

ANNUAL Report

2020-21

www.ncf-india.org





At the Nature Conservation Foundation, our goal is to contribute to the knowledge and conservation of India's unique wildlife heritage with innovative research and imaginative solutions.

Vision

A world in which nature and society flourish together

Mission

Exploring, understanding and conserving the natural world through research and responsible engagement with society

High Altitudes | 1

Oceans & Coasts | 21

Eastern Himalaya | 35

Education & Public Engagement | 53

65 | Western Ghats

87 | Labs, PhD & Conservation Leadership

99 | Publications, talks & trainings

109 | Finances





Our Work

The Nature Conservation Foundation (NCF) was established in 1996 as a public charitable trust and is now a leading non-profit conservation and research organisation in India. At NCF, our goal is to contribute to the knowledge and conservation of India's unique wildlife heritage with innovative research and imaginative solutions.

We work in a range of wildlife habitats—from coral reefs and tropical rainforests to the high mountains of the Himalaya. Here, we strive to understand the survival needs of endangered species such as snow leopards and elephants, as well as equally fascinating but lesser-known wildlife such as corals and rare plants.

Our research also addresses human resource-use and its impacts on wild species and ecosystems. Using this knowledge of wildlife ecology and human society, we design conservation strategies that are locally appropriate. These are implemented in collaboration with local communities who depend the most on natural resources, and the governments that manage them. While promoting wildlife conservation, our programmes also strive to safeguard livelihood and development options for local communities.

NCF carries out most of its work under six major programmes: High Altitudes | Oceans & Coasts | Eastern Himalaya | Education & Public Engagement | Cranes & Wetlands | Western Ghats. Other research projects and conservation initiatives are also led by our dedicated staff. In our work, we are supported by reputed Honorary Associates, Adjunct Faculty, Distinguished Wildlife Biologist, and our Research Advisory Board, besides numerous supporters to whom we are grateful.

High Altitudes



Together with the Snow Leopard Trust, we work in India's high altitude regions of the Himalaya to conserve the diversity of life and landscapes, with the snow leopard as the flagship, in a scientifically robust and socially responsible manner. We combine research, community involvement, conservation outreach, and policy-level recommendations.



Snow Leopard Friendly Pashmina

Livestock rearing is the primary source of livelihood for the nomadic pastoral Changpa community of Eastern Ladakh who share these landscapes with rare high altitude wildlife. They are the primary producers of pashmina (cashmere), of the finest quality. Reduced to competing in a commodity market where the price of cashmere is contingent on global supply, these herders are affected by market fluctuations.

In 2016, we began working with some of these pastoral communities and key local partners in Ladakh's pashmina sector to produce value-differentiated cashmere done by adopting conservation-friendly practices. In December 2019 we facilitated an exercise to prepare a joint vision for a Sustainable Ladakh Pashmina sector which was led by the Ladakh Autonomous Hill Development Council (LAHDC) and other partners including local herders. The Ladakh Pashmina vision document was formally released by the Lt. Governor of the Union Territory of Ladakh in February 2021 and is now a guiding policy document.

Community-based conservation

Predator-proofing vulnerable corals

Predator-proof corrals are secure enclosures used by herders to protect livestock from night time attacks by predators. Often such incidents are characterised by surplus killing of livestock that can wipe out a large part of a herder's flock in a single attack. Such incidents are also linked to retaliatory killing of wild carnivores.

Our team takes immediate action on any request to build new corrals or to repair and maintain old ones. We built 10 corrals in the village of Gue in Spiti where there were 8 incidents of surplus killing by a snow leopard in April–May 2020. Similarly, we built 7 corrals for the Sumdo-TR community in Eastern Ladakh, which saw 10 instances of predator attacks in January–June 2020. We successfully tested a new design of predator-proof corrals in Sumdo-TR which was shared by the herders. These structures collectively protect over 2,000 livestock.

Livestock security programme

Our community-led livestock security programme allows herding communities to seek financial relief in cases of livestock depredation by wild carnivores. The programme is set up and run by the community, while we ensure financial assistance along with help in monitoring its running.

Meetings with communities in 2020–21 were limited due to COVID-19 related restrictions. In 2020–21, herders reported 18 cases of livestock depredation from the villages of Gya, Kyungyam, Miru, and Hemya in Ladakh for which the compensation payout was INR 46,500. Similarly, the communities of Chichim, Kibber, Kee, and Sagnam reported 32 cases of livestock depredation for which a total payout of INR 224,500 was made through the year. A total of 220 herders participated in the programme across Ladakh and Spiti in 2020–21.





Grazing-free reserves

Grazing-free reserves are community-held pastures set aside by local villagers as refuges for wild herbivores. With the setting up of a grazing-free reserve, a local guard is hired from the community to ensure that these pastures are left free from grazing, and other extractive activities are limited in these areas. Meeting the community partners could not be held due to COVID-19 related travel restrictions in 2020–21. However, we continue to work with partner communities in maintaining four village reserves in Ladakh and five in Spiti, together covering an area of over 500 sq. km.

Community conservation champions

We are actively working to extend the reach of our conservation efforts to newer areas of Himachal Pradesh and Ladakh. We initiated efforts to develop a network of community conservation champions who can act as an extension to our small, but effective frontline teams. Community conservation champions include locals from these regions with an interest in wildlife and an inclination to mobilise their communities to protect wildlife. The first group of local champions from villages of Upper Kinnaur was trained at the 'PARTNERS principles for community conservation' at Rampur in March 2020. We also set up a central communication channel through a helpline to disseminate information and help them respond to situations of negative interactions between people and wildlife. Unfortunately, the COVID-19 pandemic limited our plans to conduct in-person workshops with the community conservation champions in 2020. However, we stayed in touch through the helpline number and also held online discussions. We are setting up similar networks in Spiti, Lahaul, and also among youth groups active in Eastern Ladakh. We believe that community conservation champions will play an important role in extending our conservation efforts in these remote areas.

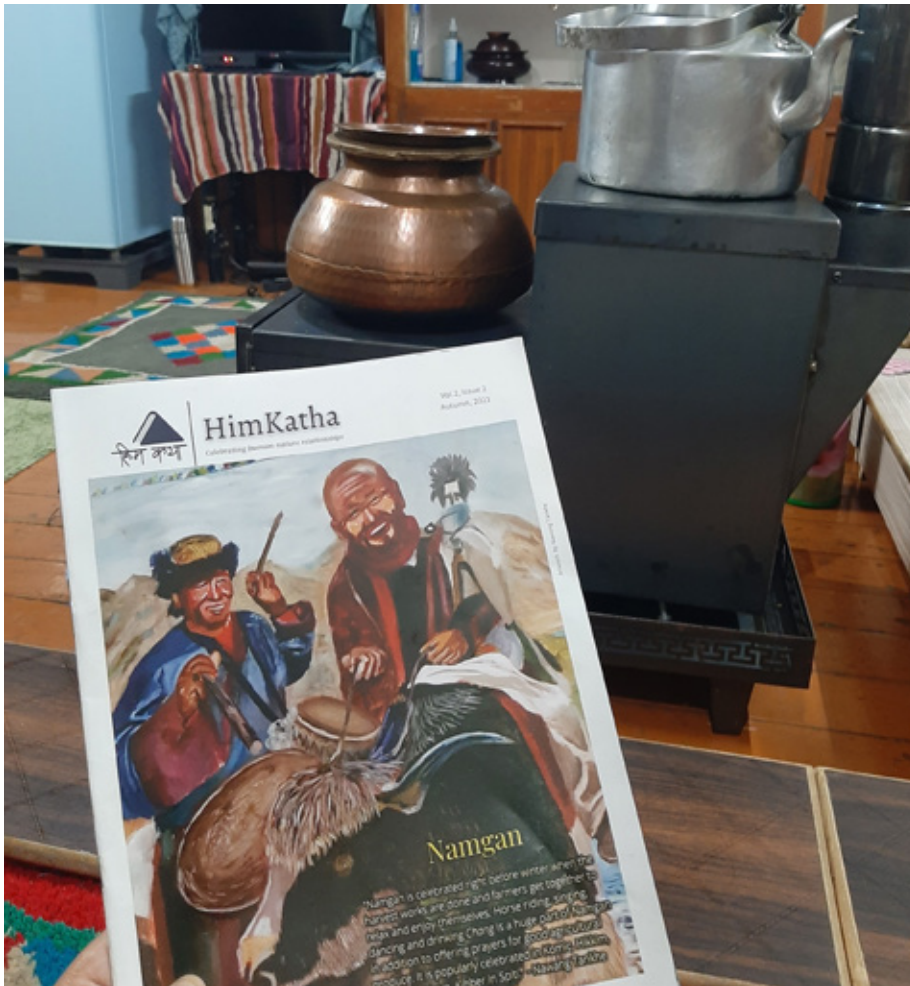
Conservation outreach

Living and learning with snow leopards

Our nature education programme was affected by the pandemic as schools remained shut for most part of the year and travel restrictions limited the ability of our field teams to engage locally. We had to alter our approach to comply with safety requirements.

In Ladakh, we ran a 'Nature from Home' series in summer, through which we sent nature-based activities to school children using WhatsApp. We shared the activities with teachers who are part of the Himalayan Nature Club (HNC) network. We ran five weekly activities reaching 6 schools and nearly 120 children in Ladakh. We also ran a village-level story writing competition that saw the participation of 51 children. Engagement in Spiti was limited as most areas were beyond network coverage. During this time we supported the local Education Department in their efforts to provide learning material to children in their villages.





Himkatha

Himkatha is a trans-Himalayan community newsletter with a focus on sharing stories of human-nature relationships. The high Himalayan and trans-Himalayan landscape of Himachal Pradesh is home to over two lakh people and a diversity of unique plants, animals and birds. The local communities have been the custodians of these natural landscapes through their traditional knowledge and practises. Most of this knowledge, however, remains implicit and localised. Through Himkatha, we are sharing the stories of such local traditions that have been crucial to conserving this rich natural heritage.

In 2020–21, we launched the first two issues of the newsletter covering stories of local women's effort to conserve their forests, importance of traditional crops, understanding petroglyphs as symbols of human-nature relationships, importance of dry toilets in water-scarce environments, and many more. We also have a section for children to share their stories, art and learn more about nature.

We have printed and distributed 4000 copies of the newsletter in over 50 villages and schools of Himachal Pradesh. We also have a website (www.himkatha.org) to reach out to a wider urban audience.

Women in Conservation

Shen

Shen is a conservation-led, handicrafts enterprise run by the local women of Spiti valley, established in 2013. This initiative strives to improve women's attitudes towards wildlife, and increase their involvement in our conservation efforts. We engaged 108 women participants from eight villages as part of this effort.

Handicraft production for 2020-21 was scaled down in the wake of COVID-19. While we did not retail at trade fairs and exhibitions like most years. We gifted the products prepared this year to our long-term supporters. Some of our products were also available at a new online retail outlet (www.pashoopakshee.com/shop). In addition, a conservation bonus was paid to the participants who participated in conservation-friendly activities.





Population estimation of snow leopards

Working with the Himachal Pradesh Forest Department we successfully completed the first state-wide assessment for snow leopard and its prey populations in January 2021. The study was carried out as per the protocols prescribed by the Ministry of Environment, Forests and Climate Change and was started in 2018.

This survey is among the first snow leopard population assessments attempted at this scale. In this assessment, camera trapping surveys were conducted at 10 large sites representative of the 26,000 km² snow leopard habitat in the State. These surveys were done in prime habitats as well as poor habitats, to ensure representation. This large-scale camera trapping survey reported detection of 44 unique snow leopards that were detected 187 times. Subsequent analysis indicate that there can be up to 73 snow leopard individuals (excluding cubs) as estimated by this study. In Himachal Pradesh, snow leopard density ranges from 0.08 to 0.37 individuals per 100 km², with the trans-Himalayan regions of Spiti and Pin valley along with Upper Kinnaur recording the highest densities. This study also reported that there is habitat overlap between the snow leopard and the common leopard based on camera trap detections at two stations in the Great Himalayan National Park.

Camera trap deployment over these mountainous terrains was led by a team of eight local youth of Kibber village in Spiti who have been working on such surveys across the Upper Spiti Landscape since 2010. Seventy-three frontline staff of the Forest Department were also trained in camera trapping techniques as part of the project. While snow leopard occurrence was recorded from the Protected Areas that were surveyed, which included parts of the Chandratal Wildlife Sanctuary, Kibber Wildlife Sanctuary, Kugti Wildlife Sanctuary, Rakcham-Chitkul Wildlife Sanctuary, Great Himalayan National Park, Kheerganga National Park, and Pin Valley National Park, a bulk of snow leopard occurrence was recorded outside Protected Areas reiterating the fact that local communities are the strongest allies for conservation in snow leopards landscapes and strengthening the case for community-based conservation initiatives across the snow leopard range.





Monitoring wild ungulates

Wild ungulates are key determinants of snow leopard populations, even in multiple-use landscapes that are accessed by pastoral communities. Additionally, wild ungulates play critical roles in keeping ecosystems healthy by influencing vegetation structure, plant species composition, and nutrient cycling. Ungulate monitoring is an annual priority for our programme, for which we use the scientifically robust double-observer method. In addition to conducting the monitoring, we train a few motivated individuals across each site in these methods to ensure local capacity for future surveys.

Ladakh

This was our eighth year of surveys in the Tsaba and Puyul regions of Ladakh, which covered approximately 180 sq. km. This year we found 104 argali in Tsaba which is comparable to last year's count. This points to the importance of the region as a wintering ground for a rare mountain ungulate like the argali. We found about 140 blue sheep in Tsaba as well. The estimates in the Puyul region were of 90 blue sheep. This is much lower than last year as the area covered was smaller owing to inclement weather conditions.

We continued our surveys in the Chushul region for the third year. We found 114 argali in this area—the highest count thus far. Our studies confirm that argalis are continually using this area.

Himachal Pradesh

The first state-wide assessment for snow leopard and its prey populations for Himachal Pradesh was completed in January 2021. The study was carried out jointly by the Himachal Pradesh Forest Department and NCF in a process that was started in 2018.

For the entire snow leopard habitat of c. 26,000 km², we recorded the populations of the primary wild ungulate prey of snow leopards—blue sheep (*Pseudois nayaur*) and ibex (*Capra sibirica*) using the double observer survey technique. These surveys estimated wild ungulate prey density to range from 0.11 to 1.09 prey per km². The trans-Himalayan region supports the highest densities—the estimate population size of blue sheep was 891 for Spiti, and that of ibex was 224 for Pin Valley. Camera trapping surveys recorded 28 species including carnivores such as the brown bear, black bear, yellow-throated marten, stone marten, masked palm civet, Himalayan weasel; pheasants, such as the monal, cheer pheasant, koklass pheasant, snow partridge; and ungulates, such as the musk deer.





Conservation of high-altitude ecosystems

Disease surveillance and management

The aim is to understand disease transmission between livestock and wild ungulates, namely blue sheep, ibex and urial. To this end, we have worked across the Gya-Miru and Upper Spiti landscapes (specifically Pin Valley), in Ladakh and Himachal Pradesh respectively. The diseases that are being studied for this project are infections by Gastrointestinal nematodes (GINs). They are determinants of fitness and affect the susceptibility of other diseases in wild and domestic ungulates.

We finished the project in Pin Valley and have written up a paper about it. We analysed over 150 faecal samples of both domestic and wild ungulates (Asiatic ibex) in Pin. Using a parasite life cycle model that incorporated host movements and the effects of weather on infective larval availability, we investigated the transmission dynamics and evaluated potential interventions to attenuate infection pressure for both the livestock and ibex. We found that although ibex used the pastures year-round, parasite eggs which they shed only contributed to infective larvae on pastures during the summer. Migratory livestock enter the Pin pastures around day 152 (i.e. 1st June) and subsequently contribute eggs and hence infective larvae onto pastures. Migratory livestock were predicted to contribute the majority of infective larvae onto shared pastures, driving infections in both livestock and ibex. Our model predicts that any amount of anti-parasitic treatment of migratory livestock resulted in some reduction in infection pressure, but we found a c.30 day intervention towards the end of the livestock's time in Pin had the highest impact, and is likely to be effective in reducing GIN burdens in both domestic and wild hosts. Our study provides a transferable multi-pronged approach and an adaptable predictive model to investigate parasite transmission in multi-use landscapes, including those with migratory hosts.

We provide a robust approach for hypothesis-testing and intervention design which can serve the dual purpose of conserving wild ungulates and protecting herders' livelihoods.

We are in the process of doing similar analyses for the Gya-Miru and Heniskot-Takmachik region, but given the restrictions due to COVID-19, we were not able to collect enough raw data.

Effects of climate change in Spiti valley

Anthropogenic pressure is one of the biggest drivers of changing climatic conditions. With an increase in this pressure and under the continued scenario of rapid climate change, high altitude Himalayan landscapes have become extremely susceptible to rapid ecological alteration. Continued evidence of faster glacial melt due to change in temperature, encroachment of vegetation in previously non-vegetated areas, and a rapid shift in the plant community is a worrying trend for this ecosystem. It is extremely important to understand how the productivity of the landscape, plant community structure changes, and invasion by non-native plants will alter the ecosystem functioning.

Nature Conservation Foundation is collaborating with Mayank Kohli (University of Minnesota, Twin Cities) and Dr. Mahesh Sankaran (NCBS, Bangalore) to understand the effects of altered temperature, rainfall and grazing pressure. We continued our collaborative effort to work Nutrient Network research in Spiti as a part of a global ecological research cooperative. Due to the COVID-19 related lockdown, we could not continue with our ecological monitoring of vegetation due to climate change. But we continued data collection on the long-term vegetation plots. We have gained more insights about climate change and the changes in disease transmission scenarios in Spiti Valley.





Pasture dynamics in Changthang

The Changthang region in Eastern Ladakh is spread over c. 17,000 km² and is home to the Changpa community who rear livestock as their primary vocation. We have been working with communities in these areas through the Snow Leopard Friendly Pashmina effort. One of the areas of interest has been to understand the pasture dynamics over the years.

We initiated an effort to gain some understanding through a preliminary study, in which we identified 40 pastures in different parts of Changthang. We identified large and small pastures and delineated them with the help of staff from the Sheep Husbandry Department and NCF's field personnel. Using remote sensing to assess productivity through Normalised Difference Vegetation Index (NDVI), we found that overall productivity in most of the pastures is very low. Analysis of NDVI values for the years 2013–18 did not suggest an overall change in pasture productivity in Changthang—i.e. productivity has remained similar across these years. Studies across multiple pastures showed that year-wise trends in different pastures vary significantly. There are pastures which showed comparatively higher productivity than others. It was difficult to list down clear reasons to explain these differences as sufficient conclusive literature is still absent. This work may need to be backed with ground surveys and manipulation experiments to understand vegetation dynamics in pastures in greater detail.

Along with this we conducted a training programme on Geospatial data analysis and mapping in the Sheep Husbandry Department. This will potentially help our partners to map and analyse pasture dynamics with better efficiency in the future.

Birds of snow leopard landscapes

The high mountains of the Indian Himalaya are home to the charismatic snow leopard, an umbrella species for conservation of these unique landscapes. These landscapes are also home to rich diversity of other fauna that co-occur with the snow leopards. One such group is formed by heavy, ground-feeding birds belonging to Phasianidae, which includes pheasants and partridges. While the umbrella species concept is suitable for the management of landscapes at a local scale, for better management at a larger scale, we need a mechanistic understanding of the environmental factors that determine species occurrences. Using the camera trap data, we are building an understanding of pheasants' species patterns through a multi-species approach. We used the ensemble modelling approach for species distributions and created maps of species richness in snow leopard landscapes. From this study we detected 6 species—Chukar partridge (*Alectoris chukar*), Himalayan monal (*Lophophorus impejanus*), Snowcock (*Tetraogallus himalayensis*), Snow partridge (*Lerwa lerwa*), Koklass pheasant (*Pucrasia macrolopha*), and Cheer pheasant (*Catreus wallichii*). This study showed that the most important ecological predictor for most species was vegetation index (NDVI) followed by temperature seasonality.





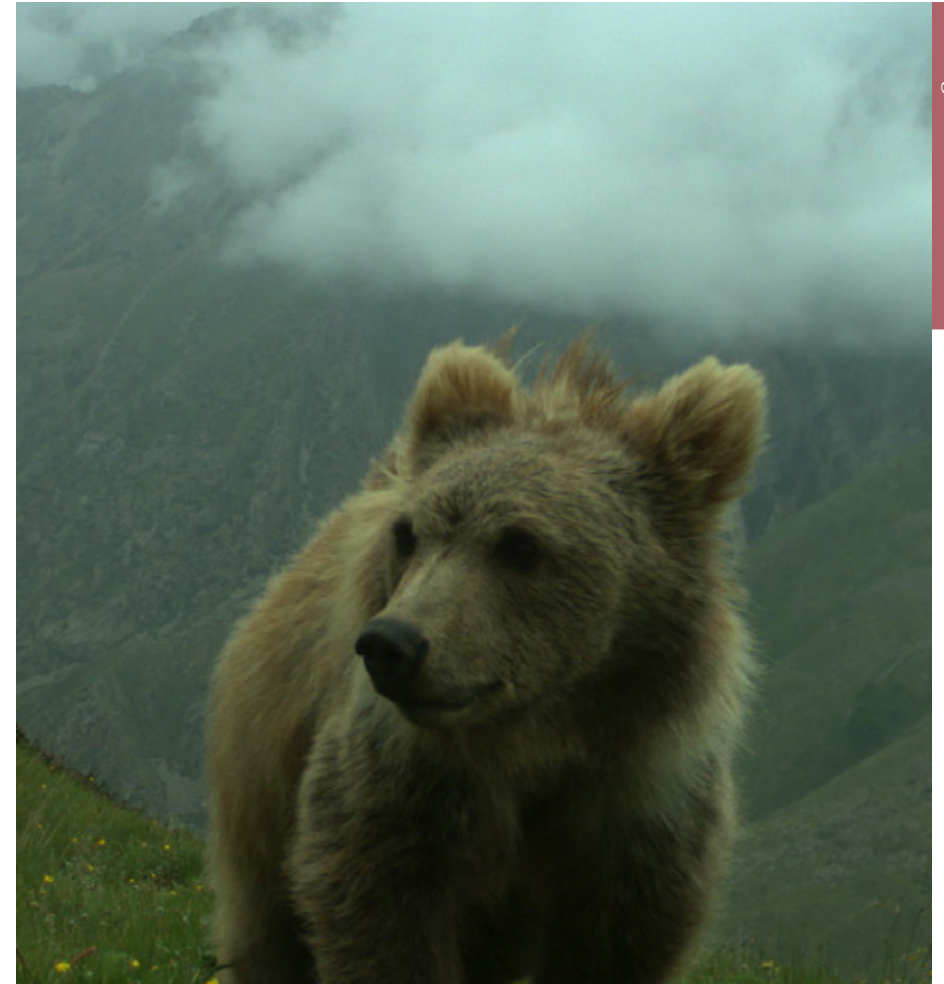
Factors affecting carnivore community structure

Environmental filtering and species interaction are the major factors that affect species assembly on landscape and local scales, however, our understanding of their relative role on different scales is limited. We are using multi-scale hierarchical occupancy models to assess the relative role of environmental factors and species interaction on landscape and local scales. We have camera trap data of carnivore occurrence from seven sites of Himachal Pradesh, including Lingti valley, Kibber and surrounding areas. In 2019, we added three more sites—Baspa, Kullu and Bharmour—to our camera trap surveys.

We used data from 72 cameras deployed at three sites. These camera trap locations were selected based on animal signs like scrapes and scent marks. The survey resulted in 1624 photographic captures of 12 carnivore species including:

- Black bear (*Ursus thibetanus*),
- Brown bear (*Ursus arctos*),
- Common leopard (*Panthera pardus*),
- Snow leopard (*Panthera uncia*),
- Leopard cat (*Prionailurus bengalensis*),
- Red fox (*Vulpes vulpes*),
- Mountain weasel (*Mustela altaica*)
- Stone marten (*Martes foina*),
- Yellow-throated marten (*Martes flavigula*),
- Himalayan weasel (*Mustela altaica*),
- Masked palm civet (*Paguma larvata*) and
- Jackal (*Canis aureus*).

We used an occupancy-based approach to assess carnivore community structuring at the local scale. Specifically, we investigated the relative importance of negative (competition) and positive (facilitative) interactions in structuring carnivore communities. We quantified interactions between carnivore pairs, as well as carnivores and their prey. Our results show that in the high mountain ecosystems, carnivore-carnivore interactions are predominantly positive, suggesting a very limited role of competition in structuring these communities. Additionally, we found a strong spatio-temporal association between prey and predators. Taken together, our study strengthens the earlier evidence that these mountain ecosystems are largely bottom-up controlled systems and conservation measures need to continue to focus on prey base and health of prey species.



Snow leopard wildlife trade

Illegal wildlife trade and hunting

Wildlife crimes against snow leopards are reported to be opportunistic and driven by supply rather than demand. Trade of snow leopards is therefore likely to be riding on trade of species co-inhabiting the landscape locally, and the global illegal trade of other species as well. Recent studies have shown that poaching and illegal wildlife trade have increased and become a substantial threat to snow leopard populations. In response, all range countries of the snow leopard committed to combat illegal wildlife trade at the third steering committee meeting of the Global Snow Leopard & Ecosystem Protection programme (GSLEP).

NCF, in partnership with GSLEP and Snow Leopard Trust, initiated work to better understand illegal wildlife trade with respect to snow leopards. Under this we monitor, record and understand wildlife trade in the high altitude regions of Himachal Pradesh with respect to all species. We are developing ways to use information generated through this effort to feed directly the international GSLEP snow leopard wildlife trade database. Through our local conservation champions network we are reaching out to larger spatial scope to gather information.

Additionally, we have created an online portal for partners and the larger public to submit incidents, request for information, and interact with the existing data. We continue to maintain the database, enhance our technologies and improve our models to inform conservation, policy and enforcement

In January 2021, we shared our first internal report with all the partners analysing the data consolidated from online sources and the information shared from our partners. We reported global trends, patterns, and established a probabilistic model set in an occupancy framework to understand drivers and hotspots of trade. Preliminary results from field research were also presented.



Field tales



by Munib Khanyari

In May 2020, when strict lockdown rules were in place owing to the COVID-19 pandemic, Gue, a remote village in Himachal Pradesh, witnessed one of the largest cases of livestock depredation. A single snow leopard individual killed almost 76 animals within two weeks. This was a huge financial and emotional setback to the herders of the village.

When our field staff learnt of this incident, we decided to take necessary permissions and travel to the village to understand the issue and work out a solution. However, when we reached the village, we found out that the snow leopard had again entered a corral and had gotten trapped. The village informed the Forest Department and wanted the snow leopard to be relocated.

However, after long discussions with the community, they decided to undertake preventive measures like reinforcing the corral to prevent livestock depredation as a long-term solution.

Amidst the lockdown when transporting material for corral reinforcement was a challenge, the lead taken by the community made material arrangements and transportation seamless and the corral was reinforced within a month's time. The community also signed an agreement stating to never harm wildlife and contribute actively to conservation efforts.

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Team & Support

Oceans & Coasts



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We work in India's oceanic islands and coasts with a broad mandate to understand how these enigmatic ecosystems work, how society interacts with them, and how regional and global influences affect this relationship.

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In the Lakshadweep islands:

Long-term monitoring of coral reef health

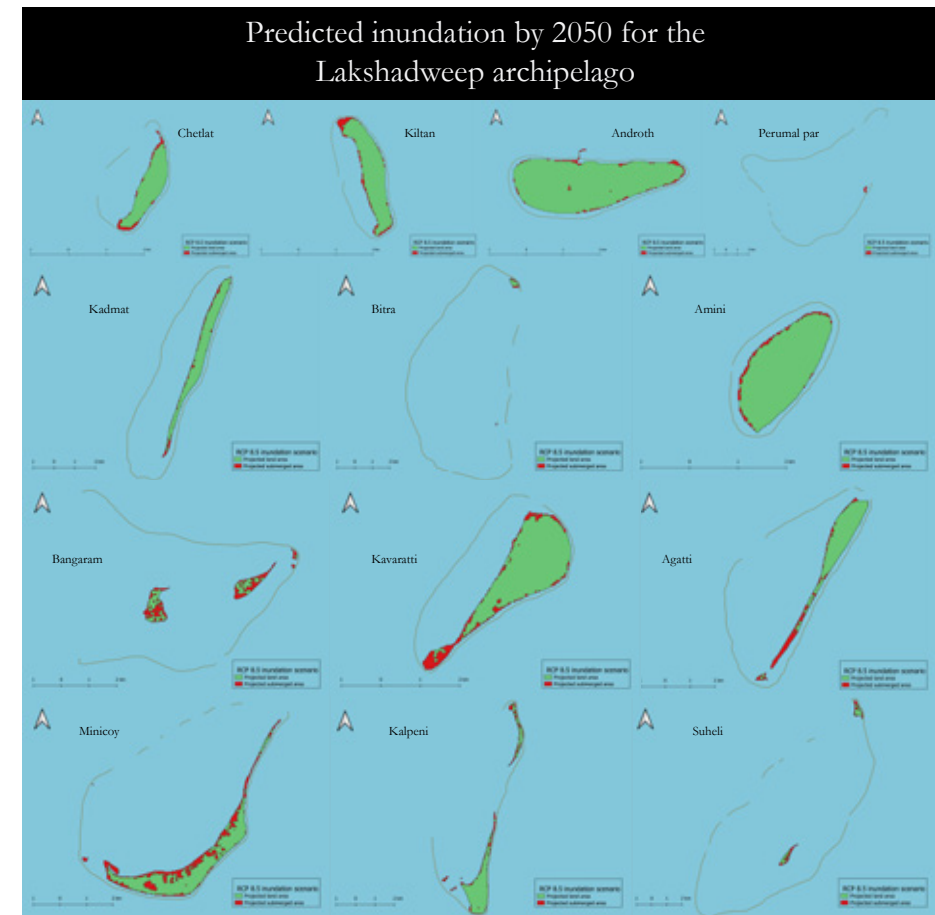
The Lakshadweep Archipelago is among the world's most climate-vulnerable places. Its reefs face an onslaught of repeated mass mortalities as oceans warm and storms increase. We conduct one of the longest-running monitoring programmes in the region, tracking climate change impacts on Lakshadweep reefs. In its 25th year, our work is uncovering complex patterns of decline and recovery, influenced by global and local factors. Successive mass mortality events over the past 25 years leave a long shadow on the reef, but intense monsoon waves are critical in shaping recovery trajectories. While many reefs have been on a steady decline, some wave-beaten locations are wildly dynamic, and show a remarkable ability to recover, given enough time. These turbulent changes also affect reef fish in complex ways, as their communities come to terms with their habitat shifting beneath them. What will be the eventual fate of Lakshadweep reefs? The next 25 years will tell.



Reef frameworks and island biosecurity

Reef accretion potential and sea level rise projections

For low-lying coral atolls, the reef is the first line of defence against rising seas and storms, but its ability to protect the islands is being seriously compromised by sea level rise and coral decline. The reef can be imagined as a complex cement-generating factory, industriously accreting carbonate to add to its framework. We have been conducting a 'factory audit', evaluating how well this production machine still works. This year, we mapped the islands' vulnerability to inundation as oceans rise. With satellite imagery analysis, we have identified areas most likely to be submerged over the next few decades on the densest Lakshadweep islands. We have to validate these findings with elevation data and ground truth exercises. However, our initial analysis is worrying. Significant southern areas (typically narrower) will be prone to submergence. While these areas have lower human densities, they often house critical infrastructure like airports, helibases, naval installations, among others.





Modelling wave exposure and sediments on coral reefs

The south-westerly winds during the Indian monsoon are a major structuring agent of coral reefs in the Lakshadweep. Over the last 25 years, our research has repeatedly highlighted how strongly these exposure gradients shape the community of coral and fish, but we had not previously attempted to model wave exposure with any great detail. Our recent analysis works to fill this gap. It uses data on prevailing wind patterns through the year, together with information on the position of each atoll in relation to wider geographical patterns to accurately predict the power of wind-driven waves on each reef. Additionally, we have used this information to model sediment suspension patterns across the atolls by incorporating data from our field surveys. With these detailed models, we now identify fine spatial differences in exposure and sedimentation patterns for all the islands in the Lakshadweep.

Parrotfish function and wave exposure

Apart from being outrageously conspicuous, parrotfish are also surprisingly important for reef health as key herbivores, bioeroders and sediment producers. How they use reefs can therefore have far-reaching implications for the system. We conducted community and behavioural studies on parrotfish to explore whether wave exposure could influence where parrotfish were found and their bioerosion function.

We found that, in parrotfish distribution, size matters. Larger-bodied parrotfish—often the most important bioeroders on reefs—just could not manage to feed effectively in wave battered reefs. Smaller species were not terribly bothered by the waves and fed even in the most exposed reefs. Of course, their overall contribution to bioerosion was relatively small. Of all the species, the Steephead Parrotfish was responsible for over 65% of total bioerosion, making it a key species on these reefs. Our study shows that even large-scale geological processes like bioerosion can be influenced by how species behave.

Household consumption of freshwater

Climate change places strong limits on the urbanisation potential of atoll islands. In Lakshadweep, the continued habitability of the islands is based mostly on the availability of freshwater and land. Communities depend on shallow groundwater which is replenished with every rain. However, as urban pressures grow, this groundwater is becoming increasingly scarce. In an ongoing study, we are documenting how households in Lakshadweep use water. Initial results from the dense island of Kavaratti show that per-capita consumption varies between 110 to >300 L/person/day. Many households close to the northeast coasts found the water already non potable and saline. Nearly half the households no longer use groundwater for drinking, relying instead on desalination facilities. These results paint a picture of an impending crisis of freshwater in Lakshadweep that needs immediate attention if the islands have to remain habitable.





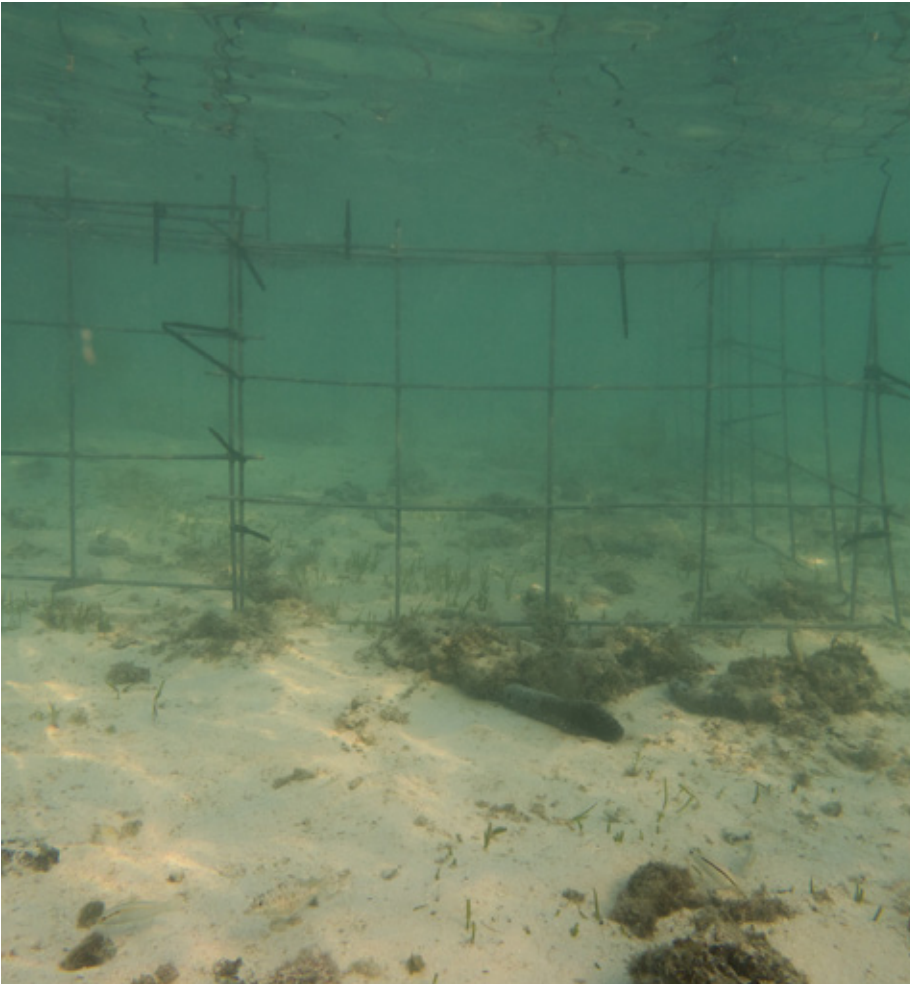
Changing fishery practises in Lakshadweep

The life histories of many coral reef fish make them vulnerable to uncontrolled commercial fishery. Commercial reef fishing is relatively recent in Lakshadweep, and is promoted by collector boats with ice holds that ply between the islands and the mainland, causing many fishers to take to reef fishing. However, during the recent Covid-19 pandemic and other restrictions, collector boats could not ply to the islands for nearly a year. As a result, many fishers found themselves without buyers. Although they could sell some of their catch locally, local demand was not sufficient to warrant catching fish in large quantities. Given this uncertainty, many fishers we interviewed have begun to switch back to pelagic tuna once again, and processing it to make masmin. However, masmin prices have also fallen dramatically, leaving fishers with few options. The commercial fishery in Lakshadweep is yet another victim of this ongoing global crisis.

Communicating marine biodiversity and climate change

Our principal outreach challenge has been to foster community resilience towards climate change through a sustained dialogue with relevant stakeholders and a comprehensive strategy to tackle climate blindness. With Lakshadweep experiencing all kinds of turmoil due to the Covid pandemic, fierce political protests, and the destructive aftermath of Cyclone Tauktae, we have had to pivot our work to adjust to these rapidly changing local realities which also left us unable to visit the islands. We have done this by getting across critical medical equipment to help with Covid recovery locally, raising funds for cyclone relief, publishing articles and interviews in popular mainland media on Lakshadweep's looming climate crisis, and embarking on an innovative online outreach strategy titled *Melem Keezem* (Above & Below) to distribute creatively designed infographics via Whatsapp and other social media so as to ensure the climate change message is kept alive despite all the recent upheavals.





Tracking changes in green sea turtles and seagrass meadows

Establishing seagrass insurance sites

The Lakshadweep Archipelago is one of few locations globally with high green turtle foraging aggregations. In the last 15 years, turtles have radically transformed meadows across the archipelago. They are now distributed at low densities in every meadow maintaining meadows in a state of protracted recovery by constant, low-level herbivory. In a small experimental intervention, we are establishing tiny exclosures in the meadows of Kalpeni and Kavaratti to protect remnant patches of seagrasses from further herbivory. The idea is that these patches will serve as sources for later recovery when turtle numbers reduce. These ‘insurance’ sites ensure that the dominant structural species of the original meadow do not go locally extinct, and are available for recolonisation when possible. Finding a balance between seagrass and green turtle conservation is complex, and we will need active and passive means to ensure that both ecosystem and species are maintained in healthy states.

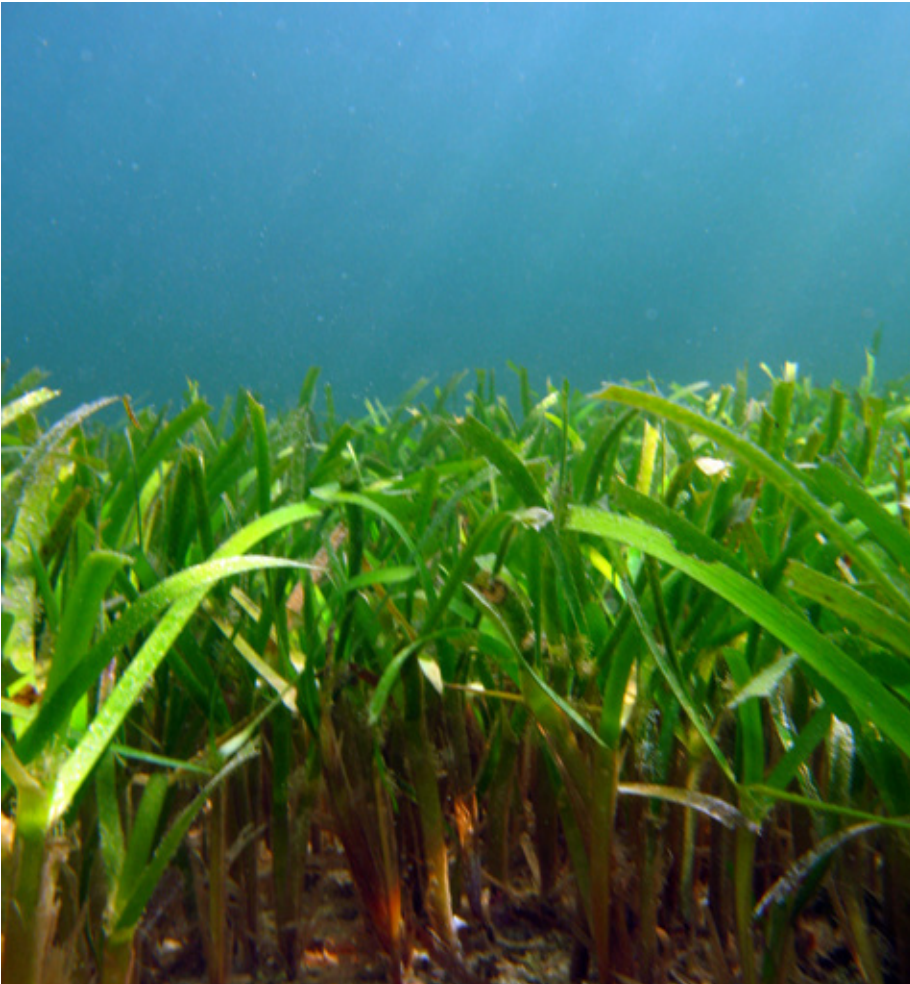
In the Andaman and Nicobar islands:

Tracking changes in seagrass meadows

Seagrasses are true marine vascular plants representing merely 0.2% area of the world's ocean. While the bulk of our knowledge of seagrasses comes from temperate meadows, how tropical species respond to changing climate and anthropogenic disturbances, remains less explored.

In order to track seagrass community dynamics and responses to disturbances, we set up long-term monitoring stations in the Andaman Islands (Mayabunder, Middle Andamans and Port Blair, South Andamans) in 2019. This is the first long-term programme of its kind for the Andamans, and is unique for tracking changes to complex multi-species meadows. The monitoring programme is still in its infancy, and over the next few decades we hope that this initiative will give us insights into how dynamic intertidal meadows work, and how climate change impacts these productive, nearshore systems.





Understanding the role of the environment in shaping seagrass communities

Between the tides is a place of extremes. Twice a day, as the sea retreats and advances, it creates conditions so harsh, that only the toughest can survive. Yet, even this difficult seascape can be a battleground, as species jostle and shove for a comfortable spot. We explored how seagrass species navigate extreme conditions in multi-species intertidal meadows of Andaman Islands. The principal challenge for seagrass here is desiccation as the tide retreats, and the few hardy species (like *Halodule uninervis*) that could tolerate drying up are the most successful and found virtually everywhere. However, the meadow is full of small pools and streams that do not dry up, and here other species (like *Cymodocea rotundata*) take over. These may be less hardy, but are much better competitors. Our work is revealing the mosaic of tolerance and competitive ability that underlies the complex patchwork of intertidal meadows.

Giant guitarfish and the role of coastal habitats in their life history

The giant guitarfish is as enigmatic a species as its name suggests, shaped like a curious cross between shark and ray. It is fished for meat and fins, and is critically endangered. We know very little of its biology, and studies on the species are few. We first confirmed the presence of giant guitarfish in the Andaman Islands and are now trying to determine their distribution, especially their pupping sites. For this, we are relying on the vast store of local knowledge from fishers, coastal dwellers, swimmers, divers and researchers spread all across the archipelago. This has helped us reliably identify several critical locations that giant guitarfish regularly use—typically characterised by shallow, soft-bottom habitats, often with seagrass present. While we continue to study the species, it is already clear that the Andamans is a globally important safe haven for giant guitarfish.





Coasts

Analysing policy mismatches in coastal fisheries in India

In the last seventy years, marine fisheries in India have seen a rapid transformation from a sustenance livelihood to a large-scale industry, facilitated by policy level directives targeted at increasing catch. To what extent is this policy informed by biological understanding? Our analysis of the last 7 decades shows that biology plays an instrumental role in shaping fishing policy—used primarily as a means of identifying new stocks, boosting productivity and improving catch-efficiency but blinded by issues of overcapacity or sustainability. Where it does acknowledge declining stocks, it promotes spatial fixes and technological intensification. Individual coastal states are left to make their own biologically-meaningful regulations, without explicitly mandating them. As a result, states have largely dedicated themselves to resolving conflict rather than managing for sustainability. What emerges from our analysis is an unceasing drive to maximise fisheries production, unmindful of the biological reality of precipitously declining coastal fisheries.

Identifying genetic boundaries of commercially important fish species along the west coast

Knowing where one population ends and another begins is a basic requirement for harvest management of fish. In India, this is particularly problematic since individual states manage their fisheries as though they were independent stocks. In an important first, we are using genetic techniques based on SNP-based ddRADseq to identify stock boundaries of nine fish species across the Indian west coast. Our preliminary results show that while Pomfret and Scoliodon have one continuous population along the shores of Maharashtra and Karnataka, Ribbon fish and Threadfin bream show strong genetic differentiation dividing their populations into essentially a northern and southern population. Maharashtra and Karnataka share populations of three out of the four analysed species. Managing these populations as though they were one will ensure their sustainability. To do that, states need to start talking to each other about their fish.



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Rufford Small Grants
Ministry of Environment, Forests and Climate Change



Team & Support

Eastern Himalaya



Our current research is primarily focussed on various aspects of hornbill biology, frugivory and seed dispersal and tree phenology in the tropical forests of Arunachal Pradesh. Our conservation work is currently focussed on protection of hornbills and their nesting habitats in multiple sites through community engagement, restoration of degraded habitats, nature education for local school children, community engagement through a festival, and awareness, training and development of livelihood needs.



Saving hornbill homes with communities

Based on the concept of shared parenting, the Hornbill Nest Adoption programme (HNAP) completed 9 years of community-based conservation for hornbills. This model brings together multiple key stakeholders—local communities, Forest Department, scientific and local organisations—to safeguard hornbill nests and their habitat in the Reserved Forest adjoining the Pakke Tiger Reserve, Arunachal Pradesh.

Despite the unexpected challenges post the COVID-19 outbreak from April 2020, the 11 nest protectors continued to monitor hornbill nests whenever local restrictions were eased. The nest protectors initially monitored 28 hornbill nests, out of which only 22 nests were active in the 2020 breeding season. Successful chick fledging was confirmed from 19 nests, with a nesting success of 86.4%.

Sadly, after the breeding season was over, one of the Oriental Pied Hornbill nest trees was cut down. The tree was found in 2014 and used for nesting by hornbills since then. The incident was immediately reported to the Forest Department and the partners.

Nature Education Programme

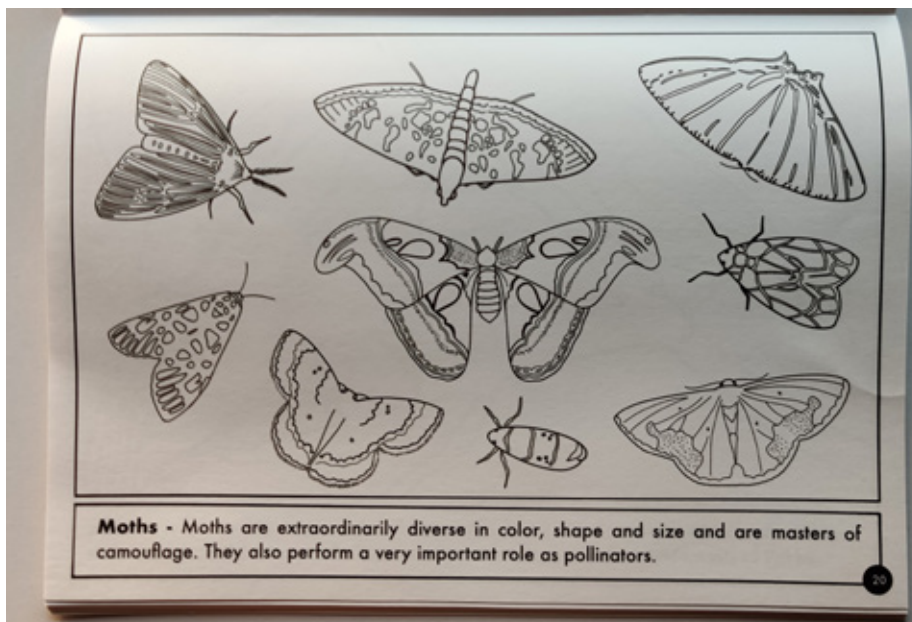
Every year, as a part of our Nature Education Programme, we conduct annual nature camps in November as well as year round activities with seven schools registered with us since 2017. However, for most of 2020, schools remained closed and our engagement with the students reduced. In July 2020, we carried out a fundraiser for our programme and an received overwhelming response from supporters. We were able to raise 8 lakhs through the crowdfunding campaign and CSR funding.

In December 2020 we carried out online activities.

Online nature games: 23 Students from class 5–8 from Vivekanand Kendriya Vidhyalay Nivedita Vihar played various online Bingo games through WhatsApp. These games are designed to encourage students to go out and observe nature in their own backyards/locality and also connect with it in the process.

In January 2021, the schools re-opened only for higher classes. Therefore, considering the health and safety of students we only conducted a few on-ground activities with some of these schools in limited strength. A total of 30 students from class 6–9 participated in campus bird walk, on ground nature





games (such as bird, nature and leaf Bingo) and some students also visited our rainforest nursery to learn about the importance of restoration and raising a nursery.

Resource material

Coloring book: We developed a coloring book and nature journal on Wildlife of Pakke to encourage connection with nature through arts.

Bird brochure: We also reproduced the brochure on Birds of Pakke to be distributed and used during the annual nature camps and bird walks.

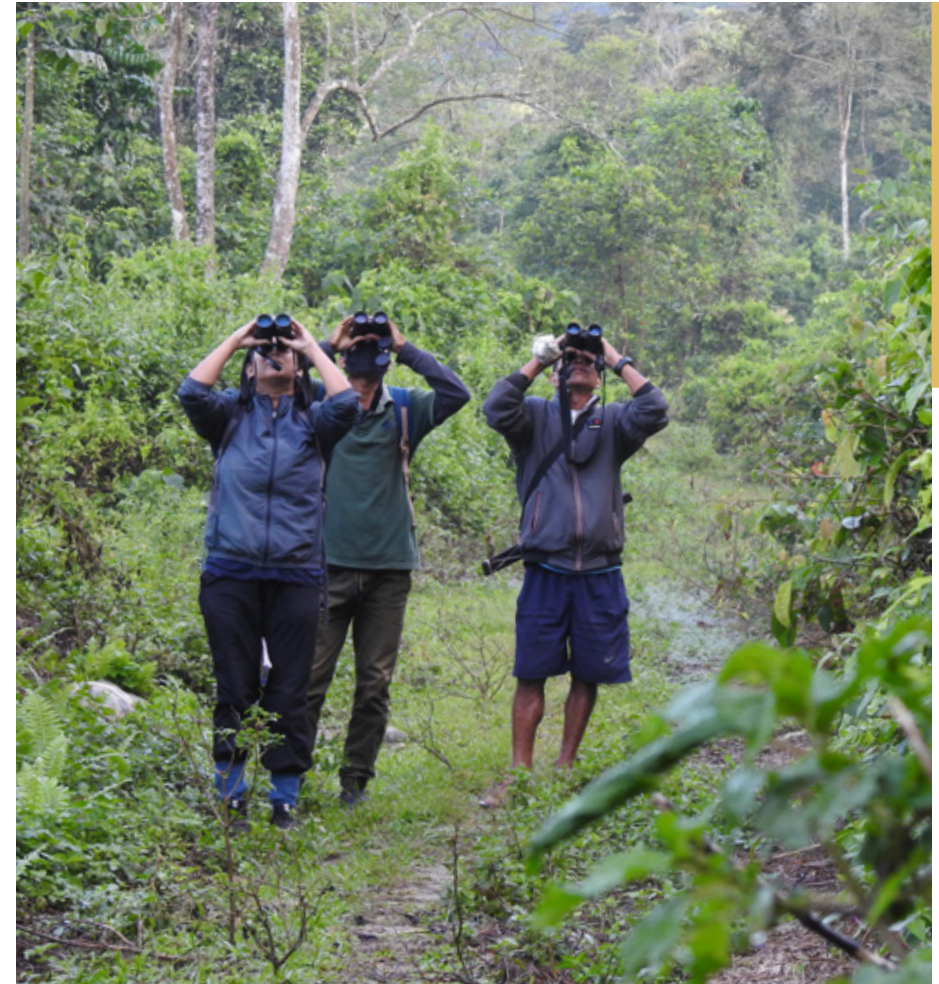
Panel for Nature Interpretation Centre: We are getting an elaborate panel on plant-bird interactions painted by the artist Meena Subramaniam. This panel is based on our recent study inside Pakke Tiger Reserve on plant-disperser networks.

Counting hornbills and other wildlife outside Pakke Tiger Reserve

The nest protectors are trained to collect crucial information on hornbill ecology. During the non-breeding season, they walk on pre-identified trails in the Reserved Forest and record hornbill sightings—direct and indirect—along with other wildlife sightings.

From September 2020 until the first week of January 2021, the nest protectors completed 67 transects across 5 unique trails. The total effort covered was approximately 70 km. In terms of combined detections (sight and call), Oriental Pied Hornbill had the highest detections (98), followed by Wreathed Hornbill (14) and Great Hornbill (13).

Oriental Pied Hornbills are easily adaptable species, which could possibly be the primary reason for their high numbers recorded in the Reserved Forests outside the Pakke Tiger Reserve, which is mostly a secondary type of forest. This year the transect effort was relatively low owing to local restrictions because of the pandemic.





Long-term monitoring of hornbill roost sites

Every evening, hornbills fly over, either in small numbers or in large groups, towards the southern boundary of the Pakke Tiger Reserve, over the Pakke river to their roost sites located close to settlements in the Reserve Forest. The nest protectors have been monitoring these hornbill roost sites in Seijosa for many years now.

From September 2020–March 2021, 10 roost sites were monitored for the Wreathed Hornbill, out of which hornbills were seen visiting only 8 sites. The number of Wreathed Hornbills recorded at these sites ranged from 1–41 individuals, with the highest number of individuals recorded at the roost site behind NCF's basecamp in Darlong village.

Similarly, 17 sites were monitored for Oriental Pied Hornbills, out of which only 12 roost sites were active from Sept 2020–March 2021. The number of Oriental Pied Hornbills recorded at the roost sites varied from 1–20 individuals.

Long-term hornbill nest monitoring

NCF has a long-term monitoring programme of hornbill nesting in Pakke and Nameri Tiger Reserves, focused on the three sympatric hornbills—Great Hornbill, Oriental Pied Hornbill and Wreathed Hornbill.

In 2020, the field team initiated the annual hornbill nest monitoring inside the Tiger Reserve from February onwards, visiting all known nests to identify signs of hornbills' visits, cleaning and nesting activities. However, from March onwards, due to the lockdown imposed because of the COVID-19 pandemic, monitoring of hornbill nests inside Pakke Tiger Reserve had to eventually stop following park regulations.

During the initial surveys, the field team confirmed nesting in 21 nests, but activity in many other nests remained unknown in 2020. This is the first time that we do not have any data on hornbill nesting from Pakke Tiger Reserve since we started hornbill nest monitoring in Pakke, some of which have been monitored since 1997.



Eastern Himalaya



Long-term monitoring of tree phenology

We are monitoring 722 trees of 53 species (wind-dispersed, bird-dispersed and mammal-dispersed) twice a month for the tree phenology study in Pakke Tiger Reserve. Different phenophases (leaf flush, leaf fall; flower buds, flowers; unripe and ripe fruits) are recorded. We set up a weather station in 2011 for weather monitoring. Our main objectives are to document:

- The seasonal and annual variation in leaf flush, flowering and fruiting of tree species at a community-level and in terms of seed dispersal modes
- The effect of climate variables on long-term tree phenological patterns,
- The effect of fruit availability patterns on timing/initiation of breeding and nesting success of hornbills,
- Examine individual species phenologies: periodicity, consistency, synchrony, and individual variation within species.

For 2020, we have data from January-February, work was halted in March 2020 due to Covid restrictions, resumed in April 2020. Work was stopped after May 2020 till mid-April 2021 as we were waiting for research permit renewal.

We summarised the 2019 data for 37 tree species (excluding the fig species) that were monitored. The percentage of bird-dispersed species in flower is highest between April and May (7-10 species), while percentage of species in fruit peaks between May (10 species) and June (7 species). The number of species in fruit declines in the post-monsoon period and increases to 5 species in November.

The percentage of mammal-dispersed species in flower is highest in March (5 species), while there are few species flowering between July and December. The percentage of species in fruit of mammal-dispersed species was staggered with several species in fruit between July and December.

The number of wind-dispersed species in flower was highest between March and April (3-4 species), with another peak in October (4 species). Wind-dispersed species were seen in fruit in the drier periods between February to May, and from September to December.

The percentage of trees in flower of mechanically-dispersed species had a bimodal peak - from February to May (17-25% of trees) and in October-November (17%), while the flowering of animal-dispersed was unimodal staggered from March to June (15-20% of trees).

The fruiting patterns of mechanically-dispersed tree species had two peaks with a major one in Feb-March (19% of trees), and a minor one in October (10%). These fruiting peaks coincided with the drier periods. The fruiting patterns of animal-dispersed species had its main peak in June (10% of trees) in the monsoon. A smaller peak was seen in October-November (6-8% of trees).





Securing hornbill conservation at new sites

Buxa Tiger Reserve, northern West Bengal

In north Bengal, our work on four species of hornbills—Great Hornbill, Wreathed Hornbill, Oriental Pied Hornbill and the Rufous-necked Hornbill—has been focused mostly in Buxa Tiger Reserve. This work is in collaboration with Nature Mates Nature Club, an NGO based in Kolkata.

In 2020, for the annual hornbill nest monitoring, 11 out of 20 known nests were occupied by breeding hornbills. Among the 11 nests, breeding success was confirmed in 7 nests with a fledging success of 77.8%.

From November 2020 to March 2021, the team repeated transects conducted in the previous year across Buxa Tiger Reserve. The hornbill densities estimated from these transects conducted over two non-breeding seasons are:

Great Hornbill: 0.21 birds/km²

Wreathed Hornbill: 0.49 birds/km²

Rufous-necked Hornbill: 0.04 birds/km²

Oriental Pied Hornbill: 10.58 birds/km².

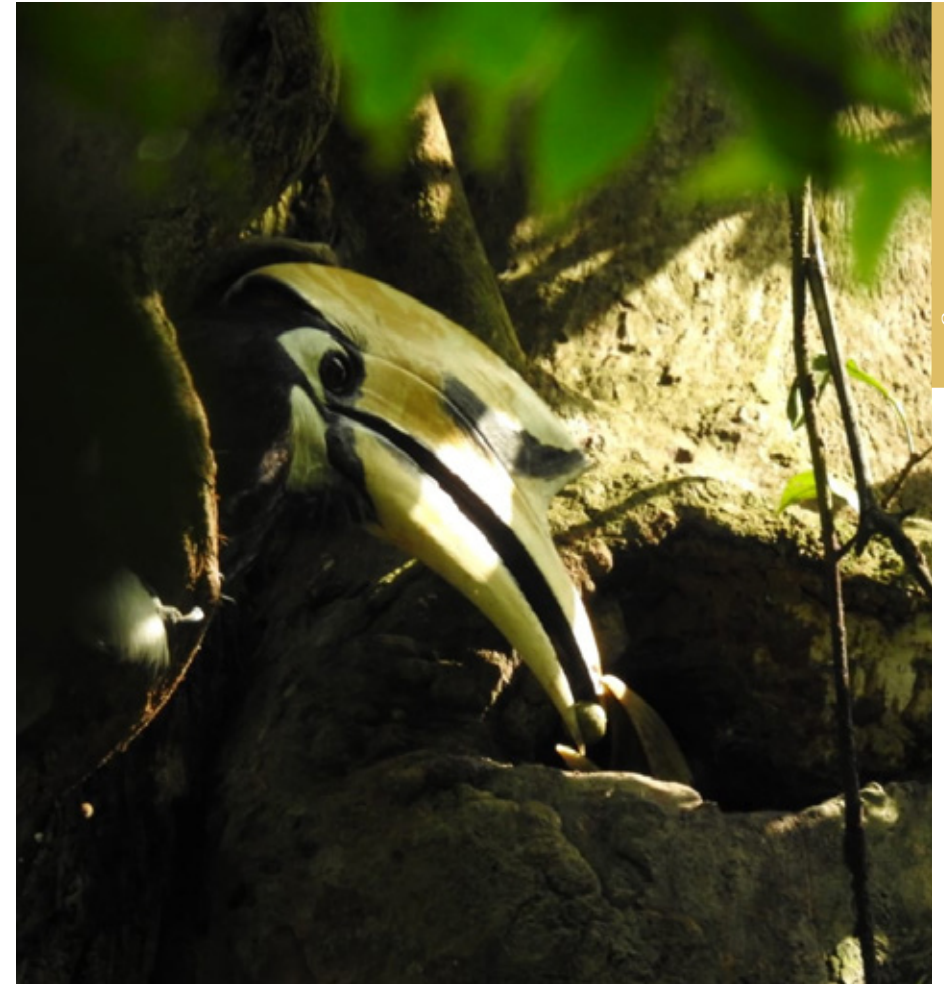
From the vegetation study using Point Centred Quadrant across 81 trails, the tree density in Buxa ranged from 6 trees/ha to 425 trees/ha with an average density of 92 trees/ha. The density is very low compared to other forests in Arunachal Pradesh where the same set of four species of hornbills are also found.

To increase our understanding on fruiting and flowering patterns of important trees, we have also started a tree phenology study in Buxa Tiger Reserve from January, 2021. An optimum number of individuals of 62 tree species are identified and marked. The fruiting, flowering and leafing patterns of these 700+ individuals are recorded between the 21st and 25th of every month.

Dihing-Patkai landscape and forest fragments in Eastern Assam

We initiated a study in the *Dipterocarpus-Mesua* forests of Upper Assam in 2017 on the White-throated Brown Hornbill. The Brown Hornbill is the only cooperatively-breeding hornbill species in India, where adult males are assisted by other male Brown Hornbills to feed the female and its chicks during the breeding season. We found ten nests from 2017 to 2020. Nest trees were in lowland rainforest at a mean elevation of 172 m with a mean GBH of 250 cm and mean tree height of 28 m. Brown Hornbills used nine different nest tree species with most nest cavities being in large emergent trees. We found that early March to mid-July was the breeding season in Upper Assam. The mean nesting duration was 95 days, ranging from 92 to 99 days. Overall nesting success was high (92%). Most successful nests (83%) produced one chick, with the remaining producing two chicks. Visitation and food delivery rates were higher in the post-hatching period compared to the pre-hatching period. The mean number of helpers at Brown Hornbill nests was 2.2, ranging from zero to five helpers (adult males or juveniles) that assisted in bringing food and guarding nests. There was no relationship between number of helpers and nesting success or the number of chicks. The role of helpers may be related to ensuring nesting success through greater vigilance or by enhancing food finding and food delivery, however there may be no incremental advantage from having more helpers. Helpers may also be constrained by limited breeding opportunities to defer their own breeding and assist the adult pairs.

Out of 19 Reserved Forests visited, we surveyed 13 Reserved Forests and 1 Wildlife Sanctuary in 2019-20. We had nine hornbill encounters of three hornbill species with a total effort of 85.5 km in 44 transect-walks; with two sightings of the Brown Hornbill. Although the Dihing-Patkai Wildlife Sanctuary and Joypur-Dirok Reserve Forest have few good forest patches, the other surveyed forests were highly degraded. Field work was suspended in most of 2020 due to the pandemic.





Restoration project

Our restoration project was initiated in 2014 with an aim to revive degraded areas in the Pakke Tiger Reserve landscape. Over the years, we have scaled up from growing 25 to 72 native tree species at our nursery. We have raised 28,000 seedlings/saplings, and planted in an area covering 11.5 ha so far.

In 2020, we had 4968 saplings of 57 species for planting at our nursery. We had identified sites for restoration and carried out site preparation activities, however, due to the COVID lockdown we were unable to initiate planting. We carried out nursery activities and could only do limited seed collection during these times.

After the COVID restrictions were relaxed, we provided 1260 saplings to locals for planting in their home gardens, and 105 saplings to the Forest Department and local organisations for tree planting campaigns. At the start of 2021, we began identifying sites for restoration, and found three sites inside Pakke and one site at a tea estate in Assam.

Trees of Arunachal Pradesh: A field guide

North-east India is a rich biodiverse area, but floristically, is still less explored and documented. Apart from some regional floras and plant monographs, there is no pictorial field guide book for plant identification from north-east India. A field guide would be handy to learn and understand this overwhelming diversity. This project to publish a field guide to trees of Arunachal was started in March 2019 in collaboration with Dr. Navendu Page, Wildlife Institute of India. It will be a richly illustrated field guide with around 2000 images and user-friendly keys for identification of 241 species of trees, shrubs and climbers mainly in the lower elevations of Arunachal Pradesh. Most of these species also occur in other states in the North-east and some, in other parts of India. This book has information about taxonomy, ecology and distribution of the species and will be widely useful for tree-watchers, foresters, researchers, students and nature enthusiasts. This book is expected to be published by December 2021.

FAMILY MAGNOLIACEAE

Magnolia hodgsonii

HODGSON MAGNOLIA
Synonym: *Talauma hodgsonii*

LOCAL NAMES: Adi: *Burgang-asing*; Apatani: *Jilying*; Assamese: *Boramthuri*; Khasi: *Dieng-soh-pytem*; Nyishi: *Parampara*

ECOLOGY: This species is common, though patchily distributed in Pakke Tiger Reserve. Elevational range is reported as 800 m to 1500 m, but in Pakke it is seen commonly below 300 m. It is insect-pollinated. Flowering is mainly in May but some flowering individuals can be seen from March to November. Fruiting is from May to November with ripe fruits seen mainly in October–November. The red arils are consumed and seeds possibly dispersed by bulbuls,

leafbirds and hornbills. The seeds are also eaten by tree squirrels, while fallen seeds are consumed by terrestrial rodents and pheasants.

USE: The wood is soft and the species has no timber value and can be sometimes used to make knife handles and agricultural implements. It is used as firewood.

IUCN Status: Least Concern



Habit: evergreen trees up to 15 m tall.



Flowers: 7-10 cm across, terminal solitary inflorescence, fragrant, bisexual; perianth 9, arranged in three series, free, mostly white, reddish in the outer side of the outer whorl; tepals; stamens many, free, crowded on the receptacle, yellowish, arranged on the disc; carpel numerous, united, crowded on the receptacle.

Fruits: 8-10 cm long, 6-7 cm broad, ellipsoid, formed by aggregation of 40-80 follicles; whitish in color; seeds black, covered with red aril.



Leaves: large, simple, alternate, crowned at the end of the branches; 20-45 cm long, 7-15 cm broad; base narrowed; apex acute; secondary nerves 18-22 pairs, prominent; margin undulating; petiole 2.5-7 with stipule scar along the entire length.

DISTRIBUTION:
Bangladesh, Bhutan, South China, north Myanmar, Nepal, Thailand; India: Himachal Pradesh, throughout North-east India, West Bengal.

128 | Trees of Arunachal
Trees of Arunachal | 129



*Neglected mutualists of the Eastern Himalaya:
defining the vital roles of medium-bodied and large mammals
(carnivores and ungulates) in seed dispersal*

Seed dispersal is critical for tropical forest persistence. Most tropical trees are animal dispersed, therefore defaunation of fruit-eating animals can have cascading effects on tree diversity and abundance. Birds and mammals are the main dispersers in tropical forests, but there are major mammalian seed dispersers whose roles remain poorly known. We propose to study the seed dispersal effectiveness of two understudied mammal groups—carnivores and ungulates in the Indian Eastern Himalayan tropical forests which is in a global biodiversity hotspot. The study will provide a quantitative understanding of tree mammal interactions and generate essential, novel insights into these neglected mutualists. Fieldwork for this study will commence in 2021.

Conserving the Chinese pangolin

In North-east India's largest and most forested state, Arunachal Pradesh, there are ad-hoc reports of the Chinese pangolin (*Manis pentadactyla*) from some Protected Areas and community-owned forests. Habitat change, combined with increased connections with illegal wildlife trade, is believed to have led to a decline in pangolin numbers across the country. In order to protect the species, it is vital to conduct rigorous scientific research and combine it with in-situ conservation involving the region's many ethnic communities.

Therefore as a first step, we seek to fill this knowledge gap by investigating the distribution and occurrence of pangolins, local perceptions of the species and relations with, and hunting pressure on the Chinese pangolin in the Siang basin through local knowledge-based interviews and camera trap surveys. Based on research results and the relationships developed during field surveys, we aim to develop evidence-based and community-led conservation of the Chinese pangolin in Arunachal Pradesh.





Dibang Programme: supporting biocultural diversity through local leadership

The Dibang Programme was launched in December 2020 by a group of Idu Mishmi people of the Dibang Valley of Arunachal Pradesh with support from NCF. Research over the past decade has highlighted that the Idu Mishmi nature-culture interlinkages have been vital in maintaining high-levels of biodiversity in Dibang Valley, including a newly registered population of tigers. Recent years have seen escalating threats to Dibang's nature and culture. This locally-led, rights-based programme seeks to strengthen Idu cultural and traditional institutions for the continued existence of Dibang's biocultural diversity. It is composed of three interrelated initiatives, each intertwining nature, culture, land, and ancestral knowledge:

- **Community-led socio-ecological research and conservation** integrates rigorous scientific methods ethically and equitably within local institutions to co-create knowledge. Socio-ecological data, generated with local people, are used to co-develop locally-relevant biocultural conservation and livelihood programs. A key outcome has been the declaration of Eastern Arunachal's first Community Conserved Area (CCA) managed entirely by the Idu owners of the land.

- **Shaman fellowship:** Idu shamans are key cultural figures central to the Idu identity. They are repositories of ancestral knowledge, maintaining moral human-human and human-nature relations. Sadly, Idu shamans are no longer self-initiating. This Idu-led pilot programme financially and logistically supports younger Idus who shadow older shamans for two years to learn shamanic knowledge and wisdom.
- **Ancestral storytelling:** Idu ancestral stories contain traditional knowledge, detailing moral and reciprocal relations people ought to have with each other, and with the animal and the spirit world. Sadly, a majority of younger Idus no longer know these stories. This initiative combines traditional oral storytelling with locally developed art and visual aids. Stories are told in modern schools—where Idu youth currently spend most of their time.



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Dibang team

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Donors for the Hornbill Nest Adoption Programme

Arnab Ray, Dr. A.J.T. Johnsingh, Anjali Powar Haridass, Arvind Datar, Ashwani Sharma, Ashwin Baindur, Astik Gupta, Balakrishnan Chandra Shekar, CR Naveen / Rajalakshmi, Diana Philip, Geetha Subramanian, Hema Maira, Janhvi Vyas, Kaushal Singh, M. Gopa Kumar, Maitreya Sukumar, Meenakshi Subramaniam, Novita Singh, Rajeshwari Ramachandran, Ram Gopalakrishnan, S. Subramanya, Shivakumar M, Sudip Datta, Ulhas Anand, Vivek Chandy

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Funding

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Education & Public Engagement

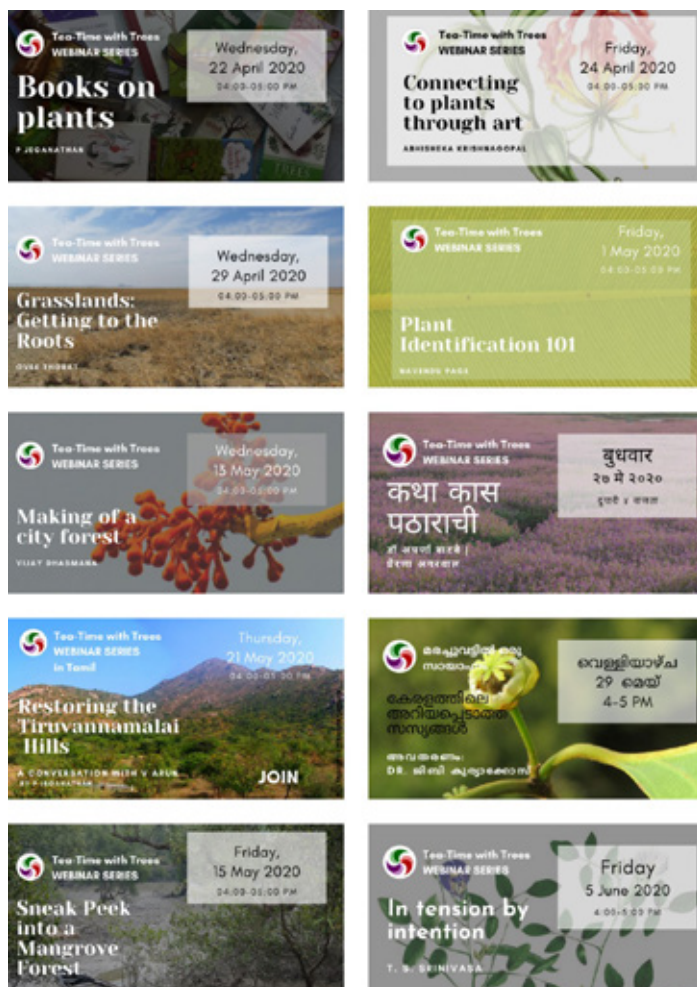


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We work to increase awareness about nature and biodiversity among the public, especially children, and to involve the larger citizenry in generating information for better documentation and conservation of nature. We believe that deep connections between people (especially children and young adults) and nature arise primarily through first-hand contact with animals and plants; with some kind of wilderness. At this programme, we want to help make these connections, and once made, help nurture and develop them.

NCF has been working in conservation education and outreach at most of our focal conservation sites across India. We are also increasingly reaching out to an audience at a national scale. This programme also cuts across the various other NCF programmes and strives to add value to NCF's existing efforts in nature and conservation education.

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SeasonWatch

SeasonWatch is an India-wide citizen science programme that studies the changing seasons by monitoring the phenology of 138 common tree species, inviting volunteers—adults and children alike—from across the country to participate.

By March 2021, a total of 123 colleges, 1245 schools and 1091 individuals from across the country had registered with the programme, contributing > 4,75,000 long-term and one-time observations on > 93,000 trees. The top species to be observed till date are mango (10385 trees), jackfruit (8352 trees), teak (7669 trees), coconut palm (5408 trees) and neem (4506 trees). As in previous years, Kerala continues to contribute more than 85% of the data to SeasonWatch.

The ongoing pandemic restricted our outreach in 2020-21 to online modes of interaction. We conducted a series of 11 webinars on trees, ecosystems, seasonality and climate change in three languages between March and June 2020. We also conducted outreach and training sessions online for schools and school festivals (Kerala district-wise workshops, DAV Pokhariput, SETU 2021, CCMB Climate change champions), organisations (RRBCA Pune, BIC Bangalore) and collectives (Wipro Sustainability Educators, NPTEL). We met with our best-performing school teachers through an online National Teachers' Meet, and presented our latest data in a preprint uploaded to bioRxiv and a talk at the Cit Sci 2020 conference. In December 2020, the SeasonWatch website was updated to include features like contributor profile, personal and public exploration of data, and data download.

Birds in India

This project, which began in January 2019, is an effort to catalyse increased impact in public engagement, research, and conservation of India's biodiversity, through birds. Birds are excellent ambassadors for all of biodiversity, by virtue of their ubiquity and familiarity. Several institutions and individuals in India are engaged with one or more of these efforts, to varying degrees. In addition to scaling up our existing work in these areas, one of the aims of this project is to encourage these different groups and individuals to work more closely together in order to increase the quantity and quality of the work, to complement each other's work in a strategic manner, and through this, to increase impact in multiple ways.



Bird Count India

NCF plays a coordinating role in Bird Count India (BCI), an informal umbrella consisting of organisations and groups interested in bird documenting and monitoring. As a citizen science effort, Bird Count India works with birdwatchers and naturalists across the country to record the birds that they see, and to share their observations on a common platform for use by everyone.

BCI conducted 19 workshops and talks on bird documenting, monitoring, and eBird across India, and engaged 1000 birdwatchers and potential birdwatchers through these. The BCI webpage ran monthly and yearly challenges and engaged on an average 2000 birdwatchers on a monthly basis. BCI also provided technical support to partners in conducting their own projects like the Kerala Bird Atlas, Coimbatore Bird Atlas, Pune Bird Atlas, and Satpura Bird Survey, amongst others.

The common location that BCI encourages birdwatchers to use to upload their observations is the global platform eBird, customised for India (ebird.org/india). The number of eBirders has grown from 200 in 2013 to 24,804 in 2021. By late 2020, eBirders in India have uploaded 1 million complete checklists, 1 million images, and 50,000 audio recordings. Due to all the engagements which are done over the last two years, there is a visible growth in eBirding in each state in India. Punjab, Jharkhand, Chandigarh, Meghalaya, and Bihar have had over 100% growth in the lists submitted. All these states were with less than 2000 lists until the end of 2018, but they have had over 100% annual growth with more than 1000 lists since then. These lists are submitted almost entirely by local birders. In Sikkim and Odisha (two other under-birded states) there has been considerable growth in birding, and in Andhra Pradesh, there has been greater spatial coverage.

A targeted bird survey was conducted at Thanamir, a village in Nagaland bordering Myanmar; the local bird watchers who were trained to do the survey continue to monitor the region.



Early Bird

This project aims to introduce children and young adults to birds and nature, by creating educational material and content, training bird educators and school teachers.

Interactive posters: We converted our series of posters on common birds of different habitats, into a mobile-friendly interactive format, available in 9 languages.

Flash cards and posters: The Tamil version of the Early Bird flash cards was printed and distributed. A new 'Birds around Human Habitation' poster was made available for download. The previous four posters were translated into Bangla, Gujarati, Hindi, Kannada, Marathi, Tamil and Telugu.

Webinars: The lockdown in March 2020 created a great interest in birds and nature around us, and a demand for good online content for children. Between April and November 2020, we conducted a series of online webinars (33 sessions in 5 languages, attended live by 1500 people) to introduce beginners of all ages to birds. The content of the sessions ranged from balcony birding to creative activities/art, touched upon aspects of ecology and behaviour of birds, and also featured talks by scientists, all sessions were uploaded on our YouTube channel (17k+ views till date).

Workshops: We converted our 'How to be a Birding Buddy' workshop into an online mode, and restarted the sessions in March 2021 with a group of 30 enthusiastic teachers. We also worked on the content for a 'Young Birders' Workshop', creating videos and activity sheets for an online engagement with children.



India–Long Term Ecological Observatories

The India–Long Term Ecological Observatories (LTEO) programme was launched by the Ministry of Environment, Forests and Climate change in March 2020. The LTEO programme is a multi-institutional collaboration with several nodal institutions for different themes across the country. The bird theme of India LTEO is housed at NCF, and has institutional partnerships with Indian Institute of Science, Bangalore; Salim Ali Centre for Ornithology and Natural History, Coimbatore; Wildlife Institute of India, Dehradun; Indian Institute of Science Education and Research, Tirupati; Indian Institute of Science Education and Research, Pune and Indian Institute of Forest Management, Bhopal.

The goal of the programme is to set up monitoring for 9 themes including birds, herpetofauna, arthropods, forests, grasslands, soils, freshwater ecosystems, marine ecosystems and movement ecology in 6 landscapes across the country. In each landscape, LTEO targets an interesting environmental or topographic gradient to potentially ask questions about species assemblages and turnover within and across landscapes over long timescales. The LTEO programme will also establish weather stations in all landscapes and over a period of time will address questions related to the effect of climate and land use change on ecosystems. The multi-theme approach also facilitates cross talk between data from different themes creating opportunities for multi-taxa studies and insights into ecosystem functioning.

During the year 2020–2021, the bird theme conducted meetings to finalize protocol and has taken steps towards obtaining permits in different landscapes from the Forest Department. Recce trips were conducted in the Western Ghats, North-west Arid Zone, Central India and Eastern Himalayan landscapes. In the next year, COVID protocol permitting, the bird team aims to conduct pilot studies in at least 4 of the 6 landscapes to try out methods and get feedback from all landscapes.





Bird Monitoring in India symposium

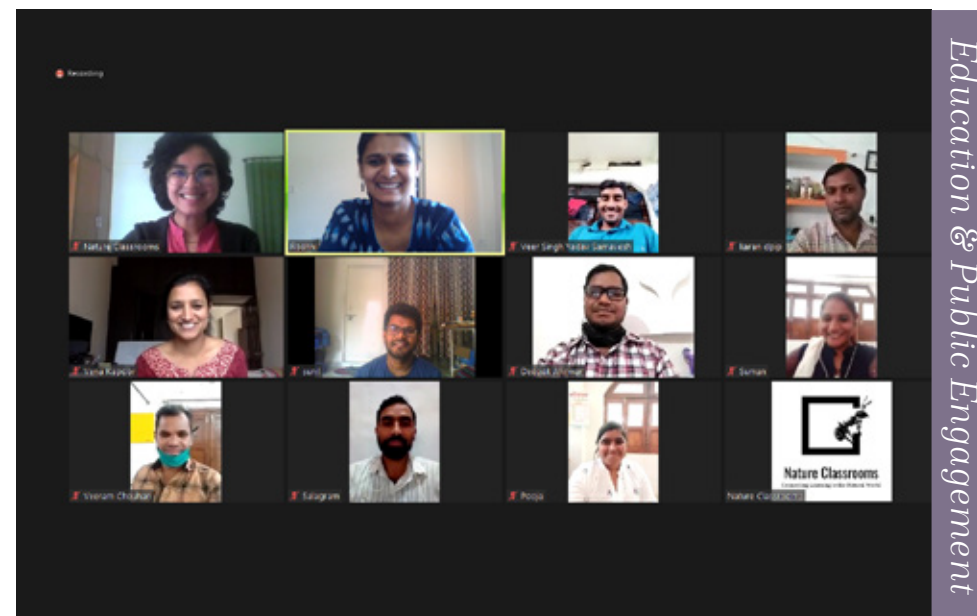
The Bird LTEO team in collaboration with CEDAR and Bird Count India, organised a symposium on bird monitoring in India in March 2021. The idea stemmed from a meeting of a group of people involved in bird monitoring activities across the country. Since examples of such efforts are few and far in between, the group sent out a questionnaire survey and solicited responses about bird monitoring programmes in India. The survey brought out examples of long-term efforts that have been able to sustain over long durations but also pointed out that several efforts fizzle out for various reasons including lack of resources, permits, students moving on to other projects, declining motivation and so on. To build a sense of community and support for interested people, the team organised a symposium on Bird Monitoring in India.

The symposium was conducted as a virtual event using Slack and Zoom. All live sessions were live-streamed on youtube. There were 19 talks and 16 posters presented at the symposium. On the last day of the symposium, participants engaged in a discussion about “Future of bird monitoring in India: Challenges and Opportunities”. This was an open discussion and led to a brainstorming about future directions for the group, current challenges and how they can be addressed. The symposium report and recorded talks are available for viewing on the website: www.birdmonitoring.in

Nature Classrooms

The Nature Classrooms project nested within the Education and Public Engagement Programme is supported by Wipro Foundation. Nature Classrooms works with schools and educators to connect learning to the natural world. We develop culturally relevant and robust nature learning resources that supplement and enrich primary school environmental studies curriculum, as well as engage in capacity building for teachers and educators across India.

The team creates nature learning resources that are cost-effective and replicable for various teaching-learning contexts (like flashcards, visual aids, worksheets, puzzles, outdoor games that explain ecological concepts and phenomena). These resources are designed to be age-appropriate, locally and culturally relevant and encourage children to engage with nature through hands-on and inquiry-based learning. The team also conducts workshops for school teachers and nature educators that allows them to design lessons that encourage their students to develop empathy, experience wonder and build a connection with their immediate natural environment.



Selected collaborations

Birds of the World (BoW) is an online resource with comprehensive life history information on 10,721 species of the world's birds. Bird Count India partnered with The Cornell Lab of Ornithology to provide free access to Birds of the World for anyone within India. In return, Bird Count India is working with c.35 ornithologists and bird experts to generate detailed accounts on Indian species for BoW. So far, over 30 such species accounts have been completely revised by our team and published on BoW.

Fig Tree Learning Centre (FTLC, Silvepura Village): We collaborate with the Fig Tree Learning Centre to develop nature-based activities and experiences for students in government schools in the outskirts of Bengaluru city. In 2020–21, the two teams were joint recipients of a small grant from the Bengaluru Sustainability Forum allowing us to develop resources that highlight the biodiversity in a rapidly changing peri-urban area.

Parikrma Humanity Foundation Schools: We collaborated with the Parikrma schools to provide consistent engagement for primary school EVS teachers through workshops, lesson planning support and resource creation.

Samavesh: Our collaboration with Samavesh, Madhya Pradesh involved a two-part workshop that introduced local educators to nature learning

pedagogy and practice. They also reviewed existing EVS lessons and supplemented them by adding local natural history stories.

Punarchith: We worked with facilitators of the Aniketana programme at Punarchith, Chamrajnagar district, Karnataka. Post the nature learning workshop, the facilitators designed and conducted sessions for the student group supplemented by collaboratively developed resources.

Wipro Sustainability Educators Network: An intensive three-part nature learning workshop was conducted for Wipro Sustainability educators from various parts of the country. These sessions allowed the participants to examine their existing approach and understanding towards nature education as well as design and contextualise activities and resources for their unique learning contexts and geographies.

NCBS: Our staff have been helping supervise and mentor young wildlife scientists in their research. Ashwin Viswanathan has been supervising Mohammad Maaz and he plans to study how tree cavities are used by birds in a dry deciduous forest in Gujarat and hopes to build a “cavity web”. Mohammad Maaz is carrying out his dissertation fieldwork as part of his MSc course in Wildlife Biology and Conservation at NCBS.

Field tales



by Roshni Ravi

Fieldwork in a pandemic

A Black Kite's piercing call beckons students and their teacher outside the four walls of the classroom. They look up from the balcony to spot a kite high up in a tree just across the compound wall. Some children put their arms out, extending them sideways and go around in circles, as if gliding, while emitting a shrill *keee-kkeee-kkee*. The teacher smiles as she sees little kites circle around her.

A love for feathered friends is born.

Nature Classrooms is a project nested within the Education and Public Engagement Programme that works with school teachers and nature educators to make nature learning an important part of a child's every day school experience.

Helping teachers reconnect with the natural world and the wonders it holds often spurs them to work to bring nature into their classrooms for their students. We facilitate this through immersive nature experiences for primary school environmental studies teachers. So, the "field" for us is really the classroom and the school campus, even the balcony from which the children watched the kite.

However, since the start of the pandemic this "field" has taken on a very different form. Teachers and students stayed home as primary schools remained closed. As a

team, we wondered how to support teachers and schools that were already stretched for time and resources with online classes and in some cases covid related duties.

With teachers at the Fig Tree Learning Centre in Silvepura, we put together physical learning kits. These were distributed along with ration kits at one of the government schools. The kits had writing and colouring materials, puzzles, poems and nature stories that the children could take home. We also included activity sheets that encouraged children to notice nature beings in and around their homes.

Like many others, another way in which our "field" grew and expanded during this time was through online meetings and workshops. Though nowhere as exciting as in-person nature immersion programmes, these workshops allowed us to connect with new individuals and organisations across different geographies. We were able to design learning for 'nature teachers' in a way that helped them continue this work, interact with peers and trial new ideas in real time.

Our hope is that we can continue to collectively build and access nurturing learning spaces for teachers and their students whatever form our "field" may take in times to come.

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Suhel Quader

Programme team

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Collaborators/partners

Fig Tree Learning Centre, Foundation for Ecological Security, Keystone Foundation, Mathrubhumi SEED, National Centre for Biological Sciences, Parikrma Humanity Foundation Schools, Punarchith, Sálím Ali Centre for Ornithology and Natural History, Samavesh, Wipro Earthian/Sustainability Educators Network, Google Arts and Culture, Quora, Storyweaver.org (Pratham Books)

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Team & Support

Western Ghats



In the Western Ghats, our work encompasses wildlife and plant research, ecological restoration, conservation with communities, and outreach and education. In the Anamalai Hills, Tamil Nadu, we carry out ecological restoration of degraded rainforest remnants in a fragmented rainforest landscape dominated by plantations. Here, and in the Hassan-Alur landscape in Karnataka, we also work to foster human-elephant coexistence through collaborative efforts including the innovative use of technology for early warning systems. In the Anamalais and in our recently established field station at Kadamane, Karnataka, we carry out research examining long-term trends and dynamics of tropical forest ecosystems and address key issues of how forests change due to fragmentation, degradation and extractive use. In other parts of Karnataka, we also study the ecology and distribution of mammals, and work to consolidate protected areas and minimise human impacts. Our work is helping the conservation of both existing wildlife reserves and their surrounding landscapes.

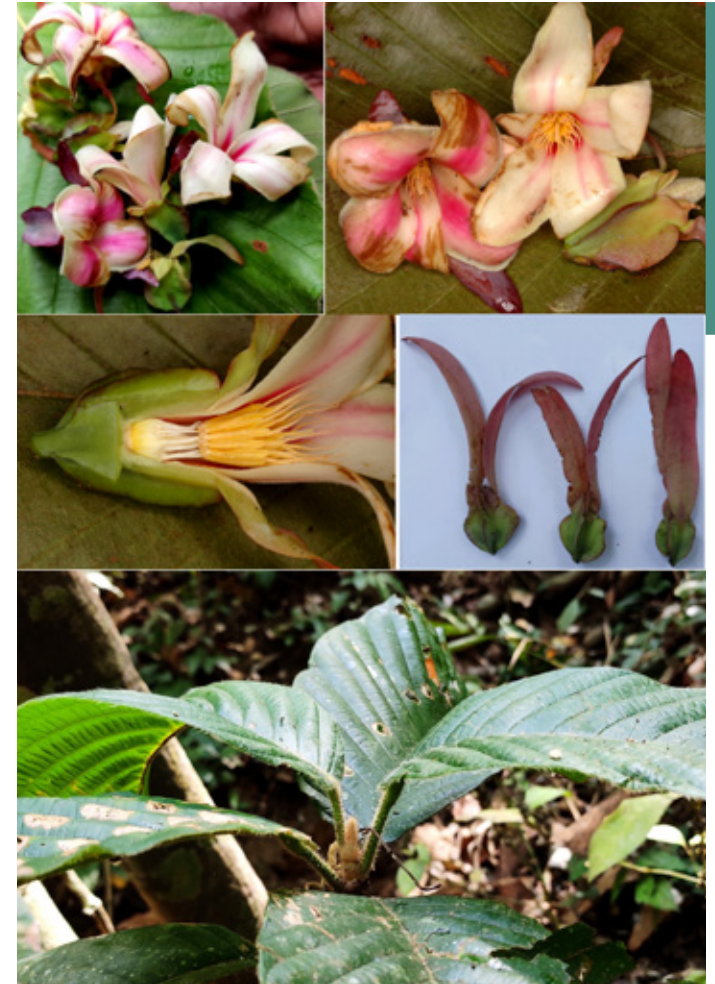


Restoring degraded rainforests

In our 21st year of rainforest restoration in the Anamalais, we continued our partnership with plantation companies such as Parry Agro Industries Limited, Tata Coffee Limited, and our partnership with the AMM Murugappa Chettiar Research Centre, Chennai, to take ahead our research and restoration efforts. This year, we planted 9936 saplings of 124 species across 13 sites in the Valparai Plateau. Further, 2100 plants of 26 species were provided to local plantations to enhance shade in coffee estates and increase tree cover within their properties. Maintenance and expansion of our native rainforest plant species nursery continued with some effort to raise endangered tree species saplings. We also conducted the field work for a research project examining differences between sites under ecological restoration, degraded forest canopies, and monoculture plantations, in patterns of native species regeneration. This research indicates that ecological restoration sites had higher native tree seedling densities and recovered plant communities towards benchmark levels compared to degraded sites, while in monocultures the community shifted in the opposite direction.

Survey of threatened tree species

In order to increase our ecological understanding and assess the conservation status of threatened rainforest trees in the rainforests of the Anamalai Hills, we launched a new project supported by Fondation Franklinia. The project focuses on 10 select tree species listed as threatened under the IUCN Red List of Threatened Taxa (IUCN 2019): 3 Critically Endangered (CR), 4 Endangered (EN), and 4 Vulnerable (VU) tree species, in the Anamalai Tiger Reserve (ATR) and Valparai Plateau. Field surveys were carried out on foot in 26 places, including 16 rainforest fragments on the Valparai Plateau and 10 rainforest tracts in the ATR. We recorded 979 trees of the 11 threatened tree species and laid 448 tree-centred plots for habitat measurements. Some key findings were that the Manamboli area in ATR had all the focal threatened tree species and emerged as most significant for in situ conservation. We discovered populations of *Phyllanthus anamalayana* (CR, earlier known from a single global location) and *Palaquium ravii* (EN) in new locations. We also found a population of the *Dipterocarpus bourdillonii* (CR) in ATR, being the first record for the Anamalai Hills and an addition to the Flora of Tamil Nadu.





Long-term forest monitoring

Long-term research underpins much of our work in the rainforests of the Anamalai Hills. The following projects focussed on tropical forest phenology and dynamics, and bird communities are underway in the landscape of the Anamalai Tiger Reserve (ATR) and the Valparai Plateau.

Tree phenology

Our monitoring of rainforest tree phenology completed its fourth year. Till the end of 2020, we continued to monitor over 1500 trees of 170 rainforest tree species monthly along seven trails in Anamalai Tiger Reserve and Valparai. From 2021 January onwards, we rationalised the survey and presently monitor 1089 trees of 59 species with at least 10 individuals, and also the 10 globally threatened tree species. We have also increased the frequency of phenology surveys to twice a month. Preliminary analyses of the phenological patterns between March 2017 and December 2020, shows that community-wide tree phenology patterns are associated with the local seasonal climatic patterns. At the community levels, leaf flushing and flowering peaked during the dry hot season of March, and fruiting peaked during the monsoon months of June–August. Further analysis is ongoing.

Forest dynamics

In our two long-term ecological monitoring (LEMon) 1 ha plots, established in collaboration with the National Centre for Biological Sciences, we have completed three full annual censuses and ten quarterly dendroband (tree growth) surveys to inventory, identify, and map stems and study growth rates and monitor carbon. The number of trees increased from 1722 to 1861 stems (63 to 67 species) in the degraded Candura site, and from 1252 to 1315 stems (85 to 86 species) in the relatively undisturbed Manamboli site. We also estimated the undisturbed old-growth rainforest to have around 201 t/ha of carbon versus only 76 t/ha in the secondary rainforest site. Overall, this research is yielding interesting and new data on tropical rainforest dynamics in terms of tree growth, recruitment of saplings, tree mortality, and carbon dynamics.

Bird monitoring

Recovery of bird communities through restoration

This year, we completed field work for a research project that tries to understand the recovery of bird communities through ecological restoration. Besides habitat measurements, we examined whether bird species richness and community composition recovery in 23 actively restored (AR) sites were significantly better than recovery in paired naturally regenerating (NR) sites, relative to 23 undisturbed benchmark (BM) rainforests. The study tracks how rainforest and open-country bird communities change across AR, NR, and BM sites. We recorded 92 bird species in 460 point-count surveys. Our initial analysis indicates that active restoration of degraded fragments performs better than natural regeneration in improving rainforest birds towards benchmark forest levels, and reduces the infiltration of open-country birds. Adding to our previous work showing that active restoration significantly improves forest structure and tree diversity, this work suggests that active restoration leads to the recovery of bird communities in degraded rainforest fragments.

Hornbills in the Anamalais

We carried out density estimation of two hornbill species of high conservation concern—the vulnerable Great Hornbill (GH, *Buceros bicornis*) and the endemic Malabar Grey Hornbill (MGH, *Ocyrceros griseus*) in the Anamalais. We monitored nests and fig fruit availability, and tracked breeding incidences in plantations and Protected Areas (PA). We found that both hornbill species used plantations and the PA year-round but distance sampling density estimates were higher in the PA in both nesting (GH by 57%; MGH by 50%) and non-nesting (GH by 53%; MGH by 144%) seasons. We also found that relative to estimates from 2004 to 2005, mean GH density appeared stable or increasing, whereas MGH had declined by 39% in the PA, and by 56% in plantations. Based





on this and other results, including the *State of India's Birds 2020* report, we contributed towards IUCN Redlist conservation assessment of Malabar Grey Hornbill resulting in the uplisting of the species as Vulnerable. The results of this study was published in the journal *Ibis* and in the online Birds of the World portal of the Cornell Lab of Ornithology.

Long-term bird monitoring

We continued our long-term bird monitoring efforts through annual road surveys, intensive monitoring of a 100 hectare rainforest remnant, and analysis of long-term data from rainforest fragments in the landscape. We almost completed in full the sixth year of road survey for birds in March 2020 (one of the six routes could not be surveyed due to the COVID-19 pandemic lockdown). The 700 point count surveys carried out so far have documented about 180 bird species and their patterns of distribution and abundance. This intensive bird survey of a 104 ha rainforest remnant has been carried out with point counts at 104 grid centroids in April and December each year till 2019 (four full surveys). This is helping documenting seasonal patterns in bird density, fine-scale distribution related to habitat structure, and inter-annual variation. Analysis from our study of birds in 18 rainforest fragments, including 14 surveyed between 2000 and 2005, is documenting longer-term changes in relation to forest fragmentation. We find species richness of all birds and three habitat guilds (rainforest, restricted-range, and open-country birds), declined over time. Density of rainforest birds declined strongly over time, while open-country and range-restricted birds did not reveal any statistically discernible trend. Further work is in progress.

Conservation education in Valparai

The Anamalai Nature Information Centre (ANIC) continues to receive visitors throughout the year apart from the months during the pandemic-related lockdowns. Our regular interactions with students from local schools came to a halt in 2020 due to the pandemic. We hope that the pandemic situation subsides and we can resume our interactions with the local schools at Valparai soon. Our conservation education work took a virtual path because of the pandemic. We initiated the first Online Nature Guide Training and Mentorship Course this year. The course is aimed at local people based in the Western Ghats who intend to pursue Nature Guiding as a profession. This course was conceptualised, developed and conducted in collaboration with Harsha Jayaramaiah and Payal Mehta, professional tour leaders and nature guides. This basic-level course attempted to reach out to rural youth offering a skill development opportunity to encourage a nature-based career in natural landscapes where tourism is fast becoming an industry. We hope the course will create a group of well-informed and sensitive nature guides capable of conducting ethical nature tourism. The first round of the course was conducted from 7 February to 10 March 2021 for 12 participants from rural backgrounds from Karnataka, Tamil Nadu and Maharashtra.





Tropical Ecology and Restoration Field Centre

We established a new research, restoration, and training centre at Kadamane in the Western Ghats of Karnataka in partnership with the Kadamane Estates Company. The Tropical Ecology and Restoration Field Centre (TERFC) hosts a number of in-house and collaborative research projects investigating both opportunities and challenges for conserving biodiversity and sustaining human well-being (through ecosystem services such as carbon sequestration) in human-dominated landscapes under a changing climate. The Centre also offers training in natural history, ecological research and monitoring, and conservation, through student projects and workshops and training programmes for researchers and practitioners.

A number of pilot research projects have been initiated to document plants, mammals, birds, amphibians, and invertebrates across different habitats and seasons at the Centre. Another study underway since December 2020 has focused on examining carbon storage in vegetation, woody litter, and soil, in relation to fuelwood extraction pressure. Preliminary results of this study show that forests subject to fuelwood extraction have 17% and 50% smaller carbon pools in vegetation and woody litter, respectively, compared to undisturbed forests. Once completed, insights from this study will guide future work on understanding and addressing fuelwood needs and impacts on the rainforest ecosystem.

In December 2020, we also began establishing a 1 ha permanent plot in Kadamane in collaboration with the Long-term Ecosystem Monitoring Network—India (LEMoN; lemonindia.weebly.com). Once fully established, our team will continuously monitor tree populations, growth rates, carbon capture rates, litterfall dynamics and respiration rates from vegetation and soil within the plot.

COVID relief in the Anamalais

The COVID-19 pandemic had brought serious challenges to the lives and livelihood of people in the Valparai region. We were part of COVID-19 relief assistance activities in collaboration with government agencies and stakeholders in Valparai. The activities mainly included, supply of groceries for migrant workers in tea and coffee estates and BPL families in Valparai. Along with the Tamil Nadu Forest Department, we have supplied provisions such as rice, vegetables, eggs, and tea to tribal communities and families of anti-poaching watchers of the state Forest Department in the Anamalai Tiger Reserve. A COVID-19-PHC Action Group document on COVID-19 Preparedness Checklist For Rural Primary Health Care and Community Settings was shared with tea plantation companies and local health authorities in Valparai.





Other student projects

This year at the Anamalai field station, we facilitated four external students—Abhishek Gopal and Aparna Krishnan from National Centre for Biological Sciences, Vijay Ramesh from Columbia University, and Ashni Dhawale from National Institute of Advanced Studies, by providing logistical and field support, for their Master's and PhD research. Their work examined the alteration of seed dispersal and predation due to forest fragmentation, the recovery of birds after ecological restoration through audio monitoring, and behavioural adaptations of lion-tailed macaques in human modified habitats.

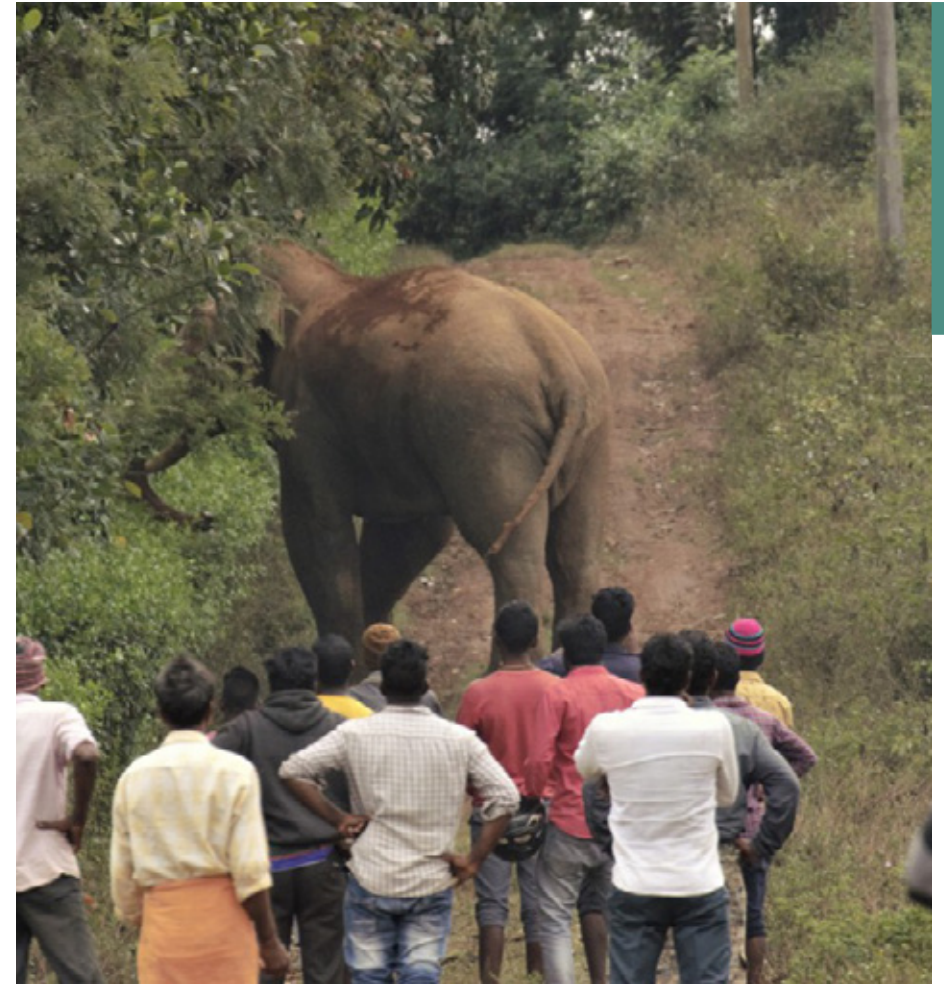


Human-elephant coexistence in Anamalais and Hassan

We continued with tracking elephants and monitoring conflicts amid the COVID-19 pandemic restrictions for most of the months in Valparai and Hassan. During the initial months of the national lockdown, some of the project activities were stopped, however, we sought permission to resume daily monitoring of elephants during later months. Recording locations, number of elephants, type of habitat, and mapping of elephant movements and land-use changes were carried out.

On the Valparai plateau, elephant movement activity was seen throughout the year with variable time spent within plantations. We have recorded around 120 elephants, which include five herds ranging between nine and 23 individuals per herd. There were eleven males which spent considerable time within tea and coffee plantations on the Valparai plateau. During 2020–21, elephants spent about 3928 herd-days. The number of days spent by elephants increased between October and March (71%, 2808 herd-days) as compared to the period between April–September (1120 herd-days), denoting peak elephant activity on the plateau.

Our elephant tracking efforts increased from 220 villages in 2019–2020 to 250 villages during 2020–21 as elephants expanded their range into new areas in the Belur range which adjoins Sakleshpur forest range in Hassan. This expansion is primarily due to the newly erected solar power fences around coffee estates in the Sakleshpur range. Coffee plantations provide shade, grass, and water availability in ponds, and have been frequently used by elephants. Monoculture plantations such as Acacia and Eucalyptus, and forest fragments constituting a mere 8% of the landscapes played a critical role as sheltering and feeding habitats and are the only refuge for elephants in these landscapes.





The early warning systems (SMS, voice call alerts, alert beacons, and information boards) continue to help people to avoid fatal encounters with elephants in Valparai and Hassan regions. These measures have been implemented in coordination with efforts by the state Forest Department and local communities in both project sites. Around 4800 families have subscribed to early alerts to receive elephant locations over phones. These numbers drastically increased from 2600 in 2019–2020 to 4800 families during 2020–21. In Valparai, an average of 1800 text and 1200 call alerts per day indicating elephant presence information were sent to mobile phones; while in Hassan, we sent an average of 2130 text and 680 call alerts. In Valparai, the local community is involved in 83% (889 or 1088 operations) of mobile-operated alert beacons located in 35 critical areas indicating sustained participation by local people in the management of human-elephant conflict. In Hassan, In addition to the existing 12 alert beacons, we have installed two more lights in critical zones along the roads for people to notice elephant presence. Over 95% of alert light operations were carried out by the local community in the Hassan region. Early warning systems have been benefiting around 55,000 estate workers and around 65,000 people living 160 villages in Valparai and Hassan respectively. In addition to the nine existing information boards, three

additional boards covering 35 critical villages were installed to display elephant information in Hassan. During the past one year, we have received 468 phone calls in Valparai, and 5325 calls from people in the Hassan region in response to SMS and voice alerts, indicating benefits of elephant alert facilities to local communities in both regions. Due to the COVID-19 pandemic, our interactions with local communities were restricted to a few essential outreach activities following strict COVID protocols.

In Valparai, two persons lost their lives due to elephants during the year. The average number of human fatal incidents continued to remain at an average of one person per year between 2003–2020. In Hassan, six people have lost their lives due to elephants between April 2020–March 2021. Four of these incidents occurred in newly expanded areas where elephants recently entered.

We have communicated project outcomes with various educational and governmental institutions over virtual meetings. We have contributed information about early warning systems to Newsletter “‘Trumpet’ by Project Elephant division of MoEFF & CC, Government of India.





Fuelling change

We expanded our efforts in the Cauvery and Malai Mahadeshwara Wildlife Sanctuary landscape to provide alternatives to families who were dependent on forests for firewood.

To date, we have carried out socio-economic surveys of 5,428 people and found 97% were dependent on firewood. Our surveys also showed that they commonly harvested 19 species of trees of which 16 also happen to be crucial food sources for herbivores such as elephant, gaur, sambar, chital and others. Over the last year, we distributed LPG connections to 436 families, bringing the total number of families supported to over 2,050, positively impacting the lives of nearly 7,300 people directly. The overall firewood consumption by the beneficiary families has reduced by around 46.5% compared to their usage before providing the LPG cookstoves. This has also reduced the carbon emissions caused by firewood burning.

This initiative is crucial to saving tree species which act as important food and nesting resources for wildlife in the region, and also helps reduce degradation of critical wildlife habitat. Switching to LPG cookstoves has also helped stabilise the health of many women as firewood smoke directly impacts lung function and can lead to chronic problems such as asthma, lung cancer, and other diseases. Additionally, women spend ~ 800 hours (100 working days) annually collecting firewood. After switching to LPG, they utilise this time to supplement their income by taking up daily wage work or carrying out other productive activities.

Alternative livelihoods

Communities living in villages on forest fringes in the Cauvery and MM Hills landscape are heavily dependent on the forests for resources for everyday use and livelihood, the most prominent of which are non-timber forest produce (NTFP) like grasses, firewood and fruits. Kokkabare in the MM Hills Wildlife Sanctuary is one such remotely located village, with about 70 households. We conducted interviews in these 70 households and found that the community members, particularly women, spend close to 36 hours every week in the surrounding forests collecting dwarf date palm fronds (*Phoenix humilis*) to make brooms. This is a meagre and seasonal source of income, putting the women at an increased risk of wildlife interactions, while also affecting resources for wildlife like elephants, sloth bears, gaur, sambar and others.

Since the project's inception, we have trained 26 women in skills like hand-stitching, tailoring, hand-embroidery, and screen printing through a consultant, who has conducted 79 days of training of which 52 were conducted in the last year alone. The women have stitched and sold several hundred masks during the pandemic, and have been fulfilling some external orders for bags and backpacks as well. This activity has generated over INR 3.75 lakh for the trainees.

In the course of the coming months, we aim to replicate this model in other villages and rope in more consultants with expertise in diverse forms of handicrafts to help these women expand their skill set and establish a sustainable business model.





Human-wildlife conflict mitigation

Communities living on the fringes of forests often face increased frequencies of human-wildlife conflict, with some incidents resulting in damage to property, injuries or even casualties on both sides.

Many families live close to the periphery of Protected Areas in isolated houses that have no electricity connection. Wild animals, especially elephants, often pass through these areas at night, and in the process may end up damaging property or crops in the dark.

Families experiencing this live in constant anxiety, affecting their lives and also breeding negative perceptions of wildlife that can lead to stronger retaliations. To mitigate this, we have been providing solar-powered lights to these remotely located households, to ensure their homes and sheds are lit at night. The lights deter approaching wild animals, and illuminate the area around the house, giving people peace of mind and alleviating their stress and fear of unseen animal interactions in the dark.

In the last one year, we expanded the installation of solar lights to 16 more homes, now bringing the total to 50 families who have benefited from this initiative so far, further improving perceptions towards wildlife.

Support to the Karnataka Forest Department

The Forest Department is the foremost agency in charge of managing and protecting forests and wildlife throughout India. Given our extensive work within and around the Cauvery and MM Hills Wildlife Sanctuaries, we have developed a close association with the Karnataka Forest Department, with support being extended both ways.

To date, we have also provided solar powered water pumps to 13 anti-poaching camps (APCs) in the Cauvery and MM Hills Wildlife Sanctuaries, of which six were installed in the past year. Most APCs are remotely located in the forest with no provision for running water or electricity. These pumps help the watchers save the time and effort required to fetch water from nearby sources, enabling them to do their work more efficiently.

We also distributed nearly 650 field kits to forest watchers, guards and staff consisting of sturdy backpacks, caps, and water bottles to aid them in carrying out their work.





Holématthi Nature Information Centre

Stressing on the importance of conservation and wildlife awareness, the Holématthi Nature Information Center was established in 2018 in a village close to the Cauvery and MM Hills Wildlife Sanctuaries as part of our outreach initiative.

Holématthi is equipped with interactive illustrations, infographics, and vibrant and realistic artwork to help impart conservation awareness among the communities in a visually engaging way. We rely on the use of learning games, video shows, activities, workshops, and storytelling to explain facts and concepts, share information, and spark interest in the students' minds. To date, Holématthi has attracted 8,754 visitors of which 6,700 were students from over 40 schools. Unfortunately, with the onset of the pandemic, this number was severely impacted with schools across the country moving to an online form of learning and an overall curb on physical meetings.

We also adapted to this situation and conducted online talks on wildlife awareness, intriguing species and more, for students. We conducted around 12 online sessions on various events in the past year, engaging nearly 500 students, teachers, wildlife enthusiasts, and the wider public.

With the easing of COVID-19 restrictions, Holématthi has now started welcoming visitors again, and we are planning sessions for students and others keeping all precautions in mind.

Insights from long-term leopard monitoring in Protected Areas

The Western Ghats Programme has been conducting long-term monitoring in the MM Hills and Cauvery Wildlife Sanctuary (Cauvery WS) since 2014. This is crucial to being able to monitor the abundance and density for leopards and tigers as well as the Relative Abundance Index (RAI) and distribution of prey species over a longer period, to monitor temporal and spatial changes with the intention of species conservation.

The long-term monitoring data shows higher abundance estimates of leopards in MM Hills and Cauvery Wildlife Sanctuaries compared to many other Protected Areas (PAs) across India. It also shows an overall upward trend since 2014, with both MM Hills and Cauvery Sanctuary sharing similar leopard densities of 6.56 (SE \pm 1.08) and 6.85 (SE \pm 0.81) leopards/100 sq. km. respectively.

These efforts also give us an insight into large carnivore ecology, for example, the number of female leopards is higher compared to the males in the study areas, suggesting that the MM Hills and Cauvery Wildlife Sanctuaries landscape is conducive to their habitation and breeding; however, their detection rate is lower, possibly as mothers would want to steer away from common trails to protect their cubs.

One of the most significant distribution updates through our camera trapping effort would be that of the Indian grey wolf (*Canis lupus pallipes*), documented in the Cauvery Wildlife Sanctuary in April 2020, now known to be the southernmost distribution extension of the canid. There has been no recorded sighting of the animal in the region before or since. The Indian grey wolf is at risk due to habitat loss, depletion of natural prey, and retaliatory killing, among other reasons.





In surveys across MM Hills and Cauvery Wildlife Sanctuaries, we have observed 29 common mammalian species. In spite of sharing commonalities in terms of area and vegetation, there are a few more species found only in either one or the other sanctuary. The blackbuck and grizzled giant squirrel for example, were found only in Cauvery Wildlife Sanctuary in our camera traps, while the stripe-necked mongoose was spotted in MM Hills, but not in the adjacent Cauvery Wildlife Sanctuary.

As part of our long-term monitoring efforts, we continued our camera trapping work in Biligiri Rangaswamy Temple Tiger Reserve (BRT) and Bannerghatta National Park (Bannerghatta NP). During this period, we observed two leopards that are common between Cauvery Wildlife Sanctuary and Bannerghatta NP. Interestingly, one individual was spotted in Cauvery Wildlife Sanctuary, MM Hills, BRT as well as the Doddasampige-Edyarahalli forest corridor. This brings to light the necessity of contiguous forest patches and safeguarding wildlife corridors for ease of movement of wildlife.

Monitoring leopards in the Deccan Plateau

The 'Deccan' Plateau, derived from the Prakrit word 'dakkhin' or 'dakkhana' is a massive peninsular region to the south of India. Comprising rocky outcrops, dry-deciduous forests and savanna woodlands, it is an important ecoregion, and a key conservation site due to the occurrence of several wildlife species and their closeness to high human density areas.

Since 2013, we have monitored leopard populations across different parts of the Deccan Plateau in Karnataka. To date we have studied leopard populations in 20 sites in the Deccan Plateau and identified 176 individuals. Of these, Jayamangali Blackbuck Reserve, Chamundi Hill Reserve Forest, Devarayanadurga Reserve Forest and Madhugiri Reserve Forest are areas where we have conducted leopard population surveys multiple times. This year we added a new area to our study areas. Marikanive State Forest, spanning across an area of 112.46 sq. km. was the latest site where we computed baseline abundance and density estimates. Our study shows that Marikanive, a dry deciduous, woodland savanna habitat in central Karnataka, hosts an abundance estimate of 7 leopards with a mean density estimate of 3.9 leopards/100 sq. km.

Overall since 2014, we have identified approximately 613 individual leopards across 25 sites.



Restoration and Human—Elephant Coexistence project team

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Labs, PhD & Conservation Leadership



Three new initiatives at NCF have taken root as new labs. The first, led by Dr Rohit Naniwadekar explores the relationships between fruiting plants and the animals that feed on them, with a study carried out in the tropical forests of Andaman and Nicobar Islands and other parts of India. The second, led by Dr P. Jeganathan in NCF, focusses on endangered species such as the Jerdon's Courser and the Black-bellied Tern in southern India. And the third, led by Dr Yash Veer Bhatnagar, aims to conduct, facilitate and catalyse long-term research and interventions that promote just and fair forms of conservation in the Himalaya.

We also have an academic programme at NCF which comprises the doctoral programme, annual courses in conservation leadership and targeted capacity building initiatives. Our doctoral programme fosters the highest standards of academic and applied research in conservation science. Our leadership modules and training strengthen the conceptual and practical skills of conservationists.



The Himalaya Lab

The lab aims to conduct, facilitate, and catalyse long-term research and interventions that promote fair and effective forms of conservation across the Himalayas. We strive to create a dynamic balance between the well-being of the natural landscape, and the economic and cultural needs and aspirations of the communities through dedicated partnerships with relevant stakeholders including communities, policy makers, government departments, scientific institutions, and the larger citizenry.

State of human-wildlife conflicts in the Lahaul landscape in Himachal Pradesh

Most of the 200 odd villages in Lahaul largely depend on cultivation as their primary livelihood. With an increase in high-value cash crops such as green peas, apple, iceberg lettuce and cauliflower, any damage from wildlife is a big cost to the local farmers. The project was designed to generate baselines to understand the patterns, processes, and socio-ecological drivers of human-wildlife interactions along a multitude of axes in Lahaul so that suitable solutions can be formulated to enable effective action on the ground. Focus Group Discussion and household-level interviews will be administered in approximately 50% of villages to collect baseline data on the magnitude and spatio-temporality of wildlife-induced losses, socio-economic indicators, historical transformations in agropastoral livelihoods, natural resource dependence, existing mitigation strategies, and institutional off-setting mechanisms available to the communities. Further, records from relevant government departments will also be accessed to understand the present patterns and trends in demography, incomes, agriculture, and animal husbandry practices. Information generated from this project will be implemented through ongoing programmes of the HPFD and UNDP in the landscape.

Assessing perception of the local community towards leopards

This project was designed to understand how remote communities are coexisting with the leopards and other wildlife. Once we understand the community through extensively designed open-ended interviews and the nature of coexistence through careful analysis of collected data (both qualitative and quantitative), various measures and mitigation controls will be devised and implemented to finally establish a community-based conservation model. We will also deduce various factors which influence the perception of the community, both individually and collectively and the impact of this coexistence in their lives. We have tested the questionnaires for the village level focal group discussions and household interviews, which will be completed during the remaining period of 2021.

Assisting with the implementation of the Project Snow Leopard and the Snow Leopard Population Assessment in India (SPAI)

The Project Snow Leopard (PSL), is a consultative national strategy for the conservation of large high altitude landscapes using knowledge and effective participation by local communities and other stakeholders. Yash Veer Bhatnagar had assisted the Himachal Pradesh Forest Department to develop and implement their first landscape level plan in 2011, and as a member of the PSL National Steering Committee and the Spiti Snow Leopard Conservation Society, he continues to assist the central and state governments to implement the PSL and management plans. He is assisting the Wildlife Institute of India, Dehradun to set up the MoEFCCs 'Snow Leopard Cell' that will help streamline both the PSL and the SPAI efforts in the country. Yash Veer is assisting the new Union Territory of Jammu and Kashmir to implement their SPAI programme in collaboration with the Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu University and the National Centre for Biological Sciences, Bangalore.

Team

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Endangered Birds Lab

Our programme carries out (i) long-term research on certain threatened birds and conservation of their habitat especially from south India, (ii) nature education and citizen science.

Accessing biodiversity data through digitizing the natural history collection records from museums

This project aims to digitize the biodiversity data from museum documents. To know the species distribution spatially and temporally, it is essential to have accurate occurrence or collection information. Faunal distribution information extracted from museum documents would be of great value for researchers and the general public. Digitizing (creating photographic records of) the corresponding specimens mentioned in the documents would be useful for future reference. To make these details available, information gathered will be shared in open access platforms such as Wikipedia, Wikimedia Commons and with Global Biodiversity Information Facility (GBIF). Currently, this work documents the natural history specimen records of the Government Museum, Chennai.

Monitoring the endangered Black-bellied Tern and other riverine bird species in Tamil Nadu, India

Black-bellied Tern (*Sterna acuticauda*) is categorised as Endangered by the IUCN. The habitat it occurs in is also under severe threat due to various anthropogenic disturbances such as construction of dams and sand mining. They are poorly studied birds, and their population status and threat levels are unknown. This proposed project intends to understand their distribution, population status and threats in south India, especially along the Kaveri river in Tamil Nadu. Except for the sight records and one short survey, no quantitative studies has been carried out on the species to know their status anywhere in their range. This study designed to fill these gaps, and the results from this work would enable us to understand their population status, habitat requirement, and threat level.

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Ecology and Evolution Lab

Our work focuses on 1) understanding the impacts of anthropogenic activities on biodiversity and ecosystem processes, 2) conducting ecological and evolutionary studies of hornbills, and 3) highlighting the conservation value of threatened wildlife. We conduct our work in diverse landscapes across India, including the Andaman Islands, Western Ghats, and the Himalayas. We are also involved in understanding hornbill ecology in Thailand and Singapore.

Impacts of land-use change on biodiversity

Human-driven forest loss or habitat modification threatens 85% of species globally. This project builds on our previous research on anthropogenic threats to hornbills and focuses on the understudied system in southern Maharashtra, part of the northern Western Ghats. A large proportion of land in this landscape is privately-owned and is being transformed into rubber, cashew, and mango plantations. There are very few Protected Areas, particularly in the foothills of the Sahyadris and the Konkan region. This project aims to document the diversity of plants, herpetofauna, birds and select diurnal mammals across different land-use to determine the impacts of land-use change on biodiversity by sampling across four districts of southern Maharashtra (Satara, Kolhapur, Ratnagiri and Sindhudurg). This information will serve as an important baseline of our future forest restoration efforts in the landscape. This study is being led in the field by Siddharth Biniwale and Ninad Gosavi.

We are also collaborating with Thailand Hornbill Project to determine the impacts of habitat degradation on fruit-eating birds and fruit availability in the Hala Bala and Budo Sungai Padi area of southern Thailand. This landscape is critical for conserving the Critically Endangered Helmeted Hornbill in Thailand.

Impacts of habitat modification on plant-frugivore interactions in the Andaman Islands

Seed dispersal by animals is a critical ecosystem process responsible for the regeneration of more than 75% of plant species in tropical forests. Because islands have a significantly smaller assemblage of seed dispersers than the mainland, there is a lack of redundancy in the seed dispersal assemblage. Therefore, the loss of fruit-eating animals due to anthropogenic threats like habitat modification can have drastic consequences on plant communities. This project builds on our previous project that demonstrated the critical role of the point endemic Narcondam Hornbill. This study aims to determine the impacts of habitat modification due to logging across different habitats in South Andamans. This study is being led in the field by Arpitha Jayanth. This project is being conducted in collaboration with Dr Navendu Page from the Wildlife Institute of India, and Sartaj Ghuman, a freelance artist.

Drivers of riverine bird diversity in the Eastern Himalaya

The Eastern Himalaya has the highest diversity of riverine birds in the world and yet they are relatively understudied. The free-flowing Eastern Himalayan riverine habitats are expected to modify given the slew of the proposed hydroelectric projects in the region. This project has built on our previous research on the Critically Endangered White-bellied Heron. It documents the species-habitat relationships of riverine bird species and the drivers of species turnover in the Himalaya. This project was led in the field by Rohan Menzies and Megha Rao. Rohan hopes to build on these studies and conduct a study on riverine birds in eastern Arunachal Pradesh for his PhD from NCF. A part of this project was done in collaboration with PhD students from the Wildlife Institute of India.





Spread and impact of alien invasive species on native biota

Alien invasive plant species, like *Lantana camara*, are among the leading threats to biodiversity. They negatively impact plant recruitment, alter forest structure, and hydrological and nutrient cycles. We are involved in two collaborative projects with the Wildlife Institute of India, Dehradun, to determine the biological factors responsible for the spread of *Lantana camara* and its impact on frugivory and seed dispersal of native plants in the deciduous forests of Western Himalaya. This work is being led in the field by Yukti Taneja (a Master's student at Wildlife Institute of India, Dehradun) and Sipu Kumar (a PhD student at the Wildlife Institute of India, Dehradun).

Hornbill population genetics and phylogeography

High genetic diversity is critical for the conservation of threatened birds. This is particularly so for island birds with small geographic ranges and populations. The global distribution of Narcondam Hornbill is restricted to the 7.8 sq. km Narcondam Island. In the past, Narcondam Hornbills faced threats from hunting, and in the early 2000s, the global population of the Narcondam Hornbill was estimated to be only around ~400 birds. Subsequently, hunting pressures have declined, and the recent population estimates of hornbills are around 1000 birds. Using non-invasive methods, we aim to determine the genetic diversity of the Narcondam Hornbill and compare it with other

island and mainland hornbill populations. This project is in collaboration with Dr Jahnavi Joshi and Dr Bharti Dharapuram from the Centre for Cellular and Molecular Biology, Hyderabad, India. We now plan to conduct a comparative phylogeography study of multiple hornbill species in the Indian subcontinent to determine the role of past climate, geographic barriers and contemporary anthropogenic activities in genetic differentiation in hornbills. Pooja Pawar, who has joined as a PhD student, will lead this work.

Narcondam Hornbill outreach efforts

Narcondam Hornbill is a point endemic threatened hornbill found on the tiny Narcondam Island in the Andaman sea. We collaborated with Sartaj Ghuman, a freelance artist, to create posters and other outreach material. We distributed this material to the Special Armed Police unit of the Andaman and Nicobar Police Department and Andaman & Nicobar Forest Department, the main stakeholders for the conservation of the species. The posters outlined the importance of Narcondam Island and the ecology of the Narcondam Hornbill. We also published several articles in national and international newspapers and magazines to spread awareness about our research.

Team

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External Students mentored

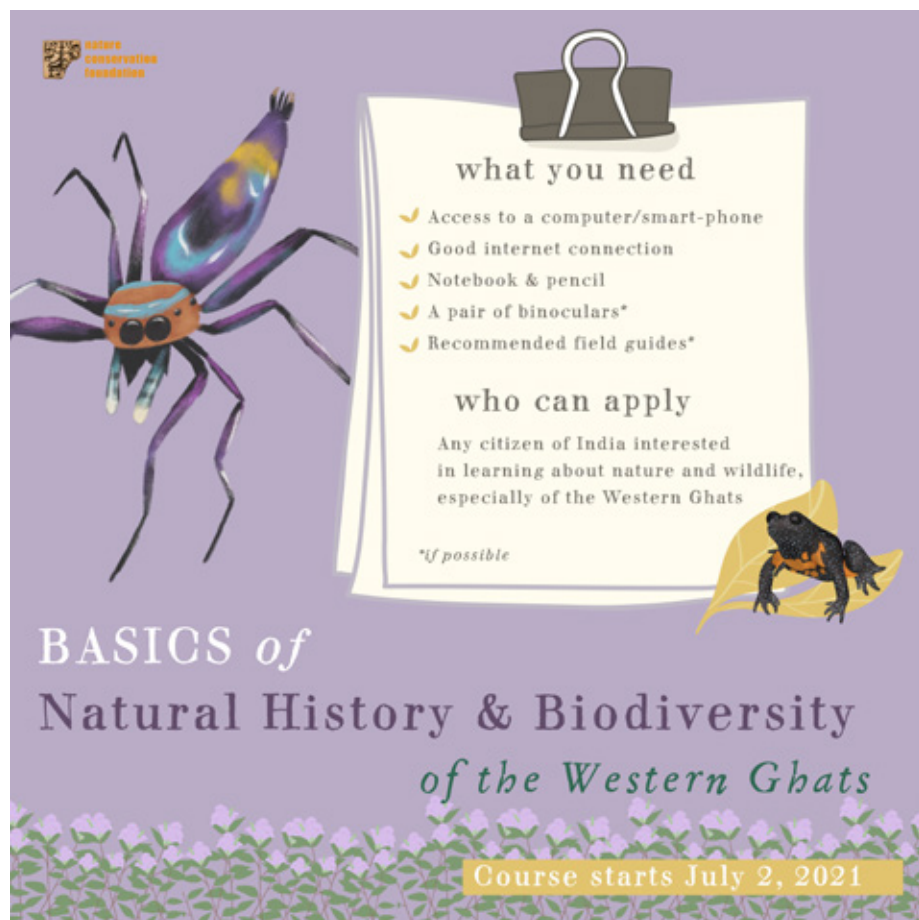
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PhD and Conservation Leadership

The academic programme at NCF comprises the doctoral programme, annual courses in conservation leadership and targeted capacity building initiatives such as the nature training guide training courses. We currently have three registered PhD students and shall be inducting a new batch in the coming year. In the past year, we held seven online courses in Conservation Leadership and four nature guide training courses.

We have been organising a suite of courses under the Conservation Leadership Programme for the last two years, and one way we have been measuring the progress has been from the number of candidates applying and the number of candidates receiving the certificates at the end of the courses. In the year 2019-2020, we received 187 applications of which 58 attended these in-person courses. In 2020-21, we conducted these courses online owing to the pandemic and received 498 applications from not just India, but from countries such as Canada, Germany, Singapore, United States, Peru, Brazil, Nepal, Pakistan, Philippines among others. Among the 124 participants selected for attending the courses, we had representation from 18 Indian states and six additional countries. Of the 124 selected participants, 104 received e-certificates for attending all the sessions of the courses they attended. In the future, we are working on developing a consolidated certificate course in Conservation Leadership, with opportunities for embedded projects within our programmes. We are also working on identifying more meaningful metrics to assess the impact of the capacity-building by tracking the progress of course alumni as they return and resume their conservation work in their parent organisations.

PhD programme

NCF currently has three PhD scholars who registered for their degrees at Manipal University in 2019 and are currently working on writing up their doctoral research. They are striving to submit their thesis in the coming year. For our PhD programme, we measure our progress by tracking the academic progress of students against certain set milestones, which include time of registration and completion of course work after admission, and submission of thesis within the stipulated time frame. Impact of the programme can be measured both in terms of the knowledge production (theses and research papers) and the roles our alumni assume in the field of ecological research and conservation after receiving their degree. These are additional metrics we are considering for evaluating the impact of our doctoral programme.

Nature guide training and natural history courses

Nature Guide Training Course is intended to encourage interested people living close to forested habitats and to pursue Nature Guiding as a profession. We are currently running our 4th batch. We have trained about 45 people (excluding mid-way drop outs) so far. After doing the course, many participants have decided to pursue further studies and there are some who expressed their interest in pursuing a career as Nature Guides and we helped them get jobs. We have had teachers and practising guides in this course as well and they have expressed this course to be useful in improving the quality of their current job.

Team

Mousumi Ghosh (Academic Dean)
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Publications, Talks, Workshops



- » Peer-reviewed publications
- » Books and book chapters
- » Reports
- » General and popular articles
- » Talks, presentations and workshops

Peer-reviewed Publications

- Barve, S., Raman, T.R.S., Datta, A., and Jathar, G. (2020). Guidelines for conducting research on the nesting biology of Indian birds. *Indian Birds* 16(1): 10-11
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Financials



- » Form 10B
- » Balance Sheet
- » Income and expenditure account
- » Receipts and payment account

Form No. 10B



Rau & Nathan
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FORM NO. 10B
 [See Rule 17B]

**Audit Report under section 12A (b) of the Income-tax Act, 1961 in the case of
 charitable or religious trusts or institutions**

We have examined the balance sheet of **Nature Conservation Foundation, AAATN 1542 Q** [name and PAN of the trust or institution] as at 31st March 2021 and the Income & Expenditure account for the year ended on that date which are in agreement with the books of account maintained by the said Trust.

We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of the audit. In our opinion, proper books of account have been kept by the above-named Trust visited by us so far as appears from our examination of the books, and proper Returns adequate for the purposes of audit have been received subject to the comments given below: -
 In our opinion and to the best of our information, and according to information given to us the said accounts give a true and fair view: -

- (i) in the case of the balance sheet, of the state of affairs of the above named Trust as at 31st March 2021 and
- (ii) in the case of Income and expenditure account, of deficit of its accounting year ending on 31st March 2021.

The prescribed particulars are annexed hereto.

For Rau & Nathan
 Chartered Accountants
 Firm Regn.# 003178S

Vaidyanathan
 Narayanamoorthy Vaidyanathan
 Partner,
 Membership #022573
 UDIN : 21022573AAAAIE8005



Place : Mysuru
 Date : 16th December, 2021



Form No. 10B

ANNEXURE STATEMENT OF PARTICULARS	
I. Application of income for charitable or religious purposes.	
1. Amount of income of the previous year applied to charitable or religious purposes in India during that year.	28,00,41,768
2. Whether the Trust has exercised the option under clause (2) of the Explanation to section 11 (1)? If so, the details of the amount of income deemed to have been applied to charitable or religious purposes in India during the previous year	No
3. Amount of income accumulated or set apart for application to charitable or religious purposes, to the extent it does not exceed 15 per cent of the income derived from property held under trust wholly for such purposes.	No 0
4. Amount of income eligible for exemption under section 11(1)(c) [Give details]	No
5. Amount of income, in addition to the amount referred to in item 3 above, accumulated or set apart for specified purposes under section 11(2)	0
6. Whether the amount of income mentioned in item 5 above has been invested or deposited in the manner laid down in section 11(2)(b)? If so, the details thereof.	NA
7. Whether any part of the income in respect of which an option was exercised under clause (2) of the Explanation to section 11(1) in any earlier year is deemed to be income of the previous year under section 11(1B)? If so, the details thereof	No
8. Whether, during the previous year, any part of income accumulated or set apart for specified purposes under section 11(2) in any earlier year: -	
(a) has been applied for purposes other than charitable or religious purposes or has ceased to be accumulated or set apart for application thereto, or	No
(b) has ceased to remain invested in any security referred to in section 11(2)(b)(i) or deposited in any account referred to in section 11(2)(b)(ii) or section 11(2) (b) (iii) or	No



Form No. 10B

(c)	has not been utilized for purposes for which it was accumulated or set apart during the period for which it was to be accumulated or set apart, or in the year immediately following the expiry thereof? If so, the details thereof.	No
-----	--	----

II. Application or use of income or property for the benefit of persons referred to in section 13

[3]

1.	Whether any part of the income or property of the Trust was lent, or continues to be lent in the previous year to any person referred to in section 13(3) [hereinafter referred to in this Annexure as such person]? If so, give details of the amount, rate of interest charged and the nature of security, if any	No
2.	Whether any land, building or other property of the Trust was made, or continued to be made, available for the use of any such person during the previous year? If so, give details of the property and the amount of rent or compensation charged, if any.	No
3.	Whether any payment was made to any such person during the previous year by way of salary, allowance or otherwise? If so, give details.	Yes As per sch. II (3)
4.	Whether the services of the Trust were made available to any such person during the previous year? If so, give details thereof together with remuneration or compensation received, if any.	No
5.	Whether any share, security or other property was purchased by or on behalf of the Trust during the previous year from any such person? If so, give details thereof together with the consideration paid	No
6.	Whether any share, security or other property was sold by or on behalf of the Trust during the previous year to any such person? If so, give details thereof together with the consideration received.	No
7.	Whether any income or property of the Trust was diverted during the previous year in favour of any such person? If so, give details thereof together with the amount of income or value of property so diverted.	No
8.	Whether the income or property of the Trust was used or applied during the previous year for the benefit of any such person in any other manner? If so, give details.	No





Form No. 10B

Sch. II (3) : Payment made to such person by way of salary allowance or otherwise

Details		Amount paid
1	T.R.SHANKAR RAMAN-Senior Scientist & Trustee	20,01,360
2	ROHAN ARTHUR- Senior Scientist & Trustee	20,01,360
3	APARAJITA DATTA -Senior Scientist(Trustee's wife)	20,01,360
4	DIVYA MUDAPPA -Senior Scientist(Trustee's Wife)	20,01,360

III. Investment held at any time during the previous year(s) in concerns in which persons referred to in section 13(3) have a substantial interest.

Sl. No	Name and address of the concern	Where the concern is a company, Number and class of shares held	Nominal value of the investment	Income from the investment	Whether the amount in Col. 4 exceeded 5 per cent of the capital of the concern during the previous year- say, Yes/No
1	2	3	4	5	6
Total					

For Rau & Nathan
Chartered Accountants
Firm Regn.# 003178S

Narayanamoorthy Vaidyanathan
Partner,
Membership #022573
UDIN : 021022573.A.A.A.A.IE8005



Place : Mysuru
Date : 16th December, 2021

Balance Sheet as at 31st March, 2021

NATURE CONSERVATION FOUNDATION		CONSOLIDATED IT			
#1311, "Amritha", 12th Main Vijayanagar 1st Stage Mysuru-576017, India		Figures in INR			
Balance Sheet as at 31st March, 2021		Schedule No	31.03.2021	31.03.2020	31.03.2020
Sources of Funds					
Corpus Fund	23		7,32,58,146	14,54,11,370	5,82,20,125
Current Grants/Current Donations					
Opening Balance					
Add: Grants received	4		19,94,47,072		
Grants Under Foreign Contribution Regulation Act	7		2,32,54,675	4,09,12,668	
Corpus Donation Received	5		96,77,229	37,12,692	
Local Grants Received	6		10,88,44,406	6,05,10,677	
F.C.R.A. Donations	25		5,35,215	31,09,216	
Donation received - U/s 35 (Cumulative)	9		73,90,954	5,11,65,124	
Bank Interest Received	15		7,56,572	5,92,868	
Sub-total	19		34,99,06,122	30,54,14,965	
Less: Grants utilized - Project Expenses	15		9,87,60,405	10,54,96,000	
Less: Grants Returned	19		7,20,552	4,71,813	
Closing Balance			25,04,25,165		19,94,47,072
Field Advance	24		15,97,885		11,06,611
Current Liabilities	13		1,24,948		(1,53,411)
Total			32,54,06,144		25,86,20,398
Application of Funds		Schedule No	31.03.2021	31.03.2020	31.03.2020
Fixed Assets	22		2,36,27,599		2,50,91,343
Other Advances	26		48,54,416		16,42,529
Income and Expenditure Account Deficit Balance B/F				5,30,90,313	
Less: Surplus / Deficit for the year				(30,29,617)	
Balance C/F			6,37,66,076		5,61,19,930
Field Advance	24		4,56,092		6,29,108
Current Assets:					
Fixed Deposits and Investments	20		19,93,11,468	15,36,38,237	
Cash & Cash Equivalents	21		3,29,03,000	2,12,88,853	
Income Tax Refund Receivable	3		1,85,518	2,10,378	
Grant Receivable			3,07,065		17,51,37,488
Total			32,54,06,144		25,86,20,398

As per our attached report under Section 10B of the Income Tax Act, 1961
For **Raj & Nathan**
Chartered Accountants
Firm Registration #0031785

Vaidyanathan
Partner
Membership No. 022573

Place: Mysuru
Date: 16th December, 2021

For Nature Conservation Foundation

T.R. Shankar Raman
Trustee







Income and expenditure account for the year ended 31st March, 2021

NATURE CONSERVATION FOUNDATION #1311, "Amritha", 12th Main Vijayanagar 1st Stage Mysuru-570017, India		CONSOLIDATED IT	
Income and Expenditure Account for the Year Ended 31st March, 2021		Figures in INR	
Income	Schedule No.	31.03.2021	31.03.2020
Interest Received on Savings Bank Account	9	5,74,652	3,97,781
Interest Received on Fixed Deposit	9	1,865	1,295
Interest on Gratuity Fund	9	1,80,055	1,93,792
Sub Total		7,56,572	5,92,868
Less: Transferred to Respective Grants		7,56,572	5,92,868
Interest on Income Tax Refund	9	4,415	1,440
Donation Received	7	88,311	21,56,003
Dividend Received		-	4,96,913
Surplus on sale of Fixed Assets	14	1,336	52,361
Total		94,062	27,06,717
Expenditure			
Administration Expenses	16	27,32,994	11,06,516
Depreciation	22	50,07,214	46,29,818
Surplus/ (Deficit) Carried to Balance Sheet		(76,46,146)	(30,29,617)
Total		94,062	27,06,717

As per our attached report under Section 10B of the Income Tax Act, 1961
For Rau & Nathan
Chartered Accountants
Firm Registration #003178S
Narayanamoorthy Vaidyanathan
Partner
Membership No. 022573
Place : Mysuru
Date : 16th December, 2021

For Nature Conservation Foundation
T.R. Shankar Raman
T R Shankar Raman
Trustee

Receipts and payments account for the year ended 31st March, 2021

NATURE CONSERVATION FOUNDATION		CONSOLIDATED IT	
#1311, "Amritha", 12th Main Vijayanagar 1st Stage Mysuru-570017, India		Figures in INR	
Receipts & Payments Account for the year ended 31st March, 2021		Schedule No.	Amount
Receipts			
Opening Balances:			
Fixed Deposits & Investments	1	15,36,38,257	
Cash & Cash Equivalents	2	2,12,88,853	17,49,27,109
Grants & Donations Received:			
Grants Under Foreign Contribution Regulation Act	4	2,32,54,675	
Local Grants Received	5	10,85,37,341	
F C R A Donations	6	5,35,215	
Corpus Donations	7	96,77,229	
Donation towards Field Assistants' Fund	23	27,360	
General Donations	7	88,311	
Donations Received under Section 35	8	73,90,954	14,95,11,084
Income Tax Refund Received - FY 2018-19	3		63,055
Bank Interest & Interest on Income Tax Refund	9		7,60,987
Surplus on Redemption of Investments	10		1,50,10,660
Field Advance	11		1,55,17,497
Other Advances Recovered	12		28,94,451
Current Liabilities	13		8,51,67,526
Sale of Fixed Assets	14		31,800
Total			44,38,84,170
Payments			
Project Expenses	15		9,87,60,405
Administration Expenses	16		27,32,994
Field Advance	17		1,49,82,158
Current Liabilities	13		8,48,89,166
Other Advances Paid	12A		59,77,387
Capital Expenditure	18		35,68,843
Other Payments	19		7,20,552
TDS for the FY 2020-21	3		38,195
Closing Balances:			
Fixed Deposit and Investments	20	19,93,11,468	
Cash & Cash Equivalents	21	3,29,03,000	23,22,14,469
Total			44,38,84,170

As per our attached report under Section 10B of the Income Tax Act, 1961

For **Ran & Nathan**

Chartered Accountants

Firm Registration #003178S

Vaidyanathan
Narayanamorthy Vaidyanathan

Partner

Membership No.022573

Place: Mysuru

Date: 16th December, 2021

For Nature Conservation Foundation

T.R. Shankar Raman

T R Shankar Raman
Trustee



Trustees

NCF is administered by a board of three trustees. The Board of Trustees works in close interaction with the Executive Board and Advisory Panel constituted by invitation, and comprises professionals of international repute in science and conservation.

Dr. Rohan Arthur

Trustee & Senior Scientist

Dr. Charudutt Mishra

Trustee & Senior Scientist

Dr. T. R. Shankar Raman

Trustee & Senior Scientist

Research Advisory Board (RAB)

Dr. Ajith Kumar

Formerly National Centre for Biological Sciences

Dr. Mewa Singh

Mysore University

Dr. Uma Ramakrishnan

National Centre for Biological Sciences, Tata Institute of Fundamental Research

Dr. Bivash Pandav

Bombay Natural History Society

Dr. Rohini Balakrishnan

Centre for Ecological Sciences, Indian Institute of Science

Dr. Nitin Rai

Independent Researcher, formerly Ashoka Trust for Research in Ecology and the Environment

We would like to thank our previous RAB members

Dr. Shomita Mukherjee, Dr. Harini Nagendra,

Dr. Sindhu Radhakrishna, Dr. Mahesh Sankaran, and Dr. Ghazala Shahabuddin

Adjunct Faculty

Dr. Teresa Alcoverro

Blanes Centre for Advanced Studies (CEAB), Spain

Dr. Abishek Harihar

Panthera, USA and India

Dr. Kavita Isvaran

Indian Institute of Science, India

Dr. Jagdish Krishnaswamy

Ashoka Trust for Research in Ecology and the Environment, India

Dr. Nuria Marbà

Mediterranean Institute for Advanced Studies (IMEDEA), Spain

Dr. Steve Redpath

University of Aberdeen, UK

Dr. Anindya Sinha

National Institute of Advanced Studies, India

Dr. Suri Venkatachalam

Connexios Life Sciences, India

Honorary Associates

Dr. A.J.T. Johnsingh (Distinguished Wildlife Biologist)

Riyaz Ahmad

Sangeeta Isvaran

Prashanth N. S.

Tanya Seshadri

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