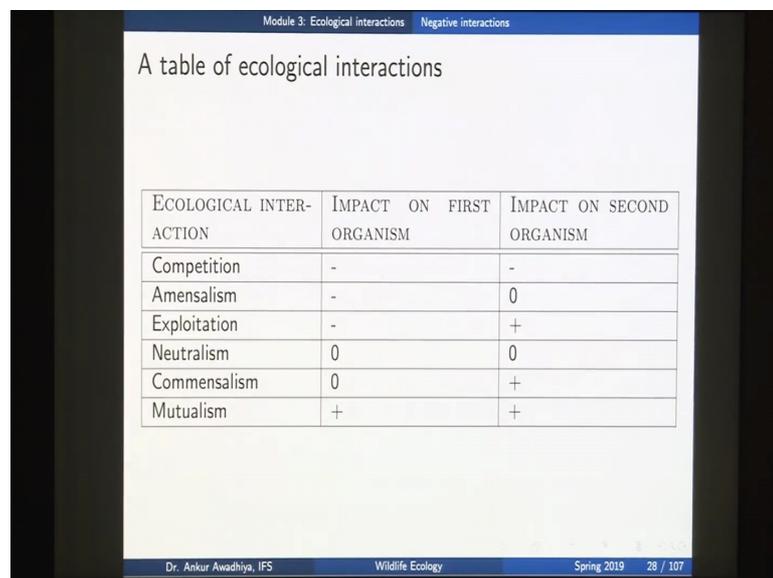


Wildlife Ecology
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Lecture - 08
Negative Interactions

[FL]. Today we will move forward our discussion on Ecological Interactions and look at Negative Interactions.

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A table of ecological interactions

ECOLOGICAL INTER-ACTION	IMPACT ON FIRST ORGANISM	IMPACT ON SECOND ORGANISM
Competition	-	-
Amensalism	-	0
Exploitation	-	+
Neutralism	0	0
Commensalism	0	+
Mutualism	+	+

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Now, before we begin let us summarize what we had learnt in the previous lecture. We had looked at 6 different kinds of ecological interactions. The first is Competition. In the case of competition, the first organism is harmed the second organism is also harmed. So, this is a negative interaction and we will explore it in greater detail today.

The second one is Amensalism. Now in the case of amensalism, one organism is harmed; the second organism does not suffer a benefit or a harm. So, this is a negative interaction because at least one party is getting a harm. So, will also look at amensalism today the third one is Exploitation. So, in the case of exploitation you have a harm to the first organism and a benefit to the second organism. So, because at least one party is getting a harm, so we call it a negative interaction or an inharmonious interaction.

So, we look at exploitation today and various forms of exploitation such as predation, parasitism and so on. Next is Neutralism. Neutralism is an ecological interaction where the first organism is not harmed and the second organism also is not harmed. So, none of them is getting a benefit or a harm. So, there is no impact on any of these two organisms because of the interaction next is, but because there is no harm, so we will call it as a harmonious interaction. Next one is Commensalism.

In the case of commensalism such as the egrets that were feeding along with the buffalos as we saw in the previous lecture, there is one party that does not get any harm or benefit that was the buffalo in our example and there was one organism that was getting a benefit that was egret in the example.

So, because none of the parties is getting a harm, so we call a harmonious interaction and the last one is Mutualism in which there are two parties that are getting benefit. Both of them are getting benefit and then we also saw it looked at a variant of mutualism that is known as Proto cooperation.

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Module 3: Ecological interactions Negative interactions

Harmonious and inharmonious interactions

Harmonious interactions
Positive ecological interactions where none of the participating organisms is harmed.

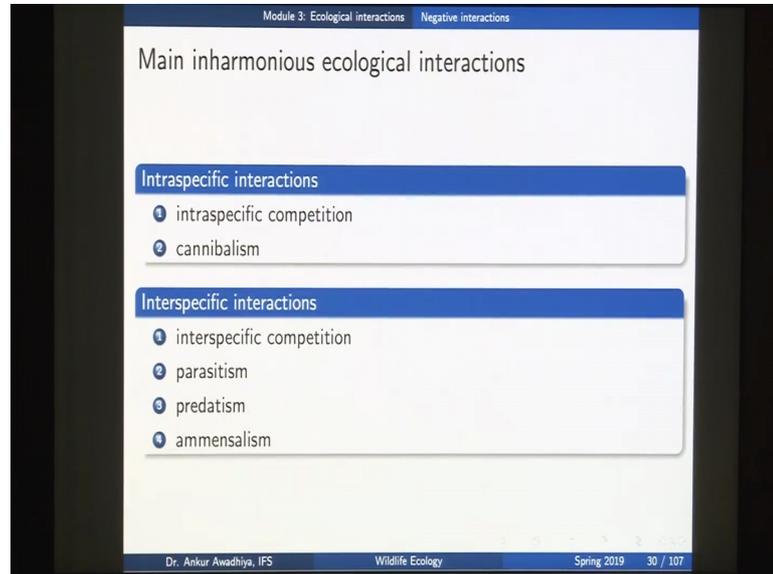
Inharmonious interactions
Negative ecological interactions where at least one of the participating organisms is harmed.

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Now, in today's lecture we will focus on the inharmonious interactions. So, what is harmonious? What is what is in harmonious? Harmonious interactions are positive ecological interactions where none of the participating organisms is harmed as you saw in the previous class and in the case of inharmonious interactions; these are negative

ecological interactions, where at least one of the participating organisms is harmed which we will consider in today's lecture.

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So, what are the main kinds of non-harmonious or inharmonious ecological interactions that we see in nature. So, here again we can divide them into intraspecific interactions and interspecific interactions. Now, in the case of intraspecific interactions we have interactions between individuals of the same species. Intra is within specific is within the same species and here we have the examples of intraspecific competition and cannibalism.

Now, intraspecific competition is where members of the same species are competing against each other. Intra is same specific is species same species competition. So, for example one human being competing against another human being, one chital competing against another chital, one tiger competing against another tiger. So, these are intraspecific competitions.

The second one is Cannibalism. Now cannibalism is a situation in which one organism eats up another individual of the same species. So, for instance a good example is the black widow spider. So, after mating the female kills and eats up the male. So, that is an example of cannibalism. Here also one organism is getting harmed. It is getting killed and eaten. So, it is an inharmonious interaction and it is intraspecific because the male and the female black widow belong to the same species.

Next is Interspecific Interactions so which is between two species. One is interspecific competition where one animal or one organism is competing against another organism of a different species. So, examples are things like chital competing with sambar or chital competing with say hares that are found in the nature. So, these will be the examples of interspecific competition or say a tiger that is competing with a leopard.

So, this is interspecific competition. Another example is Parasitism. So, parasitism is where one organism acts as a parasite on the body of another organism. Third one is Predatism or Predation in which one organism eats the member of another species. So, it eats up another organism which belongs to a different species. So, that is an interspecific inharmonious interaction.

And the fourth one is Amensalism. So, amensalism is a process in which one organism is harmed and the second one does not suffer any benefit or any harm. So, these are all the inharmonious interactions that we look in greater detail in today's lecture.

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The slide is titled "Competition" and is part of a presentation on "Ecological interactions" under the sub-topic "Negative interactions". It contains a "Definition" section and a "Types" section. The definition states: "Competition is the ecological interaction in which individuals explore the same ecological niche or their ecological niches partially coincide and, therefore, competition for the same environmental resources takes place." The types listed are: 1. intraspecific vs interspecific, 2. exploitative vs interference, and 3. apparent. The slide footer includes the name "Dr. Ankur Awadhya, IFS", the course "Wildlife Ecology", and the date "Spring 2019 31 / 107".

So, we begin with competition. Now competition is defined as the ecological interaction in which individuals explore the same ecological niche. So, when we say explore the same ecological niche, niche is the position or the role of an organism. So, for instance if you have two insectivorous birds, so there are two birds that are feeding on insects. So, their niche is the same you can have an even more precisely defined niche. So, there are two birds that are eating ground dwelling insects. So, these are exploring the same niche

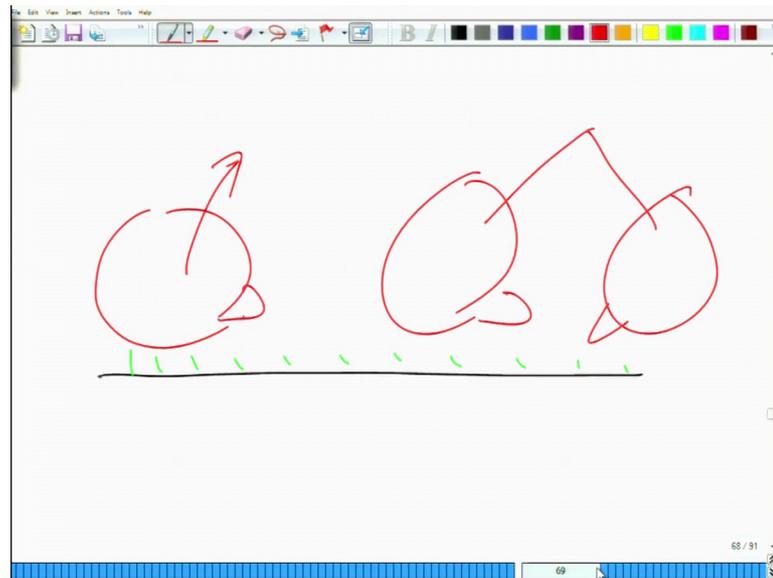
or their ecological niches partially coincide. So, when we say partially coincide it means that there is one bird that is eating insects that are found in trees and also on the ground and there is another bird that is eating the insects that are found on the ground.

So, in this case both the niches are partially coinciding because both the birds are exploring the same niche that is that of the ground even though their niches are not completely overlapping with each other. So, competition is the ecological interaction in which individuals explore the same ecological niche or their ecological niches partially coincide and therefore, competition for the same environmental resources takes place. So, there is competition for the same environmental resources and these resources could be anything such as food, they could be shelter, they could be physical space, they could be mates, there could be access to water, they could be access to sunlight so on.

So, there is competition for the same environmental resources. Now, we typify competition as intraspecific versus interspecific. So, intraspecific competition is competition between members of the same species and interspecific competition is competition between members of different species. So, we looked at their examples before the second is exploitative versus interference competition.

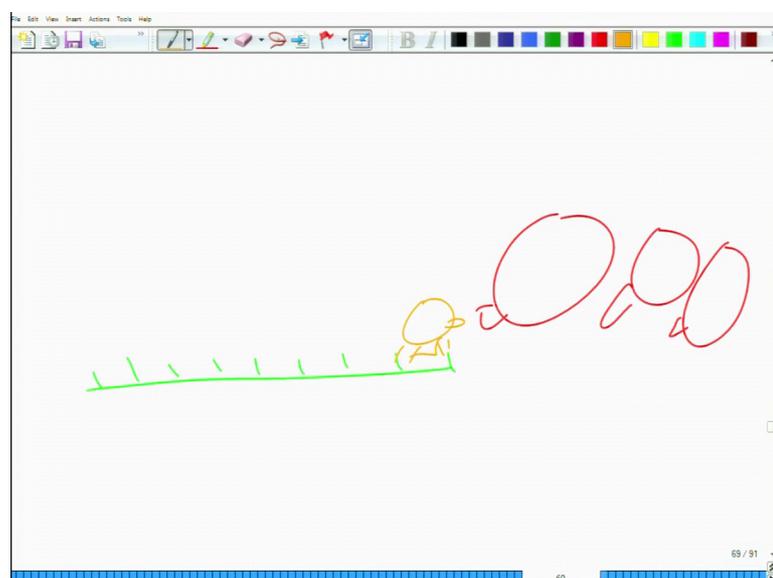
So, exploitative competition is where organisms are exploiting the same resource and interference competition is competition where organisms are not permitting another organism to use the same resource even when they are not exploiting the same resource. So, a good example of exploitative competition is the situation where there are a number of animals that are grazing together on the same grassland.

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So, in this case there is a piece of grassland and you have a number of organisms that are feeding on this. So, there is one animal, there is another animal and then, there is the third animal. Now, if this animal eats up the grass, if it eats up a majority of the grass, so the grass that is available to these two animals will be less. So, essentially in the case of exploitative competition you are exploiting the resources in such a way that you are overshooting your own share, so that the share of others reduces. So, this is exploitative competition. Now, in the case of interference competition you can have a situation in which you have the same grassland.

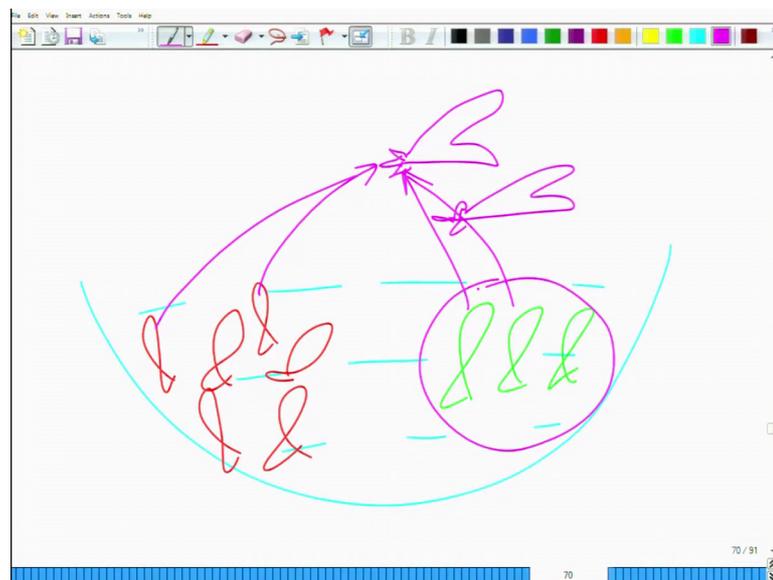
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And you have these same herbivores that are waiting to reach the grassland. So, let us reduce the size of this grassland. So, here you have the grassland, here you have the herbivores and here you have a dog that is not allowing them to get into the grassland. So, this is an interference competition. So, even though this dog is not using the grassland, this dog is not feeding on the grasses, but it is interfering with the ability of the herbivores to reach into the grassland.

So, this is an example of interference competition. Another competition goes by the name of apparent competition and we look at exploitative interference and apparent competition in more detail soon, but apparent competition and a good example is you have say a pond.

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And in this point you have these two species of fishes; the red fish and the green fish. Now, you have say 3 of green fish and 3 of red fish. Now suppose the red fish multiplies itself very much. So, and in this situation suppose you had a predator. So, that predator say is a bird. So, you have a bird that is coming and feeding on the fishes. Now, in this case because the number of red fish and the number of green fish has one in the same it is both 3 fishes.

So, equal number of these animals are removed from the system, but now if the red fish multiplied itself and it became in place of 3, it became 6 now what will happen now this bird will have an access to more amount of food because it has more number of red

fishes that are there in this pond. So, it has more amount of food. So, probably it will be able to reproduce in a much better way. So, in that case it reproduces and now in place of one bird, you have two birds. What happens now? Now you have two birds and these two birds will again require fishes to feed.

Now, when that happens these birds will not only be consuming the red fishes, they will also be consuming the green fishes. Now because in this pond you had the red fishes, they increase their number leading to an increase in the number of predators and those predators are now preying upon the green fishes as well.

So, essentially what these red fishes have done is that they have created a situation in which the green fishes are getting harmed even though that was not their intention, even though they did not want to do that even then just because they increase their numbers, so the green fishes are getting harmed and such a scenario goes by the name of apparent competition. So, we will locate apparent competition in more detail in a short while.

So, to recap competition is the ecological interaction where individuals explore the same ecological niche or their ecological niches partially coincide and therefore, competition for the same environmental resources takes place.

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Now, we will look at some examples of so let us look at these Penguins. So, we went to South Africa and there is a place known as the Boulder Beach. Now on this boulder

which we have a colony of penguins, so these are African penguins that are found in South Africa and most of these penguins were either having an egg or they were even having a baby. So, this was post their mating season.

Now if you observe these penguins they are at a certain distance from each other and this distance is what we refer to as the pecking distance. If these birds were any closer, they would start biting off the other bird because each bird requires a certain amount of space. So, here we have a competition for an environmental resource which is space on this beach and they require this space, so that they are able to make their nest, so that they are able to lay their eggs, so that their babies come out and their babies are able to survive and become the next generation.

So, to do that you require a piece of this sandy beach. Now this sandy beach is not available in plenty, the number of birds is much greater than the amount of sandy beach that is available. So, what they do? They compete for the resources. So, the best bird will get the best location and it will drive off the other birds to those locations that are not that good and if any other bird tries to come within its own territory, it will start to bite that bird or it will start to peck at that bird. So, let us now see how that looks like.

So, what these birds are doing here is that when they come close together, they peck at each other. They show a behaviour that is a behaviour of competition. They want to displace the other one out of their own territory and they then they are also showing a behaviour or a ritualistic behaviour in which this bird which has become dominant. So, it will take its beak upwards, it will start making a display, it will show off its neck and it will make a noise whereas, these birds that have become recessive so they are not as competitive as this bird. So, this one is dominant, this one is recessive.

So, in this situation this bird will show off a display that yes I am the boss here, this is my area, you cannot come into this area and these birds will keep their heads down and they will act in a submissive manner. So, we look at this clip once more. So, just keep an eye out for the dominant and the recessive behaviours when these penguins are fighting for the territory. So, the left bird it took its beak above and this one kept it down.

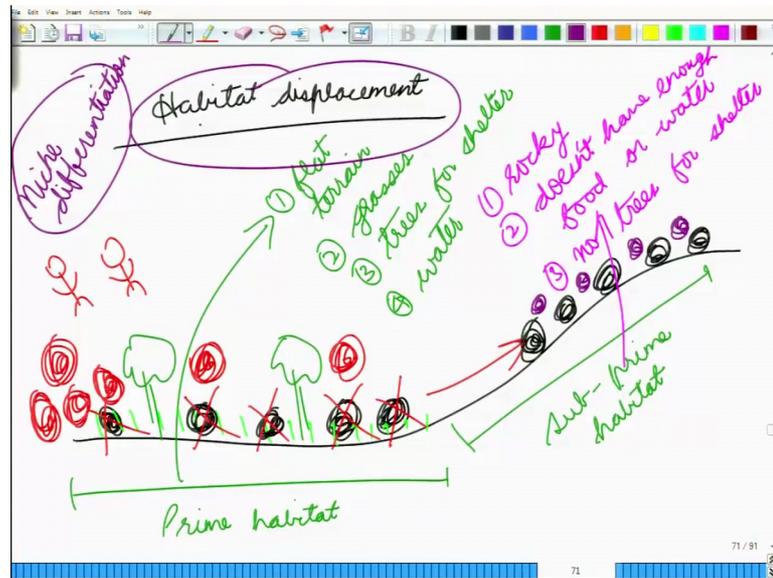
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Another example is the example of these black buck that are fighting for the mate. So, here we have two male black bucks here. We have a female black buck and these two black bucks are fighting to have access to the mate. So, in this case the resource that they are fighting for is not space. You have ample space here. It is not grasses. You have ample amount of grasses here, but they are fighting for this resource which is the mate. So, how do these animals fight?

So, this is how they will fight. So, they will use their horn. So, they have these long antlers and they will use these antlers to fight against each other. So, this one is closer to the female and this one is able to displace the other one away from the female. So, this is black bucks that are fighting for the mate. Now, when such a situation happens when there are organisms that are fighting for a resource, in the case of conservation this can have very significant consequences and one example of that consequence is the phenomenon of habitat displacement.

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Now, what happens in the case of a habitat displacement in this example what you are seeing is that you have these black bucks that are there in this grassland. Now these black bucks feed on the grass and so, they require the grasses to be there and this is one of the best suited locations that they can have to survive. So, they have ample amount of grasses, they have some trees to protect them from the sun if need be and they happily living here.

So, here you have let us say that this area also adjoins say a rocky place. So, you have here a number of grasses and grasses are there on the flat land, you also have some trees that are providing them with shade and then, you have these rocks and then, you have the black bucks. So, you have this one black buck here, one black buck here, one black buck here. So, this whole area is being used by the black bucks.

Now what happens is, if you have say people who bring in cattle into this area, so they bring in this cattle. Now, if cattle come into this area, they would also be herdsmen that would accompany the cattle. So, you will have people who come with their cattle and they want their cattle to graze on these same grasses because these grasses are not only nutritious for the black bucks, they are also nutritious for the cattle and the more nutritious grasses the cattle get, the more amount of milk they would produce. So, the farmers will be happy.

So, in that case what happens is when the farmers or when the herdsmen come with their cattle to this area, they would they probably would also come with some dogs and other stuffs. They would either kill off these black bucks or they would force these black bucks to move somewhere else. So, now this is the most prime habitat that the black buck has.

The black buck has access to food, it has access to shelter, there are also a few water bodies here. So, this is the most prime habitat, but then when the herdsmen come with their cows, they will displace away these black bucks. So, we will have a situation in which these black bucks will get into this location which is a sub prime location and this area will now have the cattle in place of the black bucks.

So, in this case here you have the prime habitat and in this area you have the sub prime habitat. Now why is that so? Because this area is the prime habitat, because it has flat terrain, it has ample amount of grasses, it has some trees for shelter between the summer season, it also has some access to water. Now, this area is a sub prime habitat? Why?

Because this area is see rocky or this area does not have enough grass or say enough food or water or maybe this area does not have trees for shelter. Now, in such a situation we are we observed that these animals are getting displaced out of their habitat into a subprime habitation and this thing is known as habitat displacement. Now in nature what we observe is that in this area you have these black bucks and they are competing against each other. Probably they will also be having some sambars, some chitals and some other such animals nearby.

Now, for instance if you have sambars in this area, you will have a phenomena that is known as niche differentiation in which you will find that the black bucks are most suited for these grassland habitats and the sambars are more suited for these rocky areas. So, they will automatically make use of both these nations, but when humans get into this picture, they tend to displace these animals from their habitat and to conquer those habitats.

So, when we say that man is able to conquer the earth, man is able to conquer the forest and we convert forests into our into areas that we want in the form of farmlands or in the form of habitations. This is what is happening. So, this important phenomenon of niche differentiation and habitat displacement together with the phenomena of computation is very much required also for conservation.

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EXPLOITATIVE COMPETITION	INTERFERENCE COMPETITION
Also called "scramble competition."	Also called "contest competition."
Competition is exploitative when species or individuals compete for the same limited resource.	Competition is interference when species or individuals deplete each other's resources by interferences such as aggressive displays or fighting.
In exploitation, organisms use up resources directly, so it is not longer available for use by others.	In interference, one organism prevents others from using the resources.
There is no direct contact or conflict between the species or individuals in exploitation.	There is direct contact or conflict between the species or individuals in interference.

Now, let us look at different kinds of competition. So, we differentiate between exploitative competition and interference competition. Now, remember exploitative competition is competition where you have a number of animals that are competing for the same resource. So, this is what we had discussed before in the case of exploitative competition. You have all of these herbivores that are competing for the same amount of grassland. In the case of interference competition, you have some animals that are not allowing others to make use of the same piece of grassland.

So, exploitative competition is also called a scramble competition whereas, interference competition is known as contest competition. So, in the case of exploitative competition there is a scramble for resources. Everybody wants to use the same resource. In the case of interference competition, everybody is contesting for the same resource. They are not using this resource, but they there is only a contest.

Now, competition is exploitative when species or individuals compete for the same limited resource that is herbivores that are fighting for the same piece of grassland and competition is interference when species or individuals deplete others resources by interferences such as aggressive displays or fightings. So, you have a dog that is barking and so is not allowing the other animals to get inside in exploitation organisms use of resources directly. So, it is no longer available for use by others. So, essentially if one

cow eats up most of the grass, this grass is not available to be used by other cows. So, the organisms are using up the resources directly.

In the case of interference, one organism prevents others from using the resources. So, it is not using the resources itself. So, when we look at this example of the dog, so here we have this dog that is not using the grassland. It is just preventing the cows or the buffaloes or the cattle to from entering into this grassland.

So, which is why we have this phrase in English there is a dog in the manger which means that you have a dog that is sitting on a pile of hay, it is not eating up that hay and it is not allowing the other organisms to eat up that hay. Now, there is no direct contact or conflict between the species or individuals in exploitation. So, there is no direct contact or conflict because when these cows are competing against each other, they are not competing personally against each other, they are just eating up the resources. So, there is no direct contact between both of these, but in the case of interference competition, there is a direct contact or conflict between the species or individuals in interference.

So, in the case of the dog and the cows, the dog is directly conflicting with the cows.

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EXPLOITATIVE COMPETITION	INTERFERENCE COMPETITION
Competitive ability in exploitation is the rate of resource consumption.	Competitive ability in interference is the ability to put on aggression or fights.
Pure exploitative competition can be modelled as affecting the carrying capacity.	Pure interference competition can be modelled as affecting the rate of increase per individual.
For pure exploitative competition the relation between the rate of change per individual of one species and abundance of the second is non-linear.	For pure interference competition the relation between the rate of change per individual of one species and abundance of the second is linear.

Module 3: Ecological interactions Negative interactions

Exploitative and Interference competition

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Further competitive ability and exploitation is the rate of resource consumption. So, competitive ability of one cow can be defined as the rate at which that cow is eating up the grass. So, the more amount of grass it eats up per unit time, the more is its

competitive ability and the less amount of grass will be available to be used by the other cows in the case of interference competition competitive ability in interference is the ability to put on aggression or fight. So, in the case of interference competition the more amount of fights you can put up, the most of the more amount of aggressive displace that you can do the more, you can bark the more. You can use your horns to keep others away the more is your competitive ability.

Now, pure exploitative competition can be modeled as affecting the carrying capacity. So, when we see carrying capacity, carrying capacity is how much amount of resources are available and how many individuals can survive on that amount of resources. So, for instance if you have a piece of grassland and if you sow some grasses that can grow very fast and are more nutritious, so more number of cows or more number of herbivores can be accommodated or sustained by that piece of grassland.

So, we will say that the carrying capacity is increased. On the other hand if you have a cow that is eating up all the grasses, so less amount of grass is remaining for the other animals. So, we will say that the carrying capacity is not going down. So, pure exploitative competition is where you do not have any amounts of interference maximum.

So, pure exploitative competition can be modeled as affecting the carrying capacity. So, it is as good as you reduce the carrying capacity of the grassland and pure interference competition can be modeled as affecting the rate of increase per individual.

So, basically when the cow eats grass, so it is using that grass or that energy or those nutrients to build up its own body and also to give rise to the next generation of off springs. So, pure interference competition can be modeled as a reduction in the ability of the animals to use the resource. So, even though you have the resource, you are not able to use it.

So, for instance this can be modeled as having like in earlier if suppose 100 kgs of grass was required to give rise to an off spring, now you can say that in place of 100 kgs of grass you will require say 200 kgs of grass. There is an impact on the rate of increase per individual or you can say that earlier you were having an off spring every 6 months. Now you will say that you will have an off spring not every 6 months, but say every 9 months. So, that would be a way of modeling the situation.

For pure exploitative competition, the relation between the rate of change per individual of one species and abundance of the second is non-linear. So, now in the case of exploitative competition, the rate of change per individual of one species and the abundance of the second is non-linear. What do we mean by that? The mode number of individuals that you have of a species, so for instance there is a piece of grassland that is being eaten by cows and buffaloes.

Now, if you have more number of cows, then what is the rate of increase of buffalo's? How does it impact that? So, if you did not have any cows, so the buffalos were having access to all the grass. So, they would use that grass to increase their weight or to increase the total amount of biomass that is available in the form of their bodies and in the bodies of their offsprings.

Now, you put in more number of cows and the amount of grass that is available for the buffaloes is less. So, the rate of increase will reduce, but then the relationship between both of these is non-linear, but in the case of interference competition the relation between the rate of change per individual of one species and the abundance of others is linear.

So, the more number of say dogs you have in your grassland, the lesser would be the rate of increase in the cows or the cattle and this relationship will be a linear relationship.

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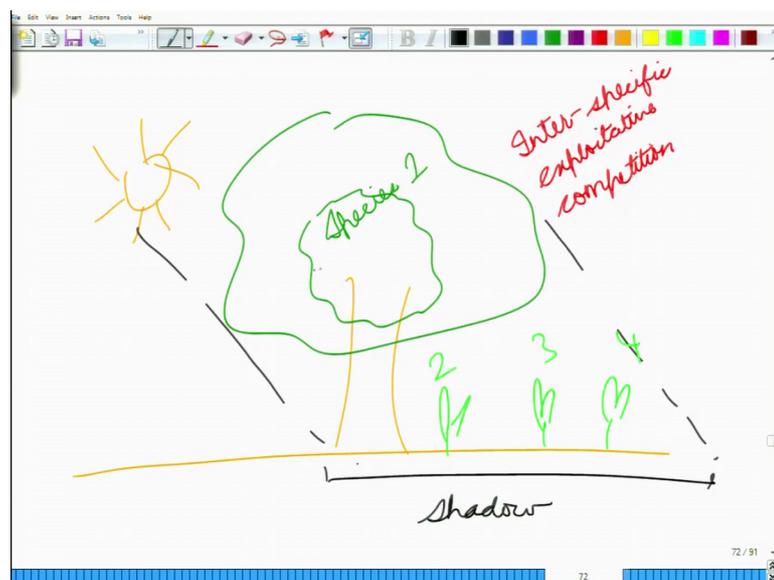
Module 3: Ecological interactions Negative interactions	
Exploitative and Interference competition	
EXPLOITATIVE COMPETITION	INTERFERENCE COMPETITION
e.g. 1. intraspecific: an organism overgrazing on a land shared by several individuals of the species. 2. interspecific: canopy trees of several species competing for the available sunlight.	e.g. 1. intraspecific: an animal showing territorial behaviour to its conspecifics. 2. interspecific: allelopathy.

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Now, let us look at some examples of exploitative and interference competition. Now, an intraspecific exploitative competition is an organism over grazing on a land shared by several individuals of the same species. So, for instance you have a grassland that is being grazed by a number of cows. So, in this case every cow is doing an exploitative competition against every other cow that is present on the same piece of grassland. So, this is an intraspecific competition and it is between animals of the same species.

Now interspecific competition. So, in this case you have the same piece of grassland that is being grazed by cows as well as buffalos. So, the so the interaction between the cow and the Buffalo, one cow and one buffalo will be an interaction of exploitative competition which is interspecific in this case because you have cows that are competing with buffalos members of another species or another example is canopy trees of several species competing for the available sunlight. So, what do we mean by this?

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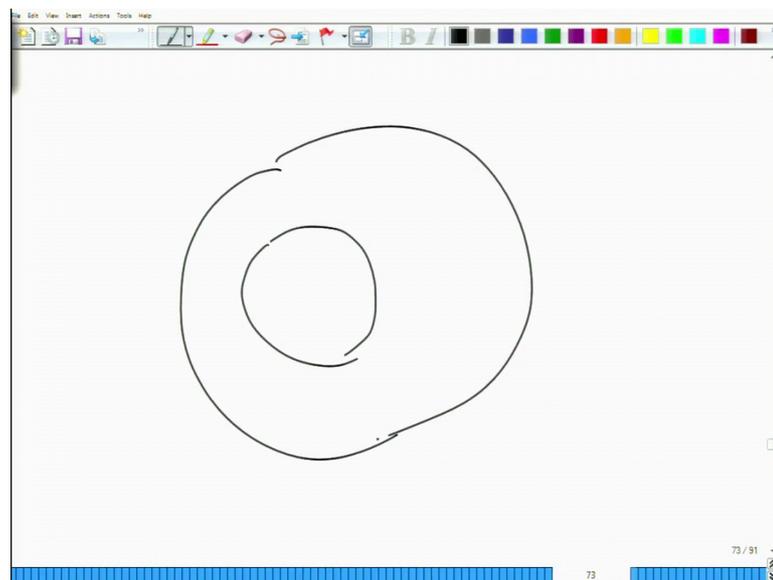
In a forest or in any piece of land the amount of sunlight that is available is limited.

So, if you have a tree. So, this tree is now casting shadow. So, this is the shadow region and if you have saplings here of different species, so all of these species are now not able to get access to the sunlight because of the presence of the first tree. So, because you have this tree of species 1, these saplings of a species 2, 3 and 4 are also not able to get access to the sunlight. So, this is an example of interspecific because this concerns two different species.

So, this is inter specific competition because they are competing for the same resource and this is an exploitative competition because the more the first species is consuming, the lesser is available for the rest. So, for instance in place of this canopy if you had a smaller canopy say if this was the canopy. So, in that case the amount of the shadow region would have been lesser and so this individual would have survived.

So, this is an example of an, inter specific exploitative competition. Now if you look at interference competition, the example in the case of intraspecific competition is an animal that is showing territorial behaviour to its conspecifics. What does that mean? When we looked at the penguins and there was a penguin that was not allowing the other penguin to use that resource, now it is also possible that in place of using.

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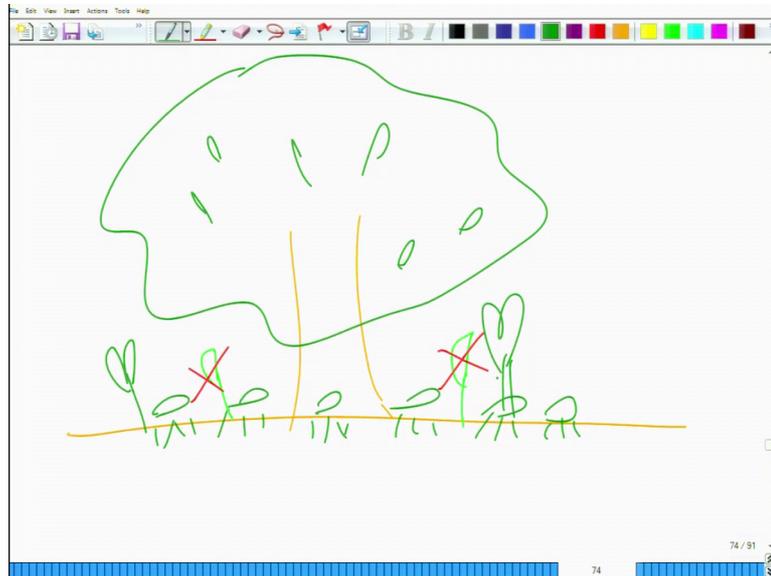


So, suppose there is a penguin that requires this much space, but it is also possible that it shows an aggressive behaviour for this much of a space. So, in that case the penguin does not require that much amount of space, but it is not allowing others to make use of that space. So, this will be an example of an intraspecific because there is one penguin that is competing against another penguin a member of the same species.

So, it is intraspecific interference competition interference because they are both directly involved with each other. There this interaction is one on one and it involves aggressive displays, it involves fighting and in the case of interspecific interaction, we can have

allelopathy. Now, what is allelopathy? Allelopathy is a situation in which now to take our same example of the tree in the forest.

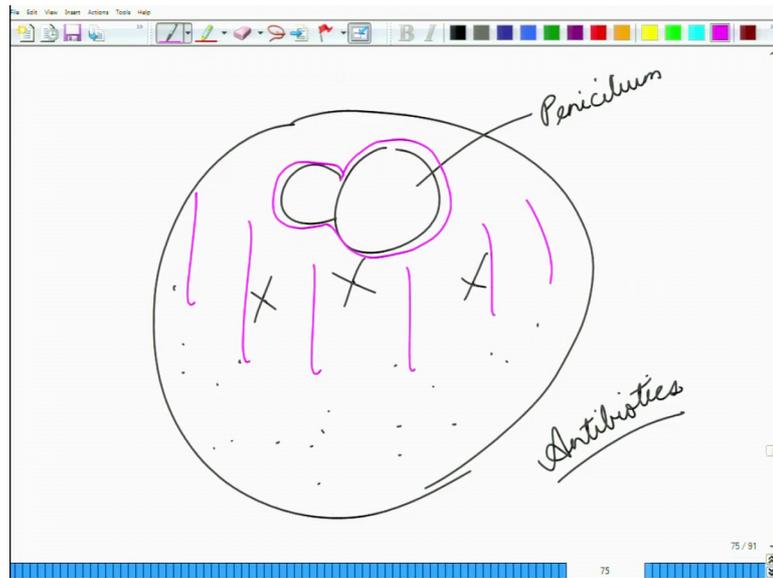
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So, you have this tree and the say the leaves of this tree when they come down. So, when they die off and they come down here, so they release some chemicals into the soil and those chemicals do not permit saplings of other species to thrive.

So, because of these chemicals these saplings would die off whereas, the saplings of their own species would survive because they are not because they are resistant against their own chemicals. So, this would be known as allelopathy. Another good example of allelopathy is what we saw in the previous lecture.

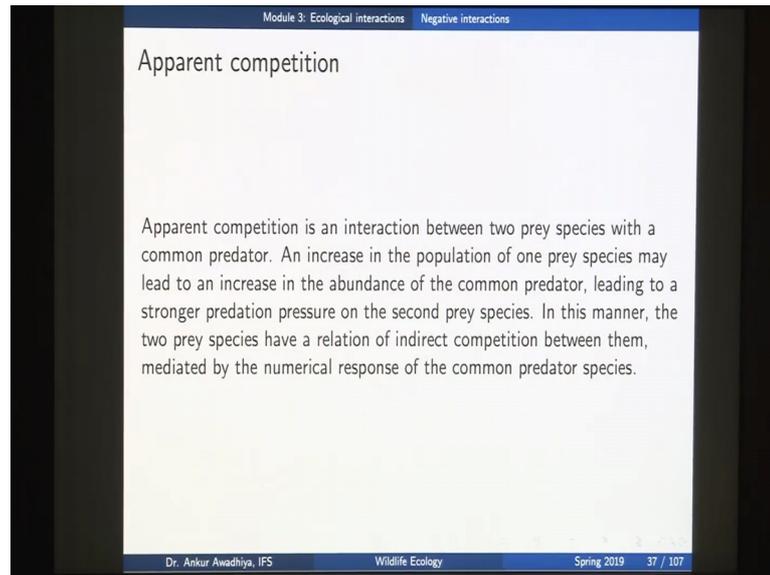
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So, you have this petri dish and you had these fungal colonies of penicillin or penicillium and you had these bacterial colonies and the bacterial colonies that were close to the to the penicillium colony. Because of the impact of penicillin, they were dying or they were lazing of. So, antibiotics again are some chemicals that are released by one species to kill off or to retard the growth of members of another species.

So, this is also an example of an inter specific. It has two different species; fungus and bacteria interference competition. Why does interference competition? Because in this particular example the colony of fungus is only using up this amount of area on the agar it is not using this area, but still it is not permitting anybody else to come here very much like the situation of our dog that was preventing other animals from getting into the grassland. So, this is an interspecific interference competition.

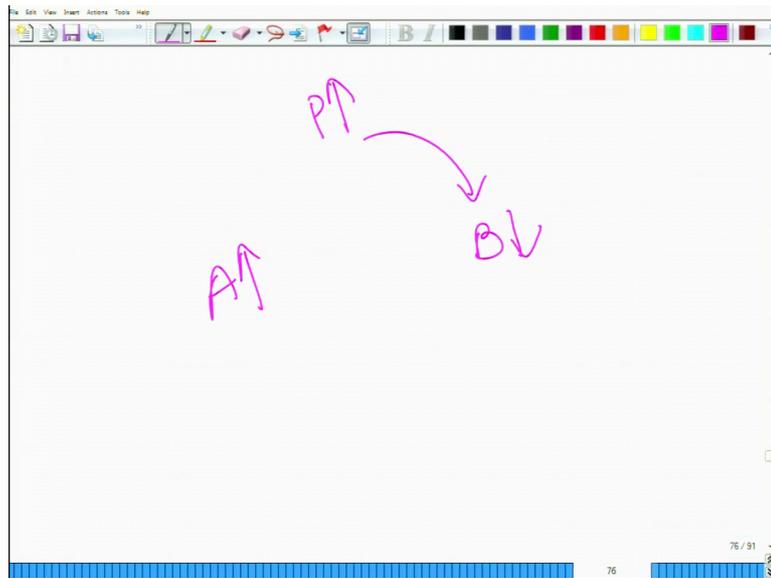
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Now, apparent competition as we saw before is an interaction between two prey species with a common predator. So, in this case there are two prey species that are competing against each other just because you have a common predator. So, you have for instance chital and sambar and so, if the number of sambars increases, so tigers would get more amount of sambas. They will get more amount of nutrition, more proteins. So, they will grow up, they will reproduce much more because you have an ample amount of food in the environment the number of tigers grows up and then, these tigers also start killing up the chitals.

So, sambars are competing against chitals not directly not because of using this the same resource, not because they are showing up a display of aggression, but just because they have a common predator. So, apparent competition is an interaction between two prey species with a common predator and increase in the population of one prey species may lead to an increase in the abundance of the common predator. In this case the tiger leading to a stronger predation pressure on the second prey species; in this manner the two prey species have a relation of indirect competition between them mediated by the numerical response of the common predator species.

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So, essentially here we have two species A and species B and you have a common predator P. So, if A increases that would cause P to increase. The predator increases and when the predator increases, that puts the pressure of the population of B down. So, the increase in A is also leading to a decrease in B. So, this is an apparent competition.

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Module 3: Ecological interactions Negative interactions

Apparent competition

Apparent competition has several interesting characteristics¹¹:

- 1 Generally, the predator in cases of apparent competition is a food-limited generalist species.
- 2 Some prey species act as "keystone" species in the community.
- 3 At times some prey species may even get excluded from the community through diffuse apparent competition.
- 4 While the prey trophic level as a whole gets regulated by the predator, each prey species is regulated by an ensemble of the predator along with the available resources.

¹¹Robert, D.H., 1977. Predation, Apparent Competition, and the Structure of Prey Communities.

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Now, it has several interesting characteristics. Generally the predator in case of apparent competition is a food limited generalist species. Now, what do we mean by generalist species versus specific species? A generalist species is something that is not very

particular, not very choosy about what it wants to eat. So, it will eat up A and it will also eat up B. So, it is a generalist species, it is a food limited species.

So, the number of predators that are available in the environment are only limited by the amount of food. So, only in that situation will have a situation of apparent competition because suppose you have this population of P that was limited not by food, but say because of some diseases. So, in that case any increase in A would not result in an increase in the P population and so will not result in a decrease in the B population. So, this is only possible when you have a food limited generalist species.

Now, some prey species act as keystone species in the community. Now some prey species act as keystone species and a good example is that of the fig trees. Now, fig trees are keystone species because their impact on the ecosystem is much greater than their numerical abundance. So, what happens in the case of forests is that, in the summer season you do not have a very large amount of or a very large variety of food that is available, but fig trees because most of their parts are edible, their leaves are edible, their fruits are edible, their flowers are edible, so they act as a source of food in the case of the dry season as well now.

When the number of fig trees increases, when the amount of food that is being provided by the fig trees when it increases, the birds that are feeding on the fig trees they also increase in their numbers and when that happens these birds will also go on aiding other trees that are available in the vicinity that have any edible portion.

So, essentially in this case the fig trees are doing an apparent competition to the other species even though they are the keystone species for the whole of the ecosystem. At times some prey species may even get excluded from community through diffuse apparent computation and so there are also situation in which some prey species may even get extinct not just excluded when the prey trophic level as a whole gets regulated by the predator. Each prey species is regulated by an ensemble of the predator along with the available resources. Now this is something that will consider in more detail in the next module.

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Module 3: Ecological interactions Negative interactions

Apparent competition

Such examples are observed in

- 1 insect host-parasitoid communities¹²
- 2 exotic shrubs and trees through the action of seed predators¹³
- 3 grasses and plants through rodents¹⁴.

¹²Holt, R.D. and Lawton, J.H., 1993. Apparent competition and enemy-free space in insect host-parasitoid communities. *The American Naturalist*, 142(4), pp.623-645.

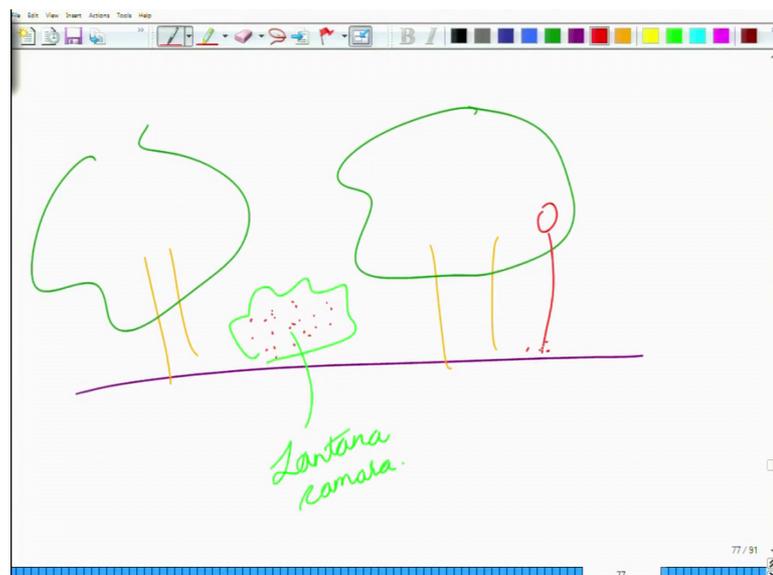
¹³Meiners, S.J., 2007. Apparent competition: an impact of exotic shrub invasion on tree regeneration. *Biological Invasions*, 9(7), pp.849-855.

¹⁴Dangremond, E.M., Pardini, E.A. and Knight, T.M., 2010. Apparent competition with an invasive plant hastens the extinction of an endangered lupine. *Ecology*, 91(8), pp.2261-2271.

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Now, some examples that are observed are insect host-parasitoid communities. So, you have insect host and you have some parasitoids. So, parasitoids are more like parasites that live inside the bodies of these animals and are later able to kill these insects. So, the more number of insects that you have, the more amount number of parasitoids that you will have and these parasitoids will also act as a decimating factor for other insect species, also exotic shrubs and trees through the action of seed predators.

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So, what happens in this case is suppose you have a forest and in this forest you have certain trees and then, you have a bush and that goes by the name of Lantana. Now, lantana is an exotic shrub. It is not native to India, it comes from Africa and this lantana has flowers and fruits and it gives off flowers and fruits in a very large number. The fruits are edible.

They are eaten up by a number of birds and these fruits are sweet and the seeds that are inside are able to survive through the gut of the birds and when these birds sit somewhere else and drop these seeds, so this lantana will be able to spread there, but then another thing that we observe in this case is that when you have this lantana around, it will give out so many number of fruits, so much amount of seeds that the number of seed predators would grow, would go up what are these seed predators things like birds.

Now, when these bird populations have exploded, so these birds will also start eating up; because they have because now you have more number of birds. So, these birds will also eat up the fruits and the seeds of the other species. Now lantana is able to give out so many number of fruits and seeds, but other plants might not be having the same mechanism. So, in that case lantana would spread, but the other plants would get decimated. So, this is also another example of apparent competition.

Another example is grasses in plants through rodents. So, for instance if you have grasses, so something like bamboo. Now, bamboo is a species of grass and when bamboo flowers and when it gives out seeds, the seeds are extremely nutritious and those seeds will lead to a boom in the population of the rodents. When the rodent numbers would increase, they would also feed on other species and they will also decimate other plants. So, this is also an example of apparent competition.

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Module 3: Ecological interactions Negative interactions

Apparent competition

Apparent competition results in the reduction of the prey species' equilibrium densities and growth rates, and is a common phenomenon observed in several food webs¹⁵. It helps us understand the dynamics of predator-prey systems, and provides insight into the top-down regulation in food webs. It helps create positive feedback loops for invasive species, enabling them to quickly colonise newer areas by negatively influencing the established species. Thus, an understanding of the phenomenon is critical for the proper management, conservation and health of ecosystems.

¹⁵Holt, R.D. and Bonsall, M.B., 2017. Apparent competition. *Annual Review of Ecology, Evolution, and Systematics*, 48, pp.447-471.

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Now, apparent competition results in the reduction of the prey species, equilibrium densities and growth rates and is a common phenomenon observed in several food webs. It helps us understand the dynamics of predator, prey systems and provides insight into the top down regulation in food webs.

So, top down regulation in food webs is something that will discuss in the next module. So, essentially in the case of any food web, you can have interactions that go by the name of trophic cascades. In the case of trophic cascades, you work on the very top predators and when you work on the top predators, you can have an impact on the other trophic levels as well.

So, for instance in this case when you are working on the top predator which is the bird, you increase the number of birds that are there in this system. So, you can also modulate the other shrubs that are available in this system. So, the other shrubs will get decimated because you have the Lantana here. Now apparent competition, it helps create positive feedback loops for invasive species. Lantana is an invasive species and it creates a positive feedback loop. Why? Because when you have Lantana when you have this invasive species, it will give out a large number of fruits.

Those fruits will be eaten up by the predators, the birds, the bird numbers would go up, these birds will also eat up the other fruits and the other shrubs that are there in the vicinity. So, the other populations will get decimated when other shrubs die off. So, quite

a lot of space is created in this ecosystem for lantana to take over. So, when lantana comes into this forest, this lantana would spread like anything because just because this lantana is there other species will get died off. When they die off, you have land available that can be taken up by the Lantana.

So, it creates a positive feedback loop for the invasive species enabling them to quickly colonize newer areas, find negatively influencing the established species because the established species will be eaten up by the birds. Thus an understanding of the phenomenon is critical for the proper management conservation and health of the ecosystems.

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Module 3: Ecological interactions Negative interactions

Cannibalism

Definition

"Cannibalism is the act of one individual of a species consuming all or part of another individual of the same species as food."

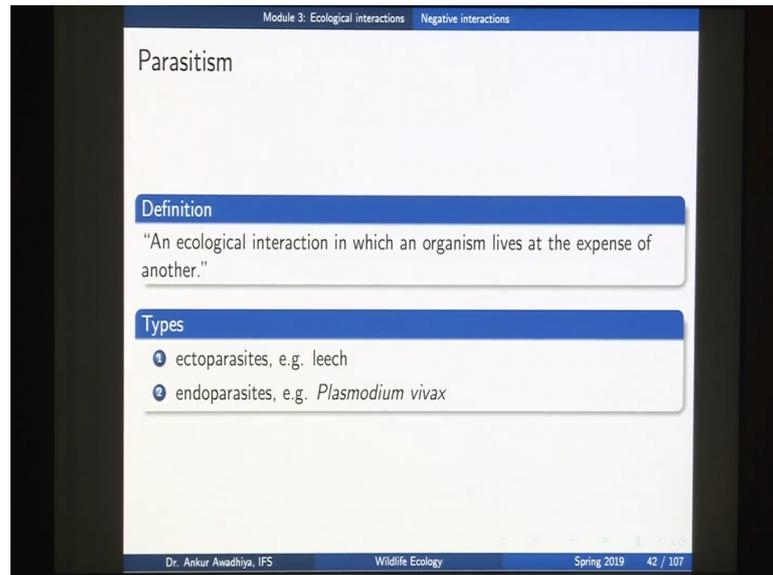
Examples

- 1 Sexual cannibalism in black widow
- 2 Sexual cannibalism in praying mantis

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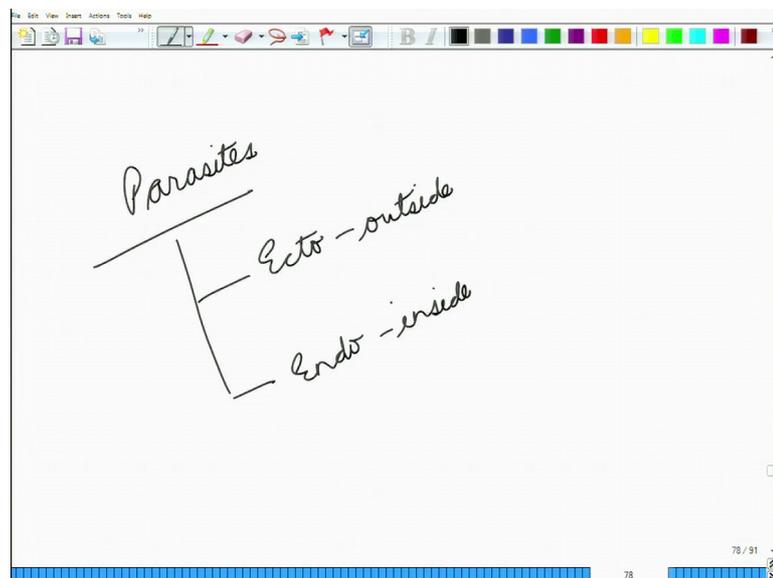
Next you look at Cannibalism. Cannibalism is the act of one individual of a species consuming all or part of another individual of the same species is food and this is something that we know very well. Examples are sexual cannibalism in black widows and sexual cannibalism in praying mantis. So, for instance in the case of black widow after the mating process is done, the female will eat up the male. So, it will use the male as a food source. So, that is an example of cannibalism.

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Next is Parasitism-an ecological interaction in which one organism lives at the expense of another. So, you have an organism that is living off the body of another organism and the examples are ectoparasites. Ecto is outside. So, in the case of parasites, you can have ectoparasites ecto is outside.

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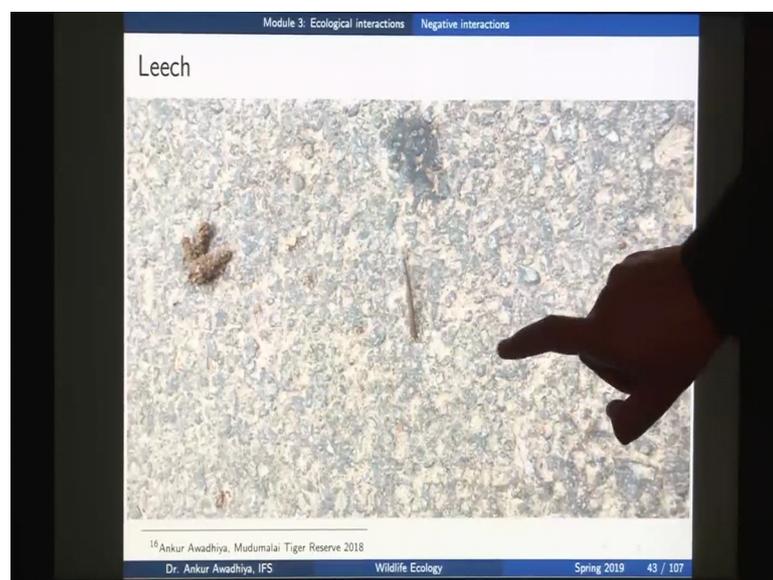


And you can have endoparasites, endo means inside. So, ectoparasites live outside the body of their host. So, a good example is leech. So, leech lives outside the body of the host, but when it gets into contact with the organism with its host, it sucks out blood

from the host and then, it is able to live off the blood. Endoparasites on the other hand live inside the body of the host. So, an a good example is the malarial parasite. So, malaria happens because of this protozoan plasmodium vivax and when you have plasmodium vivax, it is a parasite it lives inside the body, it lives in the blood vessels along with the blood cells.

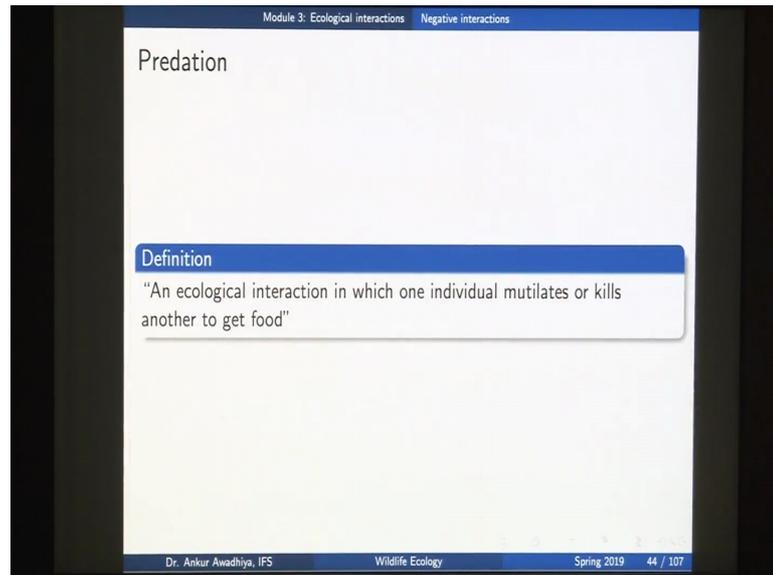
So, this is how a leech looks like. So, this is a leech that is moving on the surface of road. So, it moves with the salutatory motion. So, in this case it will use its top to get access to this land, then move back, then move like this and this. So, this is the way in which leech moves.

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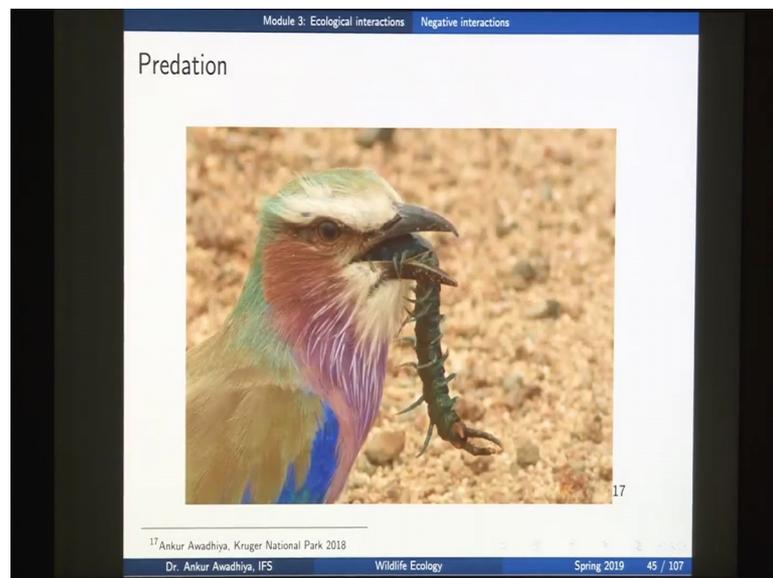
So, you have the surface, it moves, it takes the first hand forward, then moves back and then moves the second portion, then again it moves like this. So, this is the salutary motion that is used by leech. Let us look at it again. So, here we are observing a leech that is moving on the surface of land when it gets contact with one of its hosts. So, for instance when it gets into contact with the cow or with a buffalo or with say a sambar or a chital, it will attach itself to the skin of that animal and it will start sucking up blood from that animal. So, this is an ecto parasite.

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Now, the next negative interaction is predation. Predation is an ecological interaction in which one individual mutilates or kills another to get food. So, in the case of predation there is an organism that is killing off another organism, an organism of another species to use it as food and we saw an example of predation before.

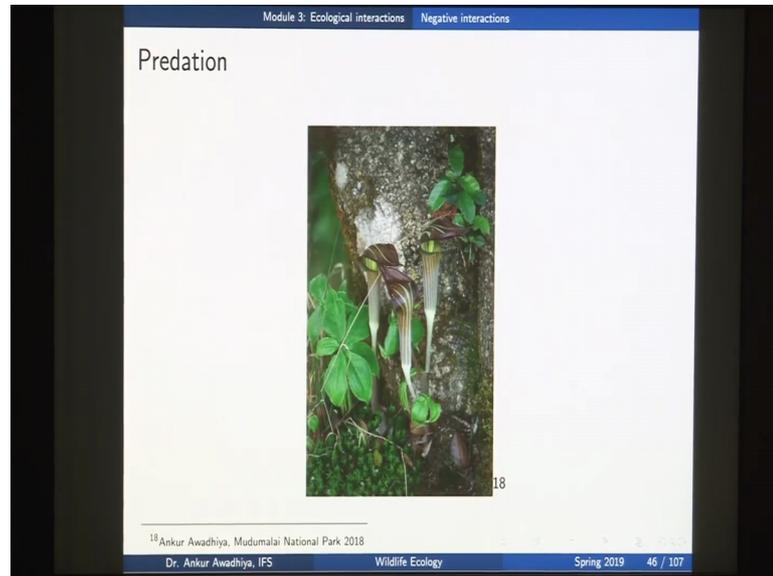
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When we saw that this bird called roller was eating up the centipede. So, now, this we say that this is the predator, this is the prey and the predator is predated upon the prey. So, this sort of an ecological interaction now here the predator is getting a benefit, the

prey is suffering a loss, the predator is getting food, the prey is getting eaten up and dies in the process. So, this process is known as predation and predation is not just common in the animal world.

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We also see it in the case of plants. So, now this is a Pitcher plant. Now, in the case of a pitcher plant so these are modified leaf structures and in this you can see that this is a funnel like tube. So, this thing is called a pitcher and then, this is the lid. Now in this pitcher plant, you will have the inside surface of this top lid will give out some sugary secretions.

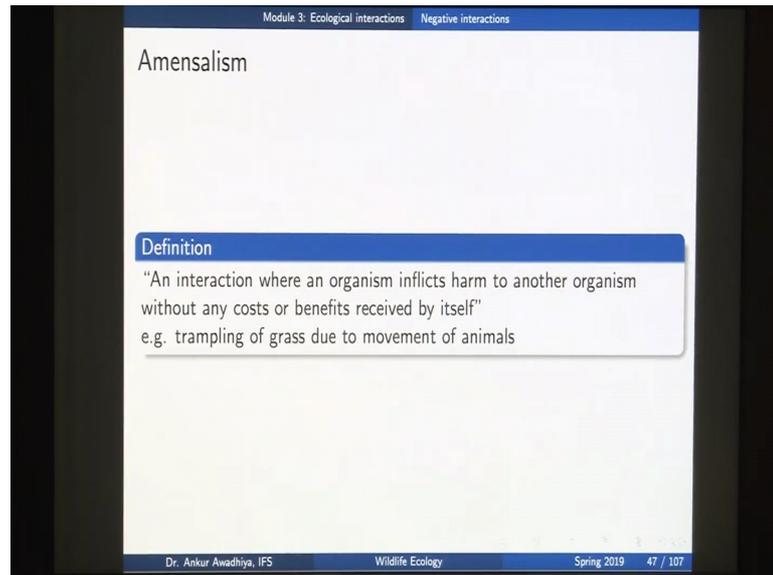
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So, for instance if we say that this is a pitcher. So, now this is a pitcher and then this is the top lid. So, what happens is this top lid, it will have a number of hairs and it will have a very smooth surface. So, it is so smooth that any organism is not able to sit here and it will give out some sugary solutions at this end which will act as a bait for the other insects.

Now, if an insect comes to eat this bait, so it has to come to this portion and as soon as it comes here because it is extremely slippery, it will fall inside the pitcher. So, this is a pitcher plant and this is an example of predation that is being done by plants. Another example is the Venus Flytrap. Now another interaction goes by the name of amensalism.

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Now, amensalism again is a negative interaction. It is an interaction where an organism inflicts harm to another organism without any cost or benefits received by itself. So, there is one organism that is harming another organism, but in return it is neither getting a benefit nor is it getting a harm and a classic example is the trampling of grass due to the movement of animals.

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So, for instance we saw these black bucks that were there in Velavadar. Now Velavadar black bucks are feeding on this grass. So, when they are feeding upon this grass, this

would be called as a form of predation herbivory predation, but when these are not eating up the grass, when they are just walking around, then also they are trampling up the grass plants. So, when they are moving and they are trampling the grass, so grass is suffering a harm, but this movement or this trampling is neither giving this black buck any benefit nor is it giving it any amount of harm. So, such kinds of interactions where one organism gets harmed, but the other organism neither gets a benefit nor a harm goes by the name of amensalism.

So, in this lecture we continued our discovery of the ecological interactions, we looked at positive interactions in the previous lecture and in this lecture, we concentrated on the negative interactions. The negative interactions can be intraspecific or within the same species or it can be interspecific or between two different species. A very good example of negative interaction is competition. Now, in the case of competition you can have interference competition, you can have exploitative competition or you can even have apparent competition.

Other negative interactions include parasitism or predation or amensalism and so on. So, a study of these interactions is extremely crucial for Ecology because it helps us understand how this system is working, how any ecosystem is working, how different populations in a community are interacting with each other. Now, different individuals are interacting because they want some benefit out of the other organism because they want to maximize their own fitness.

So, every organism wants to have the maximum share of resources. It wants you have the maximum amount of nutrition, so that it can give of a large number of off springs and most of those off springs should be able to survive to the later generations. So, for that it will fight for a territory, so that it has an exclusive access to that resource and it can make that resource available to its off springs as well for instance. So, that is all for today.

Thank you for your attention. [FL]