Forest Biometry

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Lecture – 29
Point Sampling: 2

[FL] today we shall continue our discussion on point sampling. So, if you remember from the previous classes we did computations from point sampling and we also talked about what point sampling is all about. So, to recapitulate a bit in the case of point sampling we take a basal area factor which is derived from your critical angle. So, basically you can take any object keep it at a fixed distance and the angle that is subtended by this object on your eyes at this distance is it gives you your critical angle. You can even use your thumb for this purpose and when you take readings for point sampling you essentially take your object in front of you then you go all round and you measure those trees that are subtending an angle that is greater than the critical angle that comes to be full tally.

A half tally is a tree that subtends an angle that is equal to the critical angle and those trees that subtended angle that is lesser than the critical angle have a no tally. So, essentially your total number of tallies is the total number of full tallies plus half the number of half tallies. And then multiplying this number by the basal area factor will give you the basal area per hectare.

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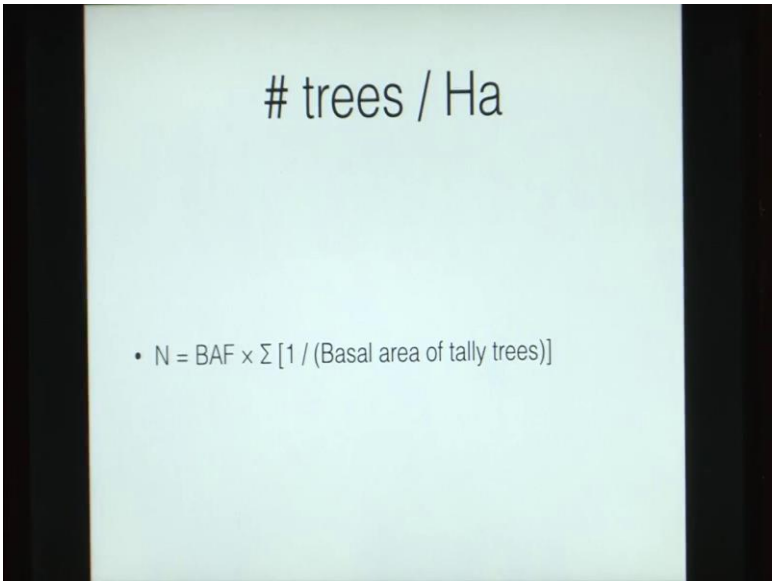

We also saw how could we calculate the number of trees per hectare which is given by this formula N is equal to basal area factor multiplied by the sum of the reciprocals of the basal areas of tally trees. So, this gives us the number of trees per hectare.

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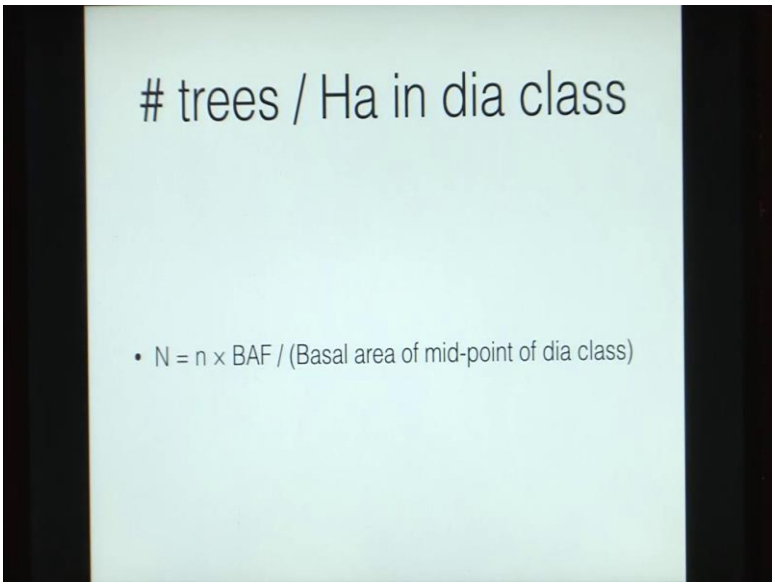

We can even find out the number of trees per hectare in each diameter class by using this formula here N is equal to number of trees in that diameter class multiplied by the basal area factor and divided by the basal area of the midpoint of the dia class.

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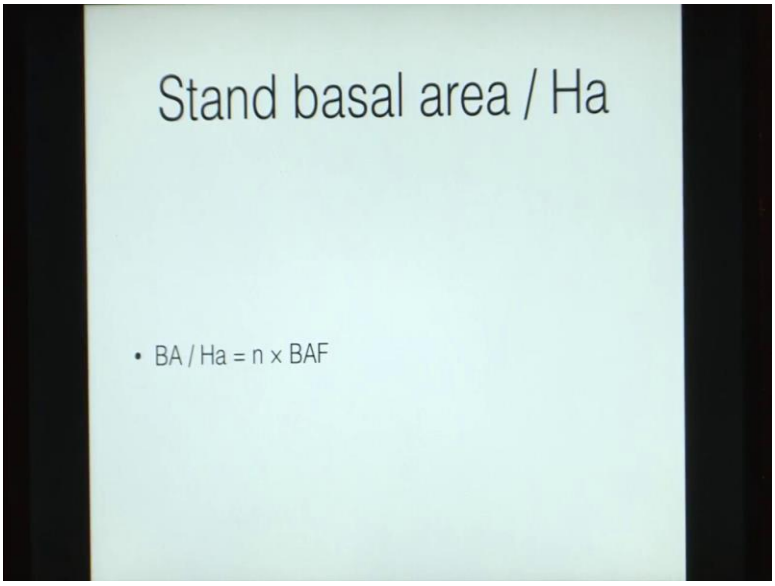

We can also calculate the stand basal area per hectare which is given by basal area per hectare is equal to the total number of tallies into the basal area factor. And you we can use this to find out the stand volume per hectare.

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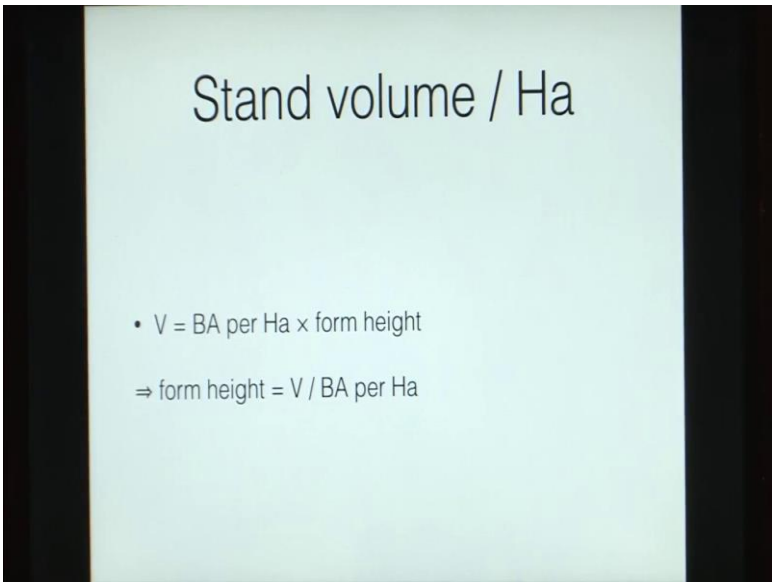

So, stand volume per hectare will be equal to the basal area per hectare multiplied by the form height and which also gives us an equation for the form height which is the volume of your stand per unit area divided by the basal area per unit area. So, why do we need point sampling, how is it better than the other ways of sampling because remember you

can calculate your basal area or the number of trees per hectare by other means as well.

Consequently you can always take a sample plot and count the number of trees that are there divided by the number of by the area of the sample plot and you will get the stand number density. To get the basal area density you can always take a sample plot and then measure each tree that is there in the sample plot get its diameter and then find out the basal area of those trees sum them up divide them by the area of your sample plot and that will give you the basal area per hectare.

So, we already have ways of finding out these values. So, how is point sampling better than the existing methods.

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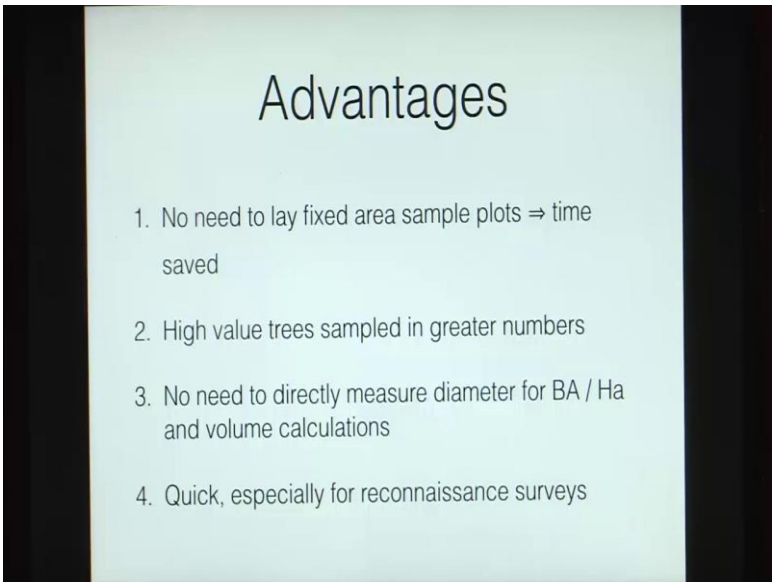

So, here are the advantages of points sampling one there is no need to lay fixed area sample plots. So, you save a lot of time. So, fixed area sample plots are those sample plots whose area has already been determined by you.

So, in those cases you can either take your when we talk about fixed area sample plots they can be of two ways you can take a circular sample plot of radius r or you can take a square shaped sample plot whose side is a.

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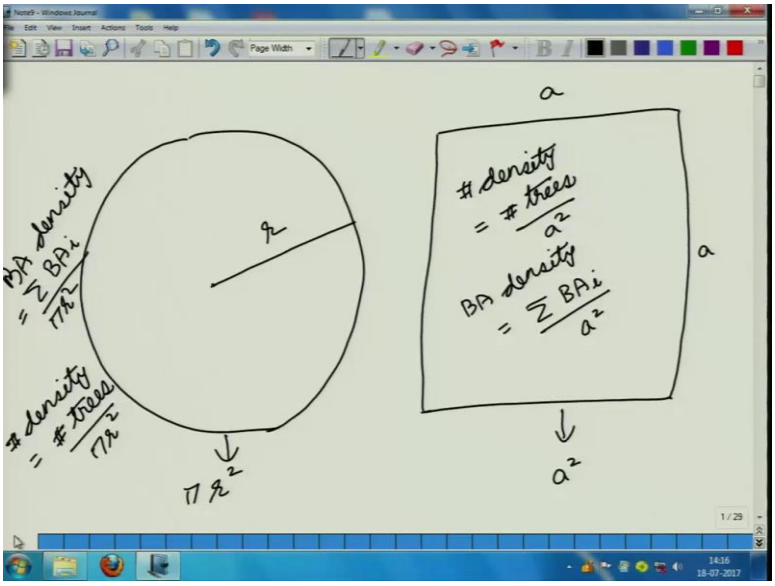

So, here your area will be pi r square. So, if you want to find out the number density it will be the number of trees divided by pi r square and if you wanted to find out the basal area density it would be the sum of the basal areas of each tree that lie in the sample plot divided by pi r square. In the case of a square sample plot of side a your number density or the stand density is the number of trees in the sample plot divided by a square because here the area is equal to a square and the basal area density is equal to the sum of the basal areas of all the trees inside the sample plot divided by a square which is the area of the sample plot.

Now, in place of, these are two standard base of taking your fixed area sample plots, but you could also take any other area you could take it in the form of a rectangle, you can take it in a form of a triangle and so on. However, a circular sample plot and square sample plot are the most traditionally in the most common sample plots.

Now, coming back to the slides what are the other advantages of point sampling. So, one we do not need to fix any fixed area sample plots. Also the high value trees in the case of points sampling are sampled in greater numbers. So, what does that mean? If we went for a fixed area sample plot then this is how our stand would look.

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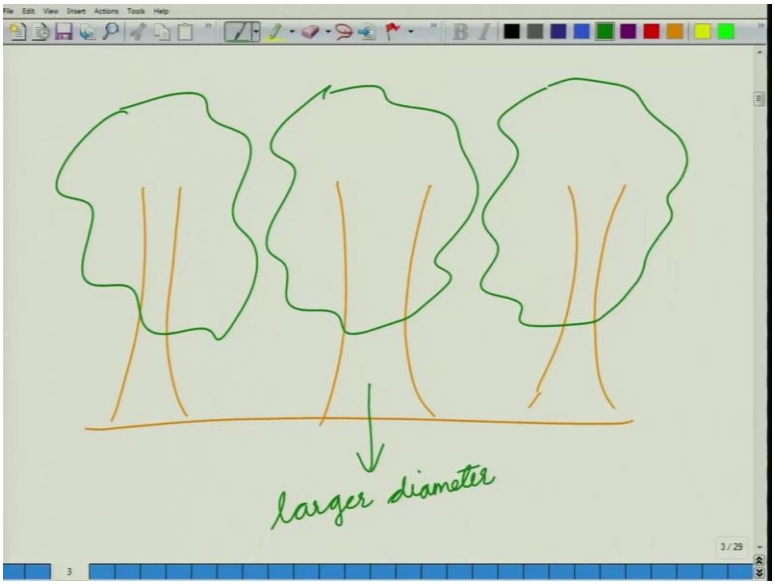

So, we will be having some small trees or some small diameter trees, some large diameter trees may be some medium diameter trees and in the case of your fixed area sample plots you measure all the trees that are inside your sample plot. However, when we are considering the point sampling in that case the trees which have a larger diameter, those trees which have a larger diameter are counted more preferentially. Now remember that our aim of having a stand is for commercial purposes. So, it could be because of say need for timber or maybe say need for carbon sequestration or for any other measure.

Now whenever we want to manage a stand for timber then we want as many large diameter trees as possible. Now in the case of our normal sampling we are measuring all the trees where as in the case of point sampling we are preferentially measuring those trees that are having a larger diameter. So, basically those tress that are more important are getting sampled more preferentially. So, that is one other advantage of the point sampling.

Now, coming back to the slides there is also no need to directly measure diameter for basal area per hectare and volume calculations. So, essentially we have forgiven or forgone any sorts of measurements. So, we are not measuring the size of the sample plot and also we are not measuring the size of the trees, we are not measuring any heights.

Now, I am informed, height might be required, but we are not measuring any diameters in this case. At the same time it is a quick method of serving especially for

reconnaissance service. So, essentially if you want to have your information in a snapshot. So, this could be one way of getting your data very quickly.

That being said point sampling also has a few limitations.

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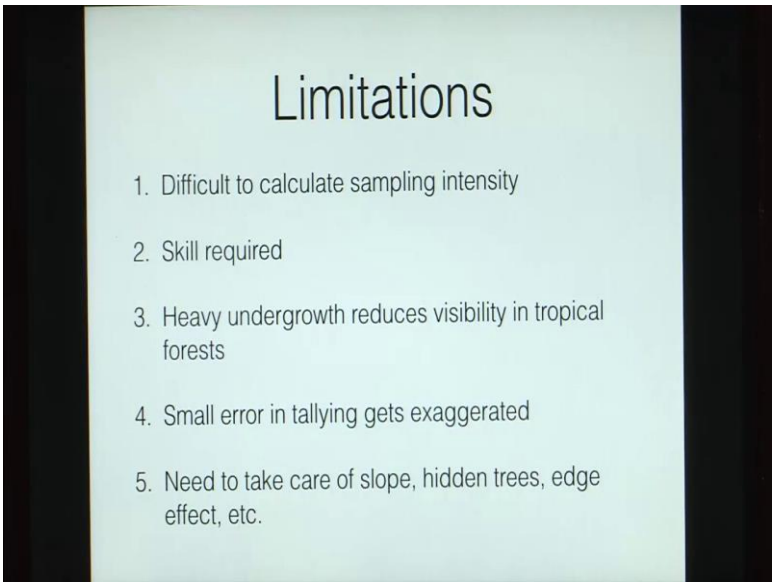

So, for instance it is difficult to calculate sampling intensity. Now what do we mean by sampling intensity? Sampling intensity or the intensity of sampling is defined as the ratio of the number of units in the sample to the number of units in the population. So, what do you mean by that.

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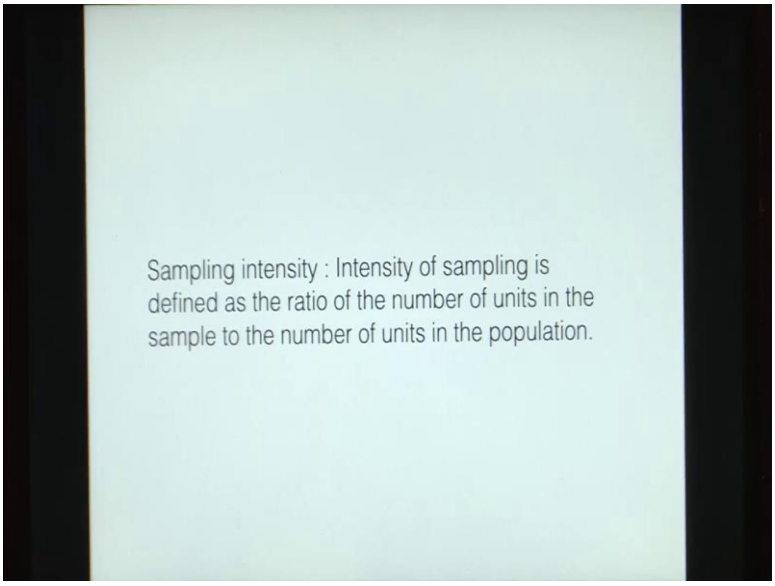

So, suppose we have this to be or total forest stand and we are taking our sample plots here here here here here. So, we are talking about the fixed area sample plots. So, these many locations we have taken our sample plots 1 2 3 4 5 6 7 8 9 10. So, we have taken 10 sample plots of fixed area in this total for a stand.

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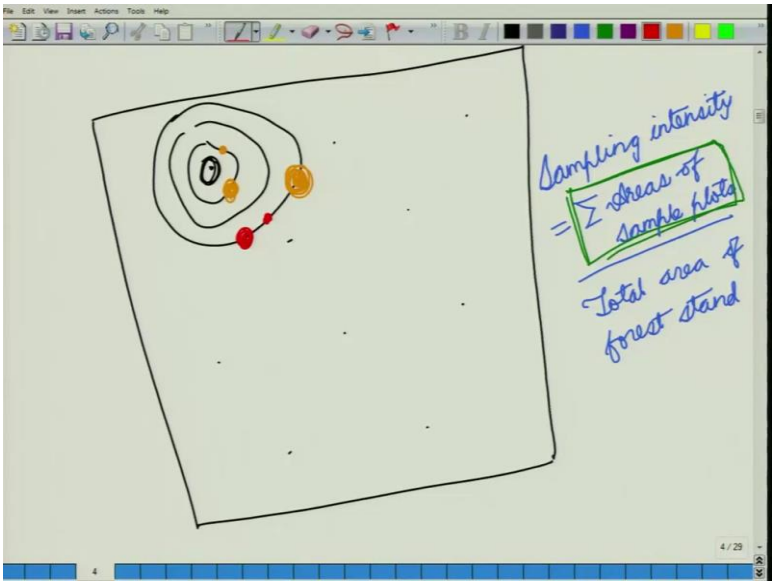

So, our sampling intensity in this case will be given by the sum of areas of sample plots divided by the total area of forest stand. So, for instance in the first case suppose we went for these ten samples. In another instance we took a few more sample plots. So, to continue with our numbering this will be 11 12 13 14 15 16 17 18 19 and 20.

So, now in this case the some of the area of the sample plots has doubled as compared to the previous instance. So, in this case we can say that is the sampling intensity has doubled. On the other hand suppose we did not go for more number of sample plots we only kept our initial 10 sample plots, but suppose we took samples plots of say larger areas. So, let us consider these to be the sample plots. So, they are roughly 4 times in the area of the initial sample plots. So, in this case as well the number of sample plots has remained constant, but the sum of the areas of the sample plots has become 4 times the original area. So, we can say that the sampling intensity has become 4 times as much as the previous instance.

But in the case of point sampling, we are not defining any fixed area sample plots. So, what we do here is that we took these 10 locations we stood at this point and we

measured trees all around. Now we cannot say what was the area of the sample that was measured. So, essentially if your trees were of a smaller diameter then may be only this area was covered because any trees that are far of would have had a smaller critical angle. On the other hand if you had a larger size tree at this distance may be it would be counted let us use another color. So, a smaller tree here is counted a larger size tree at a greater distances also counted a larger size tree here is counted, but a smaller size tree at a larger distance or maybe even a medium sized tree at a larger distance is not counted. So, in this case if you want to determine the sampling intensity it becomes very difficult because we do not know the areas of the sample plots. So, sampling intensity is the number of samples divided by your total number in the population or in this case it is the sum of the areas of the sample plots divided by the total area of the forest stand.

Now, in the case of point sampling because we have not defined any fixed area sample plot, so figuring out the sampling intensity is much more difficult. Another limitation is that you require huge amounts of skill when you are using your point sampling. So, essentially in the case of fixed area sample plots you can even out source that to people who do not have huge amounts of skills because you only need say how do we set up a fixed area sample plot.

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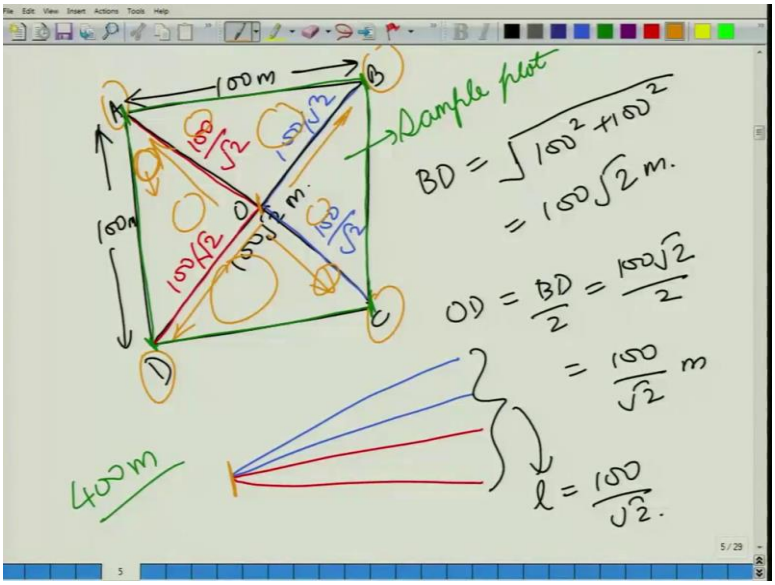

So, if you wanted to set up a fixed area sample plot of say 100 meters by 100 meters. So, this is a one hectare sample plot how do you do go about doing it, because this is a

square. So, all the sides are equal we first of all figure out its. So, we figure out this distance, let us call it A B C D now we know that B D is equal to square root of 100 square plus 100 square which is 100 root 2 meters. So, this distance B D which is the diagonal in this case is 100 root 2 meters.

So, if we took these two diagonals what is the let these intersected O. So, what is the length of say OD? Now OD is BD upon 2 is 100 root 2 upon 2 is 100 upon root 2 meters. Now in this case we can say that this length is also 100 upon root 2 this length is also 100 upon root similarly this length this length is also 100 upon root 2 and this length is also 100 upon root 2. So, what do we give to our people who are out there in the field we will give them a set of ropes. So, we will have 4 ropes with a peg in the centre. So, here you have a peg and all these 4 ropes have the same length. So, here l is equal to 100 upon root 2. So, what will your people do on the ground? They will take this peg and place it on the centre of the sample plot then extent two of the ropes in these two directions this direction and this direction. So, that gives us points D and B then they take the other two ropes and take it to the perpendicular directions given them A and C.

So, now at the ends of these ropes also you can put up pegs. So, once you have figured out this lengths you put a peg here a peg here a peg here and a peg here. So, now, you have determined your sample plot. Now you can give them ropes of 400 meters now the this rope of 400 meter will be traversed through all these four pegs to give you your sample plot. So, it is very easy to find out your sample plot out there in the field your people who are generally daily wagers or [FL]. So, they do not have to make any calculation you only give them two sets of ropes - one set has got 4 ropes connected to a peg and each of the rope is of the length of 100 by root 2 meters and in the second case you give them a single rope that is four 100 meters long and they will be able to make your sample plot out then on the ground.

So, now once you have made your sample plot what they need to do is to calculate all the number of trees that are inside. So, just by counting those trees and dividing them by your one hectare you will get the stand density. On the other hand by calculating the basal area, your people only need to go there with maybe a tape or maybe a set of calipers to get the diameters then only note down that the diameters and then when they come back you can take that data and you can use it to find out the basal area all those trees and also the basal area per hectare of the stand

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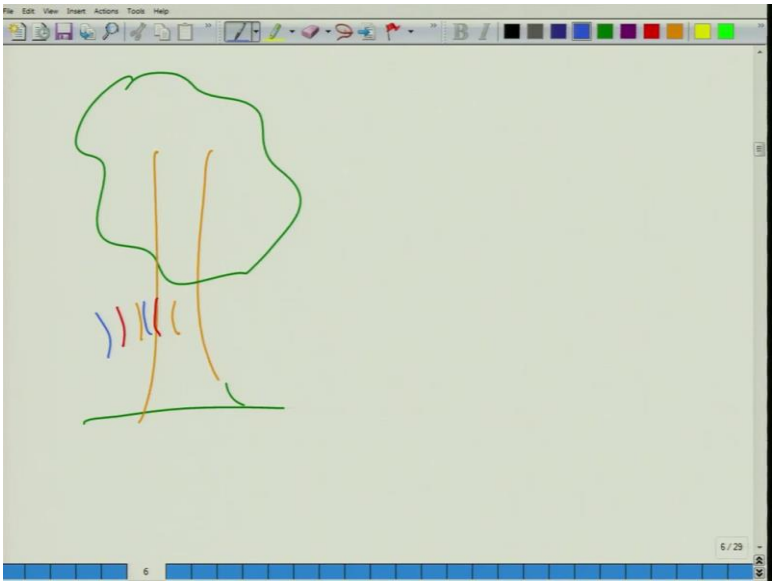

However in the case of point sampling when you observe a tree with your wedge prism you will see some sort of displacement. So, now, suppose your displacement is this much or suppose your displacement in the second cases. So, this was the displacement in the first case, in the second case your displacement became like this and in the third case your displacement came to be like this.

So, now, whether you are going to include this tree as a tally or a half tally that needs to be taught to the people who are out there in the field. So, this again becomes a very sophisticated skill to teacher person because you also need to keep in mind that all those trees that have been obscured by another tree in front have to be looked upon by swaying to the sides or in the case of any region which has a very high undergrowth when maybe you will need to shift your point of origin. But all those calculations that need to be done on the field have to be done by a professional whereas, in the case of a fixed area sample plot you can do all the calculations back home and you can give your frontlines staff only the sets of ropes and a tape and they will be able to do everything.

So, coming back to the slides a limitation of a point sampling is that you require some amount of skill. Also heavy undergrowth reduces visibility in tropical forest. So, if you go to a tropical forest, this is the kind of situation that you will go through. So, suppose these are your trees.

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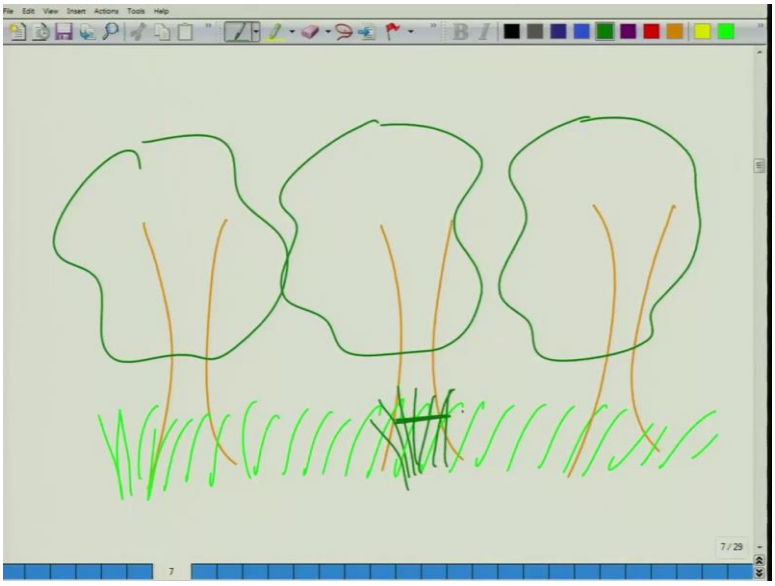

Now, if you only had your trees in the forest it would have been very easy to take their readings, but you what you will find is also a number of undergrowth. So, this undergrowth might consists of some large size grasses for instance we even have things like elephant grasses that will grow to a height that is greater than your own height or you could have some shrubs or you could even have some (Refer Time: 19:52) species such as lantana. So, when you have a lantana growth or maybe a wine growth. So, it would obscure your tree to a diameter that is greater than the DBH.

So, in this case taking the point samplings will be very difficult now in the case of your fixed area sample plots you can always go to a tree remove any undergrowth that is near your tree and take the measurements so that is easier. Whereas in the case of point sampling if you go towards a tree you have changed your point of origin and, all the readings have changed. So, which makes point sampling difficult specially in the case of tropical forest.

Coming back to the slides. Even a small error in tallying gets exaggerated. So, in the case of fixed area sample plots what we had we are taking is a large sized area in we are taking a number of readings of all different trees and then we are averaging it out or maybe summing it all. In the case of point sampling we are only taking a few readings. Now if you remember we take basal area factor in such a way that the number of trees that are counted come or the number of tallies it comes between 10 to 12 because that is

a reasonable number.

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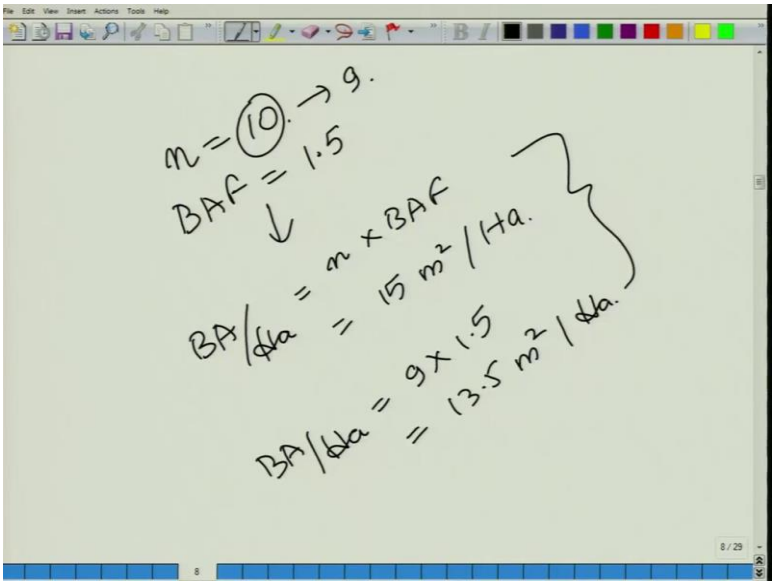

Now, suppose you had n is equal to 10 and suppose you have a basal area factor of say 1.5. So, what is the basal area density? So, basal area per hectare will be n into BAF is equal to 15 square meters per hectare. now suppose you took just one reading wrong. So, in place of 10 suppose you took 9 what would be the basal area per hectare - in that case it would be 9 into 1.5 is 13.5 meter square per hectare. So, just by removing a single reading you have reduced your value of basal area per hectare by 10 percent. So, that is a very large amount of error. So, any small error in tallying will get exaggerated.

Now, coming back to the slides we need to take care of slope hidden trees edge effect and so on. Now what do we mean by edge affect.

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So, suppose you have this forest and suppose we have a road here. So, what will happen in that case? So, now, if we consider. So, let us look at the top view. So, suppose we have trees here, now let us consider this tree. Now when we are trying to understand how much amount of sunlight it gets then this tree is blocked for sunlight by all these trees. So, essentially it is only getting sunlight when the sun is directly overhead.

On the other hand if it if we consider say this tree then it is been blocked for sunlight by these trees, but this section because this is a road, our tree can get sunlight from this direction very easily because there are no large sized trees to obscure sunlight from that direction how would that affect our stand. So, essentially in the process of photosynthesis as we have seen before, we have carbon dioxide plus water in the presence of sunlight gives us, so this is the process of photosynthesis.

So, it we see here that light is an important part of the process of photosynthesis. So, if these trees at the edges if they are getting more amount of sunlight they will be able to perform more amount of photosynthesis and maybe grow to a larger diameter. So, suppose we went for a point sampling and if we took our point sample somewhere here the readings will be very different from what will get if we took a point sample here. So, at the edges the effects get exaggerated. So, which is why if we come back to the slides it says that we need to take care of slope, hidden trees edge affect number of other factors

Now, moving on how do we estimate the number density of trees?

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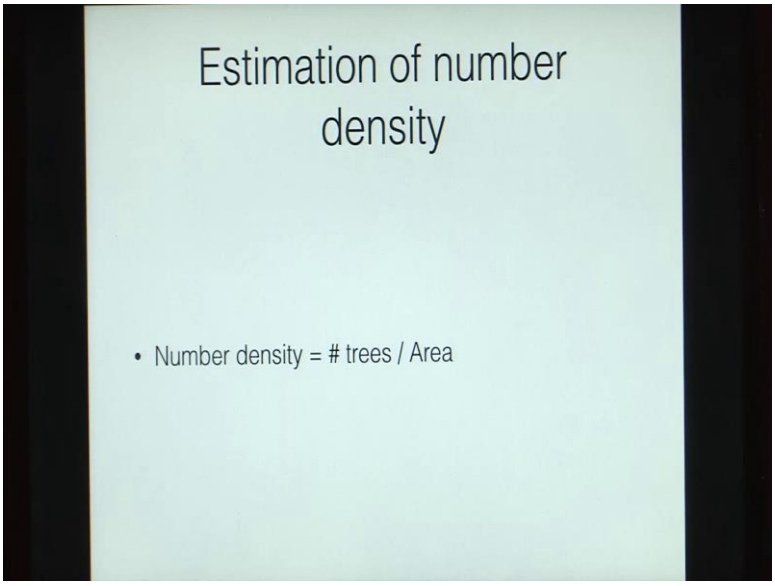

So, number density as we saw in the first case it is the number of trees per unit area. So, how can we measure the number density?

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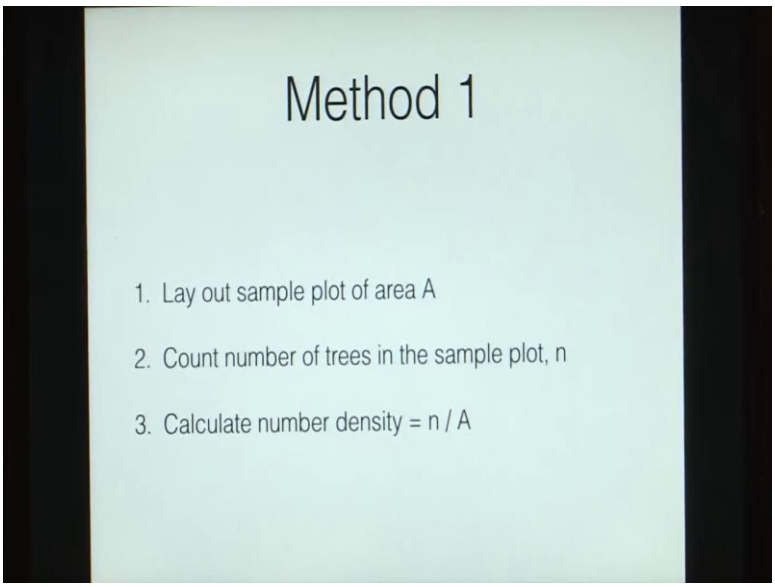

The first method is to lay out a sample plot of area a then calculate or count the number of trees that are there in the sample plot let it be n then calculate the number density which is given by the number of trees divided by the area of the sample plot.

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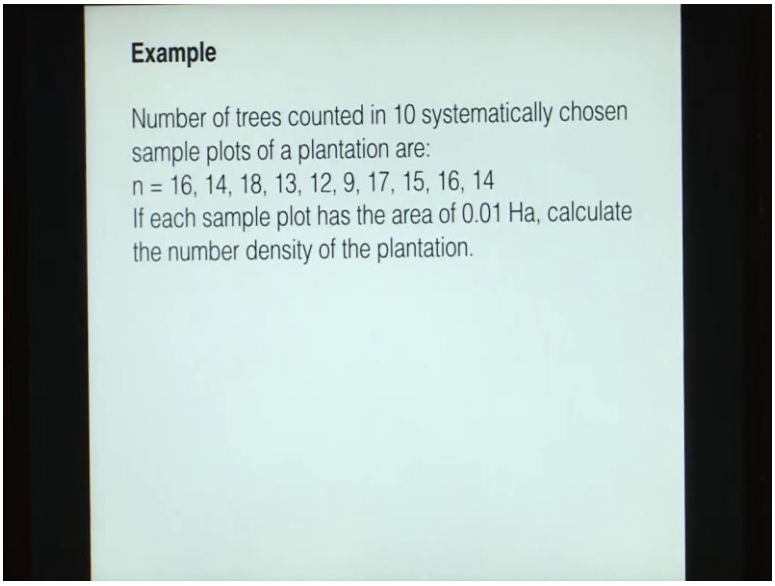

So, now let us take an example. So, this is example states that the number of trees counted in ten systematically chosen sample plots of a plantation are so, at these numbers. So, we have taken ten sample plots in each sample plot we have measured the number of trees if each sample plot has the same area of 0.01 hectare calculate the number density of the plantation. So, now, again we have taken ten sample plots and the number of trees in each sample plot is given.

So, here the problem states that we have n is equal to 16, 14, 18, 13, 12, 9, 17, 15, 16 and 14. So, we have 1 2 3 4 5 6 7 8 9 10 samples.

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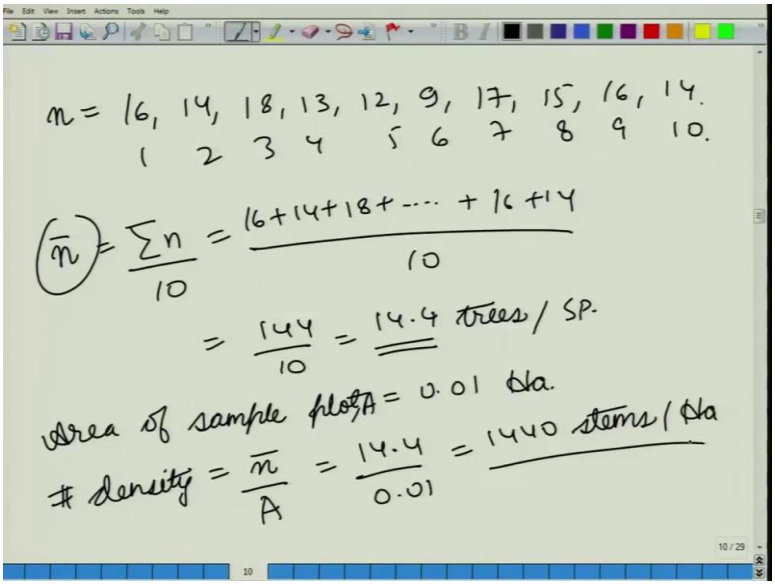

What is the average number of tree in a sample plot? So, the average number of free will be given by the sum of the number of trees divided by 10 because here we have 10 samples. So, it is 16 plus 14 plus 18 plus. So, on plus 16 plus 14 whole divided by 10 which comes to 144 by 10 is equal to 14.4. So, we have an average of 14.4 trees per sample plot.

Now, area of sample plot is given as 0.01 hectares, so that is a and here it is n bar. So, what is the number density the number density also known as the stand density is the average number of trees or the average number of stems if. So, for instance if we have a stem of a larger diameter we will call it a tree if we have a stem of a smaller diameter we will just call it a stem. So, number density is the number of stems per sample plot divided by the area of the sample plot.

So, here we get it as 14.4 divided by 0.01 is equal to 1440 stems per hectare. So, this is the stand density. So, we can very easily calculates the stand density by taking a sample plot of a fixed area counting the number of trees that are there in the sample plot and then dividing that by the area of the sample plot to get the stem density. So, that is one way of finding out the stem density.

Let us look at another way now.

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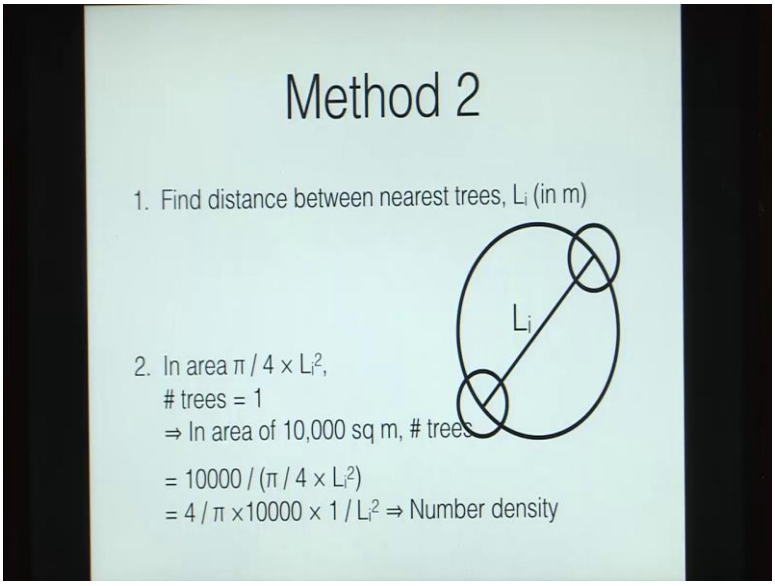

So, looking at the slides now this is a very quick way of finding out the stem density. So, or the stand density, we first find the distance between two nearest trees. So, let that be L i. So, that is the distance between two nearest trees and this is the ith sample that we have taken. So, how does it look in picture?

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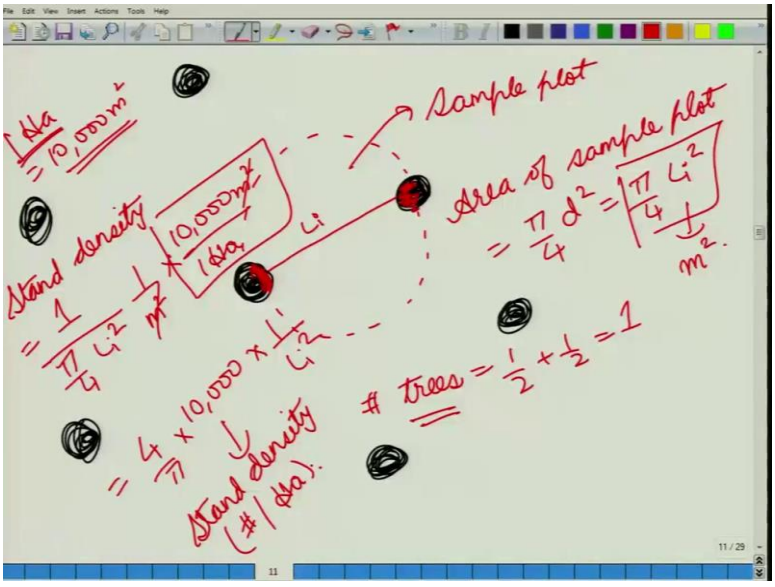

So, suppose this was one tree this is another tree. So, these are the nearest two trees. So, any other tree is at a greater distance from our sample tree. So, this is the closest distance which we have referred to as L i.

So, now let us make a circle with L i as its diameter. So, if we make this circle. So, now, consider our sample plot that is given by this circle. So, this is our sample plot. Now what is the area of the sample plot because it is a circle. So, it is given by pi by 4 d square which in this case is pi by 4 L i square. Now what is the number of trees that are in the sample plot? So, here we have this portion of a tree so that is roughly half a tree and here also we have half a tree. So, the total number of trees is half plus half that is 1 tree now we have one tree in this area pi by 4 L i square.

So, what is the stand density? The stand density is given by the number of trees that is 1 divided by the area of the sample plot which is pi by 4 L i square. Now if we have L i in meters then this area is in square meters. Now we represent our stand density in terms of hectares. So, now, 1 hectare is equal to 10000 square meters. So, now, this much is the stand density per square meter. So, the unit will be 1 by meter square.

So, let us multiply it by 10000 meter square by one hectare now because 10000 meter square and 1 hectare are 1 and the same. So, this your value is 1 unit or 1. So, now, cancelling out meter square and meter square we get 4 by pi into 10000 into 1 by L i square. So, this is the number density or the stand density n number of trees per hectare. So, the unit is 1 by hectare.

So, in this way if you go inside a forest and if you take measurements of just two trees I mean distance between the nearest two trees, you have to have only one measurement and just by using that one measurement you can calculate the stand density. So, we will look at this method in greater detail and some other problems in the next class.

Thank you for your attention [FL].