Wildlife Conservation
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Lecture - 11
What is habitat?

[FL] Today we begin a new module Monitoring and managing of habitats. So, this module will consist of 4 lectures; what is the habitat? Habitat degradation loss, fragmentation and displacement, reserve selection and design and habitat management and improvement. So, let us begin with the first lecture of this module, what is the habitat?

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So, as you can see on your screens, habitat is defined as the sub set of physical and biotic environmental factors; that permit an animal or a plant to survive and reproduce. It is a species specific concept associated with a geographic location. So, basically what we mean by a habitat is that in the environment we have certain physical factors and we have certain biological factors. Now, any organism will be able to tolerate only a certain set or a subset of these factors. So, for instance in the case of us human beings we have a temperature optimum of close to around 25 degree Celsius.

Now, in places that are very hot for instance; in the case of deserts where daily temperature goes to say about 60 degrees. So, in those areas you will find very little a

number of human beings that live in those areas, similarly in areas that are extremely cold. However, in the midpoint most of us human beings would be very comfortable. Now, this is regarding one factor which is temperature, similarly we can have an optimum condition for other factors such as the amount of rainfall that the area receives the amount of moisture that is there and so on.

So, habitat is defined as the subset of physical and biotic environmental factors. So, this subset also includes the biotic environmental factors. So, when we say biotic environmental factors we include things like do we have enough food to sustain in that area. Do we have any predators that are going to prey upon us, if will go and live in that area. So, both the physical factors as well as the biotic factors that permit an animal or a plant to survive and reproduce. Now, we have these terms survival and reproduction because even if you take an animal or a plant to an area which is not very optimum for that plant or animal.

So, it might survive in those areas, but it is generally observed that an animal or a plant reproduces only when the conditions are most optimum for that organism. So, which permit or plan to survive and reproduce, it is a species specific concept associated with a geographic location. So, this is a species specific concept it means that a certain location and it is associated with a geographical location. So, a certain location might be a good habitat for one organism and might not be a good habitat for some for certain other organism. So, for instance in the case of a of very salty water bodies, we have some organisms that go by the name of halophytes.

So, those organisms prefer those areas in which you have a very high concentration of salt; however, the other organisms which generally are found in more temperate sorts of climates which are called as mesophytes if you put those plants there they are going to die. So, a salty marsh might be a suitable habitat for a halophyte, but not be a suitable habitat for some other organism. So, the habitat is an extremely species specific concept and it is associated with a geographical location.

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Now, when we talk about the physical factors of habitat we have things like soil. so the amount of soil cover that the area has the kinds of soils that it has, whether it is black soil whether it is red soil whether its lateritic soil so on. The level of moisture that is there is a too much, is a too little, is it somewhere in between. Temperature, do we have extremes of temperatures or do we have a more enabled temperature, the light intensity in that area.

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And when we talk about biotic factors of the habitat we have things like vegetation, availability of food, presence or absence of predators and so on. So, before we move forward let us have an overview of the major Indian habitats and their residents.

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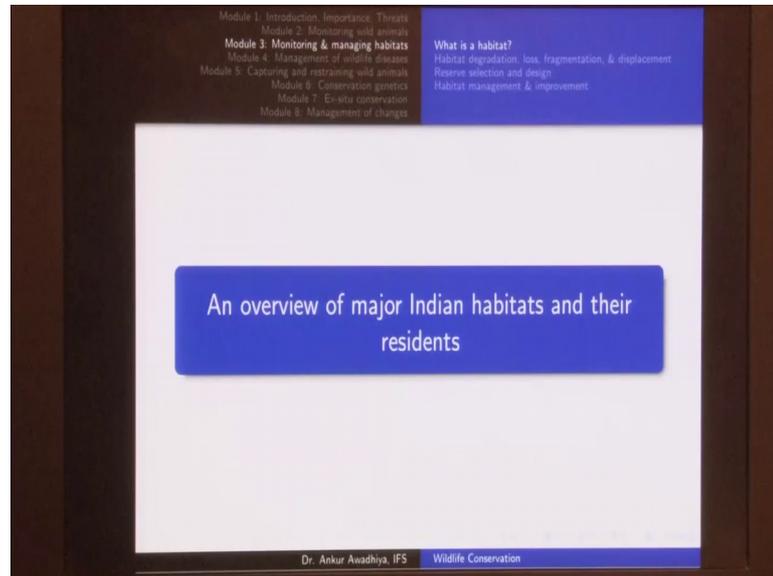
So, let us begin with the north of the country so we have alpine meadows.

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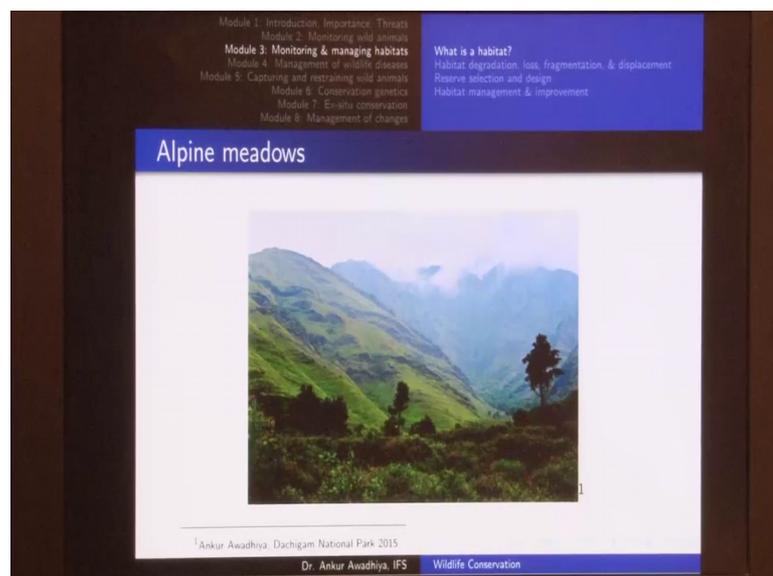
Now this is a picture from the Decigram National Park in Srinagar, And Alpine meadows refers to the fact that these areas have this hills or mountains and meadow refers to this patch or this layer of grass that is that you can see everywhere. So, these areas are

extremely cold areas we do not see much of trees in these areas especially in a higher altitudes. In the lower altitudes you would find a few trees, but in the higher altitudes the the grass is the predominant vegetation that is found. And it supports the number of species which are mostly found in these areas, so things like Hangeul. So, Hangeul is a sort of a herbivore which is found only in these areas.

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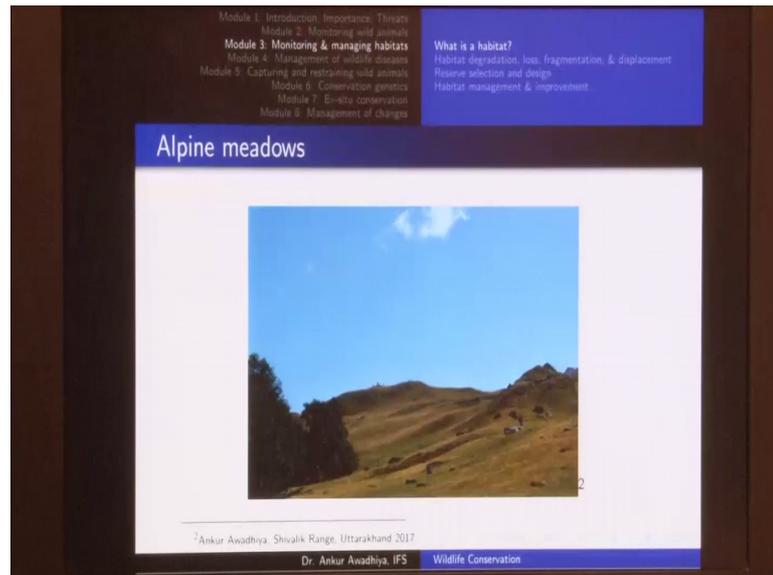
We have alpine meadows also in the state of Uttarakhand so this is an area from the Shivalik Range. And here also you can see that we have extensive areas that only have grasses around. Now a certain organism that prefers to live in trees might not find this area very suitable; however, certain organisms that prefer living in grasslands would find that that this is a very suitable habitat for those organisms.

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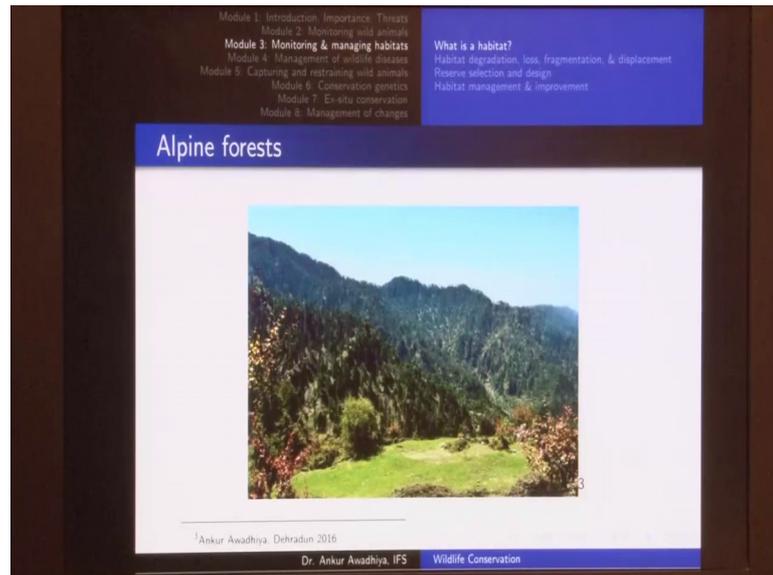
Next when we move down we see these structures called as Alpine forests. So these are still mountainous areas, but now we are seeing a large growth of trees in these areas so this is a picture from Dehradoon.

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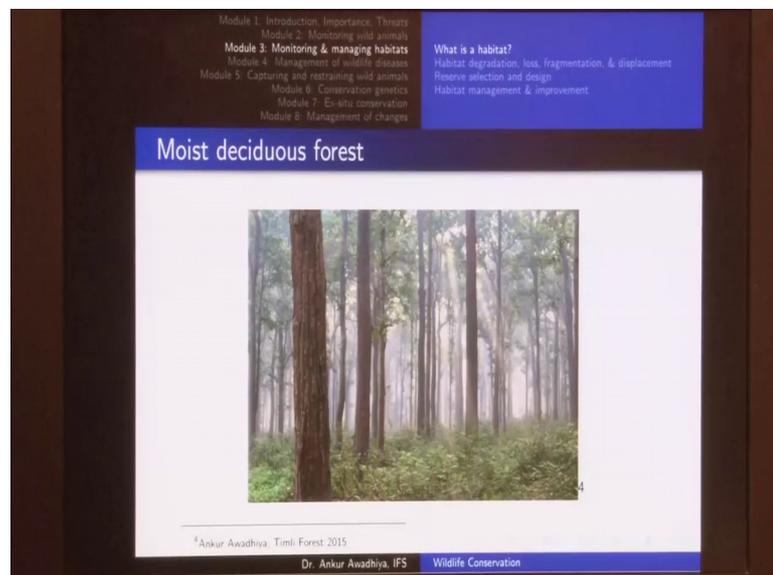
When we come down even further, we would come to a moist deciduous forest. Now in a moist deciduous forest so like this forest which is seen in Timli. So, we have a large patch of salt trees there, now when we see a deciduous forest; deciduous forest means a

type of forest in which the plants or the trees shed their leaves in the dry seasons to conserve moisture. So, this is a deciduous forest and this is a moist deciduous forest.

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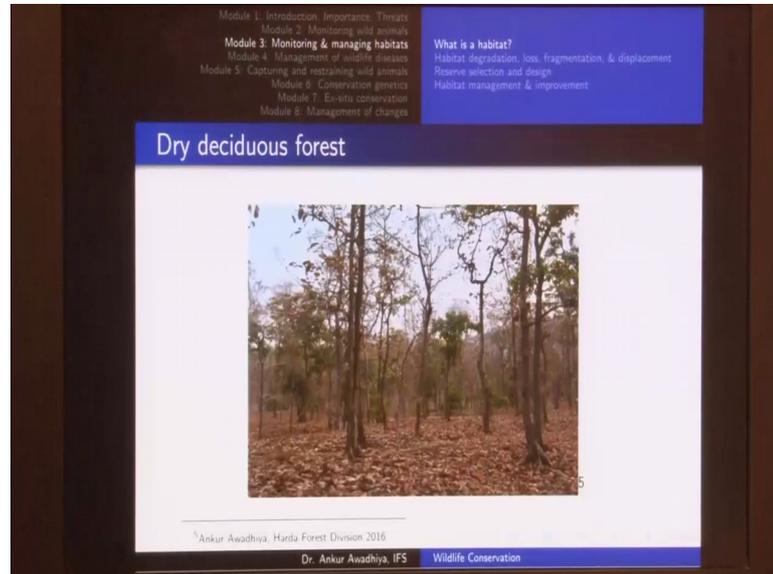
Because even though you have trees that are shedding their leaves, but the level of moisture here is greater than what we find in a dry deciduous forest. So, this is an example of a dry deciduous forest from the Harda forest division in Madhya Pradesh. So, in Madhya Pradesh are the dry deciduous forests would comprise mostly of trees such as the teak tree. So, here also you will find that in the dry season the trees will shed off their leaves and this is dry because the level of moisture here is less.

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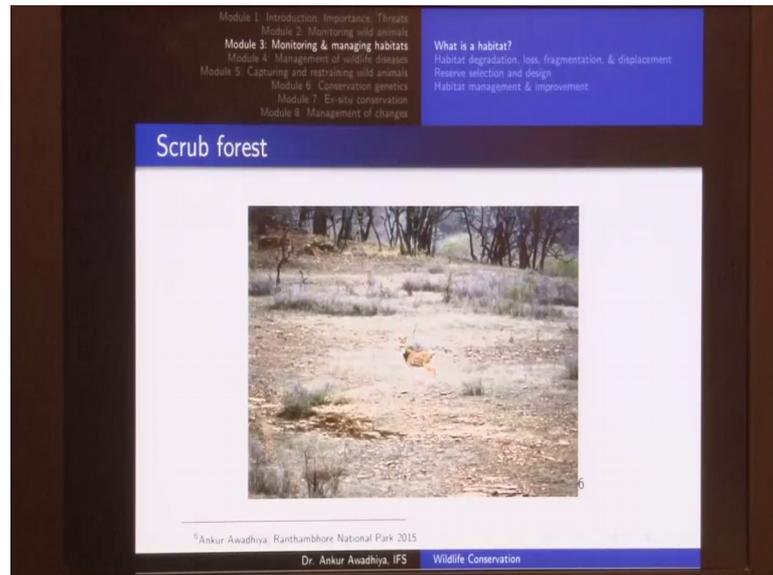
Next if we move to even drier areas we would reach places which have scrub forest. Now in the case of scrub forests so like this picture is from Ranthambore National Park. Now in the case of scrub forests you would have areas in which we do not have large sized trees but mostly we have these grasses, we have some thorny plants and we have trees such as acacia so these from the scrub forests.

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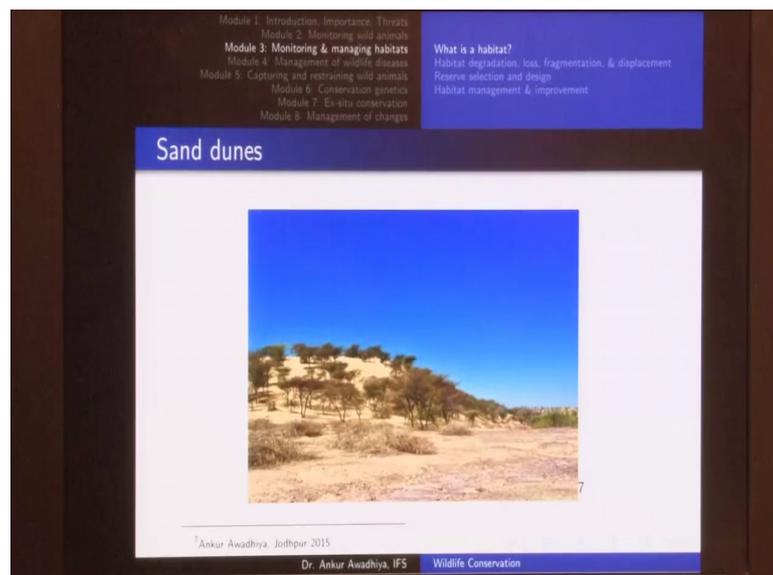
In even more drier areas we would reach the Sand dunes so this is a picture from Jodhpur. And here you can see that this is a big sand dune and we have planted these trees to stabilize the sand dune so that it does not move often.

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Now, in these areas which are extremely dry we would find certain animals that are not found anywhere else. Such as this spiny tailed lizard which is found in the desert national park. So, this only resides in areas that are too dry for a number of other species.

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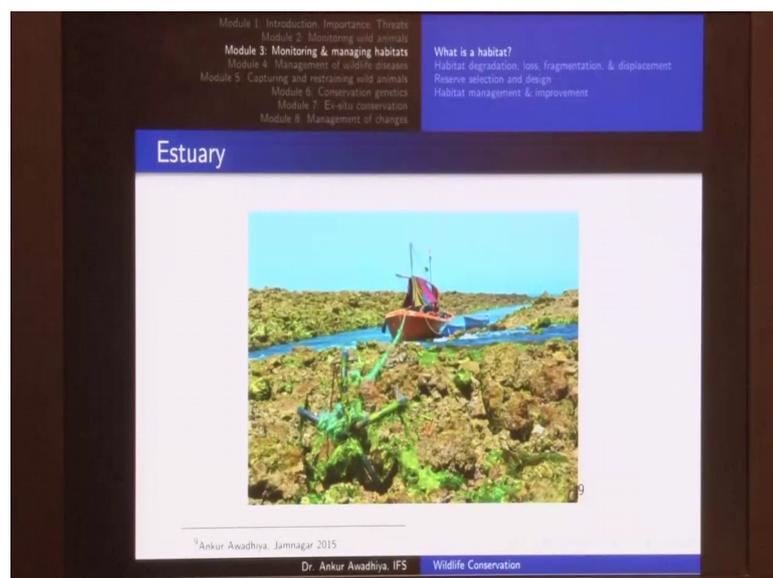
Now, one other habitat is the Estuaries so Estuaries are areas where rivers come and merge with the seas. So, this is a picture from Jamnagar so in these areas we would find plenty of water quite a lot of soil because in these areas the water is quite a lot of rocks. Because in these areas the soil is being washed away by water and we would find some organisms that are not found in the drier areas.

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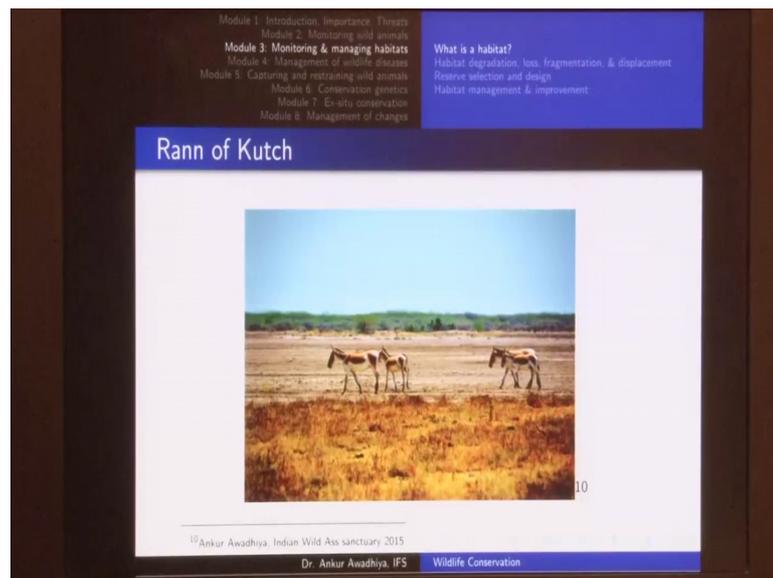
Then in the Indian Wild Ass Sanctuary which is there in the Rann of Kutch. So, we can see that that this habitat is very different from what we had seen earlier. So, here we have very flat lands these lands are extremely dry, in the monsoon season most of these areas would fill up with water. But then this water would drain out very fast and then in the dry season these areas would be fast dry. And we would find animals such as the Indian wild ass which is found only in these areas.

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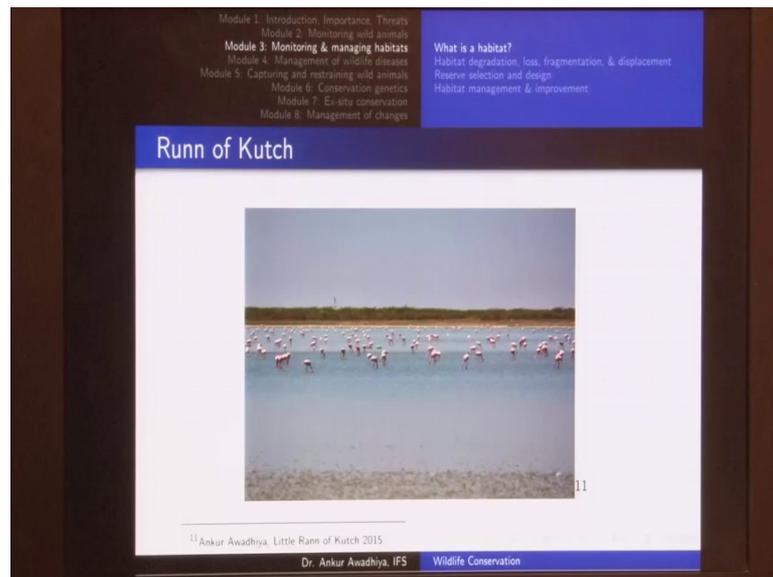
Now, Rann of Kutch an areas where we have some water bodies would have species such as the flamingos.

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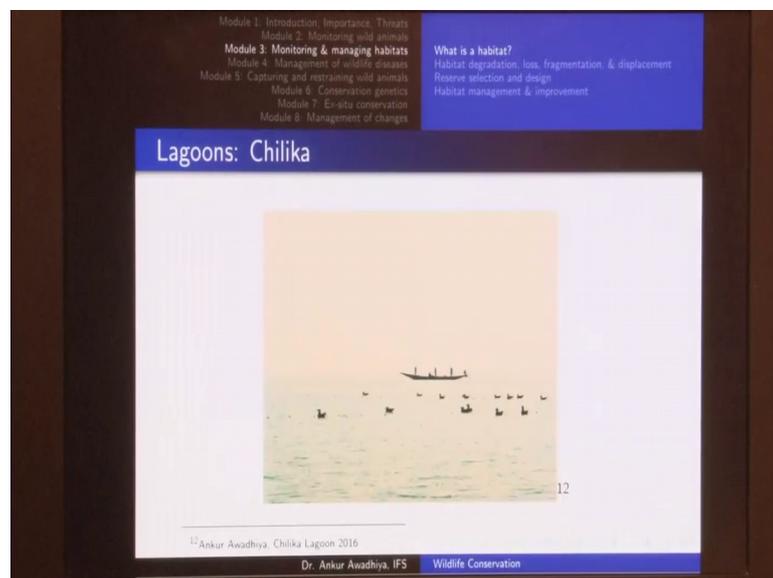
Then moving to the East of the country, we have Lagoons such as the Chilika Lagoon. Now in the case of Chilika Lagoon we have a mixing of fresh water and the sea water. So, essentially we have a gradient of salinity that is found in these areas. And this gradient of salinity supports a number of birds and animals and animals such as the

Irrawaddy Dolphin, which are found only in these areas in our country. So, as we can see even the mixing of water could create a very specific habitat for certain animals.

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Now, moving to the northeast of the country we have the Brahmaputra floodplains. Now in these areas we can see that our visibility is quite large so we can see from here up till there because this is a very flat land. So, this is flood plains so all of these areas are filled with alluvial deposits. And we have plenty of grass and this area also supports a number of animals including our Swamp deer's and even the Rhinoceros.

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So, this is another picture from the floodplains. So, in these areas we can observe that we have also quite a lot of water there in the background. So, these areas are very marshy areas and these form a very specific habitat.

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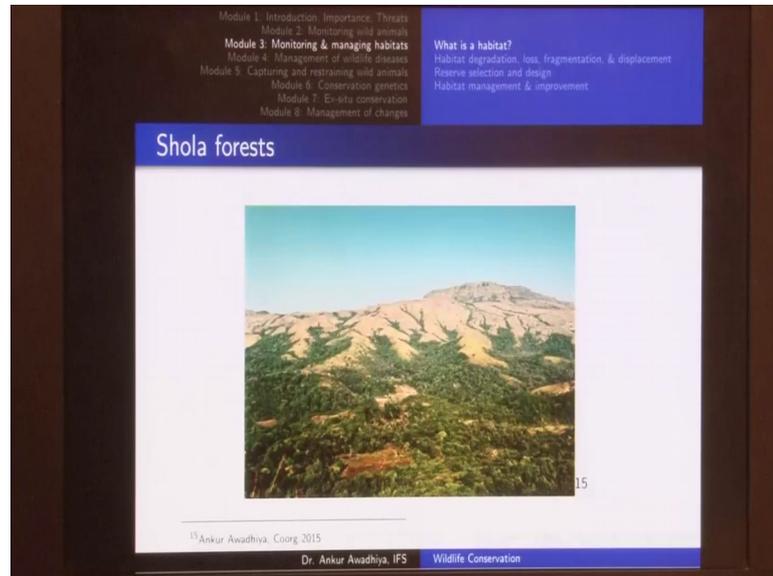
Now, we also have Shola forests in our country. So, in areas of Karnataka and Tamilnadu we would find areas in which we have trees, we have grass and there is a dynamic equilibrium between these trees and the grass and these forms the Shola forests. Now, Shola forests are a very unique ecosystem and they provide habitat to those animals which can utilize the grass for food and can utilize also the forest for the cover. So, essentially the animals that would be found in the Shola forest are those that are not found anywhere else.

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Similarly, in the case of Equatorial forest so, if we go to Andaman and Nicobar Islands, we would find equatorial forests in which we have very tall trees and these areas receive abundant sunshine, the temperature is quite high nearly all the seasons and these areas also receive quite a lot of rainfall. So, if you can see this log so here is an elephant for comparison and here is a human being for comparison and we can see that this log is a very huge sized log. So, most of the trees in the equatorial forest are not only very tall they are also extremely wide in their growth.

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Now, we also find Mangroves in areas so this is a picture again from the Andaman's. But mangroves are also found throughout our sea coast. So, these trees have very specific structures. So, if you can observe the roots here. So, these roots are curving down to provide support in a very marshy area. And then these roots would also turn upside to expose themselves to the air. So, that they are able to get oxygen in a structure that is known as the neumatophor.

Now, mangroves even though this is these comprise of a few species of trees they form a very unique habitat by themselves, Why? Because in the case of these roots. They have a very mesh like structure, even down into the water and these become very good spawning grounds for fishes. Because if there is a fish that has a laded eggs inside of these mangrove roots then it is difficult for predators to come into that area and eat those eggs.

Similarly, these areas become very specialized habitats for crocodiles, why? Because crocodiles cannot chew. So, essentially if they have a piece of meat, if they have killed an animal they would bring it into these mangroves and then they would attach them to these roots and then they would turn themselves in a round and round fashion so that this meat gets teared apart. So, when we talk about the biotic factors that are governing our habitat so this is a very good example in which there are these trees that are the primary determinants of the habitat.

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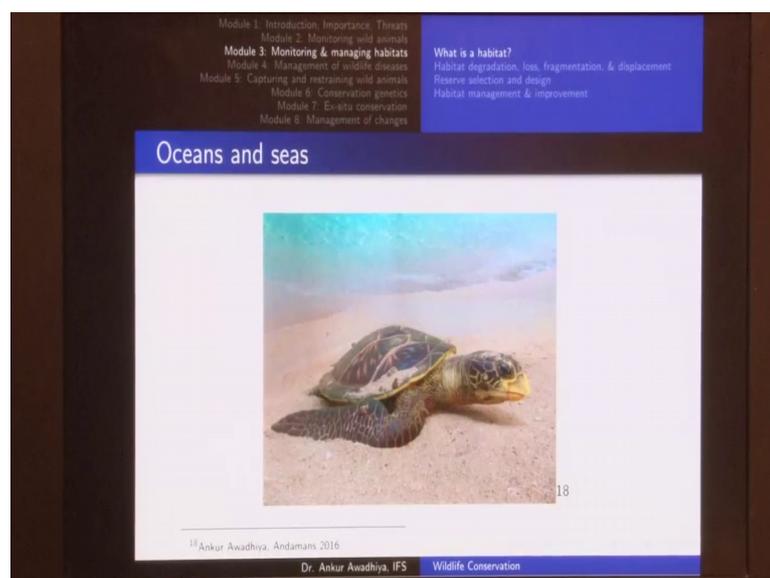
Then we also have our Oceans and Seas which also provide a very unique habitat for some other animals such as such as turtles.

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Now, when we talk about habitat and when we talk about species we can find that every species is localized to certain habitats. So, if we look at the distribution of Snow Leopard, we would find that that the Snow Leopard is found in the mountainous areas mostly in the very cold areas. And we can see that its distribution is only there in the Himalayan states of our country.

We do not have it in the Central India or in Southern India so essentially when we are talking about the conservation of any species it becomes of paramount importance, that the habitats are also conserved because only when the habitats are conserved we will we be able to conserve these species.

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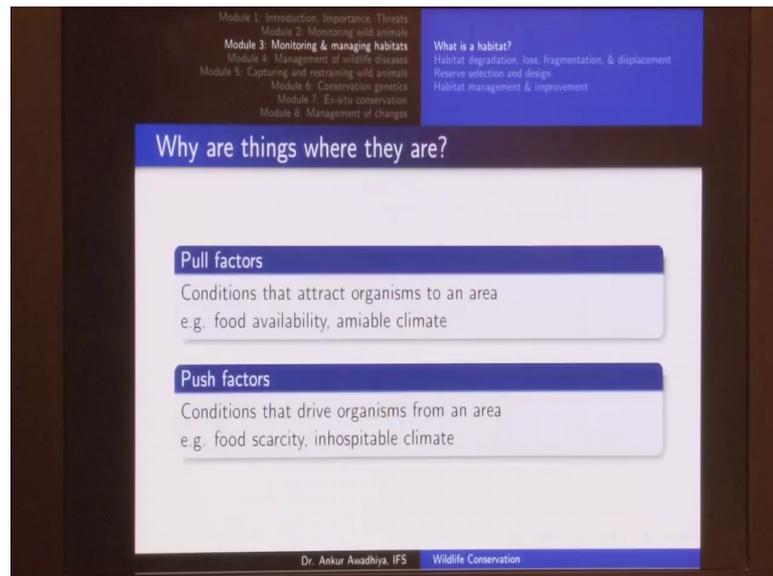
Now, talking about the animal distributions the next question that comes up is why are things where they are? So, essentially when we say that the snow leopard is distributed only in these areas. Why is the snow leopard distributed only in these areas? So, there are two kinds of factors that determine why things are where they are? The first set of factors go by the name of Pull factors.

So, Pull factors are conditions that attract organisms to an area such as good food availability and an amiable climate. So, essentially if you are having an area which is extremely suitable then no doubt the animal will be attracted to that area and these factors go by the name of Pull factors.

The other factors are called Push factors that drive organisms away from an area. So, essentially if you have an area where you have a scarcity of food or maybe you have quite a lot of predators for the animal it might not prefer to live in those areas. Similarly things like inhospitable climate, if it is very warm, if it is very cold, if it is very dry, or if it is very wet, for the animal then the animal would move out of that area and these factors go by the name of Push factors.
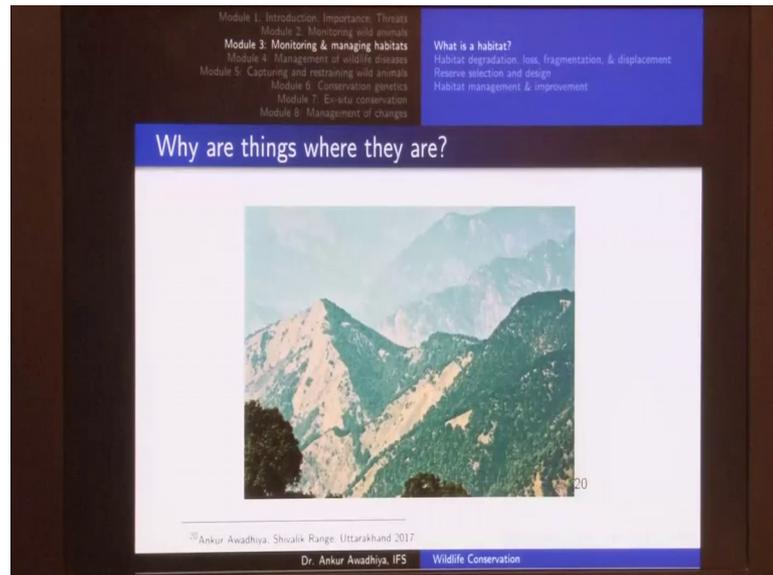
So, let us look at this image, now this image again is from the Shivalik Range of Uttarakhand and here we see some mountains or you may even call them hills because the height is not very high. But we can observe that on these slopes there is hardly any vegetation whereas, on these slopes we can observe that we have quite a lot of vegetation mostly in the form of trees.

So, now the question would be; why do we find trees here? And why do not we find trees here? So, can you think of some push and pull factors because these areas are so close together so push and pull factors must be playing a very important role to determine why trees are here and not here? Now, one push factor in this area could be the absence of soil.

So, as we can observe these slopes are very steep slopes whereas, these are more gentles slopes. Now in a steep slope whenever we have any amount of rainfall all the soil would drain down so these areas are basically barren rocks. And if we have a plant species or a tree species, that wants to grow there then trees require soil to grow and because we do not have any soil here.

So, in the absence of soil becomes a push factor in these areas. Whereas, in these areas because the gradient is less so probably we have much more amount of soil that is resident in these areas so, the presence of soil in this case would become a pull factor for

these species of trees; another thing could be that in the case of these slopes so this is a certain facing slope.

So, this would receive sunlight for most part of the year whereas, these areas because it becomes an eastern facing slope and this becomes a western facing slope. So, it does not receive sunlight for all throughout the day and in such situations we observe that these areas which are very nearly lit with sunlight they lose quite a lot of moisture.

So, essentially these areas not only have less amount of soil or essentially no soil. But these areas also are much drier as compared to these areas. So, in this way we can observe the functioning of push and pull factors even in a hill.

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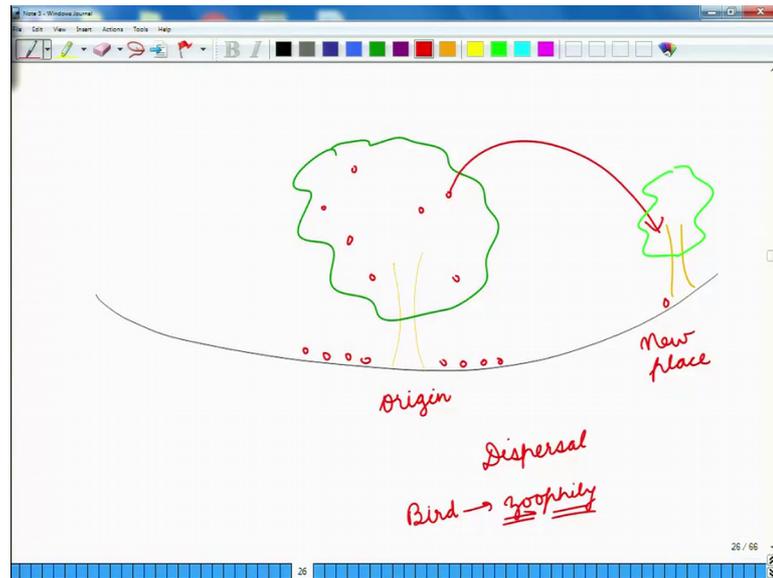Now another thing that governs why and where an organism would be things like dispersal. Now, dispersal is the movement of individuals away from their place of birth or hatching or seed production into a new habitat or area to survive and reproduce. Now what do we mean by this?

So, let us consider a piece of land and here we have a single tree and when this tree bears fruits. Then all of these fruits do not just drop below the tree, but we also observed that there would be some birds that would come eat these fruits and take those seeds along with them and maybe perch somewhere else. So, here we have another tree of a different species. So, the bird perches here and then it drops the fruit or the seed here.

Now the movement of seeds from the place of origin so, this is the origin to a new place would be called as dispersal. Now in this case this dispersal is being facilitated by a bird. So, any dispersal that is facilitated by a bird goes by the name of zoophily. So, essentially we have an animal that is zoo that is loving this thing the fruits or the seed and is dispersing it.
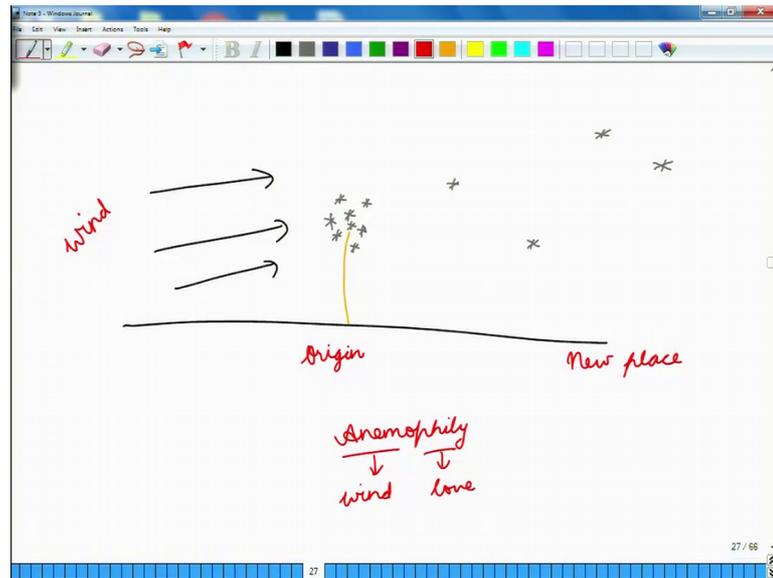
Similarly, in the case of certain plants such as the dandelions, we would observe that in a field we would be having these dandelions that are having quite a lot of seeds that have a botany growth around them. And whenever we have a wind movement then these seeds that have this cottoning cover would be dispersed away from the origin.

So, here again we have the origin and they are being dispersed to a new place because of the action of wind. Now such a dispersal would go by the name of anemophily. So, this is anemo is wind and philly is love. So, it is the wind that is acting as a dispersal agent for the moment of these seeds from the place of origin to a new place.
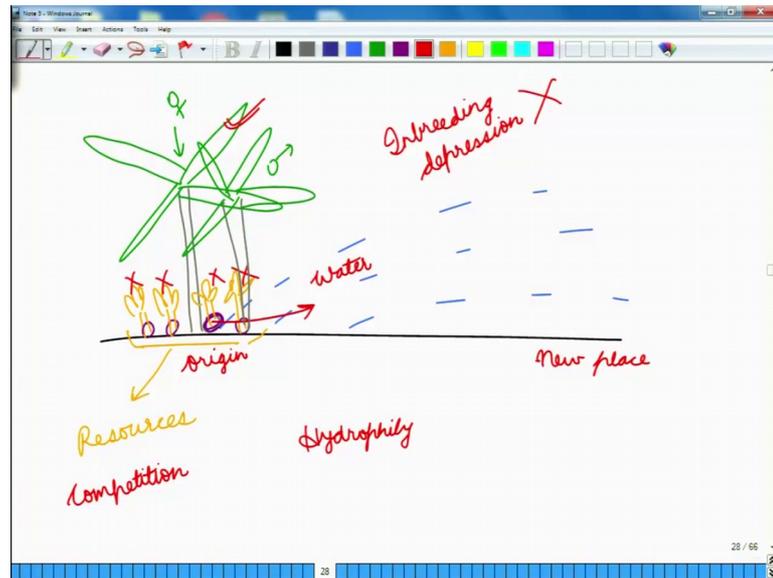
Similarly, in the case of our coastal areas you would observe that there is a tall tree of coconut so it is a coconut palm tree. And then when the coconut falls down then it is in certain areas where which are close to the coast. Then this coconut would use water and would disperse itself away from the origin to a new place. So, here we have the action of water that is dispersing this seed so this thing goes by the name of Hydrophily.

So, coming back to the slides, dispersal is the moment of individuals now these individuals could be animals, these could be plants, or these could be their seeds away from their place of birth or hatching or seed production to a new habitat or area to survive and reproduce. Now, why is it important for these plants and animals and seeds to disperse out?

Because consider the situation in which this coconut only landed here and did not go anywhere else and similarly most of the other coconuts that this tree produced also came down here. What would happen after a while they would try to grow into new plants. Now, when that happens you have certain amount of resources that are present in this area.

Now, resources would include the soil, resources would include water, resources would include the minerals or the nutrients that are there in the area. Now if you have all these plants that are growing in this area only. Then that would result in competition and it would be competing with its own parent and because this parent tree is already a last

sized tree with larger roots then it is quite possible that all of these small saplings would die off.

So, essentially dispersal is one way to reduce the level of competition that is there in the place. And then the thing is that even if this saplings did not die and would grow into a new tree nearby, in these situations what would happen is that suppose this is the female tree and we are talking about the male flowers of the second tree. So, we would be having pollination between both of these trees.

Now a pollination between these two trees would result in a situation where we are having a breeding between very close relatives, and that would lead to inbreeding and inbreeding depression. Now inbreeding and inbreeding depression are situations in which the recessive alleles become are able to express themselves. Because they come in a homozygous situation which results in a number of genetic diseases. So, this is also something that needs to be avoided and dispersal is one way in which competition and inbreeding are avoided.

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Now, talking about dispersal there are three modes of dispersal. The first mode is called diffusion. Now, in the case of diffusion we have a gradual moment over several generations often across hospitable terrain and one example is the movement of lions across the Gir landscape.

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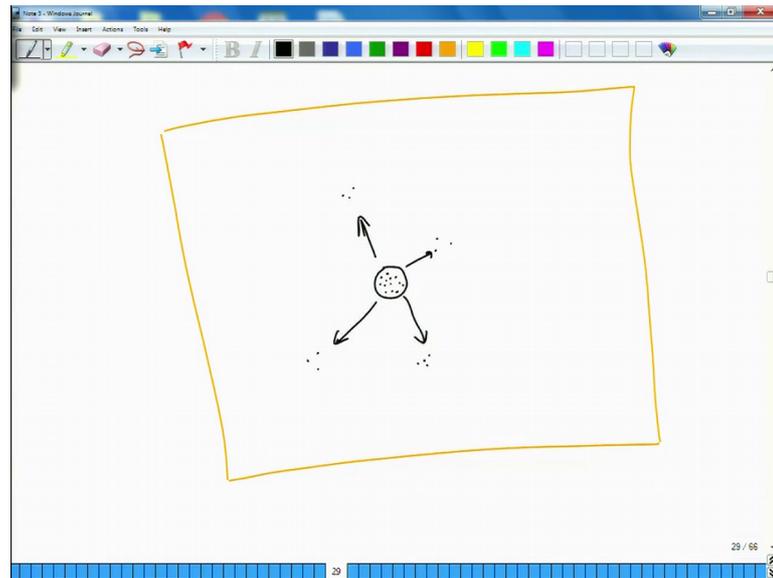
Now, what is happening in the case of diffusion is that we have a small population here and it is surrounded by a country or the areas. And everywhere in these areas the animals would be able to survive and to reproduce; however, just because we have. So, little number of animals here that it takes a while for these animals to move away to different areas. So, it is a very slow movement just because we have very less number of individuals. So, it is a gradual movement often across several generations, often across hospitable terrain. So, the movement of lions across the Gir landscape is one good example.

Second example the second mode of dispersal is called a Jump dispersal. Jump dispersal is a quick moment over large distances often across unsuitable terrain. So, this was gradual, this is quick this occurs over smaller distances every generation this occurs over larger distances. This is across hospitable terrain this is across inhospitable or unsuited suitable terrain an example is that is the dispersal of zebra mussel through ballast water. Now what we are referring to here is that in the case of a number of ships.
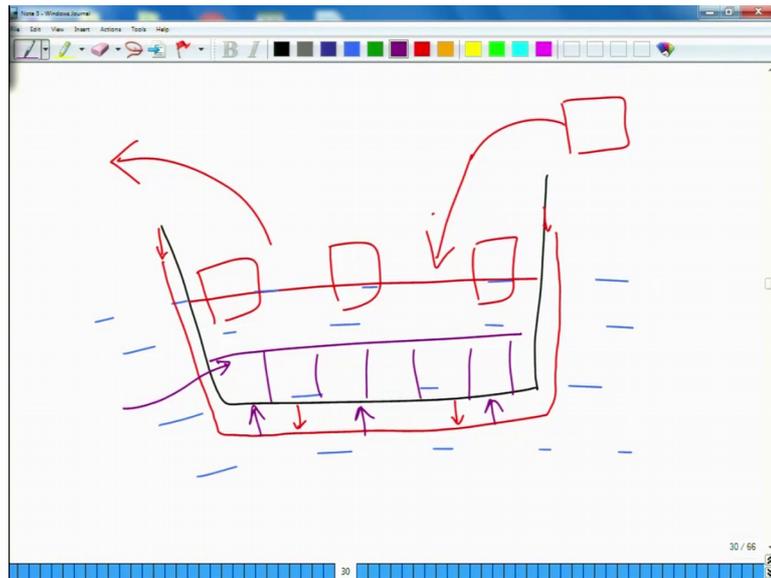
Now, when a ship is there in water then there is some portion of the ship that is above the water line and there is some portion of the ship that is below the water line. Now, if we are putting in more cargo into the ship. So, we add some cargo inside the ship. So, what would happen is that this ship would displace down. So, in place of this portion this would go down maybe like about this much and then we would be having a situation like this. So, this ship has now moved down because we have excess cargo that is put inside the ship. So, it has it is increased the weight of the ship.

Now, similarly when the cargo is taken out at the destination then we would have an opposite movement so the ship would arise in the water. Now in most of the ships for to maintain the stability of this structure what we do is that when the ship is being when the water when the when the cargo is being taken out of the ship then we add water into the ship. So, there are specific areas in the ship, specific containers in the ship in which we add water so, that at all times the level of the ship remains the same. So, in those situations whenever we are taking cargo out it would be replaced by an equal weight of water whenever we are putting cargo in then this water would be released out.

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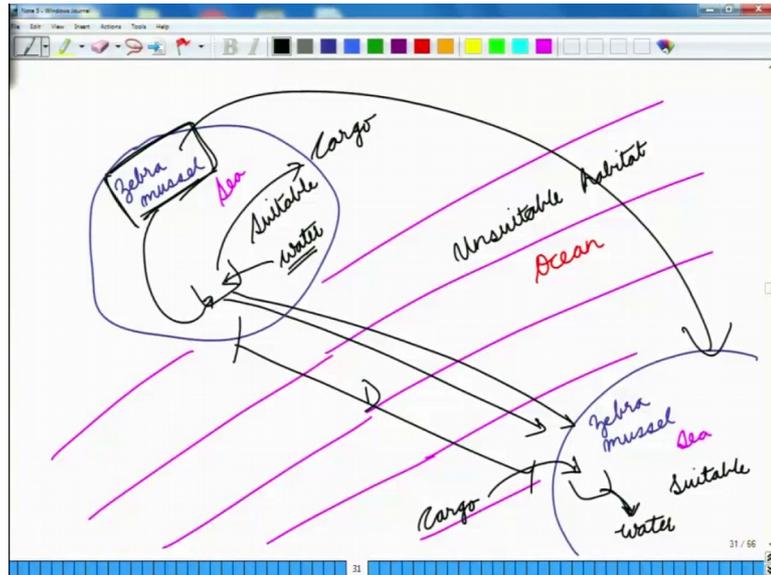
Now, what happens in so these situations is that suppose this is an area in which you can have an animal that goes by the name of the zebra mussel. This is another area in which you could have a good habitat for zebra mussel. But in all the surrounding areas probably because these are open oceans so we do not have a good habitat for zebra mussel. So, this is a small sea this is again a small sea and this area out here is the open ocean.

So, now in the smaller seas we have more nutrient concentration as compared to the oceans. So, that could be safe one reason why is zebra mussel would be found in these seas and not in the ocean. Now consider a ship that is moving from this port to this port. Now in this location it suppose unloaded certain cargo, so the cargo was taken out and this cargo was then replaced with an equal amount of water.

Then the ship moved to the second port and at this port we had cargo that was put in and water that was taken out. So, what has happened in this situation is that this zebra mussel goes inside the ship along with the water and when it has come to this area then when the water is pumped out the zebra mussel is also pumped out. So, essentially in this case the zebra mussel have been able to disperse itself from one suitable habitat.

So, this is a suitable habitat to another suitable habitat across an unsuitable habitat often across very large distances. So, the distance here is very large and in a very short period of time because we have a movement of the ship. So, this is a quick movement over large distances often across unsuitable terrain and this goes by the name of jump dispersal. So,

essentially in this case our zebra mussel was able to jump from this area to the second area. The third mode of dispersal is secular dispersal.

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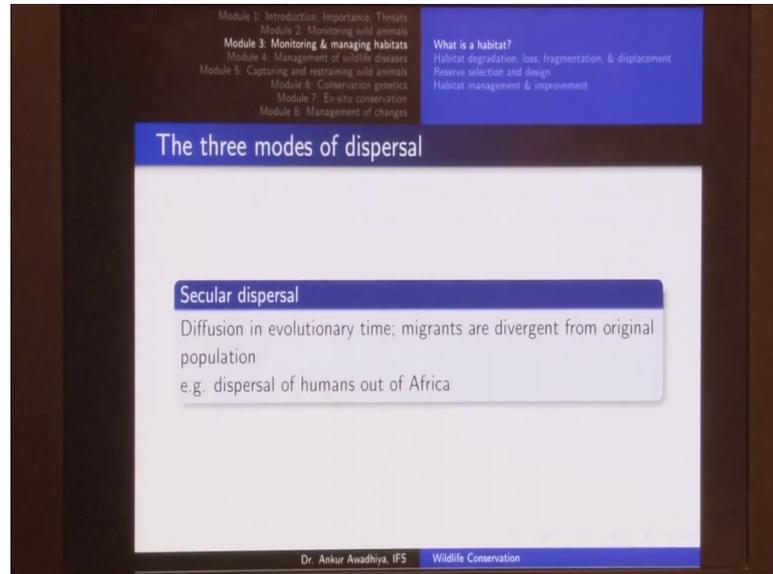
Now, in the case of secular dispersal the diffusion occurs in an evolutionary time. And the migrants are divergent from the original population for instance the dispersal of humans out of Africa.

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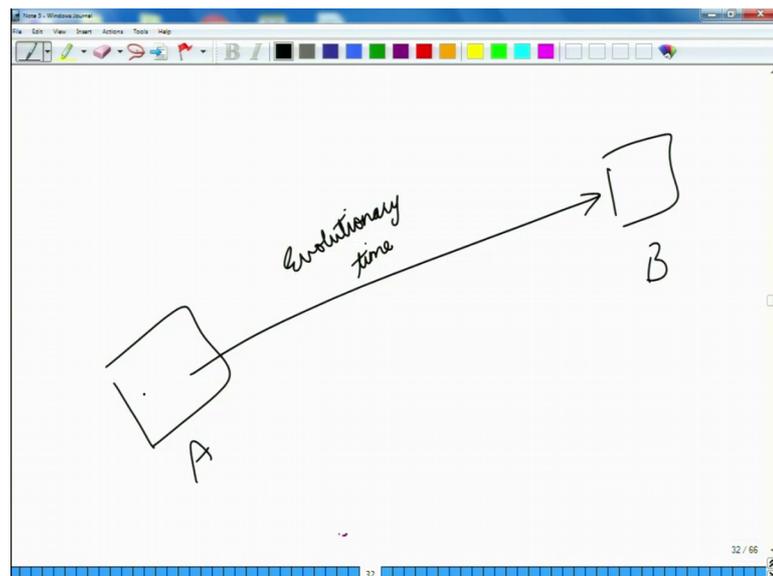
So, essentially when we have a secular dispersal then the movement from the first location A to the second location B it takes so much amount of time that it is in

evolutionary time. So, in this period the organisms themselves have changed or evolved from one species up to say another species or maybe a subspecies. So, this is a secular dispersal for example, that the dispersal of humans out of Africa.

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Now, another factor that governs why things are where they are? Is anthropogenic factors now anthropos is human, genic is form formed by. So, these factors are formed by human beings so these are the man made factors example the clearing of forests and pollution.

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So, this is a good example this again comes from the Shivalik Range and in this area. So, these areas would have been covered with the forest, but then human beings came and to these areas and clear these areas of trees. And so now we do not find any trees here. So, it is not a natural process, but the human made process.

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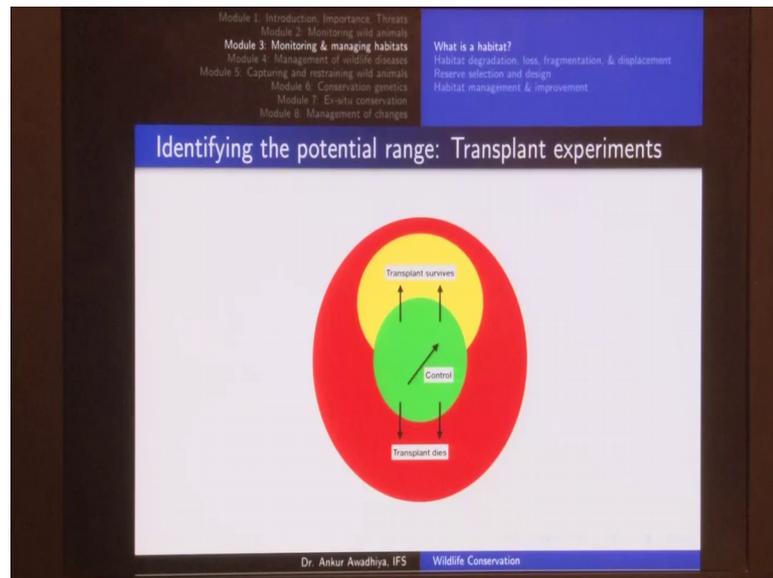
Now, when we are talking about dispersals, one thing that comes in mind is the potential range. So, essentially when we say that an animal remains in one area because it finds it a suitable habitat and does not go to another area because that is an unsuitable habitat. So, how do we prove that it is an unsuitable habitat? So, in this image the green area shows the distribution of an animal which we refer to as the control area. So, now, if you take the animal from one point here to another point in this area, where it is naturally found and we find that this animal is able to survive and reproduce in the other area as well.

So, a good example would be transportation of tigers from one tiger reserve to another tiger reserve. So, basically because in the other tiger reserve as well the tiger survives so, even if we transplant it from one tiger reserve to another tiger reserve it would be able to survive, but then in other areas we could have situations in which the transplant survives or the transplant dies.

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Now, if there is an area in which the transplant is successful. So, we are referring to those areas in which the animals could live, but they do not live. So, in those situations why are the animals not found there? In those cases they interpreted as that the distribution is limited either because the area is inaccessible. So, there is a physical barrier for example, a large sized river that is preventing the animals to go from one side to another side or their time has been too short to reach the area.

So, essentially we have insufficient dispersal time, if we give the animals more time they would be able to go to the other area or the species fails to recognize the area as a suitable living space. So, essentially it could live there, but it does not know that it can live there or there are some factors because of which it does not prefer that area. So, it goes by the name of habitat preference.

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In the other scenario in which the transplant is unsuccessful we could say that distribution is limited by some other species. So, the biotic factors or it is limited by some physical and chemical factors. So, essentially the animals are not found in those areas because the animals cannot survive there because that area is not a good habitat primarily because of biotic factors or because of the abiotic factors.

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Now, in this context we also have two laws, one goes by the name of the Liebig's law of the minimum; it says that 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. Now, what we are referring to in this case is that consider a plant.

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Now, a plant would have certain requirements for different nutrients. So, we have a requirement for say nitrogen, phosphorus, potassium, say magnesium, and so on. Now we will have some certain requirement for each of these, so which could be stated in milligram so, say it as x y z and w. Then we have an availability again in milligrams which we can say as x1, y1, z 1 and w1. Now we would have another column called the Relative availability in percentage.

So, what we are doing here is that in the case of the first one we are having x 1 by x into 100 percent. Here we have y 1 by y into 100 percent, z 1 by z into 100 percent and w 1 by w into 100 percent. Now, suppose these figures come out to be say 4 percent, 10 percent 110 percent and 50 percent. So, essentially what we are saying here is that in the case of potassium the requirement is say 100 milligrams and we are having 110 milligrams available so this resources available in plenty. Other resources are not available in plenty, but magnesium is available to a level of 50 percent, phosphorus is available to a level 10 percent and nitrogen is available to a level of 4 percent.

Now in that case the Liebig's law of the minimum would say that 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. So, when we look at, when we observe the plants

that are growing here we would find that this factor nitrogen which is available only at a 4 percent relative availability would become the limiting factor for the growth of the plants not something else like these so this becomes the limiting factor. So, the Liebig's law of the minimum says that whatever factor is available in the least amount would relative to its requirement would become the limiting factor.

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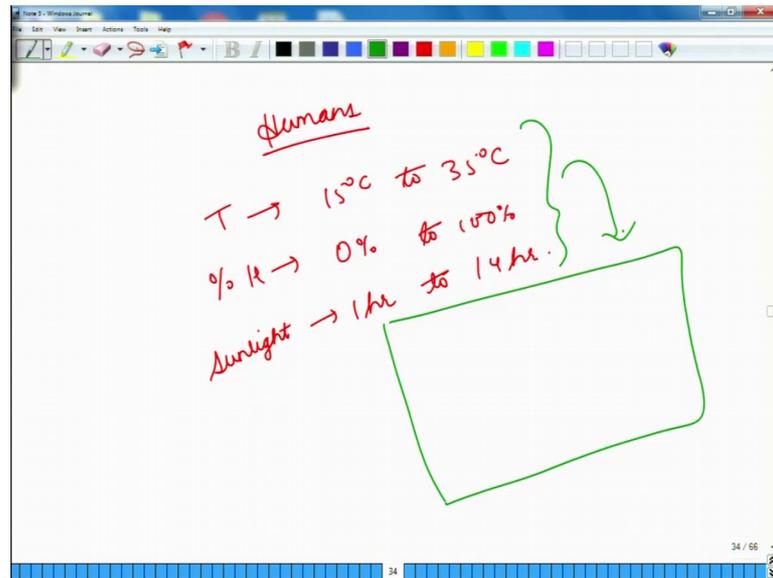The second is goes by the name of Shelford's law of tolerance. It says that the geographical distribution of a species will be controlled by that environmental factor for which the organism has the narrowest range of tolerance.

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So, for instance if we consider say humans and we have temperature tolerance level of say 15 degree Celsius, to say 35 degree Celsius. And then we have percent humidity which goes from say 0 percent to 100 percent. And let us consider one another factor say it is the availability of sunlight. So, we can tolerate days which have as little as say 1 hour of sunlight to as much as say 14 hours of sunlight.

Now in this case Shelford's law of tolerance would say that the geographical distribution of the species in this case humans will be controlled by that environmental factor for which the organism has the narrowest range of tolerance. So, essentially if we consider a large area in which all of these factors are varying everywhere, then this factor for which the species has the narrowest range of tolerance would determine where this species is found. So, this is the Shelford's law tolerance and these days we are observing it in the field in the form of changes in the range.

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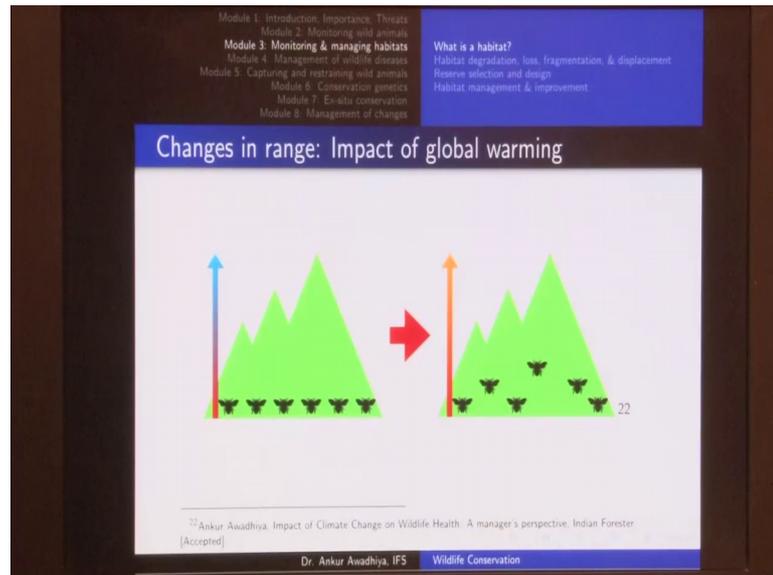
So, essentially there are certain organisms, mostly certain insects that can only survive and reproduce at higher temperatures and higher levels of moisture. Now, with climate change and with global warming what is happening is that if we consider a hill and when temperature rises so this area so because as we go up into a hill the temperature reduces.

So, which we have represented here so this area has a higher temperature this area has a lower temperature. Now, because this animal or the insect was only able to tolerate higher temperatures so it was found here. Now with global warming these areas are also heating up so, the range would increase. And we have seen it in the field in the form of the increase in the incidence of malaria and the median altitude for malaria.

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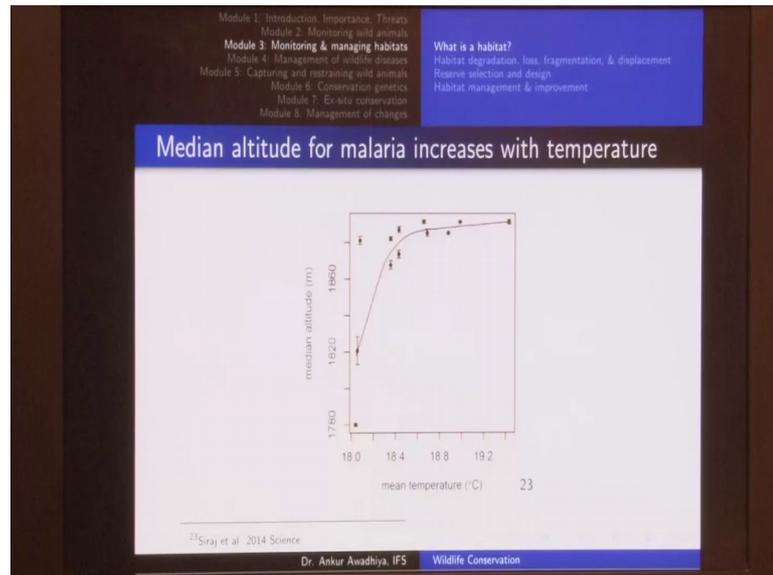
So, essentially on the y axis here we have the median altitude where we have cases of malaria and here we have the mean temperature. So, as the mean temperature increases we find that the altitude where the malaria was formed so earlier it was a lower altitude. Because the lower altitudes had a higher temperature, but then when the mean temperature of the area is increasing then we find that the insects are going up, which is leading to more and more of malaria cases.

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Now, dispersion also needs to be differentiated from migration. So, in the case of dispersion we have a movement from one area to another area or a movement from one habitat to another area. But in the case of migration we have a regular seasonal movement of animals often across fixed routes.
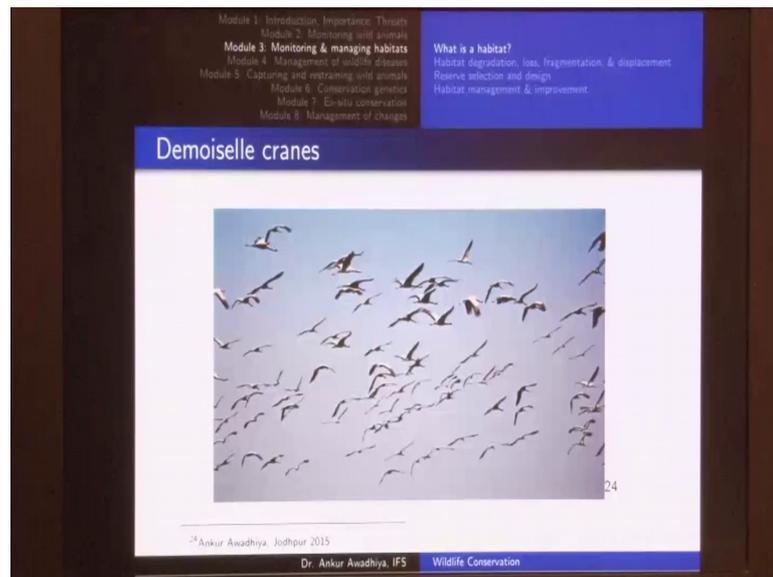
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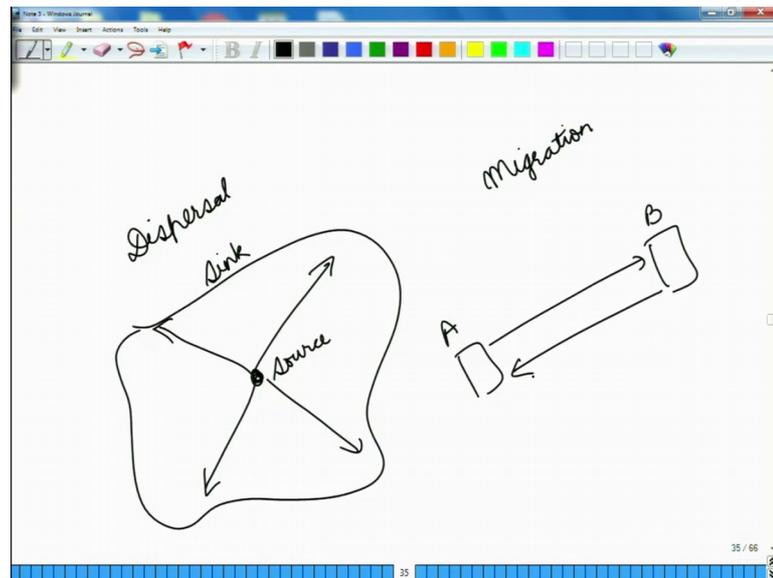
So, essentially when we talk about dispersal we have a central area and the animals are going away from this area. So, this becomes a source area and these other areas become the sink area for dispersal. In the case of migration we have two areas the animal goes from A to B in one season and it goes from B to A in another season so this is migration. And often these roots are fixed and the purpose of migration is better resources like food and breeding sites and shift from harsh to amiable climates.

So, for instance when we consider a species such as the siberian crane so, in the case of a very cold climates when there is winter in its original area then because the climate is harsh it moves down into India and then it uses the resources here because we have more food availability here. And then when the climate at its original area becomes more amiable because the summers are approaching and this area becomes less amiable because it is very hot then it moves back into Siberia.

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This is another example where we can see demoiselle cranes which are also another migratory species.

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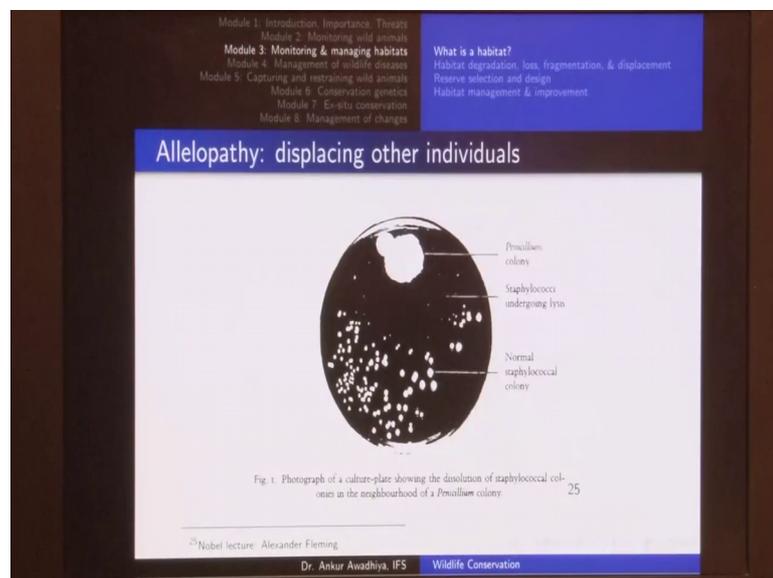
Now, in this context when we were talking about the biotic and the abiotic factors that govern where a species is found. Another thing that needs to be kept in mind is called Allelopathy. Now Allelopathy is the displacing of other individuals and a classic case is that of the antibiotics. Now, this picture which is taken from Alexander Flemings Nobel lecture. So, Alexander Fleming is the person who discovered penicillin and this is an

image from his Nobel lecture. So, here we have a culture medium on a plate, here we have a penicillin colony.

And all of this plate was strict with staphylococci bacteria and we can see that in the far off areas we have larger sized colonies of the bacterium, but as we go closer to the to the penicillium colony we find that we have these staphylococci that are dying out. And there is a distinct zone of innovation that we find in this area. So, what is happening here is that there is one organism penicillin, which is penicillium notatum which is a fungus which is giving out something into the environment which is killing off these organisms. So, it is essentially displacing these bacteria away from itself.

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Now, allelopathy is also observed in a number of our forest habitats, so for instance when we talk about our dry deciduous forest floor. Here you can observe that there is hardly any grass that is growing in the foreground, beneath these trees. Because in the case of teak trees their leaves give out some allelopathic factors which do not permit other species anything other than tea to grow or survive in these areas. So, allelopathy is another factor that governs whether an area would be a suitable habitat for a species or not.

So, essentially in this lecture we looked at the definition of habitat, the biotic and abiotic factors that govern a habitat. The different kinds of habitats that we have in India and

what makes a certain region a suitable habitat for a species and maybe not a suitable habitat for another species. So, that is all for today.

Thank you, for your attention [FL].