Basic Course in Ornithology
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Nature Conservation Foundation (NCF)

Lecture -25
Mixed Species Flocks Live Session

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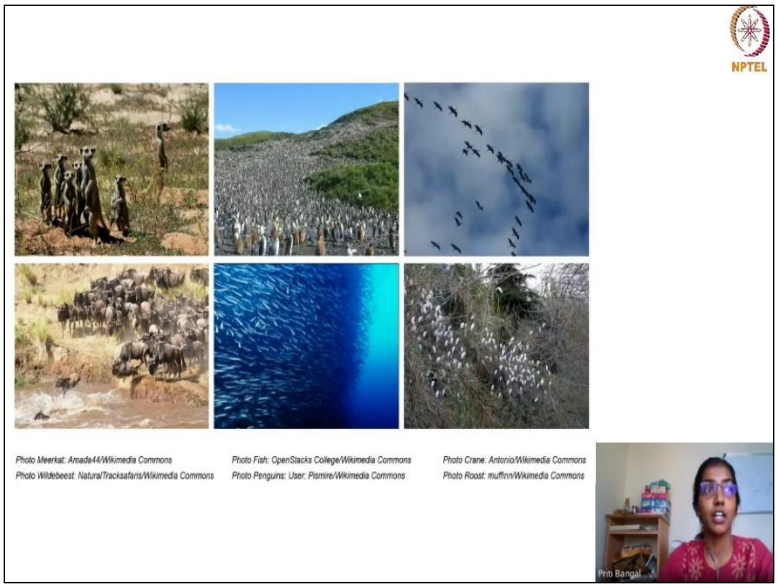

So welcome everyone today as the title suggests I will be speaking to all of you about mixed species bird flocks. But before diving in we are going to start with a little bit about animal groups because at the end of the day essentially bird flocks are an animal group right. So, animal groups are ubiquitous in nature and you see them in several different taxa are in several different contexts as well.

And some of these groups are more structured the others are extremely non-structured and some have specific functions. For example, here in this slide you can see a Meerkat family. So, there are family groups that have different individuals and hierarchies, hierarchy levels. Here you can see a large congregation of penguins it is likely that several of these individuals are distantly related to each other whereas some may be close (more closely) related to each other.

You see this flying flock of birds, you see a large group of wildebeasts, a large group of shoaling fish and also a group of birds. You may have guessed by now that these are several different

contexts, there are migratory birds that are flying, wildebeast are known to migrate in large herds and fish are known to school in really large numbers in open oceans. All the examples that we are talking about right now are of single species groups.

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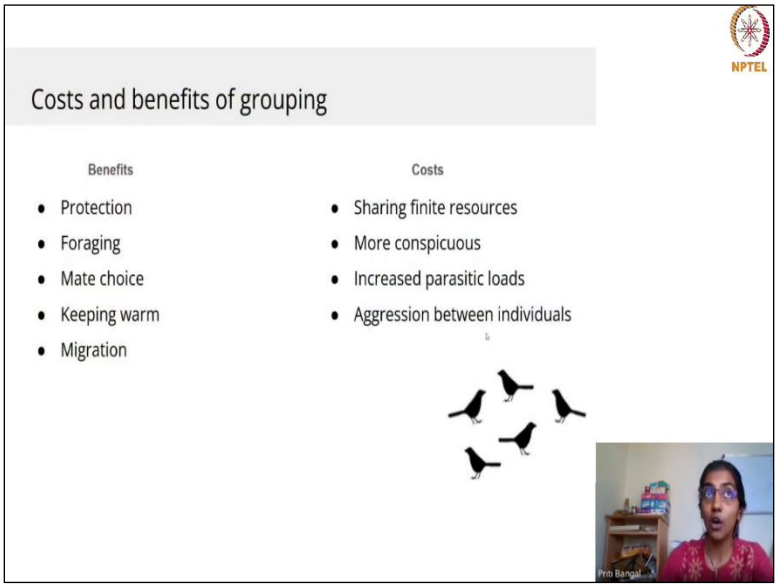

But there are still costs and benefits of grouping and some of the main benefits that we can possibly think about which you can also possibly think about that are related to grouping. There are some examples that can benefit the individuals in terms of protection right protection from any kind of threat. This could be a predatory threat, it could be a threat from other factors in the environment. Groups are also known to increase the foraging of individuals that participate in these groups, individuals are better at finding food. There are groups related to mate choice as well. I do not know how many of you may have heard about this but there are groups called ‘leks’. If you do not please do go and Google it and it is a really fascinating phenomenon. But groups do also play a part in mate choice. Penguins are known to huddle together to keep warm and of course groups are also seen in a migration context and are known to reduce the cost of movement for bird flocks.You may have seen videos and pictures of birds that migrate and certain formations to reduce the cost of the movement. At the same time there are also costs to grouping. First of all, if you are in a large group and the resource that you are targeting is finite in nature (it is limited in nature), it may lead to competition and you will have to share the finite resource. So, that is one of the many important costs of grouping. Groups which are large in size also tend to be more conspicuous. So, it can attract the attention of predators. Groups are also known to have increased

parasitic loads. An excellent example of this parasitic load and disease risk in groups is seen in the current times right. Whenever there is a surge in Covid numbers people are discouraged from gathering in large numbers. This is because, diseases can transmit really easily in large groups, in larger groups there is also likely to be aggression between individuals. There are more chances of there being conflict and that can lead to aggressive encounters between individuals could also possibly lead to injury. So, there are definitely some benefits and both costs like you can see that we have discussed are related to grouping.

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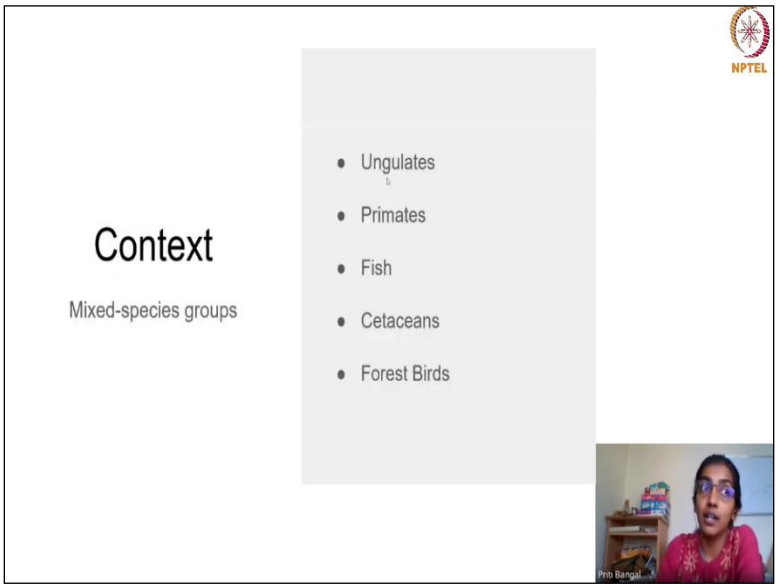

Some of these specifically, in a single species context, but we are going to talk about groups that are mixed species groups in today's talk right. And before moving on specifically to birds, I would like to introduce you all to the different contexts in which mixed species flocks are found or the different animal taxa are in which mixed species groups are found. So, there are mixed species groups in ungulates which are seen very typically in the African savanna as you will see wildebeest and Zebras foraging together, different kinds of gazelles different species of gazelles that are feeding together in the African savannas.

Mixed species groups are also seen in primates where different species of primates associate with each other while they are foraging. Reef fish is an another excellent example of mixed species grouping, there are different species of surgeon fish, parrot fish, that forage in coral reefs but mixed species associations between fish are also seen in open waters which are not always only feeding

associations but they may be only shoaling associations. Mixed groups are also seen in Cetaceans like dolphin, dolphin pods are known to have more than two species of dolphins. And some of the best known and most well studied examples of mixed species groupings are those of forest birds and we will be speaking more about mixed species flocks of forest birds in today's lecture.

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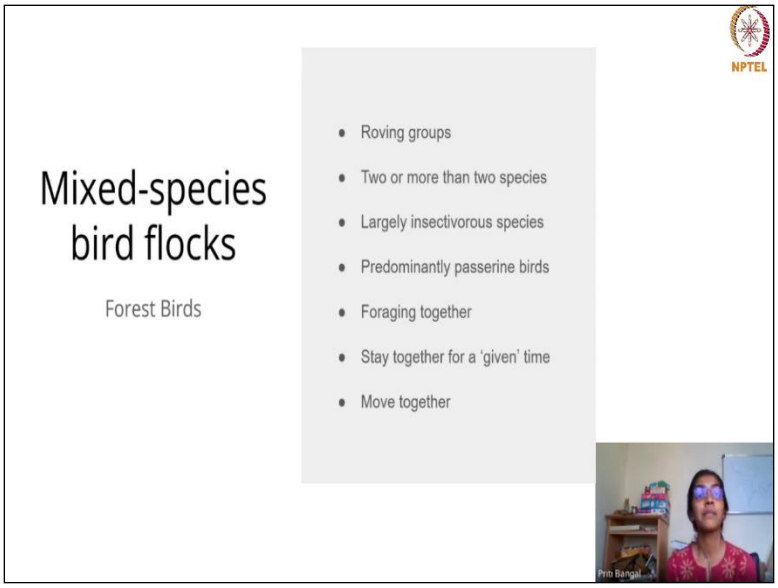

So, what are mixed species flocks of forest birds? Some of you may already know but just to go over the basics these are roving groups by that I mean these are groups that move from place to place which are composed of typically two or more than two species. Some may have several individuals in several species and they are largely composed of insectivorous species of birds. Now that is not to say that you will not find an occasional frugivore that participates in these mixed species flocks of forest birds right.

You will see occasionally a bulbul or a barbet that joins the mixed species groups of birds and you may also see a sunbird but whether or not the bird is part of the flock will be determined by a few different factors which we are going to talk about. So, these forest bird flocks are also predominantly small bodied passerine birds. Again, there are a few exceptions to this there are woodpeckers sometimes some corvids that participate in forest bird flocks.

And what these forest bird flocks are largely doing when they are together is that they are foraging, they are looking for food they are navigating the understory and the canopy of the forest they are

moving together. They are known to stay together for a given time. Now, I say quote unquote given because this definition of a mixed flock varies from study to study a little bit and different researchers over the many years have defined it according to what suits that particular habitat the most.

But there is definitely a time factor involved when you consider forest bird flocks right how long are the birds staying together and the last but not the least that they are also moving together while they are feeding in these flocks.

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And why do I emphasize on the movement part. So, to understand that let's try and understand what do not qualify as mixed species flocks in today's classes as such. So, let us say you are watching a beautiful *Ziziphus* or *Ficus* tree which has lovely fruits and a flock of bulbuls and some green pigeons and some barbets descend on this tree. There are more than two species of birds on this tree.

However, you have to understand that these birds are there primarily for the fruiting resource that they are attracted towards the street they descend on the tree at best they can be called an aggregation at a fruiting resource. These are stationary associations. Similarly, you may see multiple species of birds that gather at a flowering bush which are there primarily for feeding on the nectar of that flowering bush.

And you may also see several water birds that have aggregated at a water body, they are primarily there for the food resource that is present at the water body. So, this is although these groups of birds do have multiple species in them, these are not what we are going to be talking about today. Rather, we will be talking about mixed species forest bird flocks which are mostly composed of insectivorous birds.

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So, where are these bird flocks found? I have been telling you that there are these groups of birds that are found in the forests and they are you know they are feeding together and so on. Here is a map of the world and the black dots represent all the areas, all the regions where mixed flocks have been studied all across the world. And you may notice that mixed flocks are practically found in every continent except Antarctica.

So, forest bird flocks have been studied in all continents in the world in the tropical forest in temperate forests and in several different ecosystems.

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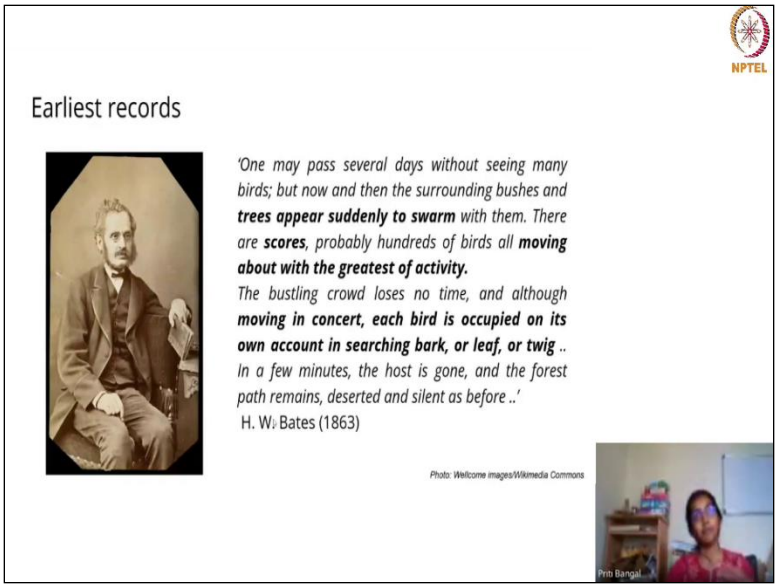

Some of the earliest records of mixed species flocks come from as long ago as 1863 where the naturalist Bates recorded them in his natural history writing. So, here is a little bit of a story an anecdote about Bates. Bates traveled to the Amazonian rainforest with Alfred Russell Wallace when he was on his natural history tour and Bates stayed in the Amazonian rainforest for a long time and he did he made really interesting collections of insects and other invertebrates and butterflies and several other things.

But Bates also wrote this really interesting volume called "Naturalist on the river Amazon" and in that volume Bates has a really nice description of mixed species flocks. Let us try and read this together and we can we can then see how we relate to this experience . So, what Bates says is that '*one may pass several days without seeing many birds; but now and then the surrounding bushes and trees appear suddenly to swarm with them.There are scores, probably hundreds of birds all moving about with the greatest of activity. The bustling crowd loses no time and although moving in concert, each bird is occupied on its own account in searching bark, or leaf or twig. In a few minutes, the host is gone and the forest path remains, deserted and silent as before..*' I think that Bates describes an experience of a naturalist who is walking around the forest searching for birds really well.

On one day you are out there searching for flocks and you see no activity at all and in a second there are suddenly there is this bird wave that comes in and each bird is busy looking under the

leaves under the bark and the nooks and corners and the forest crevices and the leaf litter and it sounds like a really busy party of birds that has suddenly come into the forest. So, yeah flocks have been recorded as long ago as in 1863.

And Bates also writes that in in his time that indigenous people reported the existence of this particular species that they called and this Uirapuru bird was there was a story that the indigenous people there told that the Uirapuru leads a bunch of other birds into the forest and the birds are singing and dancing and following this bird as if almost as if they are in a trance. So, that also sort of indicates and hints towards observations of indigenous people which were probably reduced to a myth because of lack of evidence but Bates does report that also in his in his book.

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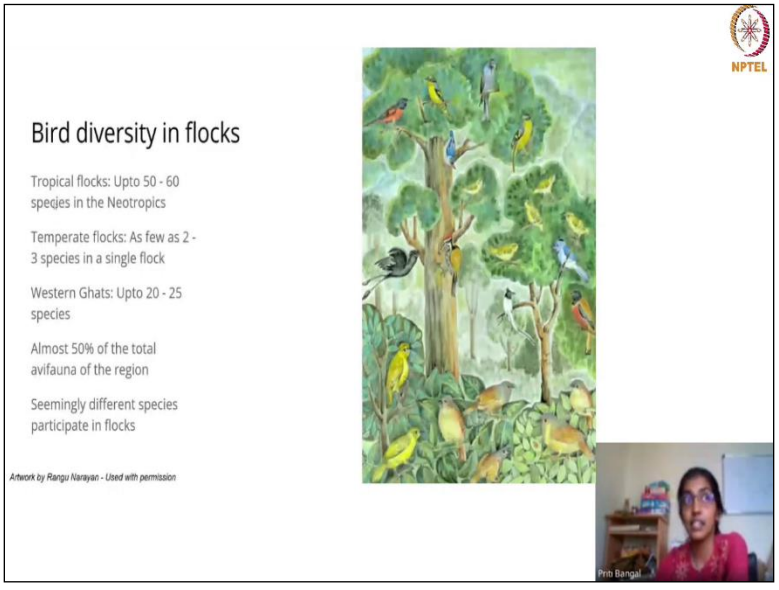

Coming back to the flocks that we are talking about today, a little bit about the diversity that is seen in flocks. So, like I described flocks are found in tropical areas as well as temperate areas and to give you an idea of how many different species participate in flocks. And how many different species participate at the same time in tropical flocks in the neotropics which is in south America and central America, one can see up to 50 to 60 different species in a single flock at the same time. People have recorded this.

And sometimes the number of individuals can go up to over a 100 individuals in a single given flock. The other extreme are temperate flocks, they may sometimes have as few as three species

in a single flock just a handful of species that are feeding together and these are also temporary associations. Closer to home in the western ghats here, we have seen up from of about 20 to 25 species of birds participate in flocks at the same time.

But this is of course the extreme end higher extreme of the numbers that I am presenting to you right now. But on an average, if you go out, you would see about 7 to 8 different species of birds participating in species flocks. In some parts of the world, almost 50% of the total avifauna of the region is known to participate in flocks and some birds depend on obligately on feeding in these flocks. By obligately, I mean that they exclusively feed on in mixed species flocks and depend on mixed species flocks for their foraging.

And if you look at this picture, it is an artist's representation of a flock that is seen in the western ghats of India. And you can see that seemingly, at a first glance it feels like so, many different kinds of birds. They look so different from each other participate in flocks. Here to tell you a little bit, you can see a woodpecker that is digging into the bark of the tree, you can see a Drongo or Racket tailed Drongo that is flying by, these two little yellow birds in the left corner.

Left bottom corner are the Bulbuls (two Yellow browed Bulbuls), there is a bunch of Fulvettas on the bottom right and there is a Paradise Flycatcher, some warblers, Nuthatch creeping up and down the trunk of the tree, there is a Trogon that is sitting, there are Minivets and there is an Ashy Drongo. So, so many different species there is so, much activity it really brings out the essence of how a flock might be in the forest and what kind of activities may be going on in these flocks.

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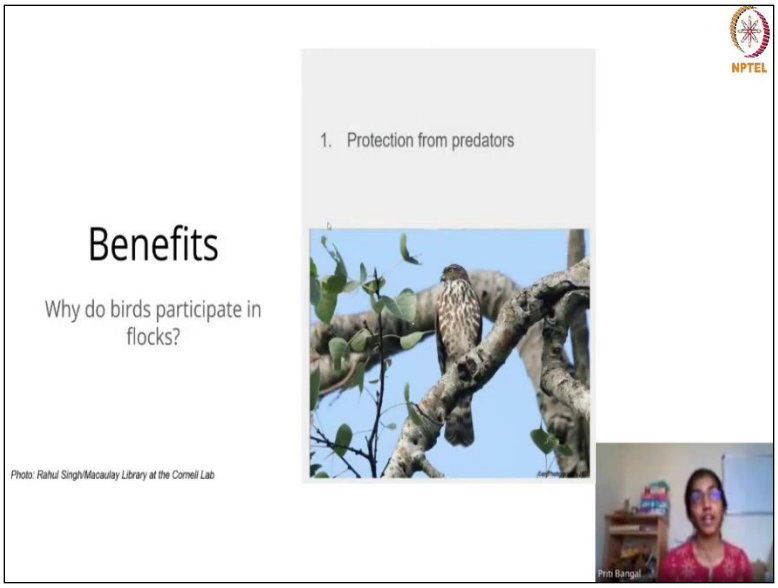

So, why is it that birds participate in mixed species flocks? People over the years have speculated and tried to answer these questions and the two main reasons that people have come up with for as a reason as an explanation for why birds participated flocks are related to two different things. The first one is protection from predators. Typically, the small birds, the passerine birds that we saw in the picture before are predated on by small hawks . These are ambush predators and they look about sit quietly in the canopy in the forest and whenever they get a chance, they will ambush the prey and catch a bird. So, the birds are known to gain protection from participating in these flocks.

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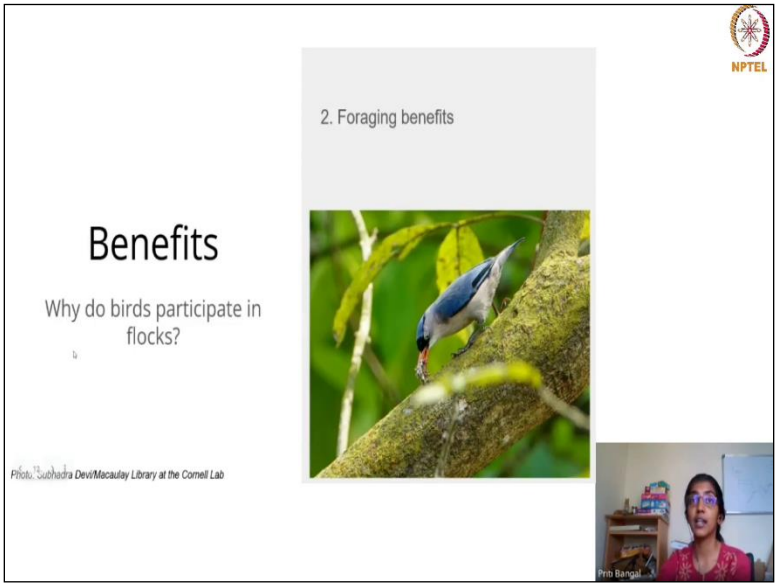

And the second benefit that people have speculated is related to foraging benefits. The birds are known to experience better food finding from participating in mixed species flocks. And we will come a little in a little bit in more detail to what might be the mechanisms that are possibly responsible for these benefits to manifest in mixed species flocks, a little bit later in the lecture.

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Before that, let's try and look at what are the common word families that participate in flocks of the Western Ghats. we start with the Western Ghats here in India, because it is more possibly more relatable to most of you. There are many different families having listed and showed representations of a few that are very common in the western ghats, you see birds like Minivets and Cuckooshrike that belong to the family Campephagidae.

There are Drongos that belong to the Dicruridae and different species of Drongos participate in flocks in different areas. There are several different species of woodpeckers Picadae and other some other families of Woodpeckers that participate in flocks. There are Trogons, there are Timallidae which is Babblers and you also see Fulvetta that are related to the Babblers. There is the Monarchidae where our Paradise flycatcher and the Monarch which are not true flycatchers that participate in mixed species flocks.

There is Pycnonotidae which is the Bulbuls, there is Nuthatches and also some parids like, the Great Tit that participate in mixed species flocks in the Western Ghats. Similarly, like I described flocks are found in different parts of the world.

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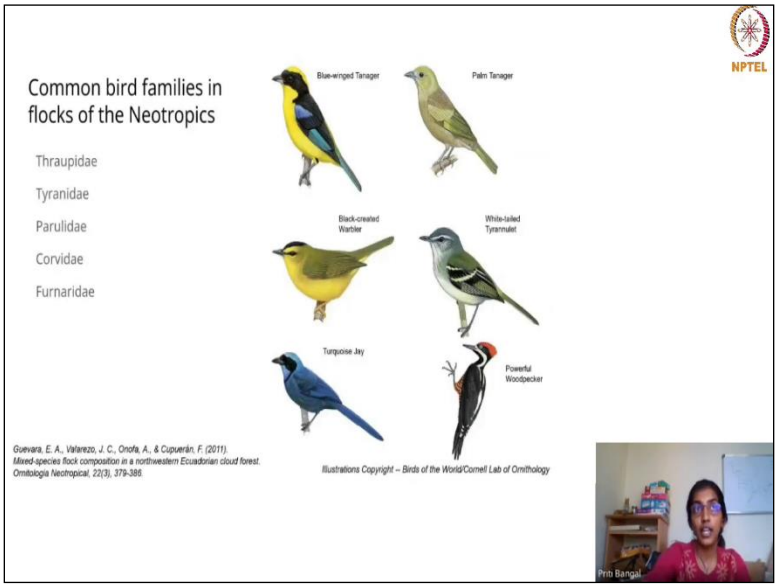

Let's look at some examples of families of birds that are found in flocks in the neotropics and the equator. From this particular paper do look at it if you are interested in finding out more but you see Tanager like the Blue-winged Tanager that belong to Thraupidae sometimes that participate in flocks. There are different kinds of Parulidae Warbler, there are some Corvidae like Jays, there is the Tyrannulet which is the Tyranidae family and there are also some other different species of Woodpeckers that participate in flocks

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in the Neotropics. Going to Australia to a different part of the world, again, there are different families that participate there in mixed flocks. There are thornbills for example, the Buff-rumped thornbill, there are robins, tree creepers, whistlers, honeyeaters. There are several examples of studies from all across the world and I would encourage you to go and look into the literature to find out more about what different kinds of word families participate in flocks all right.

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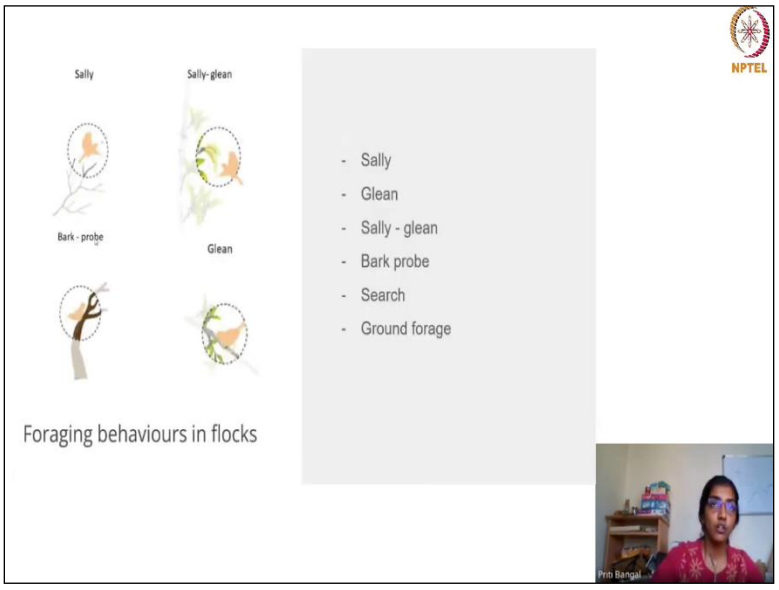

So, we have seen the taxonomic diversity in flocks and diving a little bit into the behaviour of the birds that participate in flocks. We will start with first with foraging behaviours . So, birds that

participate in flocks largely feed on insects (they are mostly insectivorous birds) but each one of them several species are known to have unique foraging techniques or foraging maneuvres.

When they attempt to catch insects, they use different maneuvers to catch these insects. And what are these different maneuvers and why is it important that they have different maneuvers we will see in the coming slides. So, the birds some birds are known to sally in flocks. Here you can see an illustration of a bird that is flying out of the branch to catch an insect and they typically come back and perch again on the branch.

You may have seen Drongos do that several times if you have been bird watching in India, it is known as sallying behaviour. Some other birds are known to sally glean what it means is that they perch they scan the surroundings for insect and they make a flight to catch an insect and finally they pick off insects off of surfaces. You can see here that the bird is picking off an insect off the surface of a leaf.

There are bark probing birds which forage along the bark of trees and then there are gleaning birds that almost always pick insects off of surfaces of leaf. These are the different kinds of behaviours. Then there are searching birds, birds that search for insects that use a mix of different behaviors and now it is hard to classify them into one or the others and there may be ground foraging birds.

Here I would also like to highlight that it is likely that if you go into a completely different area you may encounter fewer behaviours of birds or newer maneuvers foraging maneuvers of birds that foraging in that particular area. And these are most commonly seen and I have listed the most commonly seen behaviours from work in India.

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Now moving on to other diversity flocks. Species that participate in flocks are also known to use the forest strata different ways right. If you look at the entire structure of the forest there is canopy layer, there is the mid story layer and then there is the understory. Here for simplicity purposes, I have used a single tree to illustrate this, but birds in flocks forage in some of the birds forage in the canopy strata almost exclusively.

Some birds forage in the midstory and there are birds that will almost always stick to the understory and you see birds that participate in mixed flocks come from all of these forest data. Now that is not to say that a canopy species will never come into the mid story or the understory but mostly canopy birds are known to stick to the forest canopy occasionally coming down the other strata out of the forest.

And this is mainly to illustrate that there is an entire range of species that uses the entire structure of the forest while they feed them with species flocks.

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There is also diversity in group sizes in birds that participate in mixed flocks. There are some birds that may participate in flocks as a single individual (solitary). There are some birds that may participate in pairs like you saw the paradise fly catcher example in the illustration that I showed you earlier. The flycatchers sometimes participate in pairs and then there are intra-specific gregarious species. Now, what do I mean by intra- specifically gregarious species.

These are social species of birds which are often seen in groups of their own. So, a single species in a group of it is own species flock. These can sometimes be family groups of Babblers. So, you know that the example of a good example of these family groups is babbler. You may have encountered Jungle Babblers or Large gray Babblers that feed in flocks of their own species such intra-specifically gregarious species.

There are other examples from the of Indian birds that are intra- specifically gregarious like the Brown-cheeked Fulvetta, then the Dark-fronted Babblers and so on and that are intra specifically gregarious. And this is a term that may come up again in the lecture. So, do try and remember what I mean when I said the interest when I mentioned this term intra specifically gregarious.

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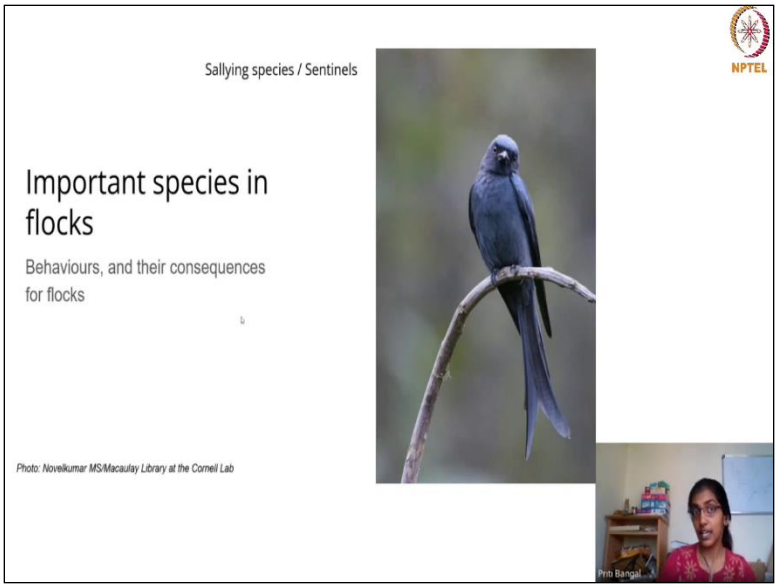

Now given that there is so, much diversity in birds that participate in flocks, there are different types of behaviors, there is different types of group sizes, there is different type of forest strata use it sort of follows that this diversity will lead to certain differences in behaviours and differences in importance from the point of view of a mixed species flock. Well, I will start with an example of an species that is important for a mixed species flock. This I define as a sentinel species or a sallying species.

So, species such as the Drongos which sally typically, sally is the foraging behaviour that I described earlier whether when the species perches on a branch and scans the surrounding for for forage or for insects and then makes a flight to catch that insect such species are known to be sentinels in the flock. Because in the process of them scanning for their food they also are generally more aware of the surroundings and can spot predators as a result much sooner than the rest of the species and the flocks and hence the name sentinel.

The Drongos are an excellent examples of sentinels in the flocks that we see here in India but also you may have seen examples from the Africa from Africa of Drongos being sentinels in Pied Babbler flocks or even associating with meerkats (meerkat groups) in the Kalahari. Right. So, these are sentinel species and typically these species are also known to be excellent alarm callers. So, they give early warning for predators making them really play a crucial role in flocks which is really important from the point of view of protection benefits.

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This behaviour of the Drongos was also recorded very, very early on. Let us read another anecdote which was reported by this scientist called Swynnerton in 1915 from another naturalist observation. So, what Swynnerton reports is that Marshall who watched flocks in the Mashonaland. He writes that '*a fact which must impress every observer is the way in which one may walk often for several miles through likely looking country and scarcely see a bird;*

then suddenly one comes upon a troop of them, composed of Drongos, Tits, small Shrikes, Flycatchers, Wobblers and Buntings, keeping more or less together in a limited area. Personally, I have little doubt that this may be attributed to a large number of birds of prey which occur here; that the smaller birds find it advisable to associate as a means of protection, the Drongos acting as a sort of bodyguard'.

So, you can see that Marshall is also speculating back in 1900 that the Drongo in this group of birds that he has seen which includes Tits, Shrikes, Flycatchers, Warblers, Bunting which you may some of you may be familiar with but the Drongo is acting as a sort of bodyguard in this group. So, this idea of sentinel species that is more vigilant for predators as compared to the other birds in the flock has been there around for a long time.

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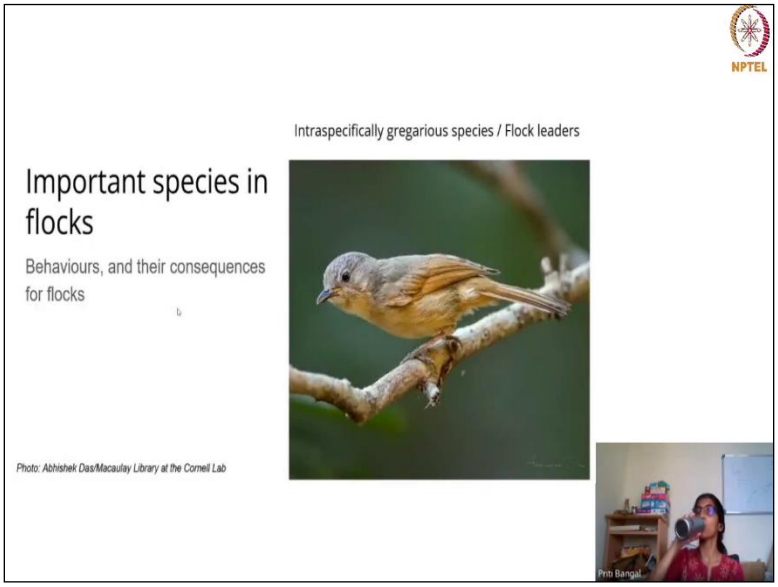

The other group of birds that is extremely important or is known to be important and has been studied in mixed flocks is the intra specifically gregarious species. Like I described earlier, these are social species found in their own groups. They tend to act as flock leaders. And by leaders, I mean that they position themselves in the front of the flocks. So, typically if you are observing a mixed flock when it is crossing let us say a forest opening or a stream in the forest or a forest trail you will see that intra specifically gregarious species are seen to lead the flock across the crossing.

So, scientists all over the world have reported that intra- specifically gregarious species or social species are often seen to be flock leaders they are also more in number right. They are social there are several individuals of the same species. So, they also make flocks easy to detect they also vocalize more and hence they play an important role in mixed species flocks.

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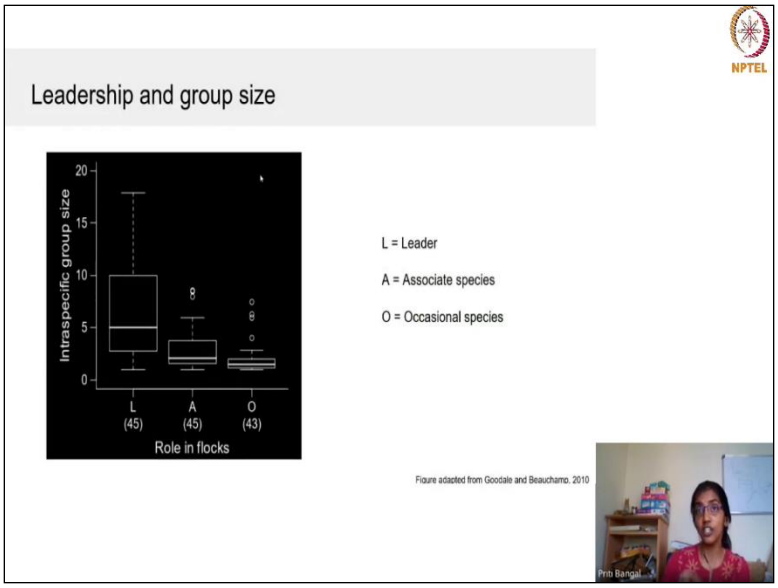

To illustrate this, I have pulled out an example where in this particular study they compiled a data set from all across the world looking at three types of species from mixed flocks. One, classified as leader depending on the position in the flock. Next, the associate species which were those species that associate most with the leaders (leader species) and O being the occasional species which are more rare than the associated species.

And what they found in the study, if you look carefully at this graph on the x axis you see the leaders, associate species and occasional species and on the y axis here plotted you see the intra specific group size of each of these categories and what they found was that these leader species tend to have higher group sizes. So, there is some kind of a relationship between the group size and leadership role in mixed species flocks. Leaders tend to be intra- specifically gregarious.

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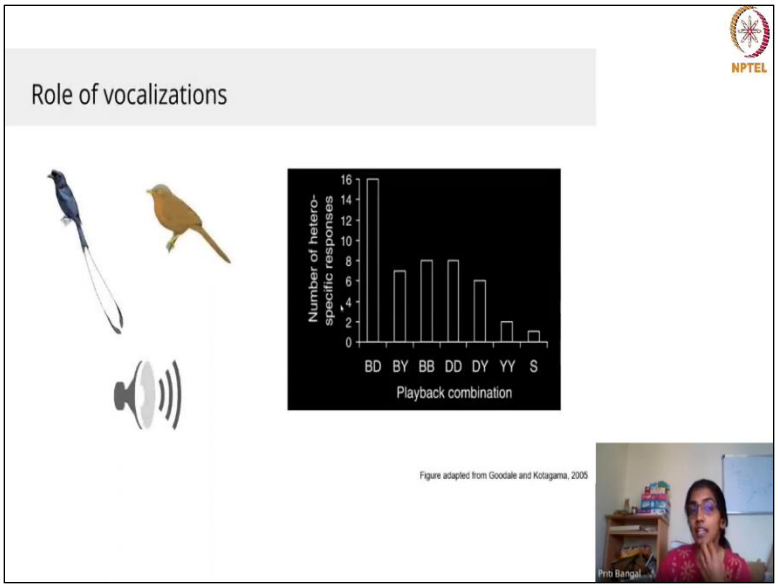

The other important factor that I alluded to during in a few earlier slides was the role of vocalizations. I said that the species become more conspicuous they vocalize more and they can potentially attract other species of birds towards themselves. And in another interesting study what people tried to do was to playback calls of a Drongo which is the sentinel species and a babbler which is an inter-specifically gregarious species to see the response of other species to these playbacks.

And what they found was is what you can see in this figure. Here a combination of Babbler-Drongo calls, y-axis is the number of heterospecific responses that each of these call playback combinations received. And you can see that the combination of a babbler call and a Drongo call which includes the intra-specifically the species and the sentinel species receive the most number of heterospecific responses.

So, vocalization in flock is also a very important characteristic which both sentinels such as Drongos and inter specifically gregory species such as Babblers and another example from India is the fulvetta tend to play this role.

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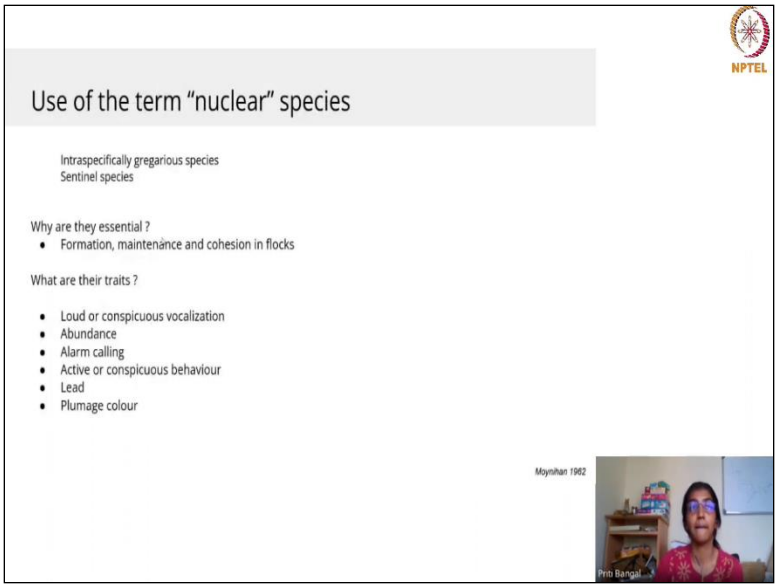

One of the other terminologies that I wanted since we are talking about important species and flocks is the use of the term nuclear species. Right. If you go into the literature on mixed species flocks, the term nuclear will be used time and again and you may wonder what it means. And it was first introduced in flocking literature many many years ago, but in a paper in 1962, the scientist Moynihan extensively described what nuclear species were and it came into the literature much more after that.

So, what are nuclear species in flocks? The typical intra-specifically gregarious species and sentinel species are called nuclear species because they are essential for multiple reasons; for formation or flock maintenance. And people have over the years used various traits to describe the nuclearity in mixed species flocks, loud and conspicuous vocalization being one of them, abundance of the species being another, alarm calling properties being another, active and conspicuous behaviours, then being in leadership positions under flock, and plumage colour. So, all of these traits have been associated with nuclear species and flocks but there is of course not great clarity on what people mean when they say nuclear species and hence it may be a bit problematic when you visit literature on mixed species flocks.

Nevertheless, it is an important terminology which you will come across often which is why I wanted to introduce you to it. So, there are two different categories of important species that have

often been called nuclear. Just to go over it once again, These are intra-specifically gregarious species and the other are sentinel species which we have just seen.

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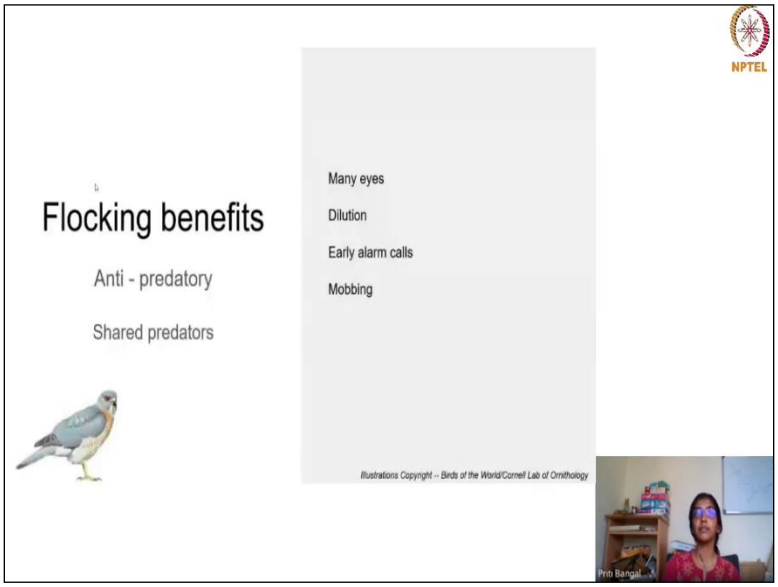

So, we know by now that flocking benefits are related to predation and they are related to foraging. Right. So, but what we have not discussed so far is how flocking species may get anti-predatory benefits or feeding benefits. And we will discuss some of the mechanisms of these benefits in the next two slides. So, flock species are known to have shared predators .

Since they have common predators, some of these anti-predatory benefits are common to all species and they may come about through various different ways. The first one that I have listed here is the many eyes effect. What does it mean? In when you are foraging alone, you are the single person or let's say a bird species looking out for predators but if you are in a large group there are many more eyes that are looking out for predators and hence the chance that you detect the predator sooner is much higher.

The other way through which birds can get anti-predatory benefits from flocks is dilution. Now, dilution is the probability that a particular bird gets picked or singled out in a flock will reduce as the flock size increases. So, larger the number of birds in the flock, the probability that a single individual gets picked is much smaller this is what is referred to as dilution effect. There is an also early alarm call in flocks and then there is mobbing behaviour.

Birds that flock together are also not known to mob a predator together and there are also some birds that are more bold that are bolder when chasing away predators such as the Drongo that we saw when I was describing to you the sentinel species which are known to be excellent mobbers. So, anti-predatory benefits and mixed flocks may come about through several different mechanisms which we just went over.

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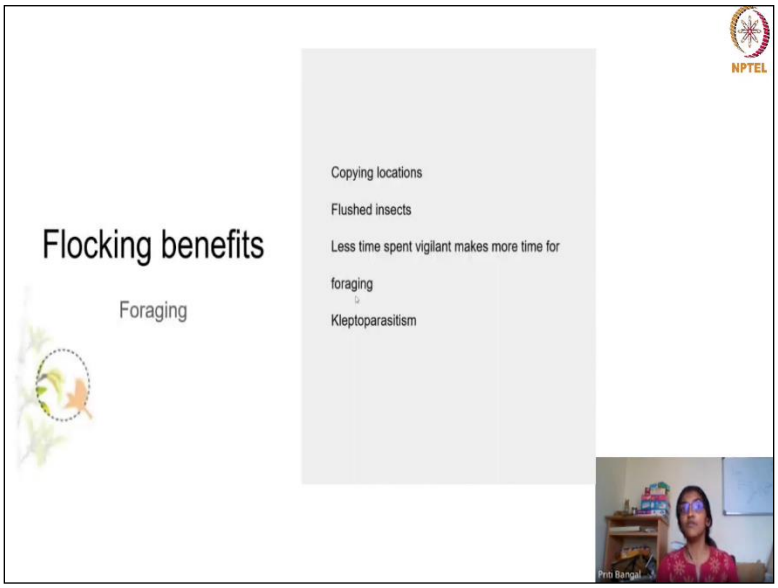

Next, we look at foraging benefits. So, how exactly would birds benefit in terms of foraging when they participate in flocks. Here are a few different examples. One, they may able to copy the locations of other species that are that have found food. The second, which is very interesting is from flushed insects, there are some species and flocks that are known to be extremely active, that are known to be really fidgety and are constantly moving from leaf to leaf.

And in the course of action, they stir up a lot of insects from the canopy of the forest. These insects are then picked by the birds that follow these particular individuals and that leads to a significant increase in the foraging efficiency of these birds that are following the birds that flush insects. When you are part of a large group you may be able to spend less time in vigilance right.

What is vigilance? You may be able to spend less time looking out for predators and that time can then be invested in foraging (in food finding) that is also how foraging efficiency may be enhanced

when you are in the mixed species flock. And finally, there is an interesting behaviour called kleptoparasitism wherein species of birds may try to steal a resource or snatch a resource an insect another bird has found.

There are certain families of birds where kleptoparasitism is seen more commonly. For example, the Drongos (the Greater Racket-tailed Drongo) kleptoparasitise several species that are the species that participate in flocks. This also to leads to improved food finding. This also makes different kinds of food available to a species that are kleptoparasitises. For example, a woodpecker is able to dig into the bark of a tree to find certain kinds of grubs and insects that it accesses from this particular feeding habit.

Another bird like a Drongo may not be able to access this kind of a resource otherwise because it does not have that beak type. When if the Drongo gets access to the food that is found by a woodpecker, it definitely increases the diversity of food that a Drongo can access that is how these kleptoparasites benefit from participating in mixed flocks.

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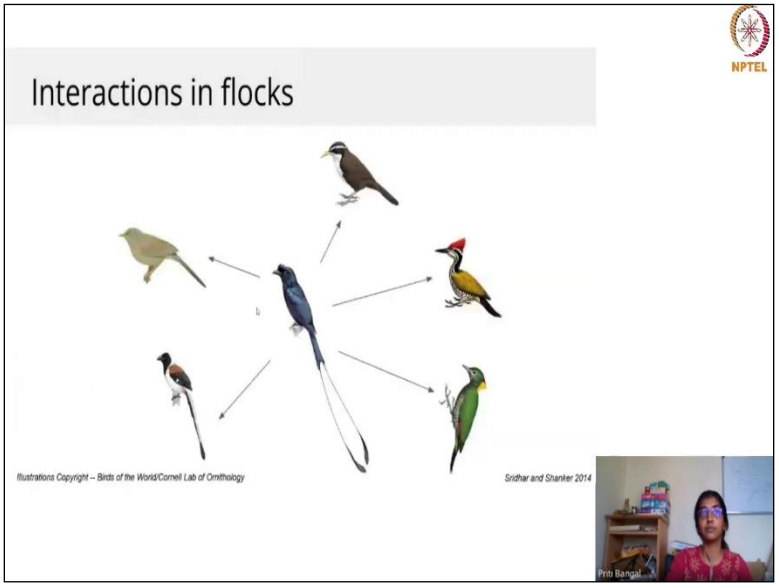

So, while at the topic of kleptoparasitism, let me describe to you certain interactions that are seen very commonly in flocks right. I was just describing to you how Racket-tailed Drongo may get access to different resources. So, some of the common associate species of the Racket-tailed Drongo can be seen depicted in this particular picture (illustration). Here, Drongo is known to

closely associate with Babblers with woodpeckers, here is the Greater flameback, the Lesser yellow Naped, the White-bellied Treepie and Babbler.

And these are examples from the western ghats but the Drongo is known to very closely follow these birds and seek opportunities to get prey that these birds have captured. So, there are very specific associations through which foraging benefits may come about.

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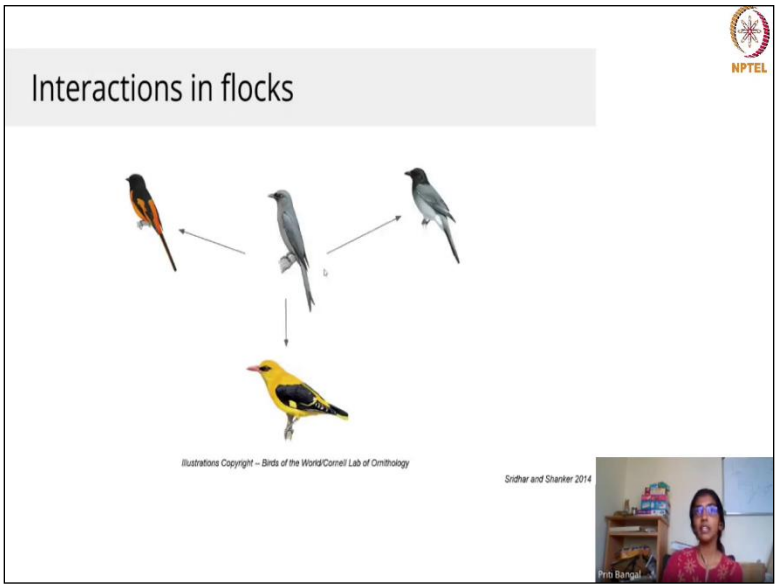

Another example is that of the Ashy Drongo that follows (that is known to closely) follow Minivets, also known to closely follow Cuckooshrikes and Orioles. Now, you may notice that these are all birds that forage in the highest rate of the forest which is the canopy of the forest. And we saw how mixed species flocks occupied the entire stratum of the forest. So, these are largely canopy bird associations.

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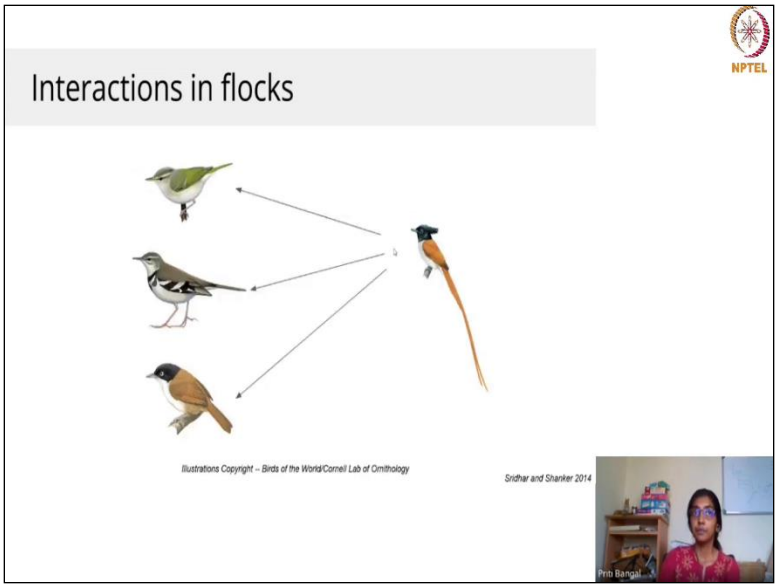

And another very interesting another example is that of what I was talking about is flushed insects. The paradise fly catcher, which is illustrated here is known to follow different species of birds that that are very active in behaviour. They are known to follow Western-crowned Warblers. The Forest Wagtail which is a ground forager which also picks leaf litter is known to turn over leaf litter and hence is known to stir up more insects from the understory.

And Dark-fronted Babblers which also largely forage in the understory of a forest and the Paradise flycatcher is known to follow and pick insects that have been stirred up by these species.

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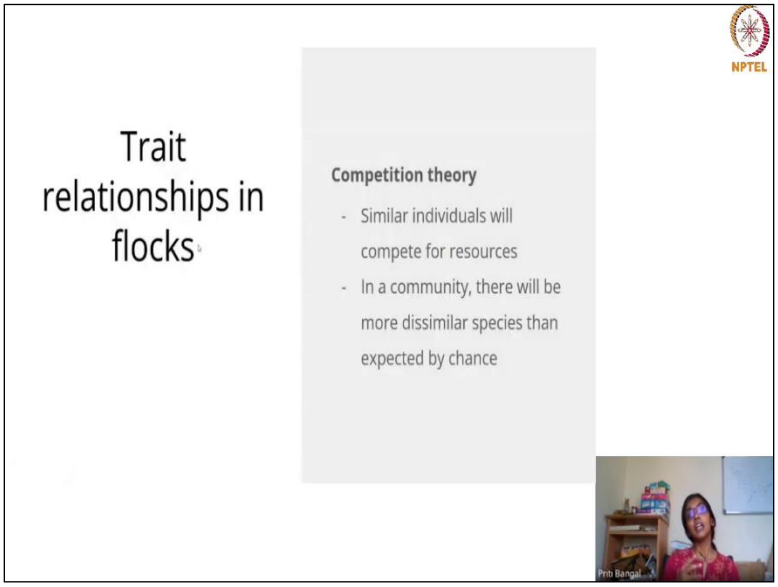

You may have noticed that there are certain characteristics of these species that I described in the last three examples of associations that they seem to be of similar body size though let us go back a little bit. The Drongo here seems to be associating with species that are larger species the Ashy Drongo on the other hand seems to be associating with slightly smaller species and then the Paradise flycatcher may be seems to be associating with even smaller species.

So, what kind of trait relationships do we see in flocks. Before we dive into great relationships and flock themselves, let us talk a little bit about competition theory. And what do I what am I referring to when I mean that when I say competition theory. So, in community ecology, it is expected that similar individuals will compete for similar resources. Right. If I have a particular feeding habit and another species has a particular similar feeding habit, it is likely that if the resources are limited, there will this will lead to competition between these two species.

So, hence in a community, it is expected that there will be more dissimilar species than one would expect by chance.

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So, what do we see in mixed species flocks in particular? In flocks, we find that most similar species associate more often than expected by chance. There are examples of large bodied and small bodied flock types in northeast India. Flocks that Dr. Umesh Srinavasan has studied, they found that there are flock types that are segregated by body size. Right. There are flocks that are

mostly composed of large bodied flocks, there are some flocks that are mostly understory small body flock types.

What mixed species flocks allow and this is an interesting thing which I will explain in the next slide as well is that they allow species to be similar in body size while having dissimilar foraging behaviour. Right. So, you can be matched up on one particular species trait while it being dissimilar in a trait that may lead to competition and we are towards the end of the talk.

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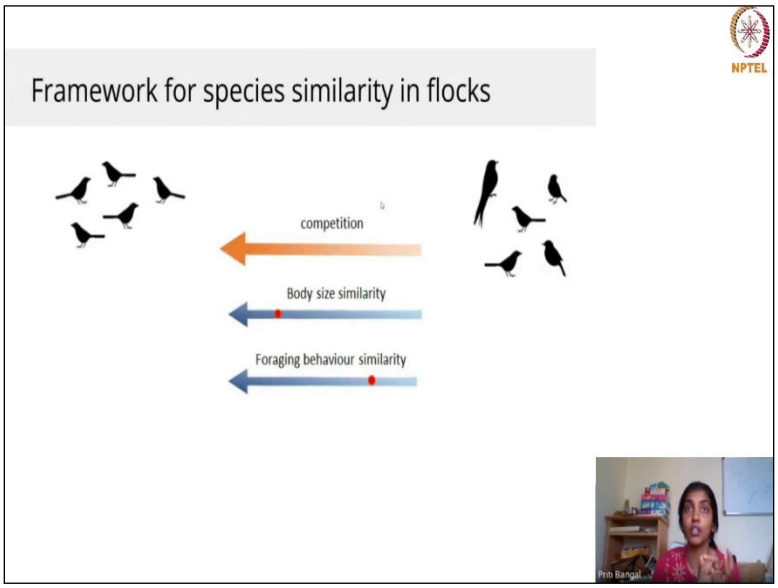

And I will leave you a little bit with something to think about more deeply about mixed species flocks. So, if we think about two extremes of grouping, at one end you have species that are extremely similar to each other and and this I am mostly talking about in terms of body size. At another end, if you have species that are very dissimilar. You will see that the similar species you will expect that similar species will have higher competition.

What flocks allow is that them to be similar in body size and at the same time dissimilar in foraging behaviour similarity and hence lead to less competition. This is a area of research that is fairly new and there has been some interesting work that has been up and coming and I would encourage you to go back and look at some of these papers that I will share with some of you later. All right.

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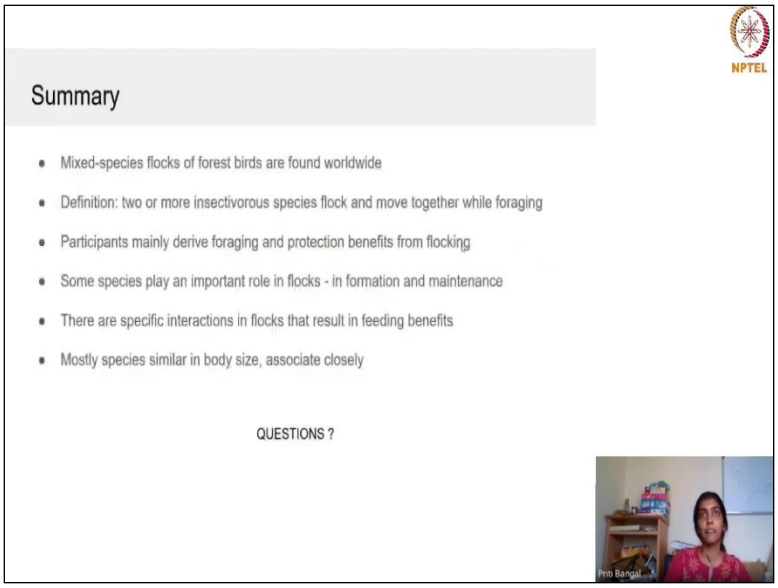

So, to summarize what we have spoken about in the last half and up just a second yeah what we have spoken about in the last half an hour. Mixed species flocks of forest birds are found worldwide and you see a diversity of species that participate in mixed flocks. Flocks are defined as groups of insectivorous birds that belong to two or more than two species and move together while foraging. Participants mainly derive feeding and protection benefits from flocking.

And there are some species that seem to play a more important role in flocks in terms of formation and maintenance and cohesion in flocks. There are very specific interactions and flocks that can result in feeding benefits and overall the group level benefits such as protection and improved feeding also exist in mixed species flocks. And finally, we spoke about towards the end that species that are similar in body size associate more closely with each other as compared to species that are highly dissimilar. So, I will stop here.