Wild Life Conservation
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Lecture – 05
Preliminaries

So, let us now begin with our first lecture of the module, which is Preliminaries.

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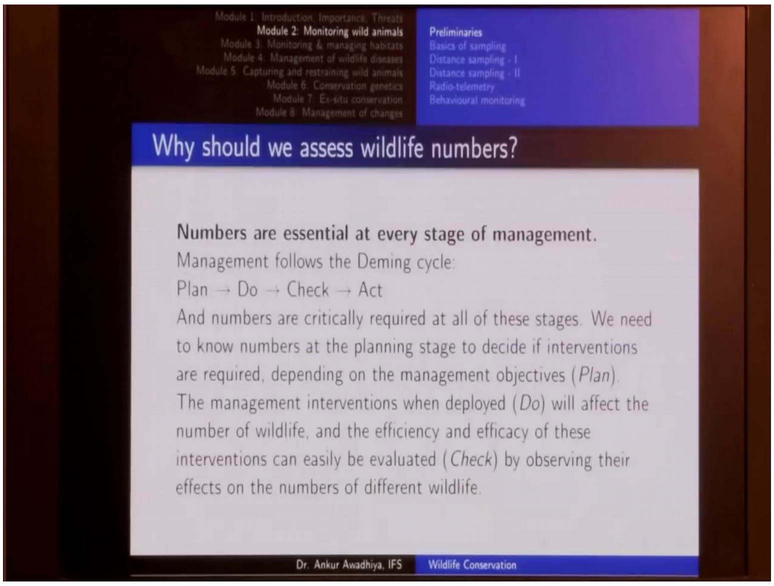

The first question that we need to ask is, why do we need to assess the number of wildlife and there are a number of reasons for that. 1: Numbers are essential at every stage of management. Now, classically management is said to follow the Deming cycle

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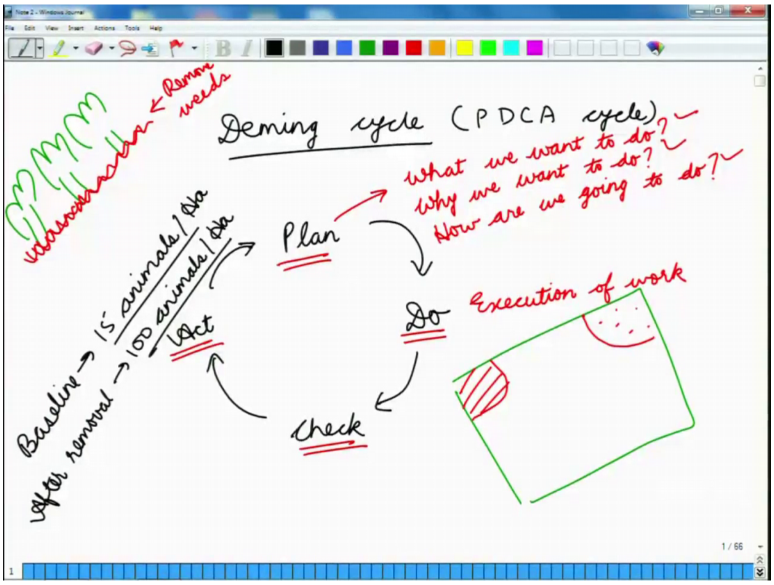

Now, Deming cycle consists of four stages. It goes by the name of PDCA cycle, which means P is for Plan followed by Do, followed by Check, followed by Act and followed by Plan again. Now, what do we mean here? Plan means to take all the steps and the decisions beforehand on what we want to do, why we want to do that and how are we going to do. So, when we answer all these three questions, this is the planning stage. The doing stage is the actual execution of work

Now, to take an example, suppose you have a forested area which also has a thick undergrowth of weed. So, one of our management interventions could be to remove these weeds, so our aim is to remove weeds. Now, why do we want to remove these weeds? Because, these weeds are of a non palatable species and because the animals are not able to utilize the this space.

Now, so what we want to do, is to remove the weeds. Why we want to do it? So, that more animals can utilize this space and how are we going to do it? Maybe say using a manual labor to uproot all these weeds. Now once we have decided that, once we have decided on how much amount of work is required, at what rate we are going to pay these laborers and things like that, we will actually execute the work on the field.

Now, while doing this execution there might be some other impacts that we had not thought of beforehand. So, for instance when we went there with our laborers and we saw that most of the animals are just running away from the field. Now, this is something that we had not expected beforehand so, which is why we will come to the checking stage.

So, while we are doing, our work will be checking our work again and again and again just to see whether we are able to reach our outcome of the animals being able to utilize this space in a more effective manner. Now, checking means that we are, we will look at how many animals are utilizing this area, when we are doing this work and also after we are done with our work and then this check will be followed by act. Now, act actually means that we will utilize our knowledge of the checking stage to incorporate it into our next planning. So, for instance if you have a last chunk of forest, maybe we are doing our weed removal in this small patch.

And, once we have, we are done with the weed removal in this patch, we will utilize the knowledge that we gained from our exercise to plan the weed removal in summary some other area so, which is the acting stage. Now, numbers are crucial inputted all of these stages, because when we said during our planning stage that we wanted to remove these weeds, so that animals would be able to utilize this area in a more effective manner and because animals are not utilizing this area in an effective manner, because of the presence of the weeds.

So, in that case what we need as our baseline information is how many animals are there in this weed infested area say in a per hectare format, while we are doing our work, while we are executing our work. We will also incorporate data about the weeds that are being removed, the rate at which we are removing the weeds, the time it is going to take to remove these weeds in a patch of area. And, we will also need information about what the animals are doing in this period of time in the checking stage.

So, once we are done with our weed removal, we again required data was this patch. Once we have removed the weeds from there, is this patch being utilized by the animals in a more effective manner. So, essentially if we said, if we found out that our baseline with the presence of feeds was say 15 animals per hectare and after removal, after we have removed all these weeds and after the animals have gotten inside and are utilizing this area, this density moved up from a 15 animals per hectare to say 100 animals per hectare. Now, this is an information which will be extremely crucial when we are doing the next stage of planning.

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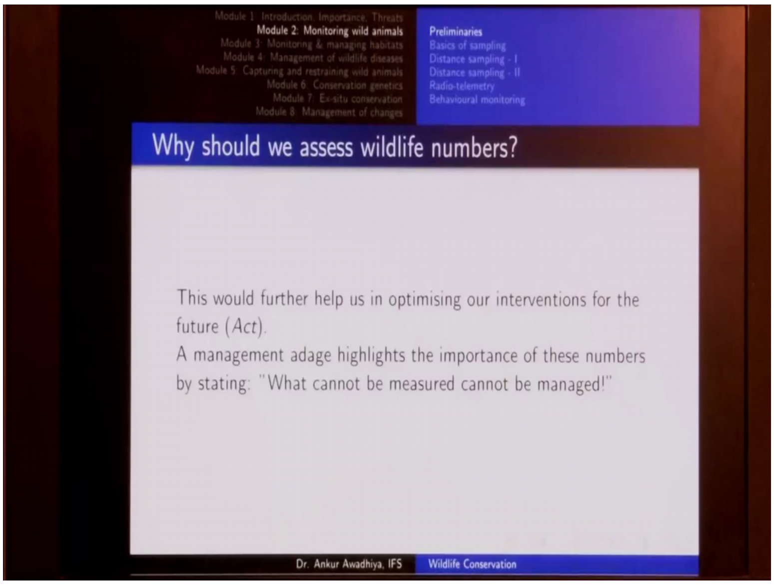

So, essentially wildlife numbers are required at every stage of management.

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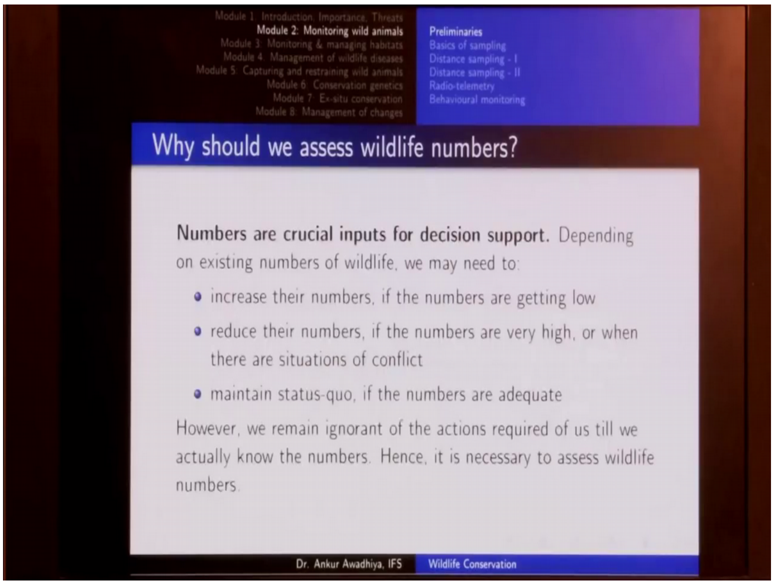

Now, second point why we need to assess wildlife numbers is that numbers are crucial inputs for decision support. Now, what does this mean? Suppose we are managing a tiger reserve and suppose we have a the, a density of the herbivores at say, 50 animals per square kilometers. Now is this 50 animals per square kilometer good for our tigers, in the tiger reserve, do we need more number of animals, do we need less number of animals, because, if we have less number of herbivores, so less prey population. So, our tigers will not be able to reach their optimal density. So, we will need to increase the numbers of the herbivores. On the other hand if we have a situation in which we have quite a lot of herbivores in our area. So, we already have a huge density of tigers which is leading to more and more fights between these tigers, so we will need to reduce our prey density.

Now, do we need to increase our prey density or do we need to reduce our prey density or do we need to keep our prey density as constant, we will able to gather information about it only when we know their numbers. So, we need to know the numbers of the herbivores, we need to know the numbers of the tigers.

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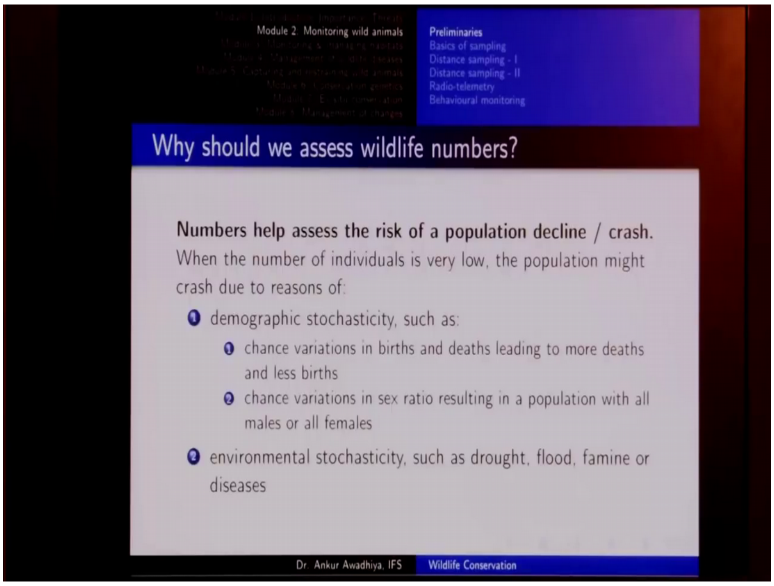

At the same time numbers also help us assess the risk of a population decline or a crash. So, as we have seen beforehand in another lecture, if we have a population that is very small, we will have a number of stochastic phenomena that will become dominant in that area. Now, stochastic phenomena means chance events. So, a chance event essentially means that, earlier if we had say 1000 animals

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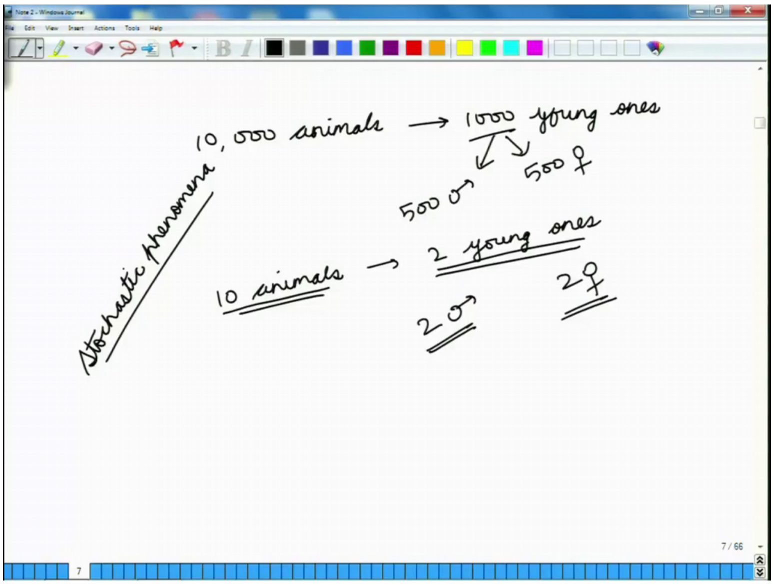

So, suppose we had a huge population size of our animals, suppose we had 10,000 animals and every year this pool of 10,000 animals is giving rise to say 1,000 young ones. Now, considering a sex ratio of 1 male is to 1 female, which is naturally found in most of the situations. We can say that out of these 1,000 individuals say around 500 would be males and we will be having 500 that are females. And, in such a scenario all of these animals would be able to mate properly, because they have a nice sex ratio. But, consider we have only say 10 animals left in our reserve and these 10 animals gave rise to say 2 young ones, and these 10 animals are now growing old, and so our population growth is only dependent on these 2 young ones.

Now, even though we say that our sex ratio of 1 is to 1, would mean that we would have on an average 1 male and 1 female, but because here we have such a small population size it is also possible that we got 2 males or 2 females. Now, if we have say 2 males and we do not have any more females then this population might be leading into a crash. Similarly, if we have only females left, if we do not have any males, the population will not be able to grow. So, these kinds of phenomena are known as stochastic phenomena. And at small population sizes we have different stochastic phenomena as you can see on your sites now. So, we have demographic stochasticity.

Now, the demographic stochasticity means demo is your people graphic is to write demographics. Stochasticity is a stochastic at the level of your population numbers. So, here you can have chance variations in births and deaths, leading to more deaths and less births for instance. So, in a very small population if more number of individuals died out, so you will be having a population crash chance variations in sex ratios, as we saw in a population with all males or all females or even environmental stochasticity; such as draught, flood, famine or diseases.

Now, if we have a large population of animals then these stochastic, these environmental stochastic phenomena like drought or floods do not have a major impact Because, if we have say 10,000 animals and the drought killed as many as say 5,000 animals, we still have 5,000 animals left.

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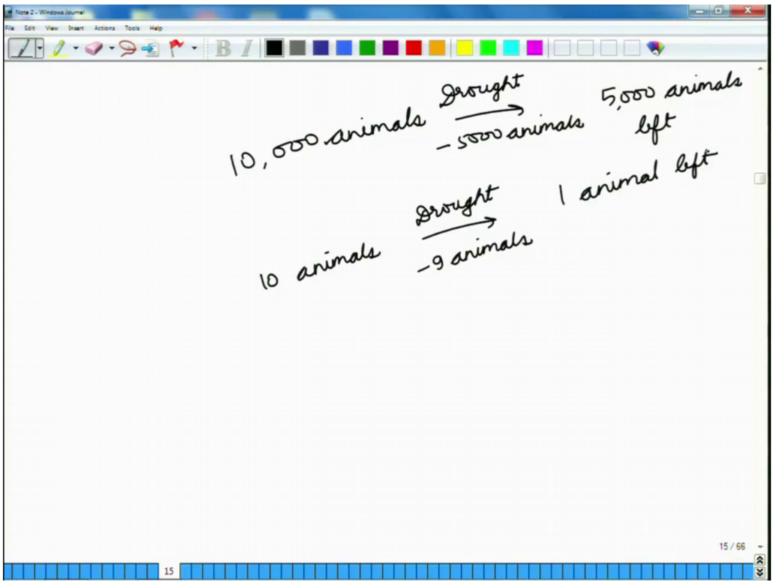

But, if we had a very small population say of 10 animals and if drought occurred and say 9 of a these animals died, will be left only with 1 animal, which will again not be able to breed and the population would be towards a crash.

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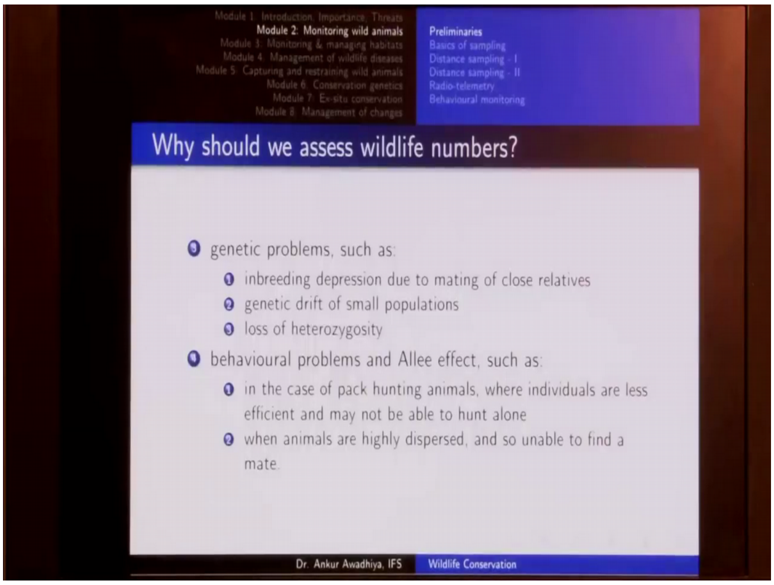

Another stochastic phenomenon, as you can see on your slides now, is genetic problems; such as inbreeding depression. Now inbreeding depression occurs when your animals are meeting with their close relatives. So, for instance if you have a very small population, say you have only two individuals left. Now, these two individuals after they have mated they would produce an offspring and because, we have very less number of individuals left. Now the next level of mating would be say between the parents and their children or maybe between those children themselves which would be a case of inbreeding, which also leads to a number of genetic problems.

Also genetic problems could include genetic drift of small populations. So, this is something that we will, we will discuss in more details in the conservation genetics module and also the loss of heterozygosity. At the same time when you have very small populations you also have behavioral problems and Allee effects. So, for instance consider the case of pack hunting animals, consider the case of wild dogs. Now, in the case of wild dogs you have a large sized pack and say 10 to 15 animals go to hunt at the same time. Now, in such a scenario if you have a population in which you have only 5 animals left and these animals are adapted to pack hunting, so they required say 15 animals to hunt and you are left only with 5 animals.

So, these 5 animals will not be able to hunt sufficiently or efficiently enough; so, that they would not be able to gain enough amount of food. So, this is another stochastic phenomenon that will happen. Another thing that happens when you have a very small population size is that the animals are highly dispersed, they are unable to find a mate. So, you have a large sized forest.

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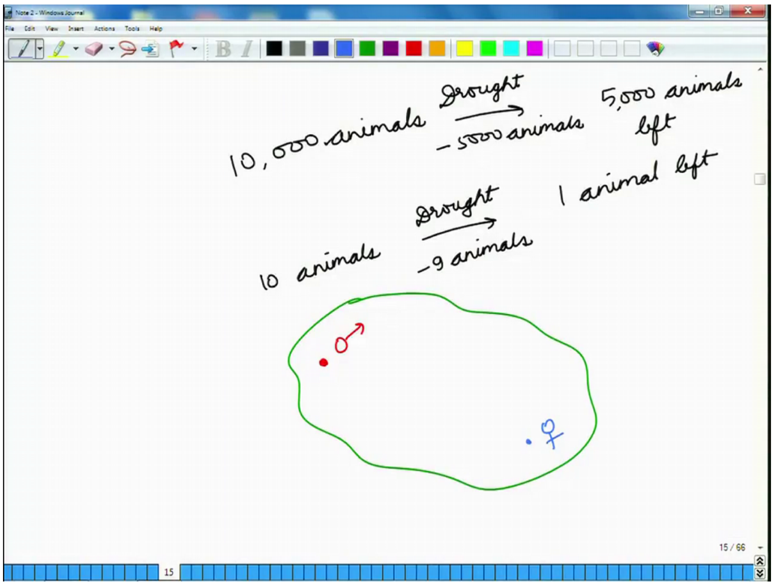

And in this forest you have an a male here and you have a female here, but just because their densities are so less, they are not able to find each other. And, so they are not able to mate which generally have happens when your population densities are very less.

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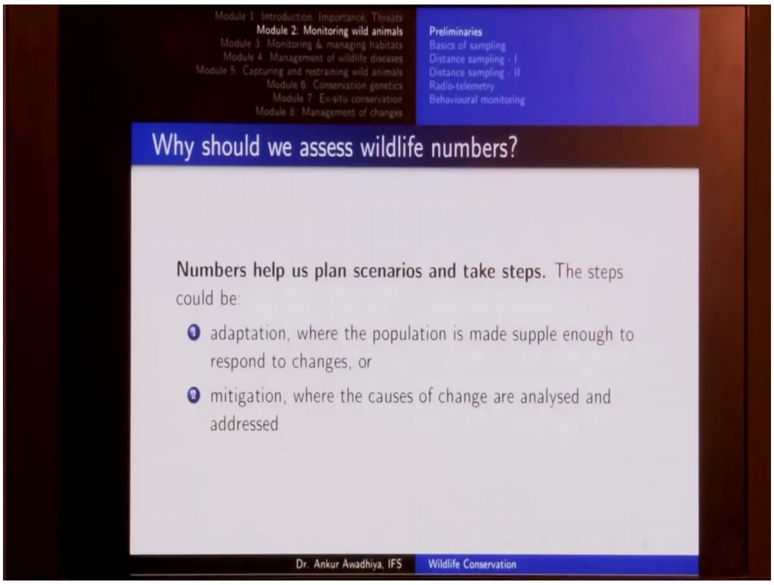

Another situation when we are required to assess wildlife numbers, is because numbers help us plan scenarios and take steps. So, if we know that our population is going down, we can take steps and these steps could include adaptation steps and mitigation steps. Now, the difference between adaptation and mitigation is that mitigation tries to remove the root cause of the problem, whereas, adaptation tries to acclimatize your population. So, that even that, even when that root cause is present you are able to cope with it.

To give an example, from a very different field when we talk about climate change adaptation and mitigation; so, climate change mitigation would mean that we would reduce the amount of carbon dioxide that we are putting into the atmosphere or we increase the amount of carbon dioxide that we are taking out of the atmosphere. So, that is mitigation, because the root cause that is the presence of carbon dioxide in the air that is being addressed. On the other hand adaptation would mean that even though we have carbon dioxide in the atmosphere, even though we are having global warming we want our populations to adapt to it.

So, that would include installation of say both number of air conditioners is, construction of more number of dams, so as to be able to cope with the situations of draughts and things like that. So, when we have numbers we can plan scenarios even for our wild life and we can take steps for them

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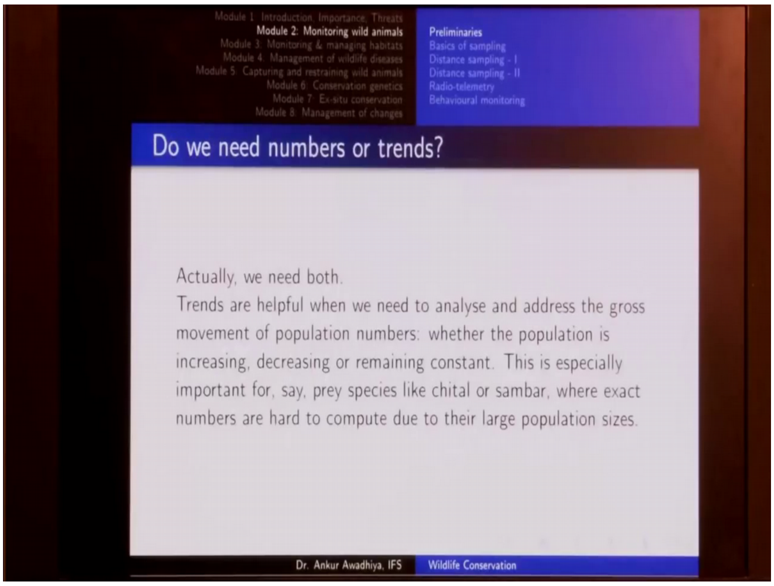

Another question that we need to answer is, do we need numbers or do we need trends. So, what do we mean by numbers and trends? So, for instance in our tiger reserve, suppose we have 50 tigers, so this number 50 would be and the number of tigers, but if we say that, say 10 years back we were having 70 tigers and now we are having 50 tigers, so we are having a downward trend.

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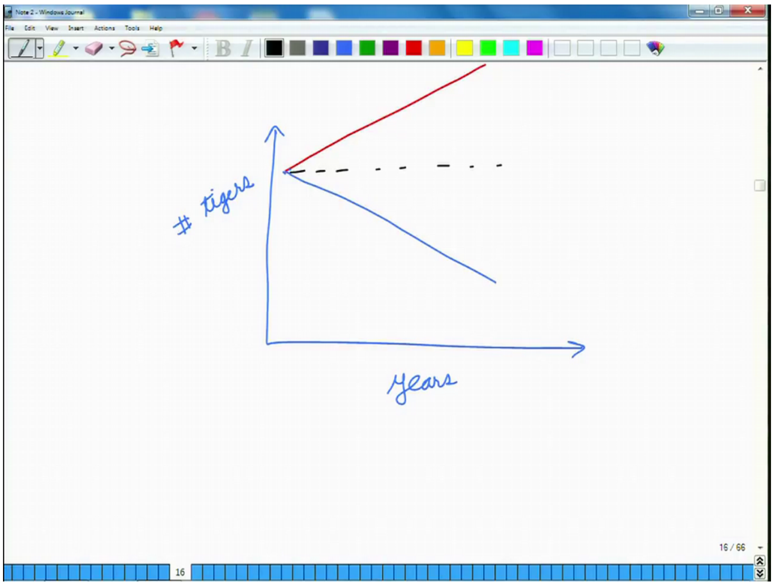

So, if we drew the number of tigers versus the years. Earlier we had 70 tigers now we have 50 tigers. So, this downward sloping graph would give us the trend that this is a decreasing trend. On the other hand we could also have an increasing trend. So, earlier we had 70 tigers now we have 90 tigers. At the same time we can also have a trend of status quo in which earlier also we had 70 tigers now also we have 70 tigers.

So, do we need numbers or do we need trends. So, actually we need both of these, why? Because in most of the situations it is easier to find out trends and it is more difficult to find out numbers. So, trends help us gather information in a very short period of time, but numbers are also important, because they give us fine resolution of data.

So, for instance in our tiger reserve we have tigers and we also have herbivores. In the case of herbivores, it does not matter much whether we have say 10000 herbivores or we have 10100 herbivores, because the purpose of having a large population of herbivores in our tiger reserve is to act as a pre population. So, in the case of herbivores, it would be worthwhile, just to know their trends whether this figure is close to 10000 or whether this figure is going down drastically or whether this figure is increasing drastically. So, that course level of information is good for us, but for other animals such as tigers which are already in a very small numbers

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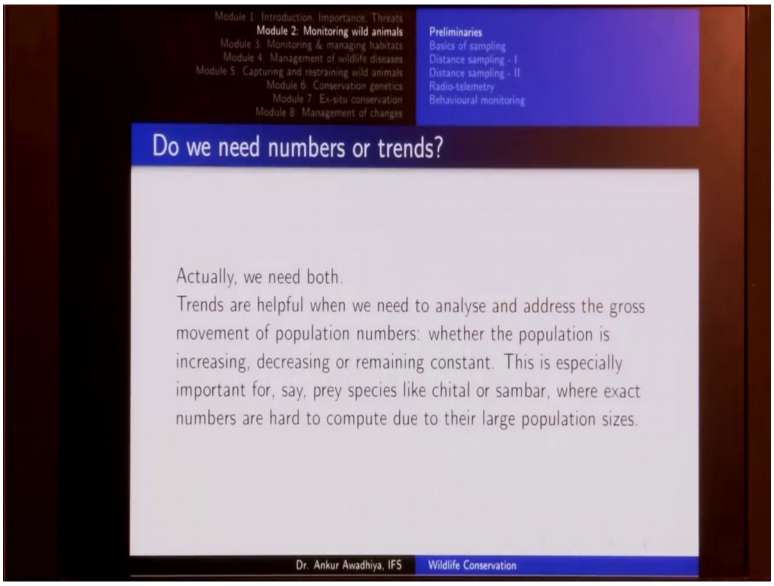

We need to know the actual number of tigers that are there in that area. Similarly with other animals; such as the dugong or the sea cow we, or we have only a few scores of sea cows left in our oceans. And, so it is extremely crucial that we know the correct numbers and even a single individual counts in that scenario.

Another point to keep in mind between numbers and trends is that with the numbers you can always figure out the trends, but not vice versa. So, for instance if I say that my trend has been increasing for the last 20 years and now I have say 20,000 animals. It is very difficult to use just this data of an increasing trend without knowing the actual numbers to back calculate the number of animals that were there beforehand.

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But on the other hand if we knew that the number of animals in different years was say 5000, 5500, 6000 and say year 2000 2005 and 2010. So, if we have these numbers, where you can very easily see that we are having an increasing trend. So, it is very easy to find out the trends from the numbers and not vice versa.

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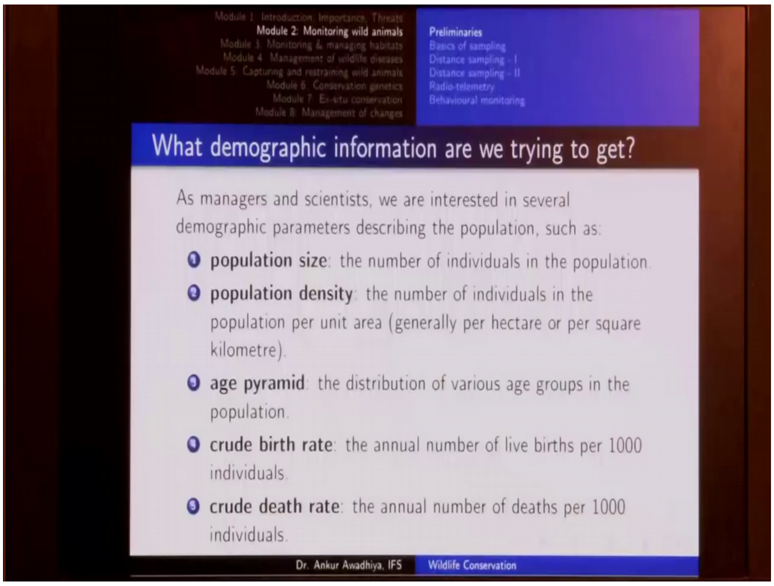

Now, the next question is: what are the kinds of demographic information that we are trying to get from our counting of animals. Just a mere count of the number of animals is not enough. We also need to know a number of other demographic parameters; one is the population size or the number of individuals that are there in the population and this is one figure that we directly get out of our counts from the population size. If you divide the size by the area you will get the population density.

So, it is generally in per unit per hectare or per square kilometer or in some animals which have an even lesser density. We, we generally make use of per 100 square kilometers. Next is the h pyramid, so the h pyramid tells us the distribution of various age groups in the population which also tells us whether our population is young population, whether it is an old population or whether it consists of a number of adults, because if our population consists of mostly old animals then it might suffer a crash in the near future. Then we have the crude birth and death rates which tells us the number of life or death or dead birth, the number of live births or the number of deaths per 1000 individuals of the population

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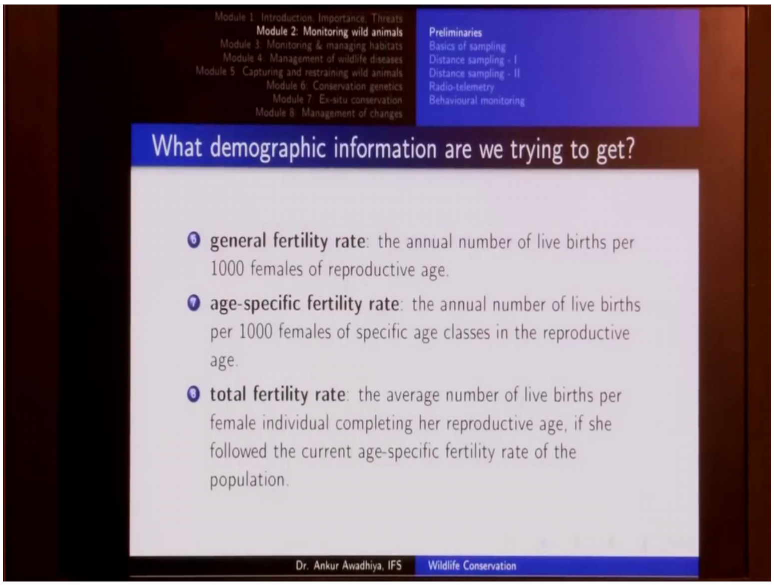

We also need to know the general fertility rate, so general fertility rate tells us the annual number of live births per 1000 females of reproductive age in the population then we also need to know the age specific fertility rate which is the annual number of live births per 1000 females of a specific age class in the reproductive age.

So, in this case we can say for instance: what is the age specific fertility rate for females of ages between 5 and seven years in a tiger population. Then next we have the total fertility rate which is the average number of live births per female individual completing her reproductive age, if she followed the current age specific fertility rate of the population. So, essentially we are integrating the age specific fertility rate data to get the total fertility rate.

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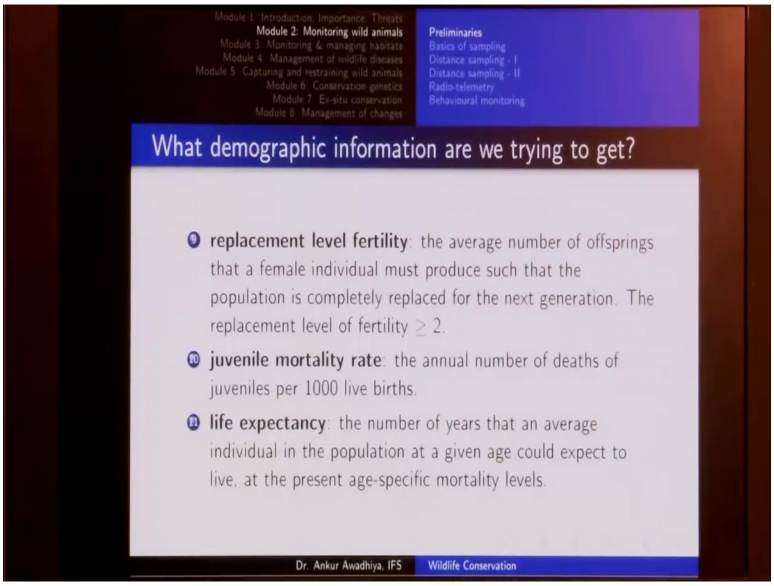

The next very important information is the replacement level fertility. Now replacement level fertility means that when you have a male and a female that have mated. How many offspring's are do they need to produce, so that they are adequately replaced by the next generation. So, the average number of offspring's that a female individual must produce such that the population is completely replaced for the next generation and the replacement level of fertility is generally greater than or equal to two.

Now, what this means is, if you have a male and a female and throughout their lifetime they are a only producing one offspring. So, in that case if our population in this generation has 1000 individuals, in the next generation it will become 500 individuals, because out of every two individuals there is only one individual that is being produced.

On the other hand if you have a replacement level of fertility which is equal to 2, so; that means, that every for every male and female they are producing 2 offspring's. So, they are getting completely replaced in the next generation, but then why do we say that the replacement level of fertility is greater than or equal to 2. Now, this is because a number of offspring's will die before reaching their reproductive age.

So, if you have a juvenile mortality or infant mortality. So, this number would be greater than 2. Now, juvenile mortality rate is the annual number of deaths of juveniles per 1000 live births. Now here it is important to note that this is 1000 live births and not 1000 births. Life expectancy is the number of years that an average individual in the population at a given age could expect to live at the present age specific mortality levels.

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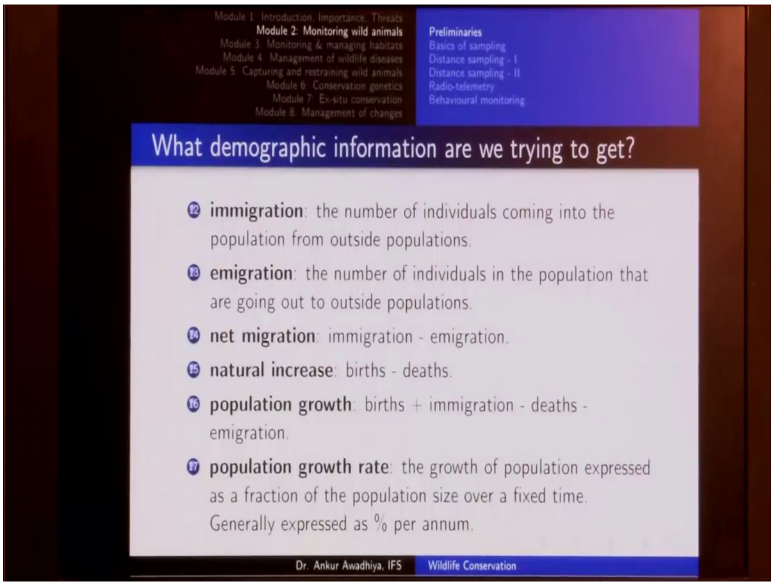

Other information include immigration which is how many individuals are coming from outside into our population emigration which is the number of individuals that are going out from our population into some other population. Net migration which is emigration minus emigration natural increase which means in the case of natural increase we do not consider migration into account.

So, natural increase is the number of births minus the number of deaths population growth which is births minus deaths plus immigration minus emigration. So, its births plus immigration minus deaths minus emigration; so, essentially how does our population grow our population will grow if we have any births in the population or if there are more animals that are coming from outside.

Now, our population would reduce if there are deaths in the population or when the animals are moving outside. So, when we consider all of these four together we get the population growth from population growth we can also figure out the population growth rate when we divide it by the size of the population over a fixed time period and it is generally expressed is percent per annum.

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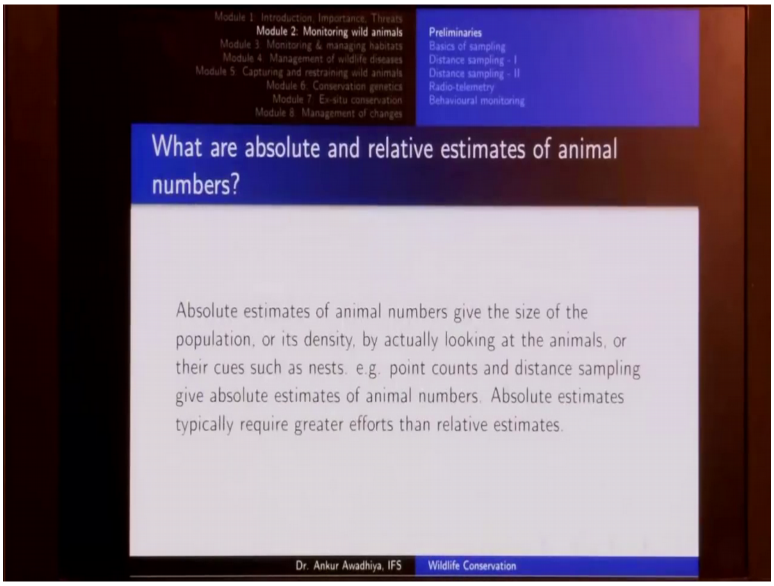

Now, the next concept when we are estimating animal numbers is absolute and relative estimates of animal numbers. Now, absolute estimates of animal numbers give us the size of the population or it's density by actually looking at the animals or their cues such as nest. So, examples include point counts and distance sampling and they generally require more effort than, relative estimates and relative estimates. On the other hand do not count the actual population rather they utilize proxies to estimate animal densities in unknown units.

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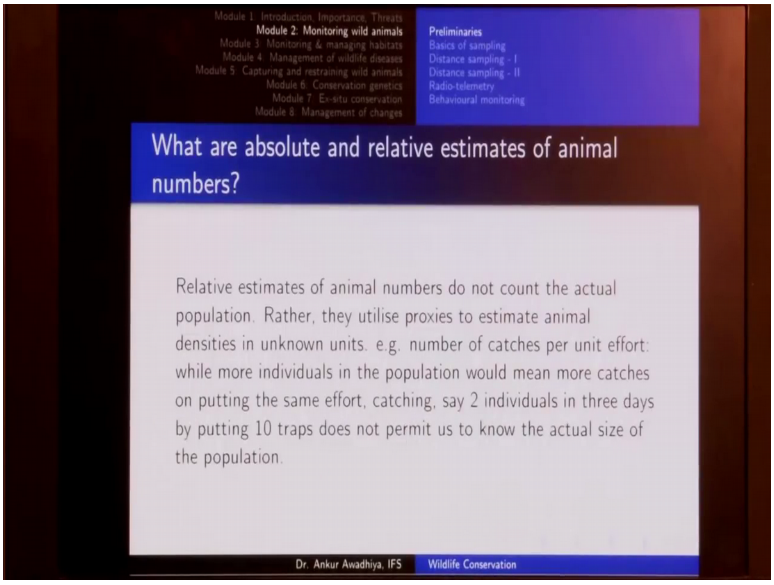

So, essentially what we want to say in this case is that suppose, you wanted to figure out how many fishes are there in a pond? Now, absolute estimate of the animal number or the number of fishes would actually involve taking a sample of fishes from that area and counting the number of fishes that are there in the sample and then extrapolating it to the whole of the area.

On the other hand a relative estimate of the number of fishes would include just say going into that, that pond fishing for say 2 hours and if I did a fishing now and suppose, I caught 100 fishes. Now, I, do this experiment again, I go to the pond again and then I again fish for the same amount of time and in place of 100 individuals, I got say 110 individuals. So, a relative estimate of animal numbers would say that the number of animals in pond 2 is greater than the number of animals in pond 1.

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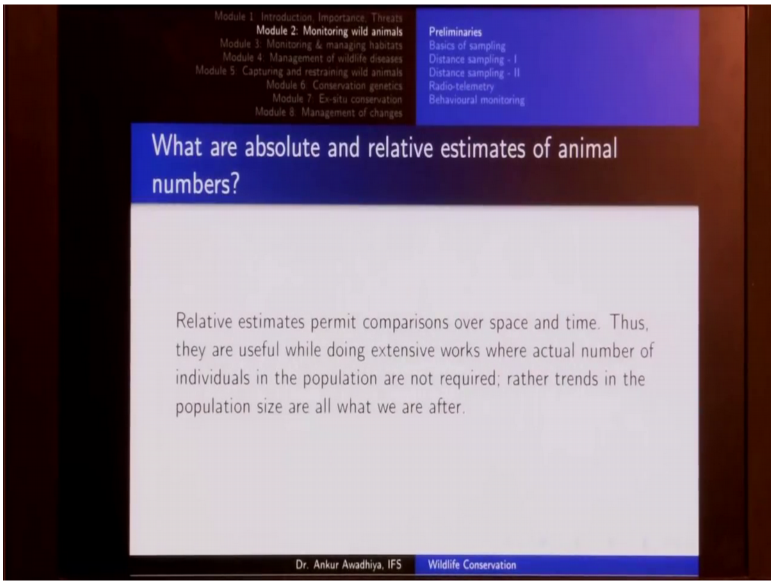

So, relative estimates permit comparisons over space and time they are useful when doing extensive works when actual number of individuals in the population are not required and rather trends are, all that we are looking after.

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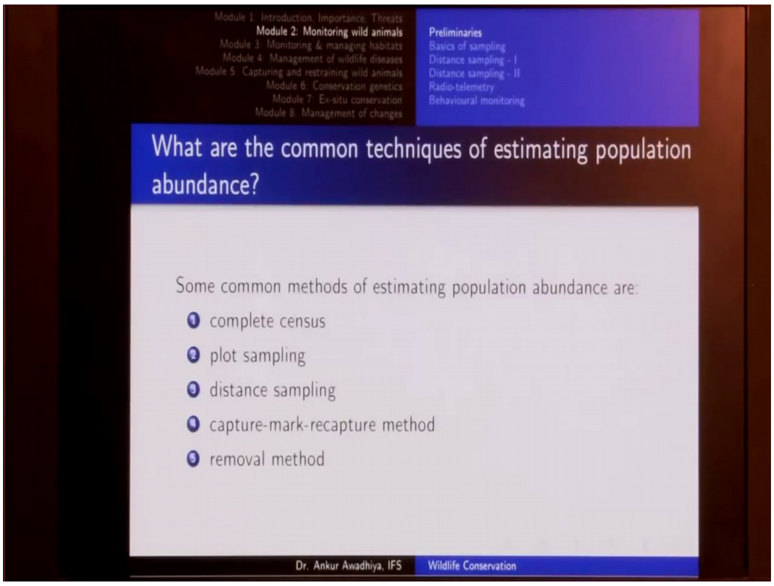

So, let us now have a look at some of the common techniques of estimating population abundance. So, some common techniques are complete census. Now, in a complete census you count each and every individual of the animal species that is present in your area. So, this is generally utilized for those animals that are already in very small numbers. So, for instance, in the case of dugongs or the sea cows we will have a complete census of the number of individuals that are there plot sampling. Now, in the case of a plot sampling, what we do is that out of our complete forest, we take some small plots.

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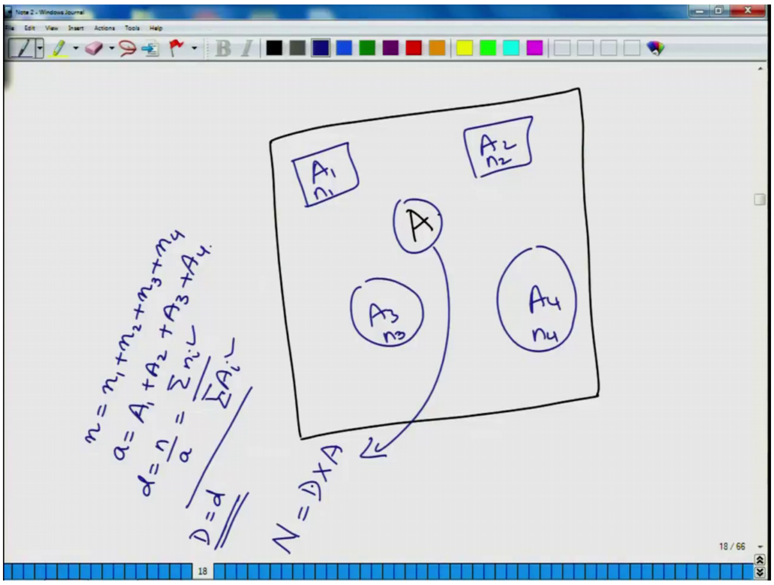

So, they can be rectangular plots or they could be circular plots or they could be even be, strip plots. So, we take some plots suppose, the areas are A 1 A 2 A 3 and A 4 and the total area of a region is capital A. Now, the number of animals that we have in A 1 as n 1 here, we have n 2 here, we have n 3 here, we have n 4. So, we did not count the total number of animals in our complete forest, but we only counted it in four of the sample plots, in that case the total number of animals in the sample plot, which is n will be n 1 plus n 2 plus n 3 plus n 4.

The total area a of all the four sample plots would be A 1 plus A 2 plus A 3 plus A 4, in which case we will get the density of animals, which is the number of animals per unit area is given by sum of n i divided by sum of A i and then we will extrapolate this density to the whole area. So, we will say that the, the density of animals that we have found using our four sample plots is the same as the density of the animals and are complete forest.

So, we will have D is equal to d. Now, this small d we can calculate, because we have the n values and we have the A i values and we have this assumption that capital D, which is the density of animals in a complete forest is the same as the density of animals in the four sample plots, in which case to find out the total number of animals in our forests. We will multiply this capital T with the total area A to get the number of animals.

So, this is plot sampling. Now, distance sampling is another technique in which, which takes a, a modification of a plot sampling and also includes the data that not all the animals are counted. So, there could be some animals that we missed out during our countings and when we incorporate that data in our formula, we get into the distance sampling. Next, we have the capture mark recapture method Ramachandraji [FL]. So, let us now understand the capture mark recapture technique by doing a small experiment.

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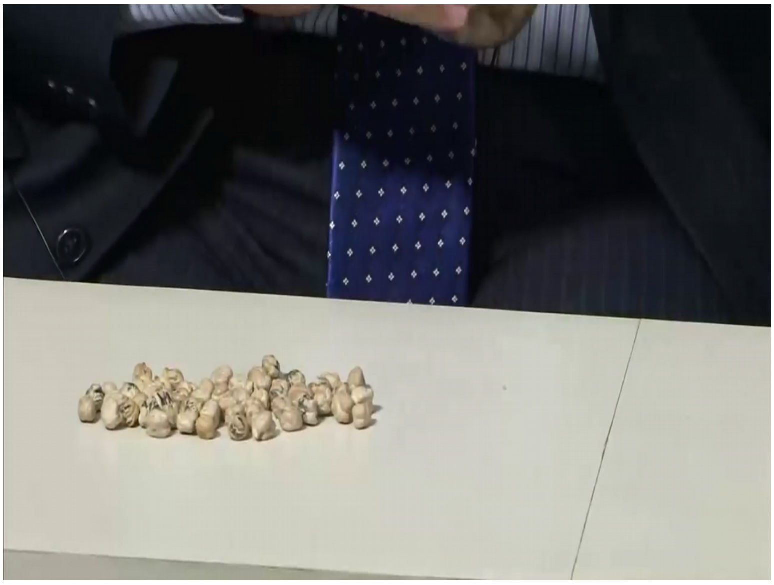

So, in this jar we have some chickpeas and we do not know the number of these chickpeas. So, we will perform the, the capture mark recapture method and I will show you all the steps to, to make an estimate of the number of chickpeas that are there in the jar. So, we first begin by doing a capture of some animals. So, we took out some animals, these chickpeas and here we have 1 2 3 4 5 10 15 20. So, we have 20 animals here let us take a few more. So, we now have 25 animals. So, we have captured these 25 animals next, we mark these animals. So, let us mark them with a felt pen.

So, I am marking them with a black color. So, in the field what we do is, this marking say in the case of, birds would be done by putting small bands into their feet, in the case of butterflies, it would be done by putting small stickers on their wings. In the case of, ants, it would be done by spraying them with, some colored dyes and so on. Now, the important thing to note here is the number of animals that we have captured, if the number of animals that we have captured is very less then our errors in the estimate would be great whereas, if the number of animals is more then we will have a much more, correct estimate of the total number of animals, in the forest. So, now that we have marked all our 25 animals, we now released them back into the forest. So, we put them back into the jar.

Remember, we had 25 animals. So, 25 marked animals and then we let them roam freely and make sure that the mix with the other animals; so, now that we have, mixed these animals. Now, let us take out a sample. So, we do a recapture of the animals and now, let us count the number of animals that we have 5 6 7 8 9 10 15 20 25 30 35 40 45 47 50 54. Now, out of these 54 animals, we have, 5 5 10 13 animals. So, we took out these samples of 54 animals and out of these 54 animals. We have 13 animals that are marked. So, now, let us do the calculations. So, let us now look at the experiment again.

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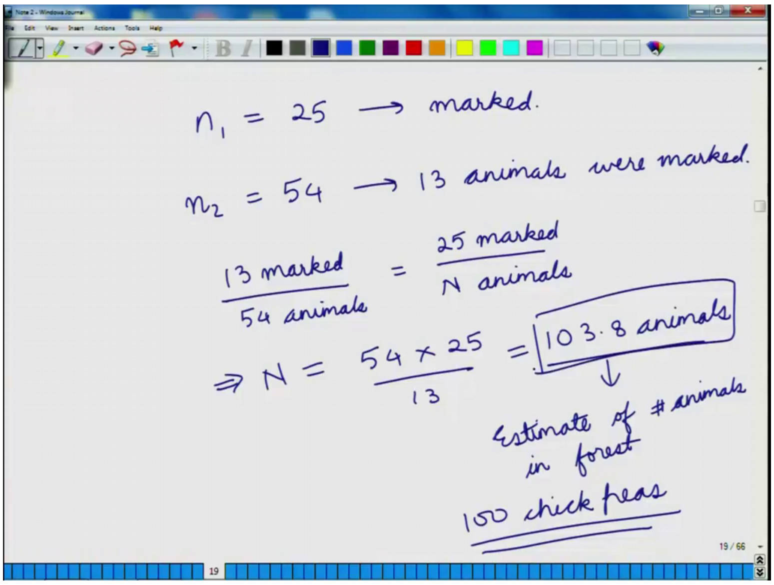

So, in the first case we took out n 1, number of animals which were 25 animals and we marked these animals in the next stage we took out n2 animals, which is 54 animals and out of these 54 animals we found that 13 animals were marked. Now, if we have thirteen marked in 54 animals this ratio would be same as 25 marked in the total n animals that we have in our forest because we are taking the assumption that these animals have mixed up completely they have not lost any marks and we were able to see all these marks very clearly.

So, from this let us find out what is N. So, N is equal to 54 into 25 divided by 13. So, from here we get the value of 103.8 animals. So, this is the estimate of number of animals in the forest which in our case means the total number of these chickpeas that were there in the jar. Now, I asked my associate to count the number of chickpeas in the jar and he came up with the figure of 100 chickpeas.

So, there were actually hundred chickpeas and our estimate is 103.8 which is a very close estimate. So, coming back to the slides capture mark recapture method is a very fast method of knowing the total number of animals that are there in our forest. Now, another method is the removal method now removal method is not generally used in our country, but it is generally used in those countries which perform hunting operations.

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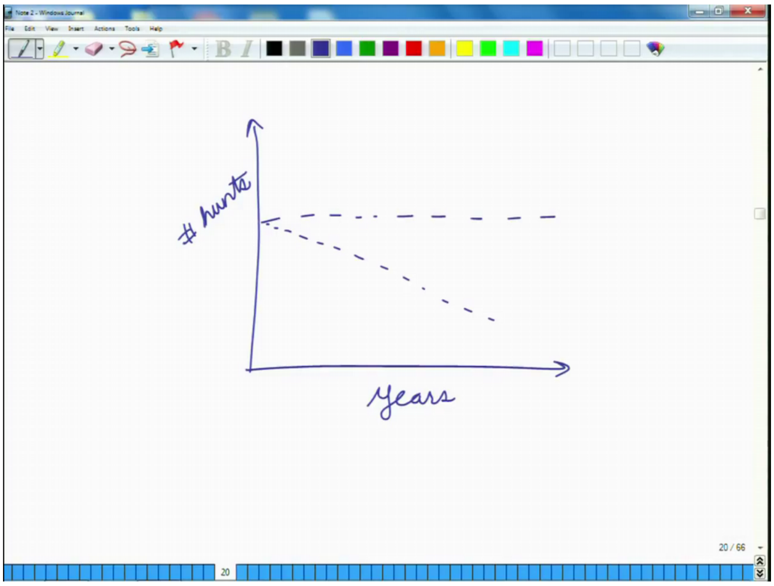

So, essentially if we take the data from hunting and over the years, the number of hunts, if it has remained constant. So, we would say that our population has remained constant, but if with the same amount of hunting effort our number of hunts is going down then we would say that the actual population is also going down, because of which we are getting a lesser density of the animals. So, which is briefly about the removal method, but it is not quite applicable to our country, because we do not permit hunting.

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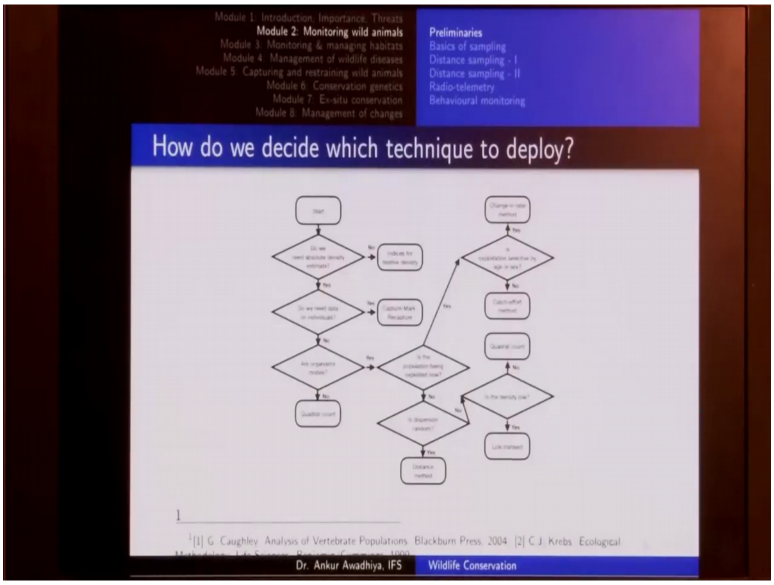

So, there are ways and means to decide which technique to deploy in different scenarios, which is sometimes that you might have a look at, but it is not extremely crucial for this particular course.

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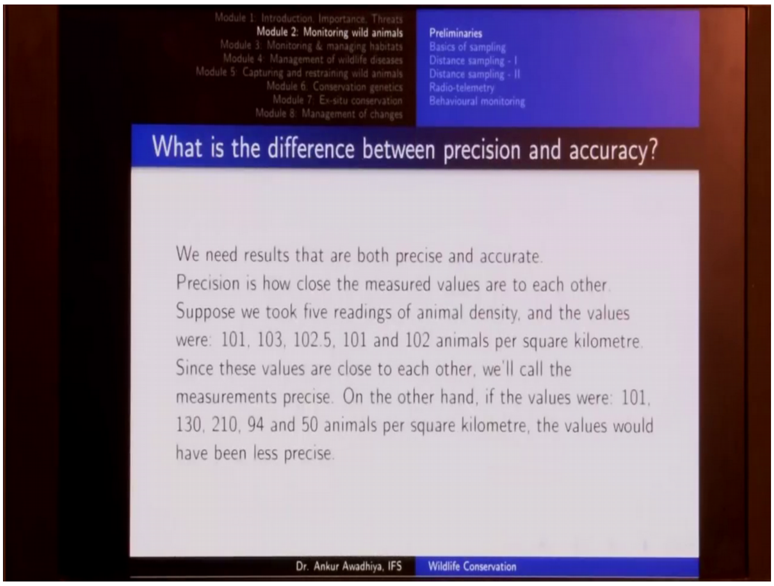

Now, the next concept is what is the difference between precision and accuracy?

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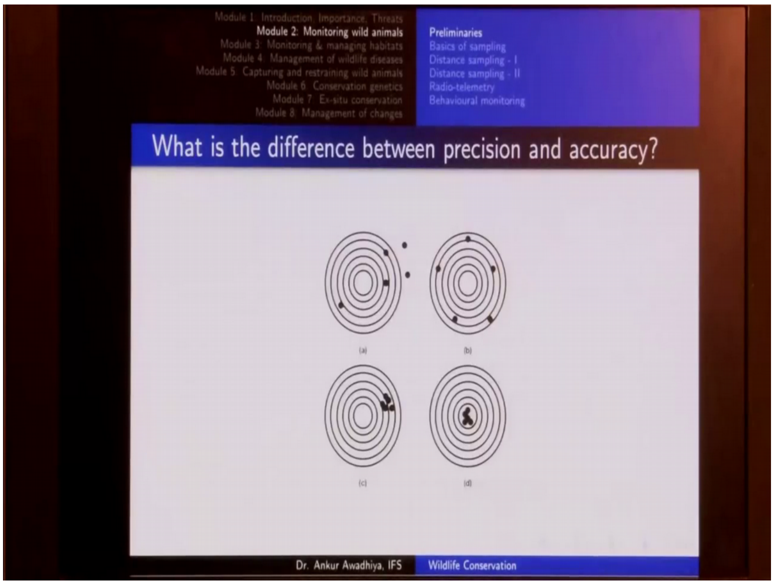

So, for instance, if we are doing any experiment if we, repeat that experiment again and again will be getting different figures from that experiment. From those figures we can figure out two things; one is precision, one is accuracy and to understand that let us look at the results of this experiment. So, we have a shooter and we have this bull's-eye and these dots represent where these bullets went into the, into the board. Now, if we look at this shooter. So, she fired 5 shots, all these 5 shots are centered at the bull's-eye and all these 5 shots are together. Now, if we know the correct value. Now, the correct value, in this case should be the bull's-eye, if the average of our values is close to the correct value, we will see that the results are accurate.

So, here the results are accurate here, even though the shots are very far off, but still we can say that the results are accurate, because the average of these 5 would fall somewhere here. But, in this case the results are not accurate because, they are at a quite a distance from the actual correct figure which should be this and in this case also the results are not accurate, because we will be seeing it at a distance. So, accuracy is how close our result is to our correct figure. So, basically, in the case of our capture mark recapture experiment; we had the correct figure of 100 animals, but we got a figure of 103.8 and animals from our experiment. So, our figure is less than 4 percent away from the actual correct figure. So, we would say that our results are pretty accurate.

Now, the next thing is about precision is how close are our values to each other. So, essentially if you look at these values, even though these values are not accurate all these 5 values are close together. Similarly, here also the 5 values are close together. So, we will say that both of these are precise results. On the other hand these values are very far off from each other; these values again are very far off from each other.

So, we would say that both of these results are not precise. Now, coming back to our experiment suppose, we did this, capture mark, recapture experiment again and in place of 103.8 we got a figure of say 102 or say 105. So, we are doing these experiments again and again and we are getting these values of.

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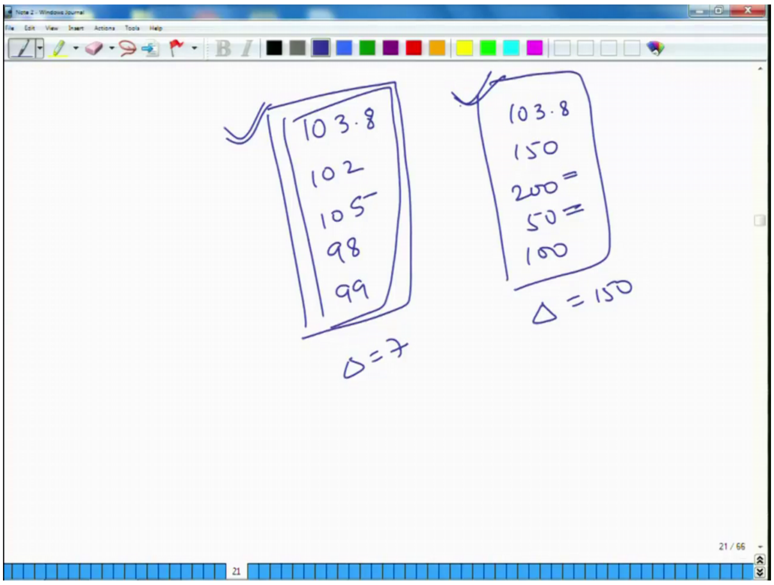

The first value was 103.8, the second value was say 102 105 say 98 and 99; we did this experiment for 5 times. On the other hand, we did this experiment again in another, other scenario. The first figure was 103.8, the second was say 150 then 250 and say 100. Now, in this case all these values are close together the lowest value is 98, the highest value is 105, which is a difference of only 7, points. In the second case our lowest value is 50, our highest value is 200. So, the difference here is 150, the difference here is 7.

So, we would say that these values are more precise as compared to these values and coming to the accuracy, if we take the average of all these 5 values, if they are close to 100, we would say that these values are accurate else not. So, this is the difference between precision and accuracy, another concept that we need to know is bias.

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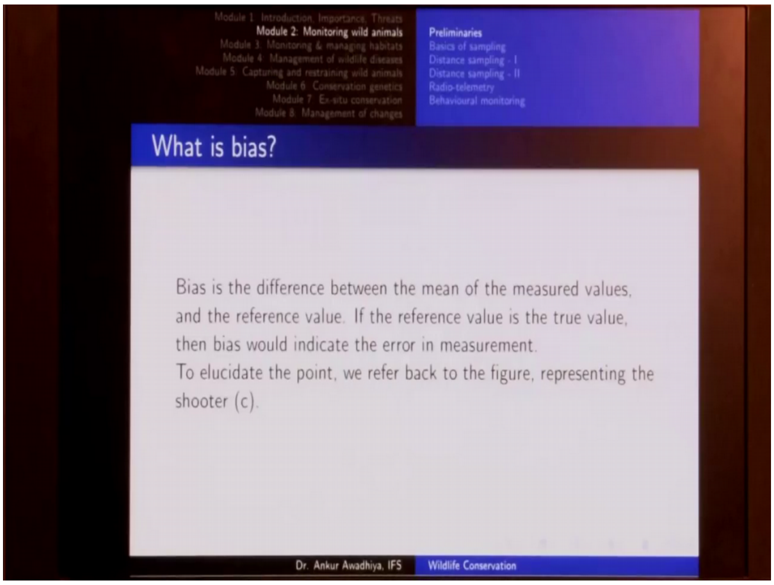

So, what is bias? Bias is the difference between the mean of the measured values and the reference value or the true value. So, if the reference value is the true value, then the bias would indicate the error of measurement. So, in this case let us again go back to our shooters example.

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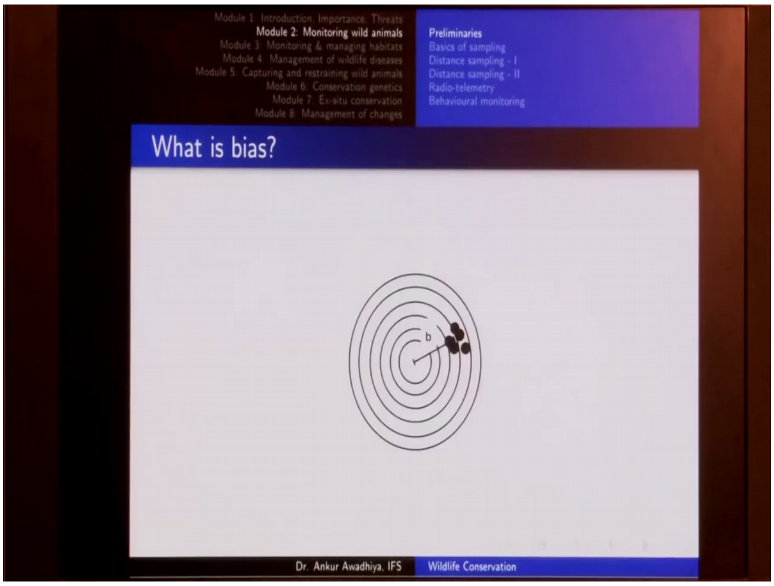

So, our shooter shot five shots, these shots are very precise, because they are all close together, but they are not accurate, they have a difference b, between them and the correct value. So, this difference b, would be called the bias. Now, whenever we have a bias in our results.

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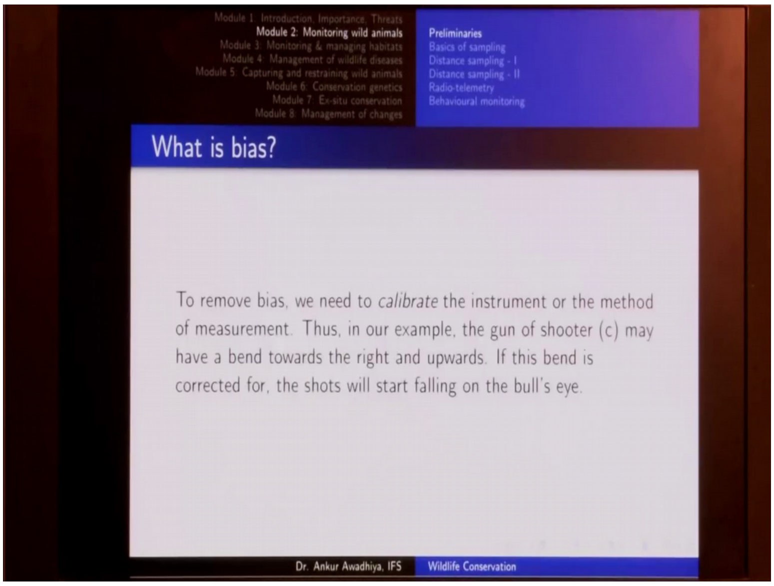

So, in those situations what we do is, we calibrate our instrument or we calibrate our method. So, in this particular case the shooter might be having a bend in her, in her gun. So, if and that bent, in this case is towards the right and towards the upside.

So, even though she was targeting this point, the results came here, because the gun had a bend like this. So, when we calibrate our instrument, we counter for this bias and we ask our shooter to shoot somewhere here. So, if she took a target here, she would come to the correct value and similarly, with all our methods of measurement. We would be having some or the other bias, which would need to be calibrated. So, that is all for today.

Thank you for your attention, jai hind.