WildLife Ecology
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Lecture - 22
Threats to Species

[FL]. Today, we begin a new module which is management of threatened species. Now conservation is a field in which we utilize all our learning's from ecology for the benefit of organisms and for the benefit of habitat. So, we will be using all different learning's that we have had so far in ecology to understand why some species are facing this threat of extinction and what can be done for those particular species.

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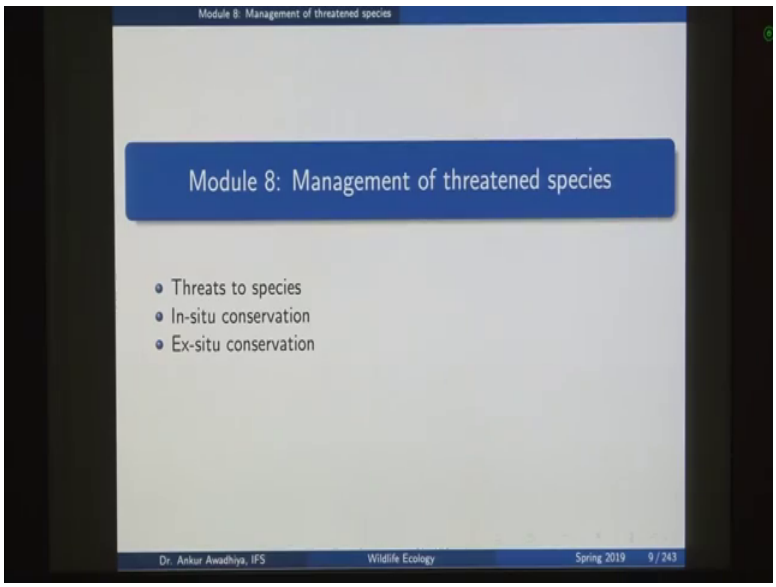

Now, this particular module will have three lectures the first is Threats to Species why are there some species that are the threat, the second would be In -Situ conservation which is conservation on site and third will be Ex-Situ conservation which is conservation away from the natural or the existing habitats of the organisms.

So, let us begin with the first lecture which is threats to species.

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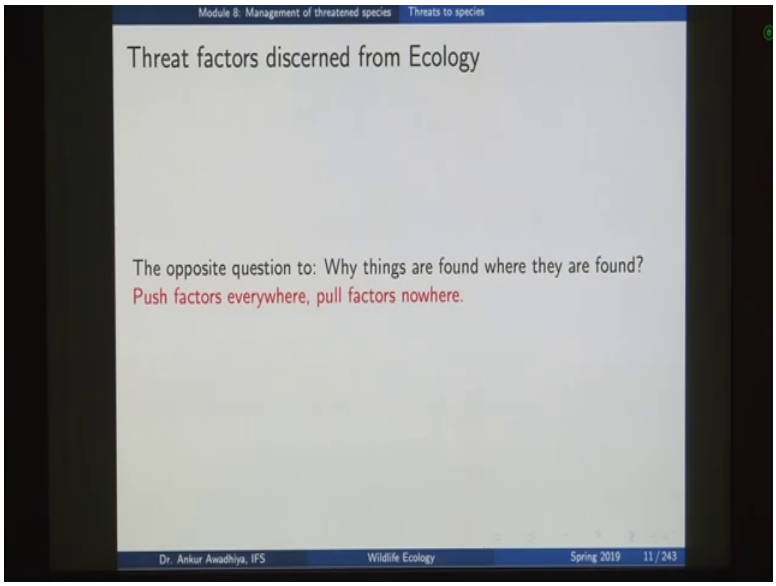

Now, the if you ask this question why are some organisms facing the threat? So, we can discern an answer from ecology, the factors that are responsible for threats to organisms are the opposite question to why things are found, where they are found.

So, in one of our earlier lectures we had looked at why are organisms found in certain locations and not in other locations. Now, organisms are found in certain locations because they have situations that are useful or that are helpful for the survival of those particular organisms in those particular areas.

So, for instance if there is an organism that requires a low temperature may be required some specific kind of foods may be require some specific kinds of filters and if we have those conditions available in certain portions of the earth so, that organism will be found in those particular location

Now, a threat to that organism would be if we remove all of these suitable conditions, so if we remove that particular source of food; if we remove that particular source of shelter or may be remove that particular life style of the organism may be encroach upon those habitats so that would result in a threat. So, this is the opposite question to why things are found where they found.

So, if you have a push factor everywhere and a pull factor nowhere, so that would mean that this organism is getting a stress from all different sides to vacate this particular

portion of habitat, but it does not have any other place to go. So, that would form a major threat to that particular species so push factors everywhere and pull factors nowhere.

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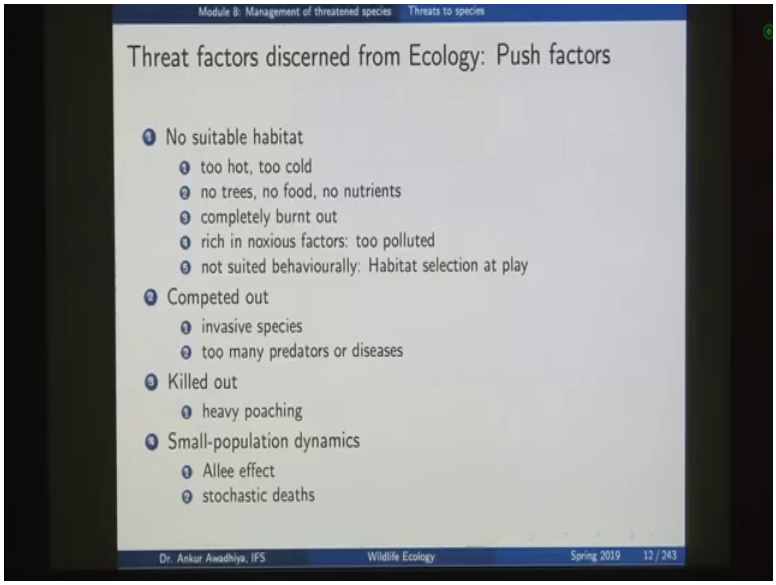

So, what could be these push factors? This push factors could be no suitable habitat for the organism either, it is too hot nor too cold or there are no trees, no food, no nutrients for this organism to survive on or if it lives in the forest and this forest is completely burnt out or if this area becomes polluted so if there is an organism that lives in a lake and you use that particular lake as a dumping site. So, you are adding a number of pollutants into that area so that it is now not able to live in that particular lake or that particular or it's habitats are now no more suited behaviorally in which case we will have a look at habitat selection.

Now, habitat selection is a behavioral process in which an organisms selects a particular habitat. So, for instance you can have a mosquitoes in paddy fields, but then different kinds of mosquitoes different species of mosquitoes will utilize different kinds of paddy fields to lay their eggs, so that is a behavioral selection.

So, if you remove any particular habitat that is being selected by an organism behaviorally. So, which is in terms of the organism that is the best suited habitat if you remove that habitat if you remove that habitat, so behaviorally it will not find itself comfortable in the other habitats, the other push factor could be a lot of competition so if you have a number of invasive species in a forest.

So, if you have a forest in which you have invasive species like lantana, so lantana is now a growing very fast in a number of forest and it covers a major portion of the ground that is there in those forest. So, if you have lantana that is covering up all the land so other herbs and shrubs would be competed out, so that is the push factor. Too many predators or diseases in any area is another push factor or if an organism is actively being hunted, it is actively being killed out, it is actively being pushed.

So, that is another push factors or small population dynamics they also act factors push factors or threat factors such as things like Allee effect. Now Allee effect is an effect in which if you have an organism that lives in (Refer Time: 05:02) packs. So, if you have a pack living organism if you reduce the size of the packs, so the efficiency of this organism to get food to get meat to protect itself gets reduced or in certain situations when the density of organisms is very less so the organisms are not able to find their mates.

So, in those situations we are seeing Allee effect in picture or you could have a small population dynamics such as stochastic death. So, just by chance you have a large number of death so these are all different threat factors. So, we have push factors that are resulting in to threats and there are some factors that are coming out because of chance events.

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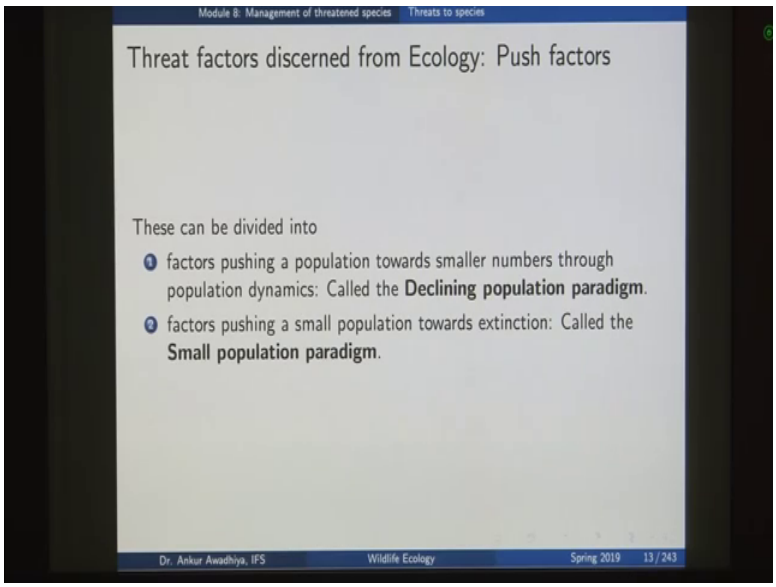

Now, these factors can be divided into two parts; one are those factors that push a

population towards a smaller numbers through population dynamics. So, we had a look at population ecology, we know how populations survive how populations increase in their sizes and if you have a scenario in which there is something that is threatening the growth of the population, there is something that is increasing the death rate, there is something that is reducing the birth rate.

So, all these kinds of factors that will a that will play a role when your population is large in size and are trying to reduce the population size through population dynamics are called as declining population paradigm. And the other factors, there are a number of other factors that push a small population towards extinction and there studied in the small population paradigm.

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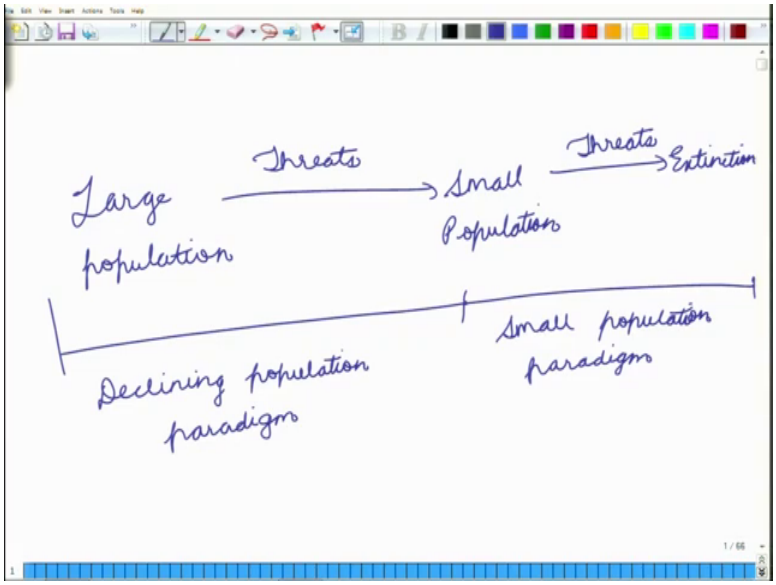

So, essentially what we are seeing here is if you consider any species that is under a threat of extinction so you will have a large population, now this large population in time because of certain threats becomes a small population and then when it is already a very small population they could be some other threats that would lead to it's extinction.

Now, when we are considering this portion how does a large population become a small population? So, in that case we are talking about the declining population paradigm. So, we are asking the question what are those threats that are causing this large population to turn towards to turn into a smaller population? And when we consider this portion, how does a small population become extinct? So, here we are talking about the small

population paradigm.

Now, we looked at a number of threat factors, now if we ask this question what are those factors that are causing a population to declined to smaller population and what are those factors that are pushing a small population towards extinction? So, will be talking about the declining population paradigm and this small population paradigm.

So, let us look at the declining population paradigm what kinds of threat factors would result in small less of a population? So, if you are eating up the habitat of any particular organism if you are causing the habitat to shrink or if you are pushing this organism away from it's own habitat. So, that it does not have enough amount of habitats left for itself or if you are putting it in some kind of competitive pressure. So, for instance in a grassland that is being used by chitals and sambar you are taking your cows and buffaloes for glazing. So, in that case the chitals and sambar are now are not able to compete with the cows and buffaloes so in that case they have been pushed out.

So, factors such as these non availability of a suitable habitat or reduced availability of a suitable habitat or being completed out or being killed out through poaching all of these would be studied under the declining population paradigm and the other kinds of factors that play a role in the small population dynamics Allee effect, stochastic depth and so on will be studied under the small population paradigm.

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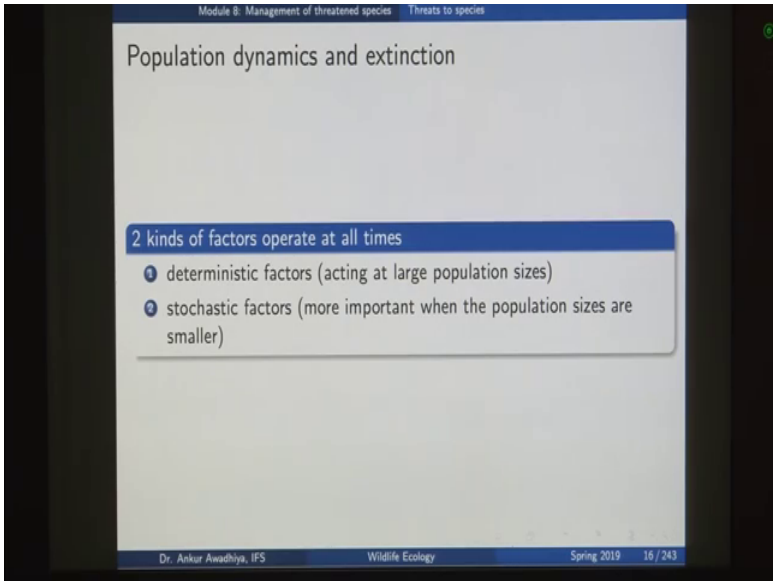

So, we can say in other words that there are 2 kinds of factors that are playing a role at all times, some of these are deterministic factors which are acting at large population sizes and some of these are stochastic factors or chance factors. Now deterministic factors are those that play a determined role in the population dynamics and stochastic factors are those factors that play a chance role in the population dynamics.

Now, chance factors become more important when you have smaller size populations why? Because if suppose you have a population in which you have 10 10,000 young ones that are born. Now on an average we can say that 50 percent of them will be males, 50 percent of them will be females. So, roughly 5000 male of a springs and 5000 female of a springs.

Now, it is possible by chance that in place of 5000 you get say 4990 male of a spring and 5010 female of a springs, but that would be roughly the amount of chance variation that you will see in the large population whereas, if you consider a very small population so suppose, you have only 4 offsprings that are born.

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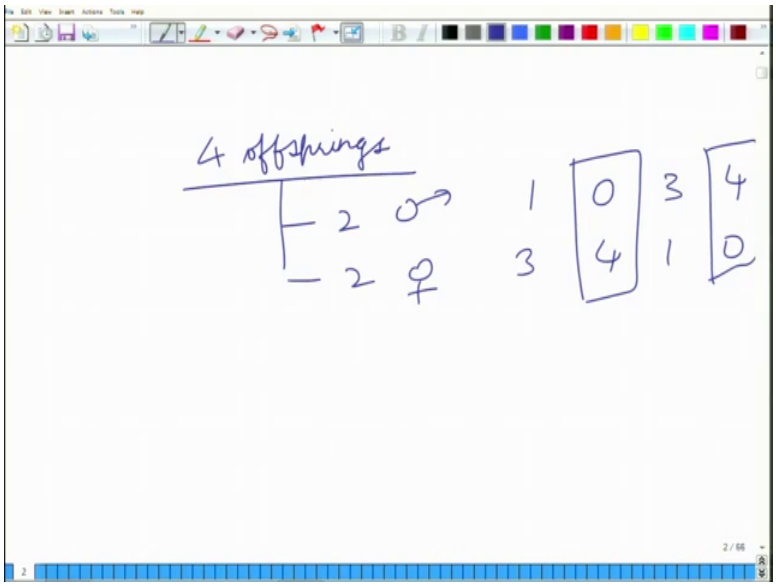

So, in those situations roughly you should be having so you have for off springs. So, in that case we expect 2 of them to be males and 2 of them to be females, but then by chance it is possible that you only have 1 male and 3 females or maybe even 0 males and 4 females or you could have whatever situation you could have 3 and 1 or you would have 4 and 0.

But then if you have a very small population so the probability that you can have one of these situations increases and the probability that you do not have any organism of a particular of a particular sex also increases very much. So, stochastic factors or chance factors play a much more important role when your population sizes are small as compared to when your population sizes are larger.

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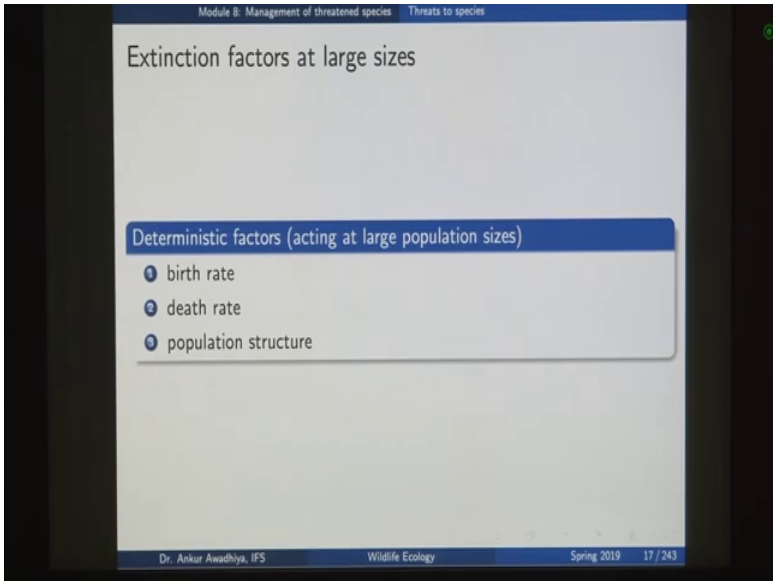

Now what are the deterministic factors and what are the stochastic factors? Now deterministic factors could be things like birthrate, death rate and population structure. So, if you have a population with a reducing birthrate so that would be a deterministic factor it will not lead to an extinction in the near future, but then we can say that if the birthrate is going down, then there is some issue in this population might be vulnerable to extinction or if there is an n increase in the death rate suppose there are some diseases that have come into the population and so they are increasing the rates of deaths in this population.

So, in this case has been we will say that there is a chance that this population is being is being push towards extinction, it is being pushed from becoming a large size population to becoming a smaller size population or things such as population structure if more and more organisms in the population are becoming old. So, in that case you have a population structure in which you have less number of young ones less number of adults and many more number of old organisms.

So, all these three factors the birthrates, the death rate and the population structure play the role of deterministic factors and may push your population from being a large size population to being a smaller size population.

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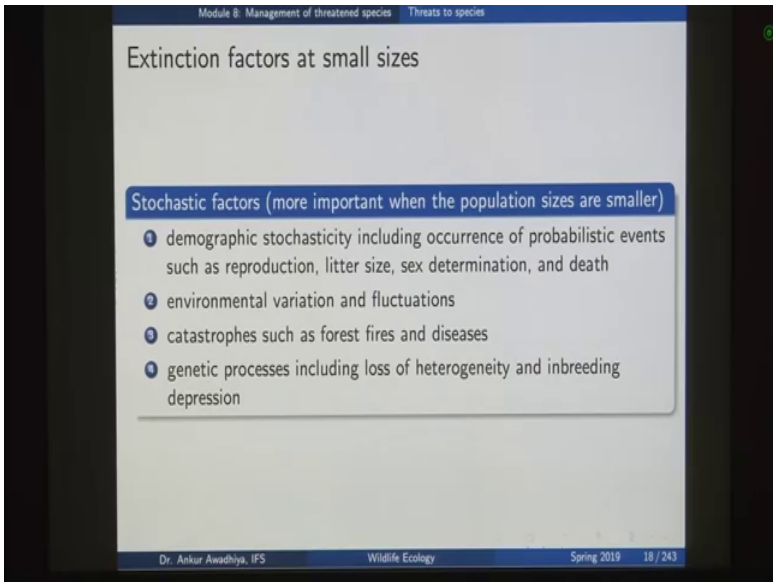

Next we have the stochastic factors or chance factors which are more important when your population sizes are smaller. So, here you have demographic stochasticity, so things like all the off springs in your litter belong to the same sex all of them are males or all of them are females. Now that is very much unlikely when you have a large size population, but in a smaller size population suppose you only have two offspring's.

So, in the population so only two offspring's there is a very high chance that both of them are male or both of them are females or say things like death in the letters. So, every population would be having some amount of infant mortality and some amount of juvenile mortality. So, there is a chance that you had only two office springs in the current generation and both of them tied.

Now it is much less likely if you have say 2000 office springs in a population, it is very less likely that all 2000 of them would die, but then if you have only two office springs it is a very it is very much much possible that both of them die out. So, these are demographic stochasticity demo is again so you have demographic is we are talking about the about the characteristics of population and these are chance factors that act on the population characteristics.

The second chance factors or environmental variations and fluctuations suppose you have a drought, suppose you have a flood. So, that would also play a very crucial role if you have if you already have a very small population or catastrophes such as forest fires and diseases or say genetic processes such as loss of heterogeneity and inbreeding depression. So, in this case what we are saying is that if you have a large size population.

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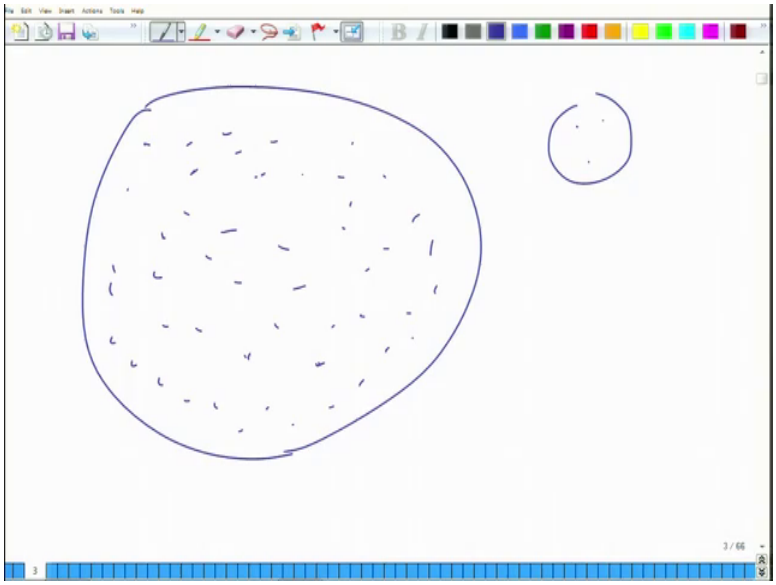

So, you have a number of males and a number of females and when they are breeding randomly, so in that case there is a very small chance that brothers and sisters would meet with each other, but then if you have a very small population suppose you only have three individuals left. So, if you have any amount of meeting then there is a very high chance that you will push this population towards inbreeding depression in no time.

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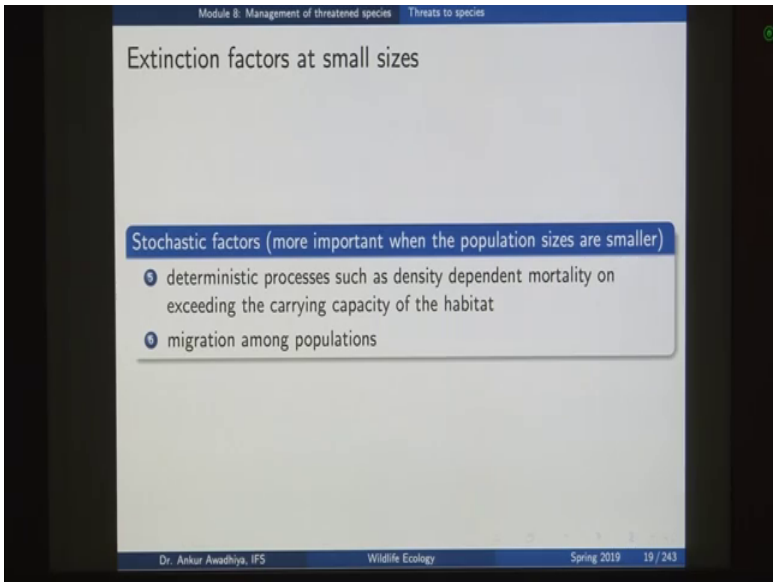

Other kinds of a stochastic factors are deterministic processes such as density dependent mortality on exceeding the carrying capacity of the habitat, then this case what we are saying is that suppose you have a habitat and this habitat can support 100 organisms.

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Now, in this case, suppose your population size is close to around 90. So, when you are reaching close to 100 so, in that case the mortality increases because your populations now reaching towards the carrying capacity. So, we had seen this and the case of the sigmoidal curve. So, when we have the sigmoidal curve this is the carrying capacity, this

is the number of organisms and this is your time.

Now, when you population has reached to this level, so it is very close to the carrying capacity. So, the in this case the death rate would increase or probably the birthrate would also go down because of some behavior reasons. Now if you can support only ninety of organisms and suppose you have two different kind of organisms, so here you have chital and here you have sambars in the so in this population.

Now, suppose you have both of these as 50; 50 so we have 50 chitals and 50 sambars. So, in both of these populations we will find some amount of mortality that is going on, but then suppose stochastically if you have a situation in which you have only see 3 chitals left and you have 97 sambars that are left.

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So, in this case it is possible that because of this density dependent mortality these 3 chitals by chance die out and in that case also you will be pushing a very small population of chitals to towards a complete extinction.

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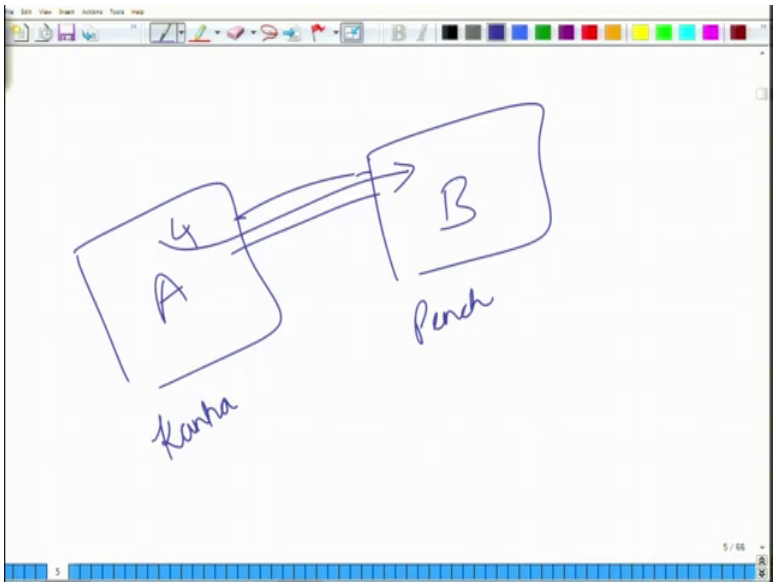

Next we have migration among, so in this case you have two populations population A and population B. So, in a suppose you have these two populations as say Kanha and Pench, now and both of these are connected. So, you have Kanha tiger reserve you have the Pench tiger reserve and they are connected through some amounts of forest.

Now, if there is some particular species that only has a 4 organisms left in Kanha, if these four organisms move out to Pench then we will say that Kanha a suffered a local extinction of this particular species. So, even things such as migration among population might be responsible for a local extinction somewhere.

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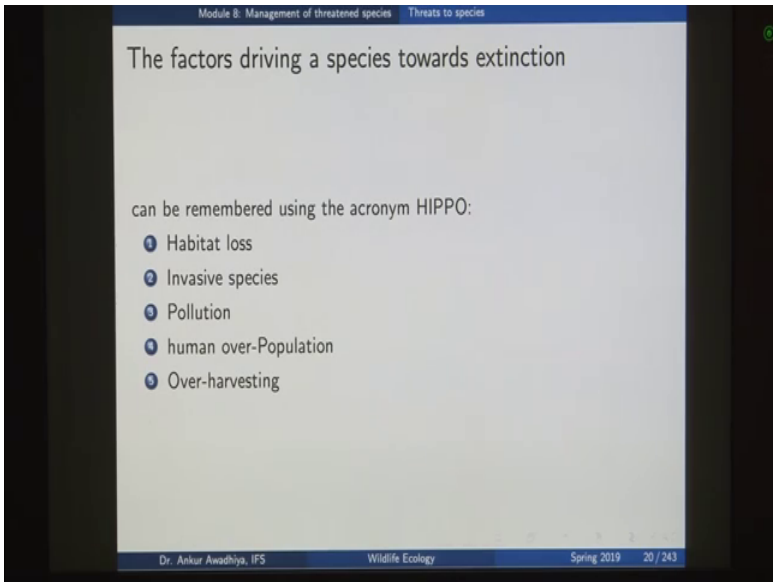

Now, the factors that are leading species towards extinction can be remembered using this acronym HIPPO. So, Hippo is short for Hippopotamus, but then you can used to remember H is habitat loss. So, here you also have things like habitat degradation or habitat fragmentation, but we classify all of this is habitat loss. So, we look at these ingredient detail in a short while I stands for invasive species, so invasive species if they come in to your forest they will out compete all the other existing natural species and then lead they will push them towards extinction.

P stands for pollution, so pollution also leads to habitat degradation, the second piece stands for human over population because the more number of humans that you have on this planet the more would be their requirements and to meet their requirements, they would be using a the resources that are available in the habitats of different organisms. So, human overpopulation also plays a very big role to in the extinction process and O refers to overharvesting.

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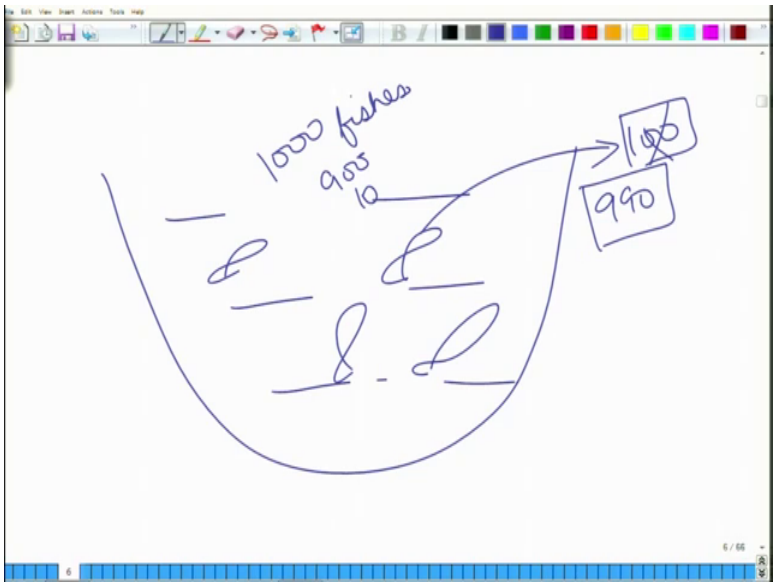

Now, overharvesting is the is a process in which suppose you have a particular lake and in this particular lake you have certain fishes and because of because the these fishes are also reproducing. So, there population would increase the time and so we can remove certain amount of fishes from this particular lake to be used as food for humans.

Now, suppose you have 1000 fishes here now out of these 1000 fishes if we remove say 100 fishes so you will be left with 900 fishes in the lake and these 900 fishes would be able to reproduce in a mannered that they are able to restock the population, but then in place of taking out 100 fishes, suppose we are taking out 990 fishes.

Now in that case what happens is that we are only left with 10 fishes in this particular pond or in this particular lake. Now 10 fishes are not sufficient to restock the whole population of the lake, so in place of exploiting 100 if you exploit 990 that is the case of overharvesting. So, overharvesting can also push a species towards extinction and very good examples of overharvesting are not only fishing in the lakes, but also killing of a whales from the oceans or maybe even poaching of certain animals for their skin or for their fur and so on.

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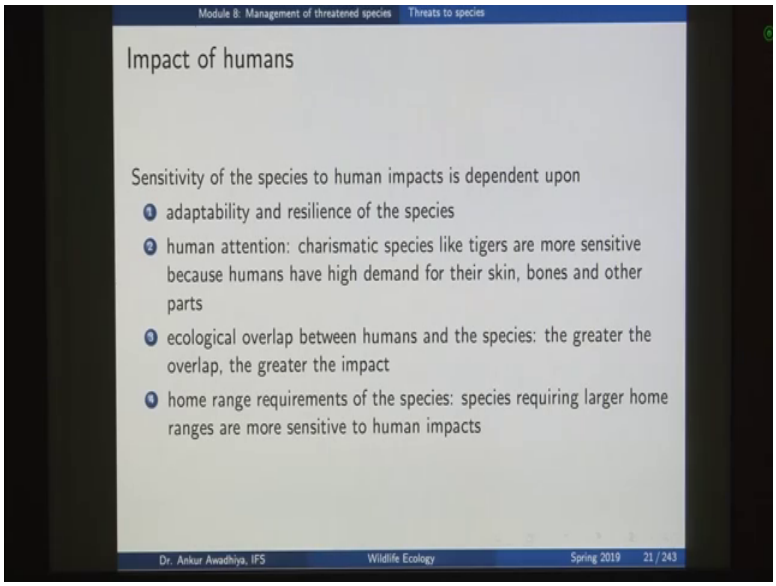

Now, different species will have different levels of impacts when we are having these factors of hippo. So, the most important factor is the impact of human beings. So, if you have more a larger sized human population, if you have more amounts of impacts of humans on certain habitat, it would lead to a differential impact on different species.

So, sensitivity of a species to human impacts would be dependent upon these factors, the first is adaptability and resilience of the species. Now if you have a species that is r selected, so here we are talking about r selected and k selected.

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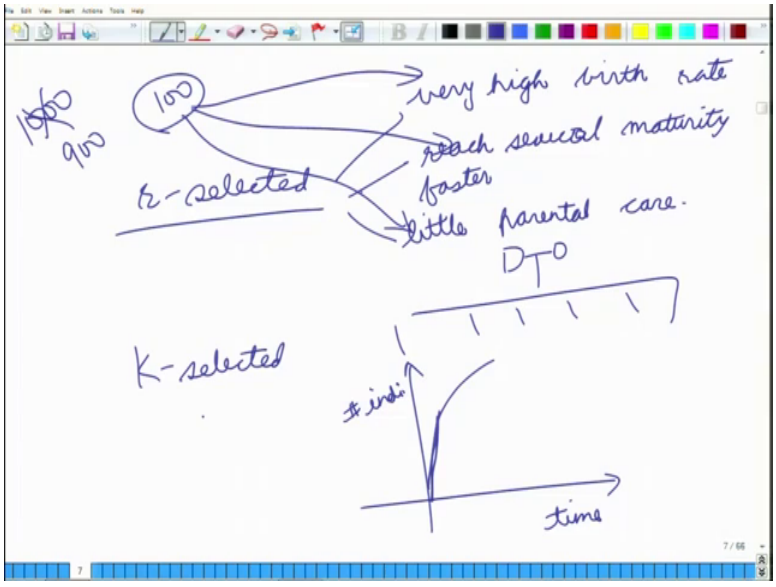

Now r selected species are those that have a very birthrate then they reach sexual maturity faster and in a number of circumstances there is little parental care. So, examples include things such as rats or mice or rabbits. Now in the case of mice so you will have a male and a female that would give rise to say 20 offspring's and then they would become sexually mature in say around 6 to 8 months and then each of them would also give rise to 20 other offspring's.

Now, what happens in that case is that you have a very high amount of r naught are the intrinsic growth rate so you have a growth rate that goes like this. So, this is the number of an individual's and this is time. Now in the case of r selected species because you have a very high r naught, so the population increases very fast and when that happens even if you are you are removing a number of organisms from that particular species the number of organisms that are left out would be resilience enough to restock this species.

So, for instance earlier suppose you had 1000 mice in a form and you are able to kill a 900 out of them. So, 900 got killed and your only left with 100, these 100 because they have a very high birthrate because they reach sexual maturity very fast because they have little parental care so they are mostly independent right from birth. So, there will be able to restock this ferment and increase their population to come back to 1000.

On the other hand if we talk about the k selected species, now key selected species are those that have the opposite characteristics of the r; r selected species. So, they have a very less amount of birthrate they reach sexual maturity in a very long period of time and there is a lot of parental care that is required a good example is say humans or organisms like tigers

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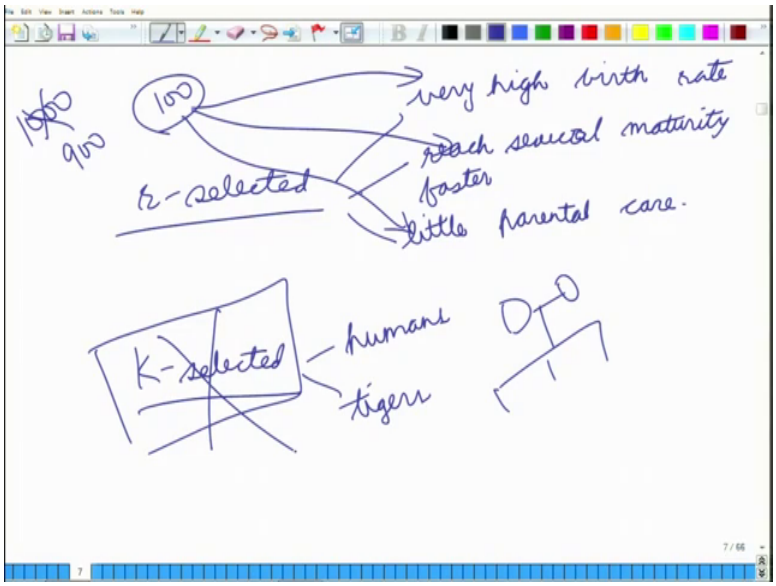

Now, in the case of tigers one litter or that is one male and a female would produce a litter of say two three or four cubs. Now those 2 3 or 4 cubs will take close to around 5 or 6 years to reach their sexual maturity and for close to around three to four years these cubs will be under the guidance and training of their mothers who will teach them how to hunt.

Now, in these species you have a very low amount of r naught there because there you have a very less amount of intensive growth rate and. So, if you kill of these species if you go and in to a forest rain if you hunt down tigers. So, the remaining tigers will take a very long time to restock the population. So, in that we will see that the resilience of this particular species say tigers towards the impacts of humans are towards poaching is less, on the other hand the resilience of organisms such as mice or rats or rabbits is much more. So, in that case tigers will suffer a greater brunt from the human impacts as compared to the mice.

The second one is human attention so we are talking about which species suffer a greater amount of impact because of human activities. So, the second fact is human attention, so charismatic species such as tigers are more sensitive because humans have high demand for their skin bones and other parts because humans have are placing much more attention on tigers. So, there will go out and want to hunt tigers whereas, they are not putting. So, much attention on so they might not go out and hunt for the mice that are

found in the forest areas, so that is another factor

The third factor is ecological overlap between humans and the species. So, the greater the overlap the greater is the impact of humans on that particular species and fourth is the home range requirements of these species that require larger home ranges are more sensitive to human impacts and good example is the case of elephants.

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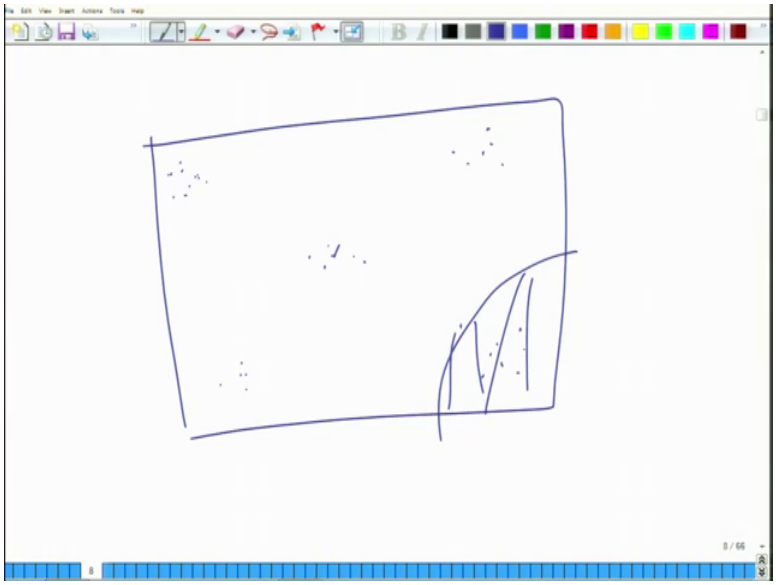

Now, elephants require a large size forest so even if you take off this much portion of the forest. So, it will it will place a very high amount of impact on the elephants, on the other hand if you consider another species that is the small size that has a small home range requirement say rabbits. Now in the case of rabbits you have these small populations that are in different areas. So, even if you take this part of the forest out so even in that case the other populations will be able to survive because they have a smaller home range requirement.

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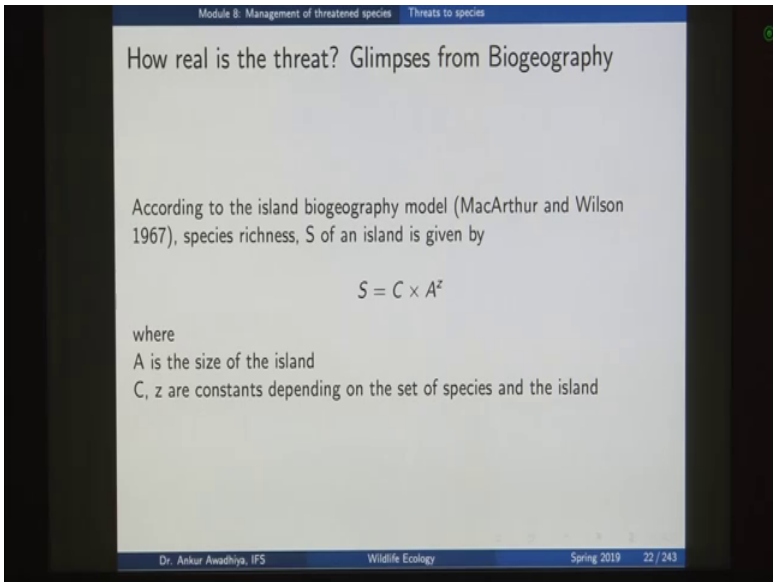

Now, the next question is when we talk about threats, when quantify this threat, how real is this threat or what is the rate at which we are using the species, what are the rate of extinction can we put a quantifiable figure on to this? So, in this case we can make use of another ecological learning which is that of biogeography. Now there is this island biogeography model by Macarthur and Wilson that says that species richness of an island is given by S is equal to C into A to the power of z.

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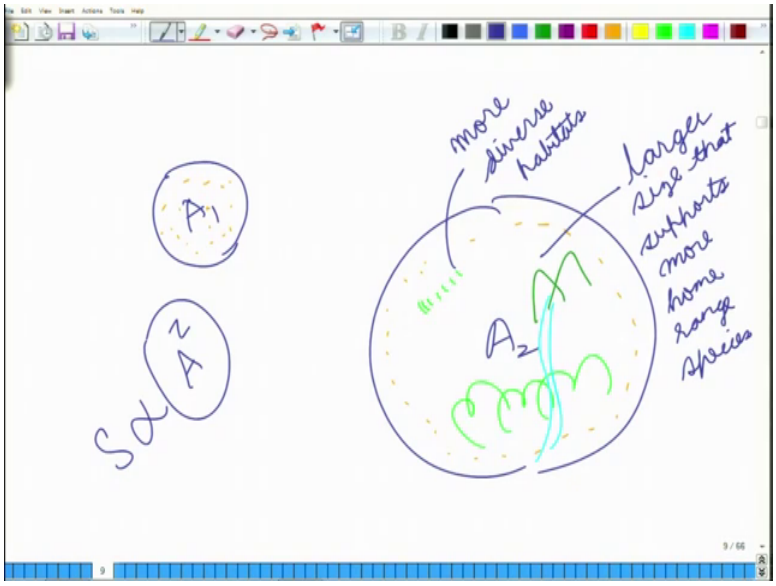

Now, here we are asking the question if you have an island so you have say this island

that has a an area of A 1 and suppose you have this another island that has an area of A 2, what will be the number of species that are found in A 1 and what will be the number of species that are found in A 2? So, that has been worked out and we say that the number of species or the species richness of an island is proportional to A to the power of z so that is it is proportional to a some power of A. So, now, that power could be say A square or it could be A cube or just A or it could be square root of A and so on, but then it is proportional to some particular function of A.

Now, why do we say that? Because if you have a larger sized island. So, this larger sized island will probably have more diverse habitats because as we had seen in our biogeography lectures, in the case of a smaller island probably you have sand everywhere, but then in the case of a larger size habitat you probably have a sand on the beaches, but then on the insides you might have say some hills or maybe you could have even a small stream that is braining out into the ocean or you would have some areas that have some grasses or you could have some areas that have certain herbs and shrubs. So, a larger sized island is able to support more amount of more amount of habitats which would then support more number of species.

Secondly it also supports more number of organisms because this has a larger size that supports more home range species that is if you have a very small island you will not be able to have organism such as, elephants that have large home range requirements whereas, if you have a larger size island you can even incorporate those species that have larger home range requirements. So, the number of species that will be found in any area would depend on the size of the island and this has been computed as S is equal to C into A to the power of z, where C and z are both constants.

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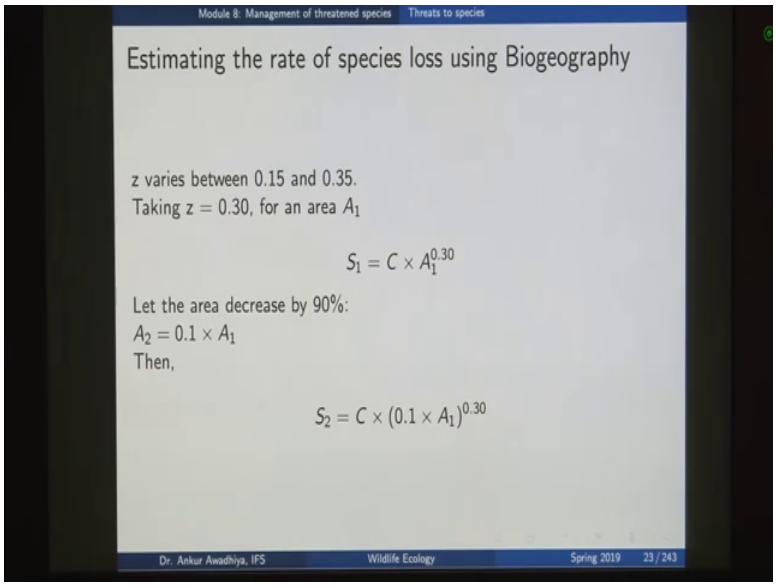

Now, we can use this equation to compute how many species they are going will lose out, if the amount of habitat that is available to these species reduces or if you are reducing the size of our forest. Now it has been seen by looking at a number of ecosystems that z varies between 0.15 and 0.35.

Now, let us take a middle value of 0.3 so in that case if you have an area of A 1, so you will say that the number of species of the species richness is C into A 1 to the power of z which is 0.3. Now we let this area decrease by as much as 90 percent.

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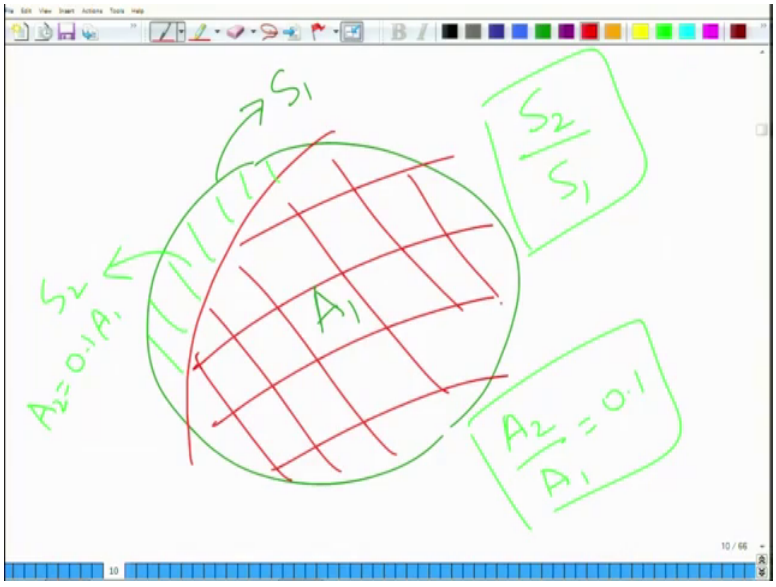

So, what we are saying in that case is earlier we had this much of forest and then this much amount of the forest has been encroached a for say human activities. So, only 10 percent of the forest remains, so in that case how many species would remain in that area. So, we have A 2 that is the amount remaining is just 10 percent or 0.1 of A 1.

So, in that case S 2 which is the number of species that are that is found in this 10 percent area of the forest now will be given by C into A to the power of z, here A is 0.1 into A 1 and z is 0.3 so it will be given as C into 0.1 A 1 to the power of 0.3. Now we can compute the ratio of these species so in the first instance in the whole of the forest we had the number of species that is given by S 1 and in the second instance we have only these many species remaining which is given by S 2 and we are finding out the S 2 S 1.

Now, the larger area is A 1 and the smaller area is A 2 which is 0.1 of A 1. So, we already know that A 2 by A 1 is 0.1, now if that be the situation what is S 2 by S 1?

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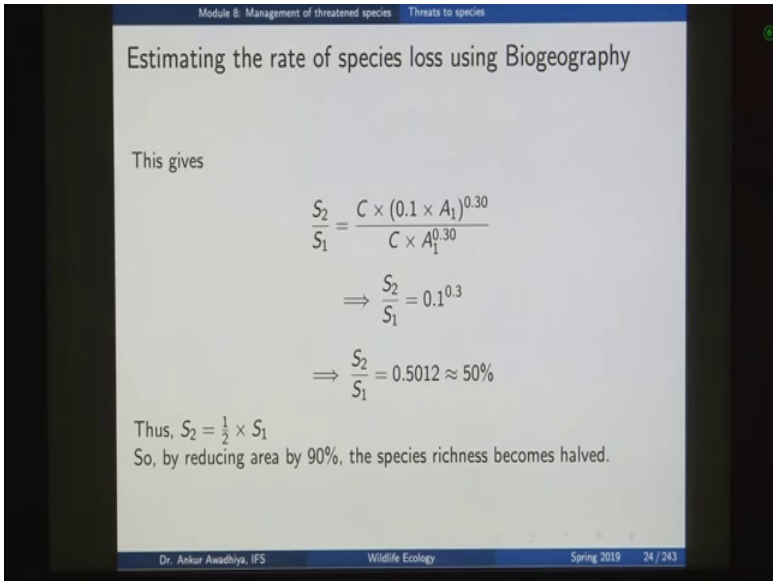

Now, if we plug in the values will find this that S 2 by S 1 is 0.1 to the power of 0.3 which roughly comes to 50 percent. So, even if you have reduced your area by as much as 90 percent the number of species that remain is as high as 50 percent. So, even though you have removed 90 percent of the area you are not loosing 90 percent of the species you are only loosing 50 percent of this species, but then those would be the species that preferentially required a larger sized of home range or probably those are the species that have a very specific habitat requirement. So, they are more specialized species.

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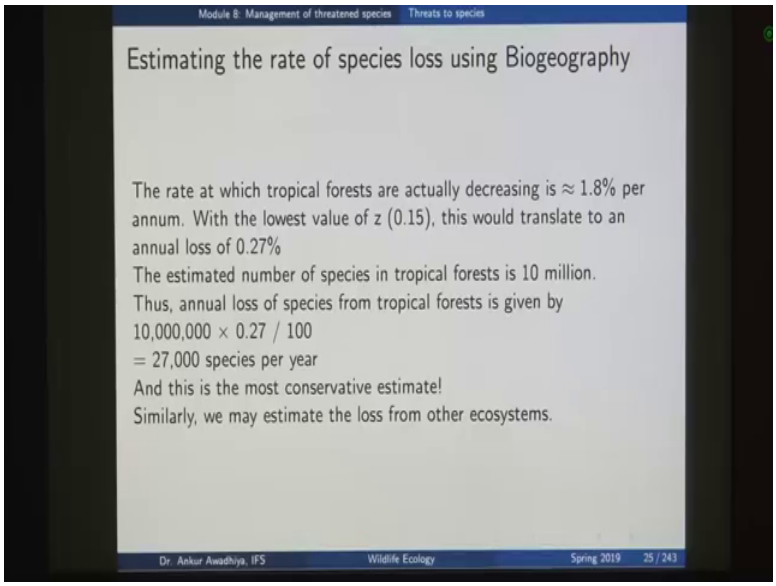

Now, we can use such a theory to compute how many species are we losing out by say losing out are different habitats, such as the habitat in the tropical forests

Now, we know from satellite studies that the rate at which tropical forest are actually decreasing is around 2 percent per annum 1.8 percent per annum and if we even take the lowest value of z. So, here we are not taking z is equal to 0.3, but we are taking z is equal to 0.15 we are taking the most conservative estimate, it would translate to a loss of 0.27 percent per year and we are estimating that the number of species that we have in the tropical forest is closed to around 10 million species

So, if you are losing 0.27 percent of 10 million it means that we are losing as high as 27000 species per year, which is a conservative estimate of the number of species that we are losing and similarly we can estimate the losses from the other ecosystems

Now, what are these species? If you ask somebody you your you would say that yeah we lost a few species, we have lost the young say dolphin, we have lost the dodo, but then most of the people will not be able to move more than say 10 species, that have been lost throughout the whole process, but then we are losing around 27000 species per year and most of these species are those that we do not even know that they exist a number of herpetofauna, a number of frogs species, a number of snake species, a number of lizards species and all of them are also very important for the biodiversity of those area.

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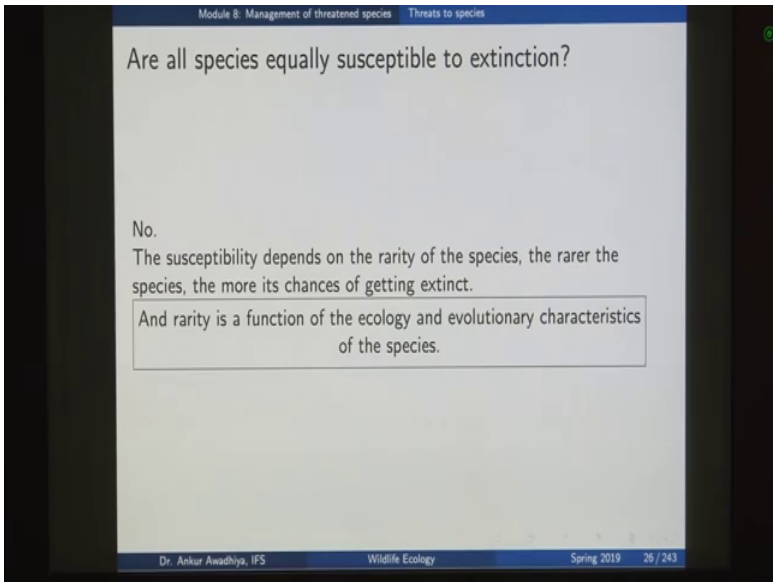

Now, which species get lost is not the same across all the species so the amount of susceptibility of a species to extinction is not the same across different species the susceptibility depends on the rarity of the species and if you have a species that is more and more rare. So, there is a greater chance that it gets extinct because if you already have a rare species it means that it has very lesser number of habitats that it can make use of or it already has a very small population size. So, the number of stochastic phenomena that can play havoc to this species are very high. Rarity is a function of the ecology and evolutionary characteristics of the species.

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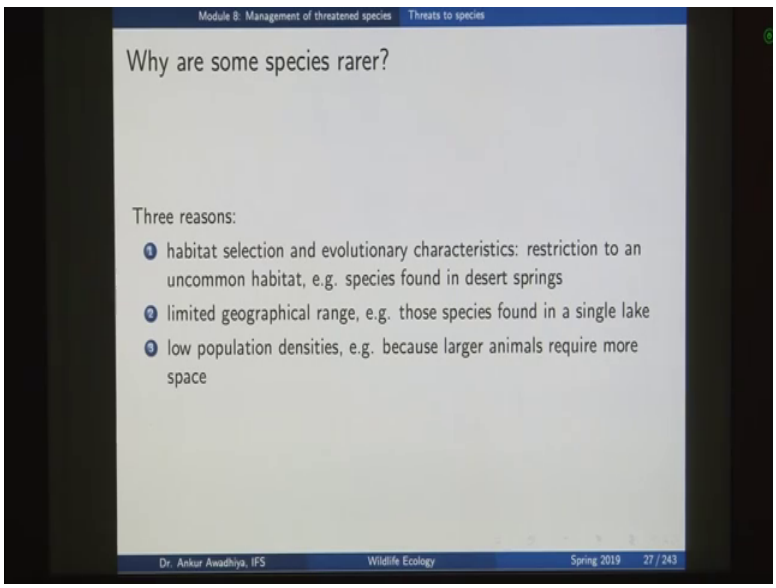
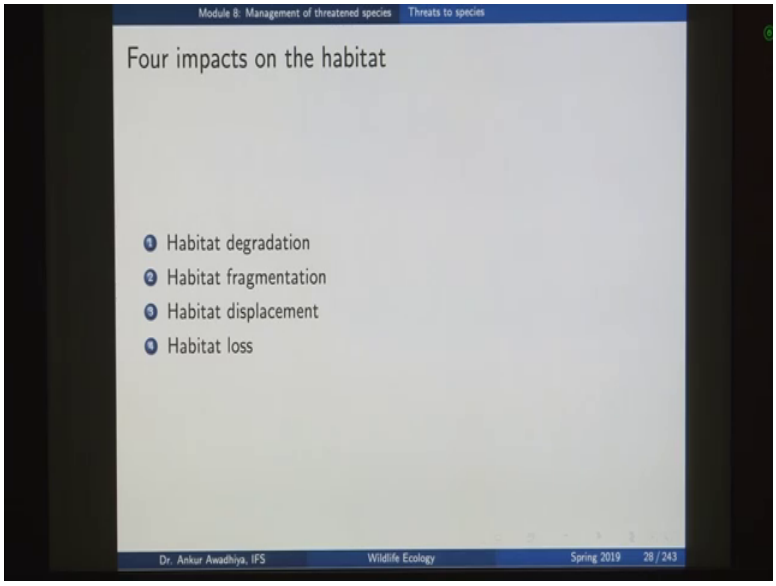


So, why are some species rarer? Some species are rarer because of three reasons one is habitat selection and evolutionary characteristics such as restriction to an uncommon habitat. So, a species that are that is found in the desert springs will be extremely rare because it is a very specialized it is a very uncommon habitat, we do not have a number of deserts, we do not have a number of springs in any desert. So, the number of deserts springs already is very less. So, the number of useful habitats for this species already very less.

The second one is a limited geographical range do the species that are found in a single lake. So, if you lose out this lake you lose out all the all this species that are found in this particular lake and third is low population densities example because the larger animals require more space. So, these are three reasons by certain species are rare and these species are much more susceptible to extinction.



Now, we were talking about the habitat loss or the impacts on habitat and the impacts on habitat can be divided into four different categories we have situations of habitat degradation, fragmentation, displacement and loss.

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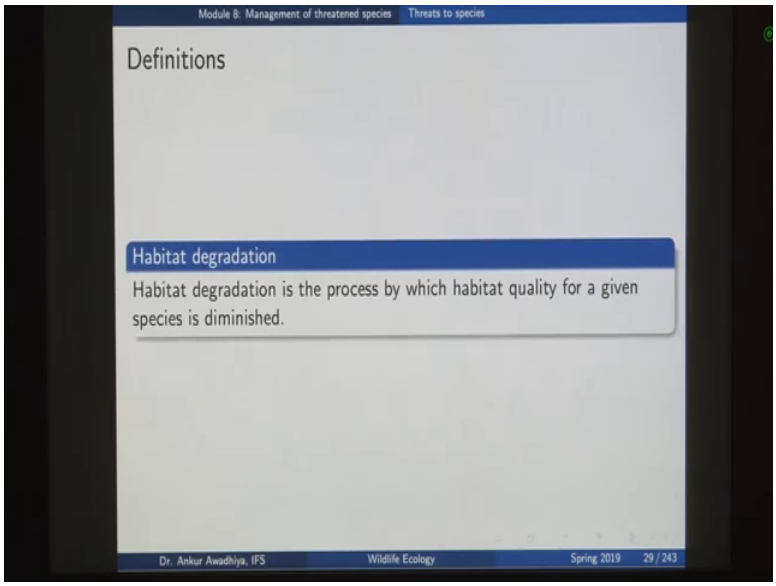

So, we look at all four of these, habitat degradation is the process by which the quality of the habitat for given a species gets diminished. So, for instance if you are living in a city and the air in the city becomes more and more polluted. So, it is an example of habitat degradation because now the habitat or the urban habitat for you is not as good as it was before, so the habitat is getting degraded.

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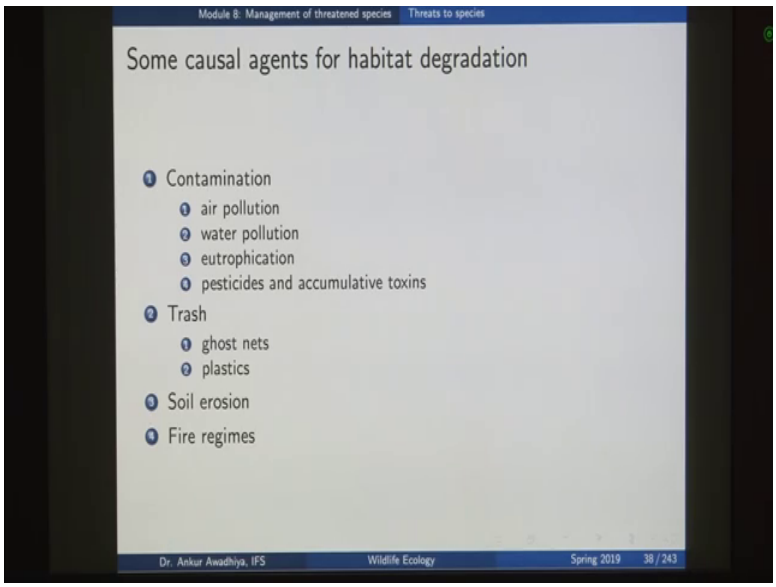

This degradation can be because of contamination air, water pollution, eutrophication pesticides, accumulated toxins and so on.

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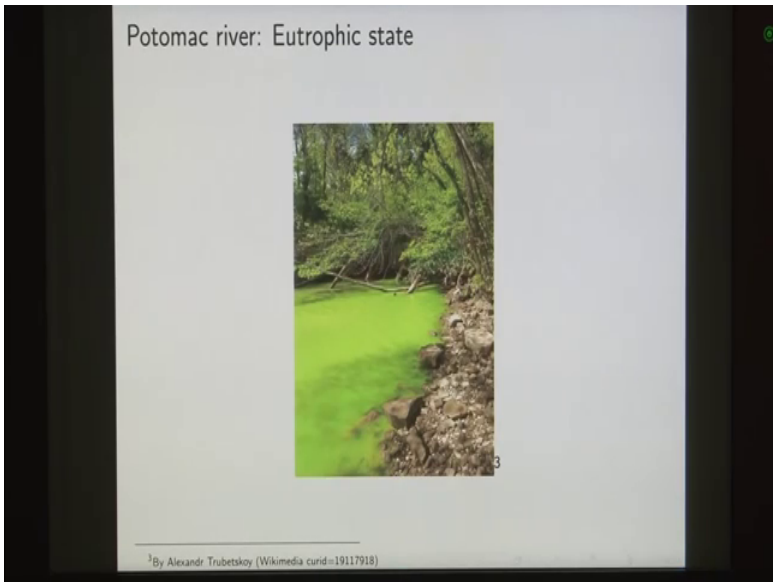

So, we talked about the phenomenon of eutrophication earlier. So, that is an example of habitat degradation.

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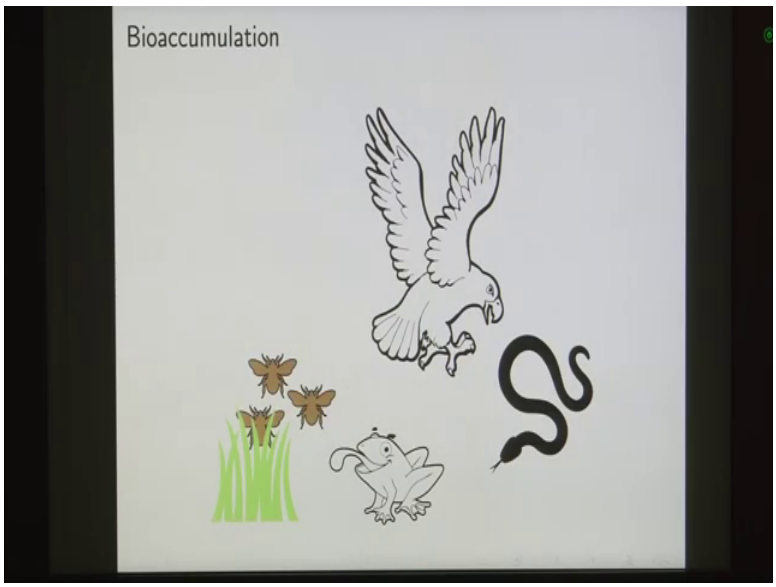

We talked about bioaccumulation earlier, so in the case of bioaccumulation if you split some pesticides on the grass. So, this pesticide is also taken up by the insects then it moves up the food chain and the amount of pesticides that is available more and more up as you go increases.

So, even if you have a very small amount of pesticides that was spread here the

concentration in the larger birds would increase to such an extinct that they would start dying off. So, even a very small amount of pesticides would be enough to degrade the habitat specially for the large size birds or you could have things such as trash; trash is also another way in which we are degrading the habitat.

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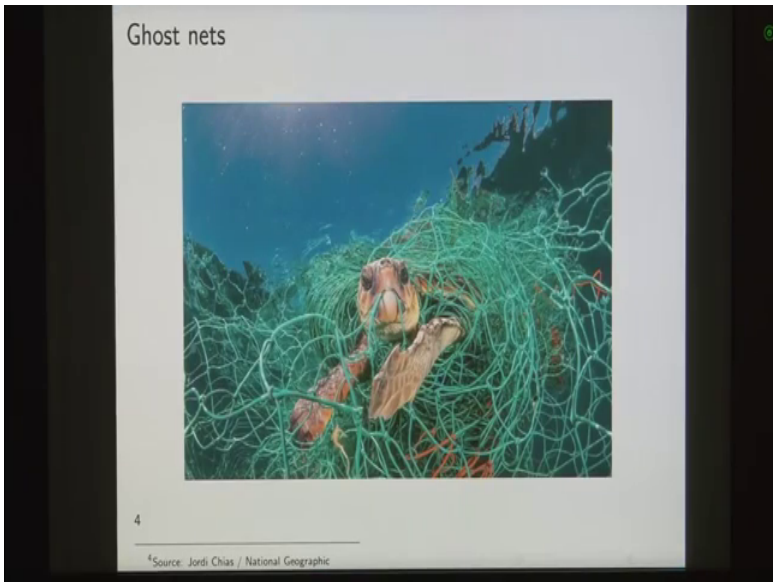

Ghost nets and plastics, so ghost nets are those nets that have a that have come out into the ocean. So, essentially there was somebody who was using these nets and probably small portion got turn off and it drifted away into the waters or probably there was a storm and the whole of this net was lost into the sea.

Now, if you have this net into the that is there in the seas so it will still be catching up organisms these organisms once they occurred they die when they are in these caught up in these nets and so the these are very important factors of habitat degradation or things, such as entanglement.

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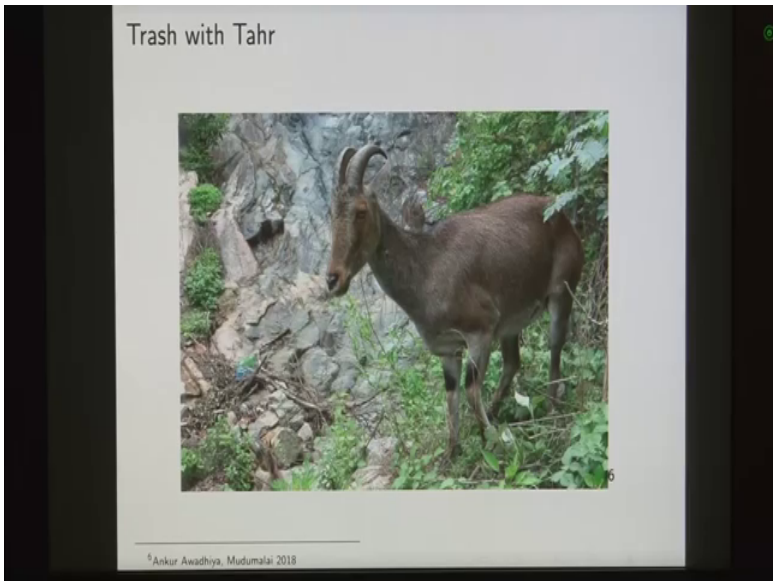

Or even in the case of r mountains here we are observing a species which is (Refer Time: 38:50) and here we are observing plastic bottles. So, piercing degradation of habitat everywhere.

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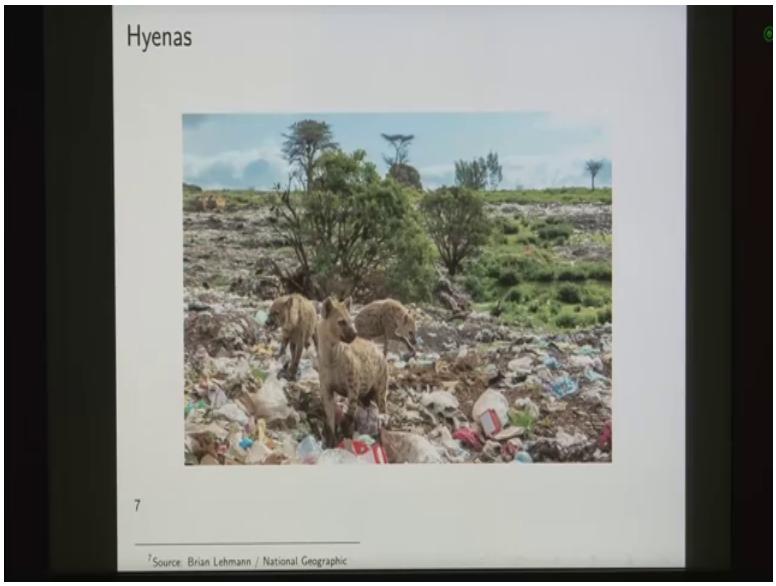

These hyenas that are near a trash side, now if you have these hyenas that are feeding along these trash sides probably they will also be feeding a some amounts of plastics because if we have some food that is wrapped in a plastics the hyena does not know that plastic is not something that is to be eaten.

So, it will eat up the plastics as well and once it eats up the plastics that will get lost into it's intestines and once or in the stomach and once it gets lost in the intestines of the stomach the amount of nutrients that this hyena will be able to absorb from the surroundings would reduce further. So, this is another example of habitat degradation or things such as soil erosion and forest fires.

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So, if you have a fire in a forest so that would also degrade this habitat because earlier you had a number of plant species that were that were available as food as shelter for different organisms, if you have a forest fire. So, all these species are lost and so, this habitat has become more and more degraded for those organisms that for dependent on those small plants.

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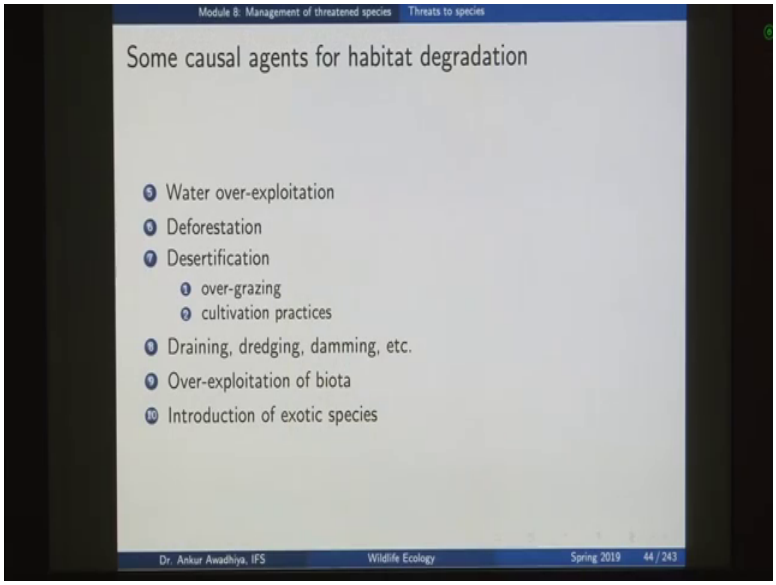

Other examples of habitat degradation are water over exploitation. So, if you have we observe this thing in Tamil Nadu in which case we had a tiger reserve and right next to

the tiger reserve where a number of villages.

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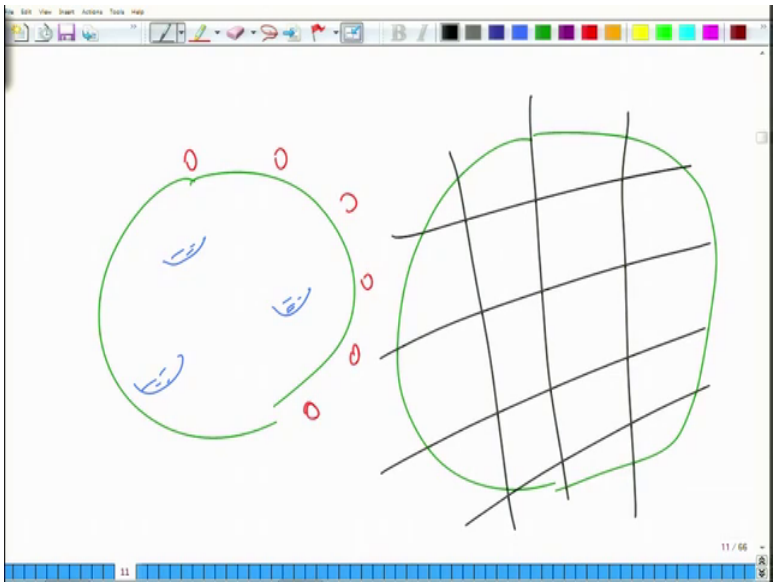

Now these villages were using quite a lot of water for irrigation once that is happening, the small water bodies that we had in the forest areas were getting ride out now if you have a forest area in which the amount of water is less. So, the habitat is not as good for the survival of animals as it was before. So, water over exploitation or deforestation these are also examples of habitat degradation.

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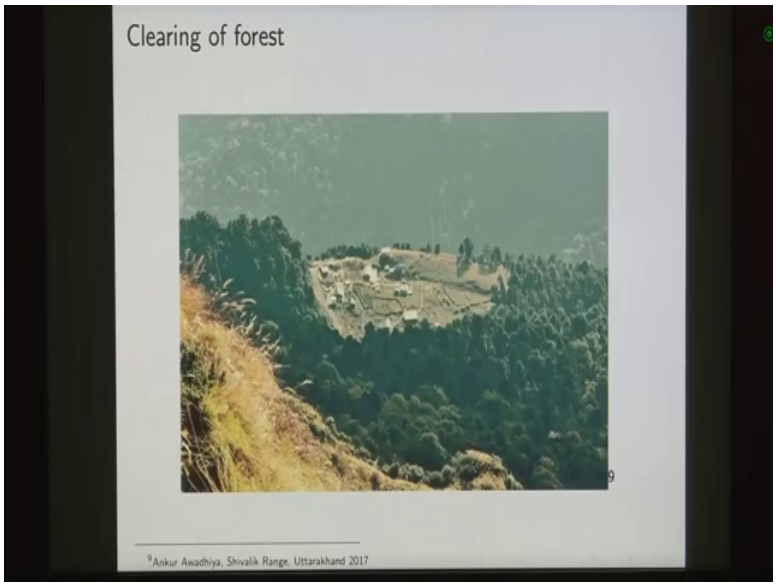

So, in this case here we observe that we have very good forest and then this is an area

that has been cleared off. So, the organisms that were dependent on the forest will not be able to utilize these areas. So, this is an example of habitat degradation that is going on or things like desertification over grazing of the plant species of cultivation practices that are leading to more amount of water being used.

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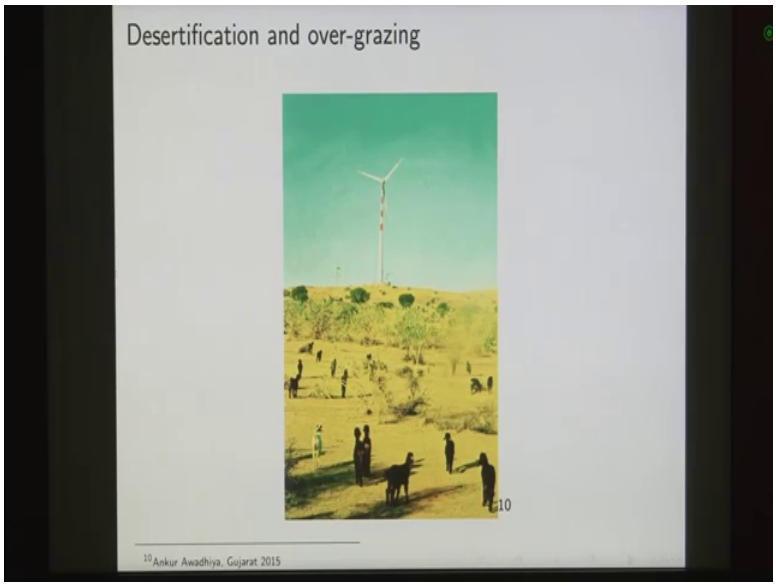

Such as these goats now if these if you have an over grazing because of these goats. So, there will be eating up all of these small plants that are remaining in this area and so the soil will not be held up by these plants it will start floating around in a very short period of time, this whole area will convert into a complete desert. So, that is also an example of habitat degradation or activities such as draining of water bodies, dredging of water bodies, damming of water bodies or over exploitation of certain species or introduction of exotic species all of these degrade the habitat.

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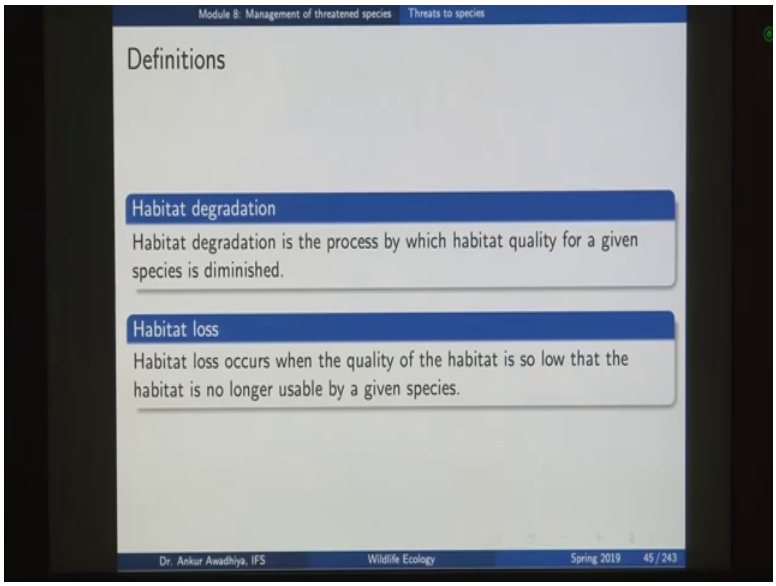

So, in the process of degradation the habitat is getting the quality of the habitat is becoming lower and lower for a particular species Now if this quality becomes low to such an extent that the organism is now no more able to use this habitat. So, in that case will say that habitat degradation has become so much that it has now resulted in the loss of the habitat; the habitat; the habitat is now completely lost that is an extreme level of degradation.

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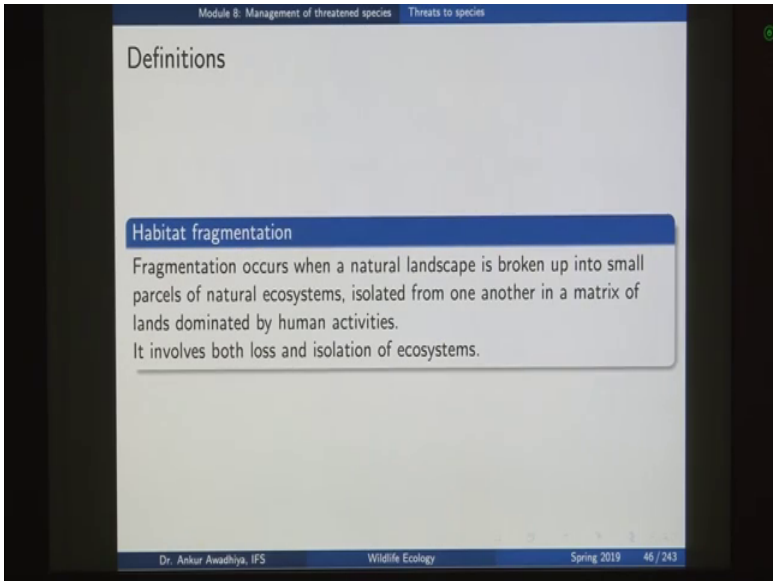

Another factor that is a roller habitat fragmentation now fragmentation occurs when an

natural habitat is broken up into smaller parcels of natural ecosystems isolated from one another in a matrix of lands dominated by human activities and it involves both loss and isolation of habitats. So, in the case of habitat fragmentation we had earlier a large size habitat and now we are dividing this habitat into smaller portions.

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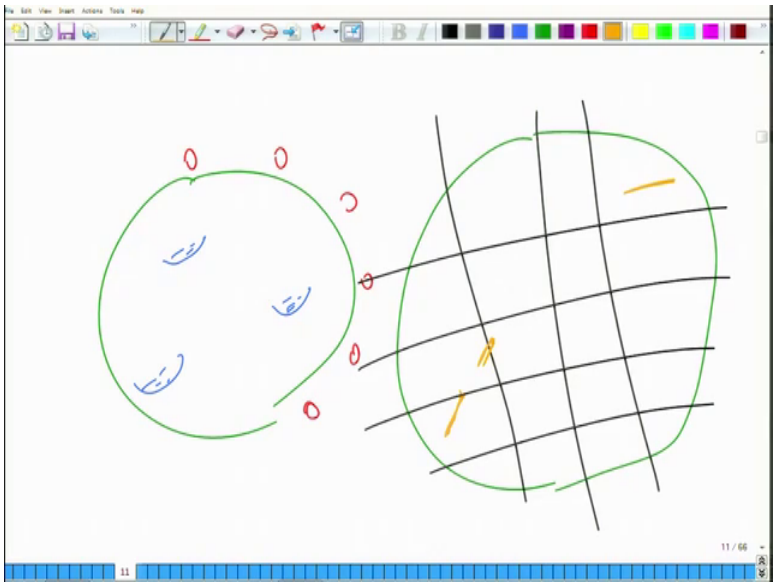

So, for instance if we have a number of roads now earlier in the whole forest I mean you did not have these road and if you had a snake say at this location and this snake wanted to reach this location it would very easily able to reach, but now if you have so many roads in this area this snake would have to come on to a road to cross this area and once it comes on top of this road, it is possible that it gets over run by some vehicle and it dies.

So, fragmentation is also a very important phenomena that is leading to extinction or death of species.

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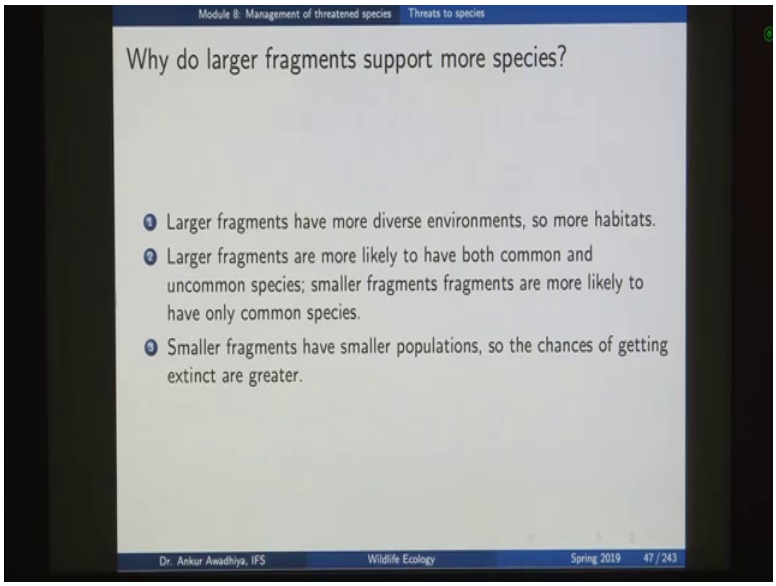

Now, we have seen before that larger sized forest or larger sized habitat support more number of species why? Because one they have more number of habitats consider the case of larger sized islands where we have hills, we have rivers, we have a strings, we have grasslands, we have shrubs which are not there in a smaller size island.

Second larger fragment is more likely to have both common and uncommon species whereas, smaller fragments are more likely to have only the common species and third smaller fragments have smaller populations, So, they chances of getting extinct are also large.

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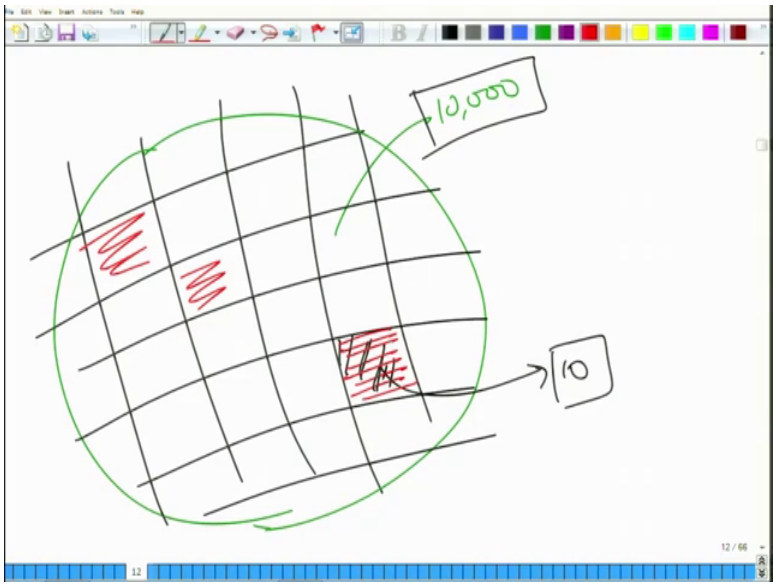

So, what we see in this, what we are saying in this case is that if you have a large sized forest and this forest supports say around 10,000 organisms of a particular species.

Now, in the process of fragmentation you have divided this forest into very small parcels of land and say this particular parcel is able to support say 10 individuals of this species. Now in the case in the earlier case where we had 10,000 individuals who only had deterministic factors that were playing a role in the population dynamics, but when we have only 10 individuals will also have the rule of stochastic factors.

So, the chances that this particular patch becomes extinct. So, there is a local extinction in this particular patch is very high similarly it is very high in this patch, it is very high in this patch. So, just by dividing the whole forest into smaller patches we have ensured that the number that the extension probability in all of these smaller patches is very high and in that case it is very likely that will have a local extinction and all of these patches and the species will devote completely. So, this is also another way in which it is bad to have this smaller patches.

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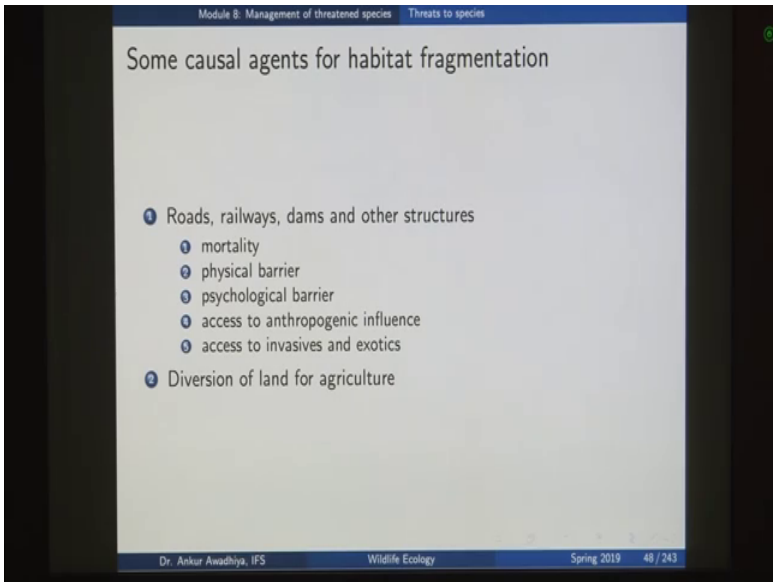

Now, how do we fragment a habitat or what are the factors that are leading to fragmentation of habitat? Here things like roads, railways, dams and other structures now these structures lead to mortality when an animal is run over by railways or they had run over by roads by vehicles that are going on the roads or they act as physical barriers. So, the animal is not able to cross to the other side because it acts as a very big barrier for the animal or it act as a psychological barriers.

So, if you have a road that is a very very much teaming with traffic, so the animal will find it extremely psychologically stressful to cross that particular road or it increases access to the anthropogenic influences. So, if you have roads and railways in an area so more number of individual more number of an of human beings will reach that area and so the amount of human influences will also increase or access to invasive species and exotic species. So, that is one way in which we are a fragmenting the habitat. The second one is diversion of land for agriculture.

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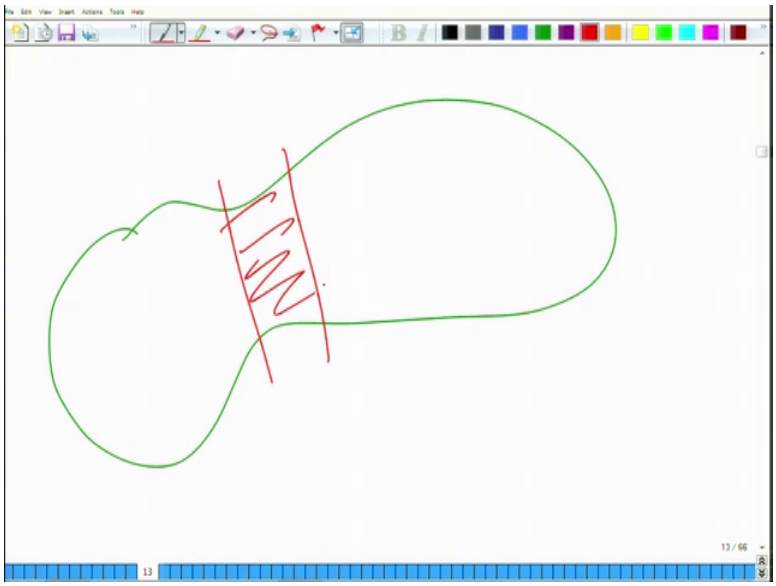

So, suppose we have this forest and suppose we divert this particular portion for agriculture. So, if that happens we have already divided this forest into those smaller patches.

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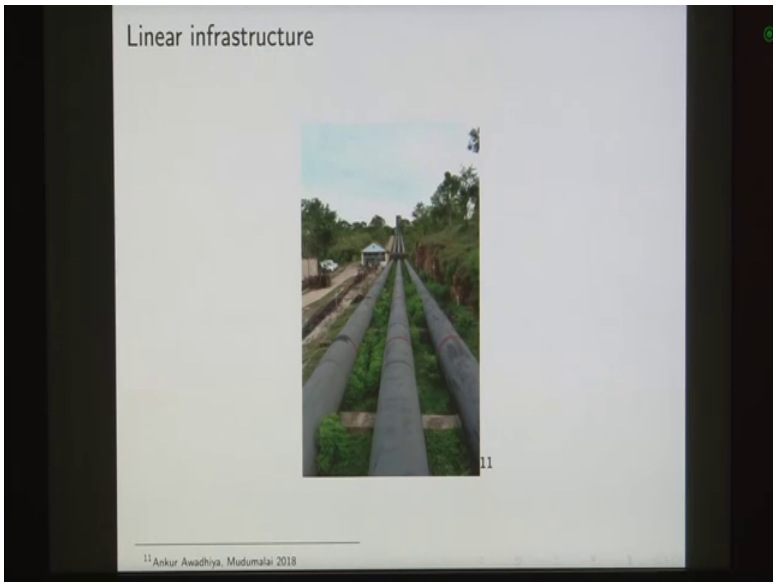

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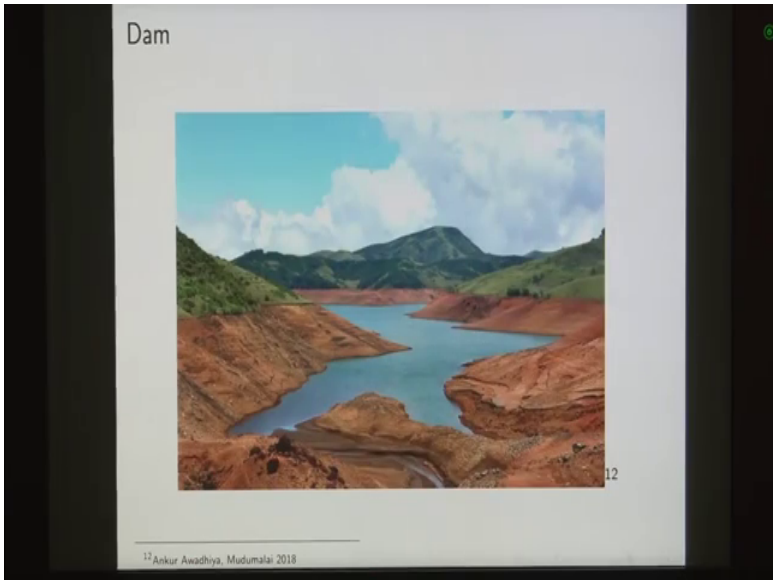

Third is linear infrastructure, so linear infrastructure includes things such as pipelines or creation of a dam; dam also play the very important role in habitat fragmentation because now organisms that are there on this side of the dam find it very difficult to reach this side whereas, earlier there was a connecting land passing, so which they were able to move. Now that would again depend on the size of the dam, but then this is also a very big factor in habitat fragmentation.

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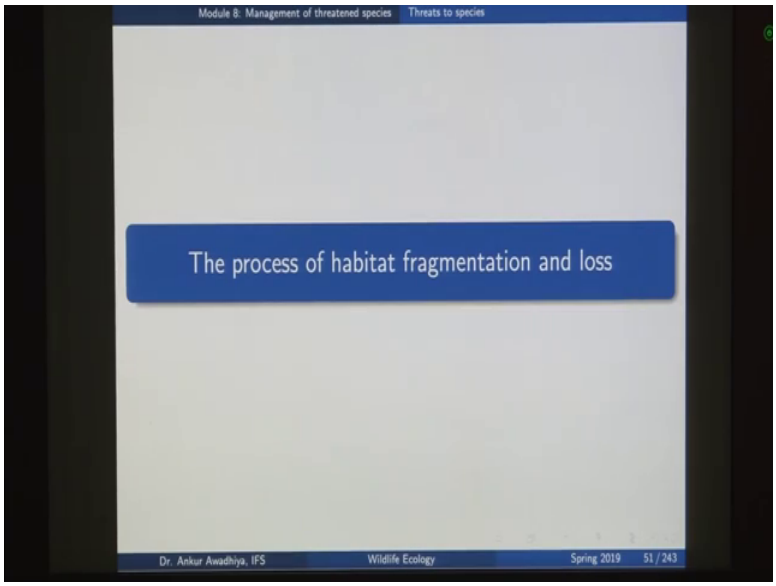

Now, habitat fragmentation, how does it actually occur when we look at the forest situations.

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So, suppose this is a forest the habitat fragmentation would start by dissecting of this forest. So, in the first place we have set of these roads so probably this is a national highway that is connecting a very two large towns and then these are small roads that are constructed. So, that some small hamlets that were inside are now more connected to the forest or to the main roads.

So, the fragmentation begins by this process of dissection once dissection happens. So, now, humans are finding it more and more possible to access these areas the accessibility has increased once you have more amount of accessibility so people would want to come and live in those areas. So, probably now there would be a small hamlet here, probably there would be one person who sets up a house somewhere here because now it is accessible for this person, probably there would be some people who would start some amount of forming or some amount of dairy or probably people would want to set up some amount of some form here.

So, that the people who are plying on this particular highway have now an access to say milk or milk products and these persons also see a livelihood opportunity because they have a ready market in terms of the people who are plying on these roads. So, in a number of forest area they will see that there are people who are sitting on the side of the rods and they are trying to sell you something, probably vegetables probably fruits or milk or milk products and so on.

So, this stage is known as perforation, now when perforation happens you have you are increasing the impacts of the human beings because if you have these cattle here, if you have some amount of grazing that is going on these cattle will go into the forest areas to graze and once that happens they are going to compete with the wild animals. So, we see things like livestock in the forest.

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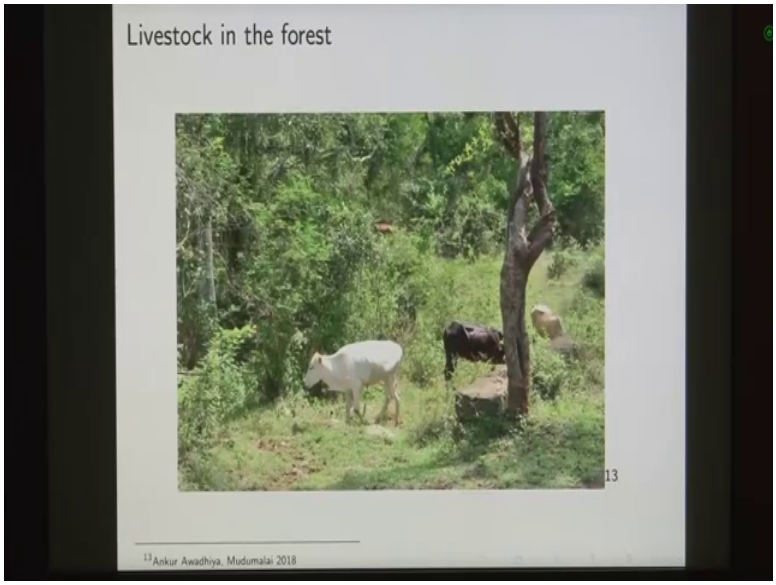

Once perforation has happened the next thing would be fragmentation because we had this small settlement here we had a settlement here now they would want to join with the main settlement. So, they would increase in their size so the size of this hamlet is now increasing once that happens this whole area becomes a settlement this whole area becomes a settlement and it joins with the other settlement here because this settlement is also increasing in size when that is happening once all of these have joined together.

So, now, if an animal wants to move from this side to this side, it will have to cross this particular village then it will reach a small patch of forest and it will have to reach cross this particular village and then it will be able to reach this side. So, in this case what we are observing is fragmentation of the habitat because in place of a large sized forest now we have smaller sized patches that are remaining.

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So, this is how a fragmentation would look like. So, here we have forests on this side on this hills on this hills we have the forest and this whole area has now been taken up for plantations now this is fragmenting this habitat. After fragmentation the next stage is that of attrition, now attrition is the process in which those smaller sized patches that were remaining there also now being taken up for human use.

So, once you have all these villages once you have so many cattle's here and there is a good market in terms of the people who are buying this product. So, government would also want to set up some schools, government would also want to provide the facilities of say hospitals in this area, probably there would be some small industries that would come up in these areas, probably there would be an access to electricity as well and when all of these happens at place a positive feedback because if you have this area that has such good environments plus it has a ready market plus it has so many people plus it has electricity.

So, now, more and more people would want to come and live in this area. So, probably there would be some people who would want to buy up these lands for investment purposes, once that happens the whole amount of human dominated landscape would increase and these patches would become even smaller in size, but time so that is the process of attrition.

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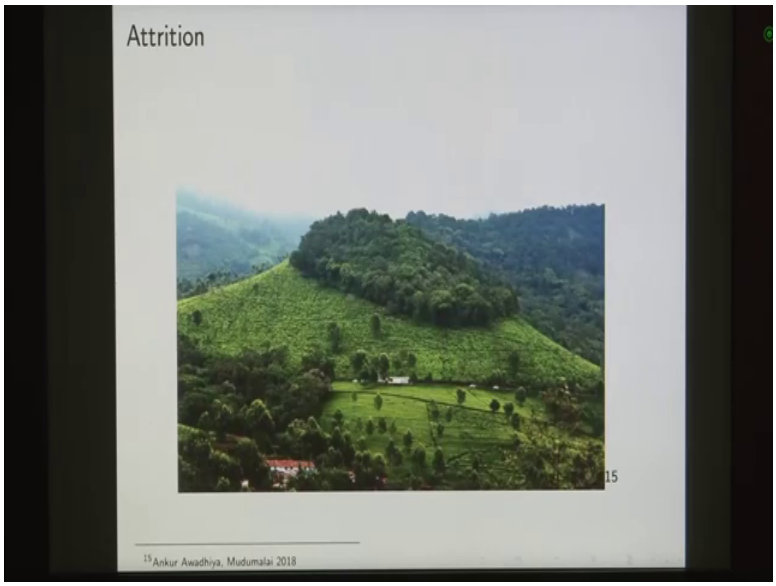

And this is a good example of attrition in which this pool hill which was earlier for lock forest, now only has this much amount of forest left rest all the places have government taken up for human use and a good example of these processes is seen in the case of Amazon rainforest.

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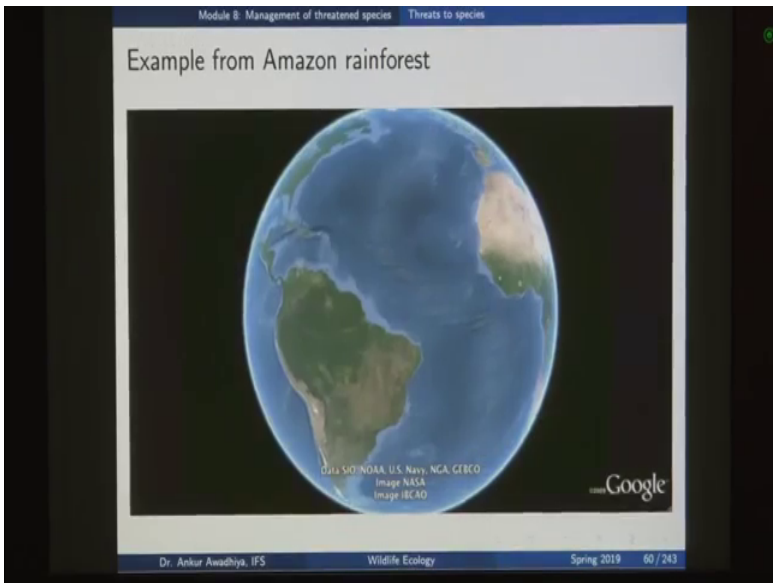

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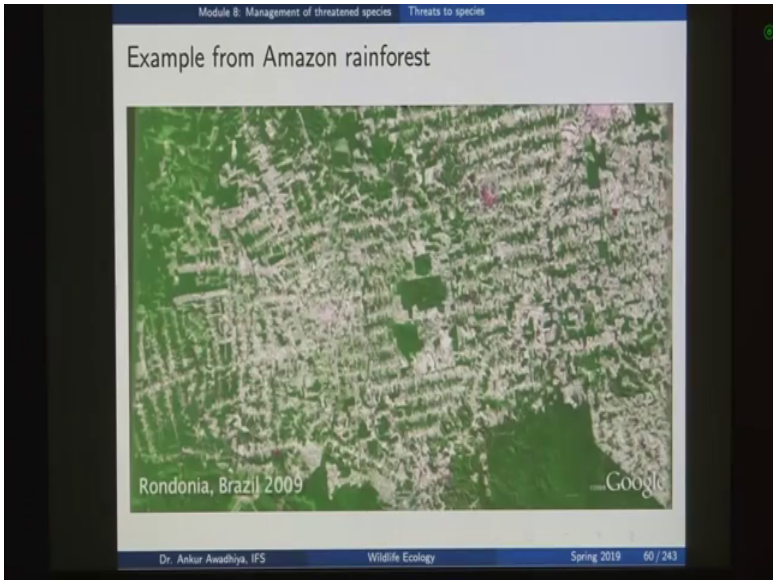

So, here we are looking at a rainforest in Brazil and we are looking at 1975 images. Now, in 1975 the whole area was forest, then there was a road that was constructed and then the amount of influences increase and then by 2001 the whole of the area was taken up and then by 2009, we can see that there is hardly any national habitat that is remaining in this particular area. So, this is an example from the satellite images.

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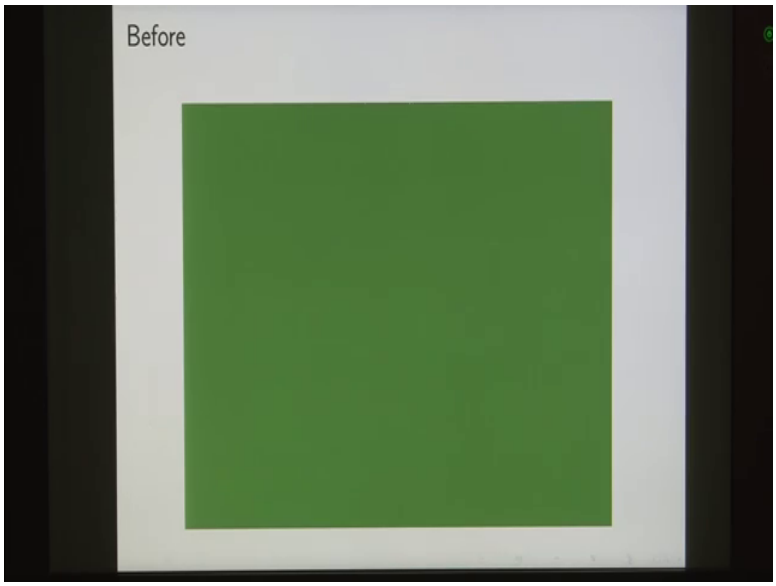

So, earlier while we had this whole big sized forest that was available as a habitat for so many species.

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Now, because of the road that was set up all of these areas have now been taken up and only very small patches are remaining. So, that is the process of habitat fragmentation and this is an example of an extremely fragmented habitat.

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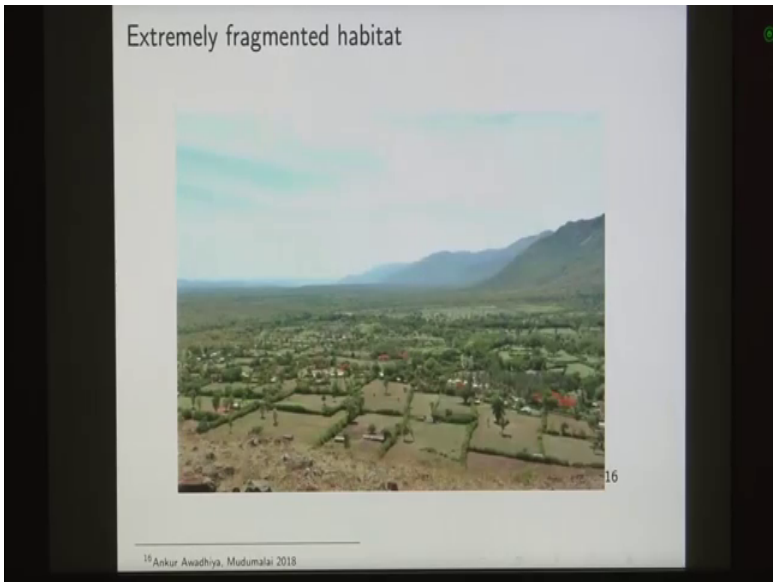

So recently Supreme Court has acted upon this habitat what people had done was that we had these forest and all these areas where taken up for the settlement of for the setting up of resorts. Now, Supreme Court came down harshly on these resort and all of these resorts were then closed down because they were fragmenting this habitat, if you had an

elephant that had to move from 0.1 to this point it could not move without passing through all these human habitations.

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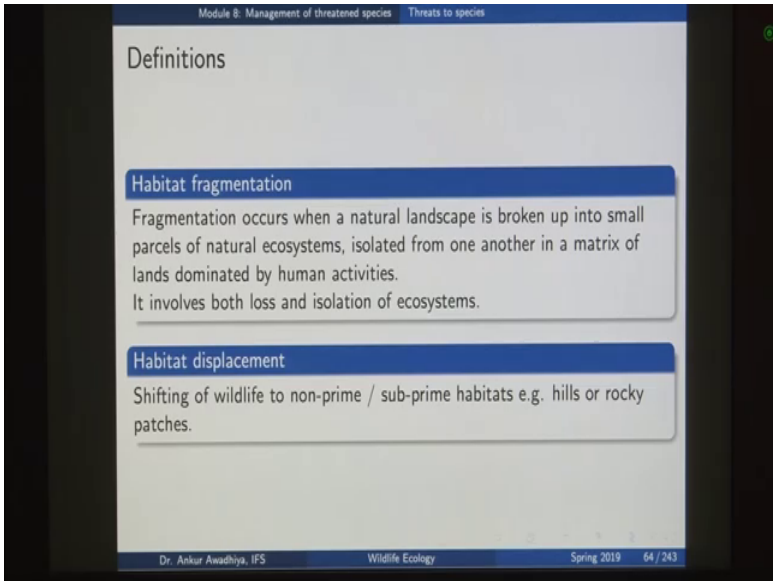

Now, besides human habitat fragmentation the other phenomenon that is playing a big role is known as habitat displacement; habitat displacement is shifting of wildlife to non prime or subprime habitats example hills or rocky patches.

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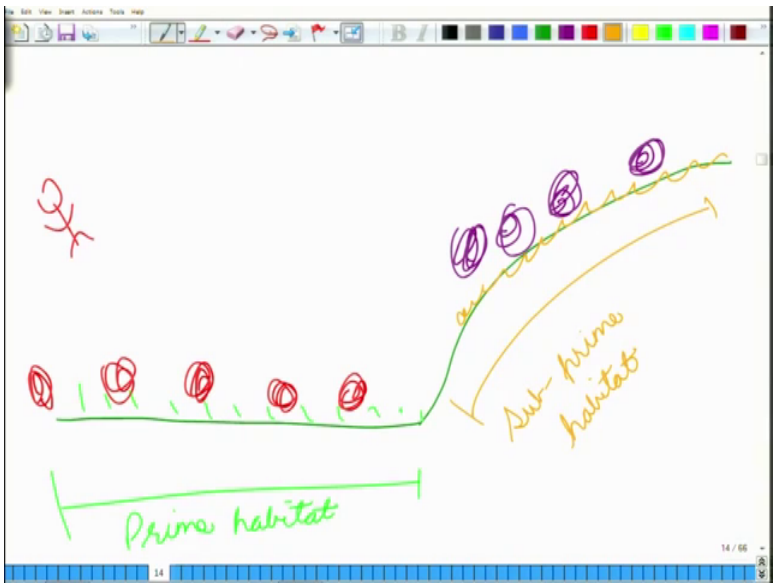

Now this is again something that we have seen earlier in ecology, the good example was you have some grasslands and then you have this hill and there are so, this area has lots

of grasses and this area probably is boldary. So, you do not have many grasses on the hill side.

Now, earlier you had a number of wild life that we using these areas because they want grasses to feed up on. Now if you have human beings that come with their cattle, so you have cattle and they are also coming with dogs once that happens the wildlife will not be able to compete with the cattle. So, in that case the wildlife will have no other option than to move to the these hilly areas. So, once that happens you will not have any wild life that is left in this area, all the wildlife is now found here and all of this area the grasslands have been taken up by the cattle.

Now, in this process this particular prime habitat so this was a prime habitat because it provided a lot of grass or a lot of fodder to the animals. Now this habitat was taken up by the cattle and the animals were shifted to this particular habitat which is a sub prime habitat because it is all full of rocks and it does not have ample amount of fodder available for the animals, once that happens we call it as habitat displacement.

So, it is shifting of wildlife to non prime or subprime habitats example hills or rocky patches. So, we can see that there are a number of processes through which the wildlife are is losing their habitat.

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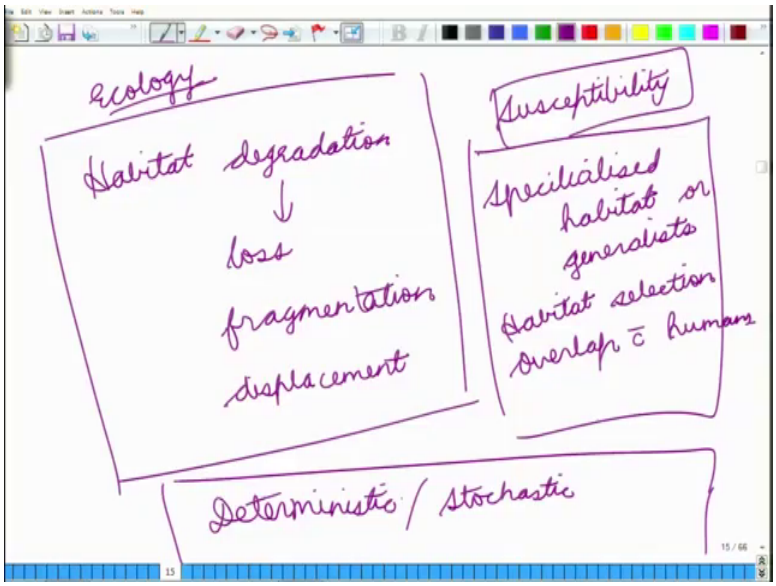

We have the process of habitat degradation where the qualities reducing, if the quality

reduces to a very high extent will have a habitat loss we can also have habitat fragmentation in which a big parcel of land is now getting converted into a small parcels of land or we can have situations of habitat displacement, where the wildlife is shifted to nonprime habitats or subprime habitats and we have also seen. So, all of these are processes that we can understand in the process of in the science of ecology.

Now, we also saw that different animals or different organisms will have different susceptibility because of different susceptibility to extinction because of factors such as how specialized are those organisms, do they require a specialized habitat or are they generalist or what is the process of habitat selection for this organisms or how close is the overlap of their habitats with humans. Now all these susceptibility factors are also things that we study in ecology.

The third set of factors is the population size or the population dynamics do we have deterministic factors that are acting on these populations because they are large in size or do we have stochastic factors. Now all of these are different subtopic or different sub fields of ecology that we have seen and we can use information from all of these to be put into the cause of conservation. So, we can say that if we wanted to conserve these pieces how do we avoid habitat degradation or habitat loss of fragmentation or displacement or how do we identify those species that are very much highly susceptible to it becoming extinct or how do we understand the population dynamics of these organism?

So, we can choose all of these information to understand the threat that is being perceived by different species and one way in which this done is known as population viability analysis.

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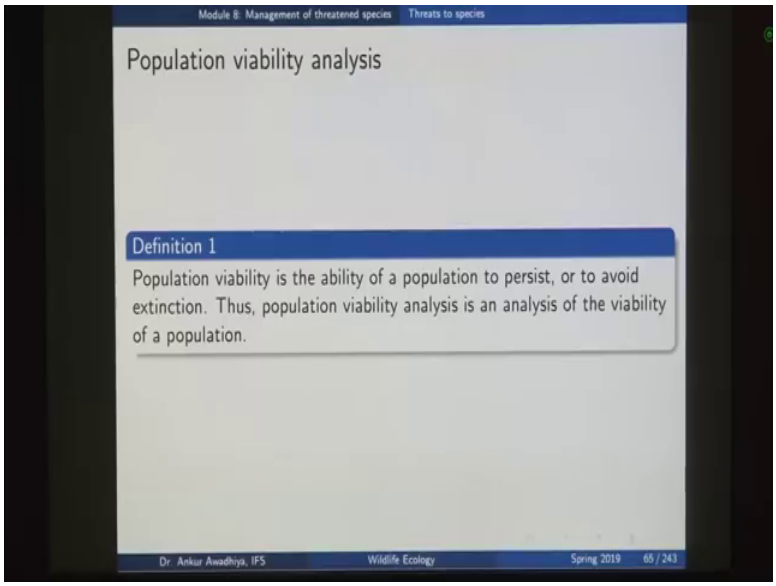

Now, population viability is the ability of the population to persist or to avoid extinction. So, what we are asking here is suppose we have 2500 tigers in our country what is the probability that they have that after 100 years we will still have tigers in our country or what is the possibility that all of these tigers will die out, they will become extinct in our country.

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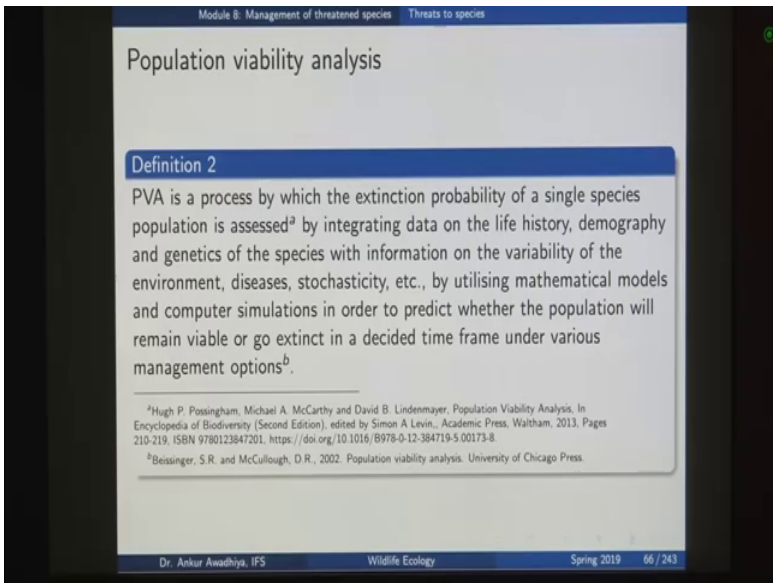

So, population viability analysis is an analysis of the viability of a population or it is a process by which extinction probability of a single species population is assessed by

integrating data on life history, demography and genetics of the species with information on the variability of the environment, diseases, stochasticity etcetera, by utilizing mathematical models and computer simulations in order to predict whether the population will remain viable or go extinct in a decided timeframe under various management options.

So, this is one place where we are using different sub disciplines of ecology, we are looking at population ecology, we are looking at genetics of different species, we are looking at environmental variations or ecosystem level perturbation to understand whether a population is going to perceive for a long time or not.

So, that is population viability analysis and in this lecture we looked at why certain species are under threat of extinction, what are the ways in which different species become exposed to different threats, what are stochastic factors, what are deterministic factors and how in through the process of habitat degradation loss fragmentation and displacement, we are putting a stress on a number of individual, now all of these are ecological learning's that we are making use of to conserve different species. So, that is all for today.

Thank you for your attention [FL].