Basic Course in Ornithology
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Lecture 31
Bird Conservation - Concepts

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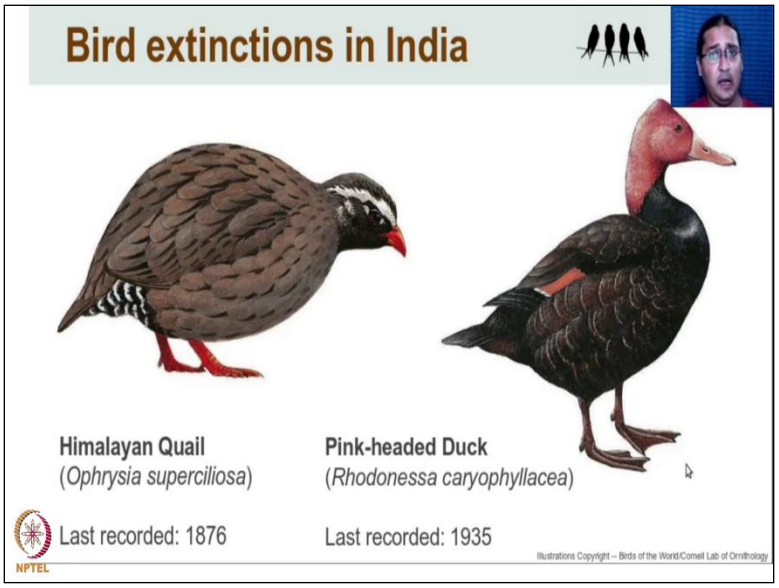

Welcome back to basic ornithology. Today, we will be talking about bird conservation. Two species of birds have almost certainly gone extinct from India, the Himalayan Quail which was last recorded in 1876 and the Pink-headed Duck which was last recorded in 1935. And but a large number of species in India are rare or threatened or endangered and in need of conservation action.

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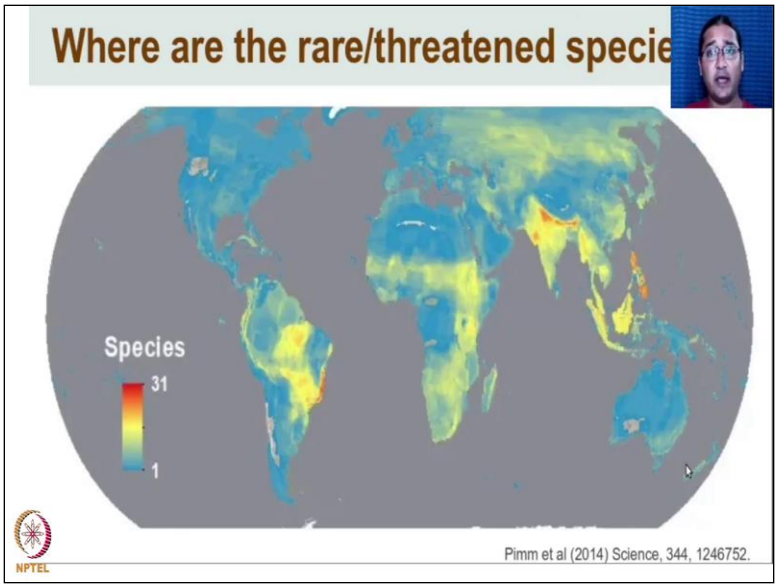

If you look at the map of the world and where the rare and threatened species are, you can see that you know if the area is actually blue the number of rare or threatened species is low. And if the as you go to a colour closer to red, through yellow the number of threatened species in that part of the world is very very high. And you can see where the threatened the rare species are these are in the Andes mountain range in South America as well as the Brazilian Atlantic forest,

where both of which are red and the Himalayas in southeast Asia, but even peninsular India and the rest of India has a large number of threatened and rare bird species which are in need of conservation.

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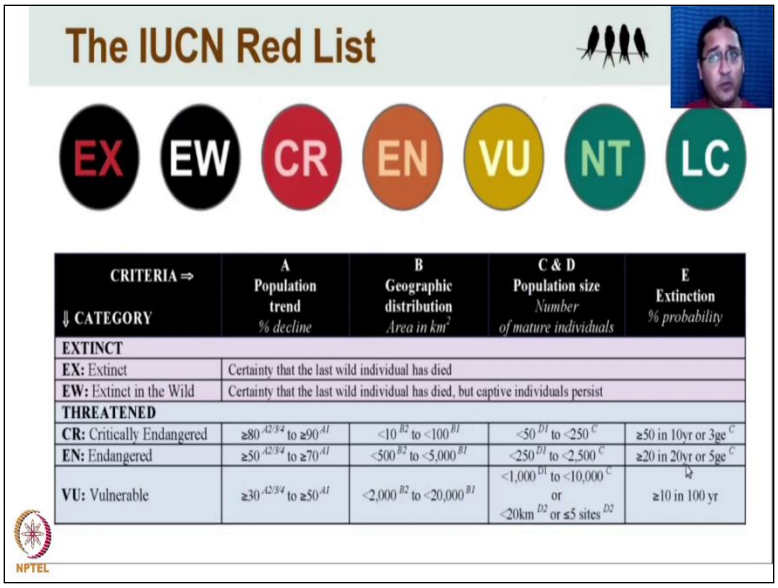

CRITERIA ⇒ / ⇓ CATEGORY	A Population trend *% decline*	B Geographic distribution *Area in km²*	C & D Population size *Number of mature individuals*	E Extinction *% probability*
EXTINCT				
EX: Extinct	Certainty that the last wild individual has died			
EW: Extinct in the Wild	Certainty that the last wild individual has died, but captive individuals persist			
THREATENED				
CR: Critically Endangered	≥80 [A2/3/4] to ≥90 [A1]	<10 [B2] to <100 [B1]	<50 [D1] to <250 [C]	≥50 in 10yr or 3ge [C]
EN: Endangered	≥50 [A2/3/4] to ≥70 [A1]	<500 [B2] to <5,000 [B1]	<250 [D1] to <2,500 [C]	≥20 in 20yr or 5ge [C]
VU: Vulnerable	≥30 [A2/3/4] to ≥50 [A1]	<2,000 [B2] to <20,000 [B1]	<1,000 [D1] to <10,000 [C] or <20km [D2] or ≤5 sites [D2]	≥10 in 100 yr

One of the ways in which we prioritize whether the species is in need of conservation or not is based on the IUCN red list. The IUCN is the International Union for the Conservation of Nature and based on certain criteria, the decline in population the geographic distribution of a species, its population size and its probability of extinction, the IUCN classifies species into various levels of threat.

These are extinct, where the species are not threatened but it is completely gone extinct. Extinct in the wild where there are no individuals in their natural habitat but there are certain individuals some individuals in captivity critically endangered. And let us take a look at the critically endangered criterion for just as an example. The critically endangered species is a species which has declined in population by 80 to 90%.

It has a geographical distribution that is between less than 10 to less than 100 square kilometers, between 50 to 250 number of mature individuals and where the extinction probability is greater than 50 in 10 years or in three generations of the species. So, that is what that is the criterion used to classify a species as critically endangered. That is the highest level of threat the highest level of vulnerability of a species.

Then you have the endangered species, you have vulnerable species, species that are near threatened that not yet on the threatened section of the IUCN red list, but it is likely that they are

going to become threatened in the future. And then species that are very common have large geographic ranges etc and those are species that are called least concern or LC species. So, there is a wide range of threat levels of species from the IUCN red list. The most threatened of which are critically endangered species.

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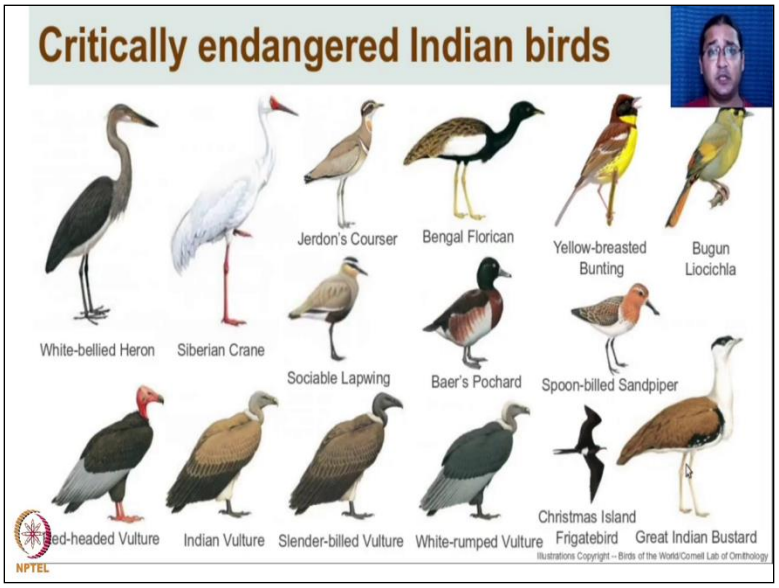

India has a number of critically endangered species the Jordan's Courser which was thought to be extinct but was rediscovered a few decades back. But a large number of other species that are critically endangered including the Gyps vultures at the bottom there, which have become very very highly endangered because of the veterinary drug diclofenac which is a toxin for these butchers and has caused their populations to collapse by over 90-98% in the last few decades.

So, these are the critically endangered birds that are found in India, that are in need of conservation initiatives to make sure that they do not go extinct.

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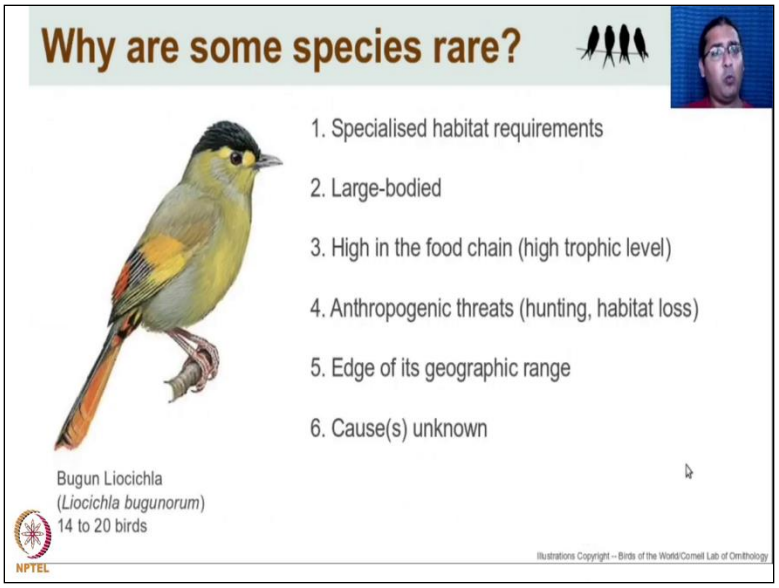

So, why are these species there? why are some species rare? It could be a variety of factors. One is that these species require specialized habitats for instance alluvial grassland or grassland that is at the terai grassland that is at the foothills of the Himalayas which is also very, very good for agriculture. And has never been replaced by agricultural land and the bird species that specialized on thoseterai grasslands are therefore some of the most endangered species in the world.

They are even specialized habitat requirements and they cannot be found elsewhere they cannot occur elsewhere an example of a species like this is the Bengal Florican which is endangered because it is losing a lot of its habitat to agricultural land. Large bodied species tend to be more likely to be rare than smaller body species large body species require large home ranges and large territories large amounts of resources.

And therefore, when habitats are destroyed or fragmented large bodies species are often the first to go extinct. Species high in the food chain high profile species like predators like raptors are also especially at risk from you know hybrid fragmentation habitat loss and so on. Obviously, some species are rare because they are targeted by hunting or they are losing habitats, some species could be rare because the edge of their geographical ranges.

Species tend to have high population sizes in the middle of their geographical range and as you come close to the edge of the geographic range, the population sizes are much smaller. And there

could be causes that we just do not know about why some species are rare. But in general, large bodied high trophic level species tend to be rare and also tend to be the first to be affected by any kind of habitat loss or climate change and soil.

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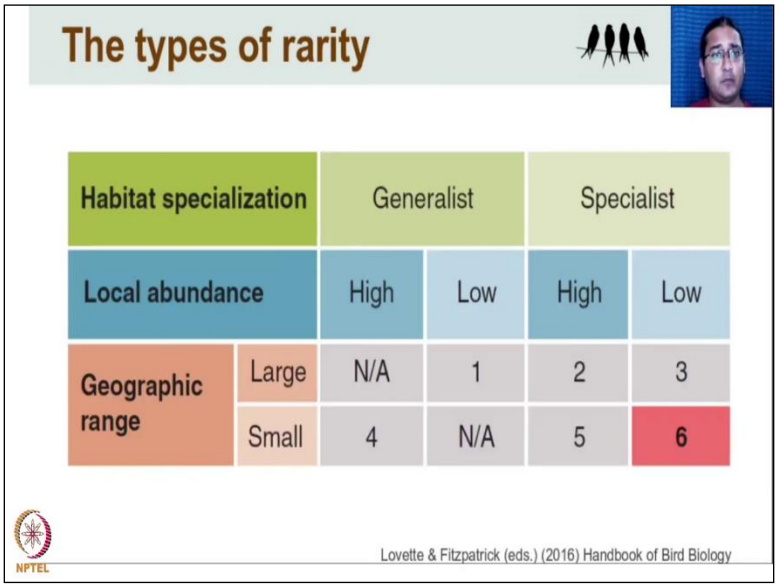

But there are various types of verity all species all rare species are not identically rare and we classify these different species in classify species into various forms of rarity. The rare species into various types of rarity depending upon, whether the species is a habitat generalist or a specialist (that is the degree of its habitat specialization), whether its local abundance is high or low (that is in its range does it does it have high population sizes or small population sizes)

and whether it is geographic ranges is large or small. And let's look at these different types of rarity here. Here is an example of a widely distributed species which is a has small local populations but broad habitat tolerances. So, it is found in across a broad geographical area but wherever it is found, it has small populations and a good example of that is the White-rumped vulture. The Lesser adjutant stork is also widely distributed.

It has large local populations wherever it is found it is abundant but it has a narrow habitat tolerance and that is another kind of rarity that you see in nature. The Lesser florican again is widely distributed, it has a very narrow habitat tolerance. It is only found in grassland and where it is

found, its population sizes are not very high, it has small local populations and that is the third type of rarity that you see in birds.

The Nicobar megapode which is restricted to the Nicobar island as a small geographical range it is it is very abundant where it is found and it has a broad habitat tolerance but because of its small geographic range it is rare. The Black-throated Parrotbill has a small geographic range where it is found though it has a large local populations and it is very very habitat specific. It is restricted to a particular kind of habitat, which is the wet grasslands of northeast India.

And that is the fifth type of rarity and the sixth type of rarity really is the most most threatening kind of rarity, where you have a very very highly special species found in a very small geographical range and wherever it is found, it has small local populations and of course. as a specialist very narrow habitat tolerance is one of the examples of this kind of species is the critically endangered White bellied Heron which is found pretty much only in a few locations in northeast India.

It is found only in along larger rivers, intermediate sized rivers and wherever it is found, it is not very abundant, it is it is actually has small population sizes. So, this is the most threatening form of rarity in that species like this the sixth form of reality are the most likely to go extinct.

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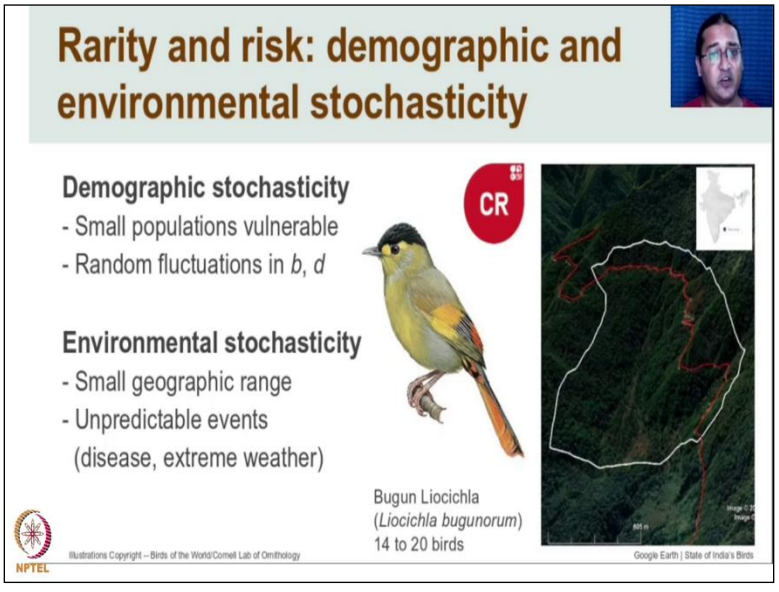

Why is geographical range and small populations so important for the vulnerability of species this arises from the process of what is called demographic and environmental stochasticity. Demographic stochasticity is a process where random fluctuations in the birth rates and death rates of a population cause it to increase or decrease in size very very drastically when these random fluctuations occur in large populations they get evened out.

And so, small populations are particularly vulnerable to demographic stochasticity. Let's say some one year randomly birth rates were very low and death rates were very high that is going to affect a small population much more than it is going to affect the large population. A large population would be able to recover from these random fluctuations in birth and death rates. But if you have a small population where you have a very very high death rate one year and a very low birth rate that that small population is much more vulnerable to extinction. It is much more likely to go extinct.

And so, small populations are those that are much more vulnerable to demographic stochasticity. Environmental stochasticity is a process by which extreme environmental effects, a cyclone, a flood and so on affects a particular species. And obviously species that have small geographical ranges are more likely to be affected by environmental stochasticity. Let's say you have a cyclone that that hits a certain part of the country.

Then if a species is found across the entire length and width of the country its population is not going to be affected much by this extreme weather event but if there is a species that is found only in the location where the cyclone hits then that species is more vulnerable to environmental stochasticity. So, species that have small geographic ranges are far more vulnerable to environmental stochasticity than species that have large geographical ranges.

One of the species in India and endemic species to the eastern Himalayas is the Bugun Liocichla which is critically endangered as far as we know there are only 40 to 20 birds. So, it is got a very small population size just 14 to 20 birds that we know of in the wild. So, it is vulnerable to demographic stochasticity because it has a very small population size, it is also vulnerable to

environmental stochasticity because it is found only in a two square kilometer area in Arunachal Pradesh.

And so, this is the kind of bird that would be the sixth form of rarity small population sizes in a small geographic range limited to valleys and ravines. So, a habitat specialist therefore most vulnerable to both these forms of stochasticity (demographic and environmental).

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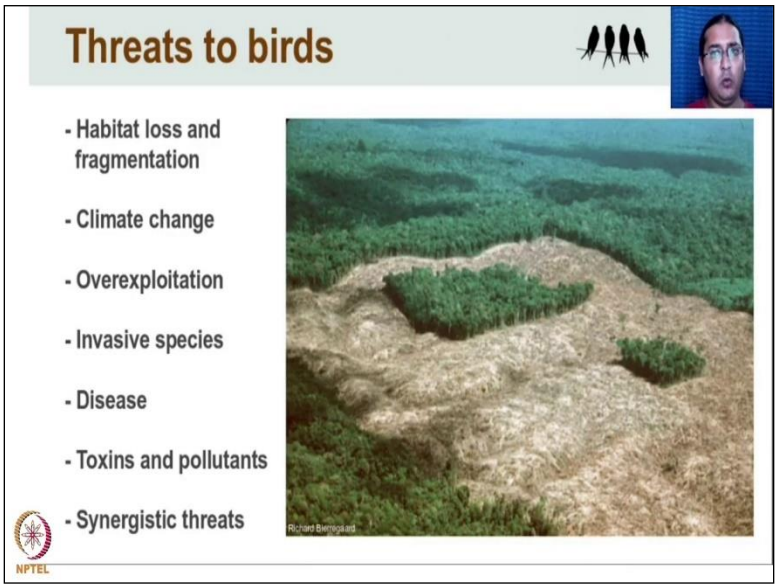

Why are birds threatened, what is it? What are the various forms of threats that birds face? Some of these are habitat loss and fragmentation. You can see a picture of a habitat fragment two habitat fragments on the right. There where vast tracts of forests that were contiguous are then fragmented into smaller patches that are then isolated and far away from the large fragment or the contiguous patches of forest.

Climate change is emerging now as a particularly large threat to bullet populations, over exploitation through hunting and other such ways of harvest have been important and continue to be important as threats to birds. You have invasive species, disease, toxins and pollutants and then very often these threats are not acting in isolation. It is not as if a bird is facing only habitat loss and not climate change or only invasive species and not you know diseases.

So, very often these threats are acting together and so, the synergistic or the interactive effects of these threats are also very very important to understand in bird conservation.

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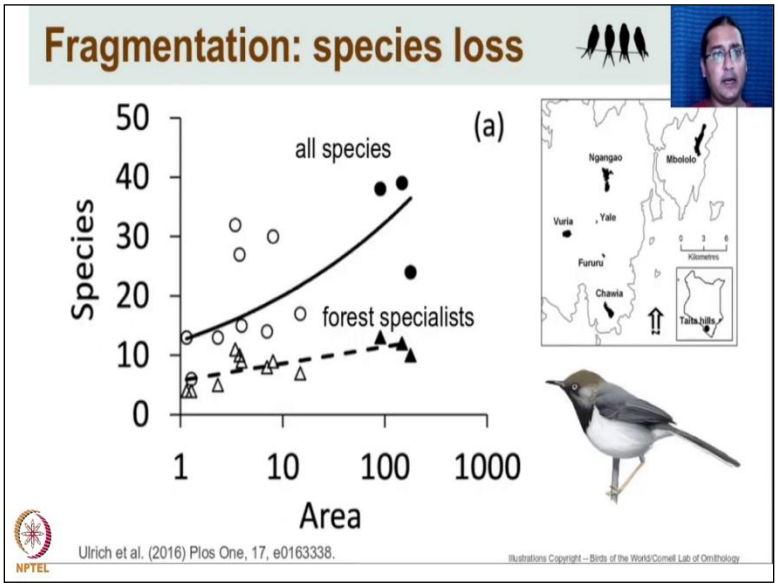

Let us start by looking at habitat fragmentation. This is a graph which has area on the x axis in the log scale, area of the fragment on the x-axis on the log scale and the number of species on the y-axis. And these are various forest fragments from the eastern Ark mountains in the tighter hills of Africa and you can see that as area increases the number of species that the fragment can hold also increases.

So, small fragments have fewer species, larger fragments have a greater number of species and that is true for all species as well as for forest specialists where smaller fragments are not able to support a large number of species. That is because some species are area sensitive, you know, they need larger area to be able to have multiple home ranges and multiple territories. And so, small fragments do not allow these wide range species to continue to exist in these fragments. And therefore, you lose especially large wide-ranging species from forest fragments.

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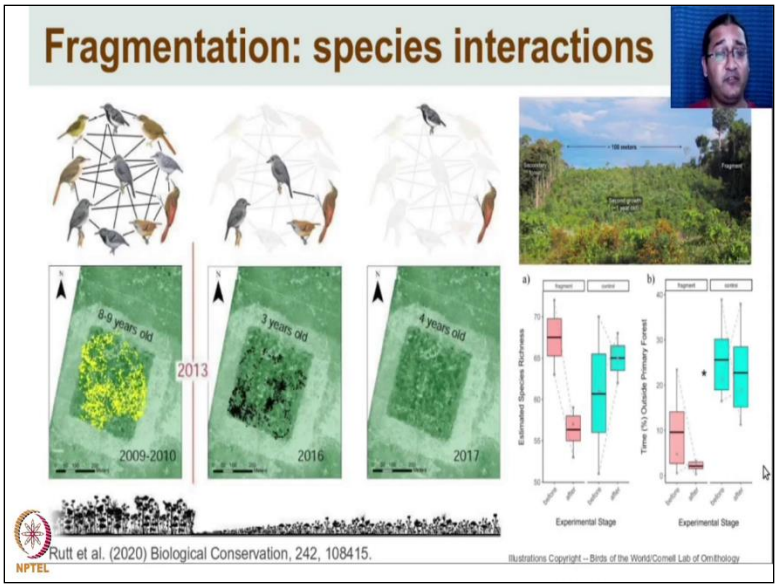

Not only do you lose species because of fragmentation you also do species interactions these are flocks mixed species bird flocks which are groups of species that feed and move together they are tied together in a very strong network of interactions. And what happens with for fragmentation is in the bottom right you are seeing that you are not only losing species from the forest fragment.

But because the fragment is isolated, because the fragment is isolated the interactions between these species are also coming down. So, what you see in the top right in that photograph there, is the distance between a secondary forest in the fragment which is 100 meters. So, that is an isolated forest fragment on the right side which is very relatively far from the secondary forest. Now after eight or nine years of regeneration of the forest in between these patches the isolation between the forest and the fragment comes down.

And because the fragment becomes less isolated after eight or nine years of regeneration which is what you see on the left over there, you have these very cohesive mixed flock species. After re-isolation of these forest patches by cutting down this secondary forest after three years of these the interactions between these species break down. Not only do you lose those species which have disappeared from the forest fragment.

Even the species that are left behind the interactions break down until the interactions are completely absent between these species and the mixed species flock itself disappears over time

from these forest fragments. So, fragmentation not only affects the number of species in the habitat it also affects the interactions very very important interactions between species. So, for example mixed flocks are very important for the survival of their participant species.

And the breakdown of these networks really has huge impacts on their survival and their ability to persist in forest fragments.

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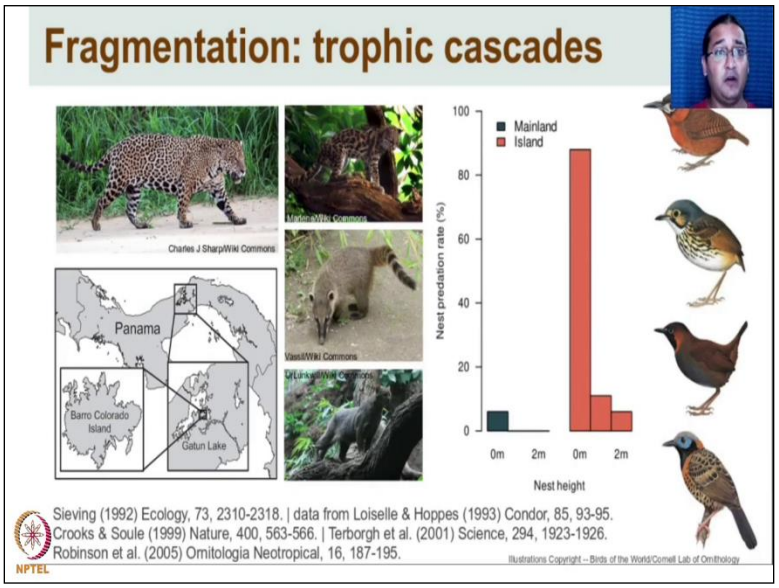

A fragmentation also causes very very interesting indirect effects. this is an example from Barro Colorado island. Barro Colorado island was an island created by a lake that was created during the construction of the Panama Canal and when the Panam Canal was created a lot of the forest area was flooded and a little bit of the forest that was relatively high elevation then became isolated as an island and it is called Barro Colorado island.

All the Jaguars have disappeared from Barro Colarado. They are large high trophic level animals they need large areas to survive and Barro Colorado islands just incapable of supporting Jaguars and so, they have disappeared from the island. The disappearance of the Jaguars has allowed what are called meso predators in the middle you see the Ocelot and the Coati and Jagarandi. These mesopredators have increased in abundance because of the absence of the Jaguar .

And these mesopredators are also nest predators. They eat the nests of ground nesting birds and look at if you look at the predation rates of nests on the ground zero meters one meter above the ground at two meters above the ground and you compare the predation rates on the mainland in green and the island in red you see huge changes. So, ground nesting birds have about a 6 to 7% predation risk of their nests on the mainland whereas they have almost 90% predation risk of 90% of the nests are lost from predation on the island.

And that is because of the jaguar absence of the jaguar. So, the jaguar is not directly interacting with these birds at all but because of fragmentation the loss of this top predator these intermediate predators or mesopredators increase in abundance and they have actually led to the extinction of a large number of ground nesting birds from Barro Colorado island. And so, fragmentation also causes these trophic cascades which is very very interesting indirect impacts that occur leading to the loss of bird species from these fragments.

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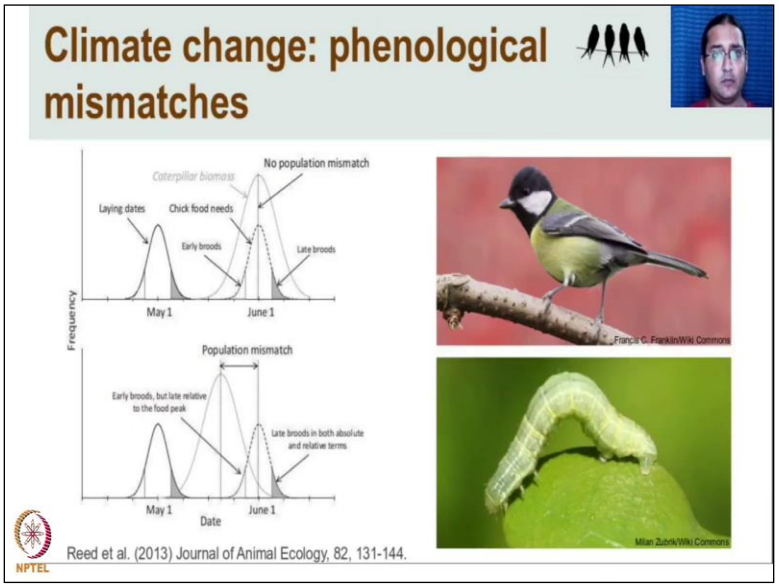

Climate change is becoming a very very important cause for threats to birds. One of the ways in which climate change is affecting birds is through what are called phenological mismatches. Phenology is the timing of which annual events happen in the life cycle of an animal. So, for example migration is a phenological event, nesting is a phenological event. So, here is an example of the Great tit from Europe.

The great tit feeds on caterpillars and the laying dates of the Great tit which are around March 1st, if you look at the graph on the top left there the laying dates of these great tits around March 1st that they timed the laying of their eggs such that when the chicks hatch and the chick food needs are the highest that is when the caterpillars are also in the habitat that is why the abundance of the caterpillars is also highest.

And so, the timing of nesting (the timing of laying eggs) is matched to the timing when caterpillars are going to emerge such that when the abundance of caterpillars is very very high in the habitat that is the time when the chicks are in the nest and the needs of the chicks are the highest. What is happening very often with climate change is that these phenological events, egg laying versus the abundance of the food in the habitat become mismatched.

So, if the Great tits continue to lay their eggs in May but because of climate change the abundances of the caterpillars the emergence of the caterpillars comes earlier. Let us say the caterpillars are using temperature to determine when to hatch from the eggs and because the habitat is getting warmer and warmer over time. They are emerging from the from their eggs earlier.

But the Great tit, if it is continuing to nest and lay eggs such that when they actually hatch the peak in the caterpillar abundance is over, the caterpillars have emerged early they have become adults earlier and so, when the chicks are in the nest and the nest requirements resource requirements in the nest are very very high there are no caterpillars or very, very few caterpillars in the habitat.

So, climate change can cause these phenological mismatches between predator and prey which affect bird fitness and bird survival and reproductive ability.

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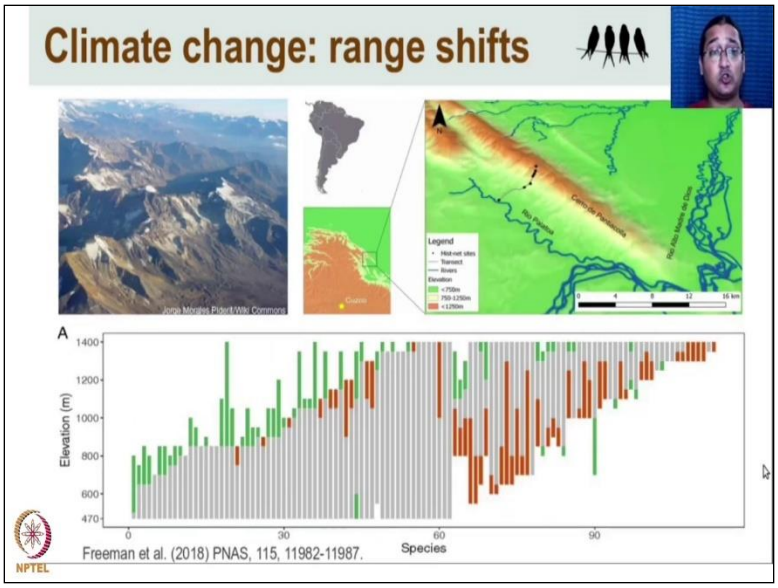

Climate change is also causing rain shifts and this is very very apparent from tropical mountains especially. This is an example from the Andes mountain range. And here you have this this particular mountain range going from an elevation of about 470 meters to the summit which is 1400 meters. So, the mountain range itself is about 1400 meters high. What you are seeing at the bottom there is one bar representing different species.

Each bar is a particular species and you have the elevational range of each of these species shown by that bar. So, the first species for example goes from 470 meters to about 800 meters. Now what the gray bars are showing is the elevational range historically. If there is a green extension of the elevational range upwards, that means that the upper limit of the range of the species is moving higher up in elevation.

And you see the red lines what that means is that the lower elevation lower limit of the elevational range is higher up today than it was historically. So, what is happening here is that as climate is becoming warmer and warmer birds are moving upwards in these mountains to adapt to remain in similar temperatures that they are adapted to historically. So, climate change is causing these birds to move upwards in these tropical mountains.

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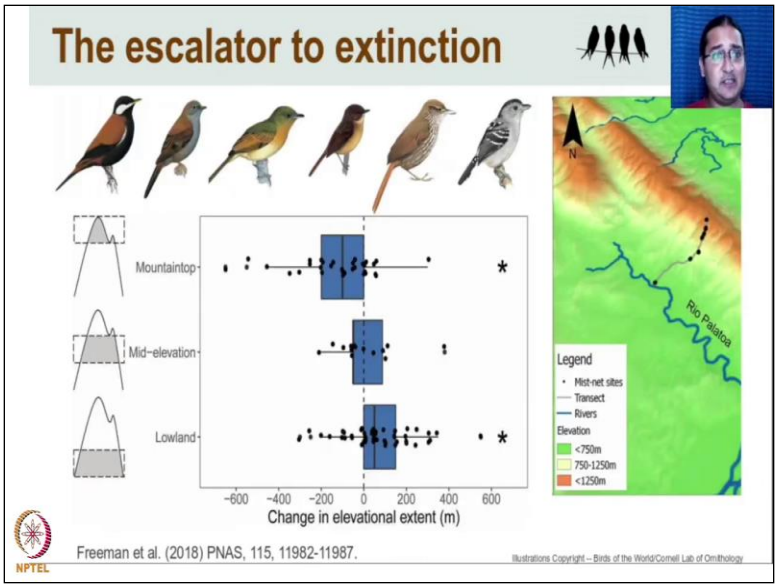

And from the same study what we are seeing is in this graph on the x-axis is the change in the elevational extent of the range of these species for three different kinds of species lowland species, mid elevation species and mountain top species. Lowland species are actually expanding their ranges they are moving upwards. So, you see that box plot there is actually mostly positive to the right of zero, which means that the lower elevation species are expanding their ranges upwards and increasing their elevational ranges in response to climate change.

The mid elevation species are moving upwards both in the lower limit of the elevational range and the upper limit of the elevation range and so, there is hardly any change the change in elevational extent over time has mostly roughly zero. The mountain top species are losing elevation. So, the lower limit of their elevational ranges is moving higher up because of that, what is happening is that they are getting squeezed at the top.

They are moving upwards and a lot of these top species are going locally extinct in these mountains because then they are moving upwards and upwards and finally there is nowhere else to go. They run out of habitat and they go extinct and this is being called the escalated to extinction. And this is a process that is happening in tropical mountains across the world where bird species are moving up in response to climate change and then unfortunately going extinct.

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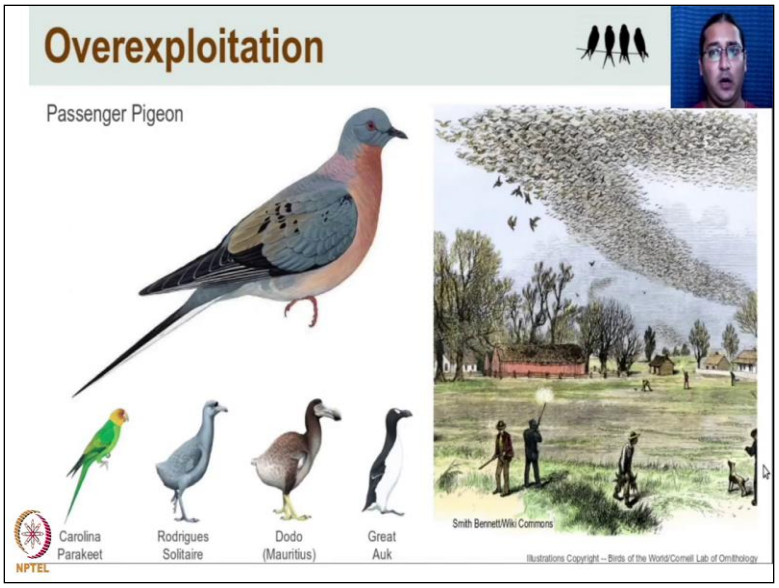

Another threat to birds is over exploitation and one of the classic examples of over exploitation is that of the passenger pigeon. The passenger pigeon was an extremely common species of pigeon in North America and there are reports of flocks of millions of birds being miles long and miles wide that was how common they were but they were hunted to extinction and that is very, very common species that has gone completely extinct because of hunting.

And that is true for a number of other species like the Carolina parakeet again from North America and a number of species of islands like the Rodrigues Solitaire, the Dodo and the Great Auk that have basically gone extinct because of over exploitation by human beings or hunting by human beings.

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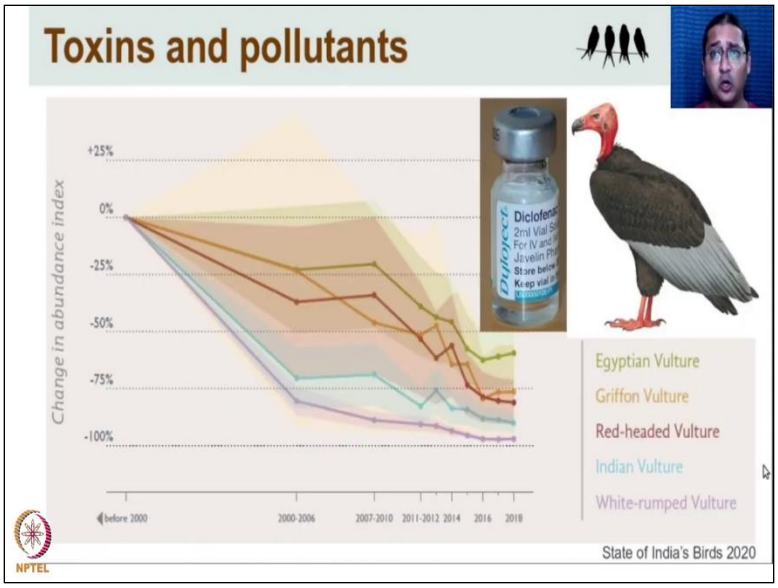

Toxins and pollutants like we were talking about have had a massive effect on Indian vultures. The veterinary drug diclofenac that is used to inject livestock that are sick. So, cattle that are ill or injected with diclofenac and after they die the vultures would feed on the carcasses of these dead animals. The tissues of which contain dichofenac and because diaphragmatic is a toxin for these vultures, the vultures would die because of poisoning and the population sizes of our vultures because of this particular veterinary drug diclofenac has declined by about 90 to 98% for different species

in the last 20 years or so, which is a massive decline all of these vultures are now critically endangered.

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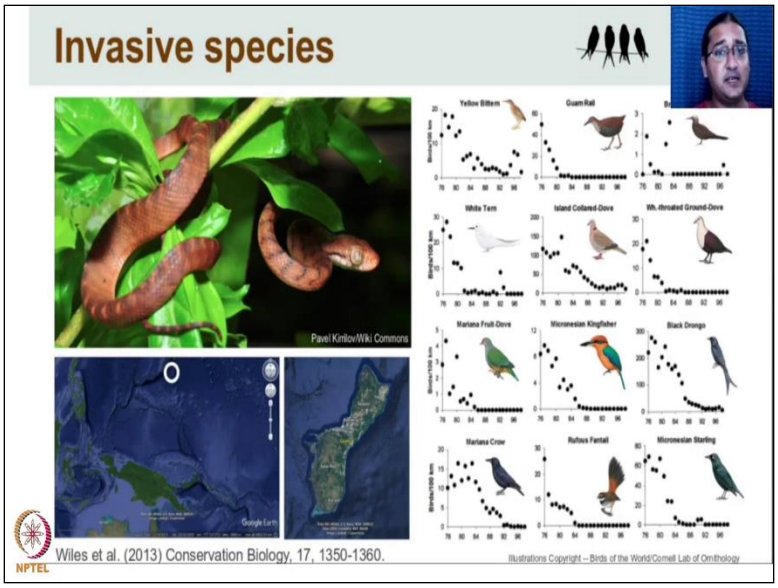

On islands especially invasive species take a huge toll on birds. One of the classic examples of a invasive species having a massive conservation implications is that of the island of Guam. The island of Guam is in the Pacific ocean and the birds on these on this island have evolved without predators and so, they are not adapted to escaping predators or having any anti-predator strategies.

The Brown tree snake which was never found on the island of Guam was introduced onto this island and it is a massive predator of the nests and the eggs of these birds. And the Brown tree snake after the introduction of the Brown tree snake in the 1970s the population sizes of the number of birds like you can see on the right have crashed completely and a lot of the endemic birds of Guam a lot of the birds of that were found only in Guam

(on the island of Guam) have actually now gone completely extinct because of this invasive species. The invasive species being a species that is not native to that habitat it has been introduced into the habitat by human beings and then it has caused these massive population declines. Other examples of invading species are rats and pigs wherever humans go they have taken rats with them and taken pigs with them.

And especially on islands where birds have not evolved in the presence of radiation, these birds are especially vulnerable to being to going extinct because of predation by pigs and rats.

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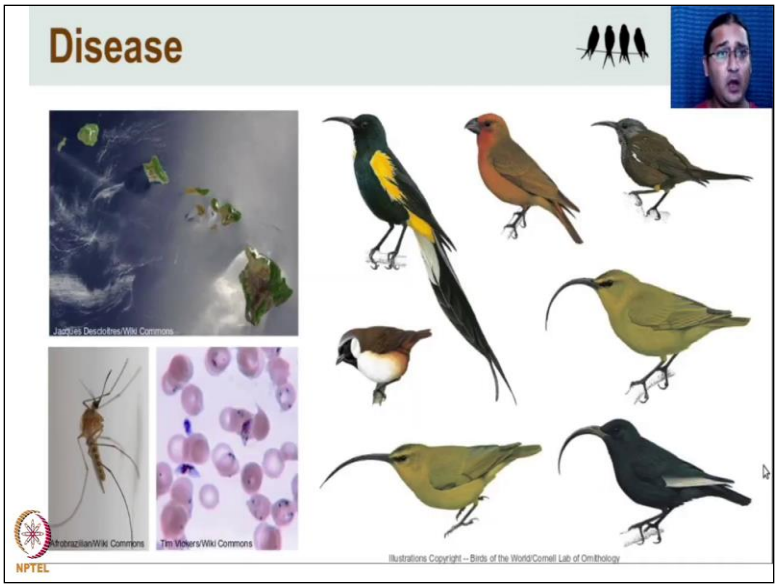

Disease is another example the Hawaiian archipelago, you see in the map over there on the top left is or was home to a number of Honey Creepers. You can see some of these Honey Creepers on the right there. These Honey Creepers were endemic to the Hawaiian island. They were found nowhere else in the world and they had evolved on these islands in the absence of mosquitoes and therefore the absence of malaria.

When human beings came to these islands, they brought mosquitoes with them and the mosquitoes obviously carry and Avian Malaria with them and these birds have no immunity (had no immunity to malaria at all) and so when these mosquitoes were introduced they brought with them even malaria and avian pox to which these birds had no resistance as a result of which malaria and pox (avian pox) have caused the extinction of a large number of the endemic Honey Creepers of the Hawaiian islands.

So, they have actually succumbed to a disease. So, disease especially on islands where birds have not evolved in the presence of such diseases and not evolved any immunity to disease has also been a cause for extinction of species.

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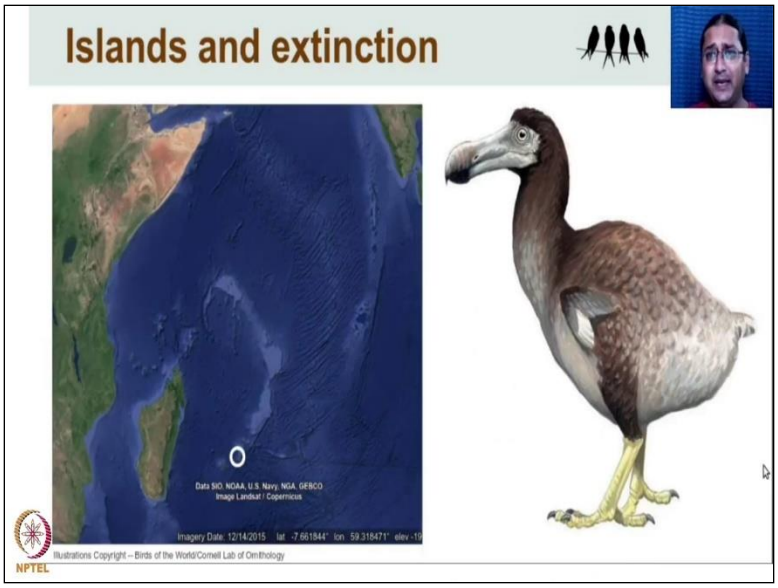

Islands are especially, you know vulnerable to these kinds of effects. Birds on island are particularly vulnerable to extinction, that is because like I was saying they have evolved there in the absence of you know things like disease,s things like predation, they have not evolved any immunity against these diseases ,they have not evolved any behavioural responses against predators. So, a lot of these island birds will nest on the ground because they are not used to having predators coming and destroying their nests and eating their eggs and fledglings.

One example of this is the Dodo from the island of Mauritius, which had no fear for example of human beings, it is supposed to be very tame and docile because it has not evolved any fear of predators. And this is a pattern that you see with island birds repeatedly where they are very very vulnerable to predation by invasive species very, very vulnerable to the introduction of new diseases onto these islands and so a lot of the extinction of birds that we see are from island systems.

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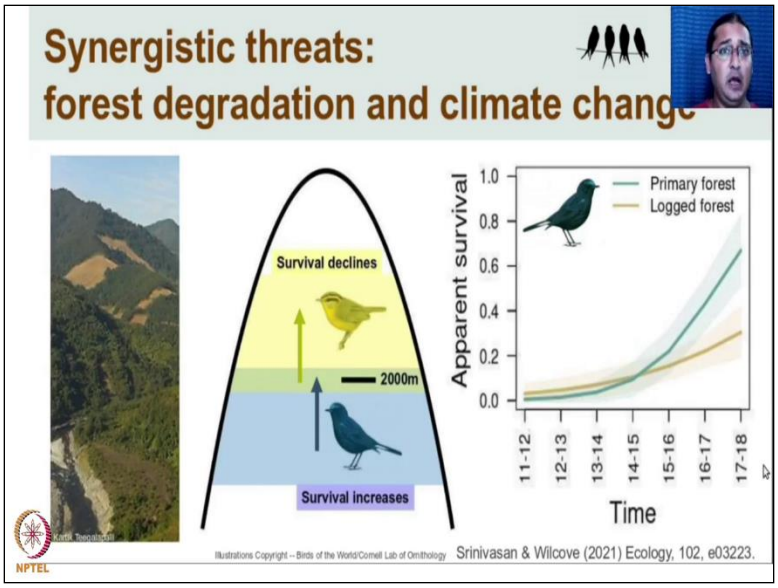

Let's look at some of the synergistic threats where two threats are acting together to influence bird species and to influence the conservation of bird species. This is an example from the eastern Himalayas what you see on the left that photograph on the left is what is happening in the eastern Himalayas now, is that across that elevational gradient, you tend to see habitats being converted forests being lost to agriculture or to settlements.

So, there is forest degradation happening and in the Himalayas you also have species moving upwards because of climate change. So, they are being impacted both by climate change as well as forest degradation. But this is work from 2000 meters elevation of 2000 meters in the Himalayas where you have this low elevation blue species the White-tailed Robin in moving up towards 2000 meters right it is it is a low elevation species its range is represented by the blue polygon.

So, it is found mostly below 2000 meters, that is its elevational range but because of climate change it is moving up towards 2000 meters. Now, as it is moving up, it is occupied it is moving to more and more favourable habitat and so you should see its survival rate going up at 2000 meters as it comes in from below because of climate change. And that is what is happening with the green line. You see in primary forest the survival rate of the White-tailed robin which was almost zero the hardly any White-tailed robins in about 2011 at 2000 meters.

Today the survival rates of the whitetail robin have gone up to about 70%. So, as they are moving up into primary forest, they are able to adapt to climate change they are able to maintain survival rates by moving up into primary forest. But if they move up into logged forest or degraded forest which is the by the representation line there then the survival rates are not going up as strongly.

So, the survival rate in log forest as they moved up is only about 20%. So, climate change and logging or forest degradation are acting together to reduce survival rates of White-tailed robin in this case but a large number of other bird species as well. So, that is an example of two of these threats operating together to influence the population viability of these species.

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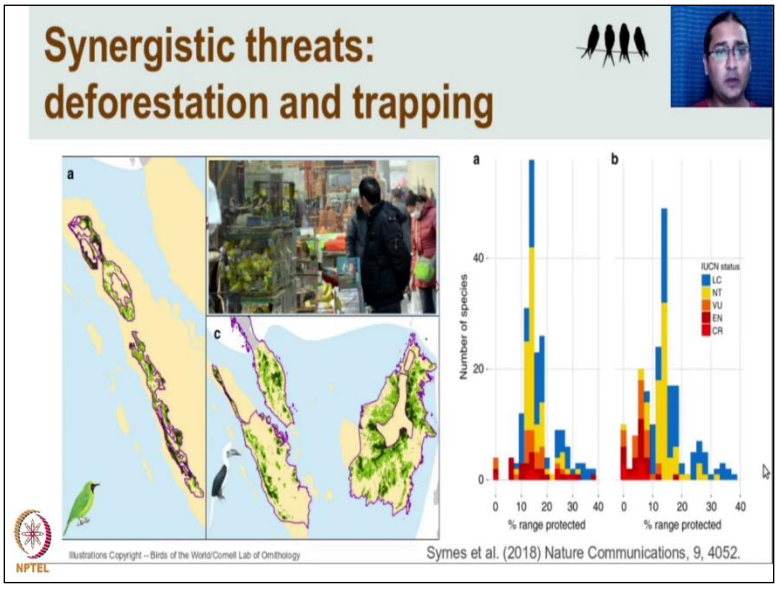

Here is the joint impact of deforestation and the trapping of birds in Indonesia. Several bird species are trapped for the pet trade in Indonesia. So, large number of songbirds are trapped and sold in markets in the Indonesian islands. Whatyou are seeing is a map of the industrial islands with two bird species you are seeing in A and C. The purple area right the purple area is the historical range of these species according to Birdlife international that is that is the range size that they occupied.

Within this range within these purple lines for this Lea bird and this Hornbill in A and C, focus on the Hornbill for example ,what you are seeing is within these purple lines you have the remnant forest in green. Now green is in two colours dark green and light green both of those represent the

forest that is left behind in the area that this bird historically occupied. So, deforestation has caused already the available habitat to shrink greatly or from historical times to today.

Now the green is in two colours, the reason for that is the trapping of these birds happens within five kilometers from the nearest access point. So, anything that is five kilometers from a road, any habitat that is five kilometers from a road has been completely trapped has been completely trapped out the birds are absent in that in that area. So, the green parts of those dark green parts of the forest are showing you forest patches that are more than five kilometers away from a road.

So, those are the areas where these birds are still present because they are not being affected by trapping whereas the light green areas are areas where these birds have completely disappeared because of trapping. So, actually it is not only a deforestation that is causing massive contractions in the ranges of these species, it but deforestation is also encouraging trapping and increasing the area in which those birds can be trapped.

And therefore, further shrinking the areas where these birds are still found in. So, an example of how deforestation and trapping are operating together to really reduce the population sizes of these trapped species.

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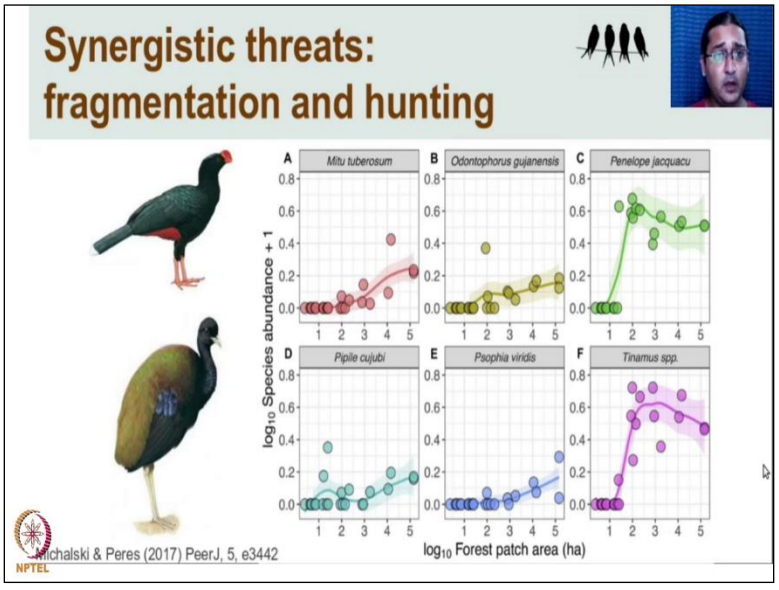

Another example is fragmentation and hunting. What you see in the x-axis is the size of forest fragments that is on a log scale under the y-axis the abundances of these various large bird species that are hunted in the Amazon basin. And you can see that the population sizes of these birds are much lower in forest fragments than the small forest fragments than they are in large forest fragments. As the size of the forest fragment increases the abundances of these birds.

So, the densities of these birds also increase and that is because of hunting because if a forest is fragmented, it's now more accessible to hunters. So, large tracks of forest are less accessible they are less people are less likely to go into those last forest fragments to hunt large forest areas to hunt than they are to go into small forest fragments to hunt. And therefore, fragmentation itself encourages further hunting.

And so, these two threats operate together often in fragmentation and hunting in influencing bird populations.

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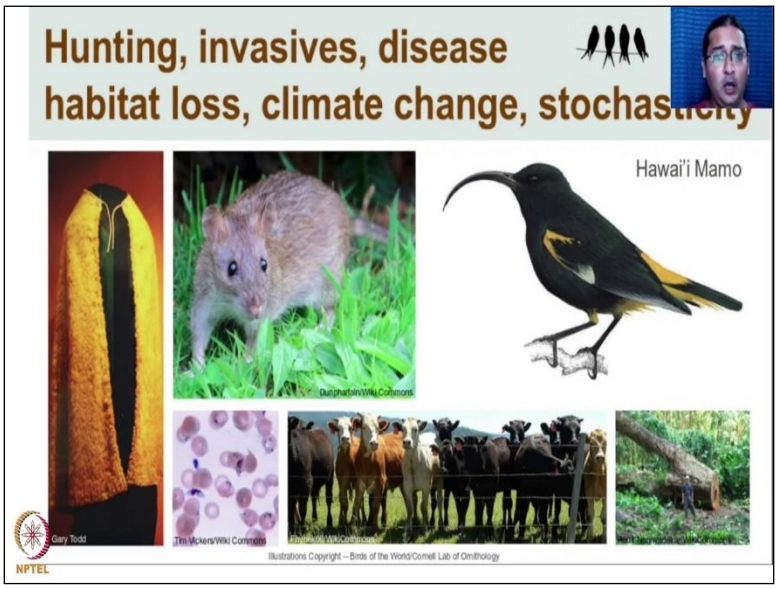

Some birds and we talked about islands especially on islands this is the Hawaii Mamo, was subject to multiple threats operating together. They were exploited greatly for their feathers to make these ceremonial cloaks that you see on the left the emperor would wear these ceremonial cloaks made of the feathers of theMamo. So, they were exploited as if they were hunted for these for their feathers, invasives like rats,

diseases like malaria were brought in by human beings. There has been a lot of loss of their native habitats to cattle pasture for feeding cows and livestock there is been a lot of hunting as well a lot of destruction of the forest because of logging. And all of this has come together to to make these populations smaller and more vulnerable to demographic and environmental stochasticity. And ultimately you have all these various threats operating together to cause the complete extinction of the Hawaii Mamo and island birds are particularly susceptible to these kinds of threats.

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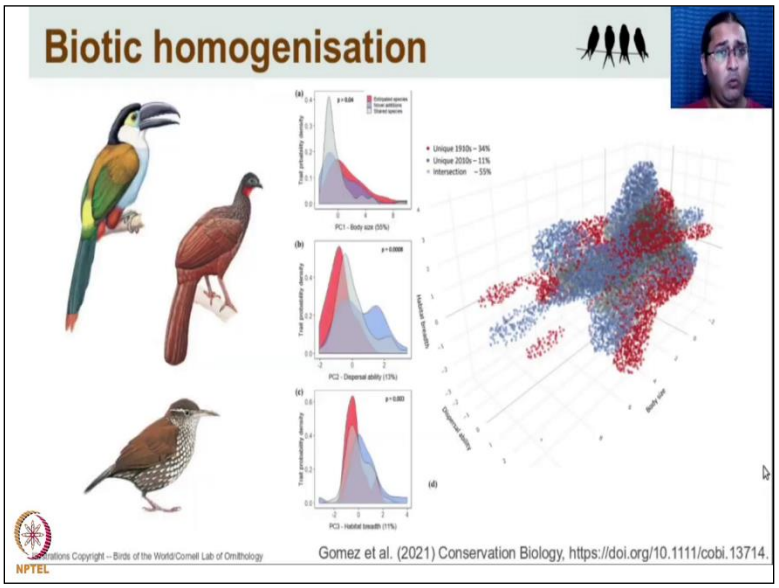

What is this cause in terms of the bird communities that are found in these areas. This is a century of change in bird communities in the Andes mountains. So, all of this is happening together in the Andes, climate change, forest loss, hunting etc. All of these changes are occurring together and that is causing what is called biotic homogenization. Stay with me for a moment here you have three graphs over here.

These three are showing you the frequency histograms of body size, dispersal ability or mobility and habitat breadth. And compare the blue line blue areas with the red areas. The blue areas are the new species that have come into this habitat. The red areas are the species that have gone extinct.You can see that the species that have gone extinct tend to be larger than the species that are the new species that have come into this habitat right.

The large species are going locally extinct, the species that are replacing them are smaller species. In terms of dispersability or mobility the species that have gone extinct are actually species that have low dispersal ability (towards the left of that x-axis right). So, their species are going the species that are going extinct are the species that are more sedentary the species that cannot move. The new species that are coming in are species that actually can move long distances, they are species that are mobile.

They have high dispersal ability and in terms of habitat specialization the species that have gone extinct are the specialist habitat. Specialist species with low niche breadths or niche habitat breadths. This new species that are coming in the blue species are those that have higher niche spreads or more generally species. So, what is happening here is that we are moving from communities that had or were represented by a large number of species that were large, sedentary, special species towards communities that are becoming dominated by smaller more mobile habitat general species.

And that is happening because of all of these things hunting climate change habitat loss and degradation and so on. It is causing the homogenization of communities such that the species that are in these new communities are species that are small mobile and habitat generalists.

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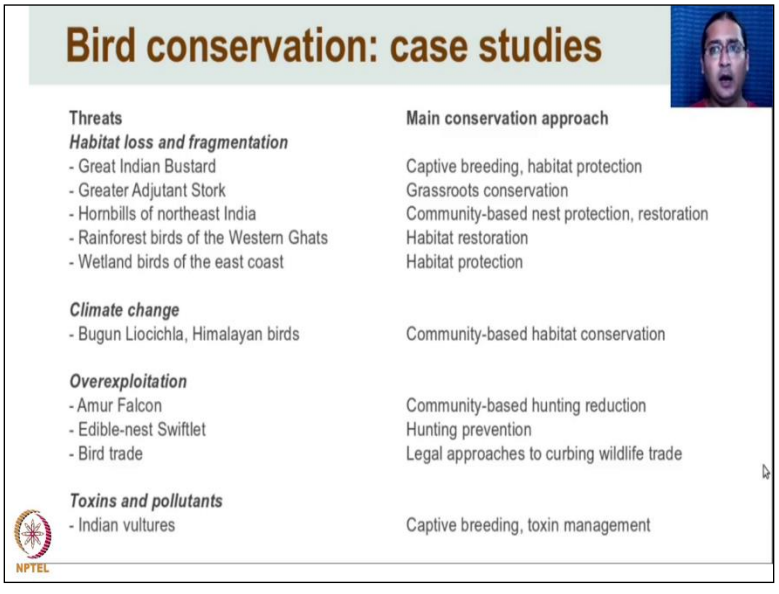

From India ,we have a number of conservation case studies that might be of interest. For example, where, you have habitat loss and fragmentation affecting bird species like the Great Indian Bastard, the Greater AdjutantStork, the Hornbills of northeast India, rainforest birds of the western ghat and so on. You know you have various conservation interventions that have been instituted to protect these bird species depending on the threats that they are facing.

For example, for the Great Indian Bastard - captive breeding and habitat protection, for the Hornbills of northeast India - nest protection (community based nest protection) and forest restoration as well same for the rainforest birds of the Western Ghats. A community-based habitat conservation for Himalayan birds in the eastern Himalayas in response to climate change and where species have been exploited in the past Amur Falcons, the Edible nest Swiftlet.

And especially the bird trade which is quite a large issue in India. What are the ways in which we can conserve these species through community-based hunting reduction, preventing hunting and so on. And with Indian vultures that are being exposed to toxins and pollutants captive breeding is emerging as a way in which to replenish their wild populations and toxin management replacing diclophenac (the veterinary drug) with alternative drugs.

So, that cattle carcasses are not poisoning these vultures anymore these are certain word conservation case studies that would be of interest to people who might be looking for a more deep dive into the kind of threats that Indian birds are facing and the kind of conservation approaches that people have taken to protect these species. Thank you.