Basic Course in Ornithology
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Lecture - 38

So, I will start with the first, question there are few which were asked during the class but I mean just like confirmation. So, basically the first question is, are Green bee-eaters sallying species. That is a great observation yes you often see Green bee-eaters perched on good vantage points and are scanning the area for insects. And they smooth down to catch bees and other insects that are flying about. Yes, they are great examples of sallying species.

And this question might have been answered why during the course of the lecture but I will still ask it off, I mean, apart from drongos what are the other common sentinel species. So, drongos largely mostly drongos are seem to be sentinel species in with species flocks that we commonly see here in the western parts of India. In other flocking systems there are other tanagers for example in the new tropics that are sentinel species.

Even among the intra specifically gregarious species some individuals tend to be sentinels. So, for example if you have seen flocks of jungle babblers, there will often be a single individual that will choose a higher vantage point and scan the area. So, even groups of intra-specifically gregarious species are going to have sentinels within them. Other species that are sallying species like paradise flycatchers, monarchs, they also have similar feeding habit except these are largely under story Birds.

They are known to make alarm calls you will see them giving out alarm calls every now and then but they do not perch higher up like the drongos and they are of course not as bold as the drongo but they are sallying species also. They may not always act as sentinel. So, yeah, intra specifically gregarious species also have sentinel and drongo and there are a few other examples like I said from the neotropics the Tanagers are sentinel species.

All right, and the next question is, if is sex specific differentiation between a sentinel in mixed flock like is there a particular male or a male or a female bird of a particular species that act as sentinel? That is an interesting one. As far as I know, this has not been looked into. So, this is especially difficult to study in species where there is very little dimorphism and in Drongo at least it is not very easy to tell apart male and females just visually.

I do not know whether there is sex specific bias in what access of sentinel and what does not. It might be an interesting study. Thank you, Priti. So, the next question is so basically the question is asking, why do the specifically the gregarious species lead like what is the reason behind them leading the group. I am trying to read the question why do these interspecifically gregarious species lead, what is the reason as they are in the group do.

They also give cover to the flock to move safely. So, intra specifically gregarious species are social species that are also like I said they may also be in their own family groups. As far as to why they lead, one can only speculate if you want to answer why questions you may have to do experimental manipulation. But, interspecifically specifically gregarious species generally when they are seen to sort of cross over a particular patch or a particular open patch or a particular stream or a path, you do see them going back and forth.

That some birds will fly across the street and sorry across the stream and then come back and then some more will pass. So, we do not know whether they give cover to the flock but they do seem to be found in the forefront of the flock. Why they do that is a question that I do not think has a very clear answer yet there could be several reasons. So, if the species are family group, then and they are cooperatively breeding then there may be some kin benefit to that particular behaviour.

And as a result of that particular sort of evolutionary hangover those benefits are also reaped by the species that are following them. So, that could be one reason why they seem to be in the leadership position. So, there is some amount of cooperation in the family group itself which then benefits the rest of the species that also follow them which is probably what makes candidates to be leader species.

And that is also related to another behaviour of gregarious species which is early alarm calling. So, if you look at cooperatively breeding birds, they are known to have really well-developed alarm calling systems. So, intraspecifically gregarious species because they are cooperatively breeders tend to be alarm callers so early alarm callers. And that also makes them great as flock leaders. So, the next so Krishna is asking for more elaboration on nuclear species characteristics.

Okay, sure, so do not I would say that do not get too caught up in the terminology of nuclear species itself, but what people I will still go ahead and describe to you what people have described as nuclear species. Nuclear species tend to be those that are important in flock initiation and they are also important in making sure that the flock stays together and they are also important in what we have we are calling leadership.

What they flocking moves together, the species are followed by inter-specifically gregarious species and nuclear species are followed by other species. These are these tend to be species that are more conspicuous in terms of numbers. That they will be several in numbers and will be easy to detect, they may act as cues for mixed species flocks. So, if there is some activity there you may be able to guess that there is a mixed flock there and my curious birds might go and check out that particular mix now if they join or not.

They also tend to be noisy, they tend to make more alarm vocalizations, they tend to make contact calls as well. Contact calls are calls that species make to just they are sort of like check-in calls 'all okay' kind of calls you may have seen jungle babbler groups if you go bird watching often that there is a lot of calling like *chuk chuk* calls that species make to stain it seems people have described contact calls as all okay calls.

So, nuclear species also tend to be have these interesting contact calls. They in some cases have been described as also being behaviourally conspicuous. So, they are so fidgety and they are so flitty that other species tend to follow them and also because they then tend to flush out so many insects. So, all of these in combination you can see now already clearly that there is no one single definition of reality.

There is no one particular line of definition that I can say that you know this clearly defines a nuclear species. So, there are several different factors that play into this and which is what makes it really difficult to define. And I then because of that I refrain from using the term nuclear so often in the talk except for that one slide because you are very likely to encounter it everywhere in the literature.

And hence I call them some species that are important in flocks, one of them being sentinel or sallying species, the others being gregarious with between the area species. But it is a combination of all of these factors that make species nuclear. Thank you, Priti. So, the next is again an elaboration on the phrase that you use ‘copying locations’. Well! by ‘copying location’, I mainly mean that if a particular individual has discovered food.

I might be able to go and take advantage of that. So, it is food that is already found so you can go and copy that foraging location and benefit from. You do not have to do your own searching or your searching effort is then can considerably reduced. That is what I meant by copying. All right, so Krishna is asking probably she is asking what I mean what flushed insects are and do birds eat only specific insects while the others are flushed. So, she wants an example as well.

Okay, what I meant by flushed insects is that insects that are disturbed by the movement of other birds. If you have observed, I do not know what a group of maybe babblers feeding they often turn to turn leaf litter they are very active. That may lead to insects being flushed out or being stirred up from the ground, from the canopy, from the leaves, in the trees and so on. That is what I meant by flushed insects they are not a particular kind of insects.

But they are insects that are disturbed by activities of other birds. That is what I meant by flushed insects. Those birds eat only specific insects and others are flushed. So, I am not entirely sure what you mean by this question. But flushed insects are eaten by birds that will sally so if there is a drongo that is following a bunch of warbler then these birds the insects that get disturbed by their activity is often eaten by caught by the drongo.

And specificity about what insects get eaten is it is a little bit challenging to study. So, I do not think there is been very specific work on what insects some of these birds are eating. So, the next question is kind of interesting, are leaders leading the flock or are they just being followed by others? Excellent yeah, that is great question yeah leaders may be leaders because they are being followed right there the others are not.

They are not necessarily leading the flock but the others are still behind those. So, yeah both are possibilities I you would have to do some experimental work to be able to answer this. But if you look at some of the flocking literature you see that definition of leaders as such that they lead or are followed. So, people have used both to describe leader species. All right I think I also saw sorry I also saw Umesh joining.

So, in case Umesh wants to, are you there Umesh? I think he there for the four o'clock session. Now you both answer the question. So, sorry he was not added as a co-host, so I just made him the calls. I was just saying that if Umesh has also studied mixed species flocks and if he has anything to contribute to some of these answers, please feel free to pitch in. So, moving on to the next question. Parth, is asking what benefits do the intraspecific gregarious species get from joining the flock.

So, that is a good question, if we are talking about them largely as birds that are leading and then other birds are benefiting then what are gregarious. The species getting from being in the flock themselves. So, some of the protection benefits and some of the foraging benefits are common to all species that participating flocks. So, the improved protection from predators is a benefit that all species get.

So, the gregarious species are also benefiting from increased group size of the group, if there are other bird species that join the flocks. If there is an overall improvement in foraging and food finding the intra specific gregarious species are also benefiting from that overall increased food foraging efficiency in flocks. So, Krishna is asking if there are more than one canopy species in mixed species flock and if there are then are

they competing and how is it that they are able to co-exist, also give some example. Great question yes there are often more than one canopy species or often more than one species that feed in one particular forest strata in make species flocks. For example, you will see Ashy drongo and minivets that largely forage in the canopy. And they for exist yeah they sure do co-exist and how do they then co-existence is the question.

They have slightly different feeding habits. First of all, insects are a dispersed resource. They are not a clump resource like you would imagine of fruiting tree to be or a flowering bush to be. And insects in tropical context insects are also a fairly abundant resource. Secondly, an Ashy drongo and a minivet are both canopy species but they forage differently. While a drongo, may be a sallying species that catches insects mostly while sallying mid-air.

Minivetss are species that are sally gleaners that sally out but also tend to pick insects off of surfaces of loose so there is a little bit of partitioning there. That is what I was trying to say talk about towards the end of my lecture. That you may be similar in certain aspects which is here that you are using the same state of the canopy. But you are different in other aspects here the example was that they are different in foraging technique that they use or the foraging manoeuvre that they use when catching an insect.

That is how they are able to coexist. So, next to us, would a flock of common and pied myna or a flock of chestnut tailed starlings and rosy starlings be called a mixed species flop. So, sure there are multiple species and they are moving together. So, you would think that it is a mixed species flop right. So, in the classical sense and what we were talking about these forest birds feeding in species flocks maybe the myna and the starlings typically fit that definition.

But that is not to say that they are not more than two species. Here, when I was defining or what when I was talking about what a mixed species flock is. We spoke about a few different things. These are moving groups of forest birds, insectivorous birds mostly Passerine and birds that that are feeding together, that stay together for a given amount of time, that navigate the forest and stay in the campaign and the story while food finding well foraging.

So, that would be a typical forest bird's flock. A flock of myna we would have to look at what the context is are they external stimulus. Is there an external stimulus? Is there an external resource that has attracted these starlings and minas to that particular area that you are looking at or are these only groups that are flying about right you often see starling groups that take off.

And then you also see starling, rosy starling murmuration which everybody has seen. So, those contexts are slightly different from what we were talking about today. I am not saying that those are not mixed groups but they are not like the groups that we were speaking about in today's lecture. So, Aditi was asking how are basically asking you to elaborate on the mate choice as a benefit of mixed species flock.

Aditi sorry that was confusing and I did not say that mate choice was a benefit of make species flock. I was talking about groups in general and that leks which are aggregations of females sorry of males of the same species which congregate in a particular area. And females come to these leks for you know these two to check out these displaying males that was the mating context that I was talking about it was not in the context of species flocks.

So, there was this question about lecture being available later. I think it will be it was recorded so yeah that should answer that question. And the next is, are these flocks randomly formed or other specific individuals that regularly come together for foraging? Thanks, that is a great question. So, I am not exactly sure what you mean by randomly formed but I do understand the later part of your question which I think explains the question better.

So, there are studies that have been done on banded birds, where you know individual identities of birds and it has been seen that these studies have been done in Australia in some birds in Australia on some birds there have been studies from the Neotropics as well on banded individuals. And you are right in guessing that there are the same individuals that come together and associate with each other in mixed flocks in these areas day after day and stay together for a long time.

One thing that I forgot to mention during the course of the lecture was also that some Neotropical flocks are also permanent flocks. In the sense that they associate for really long durations

throughout the day they are almost together all the time and flocks also hold territories. So, mixed flocks they are in a particular area they stay together, they roost in areas that are not too far from where the flock was foraging and then come back the next morning.

So, species do or individuals do tend to associate with the same individuals day after day. But having said that in India there are no studies on tagged individuals that have where we have been able to identify the identity of an individual bird. But if you do go to if you are doing field work in some parts of India you may see that if you visit a particular part of the forest time after time of time you are likely to see flocks that have similar compositions at the same spot which makes you wonder whether they are the same birds.

But there will have to be studies on tagged individuals to be able to say anything certainly about that. In other parts of the world, there is more evidence that same species same individuals associate again. So, Salochna is asking now, since, drongos and woodpeckers, forage without being a part of a flock also. So is there a trigger like is it when other species are nearby that they join or recreate themselves into the flock?

That is a good observation that it is not to say that woodpeckers and drongo do not forage outside the flock. Typically, you will see flocks being formed in sort of late in the morning. So, you avoid early morning hours when the flocks are still forming so you will not see flocking activity so much early on during the day. As the day progresses and the sun comes up, they get slightly hotter you will see flocking activity beginning.

As for specific triggers, I am not aware of anything really specific that triggers flocking. It could be that you know you the bird is over here a particular group of feeding or there is a sudden vocalization activity which stimulates sort of flocking behaviour. But I do not think there has been any study on what triggers flocking. There have been playback experiments that of the kind that I described during the course of my talk on certain species so like the babbler drongo playback that I described.

So, such vocalizations do tend to attract other species. So, perhaps vocalizations may play an important role in initiation of flocks. But you are right that you do see drongo's forage by themselves. You do see woodpeckers forage by themselves. But I am not aware of specific triggers, Umesh do you have something to add to this? I think okay. So, we will move on to the next question.

So, Parth is asking if even if it is hypothesis but many eyes have many eyes hypothesis and early warning hypothesis are they two separate mechanisms or should they be like much together one? That is interesting to think about like theoretically to think about. So, yeah, many eyes would lead to early detection is I think what he is trying to see yeah perhaps you could think of it as related to each other.

But there may be some so many eyes also just means that there are more eyes looking out for predators and early warning could also come from specific species that are good at detecting predators which for example the drongo or some other sallying species which are better at detecting. So, early warning does not necessarily have to come from does not have to follow from many eyes.

But you are right that it may follow from many eyes. That is an interesting point, thanks. I think Chandrasekharan is trying to ask for an example of obligate flock forages in India probably or somewhere else. So, it is a little bit hard to say give specific examples of obligate flock forages but there are some species that are always followed. So, in winters like for example I went in the place that I studied in Anshi in Northern Karnataka. I used to try

and find birds that are intra pacific regular species that are that forage by themselves that are in single species groups. But what was that they are always followed by something else it was very difficult to find single species groups in particularly in that season. Maybe there are other seasons and I studied largely winters starting November to about March, April. There may be other seasons where birds have you know other foraging strategies.

But in the winters, you almost always see regular species being followed. So, the next question is how do the flocks ensure that they stay together? How do they ensure that flocks stay together? That is a difficult question to answer but there are several different characteristics that probably lead to the flock staying together. Well vocalization could be one of those, species being or individuals being present in large numbers could be another species being able to detect and follow other species could be another.

So, all of these factors perhaps act in you know coincide with each other to be able to make sure that the flock stays together. Interesting! So, do the nuclear species communicate with other species and form a flock I mean? So, the nuclear species do tend to be vocal, I can see that people are catching on with nuclear species and their characteristics and traits which is why I was giving sort of disclaimers about the use of the terminology nuclear species.

But nuclear species tend to be very vocal and they do have well-developed alarm calling systems like I was saying because they are family groups of their own so there may be some kin related dynamic going on there. But whether they form a flock is something that is questionable right? They are vocalizing and there is some amount of public information that is generated from the vocalization of these species. And other species are attracted to this vocalization.

So, do nuclear species vocalize and communicate? Yes, they generate public information in the process and it is possible that other species are attracted towards these vocalizations. I am not sure if this question has already been answered, I will still ask away. The intra-specifically gregarious species in a flock what are the benefits as they I mean when they leave the flock and how are these benefits different from the other species within the flock?

I think some a part of this was covered when is answering the question related to what benefits do addresses regular species get. But I am trying to read this question again, what are the benefits associated with regular species in the flock if they need the flock? How do these benefits differ with other species? So, I think I actually may be asking what benefits do gregarious species provide and how are they different from other species.

So, Gayathri, like I was saying gregarious species are known to be flock leaders they are founded in the front of the flock. They also tend to be often species that are very active and that tend to flush out other insects that tend to disturb other insects which may be caught by the species that are following. And these benefits may not they also known to vocalize and alarm call. So, they these benefits are not exclusive or they are not extremely different.

But they but not all so for example from sallying species or sentinel species, there are very specific benefits. It is mainly protection benefits whereas with gregarious species you will see both protection and foraging benefits that other species may get. Okay, and Akshita is asking for more papers but I mean apart from the ones that are already shared could you like give me? Yeah, I can share a list of papers with the NPTEL group with Jobin and Devika perhaps and they can send it to you.

So, okay this next question first of all, first question is basically if there a carrying capacity within a flock for competing species like is there a limit to the other species e, so, if the foraging technique is different these species with the same techniques… So basically what Krishna is trying to ask is would a species with the same technique of foraging, are they able to form like be a part within the same flock like do the species have to have right yeah interesting.

So, about carrying capacity that is an interesting question you see a range of flock sizes like I described and there is a range of like this a lot of variation and what sizes of flocks you see. And a carrying capacity would be with respect to the environment. It could be it would be with respect to a limited resource. Here, it is difficult to evaluate what resource we are talking about or what the limits of the resource that we are talking about are.

So, it is difficult to define a carrying capacity of a flock now having said that like I described in the western parts we have seen up to 20 to 25 species participate in flocks and it is rare to see more than that. That could also depend on the species pool itself. So, how the community how specious the community of birds in that area is itself. So, yeah, I think the question about carrying capacity is slightly more tricky.

In the neotropics where the pool of species or even in northeast India for that matter but the pool of species itself is so diverse you will see higher species numbers that participate in flocks. So, it may have something to do more with the pool of species rather than the carrying capacity. So, yeah that is one point. You do see birds that use the same for using forging technique in flocks and like I was saying before insects are a more dispersed resource.

So, it is not that conflict incidences do not arise. They do, not they may be some conflict for those same insects sometimes here and there may be some chases and flocks. But largely it seems like an association that works. You will see two species that have the same foraging technique participate in flocks at the same time. Then they may separate by canopy strata or they may be one may be eating slightly larger insects than the other.

So, there may be subtle differences and it is hard to say every single time but it is important to think about it carefully even if they are using the same foraging technique what is it that is different about these two species. This next question… may not allow ..sorry I am suspending. It may not always be different. So, this next question is quite interesting, I mean,... are there free loaders in a part… I mean they basically would not have any advantage to the flock but they are still there a part of the flock.

So, excellent so yeah definitely, I think that there is it is very likely that species do not contribute actively to the benefits in the flock that is an interesting question. But there are things like for example, species when it joins the flock by default it is increasing the group size of the flock right it is contributing to the group size of the flock. So, that way it is contributing to the dilution effect. But it may so be that the species does not contribute so much with respect to food finding or with respect to disturbing insects which become available to other birds.

And the bird however on the other hand, the bird itself is that individual itself is kind of benefiting from these feeding related benefits itself. So, yeah there can be free birds in flocks. So, Anugopal is asking, if there are some changes in the vocalization of birds when they are within a mixed species flocks? That is a very interesting question. It has not been studied so much vocalization, changes in vocalization in flocks and outside of flocks.

In fact, there is a student who is interested and is studying some vocal behaviour and in general actually vocal behaviour and mixed flocks is very understudied. So, we would love to understand more about how vocalizations are different in flocks. But yeah, it is a question that is largely not been answered so far. The next question is probably I mean contributing to the question already been asked.

So, interesting is trying to say if many eyes hypothesis could actually many eyes could also contribute to more successful foraging, hence can it be an independently stated mechanism. Many ways could be contributed to successful right we did, I mean I think I stated it as an independent mechanism, yes, but you are right that many eyes could also contribute to successful foraging many eyes also contributes to detection of predators.

So, it is related to two different things like more individuals searching for insects, more individuals watching out for predators and then early warning is separate from this. You are right, I think they are trying to answer the question that was asked earlier yeah, you are right. Some I mean Divyapal, is thanking you for your excellent presentation and it was lucid and comprehensive.

So, I think I am misread Krishna's question, I think she has rephrased it over here. She is asking do different species consciously communicate and form a flock? Yeah, thanks Krishna, I think it is difficult to say whether species are communicating consciously, but what I wanted to say earlier what I was trying to say earlier was that when a species vocalizes it generates information which is then used by other species.

So, I am still sticking with that answer, I do not know whether this is a conscious. It is difficult to answer these questions about whether a species is doing it consciously or not consciously. And is starting a flock it is yeah, I do not know Umesh what do you think about species starting with flocks consciously? Well like you say Priti is difficult to tell whether the species is vocalizing consciously to start a flock or whether you know it is some kind of ingrained evolutionary selected behaviour.

But, I think your answer is right it is that every vocalization carries some information and therefore you know I would stick with that answer too. Okay, thanks. So, a very last question for you I think Priti, I do not think there are more questions after that but very similar to vocalization are there different behaviours as well when the speech is within a flock and when it is not? That is also an interesting question whether species behave differently when they are in flocks versus when they are not.

And this behaviour could be in terms of various things that could be in terms of vocalization in terms of foraging strategy and it is possible that species use slightly different feeding strategies when they are outside of flocks and inside species flocks. But I cannot off the top of my head think of any comparative work that has been done and demonstrated this but it is a definitely an interesting question.

Like I was saying sometimes when you are especially flock researchers when they go out into the field in the peak flocking season you almost always see species in flocks. So, it is very difficult to record them outside of flocks but that would be make a really excellent study question and if somebody was able to go out into the field and collect the data. It is likely that you will find something very interesting.

So, Mrinal is also thanking you for a great presentation and discussion which is actually great thanks Priti. So, there is next question has come sorry I will still wait for why so basically MJ is talking about parasitism I think literature that brings out that drongos also steals food from other species by mimicry. So, does not that generate mistrust among other participating species towards a small bird factor so towards the same bird acting as sentiments.

So, mistrust is a very values and judgment related terms so I would not say mistrust I would refrain from using the stress but yeah so, the drongos are known to steal food from mimicry and many of you may have seen the videos that David Attenborough's documentary has right the drongos giving alarm calls and the meerkats are feeding and the drongo gives out a warning and there is a predator and the meerkat is scurrying away to hide.

And the first time it is a true warning but then the drongos does a false alarm and then it mimics meerkats alarm call and so on. So, yeah drongos are seen to do such interesting behaviours in different systems and it is about really how many times the target species loses the food that it is it has captured. So, there is of course a trade-off between what benefit our species gets from the drongo alarm calls versus how much cost it pays in terms of the loss of food.

And if the drongo alarm calls are so important crucial to the survival of that particular individual then it is a sort of much versus life kind of a mark right. You would let go of lunch for to save your old life. So, it is an interesting element to think about it is definitely a trade-off that species probably think you know in some ways have an understanding of. I do not know if I have completely answered that question.

I think a lot of thank you is coming I think for you to read in the chat. So, I will move to Umesh's question, I wish would that be okay. Sure, go ahead thank you. So, there was one question that came and actually two questions same person. So, I will read out the question, I have not read the question but so my doubt was about the question regarding hornbills feeding off of 35 fruit trees in the absence of the competitor species.

Does ecological release indicate both population increase and niche expansion due to absence of competitor or and will niche expansion feeding from more trees always result in increased population size? Sorry, do you want me to I will just copy this question on the chat box. Yes, could you copy that question into the chat box for me please? So, about character displacement. Sorry Umesh just one thing the assignment is still open and the deadline has not passed yet.

So, yeah just want to okay. So, I am not going to reveal anything about the assignment question but about the character displacement. You know it is not necessarily only to do with morphology for example it is not necessarily that it is only beak size that changes or only body size that changes in the presence and the absence of a competitor. It could actually be you know changes in behaviour.

For example, if you have a certain species foraging only in the understory of a forest when there is a competitor in the canopy and then when you remove the competitor species from the canopy you have this other species expanding its range from the understory to the canopy as well. So, you know even foraging behaviours like that can change in response to the presence of the absence of a competitive species.

So, this okay so this is assignment 7 which apparently had been closed yesterday I do not know what this question is sorry it is not a question. I think you have answered the question that is supposed to be okay. I will yeah sorry you want to say something sorry, Go ahead I will take the next question. So, the next question is from the discussion forum. So, the person is trying to ask how accurately can we age a bird once it has attained adult plumage?

For it depends on which kinds of species you are talking about, once it is once it is got adult plumage yeah in the hand it is very very difficult to judge what the age of a bird is. fFr all passerine species it is actually impossible to do just by looking at the bird in the hand when it is an adult plumage. So, you do not know whether it is 2, 1 year old or 2 years old or 6 years old. There are ways to do this through molecular techniques.

You know if you get a blood sample then you know people have looked at the length of chromosomes length of what are called the telomeres in the chromosomes and that is been used to figure out the age of species. But in the hand, it is near impossible once a species has got adult plumage. So, the next question is from your ppt where you I think it was the slide was called estimating abundance through mark recapture.

So, the question is there was not there were numbers over there. So, in this case the 36 is an estimation and 40 is the actual population like it is a question mark basically. Yes, 36 is the estimate of the population size. The actual population size which we actually do not know right. We do not know what the actual population size is we are trying to estimate that size. So, the actual population size in nature which we do not know is in this case 40.

So, this is a sort of a contrived example so you know it is we know that we know that there are 40 individuals in that habitat and if you have satisfied all the assumptions of the market capture model and so on. Then the estimate that you get of population size will be very close to the actual true population size and I did not go over this in the presentation itself but you also get an estimate of standard error.

You know you get an estimate of the confidence that you have in your estimated population size. So, you might get for example the mean estimate of population size is 36 the range of population estimate could be from 32 to 40. So, you will also get sort of a band of you know it is 95% likely that the population size is between 32 and 40. All right, so Tahir is asking if is speciation happening by competition or because of competition, is speciation happening by competition?

Is speciation happening by competition? It is in chat box yeah these are the birds. So, that's Tahir Ahamad's question is asking question. So there are several forms of speciation, Speciation by competion ,usually what happens is that you know that there is this principle of competitive exclusion which is very very foundational in ecology which states that two species that have exactly the same niche are cannot coexist, one will drive the other extinct.

So, two species that are perfect competitors, theory predicts that one of them is going to win and is going to drive the other one to extinction. But species that do compete with each other you know you do see things like the cost of competition past where you see patterns let us say in foraging behaviour where you have an ancestral species that then splits up into multiple species but usually the cause of that is you know isolation what is called vicariance.

But I think there will be a session on speciation and Robin will talk about you know biogeography and there might be more insights about the role of competition and speciation when that session happens. All right, I think the next question is I mean, I think it is related to your spot mapping slide. So, I see that is that one in the chat box? The one in the chat box. So, the question is call count specific to some birds as the other counts are not possible or is there any other way to count.

What is the accuracy of the count based on the fact that all the birds might not call when we are counting and how do we identify same bird or different birds calling if only male birds call then how do we make out make the count inclusive of females? That is a great question and it actually shows some of the limitations of call counts. So, we for example if you want to estimate the abundance of francolins in the breeding season.

And you know that these francolins are going to be calling and you and they are going to have territories in the habitat. So, you can actually identify from where each male is calling and you know that you know this is one male in this location that is another male in another location, you know if you know all of this and you know that you are not confusing two males. Then you can say the estimate of the population size with the of males in this location is so and so.

But of course, you do not know how many females are there. So, it is true that you know the spot mapping technique is not suited generally for estimating bird population sizes. It is very, very specific cases where you know a lot about the biology of the species and you know which you know our male is calling our females calling and so on and so forth. That spot mapping is useful as a technique.

I think the bird in your last slide someone wants to know the idea of that bird. I think it was a…. that can be answered later. So, the next question is what is the actual difference between exploitation and interference competition and do the compliment both of these? So, the difference between exploitation and diffusion competition you are absolutely right that both will directly both will decrease the fitness of the organism.

But the difference between the two is the mechanism through which the competition acts. So, interference competition is where there is a direct interaction between two competitor species. So, I could if I am species A and you are species B then as competitors, I could actually chase you away from the resource. So, for example if I am a hornbill a large species foraging in a fig tree and a bunch of you know green pigeons comes into forage on the same figs.

Then I can directly as a larger body species I can you know directly chase away smaller species for example. So, that they are not competing for the same resources directly. So, that is interference competition that there is a direct interference of one species interfering with the other. In exploitation competition these two species might not ever meet they might not ever have any aggression between them.

So, but they are feeding on the same resource so for example, you know fig trees in the daytime are fed on by barbets and pigeons and so on, in the night they are fed on by bats. Now, if in the morning there is a lot of foraging happening the number of figs comes down and it is there is not that much resource available for the bats. The bats and the barbets are never going to meet but they are never going to interact.

But because they are feeding on the same resource if one feeds that depletes resources it is going to affect the fitness of the other even though they never meet. So, that is exploitation competition it is also called scramble competition which is the exploitation of a common resource. So, this other question is about transect study and while doing transect is it not difficult to actually count birds like come with come to a particular number.

And I mean, would not that counting give us a valid non-bias would it give us a valid non-biased data when the counting itself is so tough and cumbersome without you thinking? You know it takes a lot of practice it is not easy when you start doing these things, it takes a lot of practice to be able to quickly calculate or you know use the compass and the rangefinder to get at these values.

But it is not impossible and the whole point of doing this is to estimate how many birds you are missing. So, for example if it is ground birds and you know that you know ground birds are difficult to see, then the probability of detection of these ground birds is going to be low. Correct. So, you know so the fact that you might miss birds because there are too many birds in the habitat.

And you know all of this is happening at the same time is also accounted for by that detection probability process. So, the birds that are really tough to see in the forests will have a low detection probability. And the birds that are easy to see in the forest will have a high detection probability.

So, we do not calculate the detection probability for all birds species together you ideally want a separate detection probability for each species.

Because the behaviour of each species and the ability to see or hear each species differs from species to species. So, even if you miss birds because there are too many if you have enough data, you will be able to estimate how many birds you have missed. Jobin, I will just take that follow-up question there which is that in the given patch of forest one draws the transect line and then counts the birds in the ESWs how does one cover patches of forest that do not cover the assumed rectangular patch

and will not be the exact dimensions of the ESWs patchwork? So, we do not know what the ESWs is when we are doing the transect. We are walking along the transect you do not know what the Effective Strip Width is this. This is not something that we know beforehand. The Effective Script Width is calculated or estimated after we come back and analyse the data. So, birds are being counted both within what will ultimately be the Effective Strip Width and outside the Effective Strip Width.

It is the rate at which detection declines with distance from the transect that gives you the effect of strip width. That can vary from transect to transect it can vary from species to species. It can vary from habitat to habitat. it can vary from season to season. So, the Effective Strip Width is a variable measure, we do not know what that measure is. It is comes, it is estimated from the relationship between distance from the transect and detection probability.

So, the next question is, in a census counting are teams given multiple patches of say a rectangular forest and then the sum total of all the counts become the total estimated population for a given species? Yes, that is one way to do a census where you split up, you divide the habitat that you are trying to sample that you are trying to census in this case forest you divide that up into you know blocks or rectangular you know sections.

And then each team is assigned one section and then you know they come back and total up the numbers and that is how you get a yeah. So, the next question is, do scientists also use combination

of line transect and point counter point count to get a total estimate like a combination? So, you cannot, analytically you cannot combine lines and points when you come back and do the analysis you cannot combine lines and points.

What you could do is to sample the same habitat using line transect and using point counts but the data that you get will have to be handled separately. And the estimates that you get will be separate for point counts and line transactions. So, it is not possible to combine both of them into one analytical framework. So, the next question is about how to estimate populations when in water bodies like basically for water birds.

Because, it has to be I mean does it have to be point count because we cannot seem to do a transect study in water bodies and also how do we count mixed flocks like how do we estimate population of mixed flocks? So, you know water birds typically are censused by direct counts you know because the body of water is open you can stand up the shore with a with a scope. And you can actually count the number of birds that are there on that body of water.

And you are unlikely to miss species because there is not much vegetation in that area of course it depends on the skill of the person who is doing this and so on it takes practice to get accurate counts from direct counts of ducks and so on. But that is the typical way in which these are counted. Now if you have a water body that has vegetation on it. Let us say you know and the vegetation could hide species like in a forest.

You can actually do a line transect from a boat and you know line transects have been used in water to estimate densities of things like you know whales and dolphins and so on. And the same principle can be applied to birds to water birds. So, you can actually take a boat and you know go in a straight line through the water body and count birds on both sides and count the distances to those to these birds on both sides.

And actually, use line transect methodology and line transect analysis to get at population sizes or population densities of birds in water. So, if the birds in the water are swimming around how do we count them of course yes that the assumption of the line transect of course is that the speed at

which the observer is moving is much faster than the speed at which the birds are moving. So, if the birds are swimming around really fast and the boat is going at a very slow speed then the line transect methodology is not appropriate.

It is just not the way to count fast moving species. How do we count mixed flocks? So, when you are walking along the line transect what we do when we encounter a flock is to take the distance to the centre of the flock and note it down as a mixed species flock and you got you know seven species, they were all foraging you know 20 meters away at an angle of 20 degrees and all of them will get the same bearing in the same distance you are taking the bearing and the distance to the centre of the mixed flocks.

Another question is how do you avoid duplicate counting of the same individuals as birds keep flying around. So, typical like I was saying you know the line transect methodology is only going to work in a situation where the birds are moving relatively slower than the observer on the line transect. The other thing to consider when you are doing line transect is that obviously you are not going to do only one line in a habitat you could do multiple lines in a habitat.

And you have to make sure that the distance between the lines is a minimum distance such that the same bird cannot be counted from both lines. So, when you are doing the line transect study you cannot have the home range of one bird overlapping two lines. Because then you are going to count the bird here and you are going to count the bird here. So, that is a double counting. So, the birds have to be moving relatively slowly while you are walking the line.

And the next line that you are sampling should be far enough that the same bird is not counted on both the lines. Now obviously that distance is going to vary bit from species to species right some species are going to have very large home ranges. So, if you are counting you know something like you know eagles, you know I am just giving you an example here nobody really counts eagles using line transects.

But if you are counting a species that has very large home ranges that the transects also have to be placed very far apart. If you are counting a species that has a small home range then the transects

can be placed relatively closer to each other. So, it depends on all of these considerations to avoid double counting. Amit sorry Sharda, there is a question for a large flock of birds, how is counting done since one cannot count all.

So, you cannot count all for a large flock of birds and you are going to miss some. I.. so, it again you know these the large flock of birds could be water birds on a water body it could be you know rosy starlings in a in a grassland or an agricultural habitat and the methods to count these are going to vary. So, you know for example starlings or mynas are large birds that have large flocks and they come back to roost in the same location every day.

So, in that case you would do a roost count in the case of water birds you might do a direct count. So, it is going to vary with from species to species the precise method that you use to count the number of individuals in the flock is going to differ. Amit has a question is the documentation and methodology available on bird count available online or can this documentation process be shared please.

This is all available online. There is I am just going to type this into the chat box, there is a website called phidot.org which deals with the market capture methodology there is a manual that you can download online for free and it explains the whole mark capture methodology very nicely. The line transect methodology also is available online you can find that I will just paste the link here.

You can find that in here is one way to do one place where you can find this information but a lot of this information is completely free and available online. If you just google ways, you know line transect methodology or you google capture marketing capture you will be able to find this. During which season, Anuprita has a question askin,g during which season are birds counted how frequently are they counted per year?

That depends on the kind of study that you are interested in doing this will vary from study to study. So, if you are interested in looking at breeding bird densities, you would count them in the breeding season if you are interested in looking at wintering bird densities you should count them

in the winter. But how frequently are they counted that again depends on what you are trying to do with your study.

So, it is variable from study. So, if I just want to monitor how breeding bird populations are changing from year to year then I will you know go out and measure only breeding bird populations year after year. If I am interested in looking at for example survival of birds between summer and winter and the survival of birds between the winter to summer then I will sample in summer example in winter I will sample the next summer and the next winter so twice a year.

So, it depends really on the kind of question that you are interested in you might even ask what is the day-to-day variation in the densities of species that would mean you would actually go out and measure these things you could actually go out and measure these things ability. So, it depends on what kind of study that you are conducting. There is no hard and fast rule for when birds should be counted.

How do we calculate the home range of a species does it vary depending on the habitat for the same species? So, calculating the home range of a species is quite difficult especially for small birds because the ideal way in which home ranges are calculated is where you fit a you know a radio transmitter or a GPS tag onto an animal and you get you know records of the locations where this animal was and then those locations are then used to calculate the home range of the bird or of an animal.

So, we you know this has been done for animals like elephants and tigers and deer and so on which are large and which can actually carry these collars or tags with birds this has been done for larger raptors like eagles and vultures and condors, you know fitting a GPS or a satellite tag onto the backs of these birds to figure out what the habitat range of the species is. For smaller passengers the problem is that they are too small to carry a tag.

So, estimating home ranges of these birds is more difficult one of the ways in which it has been done in the past is spot mapping. But again, spot mapping can provide unreliable results if all the assumptions of spot mapping are not met. Habitats home range size does vary for the same species

from habitat to habitat. So, if you often depends for example on the distribution of resources, so if you have a habitat where there are lots of resources the density of resources is high then an individual needs a much smaller area to be able to satisfy its energy requirements.

Whereas in another habitat where the resources are less dense, they are more sparse, the amount of resources that need to be gathered to satisfy energy requirements will have to come from a larger area. So, it does depend on habitat to habitat through the distribution of resources what exactly the home range size of these species would be. Krishna has another question so this is about point counts.

So, as bird count will be lower in a 10 meter radius what is the optimum radius to be chosen for point count is there some method based on the density of land cover like in reference to grassland based on the visibility or accepted norm based on which in maximum birds can be located with minimum error. So, again you know in the classical point count method you are not actually counting birds within a certain radius.

You are not setting any particular radius within which birds have to be counted what you are doing is you are measuring the radial distance to every bird and then you are coming back and calculating the effective radial distance. So, there is no hard and fast set rule for distance sampling based on a line transect or a point count within which you know within this distance is how I am going to count birds now of course if you have a fixed radius point count.

Then it depends from habitat to habitat it depends from species to species so for instance in forest it would depend on for example if I would have to have some very clear reason to say let us say that all birds within 50 meters of myself, I am not going to miss. Now that distance might extend to 100 meters in a grassland because visibility is higher. So, it in a fixed radius point count or a belt transect which is a fixed bit line transect.

The distance within which you assume that no birds have been missed by the observer depends on visibility in a habitat, it depends on what kind of species we are talking about is the species very vocal is the species very you know spectacular easy to see easy to hear then the effects then the

you know radial bit might be higher. If the species is very cryptic and you are likely to detect it only very, very close to you then that radius has to become smaller.

Because you are not likely to detect that species beyond a certain distance. So, there is no industry standard or accepted norm it varies from species to species there is some habitat to habitat there. Point count is actually with usually used with binoculars. Anand, questions is, usually sampling counts is birds are mobile is there not a chance of recording starting the same bird multiple times.

I think we have already gone over this, line transect to point count methodology is only appropriate for birds that are relatively slow moving compared to the observer and two the distance between the lines and the distance between the points has to be minimum such that you are not double counting, you are not counting the same individuals on neighbouring lines or neighbouring points.

So, the distance between the point counts or the distance between the line transects has to be enough. That the home range of one individual does not overlap two lines or two points so that is important for. Can the camera used….image be added? Usually, you know, I am familiar with forests and doing line transition point counts and forests usually you know when you go to the forest there is quite a lot happening and if you are actually doing a proper line transectt or a proper point count.

We usually do not do any photography. And that is because while doing photography you might miss while taking photographs you might miss individuals of species and we do not want we ideally do not want to miss as many as much as possible we want to have detection probability as high as possible. So, that our estimates of abundance are better. You know the lower the detection probability the lower the confidence we have in the estimates of density species density or species abundance.

So, you know when you are taking photographs you are going to miss other individuals in the habitat. So, I at least have never used the camera on a line transectt or a point count. So, Jobin are there any other questions? No, I mean I think we have covered the discussion forum questions and

the questions on the chat box as well. Great, then thank you very much for joining I hope you enjoyed those sessions on estimating bird populations.

And you know measuring bird populations and communities thank you. Thanks Umesh thanks sweetie for a great session and thanks everyone for joining in thanks a lot.