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Communicating science for conservation

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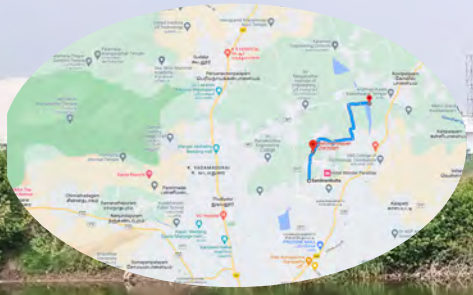
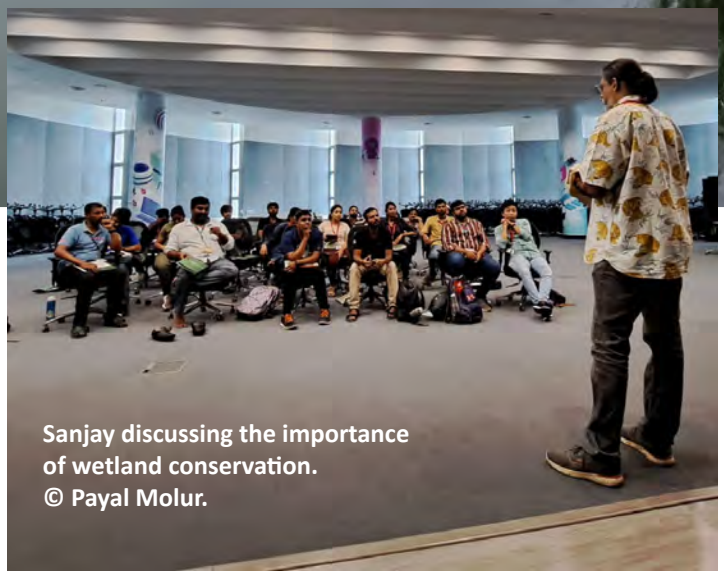
Cover photo: Oriental Garden Lizard *Calotes versicolor*. © B. Ravichandran.

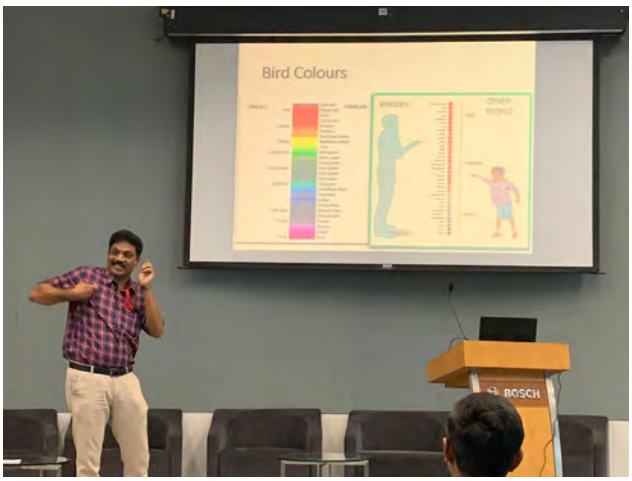
Corporates in Conservation- a model of nature education





Sanjay discussing the importance of wetland conservation.
© Payal Molur.

The scale of the ecological damage is incomprehensible, sometimes it is irreversible and irreparable. Conservation is often regarded as the responsibility of only environmentalists and conservationists. In an unprecedented climate emergency like this, conservation needs collective efforts of all the stakeholders like local communities, businesses, policymakers, scientists, and even children. And all stakeholders have a role to play, but how to go about it is the real question. Scientific data trapped in technical reports or in academics has to reach the social domain and translate into action. Unscientific conservation actions will again add to the problem.



Byju explaining the color spectrum of birders.
© Payal Molur.

Nature education backed up by science is an effective tool Zoo Outreach Organisation (Zooreach) uses to educate the common public.

Involvement through CSR (Corporate Social Responsibility) is one of the ways to create awareness among corporate employees about local ecosystems, the threats and the need for conservation. One such project in which Zooreach is involved is restoration of the Nallusamy checkdam.

The wetland- Nallusamy checkdam

The Nallusamy checkdam, once was a vital water body sustaining the local ecosystem. It was a source of livelihood for the neighboring two villages- Keeranatham and Sambrani Kuttai. The wetland starts from Sambrani Kuttai along a canal to the Nallusamy checkdam and connects to a larger lake called the SS Kulam lake. Unfortunately, it now faces a grim fate due to an improper sewage system and real estate pressures. The unchecked influx of sewage and wastewater has led to the catastrophic contamination of the dam's water, rendering it not only unusable but also detrimental to the surrounding environment.

One of the most distressing consequences of this pollution is the severe decline in species diversity. One can see the invasive plant species all along the canal. A part of the canal has already been turned into a tar road. There we saw many fishermen still trying to find some meal from the degraded waters of the checkdam. Can we imagine the amount of microplastics and other deadly pollutants flowing through the food chain!? The loss of biodiversity not only disrupts the local ecosystem but also has ripple effects on the entire food chain. The future of the Nallusamy checkdam appears bleak. The socio-economic impact is equally concerning, as communities that once depended on the dam for their water supply have already lost the connection with that landscape and migrated to the city.

This checkdam is under the Grama panchayath of Keeranatham. Many other NGOs like RAAC- (Residents Awareness Association of Coimbatore), also have taken initiatives to clean

up the canal. Implementing a robust sewage management system, raising awareness about the importance of clean water, and undertaking habitat restoration efforts can help restore this vital water body to its former glory. Without such efforts, the Nallusamy checkdam will join the list of thousands of other wetlands as a tragic symbol of environmental degradation.

CSR initiation by Bosch

CSR is a management concept, whereby companies integrate social and environmental concerns in their business operations and interactions with the stakeholders. It could be financial support or in-kind support by providing equipment or necessary materials. The support can also be by contributing their skills or expertise like software people can help with technology support or providing support for spreading awareness by conducting seminars and workshops or volunteering for the social or environmental cause.

As a part of the CSR initiatives of Bosch Global Software Technologies located at CHIL SEZ IT Park, Keeranatham Road, Coimbatore, Zooreach is involved in the restoration of the wetland at Nallusamy checkdam region just in front of the special economic zone (SEZ). Some parts of the canal have been encroached by the SEZ itself. Bosch is getting involved through providing financial support for the restoration project.

The project has three main components:

- Restoration of wetland (Rapid biodiversity assessment, perception studies of local communities).
- Education and outreach - training workshops for local NGO partners, local influencers, educator, and Bosch employees.
- Volunteering opportunities for Bosch employees.

Zooreach has already done the 'rapid biodiversity assessment' over different seasons in the first year. The assessment includes Sambrani Kuttai, Nallusamy checkdam, SS Kulam,

Some of the speices documented during the rapid biodiversity assessment

and the canal that connects these three places. It is both surprising and a good news to still have vast biodiversity there—they have documented 120 species plants, 30 species of birds, 15+ species of herpetofauna, and 120+ species of invertebrates! (Zooreach 2023).

When we, the RHATC fellows visited the checkdam, we thought that the primary challenge was to stop the influx of untreated sewage water into the water body and get the sewage treatment plants (STPs) running efficiently. There is a need to convince the authorities about the atrocious sewage water suffocating native wildlife, as well as reach out to the common people about the importance of effective waste management to maintain a clean and healthy ecosystem, concluding an immediate requirement to look for an alternative sink to redirect the water or reinforce options to reutilize and recycle the treated sewage water for other activities like toilet flushing and watering of plants or construction work within the sector. Using algae as a bio-absorption agent has been proven to be a very cost-efficient methodology to follow for sewage treatment (Almomani et al. 2019).

2-day workshop at Bosch

As part of the above Wetland Restoration Project, the 2-day educator training workshop was held on 27 & 28 October 2023 at the Bosch office. Payal and Priyanka being the lead educators, started the day by tying the Zooreach 'rakhi' and taking the oath to protect the land and share the learnings with at least 10 people everyday. The workshop was the ideal mix of fun, learning, games, and hands-on experience. Payal's creative activities and games have always proven to be unique and comprehensive.

A game to improve observation skills. © C.K. Arjun.

Busy in journaling and playing the sticker game. © B. Ravichandran.

Playing the stripes and spots game. © Payal Molur.

Sanjay giving out the certificates to one of the Bosch employee. © C.K. Arjun.

On the first day, Priyanka taught us about the lentic and lotic systems and how they work. Following the explanation, we all played the 'Ecosystem Jump' game, in which we had to jump down when any type of lotic system was called out and jump up when any of the lentic systems were called out.

Bosch employees at the Coimbatore campus are originally from different parts of India. A question that arises is, why should we restore a canal in Coimbatore which is not our hometown? Well, this training is for them to become educators and spread environmental awareness. The learnings can be applied anywhere. Understanding how to restore will help the individual to start such initiatives in their respective hometowns. And secondly, the Bosch office is very near to the checkdam, a stinking and nasty water body will cause more trouble to everyone working and living around the area. People were convinced when Sanjay addressed these questions in detail. Importance of wetland and wetland species diversity were also discussed. Byju's presentation on common birds of India was a key attraction in the workshop. It was a fun-filled, informative talk especially for the beginners. We all burst into laughter when he explained how a birder looks at the color spectrum and how common people look at it, especially the women :).

The second day we visited the checkdam to observe the biodiversity and recall the previous day's learnings. We spotted many species from the 'spots and stripes' game played the day before. Everyone journaled the list of birds and insect species they saw in a small stretch. We also played the 'sticker game'. We were given two sheets, one with the stickers of birds,

The builders in deep discussion. © Payal Molur.

Panchayat officials listening to the villagers story. © Payal Molur.

The game identify the species. © C.K. Arjun.

The sticker game.

Friends of wetlands certificate.

animals and insects of the checkdam and the other was the pond. As soon as we spotted a species, we stuck the respective sticker in the pond sheet.

The final list was surprising for all! We were proud of our improved identification skills and also of the species richness. In that small stretch, we could list at least 15 species of birds, five species of butterflies, varieties of spiders, garden lizards, etc. Returning to Bosch after the refreshing morning session, we did a role play acting in teams as various stakeholders interested in using the degraded water body like villagers, panchayat heads, builders, NGO and media personnel. One group of builders were interested in using the land for real estate, some wanted to restore the biodiversity, a few villagers didn't want the lake and wanted to create a park on the lake itself, while some wanted to build cement walls and create a recreational site along the lakeside.

The corrupt Panchayat officials (played by Nagoor, Sanjay, and Byju) listened to us but talked only about money instead of resolving the issue. We did not reach a conclusion but this way, we were able to understand the complexities involved in any conservation effort. We could understand the other perspectives of different stakeholders too, which is very necessary while working on any socio-ecological issue.

The education packet designed by Zooreach team.

As filthy as it can get. © Payal Molur.

Happy faces after the clean up drive at the checkdam. © Obuli Chandran.

The final thoughts

The workshop was successful in inspiring all of us to take action. We all enjoyed the activities and also loved the education materials. They are very thoughtfully and creatively designed, making anybody fall in love with nature. The participants also understood that cleaning and restoring the Nallusamy checkdam is a collective social responsibility. At the end of the workshop every participant was certified as 'Friends of Wetlands'. Hopefully, everyone holds on to the core message and applies the learnings in future. The workshop participants from Bosch were also given 20 education kits each of which they can use to educate others.

SEZ has more companies, for example, Microsoft and Cognizant. Though the priorities and mandates are different, it would be great if all of them come together as volunteers in their free time for the restoration, clean up drive or education. We felt happy when a few of the Bosch employees were really inspired and joined us the other day for the cleanup drive at the checkdam. Small steps like this will definitely add up to the larger impact.

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H. Maitreyi, A. Shivaani, M. Paridhi, V.B. Pannaga, N. Suraj, Amrin Ansari, L.M. Aparna, C.K. Arjun, S. Joel & Praveen Rozario, RHATC Fellows 2023–24, Zoo Outreach Organisation, Coimbatore, TN, India.

Unveiling the Vital Role of Grasslands: Earth's Green Guardians

About Kangeyam: On 28 October 2023, the RHATC fellows visited Kangeyam; a historic town based in Tiruppur district of Tamil Nadu state of India. It is 70 km from Coimbatore. The grassland is located between 11.0054 N & 77.5620 E. It is one of the driest regions that receives approximately 600mm of rain yearly. In October and November, it receives only about 250-300mm of rainfall due to the north-east monsoon; it does not get the South-west monsoon. Throughout the year, the temperature normally ranges 30–38 °C. April is the hottest month and December is the coldest month in Kangeyam. The calcium-rich soil helps retain moisture and is ideal for grass species to grow. The pride of the Kangayam town is the Kangayam breed of cows and bulls. They are an excellent drought breed known for drought power and sturdiness. Kangayam cows produce moderate amounts of milk in harsh environments. The bullocks are in great demand in Kerala and Tamil Nadu as they are great workers and the breed has been exported to Brazil, Malayasia, Srilanka and the Phillippines. (Panneerselvam & Kandasamy 2008).

Kangayam grassland in the tropical region of South India has been sustainably managed for over one hundred and fifty years (Kumar et al.

Kangayam Landscape. © S. Joel.

2011). Grassland is a dynamic ecosystem that has its own equilibrium managed by nature and also with people participation for economic benefit. Grasslands provides numerous regulating services like climate regulations, carbon sequestrations, erosion control, water and air regulation, soil formation, pest control, waste management and pollination services (Yuanyuan Zhao et al. 2020). The cultivated crops are Sorghum vulgare, Pennisetum typhoids, Oryza sativa, Arachis hypogea (The coconuts are dried and made into organic coconut oil), Zea mays etc (Panneerselvam & Kandasamy 2008).

We met Rani, Ramnathan, and Ravichandran, engineers by profession and now they are proud farmers. They are practicing organic farming in the 50 acres of land and they are the only people who are considering grasslands as a vital ecosystem and kept it preserved. They faced many challenges during their initial days because their adventures with 20 odd acres of land in an area which neither receives south west monsoon nor south east monsoon, is commendable. They follow natural farming that is without much human interference and inputs like fertilizers or pesticides. The farm is a good mix of commercial crops, medicinal plants, ornamental plants and wild varieties. In a way, they are self-sufficient. On one side, there is grazing land full of Kolukattai grass *Cenchrusciliaris*, which is abundant due to its ability to grow in drought-prone regions and calcium-rich soils and serve as fodder for the Kangeyam bulls.

The side of the farm is cultivated with mostly coconut and the other side is left wild. There is an area where all the coconuts are dried and made into organic coconut oil. The water usage is critical here. Few decades back the people had water after digging 180m underground. Unfortunately, this is not the case today, the water table has dropped drastically and digging 300–400 m doesn't yield water anymore.

This dire situation tells us even in a water scarce region with previously abundant water for daily activities, now the bore wells and wells in region are interconnected in such a way that, if one or a few withdraw water, many others will not be able to get water. In other words, there is competition among the people to draw the last drop of water. Ramanathan's land had 40 by 40 well which is 21m deep. They also had 5 bore wells dug by their fathers and forefathers. Ramanath had mentioned that they had stopped digging more bore wells as it became pointless due to the fact that water is scarce and digging

Variety of Grass species in the field of Kangayam. © Tandrali Baruah.

more wells will only cause more damage to the earth. Hence they use water only if it comes to either of their bore wells. From there the water will be transferred to the well from where it will be used for activities.

Farming: Problems and Solutions – They believe that sustainability of agriculture is difficult so the land is divided as agriculture and grassland. The challenges they faced when they started faming.

• Water scarcity

Water is the most basic fundamental resource for agriculture, so it needs to be utilized efficiently to overcome the problem of water scarcity. In agriculture farmers consider weeds as their enemy and they tend to remove it either by using herbicide or by weed cutter. But if we study the ecology of weeds and grass cover it has a lot to contribute. If we consider the Kangeyam farm that we went, their major crop was coconut and they said that they tried not to remove the weeds instead increase the grass cover so that it can retain the moisture in the soil for a long time and keep the soil temperature low. By doing this they can manage to water the trees once in 15 days, which will be sufficient for the coconut trees even in dry season when the water availability is very less. Retaining the weeds and grass cover also helps in enrichment of soil, as the grass and weed litter decomposes and forms the organic matter which will act as a manure to the trees. This is a classic example for organic farming.

• Coconut market

The farmers face a lot of problems in terms of market price when it comes to selling their produce. Even if the crop is of good quality the price, they get is very poor and the middle men make huge profits. In this context it is the coconut which is used to produce coconut oil. So instead of selling their produce as a raw material to middle men they can try to process it themselves and then market it and directly sell the product. In this case it is the coconut oil. So, by doing so they will be able to get the price that they deserve.

• Kangeyam breed

They had a hybrid jersey of cow, Murrah breed of buffalo and few other breeds of bull and goats. Due to the modern technology the conventional methods of ploughing had reduced to a great extent. Earlier where the bulls were used to plough has now replaced by tractors and tillers. So rearing cattle is also a major challenge because it costs a lot to have the cattle. So to overcome this they can use the cattle (cow dung) for producing the organic manure which if marketed properly can make a huge difference. Since, the native cow grazes on the grasses which are rich in calcium makes their milk much more rich in calcium comparing to other milks.

Cows and bulls of Kangayam. © S. Joel.

• Grazing

In Kangeyam, each household atleast has a cow or a buffalo or a goat. Due to this the grazing pressure is high in nearby grasslands. Biofencing is one such age old method which is adopted by the people belonging to Kangeyam. It is a natural boundary which is made by plants or grasses in a semi-arid region to protect the cultivated agricultural fields from humans and grazing cattles. Here the live fence is made with *Balsamodendron berryi*, a highly drought resistant throny shrub.

Species diversity in Kangeyam: We walked down in the grassland and also visited in their organic farm. Raghavan told us about many medicinal plants around his farm. The grassland species are *Pennisetum*, *Cymbopogon*, *Chryosopogon*, *Cenchrus*, and *Themeda*.

Below is the list of diversity we observed at the Kangeyam town:

***Gametis versicolor*.**
© C.K. Arjun.

Sunbird on *Hamelia patens*.
© Praveen Rozario.

1. Medicinally important plants:

	Scientific name	Native / non-native	Medicinal uses
1	*Tinospora cordifolia*	N	Leaves are applied on snake bites.
2	*Gloriosa superba*	E	Intestinal diseases, kidney ulcers.
3	*Asparagus* sp.	N	Increases blood circulation.
4	*Acacia leucophloea*	N	Antibacterial.
5	*Abutilon indicum*	E	High concentration of zinc.
6	*Euphorbia hirta*	E	Used for female disorders.
7	*Acalypha indica*	E	Antivenom.
8	*Calophyllum inophyllum*	E	Leaves used in ulcers
9	*Sida acuta*	E	Blood disorder
10	*Cissus quandrangularis*	E	Bone fractures

2. Birds:

	Common names
1	Indian Night Jar
2	Red-whiskered Bulbul
3	Spotted Dove
4	Rock Dove
5	Indian Peafowl
6	Purple Sunbird

3. Insects and beetles:

	Family / Scientific name
1	Coccinellidae
2	Chrysomelidae
3	*Blochmannia* sp.
4	*Hycleus* sp.
5	*Junonia lemonias*
6	*Buthus occitanus*
7	*Gametis versicolor*

***Crocothemis servilia*.**
© Praveen Rozario.

Conclusion: Ramanathan and Rani are a remarkable couple who have made a conscious and inspiring choice to leave their corporate life behind and embrace a more sustainable and nature-centered lifestyle in the countryside. Their decision to cherish and appreciate whatever nature provides sets a shining example for all of us, one that can have a profound impact on the environment and ecology. In a world where the relentless pursuit of corporate success often leads to overconsumption and environmental degradation, Ramanathan and Rani's choice is a breath of fresh air. By moving to the countryside, they have minimized their ecological footprint, reduced their reliance on fossil fuels, and embraced a simpler, more self-sufficient way of life. They've chosen to live closer to the land, growing their own food and utilizing renewable energy sources, which significantly reduces their impact on the environment.

By following in their footsteps, we can collectively contribute to a better environment and a healthier ecology. Their actions serve as a reminder that we don't need to sacrifice our comfort or happiness to live in harmony with nature. We can reduce waste, conserve resources, and support sustainable practices while still enjoying a fulfilling life. Ramanathan and Rani's journey is a testament to the idea that small changes can have a big impact. By emulating their commitment to a sustainable, nature-centered lifestyle, we can collectively work toward a greener, more ecologically balanced future. It's a future where we can all reap the benefits of a healthier environment while still enjoying the beauty and serenity of the countryside they cherish.

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Unwinding the World of Climbers and Lianas with Dr. Vivek Pandi

Dr. Vivek Pandi is a plant ecologist who has spent close to a decade studying the ecology and biodiversity of climbers and has contributed significantly to research on Indian climbers. He holds a Ph.D. in ecology of woody climbers and has a longstanding research interest in understanding the evolution of climbing behaviour in plants. He is currently studying the taxonomy, systematics, and phylogenetics of Indian climbing flora. He has published over 15 research materials on various themes of climber ecology. In addition, he has established a one-hectare permanent monitoring plot in India's Western Ghats biodiversity hotspot to understand better the dynamics of liana communities and their impact on forest structure. He is currently employed as an assistant professor of evolutionary biology at the Manipal Centre for Natural Sciences, Manipal Academy of Higher Education in India.

Tree and climber intertwined. © B. Ravichandran.

Dr. Pandi explaining about types of climbers. © Tandrali Baruah.

Liana in tropical dry evergreen forest of India

In many tropical forest ecosystems, lianas are an inevitable element, making up to 32% of woody stems and 35% of the variety of woody species. Unlike trees, lianas are incapable of autonomous vertical growth above a certain height and therefore, they must rely on external support to reach forest canopy. However, lianas are evolved with diverse climbing structures and strategies that aid in attaching to the host trees and expose themselves to light-rich environments. Further, lianas are also known for their peculiar characteristics including their biomechanical properties, anatomical modifications, extreme

stem hydraulic capacities and their extraordinary developmental plasticity (Pandi 2016).

Lianas play a major role in tropical forest dynamics by competing with trees for both aboveground and belowground resources, resulting in reduced recruitment, regeneration, growth, fecundity and survival of trees (Pandi & Parthasarathy 2015). There are five different climbing mechanisms (HC – hook climber; ST – stem twine; TC – tendril climber; SCR-A – armed-scrambler; SCR-UA – unarmed-scrambler). The unique physical networks between trees and lianas are often controlled by host species' traits. As expected, the host trees with mid- and high WSD (water saturation deficit) values are more prone to be infested by lianas, whereas trees with low-WSD are less infested in the studied forest (Pandi & Parthasarathy 2017).

Lianas are known for their ability to exploit aboveground resources in seasonal forests, utilizing the prevailing high solar radiation in the dry seasons. Lianas often form a dense carpet of leaves over the host trees' crown, limiting or leaving no light for the trees to perform photosynthesis. Furthermore, liana colonization

Pre debate discussion of team Forest managers. © Sanjay Molur.

on host trees is becoming more common in the tropics (Pandi et al. 2023). The dominant plant families in which most of the climbers found are Cucurbitaceae, Menispermacea, Convolvulacea. The interesting thing is there are 2,624 species of climbers belonging to 196 families, 585 belonging to the genus piper, 104 families of only Fabaceae.

Our interaction with a liana specialist

On 16–17 October 2023, we had an interesting, fun-filled debate among ourselves where we were divided into two groups and a common scenario was given to us in which we were expected to speak on lianas in a plantation. One group represented forest managers and the other represented conservationists. The debate provided us a platform to recall and recollect our

Pre debate discussion of team conservation scientist. © Payal Molur.

understanding and learnings from Vivek Pandi's session. Strong and valid arguments about liana growth, occupancy, faunal species, presence and importance of biodiversity in the plantation 2 species with 34 species of lianas.

He then explained the importance of lianas in the forest where they have ecological roles like food, microclimate, carbon sequestration, and

many more. We were asked whether a tree can grow like liana and our answer was no but, he said it is possible by giving us the evolutionary process of how climbers have evolved from trees.

The last part of the session was about the estimation of the vegetation cover that existed in the past and it was possible by using phytoliths and other microfossils which was also a completely new learning for us.

Vivek Pandi's contribution in the field of climbers and grasses

Dr. Vivek Pandi's contribution to climbers, especially liana research is incredible and significant, since there are very few liana researchers in India. He has mapped the ecology of lianas in the entire peninsular India. He has published a book 'Taxonomy and Ecology of Climbers – Climbing Plants of India'. The most fascinating thing he came to know is the pattern of tree-liana interactions in the tropical forest in India, whether climate change is going to affect the interaction, and how it will affect the structure of the forest. His few other research areas are functional trait analysis of lianas, host preferences, including the current status and future prospects of climber research in India.

One more interesting work is on the 'Diversity and carbon stock assessment of trees and lianas in tropical dry evergreen forest on the Coromandel coast of India'. Apart from climbers, his team is doing research on the plant *Indianthus virgatus*, yet another rarely touched topic in India- the 'monotypic taxa' in angiosperms. Another fascinating dimension of their work is on understanding the past vegetation and temperature of a landscape or in short 'paleoecology' based on the silica crystals called 'phytoliths' inside the cells of grasses! Through phytoliths they are also trying to understand the origin and patterns of fires in the wild places.

Walk with Pandi in Pushpagiri mountain range

On 05 November 2023, we got an opportunity to have on-site learning about lianas in their natural habitat during a trail walk in the reserve forest of Pushpagiri Wildlife Sanctuary, he explained us about the types of armed and unarmed scramblers and how the plants of genus *Amorphophallus* are capable to change their sex annually depending on their external environments and also how most of the evergreen trees have a prime characteristic feature of having serrated margins to increase the transpiration rates.

The interesting plant adaptation that he told us about is the change in leaf margin of *Olea* sp. Some leaves show serrate margin while others have the entire margin. We were amazed to see the leaf arrangement of *Macaranga* leaves in such a way that all of them receive equal sunlight and also came across an unidentified *Ceropegia* species. Along the way, we also

Field visit with Dr. Pandi in Pushpagiri, Coorg. © B. Ravichandran.

encountered the *Careya arborea* tree and got to know the dependency of mammals like Gaur and Elephants on its fruit. It was a very informative and fun learning experience.

Conclusion

One of the most noticeable features of tropical forest ecosystems is climbers. In fact, their ability and presence often serve as a distinguishing factor between tropical forests and temperate ecosystems. The diminished prevalence of climbers in temperate woods is linked to the vascular systems' malfunctioning in colder climates. Both natural and man-made causes can have an impact on the variety of lianas. Numerous important abiotic elements, such as rainfall, rainfall seasonality, soil edaphic factors like soil type and structure, texture, pH, salinity, moisture, temperature, organic carbon, nitrogen content, heavy metal content impact the abundance of liana. Ecology of liana is still unexplored. The world of Liana is still mysterious and untouched.

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N. Suraj, H. Maitreyi, Amrin Ansari, M. Paridhi, V.B. Pannaga, L.M. Aparna, A. Shivaani, C.K. Arjun, S. Joel & Praveen Rozario, RHATC Fellows 2023–24, Zoo Outreach Organisation, Coimbatore, TN, India.

Group photo. © Tandrali Baruah.

Endangered Forest Spotted Gecko observed in Sevapur Forest, Tamil Nadu, India

The Forest Spotted Gecko *Cyrtodactylus speciosus* is a terrestrial, nocturnal, forest-dwelling, secretive and is one of the least known of Indian geckoes (Smith 1935). This species was first described from Erode, and subsequently has been sighted in hills around Coimbatore, Tirupur, Salem, Namakkal, Tirupathur, Theni, Madurai, and Dindigul districts, in parts of the Eastern Ghats and the Western Ghats in Tamil Nadu (Gupta 1998; Bhupathy & Sathishkumar 2013; Agarwal et al. 2016; Ganesh & Arumugam 2016; Chaitanya et al. 2018; Ganesh et al. 2020). It is a terrestrial insectivorous lizard that lives on the ground amongst thick leaf litter and pebbles and particles on a number of the wooded area floor. This gecko is associated with dry deciduous forest and scrubland at the foot of hills. It occurs at elevations of 300 to 650 m (Smith 1935; Agarwal et al. 2016).

Forest Spotted Gecko observed from Sevapur Forest in Karur District. © S.S. Balavignesh.

Cyrtodactylus speciosus is characterised by a typical colour pattern consisting of the following configuration on the head dorsum (two interorbital spots and elongated central occipital streak longer than the two occipital spots), dorsal trunk (two dark bands from behind occiput to between hindlimb insertion, one beginning behind forelimb insertion and the last ending just above the hindlimb insertion, lighter interspaces bands, three pairs of dark spots between limb insertions) and tail (Agarwal et al. 2016). This is a species complex that has a tricky taxonomy, where the type specimen is somewhat damaged (Agarwal et al. 2016) and the species hasn't been found from the original locality

Erode, yet. This species is listed as 'Endangered' on the IUCN Red List (Achyuthan et al. 2021).

The present note reports the published occurrence of the Forest Spotted Gecko for the first time in the Sevapur forest area (10.580N, 78.156E; 375 m) in Karur District, Tamil Nadu. During the Slender Loris census in the Sevapur Forest area on 26 February 2022, a live gecko was sighted during the field visit wherein it was seen to be well-camouflaged on the ground with leaf-litter. Then we observed closely and photographed the gecko for enabling a better identification and independent verification of our sighting. The present report is the first photographic record of the Forest Spotted Gecko in the Karur District.

Surveys on the reptile fauna of these hills are rare and the nearest place from where it was reported, is Sirumalai hills as *C.* cf. *speciosus* (Ganesh & Arumugam 2016). Studies including specimen collections and DNA analysis are necessary to fully identify this population. This species is very little-known, with no published information on its habits, natural history, biological traits and so on. Further studies and field observations are very much recommended to fully understand its biology.

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S.S. Balavignesh[1], A.S. Thileepan[2] & T. Siva[3]
[1] Department of Animal Science, Bharathidasan University, Tiruchirappalli, Tamil Nadu 620024, India.
[2] 28/1, Balaji Nagar, Papanasam, Thanjavur, Tamil Nadu 614205, India.
[3] 73, Manthakarai Street, Thirukoilure, Kallakurichi, Tamil Nadu 605757, India.
Emails: [1]balasaravanan1507@gmail.com, [2]kas.thileepan@gmail.com, [3]sivanaturewild@gmail.com (corresponding author)

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Bugs R ALL

#273
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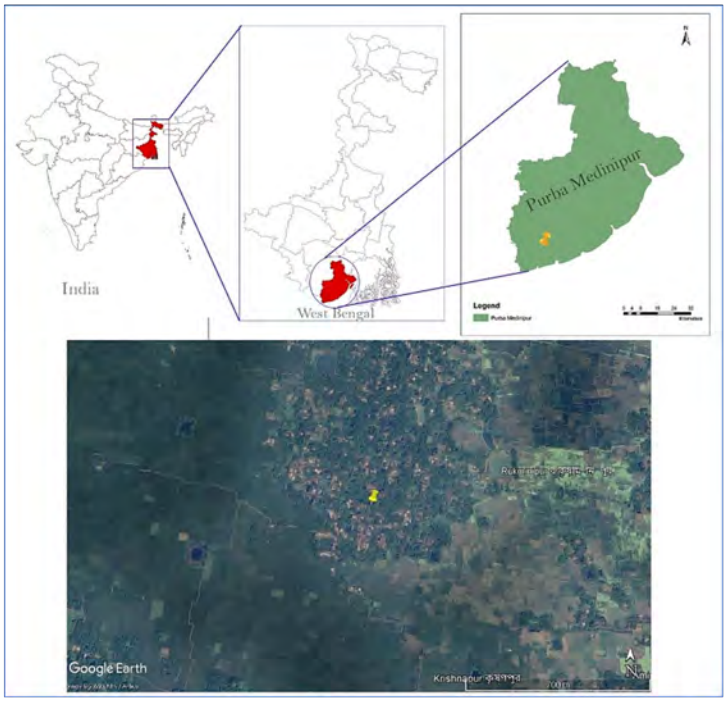
Painted Jezebel recorded for the first time from Purba Medinipur district of West Bengal, India

The Painted Jezebel *Delias hyparete* (Linnaeus, 1758) is a beautiful butterfly with mainly yellow in colour with red marginal spots which belongs from Pieridae family. Global distribution of this species is Nepal, Bhutan, Bangladesh, Myanmar, and India (Kehimkar 2008; Wynter-Blyth 2009; Smetacek 2017). And its Indian distribution is known from Uttarakhand to Arunachal Pradesh, West Bengal, Odisha, Andhra Pradesh, Maharashtra, Tamil Nadu, and Andaman Islands (Kehimkar 2008; Varshney 2015; Smetacek 2017).

Painted Jezebel *Delias hyparete* from Rukminipur village of Purba Medinipur district, West Bengal. © Asim Giri.



Location where Painted Jezebel *Delias hyparete* was photographed at Rukminipur village of Egra-II block, Purba Medinipur.

On 23 April 2020, while we were roaming around in search of birds and other wildlife in the small forest patch (21.9005 N, 87.5380 E) inside Rukminipur village of Egra-II block, Purba Medinipur, West Bengal, we saw this beautiful butterfly flying lazily and sat on a leaf. We took a few

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photographs of this and later it was identified as *Delias hyparete* following the keys from field guides and books (Evans 1932; Kehimkar 2008; Wynter-Blyth 2009). The major characters- not ringed red marginal spots on hind wing and the row outwardly bordered by black are the primary keys which differentiate it from the most similar species, Common Jezebel *D. eucharis* (Kehimkar 2008).

Though *D. hyparete* is not rare in northern part of West Bengal like Alipurduar district, there also few records from southern part too. After accessing the literature and inaturalist. org & ifoundbutterflies.org portals we found that there are only four recent records of this species in last five years from Purulia, Bankura and Howrah district of southern West Bengal (Dutta et al. 2019; Anonymous 2023; iNaturalist 2023).

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Asim Giri[1] & Tarak Samanta[2]

[1] Padmaja Naidu Himalayan Zoological Park, Darjeeling, West Bengal 734104,, India.

[2] Nature Mates – Nature Club, Kolkata, West Bengal 700032, India.

Emails: [1]giriasim2013@gmail.com (corresponding author), [2]taraksamanta995@gmail.com

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Photographic record of Golden-crested Myna from NERIST Campus, Arunachal Pradesh

On 16 October 2022, our team conducted a bird watching survey inside the North Eastern Regional Institute of Science and Technology (NERIST) campus, located at Nirjuli, Papum Pare district, 30 km from the capital complex of Itanagar, Arunachal Pradesh. The campus covers an area of 67 ha and lies between 27.1305 N & 93.7409 E. The campus comprises of a major forest habitat including muddy shrubland, grassland, and small streams. It is also home to many species of flora and fauna.

During the birding period, a small flock of Great Myna *Acridotheres grandis* and Chestnut-tailed Starling *Sturnia malabarica* perched on a tree was sighted. Among the flocks, an individual Myna species with a distinct feature was observed having a golden-yellow forehead, crown and yellow throat and a dash of bright yellow spot in the wing. At first, we thought it could be a juvenile of Jungle Myna or Great Myna. However, after complete observation of body plumage and size of the species, we later identified it as the Golden-crested Myna *Ampeliceps coronatus*. Photographs were also obtained during the observation.

A. Golden-crested Myna *Ampeliceps coronatus* and B. Golden-crested Myna with Great Myna and Chestnut-tailed Starlings. © Aribam Rocky Sharma.

Golden-crested Myna is a species of Starling or Myna which belongs to the family

Map showing the sighting location inside the NERIST campus.

Sturnidae. Confusion prevailed as the species is distributed in Myanmar region and there were few photographic records found from Arunachal Pradesh and the species is poorly known in India. The previous record of the species was from Namdapha National Park and Tiger Reserve, Miao (Srinivasan et al. 2010; Craig & Feare 2018), and also an old record from Barak River in western Manipur (Ali & Ripley 1987; Rasmussen & Anderton 2012). A total of 32 records were found from India including Assam, Arunachal Pradesh, Manipur, Mizoram and West Bengal (Ismavel & Gassah 2018). This documentation is the most recent photographic record.

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Aribam Rocky Sharma[1], Anurag Vishwakarma[2], Awadhesh Kumar[3], Mela Aihun Nora Lyngdoh[4] & Bannangiar Kurbah[5]
[1-5] Department of Forestry, North Eastern Regional Institute of Science and Technology, Nirjuli, Arunachal Pradesh 791109, India.
Email: [2]aviwild88@gmail.com (corresponding author)

Citation: Sharma, A.R., A. Vishwakarma, A. Kumar, M.A.N. Lyngodh & B. Kurbah (2023). Photographic record of Golden-crested Myna from NERIST Campus, Arunachal Pradesh. Bird-o-soar #216, In: *Zoo's Print* 38(11): 21–22.

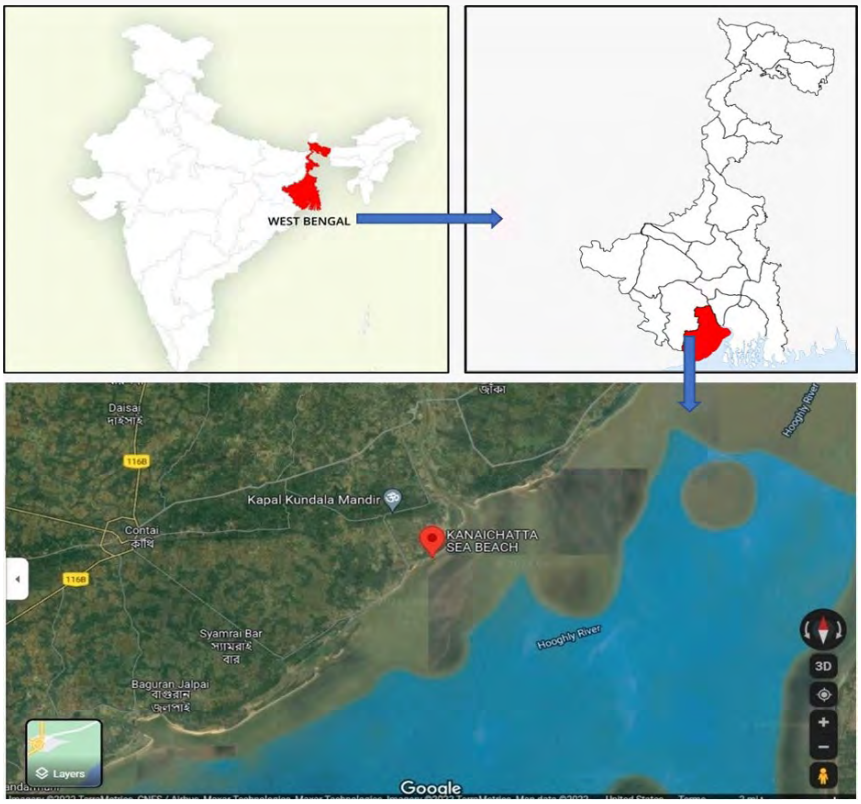
First time sighting of a large flock of Bar-headed Geese along the shore of West Bengal

The Bar-headed Goose *Anser indicus* has a pale grey and black bars on its head that is easily distinguished from other geese, native to northern, eastern and southern Asia, but escapes from waterfowl collections are occasionally seen free-flying elsewhere in the world (eBird 2022). This species has been renowned for its high-altitudinal migration because of various unique physiological adaptation, some satellite-controlled studies confirmed that the Bar-headed Goose can fly over the Himalaya at altitudes greater than 9000 m, making it one of the highest-flying birds with physiological traits adapted for sustaining flight at high altitudes (Hawkes et al. 2011; Zhang et al. 2011).

Bar-headed Geese in West Bengal. © Pulak Kanti Kar.

Bar-headed Geese start arriving in October–November, reaching their highest concentrations in December, and start returning in March (Siddiqui & Balachandran 2009). This species migrates within the Central Asia Flyway (CAF), breeds in Ladakh (India), Tibet (China), Mongolia, Uzbekistan, Tajikistan, and Kyrgyzstan (Rahmani & Islam 2008) and winters in tropical and subtropical regions in the Indian subcontinent and along the Yarlung Zangbo River, Lhasa River, Penbo River, and Niang River valleys in southern Tibet (Bishop et al. 1997; Takekawa et al. 2009; Zhang et al. 2013).

According to Grimmett et al. (2011), the wintering habitat of Bar-headed Geese, is near large rivers, lakes, and reservoirs, also coastal islands in the Sundarban, Bangladesh.



Study area.

Previous several records also show that this bird was sighted rarely along the shore of West Bengal and the number of these birds sighted was very less in number (maximum 4 individuals). Patra (2015) reported one individual of this bird from the Sundarban area was sighted by Roy in the year 2009; one individual was sighted by Gharami in the year 2014; four individuals observed by Subrata Kool & team from Panchamukhani, Sundarban, South 24 Parganas in the year 2015 and in the same year Patra sighted one individual from Sundarban area. Further Patra (2020) reported one individual of this bird from Henry's Island, South 24 Parganas sighted by Sannidhya De & team on 15 December 2020.

On 10 February 2022 at 0820 h, the first author observed about 122 individuals (counted individually) of Bar-headed Geese sitting along the shore of Kanai Chatta, East Medinipur (21.7805 N, 87.8847 E). There were low tides and the water level was approximately 600 away from the coast. A few images were taken using the Nikon Coolpix P900 camera. The birds were identified using the field guide book of Grimmett et al. (2011).

Previous records revealed that a large flock (>40) of these birds was sighted many times along the coastal region from many states in India. Parmar (2020) recorded about 1,000 individuals of Bar-headed Goose from Bhitarkanika National Park of Odisha during January (eBird 2022). Thiagarajan (2013) recorded 250 individuals of these bird from Ramanathapuram county of Tamil Nadu during March (eBird 2022). Pandya and Rajendrasinh (2022) recorded 270 individuals of this bird from Gorad, Gujarat (eBird 2022). Pandya & Sidat (2022) recorded 300 individuals of this bird from Kumbharwada wetland southern part, Bhavnagar, Gujarat (eBird 2022). Mistry (2020) recorded 250 individuals of this bird from Gujarat during November (eBird 2022).

From the latest research publication (Das et al. 2022) of birds from Purba Medinipur coastal area, it is known that approximately 263 numbers of bird species is recorded till now

from the coastal region of Purba Medinipur. But still the Bar-headed Goose is not reported from the coastal area of Purba Medinipur and no photographic evidence is found from Purba Medinipur district on eBird also.

Hence, it is the first time sighting of a large flock of Bar-headed Geese along the coastal region of West Bengal and the first photographic record of this bird from the district, Purba Medinipur.

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Pulak Kanti Kar[1] & Piklu Das[2]
[1] Department of Zoology, Midnapore College (Autonomous), West Bengal 721101, India
[2] Wildlife Biologist, Sarisha Wildlife And Ecology Society (WNE), West Bengal 743368, India.
Email. [1]pulak5325@gmail.com (corresponding author)

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Sighting of a leucistic Stork-billed Kingfisher from coastal West Bengal, India

On 30 May 2020 morning during my regular field study, I observed an abnormally coloured Kingfisher sitting on a tree in Kanai Chatta, Purba Medinipur, West Bengal, India (21.7738 N & 87.8754E).

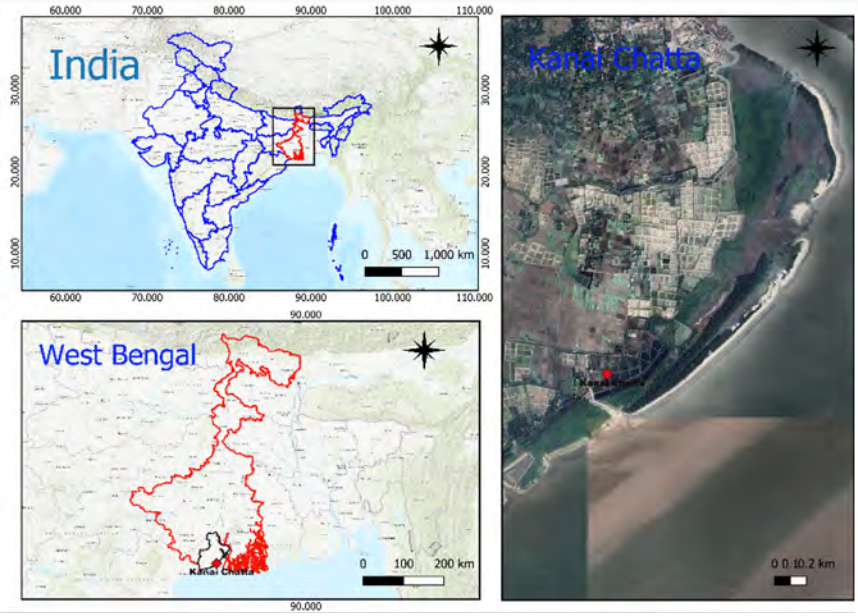
By noticing a large body size kingfisher, large size bill, and after listening to the call, I concluded that it was Stork-billed Kingfisher (S-bK). It was abnormal in colour. It had the following characteristics: very large coral red colour bill, legs yellowish or pinkish colour, eyes were dark in colour, collar and underparts of body were tinge pale orange-buff colour and remaining body parts were white colour. In general features of Stork-billed Kingfisher is a very large with a huge coral-red bill, brownish cap, pale orange-buff collar and underparts and blue-green upperparts (Grimmett et al. 2011). It is well distributed in India, Nepal, Sikkim, Bangladesh, Thailand, Myanmar, and Indonesia (Ali & Ripley 1970). These characteristic features clearly

Leucistic Stork-billed Kingfisher *Pelargopsis capensis* in Kanai Chatta, Purba, Medinipur. © Piklu Das.

indicated that this individual is 100% leucistic because of the total absence of melanin from all feathers. But melanin is still present in skin, iris and feathers also. It means carotenoid-based colours are still present (Grouw 2006). It is not albinism because melanin is still present in the collar and underparts, eyes are not red, and the bill is still coloured like normal S-bK.

Colour aberration on kingfisher is quite well documented in India as well as in West Bengal, i.e., an albinism White-throated Kingfisher *Halcyon smyrnensis* was reported from Adilabad, Arunachal Pradesh (Srinivasulu 2004); a colour aberrant kingfisher was sighted from Andaman Island (Hariprasad 2018); a colour aberrant Pied Kingfisher *Ceryle rudis* from Chennai, Tamil Nadu (Raghavan 2019); a residential Collard Kingfisher *Todiramphus chloris* was reported from Sundarban, West Bengal (Patra 2021); Common Kingfisher *Alcedo atthis* was sighted from Udaipur, Rajasthan (Rathore & Sexena 2022).

Previous sighting record of



Location where the leucistic Stork-billed Kingfisher was observed.

colour aberrant S-bK was from Sodepur, North 24 Parganas (Saha 2018). Again a leucistic S-bK was sighted from Nandigram, East Medinipur, West Bengal (Bera 2022). But there are no published accounts as of yet about colour aberrant S-bK from India.

It is noteworthy that leucistic individuals have lower survival rates than normally coloured individuals, because they are more easily detected by predators (Owen & Skimmings 1992). Owen & Skimmings (1992) studied a population of barnacle geese with a number of leucistic individuals and found the median lifespan of leucistic geese was only 2–3 years compared to 8–10 years for normally pigmented birds. Leucism in seabirds has also been attributed to deficiencies in diet (Castillo-Guerrero et al. 2005). Clapp (1974) considered leucism to be related to inadequate diet in Common Blackbirds *Turdus merula* and associated with white-wing bars in Wild Turkeys *Meleagris gallopavo*. It is also reported that these colour aberrant individuals, in occasional cases, may not be recognised or accepted by their potential mating partner (Mayntz 2020).

In conclusion, researchers should be encouraged to report records of colour-aberrant animals in wildlife in order to better understand the phenomenon and we have to gain insights into the ecological and physiological implications of that condition, which has a significant effect directly or indirectly on their survival.

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Piklu Das
Sarisha Wildlife and Ecology, South 24 Parganas, West Bengal 743368, India.
Email: pikludas8348@gmail.com

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Diversity and adundance of avifauna in terrestrial habitats of Ludhiana district in Punjab, India

India harbours 7–8% of the recorded species of the world and hence, is among the 17 mega diverse countries with four biodiversity hotspots, i.e., Western Ghats, Himalayas, Indo-Burma region, and Sundaland. Out of total animal species, bird species in India makes over 13% of the world's bird diversity with 1,300 known bird species (Grimmett & Inskipp 2010).

In Punjab, the avian fauna is represented by 428 known species (Edake 2015). The scrutiny of relevant literature revealed that though a number of workers compiled their work on avian fauna but no consolidated work has been attempted to document the terrestrial bird species especially after the green revolution in Punjab in general and district Ludhiana in particular except some scattered works by Whistler (1919), Dhindsa et al. (1988), Kler (2006, 2009), Kler & Kumar (2015a,b). It seems important to conduct fresh surveys to document the bird diversity of district as well as state as deforestation occurred widely for the expansion of agricultural fields in and after 1960s and the intensification of agriculture created extensive homogenous agricultural areas. This destruction and deterioration of habitats resulted in loss and decline in number of bird species from the State; however, some species also became more adapted to the changed ecological conditions. Hence, an attempt has been made to study the avian diversity of terrestrial habitats in district Ludhiana located in the Malwa region of Punjab.

Monthly surveys have been conducted to document avian diversity of agricultural habitats and forest habitats in study area during the span of four years from May 2016 to April 2020. To conduct these surveys, four sites were selected from agricultural habitats and two sites from forest habitats. The study sites were identified on the basis of vegetation cover, anthropogenic activities and lack of information about avian diversity prevailing in those areas.

Agricultural habitat: The main crops sown in the area includes wheat, maize, rice, barley, sugarcane, potato etc. in different seasons. Four line transects were selected in the agricultural sites in the study area.

Site-1 (S1) Lalheri to Majra line transect: This site is permanent narrow path starting from village Lalheri to village Majra falling in Khanna tehsil of the district. It is located 12 km towards east from Khanna between 30.71°N & 76.24°E. The line transect is marked by the presence of agricultural fields.

ii. Site-2 (S2) Seh to Majra line transect: The site also includes agricultural fields around the line transect. The area falls under Samrala tehsil of district Ludhiana. The site is located 9 km from Samrala between 30.76°N & 76.23°E.

iii. Site-3 (S3) Malakpur line transect: The line transect is also a straight path along agricultural fields of village Malakpur. This village falls under Payal tehsil of district. It is located 18 km away from Payal between 30.56°N & 76.10°E.

iv. Site-4 (S4) Chuhrpur line transect: The village Chuhrpur falls under Ludhiana West tehsil and shares its boundaries with Ludhiana city. It is located 11 km towards east from Ludhiana city between 30.94°N & 75.79°E.

Forest habitat: The selected forest region falls in village Mattewara of Ludhiana East tehsil. The main plantation in this forest includes *Eucalyptus* sp. Two sites, i.e., Site 1 (S5) and Site 2 (S6) were selected in this forest area for the present studies.
Site 1: It is located between 30.99°N & 75.97°E.
Site 2: It is located between 30.99°N & 75.96°E.

The bird diversity was explored using line transect method (Buckland et al. 2001). All birds seen, heard or in flight are recorded. The collected data including species name, number of individuals and habitat type was recorded in the field diary. Olympus 10X50 DPS binoculars were used to avoid disturbance to the birds. Field photography was done with the help of a DSLR camera Canon 60d. Various field guides (Ali & Ripley 1987; Ali 2002; Grimmett & Inskipp 2010; Grimmett et al. 2011) have been used to identify the bird species and not even a single species of bird was captured or killed during this investigation. The conservation status of bird species has been assigned as per IUCN Red List status 2020.

The following statistical indices were used to measure species diversity in a community. These indices are also important to describe rarity and commonness of different species in a given community and act as vital tool for biologists to understand community structures (Anthal 2017).

(i) Shannon-Wiener diversity index (H'): This is an important diversity index to account the number of individuals and number of taxa of a community. It varies from 0 to higher values depending on number of present taxa. The formula for Shannon's index is:
$H' = -[\Sigma\ Pi\ lnPi]$
where H' = Shannon's diversity index, Pi = Relative abundance, lnPi = Natural logarithm of this proportion
(ii) Margalef's species richness index (Margalef 1958): This index is used to calculate the species richness, i.e., the number of species present in a particular habitat.
$Rmf\ (d') = S-1/ln(N)$
where S = Total number of species, ln = Natural log, N = Total number of individuals in the sample
(iii) Pielou's evenness index (Pielou 1969): It is used to calculate evenness which indicates relative abundance or proportion of individuals among the species.
$E = H'/In\ S$
where H' = Index of diversity of Shannon-Wiener, In = Natural log, S = Total number of species
(iv) Berger-Parker index of dominance (Berger & Parker 1970): It is used to calculate the number of individuals of dominant taxon relative to the total number of individuals of a community. The

formula is given below.
d = Nmax/N
where d = Berger-Parker index, Nmax = Number of individuals in the most abundant species, N = Total number of individuals in a community.

During present studies, a total of 96 species referable to 14 orders and 39 families from the terrestrial habitats including agricultural and forest line transects has been recorded (Table 1). Order Passeriformes is found to have maximum number of species, i.e., 54 species belonging to 18 families. Out of 96 species, one species, i.e., Alexandrine Parakeet *Palaeornis eupatria* belongs to 'Near Threatened' category where as the remaining 95 species belong to 'Least Concern' category. Other studies in the region are of Whistler (1919), Dhindsa et al. (1988), Kler (2006), Kler (2009), Kler & Kumar (2015a,b). Similar studies conducted in other states of India found 117 species of terrestrial birds from northern Bengal (Roy et al. 2012), 41 species of birds from Chandertal Wildlife Sanctuary-cum-wetland in Trans-Himalayan cold desert region of Himachal Pradesh (Rana et al. 2014), 104 species from Telangana (Narayana et al. 2015), 139 species from Uttar Pradesh (Yashmita-Ulman & Singh 2021), and 63 species from Maharashtra (Khabade et al. 2022).

The collected data subjected to Shannon diversity index showed that all the study sites were highly diverse and the values are summarized in Table 2. On comparison of the diversity index of all the study sites, it has been found that site 3 (3.638) is highly diverse followed by site 1 (3.512), site 4 (3.431), site 2 (3.375), site 6 (3.229) and site 5 (3.098).

Similarly, the values of Margalef's Richness Index showed that site 1 (7.495) have more number of species than site 2 (6.591) followed by site 4 (5.887), site 3 (5.279), site 5 (5.078) and site 6 (4.789) possess least number of species. Hence, it is observed in the present study that agricultural habitat have more number of species as compared to forest habitat (Table 1). It has been concluded that the agricultural habitats in the study area form agricultural mosaics with combination of natural vegetations, various cropping patterns, irrigated fields and rural residential areas and thus provide number of nesting, feeding and roosting sites and ultimately harbour abundant avian diversity. After Green Revolution, the conversion of forest lands or woody patches into agricultural areas ultimately affected the avian species in the district which prefers forest or undisturbed woody areas. The area under forest cover in district as well as in state is reduced to less than 5%. Moreover, the work of highway building project also affected the presence of different bird species at transect sites 5 and 6 of Mattewara forest in the study area. On the basis Pielou's evenness index, it is found that all the study sites possess an even distribution and dispersal of species. All the values are near 1 i.e., site 3 (0.916) followed by site 4 (0.845), site 6 (0.821), site 1 (0.816) and site 2 and site 5 (0.805) each. As per Berger-Parker index the results showed that site 5 (0.121) has higher index of dominance as compared to site 2 (0.085), site 6 (0.077), site 1 (0.075), site 4 (0.074) and site 3 (0.069).

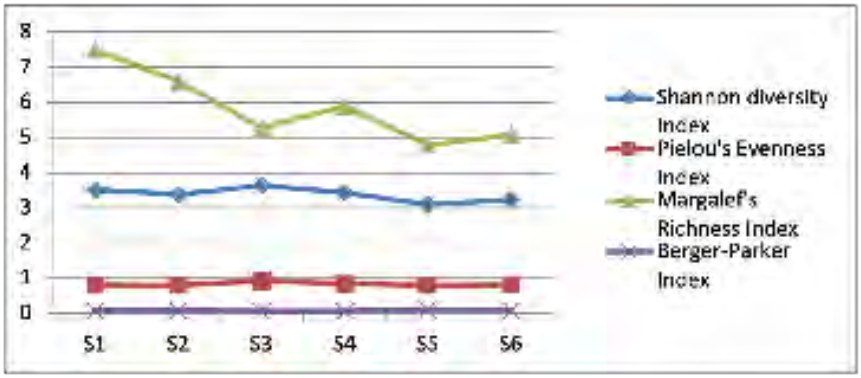
While surveying to explore the avian diversity in the study area, number of threats causing

Table 1: Distribution of recorded avian species in studied sites.

	Common name	Scientific name	IUCN List status 2020	Agriculatual Habitats				Forest Habitats	
				S1	S2	S3	S4	S5	S6
1.	Indian Pond Heron	*Ardeola grayii* (Sykes, 1832)	LC	+	+	+	+	+	+
2.	Black-crowned Night Heron	*Nycticorax nycticorax* (Linnaeus,1758)	LC	+	+	+	+	-	-
3.	Cattle Egret	*Bubulcus ibis* (Linnaeus,1758)	LC	+	+	+	+	+	+
4.	Intermediate Egret	*Ardea intermedia* Wagler, 1829	LC	+	-	-	+	-	-
5.	Little Egret	*Egretta garzetta* (Linnaeus, 1766)	LC	-	+	-	-	-	-
6.	Red-naped Ibis	*Pseudibis papillosa* (Temminck, 1824)	LC	+	+	+	+	-	-
7.	Spot-billed Duck	*Anas poecilorhyncha* Forster, 1781	LC	+	+	+	+	-	-
8.	Lesser Whistling Duck	*Dendrocygna javanica* (Horsfield, 1821)	LC	+	+	+	+	-	-
9.	Black-winged Kite	*Elanus caeruleus* (Desfontaines, 1789)	LC	+	-	-	+	-	-
10.	Black Kite	*Milvus migrans* (Boddaert, 1783)	LC	+	+	+	+	+	+
11.	Shikra	*Accipiter badius* (Gmelin, 1788)	LC	-	+	+	-	+	+
12.	White-eyed Buzzard	*Butastur teesa* (Franklin, 1831)	LC	-	-	-	-	-	+
13.	Grey Francolin	*Francolinus pondicerianus* (Gmelin, 1789)	LC	+	+	+	+	+	+
14.	Indian Peafowl	*Pavo cristatus* Linnaeus, 1758	LC	+	+	-	-	+	+
15.	White-breasted Waterhen	*Amaurornis phoenicurus* (Pennant, 1769)	LC	+	+	+	+	-	-
16.	Black-winged Stilt	*Himantopus himantopus* (Linnaeus, 1758)	LC	+	+	+	+	+	+
17.	Red-wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	LC	+	+	+	+	+	+
18.	Ruff	*Calidris pugnax* (Linnaeus, 1758)	LC	-	+	-	-	-	-
19.	Common Snipe	*Gallinago gallinago* (Linnaeus, 1758)	LC	+	-	-	-	-	-
20.	Green Sandpiper	*Tringa ochropus* Linnaeus, 1758	LC	-	-	-	-	+	+
21.	Rock Pigeon	*Columba livia* Gmelin, 1789	LC	+	+	+	+	+	+
22.	Yellow-footed Green Pigeon	*Treron phoenicopterus* (Latham, 1790)	LC	+	+	-	-	+	+
23.	Eurasian Collared Dove	*Streptopelia decaocto* (Frivaldszky, 1838)	LC	+	+	+	+	+	+
24.	Spotted Dove	*Spilopelia chinensis* (Scopoli, 1786)	LC	-	-	-	-	+	+
25.	Laughing Dove	*Spilopelia senegalensis* (Linnaeus, 1766)	LC	+	-	+	+	-	-
26.	Alexandrine Parakeet	*Palaeornis eupatria* (Linnaeus, 1766)	NT	+	-	-	-	+	+
27.	Rose-ringed Parakeet	*Alexandrinus krameri* (Scopoli, 1769)	LC	+	+	+	+	+	+
28.	Greater Coucal	*Centropus sinensis* (Stephens, 1815)	LC	+	+	+	+	+	+
29.	Asian Koel	*Eudynamys scolopaceus* (Linnaeus, 1758)	LC	+	+	+	+	+	+
30.	Common Barn Owl	*Tyto alba* (Scopoli, 1769)	LC	+	-	-	-	-	-
31.	Spotted Owlet	*Athene brama* (Temminck, 1821)	LC	-	+	+	-	+	+
32.	Indian Grey Hornbill	*Ocyceros birostris* (Scopoli, 1786)	LC	+	-	+	+	+	+
33.	Common Hoopoe	*Upupa epops* Linnaeus, 1758	LC	+	+	-	+	-	-
34.	White-breasted Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	LC	+	+	+	+	-	-
35.	Pied Kingfisher	*Ceryle rudis* (Linnaeus, 1758)	LC	-	-	-	+	-	-
36.	Green Bee-eater	*Merops orientalis* Latham, 1802	LC	+	+	+	+	+	+
37.	Indian Roller	*Coracias benghalensis* (Linnaeus, 1758)	LC	+	-	-	+	+	+
38.	Coppersmith Barbet	*Psilopogon haemacephalus* (Müller, 1776)	LC	-	+	+	-	+	+

	Common name	Scientific name	IUCN List status 2020	Agriculatual Habitats				Forest Habitats	
				S1	S2	S3	S4	S5	S6
39.	Brown-headed Barbet	*Psilopogon zeylanicus* (Gmelin, 1788)	LC	-	+	+	-	+	+
40.	Eurasian Wryneck	*Jynx torquilla* Linnaeus, 1758	LC	+	-	-	-	-	-
41.	Black-rumped Flameback	*Dinopium benghalense* (Linnaeus, 1758)	LC	-	-	-	-	+	+
42.	Brown-capped Pygmy Woodpecker	*Picoides nanus* (Vigors, 1832)	LC	-	-	-	-	+	+
43.	Wire-tailed Swallow	*Hirundo smithii* Leach, 1818	LC	+	+	+	+	-	-
44.	Barn Swallow	*Hirundo rustica* Linnaeus, 1758	LC	+	+	-	+	-	-
45.	Streak-throated Swallow	*Petrochelidon fluvicola* (Blyth, 1855)	LC	+	+	-	-	-	-
46.	Tree Pipit	*Anthus trivialis* (Linnaeus, 1758)	LC	+	+	-	-	-	-
47.	Paddyfield Pipit	*Anthus rufulus* Vieillot, 1818	LC	+	-	+	+	-	-
48.	Yellow Wagtail	*Motacilla flava* Linnaeus, 1758	LC	+	+	+	+	-	-
49.	Citrine Wagtail	*Motacilla citreola* Pallas, 1776	LC	+	+	-	+	-	-
50.	White-browed Wagtail	*Motacilla maderaspatensis* Gmelin, 1789	LC	+	+	-	-	-	-
51.	White Wagtail	*Motacilla alba* Linnaeus, 1758	LC	+	+	+	+	-	-
52.	Red-vented Bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	LC	+	+	+	+	+	+
53.	Common Chiffchaff	*Phylloscopus collybita* (Vieillot, 1817)	LC	+	+	-	-	-	-
54.	Grey-hooded Warbler	*Phylloscopus xanthoschistos* (Gray, 1846)	LC	-	+	-	-	-	+
55.	Sulphur-bellied Warbler	*Phylloscopus griseolus* Blyth, 1847	LC	+	-	-	-	-	+
56.	Hume's Leaf Warbler	*Phylloscopus humei* (Brooks, 1878)	LC	-	-	-	-	-	+
57.	Bay-backed Shrike	*Lanius vittatus* Valenciennes, 1826	LC	-	-	-	-	+	+
58.	Long-tailed Shrike	*Lanius schach* Linnaeus, 1758	LC	+	+	+	+	+	+
59.	Rufous-tailed Shrike	*Lanius isabellinus* Ehrenberg, 1833	LC	+	-	-	+	-	-
60.	Oriental Magpie Robin	*Copsychus saularis* (Linnaeus, 1758)	LC	+	-	+	+	+	+
61.	Indian Robin	*Saxicoloides fulicatus* (Linnaeus, 1766)	LC	+	-	+	+	+	+
62.	Red-breasted Flycatcher	*Ficedula parva* (Bechstein, 1792)	LC	-	+	-	-	-	-
63.	Bluethroat	*Cyanecula svecica* (Linnaeus, 1758)	LC	+	+	+	+	-	-
64.	Black Redstart	*Phoenicurus ochruros* (Gmelin, 1774)	LC	-	-	+	-	+	+
65.	Pied Bushchat	*Saxicola caprata* (Linnaeus, 1766)	LC	+	+	+	+	+	+
66.	Common Stonechat	*Saxicola torquatus* (Linnaeus, 1766)	LC	+	+	+	+	-	-
67.	Brown Rock Chat	*Oenanthe fusca* (Blyth, 1851)	LC	+	+	+	+	-	-
68.	Jungle Babbler	*Turdoides striata* (Dumont, 1823)	LC	+	-	+	-	+	+
69.	Common Babbler	*Argya caudata* (Dumont, 1823)	LC	+	-	-	-	-	-
70.	Rufous-fronted Prinia	*Prinia buchanani* Blyth, 1844	LC	+	+	-	+	-	-
71.	Yellow-bellied Prinia	*Prinia flaviventris* (Delessert, 1840)	LC	+	-	-	-	-	-
72.	Ashy Prinia	*Prinia socialis* Sykes, 1832	LC	+	+	-	+	-	-
73.	Plain Prinia	*Prinia inornata* Sykes, 1832	LC	+	+	+	+	+	+
74.	Common Tailorbird	*Orthotomus sutorius* (Pennant, 1769)	LC	+	+	+	+	+	+
75.	Zitting Cisticola	*Cisticola juncidis* (Rafinesque, 1810)	LC	+	+	+	+	+	+
76.	Purple Sunbird	*Cinnyris asiaticus* (Latham, 1790)	LC	+	+	+	+	+	+
77.	Indian Silverbill	*Euodice malabarica* (Linnaeus, 1758)	LC	+	+	+	+	-	-
78.	Scaly-breasted Munia	*Lonchura punctulata* (Linnaeus, 1758)	LC	+	+	+	+	-	-

	Common name	Scientific name	IUCN List status 2020	Agriculatual Habitats				Forest Habitats	
				S1	S2	S3	S4	S5	S6
79.	House Sparrow	*Passer domesticus* (Linnaeus, 1758)	LC	+	+	+	+	+	+
80.	Sind Sparrow	*Passer pyrrhonotus* Blyth, 1844	LC	+	+	+	+	-	-
81.	Chestnut-shouldered Petronia	*Gymnoris xanthocollis* (Burton, 1838)	LC	-	-	-	-	+	+
82.	Streaked Weaver	*Ploceus manyar* (Horsfield, 1821)	LC	-	+	-	-	-	-
83.	Baya Weaver	*Ploceus philippinus* (Linnaeus, 1766)	LC	+	+	+	+	-	-
84.	Common Starling	*Sturnus vulgaris* Linnaeus, 1758	LC	+	+	-	-	-	-
85.	Asian Pied Starling	*Gracupica contra* (Linnaeus, 1758)	LC	+	+	+	+	+	+
86.	Brahminy Starling	*Sturnia pagodarum* (Gmelin, 1789)	LC	+	-	-	-	-	-
87.	Common Myna	*Acridotheres tristis* (Linnaeus, 1766)	LC	+	+	+	+	+	+
88.	Bank Myna	*Acridotheres ginginianus* (Latham, 1790)	LC	+	+	+	+	+	+
89.	Eurasian Golden Oriole	*Oriolus oriolus* (Linnaeus, 1758)	LC	+	+	-	+	-	-
90.	Black Drongo	*Dicrurus macrocercus* Vieillot, 1817	LC	+	+	+	+	+	+
91.	Rufous Treepie	*Dendrocitta vagabunda* (Latham, 1790)	LC	+	+	+	+	+	+
92.	Large-billed Crow	*Corvus macrorhynchos* Wagler, 1827	LC	-	-	-	-	+	+
93.	House Crow	*Corvus splendens* Vieillot, 1817	LC	+	+	+	+	+	+
94.	Red-headed Bunting	*Emberiza bruniceps* Brandt, 1841	LC	+	+	-	-	-	-
95.	Ashy-crowned Sparrow Lark	*Eremopterix griseus* (Scopoli, 1786)	LC	-	-	-	-	+	+
96.	Crested Lark	*Galerida cristata* (Linnaeus, 1758)	LC	-	+	-	-	-	-
	Total			**74**	**66**	**53**	**58**	**47**	**51**
Recorded (+) Not Recorded (-)									



Species diversity, evenness, richness and dominance in study sites during year May 2016 to April 2020.

loss of bird species has been observed. These threats are mainly anthropogenic such as deforestation, extensive agriculture, excessive use of pesticides, stubble burning, deterioration of natural habitats, pollution and urbanization etc. Jerath et al. (2014) also concluded that the factors such as increased urbanization, change in land use pattern, degradation of natural habitats and pollution, increased demand of timber, deforestation, invasive alien species, poaching, illegal trade of wildlife products, forest fires and encroachments, soil erosion in Shivalik tracts are affecting the forests and wildlife in Punjab. Many studies in other parts of

Table 2: Avian diversity and richness at agricultural and forest transect sites in district Ludhiana, Punjab.

Diversity Indices	Study sites					
	S1	S2	S3	S4	S5	S6
Species number (N)	74	66	53	58	47	51
Shannon diversity Index	3.512	3.375	3.638	3.431	3.098	3.229
Pielou's evenness index	0.816	0.805	0.916	0.845	0.805	0.821
Margalef's Richness Index	7.495	6.591	5.279	5.887	4.789	5.078
Berger-Parker index	0.075	0.085	0.069	0.074	0.121	0.077

the world also observed the modern agriculture as one of the main threats for biological diversity and considered its effect comparable to extensive climate changes (Donald et al. 2002; Donald et al. 2006; Wretenberg et al. 2006). Other workers correlated the decrease in bird populations in Western and Northern Europe with extensive changes in land use and landscape structure (Chamberlain & Fuller 2000; Fuller et al. 1995; Virkkala et al. 2004).

Keeping in mind, various threats to birdlife in the study area, it is need of the hour to initiate suitable steps. As most of the bird species are dependent on native plants for feeding, roosting and nesting. Hence, the plantation of native plants should be encouraged in the region. To increase population of uncommon or rare bird species in the district such as Alexandrine Parakeet, Common Barn Owl, Golden Oriole and Chestnut-shouldered Petronia, it is recommended that different plants associated/ preferred by such species must be grown to provide them favourable foraging, roosting and nesting sites. Environmental awareness and educational programmes are also recommended to educate local people of the state about importance of different bird species and the plants associated with them.

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Sandeep Kaur Thind[1], Charn Kumar[2] & Amritpal Singh Kaleka[3]
[1&3] Department of Zoology and Environmental Sciences, Punjabi University, Patiala, Punjab 147002, India.
[2] Department of Biology, A.S. College, Khanna, Ludhiana, Punjab 141401, India.
Email: [3]apskaleka@gmail.com (corresponding author)

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“Children Crocodile Festival” promoting wildlife conservation education through games in Charotar Region, Gujarat, India

For over a decade, the non-profit Voluntary Nature Conservancy (VNC-India) has worked to conserve crocodiles and reduce human-crocodile conflicts in Gujarat. VNC has equally focused on research and education. Throughout the Charotar region, we have been conducting awareness campaigns and programs to educate the local community about the conservation value of the crocodile and the precautions to be taken when living near crocodile-occupied areas. We have been using different mediums, from distributing awareness materials, audio-video mediums, Power Point presentations and documentary screenings to create awareness. We were searching for a more effective method of raising awareness and educating people than the traditional methods. We discovered that games could be a more creative and effective way of teaching them about crocodiles. That is how VNC created the “Children Crocodile Festival” awareness campaign. VNC believes that environmental education can be transformed from dusty textbooks into interactive games, and that well-designed games can be invaluable teaching tools.

Dr. Raju Vyas addressed the young school children about the event, the crocodile and its conservation importance. © Pruthviraj Patel.

Participants making crocodiles out of mud; students during the event at Petli, Gujarat. © Vishal Mistry.

Children Crocodile Festival is a full-day event for children from government schools, including educational programmes, competitions, and games. Among other things, students learned about crocodile ecology, conservation issues, monitoring techniques, and ways of being safe around a crocodile area. Children

Participants actively engaged in drawing competitions during the event. © Vishal Mistry.

Crocodile Festival 2022 was held on 01 September 2022, at Petli Village and was sponsored by the village's Sarpanch (Village Head), Ms. Bhumi Trivedi, and her husband, Manoj Trivedi. Around 20 participants aged between 11–13 were invited to participate in the event's various activities from 15 schools in villages such as Dabhou, Laval, Heranj, Deva, Navagam, Vaso, Malataj, Tranja, Petli, Demol Roon, Alindra, and Traj. Nearly 350 students gathered at Petli Village Primary School to mark the occasion. The event's theme was "My Village, My Crocodiles".

The event started with the inaugural session by Dr. Raju Vyas, Joint-Vice Chair, IUCN-CSG South Asia & Iran, who gave a brief introduction about Crocodiles and their conservation aspects. The activities began with elocution and drawing competitions. Participants were asked to create the drawing based on their observations. The same went for the "Crocodile Making" competitions.

Moreover, their work shows how closely they have been observing crocodiles in their crocodiles. Their observation showed, about crocodile basking area, the food they eat and the space they share, the fisherman interacting with crocodiles etc. These competitions were followed by various games and concluded with prize distribution in various categories. At the end of the session, volunteers overseeing the game discussed the concepts of crocodile ecology and conservation specific to the game.

Following these competitions were games such as "Crocodile's Eggs," "Crocodile Walk," "Crocodile Burrow," and "My Friend Crocodile, and other nature conservation games." These games were modified slightly from the traditional version to incorporate crocodile ecology, biology, and conservation aspects. For example, in

Children playing the "Crocodile's Egg" game during the event at Petli, Gujarat. © Pruthviraj Patel.

Children played "My Friend Crocodile", modified from the game "Snakes and Ladders", during the event. © Vishal Mistry.

Volunteers of Voluntary Nature Conservancy at the Children Crocodile Festival 2022, Petli Village, Gujarat. © Pruthviraj Patel.

the game "Crocodile Eggs", players learn about the fact that female crocodiles can be protective and thus aggressive during the nesting season and precautions must be taken to avoid any conflict situation. "Crocodile Walk" teaches children about the habitat and physiology of crocodiles, their basking behaviour, and their food habitat. Games like "Crocodile Burrow" teach them about nesting ecology. There is also a "My Friend Crocodiles" version of Snakes and Ladders that teaches about responsible behaviour when living near a crocodile area. Winners got their prizes accordingly, in terms of certificates, writing pads, school bags, and water bottles. Moreover, all the participants were given a geometry box, as a token gift, for their participation and efforts. During this event, children learned to appreciate the presence of crocodiles right alongside them next to human settlements, which gave them an understanding of wildlife living harmoniously in a human-dominated world.

In the future, we hope to expand this program to include more than 500 students each year, allowing conservation education to reach a larger audience in a larger region.

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Submitted by Anirudhkumar Vasava Voluntary Nature Conservancy, 104-Radha Vandan, Behind Union Bank, Vallabh Vidyanagar, Gujarat 388120, India. Email: anirudh@vncindia.org

Announcement

Ten years of Kalinga Foundation – serving India's wildlife and those who protect them

In November 2013, herpetologist Dr. P. Gowri Shankar and Mrs. Sharmila Rajasegaran, aided by like-minded trustees, started the Kalinga Foundation, with its sister concerns Kalinga Centre for Rainforest Ecology (KCRE) and Kalinga Mane, aiming at biodiversity research and conservation. Nestled in Agumbe (13.5754N. 75.1065E; 860 m), one of the wettest places in India (10 m rain / yr), this place is a part of the global biodiversity hotspot – the Western Ghats. With a vast array of diversity at hand, it is the right choice for setting up this conservation center.

Kālinga Foundation

Kālinga Centre for Rainforest Ecology

S.R.Ganesh, Kalinga Foundation, Agumbe, Shivamogha 577 411, Karnataka, India. Email: snakeranglerr@gmail.com.

Gowri and Prashanth rescuing a king cobra.

Tropical evergreen rainforests are one of the most biodiverse ecosystems on the planet. The Western Ghats is one of the most threatened regions in the Oriental realm, with lot of human pressure mounting on its fragile natural resources.

The Kalinga Foundation's establishments are some of the few available biodiversity research field stations in the Western Ghats, catering to the needs of a wide array of biologists and nature enthusiasts alike. The Kalinga Foundation's base has served instrumental for the study and exploration of several life forms including plants and trees, insects and other invertebrates, birds, mammals and of course herpetofauna – amphibians and reptiles.

Learning on field with the Irulas during during STORM chennai workshop.

Why are snakes so special? Of all the human-animal conflicts, if there is one animal that has the most widespread and frequent such negative interactions of all, it is the snake. That is because snake is perhaps the only animal that broadly cohabits with people and at the same time, is capable of being life-threatening to people (i.e., venomous snakes). Though their (retaliatory) bites lead to human deaths if untreated, snakes are the only animals capable of hunting rodent pest animals like rats inside their burrows and thereby contribute to biological pest control, avoiding potential famines.

Gowri rescuing a king cobra at Agumbe. © Prashanth, P.

Recently in India, several voluntary, self-appointed people have come up aiming to protect snakes by rescuing them from stray situations by translocating them from human households, to nearby vegetated bush belts and green covers. Often, they network and synergise with the government bodies such as the forest department and secondly the fire and rescue service departments. that are officially entrusted with these tasks. To this end, the Kalinga team has contributed a lot in this one decade of its service, conducting several pro-conservation camps, workshops and other such events, as given below.

Kinds of programmes	No. of beneficiaries
No. of snakes saved indirectly	288,000
No. of King Cobras rescued	135
Total school & college students	4,490
Specialised visitors to KCRE	903
STORM workshop (all cities)	667
KCRE camp participants elsewhere	501
Others' camp participants at KCRE	525
Forest Department event officials/staff	345
Dusk to Day event participants	130
King Cobra bionomics participants	153
Student interns and trainees	83
SION & VRM (campus surveys)	52
Villagers attending our events	>20,000

True to its motto, research and informed conservation has been the mainstay of the routine works of the Kalinga Team. Training young people into becoming wildlife conservation professionals is an important task in this endeavor. To this end, since April 2014 till September 2023, the Kalinga team has nurtured and sculpted over 85 such interns and student trainees in various capacities on flora and fauna. Some of such interns have graduated from Kalinga Foundation to do their higher studies in wildlife including PhD and Post Doc in universities both in India and abroad (Germany, Switzerland to name a few).

Training forest officials at Andamans.

Needless to tell, several biodiversity research works and conservation projects have been carried out by the Kalinga team and its allies. Many studies including molecular phylogenetics of the king cobras (in collaboration with Indian Institute of Science, North Orissa University, Uppsala University Sweden and University of Bangor UK, University Malasia Sarawak), radio-telemetry studies on vipers (Mysore University), to agamid lizard ecology and man-crocodile conflict mitigation (University of Warsaw, Poland) and herpetological assemblage structure (University of Leiden, Netherlands) have been conducted by our team.

As summarised above, in this one decade, the Kalinga team has served in proper streamlined rescue of 2,88,000 snakes indirectly, in many parts of India and in educating and improving 7,677 beneficiaries from all walks of life, including students and professionals from

non-government and government sectors, involved in snake conservation. And of course, in a very direct sense, the Kalinga team has rescued and saved nearly 135 King Cobras from distress situations from human settlements in the Shivamogga district of Karnataka, southern India.

At this juncture, we also thank our like-minded, pro-conservation partners such as Rufford, IdeaWild and ERASMUS who sponsored and funded some of our activities. In the years to come, the Kalinga team looks forward to expand its horizon and delve deeper into scientifically-informed conservation.

List of publications by the KCRE team:

Bors, M., N.P. Mohanty & P.G. Shankar (2020). Anti-predatory sleep strategies are conserved in the agamid lizard *Monilesaurus rouxii*. *Behavioral Ecology and Sociobiology* 74: 1–8.

Shankar, P.G., P. Swamy, R.C. Williams, S.R. Ganesh, M. Moss, J. Höglund & S.K. Dutta (2021). King or royal family? Testing for species boundaries in the King Cobra, *Ophiophagus hannah* (Cantor, 1836), using morphology and multilocus DNA analyses. *Molecular Phylogenetics and Evolution* 165: 107300.

Bors, M., N. Mohanty & G.S. Pogiri (2022). Comparison of diurnal and nocturnal escape behaviour of the lizard *Monilesaurus rouxii* (Reptilia: Agamidae). *Herpetology Notes* 15: 839–844.

Blessy, J. & S.R. Ganesh (2023). Observation on self-locking concertina climbing in the Common Indian Krait (*Bungarus caeruleus* [Schneider, 1801]). *Sauria* 45(3): 52–54.

Sathyanarayana, M.C.S. & S.R. Ganesh (2023). First observation on multi-male nerophilic amplexus and mass mortality of amplectant adult females in the Common Asian Toads. Frogleg #148. In: *Zoo's Print* 38(10): 9–11.

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Address
Zoo Outreach Organisation
3A2 Varadharajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Phone: +91 9385339862 & 9385339863
E-mail: zooreach@zooreach.org
Website: www.zoosprint.zooreach.org, www.zooreach.org

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