Wildlife Ecology
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Lecture – 19
Biogeography: Analysis of geographic distributions

[FL]. Today we begin a new module which is distribution and abundance. So, this module will have 3 lectures.

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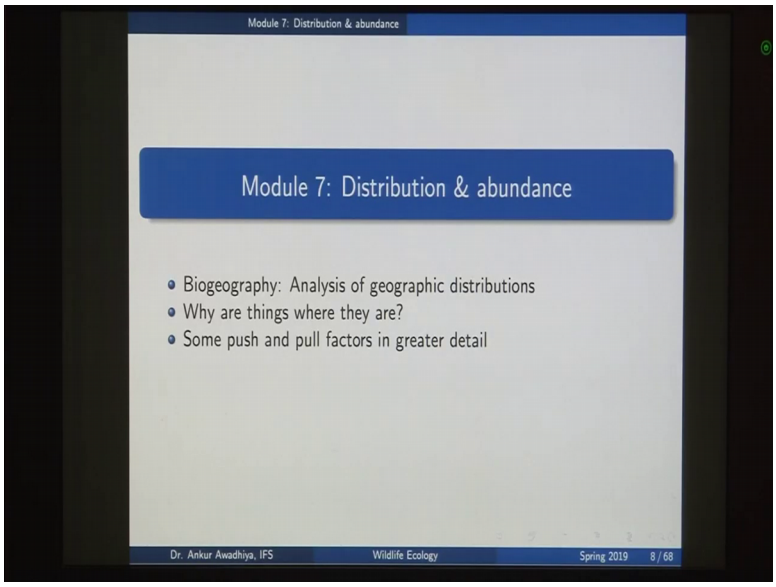

The first one is biogeography which is the analysis of geographic distributions. So, biogeography is the field of ecology that asks the questions, why are things where they are? And we look at this topic in more detail in the second lecture which is why are things, where they are?

So, here we will ask if there is a species that is found in a certain area. So, why is that species only found in that area, what is constraining the range of that species, why is it not found anywhere else and the answer to that is some push factors and some pull factors.

So, push factors are those factors that are pushing that species away from other areas and pull factors are those factors that are attracting the species to that particular area. So, every species tries to remain in an area or can or this is best able to survive in those areas

that have the most suitable climatic conditions most suitable biotic conditions for the survival of that particular species. So, which is why we get a certain geographic distribution for every species and this is what is asked in the topic of biogeography.

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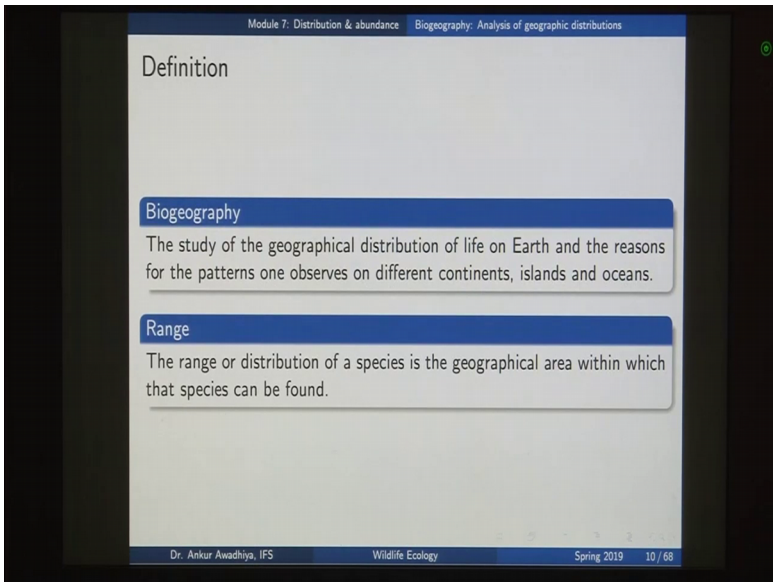

So, let us begin biogeography is the study of the geographical distribution of life on earth and the reasons for the patterns one observes on different continents islands and oceans. So, essentially it is asking why are certain species found in certain areas and it also asks it tries to document which species are found in which areas.

So, it is the study of the geographical distribution of life on earth. So, that is a cataloguing of different species in different areas and the reasons. So, not only do you catalog, but you also ask why what is the reason behind such a particular geographical distribution. So and the reasons for the patterns one observes on different continents, islands, and oceans.

Now depending on which particular areas you are concentrating on there are further subdivisions or biogeography such as island biogeography that asks the question how do species come into an island? How many species will there be in any particular island? What would that depend on? Does it depend on the structural diversity of the habitats that is therein on the island? Does it also depend on the size of the island and so on.

Similarly, you can have oceanic biogeography we shall ask the question what are the species in the oceans that are found near the continents, what are the species that I found away from the continents, what are the species that are found in the upper layers of water? What are the species that are found in the seabed, what are the species that are found in the column of water and so on? So, you can have different sub disciplines of biogeography in the term in the form of continental biogeography, island biogeography, oceanic biogeography and so on.

Now, when we are asking which species is found in this area the other scientific term that comes into picture is the range; the range is the distribution of the species. So, the range or distribution of a species is the geographical area within which that particular species can be found. Now when we are asking this question which species is found in which areas and how are these different areas different from each other, it makes sense to have an understanding of different kinds of habitats that exist on this planet.

Or at least the kinds of habitats that we have in India, because India itself is a very varied country by geographically and so, we have different kinds of habitats, we have very high mountains, we have deserts, we have the oceans, we have different kinds of forests, we have grasslands and so on.

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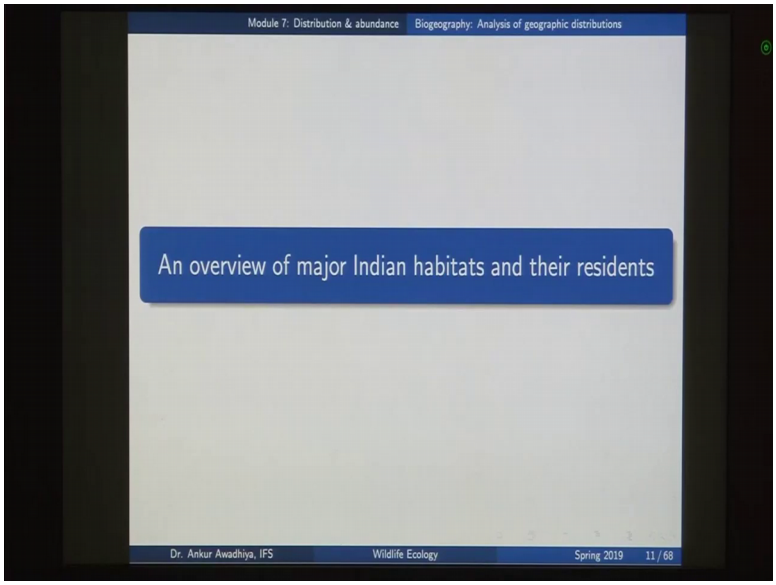

So, now we will have a look at some major Indian habitats and their residents.

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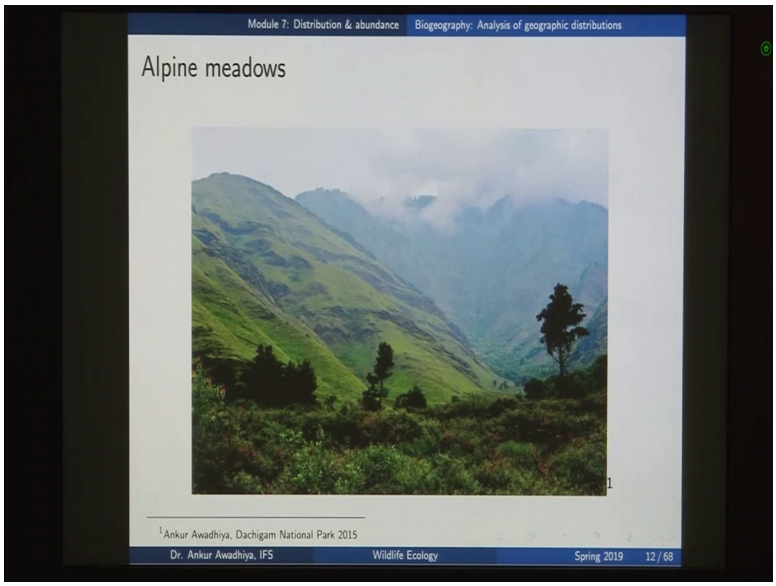

Let us begin with the Alpine meadows. Now, alpine is a term that refers to the mountains. So, this is a meadow meadows is the grassland. So, this is a grassland that is found in the mountains and a good example is the Dachigam National Park which is there in Srinagar. Now in the case of Dachigam National park here you can observe that you have these hills and these hills have these meadows or the grasslands. Now a place like Srinagar is having an extremely cold climate and that is the climate that is therein and Dachigam hill.

So, climatically we can seen that these areas that have the alpine meadows they have a cool or a cold climate. Typically they are at a great height because you have mountains, so you have hills here, typically if you talk about the wind speeds, the wind speeds will be very high because this is a mountainous area. In a mountainous area you have winds in the daytime you also have winds in the night time. Now if you look at a hill.

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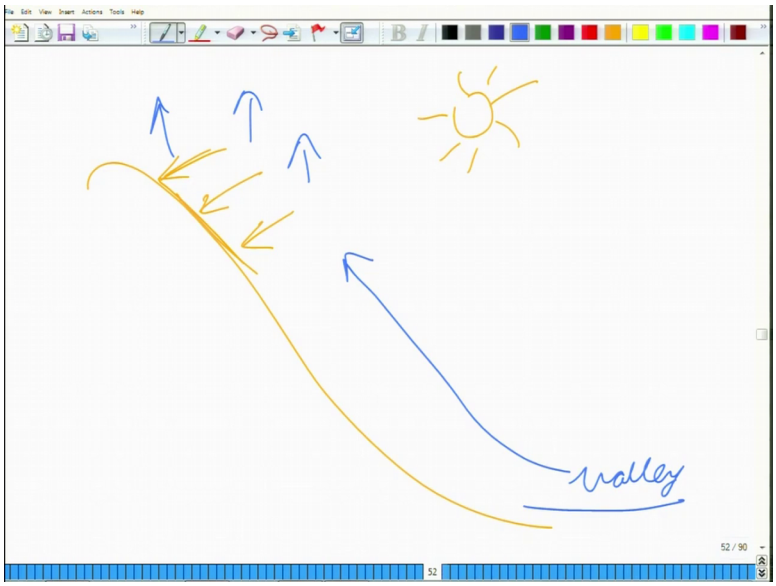

So, let us consider a hill and if you have the sun here, now in the daytime what happens is, this particular area it preferentially gets heated because of the sun rays so, this area becomes warmer. Now when this area becomes formal the air around it also becomes warmer and it starts rising, now when it starts rising the cold air that is there in the valley. So, here you have the valley and the cold air that is there in the valley it will start rising upwards to fill up the gap. So, this is the kind of wind pattern that we will observe in the daytime and this is known as a valley breeze.

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Now, in the night time so in the night time when you have them when do not have the sun. So, now, what happens is the valley area because it is sort of secluded from both the sides. So, here the air remains as such whereas, the hill areas or the top areas they are able to lose out the radiation very fast. So, they are able to lose out the heat, now when that happens, the air here becomes cooler. So, here you have a cooler air and the cooler air is more denser and so, this air now starts flowing towards the valley, now this wind is known as a hill wind.

Now in the case of these alpine meadows not only do they have a cold climate, but at the same time they also have a very high wind speed. Now at the same time we can talk about the soil characteristics that we have in these areas. So, typically the soils here will not be very fertile, why because they have been in this particular state for say thousands of years.

And whenever there is a rainfall so all the minerals that are there on the top layer of the soil and they will start dissolving in the rainwater and they will start moving down slope. So, they will reach into the streams and then they will reach into the rivers and ultimately they will get drained into the seas.

So, these areas are typically not very fertile. At the same time especially in the case of this particular area you have the rocks that are making these mountains and there is a continuous process of weathering that is going on and the process of weathering the rocks are getting broken into smaller fragments and they are ultimately making soil in these areas, now that soil with the rains it moves down exposing more rocks which ultimately makes more soil and so on.

So, this is a process that goes on, now if we are asking the question why are these particular species of grasses found in these areas we will have to make a correlation between the requirements of the species and the actual climatic conditions that we have in this area. So, it is possible that the grasses that are growing here do not require a very high level of fertility and they are tolerant to high wind speeds and they are also tolerant to low temperatures. So, these are the kinds of correlations that will make in the case of biogeography.

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Now alpine meadows are found in Jammu and Kashmir. It days are also found in Uttarakhand and in a number of areas where you have hills and typically you will find that the species are more or less common between these areas.

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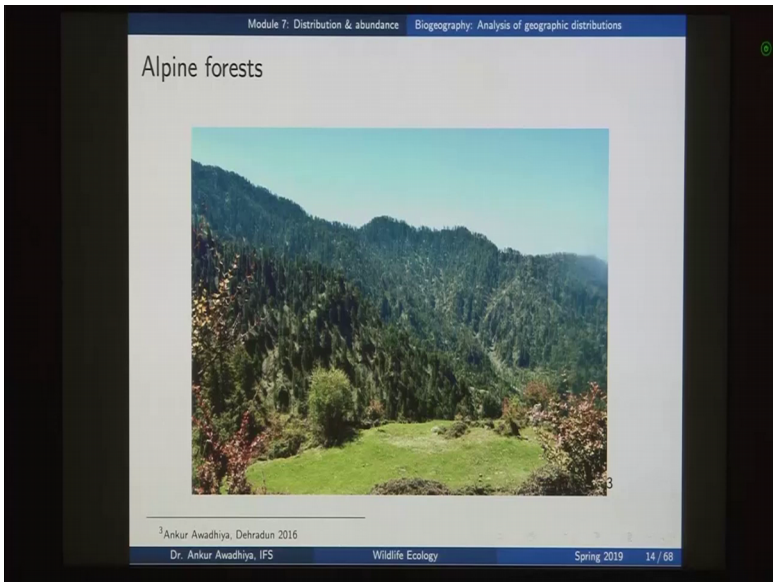

Now, another kind of habitat that we have is known as an Alpine forest, now again Alpine is a mountainous area. So, alpine forests are those forests that are found in the mountainous areas. Now typically you will find trees that are conifers trees and you will also find some broadleaf trees.

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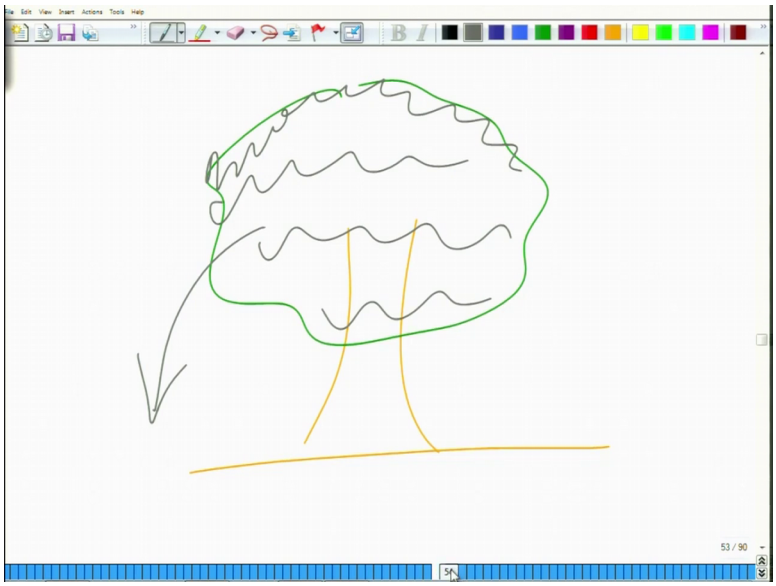

Now, in the case of these conifers trees you will have a structure that permits snow to fall down because and they will have a very specific shape of the tree. So, for instance if you have a tree like this and if there is a very heavy snowfall to all of this snow comes on these on the canopy of these trees which will make it extremely top heavy and that would facilitate the toppling of this particular tree.

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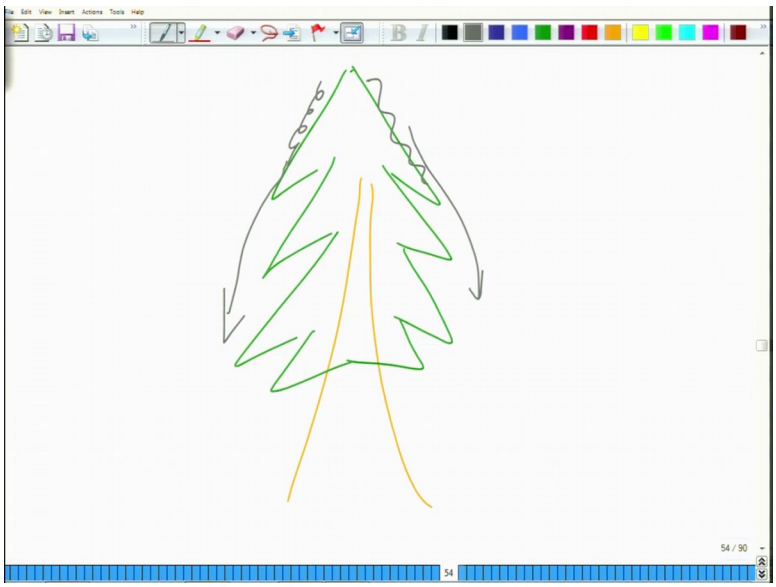

So, in the case of these areas typically you will find that the trees have a conical structure. Now this particular shape facilitates that if you have snowfall so this is

snowfall moves down to the ground. So, it is not able to activate very much on top of these trees and because of which these trees are able to withstand heavy snowfall is will.

Now in the case of Alpine forests we will find some of these conifers trees together with some associated species which would even be broad leaved species. Now when we are talking about these meadows and these forests there would also be very specific animal species that are found in these areas.

So, for instance in the case of Uttarakhand you will also find species like the pica, now pica is a very spawn mouse species that is only found on this area. Now these are the alpine forests and then if you move southwards with each the moist deciduous forests.

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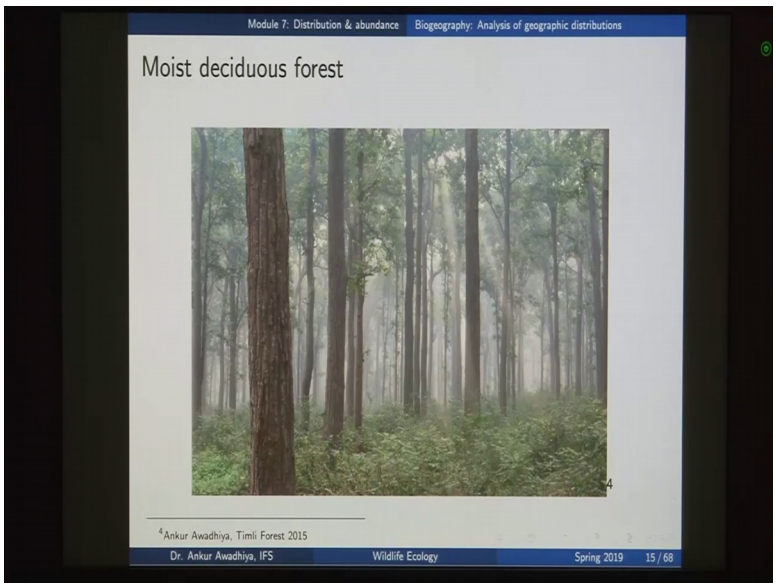

Now, these are again the deciduous forests that are found in Uttarakhand now when we say deciduous, now deciduous forest is a forest type in which the trees have this adaptation that they shed their leaves in a particular season. Now you could have trees that shed their leaves in the summer season in certain areas.

So, when trees are shedding their leaves in the summer season the main reason is that they want to conserve water, because in the summer season it is typically the pinch period for water and water is lost from the leaves through the process of transpiration. So, if you lose out all your leaves so it so the amount of water that you will be losing out every day becomes less. On the other hand there could be some other species that shed

their leaves in the spring season, in those cases at these trees typically store their waste materials into their leaves and then they shed their leaves so that the waste materials are gotten rid off.

So, these are the kinds of adaptations that we will find in these areas. Now typically in a moist deciduous forest you will find a very heavy brown cover now these are the moist deciduous forests so for Uttarakhand. If you talk about the climatic conditions here the climatic conditions will not be that extreme it is not very cold, but then it is cooled plus in these areas you have ample amount of moisture available throughout the year and the wind speeds are not very high plus the amount of solar insulation that you get in this area is also not very high because typically these areas are on a higher latitudes.

So, these would be the characteristics of the terrain of this area or the characteristics of this particular region. The soil typically again is not very fertile, but and all of these trees like these are the Sal trees that are found in this area and these trees are adapted to these conditions. Now in the case of biogeography when we ask the question why are Sal trees found in these particular areas that is because a Sal requires these conditions. So, it requires ample amount of moisture, it cannot tolerate a very heavy cold and it does not require a very fertile soil. So, this is why we can say that Sal is found in this particular area.

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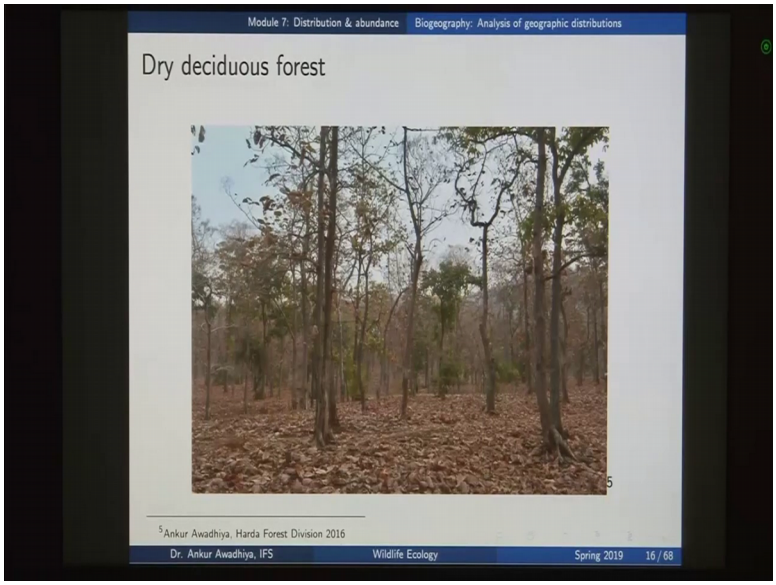

Now, in certain at the areas will find dry deciduous forests, now again this is a deciduous forest because it is shading it is leaves. Now in the case of a dry deciduous forest you will have typically less amount of moisture that is available to the plants and a good example of a dry deciduous forest is a teak forest. So, teak forest is something that you will find extensively in the case of Madhya Pradesh, Chhattisgarh, Maharashtra, Gujarat.

And in the case of teak forest these forests shed their leaves right before the summer season. So, that they are able to conserve moisture and they are found in these areas because they are able to tolerate quite a heavy amount of draught in these areas.

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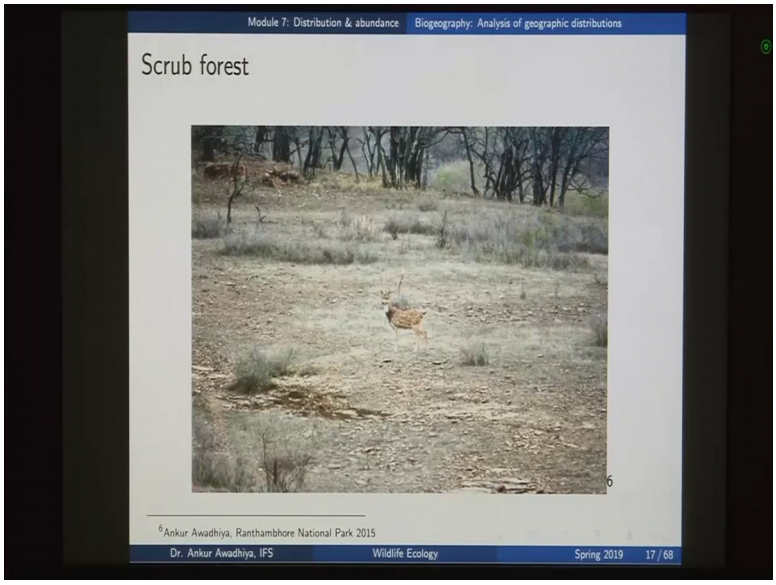

Now moving westwards in our country we have the scrub forests, now a scrub forest is you can typically find a scrub forest and Rajasthan or Gujarat. And in the case of a scrub forest you will have such a situation that the land is exposed in a number of areas plus you have these small shrubs in the area typically these shrubs are very thorny shrubs.

So, here again you have a very low amount of moisture that is available to the plants and the plants also show adaptations to conserve this moisture. So, there would be a number of plants that would have reduced their leaves into the spines or the thorns. Now when you have a leaf that is converted into a thorn so, it not only gives protection to the plant, but that is also an adaptation through which it is able to reduce the amount of water losses through transpiration.

Now, in these areas because you do not have very tall trees these areas have such low amounts of moisture that they are not able to support tall trees. So, typically the ground flora is exposed to a very heavy amount of solar radiation. So, the plants would be adapted to that as well so that you would find a number of species where the leaves are covered in a waxy coating not only to reduce the amount of moisture that is being lost, but also to reflect the solar radiation that is incident on these plants.

Now, when we talk about the animals of these areas, these areas do not support a very high density of animals typically because an amount of moisture is less and also you do not have ample amount of water that is available to the animals and green fodder is only available in certain seasons in trinity. Otherwise the animals have to make use of this dry folder or maybe some amounts of leaves that some animals can have access too.

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If you move further westward in the case of Jodhpur you will find these sand dunes, now we have moved from a scrub forest to a sand dune. Now a sand dune is typically a very dry area and these trees they have been imported and planted to stabilize the sand dune otherwise the sand dunes typically do not support a very large number of trees.

And the sand is very friable it moves from place to place and again here the amount of moisture that is available for so supporting life is very less and there would be very great amount of adaptations to severely constrain the amount of water that is being lost or to reduce the requirement of water per day.

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And in this case you will find very specialized species such as this spiny tailed lizard that is only found in this area. Now again if you ask this question why do you have this spiny tailed lizard in this area, the answer would be because this particular species is adapted to this area plus the conditions in this area are so hard that the predators of this particular species are not able to live in this area.

Otherwise, if you have a very heavy large number of predators in this area they would eat up the all the spiny tailed lizards that are found in this area. So, again you have this species because there are certain pull factors for it for this particular region. So, it is well adopted plus also it has a very less number of predators that are there in this area and also the other areas have push factors. So, other areas have conditions that this lizard is not comfortable with or the other areas has predators that would eat of this lizard. So, typically we find a distribution on this lizard more in this area.

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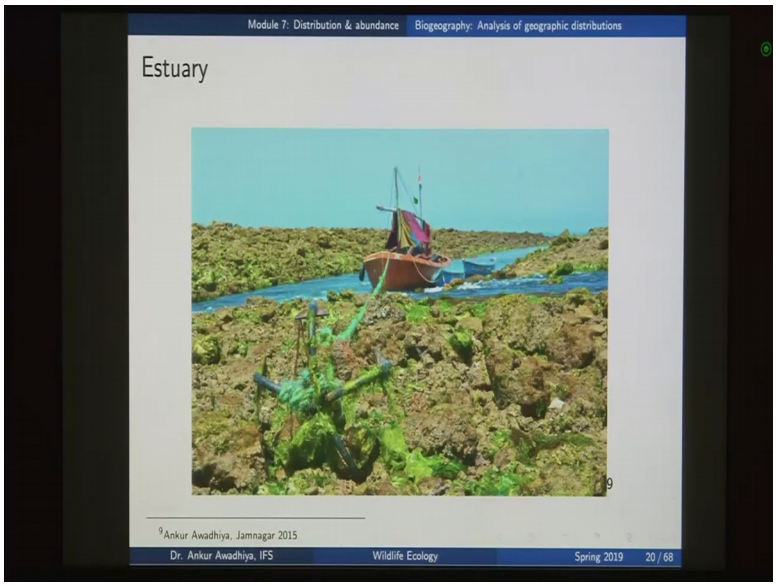

We also find Estuary's, now estuaries are very specialized habitats where you have a river that is coming and meeting the seas. So, you have a confluence of fresh water and the saline water, now here again the species that would be found would be those that are tolerant to both these levels of salinity. So, they can tolerate fresh water in and also they can tolerate the salty water plus there would be a number of species that will make use of all these 3 kinds of habitats that will be found in an estuary. So, when you have estuary so you have this river that is coming and it is meeting the ocean.

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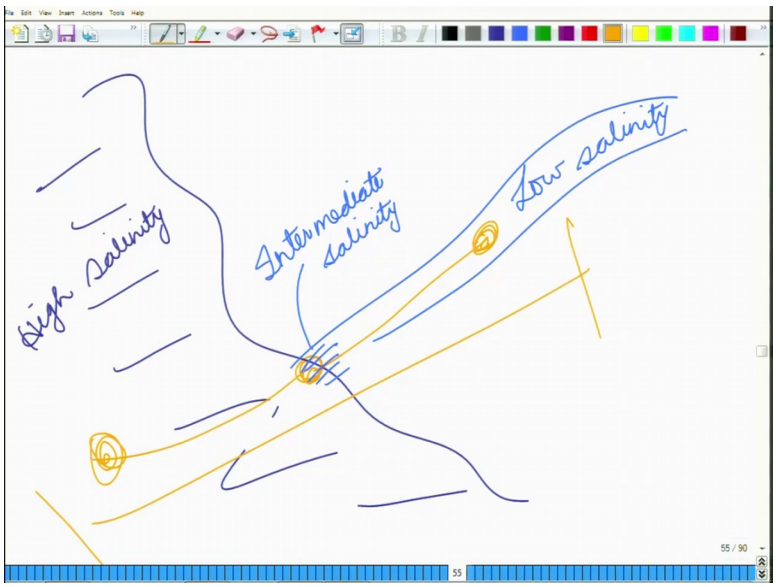

Now, in the case of the ocean you have a very high salinity whereas, in the case of the river you have a very low salinity. Now typically you will find that these intermediate areas have an intermediate level of salinity and here you will have a number of species that would spend part of their time in the high salinity areas, part of their time in the intermediate salinity areas, in part of their time in the low salinity areas.

So, this provides a very specialized habitat and the species that are found in these areas are found here because these are the only few areas where you can have all these 3 kinds of salinities that are available in the same area. So, this is why you will have these species, these specialized species that will be found in these areas.

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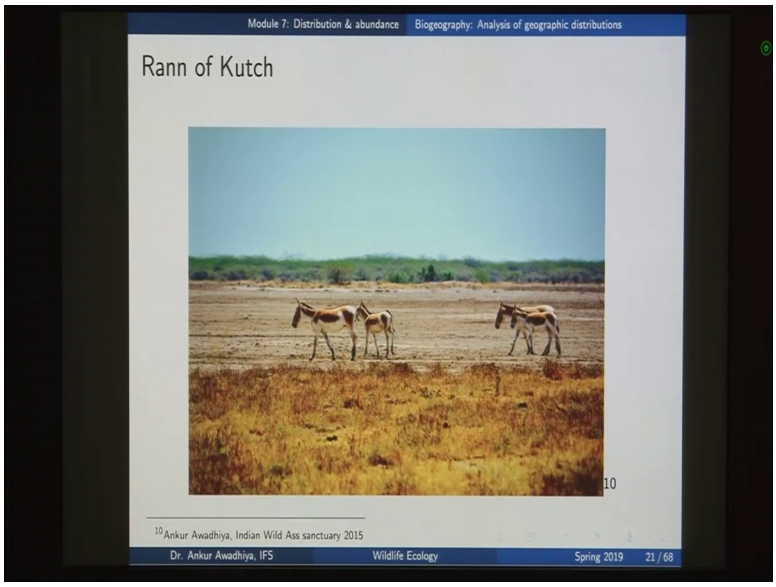

Now, near the histories of Gujarat you also have the Rann of Kutch, now Rann of Kutch is home to the wild asses that are found in our country so, you have the Indian wild life sanctuary. Now here again if you talk about the habitat conditions you will find that it is a very flat land there are hardly any hills around.

So, it is a very flat land and if you go there you can see kilometers and kilometers of very flat land. Now in the case of the rainy season this area gets somewhat inundated and in the case of the dry season it will just act like a very flat dry piece of land. Now again the habitat is so specialized that you have a few months of the year that this areas inundated in the other months of the year in which this area is completely dry. So, again the species that will be found in this area will also be extremely specialized.

And specially, in the dry season you do not have access to water in a number of places and so the species will be very constrained in their movement. Now the wild asses that I found in this area are adapted to these dry conditions so, they do not require a very large amount of water plus they are able to feed on the native vegetation that is found in this area. So, this area cannot support other predators and this area can support the wild asses because of which you have the wild asses that are living in this area.

Now, typically the water sources in this area are extremely saline, because this area when it gets inundated it also receives some amount of salty water from the seas and also the groundwater is extremely salty so that also makes this habitat extremely specialized.

So, if you take these wild asses out and place them into some other forest see if you keep these in the forests of Madhya Pradesh. So, the tigers will come and hand these wild asses, but then because tigers are not able to survive in this area. So, the wild asses are able to sustain themselves in this particular area.

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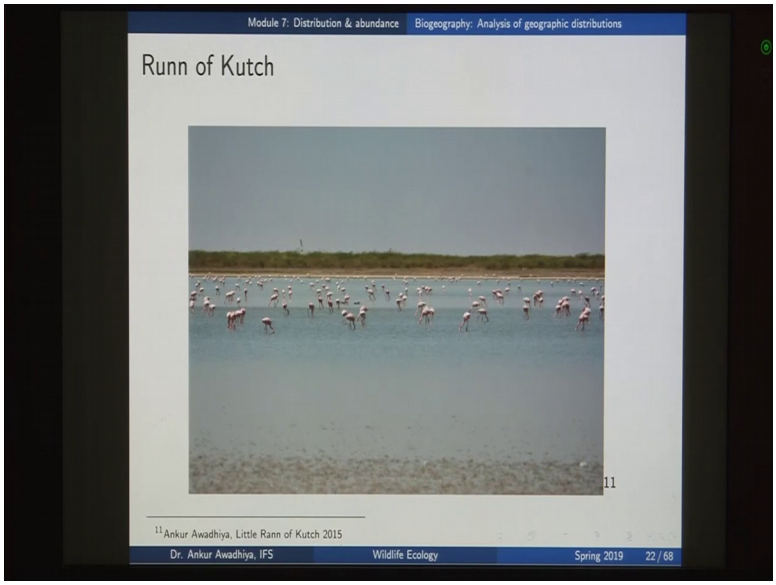

In certain regions of the Rann of Kutch we will also find these water bodies that will support a very dense population of flamingos. Now flamingos again are very specialized birds, so they are migratory birds they spend some time in India and sometime they move out and when they are here in India you can see that all of these are pinkish in color because of their very specialized diets.

Now in their diets they have certain plants that are rich in carotenoids and also certain animals that are taking these carotenoids and these carotenoids these are compounds that are getting accumulated into their bodies. So, if you talk about why this bird is found in this area you again have to make a correlation between the requirements of the bird. So, this bird requires water it is feeding in on the organisms that are found in water.

So, it will only be found in areas that have water plus this has other requirements. So, typically these flamingos come here and they also breed in these areas. So, if this bird is coming here to breed it requires an area that does not have predators it requires an area where it can have ample source of food which it can feed to it is young ones. So, I mean because this the surrounding area is extremely dry and you do not have a number of predators. So, you can have you sustained population of these birds in this area.

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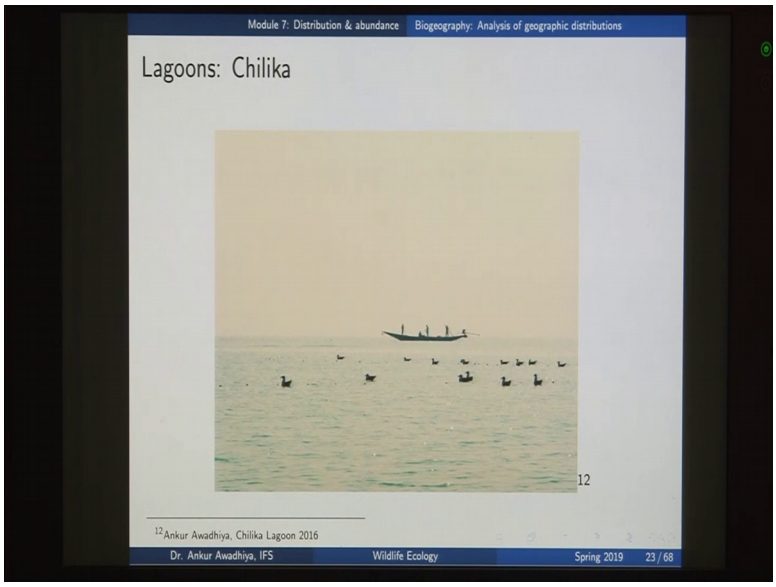

Another very specialized habitat as that of the lagoons, now here we are seeing the Chilika lagoon, now in the case of a lagoon as well similar to the case of an estuary, a lagoon is a large water body.

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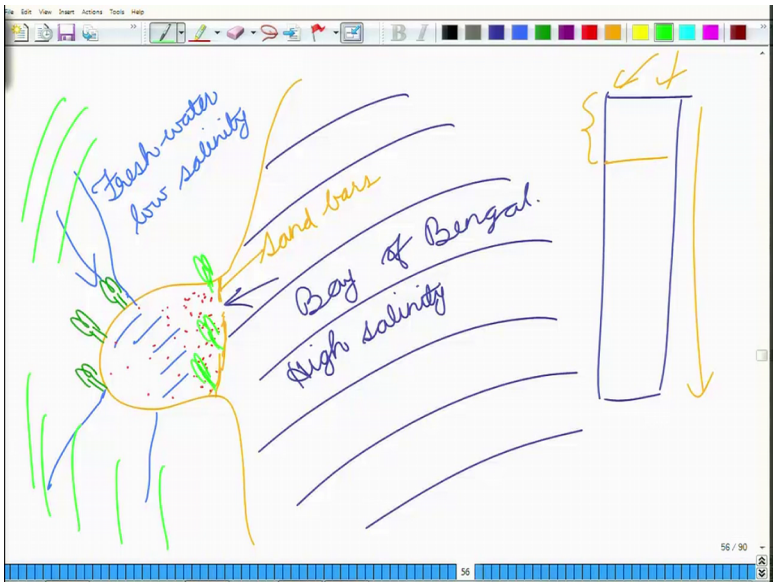

So, in the case of your Chilika lagoon you have this water body here you have the oceans and this particular case you have the Bay of Bengal. Now the lagoon is drained by a number of rivers now these rivers are bringing in fresh water or a low salinity water. Now in the case of the Bay of Bengal you have high salinity so you have saline water here, now these lagoons are separated from the sea with these sand bars.

Now, when you have these sand bars here you have fresh water coming in from this area and you have a saline water that is coming in from this area now again if you went ahead and try to measure the amount of salinity that you will have in the lagoon you will typically find that these areas that are near to the sandbars have a very high level of salinity. These areas that are near the mouths of the rivers have low level of salinity and the other areas have an intermediate level of salinity.

Now here again if you ask what are the species that are found in these areas. So, there is a dolphin by the name of the Irrawaddy dolphin that is found in this area and this dolphin makes use of it makes an extensive use of the organisms that are found in this area. Now typically, the plants that would grow here in near the banks, which have a very low salinity, will be very different from the plants that would be growing in these salinity areas. So, this makes a habitat that is structurally very diverse plus you will have especially in the case of this Chilika lake the depth of the water is very less so, the depth of the water is typically like 2 or 3 meters.

Now when you have a depth of water that is typically 2 or 3 meters so, all of this water is able to receive sunlight from, because if you look at a column of water now if you have incident sunlight. The sunlight will not be able to penetrate completely to the down surface because typically your sunlight is able to penetrate say around 5 or 6 meters of the water column. Now here because the area is extremely shallow so most of this water column is having the sunlight which makes it extremely rich photosynthetically.

So, you have a lot of photosynthetically active radiation that is available in this area, which supports a very extensive plant life, plus at the same time because you have these fresh water rivers and you have agricultural fields in this area. So, these rivers are also bringing in a number of nutrients into this area. So, typically the amount of nutrients is very high the amount of food production because of the autotrophs the photoautotrophs that are found in this area is very high that also supports a very large population of fishes in this area now if you have a heavy fish population.

So, there would be a number of predators that can now sustain in this area and examples are the Irrawaddy dolphins or a number of piscivorous birds that are supported by these kinds of habitats. Now again if you have to ask the question why is Irrawaddy dolphin found in this area, you will have to make a correlation between the a biotic factors that are found in this area and also the biotic factors that are found in this area a biotic factors as in you have you have this water that is not of a very great depth.

So, you have a lot of photosynthesis that is going on in this area, in terms of salinity you have a distribution of salinity in this area, in terms of nutrition you have a very heavy nutrition load that is coming in from the streams and then all of these a biotic factors are giving rise to biotic factors. So, you have a very heavy amount of photosynthesis that is going on in this area which is leading to a lot of food production, now that food production is supporting a number of fish species in this area because they are getting an ample amount of food.

Now if they are getting an ample amount of food they will have very large populations which will then sustain other organisms that are dependent on the fishes such as the birds and the dolphins. So, if you did not have the fishes in this area the dolphins would not have occurred in this area, if you did not have this depth of water you would not have

fishes, you would not have the dolphins. Now biogeographically if you ask the question by a dolphin, dolphin is found here is an answer.

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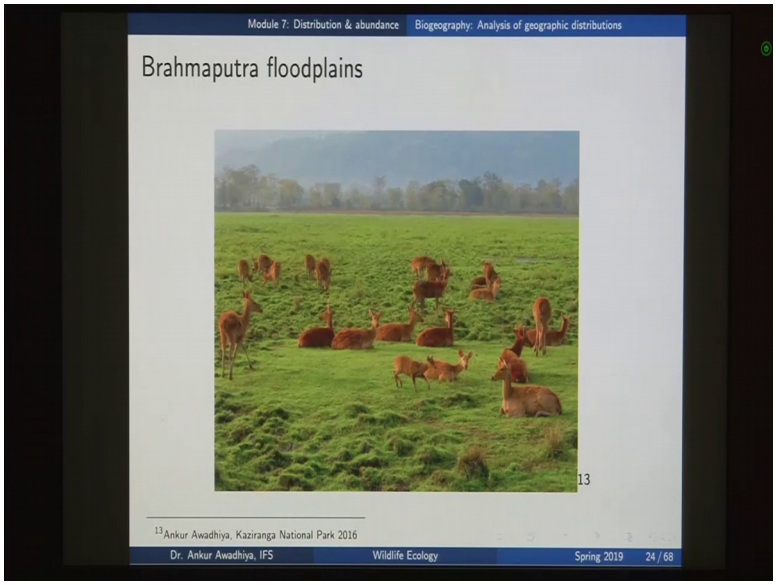

Now, moving to the northeast part of the country here we are seeing the Brahmaputra floodplains, now Brahmaputra floodplains in the state of Assam are governed by the life of the river.

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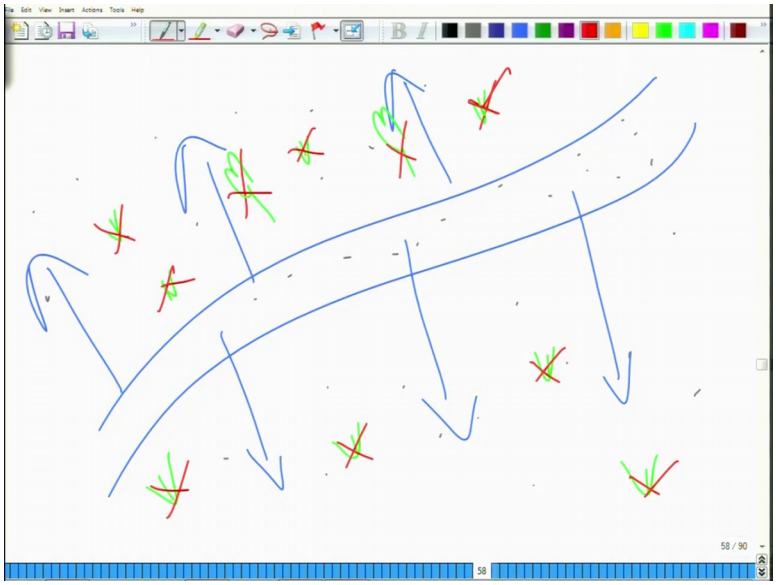

So, typically you have this river Brahmaputra which is draining this area this is Kaziranga national park and in the rainy season the river floods and when it floods it

inundates the whole of this area. So, you have these floodplains that completely get inundated. Now when these flood plains are getting inundated the sediments that were there that were brought by the river they are also distributed to all of these areas.

Now these sediments are extremely new soils so, they are extremely fertile and so, the grass growth in this area will be very high. At the same time when you have this river that floods the area whatever remains in this area gets killed. So, essentially what happens is, when you have a flooding so, all the existing grasses or other plants that would be found in this area there are a number of meiosis species that are found in this area and all of them get killed in the flood season.

Now, typically if you did not have this regular flooding in this area so, you would see that you have grasses, after the grasses it would start getting a series of successional stages. So, from grasses you would move to shrubs, from shrubs you would move to trees and ultimately this area would become a very dense tree rich forest area, but then because we are having floods every year. So, all these species any plant that is coming up in this area.

So, suppose this is a sapling of a tree so, this happening will also get killed in this area. So, typically the only period that is available for the growth of plants is the period where you are not having the floods and what are the species that can grow very fast in this area that other grasses species so, which is why in these floodplains you will see that typically for a very long distance you do not see any trees.

Now if you have an area that has these grasses species and here you have ample amount of moisture that is available, the climate is not extreme and in this in these regions you have ample amount of grasses. Now grasses are again producer organisms and they perform photosynthesis they bring in a lot of food for a number of animals and so this area supports a very heavy density of the herbivores. Now if you have a heavy density of herbivores a large population of herbivores this would also support the carnivores. So, Kaziranga National Park is also a tiger reserve it supports a dense density or a dense population of tigers in this area.

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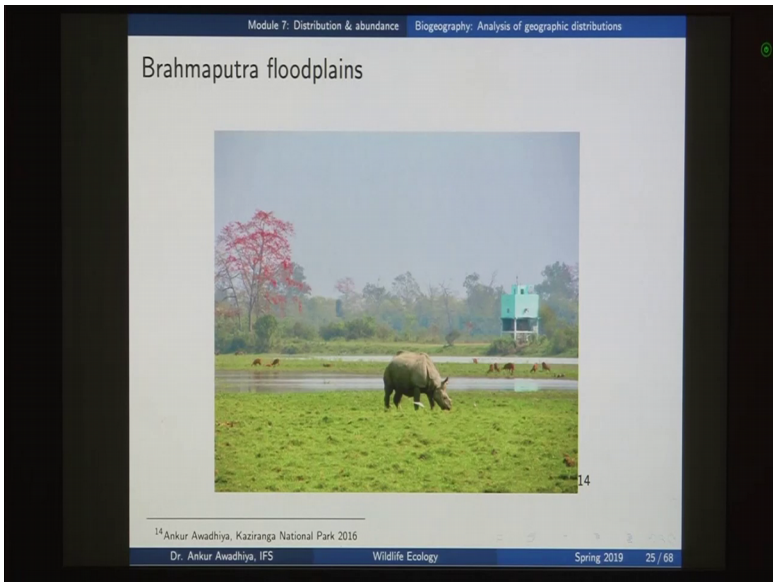

Now, this also supports organisms like the rhinoceros, now rhinoceros again is an animal that is a dependent on these grasses and because we have these grasses here you have these floods every year. So, these floods are not allowing the competitors to remain in this area so you have the rhinoceros that is found in this area. So, again if you ask why is rhinoceros found Kaziranga National Park you will have to answer in terms of the pull factors.

So, the pull factors are that you have ample amount of food that is available to this animal, you have equitable climate that is available to this animal, you have an adequate amount of protection that is being provided to this animal and in you will also have to talk about the push factors. So, this animal cannot live in see very high hills or it cannot live in the deserts. So, those are the areas where it would not be found plus if there are areas where it has some predators or there are people who are trying to kill this animal. So, it would be wiped off from the other areas and would then only be found in these areas. So, again push and pull factors would tell you what species are found in which area and why.

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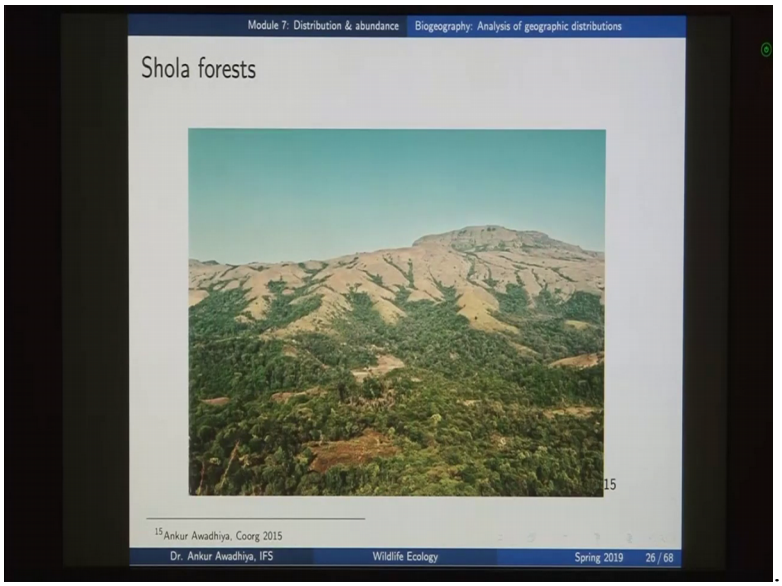

Now, moving southwards here we are observing the Shola forest, now you can see a Shola forest in see Karnataka or Tamilnadu. Now these again are very specialized habitats, what is happening here is you have certain trees.

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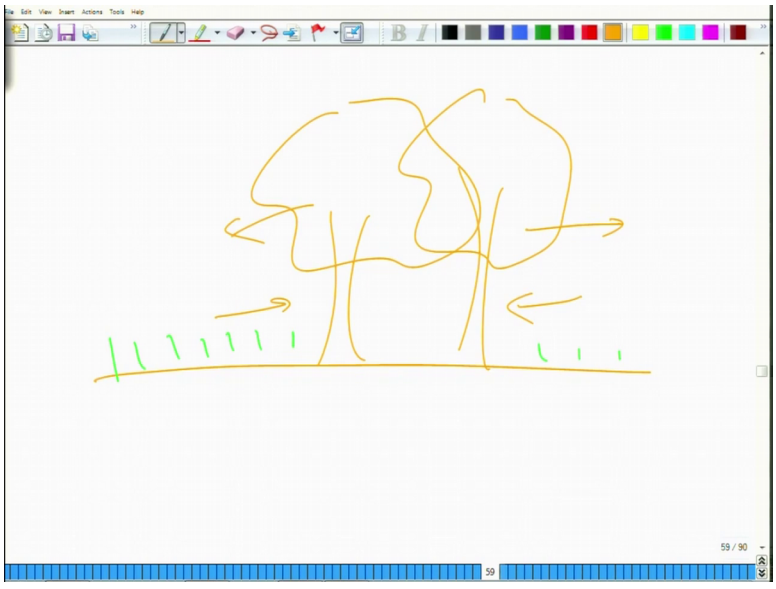

So, you have this tree and then you have in this grass, now typically the tree is not able to expand itself. So, let us say that here you have this is a patch of trees and then you have the patch of grasses. Now, in the case of these Shola forest the trees are not able to

expand their territory outside and the grass is also not able to expand its territory inside the patch of those trees.

So, in this case there is a dynamic equilibrium so, you will find trees and you will find grasses and these are found in these areas and if you try to replace one with the other they can be replaced, but then just because of their mutual competition the tree is not allowing grass to come into it is area and the grass is not allowing tree to commit to its area.

So, this makes it a very structurally diverse habitat plus you would observe that again because this is a hilly area. So, there are very high wind speeds with very high wind speeds if you have a tall tree.

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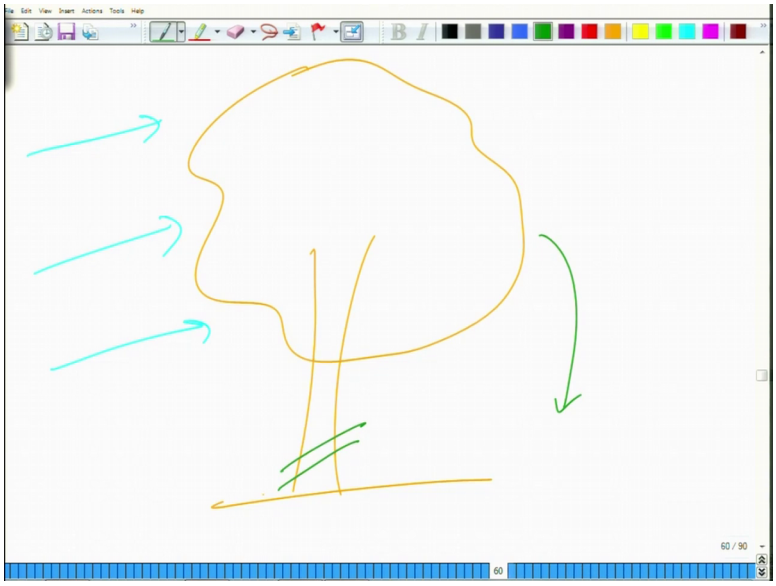

So, let us say that you have a very tall tree in an area with a large sized canopy and if there is a heavy wind in this area. So, there would be a lot of pressure that is being provided to this tree and either this tree would topple down or this tree would break somewhere. Now if that be the situation how should trees respond to a situation of very high wind speeds, now this is when adaptation with that will is fine in the Shola forest, you will find that typically the trees are very stunted so, they do not have a great height. So, you will have these trees.

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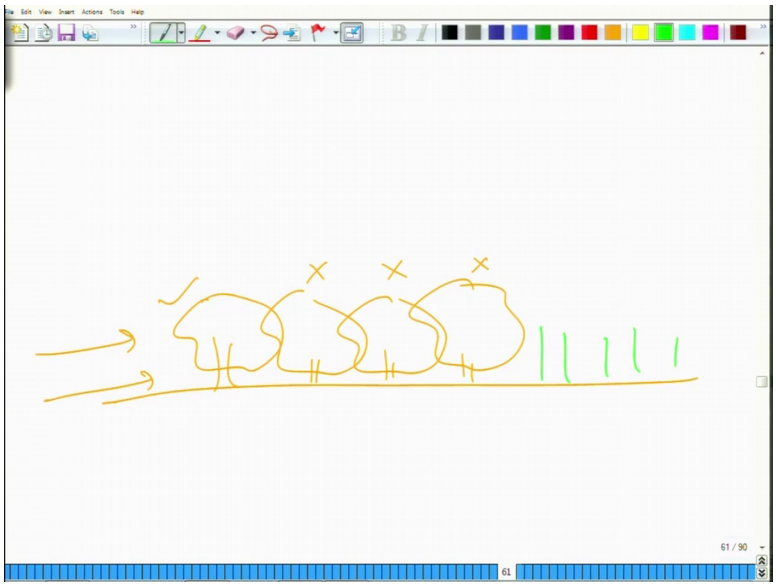

So, we will have trees that are extremely stunted, plus these trees will remain close to each other. So, in this case if there is a high wind speed that is only applied to this particular tree and the other trees get protected so, you do not have a high wind speed that is being suffered from these trees. So, these are again very specialized habitats that you have only in these particular areas and these support a very rich biodiversity that is only found in these areas because these would support those species that require both the trees and the grasses for their survival.

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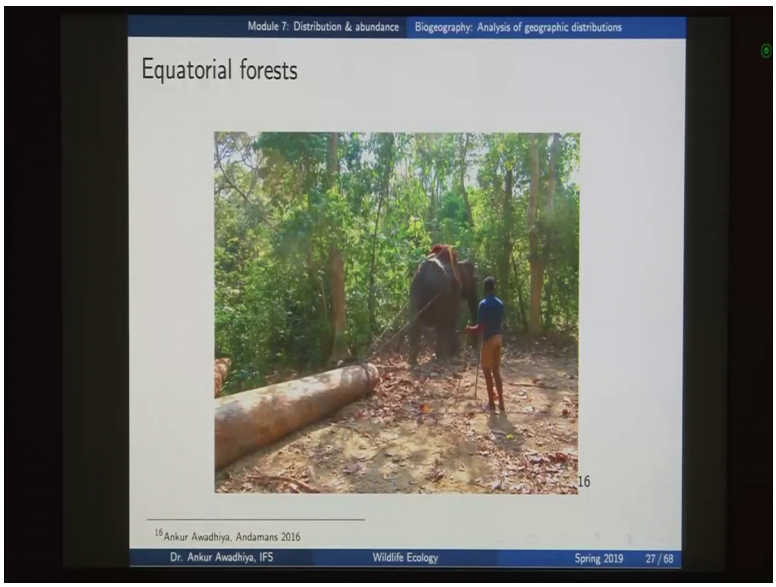

Now, moving further south if you visit the Andaman's here you have the equatorial forest, now in the case of equatorial forest if we talk about the a biotic conditions these are islands. So, the variation in temperatures is not very high, it is warm throughout the year, the rainfall is plenty and when it rains it rains horribly it rains cats and dogs. So, there is an ample amount of moisture that is available for the growth of vegetation.

Typically, the trees that you will find in this area will be very large. So, they will be very tall trees you can see this log that is being moved by this elephant. Now elephants are not naturally found in this area, but elephants are brought to this area or to help in the logging operations. Now in the case of equatorial forest because these are close to the equator you have a heavy a large amount of sun sunlight that is available for the growth of the vegetation.

So, you have ample water, you have ample sunshine, you have a fertile soil and so you have very tall trees. Now typically when you ask about the species that are found in this area they will have to be adapted to these conditions. So, these are the pull factors if you are once adapted to certain conditions you will prefer living in those conditions.

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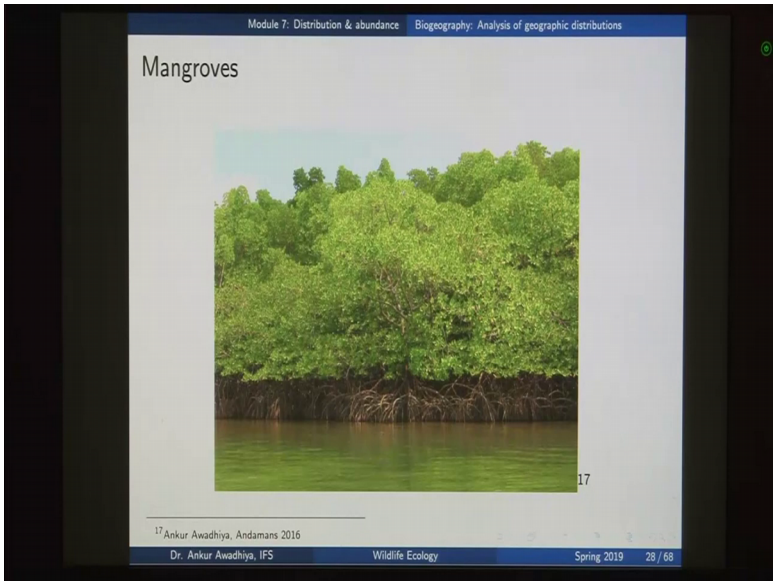

And if you go near the coastal areas you will find the mangroves, now mangroves again are very specialized organisms plus they also provide a very specialized habitat to us to a number of other organisms. Now in the case of mangroves here you can see that their roots are typically very large in size, these are the stilt roots, you also find a number of

new metaphors. The new metaphors are those roots that move from the ground upwards to get air now these are found in areas that are typically very marshy.

So, when you have a high tide a lot of this area will get inundated when you have the low tide so, this area becomes exposed again. So, these are the species that can make use of such a biotic conditions of partial inundation or compute inundation at times. These are adapted to these conditions and which is why these species can thrive well in this area. Now suppose you went to this area and you try to plant a teak tree or say a Sal tree that we normally find in a deciduous forest. So, these areas will not support a teak or Sal tree because of the high salinity that is there in the waters.

But then if you move inside the island you have ample amount of sunlight, ample amount of water and if you are able to remove the other trees. So, artificially you can have a very good teak plantation in these areas. Now once these mangrow's are here now you can also look at a number of community interactions that will happen because these mangroves are found here. These roots of the mangroves they provide a specialized habitat for a number of other species.

So, can act as breeding grounds for fishes they can act as nurseries because they are able to protect the young ones of the fishes from their predators. At the same time these areas also support a large population of saltwater crocodiles, now these crocodiles can live can live in these areas and they can make use of these roots to get their prey or to kill their prey.

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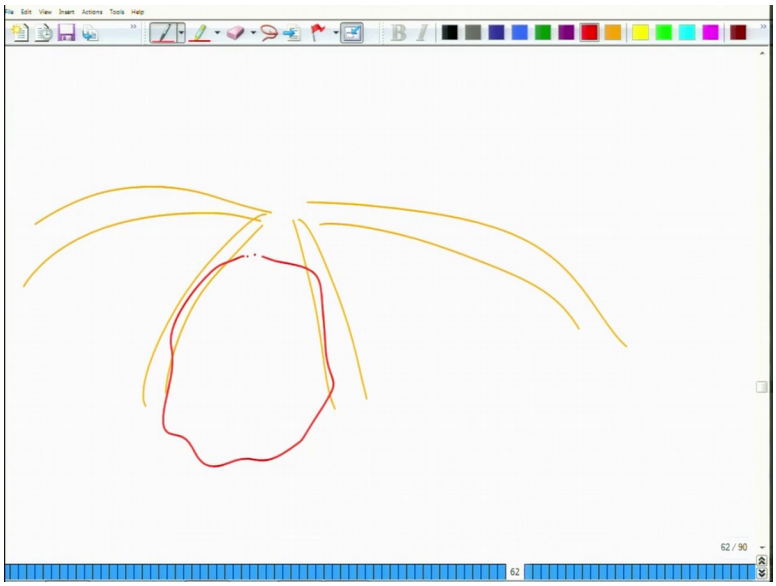

So, typically what a crocodile does is that it would come to these roots, now a crocodile is not able to chew it is food. So, it normally has to tear the flesh that it has caught. So, if there is an animal so, this crocodile has to tear it apart and then it will gulp it. Now because it is unable to chew it is food what it does is, it will typically bring its prey or the dead animal that is here and it will bring this prey inside these roots and once this prey gets entangled with the roots then it will try to tear it apart.

So, these roots also support the crocodiles in a in this particular manner, all the crocodile once it has killed an animal it will just bring the carcass and it will put it here. So, that this carcass starts rotting once it starts rotting it becomes easier for it to tear the flesh apart. So, again you have these mangroves here because you have this particular a biotic conditions of ample amount of sunlight, ample amount of water, high salinity and conditions of partial inundation.

Now once you have the mangroves they will support other species because of the community interactions they will support a number of fish species a number of crocodile and some crocodiles. Now if you have a heavy amount of fishes or a large population of fishes in this area that would also support a number of birds in this area, a number of fish eating birds for the piscivorous birds and once you have the piscivorous birds then you will also have a large amount of dropping that will happen near these mangroves which

will then further substantiate the growth of these mangrove trees. So, there is a complete ecosystem that you will find in these areas.

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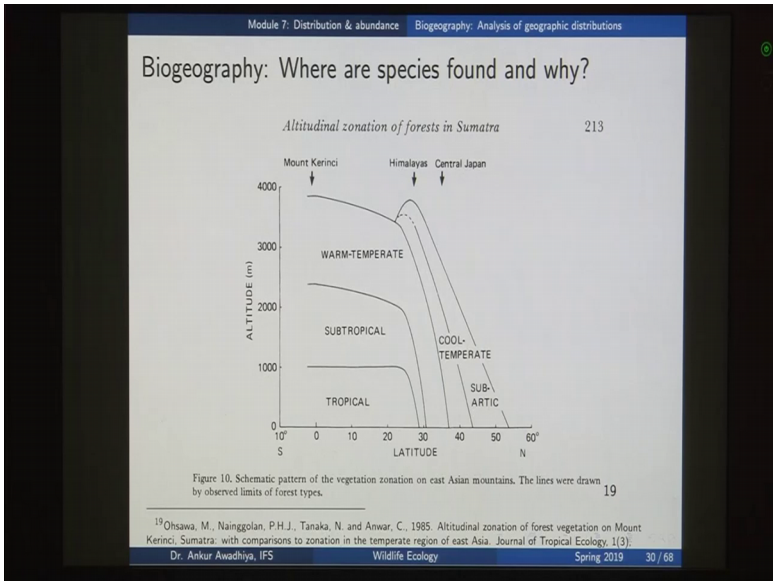

Now, in biogeography when we are asking the question where are certain species found or what are the species that are found in certain area and why are they found in those areas? The first question that you need to ask is what are the conditions that are available in this area? So, you will have to talk about the a biotic factors that are available, the amount of sunlight, that is there the amount of moisture, that is available the level of fertility of the soils, the depth of soils or say the wind speed and so on and with these a biotic factors.

The next thing you will ask is, what are the biotic factors that are available in this area, what are the other species that are found in this area, do you have a number of a prey species that are available in this area, because of these a biotic factors. Now if you have suitable prey species in this area so you will also find so a number of predator species in this in these areas. So, when we are asking this question why are these species found here, so these are the connections that we need to make.

Now here we are observing that we are talking about the altitudinal variation. So, altitudinal zonation of forests in Sumatra, now if you talk about an area say an area that is it 10 degrees latitude. Now if you move upwards so typically the temperature reduces. So, you will start seeing a tropical forest, then you will move to a subtropical forest, then

you will move to a warm temperate forest and maybe later on you will even move to the alpine forest. Now in this case when we are talking about an altitudinal zonation, it is the temperature differences that are making all these different for is possible in any particular area.

So, for instance you will find a warm temperate forest typically between 30 degrees and 35 degrees north of latitude and you will find a subtropical forest typically between say 28 and 32 degrees, but then even if you are here between 0 and 10 degrees you can find these forests if you can make these conditions of label to the species so, what we are saying here is that.

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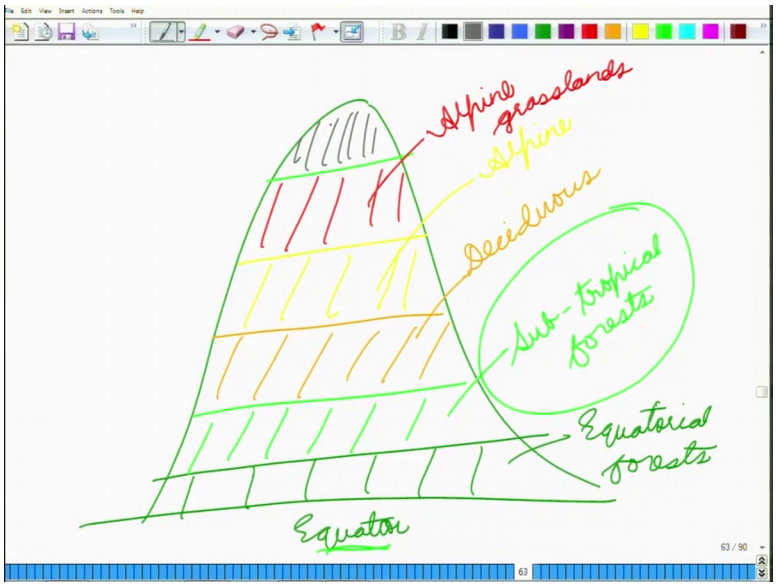

If you have this if you have a tall mountain so, in this portion you will typically find equatorial forest and the location of this mountain is say close to the equator, now close to the equator you should find the equatorial forest, but then if because this area is tall. So, you also get a zone where you have a lower temperature that is available. So, it along with the equatorial forest or along with the tropical forest you will also start seeing subtropical forest.

Now subtropical forest typically should not be found near equator, but then because you have made this conditions of level. So, you will find these species that are found in these areas as well and then the species that are found in these subtropical forests will either be very same or related to the species that are found in the actual subtropical forest which

are near the tropics. Then if you move further up you will find the next zonation so, take for instance you can start seeing deciduous forests.

Now from the deciduous forests you will have another zonation where you will start seeing the alpine forests and then even above you will start seeing the next kind of vegetation say you will start seeing the alpine grasslands and then on the very top because this area is now very cool. So, you will have a situation where it does not support any species.

So, even in any particular location if you can make the other conditions of labeled for certain species so, those species will start thriving in those areas. They will typically migrate to those areas and will start thriving; now we will look at migration in more detail later on. And we cannot ask questions just on these or tree species, but also on the on different animal species that can be found in these areas.

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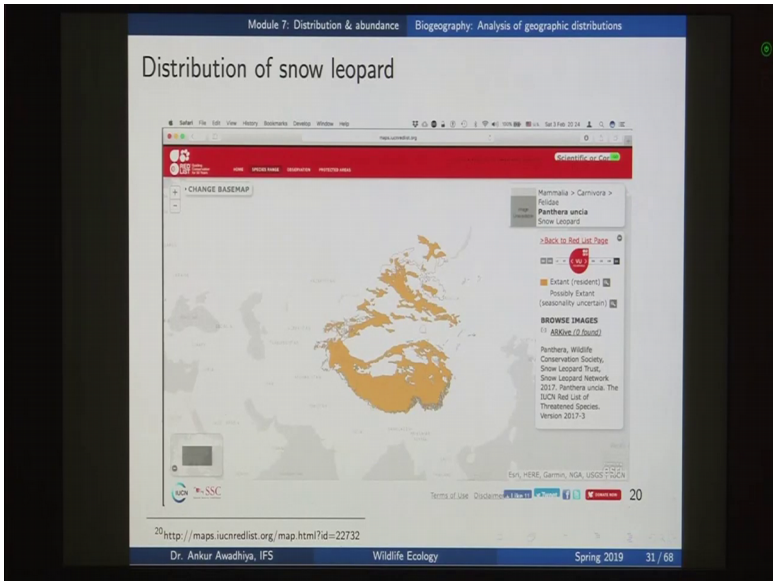

So, for instance if you look at the distribution of an animal's which is the snow leopard, now a snow leopard is found in these areas, now again you can ask this question why is snow leopard fine found in these areas? What are the biotic characteristics of the environment that are supporting the snow leopard in these areas? And what are the biotic conditions and the biotic conditions that are not supporting snow leopard in other areas?

So, here again you are asking 2 questions when if this is the distribution of snow leopard why is snow leopard found here that is the first question and the second question is why is a snow leopard not found here and once you have both these answers then you can understand the distribution of any particular species.

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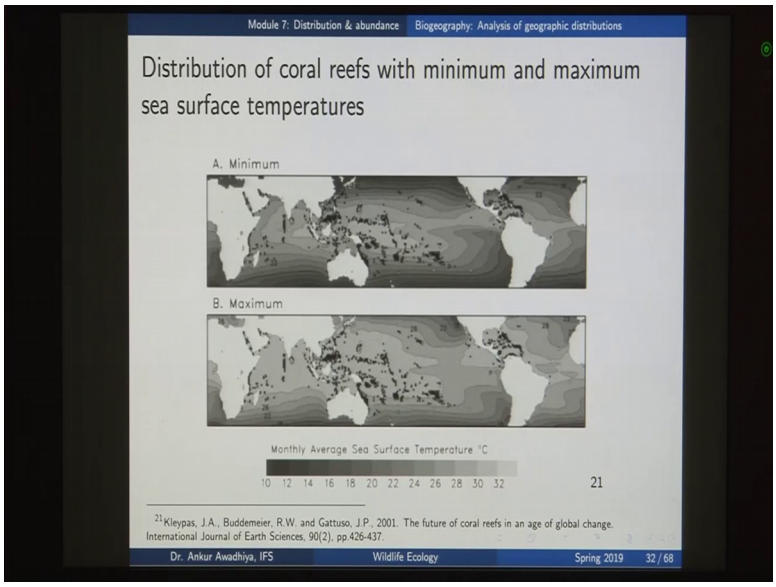

Or if we talk about say the coral reefs, now we have the coral reefs in these areas and here we have the minimum and the maximum temperatures of the seas. Now here you can see that the maximum temperature in these areas is falling following this particular isotherm.

So, maybe the question why the corals are found in this area has a lot to do with the maximum sea temperature that can be tolerated by this particular species or it can be related to the minimum sea temperature that can be tolerated by this species why is this species not found to the very north or to the very south. So, for any particular species we can start by asking the questions what are the a biotic conditions that are found in this area, what are the specific adaptations that you have in this area and what are the other biotic organisms that are found in this area, that might support or that might not support the presence or absence of a species in any particular area.

So, a study of all of these the distribution of animals or the distribution of organisms and the reasons why a certain organism is found in an area and is not found in an area is what

constitutes by a geography and we will look at it in more detail in the subsequent lectures so, that is all for today.

Thank you for your attention [FL].