Forests and Their Management
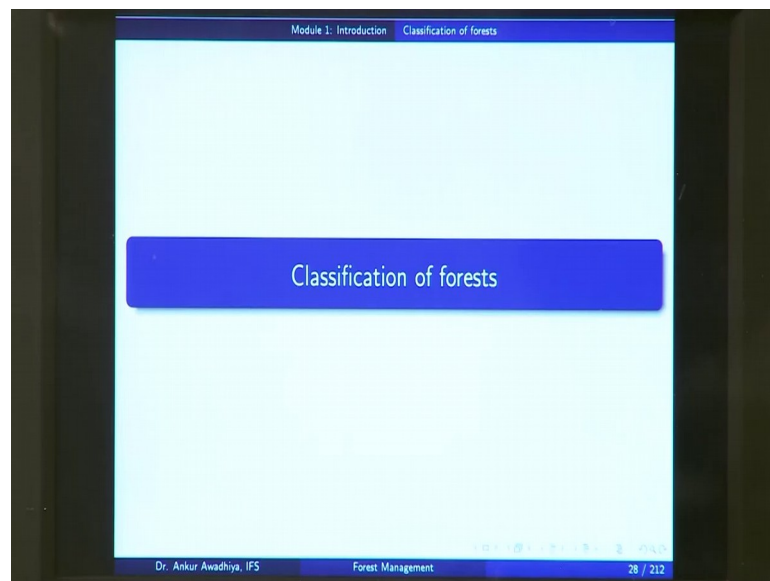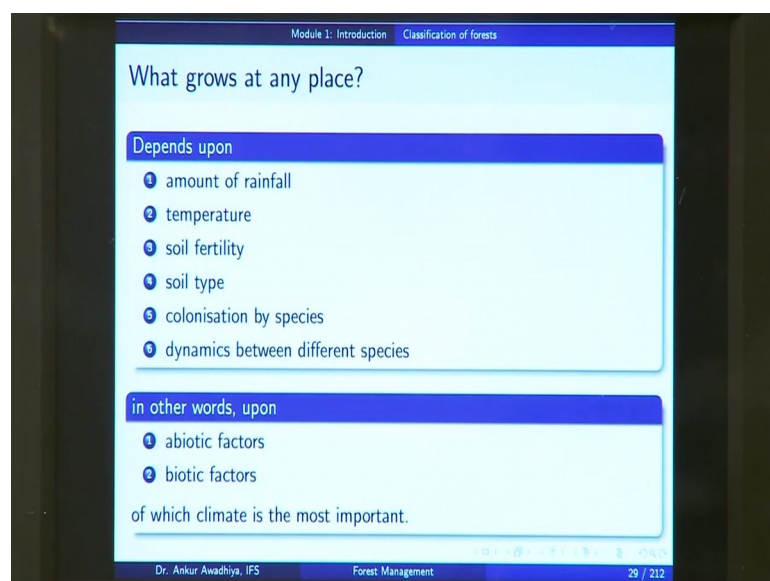**Dr. Ankur Awadhiya**
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Module - 01
Introduction
Lecture - 02
Classification of forests

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[FL]. In the last lecture, we looked at what a forest is. And today, we will have a look at the CLASSIFICATION OF FORESTS. Now, what grows at any place depends on a number of factors. So, as we saw in the previous lecture, a forest is comprised of trees. It will grow at any place, will depend on the amount of rainfall that we have at that particular location. Because, that will determine the amount of water that is available to the plants.

The different plants require different amounts of water. If we look at a mangrove, is a species that will require a much greater amount of water than say, a cactus species. So, the amount of water will determine whether you have a mangrove in an area or whether you will have a cactus in an area. It also depends on soil - it also depends on the temperature of that place.

So, for instance a banyan tree grows in a much warmer condition as compared to say chilled pine tree. A chilled pine tree will be found in mountainous areas where the temperature is much lower. Whereas, a banyan will probably be found in the plain areas where the temperature is higher. What grows will also depend on the fertility of the soil at that particular location.

If you have a location that has very infertile soil, then probably you will be seeing some pioneer species sorts of plants, which can thrive in lesser fertility as compared to those plants that require much more amount of nutrients, to put up a fast growth. It will also depend on the type of soil in that area - whether it is a clay soil; whether it is a loamy soil; whether it is silty soil; whether it is a sandy soil, and the kind of structure that we see in the soil. It will also depend on the colonization by different species.

So, probably there is a location that is very good for the growth of banyan trees. But this location does not have any banyan trees, because no banyan seeds have reached into this area, so far. But, then probably in a few more years some birds might bring up some banyan seeds in this area and then this area will be colonized by the banyan trees. So, it also depends on whether this area has been colonized by a particular species or not. And, it also depends on their dynamics between different species.

So, probably your area is good for a banyan tree, but there are a number of herbivores in that area that eat up any banyan sapling that this in the area. So, if that happens, then even though your area has adequate rainfall, adequate temperature, good soil fertility,

everything else is good, but then because of the dynamics between a herbivore and the banyan tree you might not see any banyan tree in this area.

It depends a lot on the dynamics between species and this dynamics could be in the form of competition; it can be in the form of one species eating up another species, and so on. So, in other words, if we summarize all of these, what grows at any place depends on the abiotic factors as well as the biotic factors. Now, abiotic factors are the nonliving factors in that area - the temperature, the sunshine, the amount of rainfall, the fertility of the soil and so on.

And the biotic factors refer to the living components of that area. Whether, there are birds that are able to bring the seeds to an area; whether there are herbivores that are eating up the saplings that are coming to that area; whether there are insects that are destroying the saplings in their early stages; whether there are some weeds that are out competing the plants in that area. So, all of those are referred to as the biotic factors.

Now, of all of these factors, climate is considered to be the most important factor, because it regulates the amount of rainfall; the amount of sunshine; the temperature in that area. So, this is the predominant component that will determine what will grow in an area.

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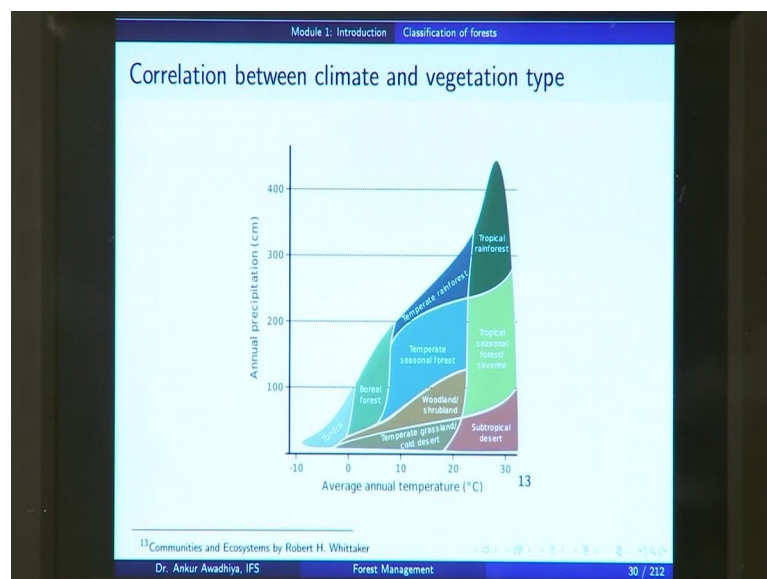
And if we plot a curve of the average annual temperature on the x axis and the annual precipitation on the y axis - we will see that there are different kinds of vegetations that grow in different locations. So, for instance; if you look at an area that has a high temperature and high rainfall, we will find a tropical rainforest in that area.

So, when we talk about a tropical rainforest typically, it will comprise of very huge tall trees, with very well-developed canopy, with a very good understory, a very good ground cover and so on. Because, you are having adequate rainfall in that area so, rainfall is not a limiting factor in that area. You also have good temperature probably, because you have a very good amount of sunshine. So, adequate amount of energy is available, adequate amount of water is available, and so, you will find a profuse growth in the form of a tropical rainforest.

Whereas, if we look at areas that have very less rainfall and very less temperature, we will find a tundra type of vegetation. Now, a tundra vegetation is typically found in areas that are mostly snow covered, the temperature is so less that the amount of metabolic activity is very less. These areas which are near the poles also have very less amount of sunshine, because of which less amount of energy is available to the plants to put up their growth. And at the same time, because you have a very less amount of energy and very less amount of water that is available to these plants in the liquid form. So, you will find a very scanty amount of growth, and that makes a the tundra vegetation.

Now, if you look at those areas that have less precipitation, but high temperatures, you will find the deserts. The tropical and the sub tropical deserts. Now, these areas they have adequate amount of sunshine. So, adequate amount of energy is available for plant growth, but the amount of water is so less that it becomes a limiting factor. And, you will find not tall trees, but cactus - but cacti and other thorny species in these areas. So, there is a very high correlation between the climate of an area and the kind of vegetation that you will find in an area.

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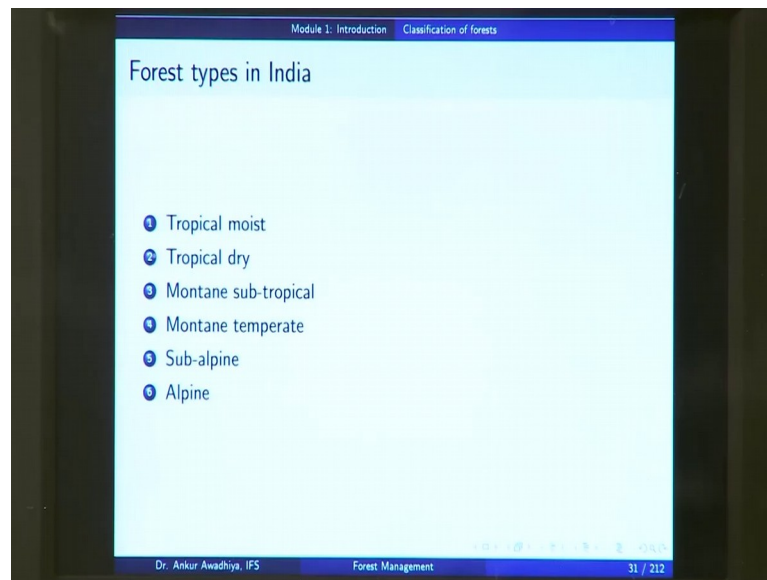
Now, if you look at the vegetation in India, we have these different types of forests that we define for our country. You have tropical moist forest, tropical dry forest, montane subtropical forest, montane temperate forest, sub-alpine forest and alpine forest. Now tropical forest will be found in tropical areas, montane forest will be found in mountainous areas and alpine and sub-alpine forest will be found in very cold areas. So, we look at all of these in more detail now.

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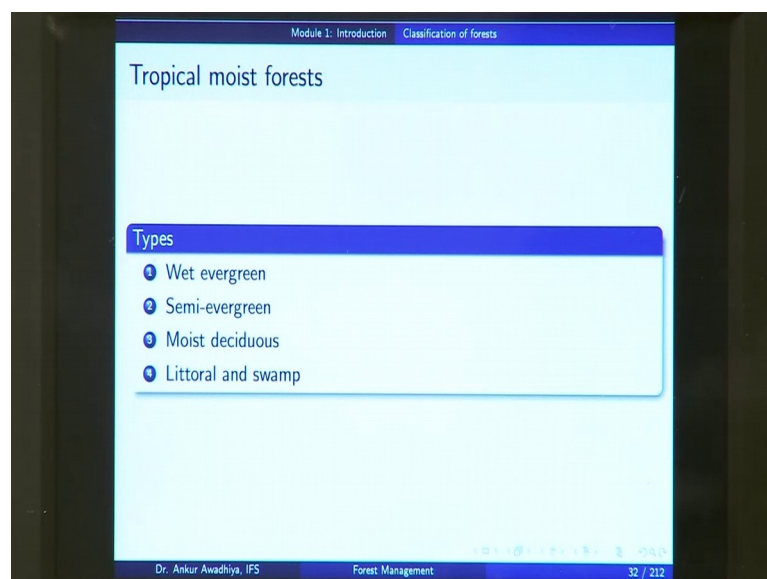
So, we begin with tropical moist forest. So, as the name suggests, you have these forests in tropical areas with adequate amount of rainfall, which are leading to the tropical moist forest, and there are four different kinds of tropical moist forests. We have the wet evergreen forest, semi-evergreen forest, moist deciduous forest and littoral and swamp forests. So, what is a wet evergreen forest?

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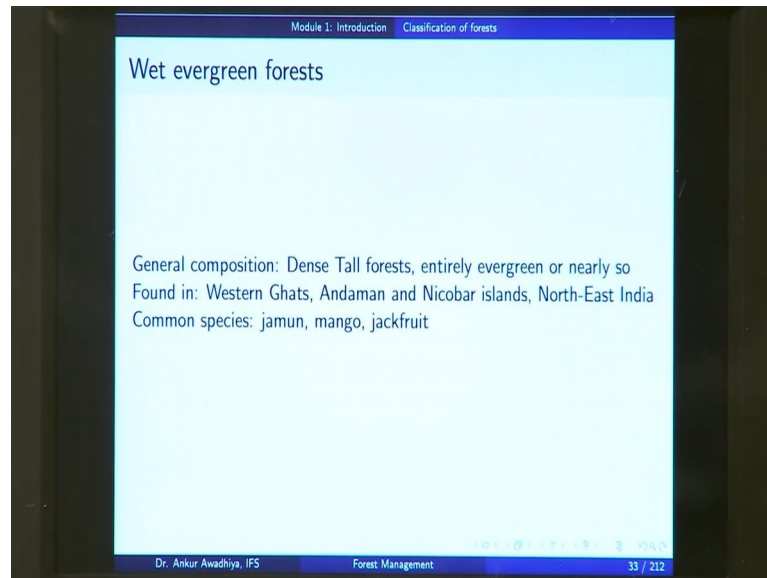
So, a wet evergreen forest - it is found in an area that has heavy amount of rainfall, which is making it wet. It is an evergreen forest which means that all round the year, the trees will be having their leaves. They will not be shedding their leaves in any particular season. The general composition comprises of dense tall forests entirely evergreen or nearly so. You have a very dense forest because these are in tropical areas, and these have adequate amount. So, these have adequate amount of sunshine, and these have adequate amount of water. So, you have you will have a profuse growth there will be a dense growth you, will have tall trees in this area which do not shed their leaves in any particular season. These are typically found in Western Ghats, Andaman and Nicobar Islands, North Eastern India, and the common in species include trees like jamun, mango and jackfruit.

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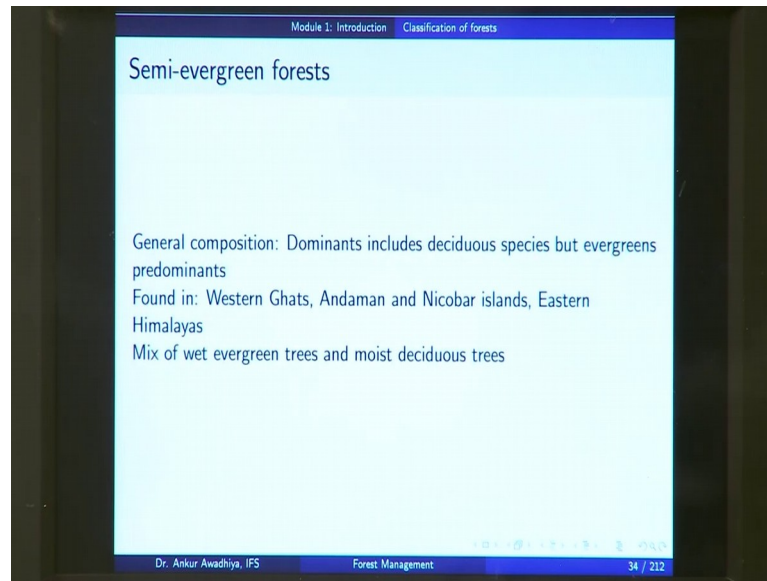
Now, if the amount of water reduces a bit, we will find semi-evergreen forests. Now, semi-evergreen is, it means that it includes not just evergreen forest, but also some deciduous species. So, here you have some deciduous species that are also dominant, but evergreens are the predominant species.

Now, what is a deciduous species? A deciduous species is one that sheds its leaves in some season of the year. And why does it do so, it does so to conserve moisture. Because, if you have leaves in a tree, then they will be losing out water because of transpiration. So, if a plant wants to reduce the amount of moisture that is that it is losing out, then it will probably through evolution become a deciduous plant.

So, in these forests you have both evergreen species as well as deciduous species, and these are also found in Western Ghats, Andaman and Nicobar Islands, in Eastern Himalayas, and you will find a mixture of trees - some wet evergreen trees and some moist deciduous trees.

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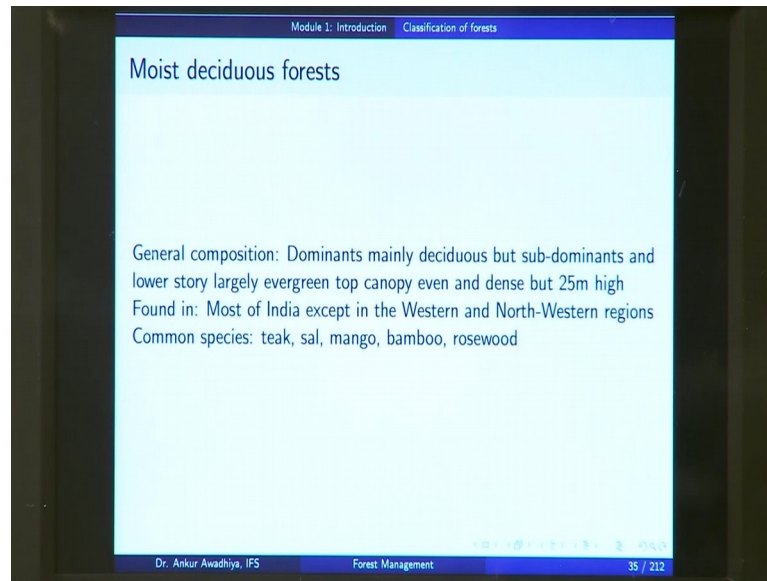
So, what are these moist deciduous trees now? So, moist deciduous forests have a general composition which includes dominance - which are mainly deciduous, but sub-dominants and lower story that are largely evergreen. Their top canopy is even, and dense, but as high as 25 meters. So, this in the case of a moist deciduous forest, the dominant species are deciduous, but then there are also some sub-dominance that can be evergreen, and these moist deciduous forests have a top canopy that is even and dense.

So, you will find a continuous canopy; continuous dense canopy that will becomes some sort of a roof of the forest. And, the trees are as high as 25 meters. And these moist deciduous forests are found in most of India, except in the western and the northwestern regions that have heavy rainfall. And, the common species include teak, sal, mango, bamboo and rosewood.
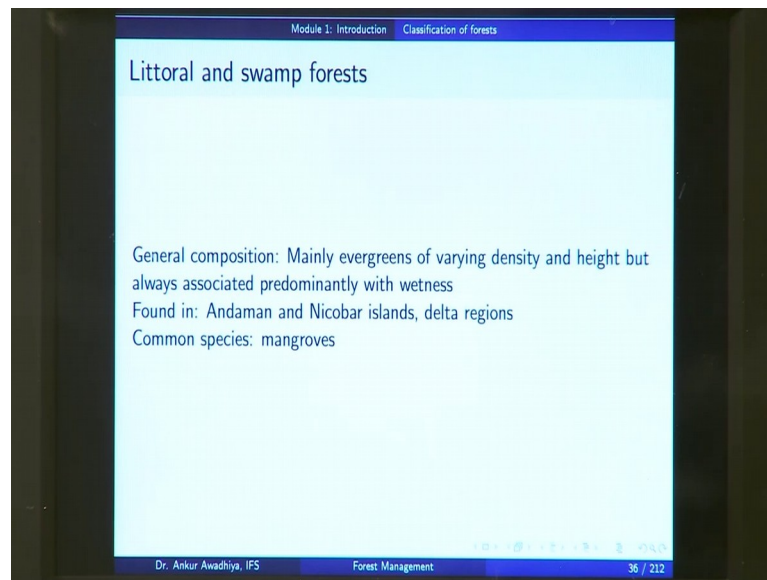
Next, we have littoral and swamp forests, which are found in very wet regions. The general composition is mainly evergreen forests of varying density and height, but always associated predominantly with wetness. So, you will find these forests next to the sea shores, you will find them in swampy areas that are waterlogged, and they are generally found in Andaman and Nicobar Islands, because you have the sea shores. They are also found in delta regions, because they have a lot of swamps, which are wet areas. And, a very common species here is in the mangroves. So, mangroves are those species that are adapted to a life in a very wet region.
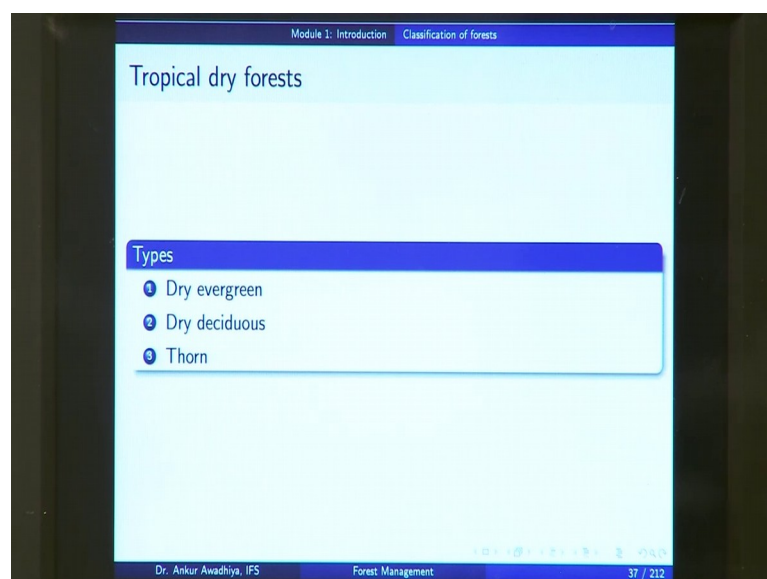
Next, we have tropical dry forests. So, these forests are found in tropical areas, and these have less amount of water. So, we are seeing that climate is a predominant theme in the whole classification of these forests. So, these forests are tropical forests, which means that these lie in tropical areas, and so, they have ample amount of sunshine - but then they are dry forests, because they have less amount of rainfall.

And, in this we have three different types; you have dry evergreen, dry deciduous and the thorny forest. Now, dry evergreen would mean that of that you have a forest in a dry region, but it does not shed its leaves in any season of the year. A dry deciduous forest would mean that it is there in a drier region, but it also sheds its leaves in some part of the year to conserve or moisture, and then you have the thorny forests.

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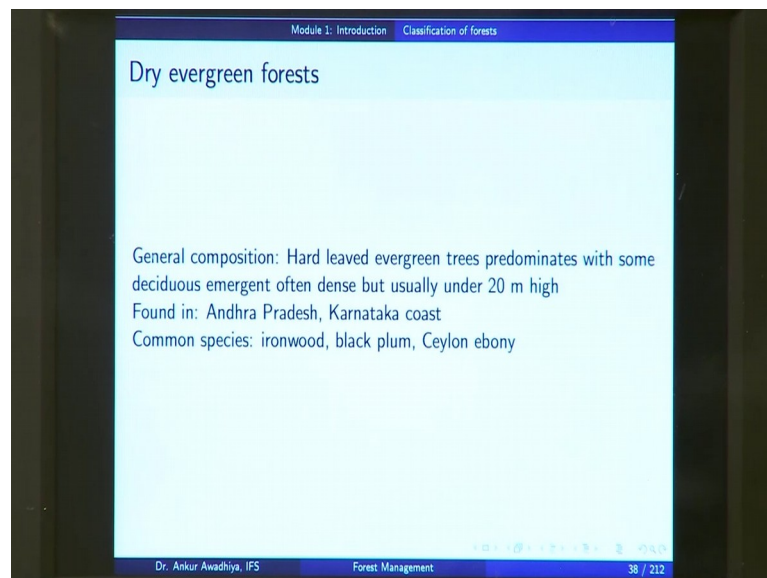
So, let us look at all three of these. Dry evergreen forest - the composition here is hard leaf evergreen trees which predominate with some deciduous emergent often dense but usually under 20 meters high. Now, because these are in dry regions, they have very hard leaves; these are evergreen forests which means is that the evergreen trees will be the predominant trees. There will be some deciduous trees as well, which are typically emergent, but the whole forest in total will look often very dense, generally the height is less than 20 meters.

So, as against a moist evergreen forest, which was as high as 25 meters; here the height is less, and it is less than 25 meters, because the amount of moisture is less. We typically

find it in Andhra Pradesh and the Karnataka coast, and the common species include ironwood, black plum and Ceylon ebony.

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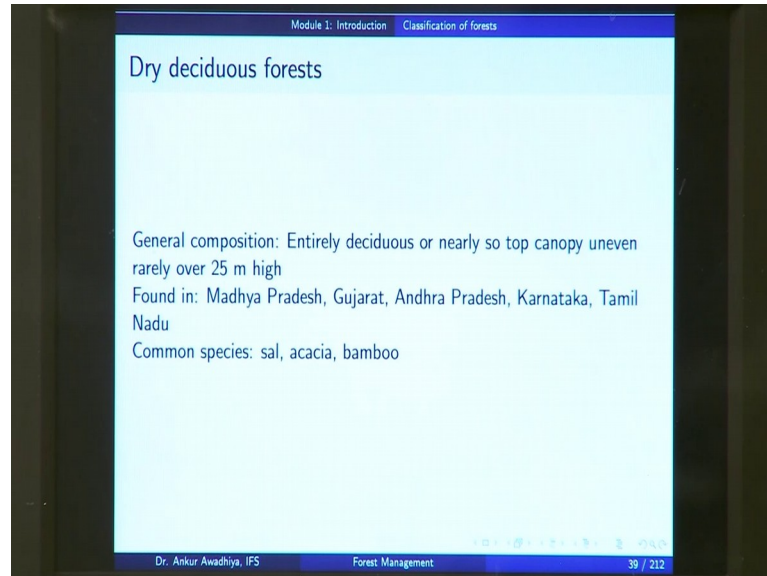
Next, we have a look at the dry deciduous forest. Now, dry deciduous forests will be entirely deciduous or nearly entirely deciduous, which would mean that the deciduous trees predominate, but then you also have some number of evergreen trees as well. The top canopy is uneven, which means that all these trees have different heights because of which you do not have a continuous canopy. And the height is rarely over 25 meters. So, the height is less these forests are found in Madhya Pradesh, Gujarat, Andhra Pradesh Karnataka and Tamil Nadu. And, common species include sal, acacia, and bamboo.

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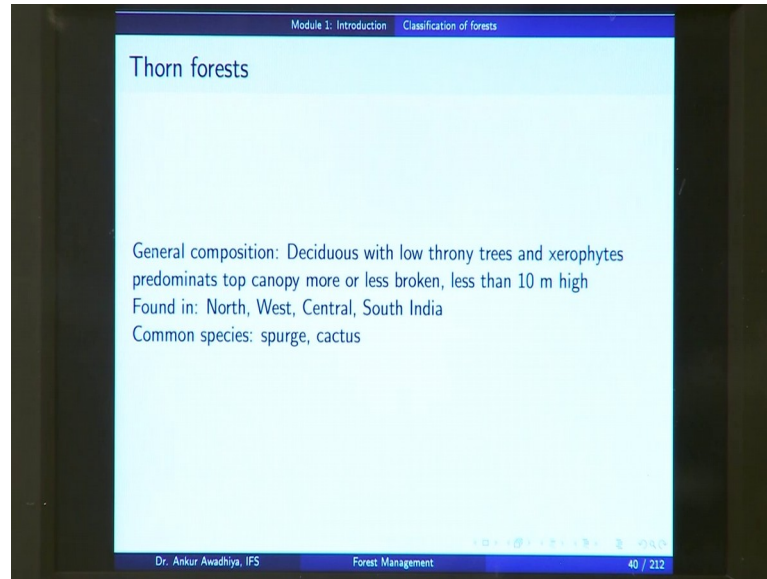
Next, we will look at thorn forest. Now, thorn forest will be found in extremely dry areas. These are generally deciduous with low thorny trees and xerophytes. Now, 'xero' is 'dry', 'phyte' is a 'vegetation'. So, this is a vegetation that grows in dry areas. So, the predominant species are some deciduous trees which will shed their leaves in certain part of the year with low thorny trees and xerophytes, and the top canopy is more or less broken because you hardly have any canopy. You will have some scattered trees in the whole area, but for most of the region the sunlight will directly be able to reach the ground. And, the height is very less these are less than 10 meters in height. These are found in north, west, central and south India - any area where you have a dearth of water and high temperatures. The common species includes spurge and cactus.

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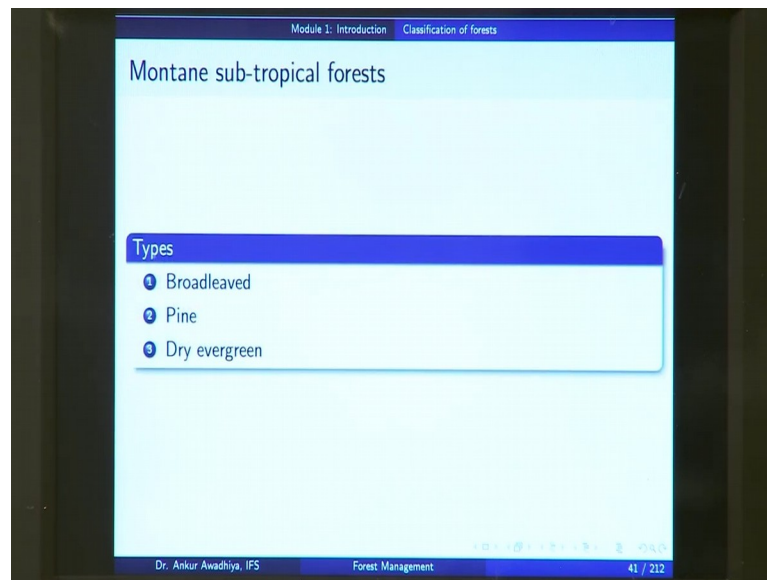
Next, we have a look at montane sub-tropical forests. Now, these forests are found in mountainous regions and in the sub-tropical regions. We have three different kinds of montane subtropical forests - you have broad leaved forests, you have pine forests, and you have the dry evergreen forests.

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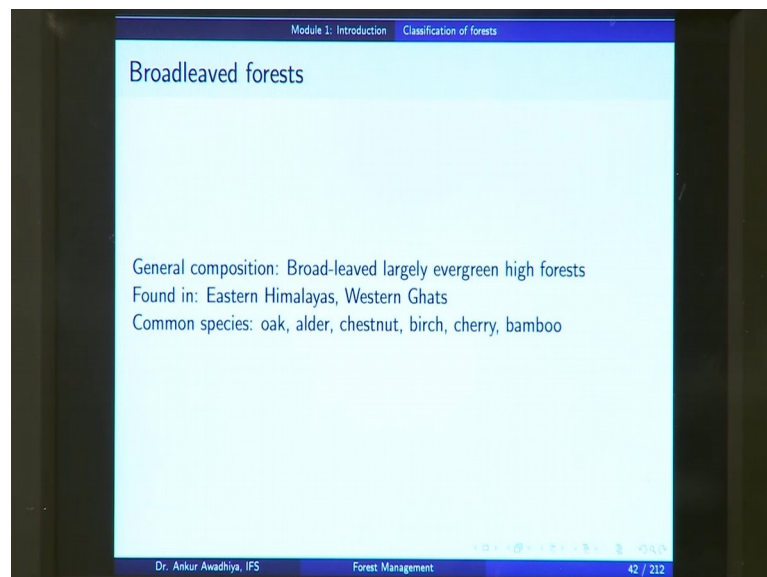
Now, broadleaved forests consist of those trees that have broad leaves. These are largely evergreen high forest found in Eastern Himalayas and the Western Ghats. And, the common species include oak, alder, chestnut, birch, cherry and bamboo. Now, these

broadleaved forests you will find it in Estern Himalayas and Western Ghats. So, both of these areas are hilly areas or mountainous areas, and near the foothills you will be finding these forests which have broad leaves, and the common species are oak, alder, chestnut and so on.

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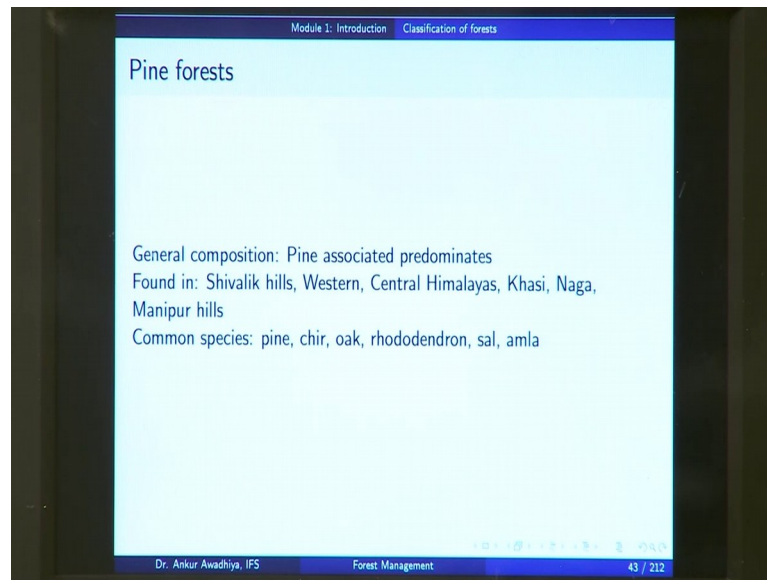
Next, we have pine forests. Now, these are again found in mountainous areas, but at greater heights as compared to the broadleaved forests. So, general composition is pine and the associates, which predominate in this area. Now, these are found in Shivalik hills, Western Central Himalayas, Khasi, Naga and Manipur hills, and the common species include pine, chir, oak, rhododendron, sal and amla.

Now, in the case of a pine tree, these are coniferous trees. They form cones and they have very needle like leaves. So, as against are a broad leaf forest that has broad leaves, here you have needle like leaves. And, pine and the associated species predominate in this region.
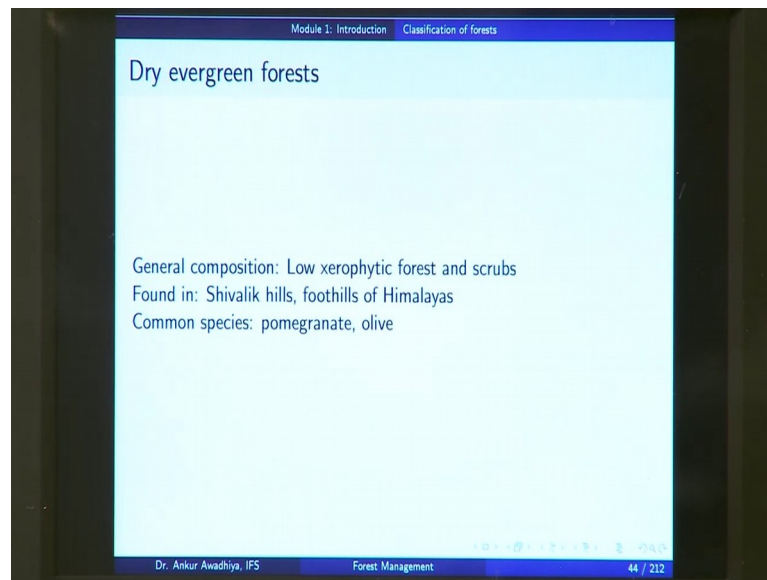
Next, you have dry evergreen forests. Now, these forests are found in drier areas, they are evergreen because they do not shed their leaves in any season of the year, and these are found in the mountainous areas. The general composition includes low xerophytic forests and scrub. So, xerophyte again is a vegetation that grows in dry areas. This is dry evergreen.

So, xerophytic forest, low forest the height is less. These are evergreen because mostly you have scrubs in this area. And, these are found in Shivalik hills and the foothills of Himalayas. The common species include pomegranate and olives.

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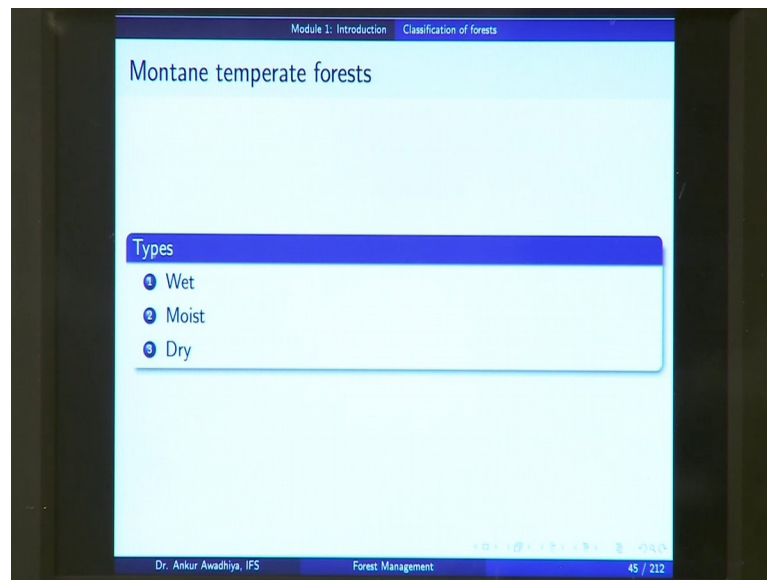
Next, we have montane temperate forests. So, these forests are found in mountainous areas - in temperate sort of conditions. So, these are neither very hot conditions nor very cold conditions. And, we have 3 different kinds - wet moist and dry. So, a wet forest will typically have an excess of rainfall, a moist forest has an adequate amount of rainfall, and a dry forest has a less amount of rainfall.

So, we are find we find these forests that are growing in mountainous areas - temperate climates neither very hot nor very cold, and depending on the rainfall you have either wet or you have moist or you have dry vegetation.
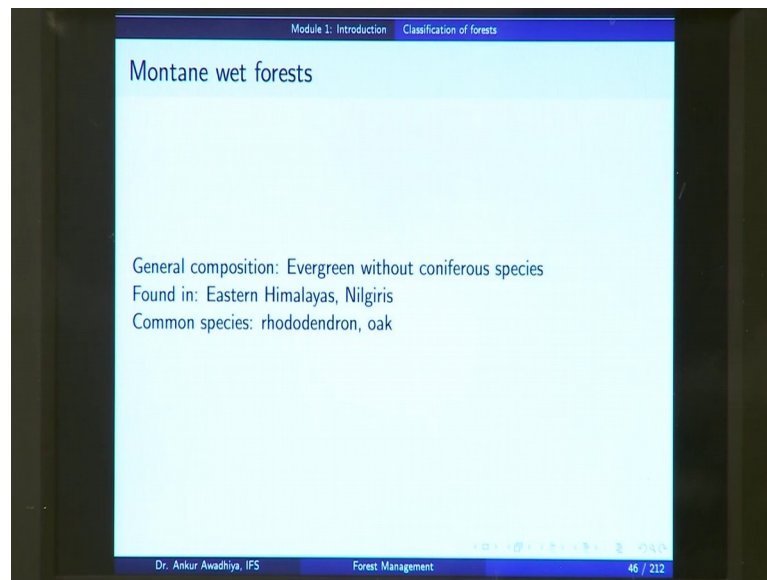
Now, in the case of montane wet forest, you have a general composition of evergreen without coniferous species. So, a montane wet forest, so it has evergreen because it does not have a cold climate. So, you do not find the coniferous species. And, these are found in Eastern Himalayas and Nilgiris, and the common species include rhododendron and oak.
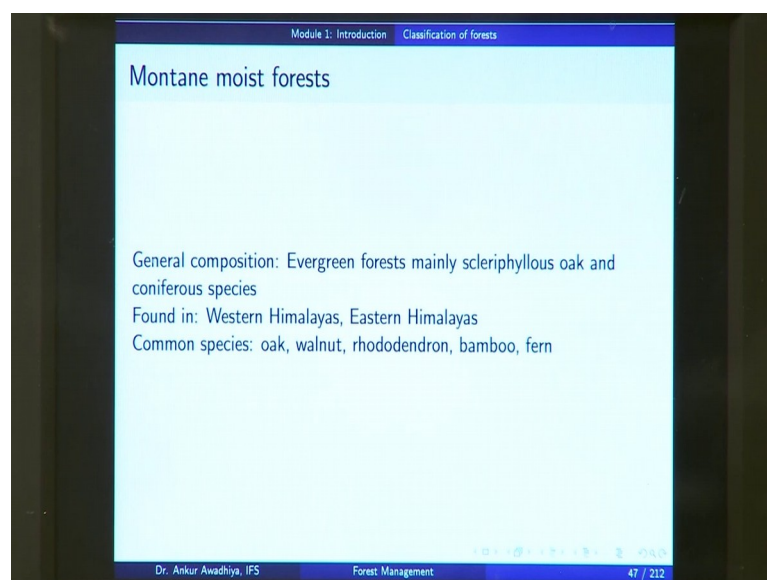
Next, we have montane moist forest. Now, these are found in mountainous regions, the amount of rainfall is limited. And here we have evergreen forests mainly scleriphyllous

oak and coniferous species. So, we are moving from an oak region to the coniferous region. These are found in Western Himalayas and Eastern Himalayas. And, the common species include oak, walnut, rhododendron, bamboos and ferns.

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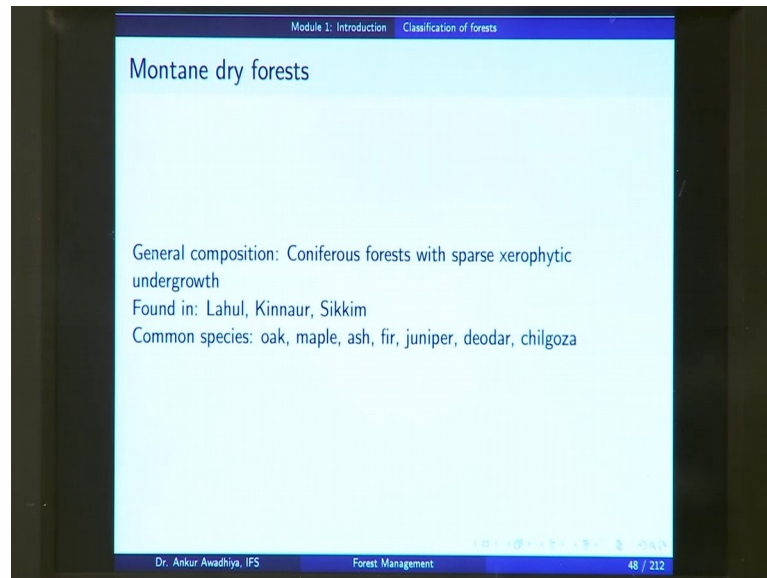
Next, we have montane dry forest. So, we are now looking at mountainous regions, but with less amount of rainfall, and the general composition is coniferous forest with sparse xerophytic undergrowth. So, the predominant vegetation is coniferous trees, but there are sparse number of xerophytic or dry undergrowth. So, commonly these are found in the Lahul region of Himachal Pradesh, Kinnaur and Sikkim. The common species include oak, maple, ash, fir, juniper, deodar and chilgoza.
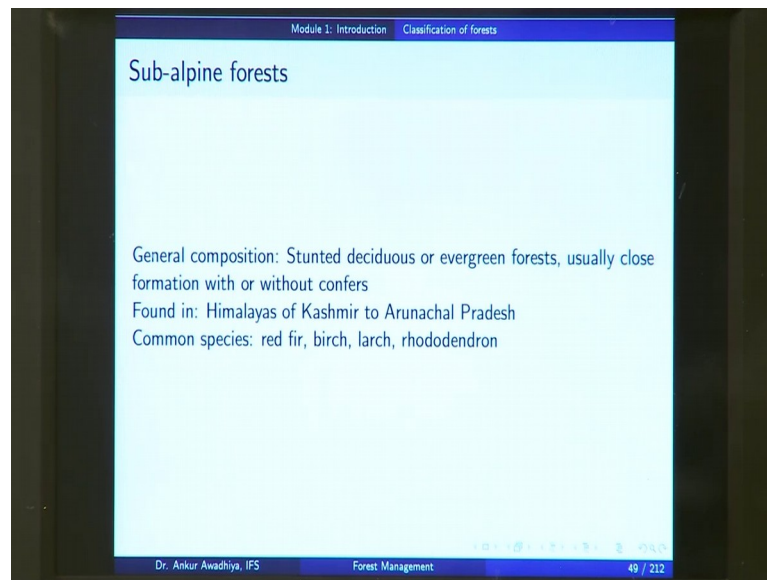
Next, we have sub-alpine forest. So, sub -means that these are moving towards very cold regions. The general composition is stunted deciduous or evergreen forests. Now, these are cold regions, because these are away from the equator; the amount of sunlight that is falling in this region is less, because of which these regions do not receive adequate warmth. And because, there is a less amount of energy that is available for the growth of plants.

So, you have stunted plants, and the sub-alpine forests can be deciduous or evergreen, and these are usually close formation with or without conifers. And, these are found in the Himalayas of Kashmir to Arunachal Pradesh. The common species include red fir, birch, larch and rhododendron. So, these are the sub-alpine forests.
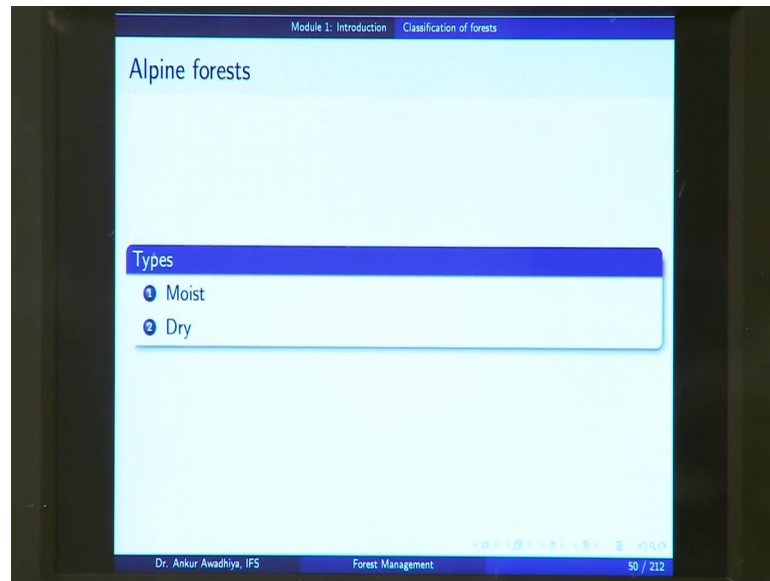
Next, we have a look at the alpine forests. So, alpine forests are those forests that are found in very cold areas. And, we have 2 different kinds of alpine forests - moist and dry. So, when we talk about an alpine forest typically these are the areas that are very cold; they receive very less amount of sunlight. Because of which, the growth will be less there is less amount of energy that is available, and depending on the amount of rainfall, you can have moist alpine forests or dry alpine forests.
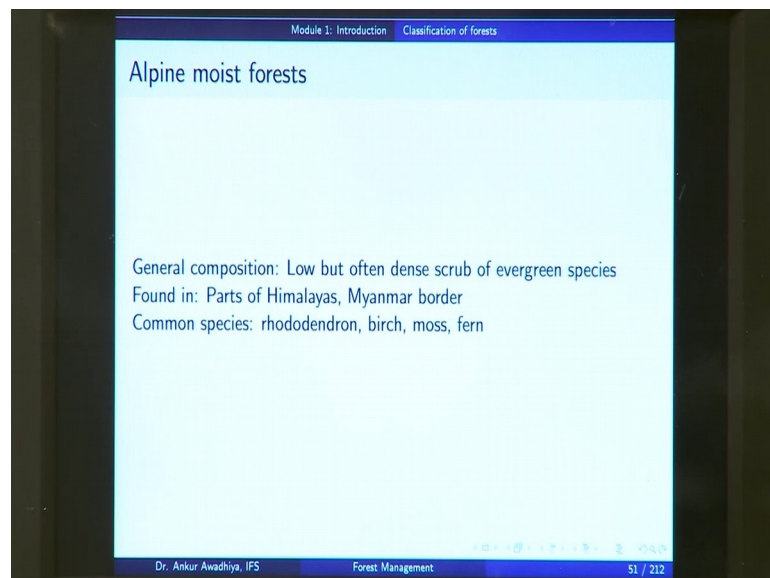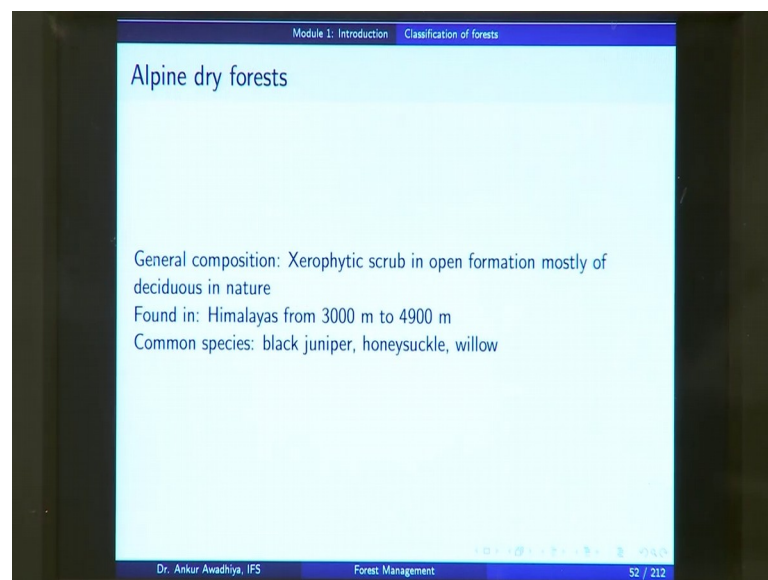
Now, alpine moist forests - the general composition is low, but often dense scrub of evergreen species. So, you have adequate amount of rainfall, but because the amount of sunlight is less. So, you have low forests, because of excess of rainfall - you have dense scrub mostly of evergreen species, because you have adequate amount of moisture. So, there is no need to conserve moisture.

So, there is no deciduous species, it is predominantly evergreen species. These are found in parts of Himalayas and the Myanmar border. The common species you will find in this area is rhododendron, birch, moss and fern.
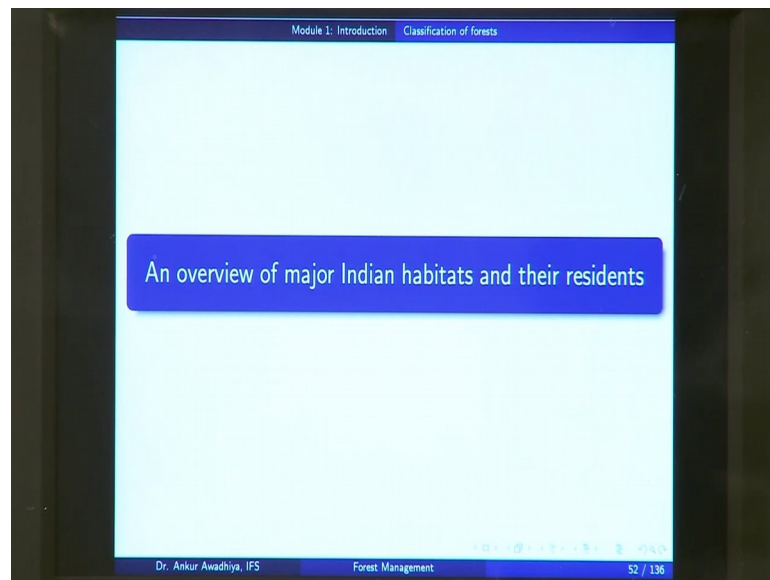
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Next, we have a look at the alpine dry forests. So, these again belong to very cold areas - the moisture is less. So, the general composition, because the moisture is less, you will find xerophytic scrub. So, xerophytic – 'xeros' is 'dry' – 'phytic' is 'plants'. So, these are plants that grow in dry areas.

So, because these are dry forests, so we find xerophytic scrub. These are found in open formation, which means that you will find them in patches and they do not cover the whole area. And, these are found in open formation mostly of deciduous in nature because they want to conserve the moisture. So, the plants are deciduous in nature. They are found in the Himalayas from 3000 meters to 4900 meters, and the common species are black juniper, honeysuckle, and willow. So, how do these forests actually look like?

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So, let us have an overview of the major Indian habitats and their residents.
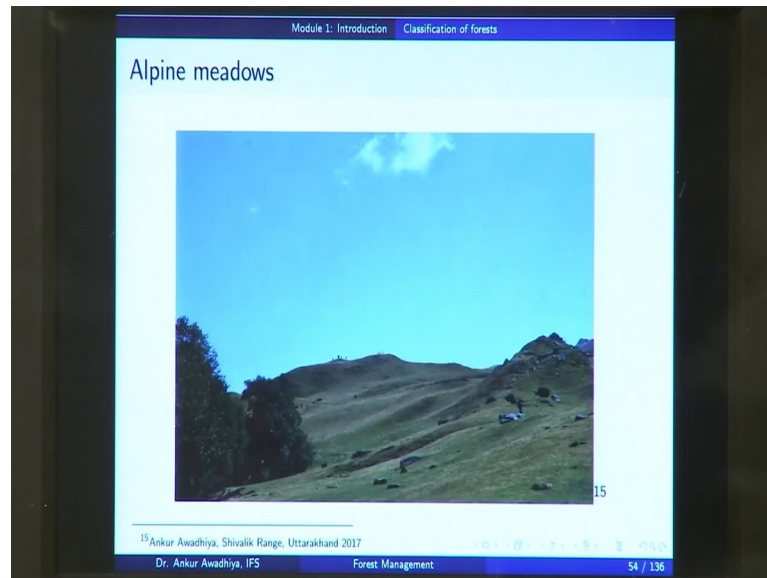
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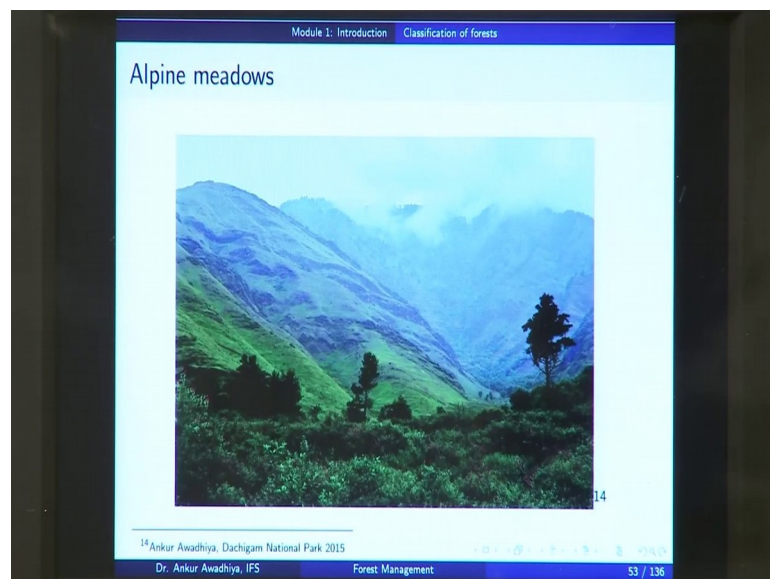
So, we will begin with the alpine meadows. So, alpine meadows - this picture is from Dachigam National Park in Jammu and Kashmir. So, this area is a very cold area, you have fast winds that are moving here, and the low height is because of less amount of sunlight that is reaching into this area, but and also because of the high wind speeds.

So, this is an adaptation of the vegetation, because if you have a greater height the amount of wind pressure that you will have to a bear is will be much more and so, the

plants are much less in height. And, here you can see that you have some shrubs there are a few scattered trees, and mostly it is grasses. So, this is what an alpine meadows looks like.

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This is another alpine meadow from the Shivalik range of Uttarakhand. Here again you can see that mostly it is grasses and some other stunted vegetation.

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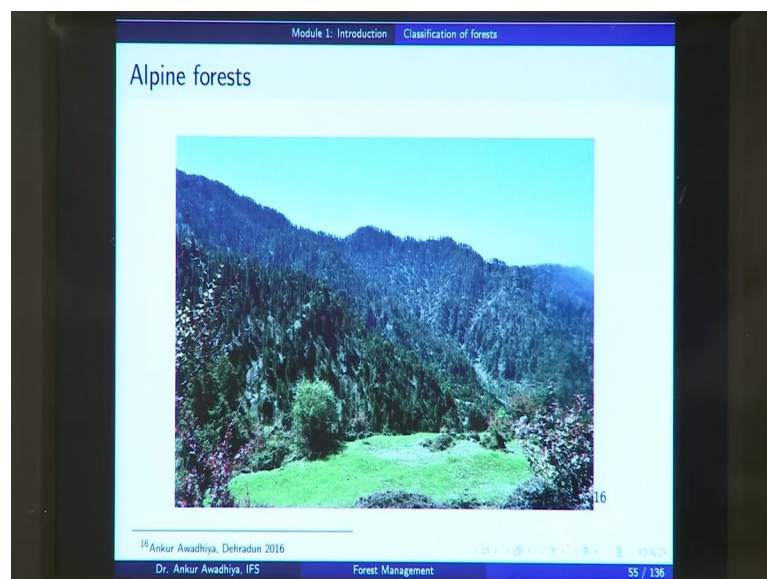
Now, if we have a look at the alpine forest, here, we find that you have some grasses, but mostly you will also see the coniferous trees. So, this picture is taken from Dehradun forest and this is an alpine forest.

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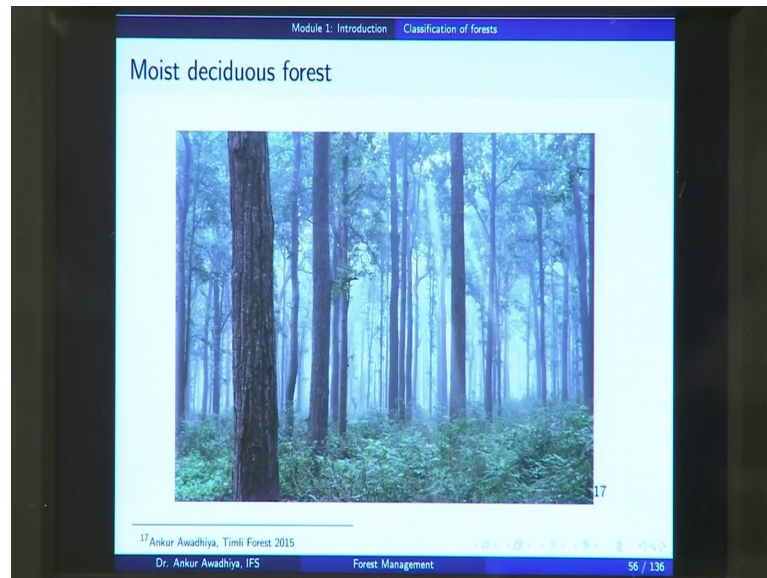
This is what a moist deciduous forest will look like. So, this picture is taken from Timli which is very close to Dehradun. And, in this picture what we can see is that there are very tall sal trees. So, because you have excess amount of moisture available so, it can support a very dense vegetation. So, you can see that these trees are very close by. There is also a very good cover on the ground.

So, the forest floor is also completely covered, and these are moist deciduous forests which means that they have moisture, but they have these deciduous trees, which shed their leaves in some season of the year. And, this shedding of leaves is primarily either to conserve moisture, or secondly to protect themselves from the very low temperatures and snowfall.
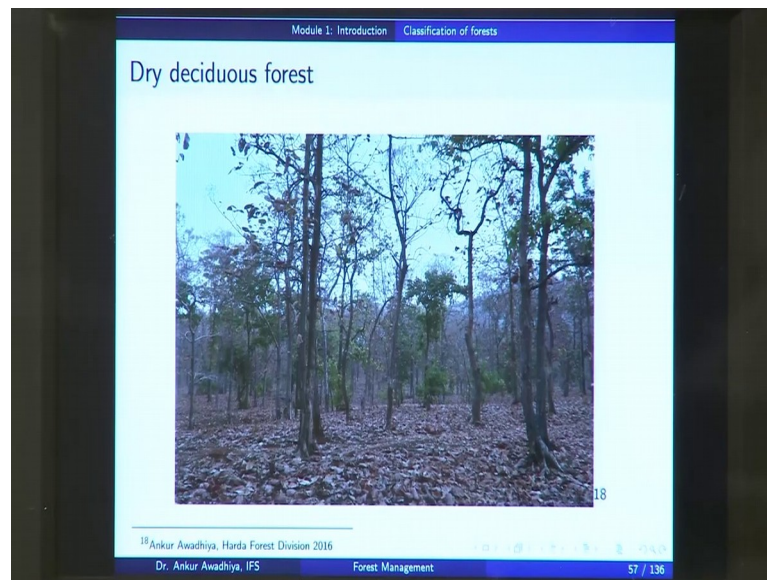
Next, we have a look at the dry deciduous forests. So, this picture is taken from Harda forest division of Madhya Pradesh. And, here you can see that these are deciduous forests, because of which you are not seeing these the leaves on these trees. These are all teak trees, and the ground cover you can see that it is devoid, mostly devoid of vegetation, but the leaves that have fallen from the trees have covered the ground. So, this is a dry deciduous forest.

Now, let us look at how a scrub forest looks like. This image is taken from Ranthambore National Park, and here you can see that this is a scrub forest. So, you will find that there are some grasses. There are some shrubs, and there are some thorny trees, but more or less you can see that this is a very open sort of a forest. You can see for a very long distance and the amount of vegetation is less.

And the amount of vegetation is less, because you have a lack of moisture in this area. Even though you have ample amount of sunshine, but the amount of moisture that you get in these areas is less.

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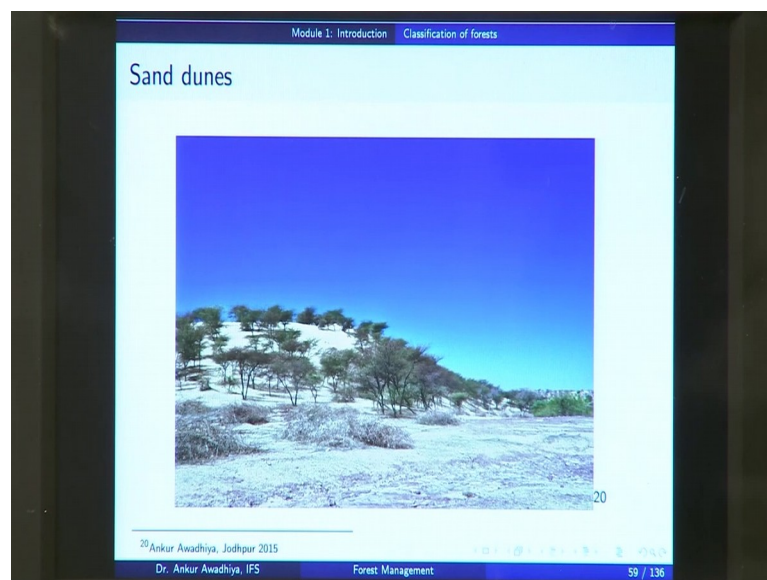
And, if the moisture reduces even further, you will have a condition of sand dunes. So, this picture from Jodhpur shows you that you have some grasses, and this is a big sand dune. These trees were later on planted these are an exotic species to stabilize the sand dune. So, that it does not move, but more or less you can see that you will find sand, you will find grasses, then you will find some thorny vegetation.

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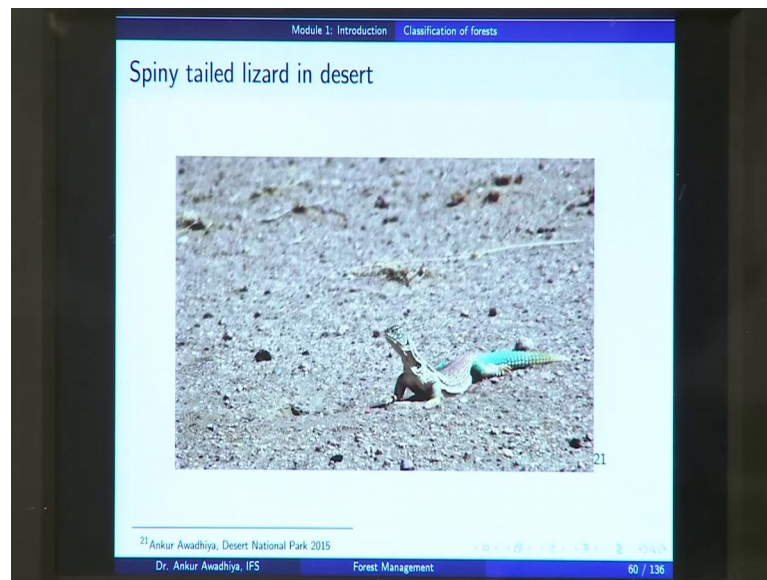
Now, even these areas are home to a number of animals such as this is spiny tailed lizard which you can find in the Desert National Park.

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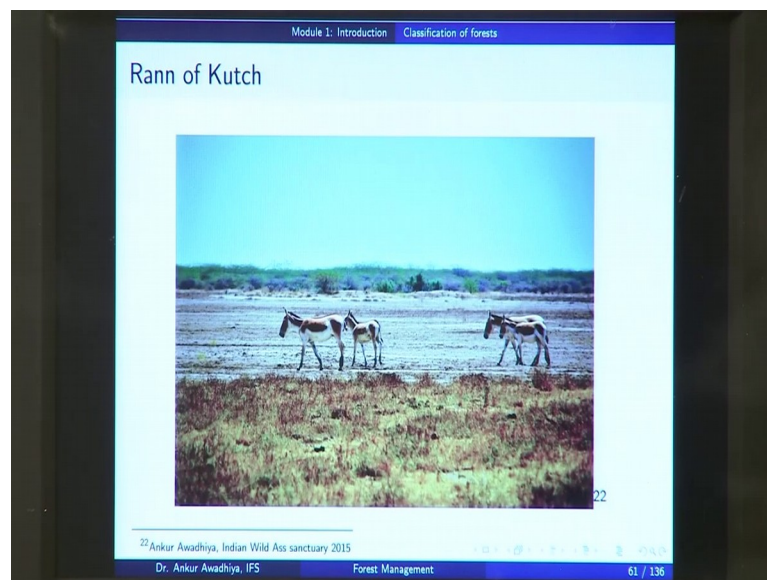
Now, another dry region of our country is the Runn of Kutch in Gujarat, and this image is from the Indian Wild Ass sanctuary. Here again you can find that it is a very plain sort of an area with some grasses, some thorny trees, and this again is a very open sort of a forest. So, here again you can see for a very long distance, here again, because of the dryness you have a dearth of vegetation.

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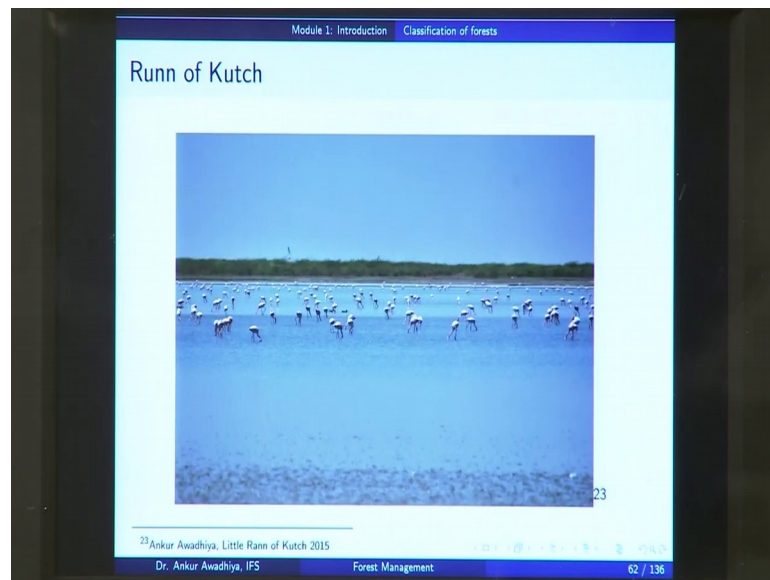
But in some locations where you have water, you will find that the vegetation will be a bit more. So, this is what we had touched upon, when we were discussing that; what are the factors which permit some plants to be in any area. So, this picture is from the little Runn of Kutch.
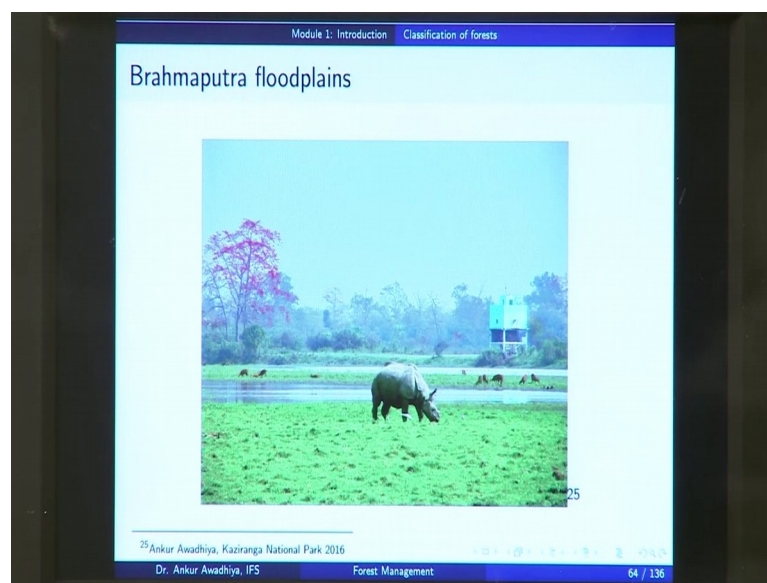
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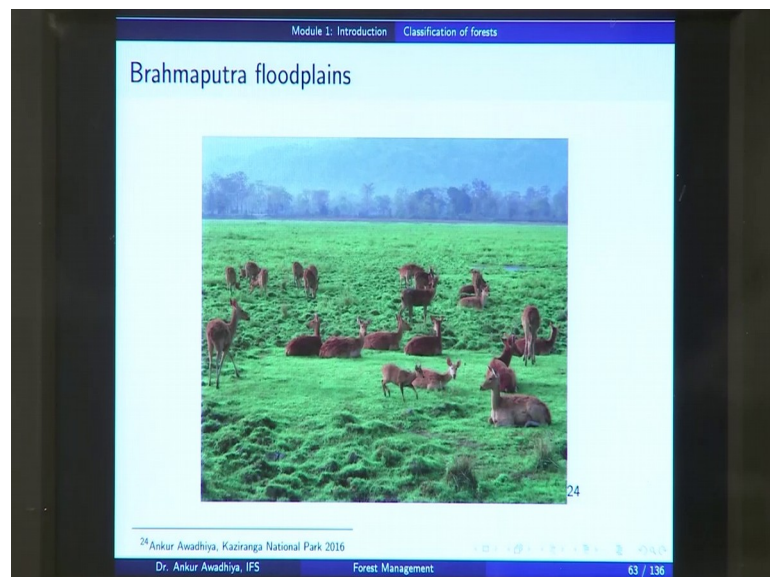
Now, if you move towards the northeast of the country, then you will find these Brahmaputra Floodplains. And in these floodplains; because you have water that is flooding this area every year, so, the trees die out, but because, you have water you have

sunshine, so grass has come up very quickly, and so, this whole area is covered with grasses. In those areas where you do not have floods, you can find, that you have trees and these trees are in a very dense formation.

So, there is a profuse growth of vegetation, and you are not able to see to a very far distance because there will be some vegetation that will obstruct your view. But this in this floodplains, because of the floods, are your trees die out, and you can see the grasses.

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This is another image from the Kaziranga National Park, here again you can see that where do you have water you will find these grasses, and after that there will be a very thick vegetation.
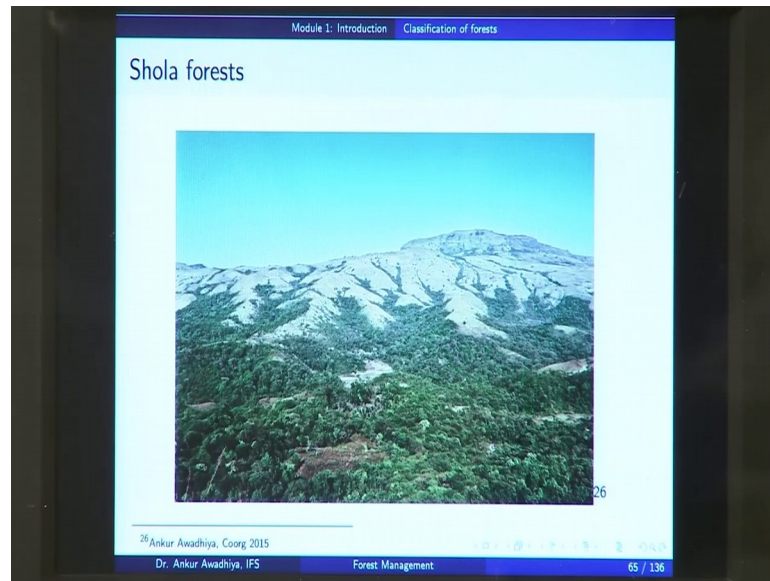
Now, if we look at a bit drier region of the country like in Karnataka and Tamil Nadu, you will find Shola forests. Now in the case of Shola forest, there is an equilibrium between the grasses and the taller trees. Now, in the case of Shola forest; the grasses and the trees compete with each other and both of them keep each other, within limits. So, this picture is from Coorg.
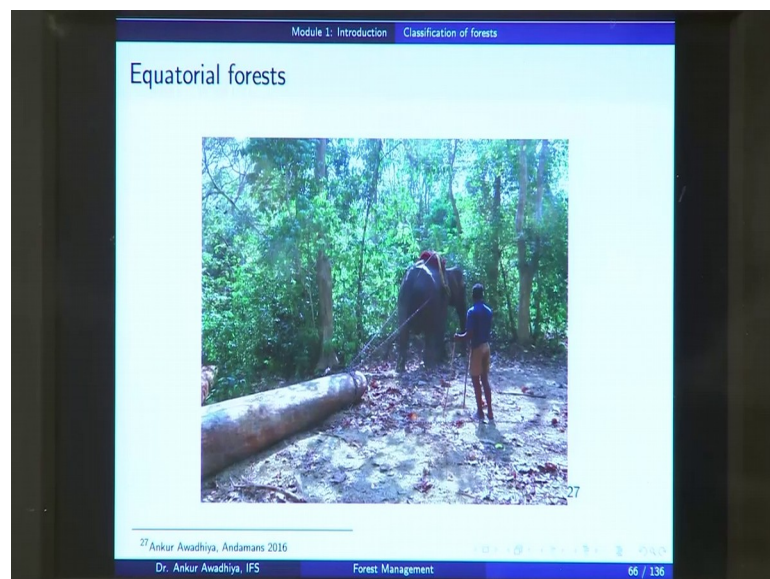
Now, if we have a look at the equatorial forest like this forests in the Andamans, here you can see that the vegetation is very dense. So, you cannot cross these forests easily

without cutting the trees. The trees are of a very great height. So, like you are using this elephant and you can see that the size of this log is very much.

So, in the equatorial forest; because you have abundance of water, because you have abundance of sunshine, so, there is a profuse growth and in these forests you will find that not only do you have a very dense canopy, but you also have a very good emergent layer, you also have the very good understory, and also the forest floor is covered with thick vegetation - especially herbs and shrubs.

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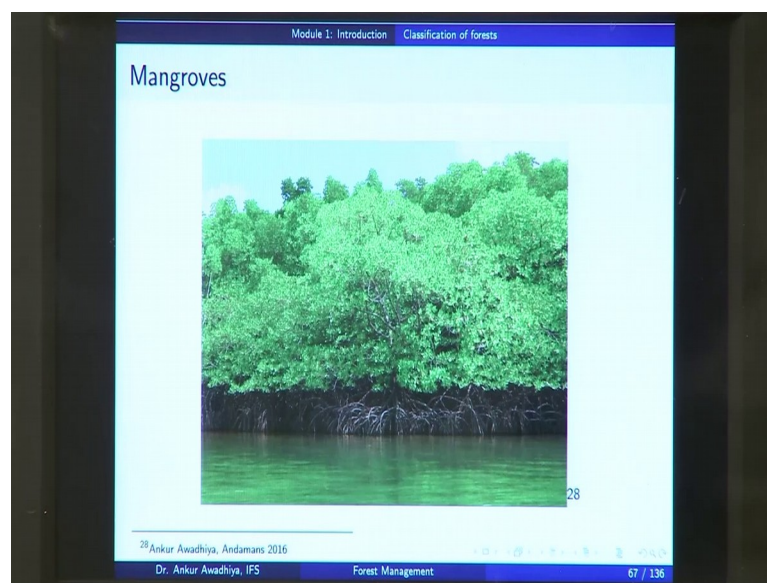

And if you move to the coast of the country such as this coast in the Andamans, you will find mangroves. So, this is an example of littoral vegetation, and in these mangroves, you can see that these roots are of such a manner that they are able to keep the plant above the water. And, these roots also have pneumatophores, which are adaptations in which your roots will move like this.

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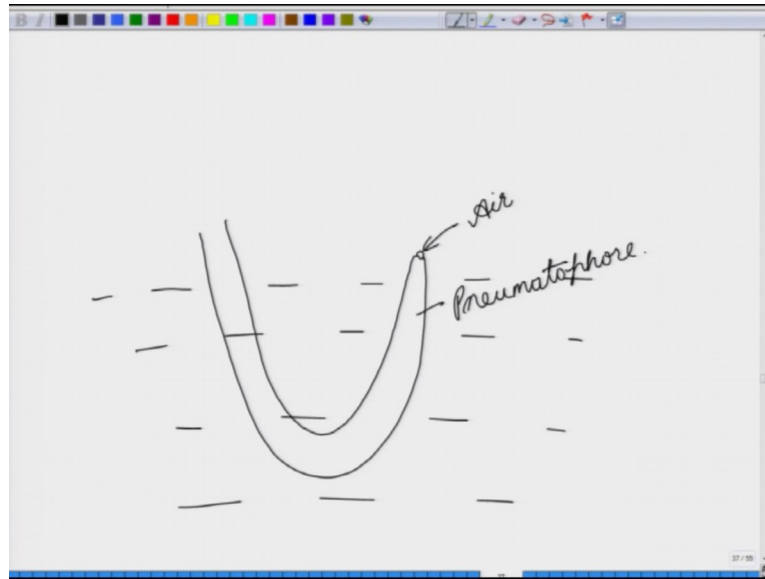
And, there will be a hole for air. And so, this is a pneumatophore, and this is your water level. These plants also show some other adaptations, for instance, these plants show vivipary.

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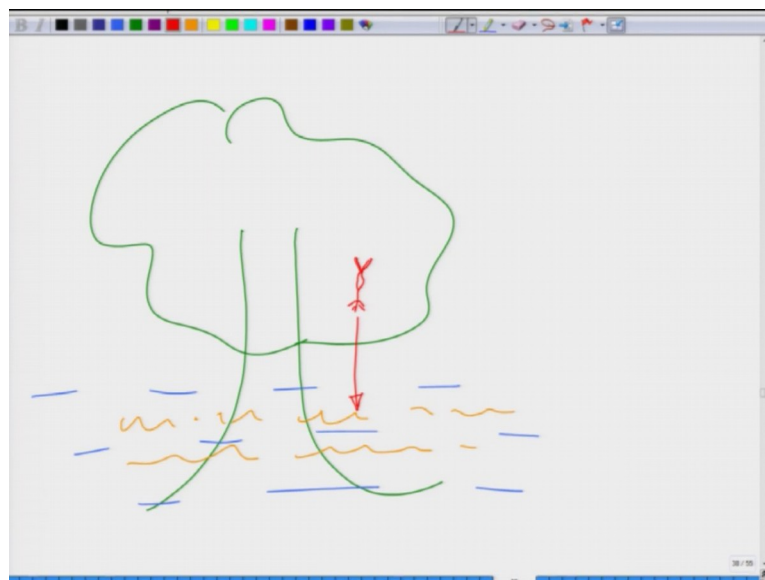
Which means that - if you look at a mangrove plant, and suppose this is the water level. So, the seeds that come up, they germinate in the on the plant itself. So, they will start showing up the roots. They will start giving out leaves, and once you have these plants, these seeds that have germinated, once your tide is at a lower level. So, when you have

this muddy, sort of muddy and sandy soil that is exposed. At that time, these germinated seedlings will drop down. So, that they do not get into the water, but they fall on the land.

And, because germination is very difficult inside water, and so, these plants germinate their seeds while they are on the plant, on the mother tree itself, and then the whole germinated seed falls down. So, these are the kind of adaptations that you will see in the case of mangroves. Now, all of these vegetations have their own characteristics and they also support a number of specific organisms that are found in these areas.

So, for instance, if you look at these mangroves, these form a very good habitat for fishes and also for crocodiles. Now, fishes use these roots as their nurseries, because if a fish lays is its eggs inside these roots, then the roots protect the young ones from their predators, because the predators are not able to enter inside. And in the case of crocodiles, they use these roots to tear off flesh when they catch hold of a prey, because the crocodiles are not able to chew their food, they have to tear it apart.

So, if you do not have any other place where to hang your flesh, in that case, the crocodiles will use these roots. They will hang there they prey inside these roots, and then they will try to tear it off. So, if you do not have mangroves, you will probably not have several species of fishes, you will probably not have the crocodiles here. So, the vegetation and the animals that are found in any area are very much correlated with each other.

So, in this lecture, we had a look at the different kinds of forests that we have in our country. We looked at the classification of forests. We saw that how temperature and the rain fall, determined to a very large extent, what will be the kind of vegetation that we will find in different areas. And, these different vegetation in turn support other organisms, and thus the biodiversity of that area.

So, the biodiversity that you will find, in say Rajasthan, will be very different from the biodiversity that you will find in the Himalayas, or the biodiversity that you will find in the coastal regions - that being said when we are doing silviculture, it is important to understand that all of these biodiversities have their own importance. So, if you come up with a proposal, say that, in the case of Rajasthan, you should clear up the vegetation.

You should put in water, and you should grow those trees that are found in say Central India, then that would not be a very good proposition. Because, the plants that you are growing in those areas one they will require an excess amount of moisture, which you will have to bring from outside, which is cost intensive, but at the same time, it cannot be done without a loss of biodiversity. So, that is all for today.

Thank you for your attention [FL].