Natural Resources Management (NRM)
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Week - 01
Lecture - 03
Introduction to Natural Resource Base: Part 2

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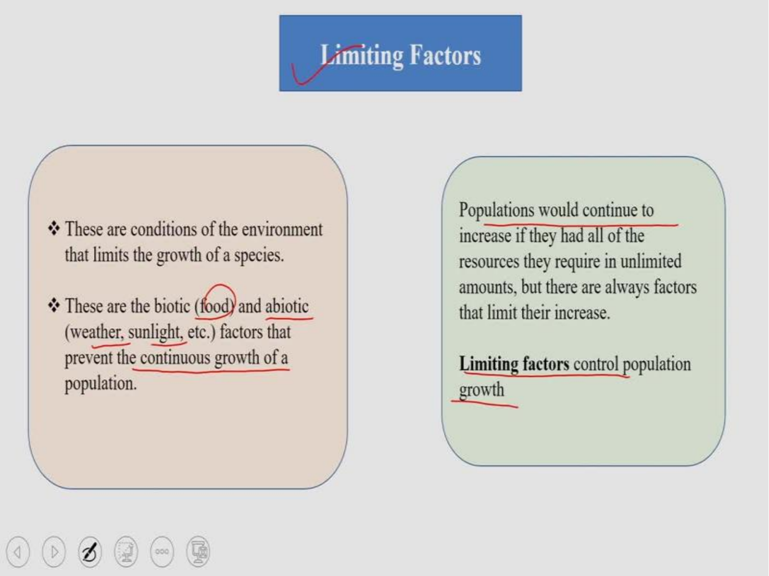

Well participants, today we will be discussing module 1b part 2 and today the topic is about limiting factors. If you recall, in the very first class, we discussed that if given an options and conditions, which is totally favorable and there is unlimited amount of different factors like food, energy, space are available, population will grow like anything. But that is not sustainable. We also discussed that day on the first class that there are few limiting factors which basically regulate these entire population dynamics. So, today we will be discussing in detail about these limiting factors.

Now, what are these limiting factors? Basically, these are conditions of the environment, which limits the growth of any species if that regulation or limiting factor is not there, as I said that a particular species or a group of species will continue growing like anything. So, as you understand that is not sustainable. What are these actually limiting factors? These are the biotic factors like food, abiotic factors like weather, sunlight, cetera, that actually prevent the continuous growth of a population.

Now, populations as I said would continue to increase if they get all the required resources in unlimited amount, but these limiting factors actually prohibit them to continue growing beyond certain limit and we will be discussing about that. So, limiting factors control the population grown beyond a sustainable limit.

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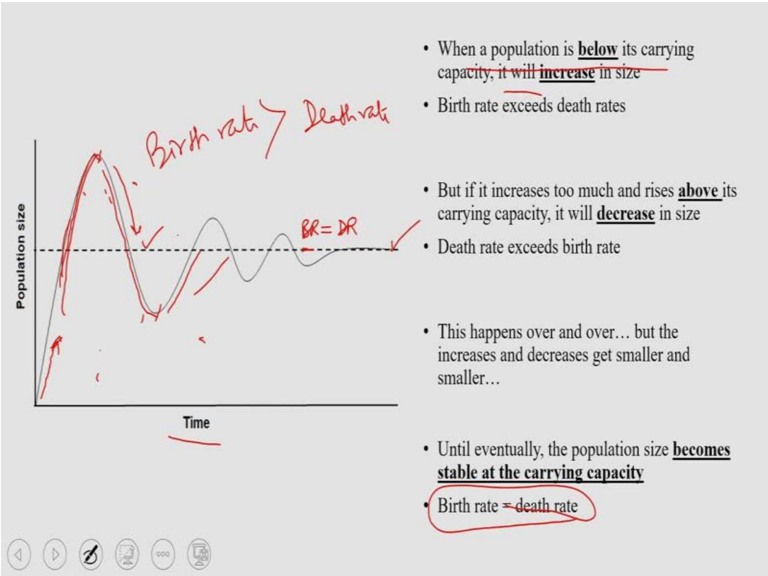

Now, this is the graph we have actually seen in the first class. Today I will discuss in great detail about this graph. This is a population graph as you see on the y axis, you have population size, on the x axis, you have time and this is the trend of population going up and down and again going up so, like this way. What basically is happening is that, at the initial stage, the population starts growing very slow, but they continue to grow, because they get all the resources which are required for their growth.

So, it goes and attained a peak, where the resources starts becoming limiting, and so, the populations start decreasing and decreasing and then it touch the bottom most peak, so, here when they reach the bottom position, then what happens population is very low. So, there is then not as much scarcity of resources. The resources start getting available more than the demand andsupply is there. So, the population starts growing again. So, these phenomena continue till they achieve a stage where population tends to be static and that is the dotted line which we call as carrying capacity of a system.

So, as you see here, when a population is below its carrying capacity means below this dotted line, they tend to increase in population because here the birth rate is higher than the death rate. So, it grows and then it drops. Here, the death rates start becoming much higher than the birth rate. So, it goes down. As you see that if the population starts going and increases too much and rises above its carrying capacity, so, it will start decreasing because the availability of resources like food, energy, conducive weather, space, there will be fight among the species for that. So, naturally the death rate goes higher, so, the population comes down.

So this keeps on happening time and again.After certain time what happens that population size becomes stable going up, down, up down and at certain point the population tends to get settled. And that point is known as carrying capacity; this dotted line. So, at carrying capacity ideally the birth rate is equals to death rate okay. At carrying capacity here the birth rate is equal to death rate, so, they tends to get stabilized.

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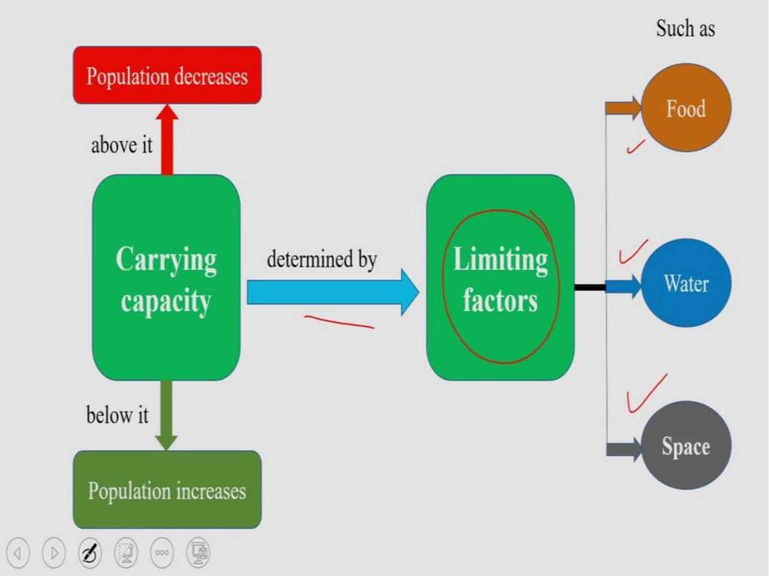

Now, as we discussed, you have the carrying capacity that dotted line where the population gets stabilized above carrying capacity if it goes population starts decreasing below if carrying capacity population goes down, it will start increasing and these entire phenomena is determined by various limiting factor mainly food, water, space. So, these three are the critical limiting factor which regulates the population growth.

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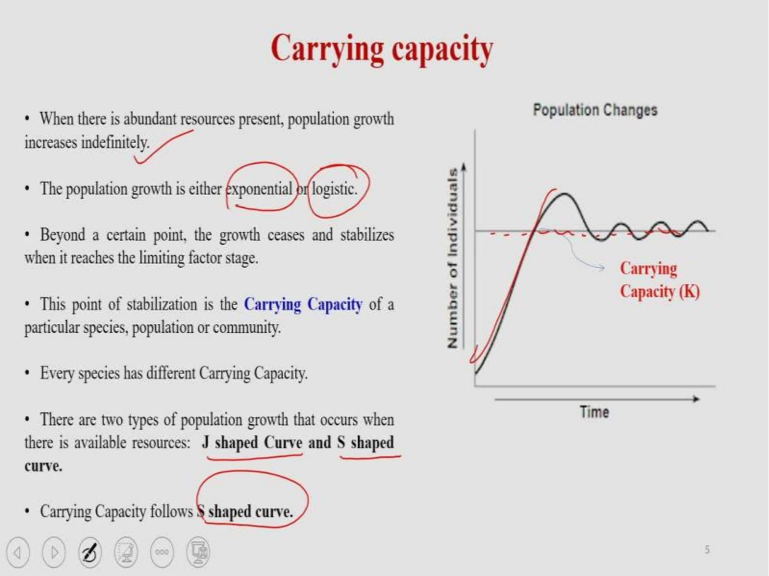

Now, we understand that carrying capacity is this line in previous graph you saw the dotted line means when a population attain a stability after increasing and decreasing depending upon the demand and supply of food, energy and conducive weather. Now, when there is abundant resources present population growth increases indefinitely we know that it goes right? So, in that stage population growth either follows exponential trend or logistic trend.

Now, beyond a certain point the growth will cease and stabilizes as we just now discussed and this stage we call a stabilization stage or carrying capacity of a particular species, population or community. Now, every species has different carrying capacity; like we as a human beings, we have some carrying capacity and other living species will have a different carrying capacity. So, there are two types of population growth type that we observe in our ecosystem and they are known as J shaped curve or S shaped curve. So, carrying capacity largely follows the S shaped curve alright.

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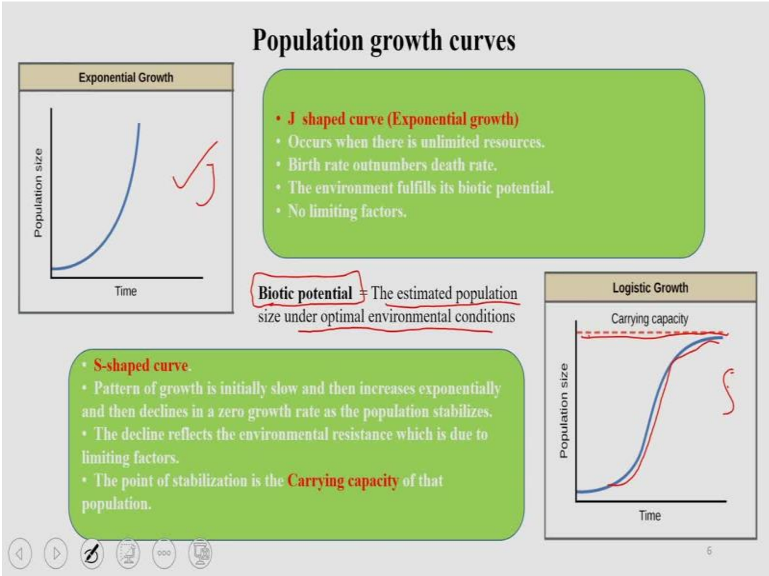

We will now next move to what is J curve and what is S curve of population growth dynamics. Now, before we go and discuss these two type of population growth curves, let us know one terminology which is biotic potential, what do we mean by biotic potential? Biotic potential is the estimated population size under optimal environmental conditions; meaning, when the environment will be conducive and optimum at that point of time the estimated population size is known as biotic potential. So, to simplify it biotic potential means that the maximum potential growth in a conducive environment and conditions for any species.

Now, let us see the J curve this one because this looks almost like J. J type so, that is why it is called as J curve. So, J shaped curve is a kind of it follows exponential growth. So, it occurs when you have unlimited amount of resources available in the ecosystem and when birth rate outnumbers the death rate means your number of species are born much higher than number of species gets out of the system. So, the environment also fulfills the biotic potential in case of J curve there is no limiting factors. So, these are the conditions when you get a J curve or exponential growth of population.

Now, let us come to S curve. This is the one it looks almost like S so, we call it S curve. Now, this is a logistic growth of population and here you see that it tries to get stabilized at the carrying capacity, that is this red dotted line and pattern of growth in case of S curve is initially slow and then it starts increasing till they get all the resources available and then tend to get slowed down once again until they touches the carrying capacity, the decline of this population growth reflects the limiting factors or the environmental resistance towards that unlimited growth of population.

So, then it limits is growth and due to those limiting factors, food, space, water, energy they go down, population rate go down and then touches that carrying capacity and this point of stabilization of population is this line is known as carrying capacity of a system. So, participants I understand that carrying capacity is now clear to all of you and also that how population growth follows two different style like J curve and S curve. S curve actually tends to attain the carrying capacity whereas, in case of J curve is unlimited growth.

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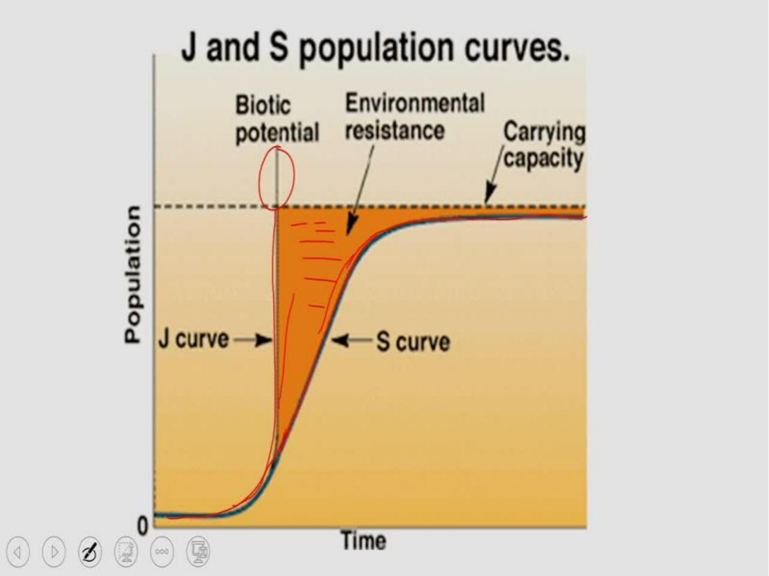

So, once again just to explain it in a much more, detailed manner, as you see this is the J curve, where sources are unlimited. So, it reaches biotic potential in that particular ecosystem for that particular species, but then again you get also S curve growth, logistic growth which we just discussed and this brown area that you see, this is basically the environment resistance as you see that the environment regsistance from down below is very less and population growth is getting higher environment resistance also getting higher and then they start putting some pressure. So, it goes down and tries to get stabilized reach that carrying capacity. So, carrying capacity of a system is a very ideal situation, where you have almost birth rate and death rate equalizes.

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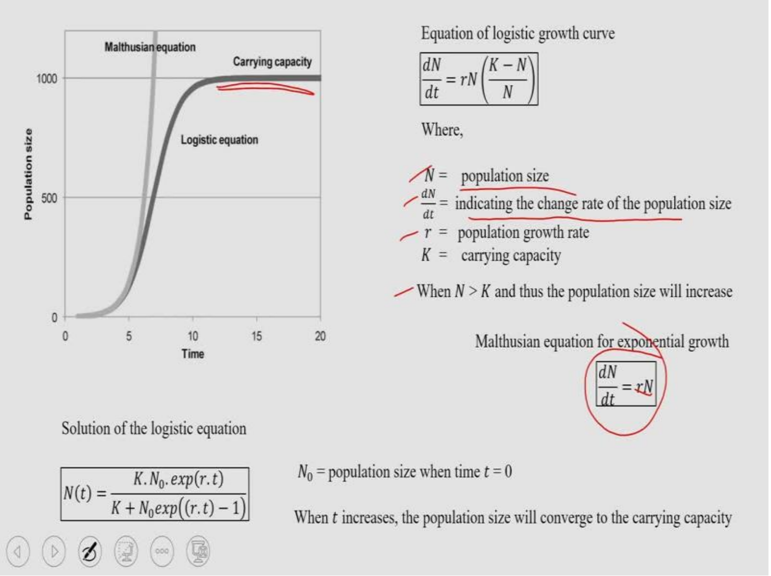

Now, there are a couple of equations and derivations that you can actually carry out to understand or calculate the system dynamics. So, these are very standard equations, where you can easily calculate that when and how a particular species growth would be limited or regulated or when it would achieve the carrying capacity or arrive at the carrying capacity. So, this is the famous Malthusian equations of exponential growth of population

dN by dt is equal to rN

Where, r denotes population growth rate and N means, the population size and dN by dt indicates the change rate of the population size. So, it is a very simple expression of the population growth.

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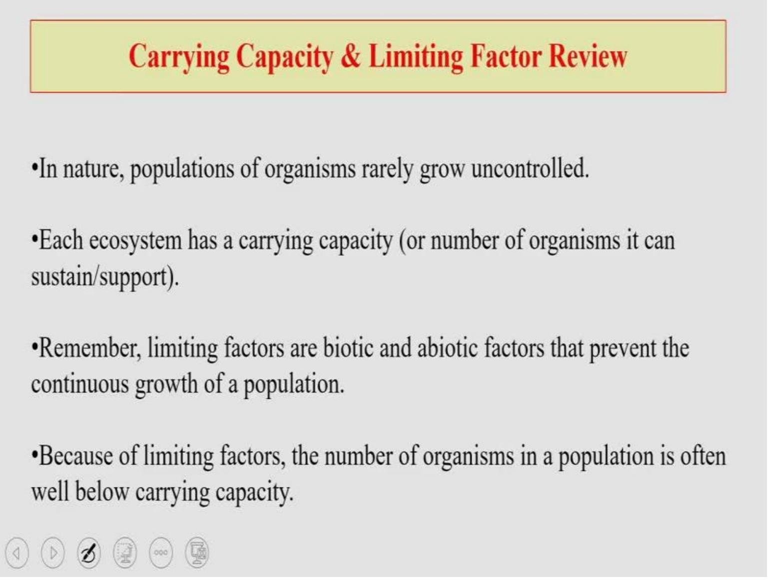

Now, what actually we discussed till now, so in nature, populations of any organisms rarely grows uncontrolled or unchecked and that is important and required for sustainability of our ecosystem. Each ecosystem has carrying capacity where the number of some organisms which can be sustained or supported in that particular ecosystem. The moment the number of population of any species of a particular ecosystem goes beyond its carrying capacity, that is the point which we call as unsustainable so, that means, it cannot sustain the population of a species in that particular ecosystem.

So, we must look at the resources availability, vis a vis the rate of population growth. Now, remember limiting factors are biotic and abiotic factors that we discussed couple of minutes back like air, water, space which actually prevents or regulate the unlimited growth of any species in a particular ecosystem or environment and because of these limiting factors, the number of organisms in a population is often well below the carrying capacity and that is why we are still surviving. Otherwise, if any ecosystem say for bacteria, so, if it gets always conducive temperature, humidity and all the other necessary, requirement or resources for their growth, imagine what would have been happened to our you know this beautiful ecosystem? Everywhere, it would be only bacteria, all right. So, we stop today for limiting factors topic, we will catch up with the next topic in the following class.