Conservation Geography
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Module - 1
Introduction to Conservation Geography
Lecture - 3
Biogeography

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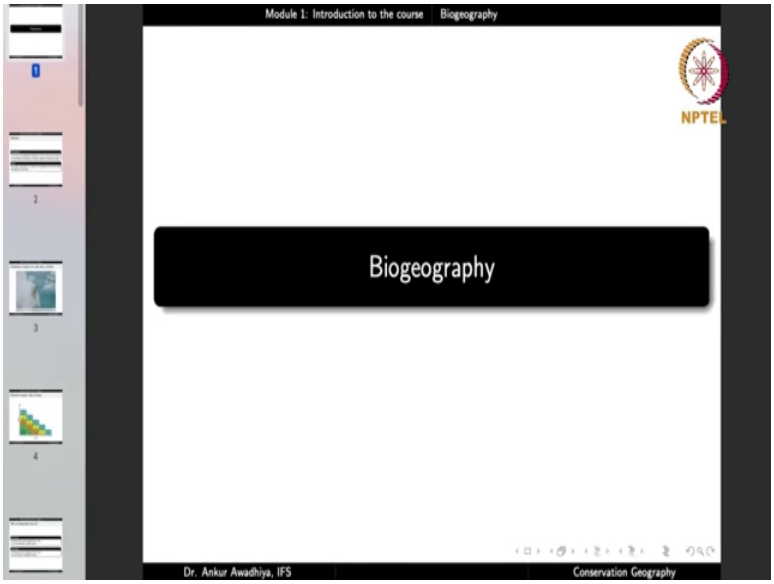

Namaste! We carry forward our discussion and in this lecture we shall have a look at Biogeography.

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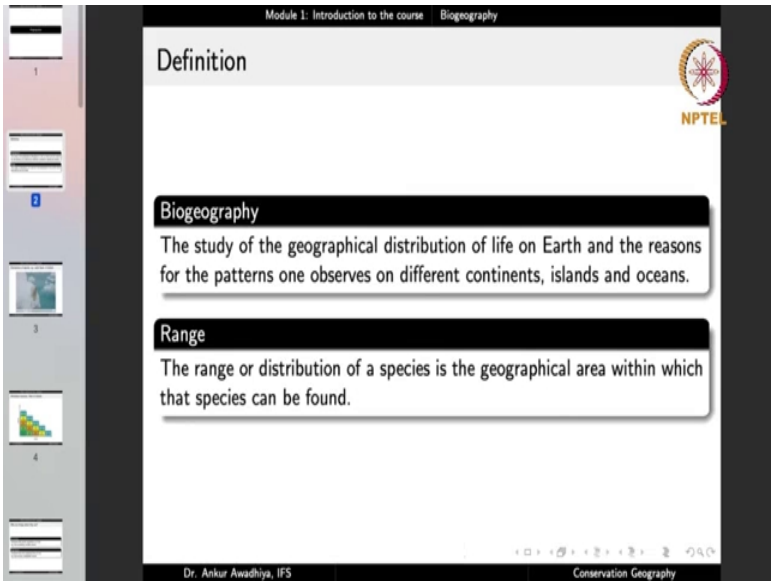

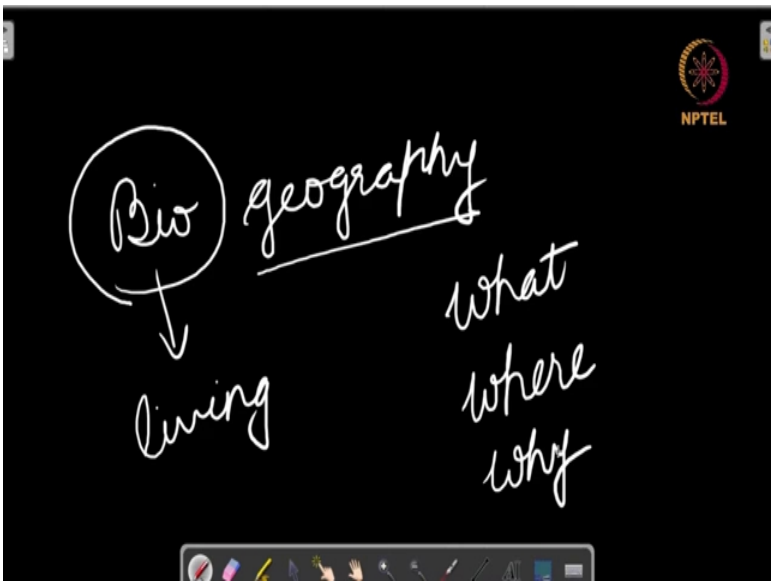

Biogeography is the study of geographical distribution of life on earth and the reasons for the patterns one observes on different continents, islands and oceans. So, basically when we use the term Biogeography, we are interested in the geography of bio. Bio means living. So, when we talk about bio, we are talking about living things, like plants and animals.

So, in the case of Biogeography, we asked the questions, what are the different plants and animals that are found in different locations of the earth? To, if you consider a particular plant or animal or a type of plant or animal, where are they found? For example, where do we find coniferous trees or where do we find cacti or where do we find the dry deciduous trees?

So, the second question is where. And the third question is why. Why do we find certain plants and animals and types of plants and animals in certain locations? So, that is when we are talking about Biogeography, we are asking the same three questions. What is found in different locations? Where are things found? And why are they found where they are found?

So, in this case, we are looking at the geographical distribution of life on earth and the reasons for the patterns. Reasons is the answer for why are they found. The reasons for the patterns one observes on different continents, islands and oceans, meaning, the reasons for patterns one observes in different locations. And in this context we define range or distribution of species as the geographical area within which that species can be found.

So, the range of a species is the area in which that species is found. That is, if we say that polar bears are found in polar areas, then polar areas are the range for polar bears. When we say that camels are found in deserts, then deserts are the range for camels. So, range is the distribution of a species, the geographical area within which that species is found.

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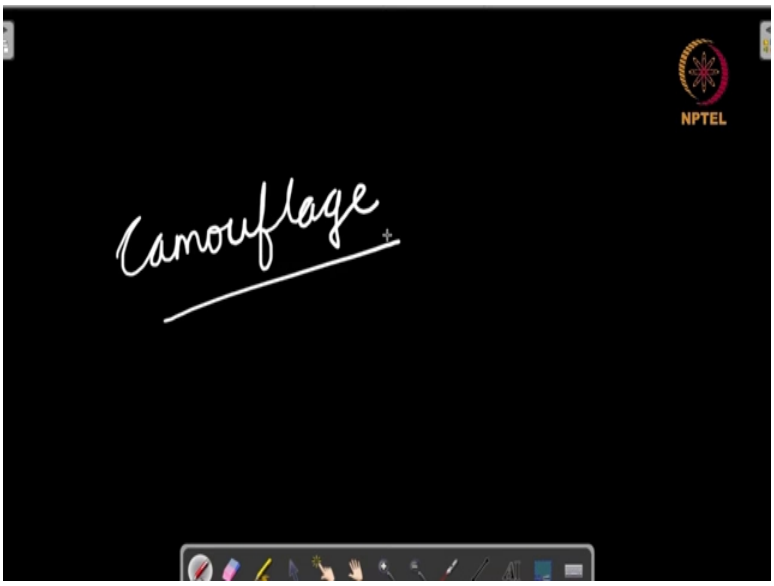

And for most of the organisms, the distribution is limited. That is, the range of organisms is limited. When we talk about the range or distribution of a species, such as the polar bear, we are alluding to the fact that these organisms have certain adaptations that make it possible for them to live in those areas. And they have or they lack those adaptations that would have enabled them to live in other areas.

So, for example, when we look at a polar bear, then you can look at certain adaptations that this animal has. If you look at the background, the background is white in color, because this is polar area, it is full of snow, and the animal also is white in color. Now, this white color enables it to merge with the background and provides it with a certain amount of cover which is known as a camouflage.

Now, camouflage is the property of an organism to blend with its surroundings. So, the polar bear is white in color, so it is able to blend with the white colored background. And so when it has to hunt, it can hunt without giving its prey an indication that it is there. And we find camouflage in a large number of organisms.

If you look at a tiger, the tiger would have stripes on its body so the color of a tiger is brown with black colored stripes, which makes it possible for the tiger to blend with its surroundings. And tiger mostly lives in those areas where there are grasses. So, it blends very well with the grasses and so the prey will not know that there is a tiger in the vicinity.

Similarly, in the case of a large number of prey species as well, they have a camouflage that enables them to blend with the surroundings, so that their predators do not know that there is a prey lurking there. And so they are saved. So, camouflage is when adaptation. Similarly, if you look at the body of the polar bear, it is having lots of fur. Now, this fur provides it with insulation to withstand the cold weather in the polar areas. It also has lots of fat in its body.

And this adipose tissue also provides it with a certain amount of insulation. There are also a large number of behavioral adaptations that the animal has. So, for example, in the winter seasons, because it is a very peak winter, so the animal would go into sleep. This is a process known as hibernation. And this hibernation enables the animal to survive through the very harsh winters in the polar areas.

Because it is not awake, it is not moving so it requires very less amount of energy. So, right before the hibernation season, right before the winter season, it would eat up like anything, it would add to its fat reserves in its body, and then it would go into sleep and it will wake up again in the spring season. Now, this is an adaptation to conserve energy.

Similarly, if you look at the feet of the animal, you will find that it has got claws. Now, these claws enable it to hunt. It has got very sharp teeth, which again enable it to hunt. It has a very good sense of smell. Now, all of these things enable the polar bear to survive in the polar areas. So, it is very well suited to the polar areas with cold conditions, lots of ice and snow.

But then, if you take this polar bear into, say, a desert area, then it would not be able to blend with the surroundings. The same feet which enable the polar bear to walk in the snow, to swim in the waters, they would be completely useless to walk in the hot desert sand. It would not be able to catch its prey, because the kinds of organisms that we find in a desert area are very different from the kinds of organisms that we find in the polar areas.

But then again, the desert also has a large number of animals. And those animals are adapted to a life in the desert. So, if you look at a camel, the camel would have certain adaptations that enable it to survive in the desert conditions. So, it would have very padded feet that enable it to walk on hot sand. It would be having long eyelashes to protect it from sand. It has a hump where it stores its energy and so on.

It has the ability to drink several liters of water in one go so that it can have a storage of water in its body. It is able to survive lots of dehydration. The polar bear would not be able to survive dehydration. Now, when we talk about the distribution of a range of organisms, the primary thing is that there is a one to one correspondence between an organism and its environment.

Now, the environment is governed by geography, the environment is governed by the kinds of rocks that are there in that area, the kind of soil that is there in that area, the amount of insulation that the area receives or the amount of sunlight that the area receives, whether it is having an energy surplus or an energy deficit would depend on the location on the earth.

So, areas near the equator would have a surplus amount of energy, areas near the poles would have a deficit of energy. Now, here when we talk about areas, we are talking about geography. So, there is a very close relationship between the distribution or range of organisms and the geography of the area.

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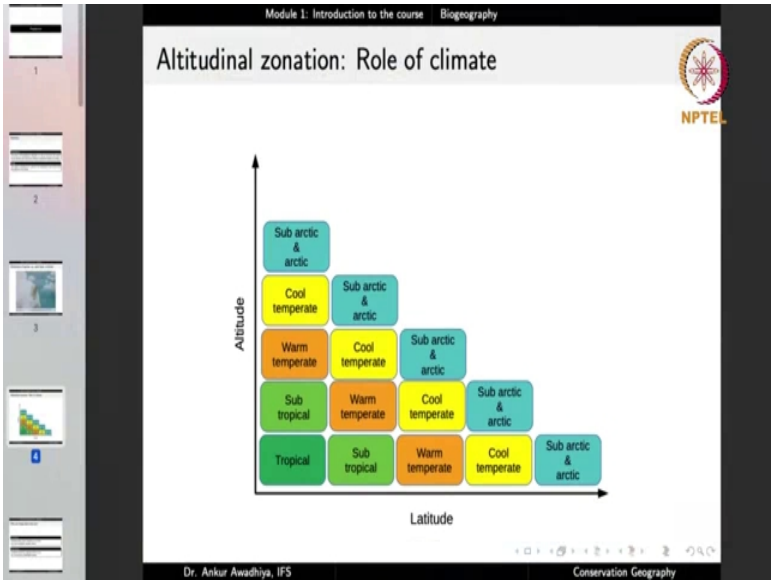

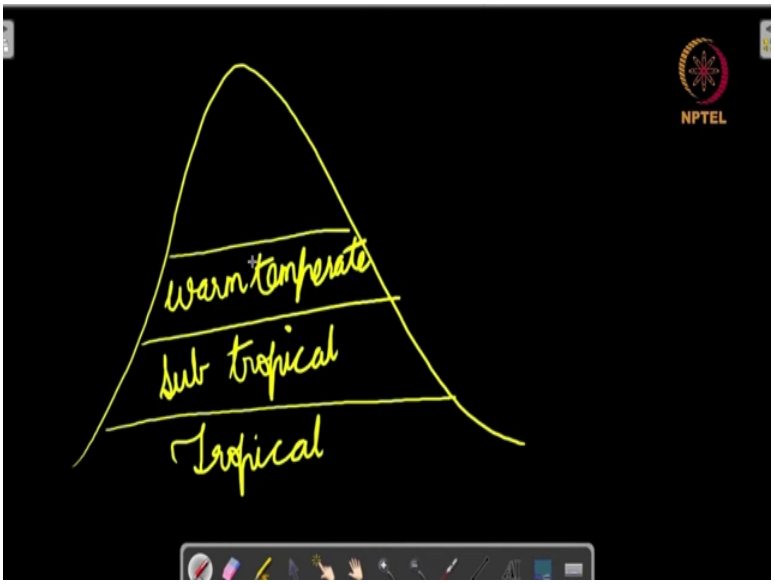

Another example is the altitudinal zonation. So, for example, if you have a location that is at a lower latitude, that is near the equator, and also at a low altitude, which means that the location is having a low height above the sea level. It is not a very high mountain area. Now, in such conditions we find tropical forests. Not tropical forests are those forests that are characterized by very tall trees that do not shed their leaves and a very dense canopy.

Because in these tropical areas, we have lots of sunshine, so there is lots of energy that is available for the growth of plants and there is lots of rainfall. Now, in these areas we will find tropical forests. But if we move upwards that is if there is a hill or a mountain and in the same

low latitude that is near the equator, if we go high up the mountain, we will find a subtropical forest.

That is what we are saying here is that, if there is a forest, if there is a mountain near the equator, so at the bottom we are getting the tropical forest. But at some more height, we are getting subtropical forests. Now, why the name subtropical, because we find the same forests at an altitude of 0 meters, but away from the equator.

So, we find these forests in the subtropics. And the kinds of plants and animals that we will find here is the same as the kind of plants and animals that we will find here. Now, if we move up even further, we will find warm temperate forests. That is here we have warm temperate forests. Now, we find the same warm temperate forests, if you go to even higher latitudes.

So, we are finding that whether we go up or whether we move towards the poles, we find a very similar distribution of organisms, a very similar distribution of forests. So, we have tropical forests followed by subtropical followed by warm temperate, then cold temperate, and then subarctic and Arctic. And the same thing we find here.

Now, if we take a position that is towards the poles, then again we will find the same altitudinal zonation, but we will lack the tropical forests. Then if we move even further towards the poles, we will lack the tropical and subtropical forests. So, at the sea level, we will have warm temperate forests followed by cold temperate followed by subarctic, arctic, and so on.

Now, this altitudinal zonation is telling us that the primary characteristic of a forest is determined by the climate. Because the only thing that is common between both of these areas is the climate. If you go from the equator towards the poles, it becomes colder and colder. Whereas at the equator, if you go higher and higher, it again becomes colder and colder.

And so the climate is determining the kind of forests that you will have in that area. So, this example tells us that there is a very close relationship between geography and the distribution of organisms, which is our premise of Biogeography. So, if you want to conserve these organisms, you will have to ensure that they are kept in those areas where the conditions are appropriate.

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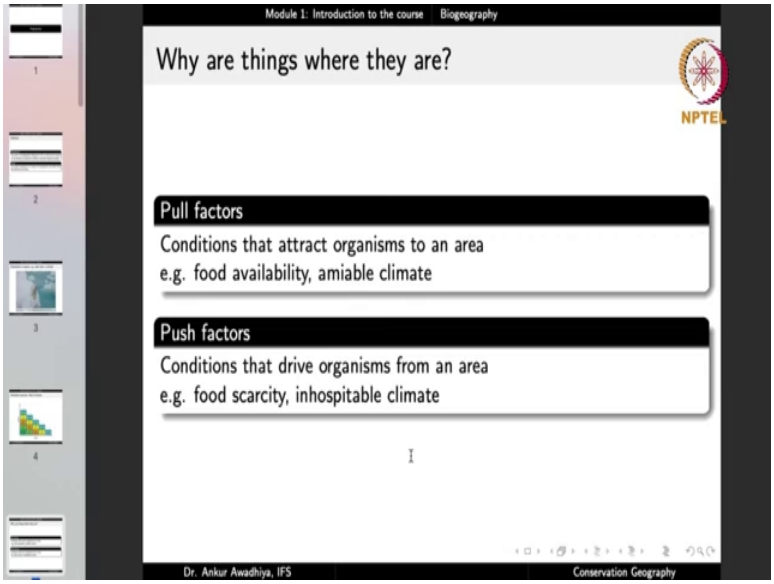

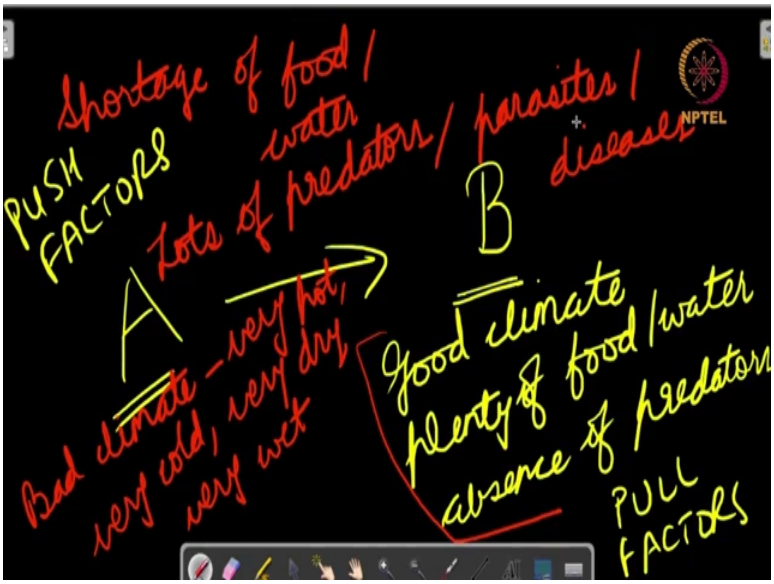

Now, when we talk about appropriate conditions, we can talk about push and pull factors. Now, pull factors are those conditions that attract organisms to an area, such as availability of food or amiable climate. On the other hand, push factors are conditions that drive organisms away from an area, such as scarcity of food or inhospitable climate.

That is, if we considered that animals are moving from place A to place B, then there must be something in place B to attract the animals towards place B and such conditions could include things like a good climate or plenty of food or water or we can have an absence of predators.

Now, all of these factors are known as the pull factors, because they are pulling the animals towards site B.

Whereas, if animals are leaving site A then there should be something that is pushing the animals away from site A, which are known as the push factors. And push factors are literally the opposite of these. So, if good climate is a pull factor, then we will be having a bad climate and a bad climate meaning say, very hot or very cold or very dry or very wet.

Now, all of these will push the animals away from site A. If we have plenty of food and water in site B as a pull factor, push factor would be, say, a shortage of food or water that will push the animals away. If in site B we have an absence of predators, here we will have lots of predators. And with predators we can also have things like parasites or we can also have things like diseases and so on.

So, essentially, the push factors are those factors that make life miserable for the animals. They create conditions where the animals cannot survive well. Whereas the pull factors create those conditions where the animals are able to survive, they are able to reproduce, they are able to thrive. Now, this is on a short temporal scale, but if you look at a larger temporal scale, the push and pull factors would determine where an organism will be found.

So, if we say that tigers are found in Madhya Pradesh, then that means that Madhya Pradesh is having certain pull factors that have permitted tigers to survive and thrive in the forest of Madhya Pradesh. So, this is a pull factor. So, the push and pull factors govern why things are where they are. So, if we say that camels are found in deserts, this is because there are certain pull factors in desert that make the camel able to survive and reproduce and thrive in the deserts.

Whereas, a camel is not found in say an equatorial forest or say a temperate forest, because there are certain push factors, because the camel will be outcompeted by other organisms that are found in those climates and so very soon the camel population will become locally extinct. It will be hunted out. But in the desert conditions, it does not have those predators. And so, push and pull factors govern why things are where they are.

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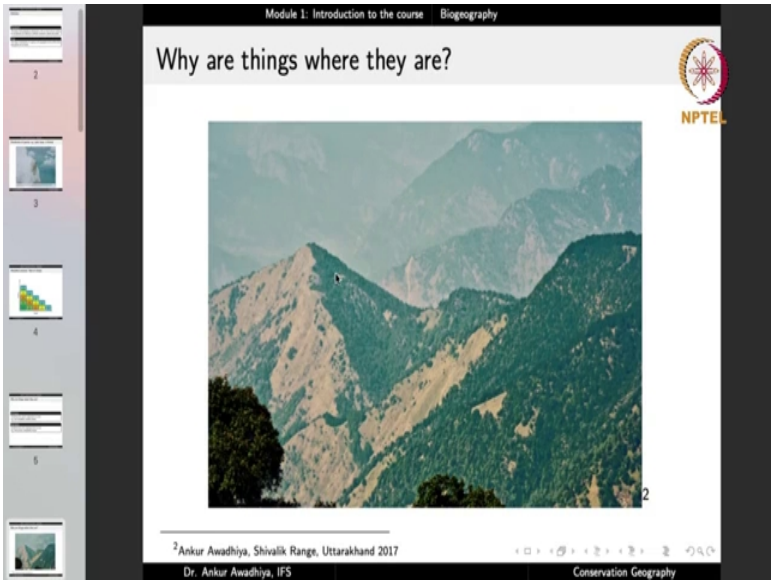

Now, we can look at this example from Shivalik Hills. And if we look at this mountain, we find that we have lots of vegetation on these slopes, but very less vegetation on these slopes. Now, why is that so? Here again you can start to think on lines of push and pull factors. What are the conditions here that are pushing these plants away from the area?

Now, when we say push, it does not mean literally pushing the animals away, because the plants are not motile organisms, but they are creating conditions where the plants are unable to survive. Now, what can those conditions be? If you look at these slopes, then we find that these slopes are very well lit, meaning that there is lots of sunshine that is falling on these slopes.

Now, in the hilly areas, if you have lots of sunshine on a particular slope, it would mean that the soil here will get desiccated or dried in no time, because the rays of the sun are also going to heat up this soil and all the water will be lost as water vapor.

So, probably there is a shortage of water in that area. Whereas on these slopes, they are not that well lit and so there is a bit more amount of water, probably sufficient water as to permit the survival and thriving of these plants in these areas. Similarly, if you look at these slopes, then we find that these are very steep slopes. Now, if you have a slope that is very steep, like this, then you would not find soil in this area, lots of soil, because any soil will slowly move down.

But if you have a more gentle slope then in those conditions you can have an accumulation of soil to a very large depth. And so, it is also possible that in these slopes the amount of soil is soulless as not to be able to support these trees. Whereas, on these slopes because these are a bit less steep, so more amount of soil can accumulate in these areas. So, here again we can start to think on push, on the lines of push and pull factors.

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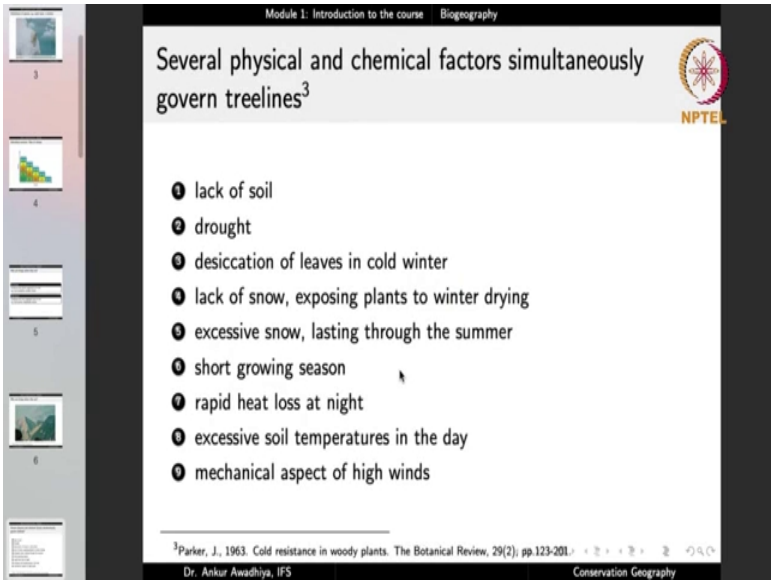

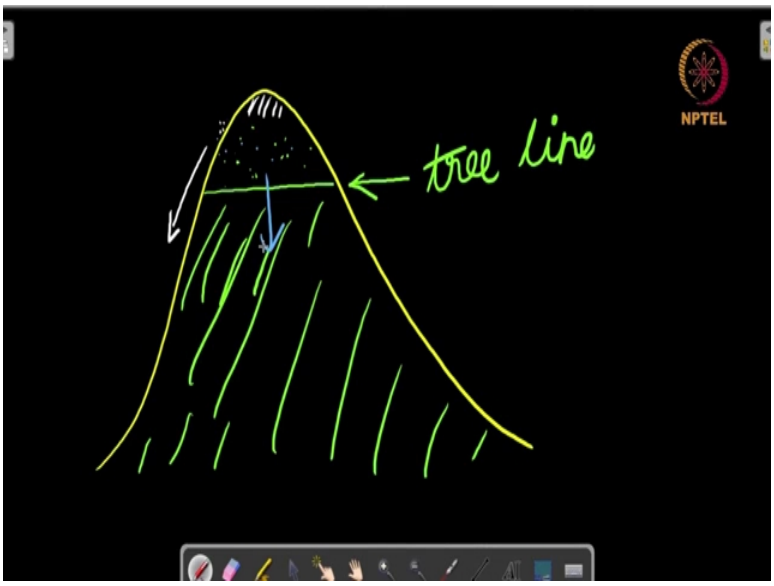

And in fact, there are several physical and chemical factors that simultaneously govern tree lines in the hills. Now, tree line refers to the fact that if you have a hill then you will find vegetation only till a particular line. So, all of these areas will be having vegetation or trees specifically. Whereas, above this line you will probably be having certain grasses or it is also possible that these areas are completely denuded.

There is no plant that grows in these areas. Now, this line above which trees are not found and below which we forget trees is known as the tree line. Now, the question is why do we have a tree line, that is why do we have trees here and why do not we get trees here.

Now, in this case, there are several factors that simultaneously govern the location and the presence of tree lines; things like lack of soil, because typically any soil that gets formed on the upper slopes, it moves down. And so the upper slopes will be having less amount of soil and the bottom areas will be having more amount of soil.

And if the soil is very less, then it will not be able to support trees. Things like drought that is less amount of moisture that is available. Again, because if there is any water in this area, the water will also move down because of gravity and so, the upper areas are much drier; or desiccation of leaves in the cold winter. So, in the winter season, when you have the moment of winds, then the plants get dissipated, the plants also get dried and then the plants die.

Or we can have conditions like lack of snow exposing plants to winter drying or excessive snow that lasts through the summer. Both are extreme conditions. If you have excessive snow throughout the year, the plants do not get liquid water. So, they will not be able to survive. Whereas, if you have certain locations where the amount of snow is a bit less that is you have plants that are adapted to living in cold conditions, but the amount of snow is a bit too less.

Why, because the snow has just moved away from that area or probably the snowfall in the very higher echelons is lesser than the snowfall in the lower areas. In that case, the plants get dried up in the winters, because there is no snow cover to protect them and that again would govern the presence and location of the tree line.

Or things like the length of the growing season, for how many months in a year do the plants receive sunlight. If it is very less then probably the plants will not be able to survive. Or if you have a condition that for many months, it is so cold, it is so dry that the plants do not get a growing season then too probably they will not be able to survive and so we will have an absence of trees.

Rapid loss of heat during the night, which is very true in the case of higher altitudes; excessive soil temperatures in the day, because once an area is denuded, once the area does not have a vegetation cover, then the sunlight will be able to heat that area very quickly. And so, there will be excessive soil temperatures in the daytime, because there is no vegetation to protect it and that will become a vicious cycle.

Because the soil temperatures are so high that they now do not permit the plants to grow which again results in a very high soil temperature and so on. Mechanical aspect of high winds, at higher altitudes we typically find faster winds. And so if there are any trees that are able to grow and survive, they will rapidly be uprooted or these trees would break because of the pressure that is being applied by the high winds.

And so all of these factors together govern whether there will be tree line are not, and if yes, where that tree line will be. So, any of these push factors will result in an absence of trees and so the creation of a tree line.

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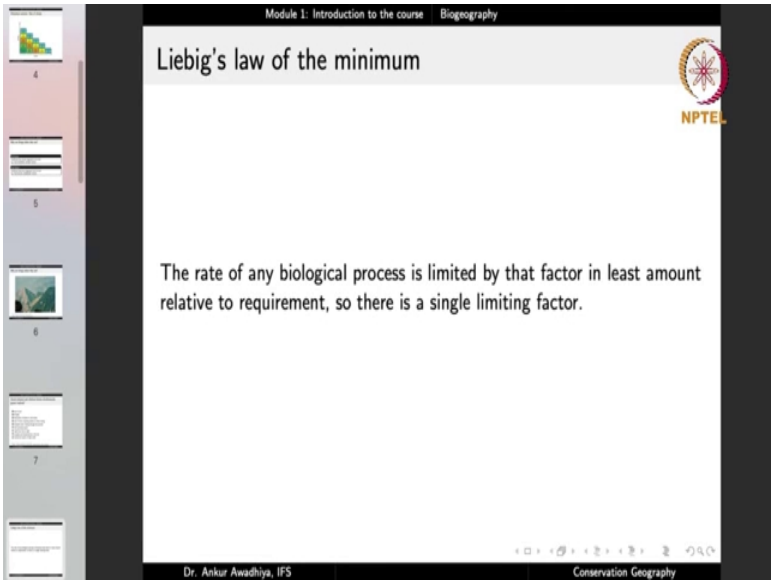

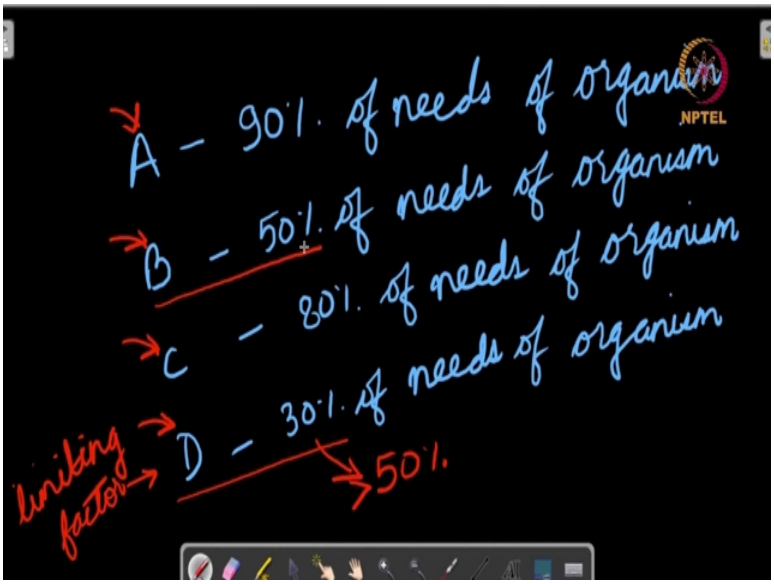

And in this context, there are two laws of ecology. We have the Liebig's law of the minimum. The rate of any biological process is limited by that factor in least amount relative to requirement so that there is a single limiting factor. Meaning that, if you take any organism and the organism requires several nutrients.

So, you have nutrient A, B, C, D, and so on and the environment is able to provide a quantity of A that fulfills 90 percent of needs of the organism. B is available in such quantities that it is able to meet 50 percent of needs of organism. C is available in quantities that are able to meet 80 percent of needs. And D is suppose able to meet only 30 percent of needs of organism.

Now, Liebig's law of the minimum would state that, because D is able to meet the least quantity relative to the requirement, so D will be the limiting factor. And there is only one limiting factor that is if you wanted to increase the amount of nutrients, so if this is the condition and you add more of A that is not going to help in the growth of the organism, because A is already available in a quantity more than D.

If you add more of B that is not going to help, if you add more of C that is not going to help, but if you add more of D then the organism will start to flourish more and this will increase till D becomes greater than 50 percent. At that stage B will become the limiting factor. And so after that stage you will have to add D and you will also have to add B.

So, that is the Liebig's law of the minimum. The rate of any biological process is limited by that factor in least amount relative to requirement so that there is a single limiting factor.

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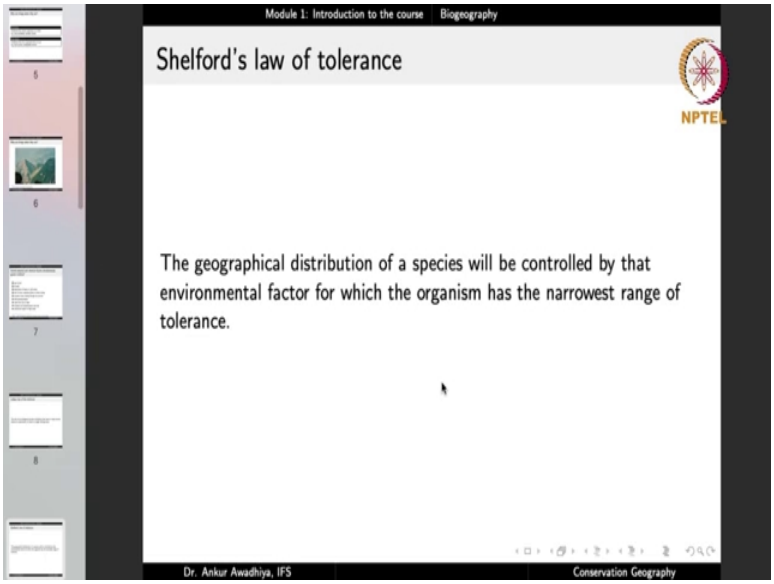

And a related rule is the Shelforld's law of tolerance. The geographical distribution of a species will be controlled by that environmental factor for which the organism has the narrowest range of tolerance. That is, if an organism is able to survive without air for two minutes and the organism is able to survive without water for five hours and in the surroundings or in the habitat there are certain locations that are anoxic locations that is they do not have sufficient oxygen or sufficient air and there are other locations that do not have sufficient water.

Now, in that case, the distribution of the organism will be governed by the presence or absence of oxygen, because it has the narrowest range of tolerance for oxygen. In those locations where you have oxygen, but the amount of water is less, it is possible that the organism will be shifting from one place to another to get, to fulfill its requirements of water.

But in those locations where oxygen is not there, it will probably not be able to fulfill the requirements. And so, the geographical distribution of the species will be controlled by that environmental factor for which the organism has the narrowest range of tolerance. And when we talk about the range of tolerance for environmental factors, there are several things.

So, the range of tolerance could be say for temperature, so an organism is able to tolerate a temperature of say 30 degrees to 45 degrees or you can have a range of tolerance for humidity or you can have a range of tolerance for say sunlight. So, for each and every environmental factors you can have a certain range of tolerance.

And that environmental factor for which the organism has the narrowest range of tolerance, that will govern the geographical distribution of the species. So, that is Shelford's law of tolerance.

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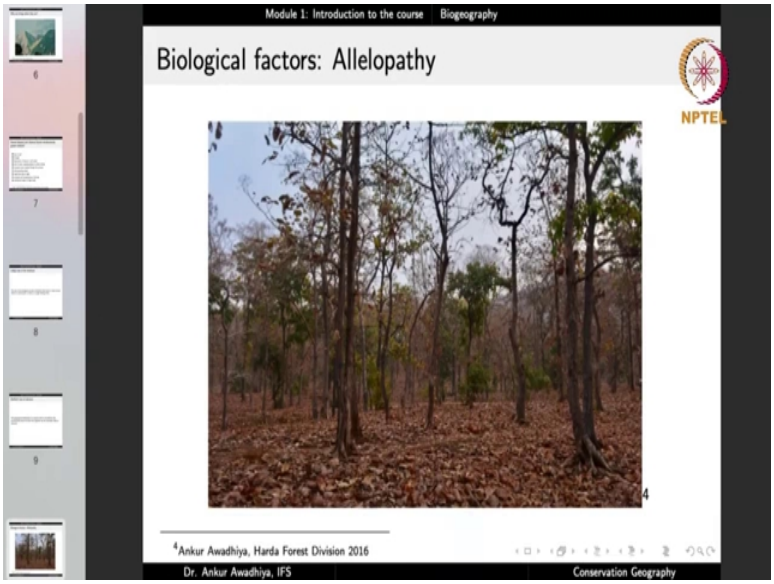

Now, we have a look at what are the different push and pull factors that govern the distribution of different organisms. Now, we have seen that push factors are those factors that push the organisms away that is they create a condition where the organism is unable to survive or

reproduce or flourish. Whereas pull factors are good conditions, suitable conditions that pull organisms towards them and they permit the organism to survive to reproduce and to flourish.

So, now we are going to have a look at certain push and pull factors. And the first one is a biological factor that is allelopathy. Now, allelopathy is a condition in which an organism secretes certain chemicals or exudes certain chemicals that do not permit other organisms to thrive in that area. A very good example is antibiotics.

Now, in the case of antibiotics, we know that penicillin is derived from a fungus of the Penicillium genus, say Penicillium notatum. Now, in this case, the Penicillium notatum will secrete penicillin into its surroundings to kill off the bacteria in its surroundings. And we extract penicillin and we produce penicillin and that can be used as an antibacterial drug, but its natural function is also the same to kill off bacteria in the surroundings of the fungal colony.

Similarly, if we look at, say, a teak forest, now, this is a teak forest in Harda forest division, so Harda forest division is in Madhya Pradesh. And in this forest division we have large swaths of teak forests. And in the case of teak, it is a dry deciduous species. Deciduous meaning that it sheds off its leaves in a certain season to conserve moisture.

Now, that is because the leaves have pores known as stomata, and these pores are playing a role in releasing water through the process of transpiration. Now, in the summer seasons or in those seasons where the plant needs to conserve moisture, it will shade the leaves, so that there are no more stomata and so there is no more transpiration or loss of water.

Now, it is observed that when the leaves fall down, together with the leaves, there are also certain chemicals that are shed together with the leaves. So, these leaves have certain chemicals that prevent the growth of other plants. So, here if you look at the forest floor, you will find that there is hardly any plant growth.

You do not find any herbs, you do not find any shrubs or in any case you will find them in very low numbers. Now, that is because of a chemical that the teak trees are releasing together with their dried leaves. So, that is allelopathy. Now, allelopathy acts as a push factor, because it creates conditions here on the ground that do not permit the other plants to grow in this area, to survive in this area, to thrive in this area. So, that is a push factor.

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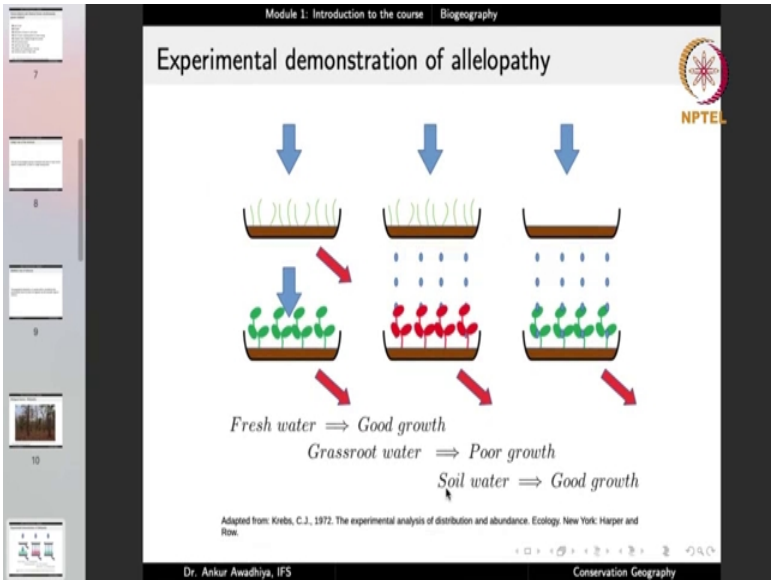

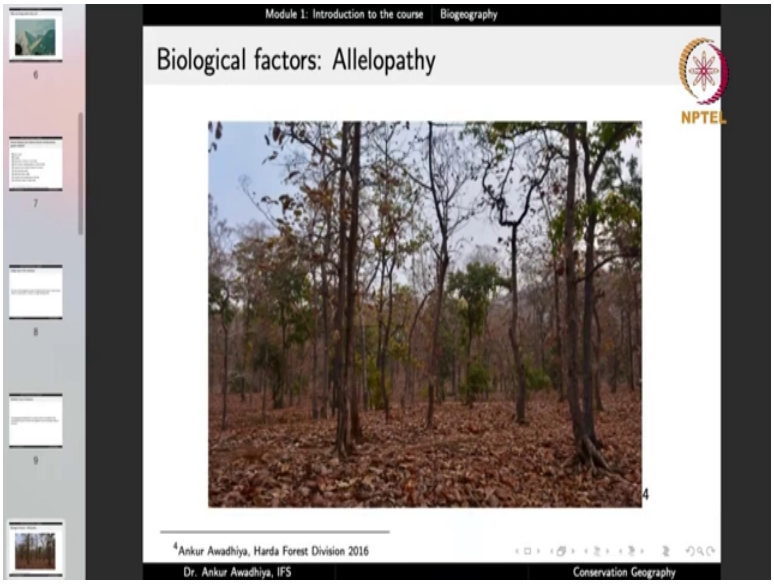

Now, how do we know that there is allelopathy? We do certain experiments. And so, for example, in this case, we are looking at whether grass is doing an allelopathy on these plants. So, what will we do? We will take two cultures, one is the culture of grass in the soil and the second is a culture of the plants that we are trying to test and we put water in the grass and we take the water away. We put water in the plants and we take the water away.

Any excess that has moved through the pot is then drained away. Now, in this case, both of these are getting fresh water and the grass is showing a good growth and these plants are also showing a good growth. So, that is the first set of experiments. The second set of experiments is that we

put fresh water on the grass and the water that overflows or the water that has passed through these grasses and the soil that water is now put to the plants that are growing in the pot.

And in this case, we find that the plants die out, which means that there is something in this medium, there is something in this water that is killing off the plants. So, there should be some chemical that is killing of the plants here. But then is that chemical coming from the grass or is that chemical coming from the soil.

To test that we do a third experiment, in which case we do not grow the grass we just take soil, put water through it, and we put that water to these plants. And in this case the plants are able to survive and grow. Now, that would tell us that if the water is moving through the soil, it is not getting any such chemical that would kill off the plant.

But if the water is moving through the roots of the grass or if the water is moving through the grasses then it gets certain chemicals that kill off the plants. So, that means that the grass must be giving out something, because the only difference between this experiment and this experiment is the presence of grass here and the absence of grass here. So, you add grass and the plants die. So, the grass must be producing something. And the first experiment is a control experiment.

Now, similarly, when we have to show that these leaves are putting an allelopathic impact on the growth of other plants, we take these leaves, we create an extract of these leaves and put that to a medium where the other plants are growing. And if those plants die out, then that would mean that there is certain chemical in these leaves that is killing off the plants. So, allelopathy is one push factor and this is a biological push factor.

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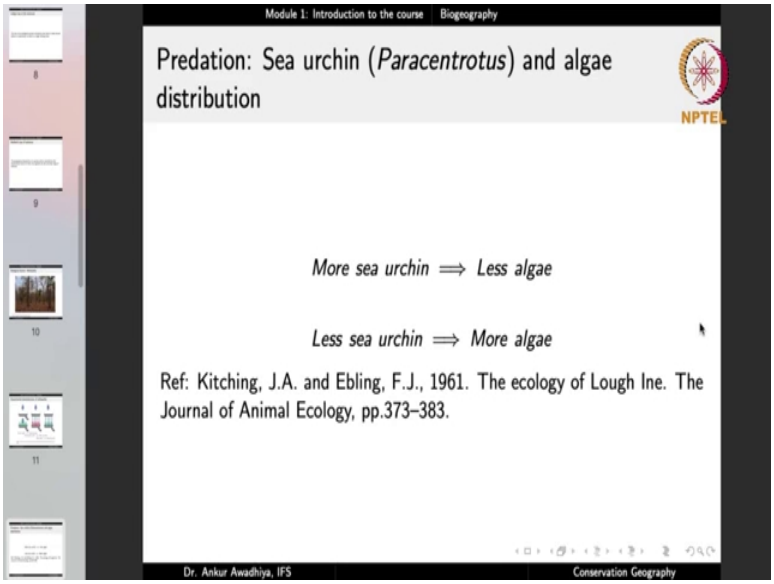

Another biological push factor is predation. And in this case, we can look at this example of sea urchins and algae. Now, experimentally, it was found that if an area has more sea urchin or if you add sea urchin to an area, then the amount of its prey, that is the algae goes down. Now, this is very similar to the case of say tigers and deer. If an area has more tigers then the deer population would go down.

If in an area you have deer population and you bring in tigers from outside then to the deer population would go down. On the other hand, when you had less sea urchin there was more algae. So, similarly, if you have less number of tigers, then the deer population would grow faster. Now, in such cases the predator can govern the amount or the numbers of the prey.

So, the tiger can regulate the deer population and similarly the sea urchin can regulate the algae population. And if an area has too many sea urchins, then you will not find algae in that area, because the sea urchins would finish off all the algae. Similarly, if an area has too many tigers, then probably you will not find any deer in that area, because off over hunting.

So, in many cases predation can govern the distribution and abundance of organisms. Predation is another push factor.

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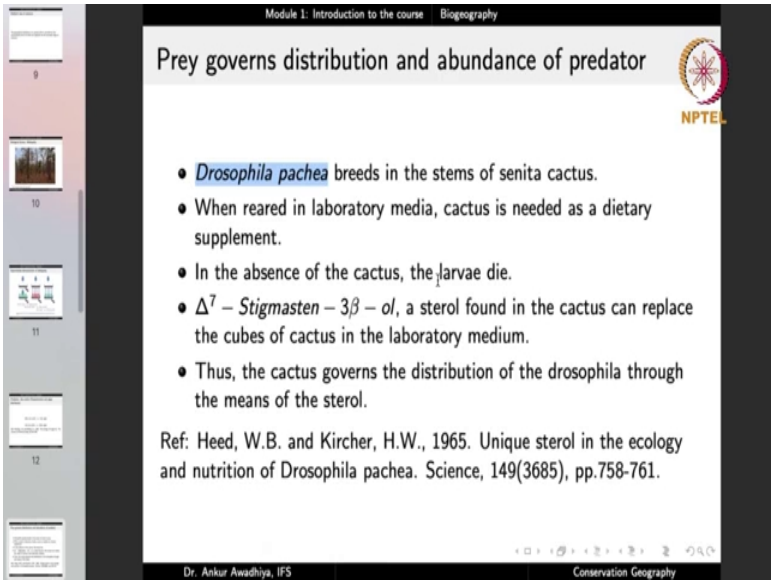

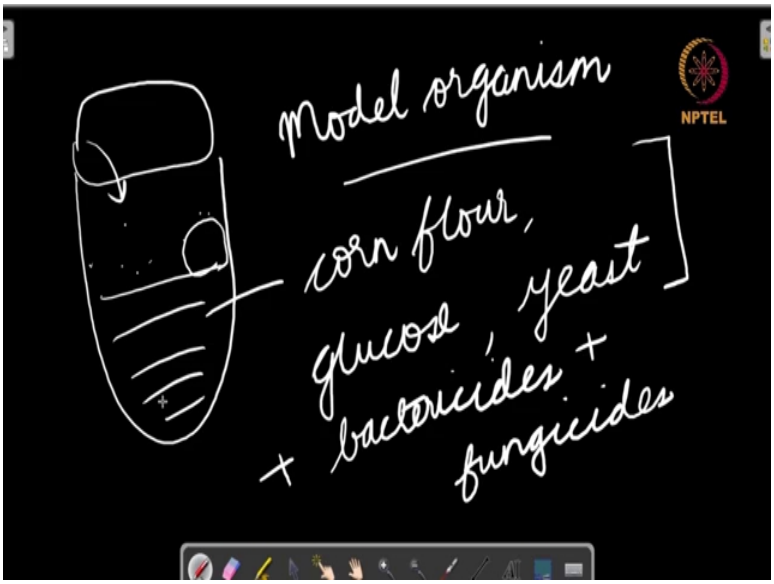

But in certain other cases, there is just the opposite thing that happens that the prey governs the distribution and abundance of the predator. And a very good example here is Drosophila pachea. Now, this is a species of fruit fly that breeds in the stems of senita cactus. And when scientists tried to rear this Drosophila in the laboratory, they found that the populations just died off.

And to maintain the population it was essential to put a piece of the senita cactus as a dietary supplement. That is, if you take a vial of food of Drosophila and typically we rear Drosophila in a medium that contains say corn flour together with glucose and yeast. So, this is typically the culture medium that is used for various Drosophila.

We typically also add certain bactericides and we also add certain fungicides so that the population is kept free from bacteria and fungi, but the food is mostly this, corn flour, glucose and yeast. We take all of these three together, add water, boil it and pour it into vials. And then we put the flies inside and cover the top with cotton. So, in that case the flies are able to get oxygen, they are getting food and so the flies are able to breed here inside.

Now, if we, and we normally do this in laboratories all over the world, because Drosophila is a model organism. Model organism means that this is an organism that can be reared easily in the laboratory, it can be reared cheaply in the laboratory and we can perform experiments on this organism and we can gain certain insides that can be used for understanding other phenomenon in other organisms.

So, for example, if you want to create a model of cancer, you cannot create a model of cancer in a human being because of ethical issues that are involved. So, basically we create models of cancers or models of developmental disorders in these primitive organisms like Drosophila. So, Drosophila is reared in many biological laboratories all over the world.

But if we took the species Drosophila pachea and if we try to reared it in this laboratory medium, then the population just tried off. And it required a piece of this senita cactus in the medium for it to be able to survive. Meaning that the senita cactus was providing it with certain very essential nutrients for its survival and in the absence of the cactus the larvae die.

And it was found that this sterol delta 7 Stigmasten 3 beta ol which is found in the cactus can replace the cubes of cactus in the laboratory medium. That is if you take this sterol and if you put that into this growth medium then your Drosophila will be able to survive. So, in this case, this sterol which the cactus was generating in its body that is governing the distribution of the Drosophila, meaning that in this case the prey is governing the abundance and distribution of the predator. A similar example is, if in an area you have deer, you can have tigers.

But in an area where you do not have deer or other prey of tiger then you will not be able to have tigers in those areas. So, not only does the predator govern the distribution and abundance of the prey, but in certain cases the prey can also govern the distribution and abundance of the predator. So, this is a pull factor. If you have prey, then only you will have the predator. So, this is the pull factor and this is a biological pull factor.

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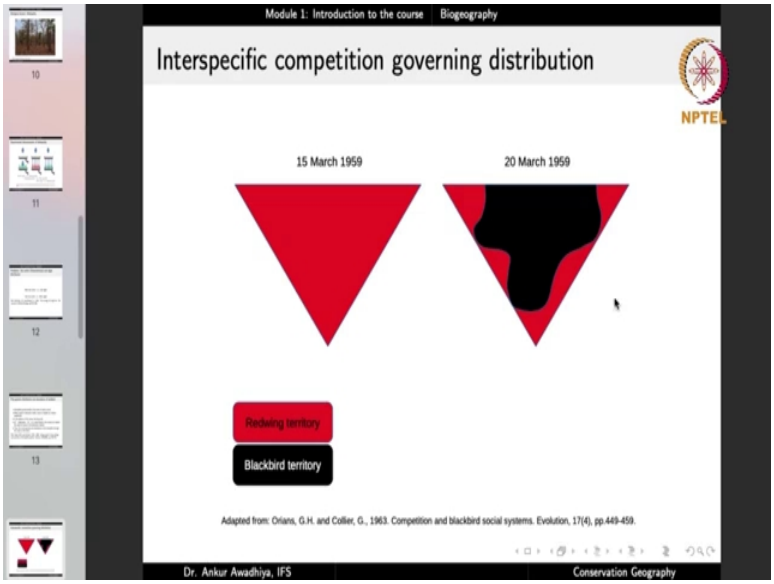

Now, a push factor is interspecific competition. That is if you consider an area that is occupied a redwing bird and later on it was found that five days after this much of the area was occupied by the blackbirds and the redwings were thrown into these outer periphery areas. Now, in this case the example being told is that certain organisms show an aggressive behavior and they push other organisms away.

So, if there is an organism that shows an aggressive behavior that can become a push factor. A very good example in the case of humans is that, when we take our cattle into the wild life areas for grazing, we normally take our dogs with the cattle, we also take things like lathi sticks or even guns with us. And in that case we push the wild animals away in a process that is known as habitat displacement.

So, we displace the wild animals away, so interspecific competition. In this case, there is a competition between humans and the wild animals and the humans are displacing the wild animals through aggression and through hunting. So, in this case, interspecific competition can also govern the distribution. It will act as a push factor.

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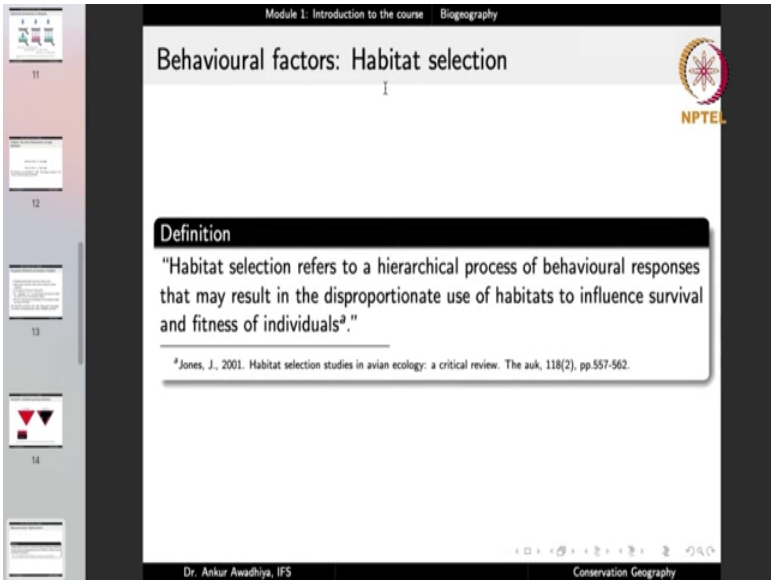

In certain cases, there are behavioral factors that are involved such as habitat selection. It is a hierarchical process of behavioral responses that may result in disproportionate use of habitats to influence survival and fitness of individuals. So, what is habitat selection mean? It means that while a bird for example can make a nest in different trees, but it will have a certain preference.

So, you can have a species of birds that prefers to lay its eggs in a nest that is build in a mango tree and it does not prefer to make its nest in a peepal tree. Now, you may think that, even in the case of a peepal tree the bird is getting sufficient amount of protection, it is getting a very good amount of cover and the peepal tree is strong enough to hold the nest, but still the bird will have certain behavioral preferences and these behavioral preferences are known as habitat selection.

So, if two or more different habitats are available, the organisms prefer something behaviorally and that is habitat selection. So, habitat selection also acts as push and pull factor. So, those habitats that are not selected they become push areas and those habitats that are selected through behavioral responses they become pull areas.

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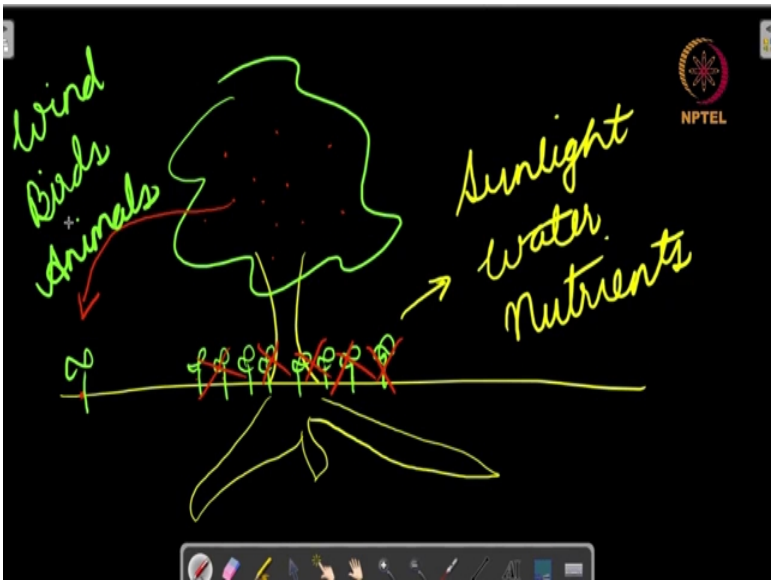

Other factors that govern the distribution are dispersal of organisms. Dispersal is the moment of individuals away from their place of birth or hatching or seed production into a new habitat or area to survive and reproduce. Now, what does that mean? If we consider a tree that is growing on a piece of land, so this is our tree.

Now, the tree makes fruits, it makes seeds and if all of these seeds were to fall down here then the next generation would come up here in the shed of the mother plant. So, in this case, the young ones will not be getting sufficient sunlight. At the same time they will have to compete

with the mother plant for other resources because the mother plant is having an extensive root system. So, in this case the plants do not get sufficient sunlight.

They do not get sufficient water. They do not get sufficient other nutrients. And in that case these plants will not be able to show a good growth. It is also possible that in a short period of time they will all die off. Now, to prevent such a sorry state of affairs we have the process of dispersal. So, dispersal is the moment of organisms away.

So, if a seed falls here and if a young plant comes up here then it is not competing with the mother plant. It is at a far off distance. So, it is able to survive better. It will be able to grow into a tree and probably reproduce. So, dispersal is the moment of individuals away from their place of birth or a hatching or seed production into a new habitat or area to survive and reproduce.

In the case of plants, this moment can occur because of wind. If certain seeds are small in size, if they have say a cot nib all with them then they can move with wind or they can move with the birds. In a large number of cases when the birds eat the fruits then the seed moves through their intestines and it comes off with their droppings or it can move with say animals.

If there are certain seeds that are sticky so they can stick to the fur of animals and they can move with the animals. So, we have n number of modes of dispersal. And similarly in the case of animals as well, there is a dispersal into newer areas.

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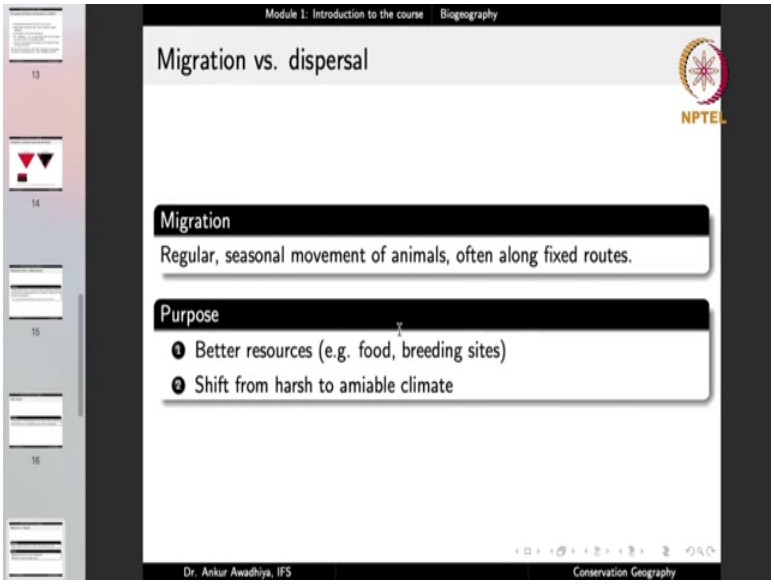

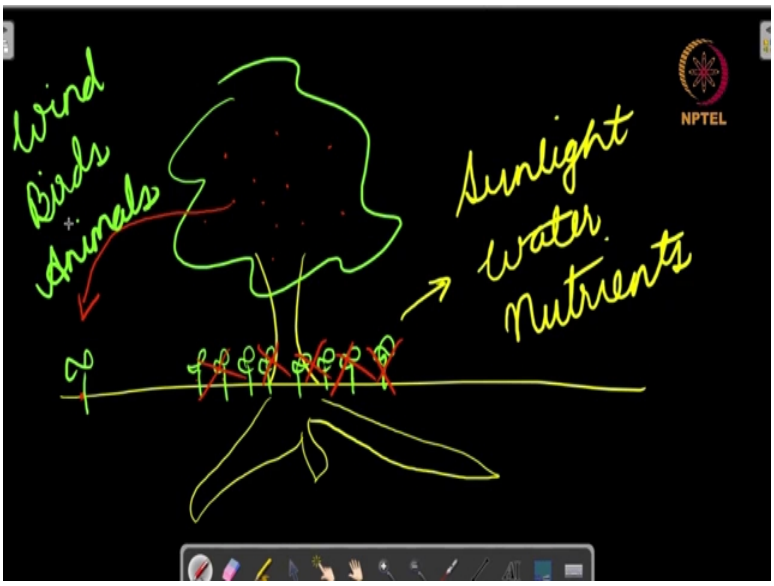

Now, in this case we are not talking about migration. There is a difference. Migration is the regular seasonal moment of animals. Migration is regular. It is seasonal. It happens only in certain seasons and often along fixed routes. But in this case we are not talking about a fixed route. The seed can be dropped here or say the seed can be dropped here. There is no fixed route. It is not seasonal. It is not regular. Migration happens to get better resources which are the pull factors or to shift away from harsh climates which are the push factors.

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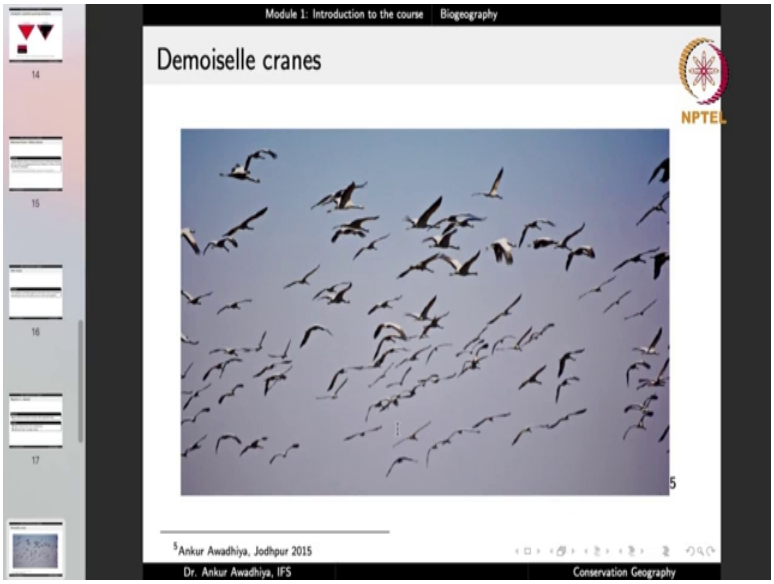

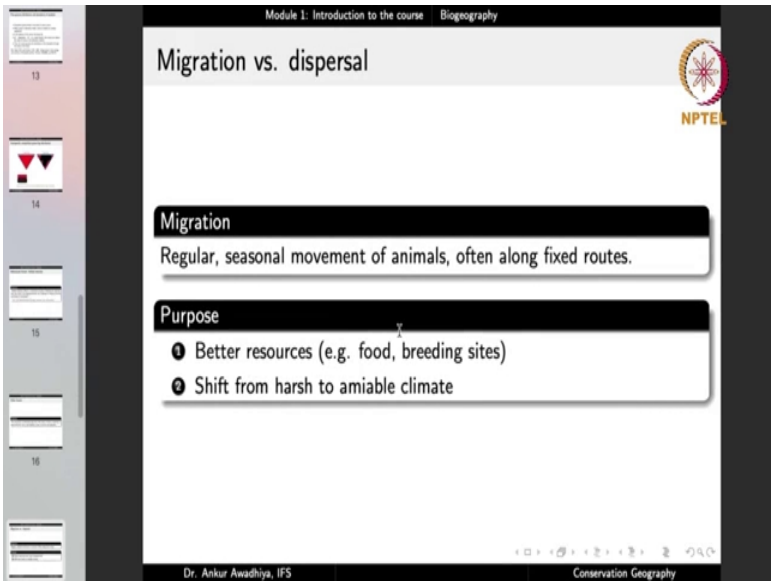

So, we normally see migration, say in the case of birds, these demoiselle cranes they spend the winter seasons in our country, because our winters are not that cold and they spend the summer season in other countries because our summers are very warm. So, you will normally find them in huge flocks. So, this is the picture from Jodhpur, this is another flock from Jodhpur. And in these cases you will find a large number of birds and they are moving regularly.

They are moving seasonally. So, they move at the start of summer and winter seasons. Often along fixed routes, so their migration pathways are well determined. So, this is a regular moment. So, this is migration.

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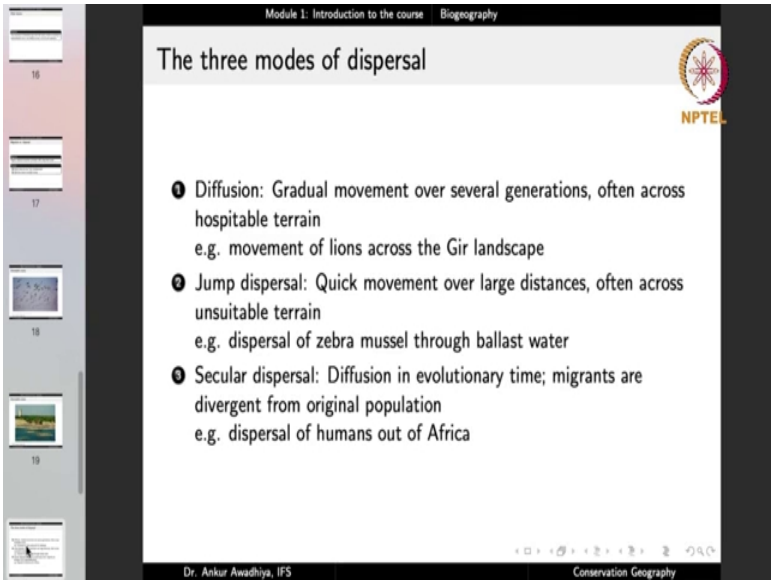

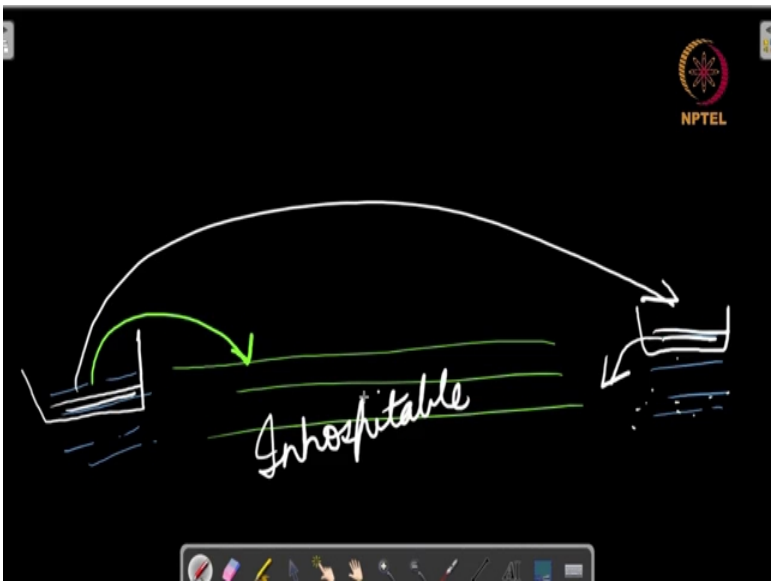

But we are talking about dispersal. Now, dispersal can happen through three different modes. We have diffusion, jump dispersal, and secular dispersal. Diffusion is gradual moment over several generation often across hospitable terrain such as moment of lions across the Gir landscape. Or in the case of this tree, we can say that there is a large span of land that is available.

You have one tree here. And say after 10 years you start to find trees here and here then after 20 more years this tree has spread to this much area. So, there is a gradual movement over several generations and that is diffusion, gradual moment over several generations often across hospitable terrain, because if you took the seeds of this tree and if you manually put it here then you will have a tree that grows up here as well.

But then because there is nobody to take the seeds to the other areas so the natural process will happen very slowly so that is diffusion. Another is jump dispersal; quick moment over large distances often across unsuitable terrain such as dispersal of zebra mussel through ballast water. Now, in this case what happens is that the zebra mussel can survive in fresh water areas. So, you have a fresh water lake here and you have a fresh water lake here.

But in between you have the salty ocean. Now, in this case the mussel if it went into the salty waters it would die. So, what it does is that it hitches a ride that is if there is a ship that has to move from this location to this location, then it would get into the ballast water of this ship and together with the ship it would move through the ocean to this location.

And when the ballast water is taken out, then the mussel will be able to propagate in these areas. So, in this case this is a very fast moment, because it is happening on a ship and through inhospitable terrain, because here you have a saline water. So, that is jump dispersal, quick moment over large distance often across unsuitable terrains.

And the third one is secular dispersal, which is diffusion but that is happening in evolutionary time and in this case the migrants are divergent from the original population, such as the dispersal of humans out of Africa. Or in the case of our tree example, if this diffusion were to happen so slowly that by the time it reached to this spot, the tree had actually become very different. So, it had started to show a very different kind of leaves.

And so now this tree looks very different from this tree which was there in the beginning, because the process is so slow that evolution has happened in the mean time. In that case, we will call it a secular dispersal. So, dispersal is another factor that governs the distribution and of different organisms on this planet. It is possible that you have a good suitable habitat for an organism, but the organism has not yet reached, because the dispersal has not yet happened. That is also possible.

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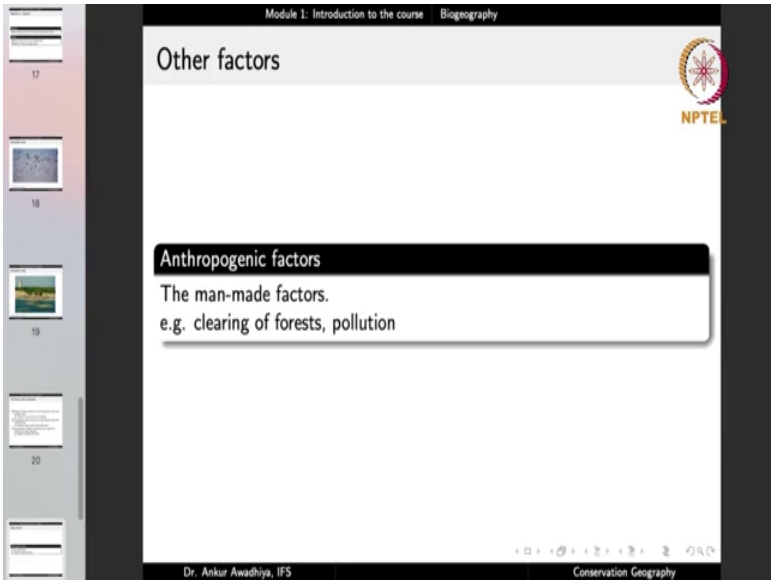

Other factors include the anthropogenic factors. Anthropos, we have seen that, it means mankind. So, anthropos plus genic, genesis is formation, so this is a factor that is produced by the human beings, manmade factors, like clearing of forest or pollution.

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Now, if you look at this image, this again is from the Shivalik Hills of the Himalayas, and here we can observe that in this location the humans have cleared off the forest. They have made certain homes. They have made certain other structures. Now, if the humans had not come into this area then all of this would have been full of trees.

Now, this area does not have trees because they have been artificially removed. They have been removed by mankind. And we have observed that in the geological time period of anthropocene the humans have become a very important factor. So, now when we talk about Biogeography we cannot ignore the human factors, because humans have become one of the most dominant factors when it comes to Biogeography.

We are moving organisms in the ships. We are creating pollution to act as a push factor. We are clearing off forests. We are killing off animals. So, that has also become a very important push factor.

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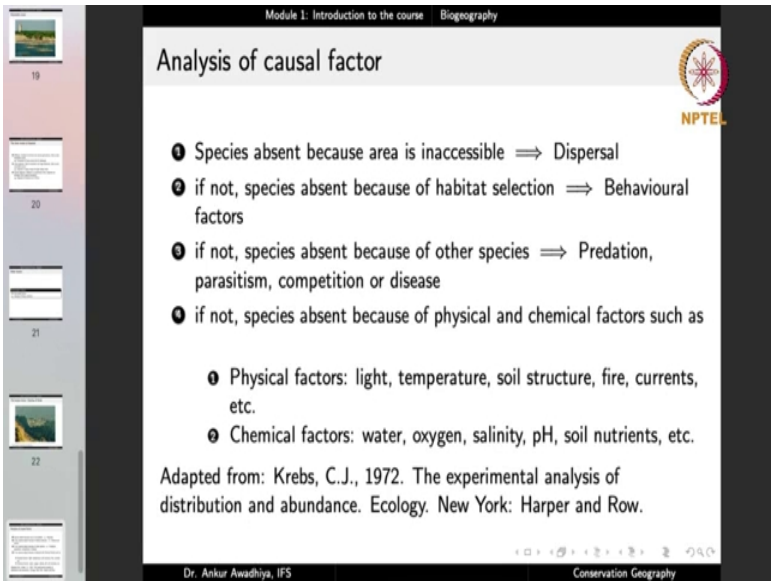

Now, with all of these different factors, if we find an organism in a place or if we do not find an organism in a place, what is the main cause of it being present or not. Now, that can be analyzed through the analysis of various causal factors. In certain cases species are not present because the area itself is inaccessible, which would mean that this species has not dispersed to that area.

So, dispersal can be a causal factor. If not, if the area is accessible but still species are not coming, it could be because of behavioral factors. The species just do not prefer that area. If behavioral factors are also ruled out then it is possible that there are certain biotech factors, there is predation that is happening. There is lots of predators.

There are can be parasitism, competition or disease that is allowing the species to live in that area. If these also are ruled out then the absence can be explained because of certain physical and chemical factors like light, temperature, soil structure, fire, currents, or chemical factors like water, oxygen, salinity, pH, soil, nutrients and so on.

Now, these factors act as push and pull factors and govern the range and distribution of different organisms. Now, if the habitat where these pull factors are found, if they are lost, the species will also become extinct. And so the study of these push and pull factors or the study of Biogeography is very important for the cause of conservation.

So, that is all for today. Thank you for your attention. Jai Hind!