Basic Course in Ornithology
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Nature Conservation Foundation

Citizen Science
Lecture - 42

Sorry about that. I just called him, he is doing it. Okay, yeah found him. Yeah, okay great, sorry about that Ashwin, no problem, okay, yeah thanks Devica and it is a real pleasure to be here, I will start my talk, is my screen visible? No not yet.

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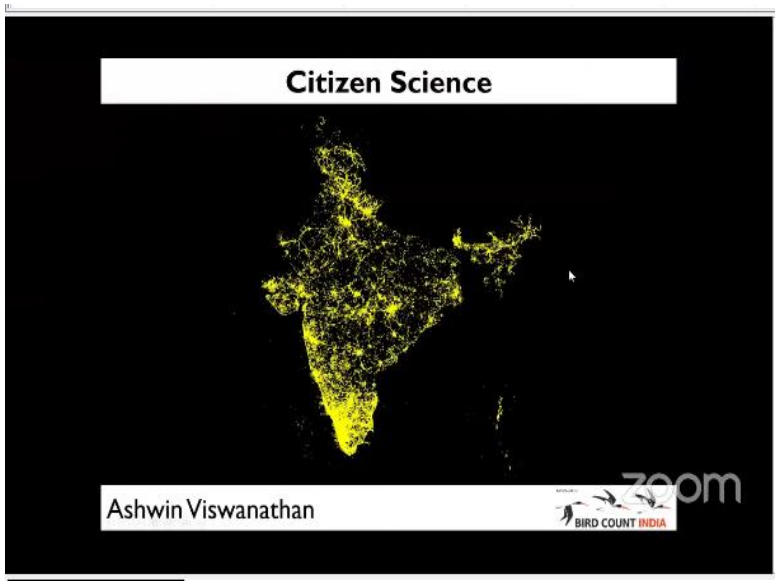

So, I am going to be speaking about citizen science today as you all know. I will come back to the significance of this map later.

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So, I will start with what is citizen science? So, I suppose our general understanding is that it is public participation in scientific research, not just professional scientists but everybody in the public any interested person contributing to science. But, in more detai,l it is the public involvement in the entire process of science, from getting ideas to asking questions, some of which you have gone through earlier in the course designing methodologies, analyzing the data that comes out of it and generating publishing knowledge, so the entire process. And this often involves collaboration with professional scientists in various capacities.

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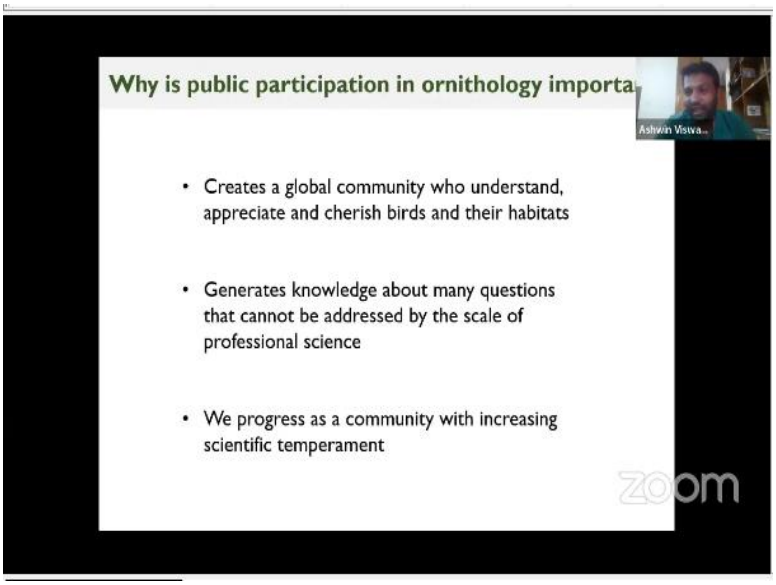

So, why is public participation important? It creates a global community who understand birds well, appreciate them and cherish them, which leads to better knowledge generation and conservation of habitats. There are many questions that cannot be answered through more

conventional science (I call it professional sciences people who are actually employed to do science) versus the general public.

And because scientists are so few citizen sciences involving general participation can answer many questions that conventional science cannot and we generally progress as a community with increasing scientific temperament.

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So, citizen science in ornithology is very old in India. I am going to focus on India alone and one of the earliest citizen science initiatives to monitor birds in India was the Asian waterbird census.

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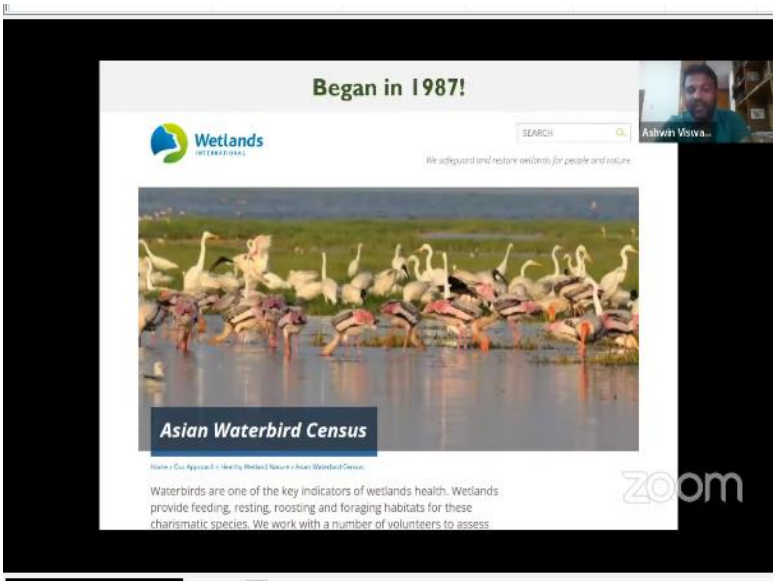

And this began in 1987.

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Since then, a number of online possibilities came up that allowed people to discuss about birds again to ask questions and learn from each other and some of these platforms included India Nature Watch which was largely a photo sharing platform, but also a place for people to learn; learn from each other, learn from bird watching experiences and yahoo groups which was an excellent discussion forum.

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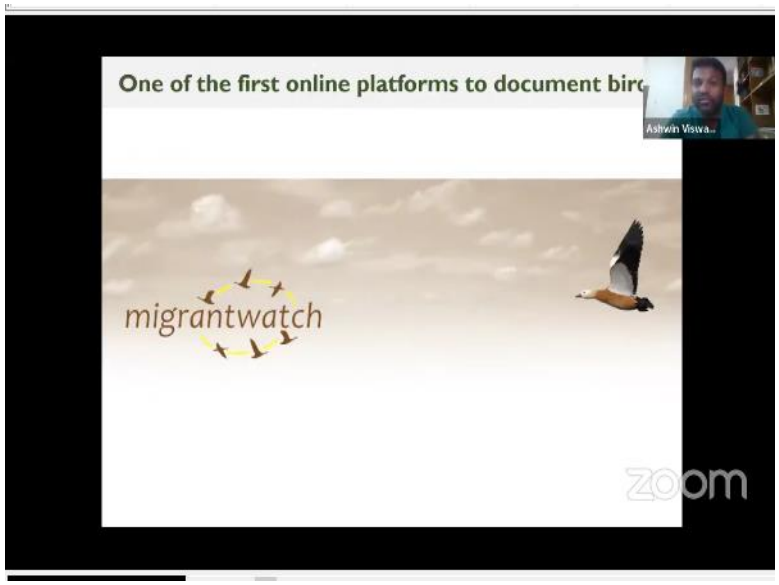

One of the earliest platforms where you could online platforms to document birds was migrant watch which began in 2007 and went until 2014 and it actually encouraged many bird watchers like me then to actually do something more and this is an opportunity that all of us that I think many bird watchers are looking for to have something more happen with their daily bird watching observation.

So, I would put records of species like rosy starling, gray wagtail whenever I saw it come down into India these are migrants and whenever it would leave.

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So, this was followed by the advent of many online tools and platforms. There are thousands and thousands of bird watchers in India and these online tools and platforms allowed a simple way for people to actually collectively aggregate information and collectively contribute

towards scientific initiatives. So, there is the India biodiversity portal eBird, iNaturalist, biodiversity atlas websites and many others that have sprung up for to be able to collect information for various taxa not just birds that mentioned some that are more somewhat specific to birds.

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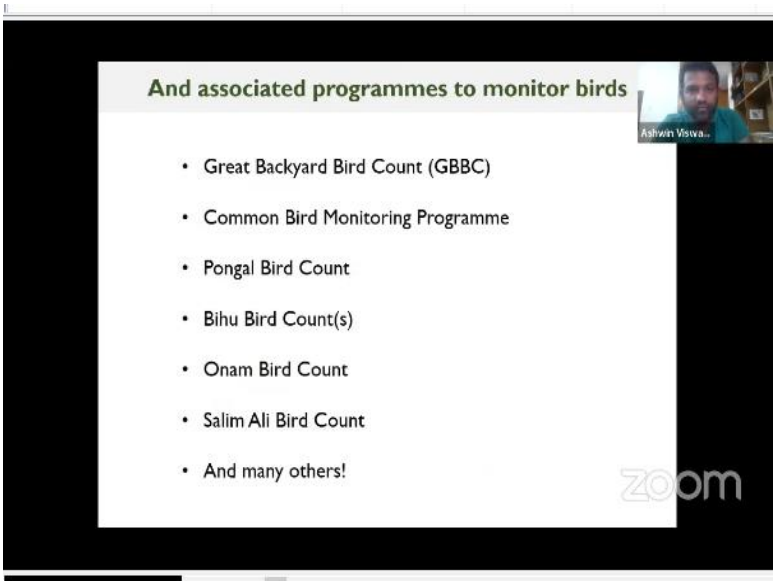

And many other programs came up to monitor birds there is a great backyard bird count that began in India in 2013, a common bird monitoring program, Pongal bird count, Bihu bird counts, Onam bird count, many of these bird count associated festivals that people were interested in coming together and counting birds for. The Salim Ali bird count and many others.

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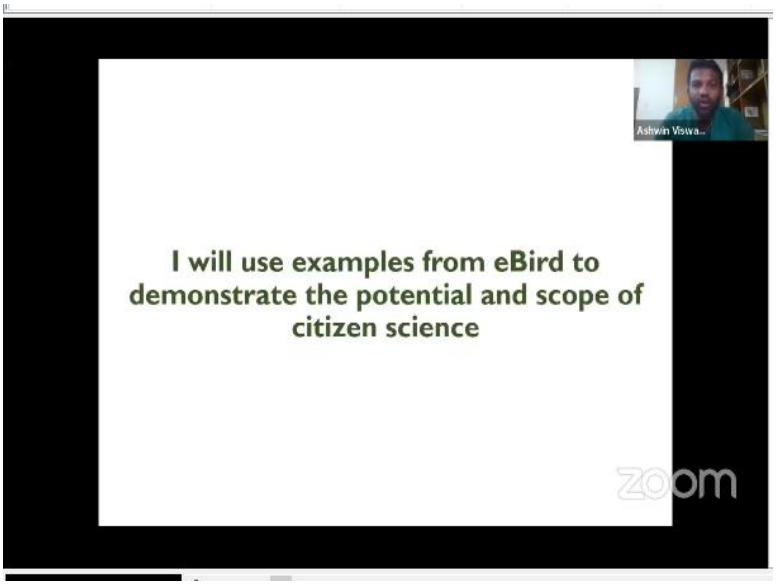

So, all of this together lead to a pretty rapid rise in public participation in bird monitoring and in citizen science. And I will use eBird as an example to demonstrate the potential and scope of citizen science and where we are putting as well.

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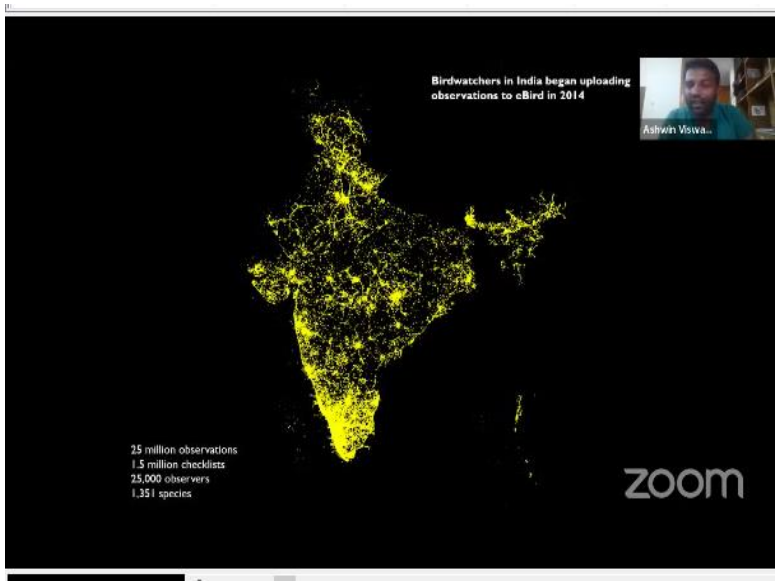

So, coming back to this map that I showed in the beginning, this is a map of observations uploaded by bird watchers to eBird since 2014 and what you see here is this map largely traces the boundaries of the country which shows the spread of bird watching and the spread of bird monitoring through eBird. There are over 25 million observations now, 1.5 million checklist, 25,000 observers and all species that have been recorded in India are now on the platform which is 1350 species.

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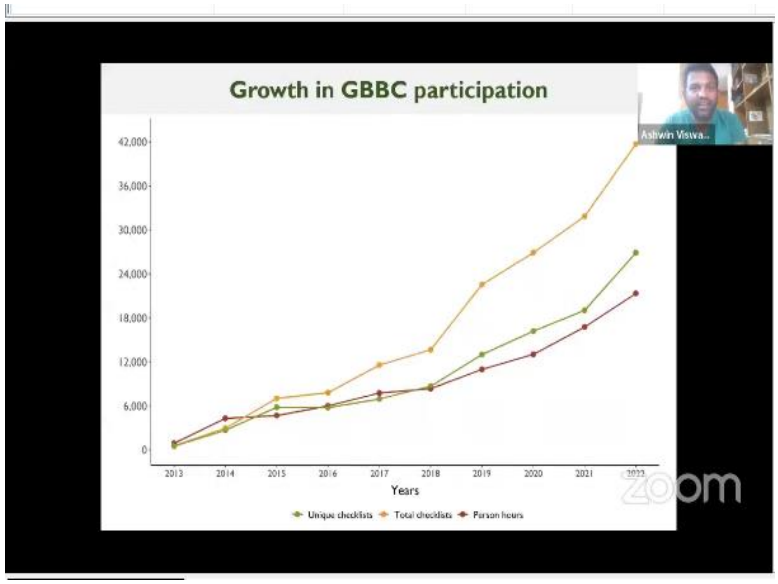

Some of this growth can be seen in the growth in GBBC participation which is a Great Backyard Bird Count which I just went through. Now, just a number of checklists and person hours, total checklist, all of these metrics are growing really rapidly over the years and you can see this constant growth and it continues to grow.

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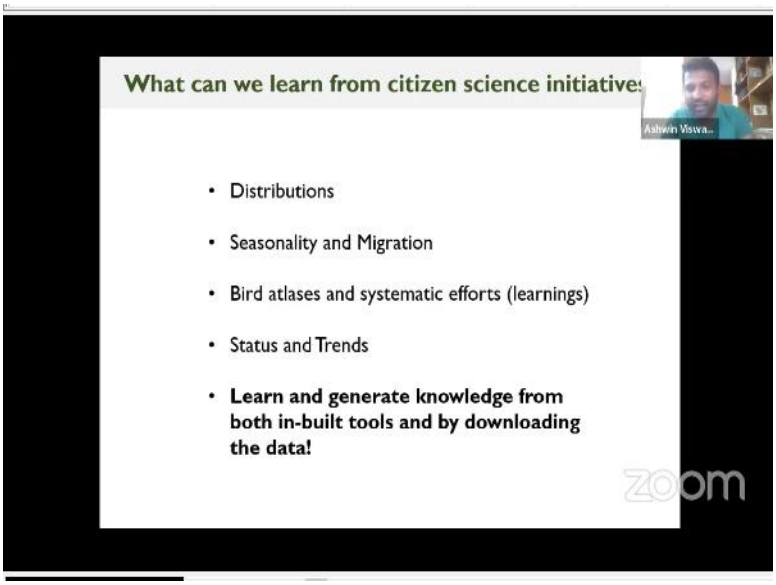

So, what can we learn from citizen science initiatives? There is this large database that has built up, there are a number of people interested in participating in science, interested in doing more with this data that has been generated, what can we learn? We can learn about species distributions where birds are in space, we can learn about seasonality and migration. When are they arriving, when do they arrive in a place, when do they leave, do these timings change or have they been changing over time about the phenomenon of migration?

There are systematic bird monitoring initiatives unlike what I spoke about which is unstructured bird monitoring, in that people can observe birds whenever they want, wherever they want and there is no consistent protocol; whereas bird atlases and other systematic efforts have consistent protocols and there are learnings that can emerge from this and then can learn about status and trends and I will explain how later.

And this knowledge can come from both inbuilt tools in all of these platforms; platforms like eBird, iNaturalist have inbuilt tools that help you explore birds and there is a lot to learn from there and that learning can lead to many questions that can then be asked and answered, also by downloading data. Most of these platforms and all of these platforms have and should have

data publicly downloadable. And any of you can download this data and answer any question that interests you. Of course, the question that is applicable that can be answered with that data.

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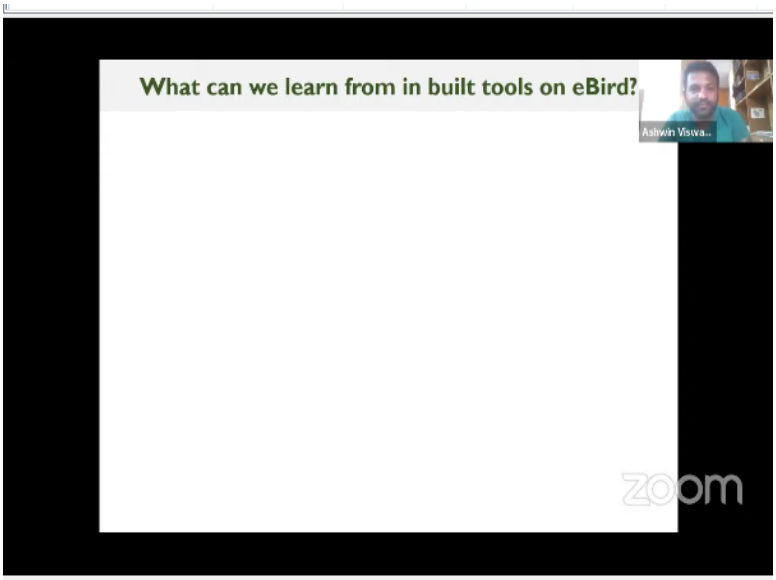

So, I will start with some learnings that are possible from inbuilt tools on eBird and again I am using eBird as an example here.

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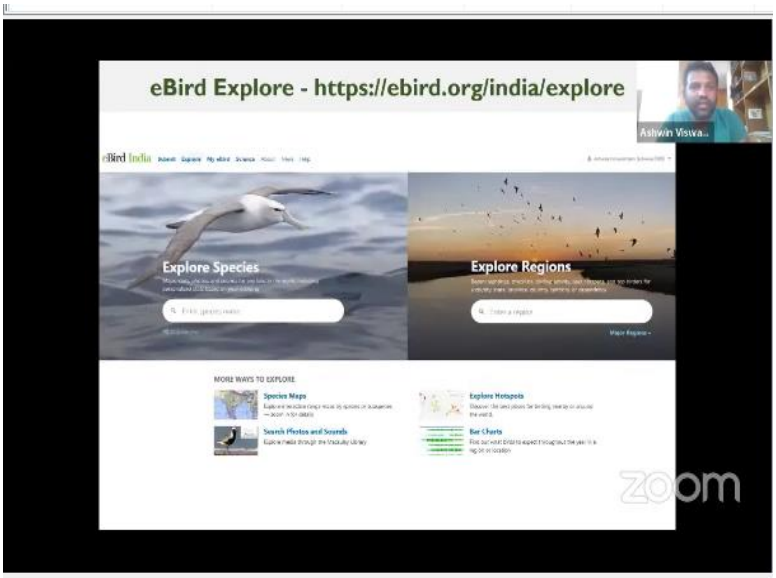

So, on the eBird India website there is this is what you will see and there is something called explore. So, you can explore and when you click on explore this is the page you get.

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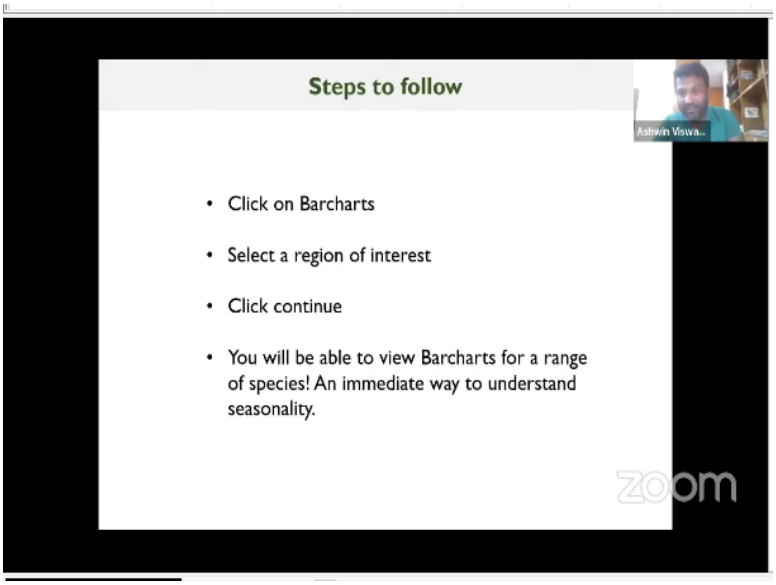

Click on Barcharts, select any region of interest, you can select states, you can select districts.

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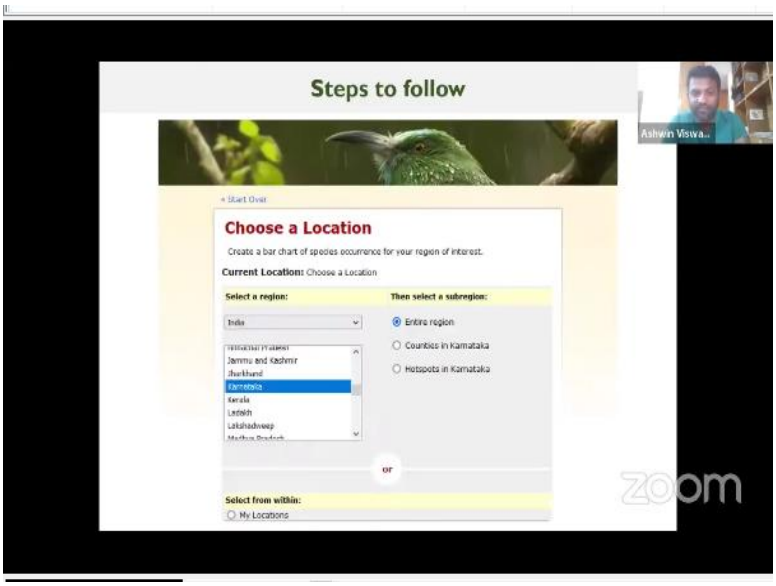

So, here I am selecting Karnataka which is where I am based, select that region and click continue, you will be able to view Barcharts for a range of species, it is an initiate way to understand seasonality.

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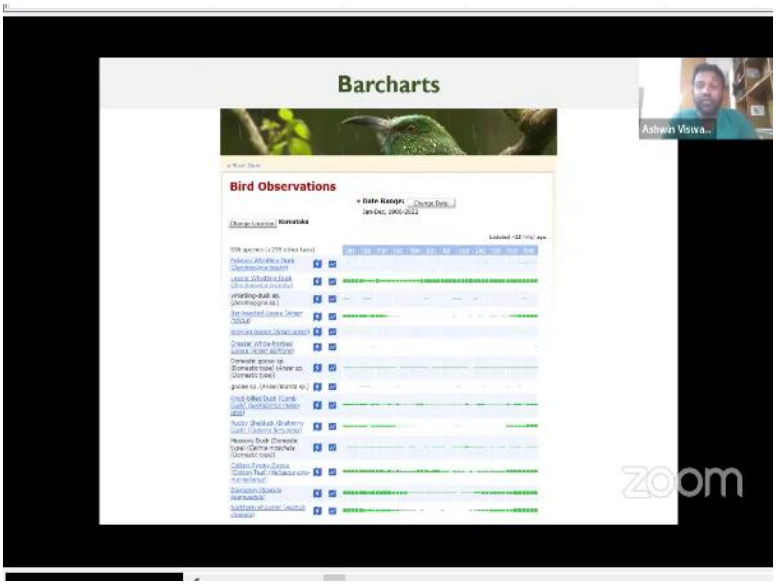

So, for example here. This is what I am going to see. I can see that lesser whistling duck in Karnataka is not a migratory species, it is resident year round, you see the width of the bars tells you how frequent it is during every week of every month of the year, you see it is divided into 48 different sections. But a species like Bar headed Goose appears to leave end of March back to its breeding grounds and arrives only in early November greatly.

So, the large period when it is not there. So, it is migratory to the state of Karnataka. Similarly, you can see species like Garganey, Northern Shoveler, Ruddy Shelduck, all of these are migrants to the state. So, to understand more about when birds arrive, when they leave? I suggest you explore Barcharts.

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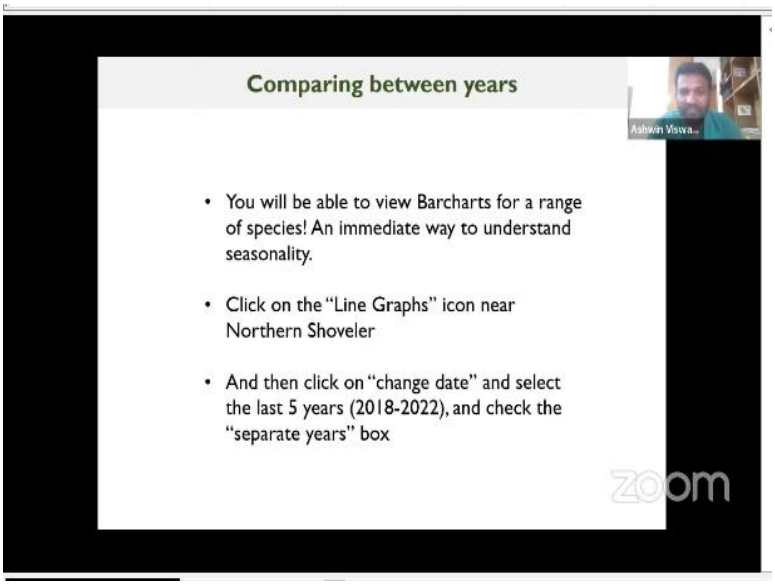

You can also compare between years, I think and this is extremely important in today's scenario of climate change in so many changes happening every year, any new events etcetera. So, it is important to see what is happening over multiple years are birds behaving differently during different years. So, click on the line graphs icon near Northern Shoveler, I am using Northern Shoveler as an example here.

And then click on change date and select the last 5 years 2018 to 22. So, that is when you can look at, you can compare across multiple years and this is important, this is also part of the assignment. So, I suggest you go and explore this.

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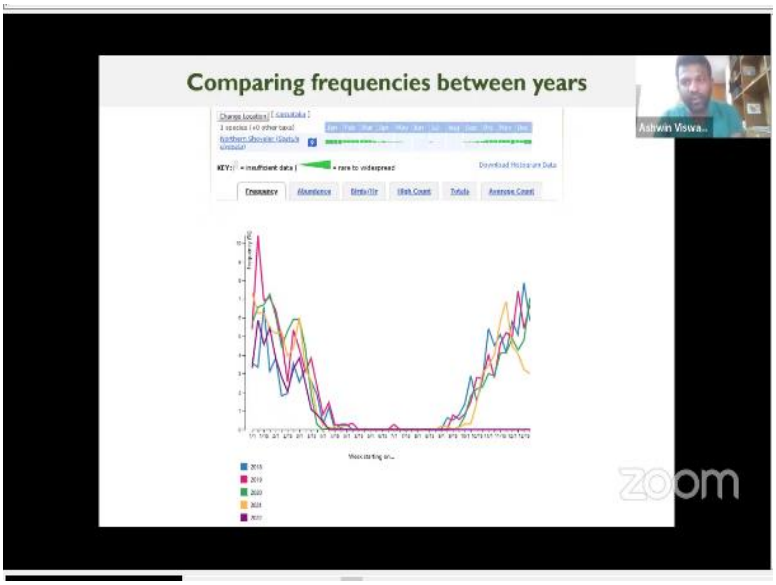

And this is what you will get. You will see that there are differences every year. So, for example in 2019 the frequency is the proportion of checklists in which a species has been seen and in eBird bird, watchers upload checklists, which are lists of birds. So, the proportion of these lists in which that species in this case Northern Shoveler was present.

So, you see that in 2019 in January Northern Shoveler were reported more frequently than during other years or other times of that year and but here there is no clear pattern between years, we can see that it is arriving and leaving but are their differences between years not very obvious.

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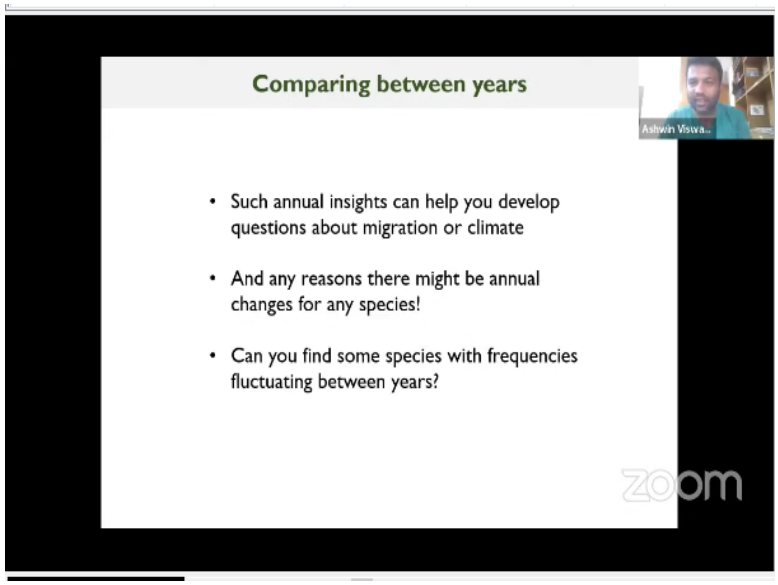

So, such annual insights can help you develop questions about migration or climate or any environmental or habitat changes that might change how much birds are using that area or that state or district. In this case there was no pattern but I would like you to look at other species to see whether if you are finding other species with fluctuations between years and there are number of species and I did not show an example here. I would like you to look at examples of fine species that show annual fluctuations.

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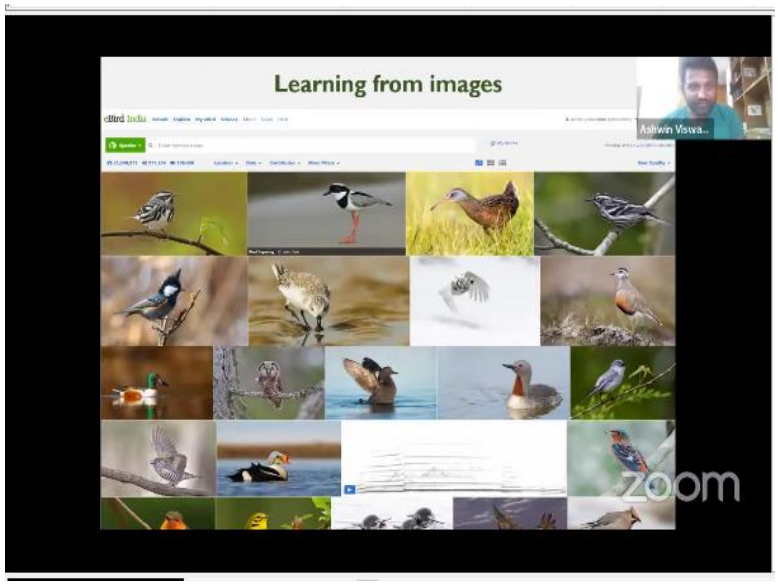

What you can also do directly from a platform is to learn from images and the platform like eBird which hosts media and Macaulay library has a vast repository of images to learn from and as you can see it is over 25 million images from the world and I think over a million much more than that from India do not remember the number but really large number of images to ask many questions about plumage, about changes in plumage over time, even about moult

timings, you might have learned something about moult about differences geographically in plumage etcetera. There are many questions to ask.

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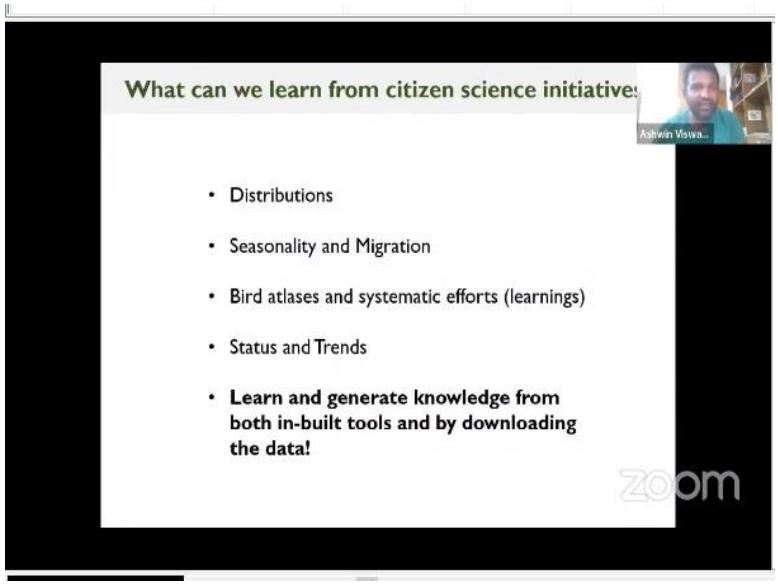

So, what can we learn from the citizen science initiatives? I listed them down earlier and I am going to go through them one by one. So, we will start with distributions.

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So, distributions are something that all of these platforms allow you to view directly on the site as well.

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But through a little bit of statistical modeling, you can get far more associations with where a species is likely to be present based on habitat and latitude and observations on these platforms. So, this is from eBird and a species like Blyth's Reed Warbler, a tiny bird that migrates all the way from northern parts of Eurasia down to India. You can see where they are there during the breeding season or where they breed, the areas that they pass through during the dates are given April to May.

So, the spring passage, but not autumn passage. Autumn passage there was not enough data to estimate autumn passage and then you have where they spend the winter. So, it appears the Indian subcontinent hosts the entire population of the species during winter.

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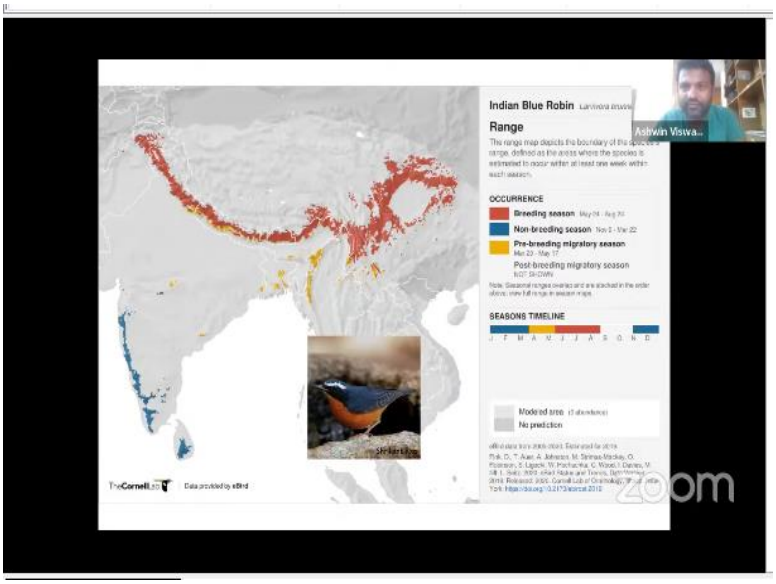

Another example Indian Blue Robin, a species that breeds in mid to high elevations across the Himalayas not just the Indian Himalayas and it migrates it spends the winter in the western Ghats and Sri Lanka largely and it migrates through West Bengal, Bangladesh and other parts of northeast India on its way back to its breeding grounds and again you have the pre-breeding migratory season given here.

So, you can see there is a relationship with both topography and latitude about where they are there during different times of the year. So, these outputs you can view directly on the you can view on the eBird page in science products and I suggest you view them and all of you can use the data to generate such outputs something I will get to later.

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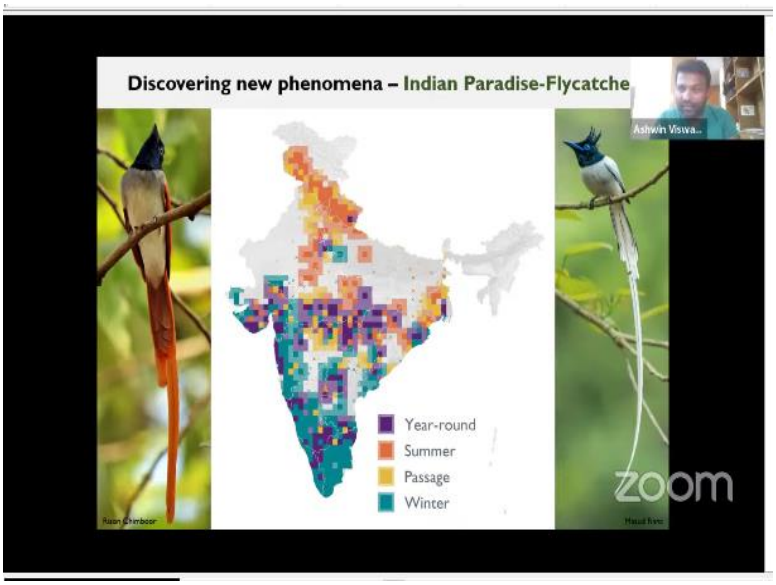

You can discover a new phenomena like with distributions when using photographs that have been uploaded. So, for example Indian Paradise-Flycatcher. There are 2 morphs; for males there is a rufous morph and a white morph and a number of bird watchers have asked this question of where is there any geographical pattern or is it age related do the morph birds always become white. So, that is a question that number of us have had.

So, looking at data uploaded to eBird and photographs uploaded to eBird in particular, you can see that there is this is the distribution of the species. So, it breeds in some part of the Himalayas, but it is also present year round in many other parts of the country and there are some places where it is only there during winter.

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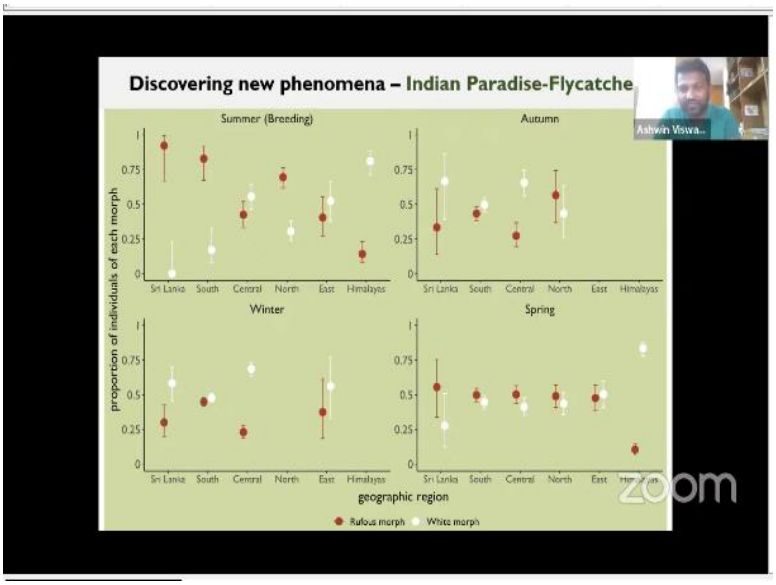

And but what we find from photos? From photos during the breeding season is that in Sri Lanka and South India during the breeding season, it is almost only rufous morph birds; whereas as you go northwards towards the Himalayas this proportion changes largely to white and in places like Sri Lanka there are no photos of white morph birds during the breeding season at all and a number of photos exist of rufous morph male breeding.

So, which indicates that it is the age-related hypothesis here that all rufous of birds become white is simply not correct. There is something more complex going on that in South India is mostly rufous morph birds in the north it is mostly white morph birds but what maintains these ratios that you see in other parts of the country. Do Northern, do Himalayan birds also go through a rufous morph it appears to be so, are the same rufous morph birds becoming white or are they is there any ratio maintained do some adults remain only rufous, to some adults remain only white.

So, these are many questions that arise from this analysis. It is a fairly simple analysis from a data set that is available to all of us, but it raises some of these questions and gives answers. I suggest to look a little more at this graph and see what else you can interpret during other seasons. But what you can see in winter is that white morphs also come down south. So, there is mixing during winter.

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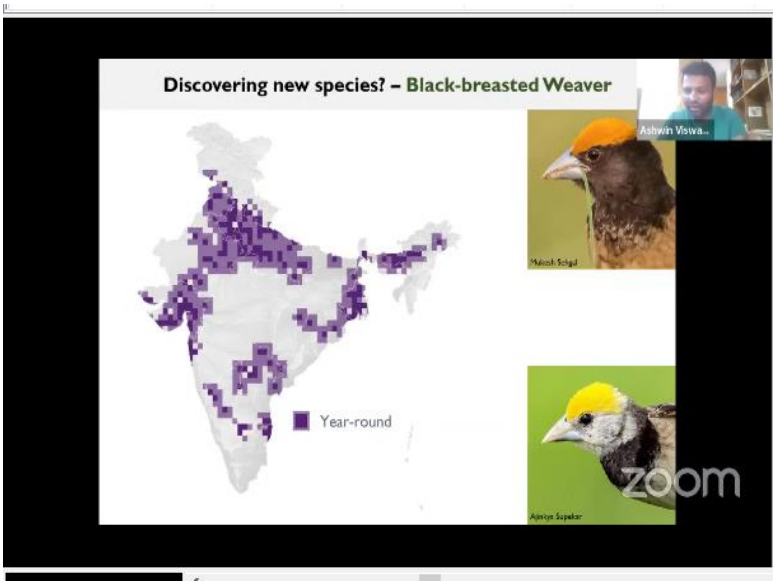

You can also discover new species or new taxa using this. For example, Black Breasted Weaver. So, Black Breasted Weaver is a species that is endemic to the Indian subcontinent and it is present in northwestern India and North India in the South and the east in various places. But this is an example of real citizen science in that this entire study from the idea to the publication was conceptualized by bird watchers in a WhatsApp group.

So, the idea came up there where people discussed with each other saying that I have only seen Black Breasted Weaver with a black face and some others said they had never seen that and where they were Black Breasted Weaver in breeding season had white faces which was really surprising to people who in another part of the country who mostly watch birds in North India, people who watch birds in the south had never seen the image in the north in the top right corner.

So, this led to some discussion and some questions asked and then this group of bird watchers got to the database and check is there any geographical difference is there something here are black breasted weavers different in the south and east of India compared to the northwest of India.

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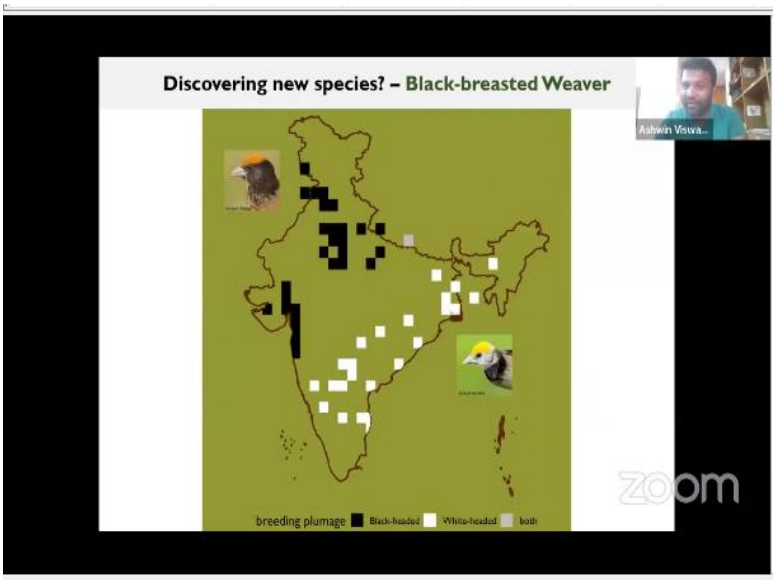

And it appears that that is indeed the case. Then there is a clear divide in where black breasted weavers are white faced during the breeding season and where they are black faced during the breeding season. And this now provides again an interesting question why are these so? Is there any geographical barrier that has caused this, is there the paper also suggests that there has been a recent influx into the south; Black Breasted Weavers have moved into the south in recent times and these are the white faced ones.

What was the historical biogeographic boundary and are these new species at all. So, this is something being the questions for ornithologist professional ornithologist perhaps to take up now an answer.

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Migration on to migration.

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And there is potential for incredible global perspectives; this is something that we do not have from many of the resources otherwise, we do not get to see migration in action although there is some phenomenal work being done by ornithologists using satellite tracking, using tags, using flags and rings. But this gives a larger perspective.

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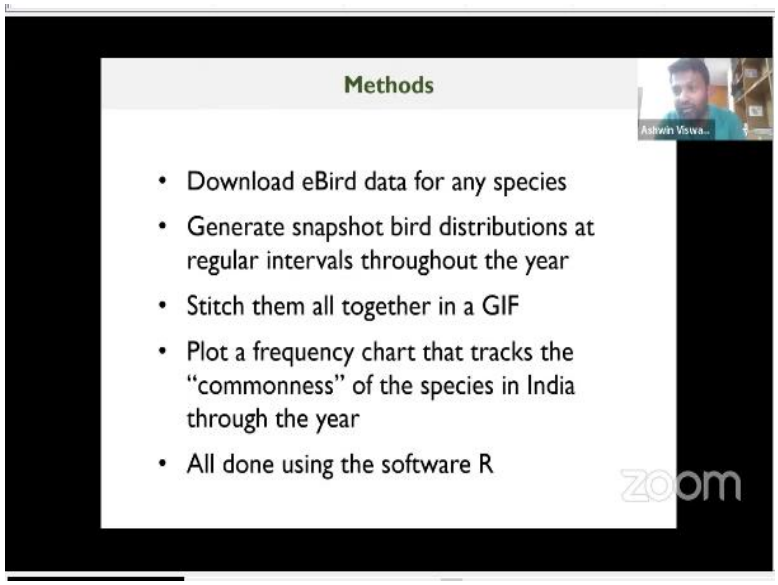

So, how can you do this, how can you plot migration on a map? Download data for any species eBird data; generate snapshot birds distributions at regular intervals throughout the year, in January, in February, in March, in April etcetera, snapshots across the globe. Stitch them all together into a GIF; plot a frequency chart that tracks the commonness of the species through the year. That tells you when it might be leaving and when it might be returning and this is all done using the software R every map that I am going to show after this.

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I will start with migration within the subcontinent. **(Video Starts: 21:17)** And this is Indian Pitta really iconic species in the country and you see that it spends the winter in South India and Sri Lanka and as it becomes April, May, June, July they move into central and North India and then again as winter comes in they migrate to the South. **(Video Ends: 21:38)**

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Breeding birds breeding in the north and migrating south for the winter. So, this is a typical migration. The migration that we all learn about migration from north to south. **(Video Starts: 21:51).** And Blyth's Reed Warbler is an excellent example of that. We saw static maps of this earlier, but now we get to see it in action. Remember that individual birds are not being tracked, observations uploaded by bird watchers.

And we are seeing how these observations or where these observations are uploaded or changing over time. So, you see during winter the entire global population is in the subcontinent. **(Video Ends: 22:21)** Breeding in the south and migrating north for the summer. So, this is something that we do not think of very often, but there are species that do this we know that Pallas's Fish-Eagle breeds in India.

We know that it breeds during winter, but what does it do during summer? **(Video Starts: 22:38).** In summer it migrates to Mongolia mostly and in winter there in the Indian subcontinent mostly along the northeast and northwest of the country and this is a species that breeds during winter in India and migrates north during the summer. **(Video Ends: 23:00)**

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Passage migration into Africa. **(Video Starts: 23:04)** I am sure everybody knows about Amur Falcon migrating from east and northeast Asia through India into Africa and it is a spectacular phenomenon that everyone should witness once in their lifetime; I still have not, but in parts of Nagaland, Manipur, Mizoram you can see aggregations of tens and hundreds of thousands of Amur Falcon moving through in November. **(Video Ends: 23:30)**

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Eastward migration into southeast Asia and Australia. **(Video Starts: 23:35)** White-throated Needletail is a species that breeds in the Himalayas and in other parts of Asia and almost the entire population migrates to southeastern Australia during the winter and this is quite interesting because we do not think of migration from India to Australia although we know of another example of oriental patent called doing this and this phenomenon was discovered due to a satellite tag. So, White-throated Needletail doing this.

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I mean opposite migration from the south to the north. So, we think of migration from the northern hemisphere down to either the tropics or the southern hemisphere. **(Video Starts: 24:17)** But we have many species that breed in Antarctica thatbreed during a northern hemisphere winter which is the southern hemisphere summer in Antarctica and during our

summer and monsoon which is their winter they migrate up into the northern hemisphere and spend their time in the global waters really. So, this is Wilson's Strom-Petrel one example of this. **(Video Ends: 24:41)**

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Comparing migratory routes. **(Video Starts: 24:45)** This is Brown Shrike and Isabelline Shrike; both of them are common birds in different parts of India. What we see here is that there is some sort of special segregation during winter, but also during the breeding period where Brown Shrike breeds eastwards of Isabelline Shrike and their wintering ranges somewhat mirror that. So, they migrate in almost parallelly and in a southwestern direction. **(Video Ends: 25:16)**

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Tracking new migratory routes. **(Video Starts: 25:19)** So, Yellow-browed Warbler until recently was thought to be a species that breeds in eastern Asia largely and also parts of Russia and migrates mostly to northeast India and southeast Asia. But over the last many years increasing numbers of observations of the species have been documented in western Europe and this is a phenomenon that has now been documented.

Almost every year there are more and more individuals of Yellow-browed Warbler wintering and passing through Western Europe which is way off their original migratory range. Why is this happening is this phenomenon going to continue, is it because of expansion of its breeding range? All of these questions remain to be answered. **(Video Ends: 26:04)**

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Some other interesting phenomena. **(Video Starts: 26:08)** Arctic Warbler. Arctic Warbler is a species that breeds almost in the Tundra of Eurasia in northern Russia, Norway, Finland and previously the species used to largely be present only in eastern parts, in eastern Russia and so on and used to winter in Southeast Asia. But increasingly, bird watchers and scientists have found that the species is expanding its breeding range westwards.

And now it breeds all the way into Sweden and Finland and the species but although it is expanded its breeding range it continues to winter in the same area. So, there is some sort of migration memory and now they move really, really long distances to their wintering grounds and it is a very similar example with the eastern populations of Northern Wheatear. Previously it used to be mostly in western Eurasia.

But now they have expanded their range eastwards actually not just to northeast Asia but into Alaska and from there they winter in Africa; the entire population winters in Africa. So, it is a huge distance for them to fly. **(Video Ends: 27:17)**

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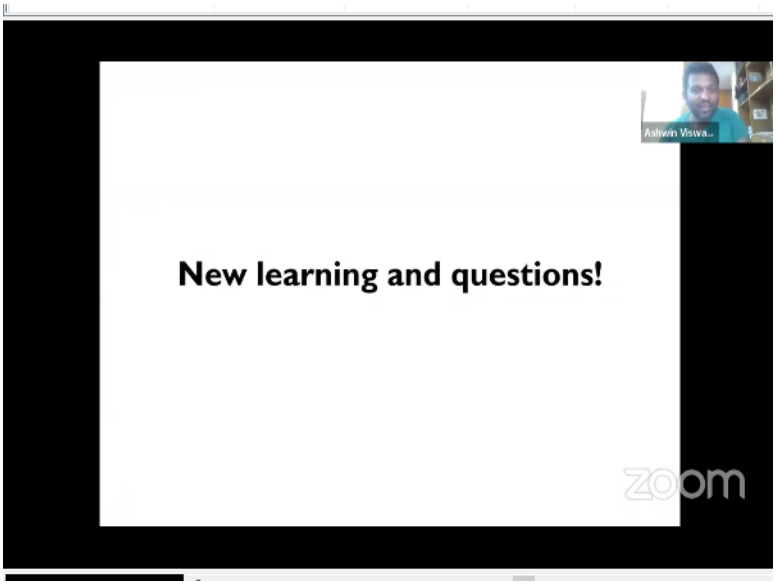

So, some new learning and questions. **(Video Starts: 27:21)** Black-capped Kingfisher. Black-capped Kingfisher, it was unclear according from our Indian literature about whether it was a winter migrant to India or a resident bird, but observations of bird watchers show categorically almost that it is a winter migrant to India and south Asia. And now that we know this we know that also Black-capped Kingfisher populations are declining quite strongly across most of their range.

And given this knowledge we need to find out how to protect the species or find out what threats this species is facing only during winter in India where it uses mangroves. So, can its status be tied to mangroves? It is a question that needs to be asked and addressed. **(Video Ends: 28:05)**

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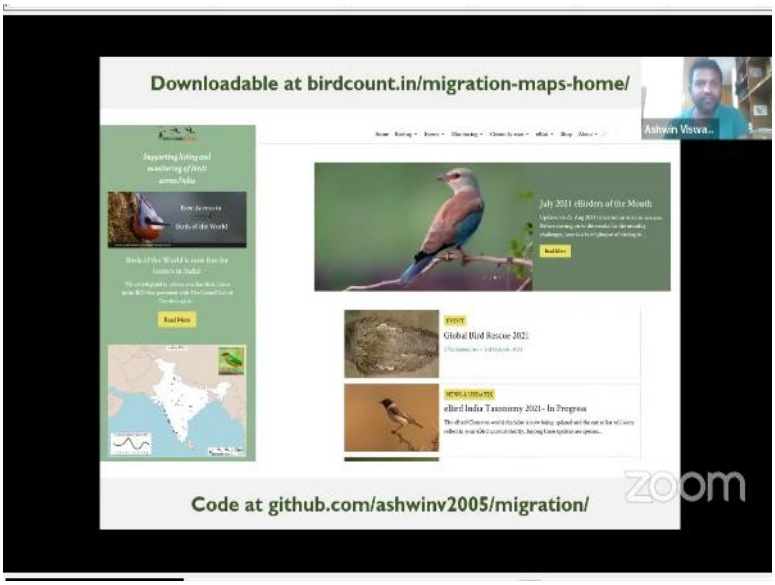

So, all of these maps are downloadable at the birdcount India website and I suggest you go through all of the available migration maps because there are some questions also that I asked about that in the assignment. Also, the code for anybody who wants to reproduce this is available at the GitHub link pasted below.

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Bird Atlases.

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So, one of the first bird atlast in the country was the Mysore bird atlas, it was the initial one that inspired the bird watchers of Kerala to also come up with a statewide bird atlas. Mysore was for the city, Kerala's for the state as a whole and they have come up with the most incredible achievement of bird watchers all over the state coming together to monitor birds systematically.

And as I mentioned earlier the difference here is that the protocols are standardized. The entire state is divided into grids; each of all of these grids are uniformly monitored with the same protocols for the same amount of time. So, that can be comparisons made in space and then relationships can be drawn with habitat with various other factors including built up area, human presence etcetera to answer many questions about where birds are found and many publications arising out of this now. All thanks to a citizen initiative.

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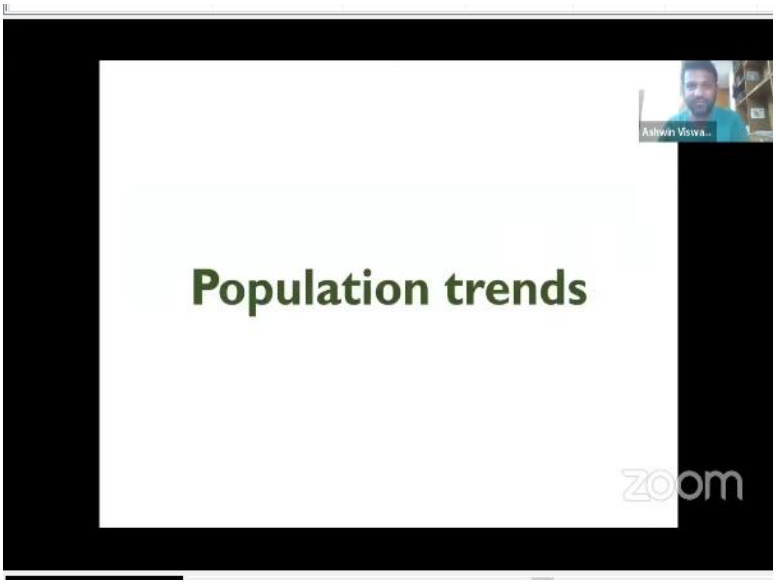

Population trends. So, population trends is an intrinsic part of bird conservation, understanding statuses of birds whether they are declining, increasing etcetera.

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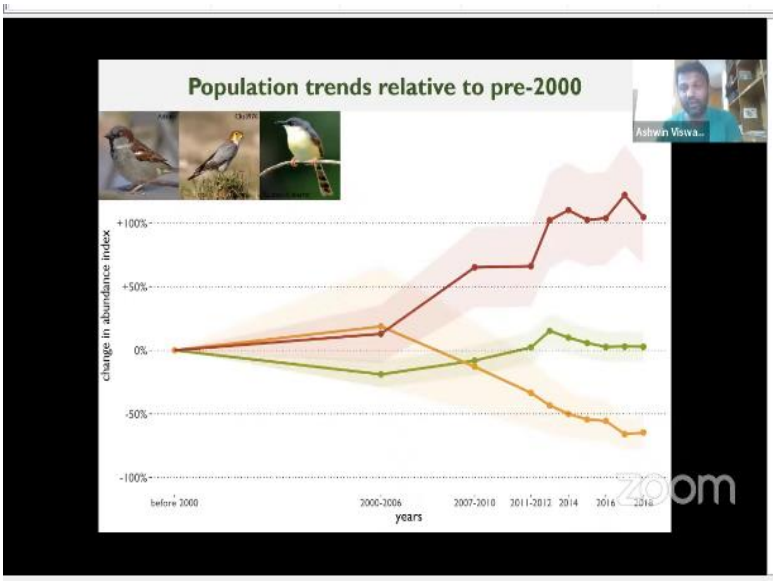

And such trends are possible by following frequencies which we discussed earlier. Frequencies of reporting across time. So, if these frequencies of a species are increasing then the bird is increasing, if it is decreasing it is decreasing and there are some statistical techniques required to minimize various biases that come from where the observations are but looking at the country as a whole these are some trends.

I will start with the house sparrow. House sparrow a number of us have felt that house sparrows are declining in the country as a whole, there have been a lot of media articles, a lot of theories about why they are declining but actually looking at data, it appears that house sparrow is

actually stable in the country as a whole. These methods have come to where you can view the methods and where you can view detailed results later.

Redneck falcon. Redneck falcon has declined considerably in the country as a whole and is a cause for worry. Why have they declined? This is a question that needs to be asked. Ashy Prinia. Ashy Prinia has increased in the country as a whole and this might be because Ashy Prinia are very generalist in terms of their habitat and perhaps they are able to live in many human modified habitats and the moment the natural habitat is converted Ashy Prinia are able to move in.

So, this is a theory that requires testing, but these are some insights that we get from analysis of this sort and this analysis was done for 867 species in the state of India's birds.

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The state of India's birds report also found that house sparrow has remained stable in the country as a whole but has declined in the big cities. So, many of us were not really wrong, we have seen these declines but it is only happening in the big cities.

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This is the report I suggest that you all go through the report and the website. It is downloadable at www dot state of India's bird dot in and also look at the methodology.

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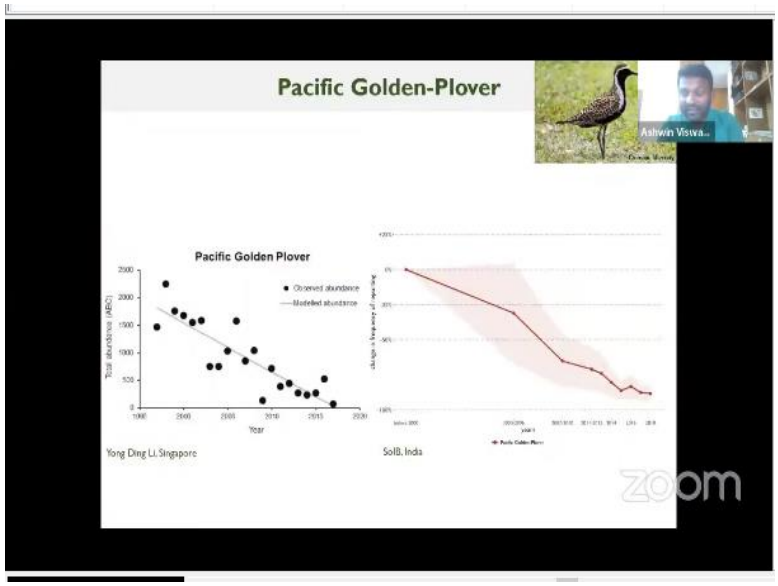

And this is a pacific golden plover. Before I get to this.

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This study was, this project but the report was a collaborative initiative between a number of scientific institutions that came together to analyze this data and publish and of course it is all thanks to the thousands of bird watchers around the country who have contributed knowledge. A number of species are of high concern, some are moderate concern and this sort of a report allows high concern species to be prioritized by conservation and policy making bodies including the government of India.

One such high concern species in India is a Pecific golden Plover and you see that it is declined by around 90% in the last 25 years and this is a decline that is mirrored in other parts of its range as well. The graph that you see on the left is from Singapore where the species has almost disappeared now.

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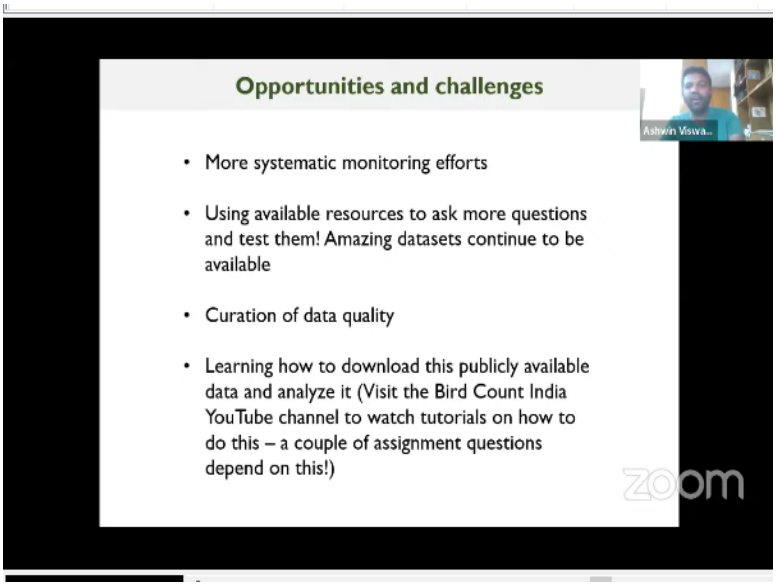

Opportunities and challenges. So, now that I have spoken about some things that can be learned from this data and some things that can be done with images with in terms of migration, trends etcetera. There are many opportunities that still remain. There are only a small number of people today actually using these valuable data sets and analyzing them. And one of the major opportunities is to systematically monitor birds more.

What we had was unstructured information, people are birding wherever they want and there are certain questions that cannot be answered like that. So, we need more atlases, we need more long-term monitoring efforts with structured protocols and these are efforts that can be initiated by citizens and a number of people are now doing that are increasingly starting to do that.

And you can use these resources to ask more questions, with the data sets available and data sets growing as rapidly the curation of the data quality is a challenge and because these data sets are so large, there are various mechanisms that the different platforms have in place. All of these mechanisms maintaining data quality is a challenge. So, learning how to download this publicly available data I think is a great opportunity.

And a number of people do not make use of this. So, there are resources on how to get started, there is a video on the bird count India YouTube channel that a couple of videos that explain how the data can be downloaded and some preliminary analysis can be done on excel and R. R is statistical software in excel that is something that most of us are familiar with.

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So, downloading and analyzing data, you can do this easily once you watch the video. I suggest all of you watch the video because there are a couple of questions also that are based on this.

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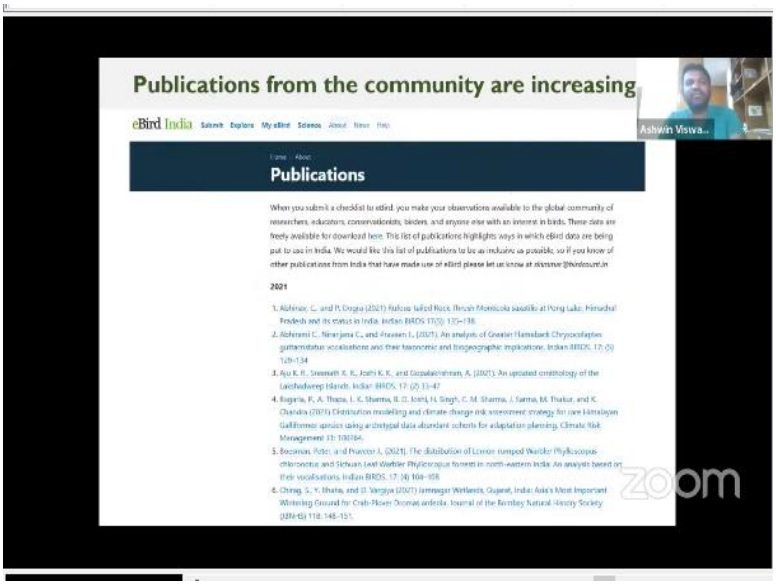

And thanks to all of this, thanks to people downloading the data analyzing it, thanks to people who are asking questions using these data sets to answer them. The number of publications that are coming out of eBird data or route of citizen science data in general are increasing considerably and along with these publications is our knowledge is increasing as well.

And this is just in 2021 and number of publications and a number of new insights in Indian ornithology have come from publicly available citizen science data sets, often led by non-professional scientists, often led by bird watchers and if you see a number of these publications here are by bird watchers and we hope that this increases considerably and a number of you download the data and start generating knowledge about India's birds.

So, I will stop here. Thank you, thanks Ashwin. That was a great session. Well! If anyone has any questions you can enter them in the chat box and we can take that up. I somewhat I went quite fast through many of the topics and I wanted to leave some time for questions. So, if any of you have questions feel free to ask especially about any details that I did not get into. There is a question on chat. Devica is there any tool where I can export, import data from iNaturalist to eBird.

Maybe this can be taken separately because it is not something that I spoke about here, but maybe you can get in touch with me directly and I will guide you through that process. Can

you actually sorry Ashwin yeah. So, I was just asking you program can write to you? Yes yeah, can I explain how the data entered by citizens is verified? So, there are some data quality mechanisms in place. These are different for different platforms.

So, for example iNaturalist is community identified or community verified in that any participant any user or iNaturalist can come and change, can decide the observation, design the identification of a species and if two people agree on a certain ID it becomes research grade which then becomes publicly downloadable. But anybody can go and suggest another ID which takes it out of this research grade status.

So, it is community identified eBird on the other hand is has a back-end data quality system which includes a set of filters, a set of filters are basically a set of species that have been documented to occur in a region. So, this list of species and there is seasonality and numbers set with that. Anything that does not fall within these numbers or within that season is then flagged.

So, when it is flagged, it does not immediately come into public output, let us say I am putting an observation of a Yellow-browed warbler because I spoke about it from Bangalore. This will automatically be flagged and will not come in public output, but will go to a set of to a group of volunteer reviewers who then look at all of these flagged observations engage with the bird watchers and discuss about whether there is any notes or any photos or any kind of documentation that can be provided.

So, that these observations can be verified and can stand the test of time because that is what is important. Eventually, all of these observations have to stand on their own merit. So, somebody is looking at it 10, 20 years from now it is important that it has some documentation and a combination of filters and reviewers tries to take care of that. Of course, it is a big challenge and it is a constantly developing process but this is how it is data quality is maintained.

So, I hope I answered the next question as well and Kasturi Rangan says it will be great to understand your journey so far, any other experience of a bird watching that was unique and enriching. Maybe I will come to this if there is time. Deeper Gujarats do we have trends that

show of populations of House crows, Black kite and federal pigeon are exploding especially in the big cities.

In the country as a whole yes there are trends and I would not speak of House crows and Black kites. I would like you to think of what the trend might be and go to the report and go to the website and see what has happened but I talk of feral pigeon. Feral pigeon have exploded in the country as a whole and they have increased more than any other species and this is something that all of us could have guessed really but they are really they do so well in human areas that they have absolutely exploded and this comes with its own set of problems perhaps one set of challenges yes feral pigeons have exploded.

What could a person like me as a novice contribute to bird conservation? So, multiple ways you can participate in many of these citizen science initiatives, many of these initiatives are led by bird watchers, amateur scientists and you can always participate in an initiative of that sort. So, do check out maybe the bird count India website or various other online forums to find out where you can participate.

What you can also do is you can go through what is available online and you can find out more about birds, more about birds in that region, you can find out which places have the greatest amount of bird diversity. All of this you can find out on the websites themselves and you can use this information then in your own area. For example, if there is a lake and as citizens who live in that area you need to take a decision.

Do we need to build something on that lake or do we need to start some sort of development activity there? You can actually have an informed decision based on the amount of diversity that has been uploaded, that has been reported from that lake, you can also look at for example you can compare lakes some lakes are just like bowls, they are they do not have shallow areas.

Some other lakes have shallow areas, then you can use you can compare bird richness in both of these lakes and if it is more in the lakes with shallow areas you as a citizen as a person who lives in that area can then suggest to your local development bodies let us see when the lake is being developed this is how it should be developed. So, there are many ways in which you can leverage this information available to make the best for your environment, for your surroundings.

Krishnanando has asked can you explain once again comparing frequency between years. So, the general concepts are specifically how to do it? So, specifically how to do it like I explained in the talk maybe it is best to watch the video again, but the general concept of frequency is that bird watchers upload birds observations in the form of checklists and actually this is a concept I did not mention there. But there is a concept of a complete checklist which has all species which includes all species that were seen or heard during that period of time in that checklist.

Let us say that I am birding for 10 minutes, in that 10 minutes everything including, crow, mina, pigeon, Blyth's Reed Warbler anything that I have seen or heard is reported in the checklist. Now let us say in I have uploaded 2 checklists, one with Blyth's Reed Warbler one without Blyth's Reed Warbler. If both are complete checklist, I can say that the frequency of seeing Blyth's Reed Warbler is one out of two checklists which is 50%.

Now this becomes instead of two checklist it becomes two 1000 checklist and I have seen Blyth's Reed Warbler in thousand one hundred of them then my frequency becomes 55% frequency of seeing Blyth's Reed Warbler. Now with multiple people's observations checklist coming into the picture across the entire country there are really lovely insights that we can get about frequencies.

You can compare this between years of course, so frequency you can look at how often I saw Blyth's Reed Warbler this year and compare it with last year and then you can find out whether there are more Blyth's Reed Warbler this year. So, actually this is something that you can check for Taiga flycatcher in Bangalore. I believe I have not actually checked the data but I think that Taiga flycatchers have actually increased this year in Bangalore.

And I would leave it to all of you to check. How can reverse migration be explained? That is wintering in the north and breeding in the south. So, that is because in the southern hemisphere the seasons are reversed. So, what is winter for us in the northern hemisphere is actually summer in Australia, in Antarctica, in New Zealand. All of these areas in southern parts of South America.

So, the seasons are reversed. So, what is now becoming summer for us in India is actually the advent of winter in the southern hemisphere. So, now our summer which is the winter for birds that are breeding in Antarctica and Australia. It becomes completely uninhabitable for birds that actually live in that area. So, in birds of Antarctica cannot remain there, they have to come up north.

So, they actually come into the tropics, they come into what is our summer which is a really clever tactic because they live their entire lives in summer. Apart from the sea cap, there other apps that can help to identify birds insects and trees, yes there are so Merlin is an excellent app to use for birds, it has an incredible AI which you can upload photos and it tells you what it is likely to be. But remember that these are just indications.

So, Merlin is an app. Merlin is a fantastic app to learn more about birds and so these are just indicative. The best way to identify bird's etcetera are through field guides, through constant time spent in field. Have I missed any question? I think you covered all. There was one question which we had said we will get back to if you have time. Yeah.

So, inferences on data are made based on uploaded checklists by birders. So, for species is not reported in a region that is an excellent question and something it is a challenge in citizen science at the moment. A challenge to have people participate from everywhere, you know not just certain regions of the country, it is not just the big cities people must be interested in watching birds and documenting them all over the country.

And many people heard everywhere; it is just about helping that interest along. So, to answer that specific question we can know based on downloading the data or even looking online. So, if you look at an eBird species map you will be able to or if you go to explore you will be able to see how many observations have been uploaded. So, the line graphs that I showed.

If you go to that page, you will actually see below that that there is the number of checklists also mentioned in another graph and using the data itself for that region the downloaded data you can look at how many checklists have been uploaded using that you can say whether it is because of a lack of birders or lack and lack of checklist or because the birds does not exist.

So, this is something that is easily verifiable because that information is out there, it is out there even on the maps if you go to the distribution map of a species on eBird there are certain cells which will not have any color. These are cells that do not have any observations. So, you will find that many parts of Russia some uninhabitable parts of the world do not have any birders or do not have any checklist at all.

So, there you can say that yes the species we do not know whether it is present or not because nobody has watched birds there nobody has documented birds from there. Yes, yeah Devica will share my email with everybody. So, would you need to normalize all data related to frequency terms. Not quite, we do not need to normalize it according to that because frequency is to an extent independent of how many checklists there are.

So, if you have 10 checklists, you can still calculate a frequency, if there are 1000 checklist you can still calculate a frequency and frequency can be calculated as long as there are some number of checklists from an area. But the two are completely different in that when you have 1000 checklist you have much more confidence in your frequency estimate than when you have 10 checklists and this is a concept that is explained in the state of India's birds methods.

I suggest to go through that with 1000 checklist, you will you will have less wide confidence bars. So, in the graphs that I showed you I hope you saw some ribbons around the line and this indicates the level of confidence in that frequency estimate. So, now that confidence increases and those bars decrease as you have more and more checklists from an area or for a species.

I also mentioned that there are some statistical techniques that are important to use while you download while analyzing eBird data and I will briefly mention a few of these, I did not do that earlier. So, there are 3 main challenges. There are biases in space. In that there are certain areas that have more bird watching than others. There are so for example if I am comparing let us say Arunachal Pradesh to Assam.

So, Assam has much higher human densities than Arunachal Pradesh. So, Assam has much more information than Arunachal Pradesh. So, now we are comparing these two, let us say I want to find out the frequency of a bird present in Assam and Arunachal Pradesh. Now, if I look at it if I actually calculate the frequency just like that I am effectively going to get the frequency in Assam because that is where most of the birding happens.

So, it is important to be able to normalize or standardize in space. So, you try and give equal weightage to Assam and to Arunachal Pradesh and if you look at the entire country as a whole to break the country up into small grids in state of India's birds it was broken up into 25 by 25 kilometer grids and every grid here is given equal weightage. So, for example a grid which has a huge amount of birding in Bangalore gets the same amount of weightage in that one frequency value effectively compared to a grid in the outskirts of Bangalore which has much less bird watching.

So, that way you are standardizing according to space and then you are averaging across space. So, that is one way to deal with that bias. Then you have bias in time in seasons, you might have all seen that bird watchers, watch birds more during winter than in summer in India because summers get hot, monsoons get rainy. So, it becomes difficult to go out and watch birds and document them.

So, a lot of the bird watching actually happens in winter. So, now what we need to do is standardize across space? Because there are some birds that are there during summer in monsoon but not during winter and in different parts of the country birds might occur at different times. So, you need some way to standardize to the average month. So, now what we do is every month gets equal weightage.

So, you find statistical means to be able to give equal weightage to each month. So, these are some two of the most important reasons to standardize data statistically. So, I hope that clarified that to some extend. Any other questions? You also need to standardize according to effort which is basically bird watchers spend different amounts of time birding, I might spend 15 minutes birding today but 1 hour birding tomorrow.

And this also you need a way to standardize according to mean effort, median effort and this is why systematic monitoring programs like atlases they need to standardize across space, across time, across effort, birding effort all of this is removed and which is why systematic initiatives are so valuable. So, all of us should help initiate systematic monitoring efforts driven by bird watchers and the public, driven by through ourselves in a sense in every part of the country.

Thanks so much Ashwin. So, last chance for questions. If there are no more questions, it is past 5. So, I think we can end the session, thanks a lot Ashwin like a very valuable session, just now a question came in. Let me quickly answer. Research grade is a concept in iNaturalist. That determines whether a record will be publicly available or not. If it is research grade it can be publicly downloaded and it shows up in the maps, you can also download the observations that are not research great but they will not show up in the public maps.

It is just a way to ensure that the community has verified the identification of that species and the maps that we see we wanted to actually reflect the distribution maps of that species. So, which is why research grade is an important concept there. Yeah, I think it is safe to end this session, thanks a lot everyone for joining in and Ashwin for taking out the time and talking to all of us today, great. Thanks Devica and thanks everyone. Bye!, Bye.