Ecological Restoration Insights: RHATC Field Trip to Ooty and the Nilgiris Shola-Grasslands with Upstream Ecology

Introduction

On 3 November 2025, RHATC Fellows embarked on a four-day field trip to Ooty. Since the theme for RHATC this year is ecological restoration, the main aim was to understand the challenges of restoring degraded landscapes in the Nilgiris. One of the characteristic ecosystem type in the Nilgiris are the Shola-grassland mosaics, which are home to many endemic species such as the Nilgiri Tahr, Nilgiri Marten, Nilgiri Salea, plants like Kurinjis, and many other native flora and fauna.

Before the trip, we had attended a session on the different Nilgiri ecosystems by Godwin Vasanth Bosco from Upstream Ecology, an organization based in Ooty, and he explained the characteristic biodiversity of the Nilgiris, the ecological importance of shola-grasslands, the threats they face, and how to restore them. He talked about how unique the shola-grassland ecosystem is and how the grasslands act like biological glaciers by trapping and slowly releasing huge amounts of water, providing a perennial source of water and preventing soil erosion. However, now with human interference in these areas, the once common Shola-grasslands are disappearing as a huge part of the landscape has undergone land use change. Both the forest and grasslands have been replaced by tea and timber plantations, resulting in fragmentation which threatens the biodiversity of this region. Other threats include dam constructions, invasive species, and human-wildlife conflict. The grasslands are the most neglected areas and are in urgent need of restoration, especially as they are reliable carbon sinks, important for mitigation of climate change and are also the habitat and food source for several endemic species, such as the Nilgiri Tahr, and are culturally important for indigenous communities such as the Todas.

Nursery visit at Upstream Ecology

Upstream Ecology nursery situated in Ooty was set up 12 years ago with the aim of growing plants native to the high altitude Nilgiris region. We started exploring the nursery by walking around, observing and taking

Godwin Vasanth Bosco explaining about *Tripogon bromoides*. © Sanjay Molur.

© Nishigandha

Cyathea nilgirensis
Tree fern

© Nishigandha

Rhododendron arboreum var. *nilgirica*

© K Gokul

Psuedoxytenanthera monadelpha
Shola Dwarf bamboo

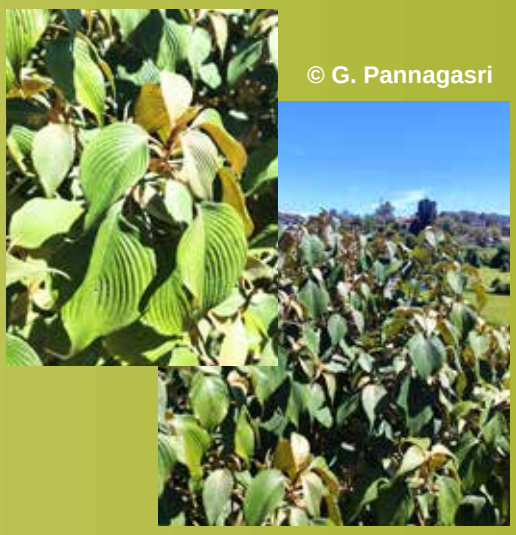
© Srijita Pal

© Nishigandha

Strobilanthes lanata
Golden kurinji

© Sanjana Vadakke Kurupath

S. kunthiana
Neelakurinji



© G. Pannagasri

S. cuspidatus
Silver kurinji

© Sanjana Vadakke Kurupath

© Nishigandha

S. lawsonii
Copper kurinji

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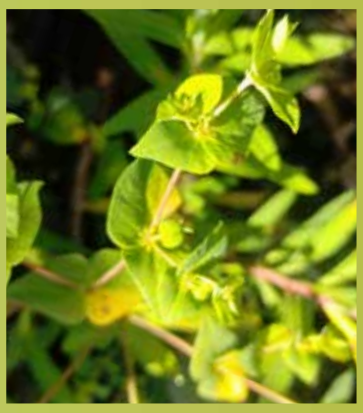

Euphorbia platyphyllos

© Sanjana Vadakke Kurupath

Impatiens cuspidata
Balsam

© Nishigandha

Epiphytes
Orchid and Lichens

© Nishigandha

Mohonia leschenaultii

© G. Pannagasri

Rubus ellipticus
Golden Himalayn Raspberry

© G. Pannagasri

Rubus niveus
Mysore Raspberry

© G. Pannagasri

Sisyrinchium sp.

© Yadav Shreya

Bidens pilosa
Black Jack

© G. Pannagasri

Calceolaria sp.
Slipper flower

pictures of invertebrates, plants, flowers, frogs and other elements. There were approximately 95 floral species in the nursery, most of which belonged to the Shola-grassland ecosystem. The office had a huge bush of Golden Kurinji *Strobilanthes lanata*, which gleamed beautifully in the morning sunlight. It is a point-endemic species which blooms once in nine years.

There are currently 28 species of kurinjis found in the Western Ghats and most of them have a similar periodic flowering pattern. Some other species of *Strobilanthes* we observed were Silver Kurinji *S. cuspidatus*, blooms once in 13 years, Purple Kurinji *S. papillosa*, Copper Kurinji *S. lawsonii*, Forest Kurinji *S. heteromalla*, Neelakurinji *S. kunthiana*, and *S. homotropa*, a rare species whose flowering pattern and microclimate are not yet known fully and are under research at their nursery.

Kurinjis are helpful in maintaining microclimates by holding water and maintaining evapo-transpiration in the shola forest. They also act as forest skirts which are well adapted to thrive in ecosystem transitions, i.e., ecotones and are great at stabilizing slopes. Hence, they are often used by Upstream Ecology in an 'ecotone approach' of restoration to help heal the habitat. The tribes of the Nilgiris also have strong cultural ties with the kurinjis. For example, some of them measure their age by how many Kurinji blooms they have witnessed in their lifetime. Growing next to the Golden Kurinji was a lush Shola Dwarf Bamboo *Psuedoxytenanthera monadelpha* whose shoots are consumed by local tribes.

We also discussed how some species are common to both the Himalaya and the Nilgiris, like *Rhododendron arboreum, Rubus ellipticus*, and *R. niveus*. The habitat similarity and suitability has also brought some non-natives and invasives from the Himalaya, like the Himalayan Knotweed *Persicaria wallichii*. There were some invasive plants on the edges of the nursery, not deliberately planted but naturally occurring. Some of those were *Lantana camara, Ageratina adenophora, Bidens pilosa*, slipper flowers, and *Sisyrinchium* sp. Many of these flowers are brightly coloured, aesthetically pleasing, and hardy, which is why people often cultivate them in gardens, making it easy for them to establish themselves widely.

Shola-grassland

On 4 November, we went to the Upstream Ecology Nursery in the morning, where Vasanth gave us a briefing on the propagation of native grass species, highlighting the ecological significance of *Tripogon bromoides* as a primary food source for the Nilgiri Tahr. We then loaded 300 saplings of *Tripogon bromoides* and headed to the restoration site, an abandoned tea and timber plantation, at Carrington, Thaishola. We carried the 300 saplings uphill to the designated planting area, helped by the on-site workers. We observed the restoration plot to be a cleared area, situated adjacent to an established tea plantation, which had been prepared for planting by the removal of invasive species and tea shrubs. Jeevit, a botanist from Upstream Ecology, guided us regarding how to plant the saplings to maximize survival rates in the high-altitude environment. We then spent the afternoon planting the saplings in a scattered manner, with a distance of approximately 0.5 m between saplings. We also created a raised crescent on the lower slope below each planted sapling to help retain rainwater. The activity provided us with a practical understanding of the multiple components of ecological restoration, particularly the logistical and labor-intensivechallenges of restoration in difficult terrain.

Jeevith explaining about *Tripogon bromoides* before plantation. © Sanjay Molur

Plantation of *Tripogon bromoides* saplings. © Sanjay Molur.

Riverine Bamboo Plantation

On 5 November, we travelled to Vazhaithottam in Mudumalai Tiger Reserve via Gudalur, where we observed the vegetation transition from moist deciduous forests to dry deciduous forest to dry thorn/scrub forest. We learned that this was due to the rainfall gradient, as the Nilgiri Hills have a rain shadow effect on the eastward landscape. In Vazhaithottam Village, which is in the Singara range of Mudumalai Tiger Reserve, we visited another restoration site of Upstream Ecology in riverine habitat. There, we planted bamboo *Bambusa bambos* saplings from the on-site nursery to the riverine area. The saplings had already grown to about 1 m in height and had developed small spines, which would improve survival by reducing the chances of predation by herbivores. In total, we moved around 90 saplings and successfully planted most of them, covering a long patch along the riverbank.

Since the site includes both reserved and private areas, forest department permission was needed to remove invasive species. Also, Vasanth mentioned that invasives (mainly *Lantana camara*) tend to regenerate quickly even after repeated removal efforts. This observation reinforced what we have learnt earlier in the course that ecological restoration is a long-term, continuous process requiring regular monitoring and maintenance. Vasanth also highlighted that for the next four to five years, the team will need to keep checking and maintaining the site to ensure the restoration efforts are successful. For many of us fellows, this was their first hands-on experience in planting and restoring bamboo, offering valuable practical exposure to the challenges and processes involved in restoration work.

During the visit, we also observed elephant dung in the area, but found no visible signs of life within it. Typically, elephant dung supports more than 50 species of invertebrates that depend on it for food and habitat. The absence of these organisms, perhaps, shows a disruption in the food chain. It may be possibly due to changes in the elephant's diet, specifically that the elephants might not be consuming the native plant species that host the invertebrates essential for maintaining ecological balance.

IISC Field Station visit

Later that afternoon, we met the staff of the IISc Centre for Ecological Sciences field station in Masinagudi, Mr. Bharanaiah, the field station manager, Dr. Nachiketha Sharma who studies elephant acoustics, Mr. Arjunan, and Mr. Albert Suresh who have been working on the long term monitoring of forest dynamics in Mudumalai. On a drive to Moyar Village, Nachiketha introduced us to his work on elephants and, with Albert, helped us understand the landscape, different animal behaviours, invasive plant presence and how it affects elephant movement in the reserve. At Moyar, we observed the south aspect of the Moyar Gorge and the vegetation distribution. Nachiketha then shared his knowledge and observation around the gorge, its dimensions, and the influence these factors have on the distribution, speciation, and movement of animals across the gorge. Albert spoke about the diversity of the invasive species and the cyclic patterns he has observed with respect to their dominance over the years.

We also visited the tree shrine that the Jenukuruba tribe residing in Moyar Village worships. We had multiple sightings of elephants and Spotted Deer on the journey

to and fro. On the way back, we were ecstatic to also see a few herds of Sambar Deer. This part of our field visit was unexpected and yet it was a genuine treat to interact with and learn from the whole team at the field station.

Kodanad Viewpoint

After leaving Ooty on 6 November, we visited the Kodanad Viewpoint, which is located at an elevation of about 1,800 m in the Western Ghats and faces north. From this viewpoint, we could see the meeting point of the Eastern and Western Ghats, as well as the Moyar River gorge. Ahead of the viewpoint lay the Deccan plateau beyond the hill ranges. We could also see the meeting point of the Mudumalai and Sathyamanagalam tiger reserves. The main purpose of visiting this place was to visualise the biogeography of the Nilgiri landscape that we had been discussing over the past few days. Dr. Sanjay Molur pointed out various features of the landscape as evidence supporting our earlier discussions about the geological and ecological evolution of the region. One major feature was the Moyar gorge, which is one of the oldest gorge in the country at 2.5 billion years. We also observed different vegetation types from the viewpoint, including moist forests of the Western Ghats, riverine vegetation in the valley, and dry grasslands and scrub forests of the Eastern Ghats, which lie in the rain shadow region. We could also see human settlements scattered throughout the area.

Moyar River

While at the viewpoint, Sanjay discussed the Moyar river with us and we learned that it originates from the catchment area in Mudumalai Tiger Reserve, flows along the Moyar gorge into the Bhavani Sagar reservoir, and acts as a tributary of the river Kaveri. The river and parts of the gorge act as a natural marker for the political boundary between Tamil Nadu and Karnataka, and supports a large population of trees like *Terminalia arjuna*, which are part of riverine vegetation, form a high canopy, and provide optimal nesting conditions for vultures. As the river flows, it collects the nutrition-rich soil from the slopes and deposits it on the banks of rivers on the plains, forming alluvial soil. This rich soil is the reason that humans selected the river sides for agriculture and settlement.

The Moyar River is the habitat of Humpback Mahseer *Tor ramadevii*, but only till the Bhavani Sagar dam. Earlier, the whole stretch of river from the Moyar to the Kaveri river supported a large population of Humpback Mahseer. However, after 1980, the Tata Hydropower bred hybrid Blue-finned Mahseer *Tor khudree* was introduced into Kaveri River, which competed with the native Humpback Mahseer and wiped out its population from its natural range. At present, the dam acts as the barrier for the invasive species to reach the Moyar River, therefore being one of the last homes for the natural population of Humpback Mahseer.

Climate and Biogeography

We also discussed the formation of the Deccan Plateau, which was caused by volcanic eruptions 65 million years ago. The multiple eruptions produced lava that were contained by the barriers of the Western and Eastern Ghats on either side, forcing them to flow and cool to form multiple layers of basaltic rock on the plains. As an example, some places like Maharashtra have elevated land mass and are found with different layers of volcanic substrate. Below the Ghats, the lack of lava flow left the grassland ecosystems covering most of the Tamil Nadu plains untouched.

Some areas of the windward side of the Western Ghats, such as Agumbe in Karnataka, receive 6,000–7,000 mm of rainfall over a longer duration of eight months. However, the rainfall pattern has changed due to climate change, with the Nilgiris currently receives around 4,000 mm of rainfall for 5–6 months. The soil gets

Elephants in Mudumalai Tiger Reserve. © Srijita Pal.


Indian Gaur. © B. Ravichandran.


Nilgiri Salea female. © Shreya Yadav.


Nilgiri Salea male. © Shreya Yadav.

oversaturated with this heavy rainfall as the water cannot percolate fast enough, especially due to the loss of grasslands, leading to soil erosion, landslides, and flooding.

Restoration learning outcomes and challenges

Overall, we had a broad introduction to the Nilgiri landscape and the practical aspects of carrying out restoration in such an ecologically diverse area. Some of our learnings about restoration include the following:

- ⇨ It requires a substantial investment of time, energy, money, and manual labour. Physical labour is not only important for planting itself, but for removing invasives or planted commercial species, preparing the soil, and spacing out plants appropriately over the given area.
- ⇨ It's important to look at published literature and untouched reference sites to understand the historical habitat and species composition before beginning restoration.
- ⇨ To be successful, it needs to be planned for in the long term (such as planting *Strobilanthes* species to create suitable microclimate for other species to grow over the years, planting bamboo only after it has developed spines to reduce the chances of herbivory, or shaping the soil to break the flow of water near each sapling and improve percolation).
- ⇨ Successful nursery management requires a good manager and enough information about the ecological role, taxonomy, germination, and growing conditions of each species.
- ⇨ Good restoration planning needs a broad foundation of knowledge about the natural ecology, taxonomy across taxa, climate, hydrology, edaphology, topography and geography of the area.
- ⇨ Monitoring should continue well after planting, ideally until the restored area starts to thrive naturally. This is to help improve chances of survival as well as to understand causes of sapling loss.
- ⇨ It requires a multilateral approach, with the involvement of all relevant stakeholders such as the local government, local communities, forest department, and ecologists.
- ⇨ It's a constant learning process, and it's better to be prepared for unforeseen factors to impact the


Moyar River Gorge. © Sanjay Molur.

project outcome from the beginning. In the case of a tea estate restoration site you cannot get water up the hill to water the grasses, you can only monitor. In the case of the riverine bamboos, the saplings could be preyed on by herbivores like elephants, wild boars, etc. or even cattle from the surrounding farm. So it is important to expect a realistic outcome, especially since native trees have a much lower survival rate than non-natives.

- ⇨ The ecotone approach uses vegetation that is adapted to thrive in between two different ecosystem types to support those that require specific microclimates to grow in either of the neighbouring ecosystems. This approach is uniquely suited to the shola-grassland mosaic.

We also learned a lot about the challenges that need to be overcome for successful restoration, both in this landscape as well as for restoration in general, such as: Working in protected areas requires permissions that can be difficult to get.

- ⇨ Invasives are a major obstacle for successful restoration and a strong, committed strategy is required for the removal of the multiple species that colonise areas cyclically. It's also important to recognise that these invasives can alter the chemical composition of the soil and make it even more difficult for native plants to grow.
- ⇨ Lack of published work on certain understudied habitats or species (like grasses) can hamper restoration efforts, making it difficult to plan planting and propagation.
- ⇨ Raising funds for restoration with native plants can be difficult because of the low survival rate compared to non-native fast-growing plants.
- ⇨ Different landscapes have different challenges - for example, working in the thorny riverine habitat versus moving plants and planting equipment up the hillside.
- ⇨ Misconceptions can be hard to work against and require a strong education campaign - for example, the idea that grasslands are nothing but wastelands, or that they have little carbon capture value.
- ⇨ Colonial practices of growing timber like eucalyptus and teak are a problem as some people can argue that it is more beneficial for those trees to remain and continue their carbon capture rather than growing native trees from scratch. However, this ignores the highly reduced biodiversity (and therefore biomass) that non-native trees or monocultures can support.

- ⇨ Restoration should include a strong component of education about waste management and why plastic should not be littered. It was very disheartening to find plastic in soil everywhere we dug in the riverine patch, which was in the middle of a tiger reserve, especially when we still don't know enough about the impacts buried plastic could have on the soil, vegetation, and fauna.

In general, **education** on why restoration is needed and the impacts of monocultures and invasives is very important. It is the only way to gather local support for sustained restoration in the long run.

Conclusion

The four-day field trip to Ooty and the Nilgiris gave us a comprehensive understanding of ecological restoration within the Shola-grassland landscape. Through visits to Upstream Ecology's nurseries, hands-on planting of native grasses and riverine bamboo, and guided sessions on landscape ecology, we explored how restoration is deeply shaped by hydrology, geology, species interactions, and long-term environmental change. Each site revealed different challenges – from invasive species and altered rainfall patterns, to labour-intensive fieldwork and limited water access – highlighting the complexity of restoring degraded ecosystems.

The landscape-level observations at Kodanad and the interactions with IISc researchers broadened our ecological perspective, showing how restoration is intertwined with animal movement, soil processes, and historical land-use decisions. These experiences helped us connect theory with practice, reinforcing that restoration is not just technical work, but a slow, adaptive, and collaborative process requiring patience, monitoring, and continuous learning. The varied approaches and on-ground realities also raised important questions about sustainability, feasibility, and long-term success. At the same time, they encouraged us to think creatively, experiment with methods, and remain flexible to ecological and social constraints. Ultimately, the field visit deepened our appreciation of the practice of restoration, equipping us with insights crucial for engaging with real-world conservation challenges in the future.

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RHATC team after plantation. © Sanjay Molur.

Yadav Shreya, Srijita Pal, K. Gokul, Pathak Hrishikesh, Sanjana Vadakke Kuruppath, S. Naufal Nazium, M. Nishigandha, G. Pannagasri & Ishika Shah
RHATC Fellows 2025–26, Zoo Outreach Organisation, Coimbatore, Tamil Nadu, India.

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