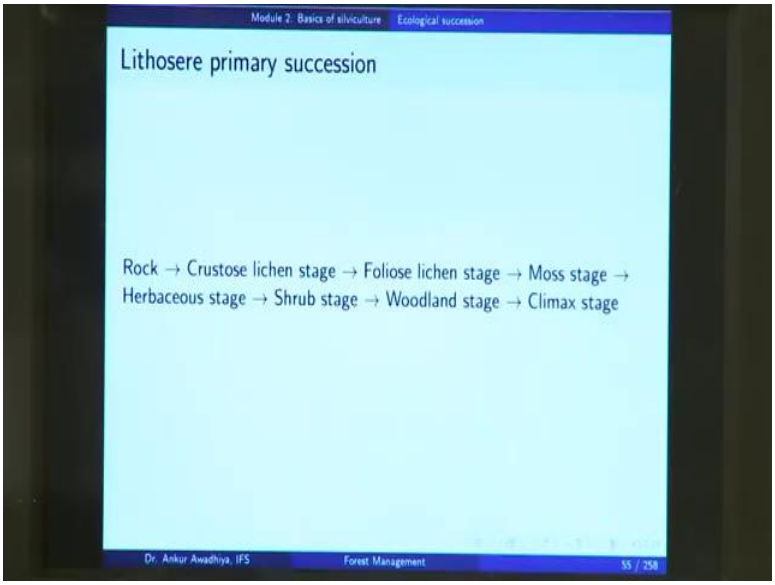

Now, if you look at primary succession, we can have the succession in over land or in water. If you have it over land, we call it a lithosere primary succession. 'Litho' is 'rock', so you have rocks seres and you have the primary succession. So, this is what we saw just before you have rock followed by crustose lichen, followed by foliose lichen, followed by moss, followed by herbaceous stage, shrub, woodland and the climax stage. So, this is the lithosere primary succession.

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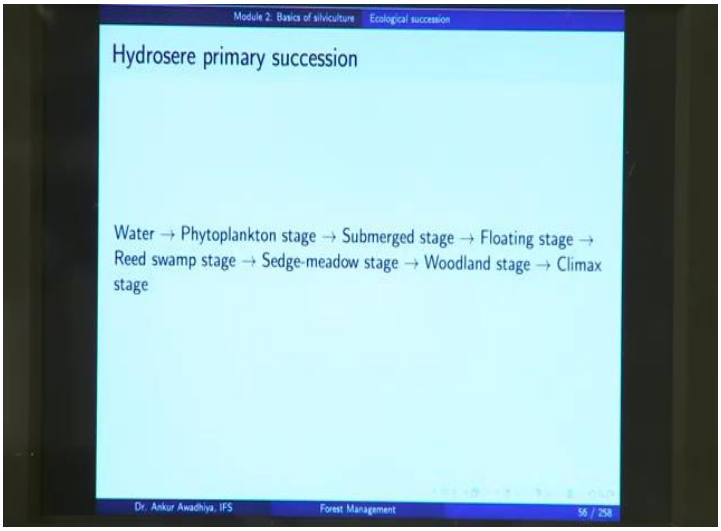

Another succession that can happen in water is the hydrosere primary succession. Now, in the case of a hydrosere primary succession, you have water, followed by a phytoplankton stage.

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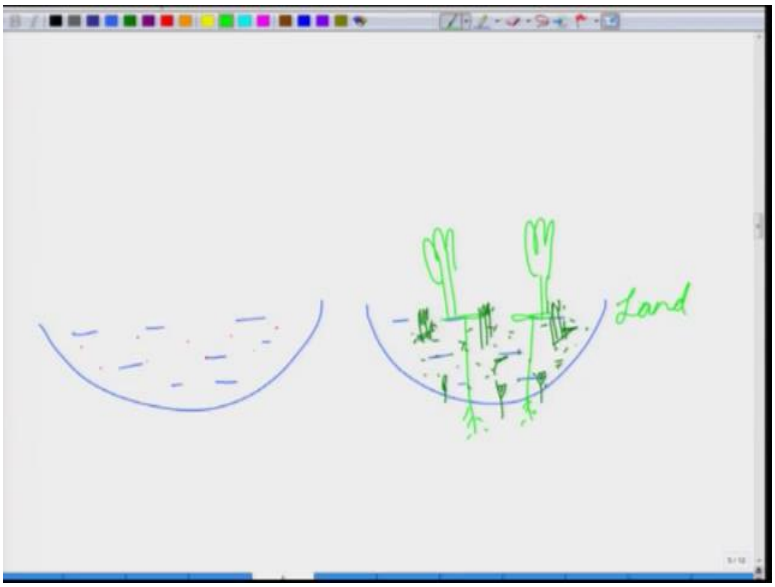

So, what is happening here is that you have a body of water with very less amount of nutrients, and then, you start seeing some planktons which has spawned microscopic plants that come into this area that colonized this area, and so, you will have a phytoplankton stage. This will be followed by a submerged state. So, in the case of a submerged state, you will have some plants that are submerged in this water.

So, they have not reached into the surface, probably they will also be a few rooted plants that are coming on the bottom, but they have not reached the surface. So, you will have a submerged stage followed by a floating stage. So, in the case of a floating stage, you will have plants that are able to reach to the top. So, you will have things like lotus plants. So, they are they have their root system, but they are also able to reach to the surface.

So, this is the floating stage. This will be followed by a reed swamp stage in which you will see some reed plants that are coming into this area, and with the coming of these reed plants, now this area is getting converted into a swamp. So, in place of very watery area, now, this is becoming a marshy area. So, you have a mix of your water and some solids that have come in this area, in the form of the reeds. Now, this - reach - reed swamp area will be followed by a sedge and a meadow stage.

So, in the sedge & meadow stage, you will have a solid surface that has come on this area, because all these plants have been dying and they have been accumulating organic matter on the bottom. Soil is getting formed, and now, you have a situation in which you have certain levels where you have plants, but then you also start seeing some grasses that are getting formed on these soils and on this organic matter. So, that is the sedge and the meadow stage. This will be followed by the woodland stage; in which case you have small trees that are getting formed over this area.

So, now this water body has completely converted into a land and it has some trees in this woodland stage, followed by a climax stage. So, this is a hydrosere primary succession. So, 'hydro' is 'water.' So, you have the seral communities in water. This is a primary succession because it started with just water over a surface of land with hardly any nutrients and which was not colonized beforehand. So, it is a primary succession which is having seral communities in water. So, this is a hydrosere primary succession.

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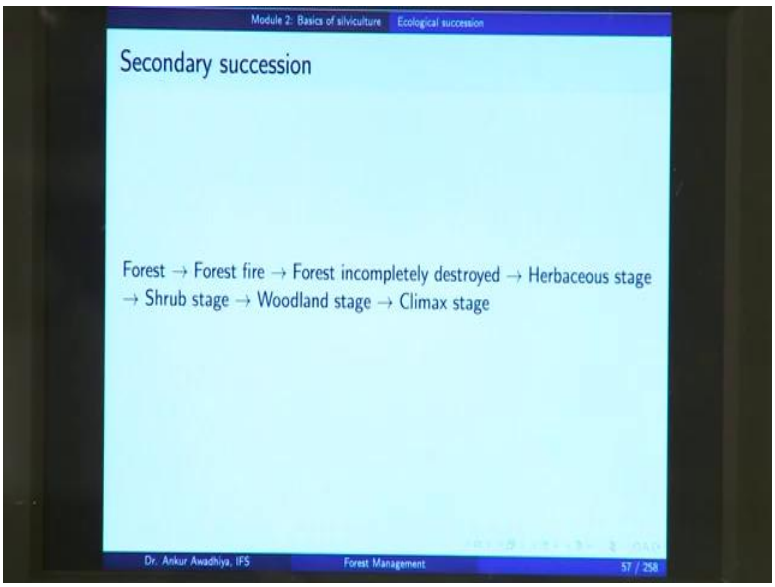

A secondary succession on the other hand, as we saw before we have a forest followed by a forest fire, and so, the forest is now incompletely destroyed. Why is it incompletely destroyed? Because you might be having some tubers, you might be having some seeds that are not completely destroyed by the forest fire.

So, in this case, you have a situation in which you have this land.

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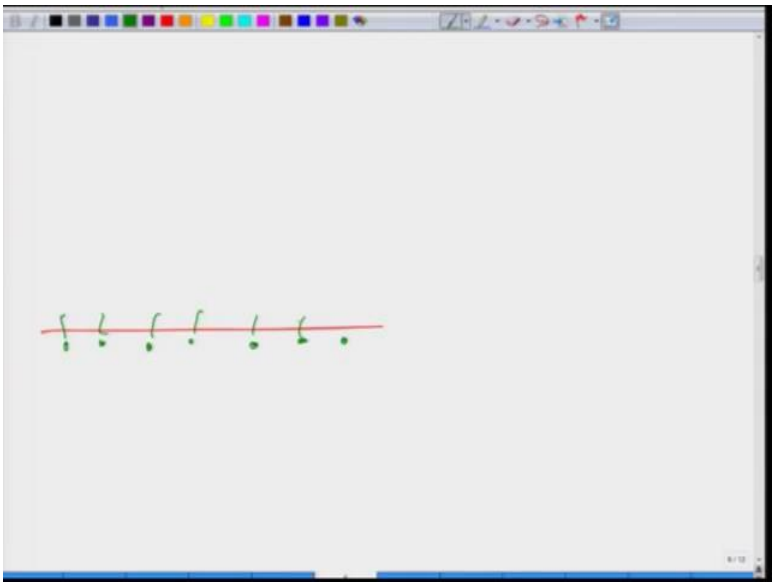

But you might also be having some seeds or some tubers that are inside this land, and so, they were not destroyed by the fire, and so, after a while they will start giving out the plants. So, here you have a forest which after a forest fire, you have an incompletely destroyed fire forest, and which begins the herbaceous stage succession followed by the shrub woodland, and the climax stage. So, this is the secondary succession.

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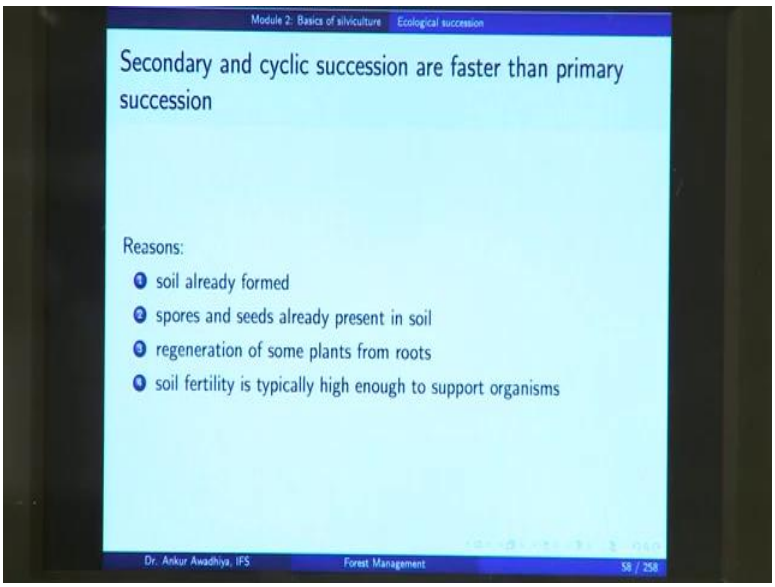

Now, typically secondary and cyclic successions are faster than the primary succession, because of four reasons. In both secondary succession and cyclic succession, you have

the soil that is already formed in this area. So, even though a number of individuals are removed, you still have the soil on which the plant life can be supported. You have spores and seeds that are already present in the soil. So, because of which you do not have to wait for new species to colonize this area. You already have some species that are left in this area, and which can jump start the process of succession.

The regeneration of some plants from roots also happens. So, you will have a situation in which the more complex communities will form much faster, because these plants are already there, and even though, the shoots portion is destroyed, the roots will start giving out small shoots in the they will be regeneration of some plants. And, also the soil fertility is typically high enough to support the organisms. So, you have the soil and you also have the fertile soil because of which your succession will be fast.

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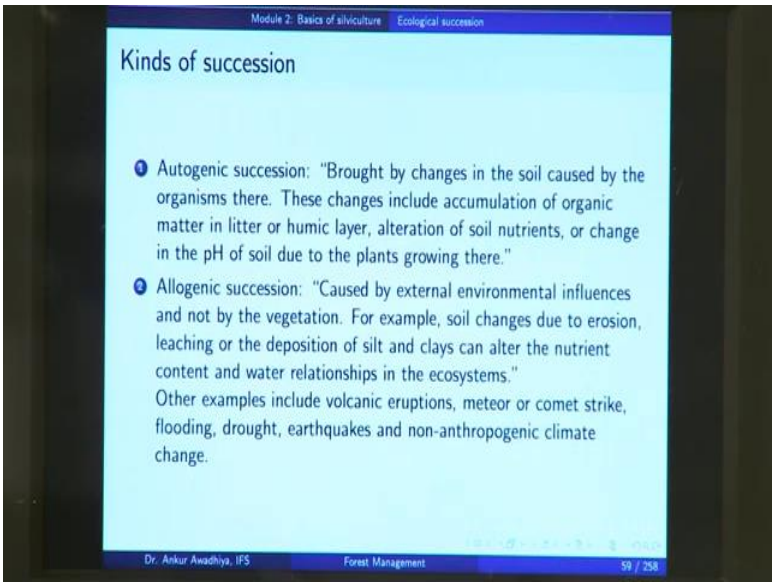

Now, another kind of classification or kinds of succession is, autogenic versus allogenic succession.

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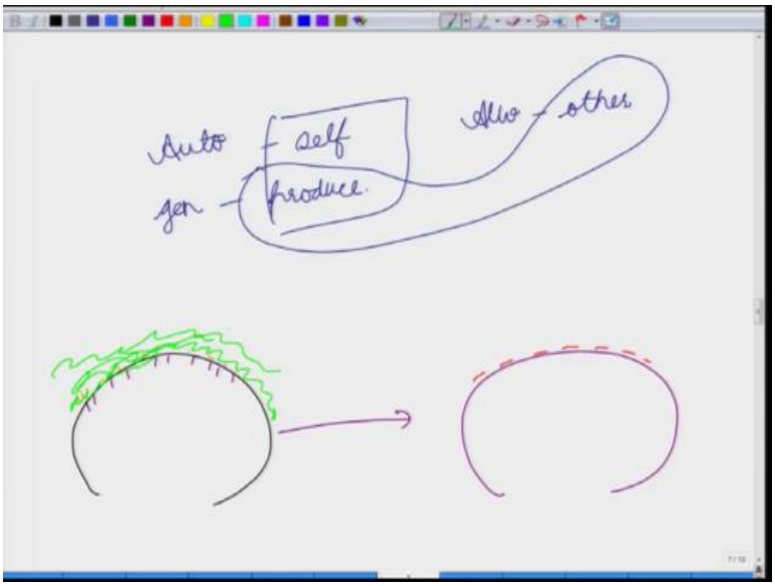

So, ‘auto’ is ‘self,’ ‘gen’ is ‘to produce,’ and ‘allo’ is ‘other.’ So, autogenic is succession that is self produced; allogenic is succession that is produced by something else - by some outside factor. So, autogenic succession is brought by changes in the soil caused by the organisms there or the organisms that are already present there. So, the changes that are being brought about by the organisms that are already present in the area is an autogenic succession.

So, a good example is that you had a rock and, on this rock, you have this crustose lichen which is acting on these rocks to disintegrate this rock. And, once this rock gets disintegrated, you have certain amount of soil that gets formed, and because of which your rock is now suitable to support the next stage of foliose lichen. So, this is a succession that is being brought about by changes in the soil or changes in the rock that is caused by the organisms already present in there, which is the crustose lichen. So, this is an autogenic succession.

Allogenic succession is caused by external environmental influences and not by the vegetation. The external environmental influences could mean that you have a situation in which you had this rock, and then, there was flood, and because of flood, you have a deposition of soil on top of this rock. So, now because you have these alluvial deposits, they will now jump start the succession. But, this deposition of soil was not brought about by the plants that were already there, it was brought about by this external

environmental influence in the form of a flood. So, the succession that happens here goes by the name of an allogenic succession. Now, autogenic succession - the changes include accumulation of organic matter in litter or humic layer, alteration of soil nutrients or change in the pH of the soil due to the plants growing there.

So, in the case of autogenic succession, you have accumulation of organic matter in the litter or humic layer. How does this organic matter get accumulated? Because, you have plants that grow there, after a while these plants age up, and then, they die. And, when they die their body masses or the organic matters that were present in their bodies, they get accumulated in the soil. When they get accumulated, they get degraded and they form the humus.

So, they form the litter layer, which means it is not completely degraded, and when it gets degraded, it forms the humic layer. Now, with this there are changes in the soil. There is an alteration of soil nutrients. There is also an alteration in the soil texture. There are changes in the pH of the soil, because when you have a degradation of these organic materials, there will be the formation of organic acids. So, there will be a change in the pH of the soil, and all of these changes are being brought about by the plants that are already there in that area. So, this is in the case of autogenic succession. You have all these different changes due to the plants that are growing there.

In the case of allogenic succession, you can have changes in soil because of erosion. Now, erosion is not caused by the plants that are already present in that area. You can have leaching, or deposition of silt and clays. Leaching; because of say rain water. So, because it when it rains, some of the soluble minerals will get dissolved in the rain and then they will be moved out of this area. So, this is known as leaching. You can have deposition of silt and clay, because of water, or because of air.

So, all of these changes are not because of the plants that are there in the area. You can have alteration in the organic in the nutrient content, and the water relationship in the ecosystem, but none of these is because of the plants in this area. So, these allogenic successions can occur because of volcanic eruptions in the area, meteors or comets strikes, flooding, draught, earthquakes and non-anthropogenic climate change, and so on.

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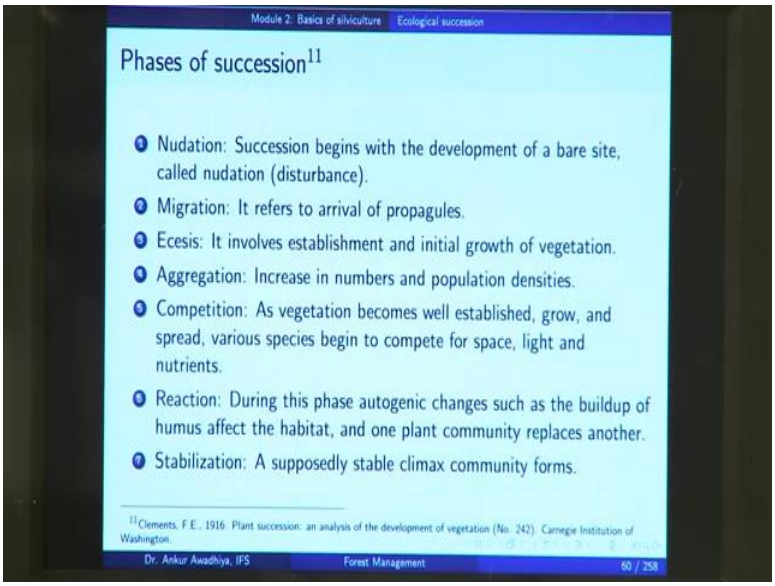

Now, we saw the whole process of succession, but if we wanted to name all these different stages, we will come up with these seven phases of succession. So, succession begins with the Nudation. Nudation is the phase in which something is made nude or it is made bare. So, it begins with the development of a bare site, which is known as 'nudation or disturbance.' So, this bare site can be formed because of say lava flow; it can form because of a forest fire that has made this whole area barren or devoid of all the living entities. So, this is the nudiation stage.

Next, we have the Migration stage. So, the migration stage refers to the arrival of the propagules. So, in the case of this new rock that got created, then these propagules came in the form of spores or seeds. So, these the coming of these seeds is or this force, is the migration stage. After a while, these migrated spores will establish themselves in this area, and this is known as the Ecesis stage - establishment and initial growth of vegetation in this area.

Now, once this vegetation gets established, the number and the pop - the number and the population density of these established individuals will increase with time. So, from ecesis, we move into the Aggregation phase in which there is an increase in the number and the population densities of these individuals. Now, once you have this area that is having a huge number density. So, now, there is a competition for resources because

earlier you had a situation in which this soil or this rock was only supporting these individuals.

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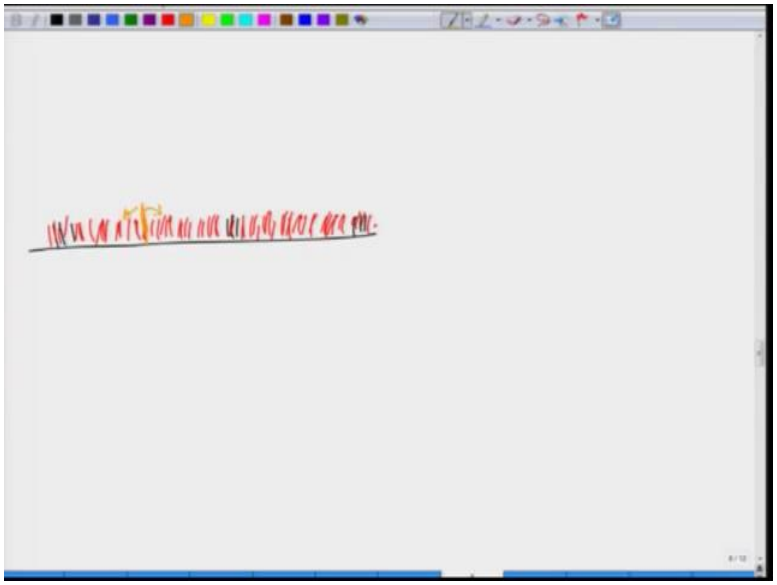

But now, you have a situation in which there are so many individuals that now the resources are now not plenty or not sufficient, for all of these individuals. So, now, there will be a competition or survival of the fittest. So, you will have competition as vegetation becomes well-established, grow and spread the various species begin to compete for space, light and nutrients.

So, there is a competition for space, because you have this piece of land or this rock that does not have enough space for all of these individuals. There is a fight for light, because if you have this individual, the it will be casting some shadow over the surrounding areas and so, there is now a fight for light. There is also a fight for nutrients. There is a fight for water. So, there is a fight for all of these different resources which comes in the competition phase.

Now, after the Competition phase, you have the Reaction phase. So, during this phase autogenic changes such as buildup of humus affect the habitat and one plant community replaces another. So, in this reaction phase what happens is that you had this bare rock, and on this rock. You had the growth of these lichens because these lichens made changes into the rock, and because there was an intense competition. So, now, some individuals of the lichens have started dying out and once they start dying out, and

because this piece of rock is down no longer just a rock, but is having some amount of soil on top of it. So, now, the next stage some mosses that come into this area, are much better prepared to use these resources than the lichens. So, they will now out compete and they will replace the lichens. So, this stage of reaction is a phase, in which the autogenic changes, such as a buildup of humus have affected the habitat to such an extent that it is now no longer suitable enough for the original community, and there is a reaction and there is a replacement of one community by the another community. So, this is the reaction stage.

And, it is followed by the Stabilization stage, in which a supposedly stable climax community forms. Now, when you have a reaction, a reaction will again lead to aggregation. So, when you have these mosses; then the mosses will start to they will establish themselves and then, they will start to increase their numbers. When you have an increased number, there is a competition amongst the individuals of the mosses which then again leads to a reaction, and in this reaction, now your mosses get replaced by the grasses and then, that again leads to the same process.

So, you again have ecesis; you are. So, you again have the migration of grasses into this area, which now leads to ecesis, in which the grass is now increase in their numbers, in which your grasses established in this area. Then, they increase their numbers; then there is competition amongst the individuals of grasses, followed by another reaction, and so, this process goes on again and again and again, till you have the formation of the final complex community, which is the climax community.

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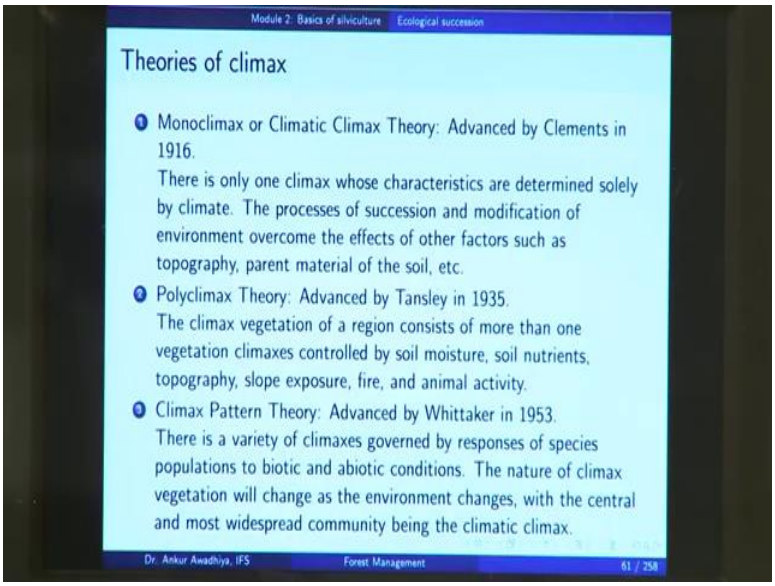

Now, how many kinds of climaxes can there be? So, you have three different theories of climax. The first one goes by the name of a 'mono climax or a climatic climax theory'; mono is one. So, in this theory it states that there is only one climax, which is governed by the climate of this area. So, this theory was advanced by Clements in 1916. There is only one climax whose characteristics are determined solely by the climate.

So, this climax is determined only because of the climate of this area; there is no other factor that governs the climax that will be formed in this area. The processes of succession and modification of environment overcome the effects of other factors such as topography, parent material of the soil etc. So, what this theory propounds is that, if you know the climate of any area, you can tell what is the climax community that will be formed in this area. Because the climax community will only be governed by the climate, it does not depend on anything else. So, one climate will give you one climax.

The second theory is the Polyclimax theory; poly is many. So, you have many climaxes, this theory was advanced by Tansley in 1935. The climax vegetation of a region consists of more than one vegetation climaxes controlled by soil moisture, soil nutrients, topography, slope exposure, fire and animal activity.

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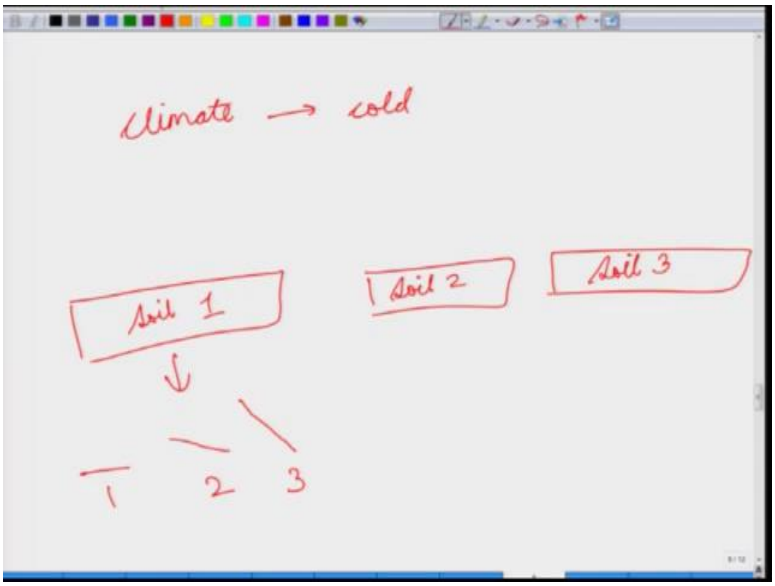

So, what Tansley said, is that even though you have one climate, you can have different climaxes; because in a very say, your climate is a cold climate; but even in this cold climate, you can have regions that have soil 1. You can have regions that have a second type of soil, so you have soil 2. You can have a soil 3, and on all these different soils, you will have different climaxes. Not only your soil, but also the topography.

So, in this soil 1, you can have a region that is plain, or you can have a region that has a moderate slope, or you can have a region that has a very large amount of slope. So, in this soil, you will have now three different kinds of climaxes. So, even though you have one climate, you will have different climaxes. So, this is the polyclimax theory; you can have different climaxes in one climate. So, the climax vegetation of a region consists of more than one vegetation climaxes controlled by soil moisture, soil nutrients, topography, soil exposure, fire, animal activity - a number of other things.

Then, you have a third theory that goes by the name of the 'Climax Pattern theory' that was advanced by Whittaker in 1953. There is a variety of climaxes governed by responses of species populations, to biotic and abiotic conditions. The nature of climax vegetation will change as the environment changes with the central and the most widespread community, being the climatic climax. So, what this climax pattern theory says is that when you talk about a climax community, it is not a rigid community. There are changes even in the climax community.

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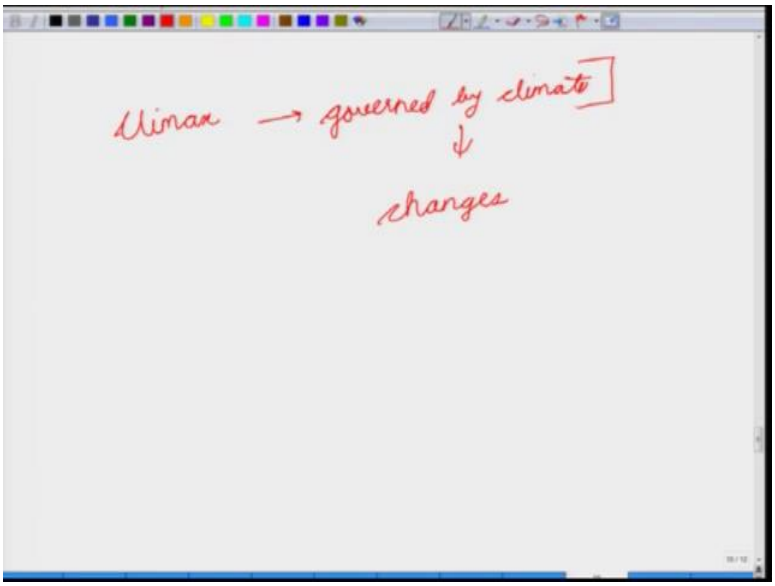

So, even though you will have a climax that is governed by climate, but still there will be changes that happen over time around this climatic climax. So, for instance, if you have a climax community that is formed out of the sal trees. So, you will have a dominance of these sal trees, but still the understory or the forest floor or the emergent layer; they will keep on changing with time. So, there is a whole pattern of these climaxes.

So, this climax is not a single climax, you have a whole pattern that is formed in this area around your climatic climax. So, why do we need to know all of these different things? Well, it is important because when we talk about forest management you need to know why these changes are happening, and what is going to be the result of these changes?

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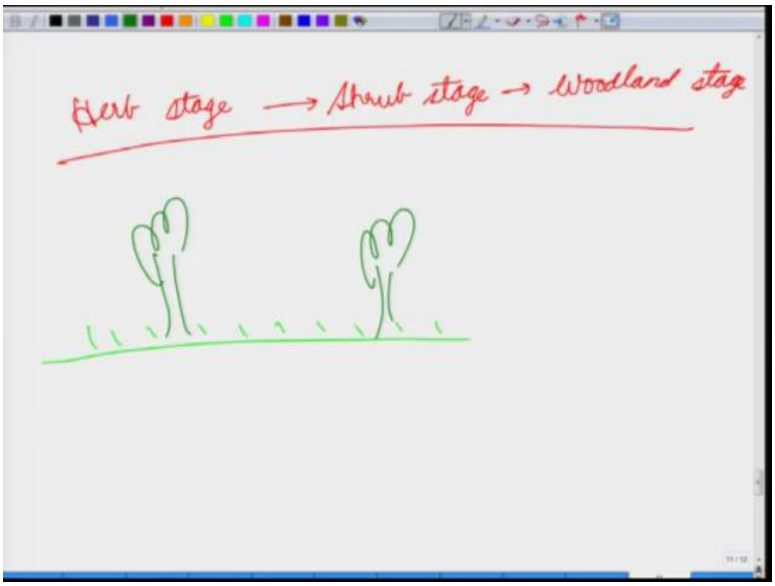

So, for instance, because we know that a herb stage - in a natural way - is followed by a shrub stage, which is followed by a woodland stage. So, this information of ecological succession can help us predict what is going to happen in this area. So, a good example is the grasslands that are present in various national parks and sanctuaries. So, we need to have these grasslands because they serve as good habitats for a number of herbivores.

So, for instance, in Kanha, we have a number of grasslands that are supporting the Barasinghas, but then even if you have a grassland. But time, you will see small shrubs that are coming up in this area; you will also see some trees that will come up in this area, and that is inevitable. They will come up, if we do not make any interventions in this area. So, you will have a situation in which you have this grassland, but then you will also have a tree that is coming up in these grasslands. Now, because we know that in the process of ecological succession, the wood the woodland stage is going to dominate over the grassland stage.

So, if you want to maintain these grasslands, you will have to intervene and remove these trees. So, the tree cutting is in an integral part of the of the management of grasslands, if you want to maintain these grasslands as grasslands. And if you do not do anything, after a while you will see that these grasslands will be replaced by woodlands, and finally, will be replaced by the climax communities.

So, the knowledge of ecological succession helps us not only predict what is going to happen in this area; but also, it helps us to make certain managerial decisions, if we want to have certain specific objectives of management in this area. So, ecological succession is extremely important to manage your forests.

So, that is all for today.

Thank you for your attention. [FL].