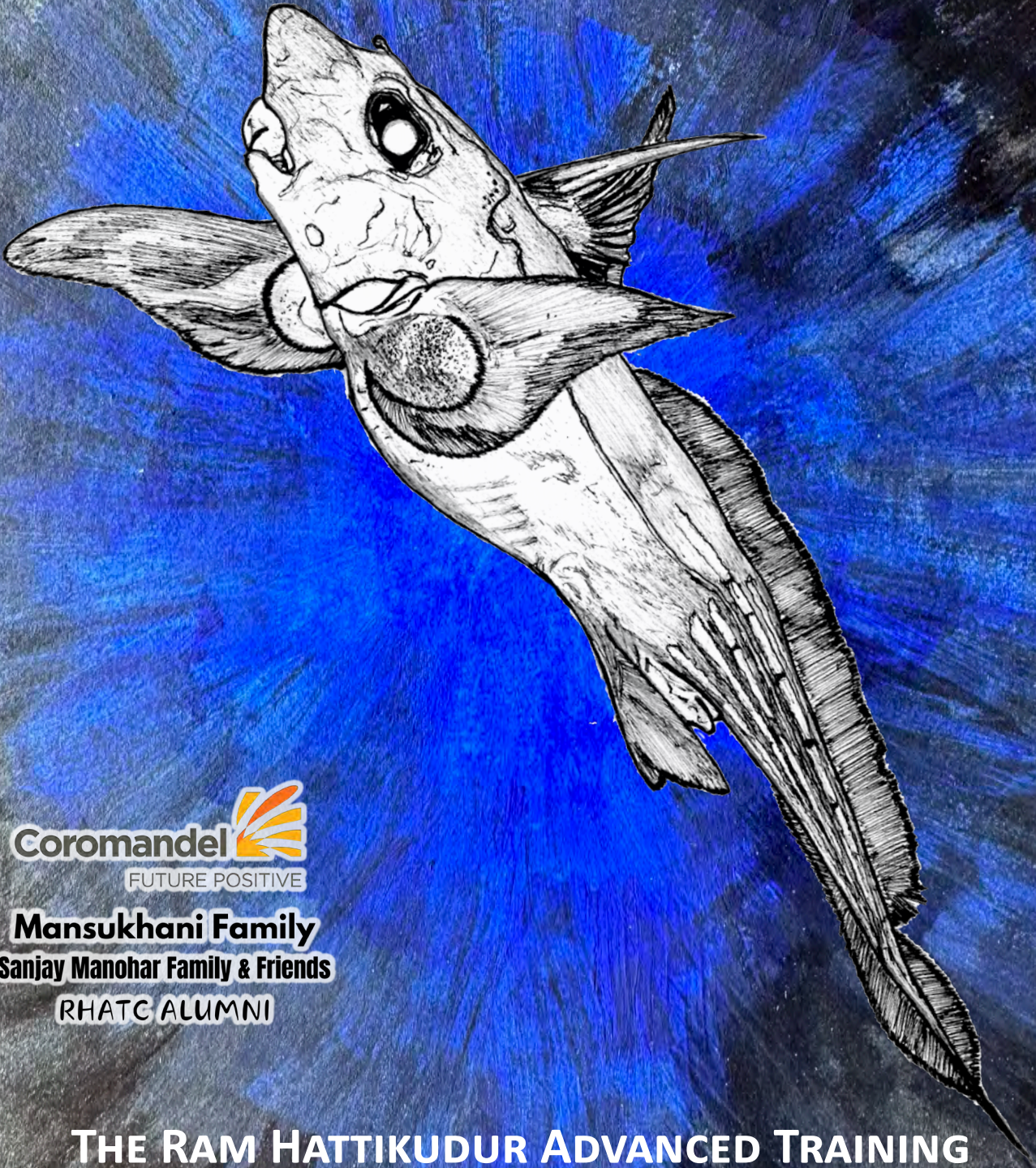


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**THE RAM HATTIKUDUR ADVANCED TRAINING
IN CONSERVATION
2023–24 Special Issue**

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Preserving Paradise: A Journey through Ecological Wonders

Zoo Outreach Organisation has been conducting the four-month Ram Hattikudur Advanced Training in Conservation (RHATC) since 2021 annually. The course provides immersive training for 10 fellows to become future leaders in the field of conservation. The RHATC 2023–24 batch is focusing on the theme of grassland ecosystem to study the principles of conservation biology. The RHATC program also teaches through practical and experiential learning by conducting many field visits to unique landscapes with diverse conservation case studies. One such significant field visit was the journey to the Western Ghats and learning with experts at Liana Trust in Hunsur, Mysuru District, Rainforest Retreat and Magnolia Mist in Kodagu District of Karnataka. Here, amidst the scenic landscapes, we the RHATC fellows delve into the intricacies of the grassland ecosystem, gaining insights into its diverse biodiversity. The Western Ghats, renowned for its ecological significance, provides a rich learning ground. Through hands-on experiences, we developed a comprehensive understanding of the interconnected web of life within the grassland habitat and nurtured a deep appreciation for the delicate balance of nature.

1. The Liana Trust: a refuge for abandoned exotics

1.1 Introduction

The Liana Trust was the first educational spot for us to explore. Situated in Hunsur, Karnataka, "Gerry Martin Project " was started by Gerry Martin and renamed as "The Liana Trust" in June

2020. The team at The Liana Trust primarily focuses on human-snake negative interaction and their mitigation, additionally working on ecological studies of Russell's Viper *Daboia russelii* using radio telemetry, a technique used for better comprehension of the species. The radio telemetry data provides information on the location of Russell's Vipers, their movement and keeps a track of their home range. It helps to warn the local people to avoid snake bites and spread awareness on conserving these species in the region. It also sheds light on post capture translocation stresses in snakes. Russell's Viper are studied due to their extensive presence in the agriculture lands and urban ecosystem of Hunsur region.

The scientific insight on all the above mentioned information was obtained from the resource person and his team. It was necessary to understand how conservation holds significance in restoring the balance in ecosystems. The



RHATC fellows interacting with Gerry Martin.
 © B. Ravichandran.

following details will talk about understanding pet trade, how the radio telemetry technique is a useful tool, and anti-venom production.

1.2 Pet Trade- A never-ending loop

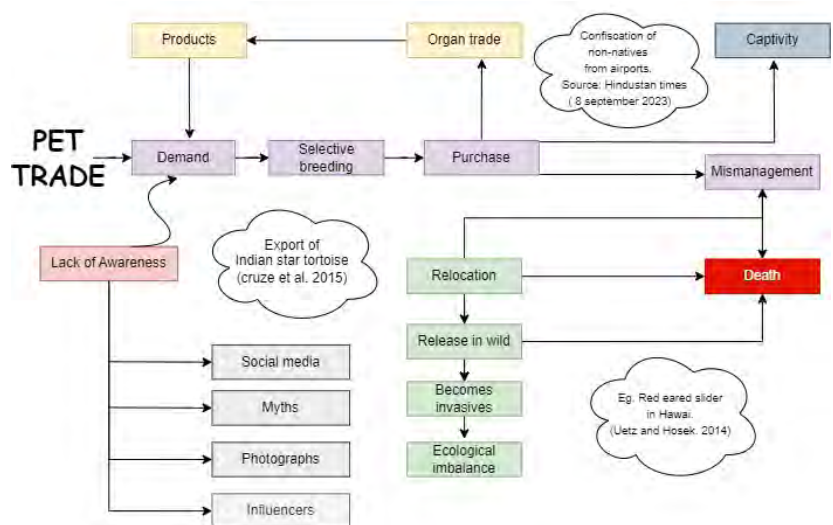
The pet trade is an inevitable chain reaction that has been going on extensively for the last few decades. The chain is fed by an increased societal demand to consider exotics as objects to show off via social media posts or photography. This increased demand for rare species has compelled the breeders to selectively breed them and induce recessive traits in the population. These species are frequently auctioned or sold off at very high prices, for example around 653 individuals of Indian Star Tortoise were reported for sale in Bangkok and Thailand in the past 10 years (Cruze et al. 2015). There is a possibility that the trafficked animals might also enter the black market to satisfy the increased demand for organs. There have also been lots of myths and superstitions associated with use of animals for medicine, as food sources, etc which is often the result of lack of awareness and education.

There have been reports of the confiscation of 55 Ball Pythons, 17 King Cobras, and six dead Capuchin Monkeys from Bengaluru International Airport (Hindustan Times News 2023). All of this demand and supply is also fuelling the entire cascade. Apart from that, the exotic species who manage to survive the tormenting journey away from their natural habitats are greatly mishandled by people. The abandoned pets either end up in captivity in zoos or pet cafes, for example a pet Red-tailed Boa Constrictor from

Florida was adopted by the Emerald Coast Zoo (nwfdailynews 2018). In most cases, the unwanted pets end up being relocated or released into the wild, where they mostly die because of unfamiliar environments or in the worst case scenario end up establishing a breeding population and becoming invasive. An excellent example would be the population of Red-eared Sliders *Trachemys scripta elegans* which is native to the central United States of America and has been reported to have established non-native populations in Brazil (Martins et al. 2014). An invasive population always ends up replacing the native species and creates an ecological imbalance. Although there are not a lot of



An interactive session for and about snakes.
 © B. Ravichandran.



A condensed flow chart showing the current pet trade culture.
 © Amrin Ansari and Praveen Rozario.

reports indicating the import of exotic species as pets in India, we found a variety of abandoned reptiles belonging to Africa, South America, Brazil, Yemen, Indonesia, the Philippines, and the Caribbean Islands which were being rescued from across the country and given a refuge in the Liana Trust.

1.3 Radio telemetry

Radiotelemetry is used to track the animal's movement, location, body condition (i.e., temperature of the body and heart beat) and its environment (i.e., atmospheric pressure and temperature) of animals through radio waves for research (Fuller & Fuller 2012). The Liana Trust has set up a module for mitigating human-snake negative interaction by introducing microchips for medically important snakes to check their movements. Russell's Viper *Daboia russelii*, being one among the medically important snakes, is found very close to agricultural patches due to the presence of rats. People working on farms or in agricultural lands are more prone to snake bites, mostly getting bitten on the arms and legs during the process of weed cutting and harvesting (Williams 2021). People tend to protect themselves from snake bites and the first thing that occurs to their mind is to kill the snake to survive. Gerry Martin and his team are catching snakes which are medically important and surgically inserting microchips for tracking their home range. This scientific method also gives information if the snake is near or in human settlements, as it can be an effective way to warn people to be aware of snakes. What was previously considered 'rescue' is considered one of the strategies to mitigate human-snake negative interactions in the region, including catching them and translocating them far away

from the location where they were caught. But according to Williams (2021), microchipping translocated snakes showed that the snakes were stressed, starvation, showed abrupt pattern of movement in the region and eventual decline in health condition sometimes leading to death (Williams 2021). Gerry Martin also mentioned this during his session that translocation of the captured snakes released far from their home range causes prolonged death.

These are some main actions that are currently helping to overcome human-snake conflict, but along with this education and outreach for the local people has been more effective in mitigating the human-snake negative interactions in the region of Hunsur. Providing gum boots and other necessary materials for avoiding snake bites among people working in agricultural sectors also contributes in making it successful. The Liana trust is thriving to create this module to spread it across all the districts of Karnataka, as well as to cover many other states of India gradually for humans and snakes to co-exist.

1.4 Anti-venom production

In India, snake bites cause around 46,000 deaths annually (Mohapatra et al. 2011) mostly impacting those belonging to lower economic backgrounds (Harrison et al. 2009). There are a lot of myths, superstitions, and malpractices associated with these misjudged creatures. India has been using a polyvalent antivenom produced against the "Big Four" namely the Spectacled Cobra *Naja naja*, the Common Krait *Bungarus caeruleus*, Russell's Viper, and the Saw-scaled Viper *Echis carinatus* for all the venomous snake bites (Laxme et al. 2019). Reports suggest that



Happy faces at The Liana Trust. © B. Ravichandran.

the antivenom produced from the Big four is not effective in neutralizing the venom of other species predominant in the country (Warrell et al. 2013). There can be a possibility of regional variation of venom composition or low potency of the polyvalent antivenom (Whitaker & Martin 2015), hence implying an immediate requirement for production of species-specific antivenom.

Currently, Gerry and his team are trying to synthesize specific anti-venoms by venom extraction of the captive vipers within the Trust rather than depending on a single polyvalent antivenom for all the snake bites. They are also trying to make a difference in the marginalized society by providing crude venom free-of-cost to pharmaceutical companies in order to reduce the cost of anti-venom.

2. Agroforestry at Rainforest Retreat

2.1 Rainforest Retreat and Mojo Plantation

From Liana Trust, we visited another wonderful place in Coorg. A unique initiative that blends ecotourism, sustainable agriculture, and environmental education is Rainforest Retreat situated amid the tropical montane rainforests of the Western Ghats of Kodagu (Coorg) District

in southern Karnataka. The Mojo Plantation Spice Farm, a project of Rainforest Retreat is a certified organic farm close to Galibeedu village, situated in an area with abundant rainfall. The rainfall in this region with an elevation of 1,100 m is between 3,500 and 5,000 mm (200 inches) each year, with the most of it falling between June and September.

Sujatha and Anurag Goel were working professionals in Delhi who quit their jobs and were passionate about farming. They came to Coorg, bought some land, and wanted to do farming in a much more meaningful way where they could produce crops without using any sort of pesticide, or synthetic fertilizers, not causing any disturbance to the ecosystem. Initially, they faced a lot of challenges and one of them was the problem of cardamom borer which used to feed on the stem of cardamom and destroyed the crop. To avoid the infestation they experimented with the extraction of phytochemicals and oil extracts from Indian Beech *Pongamia pinnata* (Raghav et al. 2019), *Annona* species (Isman & Seffrin 2014), Wild Tobacco *Lobelia nicotianifolia* and *Lantana camara*



The lovely cottages at Mojo plantation. © V.B. Pannaga.



Fellows building bridges in Mojo plantation.
 © B. Ravichandran.

(Melanie et al. 2020) and sprayed it on the stem of cardamom and it worked well and reduced the infestation. Also, leaving forest patches intact in their plantations created a microhabitat for numerous birds, insects, and frogs that feed on these insects reducing the chances of infestation. Monoculture cultivation has always been susceptible to diseases, poor diversity makes the crops vulnerable to bacteria and fungi. Having the forest patches intact reduces the chance of disease and infection among the crops. So nature by itself took care of insects and diseases thereby creating a sort of ecological balance providing more stability (Thomas & Kevan 1993).

They also refused to use any sort of synthetic fertilizers on their farm instead they produced their manure by composting. They used cow dung, litter, organic waste, and slurry from the biogas plant to create compost. All these things were piled up and covered so the microbes degraded the complex organic matter into simpler units. They used this as an organic manure for their plantation. By doing so the fertility of the soil was maintained without causing any impacts.

Rainforest Retreat offers a unique blend of education and adventure. We, RHATC fellows, had an immersive practical exposure to the ways of sustainable agriculture through hands-on activities on the farm. We built the bridges using bamboo and other wooden logs and also enjoyed bio-composting. The compost was later applied to the coffee plants in their plantation.

This wonderful place opens up opportunities to explore exciting trails and engage in educational activities that promote ecological awareness leading to a deeper understanding of sustainable agricultural practices. The retreat also includes visits to sacred groves and picturesque grasslands along riverbanks, enhancing the connection between nature and participants. This holistic approach fosters an appreciation for biodiversity and ecological balance.

2.2 Ridge Walk

On 11 November 2023, we went for a 12 km ridge walk which was full of excitement and finding interesting species of plants and insects all along the way. It was also about learning how monocultures, anthropogenic activities and invasive species are causing the ecological



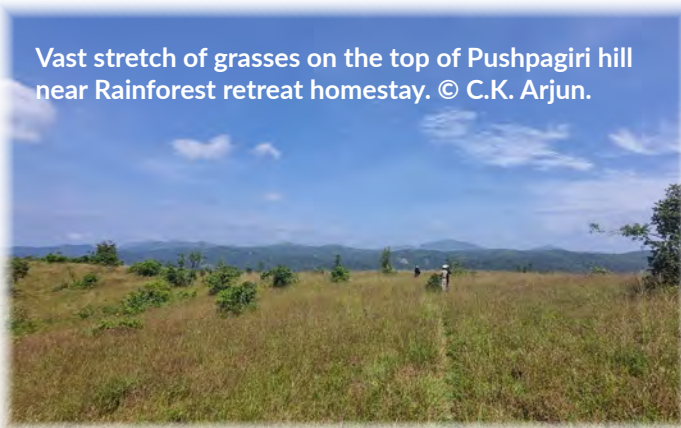
Sujatha Goel explaining about organic farming with the usage of compost and biopesticide.
 © B. Ravichandran.



Beautiful Lantern flower *Ceropogia* sp.
 © Praveen Rozario.



Malabar Giant Squirrel peacefully feeding on fruit of Fish tail palm.
 © Praveen Rozario.



Vast stretch of grasses on the top of Pushpagiri hill near Rainforest retreat homestay. © C.K. Arjun.



Image depicting the beautiful Kalur river and the patches of grasses at the river bank.
 © V.B. Pannaga.



Mesmerizing green mat outside the sacred grove temple. © C.K. Arjun.

imbalance in that area. That was evident from the remains of the 2018 landslides we observed at a few places. Dr. Sanjay Molur, course director, RHATC explained the reasons for such landslides and how the disturbed vegetation causes the soil to loosen up after heavy and continuous rainfall. Some of the landslide areas have started having new vegetation but the risk of invasive species dominating the place is very high! On the way, we saw the beautiful plant of *Ceropegia* sp. We also observed some species of *Sida*, *Ziziphus*, *Cinnamomum*, *Solanum*, *Caryota urens*. After reaching the top, we witnessed the mesmerizing view of the shola landscape all around! On our way back home, Ravi who works at Rainforest Retreat, gave us the fruits of the Balloon Vine *Cardiospermum halicacabum* to eat. It was one of the sweet memories we carried back.

2.3 Bhadrakali Sacred Grove

We visited the Bhadrakali sacred grove marshland which is 400+ years old. We were welcomed by a beautiful Malabar Giant Squirrel *Ratufa indica centralis* feeding on *Caryota* fruits. We also came across the mud puddling butterflies and the footprints of elephants and gaur making their presence evident. There was a beautiful fern along the edge of the stream and the thin layer of spores on the underside of the fern was dazzling in golden color in the sunlight, hence the name Golden Fern. There were many ephemeral plants like *Eriocaulon* sp. as well as some individuals of *Impatiens balsamina* too.

2.4 Kalur River

On the last day at Rainforest Retreat we visited Kalur River which is an unique ecosystem comprising water bodies and grasslands at the river bank. We learnt about the importance

of wetlands and grasses and their ecological role. Shallow water, deep pools, riffles, and the grassland along the banks of the stream are unique and different from each other in terms of species diversity and their roles in the ecosystem.

The species that live in each of these micro-habitats are very specific and adapted to the environment. Any disturbance to their habitat could cause imbalance and loss of stability. For example, a species of fish (A) lives in shallow water species (B) lives in deep water, and species (C) in riffle, if a check dam is constructed then the water level will increase and the riffle is transformed into stagnant water where both the species which were living in shallow water and riffle will be eliminated and the species which was living in deep water would increase in its numbers causing an imbalance (Schmutz & Sendzimir 2018). Grasslands on the river banks are crucial landscapes and play an important role in preventing soil erosion as their roots are fibrous and penetrate deep into the soil so they bind the soil tightly.

This was our experience at Rainforest Retreat. It is a nature lover's heaven, surrounded by beautiful hills and densely forested valleys. This area has some of the best trekking and birdwatching spots in southern India. Since its establishment in 2000, the Rainforest Retreat has drawn a diverse range of guests who are all connected by a love and respect for nature, including scientists, researchers, artists, farmers, students, and the elderly.

3. Magnolia Mist

3.1 Magnolia Tree

The gigantic Champa Tree *Magnolia champaca* tree “born and brought up” at the Magnolia mist is approximately 2,000–2,500 years old. The seeds of the tree are red in color and the fragrance of the flowers exceeds more than a kilometer. It is one of the 10 oldest trees in southern Asia. This is the only standing tree that harbors 23 different varieties of orchids and is home for various species like Nilgiri Marten *Martes gwatkinsii*, Rat Snake *Ptyas mucosa*, Spectacled Cobra *Naja naja*, Malabar Grey Hornbill *Ocyrceros griseus*, Lesser Racket-tailed Drongo *Dicrurus remifer*, White-cheeked Barbet *Psilopogon viridis*, Orange Minivet *Pericrocotus flammeus*.

3.2 Magnolia mist

Magnolia mist that is named after the majestic and magnificent *Magnolia champaca*, is a 25-acre plantation situated in Kodagu District of Karnataka, owned and managed by Abhishek Jain and his family. Abhishek Jain previously worked as naturalist in TATA groups of hotels.



2000 years old Magnolia tree in Magnolia mist, home for various different species. © C.K. Arjun.

His passion towards conservation and leaving a healthy planet behind for the future generation motivated him to resign as a naturalist in the TATA group and become involved in organic farming. Abhishek grows and cultivates native and exotic species in his land organically and simultaneously leaves a large portion for the ecosystems to evolve naturally to support the biodiversity in the region.

Initially a large area was cultivated with rice to generate revenue, however, he is gradually reducing the land under cultivation and aiming for subsistence. Different local varieties are grown in alternate seasons, and currently local variety ‘Khata’ that has the capacity to stay submerged in water for 15–20 days, was sown in the month of June and will be harvested by December. According to Abhishek, the natural



Abhishek Jain explaining about orchid, grown in his garden. © Sanjay Molur.

fertilizer - balls of *Gliricidia* leaves mixed with cow urine and remains of coffee husk is the best method to get rid of rodents, insects and meanwhile increasing the yields from the small area of cultivated land.

The way towards the dining area of Magnolia Mist is a distinctive beauty – it is lined by different orchids, a mini Orchidarium and fest for our eyes! At Abhishek’s orchidarium there are more than 100 species of native and rare orchids, all of which have been collected during the last five years. Vanilla is one of the luxurious growing orchids in Magnolia Mist, a moist evergreen root climber where each flower is pollinated manually. It is harvested in three batches considering the climatic factors.

Coorg is famous for its coffee and so is Magnolia Mist for its organic variety of coffee and processing coffee beans with the right amount of heat, time and blends. Over time, Abhishek has gained enough experience in this arena and revealed to us the secrets of high caffeinated coffee produced when beans are lightly roasted.

3.3 Ecology and Agriculture

Ecology and agriculture go hand-in-hand here. Following are unique examples and learnings during the field walk. Magnolia mist hosts unique biodiversity among all the plantations present in Kodagu District.

Indian Gaur *Bos gaurus* visits the open grasslands and rice fields of Magnolia Mist. The presence of species in the open field is a threat to this species as the local people hunt Indian Gaur. To ensure that the gaurs are provided with a safe foraging space that is well hidden from the

locals, the tea plants in Magnolia Mist are being uprooted and plans are in progress to plant native grasses.

Several birds nest on trees around the rice fields and cutting the nested trees will affect the natural ecosystem. So they started cultivating a part of the land with fragrant rice for bird species to feed on during the cultivation season. Hence Abhishek had planned his rice fields and the area around in such a way that nature does its job to maintain the checks and balances. The dead Silver Oak is not cut to provide habitat for tree-hole nesting species like owls that also feed on rats. Fruiting trees are grown around for birds to feed upon, allowing the ecosystem to flourish while benefiting from the same.

Abhishek explained to us the beautiful phenomenon of the Mahseer fish *Hypselobarbus wayanadensis*, a native species that breeds in the flooded rice fields of Magnolia Mist during the rainy season. This phenomenon indicates that rainfall will be surely received in the upcoming days. These species are conserved in its own natural ecology at Magnolia. In fact, Abhishek and his team guard the fishes from being hunted and leave a particular area of paddyfield unused for the fishes to thrive.

3.4 Mycelium and Dancing Frog

Abhishek and his friends had come up with a remarkable idea to conserve the Western Ghats. A private limited company named Mycelium Ecology was started with rules drafted in such a way that the founders themselves can’t change the land use policy. Mycelium’s first project called the Dancing Frog Habitat focuses on buying private lands near the reserve forests in

Coorg for the purpose of conservation. Mycelium Ecology works like a company rather than a NGO or a Trust. Mycelium ecology now holds 52% of The Dancing Frog Habitat and the remaining 48% is given to its shareholders. The interesting part is that the shareholders do not get any rights to own any part of the land, instead they receive a share of the Dancing Frog Habitat ensuring people have no rights to change the use of the land.

The idea to start Dancing frog and Mycelium Ecology comes from the strong motive and passion to leave behind a reservoir of clean air, water and pristine nature to the upcoming generations, many of whom have not lived, witnessed and understood nature at all.

The owners of private land around the reserve forests had initially planned to convert them into resorts and coffee plantations. This would have contributed to the short-sighted economic development of the place but adversely impacted the biodiversity and led to extinction of many endemic species. However, the efforts taken by Abhishek to convince a few landowners ensured that the land was left as it had been with least human intervention. Hence Mycelium Ecology started acquiring private lands under the name of Dancing Frog Habitat to preserve more of what is left and at the same time restore the sacred groves of Kodagu.

4. Conclusion

The first field visit to Western Ghats was a plethora of experiences, knowledge, learnings, takeaways for all of us. From learning about ecosystems especially the Sholas in the classroom to trekking and witnessing the

mesmerizing beautiful grasslands and also the invasiveness of invasive species, we learnt our lessons. The grave impact of anthropogenic activities was evident in these landscapes in the form of landslides, invasive plant species taking over the natural habitat, linear intrusions in the form of roads, electrical towers and poles, excessive use of pesticides by many farmers in the region, electric fences, construction activities, and resort expansions. Our journey has been an exclusive experience through diverse landscapes, each presenting unique challenges and valuable lessons serving as a fundamental principles which are forever relevant and shaping us to become better leaders in conservation!

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EXPERIMENTAL INSIGHT: A RESEARCH TRIP THROUGH PRACTICAL LEARNING

Vulture Venture

Around 30 km east of Udhagamandalam (Ooty) in the Nilgiri District, Tamil Nadu within Mudumalai Tiger Reserve resides a beautiful landscape called "The Moyar Gorge" which connects the Western Ghats to the southernmost part of the Eastern Ghats. The Moyar gorge bears rich riparian forest and is home to rich faunal diversity (Nagarajan & Bhaskar 2023). On 27 November 2023, the RHATC fellows went to venture with vultures accompanied by wildlife researchers H. Byju and Dr. S. Manigandan; they have been studying vultures since 2016. Byju serves as an executive board member of the Wildlife Information Liaison Development (WILD) Society and is also the author of wonderful books 'Valley of Hope – Moyar' and 'Vultures and The Matriarch: autobiography of an Elephant'.

Vultures have a very acidic gut which enables them to feed and digest carcasses (Manigandan et al. 2021). Being scavengers, vultures are also called the cleaners of the ecosystem (Green et al. 2004) because they prevent the spread of deadly diseases like rabies and anthrax (Prakash et al. 2003). There are four species of vultures found in southern India, namely, White-rumped *Gyps bengalensis*, Long-billed *Gyps indicus*, Red-headed *Sarcogyps calvus*, and Egyptian *Neophron percnopterus* (Manigandan et al. 2021). Unfortunately, their populations have declined by more than 95% within 10 years (Prakash et al. 2003), and White-rumped Vulture, Long-billed Vulture, and Slender-billed Vulture *Gyps tenuirostris* have been assessed as Critically Endangered as per IUCN Red List Categories. The major threat to vultures is due to anthropogenic activities and the veterinary usage of NSAIDs (Non-steroidal



Fellows at Moyar Gorge. © Sanjay Molur.

anti-inflammatory drugs) like diclofenac used for treatment of livestock diseases (Green et al. 2004). Vultures feeding on carcasses of livestock treated with diclofenac caused renal disease showing extensive visceral gout with deposits of uric acid on and within internal organs (Green et al. 2004). As part of conservation initiatives of threatened vultures, diclofenac use for livestock treatment is banned in India (Senacha et al. 2008).

The fellows had an amazing experience to see these phenomenal scavengers at their prime, hovering and scanning their surroundings for food. The vulture experts taught the fellows basic identification keys and identified three species of vultures, namely, Red-headed Vulture, White-rumped Vulture, and Long-billed Vulture.

Later, the fellows visited the Moyar gorge and had a look at the riverine-forest habitat and witnessed charismatic trees like Arjuna tree *Terminalia arjuna* along the river banks. The rest of the gorge typically has dry deciduous vegetation due to the leeward effect. The fellows were overjoyed to spot two Elephants *Elephas maximus* grazing in the gorge along



RHATC fellows looking at the MM Hills and BRT surrounding the HNF interpretation centre. © C.K. Arjun.



HNF team instructing about the usage of Gujarat boilers.
 © Trisa Bhattacharjee.

with Spotted Deer *Axis axis* and Indian Gaur *Bos gaurus*. Watching vultures close by was an amazing opportunity and getting to know personalities like Byju and Manigandan working for the conservation of these vulture species is a privilege.

About Holématti Nature Foundation

For a hands-on experience, the RHATC fellows visited The Holématti Nature Foundation (HNF; Holématti, is a fusion of two words – ‘holé’, denoting a stream, and ‘matthi’, meaning Arjuna Tree *Terminalia arjuna*) situated in Hanur, Chamarajanagara District, Karnataka.

The fellows met Dr. Sanjay Gubbi and his team, who are focusing on preserving the rich tapestry of wild landscapes and diverse species native to Karnataka, employing a multifaceted approach towards conservation. After engaging with the team the fellows came to understand the prolonged population studies on Elephants, Leopards, Tigers, and their prey species; the HNF has partnered closely with the Karnataka Forest Department. This collaboration involves the establishment of new protected areas, the expansion of existing ones, and the identification of vital wildlife corridors.

These efforts aim to protect wildlife habitats and facilitate the movement of wildlife across fragmented landscapes.

Community engagement lies at the heart of their efforts, fostering a sense of shared responsibility for the region's biodiversity. HNF also prioritizes capacity building & awareness initiatives and empowers individuals & communities with the knowledge & skills needed to contribute to conservation efforts actively.

RHATC fellows at HNF Information Centre:

On 28 November 2023, RHATC fellows visited HNF's Nature Information Centre to gain insights about working with the community.

The Holématti Nature Information Centre is situated on the outskirts of the Malai Mahadeshwara Wildlife Sanctuary in the Hanur District of Karnataka and serves as a hub for information about the diverse riverine habitats in and around the region. It emphasizes giving valuable insights into the natural wealth of the area, fostering awareness and appreciation for



RHATC fellows along with the HNF team demonstrating posters on saving chameleons to the locals.
 © V.B. Pannaga.



RHATC fellows interacting with users of Gujarat boilers. Left: © Narmada Naik. Right: © Sanjay Molur.

the rich biodiversity of the Sanctuary. The fellows had an amazing educational session with Dr. Sanjay Gubbi took the fellows through an inspiring journey by sharing his career experience. Supported by intense group discussions, one-on-one interactions, brainstorming sessions for conservation planning, and group-wise community outreach planning, the fellows got a wider understanding of on ground challenges and ways to overcome them. The HNF nature information centre was a platform for the fellows to learn the utilization of space. The information centre helps to improve and deepen the educational experience of all visitors by using interactive, paintings, murals, digital art, infographic prints, and hands-on exhibitions in their small and effectively equipped room. The local audience, including visitors, employees of the forest department, instructors, school students, and residents of the neighbouring villages, are always welcomed and information is made easy to understand by having the materials in Kannada (regional language). The centre's philosophy is to bring the community and other stakeholders under the same umbrella by deploying the relevant tools and explaining niche arenas.

The visit to the information centre was followed by an engaging session of working with the communities. The fellows along with the HNF staff visited Ponnachi, a small village located in the Male Mahadeshwara hills range, where for the past couple of years HNF has been actively involved in community conservation. Earlier, the villagers were entirely dependent upon forests for firewood which led to an increase in human-wildlife negative interactions. To reduce reliance on forests, the HNF team has been actively distributing LPG cylinders and stoves along with Gujarat boilers to the villagers at minimal cost. The fellows took part in the distribution of 24 boilers to the locals alongside witnessing the working mechanism of the boilers being demonstrated by the HNF staff. The HNF team along with the fellows also spread awareness to the locals about chameleons and their importance in the ecosystem through an infographic poster.

In the latter part of the day, the RHATC fellows engaged with individuals who received the Gujarat boiler, seeking to comprehend their perspectives on the product. There was a collective positive response from the previous

users and the villagers reported a decrease in their firewood consumption since the arrival of the boilers. As the boilers are accessible to them at only 25% of their original cost, the residents were delighted and eager to make a purchase and they believe that these efforts have significantly improved their way of living. To sum up, HNF exemplifies an effective approach to conservation by involving the community, offering alternative resources, and fostering wildlife and sustainable development.

Kolekar on Corridors:

On 30 November 2023, the RHATC fellows acquired an insight into wildlife corridors from Aparna Kolekar, a wildlife researcher at HNF primarily working on corridor ecology, human-

leopard interactions, and studying the impact of linear intrusions (mainly roadways) on wildlife movement. The fellows gained knowledge regarding the wildlife corridors which are connecting matrices of isolated habitats like forest fragments, which will help the animal movement from one patch of habitat to the other.

Corridors help in reducing the negative interactions between humans and animals apart from minimizing inbreeding, facilitating genetic exchange and providing access to resources. An added advantage of corridors is that they aid re-colonization in certain habitats where the species may be endangered or at the brink of extinction.



The fellows with team HNF. © Sanjay Molur.

The fellows also gained insights about the current projects of HNF in the Edyarahalli-Doddasampige corridor that connects the Biligiri Ranganathaswamy Temple Tiger Reserve (BRT) and Male Mahadeshwara Wildlife Sanctuary (MM Hills).

The fellows were then accompanied by the HNF team to visit the Edyarahalli-Doddasampige corridor and encounter the ground realities of the landscape where they noted that the efforts of HNF translated to action. Some major actions that were being implemented were the maintenance of a speed limit of 30 km/h within the forest areas in Chamarajanagara District. Apart from that the team also takes part in outreach programs, distribution of educative posters and handouts for drivers on roadsides, alongside conducting clean-up drives along the corridor, etc. The fellows appreciated the commendable work of installing speed bumps along the corridor road by HNF to reduce over-speeding and roadkills.

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The RHATC fellows are thankful to Dr. Sanjay Gubbi, Ashrita Anoop (RHATC fellow 2021–22), Prabhu Veerappa, Narmada S. Naik, and N. Ganesh from the HNF team for their knowledgeable insights and field efforts and also to the Zoo Outreach Organisation team for organizing this educational and enjoyable trip.

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NILGIRI BIOSPHERE RESERVE PARK: AN EXAMPLE OF SCIENTIFIC TRIUMPH



RHATC 2023-24 Fellows at the NBNP with the alumni and Zooreach team. © B. Ravichandran.

Introduction about NBNP

On 14 October 2023, we visited the Nilgiri Biosphere Nature Park (NBNP) along with the Zooreach team. NBNP is located within the Nilgiri Biosphere Reserve (NBR), India's first biosphere reserve, located at Anaikatti, about 32 km from Coimbatore, and home to roughly 110 exclusively endemic plants (NBNP 2022). With an emphasis on protecting its native wildlife, NBNP is an attempt to replicate elements of NBR.

The story of the park starts long back in 1986 when the young couple Shri Rangaswamy and

Nandini Rangaswamy, who were passionate wildlife lovers thought of setting up a zoo in a vast 250-acre barren land. So, they consulted Sally Walker at Zooreach to construct a zoo on this land. Sally had been a part of and worked with Mysore Zoo for years and was instrumental in the setting up of the Central Zoo Authority. Her work stated that our country already has almost 600 zoos and making a new one would not be the best thing to do for animals. Sally was successful in convincing the couple to restore the same land into a biodiversity park full of native species and a haven for the flora and fauna in the region. Out

of the whopping 250 acres of the total area, NBNP occupies 70 acres of the space and has been successfully restored and open to visitors. It is home to 300+ invertebrates, 22 species of amphibians, 100 species of birds, 18 species of mammals, and over 430 species of plants of which 85 species are exclusively found in Nilgiri Biosphere Reserve and, interestingly, nearly 30% of these 85 species are endangered in the wild (NBNP 2022). Also, NBNP is one of only two botanic gardens in the world which has more than 90% native plant species.

The land is flourishing gradually. We could see several seedlings and saplings emerging amidst the existing huge trees planted during the initial stage of the restoration program providing habitat for various species of fauna enriching the ecosystem. The region witnesses several species of butterflies, birds, small mammals, and herpetofauna. Before the restoration program, the nearby villages and farms were frequently visited by elephants due to the absence of food plants and water. This created a lot of negative interactions which caused harm to both people and the elephants. Thus, successful native reforestation ensured a niche for elephants and has actively reduced the interactions in the landscape.

Restoring the area was never a cakewalk and had complications for several reasons such as lack of cooperation, knowledge, external pressures, etc. Sally and the Coimbatore Zoo team started the work by collecting seeds of around 400 native plant species from the NBR, nurtured them in a nursery, and planted them. The team collected seeds for plantation from the nearby forest edges and near Silent Valley,

thinking that all the seeds would be native, little did they know that a few of the species they planted in the region were non-native.

The real challenges began when more than 1,500 plants died. It took the team quite some time to understand that it was heavy wind and lack of shade causing the deaths. Soon they came up with a solution, they made thatches of coconut leaves to provide shade and barricade of sheets along the edges in the wind direction which ensured the proper growth of the saplings. Slowly they started seeing success. Accepting failures that happened while restoring is great evidence of the sincerity and honesty of the endeavour. Over the years, plants were doing well, elephants found a haven, and the villagers were happy.

Along the trail

The Father of Biodiversity, Edward O. Wilson said, "If all the humans die off the planet will not suffer, without mammals, it will recover but without invertebrates, the planet will not survive". At the entrance of the park, there is a board showing some facts, 'A fully matured tree is worth Rs. 1,39,75,840. A tree living for 50 years will generate Rs. 22,60,000 worth of oxygen, provide Rs. 44,83,840 worth of air pollution control, control soil erosion and increase soil fertility to the tune of Rs. 22,60,000, recycle Rs. 27,12,000 worth of water, and provide a home for animals worth Rs. 22,60,000' (derived from the board at NBNP based on Das 1979 – original reference not found). Sanjay explained to us that this figure does not include the value of fruits, lumber, or beauty derived from trees. This helped us understand how much we are taking

the trees for granted and never bothering to repay the debt.

We were welcomed by a huge Banyan tree standing at the centre near the entrance of the garden. The tree has been there since the making of the garden and is of cultural significance for the communities around. There are various native tree species as we looked around, like the Flame of the Forest *Butea monosperma*, Scholar tree *Alstonia scholaris*, Jangli Almonds *Terminalia catappa* & *Hydnocarpus pentandra*, Red Silk Cotton *Bombax ceiba*, Kamala tree *Mallotus philippensis*, and Indian Trumpet Flower tree *Oroxylum indicum* among hundreds of other native species that makes the park look very natural. The park also has a good diversity of lichens, which indicates that the ecosystem is thriving amazingly with good air quality and less pollution.

The Red Silk Cotton Tree *Bombax ceiba* produces white ball of seeds which is similar to cotton, it's used to manufacture pillows

On reaching the park Mr. Kandhaswamy, a botanist at NBNP for the past 12 years, took us around. He explained to us about the native species in the park and their importance in the ecosystem. Alongside, he is a wonderful lepidopterist. We visited the Butterfly Garden within the park where he told us that NBNP is home to around 40 butterfly species! The park has a pond in the centre which homes several native water plants and flowering plants around it. We were lucky to witness species like the



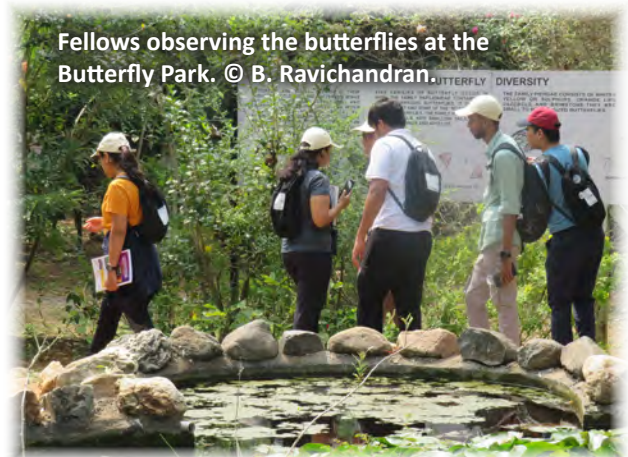
Common Crow
Euploea core.
 © S. Joel.



Orange Blistering beetle
Mylabris pustulata. © Praveen Rozario.



Common Tiger *Danaus genutia.* © S. Joel.



Fellows observing the butterflies at the Butterfly Park. © B. Ravichandran

Common Tiger *Danaus genutia*, Blue Tiger *Tirumala limniace*, Common Crow *Euploea core*, Great Orange Tip *Hebomoia glaucippe*, and many more. There were beautiful water lilies, dragonflies, mating damselfly pairs, a couple of skittering frogs, and the list goes on.

**The fruits of Kamala tree
Mallotus philippensis are
 used to make sindhuram**

After this, Sanjay joined us and as always, he began with a piece of myth-busting discussions. Did you know? The Indian laburnum *Cassia fistula* is a non-native tree and this came as a shock to us considering the history behind the flower 'Kanikonna' — which is majorly used in Kerala during the festival of Vishu. Sanjay also told us that there is a Cycas *Cycas circinalis* belonging to the Cycadaceae family, a group of plants belonging to gymnosperms that have been on earth since the reign of dinosaurs! The species found in the past are predicted to have been ~30 m tall but have adapted and now appear short and stout.

Walking along the trail we noticed that the information and education boards were embedded in concrete structures. This is when Payal (RHATC mentor), explained to us the different challenges conservationists face. This one was quite funny though, as the reason for not having metal boards was that the earlier ones were smashed down by the elephants while using it to scratch their body. Also, she took the opportunity to explain to us about the matriarch movement of elephants and how the park has played a crucial role in

reducing human elephant negative interactions. Earlier before the restoration project started, the elephants from the forests would go into the villages, leading to antagonistic situations. But now, NBNP holds native food trees for the wildlife and thus they are content within the park and don't raid the agricultural farms anymore.

During the 3 km long walk, we saw four nature information centres. The first one showcases hoof and pug marks of major mammals, second one is an insect hut exhibiting beautiful posters of a variety of insects, the third one is an information hut on the bird diversity, an excellent birding spot, and the fourth one an information centre for Tamil Nadu state biodiversity exhibit. We were amazed to spot a Two-tailed Spider *Hersilia* sp. and witness its wonderful camouflage, a Coppersmith Barbet *Megalaima haemacephala* feeding on the trunk of the Indian Rain Tree *Albizia lebbek*, and a couple of Orange Minivets *Pericrocotus flammeus* flying nearby. We came across an intrusion of Indian Red Bugs *Probergrothius sanguinolens* feeding on the seeds of Indian Chestnut Tree *Sterculia* sp. The leaf structure of the fern tree was an absolute piece of beauty! The trail ended with the greetings from a group of Yellow-billed Babblers *Argya affinis*.

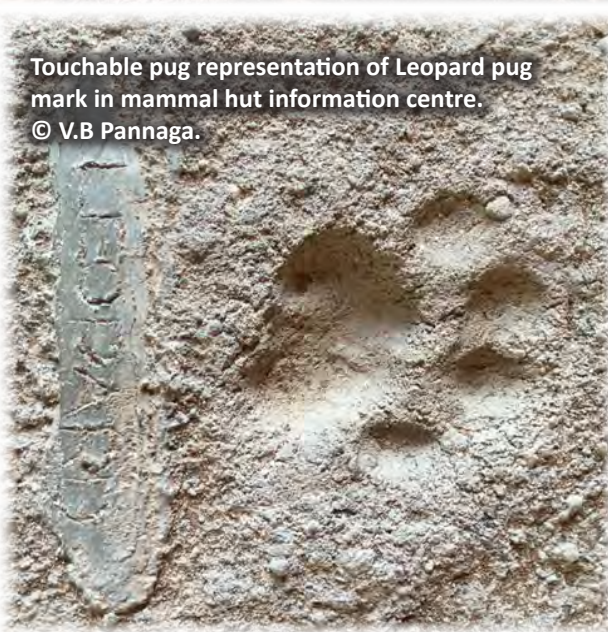
The interconnectedness of nature, the relationship between the Banyan tree and specific fig wasps, as well as the bamboo's unique flowering and fruiting characteristics, which occur only once in a lifetime was something that intrigued all of us. The park is a good example of how restoration if carried out ecologically and scientifically can bring back



Along the trail. © Praveen Rozario.



Tree diversity in NBNP. © V.B. Pannaga



Touchable pug representation of Leopard pug mark in mammal hut information centre.
 © V.B Pannaga.

the wilderness and if taken care for a while will become a self-thriving piece of biodiversity rich land. The trip was a perfect experience for us to learn on the ground and as they say, “stand on the shoulder of giants”.

Involvement of Corporates in Conservation

Halfway during the visit, we were accompanied by around 100 employees from Bosch Global Software Technologies (BOSCH) who were there to learn from the Zooreach team about the park just like us.

Zooreach collaborates with Bosch for a wetland restoration project in Coimbatore as part of their CSR initiative. CSR refers to Corporate Social Responsibility whereby companies give back to society by integrating social and environmental concerns in their business operations and interactions with the stakeholders. It could be financial support or providing support for spreading awareness by conducting seminars and workshops or volunteering for social or environmental causes. In this context, Zooreach conducts a regular field visit to NBNP for the Bosch employees to make them understand the restoration process, and educate them about the ecological significance of species. The goal is to create a sense of responsibility among the urban crowd to conserve and appreciate the native life around them.

For the trail we were divided into three groups, a mix of Bosch employees and RHATC Fellows. After the trail, the employees were given saplings of native trees such as Indian Beech *Pongamia pinnata*, Indian Bullet Tree *Mimusops elengi*, Purple Orchid Tree *Bauhinia purpurea*,

Indian Rain Tree, Indian Bombax *Bombax ceiba*, and Flame of the Forest based on the part of the country they came from and thus giving them sapling native to their home. The idea of giving native trees over exotic tree species was commendable and Sanjay explained the need to plant these native tree species and how to keep them thriving. The awe in their eyes was priceless. Just like us, they were also given amazing new information that is helpful to all of us to understand the conservation and ecological world better.

Visit to Vidya Vanam

After leaving NBNP, all of us (including Bosch employees) visited 'Vidya Vanam' School initiated to provide holistic learning and education for kids from communities and nearby tribes. The school was established in 2007 (Vidya Vanam 2024) with the sole idea of Mrs. Prema Rangachari whose plan was to bring change and give the marginalized equal opportunities for education. An epitome of bravery, she echoes the fact that age is never a barrier to bring change in the society. The school supports a conventional knowledge foundation and gives the students exposure to various experiences to shape them into future leaders and changemakers. At Vidya Vanam, every kid is given the freedom to express their thoughts, fostering a generation of young people who don't hesitate to follow their aspirations.

The journey began when Prema Rangachari in her early 60s left behind city life and started reaching out to the underprivileged, setting an example for others by providing education to the less fortunate, a noble endeavour that reflects the very essence of compassion and



Priyanka explaining about trees to BOSCH employees and RHATC fellows. © B. Ravichandran.



Zooreach team and BOSCH employees at NBNP. © B. Ravichandran.



Mrs. Prema Rangachari conversating with RHATC fellows and BOSCH employees. © B. Ravichandran.



RHATC Fellows at Vidya Vanam School. © B. Ravichandran.

social responsibility. Education is a powerful tool that can uplift individuals and entire communities from the shackles of poverty. When we extend a helping hand to those who lack access to quality education, we not only equip them with the knowledge and skills they need to improve their lives but, also instil in them the belief that their dreams are attainable. By sharing the gift of education, we sow the seeds of hope, empowerment, and progress. As we do so, we not only create a brighter future for those we assist but also inspire a ripple effect of generosity and support, demonstrating that together, we can make the world a better place for all.

Conclusion

The trip offered us a wonderful opportunity to spend time and learn in the field from our course director, Sanjay Molur, course planners Payal Molur and Priyanka Iyer, course coordinator Trisa Bhattacharjee and provided us an amazing advantage to interact with the RHATC alumni Fellows; Usha, Tandrali, Lakshmi, Aishwaria, Swaathi, and Pooja. We learnt from experts like Mr. Kandhaswaami and Mrs. Prema Rangachari and interacted with them to the fullest. The fact that we got the opportunity

to mingle with the employees from Bosch gave us an insight on how the people from the corporate world feel about the natural world and conservation. The trip gave us insights about various things such as the truth about invasive plants, different commercial usage of trees & their characteristics, and roles played by flora and fauna in the ecosystem. NBNP is a perfect example to show that nothing is impossible if you have clear scientific knowledge and the patience to wait for success and the will to learn from your mistakes.

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Keep calm, it's all palm!

The Ram Hattikudur Advanced Training in Conservation (RHATC) places a strong emphasis on practical learning and recognizing its importance in understanding ecological conservation. We embarked on an exhilarating and hands-on learning expedition to Vagamon, Kerala. Located at an elevation of around 1,200 m, the place has an amazing landscape destroyed by artificial turf-like tea plantations the first of which were established way back in the 1860s. The beautiful grasslands at the hilltops along with the serene mist were an absolute joy to encounter.

This immersive trip was not just a journey, it was an exploration into the heart of biodiversity. The trip provided a unique setting for us to apply our theoretical knowledge in a real-world context. The rich biodiversity of the Western Ghats with the guidance of Dr. Sanjay

Molur, RHATC course director, and H. Byju, RHATC mentor, allowed all of us to witness diverse ecosystems.

A heck of a trek

On 05 December 2023 we went for a 12 km long trek on the Vagamon hills. It was a mesmerizing open landscape having rocky patches interspersed with grasses, and mostly shrubs and medium-sized trees. Not surprisingly, we also came across a lot of invasive species like *Eupatorium*, *Lantana*, and *Parthenium*.

Smiling wide at the foggy sight.
© B. Ravichandran



The picturesque tea plantations. © S. Joel.



Some of the other plant species we observed during the trek were *Bulbophyllum* sp., *Dendrobium* sp. of orchids, and *Cymbopogon* sp. of grass. We were also elated to find the endemic and endangered palm trees on the rock cliffs of the mountain like:

***Bentinckia condapanna* Berry.**

Bentinckia condapanna is one of the uncommon, endangered, and indigenous palms found in the forests of southern Western Ghats. Often mixed in with high-altitude evergreen woods or in homogenous brakes. The distribution range of the species is Agastyamala, Kulathupuzha, Peerumedu, Pachakkanaum, Uppupara, Moozhiar, and Peppara (Varghese 1997; Renuka 1999).

Stumbling across rocky cliffs and crossing silent streams, we climbed up the Urumbikkara top point overlooking the beautiful twin rocks that gave an essence of serenity. We encountered three individuals of *Bentinckia condapanna* on

Studying the native flora.
 © B.Ravichandran.



***Bentinckia condapanna* Palm species on the edge of mountain cliff at Kottayam district, Vagamon.**
 © Sanjay Molur.



Descending down the hill.
 © B.Ravichandran.



Twin Rocks at Urumbikkara top point.
 © C.K. Arjun.



the Urumbikkara hilltop. The place is also one of the last remnants of shola grasslands, being home to patches of native tussock grasses.

During our trek, we spotted the Asian Common Toad *Duttaphrynus melanostictus*, and some butterflies like Sahyadri Dartlet *Oriens concinna*, Long-tailed Blue *Lampides boeticus*, and Blue Tiger *Tirumala limniace*. We heard the soothing calls of Nilgiri Laughingthrush *Trochalopteron cachinnans* but sadly we were unable to spot them. We were also lucky enough to sight a Common Kestrel perched on a rock. The trek concluded with us enjoying some delicious lunch at the spectacular Madammakkulam waterfalls.

Kottathavalam visit

On 06 December 2023, we began on yet another trek to the picturesque Kottathavalam waterfalls down the steep valleys. The whole path was covered with thick tussock grasses and on the way Dr. Sanjay explained about the native plants and grasses, their importance, and ecological roles. Some of the native species we came across along the way are listed below.

Crotalaria juncea

It is an undershrub, annual, and grassland species that grows primarily in subtropical biomes. It is a legume that helps in soil nitrogen fixation. It was abundant in the region.

***Calamus brandisii* Becc.**

It is a clustered palm. Stem with sheath, leaves are about 1-m long. The leaf sheath is green with bristle-

Madammakkulam waterfalls. © C.K. Arjun.



Native grass
Chrysopogon sp.
© Praveen Rozario.

like spines, leaflets grouped, male and female inflorescence are longer, and slender fruits are ovate. *Calamus brandisii* is distributed in Agasthyamala in Kerala, Kalakkadu, Muthukuzhivayal, and upper Kothayar in Tamil Nadu. We observed it in the Kottayam District of Kerala. There were many individuals, all scattered in the population.

Dillenia pentagyna

A deciduous tree that grows primarily in the wet tropical biome. It is widely distributed and native to the Indian subcontinent. The tree was standing tall amidst the grasses at the slopes.

***Arenga wightii* Griff.**

It is distributed in the evergreen forest at 300– 1,000 m elevation, on the way to Peerumedu, Dhoni, Wayanad, Nellyampathy, Neriamangalam, Muthikulam, Attapaddy, Kottiyur, and Sholayar. We observed this palm while trekking to Kottathavalam waterfalls, Kottayam District, Kerala. There were three individuals.

Other observations

The phenomenal landscape of Kottathavalam waterfalls was filled with numerous odonates like Common Sailor *Phaedyra columella*, Three-spotted Grass Yellow *Eurema blanda*, Stream Glory *Neurobasis chinensis*, and Ruddy Marsh Skimmer *Crocothemis servilia*.

Threats

The landscape is under threat due to changes in the land use pattern and anthropogenic activities rapidly escalating because of the



**Native Legume
Crotalaria juncea.
 © C.K. Arjun.**



***Phoenix pedunculata*
 - Palm species in
 midst of the grasses
 on the mountain.
 © Sanjay Molur.**



***Arenga wightii* Palm.
 © Sanjay Molur.**



**Common Sailor
Phaedyra columella.
 © B. Ravichandran.**



**Three-spotted Grass
 Yellow *Eurema blanda.*
 © B. Ravichandran.**

constant demand for monocultural products like tea and rubber. The rapid growth of invasive plant species and lack of knowledge about plants in general are also major threats.

Conclusion

It was heartbreaking for us to encounter the sight of vast tea plantations stretching across hectares of land, creating a monotonous sea of tea. In areas without the tea plantations, invasive plant species held their dominance, erasing the memory of native plants and trees from the picture completely. Venturing into areas with minimal human interference along our trek, we encountered thriving native vegetation, offering a stark contrast to the invasive-dominated areas. We also stumbled upon an abandoned tea plantation that had been abandoned for over 30 years and was now nearly concealed by, hopefully, native grass species. Witnessing these changes filled us with joy and instilled hope for the rejuvenation of the landscape, envisioning a return to its forgotten natural splendour.

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ZOO in the WILD © B. Ravichandran.

RHATC's coastal chronicles: a journey through 8 unique habitats!

We had eight days field visit to the Gulf of Mannar Biosphere Reserve (GoM), Rameswaram and Point Calimere to practically understand and observe the flora and fauna in their natural habitat. Mr. Raveendran Natarajan, the founder of the Iragukal Amritha Nature Trust, organized the trip. Even though he is an engineer by qualification, his passion for wildlife put him on a journey to becoming a phenomenal birder, working in the field of conservation and outreach programs since 2005.

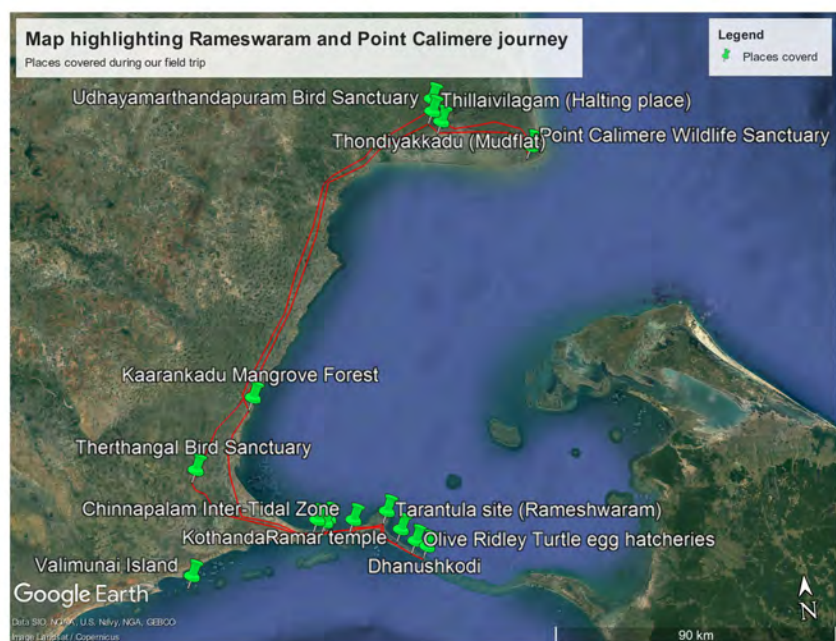
Moreover, this phenomenal exposure to diverse ecosystems wouldn't have been possible without another resource person, H. Byju, a bird expert. He is an executive board member of the Wildlife Information Liaison Development (WILD) Society and is also the author of wonderful books like 'Valley of Hope - Moyal and Vultures' and 'The Matriarch: The Autobiography of an Elephant'. He has also been working with Raveendran since 2015, and together they have published several scientific papers from the southeastern coast of peninsular India.

This article covers our day-wise experience during the field visits to eight different landscapes and meeting inspiring people during the entire trip.

DAY I - KARANKADU MANGROVE ECOSYSTEM

On 26 December 2023, we visited Karankadu community-based ecotourism, established by the forest department and managed by the eco development committee (EDC) that is part of Palk Bay, which is located in Tamil Nadu's Ramanathapuram District.

Diverse resident and migratory species of birds congregate there in large flocks to feast on the mangrove inhabitants, like fish, crabs, and bivalves. We saw a spectacular sight of a Greater Crested Tern *Thalasseus bergii* diving into the water to catch fish. The other species of water birds we saw include Great Cormorant *Phalacrocorax carbo*, Intermediate Egret *Ardea intermedia*, Whiskered Tern *Chlidonias hybrida*, Little Tern *Sternula albifrons*, Common Sandpiper



The locations visited by RHATC fellows in Rameswaram and Point Calimere



Mangrove ecosystems. © Amrin Ansari.

Actitis hypoleucos, and Black-winged Stilt *Himantopus himantopus*. We also saw wetland-associated species like Pied Kingfisher *Ceryle rudis* and a passage migrant Rosy Starling *Pastor roseus*.

Byju and Raveendran mentioned that mangroves have evolved to withstand the fluctuating salinity of the environment, and their specialised root system called pneumatophores protects the shorelines from erosion and tsunamis. Factors like pollution and siltation are the major threats to the degradation of mangrove ecosystems, resulting in the loss of biodiversity. As a result, the conservation of mangroves is critical. In mangrove areas, biodiversity protection and ecological restoration should

be prioritised. The most crucial part of the conservation of mangroves in Karankadu is raising public awareness.

All of us walked for the first time on the sandy sea grass bed in the middle of an estuary. For most of us, walking among the sea grasses and observing the molluscs, crabs,

and other benthic flora and fauna was a fantastic practical and experiential learning experience.

Priyanka, Tandralli, and Usha, from the 'IOCEAN' (Ocean Conservation Educator Action Network) initiative of the Zoo Outreach Organisation, informed that mangrove ecosystem and estuaries are nurseries for some shark species and support unique species dependent on mangroves. Raveendran explained his work on shore birds from the region. This mangrove ecosystem, which is part of the Gulf of Mannar Marine National Park, is situated in the Palk Bay area of the southeastern coast of India. The most common mangrove tree species in the



Fellows interacting with N. Raveendran. © H. Byju.

Karankadu forest is *Avicennia marina*, followed by *Rhizophora apiculata*, and *Rhizophora mucronata* (Byju et al. 2023).

DAY 2 - INTERTIDAL ECOSYSTEM, CMFRI MUSEUM, AND BYCATCH

Shore walk:

On 27 December 2023, we went to Chinnapalam village in Pamban panchayat, Rameshwaram Island. We met Lakshmi Moorthy, a visionary and former seaweed collector who was then elected as a councillor for eight wards in the Pamban area. We learned about her inspiring journey through a visionary idea of sustainable seaweed collection, which she has been successfully implementing with local communities for



Interesting observation on marine flora and fauna in Chinnapalam beach. © H. Byju.

several decades. She is also the recipient of the Seacology Prize 2015 from Berkely, California, for her exceptional effort in preserving marine environments and fisherfolk culture. She received a sum of Rs. two lakhs along with the prize. She utilized the amount to purchase a piece of land for the construction

of a school and also helped in the renovation of an existing school. The government then followed her lead to build two more schools in the area. She also shared her story of how she inspired other women from the community and grew to a 150-member group from merely 18 women over the last decade.



Lakshmi- a true inspiration. © Sanjay Molur.

This interaction provided us with a better understanding of the fishing communities. Following that, Lakshmi took us to the Chinnapalam intertidal muddy shore to learn more about the biodiversity during the morning low tide. We walked in the intertidal zone for the first time, and the diverse marine organisms in such a small area made us very excited. Chinnapalam is located on the Gulf of Mannar side

but is very close to the Pamban bridge. This region is referred as the Pamban channel which connects the GoM and Palk Bay. We observed the sunrise as we drove on the Pamban bridge at 6:26 AM and the first neap tide was at 08:22 AM (Tides4fishing 2023), and the tidal height at 09:16 AM was 0.24 m (Survey of India 2024). This ensured that we were able to see many fantastic intertidal marine biodiversity on the exposed sea floor.

Like any other beach, the shore was busy with the presence of fishermen engaged in their daily routines since dawn, showcasing the vibrant livelihoods of those who depended on the sea for their sustenance. We strolled along the muddy shore and had the following observations:

Sea grasses and Sea weeds:

As the name suggests, seagrasses are aquatic plants found in the marine ecosystem. Seagrass species are primary producers and support substantial proportion of marine biodiversity in this ecosystem (Kaldy & Dunton 2000; Mateo et al. 2006). They are excellent at carbon sequestration in the oceans (Duarte et al. 2005; Macreadie et al. 2014) and exist as meadows covering the sea bed, acting as a source of food for a wide range of marine fauna like Sea Cow *Dugong dugon*, sea turtles, scarids (parrotfish), etc. (Lanyon et al. 1989; den Hartog & Kuo 2006; Unsworth et al. 2007). Apart from that, seagrass beds also serve as excellent breeding grounds and nurseries for fish as they protect them from predators (Jackson et al. 2001).

Sea weeds inhabit marine or brackish water in the intertidal region of seas and oceans. We saw both sea grass and sea weeds and were intrigued by the differences. Sea weeds are non-vascular plants and we saw them to be free floating, whereas the sea grasses are flowering, vascular plants that has roots, and some species were flowering and fruiting as well. Both sea grasses and seaweeds are extremely unique aquatic flora that play a significant role in coastal and marine ecosystems. Some of the sea weeds we observed are *Caulerpa* spp., *Sargassum* spp., *Halimeda* spp., and *Ulva* spp.

Not your average cucumber

Sea cucumbers are echinoderms and are closely related to starfish and sea urchins. They are benthic filter feeders and are found in most marine ecosystems. They use tube feet for feeding and locomotion, which are retractable tubular skin projections (Slater & Chen 2015). We came across three species, namely *Holothuria atra*, *H. scabra*, and *Stichopus* sp. We observed *Stichopus* sp. excreting, and the excreta contains nitrogen and phosphorus that enhance the productivity of benthic biota. They also host more than 200 species of parasitic symbionts



Sea Cucumber along with sea grasses.
 © C.K. Arjun.



Peacock-tailed Shrimp on Haddon's Carpet Sea Anemone.
 © Sanjay Molur.

and thus play an important role in maintaining benthic biodiversity (Purcell et al. 2016).

Even though all the sea cucumber species are protected under Schedule I of the Wildlife (Protection) Act, these species are considered delicacies and get overexploited for human consumption. In India, illegal sea cucumber catches (both live and dead) have been caught by forest department officials in regular intervals. But as is the case with most illegal wildlife trade, many sea cucumber catches slip through the underground market and get exported every year (Fernandes et al. 2022).

Under the tentacles

Sea anemones are cnidarians that bear specialized stinging cells called nematocysts on their tentacles that are used as defense mechanism (Bruce & Svoboda 1983). We spotted some Haddon's Carpet sea anemones *Stichodactyla haddonion* in the muddy substratum,

with Peacock-tailed Shrimps *Periclimenes brevicarpalis* moving along the tentacles. The female shrimps most often hide under the sea anemone's tentacles, whereas males most frequently are found on top of the sea anemone's dorsal surface (Bruce & Svoboda 1983). The symbiotic interrelationship between *P. brevicarpalis* and sea anemones seems to be parasitic because these shrimps feed upon the tentacles of the host (Suzuki & Hayashi 1977; Bruce & Svoboda 1983). When *P. brevicarpalis* is associated with sea anemones, its growth rate, molting interval, and larval production all increase (Fautin et al. 1995). The ornamental fish industries collect and trade this shrimp species along with sea anemones (Prakash et al. 2017).

Barnacles everywhere

Barnacles are arthropods and are closely related to crabs, prawns, and lobsters. The origin of the term 'barnacle' is intriguing, as its abrupt emergence parallels the sudden appearance of maggots on decaying meat (Anil et al. 2012). They have a wide range of occurrences, from intertidal zones to the deepest oceans (Chan & Høeg 2015). They are epibiotic organisms that attach to any substratum or host organism but do not feed on the host as they are filter feeders (Fertl & Newman 2018). We came across a lot of barnacles attached to boats, anchors, wood logs, and even on some mollusc shells.

Hermits in shells

Hermit Crabs are arthropods that have evolved to use empty gastropod shells as homes. The tough shells provide protection against their predators (Resse 1962). The crabs select the shells based on two criteria: (i) they should be

easy to carry and (ii) they should be spacious for accommodation (Resse 1963; Volker 1967). We observed quite a few of these shy crabs goofing around the mud flats.

Egg cases on molluscs

We observed the egg cases of the Dog Conch *Laevistrombus canarium* on some twigs as a substrate. Also, we observed that some of the bivalves, like *Pinna* sp. happen to serve as a substratum for marine invertebrates to lay their eggs.

See Sea Shells

We observed various mollusc species during our shore walk, and later Dr. R. Ravinesh, University of Kerala, helped us identify the gastropod species.

Pipe fishes

Pipefish belong to the same family as seahorses — Syngnathidae. They are sit-and-wait predators, which have a tubular, toothless mouth that they use to slurp up their prey. They have been actively traded for both medicinal and ornamental purposes. The distinctive body structure and captivating behaviours of these creatures make live pipefish a high demand group for marine aquaria. Unfortunately, these pipefishes are frequently captured unintentionally as ‘by-catch’ during fishing operations, worldwide. Some most economically disadvantaged fishers deliberately target pipefish as a means of sustaining their livelihoods. This dual pressure from trade and unintentional capture poses significant challenges for the well-being of pipefish populations (Murugan et al. 2008). We observed a shy pipefish swimming and hiding among the sea grasses. It is quite

Checklist of gastropods observed at Chinnapalam sea grass bed.

	Family	Scientific name	Depicted by
1	Babyloniidae	<i>Babylonia spirata</i>	Linnaeus, 1758
2	Cardiidae	<i>Vepricardium asiaticum</i>	Bruguère, 1789
3	Carditidae	<i>Cardites bicolor</i>	Lamarck, 1819
4	Cypraeidae	<i>Naria erosa</i>	Linnaeus, 1758
5		<i>Erronea</i> sp.	
6	Fascioliariidae	<i>Pleuroploca ponderosa</i>	Jonas, 1850
7	Glycymerididae	<i>Glycymeris</i> sp.	
8		<i>Glycymeris taylori</i>	Angas, 1879
9	Melongenidae	<i>Volegalea cochlidium</i>	Linnaeus, 1758
10	Muricidae	<i>Chicoreus virgineus</i>	Röding, 1798
11		<i>Murex carbonnieri</i>	Jousseau, 1881
12	Mytilidae	<i>Modiolus philippinarum</i>	Hanley, 1843
13	Nassariidae	<i>Nassarius canaliculatum</i>	Lamarck, 1822
14	Naticidae	<i>Notocochlis gualteriana</i>	Récluz, 1844
15	Neritidae	<i>Clithon oualaniense</i>	Lesson, 1831
16	Olividae	<i>Agaronia gibbosa</i>	Born, 1778
17	Pinnidae	<i>Pinna bicolor</i>	Gmelin, 1791
18	Potamididae	<i>Pirenella cingulata</i>	Gmelin, 1791
19		<i>Terebralia palustris</i>	Linnaeus, 1767
20	Strombidae	<i>Laevistrombus canarium</i>	Linnaeus, 1758
21		<i>Lambis lambis</i>	Linnaeus, 1758
22	Synaptidae	<i>Synaptula reticulata</i>	Semper, 1867
23	Tonnidae	<i>Tonna dolium</i>	Linnaeus, 1758
24	Turbinellidae	<i>Turbinella pyrum</i>	Linnaeus, 1767
25	Veneridae	<i>Circe scripta</i>	Linnaeus, 1758
26		<i>Gafrarium pectinatum</i>	Linnaeus, 1758
27		<i>Sunetta</i> sp.	
28		<i>Sunetta solanderii</i>	Gray, 1825
29		<i>Sunetta effossa</i>	Hanley, 1843
30		<i>Antigona chemnitzii</i>	Hanley, 1845

uncommon to see a live pipefish in its habitat, and we were lucky enough to see one.

<https://youtu.be/nwZd3xRUY80?si=sNEgQDRqKuFAEFdr>

CMFRI Museum:

To gain more insights from the field visit in the morning, we paid a visit to the National Marine Biodiversity Museum at the Central Marine Fisheries Research Institute (CMFRI),



Hermit crab using an abandoned gastropod shell. © Amrin Ansari.



Collection of commonly available molluscs of Mandapam coast at CMFRI museum. © C.K. Arjun.



Commonly available molluscs at Chinnapalam (a) *Circe scripta* (b) *Babylonia spirata* (left) and *Gafrarium pectinatum* (right) (c) *Chicoreus virgineus*. © Amrin Ansari.

situated in Mandapam, near Rameswaram. It was established in February 1947 under the Ministry of Agriculture and Farmers Welfare; later in the year 1967, it was shifted under the Indian Council for Agricultural Research (ICAR).

CMFRI primarily focuses on the estimation of marine fishery catch and landings, research related to the taxonomy of marine organisms, coastal mariculture, and the bio-economic values of fish and other marine organisms. The establishment of the marine biodiversity museum at CMFRI is focused on the collection, preservation, cataloguing and display of marine organisms for educational purposes, research activities, and public information. We were amazed to see the specimens displayed at the museum. For most of us, it was our first exposure to innumerable marine organisms. Mr. Ramamurthy, an experienced curator who has profound knowledge of marine organisms, explained about the specimens displayed in the museum. Following are categories under which we have classified some species that caught our attention.

Species having commercial value

- Blue-swimmer Crab *Portunus pelagicus* is used as food and has huge demand.
- Oyster species and the process involved in pearl culture.
- Lobsters that are exported to Singapore for food, especially live ones, have high demand.
- Various species of seaweeds that are commercially important, such as Cobia *Rachycentron canadum*, are cultured and generate good revenue.
- Indian Mackerel *Rastrelliger kanagartha* is one of the most consumed fish.

Species that are endangered and protected under the Wildlife (Protection) Act

- The shells of Leather-back Turtle *Dermochelys coriacea*
- Olive Ridley Turtle *Lepidochelys olivacea* and Seahorse *Hippocampus kuda*
- Various species of corals
- Shovelnose Ray *Glaucostegus typus*, one of the endangered species

Other species

Molluscs, especially gastropods, crustaceans such as shrimps, small crabs, prawns, Tuna *Thunnus thynnus*, various species of starfish, various species of coelenterates, Giant Guitarfish *Rhynchobatus australiae*, jellyfish, stingrays, Stonefish *Synanceia verrucosa* which is a highly venomous species, False Killer Whale *Pseudorca crassidens*, species of eels, Porcupine Fish *Diodon hystrix* and sawfish.

We saw an enormous skull of a Sperm Whale *Physeter microcephalus*. We came to know some interesting facts about the organism, such as ambergris produced in the digestive system of the Sperm Whale, which has a huge demand as it is used in the synthesis of perfumes, flavoring agents in alcoholic beverages, etc. The skeleton of Sea Cow was also on display.



Stuffed specimens of Guitar fishes *Rhynchobatus* sp in CMFRI museum. © C.K. Arjun.

Preservation:

Preservation is the art of making sure the specimens retain their original structure and pigments for longer periods of time. Formalin is most commonly used for preserving most of the specimens except for the phylum Echinodermata (which comprises starfish, sea urchins, sea anemones, sea cucumbers, etc.), for which rectified spirit is used. We were also fascinated to learn about taxidermy, the art of preparing, stuffing, and mounting the skins of animals.

We visited the CMFRI aquarium and witnessed various species of crustaceans, Hawksbill Sea Turtles, and ornamental fish.

The way the curator explained it focused more on the commercial use and economic value of marine biodiversity than the conservation aspects of the species. We felt disappointed that such a distinguished institution prioritizes human interests while contributing very little to conservation.

Bycatch

In the evening, we visited Munakkad Beach in the Pillaimadam region. It is a site for fishing and seaweed culture. We witnessed enormous piles of bycatch (an unintentional capture of non-targeted species), which comprised various species of gastropods, bivalves, cephalopods, and echinoderms, along with several species of fish. Priyanka Iyer explained about eight to ten groups of organisms that were present in the pile, which were difficult to identify, and highlighted the bycatch issue and how a lot of marine organisms are affected due to the bycatch, which includes several endangered and unidentified species. It is unfortunate to lose out



Priyanka explains bycatch and its effect on marine ecosystems. © H. Byju.

on species even before knowing them. All of us were disheartened to look at this gloomy and darker side of human use of marine life. This pile is formed every day, and millions of animals are eliminated from their precious ecosystems.

DAY 3 - DHANUSHKODI, TURTLE HATCHERY, MAN AND BIOSPHERE, THREATS & HANUMAN PLOVER

After witnessing the diverse marine life in their natural ecosystem, we visited Dhanushkodi, at the southeastern tip of India, on 28 December 2023. It is a ghost town that is a part of Rameswaram island in the Gulf of Mannar located between peninsular India and Sri Lanka.

The Gulf of Mannar extends from Rameswaram Island in the north to Kanyakumari in the south with 21 other islands, from Mandapam to Tuticorin (Kumaraguru et al. 2006).

We stopped near the Kothandaramar temple to understand the geographic features like the lagoon, bay, gulf, and isthmus which harbour different ecosystems. We were standing on the isthmus, and on one side we saw Kothandaramar lagoon, and on the other side there was a Gulf of Mannar. H. Byju and Dr. Sanjay Molur, course



Sanjay explaining The Man and the Biosphere (MAB). © H. Byju.



Sunset Selfie at Pillaimadam.
 © Sanjay Molur.

director of RHATC and executive director of the Zoo Outreach Organisation were explaining to us about the landscape in our surroundings.

On 28 December, on the way to Dhanushkodi we stopped by a hatchery station along the beach, which is a part of the GoM. Mr. Ravindran explained about the sea turtles coming ashore

to lay their eggs on specific nesting sites along the coast of the GoM. He also added that a total of 1,600–1,800 turtle eggs were collected from the nesting sites to protect them from threats like street dogs and local people. Once collected, the eggs are reburied on the same beach at a different location with fencing and regular monitoring by the anti-poaching watchers of the forest department. The incubation process is crucial for the success of turtle hatcheries where it takes 45 days on average for the eggs to hatch. The Olive Ridley Turtles lay their eggs from January to March. After the eggs hatch, the hatchlings are released into the sea and he mentioned that the GoM region has 42 hatcheries managed by the forest department essential for the conservation of Olive Ridley Turtles *Lepidochelys olivacea*. He also mentioned the important role of the turtle hatcheries in raising in the GoM about the importance of sea turtle conservation.

Along the way we came across the memorial stone on a project initiated by the United Nations Educational, Scientific and Cultural

Is it a lagoon? A gulf? A bay?

A gulf is a large body of water that is completely surrounded by land and has a narrow mouth. The Gulf of Mannar is an example from the field. An isthmus is a narrow strip of land that connects two larger land masses. The strip of land that connected the main road to the Konthadaramar temple was an example we saw in the field. A bay is a larger, curved inlet of the sea or a coastline surrounded by land. In the field, we saw Palk Bay as an example. A lagoon is a shallow body of water that may have an opening to a larger body of water but is also protected from it by a sandbar or coral reef. The best example we saw was at the Pillaimadam lagoon. The visit provided us with practical exposure to and understanding of different marine ecosystems, such as gulf, lagoon, and bay.

Organization (UNESCO), The Man and the Biosphere (MAB). Sanjay explained about the program, where it aims to establish a scientific basis for the improvement of relationships between people and the environment. One of the key components of the MAB Programme is the designation of Gulf of Mannar as a Biosphere Reserve. It was established in 1989 and covers a diverse range of ecosystems, including coral reefs, seagrass meadows, mangroves, and other coastal habitats.

Byju shared a brief overview of the newly proposed upcoming project for the construction of a railway track by the Government of India along the coastline of Dhanushkodi with us.

This region is one of the most visited tourist places in Tamil Nadu, particularly for the famous Rameswaram temple, but the railway line exists until Rameswaram and Dhanushkodi is well connected by road, hence there is no need for the railway line. Also mentioned the proposal to declare this area of Dhanushkodi as a bird sanctuary. It is a crucially diverse habitat that is an attractive destination for a variety of migratory bird species, including Curlew Sandpiper *Calidris ferruginea*, Black-tailed Godwit *Limosa limosa*, Broad-billed Sandpiper *Calidris falcinellus*, Sanderling *Calidris alba*, Common Redshank *Tringa totanus*, Common Greenshank *Tringa nebularia*, and Terek Sandpiper *Xenus cinereus*.

What is left now of the natural ecosystem will be completely lost with the development project the government is planning. On the other hand, declaring the area a bird sanctuary will help save the existing ecosystem.

Breeding site of Hanuman Plover *Charadrius seebohmi* at Pillai madam

We walked in the shallow pool of freshwater at the Pillai madam abutting Palk Bay, adjacent to Rameswaram Island, which is a saltwater lagoon and is bridged by a bar mouth to Palk Bay in the north. On the landward side, the lagoon is surrounded by grass patches. Shorebirds, large wading birds, gulls, and terns are seen regularly in this region (Byju et al. 2023). The site is characteristically a lagoon that holds seawater on one side and the other side becomes inundated during rains. This site is one of the six breeding sites of Hanuman Plover in India.

Byju led us to the breeding site where the Hanuman Plover was discovered. We walked in the shallow water, collected due to heavy downpours that happened in the previous week of the visit, and thus there were very few birds. The presence of water meant that the breeding site couldn't be closely examined by us, but Byju did his best to provide an accurate account of the discovery and his experiences.

According to Byju, the species was suspected to be seen here by his mentor, Dr. Balachandran of the Bombay Natural History Society (BNHS), who used to work in that region, and he also shared old stories while working in the field. Byju also pointed out the challenges in identifying these small birds, even though they chose an open, vast environment for breeding; their colour makes it extremely difficult to spot them in the landscape, and these birds are also very timid, which makes it strenuous to observe them for a long period of time. He then talks about the interaction and relationship he has been maintaining with the local community

there. We understood the importance of involving the local people in assisting with research and the conservation of animals.

Unfortunately, this place comes under the proposed site for the Rameswaram airstrip. These changes to this fragile and crucial habitat will be highly detrimental for the native species ranging from the tiniest fungus to the largest animal.

DAY 4 - VISIT TO THE HOME OF CORALS AND TARANTULAS

Snorkeling all the way

On 29 December 2023 we started an exciting and thrilling journey from Ervadi beach to reach Valimunai, a stunning coral island which is a part of Keelakarai group of Islands and one among the 21 Islands of GoM. The area range of the island is less than 2 km square, and the coastline is around 1.43 km (DWIEP 2018).

The land part of the island is completely dominated by invasive trees like the Mesquite Tree, *Prosopis juliflora* and Indian Tulip *Thespesia populnea* (DWIEP 2018).

Captivating Corals

We went for an intertidal reef walk to the ecological sensitive areas (ESAs) of Valimunai island's coral reefs, seagrass, and seaweed beds and encountered mesmerizing coral reefs featuring Lesser Star Coral *Goniastrea ratiformis*, Hump or Finger coral *Porites* sp., Table coral *Acropora* sp., Pore coral

Montipora spumosa, Brain coral *Favia* sp., Lesser Valley coral *Platygyra lamellina*, and Larger Star coral *Favites abdita*. Every step during our walk unveiled the wonders of the underwater world, leaving us fascinated by the intricate tapestry of life flourishing in the coral patch.

The diversity extended beyond coral formations, captivating us with the intricate beauty of seagrasses such as Serrated Ribbon Seagrass *Cymodocea serulata*, Halophila sp., and Turtle Grass *Thalassia hemprichii*. Engaging in snorkeling was the best way to observe the diverse and vibrant schools of fish associated with the seagrass beds, swimming in rhythmic harmony, the elusive crabs running on the sandy substrate, and sea cucumbers looking like shiny blobs. We observed shy mantis shrimp camouflaging within the vibrant corals.

Here, There, Everywhere – The Sea Hare

We saw a lot of sea hares on the coral beds. They are sluggish, soft-bodied molluscs that lack an external shell. We accidentally stepped on one and noticed a blood-like fluid diffusing



Fellows on a boat ride to coral island. © C.K. Arjun.



Coral reef ecosystem in Valimunai Island.
 © Praveen Rozario.



A coral exhibiting nature's intricate patterns.
 © C.K. Arjun.



Sea hare sliding along the Sea grapes.
 © Praveen Rozario.



Pee-ka-boo, I see you (Fish peeking out of its burrow). © Praveen Rozario.



An adult female Tarantula *Poecilotheria hanumavilasumica* at Hanumavilasum Sacred grove.
 © C.K. Arjun.



The master of camouflage- a Crab concealed among the Sea Grapes. © Praveen Rozario.

in the water between the coral beds, and we got worried for the poor creature. Later, we came to know that the slug was very much alive and that the fluid was in fact ink, which is part of their defense mechanism to escape from predatory sea anemones, crabs, gastropods, lobsters, starfish, sea turtles, and wrasses. They secrete the dark pinkish-purple ink from a specialized gland called the 'Purple gland' on the roof of their mantle cavity (Johnson & Willows 1999).

We also spotted a vibrant greenish-black and yellow sea slug crawling its way through the corals. Looking at its morphology, we came to know that it was a nudibranch *Elysia grandifolia* (Kumar et al. 2011). Nudibranchs are shell-less gastropods that feed on algae and are commonly referred to as sea slugs.

A familiar sight from the Chinnapalam intertidal mudflats, we saw the same association between Haddon's Carpet Sea Anemone *Stichodactyla haddonian* and Peacock-tailed Shrimp *Periclimenes brevicarpalis* moving along its tentacles.

Sacred grove

After our exhilarating journey in the morning to the island, we visited the Hanumavilasum sacred grove in the night. This place is the last refuge for the endemic arboreal tarantula. It was a patch of old tamarind trees *Tamarindus indica* inhabited predominantly by *Poecilotheria hanumavilasumica*. While walking in the dark towards the tree where a female tarantula was waiting for us, we were warned to watch out for the snakes. Sanjay and Priyanka enriched our knowledge about tarantulas.

The genus *Poecilotheria* is the only arboreal tarantula found in India and Sri Lanka.

Poecilotheria hanumavilasumica is endemic to Rameswaram. Sanjay explained that the species has a high demand in the pet trade because they are very aggressive and this brings up the macho factor. Hence, conservation, national, and international legislation for the species is required. He and his team are planning to do a IUCN Red List conservation assessment of the species belonging to the family Theraphosidae.

He also mentioned that, due to construction activities at a nearby tarantula site, the entire tamarind grove was cut down. His team collected 90 individuals of *P. hanumavilasumica* and then translocated them to the present Hanumavilasum sacred grove. For decades, he and his team have been observing the adaptation of the species, and they came to know that *P. hanumavilasumica* is tolerant of changes in habitat quality and adapts to secondary habitats like casuarina plantations.



Pelicans and Painted stork families in their nests on *Acacia* trees. © Amrin Ansari.

We were amazed to know the behaviour and morphology of the tarantula. These spiders live in the tree crevices. Females are bigger than males. The breeding season is from July to September. They lay eggs in October; by December, juveniles are observed. Females mature around 5 to 7 years, and their lifespan is about 12 to 18 years. The male matures at 10 to 18 months, and their lifespan is about one breeding season since the female may eat the male when they attempt to mate. If males are strong enough while mating, they push female front legs up and mate, then they will flee before the females chase and eat the males. If the male survives he will attempt to mate with another female but since the males are constantly on the move in search of females that reside in burrows, chances of mortality by predation or roadkill are high. Females are constantly looking to eat, not to mate. Some males are successful, and most of them die. This is one of the rarest breeding behaviours observed in tarantulas. They are ambush predators and feed on invertebrates and geckos. They line their crevices with webs. They have a very unique way of residing in the crevices. They have poor vision but are very susceptible to touch; through tactile receptors, they sense their surroundings. We were then split into five groups of two each to look out for tarantulas in the sacred grove.

DAY 5 - WETLANDS and MUDFLATS

Therthangal Bird Sanctuary

On 30 December 2023 morning a visit to the Therthangal bird sanctuary evoked curiosity when the expert birder Byju asked us to recognise the noise that was emerging from far behind. We all looked around and were trying to find out which bird species it was. Immediately

in the sky, appeared a big bird! Our mentors, Byju, Raveendran, and Priyanka, all said it was an Asian Openbill. Our curiosity did not end there; instead, we became more enthusiastic and reached the watch tower for a better view. The view was phenomenal, as it entirely covered the landscape. Witnessing and observing birds on trees in their respective nests and new hatchlings associated with their mother; a few birds majestically flying, foraging, feeding, and gathering materials for building their nests was beautiful.

Therthangal Bird Sanctuary is a wetland habitat situated in Therthangal Village in Paramakudi Taluk, Ramanathapuram District, Tamil Nadu, India. The bird sanctuary spans an area of approximately 29 ha. The migratory season, from October to March, is the favourite time for birdwatchers and nature enthusiasts to visit this place. It is surrounded by villages, each with its own set of kanmois (irrigation tanks) and ooranis (village ponds) (Mohan et al. 2020). These provide feeding grounds for the birds.

There were mostly *Acacia nilotica* trees, which seemed to be favourable nesting sites for most of the bird species. The checklists for the birds we observed are provided on the next page.

When we were keenly looking for the birds, we were excited to spot hundreds of fruit bats *Pteropus medius* roosting on a tamarind tree.

Thondiyakaadu (mudflat)

On 30 December, we visited the southern delta of Kaveri in Tamil Nadu at Thondiyakaadu, witnessing a shift from marine ecosystems to a vast and continuous mudflat. We reached

Checklist of birds observed at Therthangal Bird Sanctuary.

	Common name	Scientific name	IUCN Red List	Migratory status
1	Asian Openbill	<i>Anastomus oscitans</i>	LC	R
2	Spot-billed Pelican	<i>Pelecanus philippensis</i>	NT	R
3	Painted Stork	<i>Mycteria leucocephala</i>	LC	R
4	Black-headed Ibis	<i>Threskiornis melanocephalus</i>	NT	R
5	Great Cormorant	<i>Phalacrocorax carbo</i>	LC	R
6	Indian Cormorant	<i>Phalacrocorax fuscicollis</i>	LC	R
7	Grey Heron	<i>Ardea cinerea</i>	LC	R
8	Little Egret	<i>Egretta garzetta</i>	LC	R
9	Intermediate Egret	<i>Ardea intermedia</i>	LC	R
10	Indian Pond Heron	<i>Ardeola grayii</i>	LC	R
11	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	LC	R
12	Eurasian Spoonbill	<i>Platalea leucorodia</i>	LC	R
13	Glossy Ibis	<i>Plegadis falcinellus</i>	LC	R
14	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	LC	R
15	Grey-headed Swampphen	<i>Porphyrio poliocephalus</i>	LC	R
16	Brahminy Kite	<i>Haliastur indus</i>	LC	R
17	Oriental Darter	<i>Anhinga melanogaster</i>	NT	R

Migratory status: Resident (R), Winter visitor (WV), Passage migrant (PM); IUCN status: Least Concern (LC), Near Threatened (NT).

Checklist of birds observed at Kodyyakarai Wildlife Sanctuary.

	Common name	Scientific name	IUCN Red List status	Migratory status
1	Northern Shoveler	<i>Anas clypeata</i>	LC	WV
2	Northern Pintail	<i>Anas acuta</i>	LC	WV
3	Garganey	<i>Anas querquedula</i>	LC	WV
4	Painted Stork	<i>Mycteria leucocephala</i>	LC	R
5	Great Egret	<i>Ardea alba</i>	LC	R
6	Intermediate Egret	<i>Ardea intermedia</i>	LC	R
7	Little Egret	<i>Egretta garzetta</i>	LC	R
8	Spot-billed Pelican	<i>Pelecanus philippensis</i>	NT	R
9	Black-winged Stilt	<i>Himantopus struthersii</i>	LC	WV
10	Black-tailed Godwit	<i>Limosa limosa</i>	NT	WV
11	Eurasian Curlew	<i>Numenius arquata</i>	NT	WV
12	Common Redshank	<i>Tringa totanus</i>	LC	WV
13	Common Greenshank	<i>Tringa nebularia</i>	LC	WV
14	Marsh Sandpiper	<i>Tringa stagnatilis</i>	LC	WV
15	Wood Sandpiper	<i>Tringa glareola</i>	LC	WV
16	Common Sandpiper	<i>Actitis hypoleucos</i>	LC	WV
17	Little Stint	<i>Calidris minuta</i>	LC	WV
18	Brown-headed Gull	<i>Choricocephalus brunnicephalus</i>	LC	WV
19	Gull-billed Tern	<i>Gelochelidon nilotica</i>	LC	WV
20	Caspian Tern	<i>Hydroprogne caspia</i>	LC	WV
21	Little Tern	<i>Sternula albifrons</i>	LC	WV
22	Whiskered Tern	<i>Chidonias hybrida</i>	LC	WV
23	Little Ringed Plover	<i>Charadrius dubius</i>	LC	R
24	Greater Sand Plover	<i>Charadrius leschenaultii</i>	LC	WV
25	Lesser Sand Plover	<i>Charadrius mongolus</i>	LC	WV
26	Common Snipe	<i>Gallinago gallinago</i>	LC	WV
27	Eurasian Spoonbill	<i>Platalea leucorodia</i>	LC	R
28	Whimbrel	<i>Numenius Phaeopus</i>	LC	WV
29	Black-headed Ibis	<i>Threskiornis melanocephalus</i>	NT	R

Migratory status: Resident (R); IUCN status: Least Concern (LC), Near Threatened (NT).

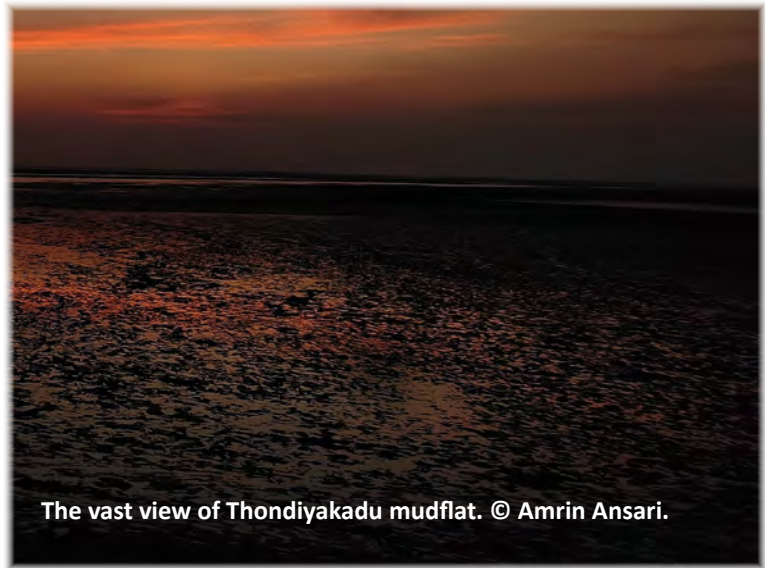
and settled in our new field station at Thillaivilagam and we were taken to the delta region at Thondiyakaadu where, Mother Nature's grand spectacle of the magnificent sunset above the Kaveri Delta was welcoming us with her warm embrace.

Sanjay gave us a brief explanation about this wide delta that is formed when the Kaveri River breaks into multiple tributaries before emptying into the Bay of Bengal. Byju, Priyanka, and Senthil were along with the fellows, explaining the ecosystem and the names of various rivers that form the delta of the mighty Kaveri. The Kaveri River originates in the Western Ghats in Karnataka and flows through the Deccan Plateau. It is one of the major rivers in southern India, originating at Talakaveri in Kodagu flowing through Mysuru. After flowing through Karnataka, the river enters the state of Tamil Nadu, where it further branches out and forms the Kaveri Delta. Here we also spotted a colony of flamingos and few other birds like, Spot-billed Pelican *Pelecanus phillippensis* and Marsh Sandpiper *Tringa stagnatilis*.

DAY 6 - MAN MADE NATURAL ECOSYSTEM

Fabulous flocks: Kodiakkarai Wildlife Sanctuary

On 31 December 2023 we went to the Point Calimere Wildlife Sanctuary (PCWS), which is also known as Kodiakkarai Wildlife Sanctuary, to gain a deeper understanding of shore birds and their habitat. Located in Nagapattinam District, Tamil Nadu, PCWS is one of the most important wetlands in southern India and was declared a



The vast view of Thondiyakadu mudflat. © Amrin Ansari.

Ramsar site on 19 August 2002. It is part of the Central Asian Flyway, hence harbouring a lot of migratory birds with feeding and wintering grounds (Jagadeeshan et al. 2016). The shoreline habitat varies seasonally, from a shallow sheet of saline water during the monsoon to continuous stretches of mudflats in the drier seasons. These mudflats provide excellent feeding and breeding habitats for a lot of fauna, including birds. During our visit, mentors Byjus and Raveendran assisted in identifying the following waterbirds we encountered.

During our visit, we also came across two native fisherfolk who were actively fishing throughout the time. Upon an informal interaction, we came to know that they were collecting shrimp for personal consumption, which is a practice they do almost three times a week. The fisherfolk used the traditional method of splashing the seawater with bare hands to loosen the balance of the shrimp on the flat surface of the mud and then collecting them in their waist bags. The PCWS is an area of utmost importance, but the area is getting degraded as a result of human interference, and a decline of over 70% has been noted in the wader's populations (Balachandran

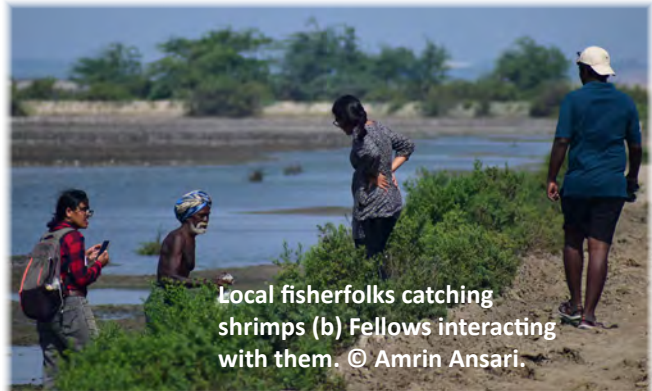
Fellows observing wetland birds using Spotting scope. © C.K. Arjun.



Feeding party of Painted Storks. © Amrin Ansari.



Local fisherfolks catching shrimps (b) Fellows interacting with them. © Amrin Ansari.



Eurasian Sponbill showing its breeding plumage. © Amrin Ansari.



Salt and pepper: Glossy Ibis with Intermediate Egret. © Praveen Rozario.



2006). Climate change and changing rainfall patterns in the area is also a potential threat to shorebirds.

DAY 7 - Mosaic Landscapes

Point Calimere Wildlife Sanctuary

A new year, a new landscape, and a fresh start. After reaching Point Calimere Wildlife Sanctuary on 1 January 2024, we were the first to go on the safari. Point Calimere Wildlife Sanctuary is in the Vedaranyam block of Nagapattinam District of Tamil Nadu. The Point Calimere region was first identified as an area of high significance in bird conservation by late Dr. Salim Ali in 1962. The sanctuary covers an area of 1,728.81 ha along the Palk Strait, where it meets the Bay of Bengal. It was declared in 1967 for the conservation of Blackbucks *Antelope cervicapra* and also for birds. Point Calimere Wildlife Sanctuary, along with the Great Vedaranyam Swamp, was declared a Ramsar Wetland Site (No. 1210) on 19 August 2002, and it is also one of the 554 Important Bird Areas of India (Ramsar Sites Information Service 2002; Tamil Nadu Forest Department 2007; National Wetland Atlas 2010).

The sanctuary has a unique landscape, covered by the Bay of Bengal in the east, the Palk Strait in the south, swampy backwaters, and salt pans to the west and north, respectively. Low sand dunes are located along the coast; the western periphery has coastal plains, tidal mud flats, and shallow seasonal ponds.

The sanctuary hosts a combination of history and a rich diversity of flora and fauna. There are remnants of a brick-and-mortar lighthouse that dates back more than 1,000 years built by the great Chola empires. The Chola lighthouse was severely destroyed by the 2004 Indian Ocean earthquake and tsunami (Sivasubramaniam et al. 2005). There is also a British-period lighthouse which was built in 1890 (DGLL 2023).

The landscape of the sanctuary is a mix of salt pans, mangroves, backwaters, grasslands, and dry evergreen forests. PCWS boasts of 14 mammal species, 18 reptile species, and nine amphibian species. Similarly, it has about 154 species of medicinal plants (Point Calimere Wildlife Sanctuary 2023) in the dry evergreen forests.

Of this unique biodiversity we were fortunate to see Blackbucks *Antelope cervicapra*, one of the six antelope species of India and the flagship species of the sanctuary. Apart from that, we saw animals such as Bonnet Macaque *Macaca radiata*, Wild Boar *Sus scrofa cristatus*, Monitor Lizard *Varanus bengalensis*, Spotted Deer *Axis axis*, Indian Grey Mongoose *Urva edwardsii*, and Indian Star Tortoise *Geochelone elegans*. But we didn't encounter the apex predator, Golden Jackals *Canis aureus*.

The sanctuary is home to an enormous number of bird species, both resident and migratory birds. The checklists for the birds we observed are provided on the next page. This rich biodiversity is threatened by an antagonist growing stronger every year which is the abundance of invasive species such as *Prosopis juliflora*, *Senna auriculata*, *Suaeda maritima*, *Opuntia dillenii*, *Chloris virgata*, *Lantana camara*, *Vitex*

Blackbuck- the star of Point Calimere Wildlife Sanctuary. © Praveen Rozario.



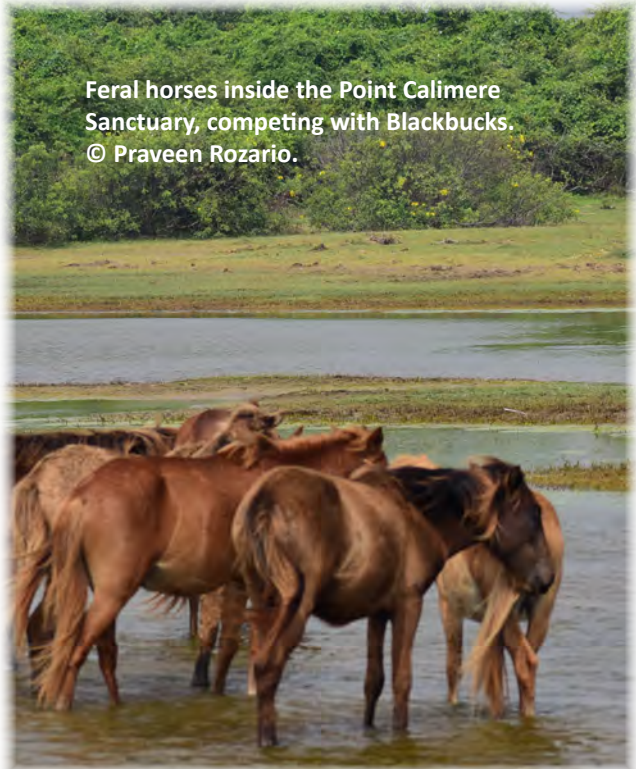
Territorial fight of mudskippers at Point Calimere wildlife sanctuary. © Amrin Ansari.



**The wild boar family.
© Praveen Rozario.**



**Feral horses inside the Point Calimere Sanctuary, competing with Blackbucks.
© Praveen Rozario.**



Feral dogs in the wetland: major threat to shore birds. © Praveen Rozario.



Checklist of birds observed at Point Calimere Wildlife Sanctuary.

	Common name	Scientific name	IUCN Red List status	Migration status
1	Oriental Pratincole	<i>Glareola maldivarum</i>	LC	WV
2	Wood Sandpiper	<i>Tringa glareola</i>	LC	WV
3	Common Sandpiper	<i>Actitis hypoleucos</i>	LC	WV
4	Common Ringed Plover	<i>Charadrius hiaticula</i>	LC	R
5	Little Ringed Plover	<i>Charadrius dubius</i>	LC	WV
6	Spot-billed Pelican	<i>Pelecanus philippensis</i>	NT	R
7	Black-headed Ibis	<i>Threskiornis melanocephalus</i>	NT	R
8	Painted Stork	<i>Mycteria leucocephala</i>	NT	R
9	Western Reef Egret	<i>Egretta gularis</i>	LC	R
10	Brown-headed Gull	<i>Chroicocephalus brunnicephalus</i>	LC	WV
11	Paddyfield Pipit	<i>Anthus rufulus</i>	LC	R
12	Indian Bush-Lark	<i>Mirafra erythroptera</i>	LC	R
13	Glossy Ibis	<i>Plegadis falcinellus</i>	LC	R
14	Little Egret	<i>Egretta garzetta</i>	LC	R
15	Green Bee-eater	<i>Merops orientalis</i>	LC	R
16	Blue-tailed Bee-eater	<i>Merops philippinus</i>	LC	WV
17	Barn Swallow	<i>Hirundo rustica</i>	LC	WV
18	Brahminy Kite	<i>Haliastur indus</i>	LC	R
19	Booted Eagle	<i>Hieraetus pennatus</i>	LC	WV
20	Black Kite	<i>Milvus migrans</i>	LC	R
21	Eurasian Curlew	<i>Numenius arquata</i>	NT	WV
22	Yellow Wagtail	<i>Motacilla flava</i>	LC	WV
23	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC	R
24	Rosy Starling	<i>Pastor roseus</i>	LC	PM
25	Marsh Sandpiper	<i>Tringa stagnatilis</i>	LC	WV

Migratory status: Resident (R), Winter Visitor (WV), Passage Migrant (PM); IUCN status: Least Concern (LC), Near Threatened (NT).

negundo, and *Gloriosa superba* that impact the native species populations. Apart from this, the presence of cattle, feral dogs, and feral horses is a threat to the native species thriving there.

The mudflats of the sanctuary are inhabited by Boddart's Goggle-eyed Goby *Boleophthalmus boddarti*, which was a sight to observe. Watching the territorial behavior of mudskippers was something great and unique. The forest department is planting mangroves in mudflats that would gradually restore the habitat of these conspicuous fishes.

Udayamarthandapuram Bird Sanctuary

On 1 January 2024, we visited the Udayamarthandapuram Bird Sanctuary (UBS) located in Tiruvarur District, Tamil Nadu, India. We loved that evening, walking among the lush green vegetation, looking at birds everywhere.

This sanctuary, spanning an area of around 43 ha, was declared as a protected area in 1999.

It has been designated as a Ramsar site since 2022. UBS has a diverse habitat including large and deep water body with a number of inlets

Checklist of birds observed at Udayamarthandapuram Bird Sanctuary.

	Common name	Scientific name	IUCN Red List status	Migration status
1	Indian Roller	<i>Coracias benghalensis</i>	LC	R
2	Common Kingfisher	<i>Alcedo atthis</i>	LC	R
3	Green Bee-eater	<i>Merops orientalis</i>	LC	R
4	Greater Coucal	<i>Centropus sinensis</i>	LC	R
5	Blue-faced Malkoha	<i>Phaenicophaeus viridirostris</i>	LC	R
6	Rose-ringed Parakeet	<i>Psittacula krameri</i>	LC	R
7	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	LC	R
8	Indian Paradise Flycatcher	<i>Terpsiphone paradisi</i>	LC	R
9	Rufous Treepie	<i>Dendrocitta vagabunda</i>	LC	R
10	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC	R
11	Grey Heron	<i>Ardea cinerea</i>	LC	R
12	Oriental Darter	<i>Anhinga melanogaster</i>	NT	R
13	Common Coot	<i>Fulica atra</i>	LC	R
14	Grey-headed Swampphen	<i>Porphyrio Ploiocephalus</i>	LC	R
15	Eurasian Moorhen	<i>Gallinula chloropus</i>	LC	R
16	Glossy Ibis	<i>Plegadis falcinellus</i>	LC	R
17	Asian Openbill Stork	<i>Anastomus oscitans</i>	LC	R
18	Indian Spotted Eagle	<i>Clanga hastata</i>	VU	R
19	Shikra	<i>Accipiter badius</i>	LC	R
20	Western Marsh Harrier	<i>Circus aeruginosus</i>	LC	WV
21	Brahminy Kite	<i>Haliastur indus</i>	LC	R
22	Brahminy Starling	<i>Sturnia pagodarum</i>	LC	R
23	Rosy Starling	<i>Pastor roseus</i>	LC	PM
24	Black Drongo	<i>Dicrurus macrocerus</i>	LC	R
25	Tricolored Munia	<i>Lonchura malacca</i>	LC	R
26	White-browed Bulbul	<i>Pycnonotus luteolus</i>	LC	R
27	Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i>	LC	WV
28	Red Collared Dove	<i>Streptopelia tranquebarica</i>	LC	R
29	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	LC	R
30	Black-headed Ibis	<i>Threskiornis melanocephalus</i>	NT	R
31	Painted Stork	<i>Mycteria leucocephala</i>	NT	R
32	White-browed Wagtail	<i>Motacilla maderaspatensis</i>	LC	R
33	Little Egret	<i>Egretta gazetta</i>	LC	R
34	Intermediate Egret	<i>Egretta intermedia</i>	LC	R
35	Large Egret	<i>Ardea alba</i>	LC	R
36	Barn Swallow	<i>Hirundo rustica</i>	LC	WV

Migratory status: Resident (R), Winter Visitor (WV), Passage Migrant (PM); Red List status: Least Concern (LC), Near Threatened (NT).

and surrounding irrigated agricultural fields. This site is a part of the Central Asian Flyway (Tamil Nadu State Wetlands Mission 2023). A little more research about the place gave us

the real picture of the threats this beautiful bird sanctuary faces. The wetland receive the runoff of chemicals fertilizers and pesticides used in the paddy fields. The birds are dependent on the

water body and surrounding paddy fields for food and are prone to poaching (Mohan et al. 2020).

CONCLUSION:

Our journey through eight different landscapes enriched our knowledge, understanding and gave us deeper insights in the field of conservation and role of communities in conservation.

The wetlands and grasslands near marine ecosystems are different from those we had visited previously. We were able to recognise and differentiate the adaptations of species in different landscapes from our earlier field visits adding to our understanding of concepts taught in the class. Observing biodiversity and at the same time comprehending anthropogenic pressure was an eye opener for all of us at the mangrove ecosystem, intertidal mudflat zone, mudflats near Point Calimere, island, and coral ecosystem.

This introduction to the marine ecosystem helped us establish links between classroom sessions and on-field learning. This raised our curiosity to keep exploring and observing biodiversity, landscapes, ecosystems and build conservation interventions based on scientific evidence to mitigate threats to wildlife.

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encouraging and educating us throughout the field visit. The Ram Hattikudur Advanced Training in Conservation (RHATC) course at Zoo Outreach Organisation has provided us an opportunity to have an exposure to all the different ecosystems and we are immensely happy and grateful. We would also like to take this opportunity to thank all the funding agencies and individuals who have supported to make this learning expedition possible.

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Serene shore of Valimunai Island. © Praveen Rozario.



Wild and native palms of Kerala

We went on a field trip to Vagamon, Kerala from 04–07 December 2023, to understand the landscape of Kerala, the shola grasses, and the grassland habitat. During the field exploration we climbed a few hill tops and waterfalls and observed some of the endemic palm trees.

The diversity of palms in India is very rich. Palms belong to the family Aceraceae, also called Palmae, a monocotyledon family. Globally, they are distributed in tropical and temperate regions. In India there are about 21 genera and 100 species of palms in three geographical regions – Peninsular India, northeastern India, and Andaman & Nicobar Islands. Peninsular India is represented by 11 genera and 32 species of palms. The majority of the genus are monotypic; genus *Calamus* is an exception. The indigenous genera distributed in Kerala are *Arenga*, *Bentinckia*, *Calamus*, *Caryota*, *Corypha*, *Phoenix*, and *Pinanga* (Abhilash & Sathian 2013).

1. *Bentinckia condapanna* Berry ex Roxb.

Bentinckia condapanna Berry ex Roxb. commonly referred to as Hill Arecanut. It is named after Sir William Henry Cavendish Bentinck, an ex-Governor General of East-Indies by Berry in Roxb, Flora of British India III, 621. In India the genus is represented by only 2 native species, *Bentinckia condapanna* Berry ex Roxb and *Bentinckia nicobarica* (Kurz) Becc. The specific name of *Bentinckia condapanna* is a compound word derived from two words, 'conda' and 'pana'. Conda describes the casual knot in the hairstyle worn by the women in South India; while pana describes the palm (Manilal & Renuka 1983).



Distribution map of palms in Kerala.



Distribution map of palms in Kerala.



The habitat of *Bentinckia condapanna*. © Sanjay Molur.



Morphological description: *B. condapanna* is a solitary, monoecious (both male and female reproductive structures are present on the same plant) palm that has a thin stem of roughly 15–20 cm and approximately 10 m in height. The leaves are pinnately compound. The caudex is 2–3 m across. Leaflets are linear-lanceolate, 50–70 x 3–5 cm, evenly scattered and sessile. The sheath is rounded and encircling the stem. Spadix is axillary and branched with numerous spathes. Male flowers measure up to 0.25 cm size and are small and sunken in the spirally arranged pits towards the tip of branches. Female flowers are measured as 0.38–0.51 cm sized and are larger towards the base of the spadix. The ovary is 3-celled. The fruit is sub-spherical which turns purple when ripe. The terminal buds and juvenile leaves are edible (Mohanani & Henry 1994).



Distribution: *B. condapanna* is highly restricted in its distribution. It only occurs in southern Western Ghats states of Kerala and Tamil Nadu at the rock cliffs with an elevation of 1,500 m. It has been recorded from Agastyamala & Peppara (Thiruvananthapuram), Kalathupuzha (Kollam), Moozhiyar & Kakki (Pathanamthitta) and Pachakkanam, Uppupra, Peerumedu (Idukki) in Kerala (Renuka 1999). During our field exploration in (Urumbikkara hill top) Idukki and Kottayam districts, Kerala; Dr Sanjay identified this palm as *Bentinckia* from a far distance. We climbed down and observed that the population consists of 4–5 adult individuals on the steep rocky cliff (9.6023125 °N, 76.9266875 °E).

2. *Corypha umbraculifera* Linn.

Morphological description: The tree trunk is approximately 18 m in diameter. Leaves are 1.8

Bentinckia condapanna: a) A tree at the cliff. b) Part of fruiting branch. © Sanjay Molur.

m long and 3.9 m broad. Spines on the petiole are paired (Mohanani & Henry 1994). It flowers once in its lifetime when 30–40 years old, a monocarpic palm. The palm stores a significant amount of starch in its huge trunk before it flowers; this starch is used to create the massive terminal inflorescence. This palm is the national floral emblem of Sri Lanka (Renuka 1999).

Distribution: *C. umbraculifera* is distributed in semi-wild conditions of Malappuram, Kozhikode, Palakkad, and Kottayam districts of Kerala. It is also cultivated in some districts. During our way towards Eravikulam National Park, Munnar, Kerala; one of the fellows Maithreyi Hegde observed the flowering of *Corypha umbraculifera* as it was distinctly visible from the canopy cover. There was only one individual in flowering. The same palm has been reported from Sri Lanka also (Renuka 1999).

3. *Arenga wightii* Griff.

Morphological description: It is a solitary and monoecious palm. The *Arenga* stem grows to a height of 10 m by 30 cm. Leaves are approximately 4–7 m long. The adaxial surface of leaflets are dark green while the abaxial surface is white with two auricles at the base. Inflorescence is produced in the axil of the leaf. Fruits are globose yellowish-green when ripe (Renuka 1999).

Distribution: It is distributed in the evergreen forest of Peerumedu, Dhoni, Wayanad, Nelliampathy, Neriamangalam, Muthikulam, Attapaddy, Kottiyur, and Sholayar at an elevation of 300–1000 m (Renuka 1999). During the trek to Kottathavalam waterfalls, Kottayam district, Kerala Dr Sanjay observed this palm. There were



The inflorescence of *Corypha umbraculifera*.
© H. Maitreyi.



Arenga wightii on the slopes of Kottathavalam waterfalls. © Sanjay Molur.

2–3 individuals seen from the top of a waterfall. He also called it Indian coconut. It was on the rocky edge which was again difficult to reach.

The species is very important for the Muthuvan tribe in Idukki district as they extract starch from the cylindrical stem when the plant is 15–30 years of age. The starch is concentrated in the pith region so the tree is cut down and sliced into different length. They also consume large quantities of wine from the palm (Manihottam & Francis 2007).

4. *Calamus brandisii* Becc.

Morphological description: The stem is slender. Leaflet few fascicled lanceolate ensiform naked beneath sparsely setose above on the 3 costae, petiole slender with very long straight spines, rachis with long stout solitary straight and recurved spines, sheath armed with solitary or aggregate slender flattened straight spines mouth with very long needle-shaped spinules. Male spadix elongates shortly flagelliferous with few partial inflorescences. Spathes narrow tubular, upper funnel shaped unarmed. Flowers 4-seriate in bud (Mohanani & Henry 1994).



Calamus brandisii and *Phoenix pedunculata* interspersed on the slopes of Kottathavalam waterfalls, Kottayam district, Kerala. © Sanjay Molur.

Distribution: *Calamus* is distributed in the evergreen forest at an elevation of 1,000–1500 m at Bonacaud & Agasthyamala in Kerala, Kalakkadu, Muthukuzhivayal, and upper Kothayar in Tamil Nadu (Renuka 1999). We all observed this palm during our field visit to Kottathavalam waterfalls, Kottayam district, Kerala. It was spread on the entire slope on the way towards the waterfalls. It appeared as if it was planted.

5. *Phoenix pedunculata* Griff.

Morphological description: A dwarf pleonastic, clustered palm that grows up to 3 m in height. The persistent leaf bases, grouped in an almost helical pattern, span the whole stem. Leaves: 1–2 m long, flexible leaflets that range in colour from pale green to slightly bluish-green, fascicled. Flowers on different plants for the male and female. Fruits from orange to black in colour. It blossoms from January to March and bears fruit from October to December (Renuka 1999).

Distribution: It is typically found in higher elevation grasslands, between 1,000 and 2,000 m. It has been seen at Thekkady, Muthikulam, Chinnar, Peerumedu, Parambikulam, Silent Valley, and the Eravikulam slopes in Kerala (Renuka 1999). *Phoenix pedunculata* was interspersed with *Calamus brandisii* on the slopes of Kottathavalam waterfalls, Kottayam district, Kerala.

The terminal bud and the pulp of the fruit are edible. Leaves are used as brooms. In Tamil Nadu broom industry based on *Phoenix* is a major threat to the survival of the species (Renuka 1999).

Note: *Phoenix pedunculata* Griff has now been shifted to a variety. *Phoenix loureiroi* var. *pedunculata*.

Threats to the species: All the palm species have a variety of uses and they have been exploited since time immemorial. The shoot apex of *B. condapanna* is the most favourite of elephants. (Kulkarni & Mulani 2004). The leaves have been exploited for human uses like for thatching purpose, for making writing material, umbrellas, and baskets. The tree trunk is used for fibre and sap. The seed of *C. umbraculifera* is as hard as ivory so it has been used to make buttons (Irawanto 2013).

Overexploitation of the plant material, habitat loss due to change in land use pattern and anthropogenic pressure are the reasons for shrinkage of population.

Conservation status: Most of the abovementioned palms are found in some of the inaccessible rocky cliffs which are hard to climb. So, there is not enough data on population count, species description. Only few of the species have been assessed like *B. condapanna* as Vulnerable (Johnson 1998).

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Male and Female inflorescence of *Phoenix pedunculata* at the high altitude grasslands. © Sanjay Molur & L.M. Aparna.

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Discovering the Shola Grasslands - the Jewels of Nilgiris with Godwin Vasanth Bosco

The beautiful shola-grasslands at Thiashola, Ooty.
© V.B. Pannaga.



About Vasanth Bosco

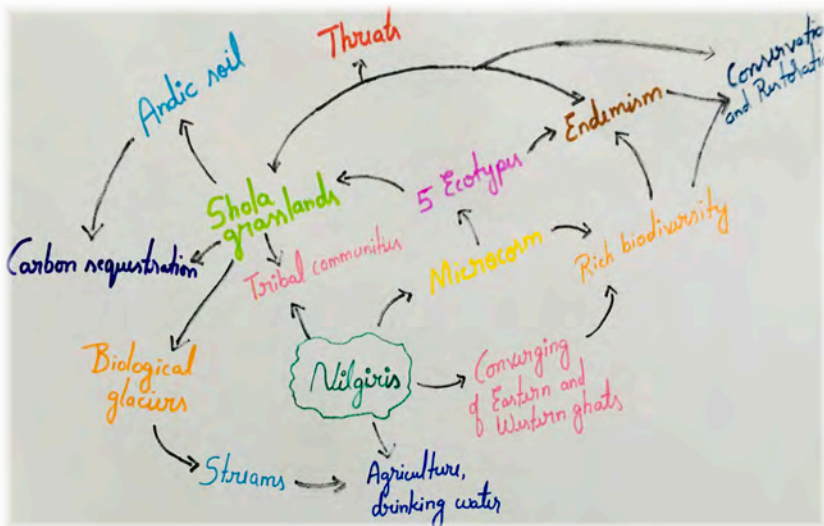
Godwin Vasanth Bosco is a conservationist and researcher working towards the restoration of the shola grasslands in the Nilgiris. Even as a child he was fascinated by the grasslands and sholas and ventured to grasslands for the first time when he was in school. And this experience developed a curiosity towards the grasslands and shola which created an impression that stayed with him forever. He refers to the landscape as one of the greatest teachers he has come across so far.

He went to Finland to pursue his higher studies in environmental engineering.

He owns two patents in the domain of alternative technology. Even after achieving all these somewhere deep in his mind, he had a sense of unfulfillment so he returned to his native place. After attending a program at the Gurukula Botanical Sanctuary on the ecology of mountain landscapes and observing the destruction of precious landscapes he decided to work towards the conservation of grasslands and sholas.

Upstream Ecology

On 27 October 2022, Upstream Ecology was established as a private, non-profit company by Godwin Vasanth Bosco



Mind map about Nilgiris. © V.B. Pannaga.



Image depicting importance of grasses. © V.B. Pannaga.



A glimpse of nursery at Upstream Ecology, Ooty nurturing native species of grasses, shrubs, and trees. © V.B. Pannaga.

with a strong motive to make a difference in the society, from the level of plant ecology ascending to social, political, and economic obstacles towards sustainable solutions. In this regard, all the three dimensions are interlinked with the foundation of ecological studies.

Upstream Ecology believes in a bottom-up approach; changes need to take place from the ground level by understanding the root cause of a problem and ascending upwards to fix the issues from the source. The ultimate aim of the foundation is to conserve and restore the shola-grasslands which are the biological glaciers. Hence by restoration of these precious landscapes, all the other types of vegetation which are downstream could be conserved (Upstream Ecology 2023; Zauba Corp 2023).

Our interaction with Godwin Vasanth Bosco
Vasanth is a soft-spoken and an incredibly talented person. He started his session by explaining the evolution of the Nilgiris.

Nilgiris means blue-mountains it is due to the presence of *Strobilanthes*, which makes the whole mountain range bluish. Nilgiris is a mountain range spread among the states of Karnataka, Tamil Nadu, and Kerala.

He explained about the landscape of the Nilgiris, the extent, rainfall patterns and temperature variations, types of vegetation, floral and faunal diversity, and endemism. The most fascinating thing was to know about the tribal community who are living in the Nilgiris. There are a total 22 tribes who are completely dependent on the grasslands which is a very interesting fact. We were very curious to know about the speciality of the soil which is known as the andic soil which acts as a rich source of carbon. Due to the presence of organo-metallic compounds in the soil, the carbon is retained in the soil which makes it more porous and the water-retaining capacity is increased which is why grasslands are termed ‘biological glaciers’ giving rise to perennial streams. He explained about the invasive species and challenges and other threats due to anthropogenic activities. Later, he concentrated on the sholas as a distinct habitat, the microclimate associated with it nurturing unique life forms within. At the beginning of the session, we were asked about the grasslands and we shared our opinion with only a few points but after his explanation, our whole perspective changed.

Our interactive session with him comprised



Native tussock grass, *Eriochrysis rangachari* saplings at Upstream Ecology. © Praveen Rozario.



The picturesque Lawrence School. © C.K. Arjun.



Diligent labor uprooting the invasives. © Payal B Molur.



Smiling faces after Thiashola restoration. © H. Byju.

very informative group assignments on understanding the origin and distribution of three grass species- *Crysopogon*, *Themeda*, and *Dicanthium*, mapping grasslands of southern India and the history of the origin of grasslands, which expanded our understanding and gave us more clarity on these topics. Just in two hours, we were surprised to see how much we read and learned about grasses through this activity. He also amazed us by informing us of a lot of myth-busting facts about solar panels and their contribution to global warming. Our interaction with him has made such an impression that now wherever we see grasses, we remember him first.

Bosco has a great passion for music; he has written and composed many songs. He started his session the next day by making us sing one of his songs on nature named, 'May Be the Mist Knows'. We loved the lyrics, so deep and intense, a particular line says 'maybe the heart speaks, it's made of the same essence that fills the forest floor'.

We also went out for a short field visit where he explained about the grass diversity and invasive species. We came across some of the genera of grasses which included *Pennisetum*, *Themeda*, *Eragrostis*, *Cyperus*, *Festuca*.

Vasanth Bosco's contribution towards shola-grassland

His contribution in the field of



Pennisetum grasses spotted in Coimbatore on a short field visit. © Praveen Rozario.

conservation, restoration and choosing to revive the shola-grassland of Nilgiri is truly remarkable! Upstream Ecology focuses on restoration and research on shola-grasslands. Research includes his 12 years of experience, observation and understanding of rapid change due to various pressures on the landscape. He also strives to promulgate a deeper understanding of nature that the world needs.

Upstream Ecology has developed the nursery which is dedicated towards growing and nurturing of native species of shrubs, plants, trees, and grasses. The nursery focuses on the selection and propagation of mature plants that can be planted at the restoration sites. After figuring out land topography, soil texture, rainfall, weather, and complex ecology specific sites are marked for the restoration process. They are also involved in the eradication of exotic, invasive species from the grasslands.

It is a very hectic and requires lot of coordination and collaboration with support from the forest department and volunteers. They have successfully removed exotic pine trees from a particular region of Nilgiris. Upstream Ecology also works with 15 stakeholders, across 5,500 km² in close to 60 different sites across the biosphere in the restoration and conservation process. Bosco has also written a book titled 'Voice of a Sentient Highland'

in which he has depicted Nilgiris, grasslands and sholas, the changes and altered ecology, challenges, regeneration, and conservation.

Nursery visit

On 24 November 2023, we visited the Upstream Ecology nursery which is being maintained by Godwin Vasanth Bosco in Ooty where we had a small tour to learn about the variety of shola trees, shrubs, and grasses that have been propagated successfully for restoration. The nursery has a total of 110 species of native flora.

A few native species which play an important role in the shola grassland ecosystem are:

- The nitrogen-fixing legume *Crotalaria longipes* which can be planted on the restoration sites to make the soil fertile and support the growth of other native flora.
- Hill guava *Rhodomyrtus tomentosa* which is widely distributed in the Nilgiris at higher altitudes, bears edible fruits that serve as a food source for many animals.
- The endemic *Kalanchoe grandiflora* which evolved in Pangia around 120 million years ago and shares a common ancestor from India and South Africa.
- *Rhododendron arboreum* which efficiently stores water in its bark and makes it a suitable habitat for the growth of mosses.

- The recently rediscovered Toda Grass *Eriochrysis rangacharii* which was earlier assumed to be extinct. It is a native and utilized by the Toda tribe for building their temples and traditional houses.

Below is the list of *Strobilanthes* species present in the nursery:

Scientific name	Common name	Flowering
<i>Strobilanthes kunthiana</i>	Neelakurinji	12 years
<i>Strobilanthes cuspidatus</i>	Silver Kurinji	6 years
<i>Strobilanthes lawsoni</i>	Copper Kurinji	17 years
<i>Strobilanthes heteromalla</i>	Forest Kurinji	8 years
<i>Strobilanthes wightiana</i>	NA	every year
<i>Strobilanthes lanata</i>	Golden Kurinji	9 years
<i>Strobilanthes homotropa</i>	NA	

Sapling segregation:

In the later part of the day, we were involved in individual replantation of the native Toda Grass *Eriochrysis rangacharii* into polybags to make them easy to carry for the upcoming restoration projects. Some of us sorted and arranged different sapling batches based on their age and also measured the height of all saplings to record their growth. Another group prepared a suitable medium for the grasses by mixing three different types of soil and compost and filled them in the bags. And last group separated individual grass that were ready for planting at the restoration site from the cluster and planted the root slips in the packets.

Restoration at Carrington

On the second day, we visited one of the sites owned by Upstream Ecology at Carrington, located 60 km away from Ooty town. It is located on top of the hill next to a small patch of tea plantation, which is currently not under active cultivation.

The place is indeed a treasure land with plenty of flora, including captivating orchids like *Calanthe sylvatica*, *Osbeckia sublaevia*, and an amazing variety of endemic fauna. Along the way, the fellows also came across Tiger pugmarks. They had a small tour of the restoration site where Vasant claimed the gradual succession of grasslands post-restoration. He also instructed the fellows on plantation techniques and tool usage. He enlightened them about the nutrient-rich black soil (Andic soil). The fellows successfully planted 21 saplings of Golden Kurinji and Toda grass. They also effectively removed the invasive *Cestrum trees* from the adjoining rainforest patch which had overgrown and dominated the landscape.

Lawrence school

The Lawrence School, Lovedale, Ooty was established in 1858 during the colonial period. It is a picturesque landscape with rich biodiversity of grasslands capturing the beauty of Nilgiris. Vasant is currently involved in restoring five acres of land with the vision of restoring 100 acres in the

next five years. We were accompanied by the NCC cadets of Lawrence and spent the day uprooting invasives like *Eupatorium* and African Mat Grass (*Kikyui*) *Pennisetum clandestinum* that were suffocating the native grass from growing. After successfully uprooting a giant heap of invasive plants, the landscape looked a little different, not a great change but a small step towards a better future for the species.

Restoration without regular monitoring and intervention has no point. Vasant is meticulous in maintaining restoration, intervention, and regular monitoring of the landscape. He is truly an inspiration for budding conservationists.

Conclusion

The Nilgiri Biosphere or the microcosm of Earth is a unique landscape catering different types of vegetation, providing habitat for numerous species of flora and fauna also sheltering different tribal communities making it one of the world's most diverse ecosystems. The shola-grasslands are the most special and precious landscapes which are present only in a small portion of southern India which serves as the source of fresh water to millions of people downstream. However, due to increased developmental activities these grasslands have undergone drastic changes. We are losing the grasslands and sholas gradually due to various factors such as climate change, invasive

species and anthropogenic activities. We are destroying the habitat of numerous endemic species and pushing them towards the urge of extinction. Our mentor Godwin Bosco with his organization 'upstream ecology' is working towards the restoration and conservation of the grasslands. His contribution in developing the nursery, removal of invasive species, education, and outreach programs is phenomenal. We all know that reformation cannot be brought in one night and also not by one man. It is the collective responsibility of every individual to understand the essence of nature and try to conserve it in all aspects. We need to remind ourselves that we are also a part of nature and we cannot exist without it. We should think about the future generation, what are we leaving behind for them? Is it the money, property, inheritance, unbearable

temperature, scarcity of freshwater, harsh climate, barren-infertile land or the precious forests, pleasant weather, good rainfall, fresh water, and air?! We need to think.

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It gives us immense pleasure to express our heartfelt gratitude to Godwin Vasanth Bosco for spending his valuable time and sharing his knowledge and expertise on the shola-grasslands. We would also like to thank the entire Zoo Outreach Organisation — Sanjay Molur and all the team members for organizing this amazing session.

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Plant a thought!

- *Magnolia nilagirica* is one of the species that is endemic to the Nilgiris. It is now facing changing flowering seasons and patterns due climate crisis.
- Gaurs prefer feeding on native grass species over non-natives.

The picturesque mist on the Thiashola restoration site.
© Praveen Rozario.

Bonnet Macaque *Macaca radiata*

Taxonomy

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Primates

Family: Cercopithecidae

Scientific name: *Macaca radiata*

Species Authority: E. Geoffroy, 1812

Common Name(s): Bonnet Macaque

Subspecies: *M. radiata radiata*, *M. r. diluta*.

Geographic Range

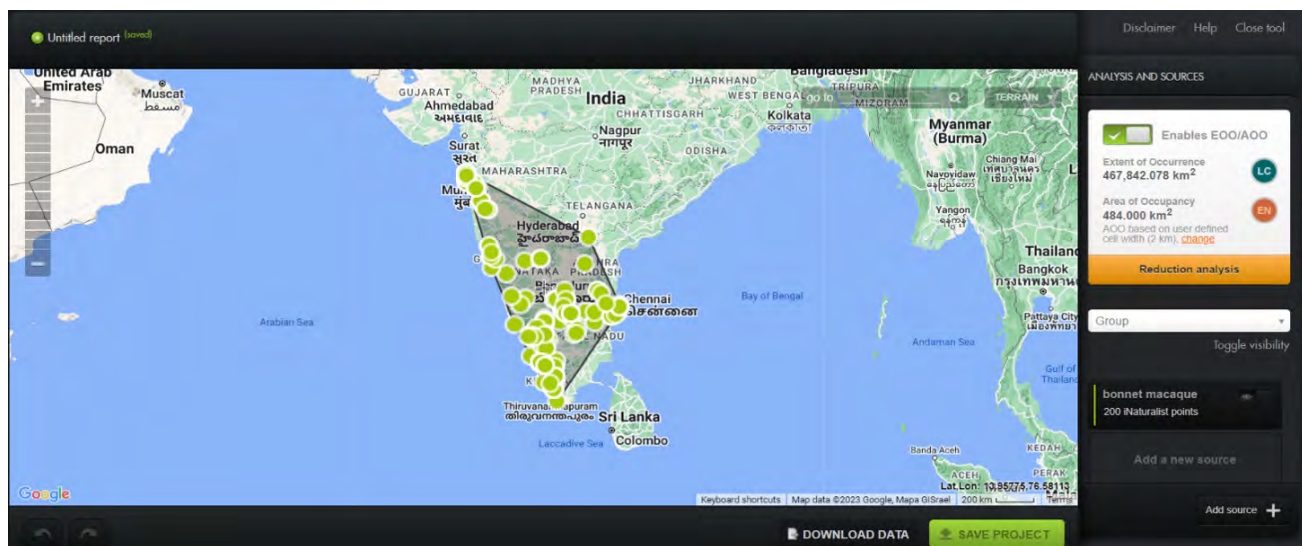
Bonnet Macaque is a common and widely distributed but endemic primate of peninsular India. The northward distribution range is believed to be up to the rivers Godavari in the east and Tapti in the west (Foode et al. 1989). Kumara et al. (2010) showed the northward distribution till the end of the Western Ghats specifically up to the town of Surat, Gujarat in the west and the town of Guntur, Andhra Pradesh in the east. *M. radiata radiata*, occurs north of Kambam valley in the southern

Western Ghats to the northern tip of hill ranges, *M. r. diluta* is restricted to south of the Kambam valley (Ali 1981).

Geographical distribution of *Macaca radiata*

Population According to Kumara et al.

(2010, 2011): 205 Bonnet Macaque groups encountered during the road survey in different districts of Karnataka; 158 groups encountered in different protected areas and reserve forests of Karnataka. Kumara et al. (2010) estimated the population density in rural and urban areas of southern India to be about 0.34 individual/km², with the largest population in Karnataka. These macaques live in multimale and multifemale groups. The group size ranges from 5 to 75 individuals (Kumara et al. 2010); 140 Bonnet Macaque troops were recorded in Maharashtra, Goa, Andhra Pradesh, Gujarat and Karnataka (Kumara et al. 2011).



Population trend

In 1989, 54 troops and 1,207 individuals were recorded (D'Souza et al. 1992). In 1998, 55 troops and 1,022 animals were recorded (Sharma 1998). In 2003, 47 troops and 950 animals were recorded (Singh & Rao 2004). In 2009, 31 troops and 697 individuals were recorded (Singh et al. 2011) in Chamundi Hill, Mysuru. The four surveys show that during a 20-year period, the population of Bonnet Macaques has consistently decreased 57.74%, with the exception of the scrub forest habitat of Chamundi Hill, Mysuru. Additionally, the findings demonstrated a consistent decrease in the groups' adult-immature ratio, which dropped from 1:0.94 in 1989 to just 1:0.58 in 2009 (Singh et al. 2011).

Habitat and Ecology

Bonnet Macaques live in a wide variety of habitat types, including montane evergreen forests, deciduous forests, scrub forests, agriculture fields and human habitats. They feed on the leaves, petioles, stems, pith, tendrils, roots, flowers, fruits, seeds, and even the leaf-galls of various herbs, climbers, shrubs, trees, and grasses. They also consume vegetative, floral, and fruit buds. In a dry deciduous forest, 86 plant species have been found to provide food for this primate, while in a tropical evergreen forest, 39 plant species have been reported. Macaque also been seen consuming spiders and bird eggs, as well as insects such as termites, grasshoppers, cicadas, crickets, and insect pupae. However, fruits are typically the most significant food item, followed by foliage and invertebrates. Every now and again, tourists along the highway that passes through the sanctuaries give high-calorie human food to

some of the troops. Females spend their entire lives in their natal group, and linear, matrilineal dominance hierarchies as adults, with daughters ranking slightly lower than their mothers. In the dominance hierarchy, females typically form tight affiliative connections with high amounts of allogrooming exchanged between unrelated individuals and genetic relatives.

Male cercopithecines, both juvenile and adult, typically leave their birthplace troops; however, male Bonnet Macaques seem to be an exception to this rule, with some even choosing to remain and rise to the position of dominance within their natal troops. Unlike their female counterparts, adult Bonnet Macaque males create unstable hierarchies of dominance through coalitions and direct aggression. They often hold low ranks when they are very young or old but hold relatively high positions when they are mature. Among cercopithecine species, males are also distinct in that they exhibit high degrees of allogrooming and other affiliative conduct towards one another, behaviour that is both equal in quality and quantity to that displayed by females (Sinha et al. 2005; Sinha & Mukhopadhyay 2012)

Reproduction

Bonnet Macaques are typically promiscuous with ample mating opportunities for both males and females. Adult males appear to follow different sexual strategies, with some males forming consort ships of varying periods of time while others simply copulate opportunistically with the available females. Subadult or juvenile males are also not denied access to oestrus females. Finally, although Bonnet Macaque females appear to

be remarkably indiscriminating, mating freely with males of all ages and ranks. Females also clearly prefer to sexually solicit new immigrant males over resident males, even if the latter are much more dominant. Females attain sexual maturity at 3–3.5 years and males at 5 years (Rao et al. 1998; Sinha et al. 2005).

Generation length

10–12 years (from IUCN Red List).

Use and Trade

Research purpose, keeping as pet, consumed for meat.

Major threats

The habitat of Bonnet Macaques in India has significantly decreased over time as a result of increased agricultural production, urbanisation, and road construction. Simultaneously, the likelihood of dying from causes like car crashes and electrocution has grown. These human-caused variables have been linked to a sharp fall in the number of Bonnet Macaques in recent years (Małgorzata et al. 2021).

Rhesus Macaques have extended the boundaries of their geographical range in southeastern India due to construction of dam in Krishna River basin in Andhra Pradesh. Rhesus Macaque is very aggressive and they are crossing over the bridge and competing with Bonnet Macaque for geographical area this is leading to habitat loss of Bonnet Macaque. Human interaction and aggressive behaviour of Rhesus Macaque (Kumar et al. 2011)

Conservation Measure

Schedule II, Indian Wildlife (protection) Act, 1972.

Assessment

EN A2abcde / **CR A3bcde**. as it mentioned in IUCN Red List criteria, selecting the highest level of assessment, the Bonnet Macaque is assessed as Critically Endangered, due to increase in various threats such as habitat loss, loss of fruiting trees, more human-macaque interactions, and overlapping of home range by Rhesus Macaque in the next 30–36 years (3 generations). Since Bonnets are endemic to southern India and the population has already declined by about 60%, the prediction is more precarious for the species.

Actions Needed

Educating people (tourist and farmers) about species and its important in ecosystem.

Research Needed

Adapting abilities, stress level and current home range status of Bonnet Macaque.

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King Cobra *Ophiophagus hannah*

Taxonomy

Kingdom: Animalia

Phylum: Chordata

Class: Reptiles

Order: Squamata

Family: Elapidae

Genus: *Ophiophagus*

Species: *O. hannah*

Introduction

In the past King Cobra was considered as one species and it was thought to be widely distributed across southern and southeastern Asia. Shankar et al. (2021) studied the genetic makeup of the species and came to a conclusion that it was four different species of King Cobra. They referred to it as CCS1, CCS2, CCS3, and CCS4 where: CCS1 is the species that is found in the Western Ghats region and it is endemic to that region; CCS2 is widely distributed across eastern, northern, and northeastern part of India and Andamans; CCS3 is the Indo-China lineage and it is found in southern parts of China and some parts of northeastern India, Myanmar, Thailand, Indonesia, Philippines, and Malaysia; and CCS4 is found only in Luzon Island of Philippines.

So the species that I considered was the CCS1 lineage which is endemic to the Western Ghats of India.

Habitat and ecology

According to S.R. Ganesh (pers. comm. 19 November 2023), herpetologist, he mentioned that the habitat range is from Agasthyamalai hill range in the south till Sindhudurg plateau in the north, which is a stretch of around 950 km.

It is found in moist deciduous, semi-evergreen, evergreen, and montane shola forest but highest density is in tropical evergreen forest. It takes five years for an individual to mature sexually and to be able to breed, the life span is about 15 years (S. R. Ganesh pers. comm. 19 January 2024).

The breeding season is from January to April, it lays 15–16 eggs in a nest prepared by using leaf litter. It mainly feeds on snakes and other reptiles and it also exhibits cannibalism (Bhattacharyya & Mitra 2005).

Generation length

It can be guesstimated that the generation length might be 8–10 years based on personal communication with S.R. Ganesh.

Population

There have been no specific studies focused on population. The only quantifiable data available on King Cobras is regarding capture of 106 individuals from the year 2005–2009 at Agumbe Rainforest Research Station, Karnataka (Shankar et al. 2013).

Threats

The major threat is habitat loss, since Western Ghats has lost around 35.3% of its forest cover in the past 100 years (Reddy et al. 2016). The other threat is the human-snake encounters where in 80% of the instances people wanted to kill the snake. The relocation is also considered as a threat because distantly relocated snakes are under stress and usually die (Shankar et al. 2013).



Distribution of King Cobra.

Assessment

It was difficult to assess the species due to lack of data on population, extent of occurrence and area of occupancy. But there are enough threats which has caused decline in the species population. Although population declines over three generations (24–30 years) is not established with data, people’s perception and researchers encounters with King Cobras indicate a perceptible decline due to various threats. Hence I categorize it as **Near Threatened (NT) A2cd**.

Research needed

Since the species is endemic to the Western Ghats and not much studies have been carried out regarding population, area of occurrence, behaviour, and threats, further research is needed.

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Malabar Snakehead *Channa diplogramma* (Day, 1865)

Taxonomy

Kingdom: Animalia

Phylum: Chordata

Class: Actinopterygii

Order: Perciformes

Family: Channidae

Taxon Name: *Channa diplogramma* (Day, 1865)

Synonyms: *Ophiocephalus diplogramma*,
Channa diplogramma

Taxonomic Notes

Sir Francis Day described *Channa diplogramma* as *Ophiocephalus diplogramma* in 1865 based on one juvenile specimen collected near the mouth of the Cochin river in the port city of Cochin (southwestern India) and called it Malabar Snakehead (Day 1865). The color pattern of this juvenile matched with that of juveniles of another species of snakehead, *O. micropeltes*, originally described by Cuvier and Valenciennes from Java, Indonesia. This possibly led Day to synonymise *C. diplogramma* with *C. micropeltes* in 1878. *C. diplogramma* was shown to be a valid species 134 years after it was synonymized, making it an endemic species of peninsular India (Benziger et al. 2011).

Assessment Information

Red List Criteria & Category: CR
A2abcde+A3bcde

Justification: There is a clear indication of a population decline of more than 90% in Pamba river (Benziger et al. 2011) and the meristic study also shows the decline in the size of the

fish from ~100 cm to less than 21–32 cm from 1991 to 2011 (Gopalakrishnan & Ponniah 2000; Renjithkumar et al. 2011). It qualified all the sub-criterion a, b, c, d, and e for criteria A (except a in A3). Since there was no information about the generation length of *C. diplogramma*, I considered a similar snakehead species *Channa argus* (8.5 years) for generation length.

Geographic Range

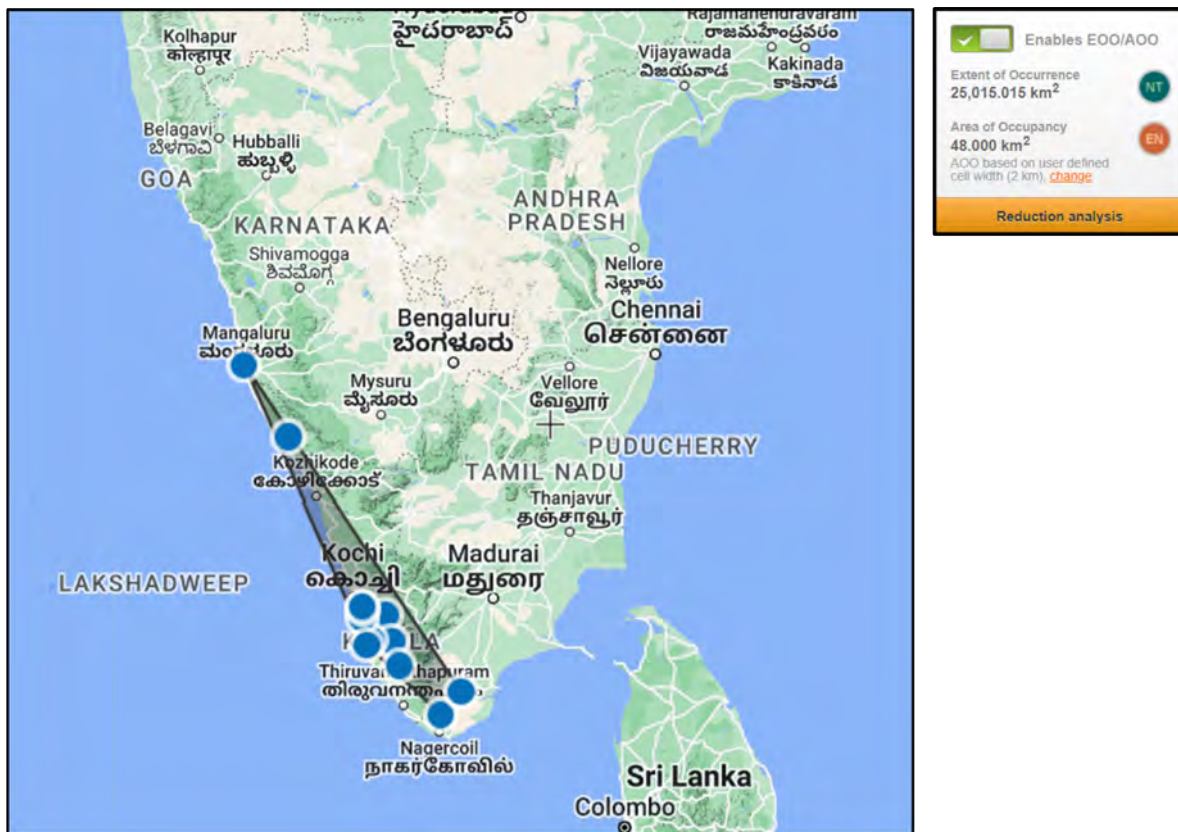
Range Description: *C. diplogramma* is a Western Ghat endemic species. Distribution is restricted to Kerala, Karnataka, and Tamil Nadu. It is known from the rivers (including its principal reservoirs) Meenachil, Manimala, Pampa, Achenkovil, and Kallada in Kerala, as well as the Chittar and Tamarabarani rivers (and its reservoirs) in Tamil Nadu, Netravati river in Karnataka (Benziger et al. 2011). It is also seen in northern Kerala, in Valapattanam river (Sajeevan et al. 2014).

Country of Occurrence: Native: India (Kerala, Tamil Nadu, and Karnataka)

Population: A population study was done in the Pampa river and Kallada river using landing in tonnes (Renjithkumar et al. 2011, 2020). Local fishers operating in the rivers and reservoirs where this species is known to occur have confirmed its rarity and populations have declined considerably (~90%) over the last two decades (Benziger et al. 2011). Meristic studies have found that over the past two decades, the size of the species has decreased significantly,



Adult *Channa diplogramma*. © Psiby/wikimedia.



Map showing the distribution of *Channa diplogramma*. (Created using Geocat).

thus showing a population reduction (Renjithkumar et al. 2011; Gopalakrishnan & Ponniah 2000). Also, the local fisherman Mr. Vineesh said that there has been an increased decline in fish population for the past two decades.

Current population trend

Declining at a rate of ~90%.

Habitat and Ecology

C. diplogramma is a freshwater benthopelagic

fish. They are hunter-fish and carnivores; thus, they occupy the highest level in the trophic level. They perform parental care and they are gregarious, 100+ juvenile fishes can be seen with parent fish. Also, they build their nest in the litter found in water (Anwar & Rajeev published in Malsyalokam). They are extremely brilliant fishes, and nowadays they omit feeding on hook angles even if they are fed in front of the mouth (according to local fisherman Mr. Vineesh).

Systems

Freshwater (Present in both western and eastern flowing rivers of Kerala, Tamil Nadu) and also in estuaries.

Use and Trade

The species is extensively used as food (Kurup 2004) and also in the ornamental fish trade across the globe (Ramachandran et al. 2015)

Threats

1. Habitat destruction or alteration of habitat is a major threat, apart from that, the use of destructive types of fishing methods are reasons for the rapid decline of native species population (Rajeev et al. 2008)
2. This species is extensively used as food and traded globally as ornamental fish (Benzigar et al. 2011) (Ramachandran et al. 2015).
3. *Channa micropeltes*, a kind of snakehead is reported only from the Pampa river which showed a decline of its population of the tune of 99% of its original population size due to EUS disease, dynamiting, and other destructive types of fishing activities, habitat alteration, poisoning and pollution (Kurup 2000).
4. Increased Food consumption, fishing, Aquarium trade, Presence of invasive (Arapaima and Piranha not sure), according to local fisherman (Vineesh 19 November 2023).
5. Leaching of pesticides from agricultural cultivation, and extensive use of Vietnam Murrel *Channa striata* for cultivation neglects native *C. diplogramma* (Dr. Simi KAU 19 November 2023).

6. Both invasive fishes and macrophytes act as a threat to the population of native species. *Oreochromis mossambicus*, *O. niloticus*, *Poecilia reticulata*, *Gambusia affinis*, *Pterygoplichthys pardalis*, *Cyprinus carpio*, and *Clarias gariepinus* are some of the major invasive species found across rivers in Kerala which has overgrown the native species (Raj et al. 2021).

7. Construction of dams in rivers acts as a major threat in reduction of native fish species (Ranjithkumar et al. 2011).

8. Habitat destruction and sand mining in the river basin of Valapattanam river have posed serious problems to the freshwater fish population by affecting their breeding and spawning grounds (Sajeevan et al. 2014).

Conservation Actions

1. Conservation measures are taken, repopulating by river ranching and, prioritization of endemic species to culture are some of the conservation measures taken. The species still face high exploitation in various disastrous fishing practices (Gopalakrishnan & Ponniah 2000).
2. Since the population is declining at a rate of ~90% proper conservation measures need to be taken.

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Fishing Cat *Prionailurus viverrinus*

Taxonomy

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Carnivora

Family: Felidae

Scientific Name: *Prionailurus viverrinus*

(Bennett, 1833)

Species Authority: Bennett, 1833

Common Name(s): Fishing Cat

Synonym: *Felis viverrina* Bennett, 1833

Subspecies- *Prionailurus viverrinus viverrinus*

(Bennett, 1833; 65), *Prionailurus viverrinus*

rhizophoreus (Sody, 1936; 45).

subspecies *Prionailurus viverrinus rhizophoreus* (Sody, 1936) is only restricted to Java, Indonesia (Kitchener et al. 2017).

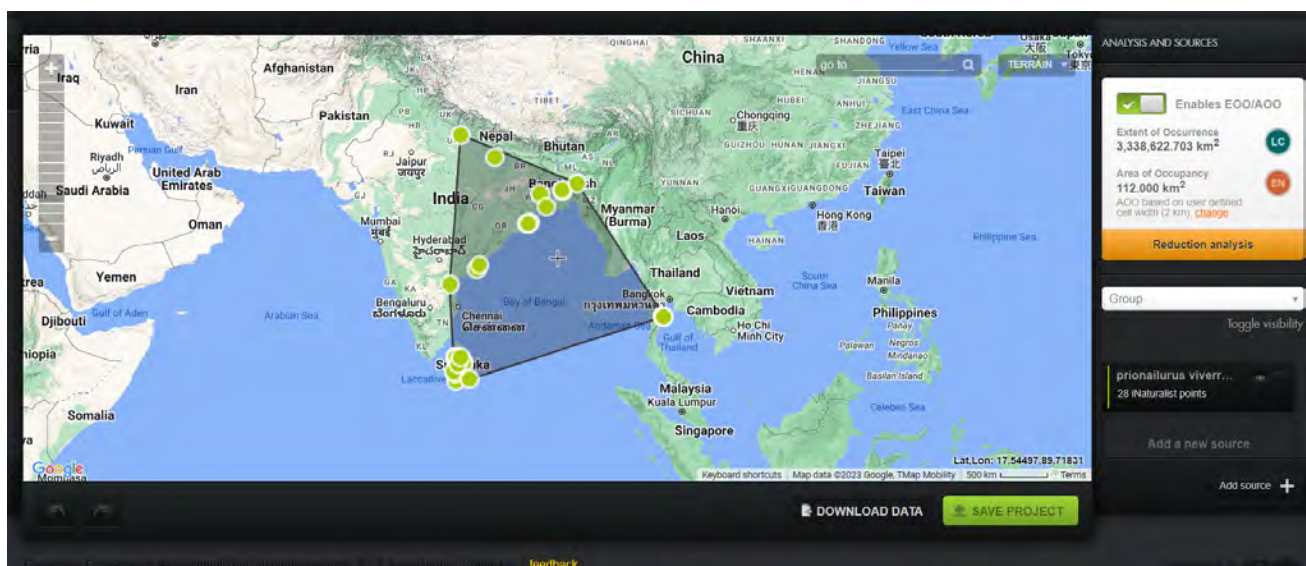
In India, the distribution of the Fishing Cat is patchy, it is limited to three broad clusters in the Terai region, eastern Coast, and Brahmaputra floodplains (Rana et al. 2022). Earlier, Fishing Cats were recorded in 12 Indian states but today their distribution ranges from the Sundarbans Mangroves & Hoogly in West Bengal, Bharatpur in Rajasthan, Andhra Pradesh, Odisha, Uttarakhand and Uttar Pradesh (Pocock 1939; Sunquist & Sunquist 2002; Rais et al. 2011; Mishra et al. 2018).

Geographic Distribution

It is restricted to southern and southeastern Asia. *Prionailurus viverrinus viverrinus* is widely distributed in India, Nepal, Pakistan, Bangladesh, Malaysia, Myanmar, Thailand, Bhutan, Vietnam, Indonesia (Java), Cambodia, Laos, Sri Lanka (Roberts 1977; Mukherjee et al. 2010; Chowdhury et al. 2015) and the other

Habitat

This cat mainly prefers wetland habitats like swamps, marshes, rivers, mangroves (Mishra et al. 2018), agricultural fields, fish farms (Mukherjee et al. 2010; Chowdhury et al. 2015) including alluvial floodplains, river deltas, and mangrove forests (Mukherjee et al. 2012). Ponds, canals, rivers, tidal creeks, mangroves,



etc. are also considered as critical habitats for this species (Cutter 2015), and the individuals that are mostly observed have been reported near the vegetation patches or grasses adjoining rivers or streams (Mukherjee et al. 2012). Being an opportunistic feeder, this species is also well-recorded in man-made habitats like shrimp and fish culture ponds, rice fields, and coconut plantations (Cutter 2015) including human habitation areas like mosques and abandoned houses (Eva et al. 2022).

Uses and Trade

Fishing Cat skin are usually traded globally (Mukherjee et al. 2012).

Major Threats

Habitat destruction is the major threat to the species. Their prime habitats are being severely damaged by rapidly expanding brick industries, sand mining, and illegal logging (Mukherjee et al. 2012; Chakraborty et al. 2020). Invasives like Water Hyacinth and red algae often deteriorate water quality and visibility which hampers the feeding patterns of this cat (Mugerwa et al. 2020), these factors often drive the species to venture out into the human habitats where they get trapped into snares. They are often mistaken to be leopard or tiger cubs and face gruesome deaths by cruel means like poisoning by the locals. They are also a delicacy in West Bengal and Thailand (Cutter 2015). Road accidents also contribute to mortality in great numbers (Mukherjee et al. 2012).

Assessment

NT (A2cde + A3cde)

Being an elusive species there are very few studies on population dynamics. The threats are

known and understood but they are in no way reversible in the near future.

Assessment is based on the following categories and criteria:

(c) A decline in AOO or EOO/ habitat quality: since the distribution is widespread, a decline in AOO or EOO is not reflected by the data, but the quality of habitat is rapidly declining because of the above listed factors.

(d) Actual or potential levels of exploitation.

This species is hunted for a variety of reasons which indicate their overexploitation.

(e) Effects of introduced taxa, hybridisation, pathogens, pollutants, competitors, or parasites. Recent studies indicate the presence of micro, meso, and macro plastics in the scats of Fishing Cats, which might lead to serious damage to the species in the near future (Ratnayaka et al. 2023). Invasive species are also playing a vital role in habitat destruction.

A3: A3 can also be applied based on the increased threats, since it would be easy to predict a reduction in population in the next 100 years.

Due to the lack of studies on population dynamics, the generation length of the species is not understood. It has a widespread distribution but is restricted to small areas within the range.

Therefore, based on past threats, the species has declined visibly although the rate of decline is unknown. Due to ongoing threats, it can be predicted that the population might undergo a decline over the next three generations. That

is why I have placed the species in the Near Threatened category of the IUCN Red List for species with the criteria A2cde + A3cde.

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- Amrin Ansari, RHATC Fellow 2023–24, Zoo Outreach Organisation, Coimbatore, TN, India.**

Arrowhead Softshell Turtle *Amyda ornata* (Gray, 1861)

Taxonomy

The Arrowhead Softshell Turtle was originally described as *Amyda ornata* by Gray, 1861. It was formerly considered to be part of *Amyda cartilaginea*, however, it is now considered a genetically distinct species with three subspecies (Fritz et al. 2014), *Amyda ornata ornata* (Gray, 1861), *Amyda ornata jongli* (Praschag & Gemel, 2022), and *Amyda ornata phayrei* (Theobald, 1868).

Geographic Range

Assam: Cachar District, Dhalchera, Phaisen Hills; Kamrup District, Guwahati (Praschag & Gemel 2022).

Manipur: Tangjeng Khunou, Bishnupur District; Tallian, Pherzwal district Tallian (Zothanmawia 2022); Tuilen, Tallian, Bungjang, Suahzahau & Tuolbung, Churachandpur District (Linthoi 2013; Habibullah 2016).

Mizoram: Dampa Tiger Reserve; Palak Lake (Ahmed & Das 2010; Pawar & Birand 2001); Tuirial River drainage, Ngengpui Wildlife Sanctuary (Praschag & Gemel 2022).

Nagaland: Exact location not specified (Chandra et al. 2021).

Tripura: Narichera Stream, tributary of Khowai River, North District (Praschag & Gemel 2022).

Population

There is no information available on the population of this species in the northeastern region of India. It has been only reported from a few specimens.

Habitat & Ecology

In the dry seasons when the hill streams flow sluggishly, they burrow in silt/sand of the streambed in the daytime (Pawar & Choudhury 2000). Generally found in rivers, marshes, and upland streams with soft bottoms (Linthoi 2013) and rocky bottomed hill streams (Ahmed & Das 2010). They are mainly recorded from river banks, lakes, streams, swamps, and tributaries (Auliya et al. 2016).

Threats

Overexploitation may be responsible for the fact that recent reports of its occurrence exist only from the headwaters of the major river systems (Praschag & Gemel 2022). Turtles have declined dramatically in the region due to indiscriminate harvest from the wild as well as loss of habitats and also being harbored as pet in public houses as well as being sold as bush meat in the local markets (Kundu et al. 2016) and for pet trade (Rahman et al. 2015).

Red List Status

India: Although there are several threats, the Indian population of this species is 'Least Concern' as the population size reduction (population trends) cannot be assessed due to

unavailability of data on the population trend of the species; geographic range of the species involving extent of occurrence is >20,000 km² and the area of occupancy is >2,000 km². But

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- S. Joel, RHATC Fellow 2023–24, Zoo Outreach Organisation, Coimbatore, TN, India.**

Ceropegia evansii

Taxonomy

Kingdom: Plantae
Phylum: Tracheophyta
Class: Equisetopsida
Order: Gentianales
Family: Apocyanaceae
Genus: *Ceropegia*
Species: *evansii*
Authority: McCann

Taxonomic Notes

C. evansii McCann, *C. evansii* var. *media* H. Huber (presently known as *C. media*).

Assessment information

Red list category and criterion: Critically Endangered B2ab(iii,iv,v) + C2a(i) + D.

Justification

Ceropegia evansii is assessed as Critically

Endangered since it is restricted to a very small range which is less than 100 km² and area of occupancy is less than 10 km² in three severely fragmented populations with less than 50 mature individuals. The species is under threat due to habitat loss, fragmentation of population, and tubers are eaten by locals.

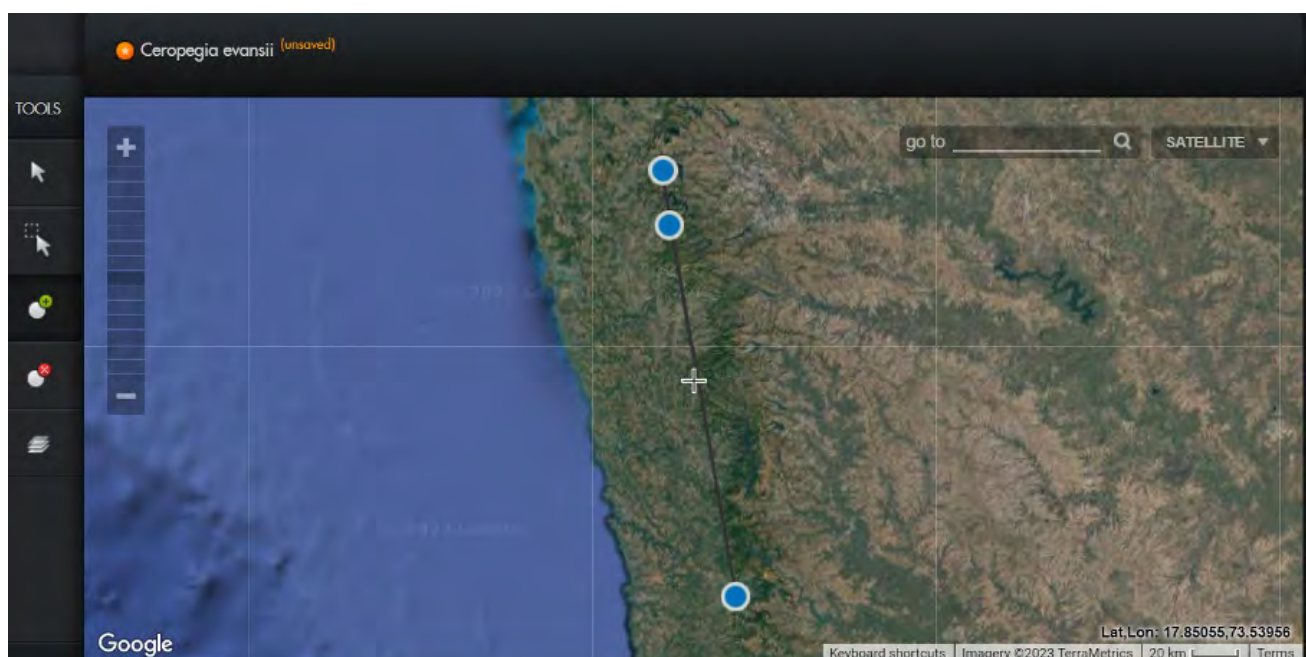
Geographic range information

Range: The species is distributed at few locations in patches in Pune, Ratnagiri, and Raigad of Maharashtra state (Singh et al. 2022).

Countries of Occurrence: Native to India (Maharashtra).

Extent of Occurrence (EOO): Estimated to be less than 100 km².

Area of Occupancy (AOO): Estimated to be less than 10 km².



Distribution map (Geocat.iucnrestlist.org).

Number of locations: The species is severely fragmented in Ratnagiri, Pune, and Raigad districts.

Population

There are estimated to be less than 50 mature individuals in the population of Ratnagiri, Pune, and Raigad districts. (Aparna pers. obs. 2023).

Population trends

The population trend is unknown since no studies are conducted.

Habitat and Ecological information

Ceropegia prefers very specific habitat, on the edges of forest and hill slopes associated with *Strobilanthes callosa* and *Carissa congesta* (Rawat 2008).

It is a perennial twining herb that has a fibrous root system, the stem is glabrous, the lamina is membranous, ovate-lanceolate in shape, the apex of the leaf is acute or acuminate, and a rounded base. Cyme inflorescence with bi-seriate corona which is saucer-shaped (Kambale & Yadav 2019).

System

A perennial herbaceous climber.

Information on threats

Threats: There are many threats to the species. Destruction of habitat, forest fragmentation, introduction of exotic weeds, fragmentation of population, highly specific 'fly trap flower' pollination mechanism (Rawat 2008).

Use and Trade

Use: The tubers are eaten by local people (Kambale & Yadav 2019).



Ceropegia evansii in the forest of Ratnagiri district, Maharashtra. © L.M. Aparna.

Trade: All *Ceropegia* species are included in the negative list of exports and imports (COP11 2022).

Information on Conservation Action

Conservation: The species is not in any systematic conservation program. There is no systematic research in place other than opportunistic surveys.

Research needed: Systematic survey on morphology, population studies, population in wild and in nursery, studies on micro-propagation, habitat monitoring are all needed.

Education: Outreach program about the species among local communities, forest department, students and other stakeholders is needed.

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Spectacled Cobra *Naja naja*

Taxonomy

Kingdom: Animalia

Phylum: Chordata

Class: Reptiles

Order: Squamata

Family: Elapidae

Genus: *Naja*

Species: *naja*

Distribution

The Spectacled Cobra (*Naja naja*) is a venomous snake found in India, Pakistan, Sri Lanka, Bangladesh, Nepal, Bhutan, and Afghanistan (Uetz et al. 2022).

Habitat and Ecology

Inhabits almost all habitat types, from dry arid scrubs to pristine rainforests and thrives in agricultural areas and countryside human habitations (Ganesh 2015). Prey includes rodents, toads, frogs, birds, lizards, and other snakes (Whitaker & Captain 2004). Lays of 12–30 eggs during March–July which hatch after two months. Female stays with the clutch during incubation (Ganesh 2015).

Habits

It is active in the day or night depending on the weather or atmospheric conditions. Highly venomous with short-fixed front fangs. Produces neurotoxic venom. Its defensive behavior or threat display is observed forming a distinctive hood, which has a spectacle marking to ward off its predators (Ganesh 2015).

Population

The studies on population trends have not been done since it is widely distributed and very commonly occurring, as they are diurnal, large (150–220 cm) in body size and adaptive to the fluctuations in the environment (Ganesh 2015). Research on snakes and its diversity in different parts of countries has been conducted that includes *Naja naja* species as well, but the exact population cannot be estimated, because it is an opportunistic survey, and the record of these species will mostly be through snake capturing and re-location or translocation. Chances of the same individual being rescued might be repetitive and few individuals might have escaped without our notice.

Threats

- The major threat is habitat loss, as there is rapid growth of human population, the resources and the habitats are being used to a greater extent. Cobras are adaptable to urbanized sectors and fluctuations in the surroundings (Chowdhury et al. 2021), but it doesn't mean that there is no habitat degradation or loss. Humans have invaded their habitat due to which *Naja naja* species are being sighted more in the urbanized ecosystem, as they must go in search of prey for their survival.
- It has been predicted that species of Cobras that includes *Naja naja* will face threat from climate change in the next 50 years. Over exploitation due to trading, medicinal studies and human population growth are the major threats (Chowdhury et al. 2021).

- Snake-human interactions are direct threat (Kalki et al. 2021), as people lack awareness about the snake and are afraid of snakebite, so to avoid this they kill the spectacled cobra as soon as they spot in their surroundings.
- There are reports regarding spectacled cobras being captured by snake charmers in huge numbers especially during “Nag Panchami festival” and are brutally tortured and killed, as it is a common religious belief of people (Menon 2015).
- Post capture translocation at one location by snake catchers might cause conflicts between species and can lead to less availability of resources and space in that area.

Assessment

Species assessment becomes difficult due to lack of data on population trends over the years; however, there is a perceptible decline in the populations all across as reported by many people. The extent of occurrence and area of occupancy of spectacled cobra is larger as it is widely distributed, and other criteria for the assessment will not be applicable as well, but based on the threats I could co-relate and predict the species risk in the near future. My inference based on the collected data of Spectacled Cobra, due to past, ongoing and increasing predicted threats, it falls under the category **Near Threatened (NT) A2cd + A3cd**.

Research needed

- Even though the *Naja naja* species are widely distributed there are new threats being faced as years pass. There is a need for research on these species, such as,
- Geo tagging should be done and studied so that we can document more data. Post capture

release of snakes undergo a lot of stress due to change in the home range and it should be studied with more individuals.

- Taxonomical studies play a significant role as there are different species and subspecies sharing adjacent habitat and being sure or certain of the classifications will aid in accurate assessment and avoid unnecessary confusions among the species.
- Population trend-related studies must be carried out, as the data provides us an insight on fluctuations in population over the years.
- Behavioral studies.

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Scalloped Hammerhead Shark *Sphyrna lewini* (Griffith & Smith, 1834)

Taxonomy

Kingdom: Animalia

Phylum: Chordata

Class: Chondrichthyes

Order: Carcharhiniformes

Family: Sphyrnidae

Genus: *Sphyrna*

Species: *S. lewini*

System

Marine

Habitat and Ecology

Marine neritic, marine oceanic.

Range description

Coastal warm temperate and tropical seas.

Geographical Distribution

Essentially circumglobal in coastal warm temperate and tropical seas. Western

Atlantic: New Jersey to Brazil, including Gulf of Mexico and Caribbean. Eastern Atlantic from Mediterranean and Senegal to Zaire.

Indo-West Pacific: South Africa and Red Sea to Pakistan, India, Burma, Thailand, Indonesia, China (including Taiwan Island), Japan, The Philippines, Australia (Queensland, Western Australia), New Caledonia. Central Pacific: Hawaii and Tahiti. Eastern Pacific: Southern California and Gulf of California to Panama, Ecuador and northern Peru.

Habitat and Biology

It is probably the most abundant hammerhead species, Ranges from the intertidal and surface down to at least 275 m depth. It is a minimal migratory species, forms large true schools at different stages of its life-history (Compagno 1984). The age at maturity varies from region to region. Thomas et al. (2021) estimated the length at maturity for male and female *S. lewini* (171.92 and 239.6 cm TL, respectively); earlier



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reports of length at maturity were in the range 180–210 cm TL from Indian waters (Raje et al. 2007; Kizhakudan et al. 2015); while those from different regions globally were in the range of 200–240 cm TL for females and 129–180 cm TL for males. The gestation period is 9–12 months; reproduces every 2–3 years and the survival of sharks to Age 1 and Age 2 is crucial for the maintenance of viable adult populations (Liu & Chen 1999). Females move inshore for breeding and often use near-shore nurseries (Duncan et al. 2006). The litter size is 1–41 pups (Baum et al. 2007). In Indian waters the breeding season is reported to be from August to October (Raje et al. 2007). The litter size is found to be 38–40, the size at birth ranges 38–57 cm, the maximum number of juveniles recorded from near shore waters was during August to December (CMFRI 2015).

Population & Population size

Unknown.

Generation length

17–21 years (Rigby et al. 2019).

Major threats

Fishery; the *Sphyrna lewini* is the commonest hammerhead in the tropics and is readily available in abundance to inshore artisanal and small commercial fisheries as well as offshore operations; it is caught with pelagic longlines, fixed bottom longlines, fixed bottom nets, and even bottom and pelagic trawls; the young are easily caught on light longline gear (Compagno 1984). The three hammerhead species are taken in targeted fisheries and as bycatch in fisheries for pelagic and demersal species (FAO 2013b). The average global production of hammerhead

during 2000–2014 was 4,511 tonnes, where the average catch of *S. lewini* during 2000–2014 was 322 t, with a maximum of 523 t in 2002 (FAO 2016). The average landing of *S. lewini* along the Indian coast during 2007–2015 was about 621 t, where the maximum catch was 1,070 t in 2007 (Zacharia et al. 2017). India's average annual landings of elasmobranchs was estimated at 48,865 t during 2007–2018, in which hammerhead sharks, with an annual average landing of 639 t, contributed about 1.31%. The landings fluctuated between years, with maximum landings recorded in 2016 (1,172 t) and minimum in 2018 (290 t) of which *Sphyrna lewini* was the dominant species accounting for more than 95% of the hammerhead and are caught throughout the year in all gears and from all regions along the Indian coast (Thomas et al. 2021). The hammerhead sharks are highly sensitive to the fishing gears, where the research from USA shark bottom-longline fishery for the period 1994–2005 indicates that 70–95% of Scalloped Hammerheads are dead prior to being landed on the fishing vessel, depending on the gear soak time (Morgan & Burgess 2007). Baum et al. (2003) estimated an 89% decline in stocks of scalloped hammerheads in the western North Atlantic Ocean. Hayes et al. (2009) concluded that the North-West Atlantic and Gulf of Mexico scalloped hammerhead population has been depleted by approximately 83% since 1981.

Use and trade

The meat is utilized fresh, fresh-frozen, dried salted, and smoked for human consumption; the fins are used to prepare shark-fin soup base; the skins are prepared into leather; the liver oil is used for vitamins; and carcasses for fishmeal (Compagno 1984).

Justification

The species is caught globally as target and bycatch in pelagic commercial and small-scale fisheries, and is retained for the meat and fins. The Scalloped Hammerhead has undergone steep declines in all oceans, the population reductions are observed over 76.9–97.3%, with the highest probability of >80% reductions over three generation lengths (60 years), and is therefore assessed as Critically Endangered (CR) in the category of A2abd+A3bcd.

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- Praveen Rozario, RHATC Fellow 2023–24, Zoo Outreach Organisation, Coimbatore, TN, India.**

Grizzled Giant Squirrel *Ratufa macroura* (Pennant, 1769)

Taxonomy

Synonyms

Sciurus zeylanicus (Ray, 1693)
Sciurus macrourus (Pennant, 1769)
Sciurus ceylonicus (Erxleben, 1777)
Sciurus ceylonica (Erxleben, 1777)
Sciurus ceilonensis (Boddaert, 1785)
Sciurus tennentii (Blyth, 1849)
Sciurus macrourus var. *montanus* (Kelaart, 1852)
Sciurus macrourus var. *montana* (Kelaart, 1852)
Ratufa macrourus albipes (Blyth, 1859)
Sciurus macrura (Blanford, 1891)
Ratufa macroura sinhala (Phillips, 1931)

Family: Sciuridae

Level of Assessment: Subspecies - *Ratufa macroura dandolena*

Common Names:

Grizzled Giant Squirrel
 Sri Lankan Giant Squirrel

Subspecies

Ratufa macroura macroura (Pennant, 1769)
Ratufa macroura melanochra (Thomas & Wroughton, 1915)
Ratufa macroura dandolena (Thomas & Wroughton, 1915)

Notes on Taxonomy

Ellerman (1961) listed three subspecies that were accepted later by Moore and Tate (1965),

Phillips (1981) and Corbet and Hill (1992). *Ratufa macroura dandolena* is the taxon occurring in India (Ellerman 1961) (Agrawal & Chakraborty 1979).

Habit

Arboreal, diurnal, limited social behaviour (Vanitharani 2018).

Habitat and Ecology

Riparian patches (Babu & Kalaimani 2014), five plant species preferred by the *R. macroura* at Chinnar are *Terminalia arjuna*, *Mangifera indica*, *Tamarindus indica*, *Ficus macrocarpa*, and *Syzygium cumini* (Thomas & Nameer 2018).

Niche

Canopy dwellers, forked tree branches (Baskaran et al. 2011).

Distribution

Global: India and Sri Lanka (Srinivasulu et al. 2004).

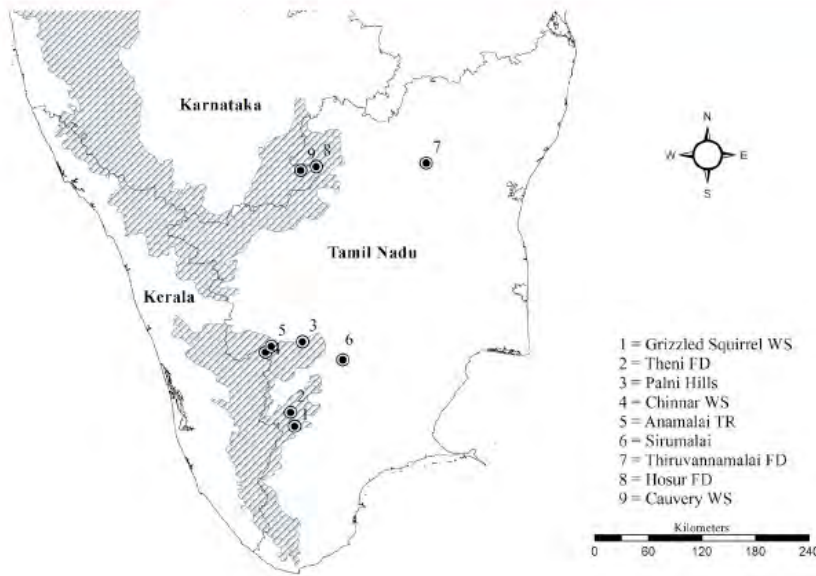
Extent of occurrence: >20,000 km²

Locations/Subpopulation: 9-10 (in India)

Habitat Status: Severely fragmented by anthropogenic activities, discontinuous forests (Thomas & Nameer 2021).

Geographical Distribution: Srivilliputhur Grizzled Squirrel Wildlife Sanctuary, Theni Forest Division, Palani Hills, Anamalai Tiger

New sighting record of Grizzled Giant Squirrel



Maps indicating geographical distribution of *Ratufa macroura dandolena* in India.
Source: Babu & Kalaimani 2014, *Journal of Threatened Taxa*.

Reserve, Thiruvannamalai Forest Division, Hosur Forest Division, Pakkamalai Reserve Forest in Gingee, Cauvery Wildlife Sanctuary – Shivanasamudra Falls and Mekedatu on the Cauvery river basin, and Chinnar Wildlife Sanctuary (Thomas & Nameer 2021).

Threats: High risk of extinction because of high deforestation rate and habitat fragmentation, eco-tourism, habitat destruction, poor regeneration of fruiting and nesting trees, pilgrim sites, gaps in canopy (Vanitharani, 2018), road kills, increased predation risk due to opening up of the canopy (Baskaran et al. 2011), hybridisation (Thomas et al. 2018).

Trade: Not traded.

Population

Generation Time: 7–8 years (Vanitharani 2018).

Mature Individual: <500 (India = <500) (Thomas & Nameer 2018).

Population trend: The overall population of the species was estimated as >500 mature individuals with the individual populations having declined by 30% in the last three decades (Babu & Kalaimani 2014). There has been a decline of about 78 to 85%, in Chinnar Wildlife Sanctuary from its previous estimates in 1993 and 2007 (Thomas & Nammer 2018).

Population Density: The previous density estimations from Chinnar were 18–23 squirrels/ km² (Ramachandran 1993) and 64 squirrels/ km² (Senthilkumar et al. 2007). However, in 2018 the population density of the *R. macroura* in CWS was found to be 15.26 squirrels/ km² (Thomas & Nammer 2018).

Data Source: Census or monitoring, Field study, informal sightings, literature: observed, estimated and inferred (Joshua & Johnsingh 2015).

Status: Endangered

Red list criteria: A2ace + A3ce + C1 + C2a(i)

Justification

Ratufa macroura are arboreal creatures and the severe fragmentation of forests have impacted their habitat. The threats to the subspecies - *Ratufa macroura dandolena* in India is not reversible in near future. The assessment is based on the following categories and criteria.

Criterion A

Trends in population decline

A2: There has been an increase in percentage of population decline due to loss of habitat from anthropogenic activities. The causes of reduction have not ceased and reduction may not be reversible.

(a) Direct observation - Several studies have recorded the decline in the population.

(c) A decline in AOO or EOO/ habitat quality- The habitat of this species has become severely fragmented due high threats from anthropogenic activities. The degradation and contiguity of canopy has led to loss of the habitat.

(e) Effects of introduced taxa, hybridisation, pathogens, pollutants, competitors, or parasites- One of the studies has reported hybridization between *Ratufa macroura* and *Ratufa indica* from the Chinnar Wildlife Sanctuary.

A3: This criterion can be applied as there is possible future decline.

(c) A decline in AOO or EOO/ habitat quality- The habitat for this species may continue to decline with continues anthropogenic activities like religious tourism, logging, industrial development.

(e) Effects of introduced taxa, hybridisation, pathogens, pollutants, competitors, or parasites-

Hybridization may lead to complexities in the offsprings and pose a threat to viable population of the species.

Criterion C

The population size is estimated to be <500 mature individuals.

C1: The population of *R. macroura* has declined by 30% in three decades (Babu & Kalaimani 2014).

C2a(i): The total population is estimated to be approximately 500 mature individuals collectively in 9 different locations. Therefore, there is no subpopulation estimated to contain more than 250 mature individuals.

Hence the assessment for *Ratufa macroura* is EN A2ace + A3ce + C1 + C2a(i).

Recommendations

Research needed: Urgent steps to be taken to undertake studies on the genetics of *R. macroura*, Population Habitat Viability Analysis (PHVA) (Thomas & Nameer 2018).

Management: Habitat restoration to maintain the canopy contiguity and regulation of the pilgrimage and the tourism activities in and around the *R. macroura* habitat (Thomas & Nameer 2018).

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Malabar Pied Hornbill *Anthracoceros coronatus* (Boddaert, 1783)

Taxonomy

Kingdom: Animalia

Phylum: Chordata

Class: Aves

Order: Bucerotiformes

Family: Bucerotidae

Red list category and criteria

Critically Endangered- A2abcde+ A3bcde

Assessor: Maitreyi Hegde

Justification

Malabar Pied Hornbill population is observed to be declining especially in the southern and central Western Ghats. The population trend data over last 35 years show 85% decline because of continuing habitat loss, habitat degradation, and poaching. Considering the continuing threats in both protected and non-protected areas, it can be inferred that the species will continue to decline to an extent of >90% in the next 30 years which makes it being classified as 'Critically Endangered' under criterion A. The habitat quality is decreasing, and the threats of invasive species taking over its vital food plants and nest trees are also evident.

Geographic Range

Anthracoceros coronatus is distributed in the forests of central India (Madhya Pradesh, Andhra Pradesh), eastern India (Bihar, Odisha), and in the foothills of the Western Ghats in

parts of Maharashtra, Karnataka, Tamil Nadu, and Kerala. It is also native to Sri Lanka.

Extent of occurrence: 1,196,214.297 km²

Generation Length: 9.7 years

Habitat and Ecology

A. coronatus is found in subtropical/tropical dry or tropical moist lowland or riverine forests, usually at the plains up to 300 m.

Hornbills are generally frugivorous, arboreal, and secondary cavity-nesters. They are the important agents of seed dispersal in tropical forests. One of the studies say, diet of hornbills of *A. coronatus* includes 68% fruits and 32% animals. Of the fruits, figs contribute 20% and non-fig fruits are 48% (Reddy 1988). They generally feed on fruits of *Styrcnhus nux-vomica*, *Ficus glomerata*, *F. asperrima*, *F. mysorensis*, and *Diospyros montana* (Sneha & Davidar 2011). Five species of trees commonly preferred by these hornbills for nesting are *Madhuca longifolia*, *Terminalia* sp., *Dysoxylum binectariferum*, *Spondias pinnata*, and *Syzygium cumini*.

Use and Trade

It is said that the oil glands are used for traditional medicine but there is no evidence and no literature available. The hornbill is usually hunted for its meat.

Major threats

One of the major threats which is likely to continue in future is habitat destruction, due to encroachments, agriculture, monoculture timber plantations, hydro-electric and irrigation projects, tourism, and urban development (Mudappa & Raman 2009). Hunting by tribals and non-tribals and forest fire are proven to be major threats both in protected and non-protected areas of the Western Ghats (Bachan et al. 2011). Large scale collection of plant parts (NTFPs) of the nest trees and food trees of hornbills and spread of exotic weeds are also other major threats (Balasubramanian et al. 2004).

Population

Two-hundred-and-eighty-two individuals of *A. coronatus* were recorded from December 1983 to December 1984 (Reddy 1988) in Dandeli. The same study recorded encounter rate of 8 individuals per km² of these hornbills. Maximum number of 74 and a single biggest flock of 58 hornbills were recorded at Dandeli in March 1984. Highest number was noted near the food plants and the average number of hornbills in Dandeli was 21.69 (Reddy et al. 1990). In the year 2006–2007, total 44 individuals were observed in Dandeli. The mean numbers of hornbills recorded at the two roost sites, were 26±4.47 (n = 16) and 31.78±3.53 (n = 14), respectively. (Sneha & Davidar 2011). In the study conducted by Mudappa & Raman (2009), 96 individuals were recorded in Dandeli, Ganeshgudi, Mookambika, and Bhadra area. Dandeli–Goa landscape in Karnataka, Goa, and adjoining areas of Maharashtra (Amboli) were proven to be the main areas where two-thirds of the 131 Malabar Pied Hornbills recorded

during the entire survey across Western Ghats were recorded. All detections were at elevations <600 m, with most being at elevations between 100 and 450 m. In the study by Pawar & Sadekar (2022), 62 individuals of Malabar Pied Hornbills in Dandeli region were observed. Bachan et al. (2011), in their study during 2004–2005, observed only two nests of Malabar Pied Hornbills in Vazhachal division of Anamalai range of Kerala State. Malabar Pied Hornbill nests were found only in low elevation riparian forests and they observed a very rare nesting density 0.009/ km² (Bachan et al. 2011).

In the central Indian region, *A. coronatus* have already been reported from different parts of the Satpuda range including Satpuda National Park, Pench Tiger Reserve, Satpuda Tiger Reserve in Madhya Pradesh and also in eastern Madhya Pradesh. From the Melghat Tiger Reserve (MTR), Maharashtra, *A. coronatus* was not documented until 2003. After effective protection measures for the forest corridors, *A. coronatus* habitat seems to be more favorable (Wagh et al. 2015). It is evident that *A. coronatus* has become well established based on the sighting data in MTR from 2003 to 2008 (Wagh et al. 2011).

Population Trend: There is a decreasing trend in population over 35 years of records since 1983–1984 till 2019. In Dandeli, which is still one of the strongholds for Malabar Pied Hornbill, declining encounter rates from 8.5 birds per km during 1983–1984 (Reddy 1988) to four birds/km in Dandeli in 2007 (Sneha & Davidar 2011) were reported. Transect surveys by Mudappa & Raman (2009), in the various locations across the Western

Ghats revealed highest encounter rates of this species in Mollem National Park and Wildlife Sanctuary (range = 0.13/km to 1.61/km across six transects), Madei Wildlife Sanctuary, Goa (0/km to 0.84/km across three transects), and lowest encounters at Dandeli Wildlife Sanctuary, Karnataka (0/km to 0.6/km across three transects).

In the study conducted in 2019, the Malabar Pied Hornbill density (\pm se) was 4.4 (\pm 1.6) individuals per km² and encounter rates were much lower (0.53 individual per km) (Pawar & Sadekar 2022).

Rapid surveys from 2004–2005 in the Western and Eastern Ghats of Tamil Nadu, Kerala, Karnataka, Goa and Andhra Pradesh include protected areas & reserved areas. Out of the total 536 hornbill individuals observed, only 12.3% were Malabar Pied Hornbills. Though Malabar Pied Hornbill was recorded in both Eastern and Western Ghats, it only occurred at a few localities as isolated populations (Balasubramanian et al. 2007).

There is 85% decrease in encounter rates of Malabar Pied Hornbills per km in last 35 years, in Dandeli and surrounding central Western Ghats region. Trend inferred from the literature data of 1984 till 2019 and lack of initiatives to restore degraded habitats proves the fact that the population will continue to decline to more than 90% in future. It should be noted that this decline is in its natural habitat inside the protected areas. Non-protected areas face even more threats and developmental pressures, hence endangering the hornbill populations in those regions as well.

Conservation actions

Participatory conservation, which includes tribals for hornbill conservation and monitoring, has been effectively adopted with the 'Kadars' endemic to the Anamalais, who perform traditional hornbill hunting (Bachan et al. 2011). To emphasize hornbill conservation in the region, a Hornbill Conservation Reserve was established in Karnataka's Uttara Kannada District in 2011. The northern Western Ghats' foothills and lowland forests, including sections of the Tillari region, have been designated as conservation reserves from 2020 to 2021 to help conserve the Sahyadri-Konkan corridor (Pawar & Sadekar 2022).

Research needed

Status and distribution data for *A. coronatus* is mainly confined to high occurrence areas such as Western Ghats, mostly to protected areas. Research is needed on bridging the knowledge gaps in population assessment and ecology in non-protected areas too since such habitats are at higher risk. More rigorous study is needed in its other native ranges in central or eastern states of India.

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Imaginary species

Adaptation, taxonomy, and niche are concepts taught at RHATC 23–24 as part of the course. This is as a refresher for those who may have studied the subject. Payal Molur ended the session by having us draw our own imaginary animal but with certain conditions. We had to ensure the following for our animal:

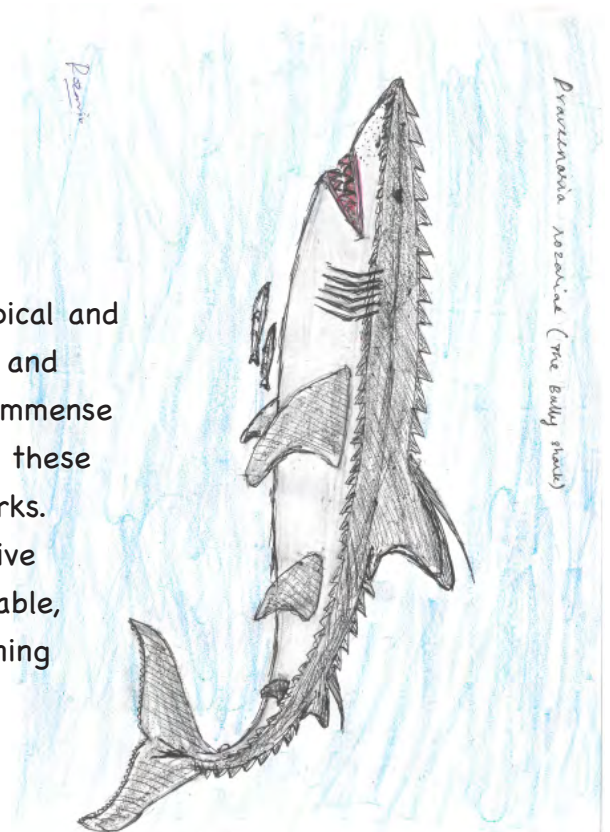
1. It had a place to live (ecology)
2. It had food to eat
3. It could defend itself from predators
4. Morphological structure and characteristics
5. Have a name

The task was interesting and really made us come up with something creative while keeping what we had learnt about in mind.

The following drawings are what we each came up.

Praveenaria rozariae **(The Bully Shark)**

The Bully shark are the 'Guardians' or the 'top-G' of the ocean, which evolved into an apex predator to compete their all-time opponents 'The Orcas'. They developed a leathery armoured outer skin covered with spines and spicules which can be a serious threat to their prey and other opponents. They are distributed all over the world in the tropical and warm temporal regions; they feed on larger fishes and marine mammals. Displaying impressive speed and immense size, surpassing even the lesser-known megalodon, these sharks boast a longer lifespan than Greenland sharks. Moreover, the most impressive adaptation is they live in schools/pods like the Orcas that makes them stable, risk free, extremely successful hunters, hence gaining popularity as bullies or guardians of the ocean.



Praveen Rozario, RHATC Fellow 2023–24,
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3-striped Liana Eater

My imaginary animal is called 3-striped Liana Eater. It is a green colour bird with three yellow stripes, a little bigger than a crow, and doesn't have a beak. It's main diet is leaves and stems and is eaten by larger birds and raptors. It is a social animal and have the ability to easily camouflage with the leaves. It is generally found on the edges of forests making it easy for raptors to hunt and the camouflage ability helps it escape from predators.



M. Paridhi, RHATC Fellow
2023-24, Zoo Outreach Organisation,
Coimbatore, TN, India.

Felis amrin

A master of camouflage, *Felis amrin* is a beautiful mesocarnivore of the wetland ecosystem. With elongated pupils, the cat has excellent night vision and its small paws provide agile strength to the species. It has an additional feature of having frog legs with smooth skin which allows the cat to stand long hours in the water to search for its primary diet-fishes. It is also capable of swimming underwater with the help of its beaver tail to attain immense speed and body balance. Like most small cats, this cat is also a solitary animal that prefers camouflaging in the grasses to escape from raptors during their juvenile stage.



Amrin Ansari, RHATC Fellow 2023-24,
Zoo Outreach Organisation, Coimbatore, TN, India.

Flamed devil (*Wingardium devilensis*)

The Apex predator with a sweet craving.

The animal has evolved with all features to become an apex predator of the forest and the animal has completely evolved to be a predator but the presence of a siphoning tongue makes it unique from all other behaviors. The jet-black color and the presence of bright red strands of feathers make it look like a flame flying through the forest, something more like from a fairy world. It has eight salient features which makes it a perfect apex predator of the woods.

1. Eyes with nictitating membrane for underwater predation
2. Siphoning tongue for nectar feeding
3. Strong jaw and teeth for a powerful bite
4. Perfectly aerodynamically designed wings for flight
5. Retractable spines on the tail with a 180-degree axis
6. Strong limbs for firm walk
7. Sharp and strong claws
8. Open ear with tympanum



C.K. Arjun, RHATC Fellow 2023–24,
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Beakbrown prickianium

Imaginary drawing exercise happened in the very beginning of the course in the month of October during the end of Dr Vivek Pandi's session. It was a good exercise, the last time I drew something out of my imagination is when I was in drawing class. Here I draw a *Beakbrown prickianium* which is an aquatic bird that eats exclusively yellow-red fishes all large and small. It has blue coloured small prickles on the feathers that protect it from the predators. The etymology of *Beakbrown prickianium* – Beakbrown because the bird has a large brown coloured beak; prickianium is the species as it has small pink coloured prickles all over on the feathers.

It also has a great vision, immediately the bird can see the red-yellow very quick. The bird plays an important role in the ecosystem as it controls the population of fish in the lake.



L.M. Aparna, RHATC Fellow 2023-24,
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Aviola duckisaurs

This imaginary bird lives in the forests especially along the freshwater bodies like river. Most body is yellowish-green and wings are green in color so that it can easily camouflage in the tree canopies. This bird is as large as an eagle. It has webbed feet like a duck and sharp claws like an eagle. The claws are retractable like the claws of a cat, same flexibility is with the webs also. When swimming in water, the interdigital membranes come out and while hunting, the claws come out. It can both swim in water and fly in air. It mainly feeds on fruits, fishes, other aquatic animals, and small mammals.

The biggest threat to this bird is humans along with other carnivorous animals. It is being extensively hunted for meat and beautiful feathers.



H. Maitreyi, RHATC Fellow 2023-24,
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Piku ungulate

Piku ungulate (hoofed animal), it lives in all types of forest habitat. Herbivore species which primarily feeds on all types of leaves and grasses, mainly feeds on liana specifically tender leaves of all kinds of liana. By feeding on liana, it controls the over growth of liana and maintains balanced ecosystem also helps the trees to get rid of coiling by liana. In other terms *Piku ungulate* is the favourite animal for trees which are suffering from liana. Body has a thick fur and it protects the ungulate from harsh cold wind and also from leeches. Head consists of pairs of convertible ears, which helps in listening high and low frequency sound. For protection the ears act as long and sharp horns to pierce major carnivores like tiger and leopard. At the tip of the tail, it has a round mass of muscle, which it uses by rotating the tail for protection. *Piku ungulate* is very close to elephants and both share common ground, they feed, play and benefit each other; this is best example for mutualism. The average life span is 20–22 years in the wild. Hard to rear in captive condition. It is a social animal living in groups usually of 5–6 individuals. Multi male–female group, no hierarchy in group. There is no major predator for *Piku ungulates*. Now it is slowly adapting to climate change.



N. Suraj, RHATC Fellow 2023–24,
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Sholansis savioura

It is a reptile species which is about two to three feet long and is found only in shola-grasslands. It extensively feeds on insects like crickets, grasshoppers, caterpillars, and locusts which are a major threat for the growth of grasses; hence it protects the crucial habitat and maintains the stability of the ecosystem which is why it is named as such. Its main predators are birds since it is found on open grasslands the chances of getting predated are very high in-order to protect itself it has the ability to change colours hence perfect camouflage prevents it from being predated. In addition to this it has spines all over the body which synthesis a pungent chemical to safeguard itself.



V.B. Pannaga, RHATC Fellow 2023–24,
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Sanjenbamia omnitor

The name of the species is *Sanjenbamia omnitor*, the genus name is taken out from the name of a community from Manipur and the species name is given from omnivores since it is an opportunistic species depending on both plants (fruits) and animals (rodents). Distribution:- They are only found in the northeast India and in some parts of southeastern Asia. Habitat: - Omnitor are both fresh water and terrestrial species. Rainforest is the main habitat. River bank, marshy areas and bushes are their niche.

They are more active in night then during the day.

Morphology:- Moist Skin, dull brownish color, large eyed and far sighted, long limbs and webbed feet for swimming and running in high pace, short neck, long and thin ears, small feet, and flat tail.



S. Joel, RHATC Fellow 2023–24,
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Spinus slitherensis

The word 'Spinus' means a spiny end or a sharp pointy end and 'slitherensis' refers to movement on a surface.

Distribution: Endemic to India

Habitat: Tropical forest, land-dwelling (Terrestrial)

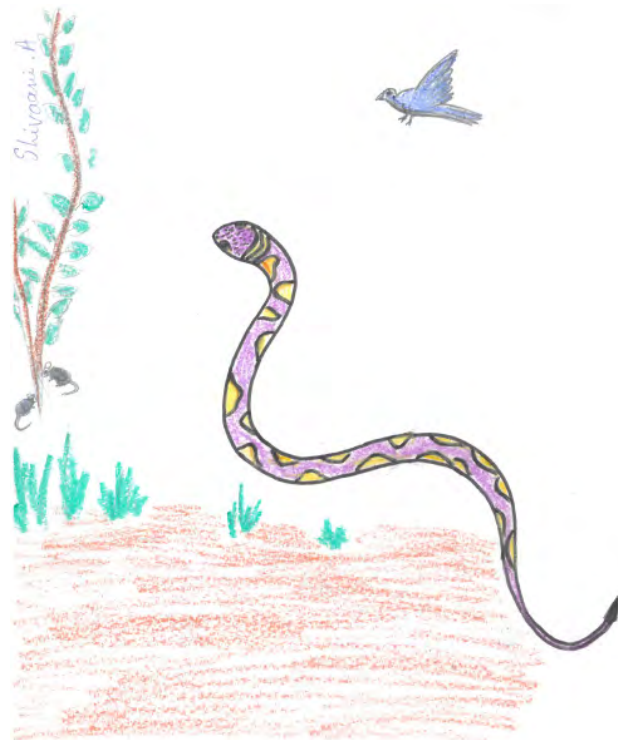
Diet: Rodents and Birds

Predators: Raptors

Description:

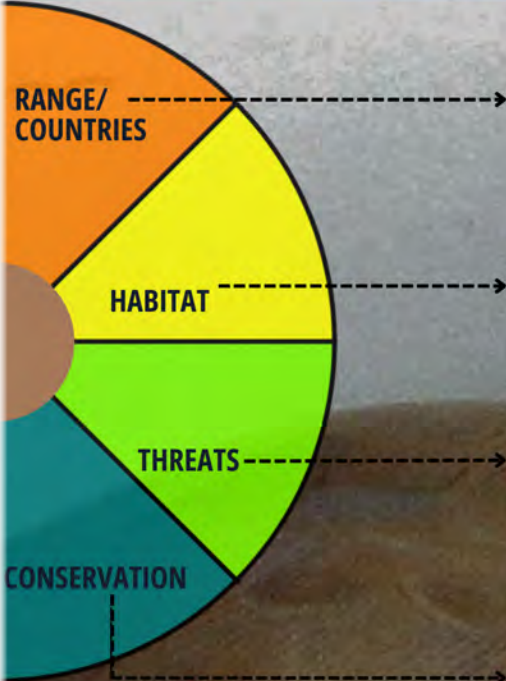
Spinus slitherensis is a marvellous snake, which slithers on the land surface very swiftly and has a spiny arrow tail, hence the name. It has a captivating coloration – purple body with yellow patches on the dorsal side, which portrays a warning coloration.

It lives in the tropical forests and hunts rodents and birds, as they are the major source of food. Other than the warning coloration it also defends itself from potential predators through the spiny arrow tail that is connected to the venom gland in the abdomen. As raptors are a threat to their survival, it uses this to sting and ward off the opponent, eventually leading to the death of the predator. Stinging to kill its prey during foraging is also observed. It plays a vital role in checking the population of rodents and birds as part of the food web.



A. Shivaani, RHATC Fellow 2023–24,
Zoo Outreach Organisation, Coimbatore, TN, India.

CENTRAL ASIAN FLYWAY (CAF)- HOME TO 600+ MIGRATORY BIRDS



- Shortest flyway among the 9 flyways in the world
- Range: Siberia in the north to the tropical islands of the Maldives, British Indian Ocean territory in the south
- Countries- 30, Area- 34,089,399 Km²

- Habitats - lakes, mud-flats, wetlands, coasts, estuaries and grasslands

- Habitat destruction
- Climate change
- Salt water intrusion
- Illegal hunting
- Energy infrastructure

- Habitat protection
- Education and awareness
- Community engagement
- International collaboration
- Extensive research

More than 48 species that use the Central Asian Flyway are globally threatened and 40% population are in decline!!

CENTRAL ASIAN FLYWAY



WORLD MAP

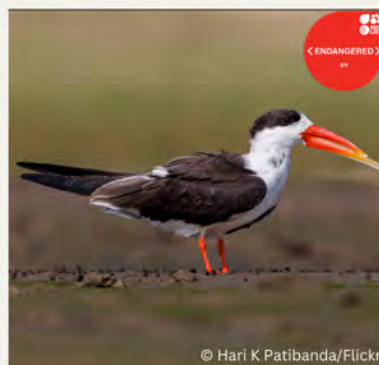


71% of the migratory waterbirds of the CAF use India as a stopover site

SOME PRIORITY SPECIES FOR CONSERVATION



Sociable Lapwing
Vanellus gregarius



Indian Skimmer
Rynchops albicollis



Pied Avocet
Recurvirostra avoetta

HANUMAN PLOVER A FLAGSHIP SPECIES TO CONSIDER IN CENTRAL ASIAN FLYWAY

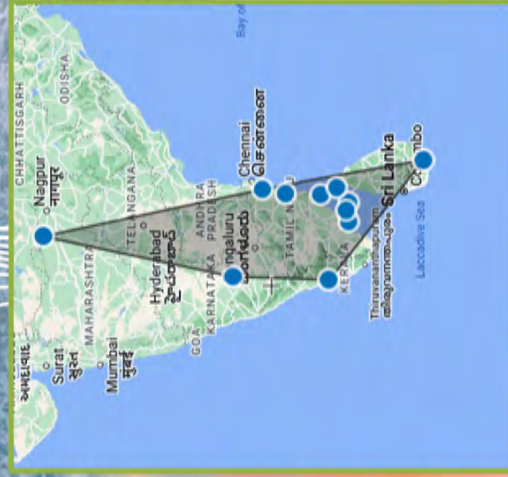


- Hanuman Plover *Charadrius seebohmi* was earlier considered as a sub-species of the Kentish Plover *Charadrius alexandrinus* but recent studies elevated it to species level.
- The species is an endemic bird with breeding record in the Indian Subcontinent making it a flagship species in the CAF in Sri Lanka and India.

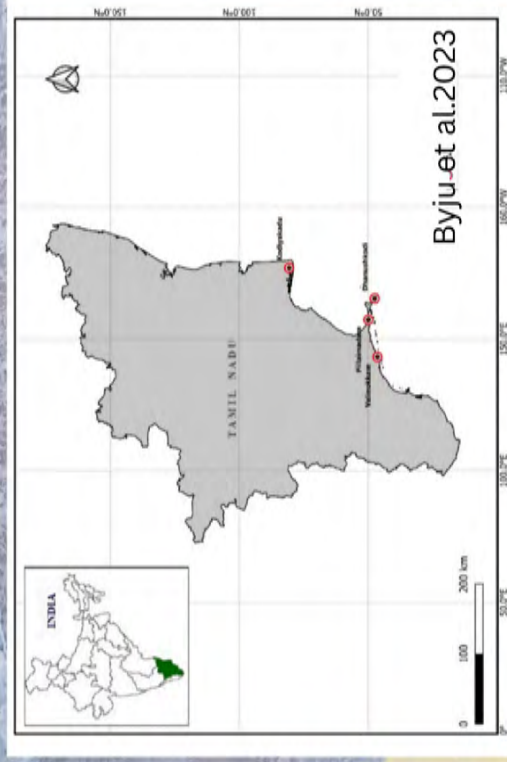
Research priorities :

- Ecology
- Distribution
- Threats
- Habitat
- Behaviour
- Breeding, etc.

Distribution Map



New Breeding Record



Bar-headed Goose *Anser indicus*



The Undisputed Ave

~8,900 m



Bar-headed Geese fly through the Himalayan range, even above the **Mount Everest!**



They can fly over **80 kph (50 mph)** without wind to assist them!

Morphology

- Gray and white with two horseshoe-shaped, brownish-black bars on the back of its white head.
- Orange-yellow beak and legs and the male bird is slightly larger than the female.

Geographic Range

- Afghanistan, Bangladesh, Bhutan, China, India, Mongolia, Myanmar, Nepal, Pakistan, Russia, Thailand and Vietnam.

Habitat and Threats

- Reside near water bodies, preferring high-altitude lakes.
- Over-hunting, unsustainable levels of egg collecting and habitat destruction.

Migration

- One of the impeccable migratory record of crossing the mighty Himalayan range at heights of 3,658 m to 4,267 m recorded.

They are able to migrate more than **1,609 km (1,000 mi.)** in a **single day!**



©Rdevany/wikimedia

© Hari K Patibanda/wikimedia

© Rajukhan Pathan via Pixels

RAMSAR SITES

Adopted in the Iranian city of Ramsar in 1971, came into force in 1975.

9 CRITERIA

2 Groups

172 contracting parties

Sites containing representative unique/rare wetlands

Sites of international importance for conserving biological diversity

Convention includes- lakes, rivers, aquifers, swamps, marshes, wet grassland, peatlands, marshes, oasis, estuaries, deltas, tidal flats, mangroves, coral reefs, fish ponds, paddy field, reservoirs, salt pans.

Largest site
Rio Negro, Brazil
1,20,000 sq km

Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Most sites in United Kingdom 175 & Mexico 142.

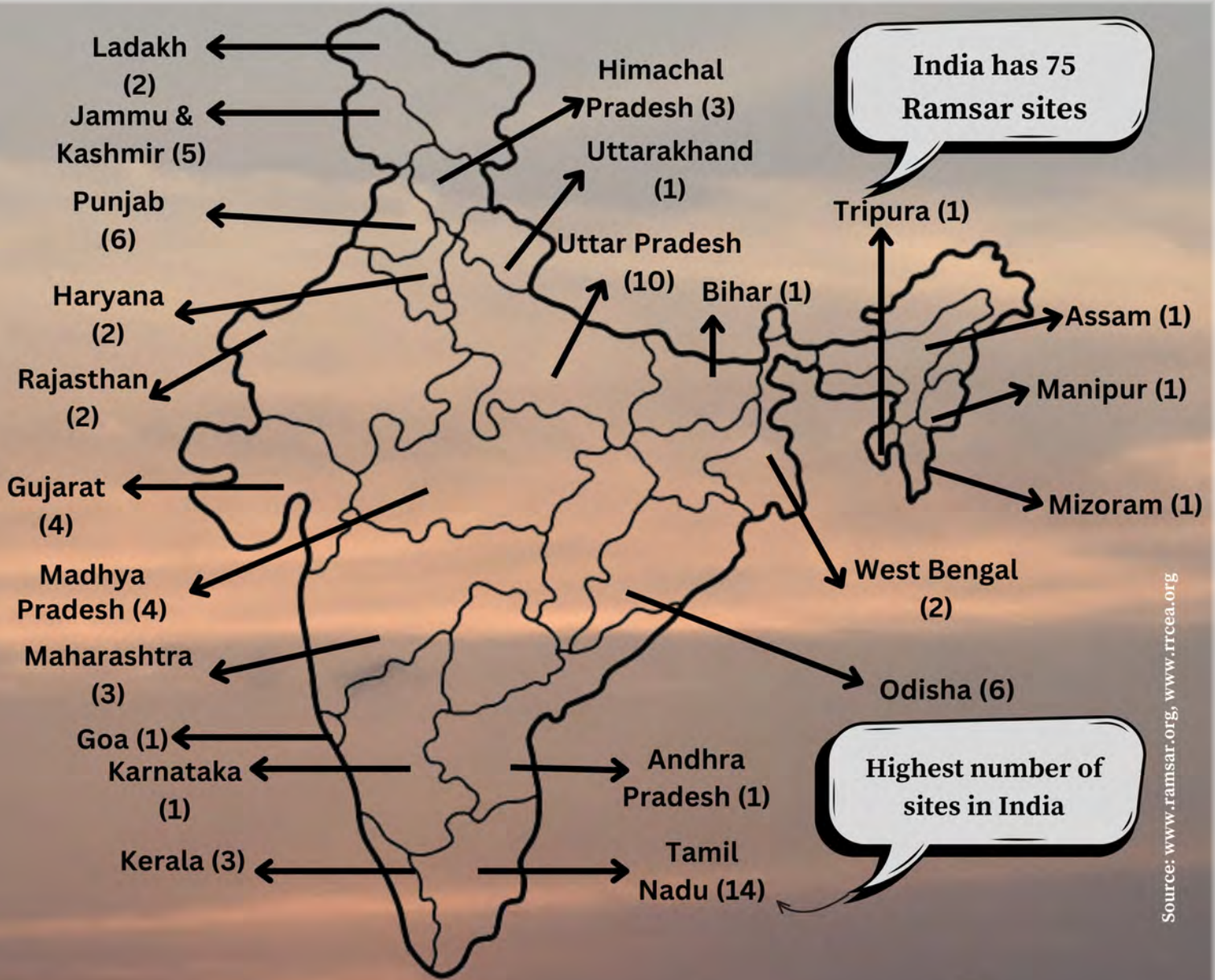
World Wetland Day!

2 February

2502 Ramsar sites in the world

Total area cover 2.5 million sq kms.





Source: www.ramsar.org, www.ircea.org

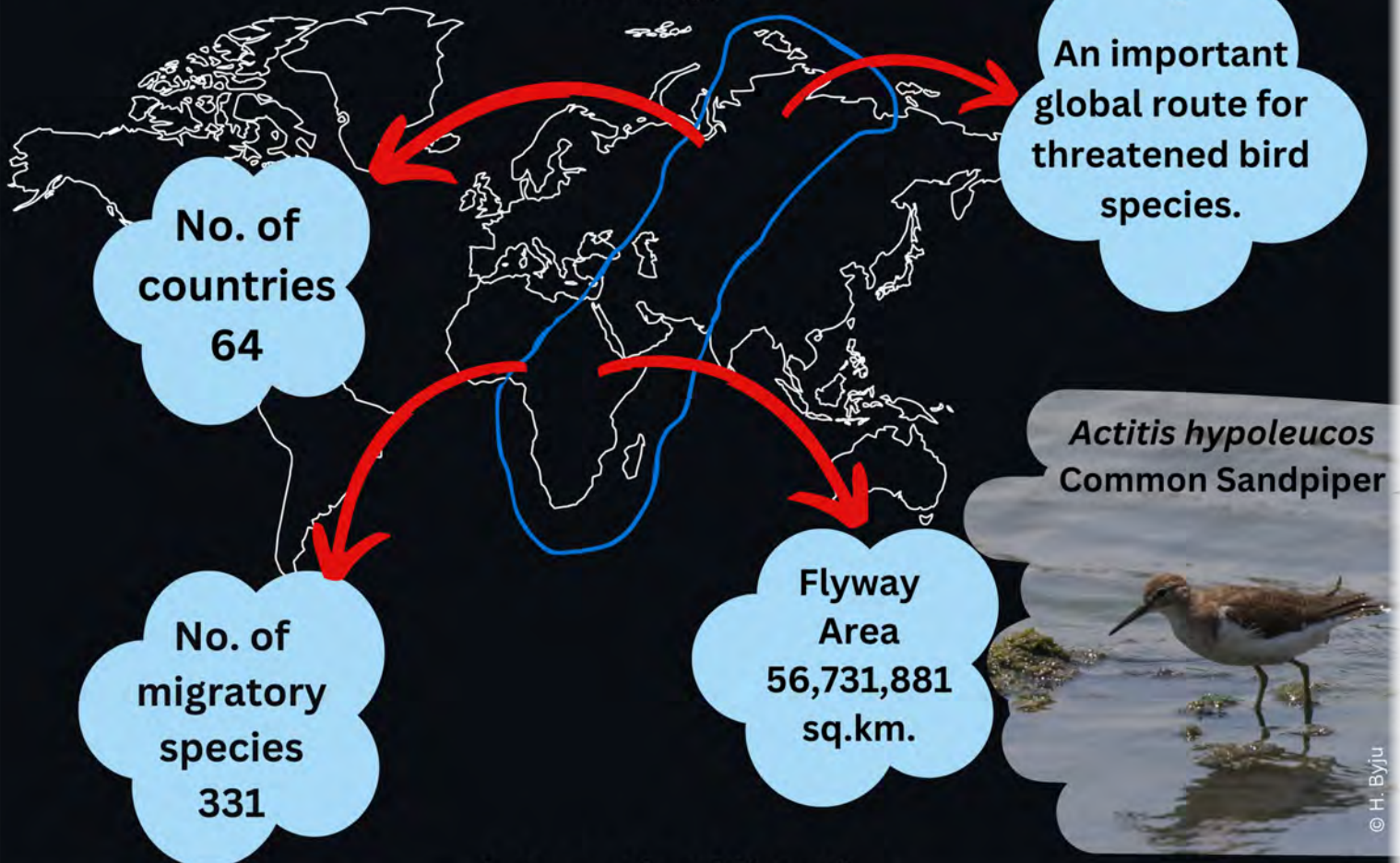


-  Flood control
-  Disease control
-  Fresh water supply
-  Species conservation
-  Groundwater recharge
-  Climate change mitigation

© Amrin Ansari

East African and West Asian Flyway

EAWA flyway is used by migratory birds during their annual cycle of breeding and non-breeding period.



Interesting Migration Journeys

Sociable Lapwing
Vanellus gregarius

Willow Warbler
Phylloscopus trochilus



From Turkey in late October to central Sudan after a total trip of more than 8,000 km



Travel 11,300 km from the far northeast of Siberia to winter in southern Africa, an incredible journey for a bird weighing no more than 10 g

Two principal migration routes

Equatorial eastern Africa - Uganda and the Lake Victoria basin.

Further east through the Kenyan highlands..



Hirundo rustica
Barn swallow



Lanius collurio
Red-backed Shrike



Acrocephalus palustris
Marsh Warbler



Luscinia luscinia
Thrush Nightingale

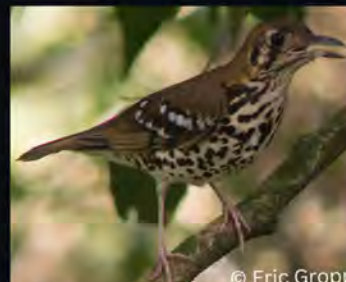
4 of the 20 globally threatened species



Northern Bald ibis
Geronticus eremita



Black Stork
Ciconia nigra



Spotted Ground thrush
Zoothera guttata



Basra Reed Warbler
Acrocephalus griseldis

THREATS

Pollution



© rawpixel.com/Earth.org

Sport hunting



© Mohamed Mahmoud Hassan

Power lines



© L.M. Aparna

zooreach
Zoo Outreach Organisation



L.M. Aparna &
Praveen Rozario

EAST ASIAN AUSTRALASIAN FLYWAY

Limosa lapponica



The Bar-tailed Godwit is the longest distance non-stop traveler 13,000 km!

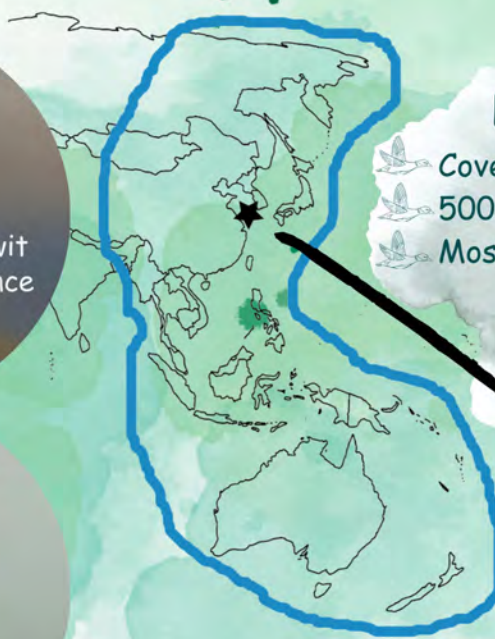
© J.J. Harrison

Calliope calliope



The Siberian Ruby weighs just 25 g but travels 11,000 km

© Supratim Deb



Largest Flyway

- ✈ Covers 22 countries
- ✈ 500+ bird species use this flyway
- ✈ Most studied flyway

Key wintering site - THE YELLOW SEA

Developmental activities are destroying the wintering sites

THREATS

Accidentally caught



© Júlio Reis

Hunting



© Bryan McDonald

Climate change



© Tony Webster

Pollution



© Kim Starr

Habitat loss



© Pjotr Mahhonin

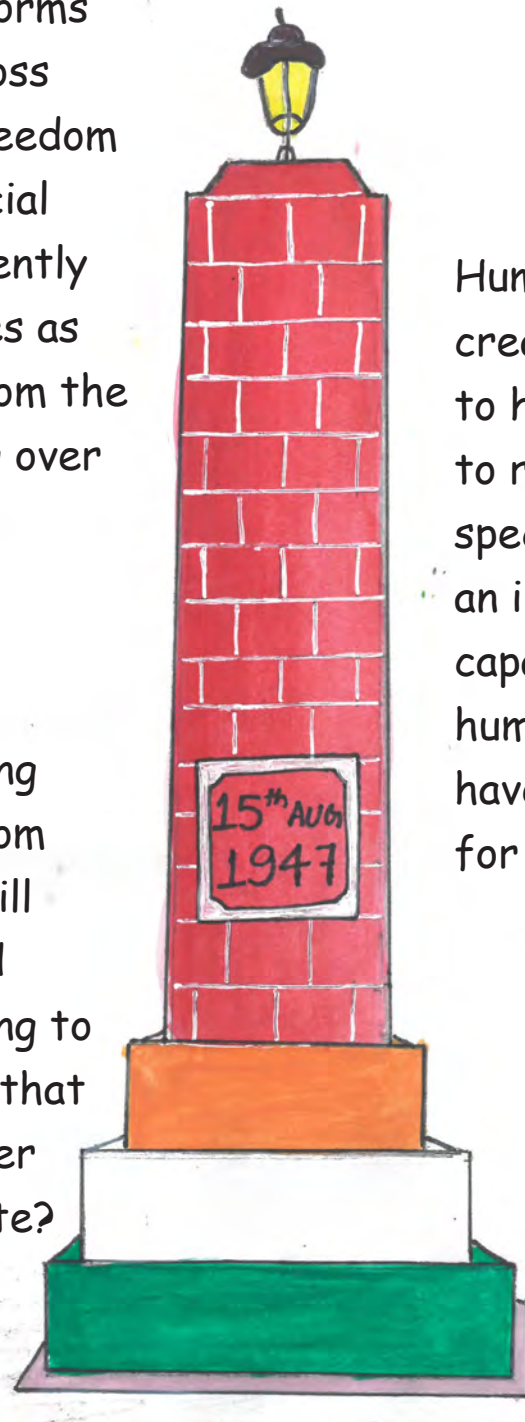
CONSERVATION INITIATIVES



UNSCRUPULOUS

Liberation of nations and establishment of forms of government across the globe led to freedom of one group of social animals, who apparently consider themselves as superior beings, from the same species ruling over them.

But what about living creatures apart from humans that are still being colonized and constantly struggling to live in their homes that are getting narrower every passing minute?



Humans are such proud creatures to assume to have eternal rights to rule over other species. Does having an increased brain capacity really give humans the right to have wildlife merely for entertainment?

I don't belong to a bowl.
Stop using me as a showpiece.



Denison Barb Fish (Rajeev Raghavan)

Idea and thought by:
Amrin Ansari & M. Paridhi
Drawing by: Praveen Rozario

Teary Tale

I fought with the waves and argued with the tides
I travelled so far for miles and miles
On lonely nights, I saw the starry sky
A journey so harsh, worth a try.

One fine evening, I reached the sandy shores
Filled with gigantic boats and massive oars.
I struggled my way and dug very deep
On the sandy dune near a rocky steep.
The place looks familiar, I rose from this very neap
Oh, the nostalgia! Makes me weep.

I buried my eggs with all my might
Ensuring they are kept out of sight.
When I go back, my kids will be alone
In this dark world – vulnerable and prone.

As soon as I began my journey to the west
I saw some scavengers waiting by my nest.
But, the men in olive vests shooed them away
Took my babies to a safer place to stay.
Until my little ones are ready to stray
I will be waiting for them by the bay.



Illustration by: Elakshi Mahika Molur

Notions and Questions - Retrospective to Sanjay's sessions

I have always been curious to understand why humans have evolved and how technology has become integral parts of our life while a century and some millennia ago, it was not as prominent as it is today. In the ancient time handmade items and tools were used but a majority of things we use today are a product of mechanization. Why humans are fighting over resource and land that involves destruction of natural resources during wars which in turn has ripple effect on the global economy. The answer to all these notions lay in Sanjay Molur's talk.

Can we rewind the clock?

This was a talk given by Sanjay Molur for BOSCH. It had answered many of my questions and conjectures I had about the financial world, why we are the way we are today, how did innumerable fields of studies have emerged, and how luxuries have changed our lifestyles. Among all this I was able to assimilate a new perspective to the basic concept in economics of need and want.

Sentences like 'We have moved away from biological living to societal living', 'People are so gullible that fiction is ruling our lives', 'Fiction revolves around gossips' and discussions on facts vs fiction which Sanjay Molur mentions and re-emphasises in most of his classroom sessions and field talks, has given a broader understanding about the happenings in our surroundings and our current living styles. It helped me rationalize and come to terms with reality of our actions and most importantly understand that we are living in a fictional world. As a part of this course all of us have unlearned the learned and learnt the unlearned aspects of life and science.

The following diagram depicts the human evolution from a biological living to complete loss of biological living. It is taken from Sanjay's presentation - Can we rewind the clock?

The transition from biological living to proto-societal living was the first major shift of *Homo sapiens* and the second major shift happened from proto-societal living to societal living. We have now moved from societal living and completely lost our biological way of living. The talk and the slides with this information had the rationale for the above notions and questions.

M. Paridhi, RHATC Fellow 2023-24, Zoo Outreach Organisation, Coimbatore, TN, India.

4.2 BILLION years of EVOLUTION

DESTROYED

IN A

MILLENNIA

BIOLOGICAL LIVING

- Cavemen
- Hunting for food
- Little planning for future
- No business or trade
- Simplistic living
- Natural lifestyle

PROTO SOCIAL LIVING

- Settlers
- Growing of food
- Barter
- Cooperative lifestyle
- Establishing orders

SOCIETAL LIVING

- Civilizations
- Trading of food
- Future Trading
- Metallurgy Art

- Invention of Philosophies
- Establishment of territories
- Ethics and Morals
- Family norms
- War

- Irritant settlers
- Industrial growing of food
- Ironic future
- Capitalism
- Corporate lifestyle

LOSS OF BIOLOGICAL LIVING

- Psychological disorder
- Stress and trauma
- Conspiracy theories
- Environmental disaster

It should be our human nature to once again become

NATURE'S

HUMANS

State of India's Birds report- a brief review

India, a mega biodiverse country, is losing out its unique biodiversity to rapid economic development across different landscapes. Birds are one of the victims and they are among the best visible indicators of ecosystem health. To assess the status of India's bird populations, there is a lack of structured surveys nationwide and systematic collation of data from scientific research in India. This has contributed to either the lack of data or disproportionate data and hinders the much-needed understanding of any species or group of species to plan conservation actions and policy.

To overcome this shortcoming, one way is to gather huge amount of data across the country through the process of citizen science. With advancement of technology, citizen science applications are gaining more popularity among Indian birdwatchers and nature enthusiasts through platforms like India Biodiversity Portal, eBird, and iNaturalist, as well as globally.

The State of India's Birds (SolB) report is one such attempt to assess the distribution of birds that regularly occur in India, trends in their abundance and conservation status using one such citizen science program called eBird, developed by Cornell Lab of Ornithology, a unit of Cornell University, United States of America. SolB is a collaborative effort of 13 organizations (six government institutions and seven conservation NGOs). The first assessment was published in February 2020 and the latest assessment report in August 2023.

Methodology

The 2023 assessment is based on the data uploaded to eBird until 31 May 2023. The final filtered dataset contained 1,496,558 unique 'complete' checklists, containing a total of 26,647,037 unique observations. A complete checklist is a list of all species observed during the period of birding.



SolB 2023 report cover.

Only 'completed checklists' were chosen to create the 'index of abundance.' Index of abundance indicates the 'frequency of reporting' for any species. As Dr. Rajah Jayapal, Senior Principal Scientist, Salim Ali Center for Ornithology, Coimbatore stated, "frequency of reporting here, is a combination of detection probability which can vary on certain site specific factors like season, visibility and birder's ability to detect the bird and a species' abundance in a particular geographical area" (Rajah



Indian Roller. © H. Byju.

Jayapal pers. comm. 06 January 2024). Initial data categorization is based on ‘presence/absence information’ for each species in each checklist to derive an index of reporting frequency for that species. By following changes in frequency of reporting over several years, an idea of ‘trend in abundance’ was estimated.

To overcome the variabilities and discrepancies in eBird data, a statistical model was used to standardize frequency of reporting. They used the generalised linear mixed-effects model (GLMM) to estimate the standardized frequency of reporting of each species, modelling its India-wide results (SoIB 2020). As stated by Dr. Jayapal “they calculated Confidence Intervals (CI) for the insufficient data using which a trend could not be concluded. CI is used to indicate how much maximum tolerable limits are there in data variability. In SoIB, they examined CI about the mean (which is computed by multiplying standard error (SE) of the mean with 1.96 as they had earlier fixed the confidence level at 95%). When

the CI exceed 50% of the ranges below and above mean, any inference about the data is statistically unreliable” (Rajah Jayapal in. litt. 05 January 2024). Keeping that data, the SoIB assessed the population trend of a species based on three indices:

1. Long-term trend is the percentage change in frequency of reporting in 2018 when compared to pre-2000 levels.
2. Current annual trend is the mean percentage annual change in frequency of reporting in the last eight years, from 2015 to 2022.
3. Distribution Range- The area covered by all the 25 × 25 km² grid cells that are occupied by a species within the country during the last five years. Country is divided into 100 × 100 km² grid cells, each of which is further subdivided into 25 × 25 km² sub cells.

The report states that out of a total of 1,358 species reported from the country on eBird (as of 31 May 2023), 942 met the data requirement criteria for assessments. The species for assessments were not just based on their availability of data for trend calculations but also in a few cases their importance in the Indian context were also considered (e.g., endemics).

Number of species		
Trend status	Long-term trend	Current annual trend
Rapid decline	98	64
Decline	106	78
Stable	98	189
Increase	19	17
Rapid increase	17	11
Trend inconclusive	185	284
Insufficient data	419	299
Total	942	942
Reference: SoIB (2023)		

Table 1. Summary of the distribution, population trend and conservation status of the five selected bird species.

Species	Scientific name	Long-term trend	Current annual trend	Distribution range size	SoIB status	Global IUCN Red List status
Malabar Pied Hornbill	<i>Anthracoceros coronatus</i>	Trend inconclusive	Trend inconclusive	Moderate	Moderate Priority	Near Threatened
Indian Roller	<i>Coracias benghalensis</i>	Decline	Decline	Very large	High Priority	Least Concern
Sarus Crane	<i>Antigone antigone</i>	Rapid decline	Rapid decline	Large	High Priority	Vulnerable
Black-headed Ibis	<i>Threskiornis melanocephalus</i>	Rapid increase	Stable	Very large	Low Priority	Near Threatened
Oriental Darter	<i>Anhinga melanogaster</i>	Trend inconclusive	Stable	Very large	Low Priority	Near Threatened

Out of the 942 species, 523 of them qualified based on the criteria for countrywide long-term trend analyses, and 643 qualified for current trend analyses.

Based on these three indices together with the IUCN global Red List of Threatened Species 2022 (hereinafter 'IUCN Red List'), species were classified into categories—High, Medium, and Low—conservation priorities for the assessments in SoIB.

High conservation priority status species are when abundance indices have declined considerably in the long-term and continue to decline today. Species were also categorized as High Priority species for India, if their abundance trend could not be assessed or conclusive trends could not be derived from eBird data but they are classified as globally threatened in the IUCN Red List 2022. A species is reported as 'Rapid Decline' if it is less than half in 2022 as it was before the year 2000. For the present review, the following five bird species were selected randomly from different habitat types. Malabar Pied Hornbill *Anthracoceros coronatus* of tropical dry or tropical moist lowland or riverine forests, Indian

Roller *Coracias benghalensis* & Sarus Crane *Antigone antigone* of open natural habitats, and Black-headed Ibis *Threskiornis melanocephalus* & Oriental Darter *Anhinga melanogaster* of wetlands. Table 1 summarizes the population trends, distribution ranges and conservation status of these species.

Distribution of Malabar Pied Hornbill is found



Oriental Darter. © H. Byju.

throughout peninsular India and Sri Lanka in the riverine forest habitats. For example, Anshi National Park, Dandeli, Karnataka, is the highest density area for these hornbills and so is for the birders and nature photographers. Review of the eBird data also shows the records are mainly concentrated from these hotspots. Hence, it can't be true representative of the status of this species as neither for entire Karnataka nor for the entire central Western Ghats. At the same time, it can't be excluded from the 'priority list' for Karnataka based on these observations. Some of the scientific research clearly show that Malabar Pied Hornbill has declined to around 85% in 12 years from 2007 to 2019 in the Western Ghats of Goa, Karnataka, and Maharashtra (see Reddy 1988; Mudappa & Raman 2009; Sneha & Davidar 2011). These findings are interesting as the period mentioned also falls in the categorization of the



Malabar Pied Hornbill. © H. Byju.



Sarus Crane. © H. Byju.

SoIB for species. In other states of peninsular India, enough data is not available on eBird. This may be due to lack of submissions from many regions. IUCN Red List categorizes this species as 'Near Threatened' in its entire distribution range of India and Sri Lanka when it was last assessed in 2016. This shows a clear knowledge gap of the actual conservation status of Malabar Pied Hornbills in India when we consider only the eBird data based SoIB report. In case of the Indian Roller, though it is globally categorized as 'Least Concern', assessment in India through eBird data shows rapid decline and gives 'High priority' status. SoIB report shows that Indian Roller population has seen 30% decline in 12 years in India.

Meanwhile, wetland birds like Black-headed Ibis population is reported to have increased as per the latest report. Black-headed Ibis & Oriental Darter are categorized as 'Globally Near Threatened Species.' In SoIB both the bird species are categorized as 'Low priority' species. With increased pressure on wetlands and decreasing

quality of the last remaining habitats, they may need further research to assess the actual status. There are no current population evaluations of darters from India. If the population is increasing despite various threats, that is also an indicator of ecological imbalance implying need of immediate attention. Just like the increase in Pea Fowl population is indicating greater crop damage in some parts of India, and may have negative impacts on snakes and other reptiles. More data analysis and research is needed on the Black-headed Ibis, at regional level, to understand the distribution.

Overall, the larger picture in India is bleak as stated earlier by assessing the randomly selected five species trends. The SoIB 2023 states that, “60% of species show long-term declines (out of 348 species that could be assessed for long-term trend), and 40% species are declining currently (out of 359 species assessed for current annual trend)”.

Strengths

The SoIB attempts to provide a comprehensive overview of the avian population in the country, shedding light on the current state of affairs in the realm of bird conservation. The report provides detailed picture of major trends and patterns across diverse habitats in detail with thoughts for future research and actions. It lists priority species for each state in India and for each habitat type like grasslands and wetlands. One of the

primary strengths lies in its potential to raise awareness. By presenting a consolidated view of the avian population, the report has the potential to catalyze public and policy attention towards bird conservation.

Weaknesses

Citizen science, has its own drawbacks. A more collaborative approach could provide a richer understanding of the challenges faced by birds and lead to formulating more effective conservation strategies. The data presented may be limited by temporal disparities, with certain regions or time periods having more robust data than others. This could affect the accuracy of the overall assessment. Birding is often done in day time and the assessment will naturally exclude species that are primarily nocturnal (including most owls and nightjars). Exceptions are Jerdon Courser *Rhinoptilus bitorquatus* and Forest Owlet *Athene blewitti* which are included in the SoIB report because they are known to be ‘Critically Endangered’ species according to the IUCN Red List.

Another major factor that influence these



Black-headed Ibis. © H. Byju.

herculean tasks of data curing is that we can't ignore the human errors involved in the detection and correct reporting of a bird when quantification in listing has become prioritized over the quality with only 150 reviewers (volunteers) across the country with this huge number of data being uploaded. Also, only relatively well reported birds on eBird are used for trend analysis.

Some of the birds like Malabar Pied Hornbill in this case, may not get immediate attention for conservation action, though their riverine forest habitats are under severe threat. Some of the places are naturally less birded regions, like too interior areas, deserts or high elevation areas. Representations from such areas will make the SolB report more comprehensive. The priority species representatives for each state have high chances of excluding important birds whose data is scarce on eBird.

SolB analyzes only the overall trend and surface level understandings of the population which may help in informed conservation action plans for a few bird species or their habitats. Since index of abundance is not proportional to population size, only a population trend over the years can be inferred. The distribution range calculation is based on last five years and the grids may not cover the species not so common or whose data is scattered on eBird reports, which definitely leads to biases in the results.

Recommendations

Given the absence of a structured countrywide program that monitors all species in every habitat, assessments like SolB is a good approach even though it is based on a semi-structured information uploaded in eBird.

There is more ground to be covered. This is a

significant challenge for a country like India of such varied landscapes. State of India's Birds report serves the purpose of creating awareness among common public and policy makers. Keeping this baseline data future reports should consider a more participatory approach, involving other stakeholders in the data collection and analysis process. Efforts should be made to fill data gaps, ensuring a more temporal and spatial coverage. This would enhance the accuracy and reliability of the report's conclusion. If the citizens themselves can be trained and involved in bird surveys at regional levels, the list can be more comprehensive with reduced errors or biases and have the potential to contribute to a countrywide movement of conservation awareness and policy change.

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H. Maitreyi, RHATC Fellow 2023–24, Zoo Outreach Organisation, Coimbatore, TN, India.

ZOO'S PRINT

Communicating science for conservation

ZOO'S PRINT Publication Guidelines

We welcome articles from the conservation community of all SAARC countries, including Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka and other tropical countries if relevant to SAARC countries' problems and potential.

Type — Articles of semi-scientific or technical nature. News, notes, announcements of interest to conservation community and personal opinion pieces.

Feature articles — articles of a conjectural nature — opinions, theoretical, subjective.

Case reports: case studies or notes, short factual reports and descriptions.

News and announcements — short items of news or announcements of interest to zoo and wildlife community

Cartoons, puzzles, crossword and stories

Subject matter: Captive breeding, (wild) animal husbandry and management, wildlife management, field notes, conservation biology, population dynamics, population genetics, conservation education and interpretation, wild animal welfare, conservation of flora, natural history and history of zoos. Articles on rare breeds of domestic animals are also considered.

Source: Zoos, breeding facilities, holding facilities, rescue centres, research institutes, wildlife departments, wildlife protected areas, bioparks, conservation centres, botanic gardens, museums, universities, etc. Individuals interested in conservation with information and opinions to share can submit articles ZOOS' PRINT magazine.

Manuscript requirements

Articles should be typed into a Word document with no more than 800 words of text and 10 key References (Tables, Images with copyright information, and Videos are encouraged) and emailed to zp@zooreach.org. Include the names of one or two potential reviewers when submitting a publication.

Articles which should contain citations should follow this guideline: a bibliography organized alphabetically and containing all details referred in the following style: surname, initial(s), year, title of the article, name of journal, volume, number, pages.

Editorial details

Articles will be edited without consultation unless previously requested by the authors in writing. Authors should inform editors if the article has been published or submitted elsewhere for publication.

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Call for donations

In the first phase of the fundraiser for the **Sally Walker Conservation Fund**, we target three objectives.

- (i) **The Sally Walker Lifetime Award for Conservation**
- (ii) **The Sally Walker Training Programme in Conservation Biology and Application**
- (iii) **Communicating Science for Conservation through innovative education programs**

We solicit your generous contributions to the above activities of your choice. Please log onto our website www.zooreach.org and click on the **SWCF page** for information on how to donate.

You can also click here to go directly to the donation page.

Donations by Indians

Donations by non Indians

In case you wish to know more about the **Sally Walker Conservation Fund**, please contact Dr. Sanjay Molur by email <sanjay@zooreach.org> or by phone +91 9677822997.

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