Wildlife Conservation
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Lecture – 38
Revision – I

[FL] Now that we have reached to the end our course, we are going to have 3 revision classes and which we will go through, what we learned in the whole of the course.

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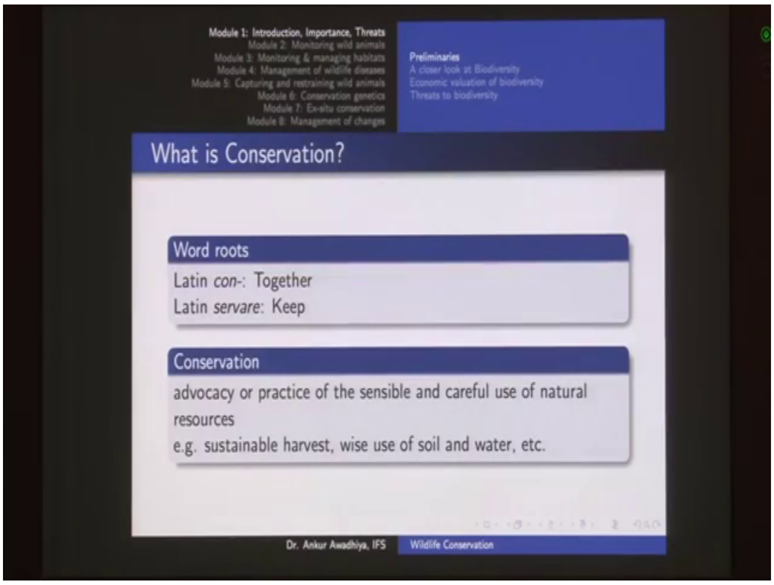

So, let us begin with our first class. So, we began with this module of introduction importance and threats. In which the most important thing is when we talk about wild life conservation, what is conversation? What is wild life?.

So, conversation is advocacy or practice of sensible and careful use of natural resources and it means any of the sustainable use of resources. So, whether you are talking about sustainable harvest or you are talking about sustainable use of soil, sustainable use of water and so on.

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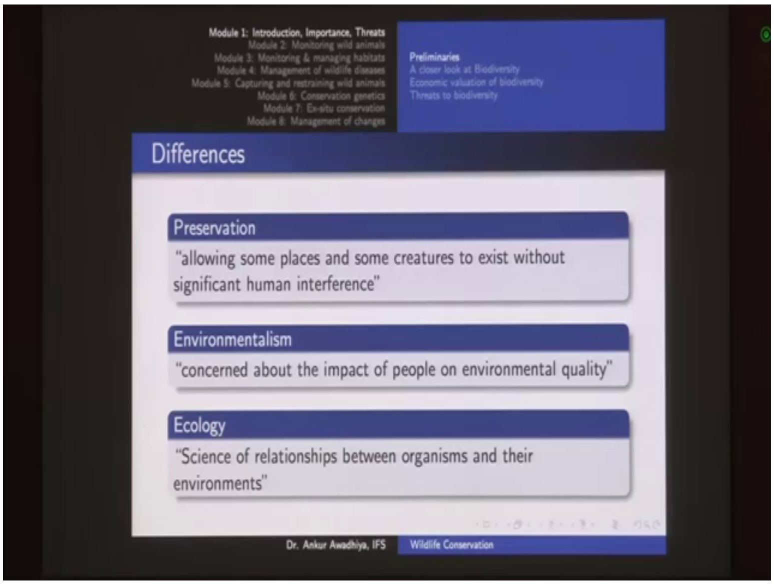

And this is different from preservation, in which you do not touch anything, environmentalism which is concerned with environmental quality and ecology, which is the science of relationship between organisms and their environment..

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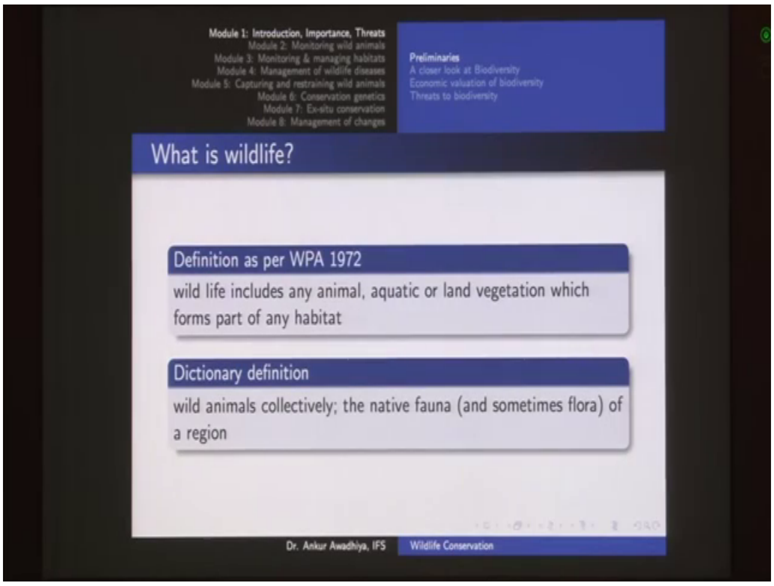

Now, when we talk about wild life conservation, what is wild life? So, this is the most important definition because, this is coming from one of our laws, the Wildlife Protection Act. So, wildlife includes any animal aquatic or land vegetation, which forms part of any habitat. Now the important thing is it includes animals, it includes plants and which form part of any habitat. So, this habitat may be a wild habitat or this habitat may be any other habitat as well..

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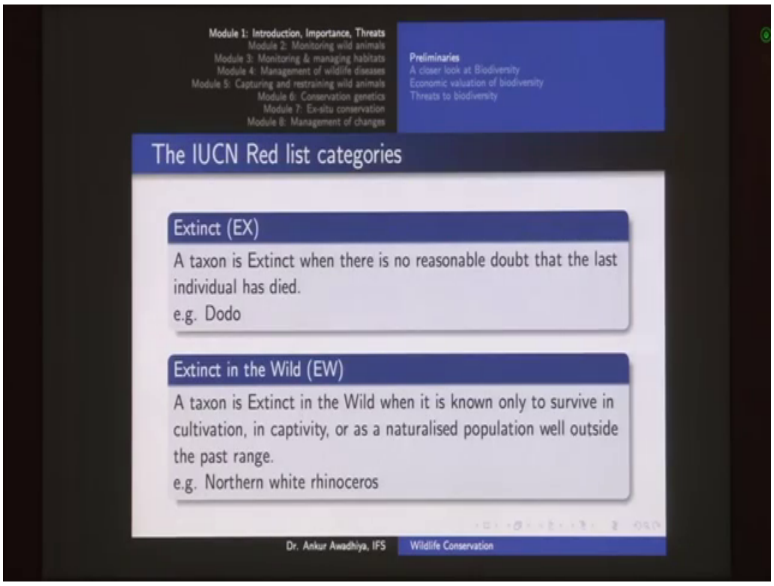

Next we talked about the IUCN red list categories. So, we have these categories of a animals, there are animals that are completely extinct, there are animals that are only there in captivity..

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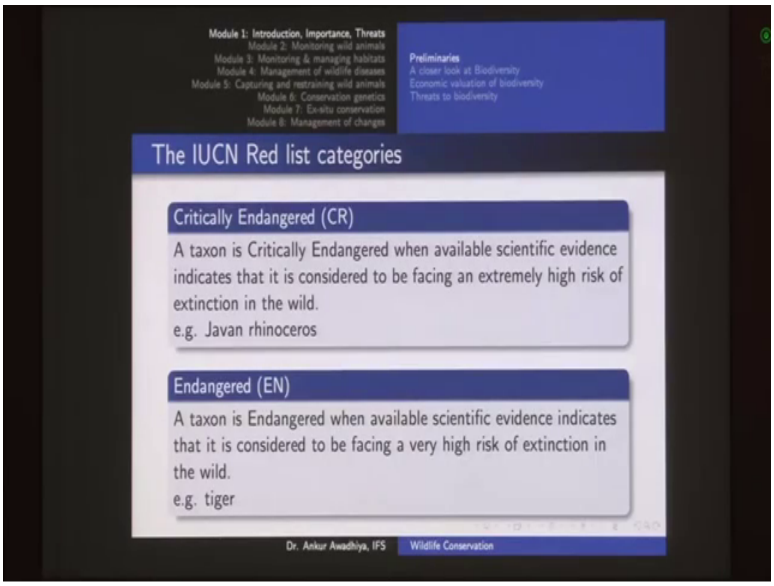

Then there are animals that are critically endangered. Now a good example is the Javan rhinoceros; now critically endangered and then next is endangered. So, tiger is endangered, Javan rhinoceros is critically endangered.

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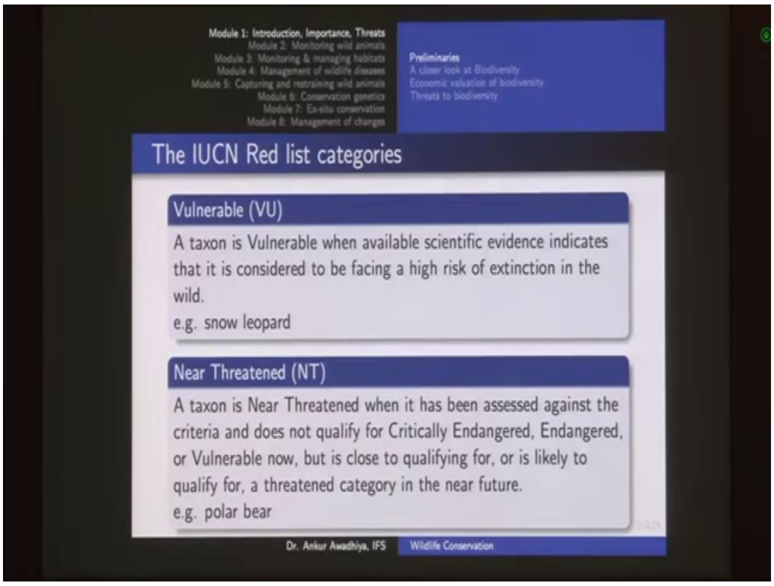

Extincting species include dodo, then we have vulnerable near threatened. So, we are coming down in the threat category..

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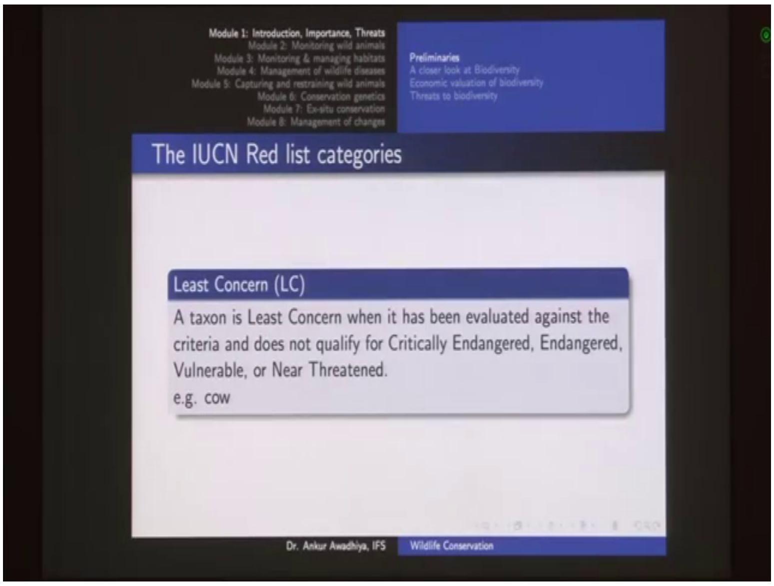

Then there are domesticated animals like cows, dogs, cats, that are the least concerned animals..

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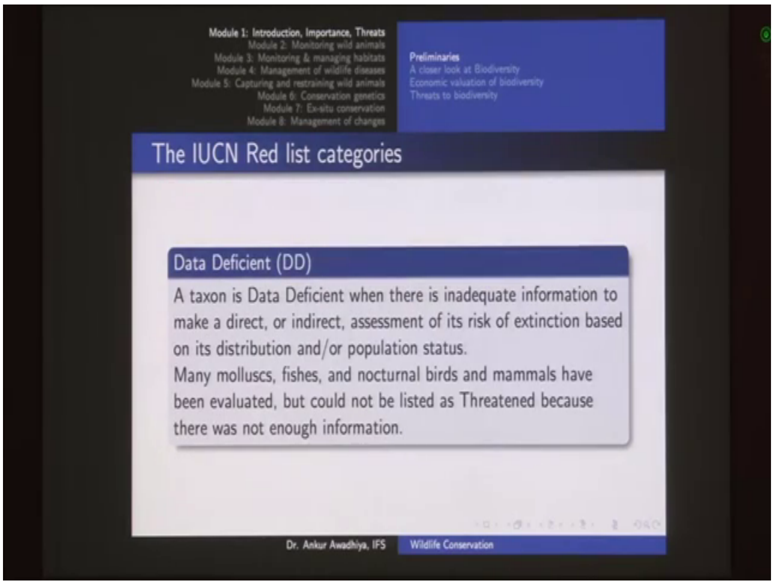

There are some animals for which we do not have enough data..

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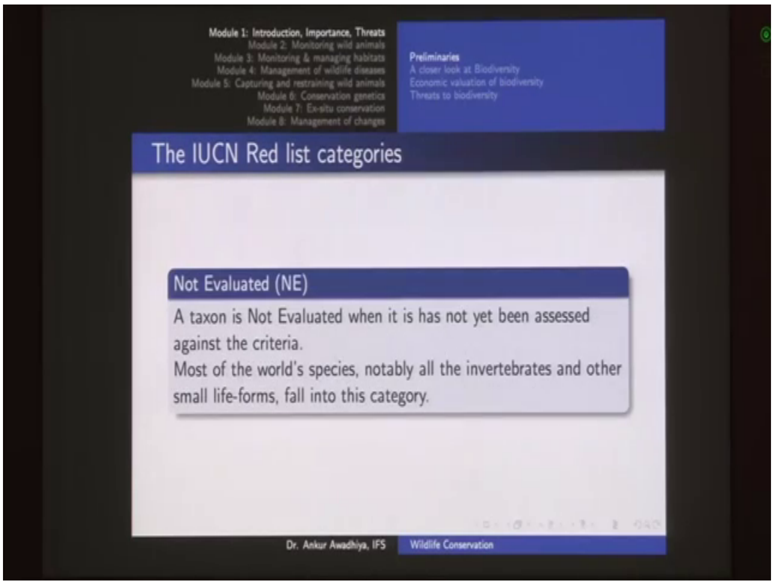

There are some animals for which we have not done the evaluation.

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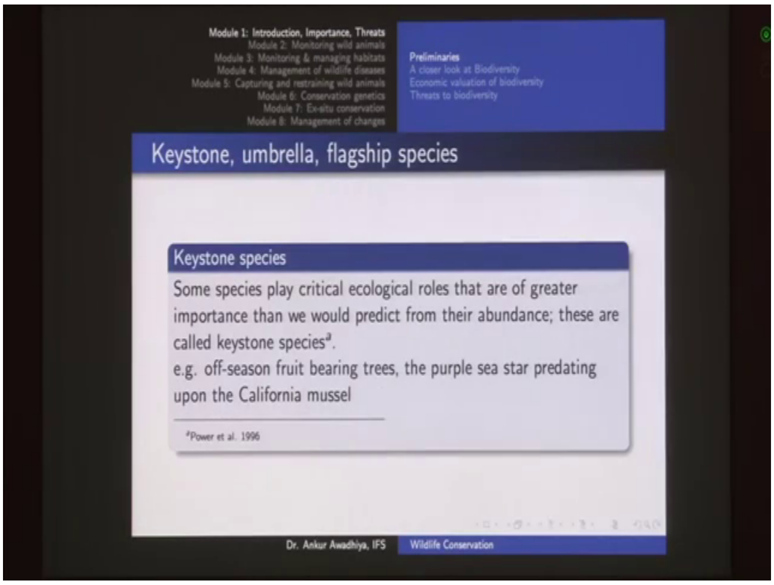

The next important concept was that of keys stone species, umbrella species and flagship species. Now keystone species are those species that are extremely important for the habitat and their importance is much greater than their numerical abundance. So, the example is off season fruit bearing trees such as the ficus tree..

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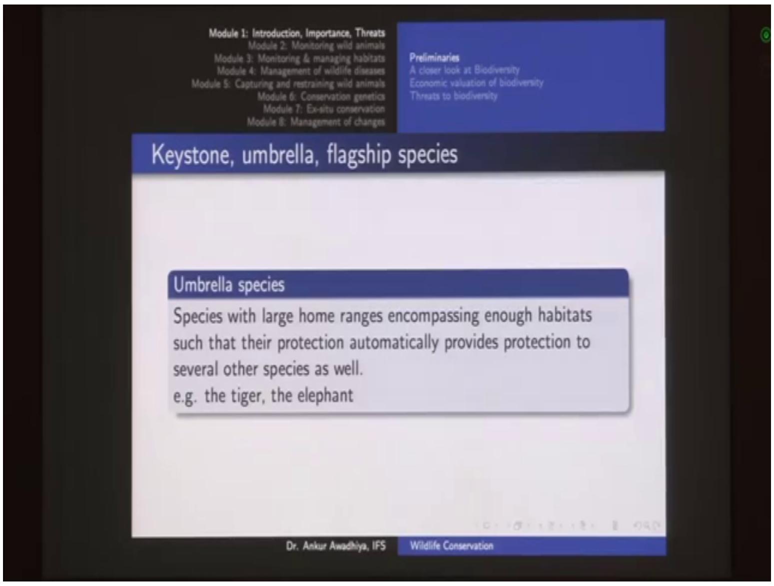

Umbrella species are those species that have a very large home range requirement..

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So, when we are talking about an umbrella species, just remember that an umbrella has a very large area. So, this is much greater than my own area. So, an umbrella spices is a species that has a very large home range requirement. And so this is species is able to protect other species because, when we are protecting this species. A number of other species are also getting protection at the same time, just because they have a very large home range requirement, such as the elephant.

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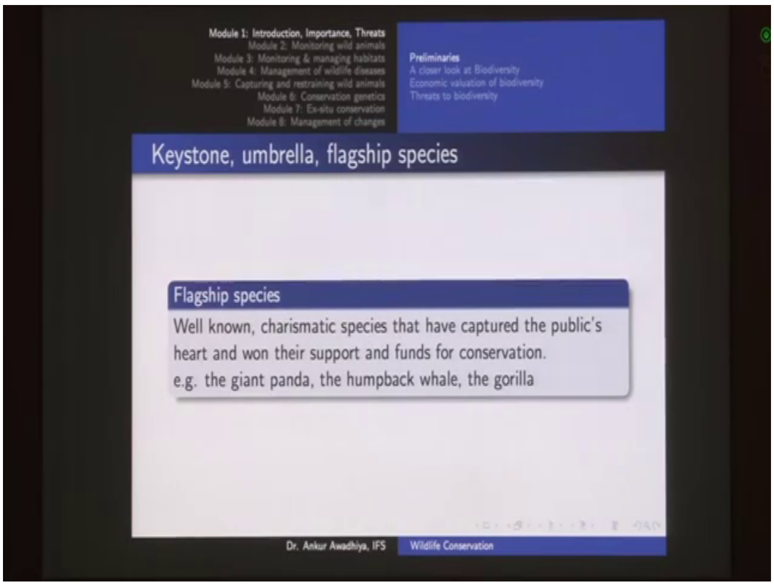

Next is the flag ship species, now flag ship spices is the species that you want to project that are the most charismatic organisms or that are the organism that people want to come and see. So, for example, the giant panda, humpback whale, gorilla, tiger, a number of flowers and so on..

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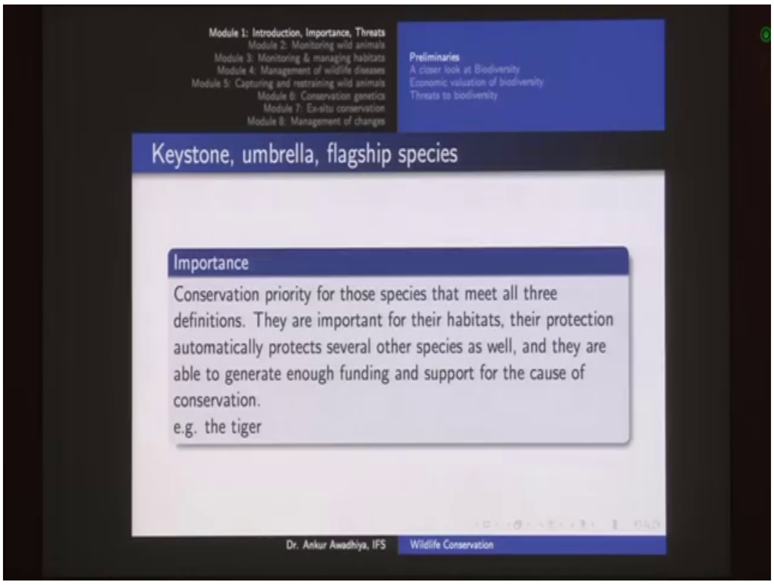

So, the importance is that, if there is a species that is key stone umbrella and flagship at the same time, then that has to be given the most importance..

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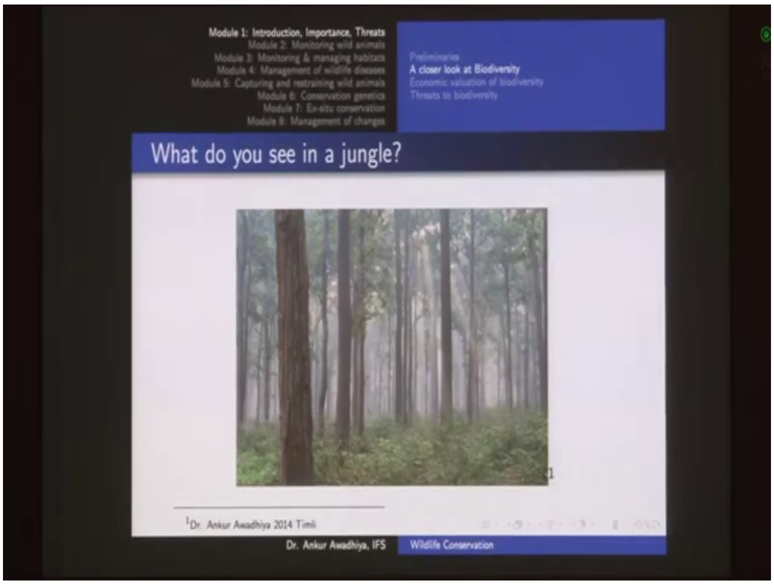

Then we went through the outline of the course. In the next lecture, we looked at different forms of biodiversity that we observe in a forest area; so from plants, animals, fungi, microorganisms, everything..

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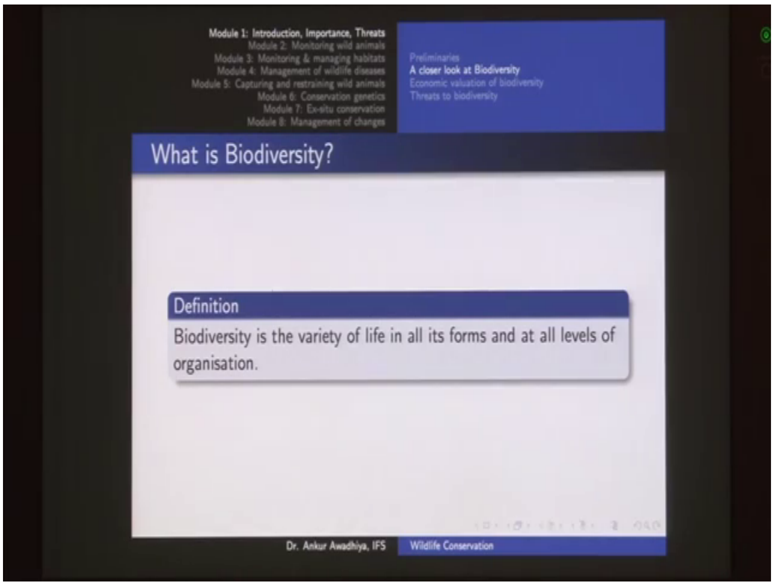

And then we came to this definition of biodiversity, it is a variety of life in all it is forms and all it is levels of organization..

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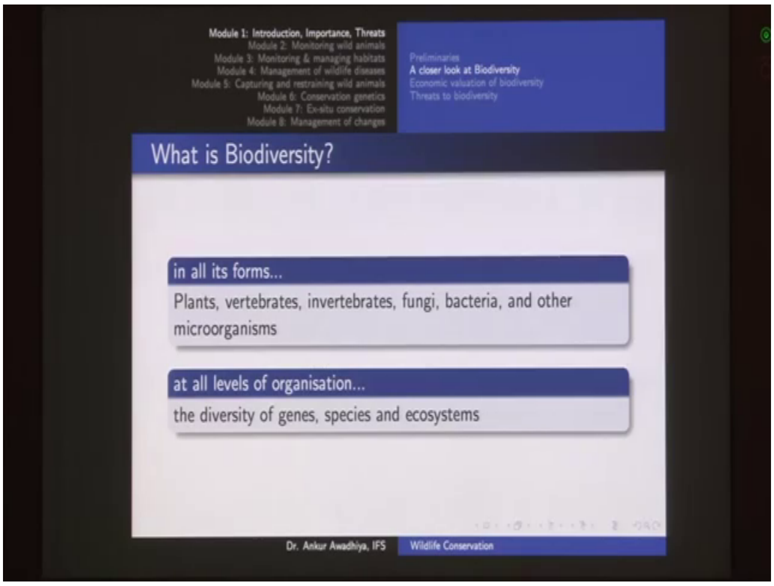

So, plants vertebrates, invertebrates, everything are involved and we also look at 3 levels of organization genes, species and ecosystems.

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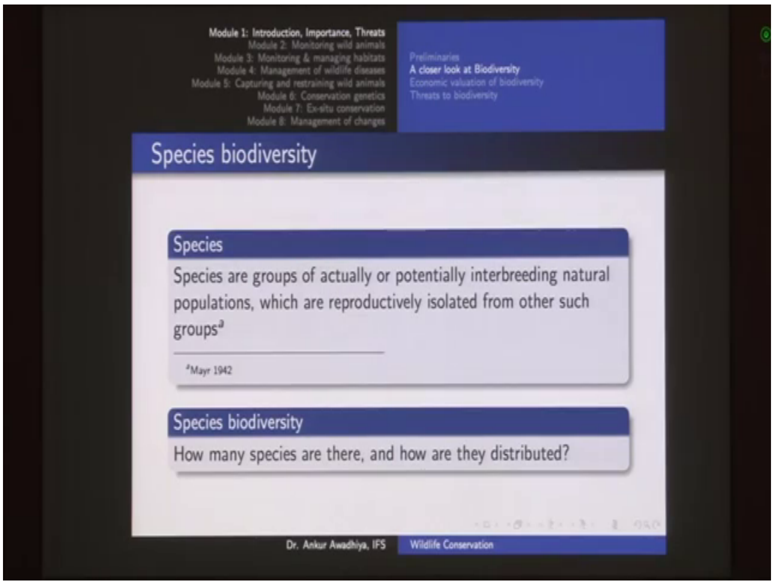

So, then we talked about what is the species? What is the species biodiversity?

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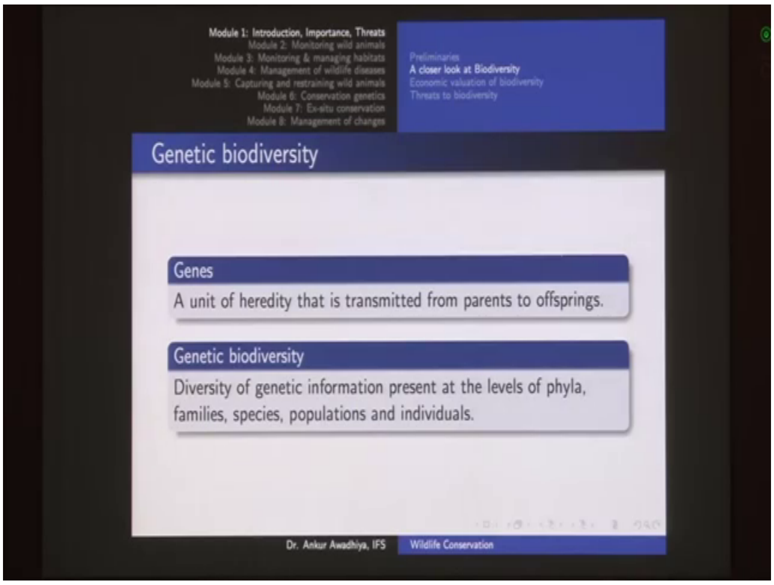

What is the gene? What is the genetic biodiversity?.

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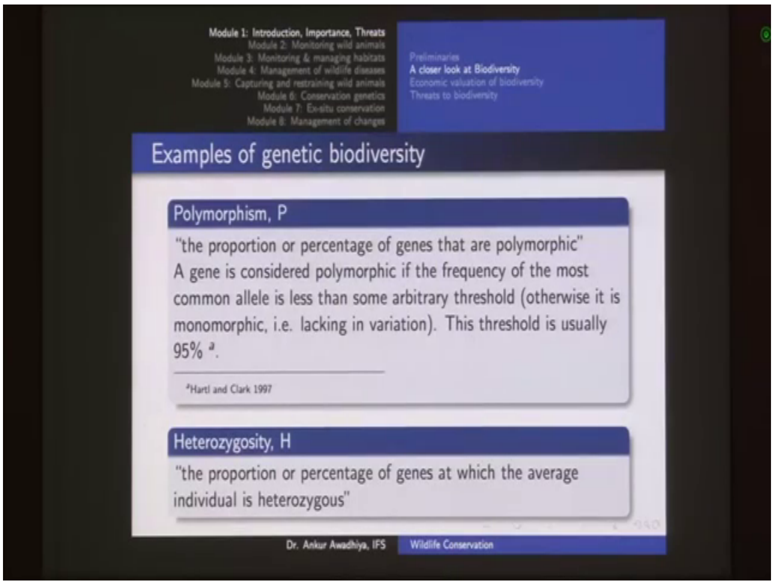

Now, in this case 2 things are important when we are talking about genetic biodiversity, we have these 2 concepts. Polymorphism, which tells us that when we have different allele, what is the frequency of the most common allele? So, this has to be less than some threshold and that threshold is 95 percent. Your frequency of the most common allele is less than 95 percent, then it is a polymorphic gene, the second was heterozygosity the proportion of or percentage of genes at which the average individual is heterozygous..

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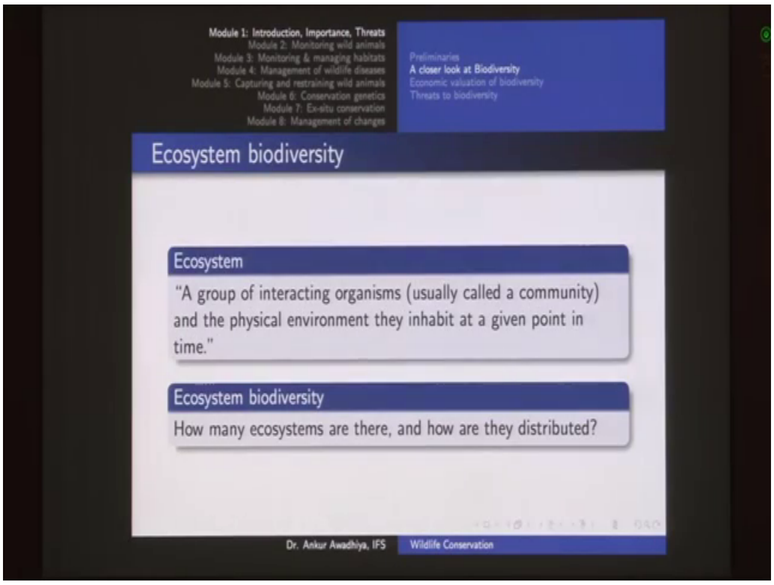

Next we talked about eco systems group of interacting organisms and the physical environment. Then ecosystem biodiversity's, how many ecosystems are there and how are they distributed?.

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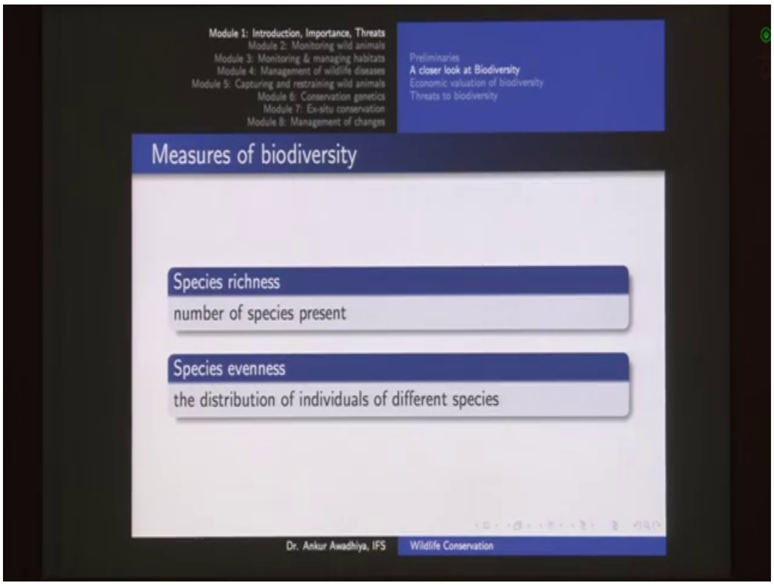

Now, when we talk about species biodiversity, we talk about 2 things species richness and species evenness the number of species that are present and how are they distributed?.

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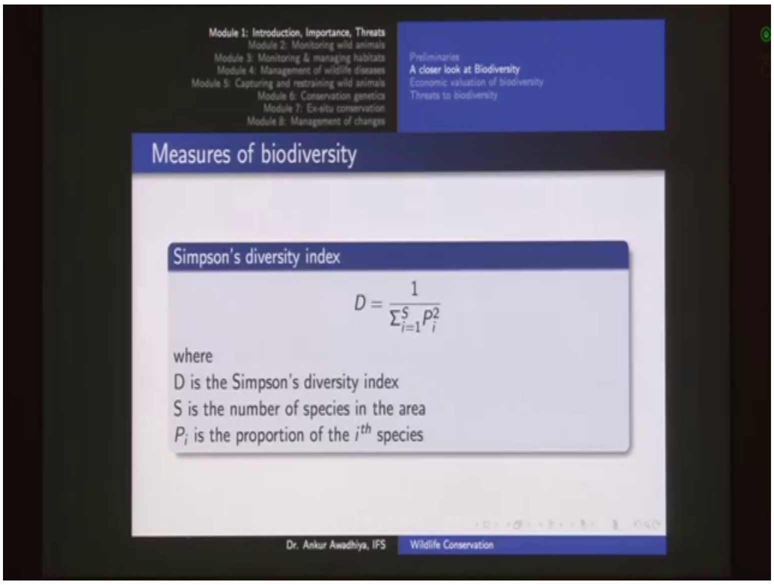

So, for this we had 2 different indices the Simpson index and the Shannon index.

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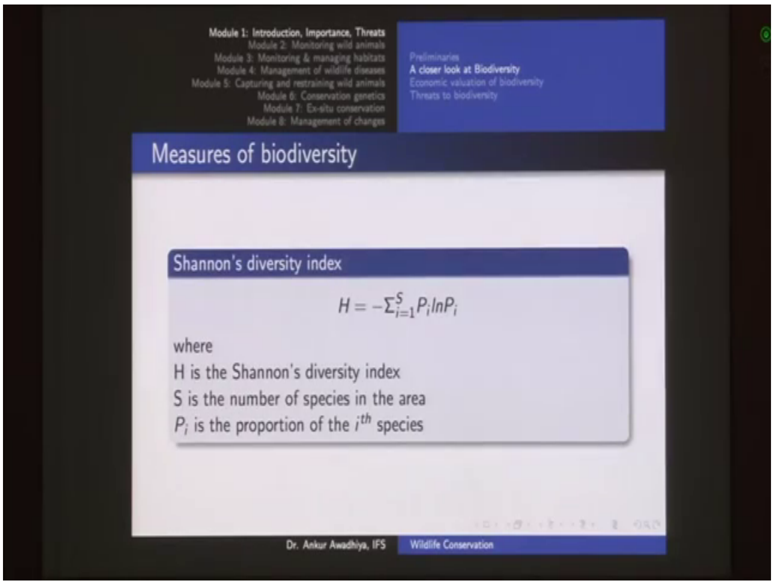

And for both of these, we talk about the diversity and we talk about the evenness..

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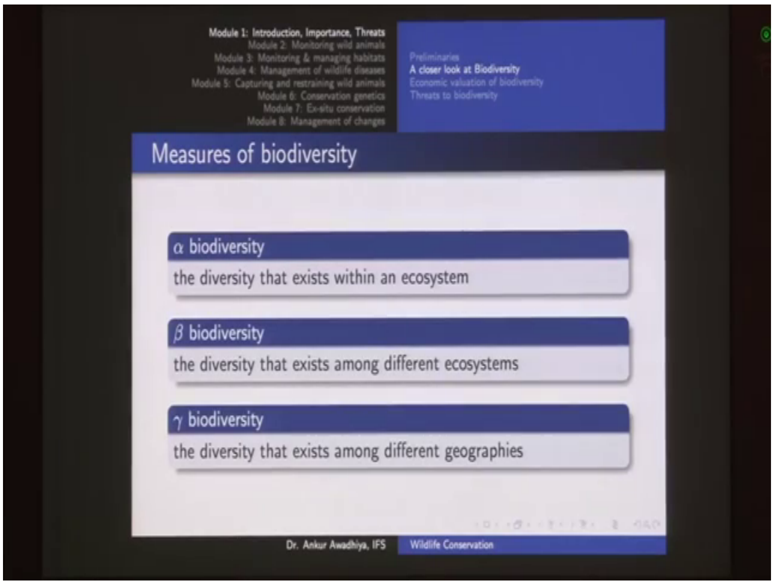

Now, these are 3 important definitions the measures of biodiversity include the alpha biodiversity, beta biodiversity and the gamma biodiversity. Alpha is diversity that exist, within an ecosystem, beta is diversity that exist among different ecosystems. So, here we are comparing different ecosystems and gamma is at a very large scale that is existing, among different geographies.

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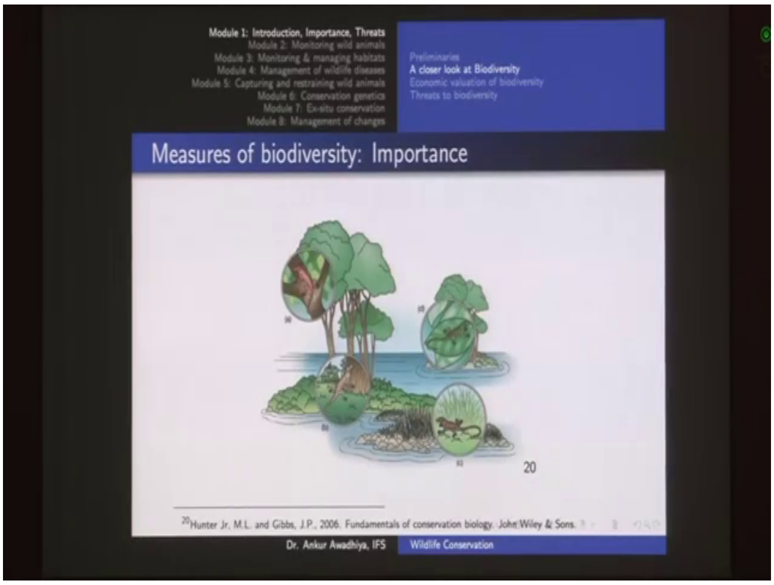

And then we made use of this example though to say, what is alpha, beta and gamma?.

So for instance, when we talk about this patch in this island, so here we have 2 islands and if you talk about just one patch that is one ecosystem; the diversity that is inside it is alpha biodiversity, when we compare these 2 patches in the same island, we are talking about the beta biodiversity. And we are including this island that is very far apart, then we are talking about the gamma biodiversity because, we are including different geographies.

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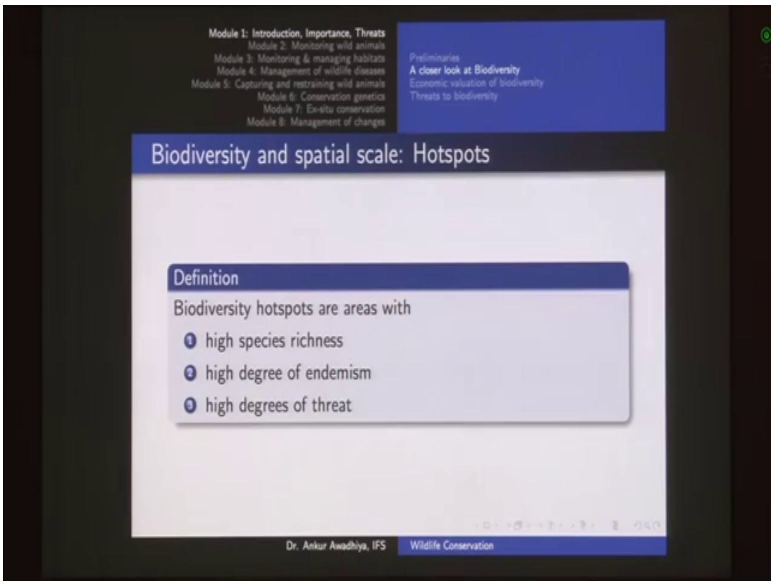

Here we had this concept of hotspots areas with high richness, high endemism and high degree of threat.

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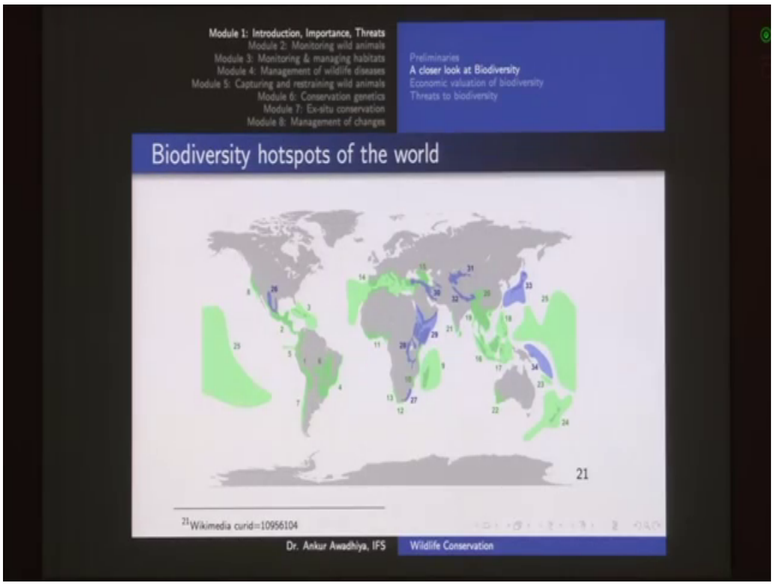

So, these are the biodiversity hotspots that need to be preserved a lot..

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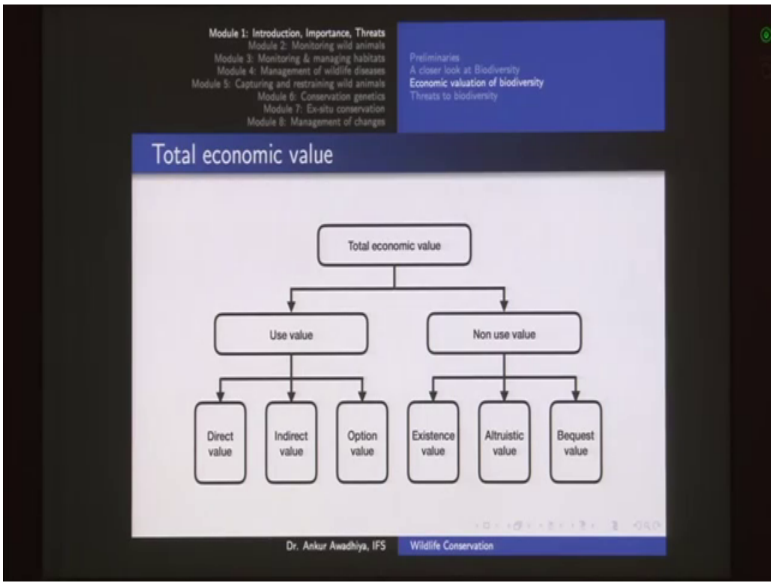

Now, in the next lecture we had economic valuation of biodiversity and this is a very important chart that, you need to remember because, when we talk about total economic value in any case, we include the use value and the nonuse value. So, things that we can use and things that, we cannot use directly. Now in the case of use, we talk about direct use value, indirect use value and option value. And in the case of nonuse value, we talk about existence value, altruistic value and bequest value..

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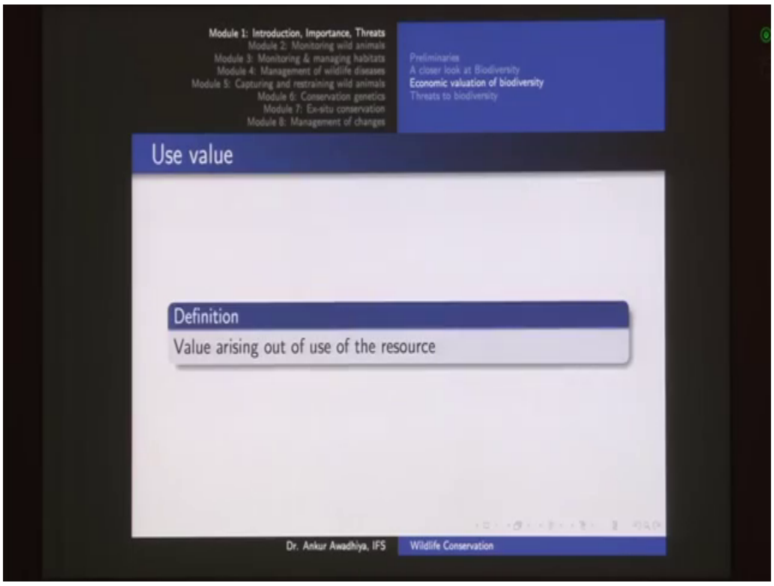

So, we looked at the definitions of all of these and these definitions become important the use and nonuse values.

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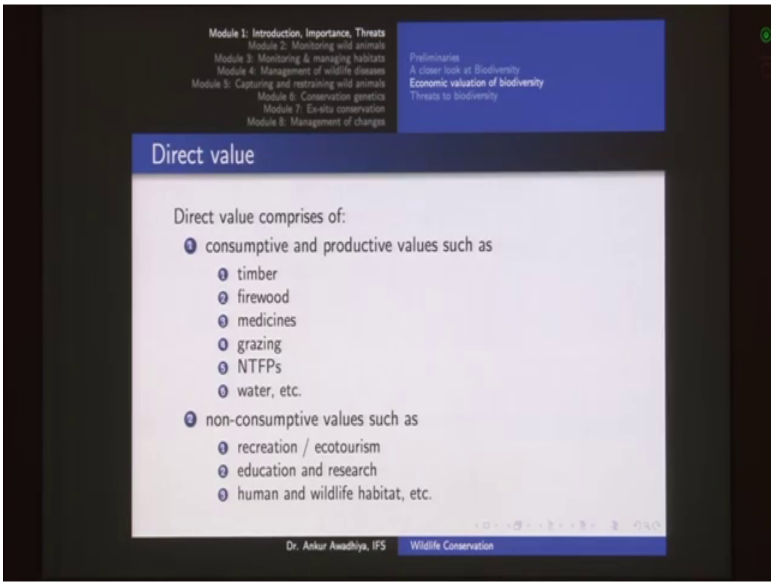

Direct values include consumptive values and non consumptive values. So, consumptive values are those, where if you consume this resource the amount of resource in the forest will go down. Non consumptive resource is that in which, when you use this resource the total amount that is available for the use of someone else remains the same.

Now, indirect values include watershed benefits, ecosystem services and evolutionary processes. So, we are not directly using these values..

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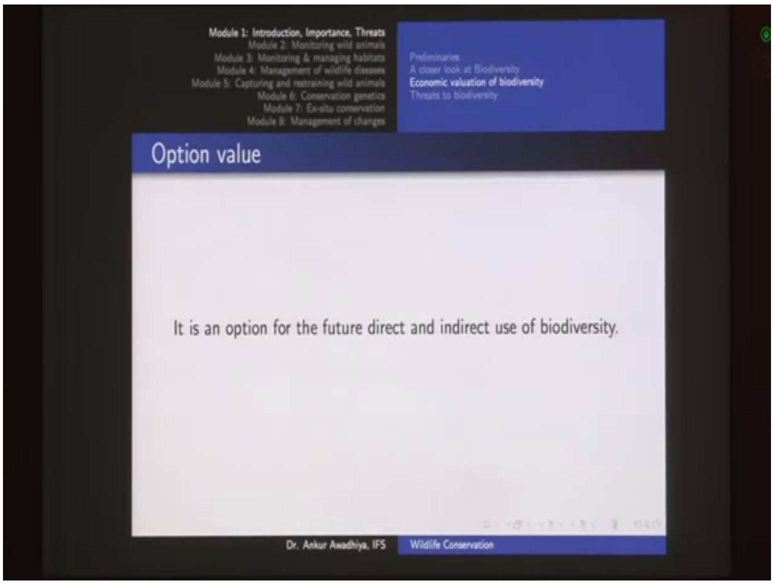

Option value is when we considered the example of booking a flat. So, I do not want to decide whether I should buy flat a or flat b, but at the same time I also want that this both, this option should be available to me after say, 6 months. So, I will pay some amount for these 2 things to be blocked for me and that is known as option value, it is an option for the future direct and indirect use of biodiversity.

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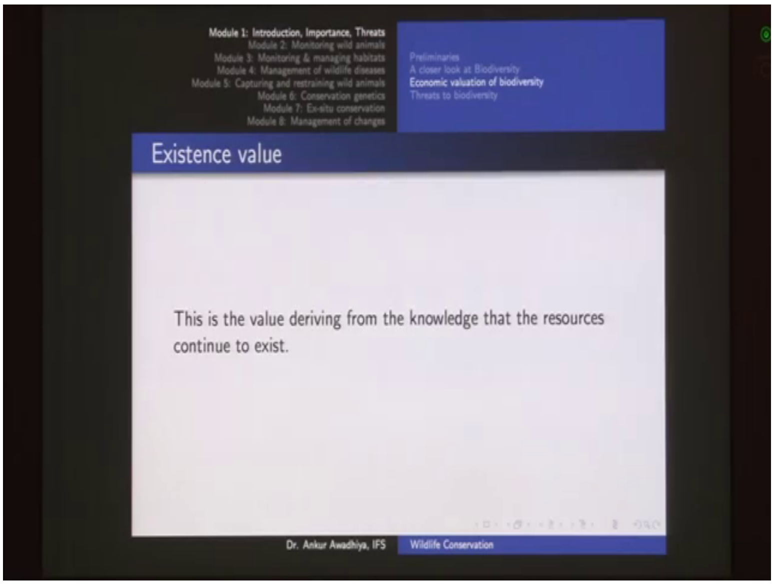

Next we have the existence value existence value is just because something is existing. So, I have a value for it..

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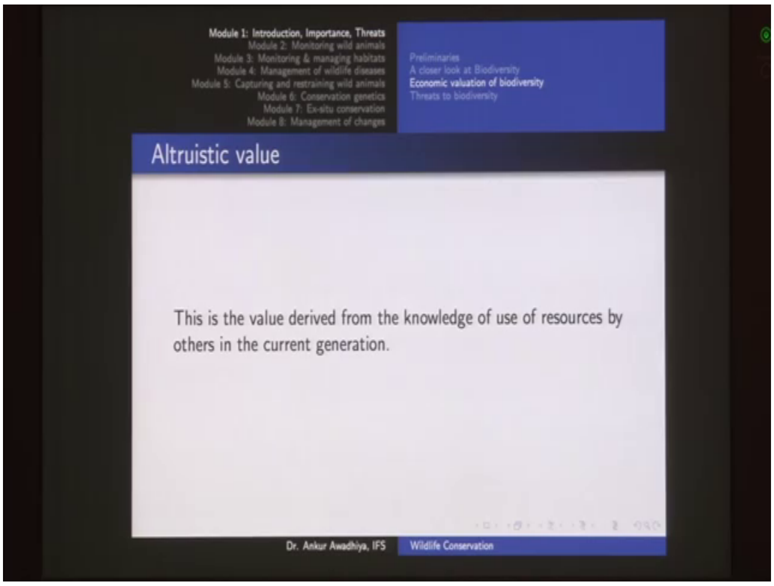

Altruistic value is been someone else of my own generation is using it. So for instance, Marine Drive is there in Mumbai and people from Mumbai or people that are going to Mumbai are able to use it, I am not able to use it, but this Marine Drive still have the value for me because, people from my generation are using it. So, this is an altruistic value..

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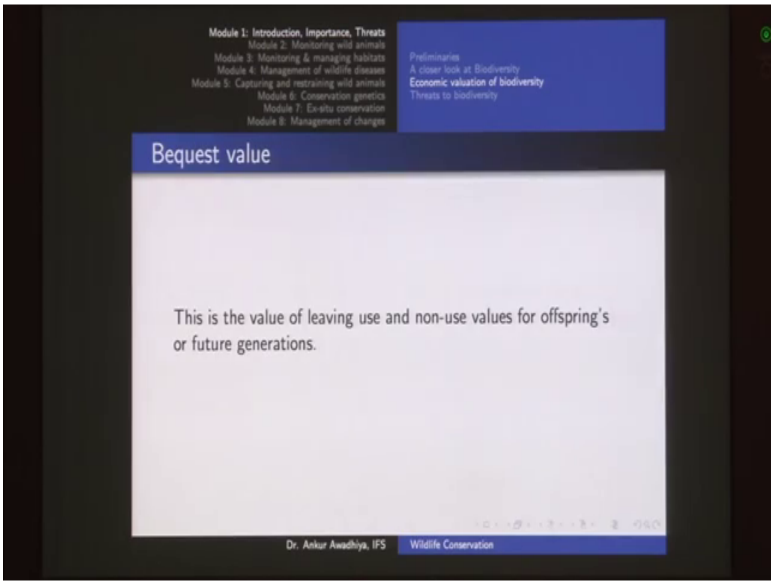

Then, we had the bequest value, the value that is there because I am leaving something for my sons and daughters and for my sons and daughters. So, for the offsprings and their offsprings is known as the bequest value..

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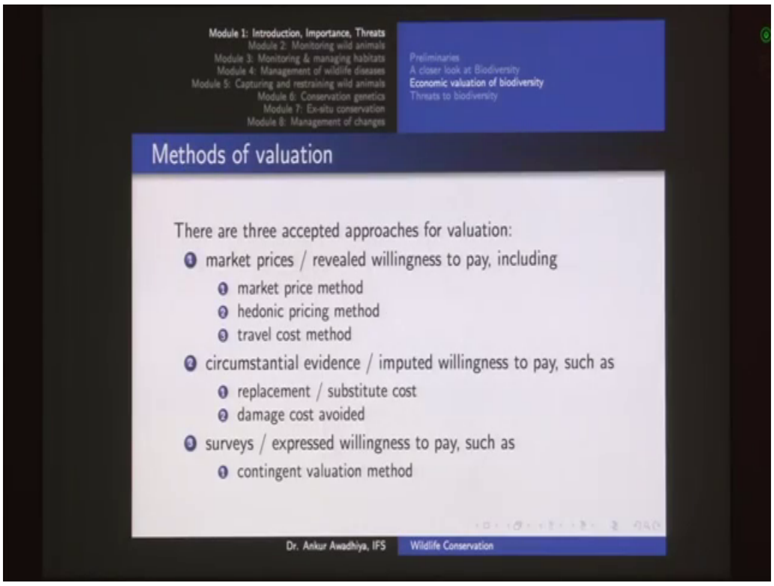

Now next, we talked about the methods of valuation. So, there are 3 methods revealed willingness to pay, which is the market price method then, we have imputed willingness to pay such as replacement cost or substitute cost, damage cost avoided and the expressed willingness to pay such as the contingent valuation method. Now in this case here, you should go through the examples once again. So for instance, in the case of a tsunami barrier when we talk about replacing mangroves with artificial tsunami barriers, we are talking about replacement cost, when we talk about the damage that is avoided, because of our mangroves, we are talking about the damage cost avoided method..

Similarly, when we talk about people coming to a protected area, we are computing the travel cost method and so on. So, these examples become important..

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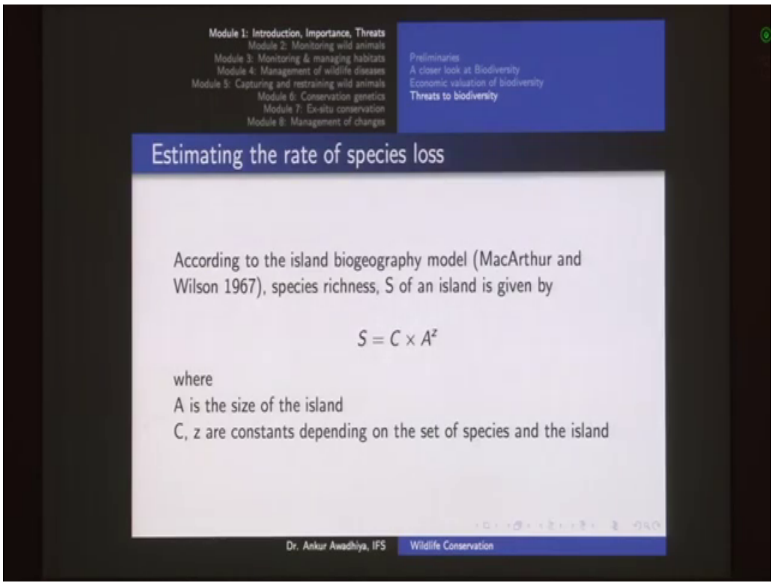

Next lecture was on threats on biodiversity and here we had this formula S is equal to C into A to power of z. So, S is the species richness of an island, A is the area of the island C and z are some constraints that need to be figured out..

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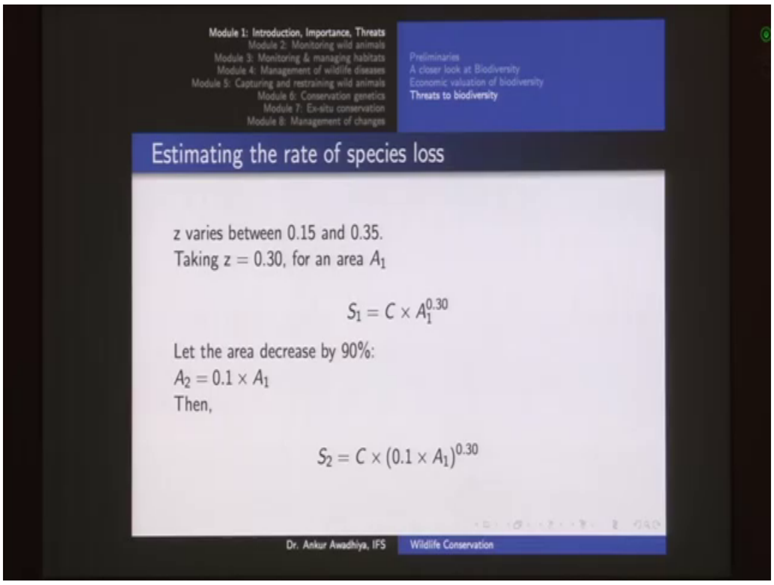

And this is a very important equation, because we used it to figure out the rate of species lost from an area.

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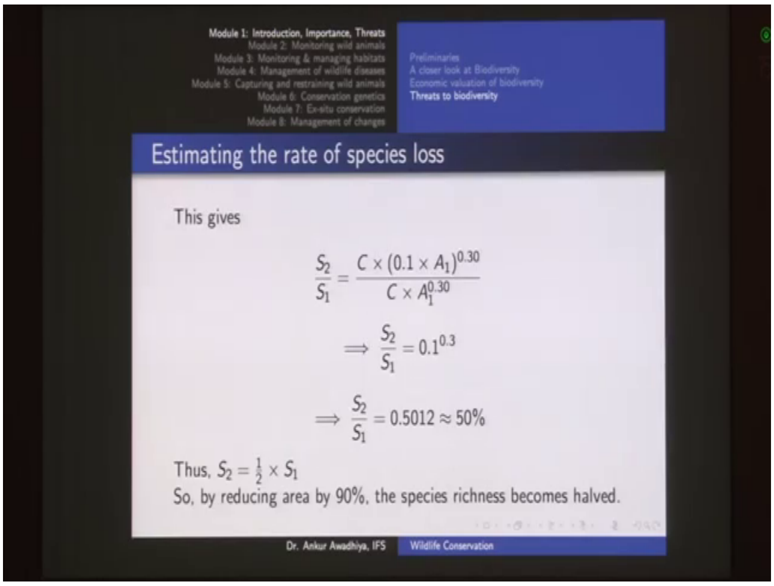

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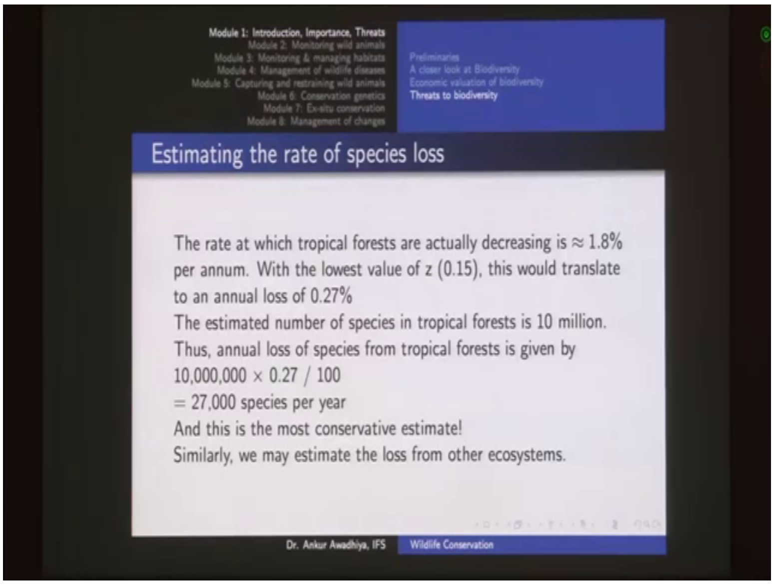

And we also used it to compute, how many species are we losing from our tropical forest. So, we are losing as much as 27000 species per year in a very conservative estimate.

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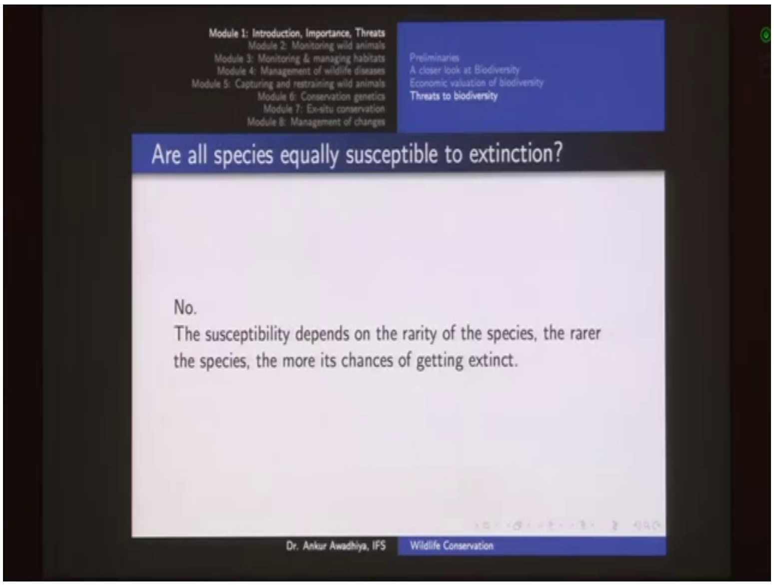

So, next we talked about the susceptibility of species to extinction. So all this species are not equally susceptible to become extinct it depends on the rarity of the species..

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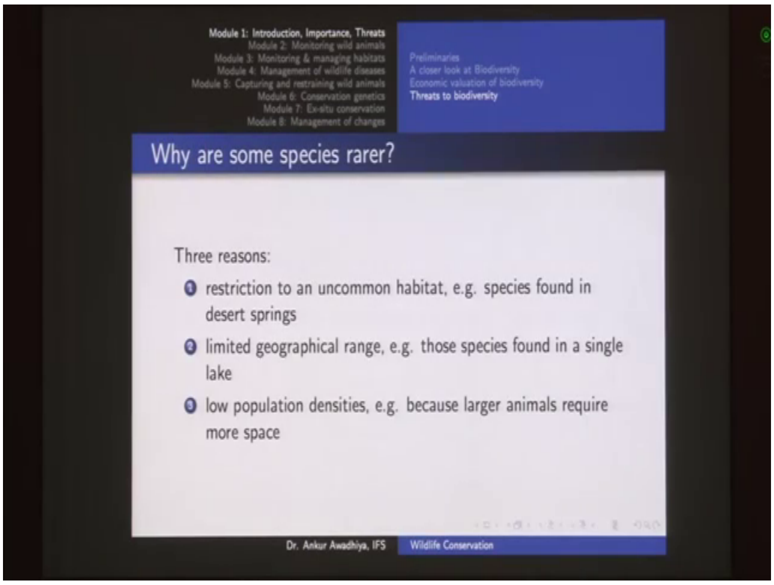

So, there are 3 common reasons restriction to an uncommon habitat, limited geographical range and low population densities, because of which a species is rare..

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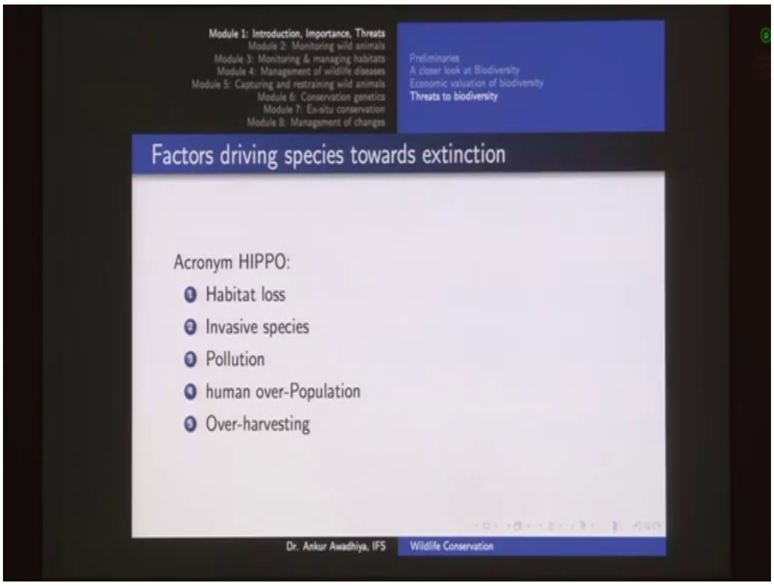

Now here, we talked about the 5 factors that lead a species to extinction. So, this is a very important acronym because, it helps us to remember all of these. So, hippo H stands for habitat loss, I stands for invasive species, P is a pollution, the second P is population which talks about the human over population and the last O is over harvesting of resources in the case of over harvesting. For instance, there are we can take out 10 whales from an ocean, but we are taking out 30 whales. So, that becomes an over harvest of resources..

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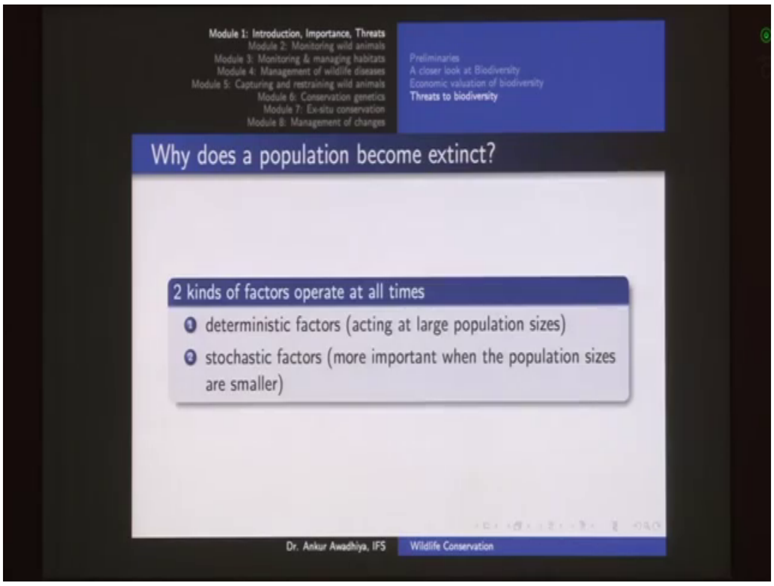

Now, there are 2 kinds of factors, because of which a population becomes extinct, we have deterministic factors and we have stochastic factors. Now deterministic factors acted large population sizes, stochastics factors are more important at small population sizes..

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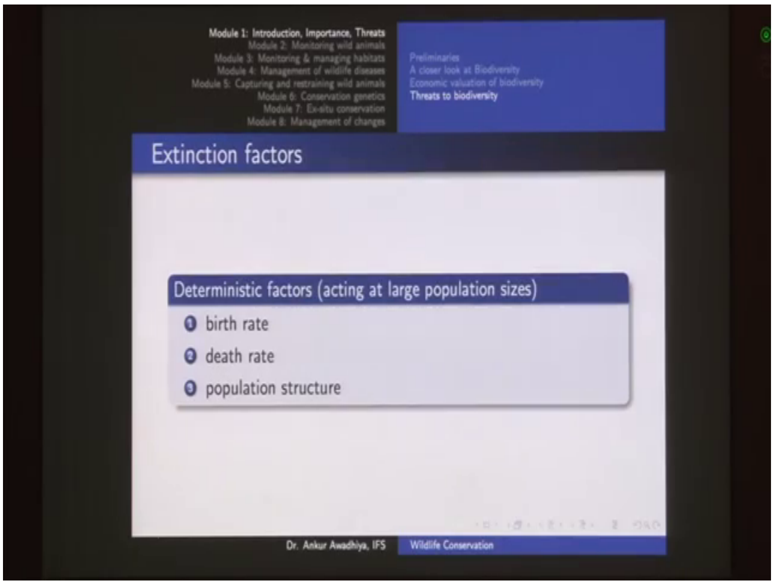

Now in this case, we looked at different deterministic factors birth rate, death rate and the populations structure especially, if our population is getting old or not.

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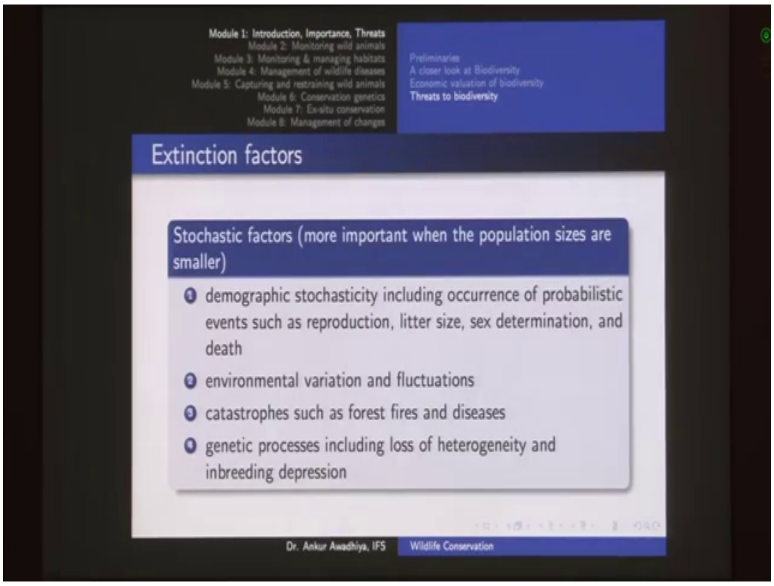

Now, stochastic factors are chance factors. So, these are just probabilistic factors that could occur just by chance. So, by chance you could have all the offsprings that are male, you could have very small little sizes, you could have a year that is very hot or year that is very cold or a year in which you get a forest fire or may be a disease outbreak and so on..

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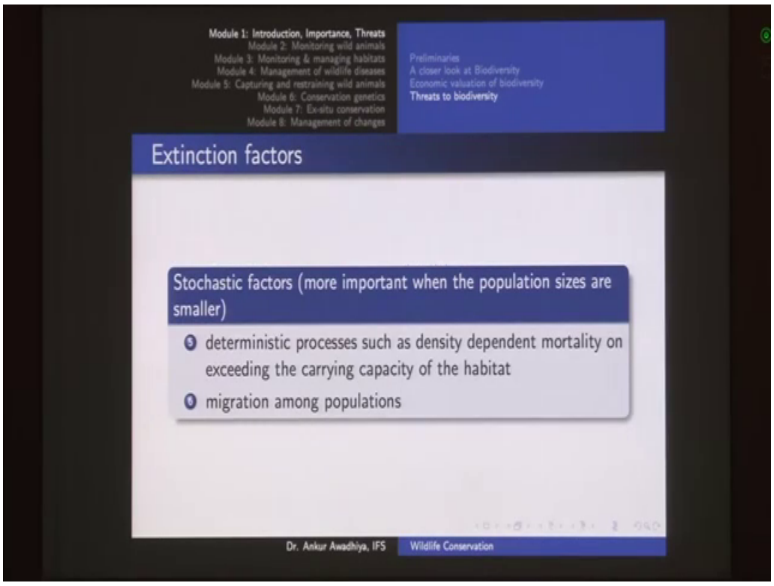

So, these all factors go by the name by the name of stochastic factors..

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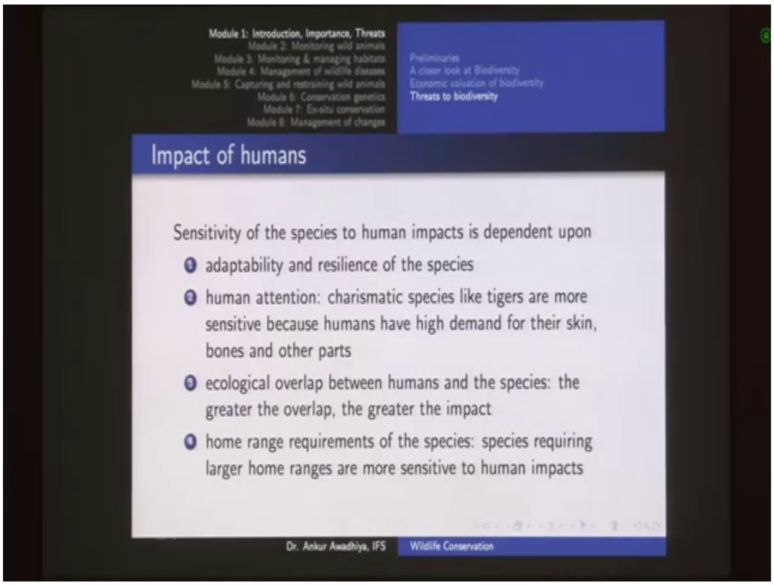

Then the impact of humans: so, the sensitivity of a species would depend on it is adaptability and resilience. It would also depend on whether, this is species is having an ecological overlap with the humans, how much attention the humans are given to it? And the home range it requirements of this species whether it, it can survive in smaller areas or whether it requires very large areas..

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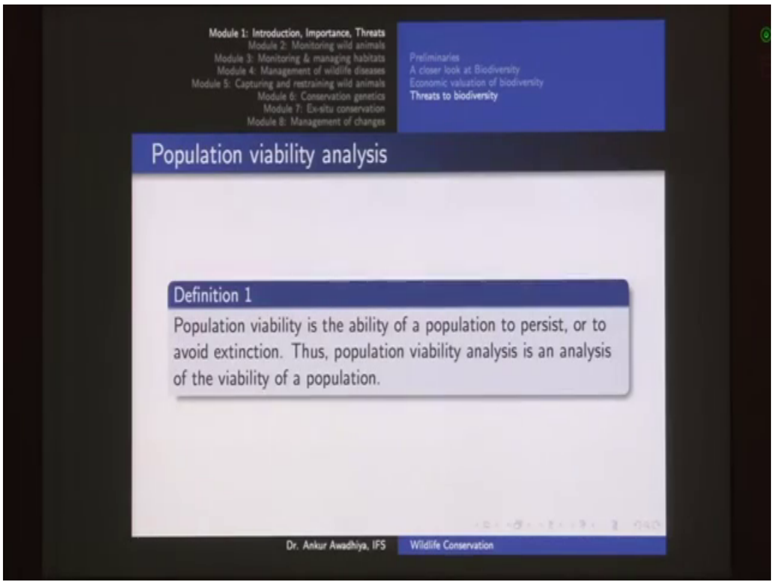

Now, to evaluate the risk of extinction, we have this method of pollution viability analysis, which an which is an analysis of the viability of a population or the ability of a population to exist for n number of years..

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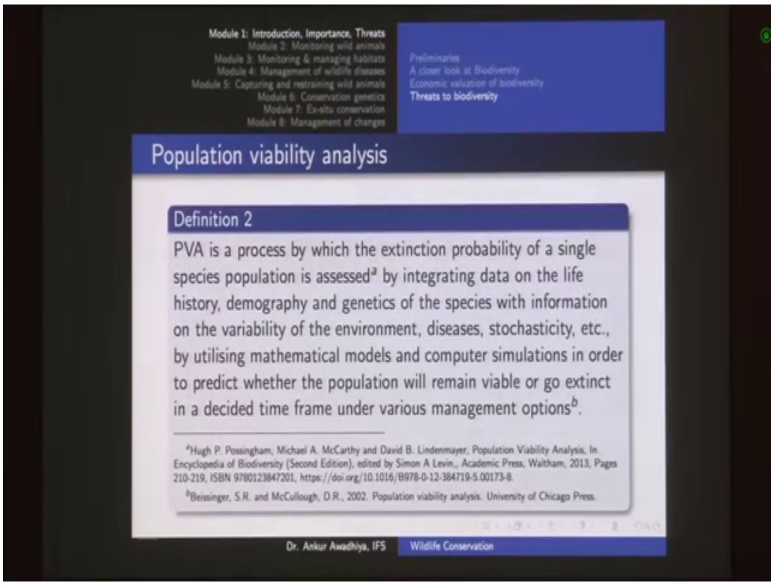

Typically we talk about 100 years or the 1000 years and in this case, we go for a mathematical modeling or computer simulation in which, we take all of these deterministic factors and it is stochastic factors, we add data of the life history and demography and genetics of the population and then we ask our simulation to predict, what is going to happen in the next n number of years?

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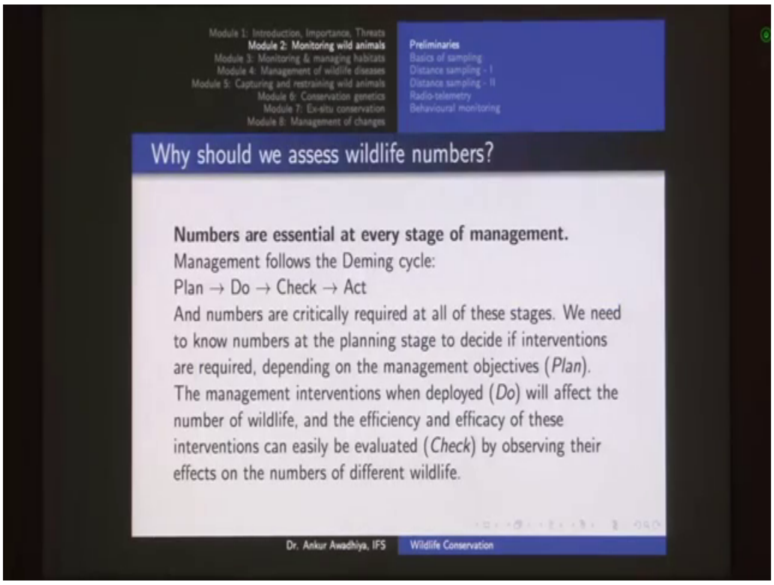

In the second module, we had moderating of wild animals. So, we began with the deming cycle. Now deming cycle is important because, it is not only there for wild life management, but in most of the kinds of management and this can be remembered by the acronym of PDCA. So, this also goes by the name PDCA cycle. P is plan do, d is do, c is check and a is act. So, you make a plan, then you implement that plan then, you see whether the plan is working properly or not and after that, you make changes.

So for instance, when we talked about our Sariska crisis, there was earlier a plan, which talked about estimation of tiger numbers through pugmarks. Now, that method was implemented then, there were checks and then later on it was figured out that this method was not working. Because, we lost all of our tigers in the Sariska tiger reserve and so we came up with different sets of prescription in the act part..

So, these days we shifted from the pugmark method into a camera trap method. So, this is a very important, acronym to remember PDCA..

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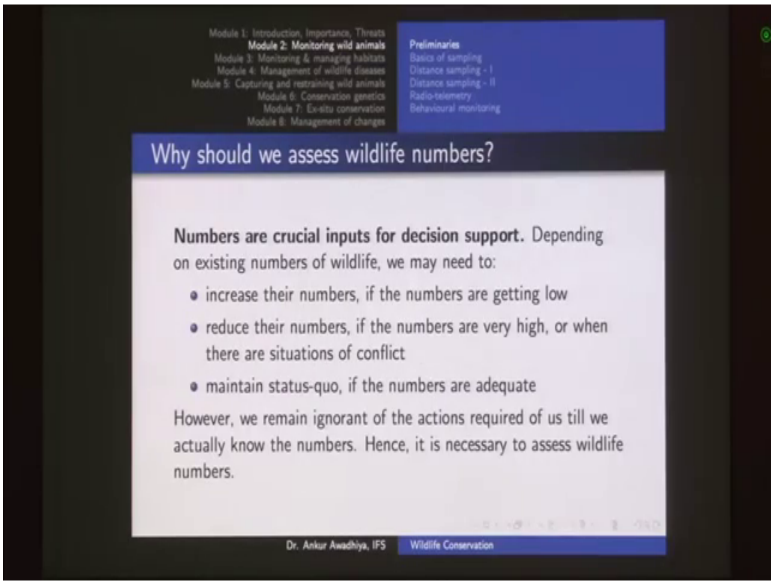

Now next, we had, why should we assist wild life numbers?

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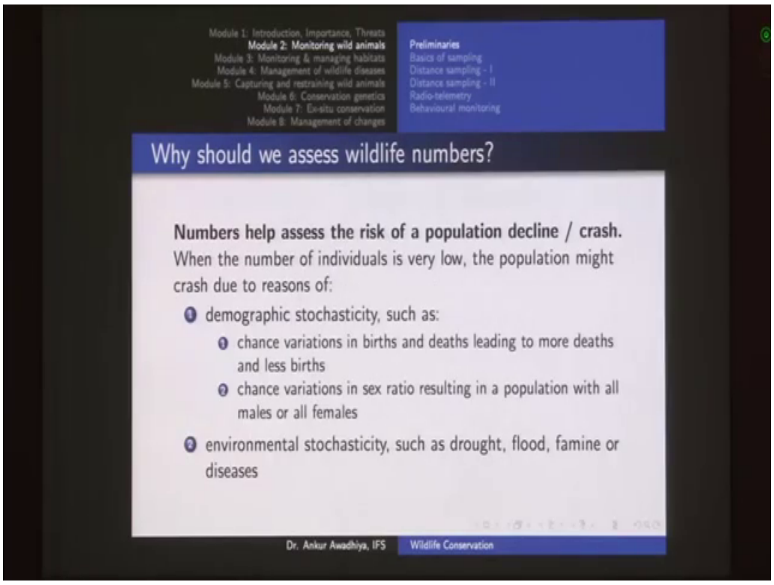

Because they are crucial for decisions support.

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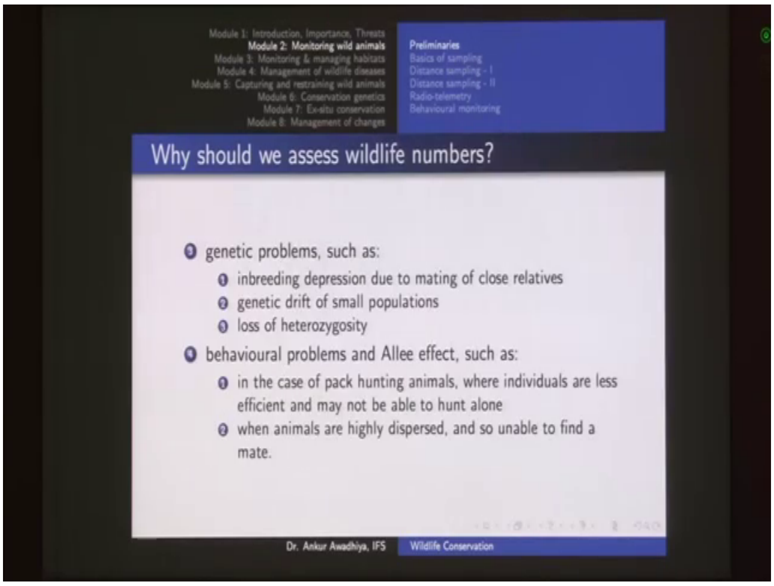

They help us assist the risk of population decline or crash.

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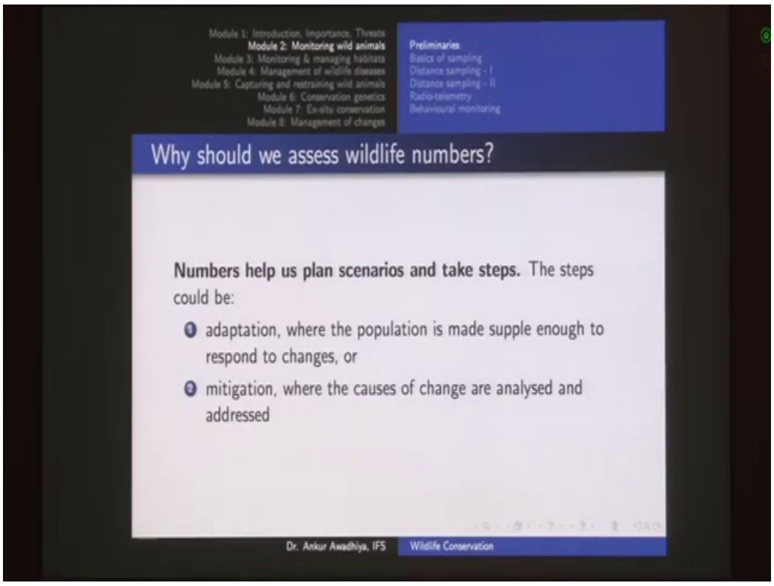

And they also help us plan scenarios and take steps..

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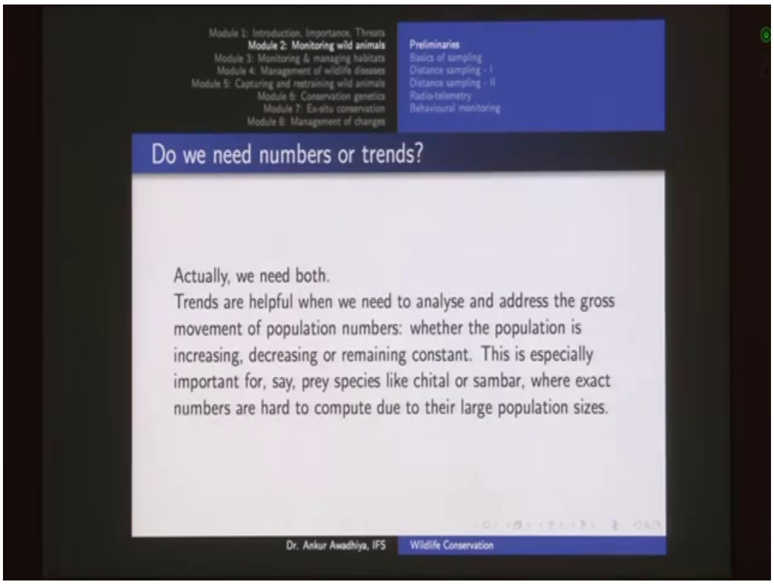

Then, we need both numbers and the trends.

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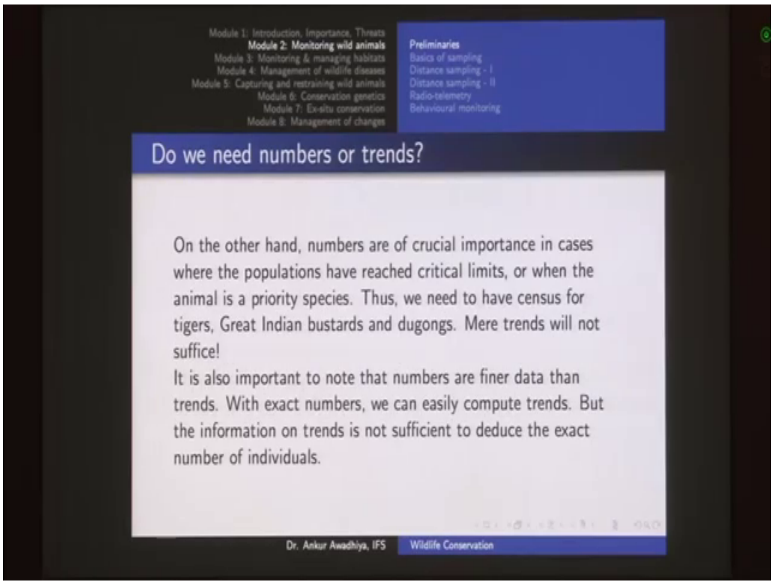

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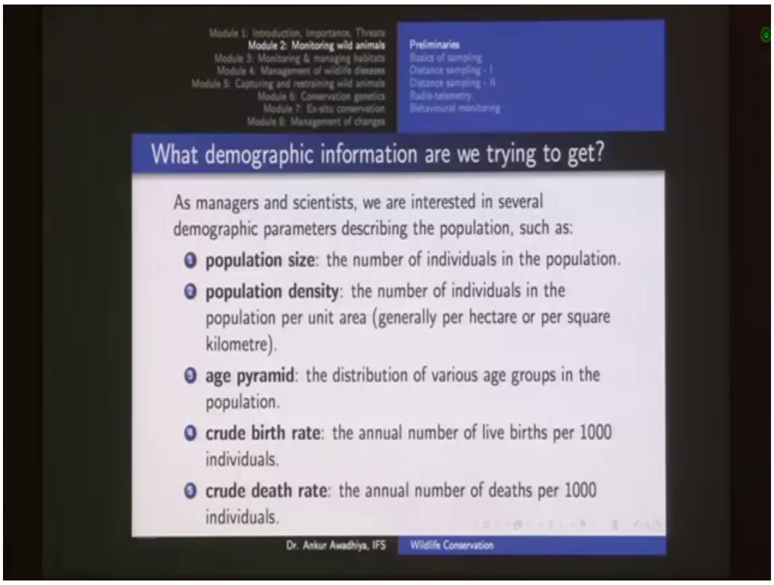

So, trends are easy to get, but numbers are more important, when we are talking about very important species or those species in for which, we have very less number of individuals left. Now, when we talk about monitoring these are the demographic information that, we are trying to get size, density, age, pyramid, crude birth rate, crude death rate..

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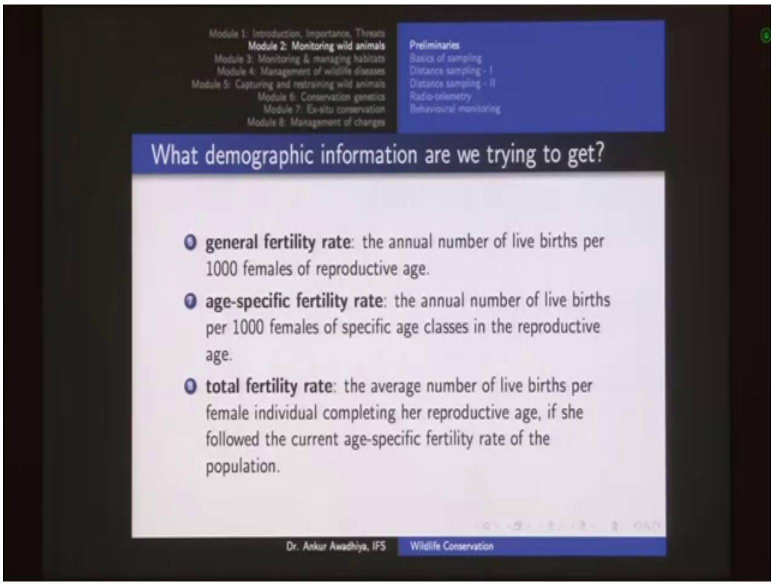

Then general fertility rate, age specific fertility rate, total fertility rate..

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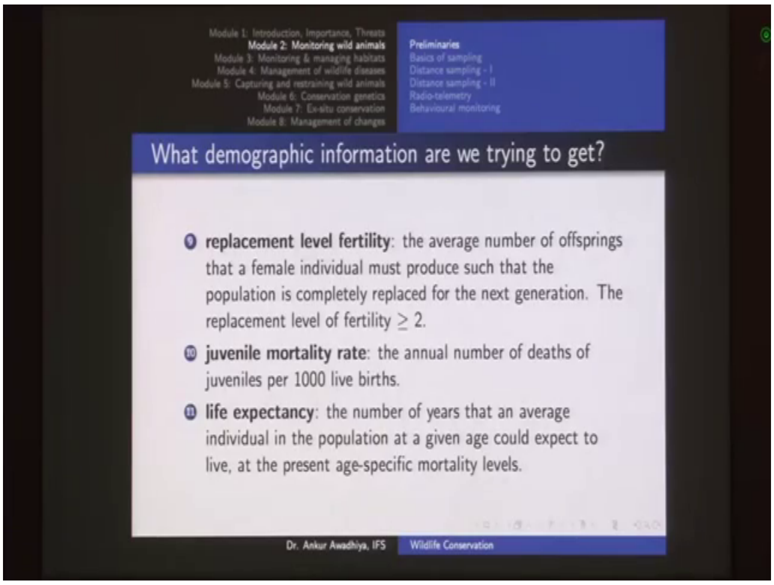

Now, replacement level fertility is important because, this is a very easy concept that, if you have 2 animals, they are breeding, the number of off-springs that they are producing for the next generation. If it is anything that is less than 2; so, for every 2 animals, you are only producing 1 offspring. So, your population will go towards the decline; if it is just equal to 2 then, because there would be some number of animals that die out before reaching a reproductive age. So, this was also not be sufficient. So, it has to be greater than or equal to 2.

Then we talked about juvenile mortality rate, life expectancy and in case of juvenile mortality rate, this is the death of juveniles per 1000 live births, why 1000 live births? Because in this case, there is a an animal that was already born dead, we cannot calculate the juvenile mortality rate, because it died before coming into existence.

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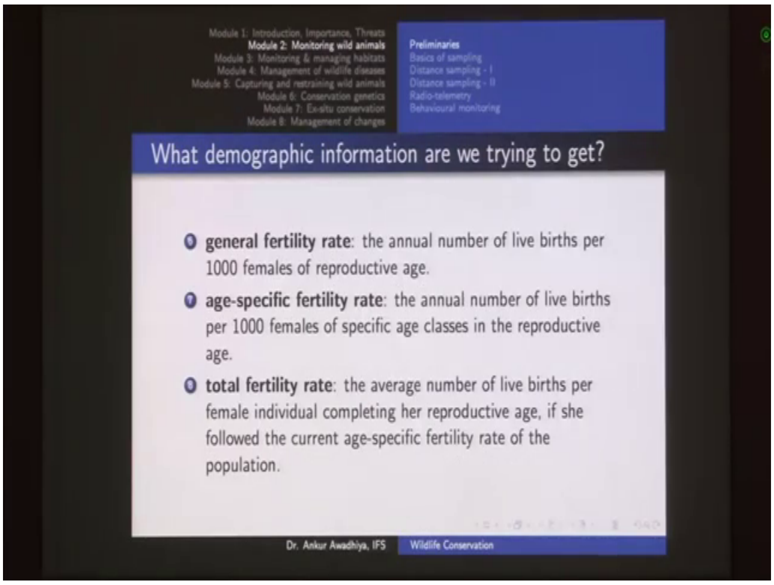

Whereas in the case of other factors.

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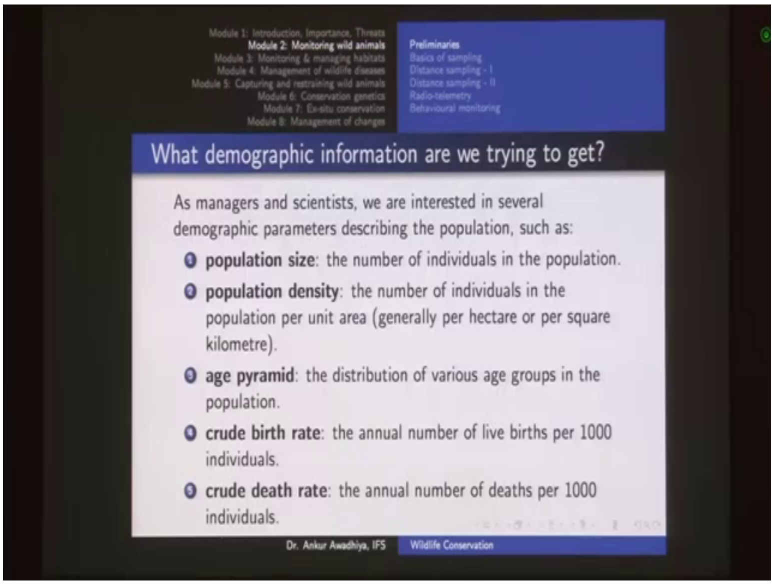

So for instance, when we talked about the crude birth rate, it is the number of live births per 1000 individual like individuals..

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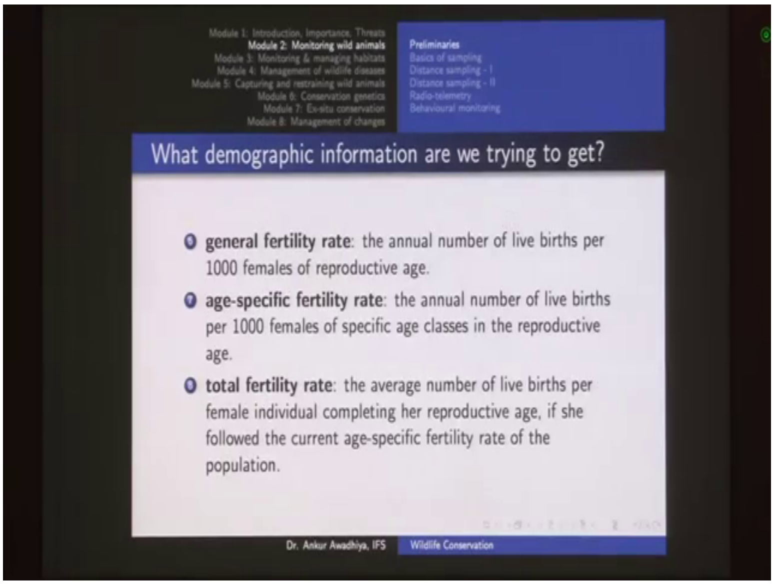

But in the case of juvenile mortality rate, we are talking about 1000 live births..

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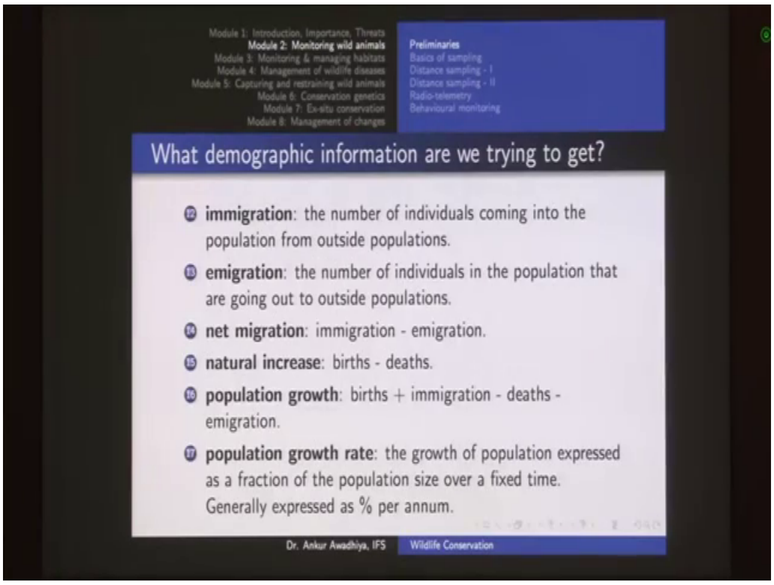

Next we had immigration, emigration, migration then natural increase. Natural increases birth minus death and when you increase, when you add your total migration then, it becomes the population growth. So, it is birth minus death plus immigration minus emigration.

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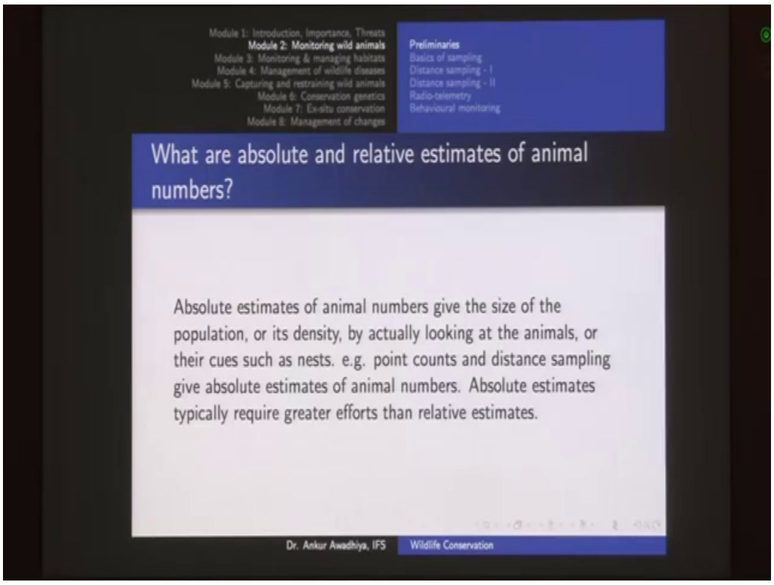

Then, we talked about the population growth rate and then absolute and relative estimates of animal numbers. Now in the case of absolute, estimates of animal numbers, you are actually looking at the animals for their cues..

In the case of relative estimates, you are taking a proxy. For instance, how many animals are you able to capture, in say 10 hours?.

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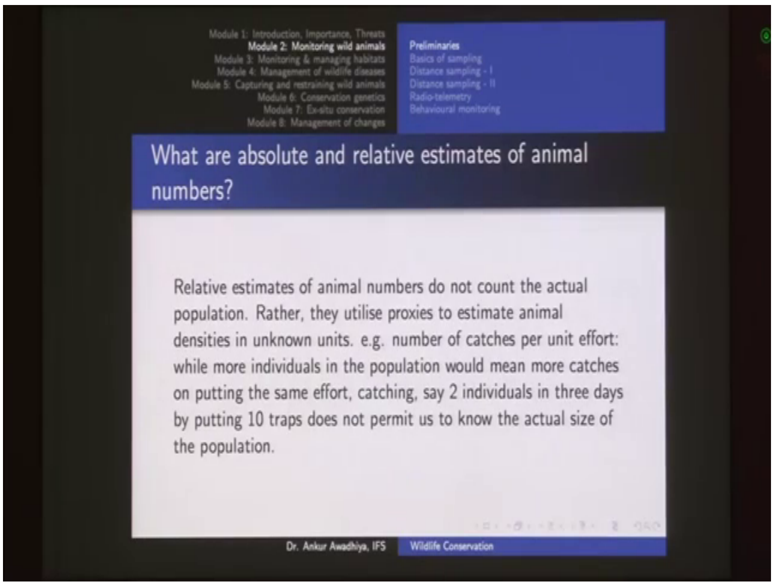

This is a relative estimate.

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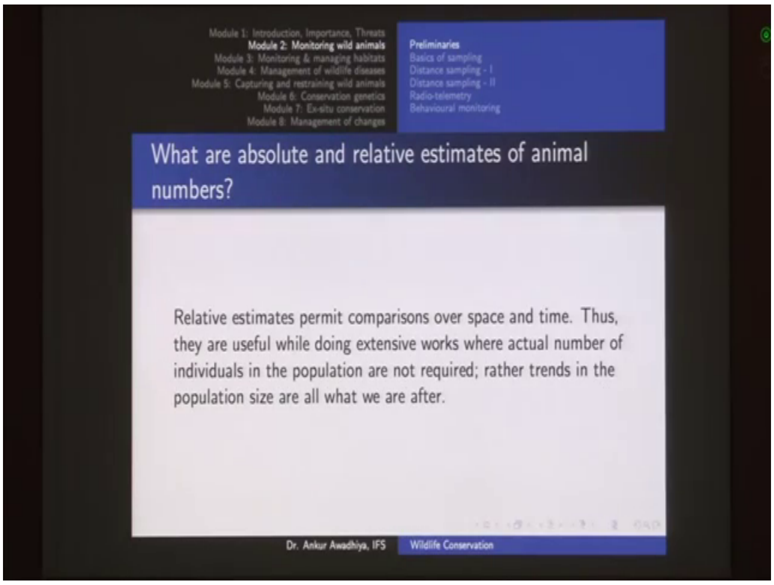

Now, relative estimate is easier to do it, it permits comparisons over time and space and they are useful, while doing extensive works, when actual number of individuals in the population are not required, but trends are required..

So, we mostly go for relative estimates for things such as the herbivore population. The number of deer in a forest, but in the case of our carnivore population, such as the number of tigers in the forest, you would go for an absolute estimate..

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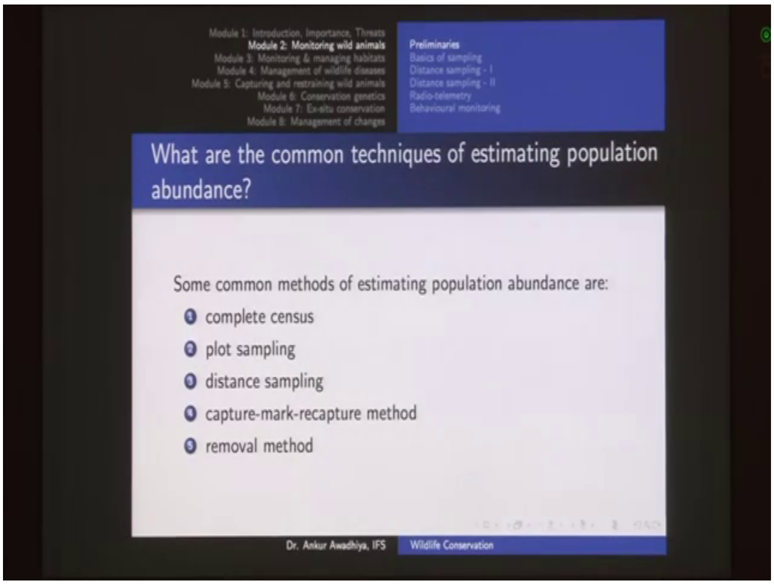

Next we looked at different kinds of methods for the estimation and then we talked about precision and accuracy..

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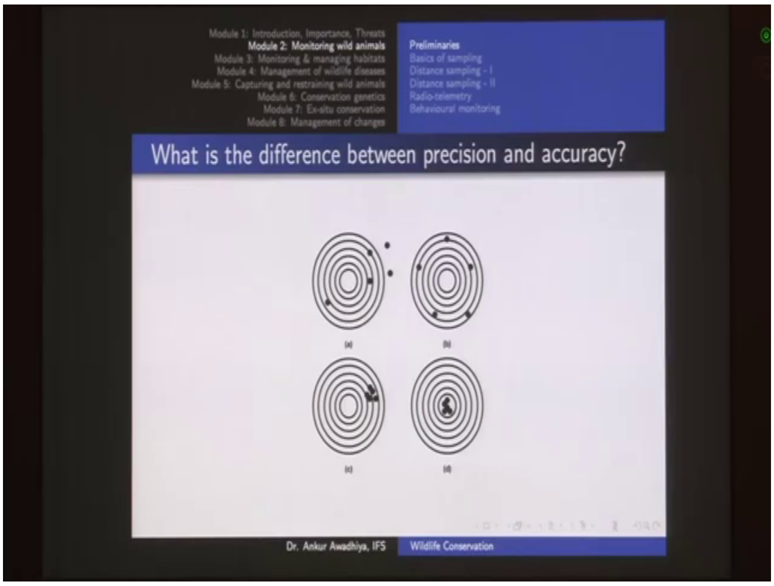

Now, precision is when you are doing an experiment again and again. How close all your values to each other? So, if they are very close together then, it is a precise value, this is a precise value, but these are not precise values because, your results of the experiment are very far apart from each other then in the case of accuracy, we are asking whether the our experimental results are close to the actual result or to the correct result? So for instance, this would be called an accurate result, but this is not an accurate result..

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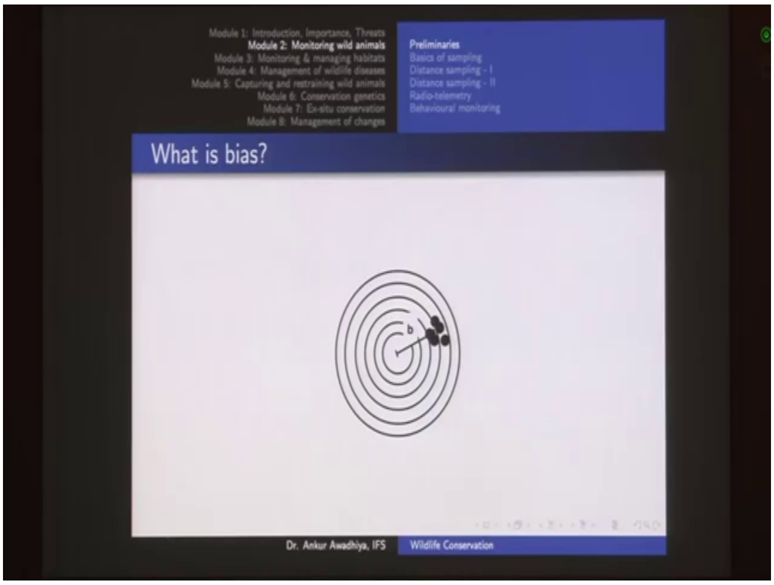

Now for situations, where we have precision, but not accuracy, we can talk about bias. Now bias is the difference that, we have from the actual value and the center of the precise values..

Now, if you have a bias in your result, you could go for a calibration of the equipment or a calibration of the method.

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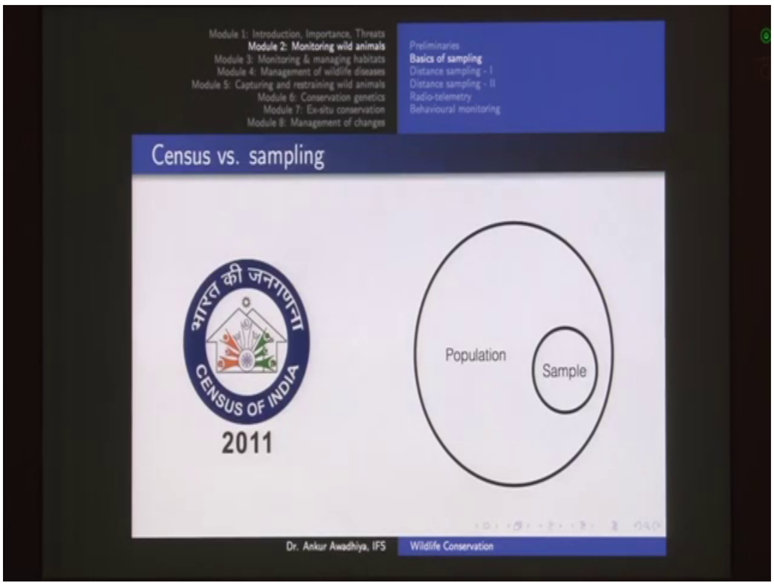

Next we talked about the basics of sampling. So here, we had census versus sample. So, in the case of a census, you are going to observe or count each and every animal that is there in the forest, but in the case of your sampling, you only go for a small portion of that huge population, which is called a sample..

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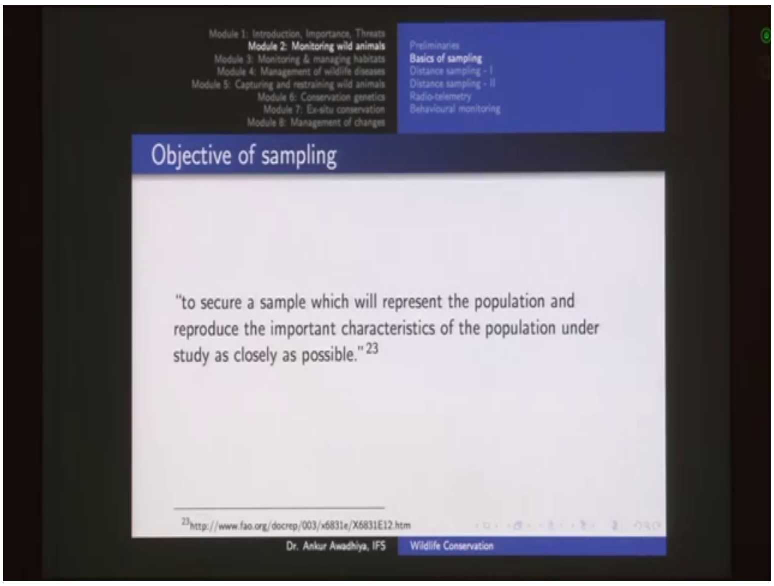

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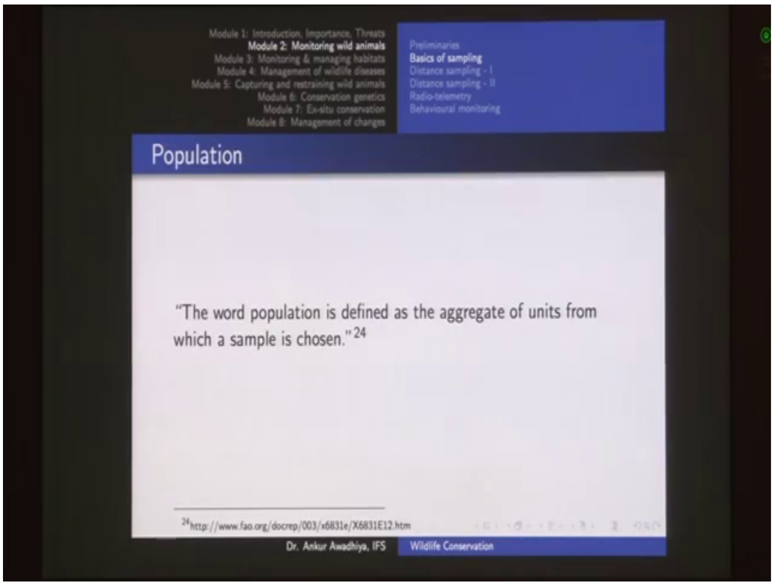

So, we want to have most of the characteristics of the census with as little effort and time as possible..

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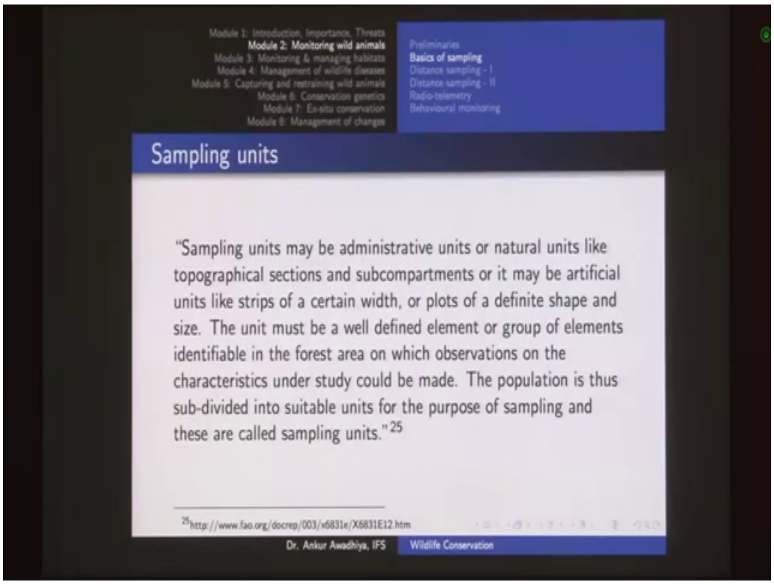

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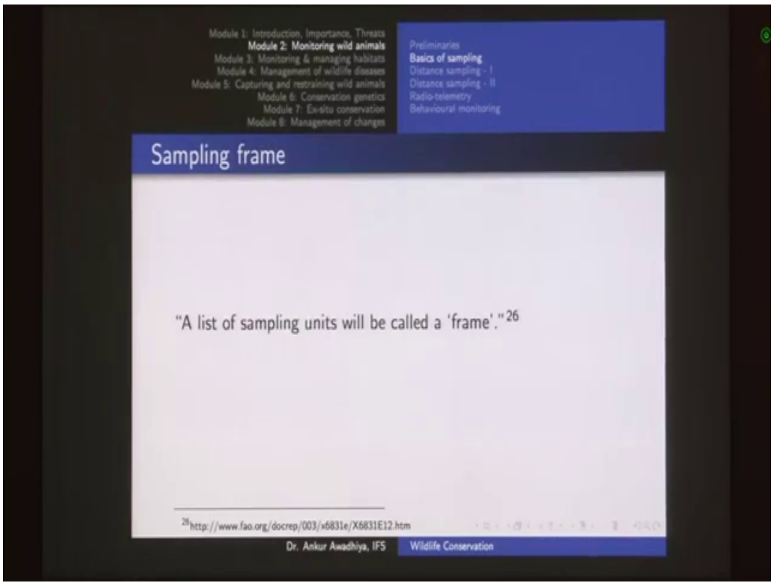

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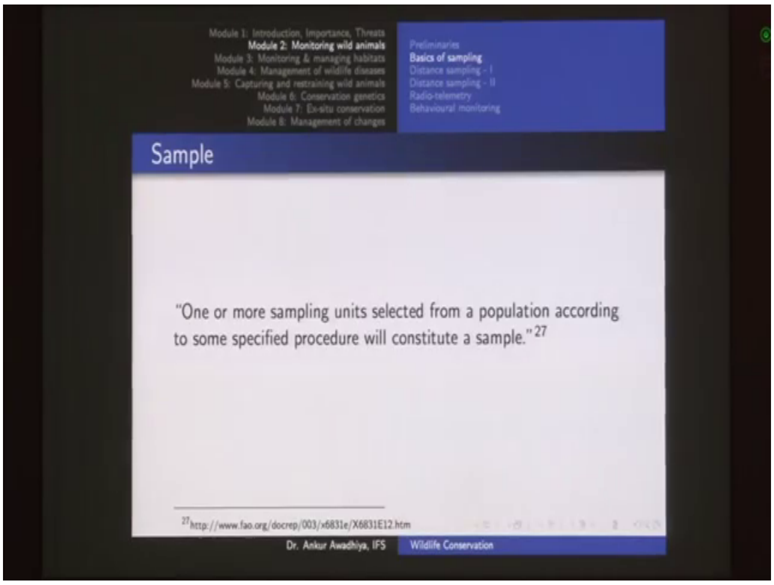

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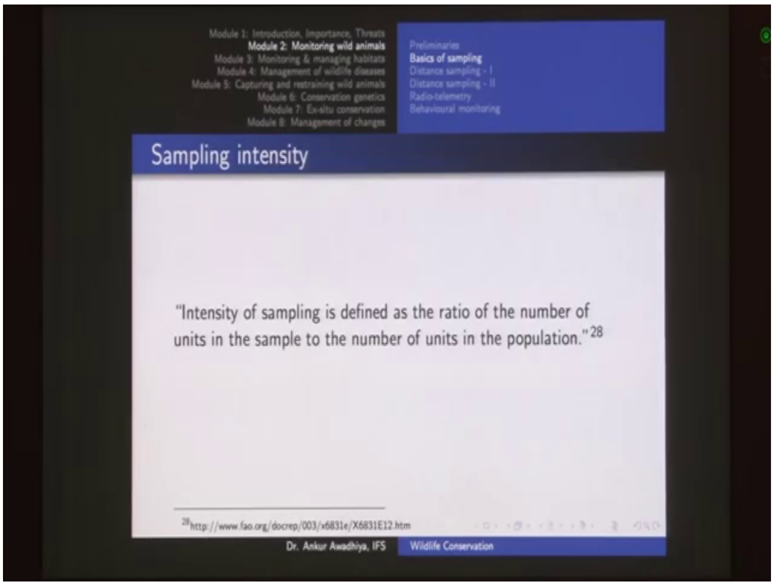

Now, we had all these definitions, so the definitions are important..

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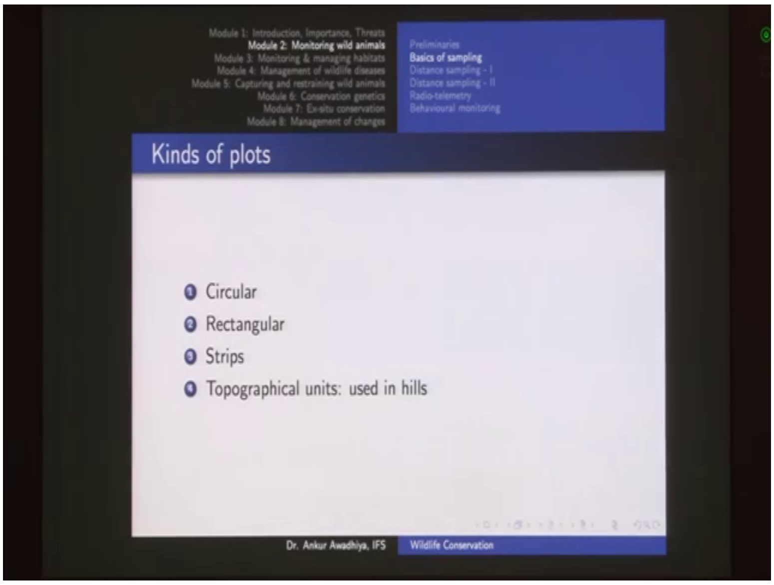

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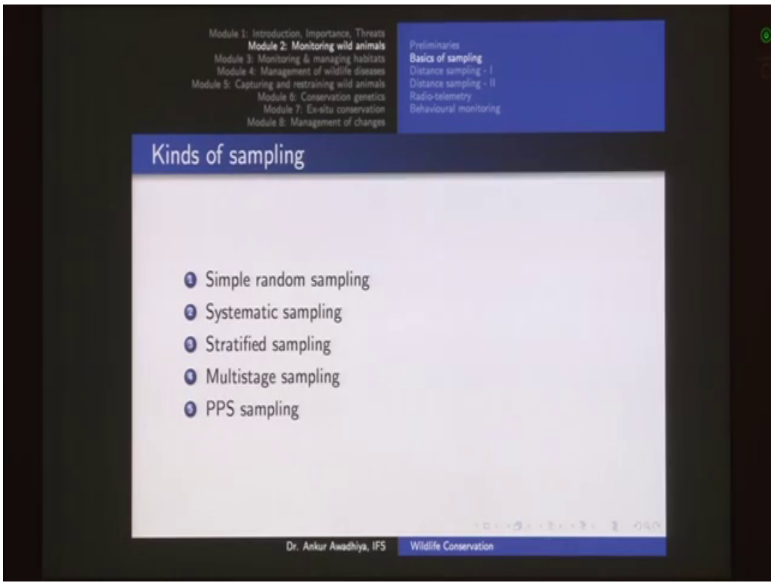

Then we talked about different kinds of plots and different kinds of sampling. Now in this case, the definitions here are important here as well. So, in the case of simple random sampling, we have a situation in which, every individual has an equal probability of being a part of the sample. So, example things like lotteries..

In the case of systematic sampling, we go with a formula. So, this formula could be say every fourth animal needs to be a part of the sample. So, that would be a systematic sampling in the case of a stratified sampling, we would divide our whole population or the whole sampling frame into a number of strata. So, those strata's will be very much homogenous..

So for instance, if you want to have an estimate of the total number of animals in your forest, you can divide your total area into the areas that are hilly, the areas that are planes, the areas that are wet lands and the and you then go and figure out the animal densities, in each and every of these areas then, multiply them with their areas to get the total figures. So, that would be known as a stratified sampling because, in this case whenever you are taking any strata. So, whenever you are taking things like grasslands. So, the figure of grassland would be the same everywhere in the grassland, but it will not be the same as the figure in the or hills. So, stratified sampling increases your accuracy..

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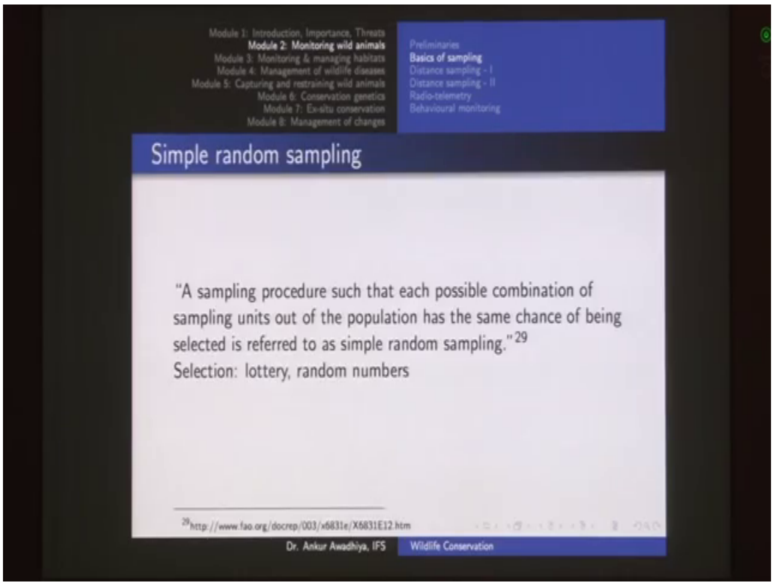

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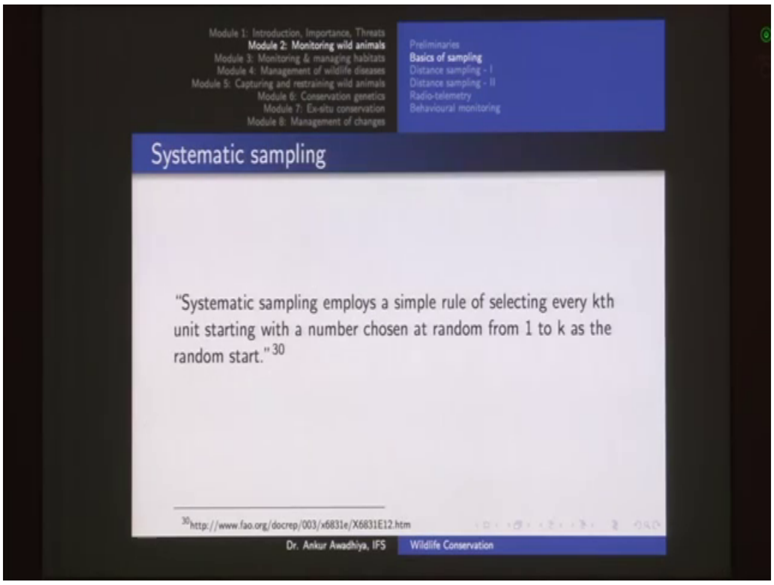

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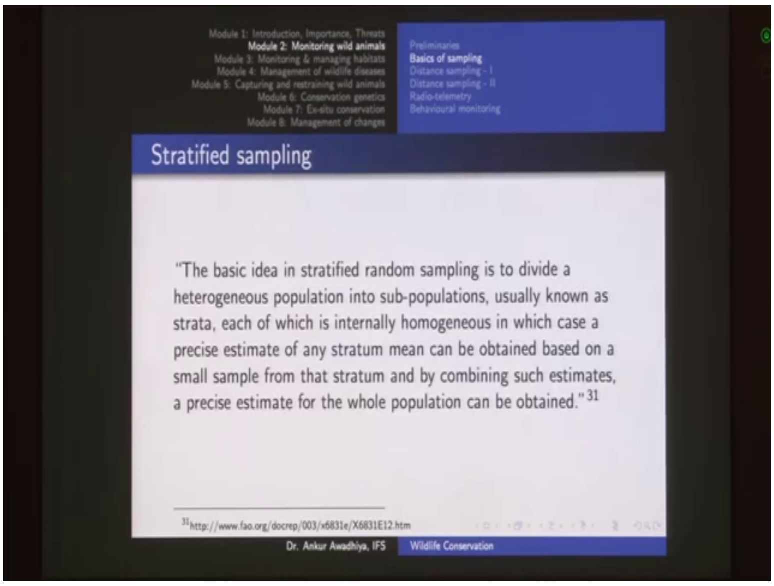

Then we had things like multistage sampling in which, you take two or more stages for your sample. And we also had probability proportional to size sampling in which, the probability of getting into a sample depends on the importance or the size of the variable under study..

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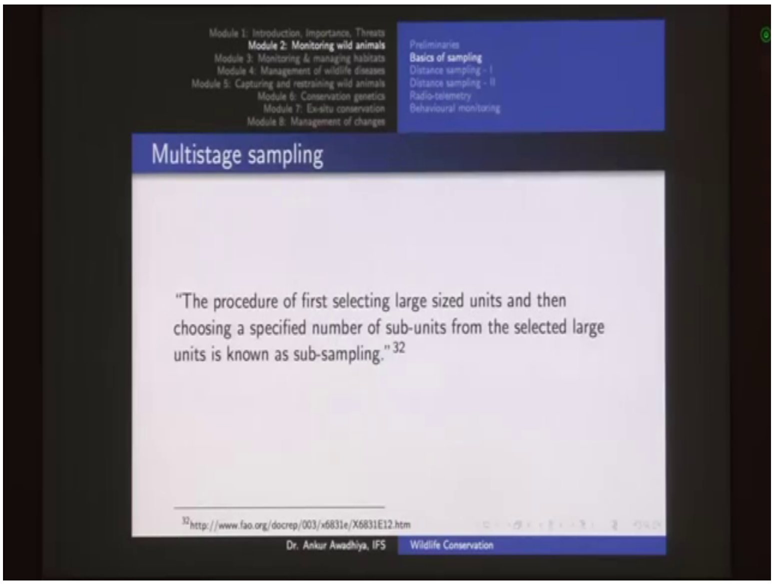

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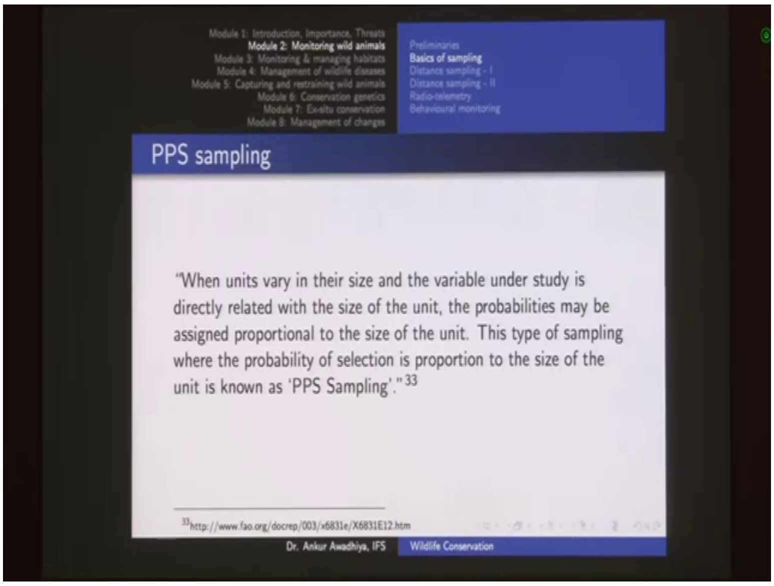

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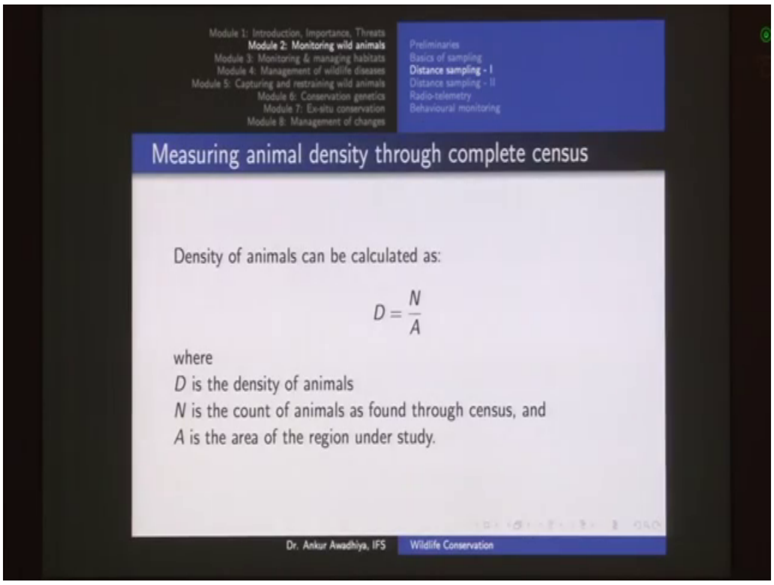

Next we talked about distance sampling. So, distance sampling starts with our basic formula of density of animals, number of animals per unit area.

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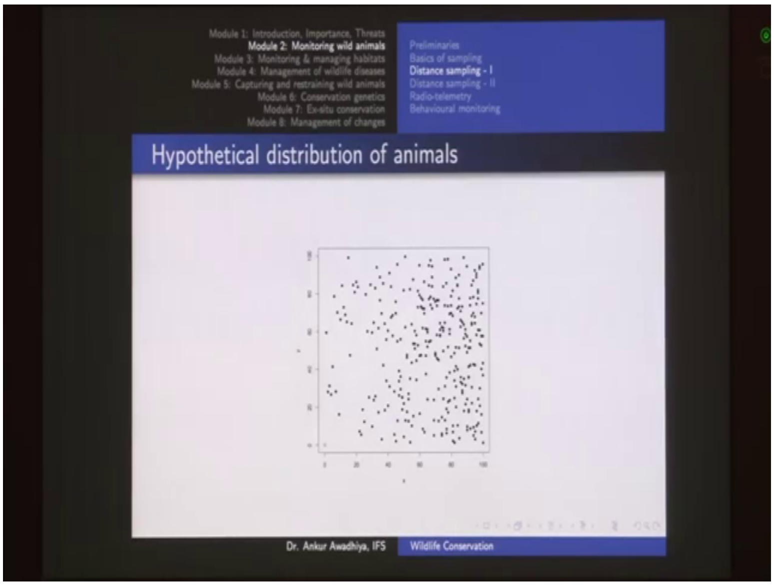

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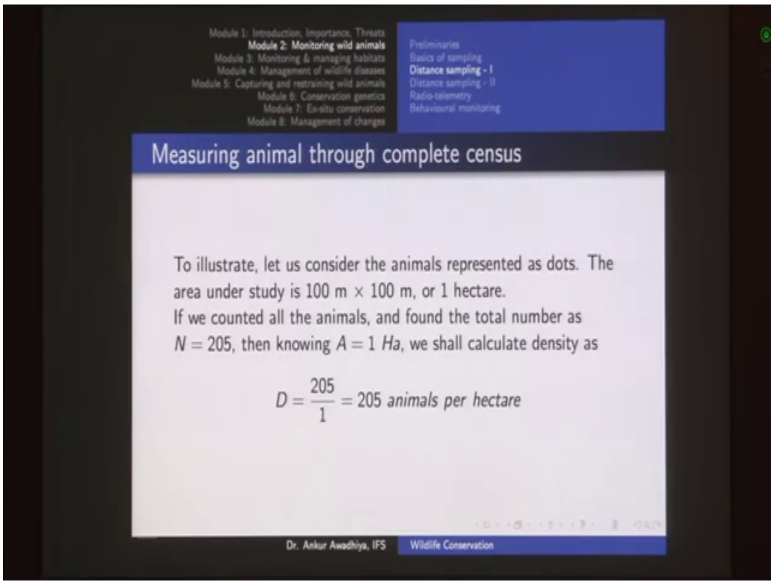

Now, then we have hypothetical distribution of animals, we could go with a complete senses in which, we will get your densities number by area..

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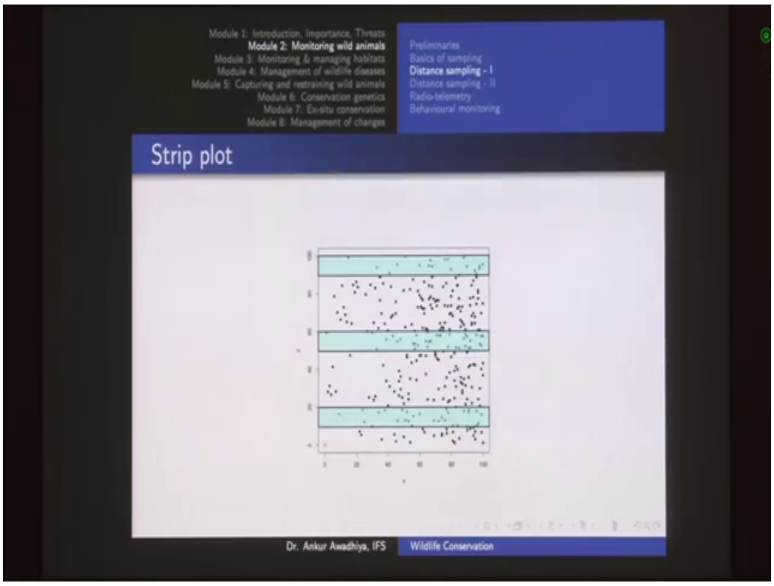

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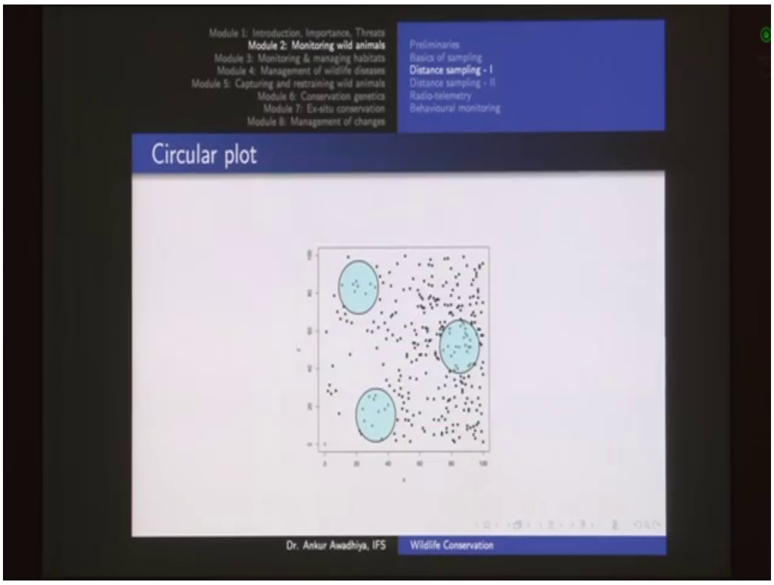

Or we could go for a sample in the form of a strip plot or in the form of a circular plot.

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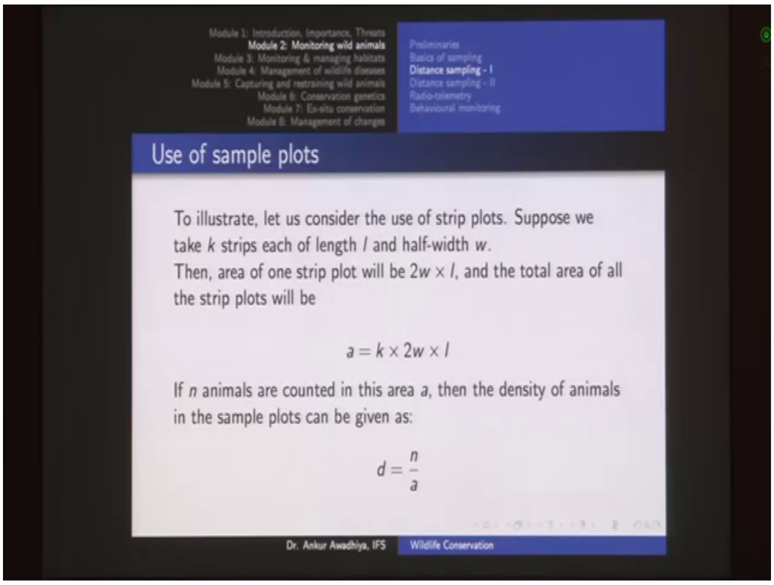

Now, when we go for a strip plot; A strip plot is the most commonly used plot and it is mostly used in the form of transects. So in the case of a transect, you move on a straight line, you look on your right, you look on your left. So, that it becomes a strip..

Now, in the case of sample plots, the area of the sample plot will be given by this value. So, l is the length that you are walking then 2 w, because w refers to the half width. So, the total width of the strip would be 2 into w.

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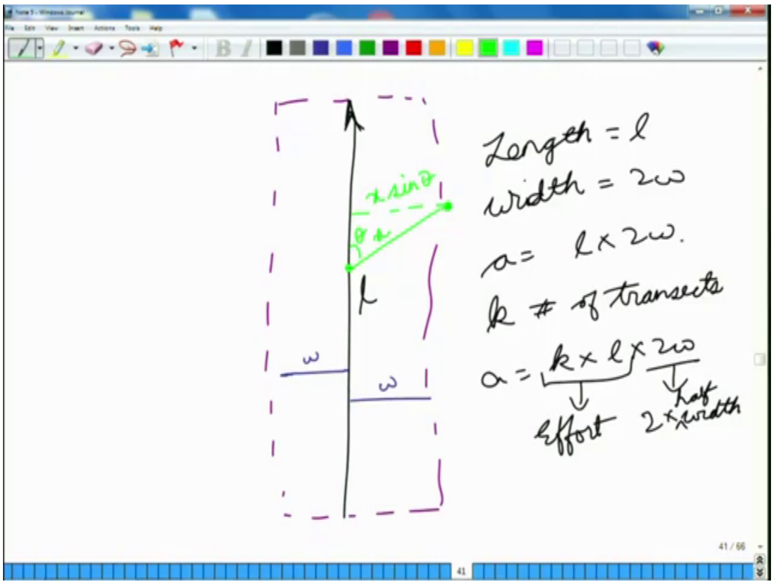

So, essentially what we are doing here? Is that you are moving on a straight line. So, this is the length of l, then you are taking a width w on your right and a width w on your left..

So, the total area of this strip would be the width of this strip multiplied with the length of the strip. So in this case, your length is l the width is thrice of w. So, the area becomes l into 2 w and if your take k number of transects. We have the area that is given by k into l into 2 w that is k into the area of each strip..

Now, k into l is the total length that you have want. So, this is something that is also known as effort. So, effort into twice width or twice of half width, becomes your total area of transect. So, you have this formula, if you observed n number of animals then you divide n divided by this value, k into 2 w into l to get the total density of animals, in your forest..

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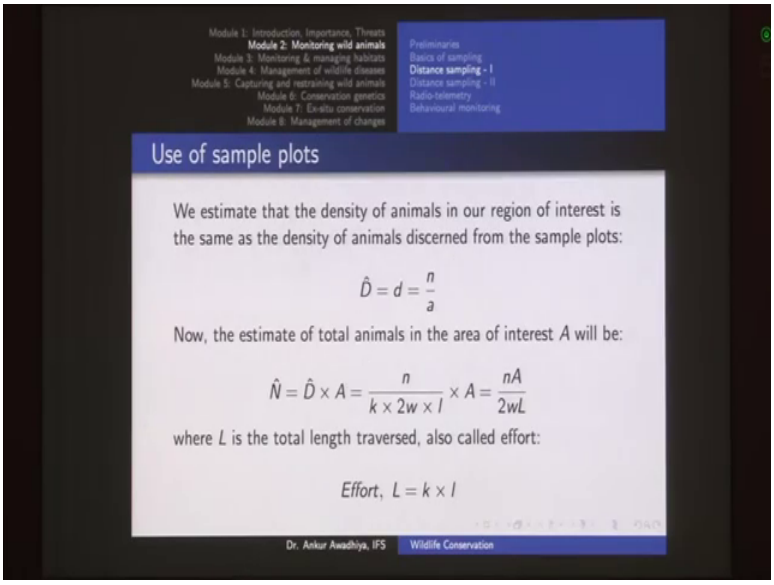

Now, in this case, effort refers to the total distance that you have walked, which is k into small l, we also represent this by capital L.

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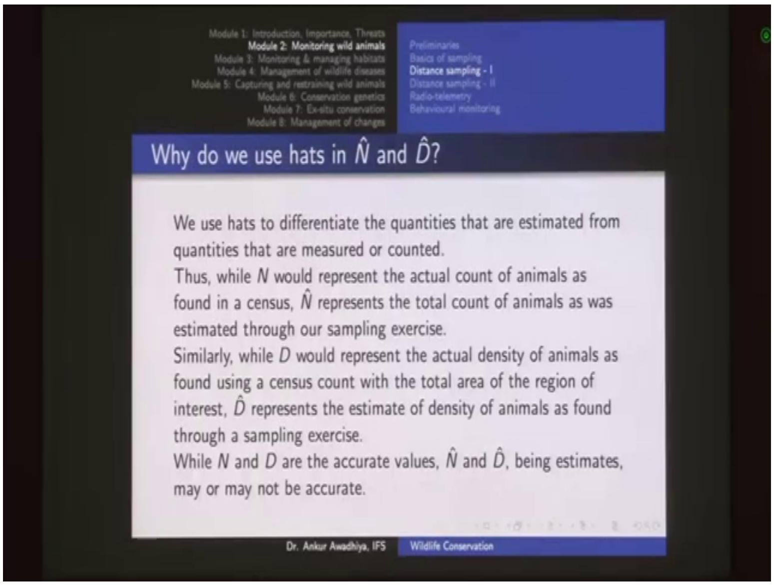

The next concept was why do we use hats? So, if there is something that you are actually observing then it will be a very correct number, but in the case of estimates, we differentiate between estimates and the correct values by giving the estimates a hat..

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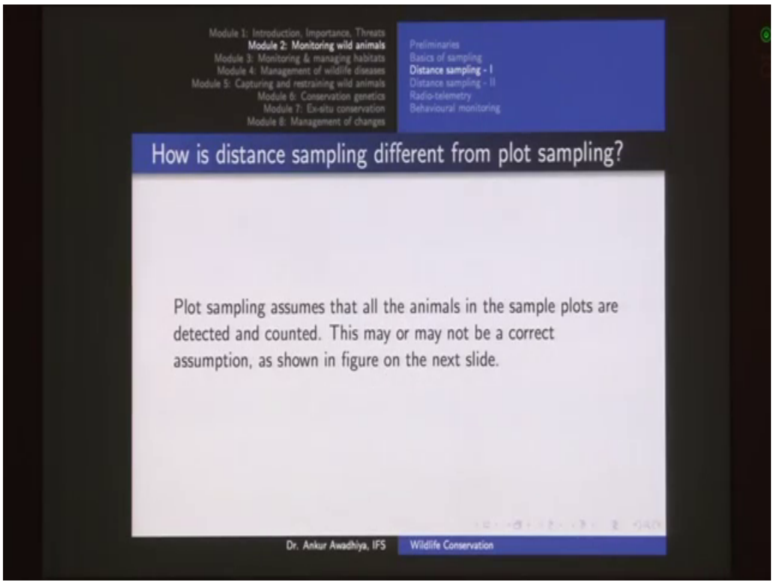

So, how is distance sampling from the different from the plot sampling?.

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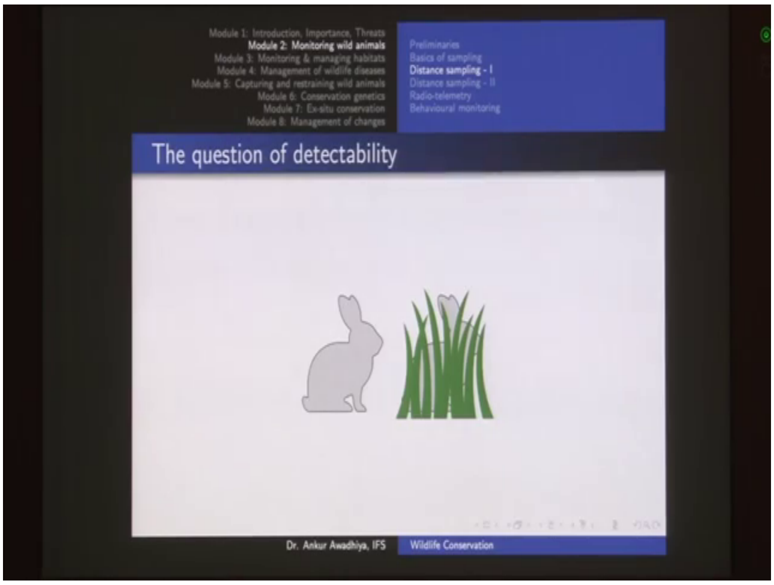

When we are moving in the forest, then there are situations in which, there would be an animal that has come inside the grasses or maybe it is standing behind a tree. So, we will not be able to detect that animal..

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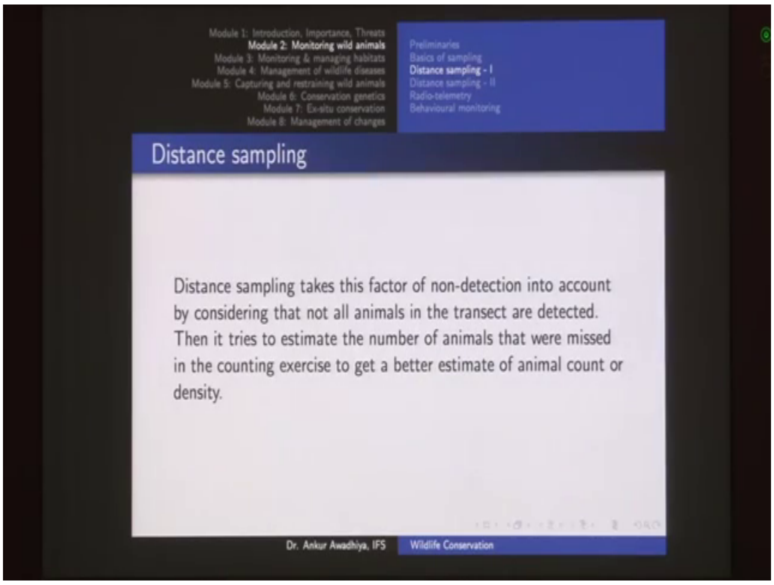

So, we have a probability of detection of animals and when we incorporate that we get into the distance sampling..

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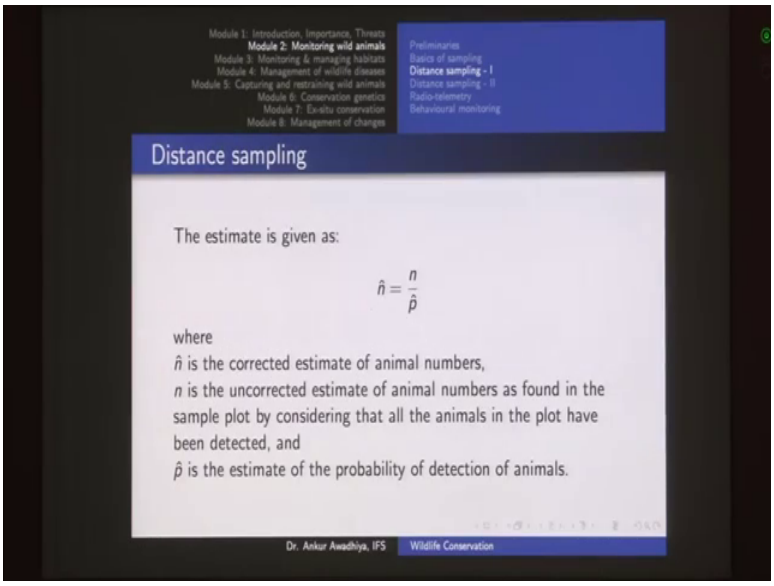

So, the probability of detection is given by p hat. So, if you are observing n animals and if you have this value of p hat, the correct number of animals will be n divided by p hat.

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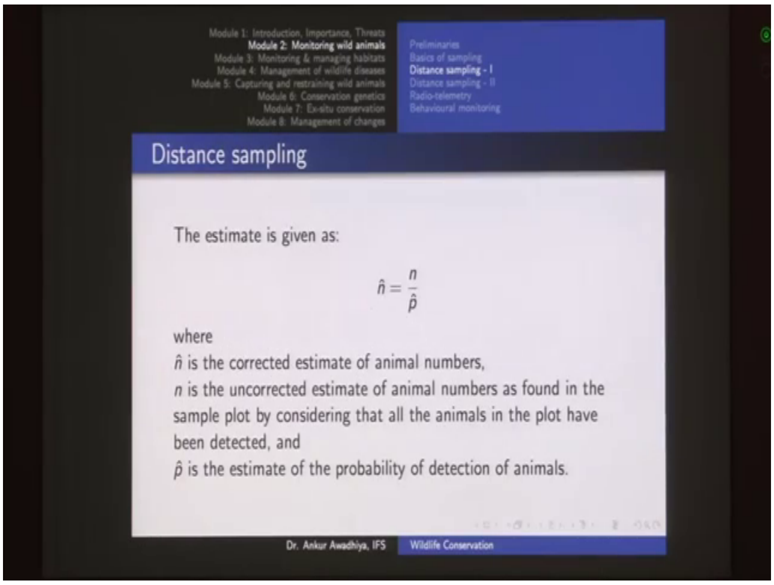

So then, we had this example, if p hat is 0.75 and if you are observing say 30 animals. So, the correct number of animals will be n divided by p hat, which is thirty divided by 0.75, which is 40. So, this is an important concept p hat.

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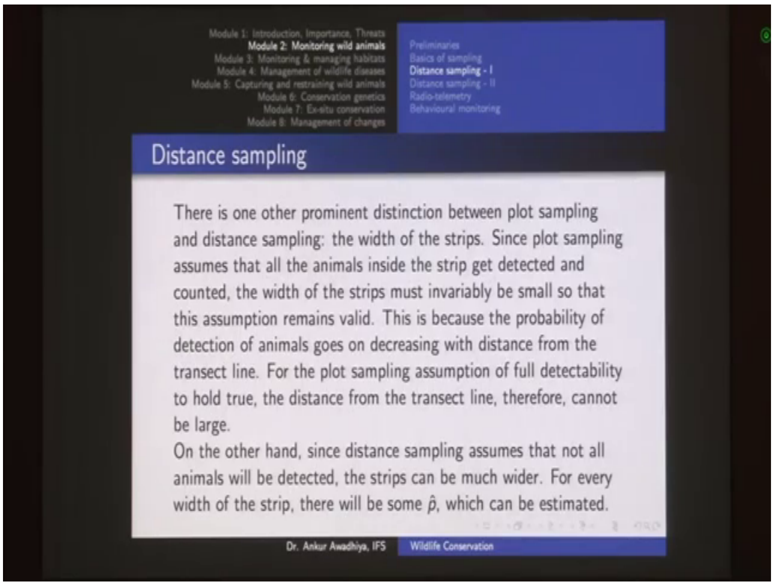

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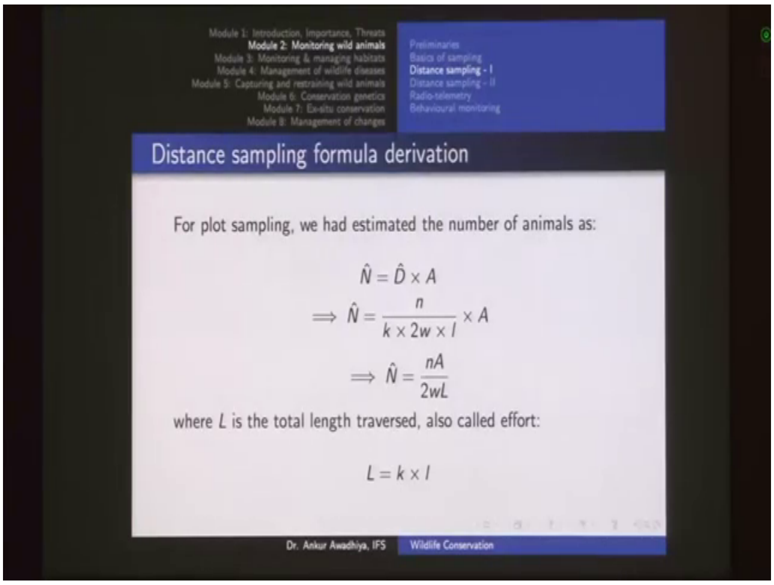

So, next is, the width of the strips can be very large; in the case of distance sampling, because we will have a different p hat..

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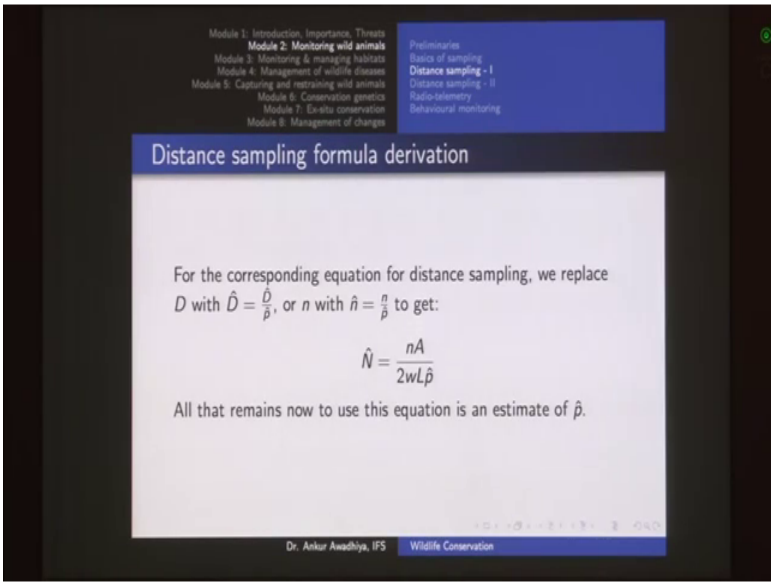

Now, in the case of distance sampling, the previous formula, we divided by p hat and then to get the number of animals, we have multiply it with the total area of the forest..

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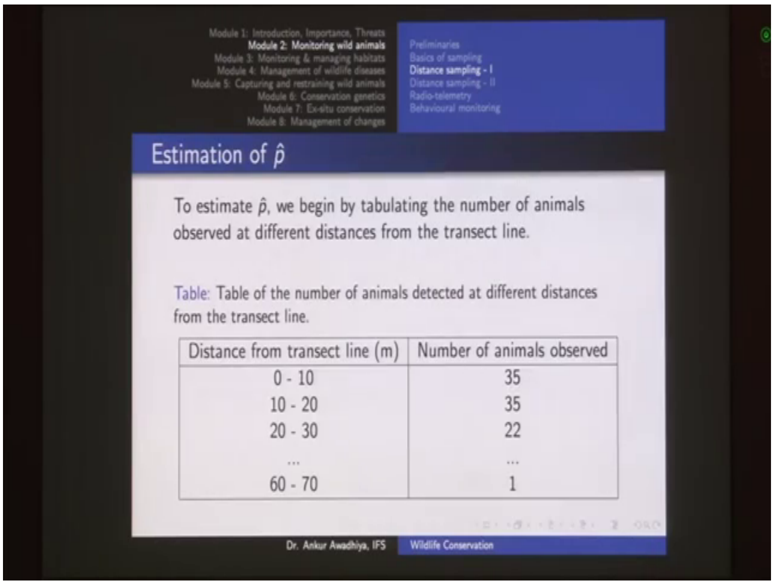

So, how do we determine p hat?

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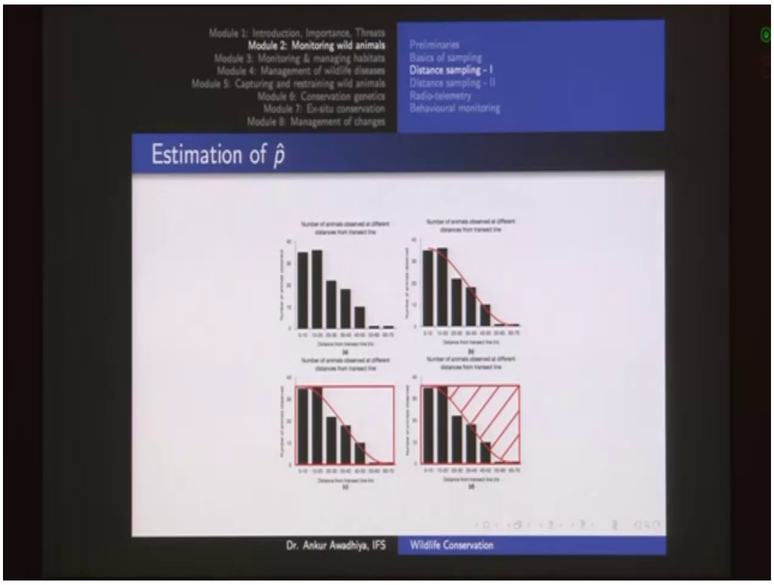

We determine p hat by plotting the number of animals with different distances then, we make a curve and then the area of that is under the curve divided by the area that is under the rectangle gives us the p hat..

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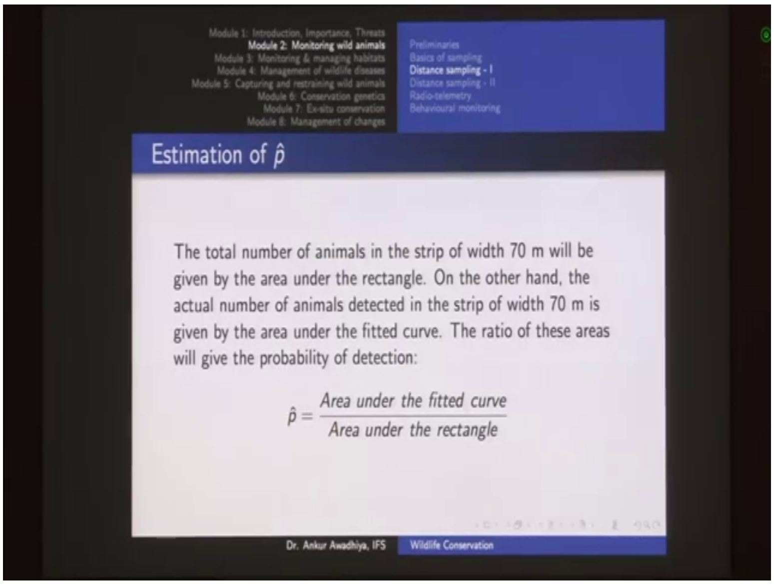

Area under the fitted curve divided by area under the rectangle.

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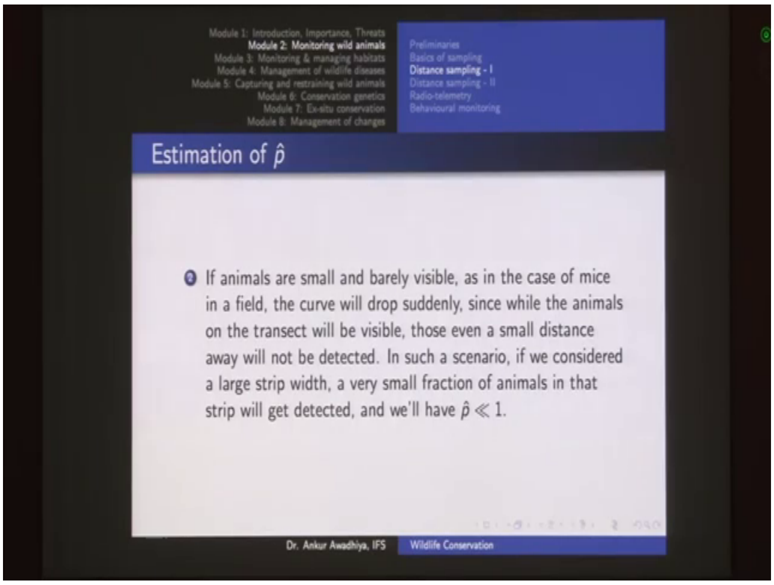

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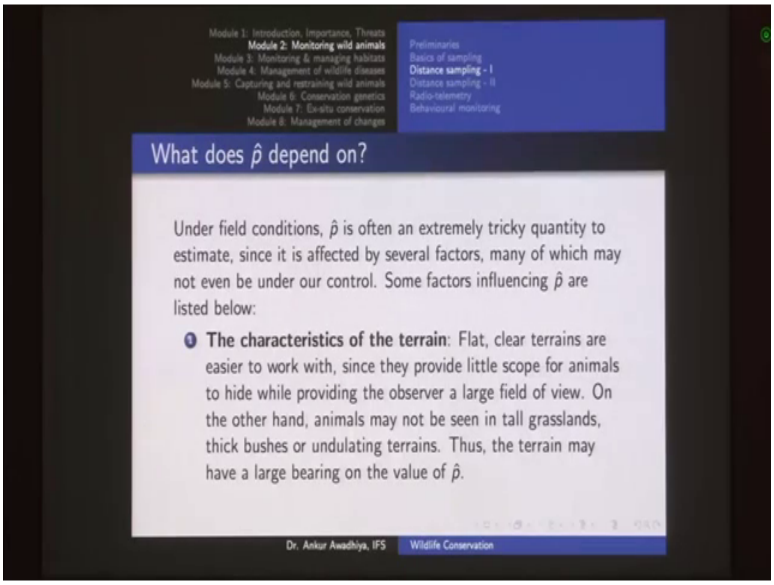

Now, we talked about the estimation of p hat in different areas. So, what this p hat depend on? So, there are a number of factors on which, your p hat would depend. It would depend on the characteristics of the terrain, whether it is flat.

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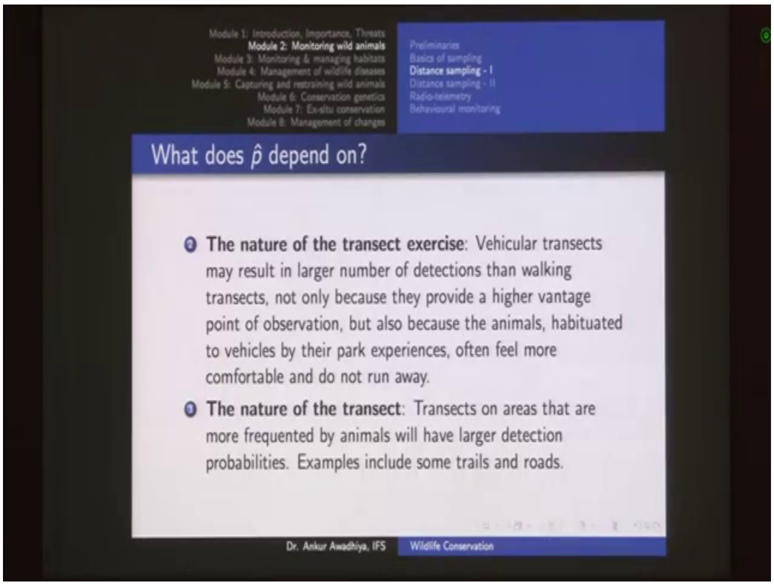

Whether it is undulating the nature of the transect exercise whether you are walking on foot whether you are walking, whether you are moving in a vehicle, the nature of the transect. ..

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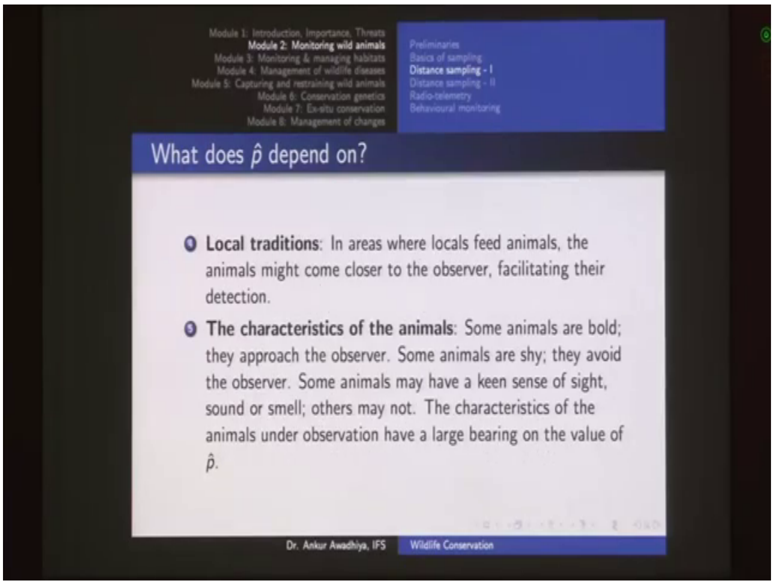

The local traditions, the characteristics of the animals.

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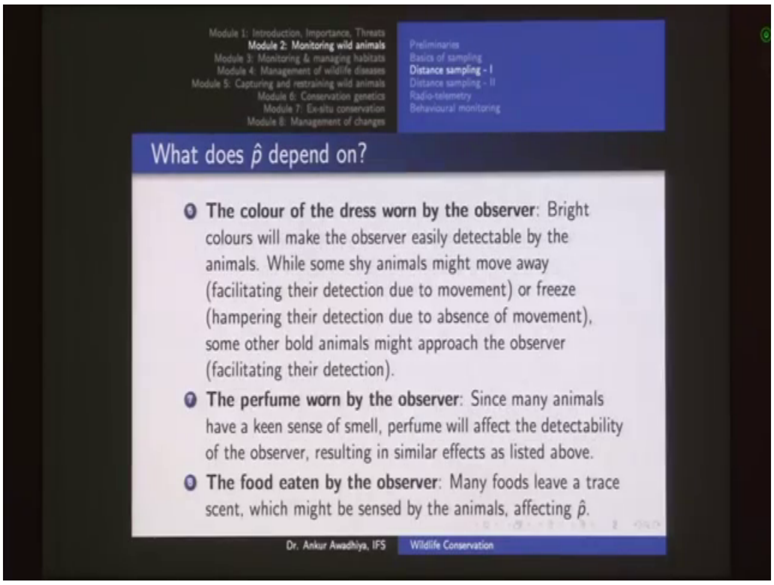

The colour of dress that you are wearing, the perfume that you are wearing.

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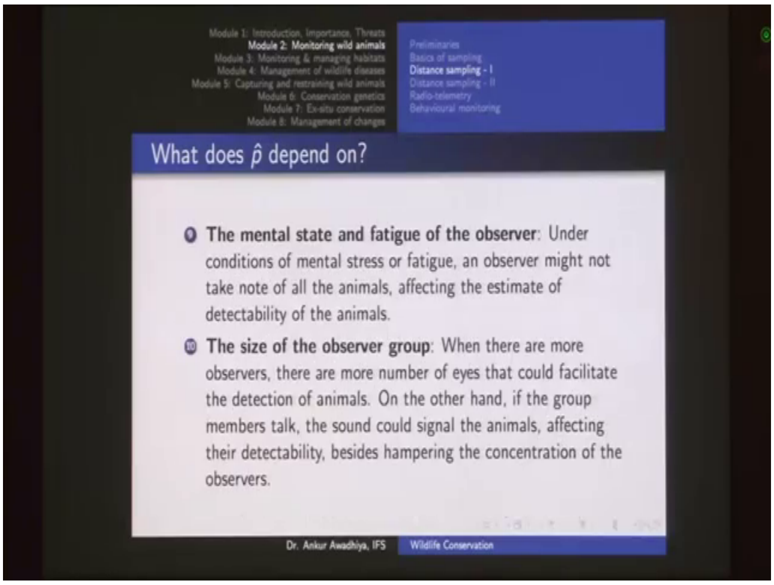

The food that you are that you have eaten; the mental state and fatigue of the observer the size of the group.

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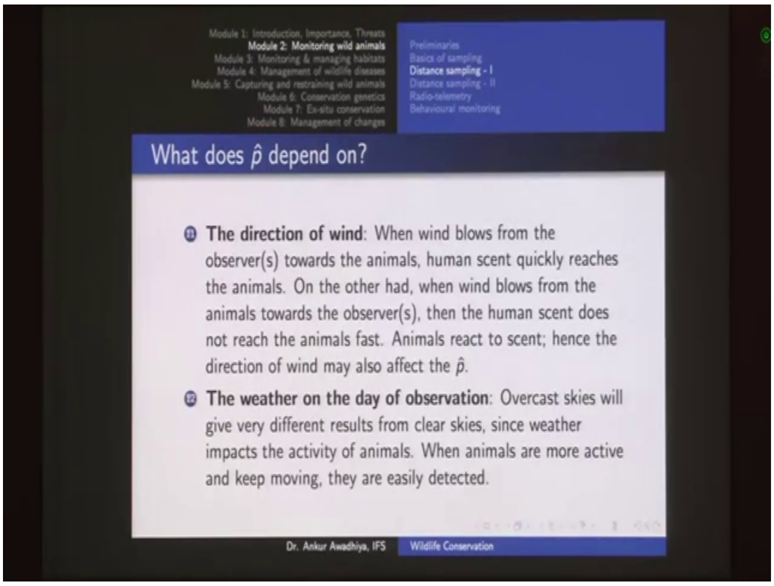

The direction of wind, the weather on the day of observation and n number of other factors as well. So, p hat is something that is tricky to determine.

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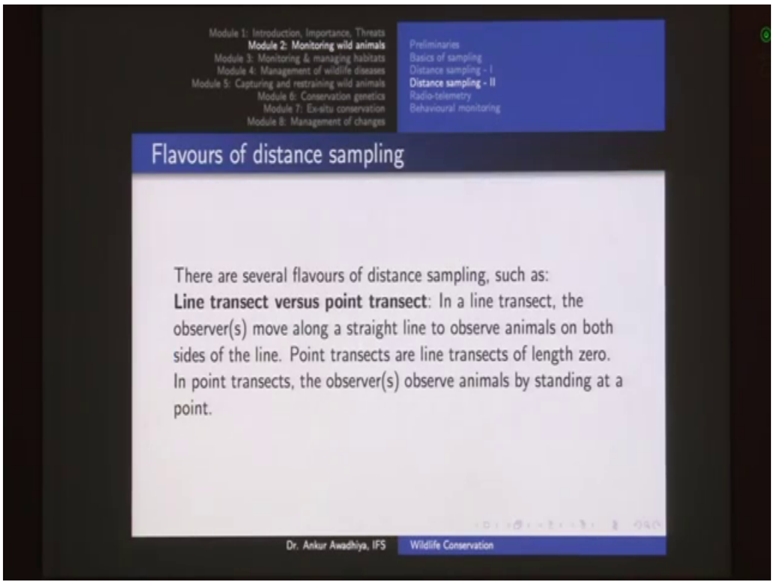

So, next we had distance sampling 2. So here, we talked about different flavors. So, this line transect versus point transect..

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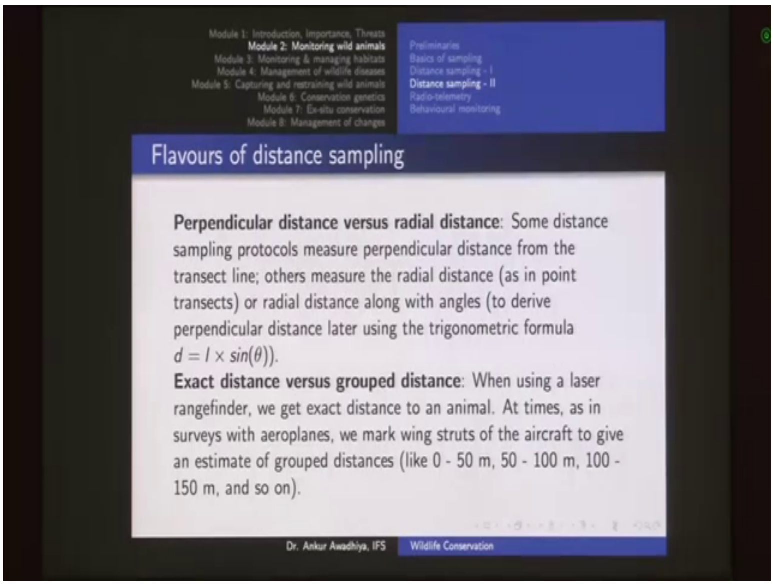

So, in the case of point transect, you have circular plots then you have perpendicular distance versus radial distance. So, you can when you are observing an animal somewhere. So, you can and this is your position. So, you can directly, take this distance say, this is x and you can measure this angle theta or you can directly put it as x into sin theta, which is the perpendicular distance of the animal with respect to your transect line..

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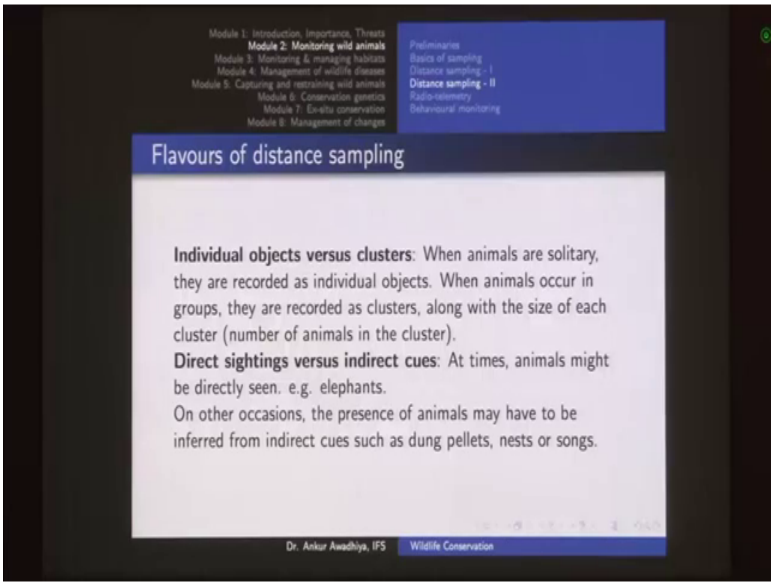

Next we talked about exact distance versus group distance, then individual objects versus clusters. Direct sightings versus indirect cues active detection on the field versus passive detection with camera traps..

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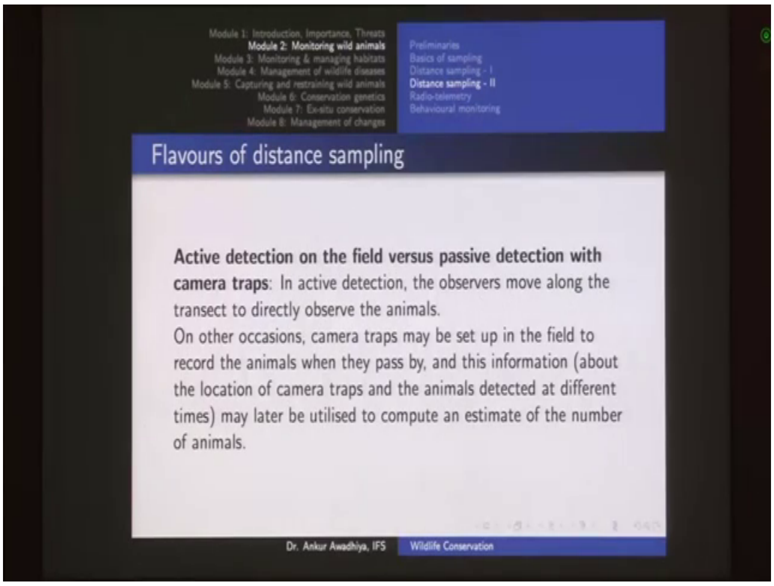

Direct sightings versus indirect cues active detection, on the field versus passive detection with camera traps.

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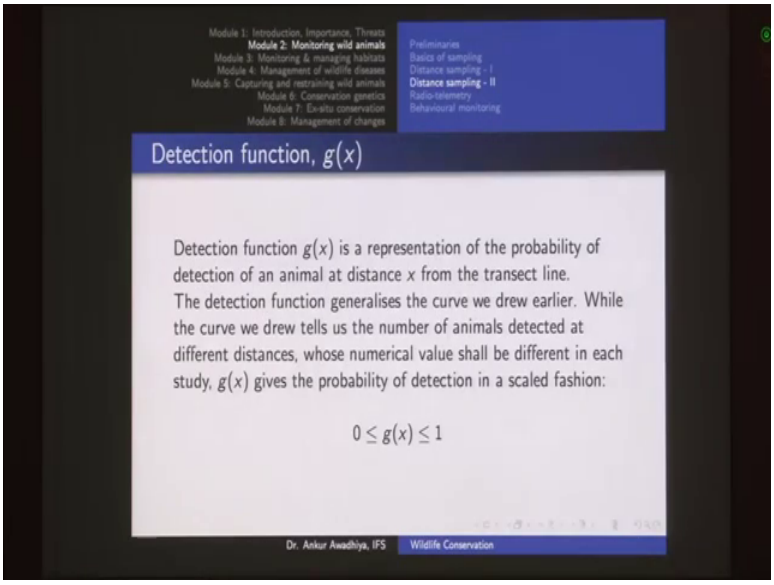

Then we talked about the detection function.

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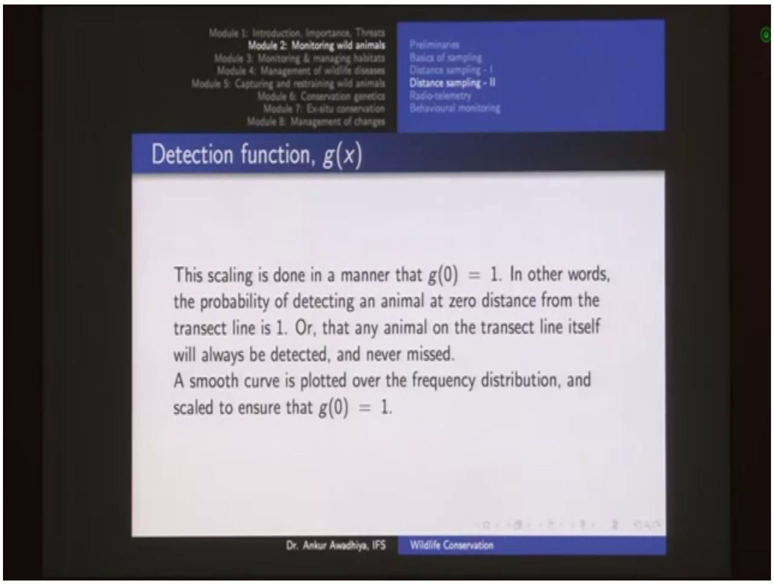

Now, in the case of detection function, you scale your value of p to. So, as to get g at 0 is equal to 1, which means that any animal that is there on transect has a 100 percent probability of getting detected..

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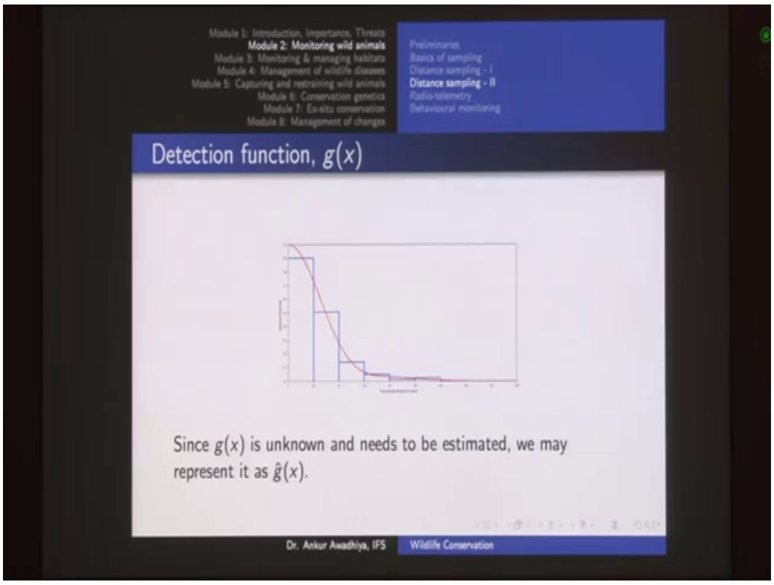

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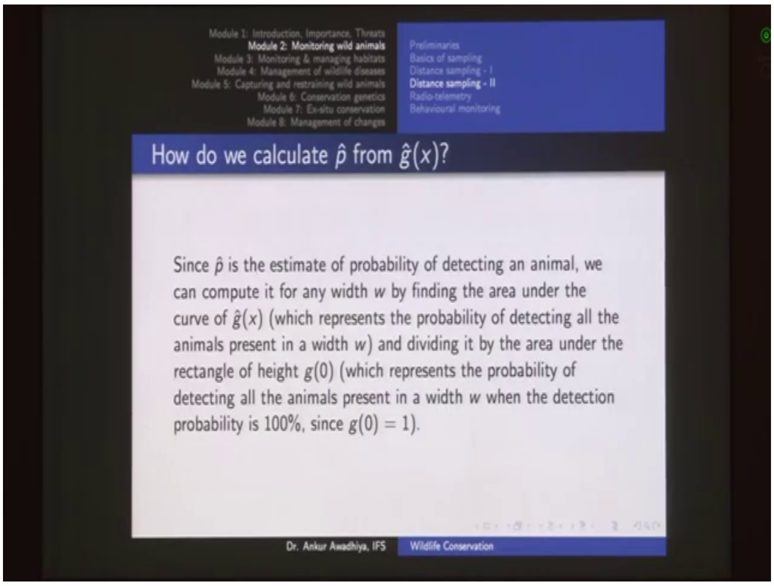

Now, we use this to be able to compute our p hat..

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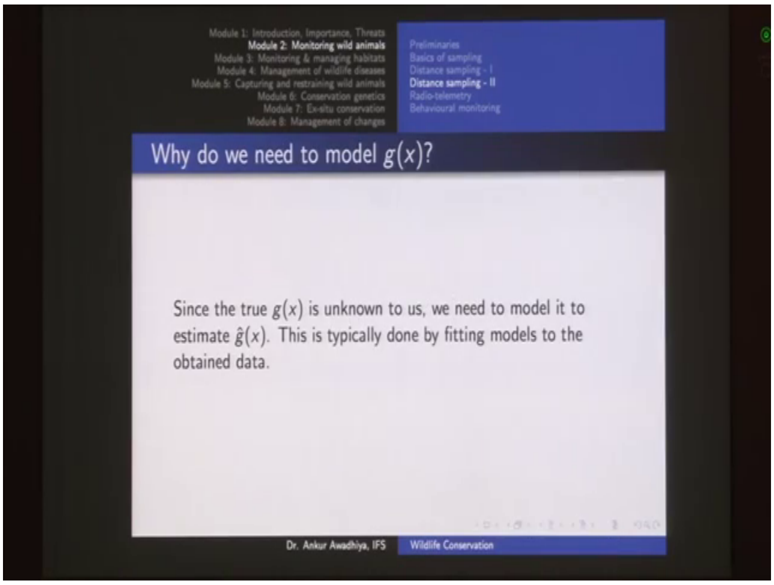

So, when we want to perform our are computations in a computer then this equation becomes very important..

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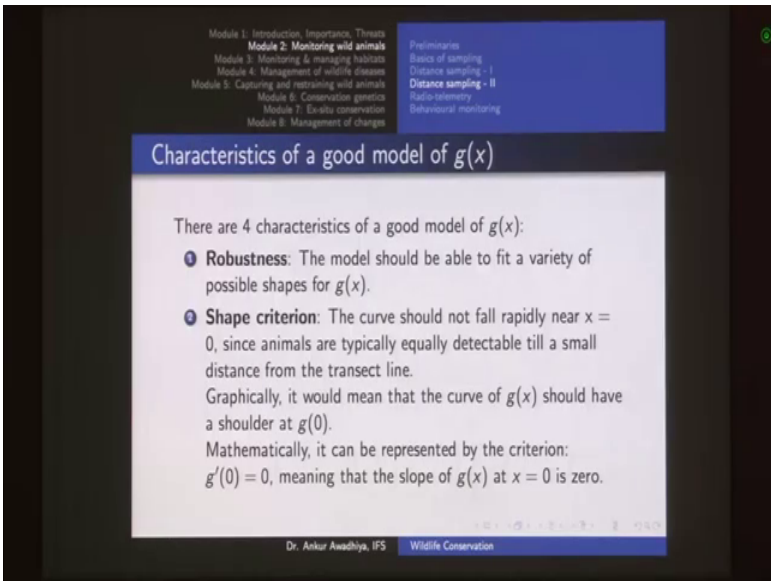

Now, there are 4 characteristics for a good model of g x. One is robustness, one is shape criterion..

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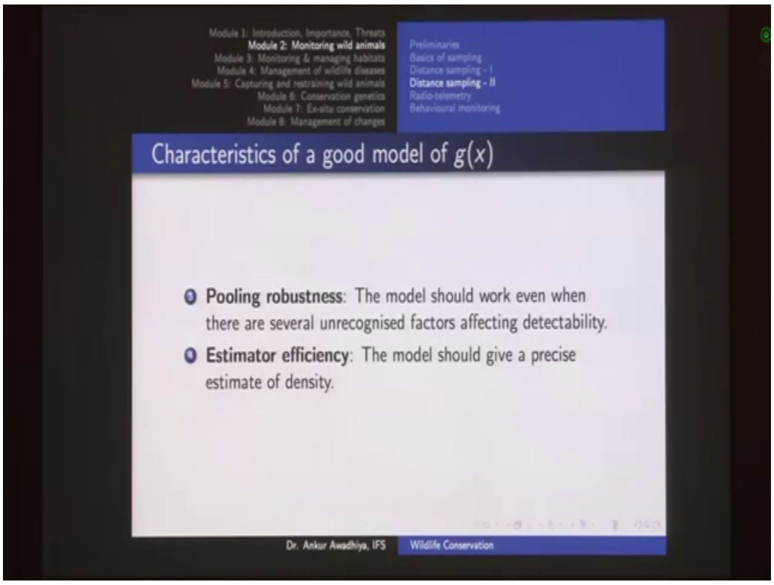

Pooling robustness and also the estimator efficiency.

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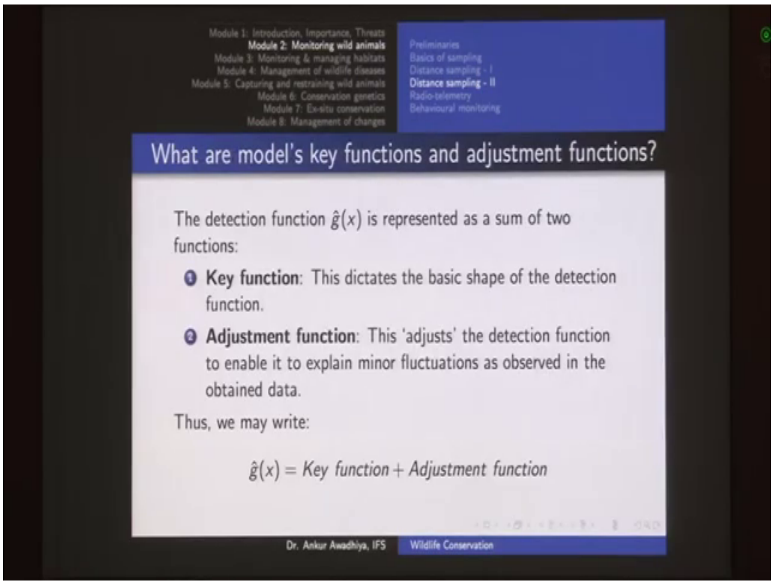

And when we are computing g of x then there are 2 functions that, we need to keep in mind. One is the key function, which tells us the basic shape of the detection function and the second is the adjustment function, which adjust are g of x, so as to include, any small fluctuations that are there in the data..

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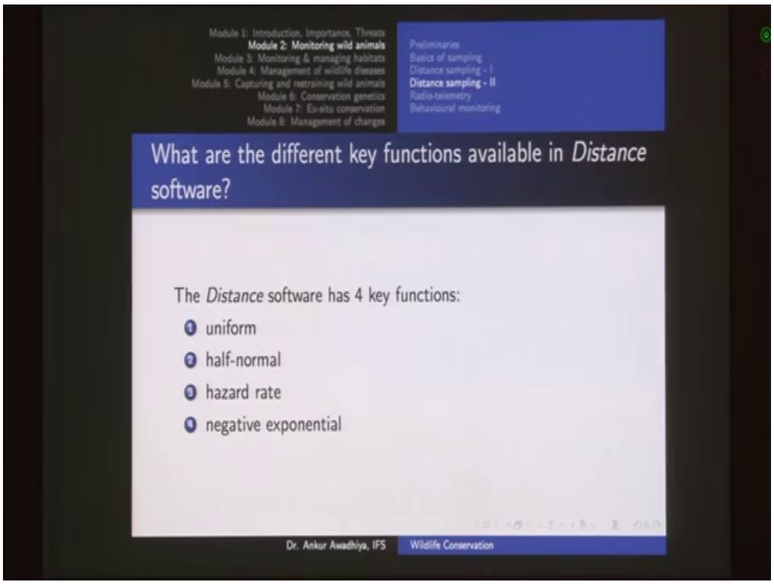

Now, there are 4 important key function, that you should remember uniform, half normal, hazard rate and negative exponentials. These are the 4 different key functions that are available in our software..

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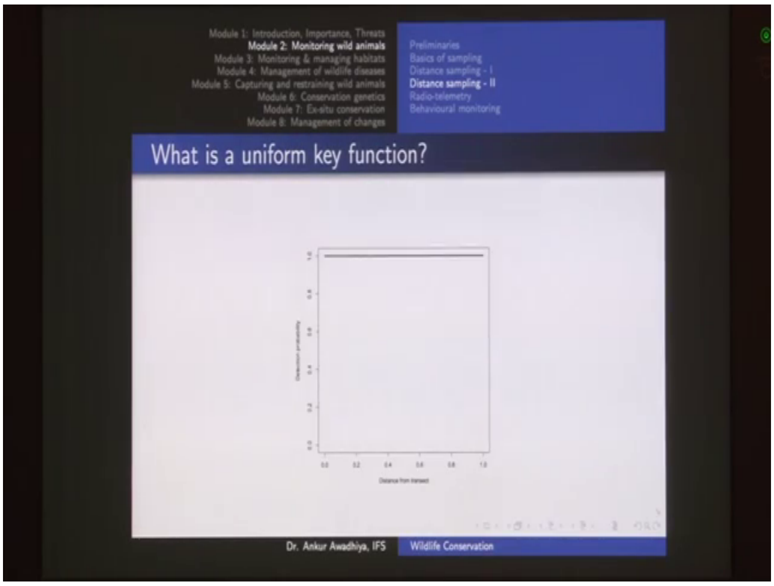

Now, uniform function is when your probability of detection is the same everywhere. So, a good example would be a elephants that are there in the grasslands. So, even if they are very far away, you will be able to see those..

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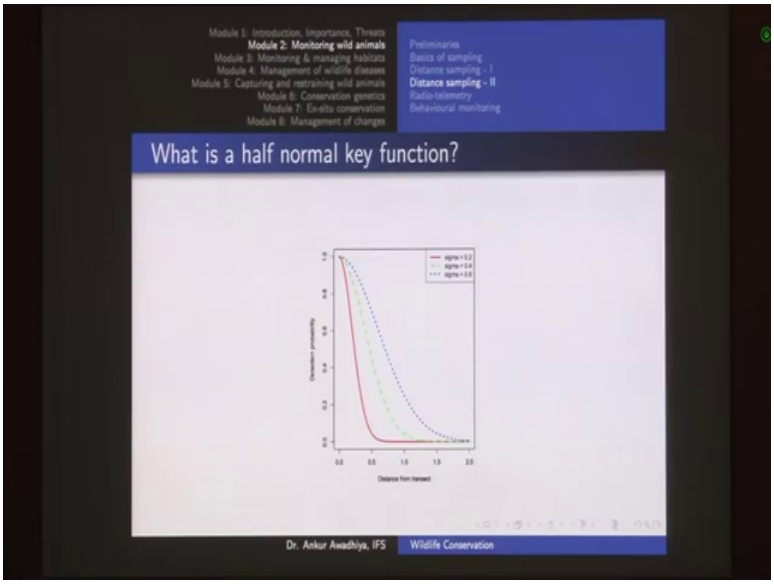

Now, the second is the half normal key function, which is half of the bell shaped curve. So, if we do it on the other side as well, we will get a bell shaped curve and then we take half of it. So, we get the half normal key function.

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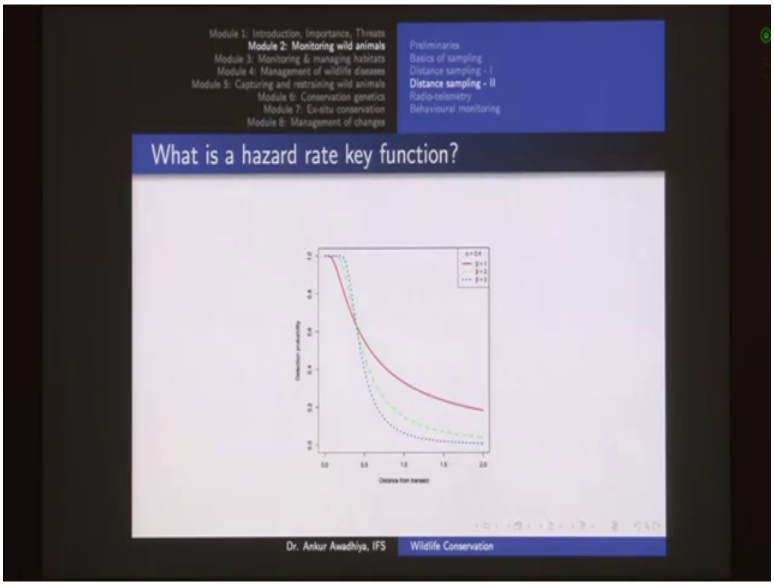

Next is the hazard rate key function and the hazard rate key function, we have a small shoulder that is near x is equal to 0 and then it rapidly drops down and an example includes, the animals that have a flight distance.So, if you go any closer to them, there are they will run and they will be detected..

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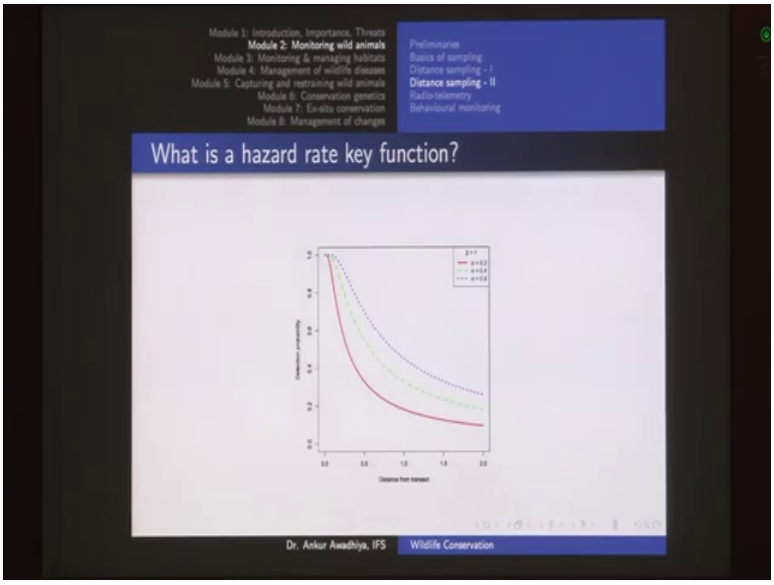

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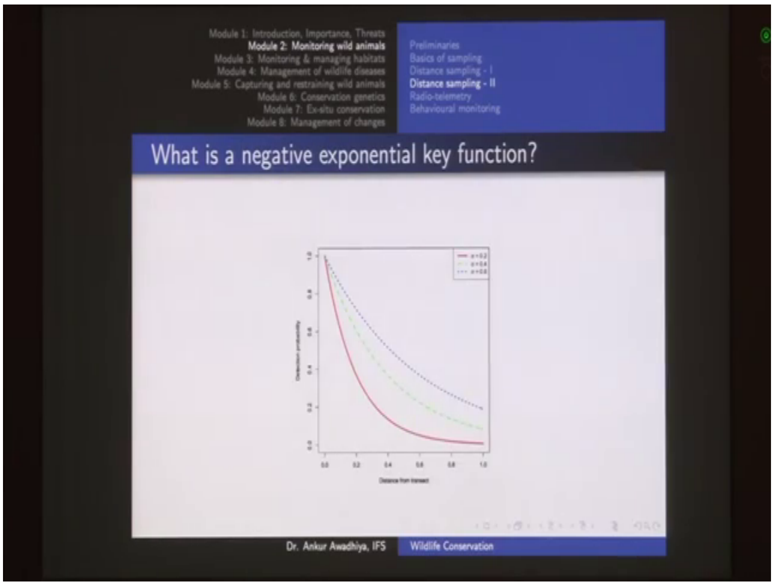

Next is the hazard rate key function. So, hazard rate is what we have talked about. Next, we have the negative exponential key function, which right a at 0, it starts going down..

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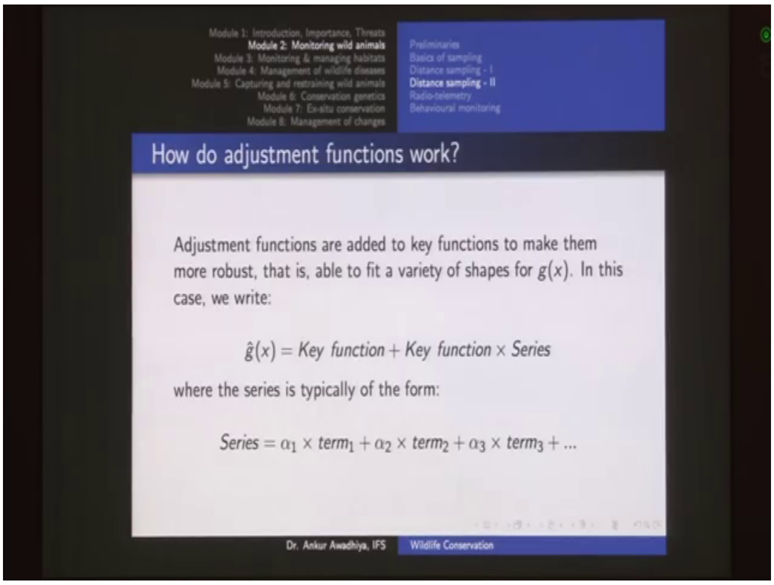

So, your g x is given by key function plus key function into some series, which is the adjustment function..

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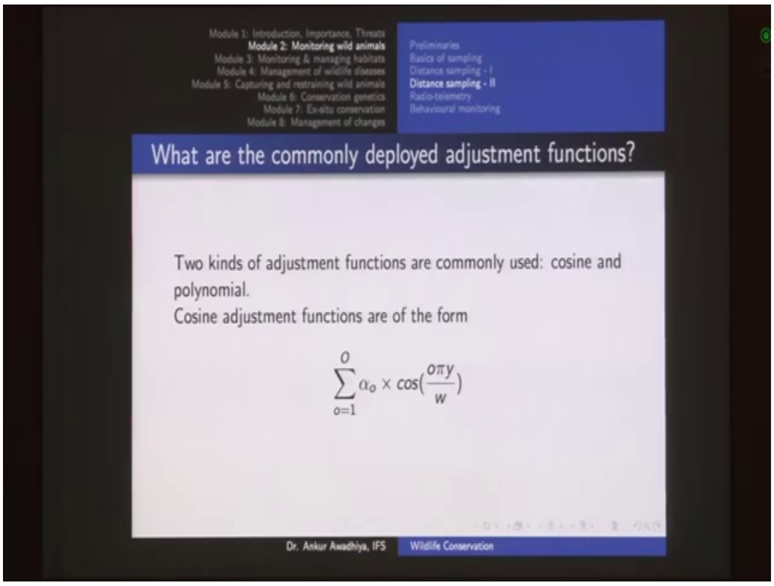

And we normally have used two kinds of adjustment functions.

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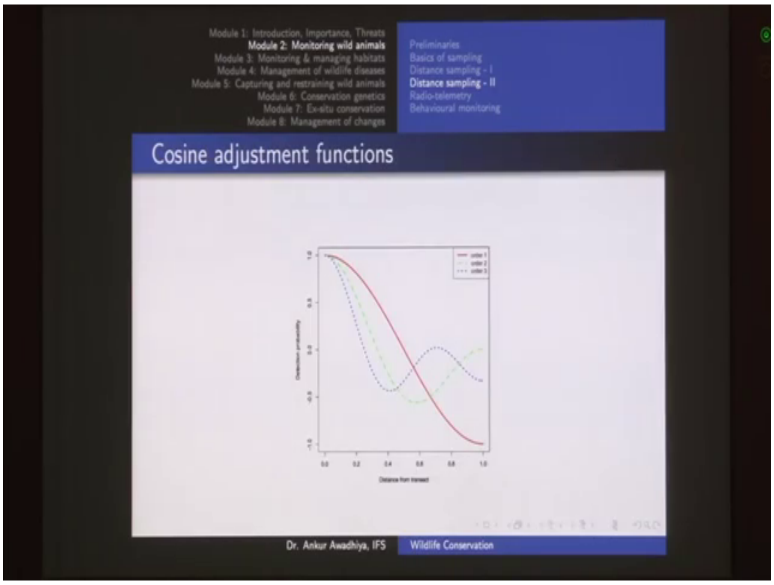

One is the cosine adjustment function.

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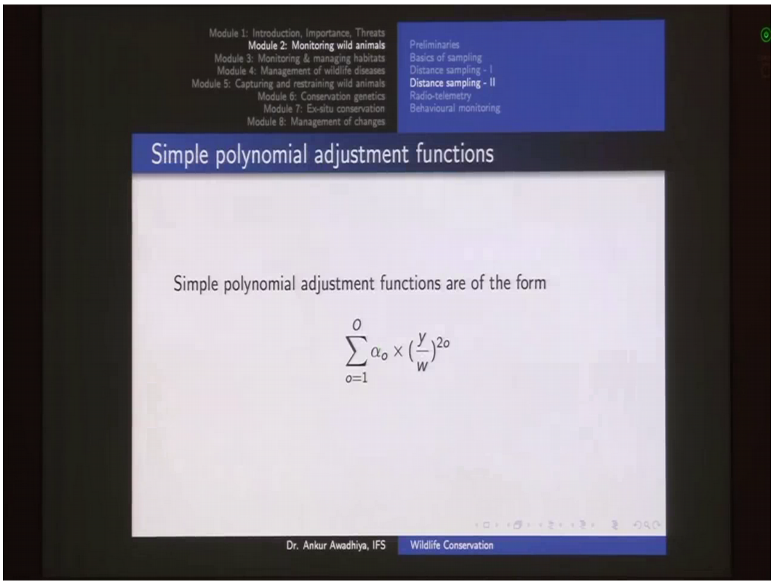

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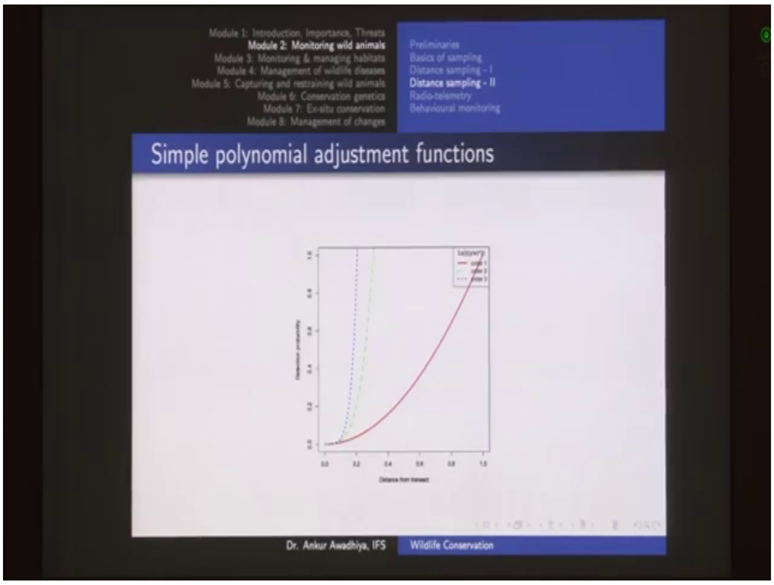

And the second one is a simple polynomial adjustment function..

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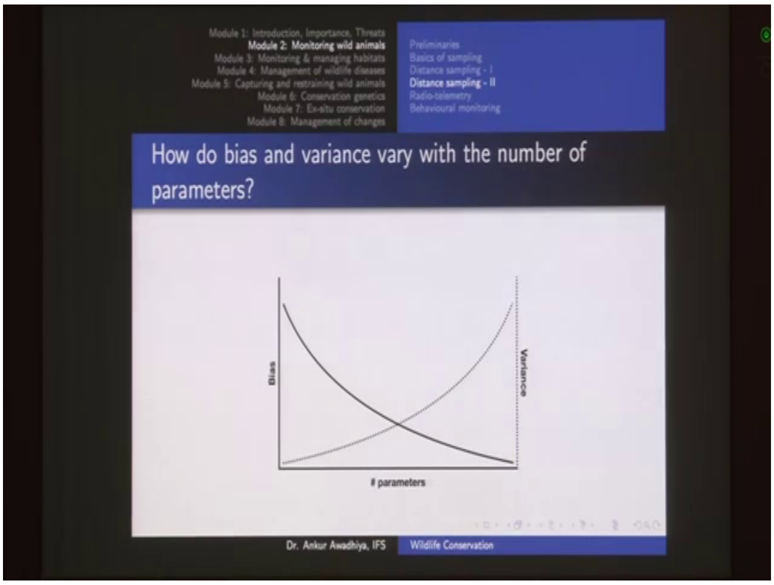

Now, this is an important concept, when we increase the number of parameters. The bias decreases because, with more number of parameters, the more amount of corrections that you are doing to your g of x, all this smaller fluctuations are taken care of so, the bias reduces, but at the same time, the variance increase. The variable increase because, when you are adjusting your function to include all these smaller values, then the amount of noise in the data is also being computed..

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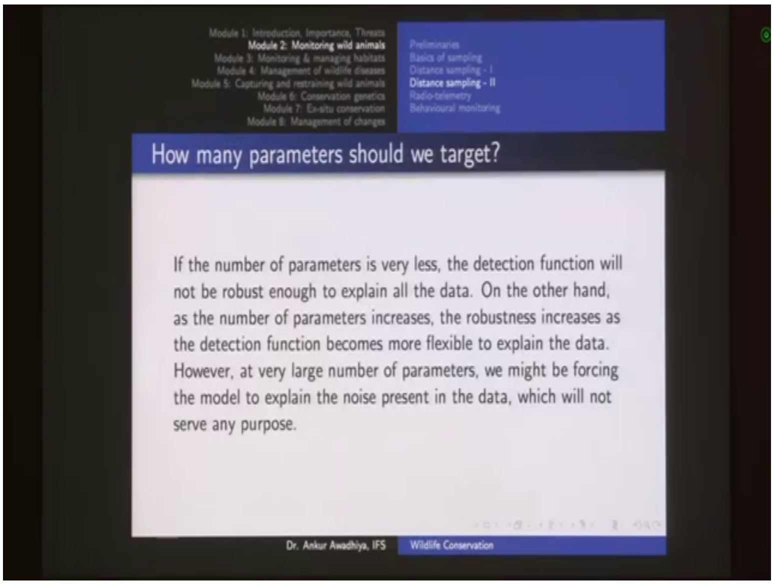

So, we should go for a mid value of these parameters.

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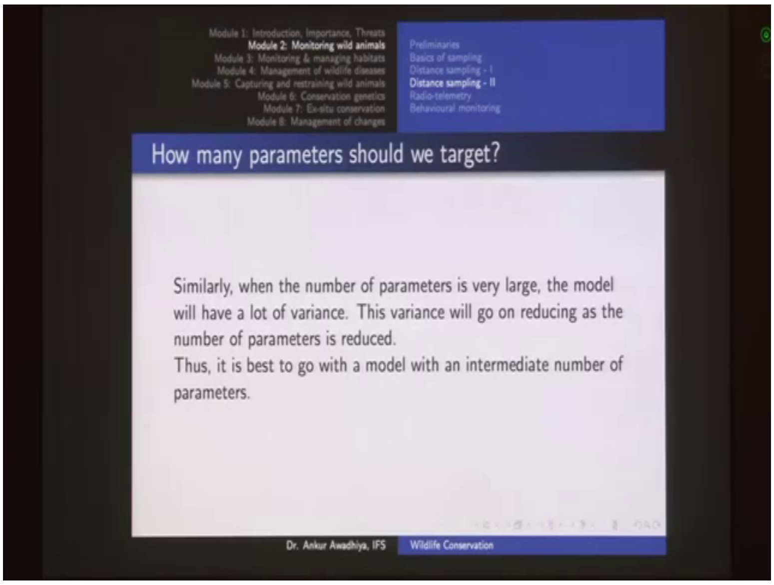

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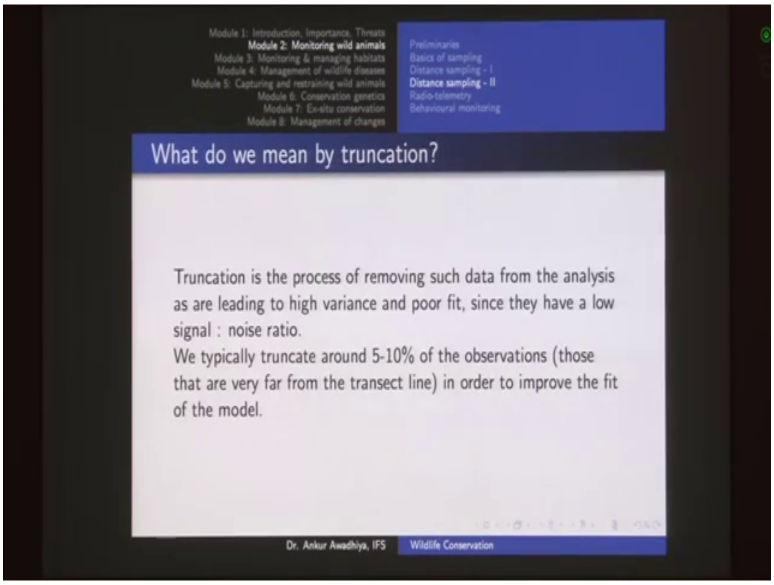

And then, we had this concept of truncation. So, truncation means that we typically remove 5 to 10 percent of observations, that are very far from the transect line, because these are those observations for which our distance computations or the angular computations will not be very correct. So, the amount of noise is high..

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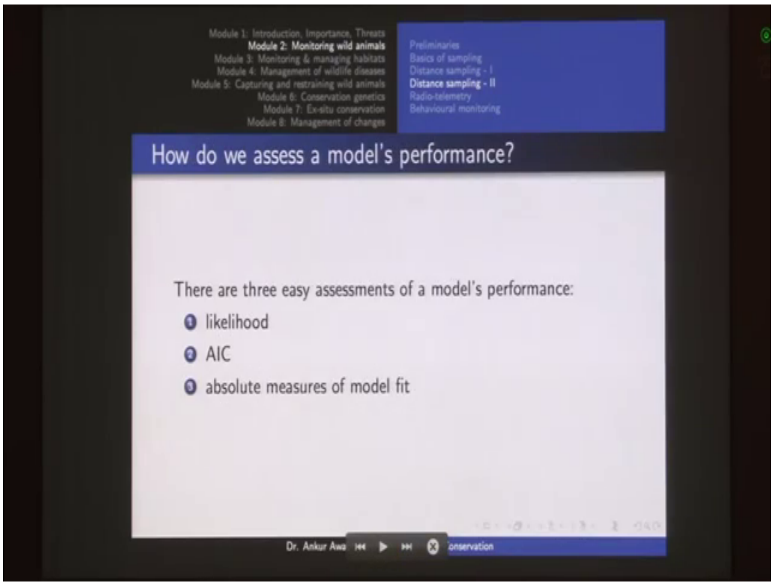

Now, there are 3 easy parameters of assessing a models performance. So, these are 3 mathematical methods, one is the likelihood. What is the likelihood that your function is correct? The second is AIC, which stands for akaike information criterion, which tells us with just one number, what is the likelihood of your function being correct and the third one is there absolute measure of model fit.

So, these are 3 assessments of model performance..

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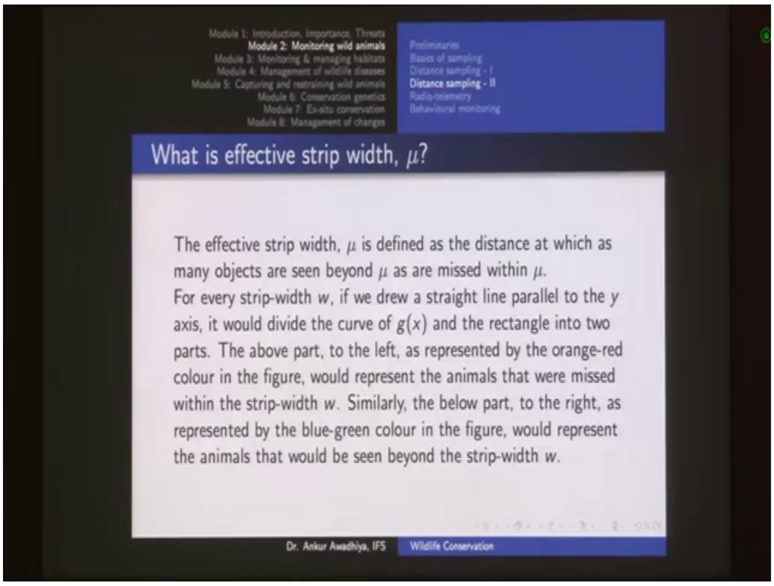

Then we talked about effective strip width.

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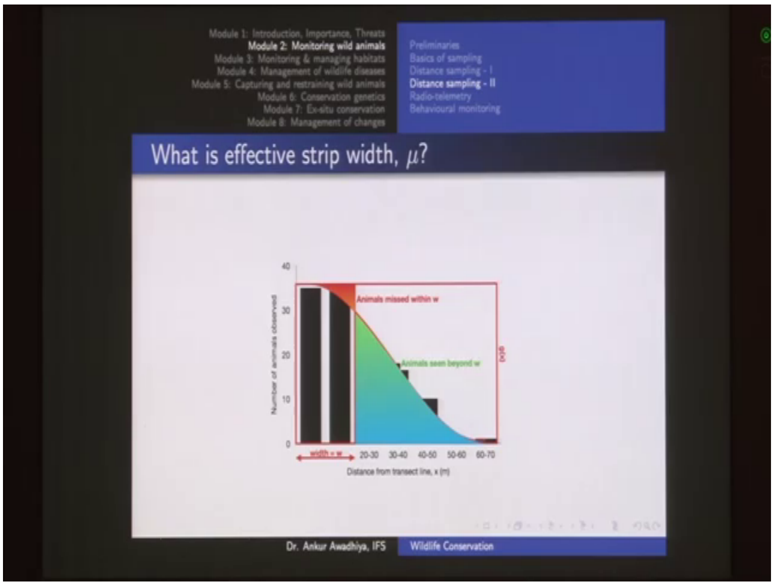

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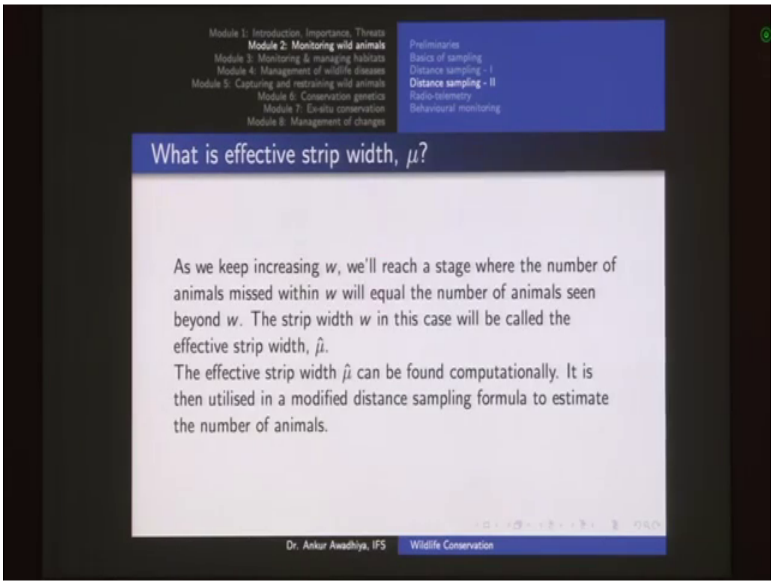

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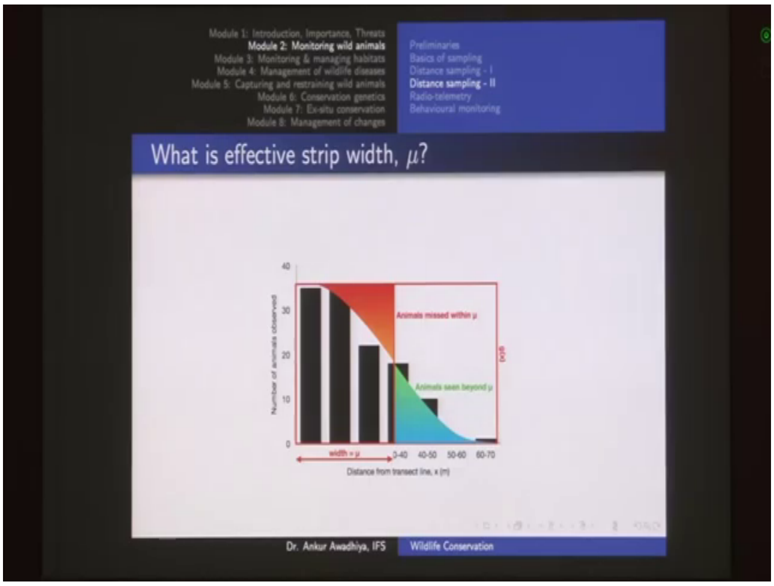

So, effective strip width is computed in a manner so that, at this particular width, the number of animals that you have missed out within mu is the same as the number of animals that you would have detected beyond mu. So, in that case if you take just this width and put it into your formula, you will get the value of the total number of animals..

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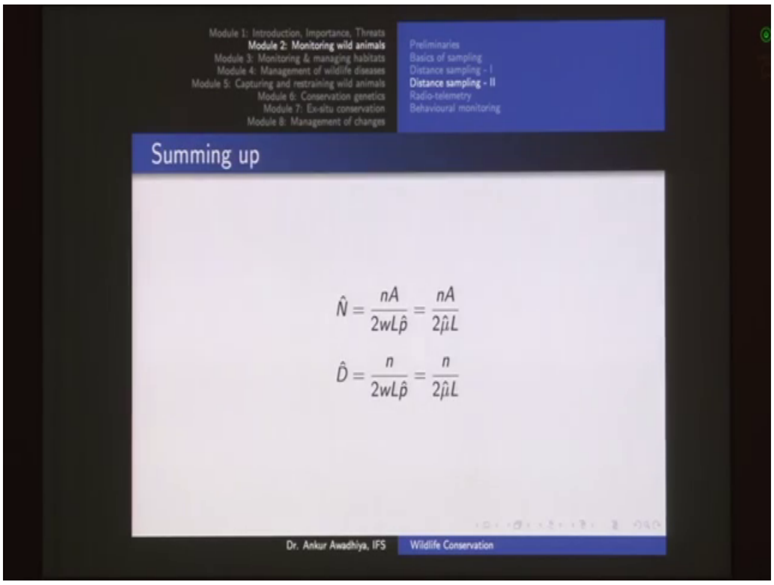

So, then we got to these formula. So, these are the formula of the number of animals and the density estimates of animals..

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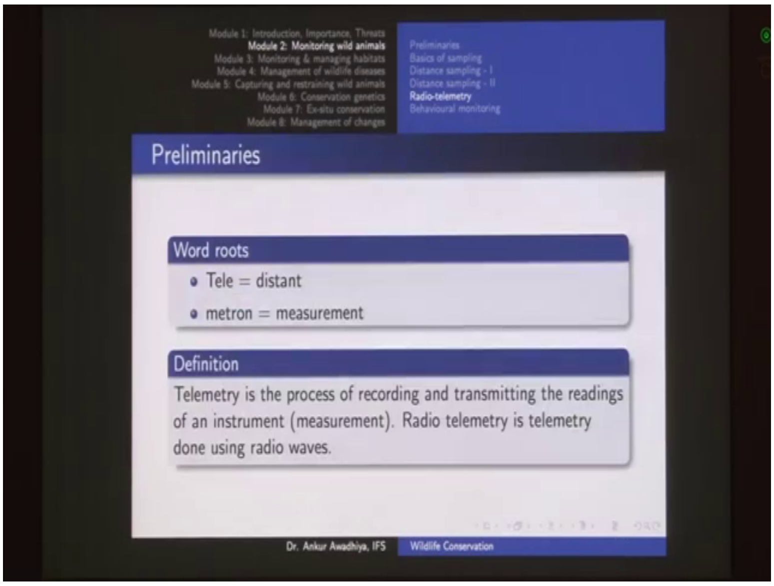

Next we talked about radio telemetry. So, it has uses radio waves to do measurements at a distance..

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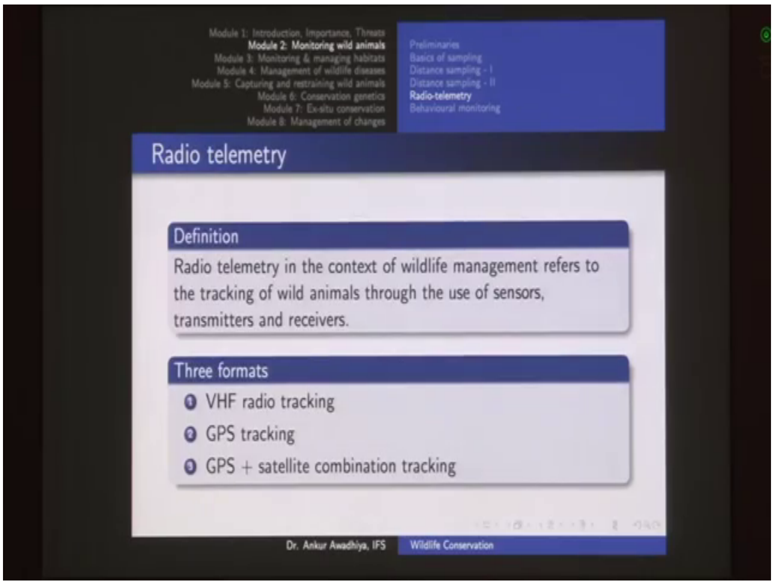

And we talked about 3 different phase, VHF radio tracking, which is very high frequency then, we looked at GPS tracking, which is global positioning system and then GPS plus satellite combination tracking..

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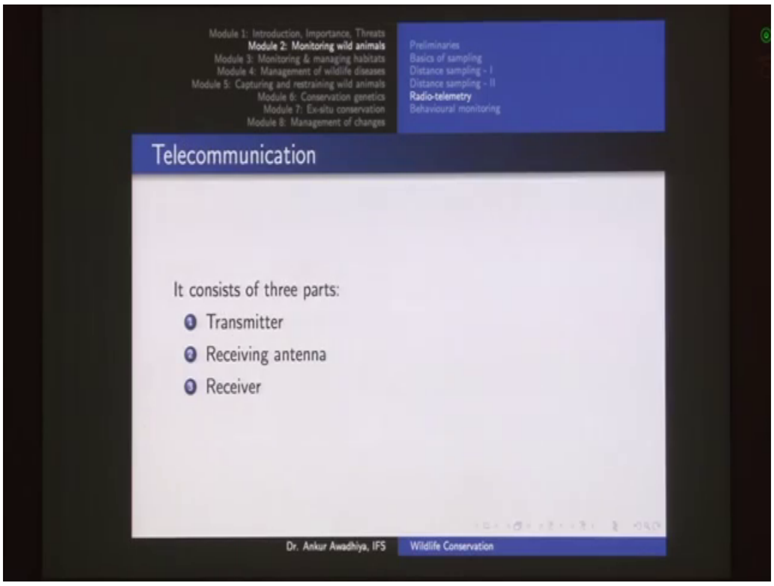

So, there are 3 parts, transmitter, receiving antenna and the receiver..

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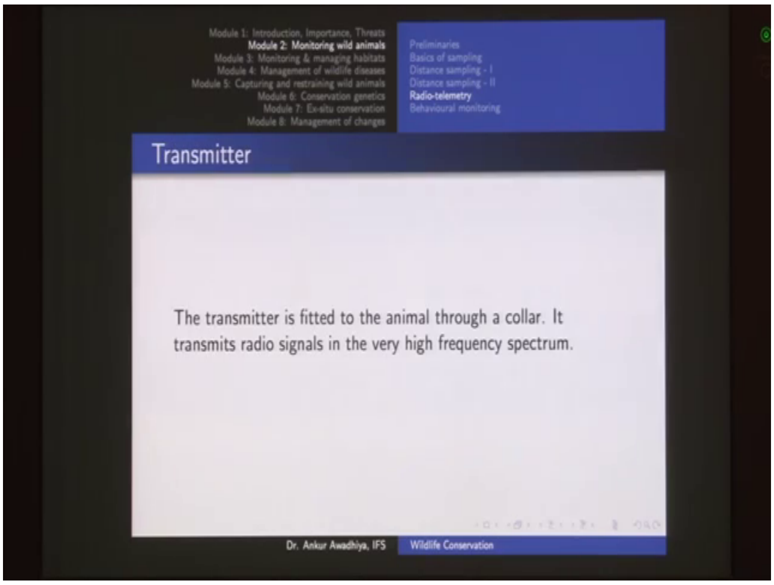

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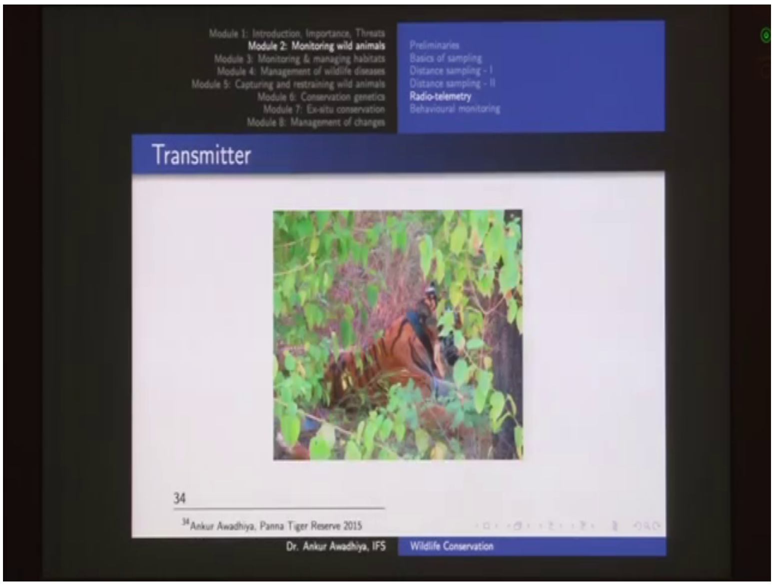

So, we talked about all of these.

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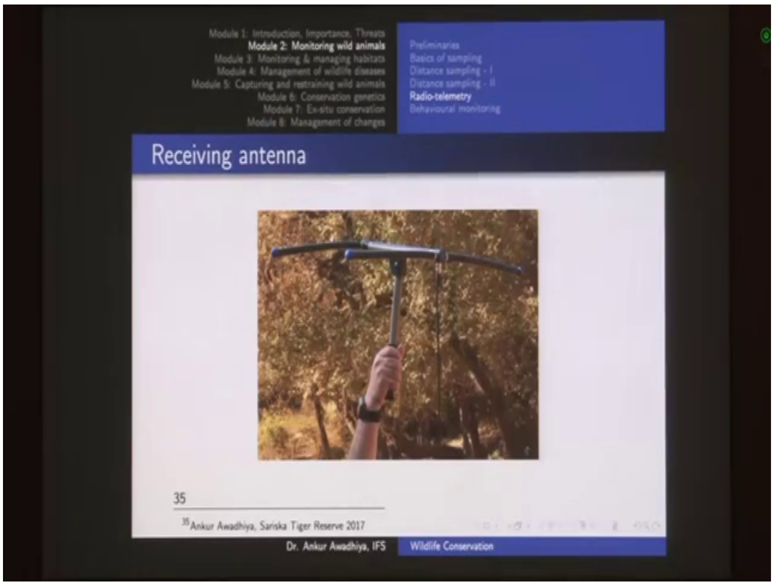

In the case of transmit of the receiving antenna, we normally go for a Yagi antenna..

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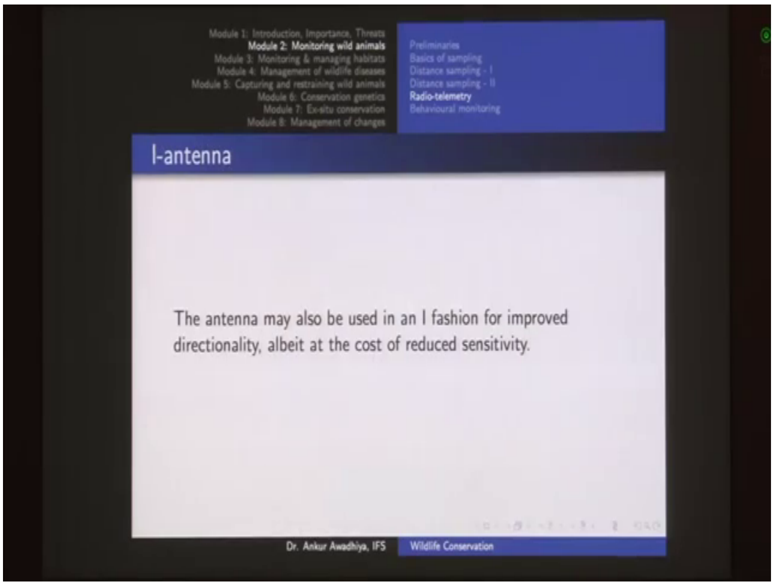

And this antenna can be used in this fashion..

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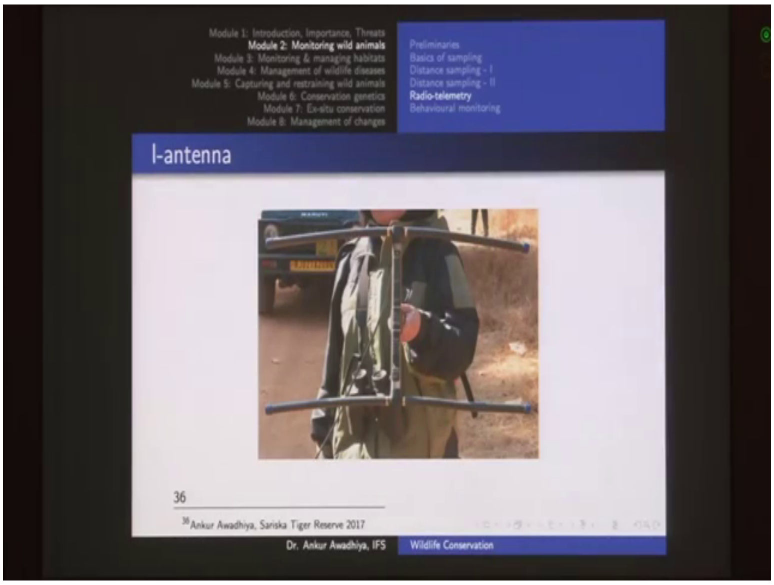

Or it can be used in the I fashion.

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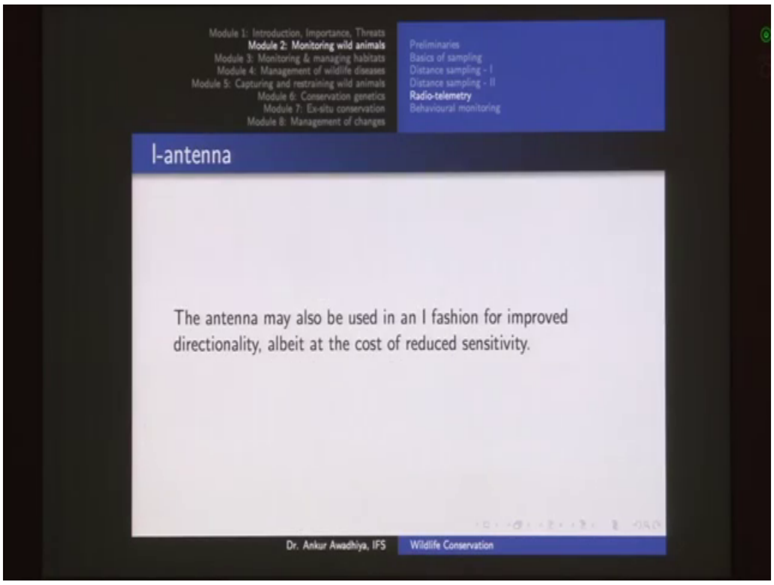

Now, when you go for an I fashion, this is used, when you are already very closed to the animal, because in this fashion, your directionality is very good, but the sensitivity is not that good.

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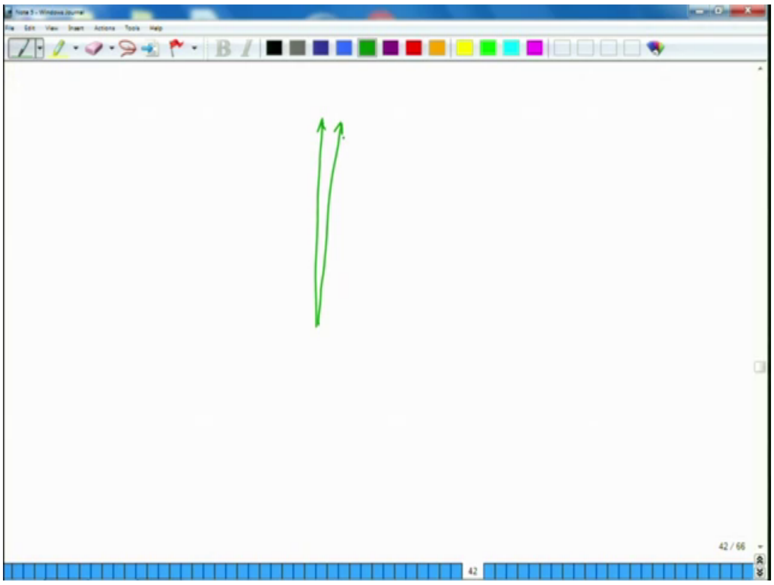

Which means, that when you are using your antenna in the I fashion you can tell whether your animal is here or whether your animal is here. So, it gives a very good directionality, but the problem is that you cannot use it at a greater distance, because the amount of sensitivity that this fashion gives you is very less.

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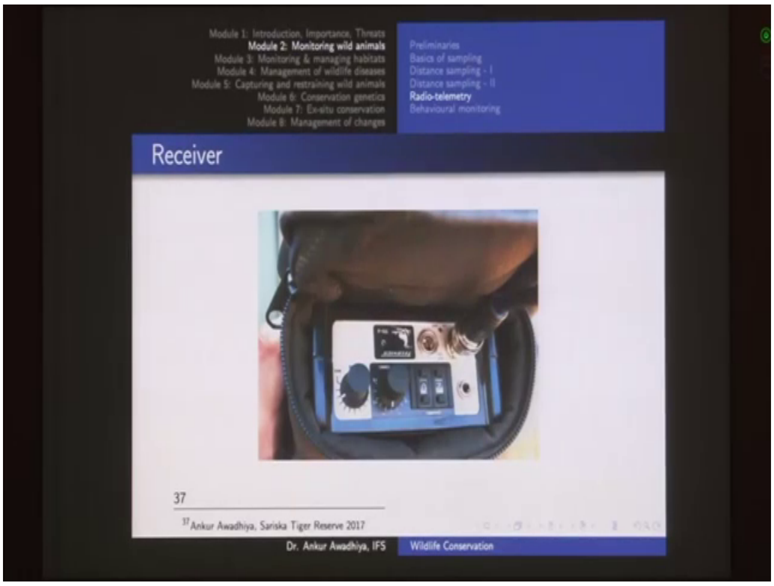

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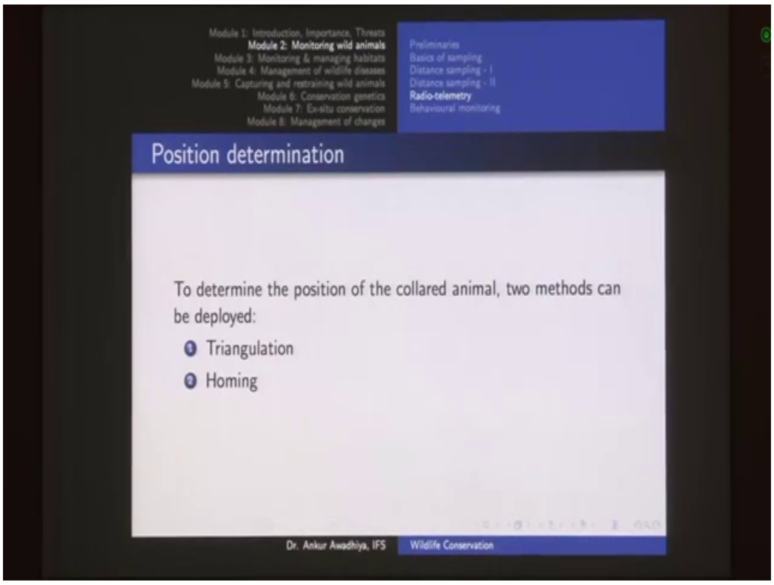

Next we talked about the receiver, different (Refer Time: 30:32) to your signal to noise values that are computed using digital single processing.

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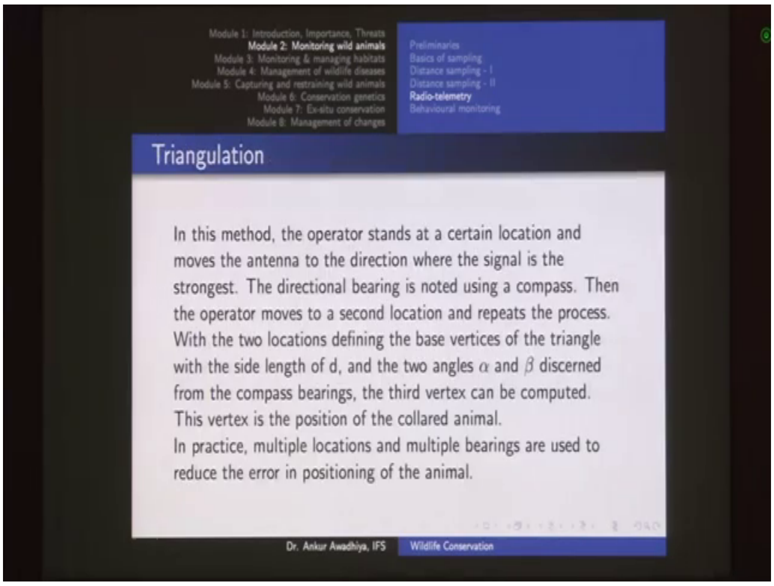

And there are 2 ways of determining the position of the animal.

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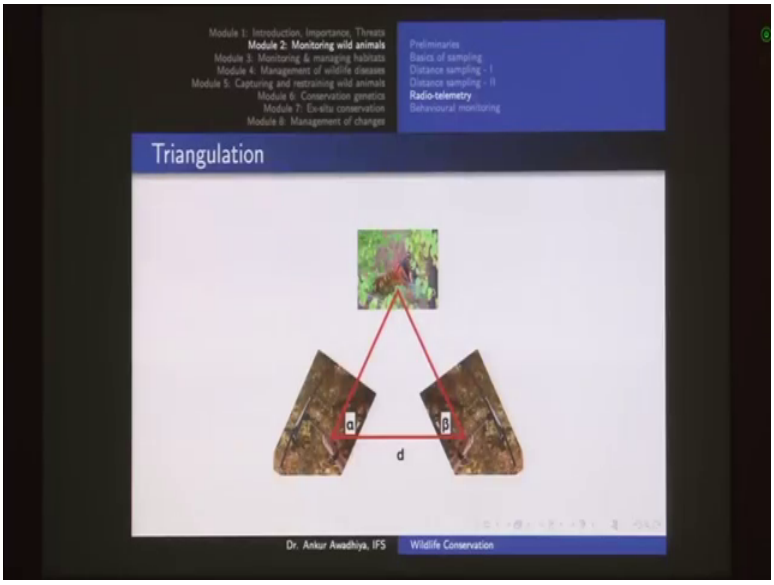

One is triangulation. So in the case of triangulation, you take 2 readings. So, you know these 2 points and at both of these points, you take the reading of the bearing of the animal with respect to that line and with that you can triangulate the position of the animal..

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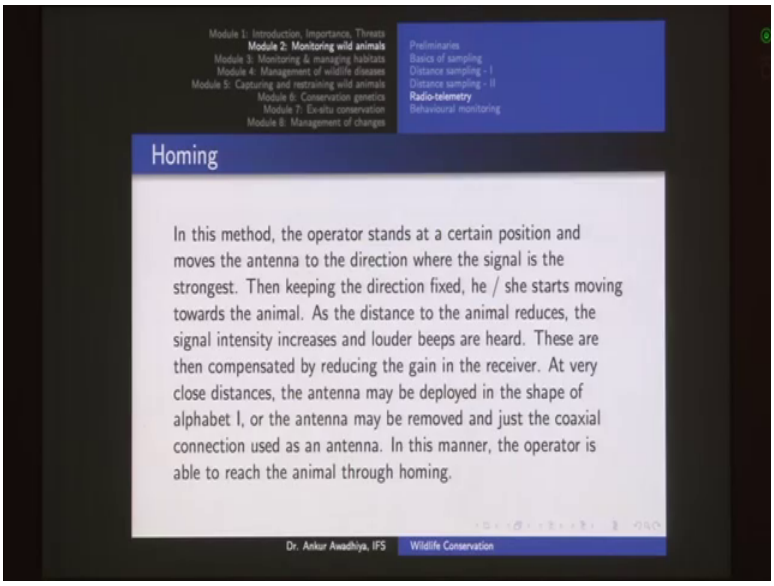

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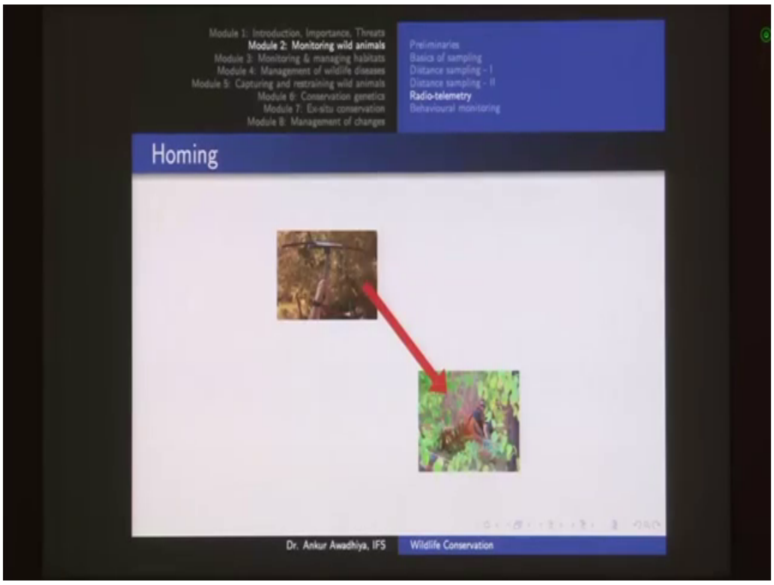

And the second method is homing. So, in the case of homing, you just take your antenna, get the direction then start moving towards the animal, when you are very close to the animal, you shift from this fashion to I fashion, for an improved directionality and slowly and steadily, you will reach the animal..

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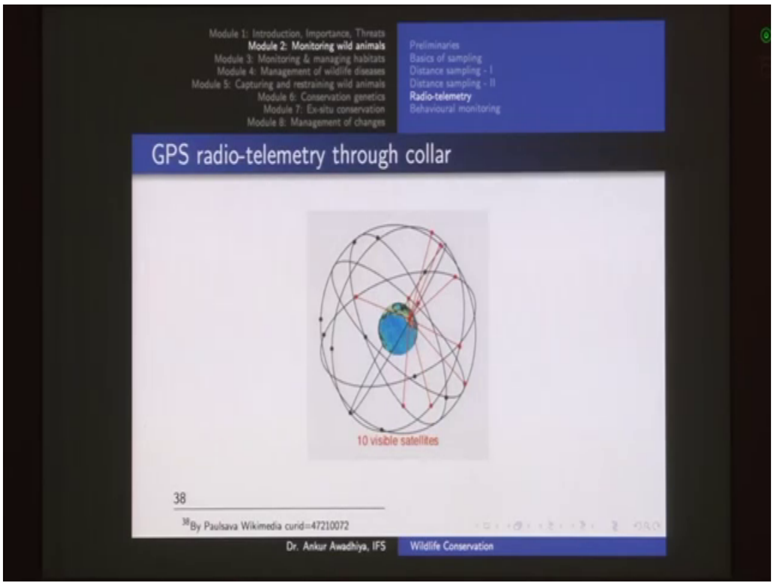

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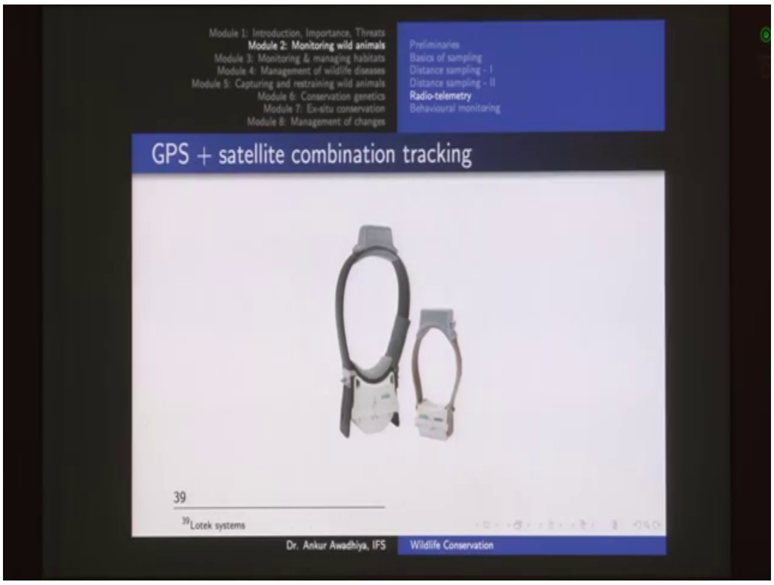

Next is GPS radio telemetry that we talked about.

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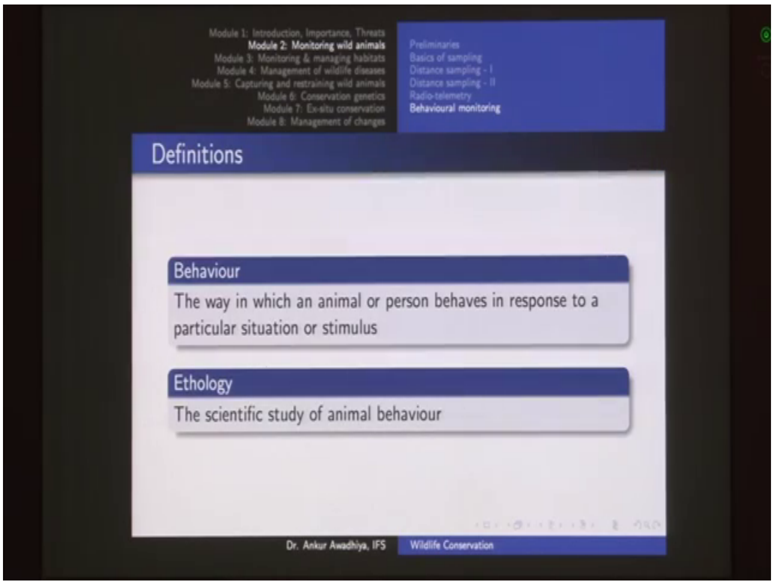

The last one was behavior monitoring. So, behavior is the way in which, an animal or person behaves in response to a particular stimulus or a situation..

Now, the scientific study of animal behavior is called ethology..

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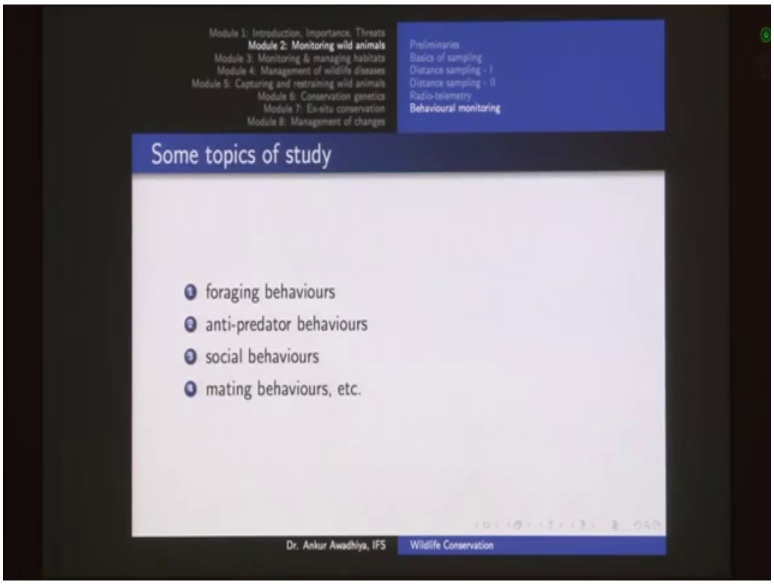

Now, these are some topics of study.

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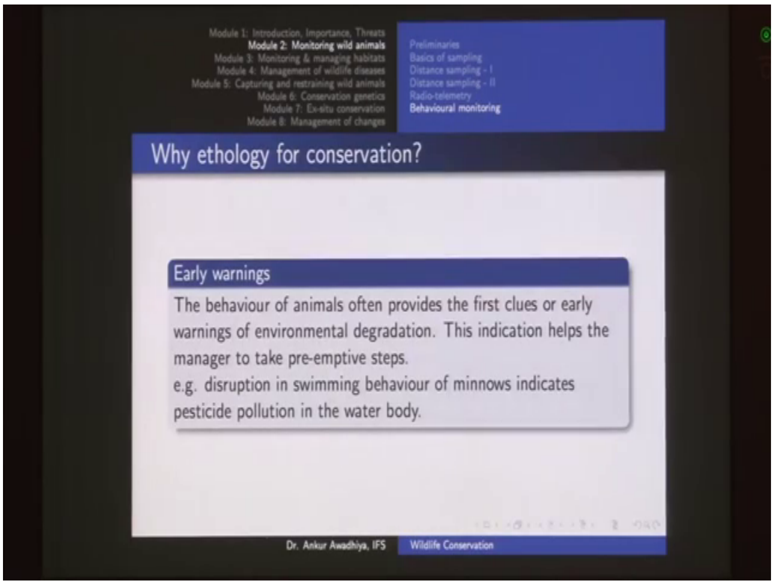

And these are important for conservation as early warnings for making of a effective reserves..

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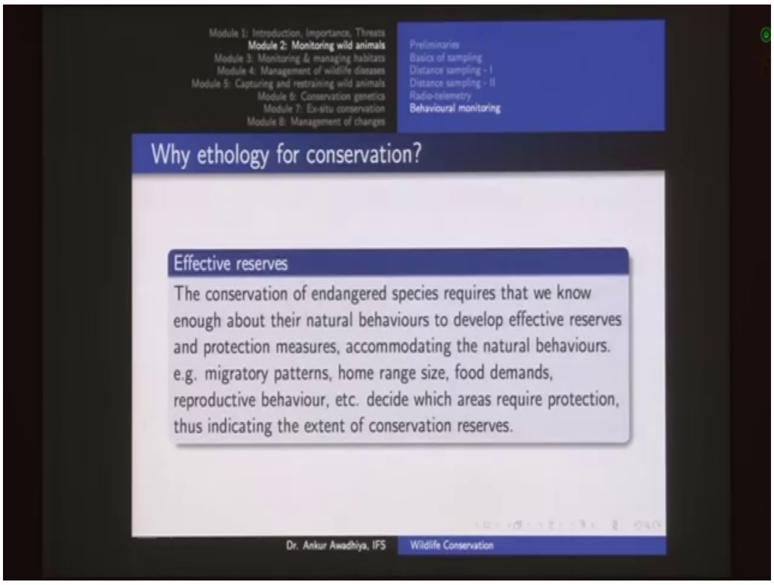

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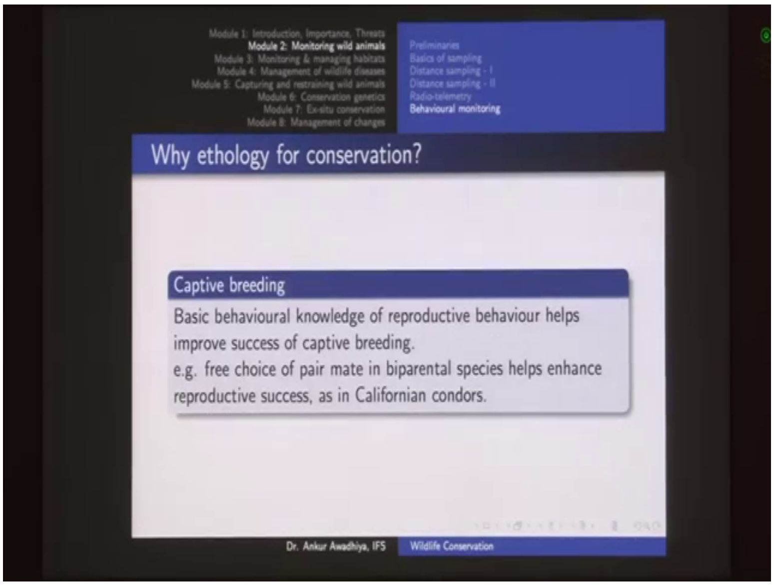

For captive breeding..

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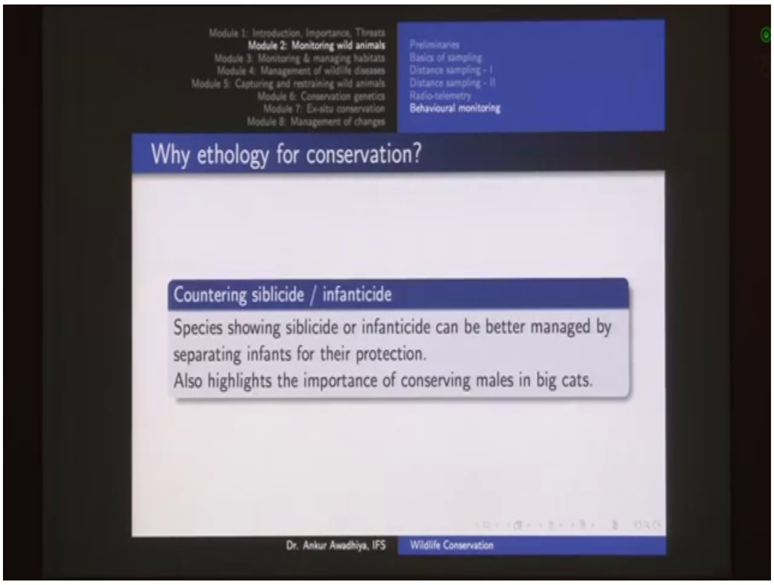

Countering siblicide or infanticide..

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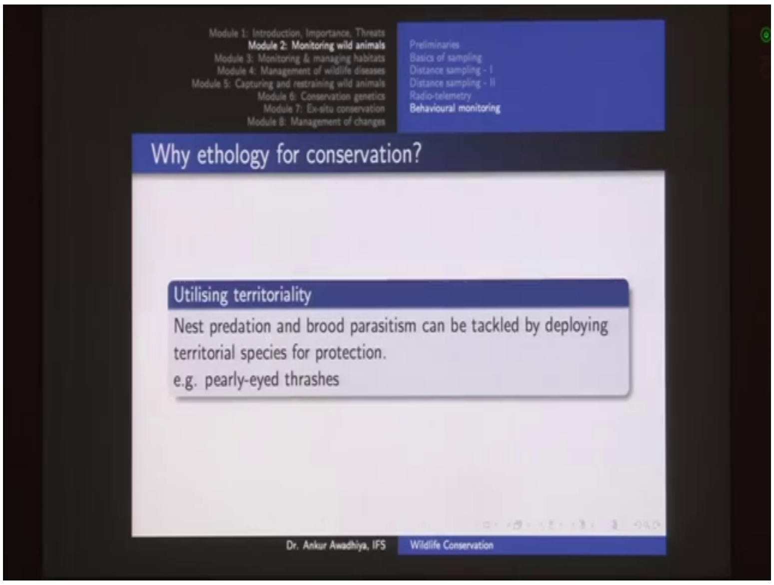

Utilizing territoriality. Now then we had reproductive separation imprinting that needs to be remove translocation, reducing human impact and as management indicators.

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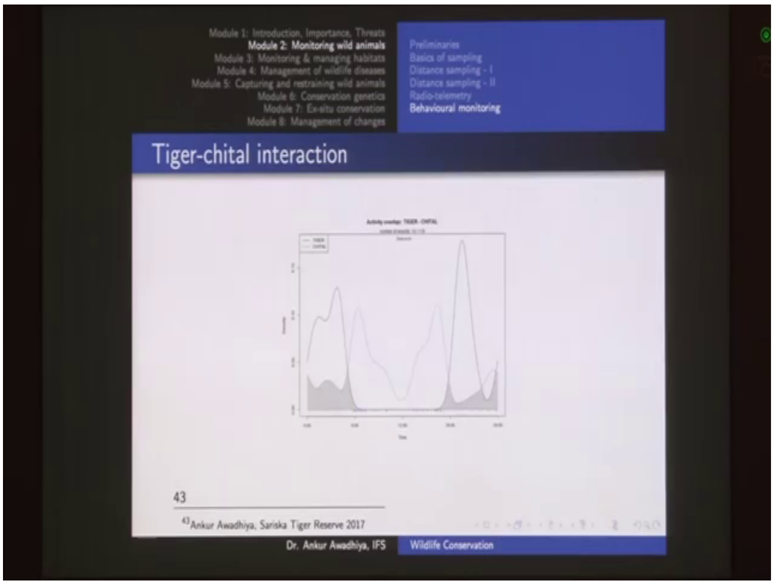

So, we talked about activity patterns of different animals. So here, we have a predator and a prey activity pattern. So, there is a very less amount of overlap between both of these..

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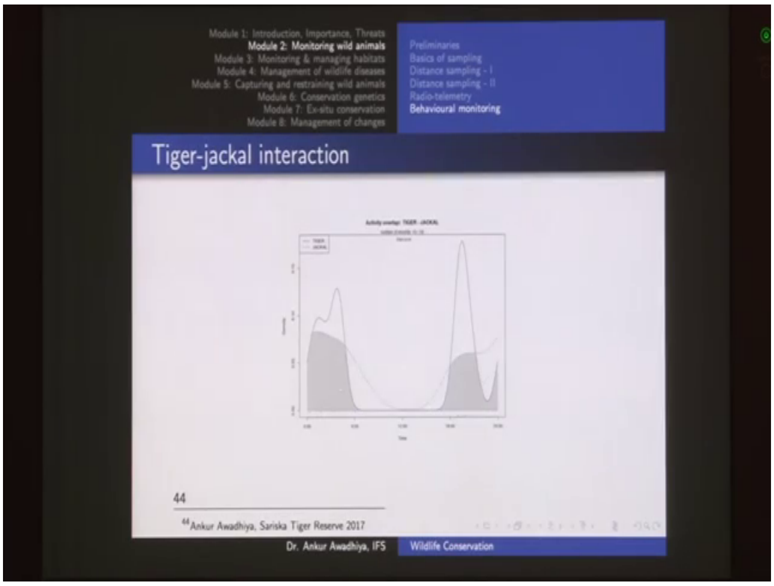

But we if we look at 2 different predators then, there would be a higher level of overlap.

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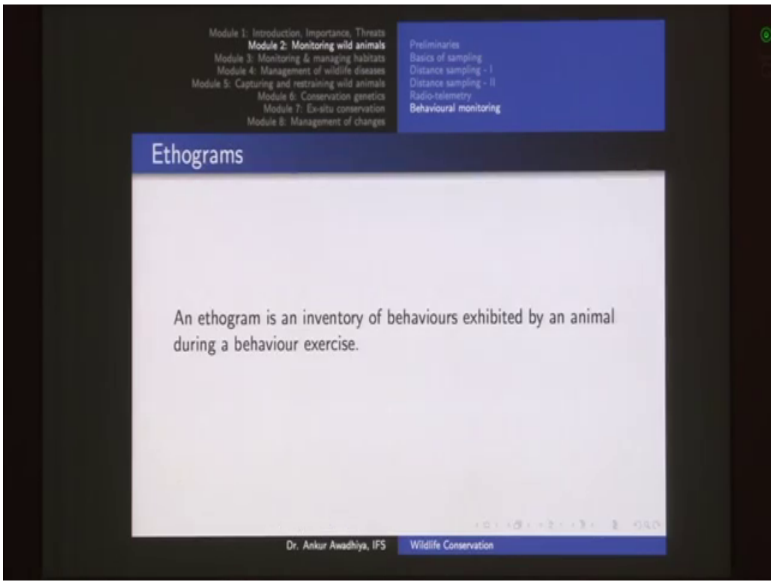

Then ethogram is an inventory of behaviors that is exhibited by an animal during a behavior exercise..

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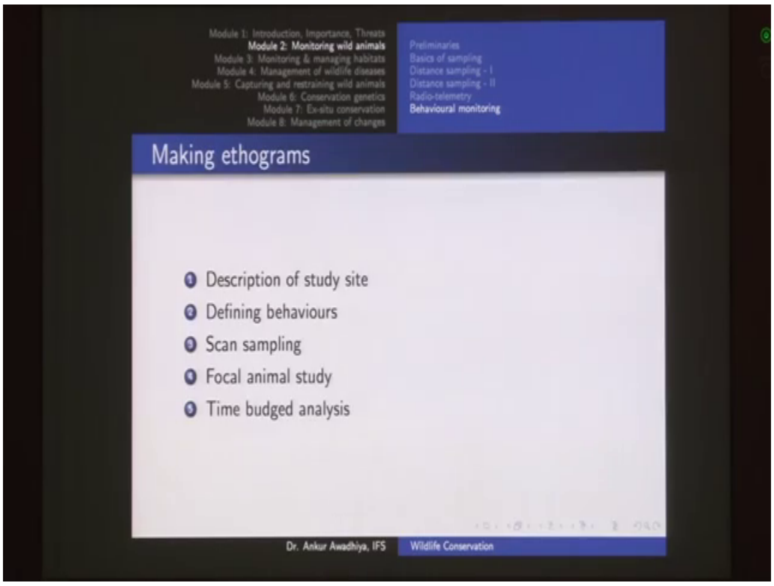

And then we talked about 2 methods.

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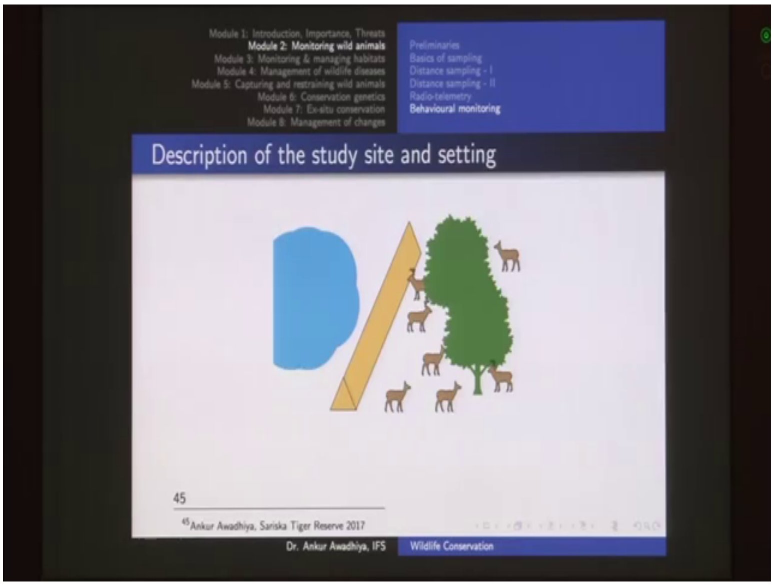

One is a scan sampling, one is a focal animal study..

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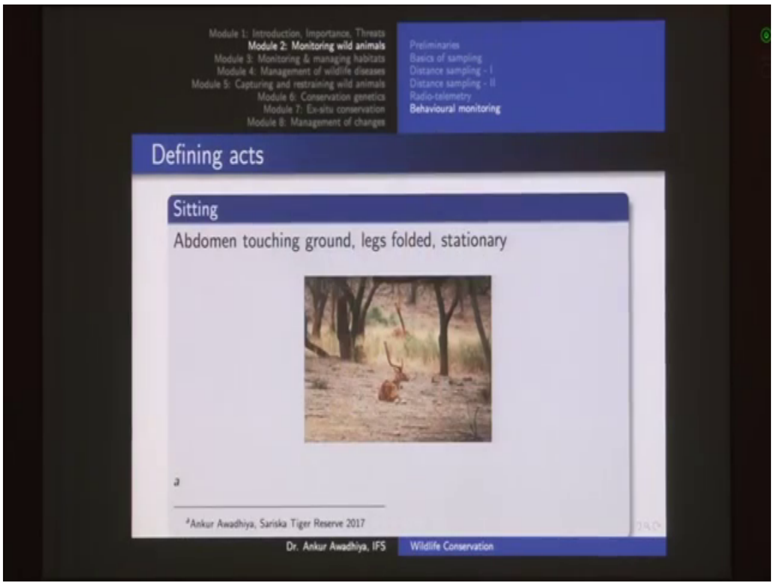

So, we defined a number of acts such as sitting

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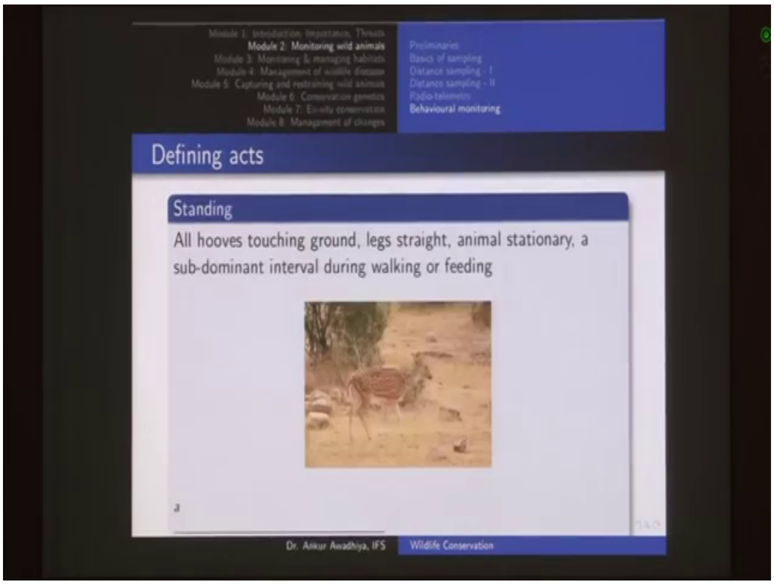

Standing..

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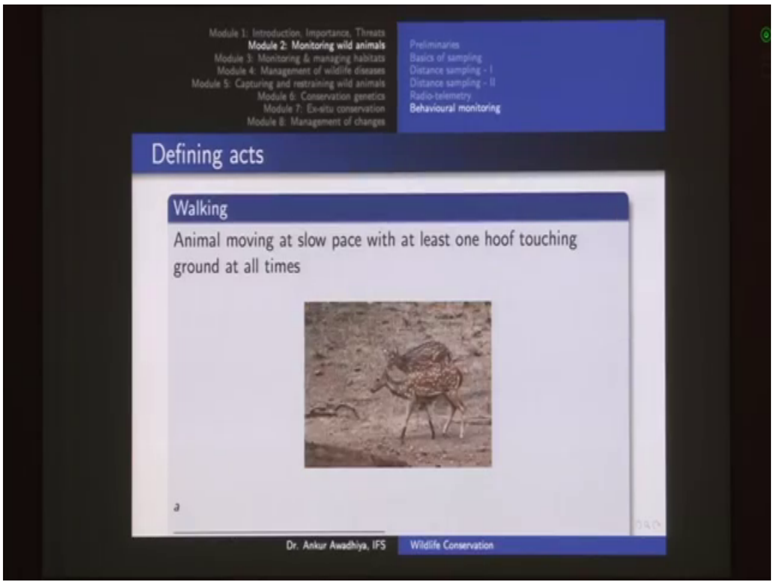

Walking..

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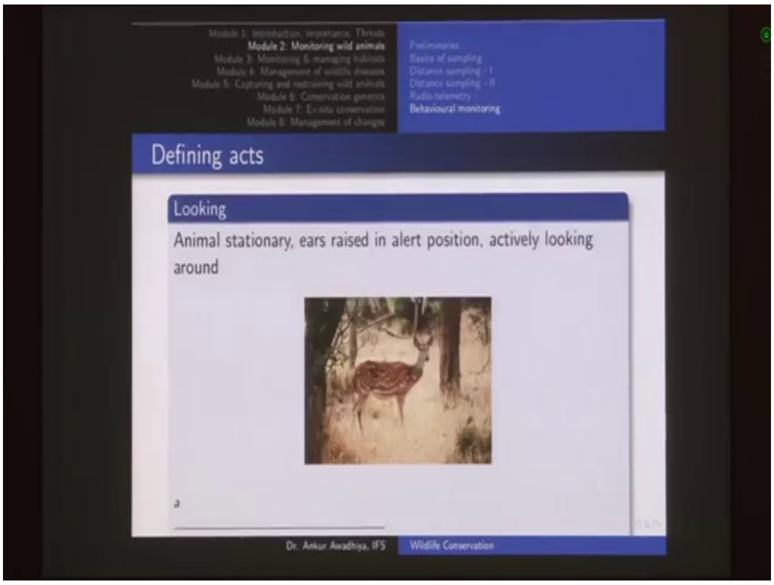

Looking..

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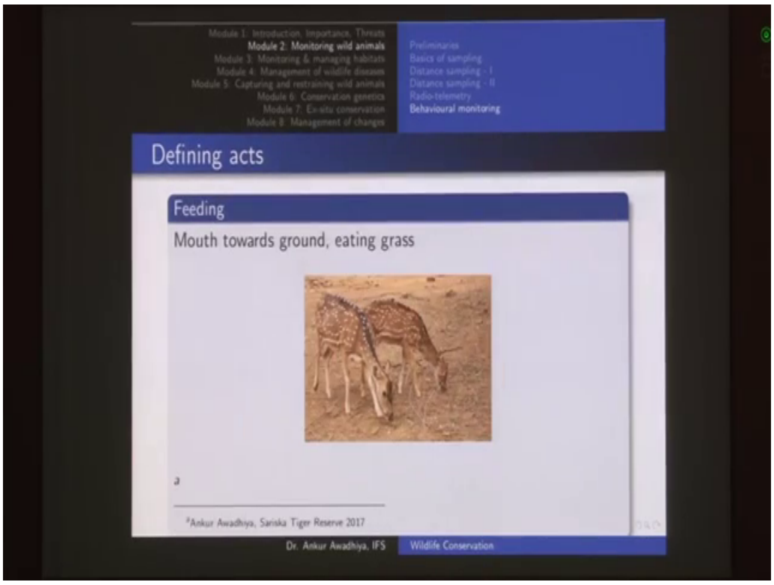

Feeding..

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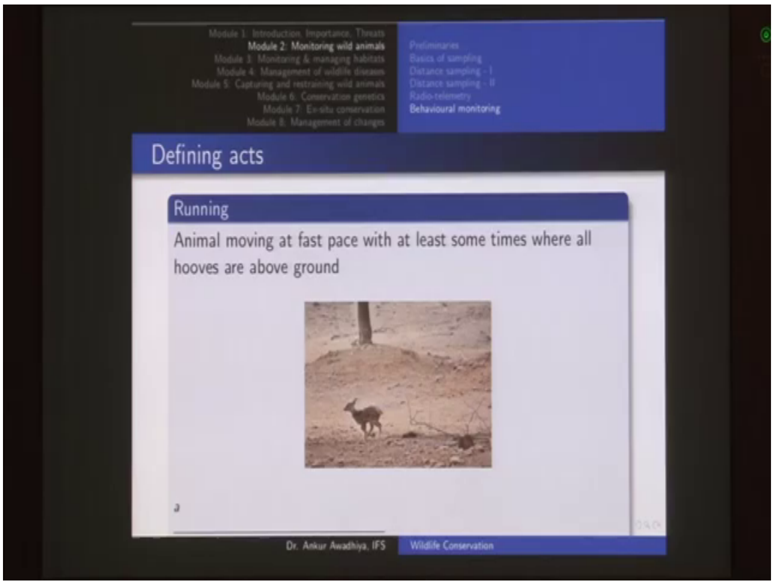

Running..

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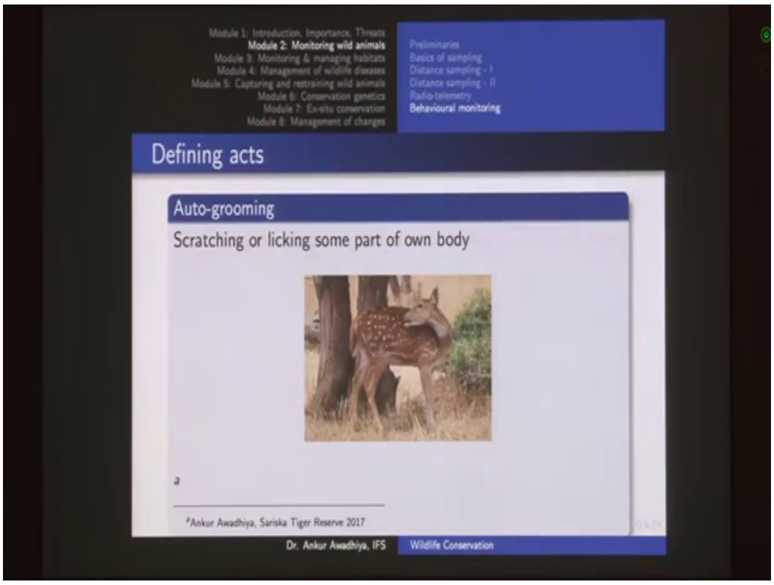

Auto-grooming and allo-grooming. Now, auto-grooming and allo-grooming are important, because in the case of auto grooming. The animal is licking or scratching some parts of it is own body. So, it is trying to clean itself or it is trying to make it is appearance look better..

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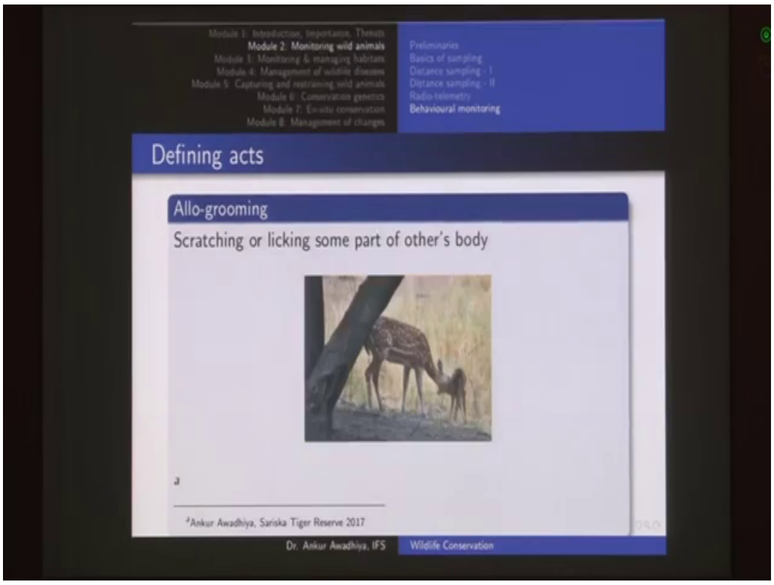

In the case of allo-grooming, it is doing this with some other animals. So for instance, when you observe an animal that is say. So for instance, if this animal had some parasites on it is body and if there is some other animal that is removing those parasite, it would also be an indication of allo-grooming because, it is grooming some other animal, whereas, if this animal had a parasite on it is own body and when it is trying to remove that parasite. So for instance: when a bird is doing a preening, so that would be called as auto grooming..

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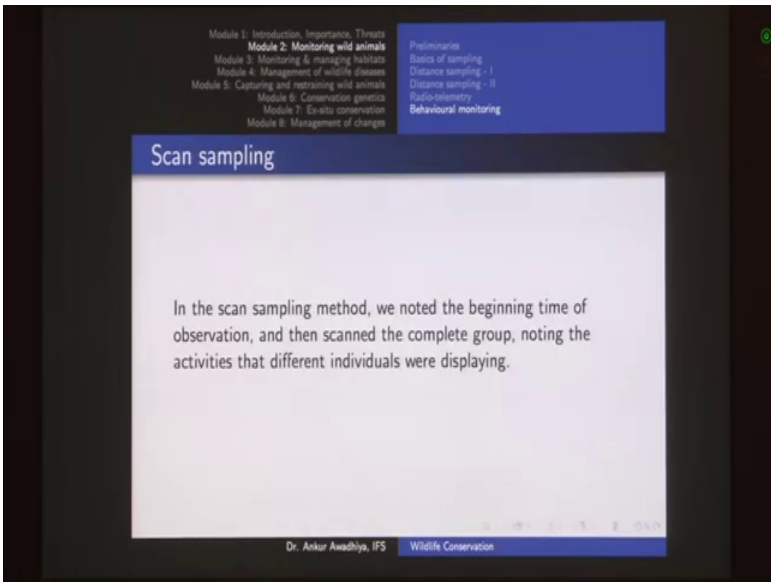

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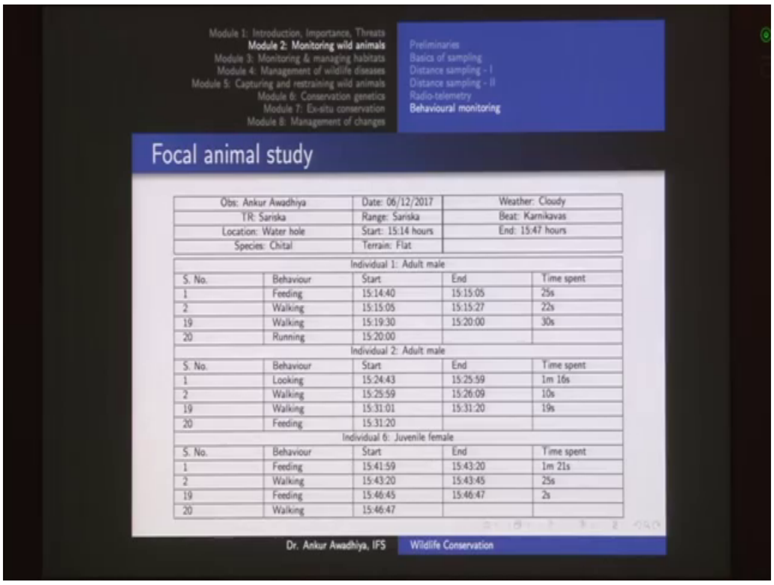

Now, we talked about scan sampling and focal animal sampling..

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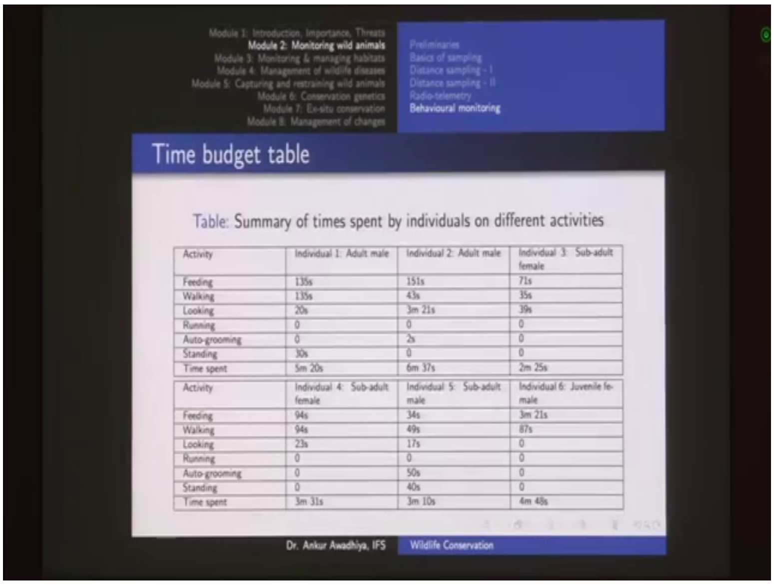

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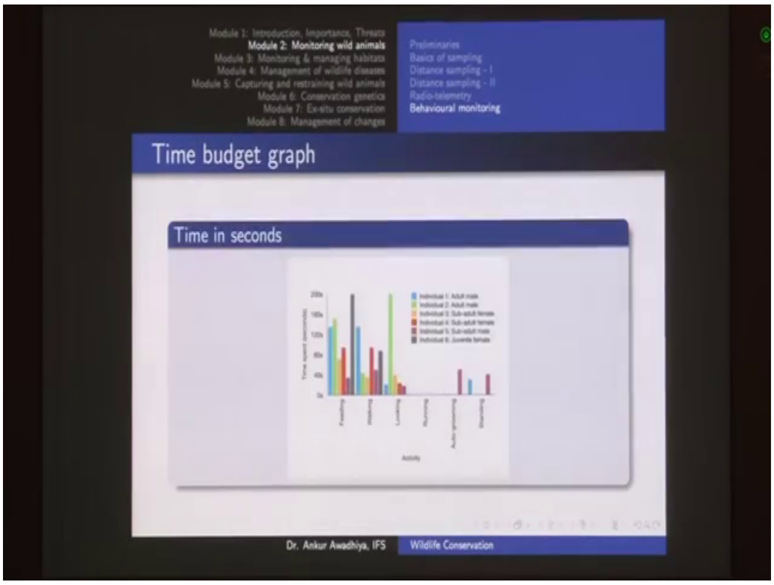

Time budget graph.

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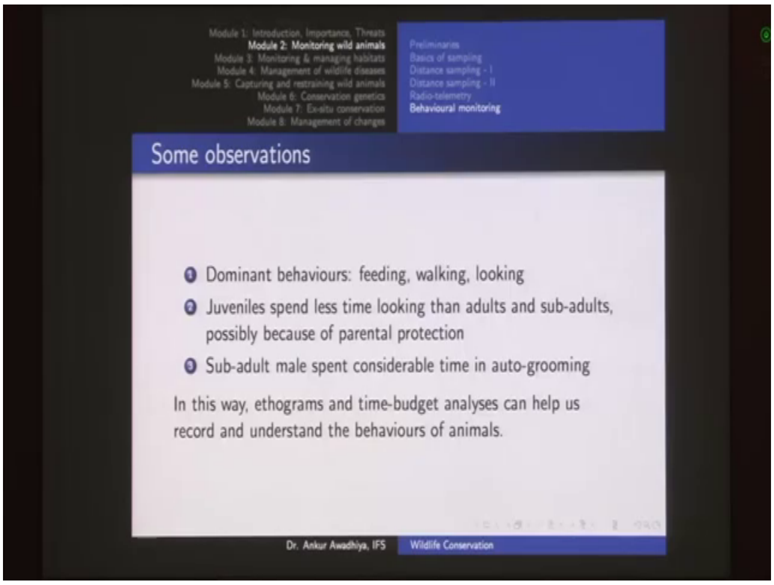

And then, you also looked at what kinds of observation we can make? So for instance, we can look at dominant behaviors. Behaviors that are different between different age groups or may be different positions of animals, the animals that are closer to the periphery, the animals that are closer to the to the core area, then sub adult males. So, differences between sub adults and adults. So, all these things are things that can be observed using behavioral monitoring.

So, let us end it here. So, this is the first part of the revision class and tomorrow we will move up with the other lectures.

Thank you for your attention. [FL].