ANNUAL REPORT 2018–19

ASHOKA TRUST FOR RESEARCH IN ECOLOGY AND THE ENVIRONMENT

Cover Photo: A group of Sarus Cranes (Grus antigone), the tallest flying bird, in the agricultural fields and wetlands around the village of Dhanauri, Uttar Pradesh. *© Anjan Katna*

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Elephants spotted in Nilgiri Biosphere Reserve.
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President's Message

Meeting big challenges.

Environmental challenges have been around for quite some time, but this summer has reminded us of how precarious our situation is. We have experienced unprecedented high temperatures and water shortage. Nature that not only provides us the buffer against environmental hazards, but a variety of other services, is itself under assault every day.

At ATREE, our commitment to address these challenges at scale continues to grow. First, with a group of individuals and institutions, ATREE has proposed a National Mission on Biodiversity and Human Well-being to the Government of India. This was formally announced to the public by the Prime Minister's Principal Scientific Adviser in March 2019. Second, in partnership with other organisations, we will soon launch an ambitious programme on the restoration of degraded lands. Third, at the institutional level, we have created two new centres, the Centre for Social and Environmental Innovation (CSEI) and the Centre for Policy Design (CPD).

Implementation of these and many other programmes will require strong leadership. Thus, ATREE is fortunate to have Dr. Nitin Pandit as the new Director. Dr. Pandit brings a wealth of leadership experience in private and public sectors to steer us during this next critical phase of ATREE's journey.

In order to undertake these and other large scale programmes, we are grateful to our donors for providing core support, to think big and at appropriate scales. We particularly thank Rohini Nilekani, the Shibulal family, Anthony Killough, Sandeep Singhal, S. Viji, Vasudev Rao and Chitra Phadnis and others mentioned in this report. We also thank our numerous friends for their encouragement and support.

Kamaljit S. Bawa
President, ATREE

From the Director's Desk

What a fascinating first six months!!! And why?

Well, first I must take this opportunity to thank the outgoing Director, Dr. Kartik Shanker, who played a huge role in laying the foundation for the future Centres on Policy Design and Social and Environmental Innovation.

Second, we now have two new centres – the Centre for Social and Environmental Innovation (CSEI) and the Centre for Policy Design (CPD). Through the CSEI, we will foster self-reliance and responsibility within and across communities and markets in urban, forest and cultivated landscapes in the areas of biodiversity and water. Through the CPD, we aim to apply knowledge to improve the formulation and implementation of policies to provide guidance for public policy and decision support.

Third, it is such a pleasure to congratulate our Founder-President, Dr. Kamal Bawa, on being awarded the prestigious Linnean Medal in Botany from the Linnean Society of London on May 24, 2018. Dr. Bawa is the first Indian to win the award ever since it was first constituted in 1888. He was recognised for his pioneering work on the evolution of tropical plants, tropical deforestation, non-timber forest products and for decades of work on the biodiversity of forests in Central America, the Western Ghats and the Eastern Himalaya.

Finally, we welcome to the ATREE family, Anthony Killough, Sandeep Singhal, S. Viji and T. T. Srinivasaraghavan. We are thankful for your support and belief in our work.

Dr. Nitin Pandit, Director, ATREE

Recognitions and Achievements

2018–19

ATREE is among the top 20 environmental think tanks in the world according to the University of Pennsylvania's 2018 Global Go To Think Tank Index Report.

Prof. Kamal Bawa, Founder President, ATREE, became the first Indian to receive the Linnean Medal in Botany by the Linnean Society of London. He was awarded the medal for his research on the evolution of tropical plants, tropical deforestation, non-timber forest products and biodiversity of forests in Central America, the Western Ghats and the Eastern Himalaya.

FACULTY AND STUDENTS

Dr. Sharachchandra Lele, Distinguished Fellow, ATREE, was nominated by the Government of India as a lead author for the IPBES Values Assessment (or more specifically: Methodological assessment regarding the diverse conceptualization of multiple values of nature and its benefits by the Intergovernmental Panel on Biodiversity and Ecosystem Services).

Dr. Sharachchandra Lele was appointed to the Board of Studies for a new Postgraduate Diploma Programme in Bioscience Policy Research at the Institute for Bioinformatics and Applied Biotechnology.

Dr. Veena Srinivasan, Fellow, ATREE, was awarded the Prince Claus Chair at Utrecht University for her research in sustainable and inclusive food production in Asian delta regions.

Dr. Veena Srinivasan was invited to be a national resource person at the National Water Mission's regional workshops on State Specific Action Plans (SSAPs) in Pune on September 14, 2018 and Bhubaneshwar on September 19, 2018.

Dr. Veena Srinivasan was appointed to the Strategic Advisory Group for the UN-Water Integrated Monitoring Initiative for Sustainable Development Goal 6.

Dr. Bejoy Thomas, Fellow, ATREE, was appointed as an expert member to the committee constituted by the Karnataka State Government to prepare the State Action Plan for achieving Sustainable Development Goal 2.

Dr. Jagdish Krishnaswamy, Senior Fellow, ATREE, was appointed as a coordinating lead author for Climate Change and Land: An Intergovernmental Panel on Climate Change (IPCC) Special Report on climate change, desertification, land degradation, sustainable land management, food security and greenhouse gas fluxes in terrestrial ecosystems. He is also an Expert Reviewer for the IPCC Special Report on Global Warming of 1.5C (SR15).

Yangchenla Bhutia, PhD Scholar, won the International Union of Forest Research Organization's – IUFRO's Young Scientist Award.

Madhushri Mudke, PhD scholar, received the Edge Fellowship – a two-year fellowship. Madhushri also won a scholarship to attend the Advanced Field Course in Ecology and Conservation (AFEC-X 2018) at the Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences.

Shweta Basnett, PhD scholar, won the first place for her paper presentation on 'Reproductive Phenology of Himalayan Rhododendrons: Influence of phylogeny and abiotic factors', at the International Phenology Conference in Melbourne, Australia.

Vikram Aditya, a PhD scholar, won the Rufford grant for his project 'Assessing the impacts of hunting and illegal trade on wildlife in the northern Eastern Ghats, India, focusing on the Indian pangolin'.

Rathnavel Pandian, a project intern, received the WWF Small Grants Innovation Program (SGIP) grant to work on 'The Relationship between Soil Carbon Sequestration, Dung Beetles and Grassland Management in the Korangadu Grasslands of Western Tamil Nadu.

Research Highlights

ATREE's research spans across two centres, each housing three programmes

Centre for Environment and Development

WATER, LAND AND SOCIETY

The programme aims to generate valuable insights that can help identify social, technological and governance solutions to India's water problems.

FACULTY: Dr. Veena Srinivasan (Programme Leader), Dr. Bejoy Thomas, Dr. Durba Biswas, Dr. Priyanka Jamwal and Dr. Shrinivas Badiger

FORESTS AND GOVERNANCE

The programme aims to influence the forest policy debate by incorporating the changing socio-economic contexts of local communities, the importance of historically-situated and locally nuanced forest rights arrangements, and the need for institutional arrangements that fairly link local and global stakeholders.

FACULTY: Dr. Siddappa Setty (Programme Leader)

CLIMATE CHANGE MITIGATION AND DEVELOPMENT

The programme aims to decouple economic growth and greenhouse gas emissions and harness co-benefits for the local environment, health, and energy security.

FACULTY: Dr. Shoibal Chakravarty(Programme Leader), Dr. Sharachchandra Lele, and Dr. Shikha Lakhanpal

Centre for Biodiversity and Conservation

BIODIVERSITY MONITORING AND CONSERVATION PLANNING

The programme aims to describe, assess and monitor biodiversity across scales, taxa, and landscapes. It applies broad interdisciplinary approaches to conservation planning and adaptive management practices to further ecological sustainability.

FACULTY: Dr. R Ganesan (Programme Leader), Dr. Priyadarsanan Dharma Rajan, Dr. G Ravikanth and Dr. N A Aravind.

LANDSCAPES, LIVELIHOODS AND CONSERVATION

The programme aims to examine the contrasting and synergistic strengths of natural and social drivers of environmental change at the landscape level and at the same time find solutions to enhance both conservation and livelihoods.

FACULTY: Dr. T Ganesh (Programme Leader), Dr. Ankila Hiremath, Dr. Abi Tamim Vanak and Dr. Nitin Rai.

ECOSYSTEM SERVICES AND HUMAN WELLBEING

The programme aims to understand the various dimensions of ecosystem services and mainstream them into societal and policy discussions.

FACULTY: Dr. Jagdish Krishnawamy (Programme Leader), Dr. Soubadra Devy, Dr. Nirmalya Chatterjee and Dr. Siddhartha Krishnan.

Centre for Environment and Development

Water, Land and Society

The programme's faculty members are engaged in several large research projects as well as direct engagement in piloting new solutions and informing policy and practice

DECENTRALISED WASTEWATER TREATMENT - GLOBAL INNOVATION FOR SUSTAINABLE RURAL COMMUNITIES (ONGOING)

Scottish and Indian scientists are collaborating on a project seeking to deliver a low-cost, decentralised wastewater treatment system (DWWTS) in Indian rural schools, with the aim of improving public sanitation and environmental health in the country. Designed with consideration for the various socio-cultural and economic factors that shape sanitation behaviour and change,the system is modular and can be adapted to different local conditions such as climate variability, population density, and land availability. The pilot system has been implemented in Berambadi Primary School, Karnataka, and is designed to serve the needs of 10 staff and 180 students between the ages of five and 14. It was launched on November 28, 2018 by Scotland's Deputy First Minister, John Swinney MSP, during an official visit to India. The system contains several established processes and is supplemented with a range of innovative technologies including grey water recycling, rain water harvesting, and solar power. The project is unique in its integration of the component parts and engagement with the local community at all stages of the project.

Left: Inspecting the first flush rainwater harvesting. *© Lakshmi Raveendran.*

Above: Studying the grey water treatment system. *© Rohan Sunny.*

requires a more complete understanding of the demand for new sanitation infrastructure among the affected community.

While designing and implementing the DWWT system, sustainability issues were taken into consideration by accounting for both the water quality and water availability. ATREE's specific role in the project is to deploy a monitoring strategy to establish the existing baseline water quality going into the pilot system and the wastewater effluent discharge. A monitoring strategy will be enacted through the project cycle to capture data that informs optimisation of the system and provides evidence that the system delivers water quality improvements.

Key Findings:

The monitoring results suggest that the waste stream from both the hand wash and kitchen wash treatment units meet the discharge standards set by CPCB and is safe when used for flushing.

The quality of effluent from the single tank treatment system is better as compared to the plug flow treatment system.

For any improved sanitation infrastructure to be successful in terms of the aforementioned objectives

UPSCALING CATCHMENT PROCESSES FOR SUSTAINABLE WATER MANAGEMENT IN PENINSULAR INDIA (UPSCAPE) (ONGOING)

Focusing on the highly contentious inter-state Cauvery River basin (with an area of c.80,000 km^2) the ongoing project addresses the key scientific challenge of representing the many local, small-scale interventions in Peninsular India at larger scales. Using observations from established experimental catchments in both rural and urban settings, the project explores how changes

Nitrate analysis. *© Anu Karippal*

in land-use, land-cover, irrigation practices, and small-scale water management interventions locally affect hydrological processes. The impact of local-scale interventions will further be modeled alongside projections of population growth, climate and land-use change, and water demand to assess future impacts on water security across the basin. By developing novel upscaling techniques, the project demonstrates the capability to generically represent the cumulative impact of abundant small-scale changes in basin-wide integrated water resources management models. This collaborative project research project is part of the Newton-Bhabha "Sustaining Water Resources" programme, funded by the UK Natural Environment Research Council and the India Ministry of Earth Sciences. The project involves six organisations, from India (IISc, ATREE, and ICRISAT) and the UK (CEH, BGS and the University of Dundee).

Key Findings:

Increases in agricultural intensification and groundwater irrigated areas in both Karnataka and the Cauvery Delta using Google Earth Engine along with extensive ground surveys and expert interviews, suggests continuing and intensifying competition over water.

An increase in urban extent and land fallowing, particularly near urban areas was observed.

A shift from surface to groundwater sources was also observed during this time period. Within the towns, the quantity of water abstracted increased almost six-fold in 30 years.

A novel contribution was the use of Google Earth Engine (GEE), a cloud-based platform that greatly reduced computation time, unlike traditional remote sensing approaches, especially for a large area like Cauvery basin and over a long time span. Additionally, because all the analysis remains on the cloud, the approach is completely transparent and can be independently and quickly replicated.

CITIZEN'S DASHBOARD FOR BANGALORE'S LAKES (ONGOING)

Bangalore is grappling with issues of an imminent water crisis, inequitable access to water supply, and public health hazards. There have been growing concerns amongst citizens about the health of the city's lakes. This has in fact been acknowledged by the government which has now appointed citizen's groups as 'Lake Watchdogs'. However, despite years of research, both the government agencies and the citizens are ill-equipped to handle the management of these lakes as information is neither consolidated nor made usable to facilitate easy and informed decision making.

The ongoing Citizen Lake Dashboard project, sponsored by a CSR grant from Oracle Corporation, aims to make relevant data available to all those citizens' groups which are actively responsible for maintenance of their lakes and to ensure that the correct use of data brings in the required social change. The project brings together citizens' groups, agencies, researchers, innovators, and students, to facilitate the exchange of views and ideas to keep the city's lakes healthy.

Using a combination of state-of-the-art sensors and citizen science to measure dissolved oxygen, lake levels, nutrient levels, and pH balance, the data is wirelessly stored on a cloud dashboard. Additionally, scientific data collected by citizens on the biodiversity around lakes is also being uploaded. Simple analytics in the form of graphs such as rainfall versus inflow, DO versus time of day/temperature, etc can be downloaded from the website.

The project has involved three types of activities:

1. Development of the Dashboard to curate and display content on lakes.
2. Outreach to citizen groups to improve engagement with lakes, including biodiversity walks and display boards.
3. Content generation to continuously improve the information available – including videos, photo-stories, blogs, infographics and system maps.

Jakkur lake water testing. *© V Shankar.*

Key Outcomes:

An improved online citizen's dashboard with a new partner, NextDrop Technologies. The first version has been released with exciting content at www. blrlakesdashboard.org

—

Partnership with Foundation for Environmental Monitoring (FFEM) on a citizen science programme using smartphone-based low-cost test water quality kits. The Jakkur lake community has been trained to use these kits. They now use these kits to monitor lake water quality.

—

Design and fabrication of information display boards at Kaikondrahalli and Jakkur Lakes. They were done in partnership with the lake trust groups and have proven to be very popular with the lake visitors.

—

Content partnership with Janaagraha and Biome to create a detailed 'Systems-Map' and allied collaterals to document the causes and actionable reform-roadmap for lake pollution.

—

"Biodiversity Lake Walks" initiative, which involves guided tours that explain, through stories, the interdependencies between the flora and fauna at the lake and water quality. Three such walks were conducted at Jakkur lake and have been well-received.

CONTEXT-BASED WATER TARGETS PILOT STUDY – NOYYAL-BHAVANI RIVER BASIN

At the global level, there is an emerging recognition and a push for industries to take greater responsibility towards efficient and sustainable water management within and beyond their fence. For product-based industries in developed economies that have outsourced water-intensive manufacturing to developing countries, the water footprints in river basins are significant and the issues around them complex.

One of the initiatives to improve corporate water stewardship involves setting water targets for

industrial facilities by defining metrics related to the issues that are contextually relevant to the river basins in which they are situated. This approach involves the identification of shared water challenges in river basins, water target setting and metrics relevant to the basins and that are in line with local and national policy and the SDGs. ATREE has received a grant from the Pacific Institute, USA for conducting a pilot study in the Noyyal-Bhavani river basin in South India. This is a part of a larger initiative by the Pacific Institute and the CEO Water Mandate to advocate for corporate water target setting which includes pilot studies in different river basins.

The objectives of ATREE's study include identifying main water challenges in the Noyyal-Bhavani river basin, describing the baseline and desired end line conditions for a set of water-related metrics and estimating water use by different sectors. The study is based on secondary data analysis, GIS mapping and key informant interviews.

Key Outcomes:
The draft study report was submitted and a stakeholder workshop was held in Tiruppur on March 29, 2019 to suggest recommendations to the textile industry and clothing brand managers.

IMPACT OF CLIMATE CHANGE AND CLIMATE VARIABILITY ON FOOD AND NUTRITIONAL SECURITY OF AGRARIAN HOUSEHOLDS

Household food and nutritional security is the foremost development challenge in India, with more than 15 percent of the population undernourished despite recent improvements in the regional food security. Over the last few decades, increasing urbanisation, uncertain rainfall patterns and increasing temperatures, and intense use of land and water resources have altered cropping patterns, especially of non-staple food grains. Food security, and more specifically nutritional security has severely affected the overall well being of the vulnerable due to changing crop choices and declining agricultural productivity. The threats of climate change and water scarcity further complicate the challenge of achieving food, water and nutritional security.

As part of the ASSAR project, researchers at ATREE looked at climatic and non-climatic drivers of vulnerability in the Moyar-Bhavani sub-region of Tamil Nadu. Here, agriculture plays a pivotal role with more than 40 percent of the population directly dependent on land-based occupations for their livelihood. Although the state reports one of the highest agricultural productivity rates, this performance is not consistent across the state due to varying climatic conditions. In the last few years, this region has received below average rainfall, and has been experiencing frequent drought like conditions. Agriculture in many semi-arid regions of the state is increasingly becoming dependent on irrigation, especially sourced from groundwater – which is drastically depleting. In the lower Bhavani, multiple factors have resulted in shifting cropping patterns, and this has led to a decline in the overall wellbeing including household nutrition, loss in labour productivity, and increased migration. Dietary patterns in the region have also shifted due to various development policies, such as the White Revolution, and a so-called successful Public Distribution System

Key Outcomes:
Significant Change in Dietary Composition: Primary cereals have shifted from millets to rice, and dairy products have been added to the diet. Cropping pattern has a weighted influence on household nutritional status. Farmers have shifted from subsistence farming to high-value commercial farming in the hope of a 'bumper crop'. Given India's focus on nutrition security, it has become imperative to understand the impacts of the agricultural transition on household diets. These insights provide empirical evidence to suggest nutrition is being compromised as a result of commercial farming, though food security itself may have improved at the household level.

Shift from subsistence farming to commercial crops has a significant impact on household nutritional security. *© Shrinivas Badiger*

NEW PROJECTS

STRATEGIC IN-STREAM SYSTEMS: A DECENTRALISED ANTICIPATORY APPROACH TO WASTEWATER CONTAMINATION IN BANGALORE

Bangalore is in the midst of a serious urban water crisis. The surface water flows to the city through a complex system of lakes and open channels (often referred to as the "Tank Cascade System"). Unregulated urban development in the past two decades has resulted in untreated domestic and industrial effluents entering the city's lakes. These untreated effluents hyper-accumulate as they make their way through the interconnected lake system, causing a range of impacts on local ecosystems, livelihoods, and public health.

STRAINS "Strategic In-stream Systems" is a frugal, flexible, small-scale, low-tech, in-stream approach to wastewater contamination in Bangalore. Researchers are deploying a small scale intervention, a "model nallah", approximately 2M wide and 8M long at one lake, Sowl Kere, in Bangalore. Within this space, researchers will run a series of experiments with a variety of materials and treatments. The project, for the first time, pilots a nature-based solution approach in a stream stretch within Bangalore.

The project consists of three stages aimed at:

- Diverting and collecting solid waste
- Slowing and settling sediment and suspended solids
- Lowering BOD and trace metals levels through biofiltration using locally available aggregate materials.

The ultimate aim is to use the insights of the Sowl Kere study to develop a series of larger interventions which can be placed directly within nallahs to prevent the contamination and eutrophication of urban lakes.

The overall goals are to:

- Optimise the design of STRAINS for efficient removal of contaminants.
- Develop an approach to enhance community participation.

Researchers plan to hand over the maintenance of the systems to communities. This will help in promoting

IWRM training participants with the ATREE team during the field trip. *© Manjunath G*

community engagement that will lead to a greater impact. This project is a collaborative partnership between six groups, receiving inputs from Biome Trust, (project management, collaboration, coordination) MAPSAS (community engagement) Eco Paradigm (engineering & construction), Common Studio (design), Wipro (fiscal sponsorship) and ATREE. ATREE's role is water quality monitoring to establish the efficacy of the STRAINS system.

POLICY ENGAGEMENT

ATREE Fellow, Bejoy Thomas is an academic expert member in the Karnataka government committee constituted to prepare an action plan to achieve Sustainable Development Goals – 2 (related to hunger, food security, and agriculture). It is a technical committee tasked with setting targets for several sub-indicators that have been identified under SDG – 2 to be achieved before 2030.

The Karnataka Jnana Aayoga (Karnataka Knowledge Commission) set up a Task Group on Water Policy. ATREE faculty contributed substantially to this report. ATREE's Distinguished Fellow, Sharachchandra Lele served as the Member-Secretary of the Task Group and co-authored the bulk of the final report along with TG Chair, Professor, Mihir Shah. ATREE Fellows, Veena Srinivasan, Shrinivas Badiger and Priyanka Jamwal participated in Sub-groups formed for obtaining wider inputs on hydrology, agriculture and water pollution respectively. The report is expected to be released on May 2019. Sharachchandra Lele is also serving on the Bellandur Lake Monitoring Committee set up by the Government of Karnataka and is also interacting with the Karnataka Tank Conservation & Development Authority to improve the quality of DPRs for lake rejuvenation.

Veena Srinivasan was appointed to the Strategic Advisory Group for SDG6 by UN Water. The Group is tasked

with reviewing and offering advice on the monitoring framework and indicators and data collected on SDG6. She has also served as a resource person on Water Accounting for National Water Mission.

CAPACITY BUILDING

INTEGRATED WATER RESOURCES MANAGEMENT PROGRAMME FOR ENGINEERS NOMINATED BY THE IRRIGATION DEPARTMENT

A management development programme for engineers and managers of the Irrigation Department, Government of Karnataka was held, to enhance the capacities of engineers and managers in water-related departments of the government to understand, analyse and address water resource management in an integrated and holistic manner.

In India, most water resources departments are staffed by engineers, who are usually trained on the technical aspects of water resources management. But there is an increasing realisation that a more integrated approach is needed. India has moved from the era of "Water Resources Development" where the primary objective was to develop water resources to achieve drinking water and livelihoods security to "Water Resources Management"; because today, ground and surface water resources in most basins are fully allocated. Since no new development is possible, we have to manage what is available, improving efficiency and ensuring fair allocation.

Integrated water resources management (IWRM) involves addressing trade-offs between competing uses and users in a coordinated manner. This requires significant capacity building in the relevant government departments in both understanding of core concepts in social and ecological sciences in addition to engineering pertaining to water. There is also a need to develop soft skills to communicate with diverse stakeholders, build new institutions for water management, and develop an understanding of new tools in water resource modelling and remote sensing.

The course spanning 12 days included classroom sessions and one day of field trip. The programme was attended by 19 engineers nominated by the Irrigation Department. The IWRM training programme employed a learning-centered pedagogical approach. Each session was interactive and included exercises (including group discussions, case studies, and games) to help the course participants learn. Training in specific techniques like hydrological monitoring, water quality, remote sensing, and GIS was also imparted. The learning-centered approach formed the core of the pedagogy.

INDO-UK WORKSHOP ON MONITORING AND ANALYSIS STRATEGIES FOR ANTHROPOGENIC POLLUTANTS IN ENVIRONMENTAL AND WASTE WATERS

ATREE under the Researcher Links scheme offered within the Newton Fund, along with British Council and the Royal Society of Chemistry, organized a four day workshop on – 'Monitoring and Analysis Strategies for Anthropogenic Pollutants in Environmental and Waste Waters' between between November 12 – 15, 2018 at Royal Orchid Resort in Bangalore.

The key objective of the workshop was to support both Indian and UK early career researchers (ECRs) in leading the development of monitoring strategies for chemical parameters that could inform and support national regulatory and policy initiatives in India and the UK. The ECRs interacted with a number of international

Water governance session at the workshop.
© Chidanand Aradhya

Prof. Gary Fones at the Inaugural of the Indo-UK workshop. *© Kiran Thomas*

Paolo Bombelli interacting with the participants during the Plant-BES workshop. *© Kiran Thomas*

Participants of Plant-BES workshop. *© Chidanand Aradhya*

experts and worked towards developing a national strategy for monitoring chemical parameters to build a national database of water quality data.

The workshop was coordinated by Dr. Richard Allan from the James Hutton Institute, UK, Dr. Priyanka Jamwal, Fellow, ATREE and Prof. Gary Fones from the University of Portsmouth, UK. 18 participants attended the workshop which included nine ECRs from UK and nine ECRs from India.

PLANT-BES WORKSHOP FOR SCHOOL STUDENTS

ATREE organized a workshop for ninth-eleventh standard school children on November 09, 2018 to introduce them to plant bioelectrochemical systems (Plant-BES). The students explored the possibility of generating electricity using plant biochemical systems and microbial fuel cells. As part of the workshop, they visited the water and soil lab at ATREE.

Plant-BES project is one of the third rounds of Frontiers of Engineering for Development seed funding projects, funded by the Royal Academy of Engineering. It hopes to build a working prototype that uses plants to treat wastewater and generate electricity to power an environmental sensor for water quality monitoring.

This workshop was coordinated by Dr. Priyanka Jamwal, Fellow, ATREE and Paolo Bombelli, Postdoctoral Fellow, University of Cambridge. 15 students from around 11 different schools in Bangalore attended this workshop.

Centre for Environment and Development

Forests and Governance

The Forests and Governance programme contributes to enabling sustainable and equitable forest management in India by understanding the multiple benefits derived from forests and their long-term socio-ecological dynamics. It analyses the performance of community forestry institutions and proposes approaches to multi-layered democratic governance.

Community meeting at Borda, Dist. Amravati. *© Khoj*

The programme addresses key questions of reconciling community rights and livelihood needs with conservation goals in protected areas in southern india. The programme also conducts action-based research on the enterprise -linked conservation of non-timber forest products (NTFP) and provisioning of community forest rights under the Forest Rights Act (2006).

ROLE OF CIVIL SOCIETY ORGANISATIONS IN ENABLING SUSTAINABLE AND EQUITABLE COMMUNITY FOREST RESOURCE (CFR) MANAGEMENT IN MAHARASHTRA (COMPLETED)

This study by Divya Gupta, Sharachchandra Lele and Geetanjoy Sahu (collaborator from TISS, Mumbai) aimed to understand the various roles and strategies of Civil Society Organisations (CSOs) in supporting the communities of eastern Maharashtra in exercising the Community Forest Resource (CFR) rights recognised under Forest Rights Act. It identified the multiple levels at which CSOs contribute, and the structural factors that make such a contribution necessary for communities to exercise their rights to manage their newly claimed forests sustainably, equitably and gainfully.
The results have been submitted to a special issue of Forest Policy & Economics. Another paper focusing on the functioning of Gram Sabha federations has been submitted to the Indian Journal of Social Work.

Key Impact:
This study informed policy makers of the need for continued support to communities and CSOs in implementing CFR management.

MANAGEMENT OF INVASIVE SPECIES (COMPLETED)

The impact of invasive alien species is a real-world issue and has attracted worldwide attention. *Lantana camara L.* is one of the world's worst invasive plant species, posing a serious threat to native biodiversity, wildlife, and ecosystem services.

Hence, the control of Lantana spread has become an important management challenge and a high priority for forest managers and farmers.

ATREE researchers monitored native biodiversity in Lantana uprooted plots in collaboration with the Karnataka Forest Department. 22 plots of 20m x 20m size were established. 10 plots were laid in Lantana uprooted areas by the forest department and 12 were laid within lantana thickets as control plots. These plots were monitored for three years. Seedlings, saplings, and trees were enumerated for recruitment and mortality rates (tagged all individuals permanently for monitoring).

Key Findings:

Lantana uprooted areas support higher number of native herbaceous and woody plant species.

Lantana removal favors the regeneration of native plant species in terms of both density and diversity at seedling and sapling stage. Lantana affects native plant diversity at seedling and sapling stage.Grass cover is relatively higher in Lantana uprooted areas compared to Lantana invaded areas.

Bamboo seems to be one of the potential native plant species showing positive response to vegetation enrichment/restoration in the uprooted area.

MANAGEMENT OF IMPORTANT NON-TIMBER FOREST PRODUCTS (NTFPs) (COMPLETED)

Sustainable management of natural resources is inherently a product of complex interactions between ecological, cultural, economic, and political components. Understanding the ecology of any species hence is critical for conserving and comprehending its sustainability for future use.

Non-Timber Forest Products (NTFP) Monitoring. *© Siddappa Setty*

In the Western Ghats, ATREE has been monitoring fruit production, extraction and regeneration of NTFPs species such as Phyllanthus emblica, Phyllanthus indofischeri, Terminalia chebula and also Rock bee (Apis dorsata) honey, to develop improved and sustainable harvesting protocols for NTFPs.

The research was based on the importance of understanding the impacts of human disturbances and ecological factors on NTFPs species, which are of conservation concern.
Site-based adaptive management and participatory resource monitoring approach as provisioned in the recent Forest Rights Act hold great potential for developing sustainable use and co-management practices in the project sites.

To measure harvesting pressures, three methods were employed: participatory resource monitoring (PRM) approach, scientific biological monitoring and monitoring harvested species at genetic level. PRM and scientific approach were used to document the status of the resource, extraction and impact of harvest on the population.

Project Outcomes:

Improved Harvest Techniques

Based on four years of extensive field survey and monitoring of fruit productivity, extraction and regeneration, researchers developed sustainable harvesting protocols for NTFPs tree species such as P. emblica, P. indofischeri, T. chebula and also rock honey bee (Apis dorsata).

An illustrated manual focused on sustainable harvest practices for NTFPs was produced in the local language (Kannada) for the harvesters.

The NTFP project has three other components: assessment of gum-resin harvest, role of traditional knowledge and monitoring honeybees (Apis dorsata) and impacts on population.

GUM-RESIN HARVEST

ATREE researchers aimed to assess current gum-resin extraction patterns, map the resource, and improve the gum-resin harvest technique. Research from the project indicated that the three most sustainable extraction methods were; hand picking naturally exuded gum-resin (from animal made or wind-mediated injuries), harvesting the soil-mixed gum-resin with an iron rod, rather than digging out from the roots, and hand picking from dead-wood.

Key Findings:

Not all B. serrata trees yield gum-resin, and harvest is subject to availability of gum-resin. The survey conducted with the harvesters highlighted that on an average 24.6 per cent of the trees yielded gum-resin during a single visit to the forest.

Research shows that the increasing demand for gum-resin appears to be placing pressures on local stocks and dynamics of B. serrata in the MM Hills region. However, the cause-effect relationship has not been established since Lantana invasion may also be causing lower densities of B. serrata trees and seedlings.

ROLE OF TRADITIONAL KNOWLEDGE

Researchers documented traditional knowledge of the Soligas, in MM Hills and BRT, to understand their relationship with forest resources and different methods employed for extraction of resources. Along with resource monitoring, changes in landscape were also studied.

Key Findings:

The community uses traditional knowledge for both forest conservation and extraction of forest resources.

Apis dorsata (Rock bee) colonies on Albizia odoratissima in BRT Tiger Reserve.
© Siddappa Setty

The community monitors resources and the landscape in the same manner as their ancestors.

MONITORING HONEYBEES (APIS DORSATA) AND IMPACTS ON POPULATION

Honeybees play an important role in the ecology of tropical forests, besides supporting the livelihood of people/ indigenous communities. Apis dorsata contributes to more than 80 per cent of the total honey production in India. The indigenous Soliga community that resides in the research site harvests around 15 to 18 tons of honey per annum.

To estimate the number of bee colonies, 17 one km transects were laid along streams in different habitat types and thirteen rock cliffs were also monitored. Bee colonies were counted before harvest to understand the level of extraction and after harvest to understand the level of extraction.

Key Findings:

The density of bee colonies in the forest landscape coincides with the flowering season. After the flowering season, honeybees migrate to agricultural plains, where crops are flowering.

Bee colony distribution showed distinct spatial variability with respect to habitat types. The highest density of bee colonies was recorded in evergreen forests, followed by dry deciduous forests and scrub forest.

The level of extraction was high in scrub, then dry deciduous forest, followed by the evergreen forest. It was least in cliffs and depended on accessibility.

Results showed gradual decrease in bee colony numbers across years.

COMMUNITY INITIATIVES UNDER FORESTS AND GOVERNANCE PROGRAMME

One of the major initiatives of the Forests & Governance programme is community engagement. Through consistent engagement with Soligas, ATREE has aided in the implementation of the Forest Rights Act, led community conservation initiatives and ensured their rights over NTFPs.

ATREE researchers have facilitated activities through the community institutions like District and Taluka Soliga Abirudhi Sangha which have been instrumental in driving sustainable livelihood initiatives.

The main community led initiatives supported by ATREE include: Access to Community Forests Rights under FRA, Sustainable Coffee Cultivation in BR Hills and Value addition to NTFP products.

COMMUNITY RIGHTS UNDER FOREST RIGHTS ACT (FRA)

ATREE along with NGOs like Vivekananda Girijana Kalyana Kendra offers active support to community institutions like Soliga Abirudhi Sangha and raises awareness about the provisions of Forest Rights Act. It is due to this support that 64 Gram Sabhas (76 villages) of BRT, MM Hills, and Cauvery Wildlife Sanctuary successfully received Community Forest Rights (CFR). ATREE's continued presence in this region has helped safeguard traditional livelihoods of the Soligas.

Distribution of individual and community rights under Forest Rights Act at Hanur, Chamarajanagara district. *© Jade Swamy*

COFFEE AND COLLABORATIVE WORK

Together with Karnataka Coffee Board and Black Baza Coffee Company Ltd, ATREE facilitated the cultivation of coffee by Shri Biligiri Rangaswamy Coffee Belegarara


Adavi
COFFEE

Sangha (Soliga coffee farmers association) under the brand name ADAVI. This initiative benefitted 221 families and led to a rise in their incomes by 11.11 per cent. ATREE has been working closely with the indigenous communities to ensure coffee cultivation happens in a forest-friendly way by keeping overall biodiversity, pollinator service and soil health of the ecosystem in mind.

VALUE ADDITION TO NON-TIMBER FOREST PRODUCTS

This initiative began as a project with the aim of creating decentralised Non-timber forest products (NTFPs) processing under an enterprise based conservation model. Three decentralised Non-timber forest products (NTFPs) processing units were established in BRT and MM Hills with the participation of the indigenous Soliga community. 12 diverse NTFP products are being sold under the ADAVI brand, registered with Karnataka State Organic Certification Agency. Even after completion, ATREE researchers continue to support and encourage the community and their institutions to sustain the NTFP units created under the aegis of USAID project.

Key Findings

Honey, worth Rs. one million was purchased by Value Addition Units (VAUs) and sold by the VAUs for about Rs. 2.5 million (77% profit generated).

51 families at Yerakanagadde VAU and 32 Families at Kanneri Colony VAU benefitted and saw a rise in their income by 42.85 per cent from honey collection and sale. The three decentralised community enterprises made a cumulative profit of Rs. 10 lakh from the sale of diverse NTFP products.

A NTFP sales outlet was opened at Mysore Zoo in collaboration with Karnataka Forest Department, LAMPS and Zoo Authority of Karnataka.

Facing Page: Priyanak M. Kharge, Social Welfare Minister, Government of Karnataka and MLA's from Chamarajanagara district at the launch of ADAVI brand coffee. *© Jade Swamy*

Centre for Environment and Development

Climate Change Mitigation and Development

The CCMD programme aims to explore the social, environmental and equity implications of sustainable, low carbon development pathways and propose actionable policy solutions

The programme's faculty members are engaged in several research projects and collaborations on environmental impacts of coal power plants, integration of renewables in the electricity grid, residential electricity demand growth, decentralised renewable energy generation, biodiversity impacts of renewable energy projects and conspicuous consumption behaviour.

POLICY DRIVERS OF RENEWABLE ENERGY EXPANSION IN INDIA (ONGOING)

This study, by Shikha Lakhanpal, in collaboration with Ashwini Chhatre, Indian School of Business, investigates the rapid increase in wind power investments in select Indian states in the period 2001–2010 and shows that it is a function of the interaction between the international Clean Development Mechanism and two domestic policy instruments. The findings highlight how multi-scalar policy pathways enable renewable energy outcomes.

Key Findings:

There is a lot of variation in India's wind energy installed capacity that does not correspond to the natural resource endowment.

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India's wind energy installed capacity outcomes cannot be solely explained on the basis of domestic policy instruments

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It is the interaction between the international Clean Development Mechanism and domestic policy instruments that has shaped India's wind energy installation.

Policy drivers of renewable energy expansion in India.

BIODIVERSITY IMPACTS OF LARGE SCALE SOLAR AND WIND ENERGY PROJECTS (ONGOING)

This is a collaborative research project between the Climate Change Mitigation and Development Programme (Shikha Lakhanpal) as well as fellows from the Center for Biodiversity and Conservation (Abi T. Vanak and T. Ganesh). This project examines the trade-offs between biodiversity and large scale solar and wind energy projects located in the states of Karnataka, Madhya Pradesh, Andhra Pradesh and Maharashtra. The project will analyse the impacts of these large-scale renewable energy projects on migratory species such as the Great Indian Bustard, Lesser Florican and the Harrier.

Key Findings:

Between 30-35% of Renewable Energy projects are within 5km of areas of biodiversity concern.

There is need for better categorisation and landscape prioritisation for situating Renewable Energy projects.

WATER-ENERGY-FOOD NEXUS IN THE INDIAN HIMALAYAS (ONGOING)

This project by Shikha Lakhanpal, in collaboration with Ashwini Chhatre, Indian School of Business, critically examines the water-energy-food nexus in the Himalayan region by exploring the dynamic relationships between

Conflict between renewable energy and biodiversity protection.

water resources, renewable energy development and food systems. Specifically, it analyses how local institutions serve as the bedrock upon which conflicts related to water resources, energy and agricultural needs are reconciled and contributes to global debates on the water-energy-food nexus in mountain river basins.

Key Findings:
Local institutions that have accountability and exhibit state-like effects are better able to negotiate community rights for critical resources.

DRIVERS OF CONSUMPTION DECISIONS (ONGOING)
Income growth and rising consumption have led to significant environment impacts. Soumyajit Bhar in his PhD thesis identifies economic and socio-cultural correlations of conspicuous consumption behaviour in the high income deciles of India. Using a mixed-methods approach involving detailed interviews of high-income households, he finds that while exposure to mass media and social networking drive increase in consumption, education mitigates some of these increases.

Key Findings:
The aspiration of 'good life' drives big tickets consumption choices or practices like owning an SUV or opting foreign vacations.

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Education is the most important factor ameliorating consumption choices of high income households.

ENGAGING WITH THE ENVIRONMENTAL REGULATION PROCESS (ONGOING)
Sharachchandra Lele, as member of Expert Appraisal Committee (Thermal Power Projects & Coal Mining), Ministry of Environment, Forests & Climate Change continues to engage with complex issues of environmental regulations, impact assessments and clearances for power plants and mines. This engagement has improved the rigour of these processes by incorporating research and evidence based policy-making.

SOCIAL COST OF ELECTRICITY GENERATION AND THE POLLUTION IMPACT OF COAL (COMPLETED)
Shoibal Chakravarty and E. Somanathan, Indian Statistical Institute, analysed the true social cost of electricity from coal and renewable power. The study also projects the cost of coal and renewables with storage in the next decade.

Key Findings:
The environmental and health cost of coal makes it more expensive than any other renewable source of power in India.

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Renewables with storage will be cost-competitive with the cheapest new coal power plants by the middle of the next decade.

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The findings of the study have been presented to the Ministry of Environment, Forests and Climate Change.

MODELING THE ELECTRICITY SYSTEM AND RESIDENTIAL DEMAND (ONGOING)
The Indian electricity system is going through a rapid transition with the rapidly increasing share of renewable sources like wind and solar as well as an equally rapid growth in residential electricity demand with increasing incomes and progress towards universal electrification. Shoibal Chakravarty, and PhD scholars CS Vijay and C Sashikiran in the National Institute of Advanced Study, are using high resolution electricity generation, weather data, Indian Human Development Survey data, and primary surveys of residential electricity demand to analyse and model this transition.

Centre for Biodiversity and Conservation

Biodiversity Monitoring and Conservation Planning

The Biodiversity Monitoring and Conservation Planning Programme generates knowledge through applied research and outreach activities by using integrative taxonomy and by monitoring biodiversity and ecosystem changes at various levels—Genes to Ecosystems. The programme aims to improve management of biodiversity and ecosystems through a variety of outputs that could potentially influence existing policies and conservation planning.

Research staff quantify the biodiversity and biological resources in the forests of Northeast, India. *© R Ganesan*

BIO-RESOURCES AND SUSTAINABLE LIVELIHOODS IN NORTHEAST INDIA (ONGOING)

This Project funded by Department of Biotechnology, Government of India, is co-ordinated by ATREE and aims to generate an extensive inventory of flowering plants, non-flowering plants and a few understudied animal groups along with their associated bio-resources across Northeast, India.

The other broad objectives of the project include: performing taxonomic studies related to diversity and phylogenetics of selected plant groups of high economic and cultural importance, exploring ecotourism and product-development potential of selected bio-resources, and improving scientific and technical capacity in the Northeast.

The project will also analyse data on biological resource harvest from the forest which will be used to identify high value biological resource and promote sustainable harvest and management.

To document biodiversity, ten research teams spread across ten universities and research institutions in the Northeast are sampling 4777 grids for flowering plant

Part of the research team in a methodology workshop on documenting and quantifying biodiversity in Northeast India. *© Ravikanth G*

richness and diversity. Nine other teams are sampling one-fourth of those grids (~1200) each for the non-flowering plant groups, edible insects and selected animal groups. Abundance and distribution data of plants from grids will help generate species and biological resource distribution maps. From spatial and quantitative data of species, unique habitats and ecosystems will be identified for conservation in the Northeast.

The project has six components and 27 research and monitoring teams spread across 13 institutions. ATREE apart from leading the co-ordination of research teams across institutions is also developing eco-informatics and spatial analytical tools to enable visualisation and dissemination of the data to society and policy makers.

Project Updates:

62 plant grids and 217 animal grids have been sampled as of February 2019 for the quantitative inventory through line transects.

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High diversity of bio-resources were recorded from the markets surveyed across Sikkim (72 species from four markets and 94 vendors).

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Preliminary analysis of the market data from Sikkim showed high volume of bio-resources being sold through formal markets.

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Cataloguing insect diversity:

One of the main components of the project is 'Quantitative assessment and mapping of Dung Beetles (Scarabaeinae: Coleoptera) and Ants (Formicidae: Hymenoptera) from Northeast India'. 417 species of ants and 195 species of dung beetles have been catalogued from Northeast India. An extensive standardised field sampling is being conducted across all Northeast states.

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Cataloguing land and freshwater snails:

Nearly 100 species of land and fresh water molluscs have been collected from the Northeast.

A new species of freshwater snail belonging to the genus *pila* has been discovered from Mizoram.

Ten species of freshwater molluscs belonging to seven genera and five families have been identified as being used for food and medicine by indigenous communities. As far as cataloguing of fresh water snails is concerned, preliminary analysis of data from markets from Sikkim showed high volume of bio-resources being sold through formal markets.

Database of plants and animals:

Around 5000 plant species (Sikkim and Mizoram) are now part of the database of existing resources in the form of floras and herbarium collections. The plant database has taxonomically curated names of flowering plants, details about phenology, altitude and location. As part of the database, researchers also sourced plant photographs with taxonomic identity, and obtained multiple pictures of a species to prepare a "species page" to be hosted on the web.

Boosting scientific capacity:

ATREE and Institute of Bioresources and Sustainable Development (IBSD) team has also been building capacity in biodiversity science for research groups engaged in the project.

Workshops and meetings were conducted as part of the project. It included an inception meeting, three technical and scientific-based meetings, three nature-tourism based vocational training workshops and one outreach workshop on conservation of insect diversity in the Northeast. These meetings and workshops facilitated capacity building of more than 200 participants from over 20 institutions across the Northeast and other regions of the country.

ATREE also collaborated with Green Hub, which is the first youth and community fellowship and video documentation centre for recording environment, wildlife & peoples' biodiversity in Northeast. This collaboration helped ATREE generate short outreach material in audio-visual format for wider dissemination of project findings.

Wild ginger, turmeric and caterpillars being sold at a weekly market in Guwahati city. *© R Ganesan*

SYSTEMATIC INVENTORY AND DOCUMENTATION OF ASSOCIATED COMMUNITY KNOWLEDGE OF EDIBLE INSECTS IN NORTHEAST INDIA (ONGOING)

Insects are an important natural and sustainable source of food for many vertebrates, including human beings. They are an excellent source of protein and integral to the diet of several communities around the world. The global increase in the demand for meat and limited availability of land has led to the search for alternative protein sources.

Edible insects, as an alternative protein source for human food and animal feed are interesting in terms of low greenhouse gas emissions, high feed conversion efficiency, low land use, and their ability to transform low value organic side streams into high value protein products. In India, for many indigenous communities living in remote areas, insects are a routine source of protein and luxury food. As per traditional ethnological knowledge, many insects are consumed as dietary supplements and may have therapeutic value.

The Northeast is one such region where entomophagy (eating insects as food) is prevalent among the indigenous communities. Traditional knowledge on effective utilization of edible insects and other edible invertebrates are acquired through experience and usually passed on through oral traditions across generations.

Among the approximate 2000 species of edible insects recorded from over 300 ethnic groups around the world, it is estimated that over 200 species of insects and other invertebrates are consumed in the Northeast. Documentation of edible insects, utilisation for wider acceptance and value addition remain scientifically neglected areas of research. This project aims to build a systematic inventory of edible insects and document community knowledge associated with insect bio-resources of the Northeast. Institute of Bioresources and Sustainable Development (IBSD) at Imphal and Central Agricultural University Imphal are partners in this project.

Project Updates:

224 species of insects belonging to 11 orders consumed by the local communities in Northeast, India have been catalogued.

Field sampling of edible insects and ethnographic surveys from households and markets are being conducted in Arunachal Pradesh, Nagaland, Manipur, Mizoram.

Luxury food: As opposed to the common belief that insects are poor man's replacement for protein source, some sell for quite a high price in the market.

Cultural values and social stature: Apart from food and medicine, insects have cultural significance in many communities. Some communities associate entomophagy with higher social stature.

Many insects, though routinely consumed by people are now identified as new species.

Hornets nest being sold in Mao Market (Kohima) *© Priyadarsanan*

Looking for wood grubs in the forest. *© Barkha Subha*

Eri silk larvae for sale. *© Aavika Dhanda*

Wood grubs for sale in the local market. *© Alezone*

Conducting household surveys for edible insects. *© Smitha Krishnan*

An edible Cicada specimen prepared for the museum. *© Swapnil*

Stink bug specimen prepared for the museum.
© Nikhil

Insects have cultural significance in many tribes. A Bullet jewel beetle necklace worn by an Angami man during a festival. *© Aavika Dhanda*

Microhyla kodial– narrow mouthed frog. *© Vineeth Kumar*

DISCOVERY OF NEW SPECIES OF FROG OF THE GENUS MICROHYLA (NARROW MOUTHED FROG)

Researchers from ATREE and Mangalore University described a new species of frog belonging to the genus *Microhyla* (Narrow Mouthed Frog) in Mangalore. The new species is called as *Microhyla kodial*. *Kodial* is an alternative name for Mangalore in the Konkani language. The molecular analysis showed that this new species is closely related to *Microhyla* from Southeast Asia. It is believed that few individuals were accidentally introduced through the timber trade in the New Mangalore Port Trust. The new species has established good breeding populations around Mangalore and thrives well even in highly disturbed areas.

Centre for Biodiversity and Conservation

Landscapes, Livelihoods and Conservation

The work of the Landscapes, Livelihoods and Conservation programme is focused on examining ecosystem processes across different types of landscape (ranging from arid and semi-arid grasslands to savannah and moist forests). The programme is also involved in studying the different natural and social drivers that feed into and affect these processes.

MONKEY FEVER RISK (ONGOING)

The project on Monkey Fever (Kyasanur Forest Disease) is a multi-disciplinary project led by the researchers at the Centre for Ecology and Hydrology involving several institutes (ATREE leads the ecological and social components) with expertise in different fields. The project aims to understand the prevalence and spread of the disease from a scientific, socio-economic and healthcare perspective. The field team consisting of researchers with expertise in different fields have been working together to collect and analyse data from the field. The project will also produce a decision support tool that can be used by the local authorities and the health care system to predict and mitigate outbreak instances in the future.

Above: The Indian Fox is an endemic grassland specialist species. Researchers are using GPS telemetry to understand their fine-scale movement patterns in a rapidly shrinking grassland habitat. *© Abhijeet*

Left: Dr. Abi T. Vanak conducting morphometry of a Golden Jackal, during the process of deploying a GPS-collar. *© Indian Mesocarnivore Project*

Facing Page: Rodents are an important vector for ticks and tick borne viruses. Researchers sampled rodents from a variety of habitats to determine tick and viral loads. *© Sarah Burthe*

Project Outcomes:

The field team has completed a full field season starting from November 2018 to March 2019.

More than 16000 samples have been collected so far from the two field sites (Shimoga and Wayanad).

Samples and data are being analysed at respective institutions.

Stakeholder workshop conducted in August 2018 will conclude in a knowledge integration workshop in September 2019.

Draft spatial model of KFD risk mapping has been submitted as a manuscript.

COEXISTENCE OF MESOCARNIVORES IN HUMAN-DOMINATED LANDSCAPES

This project in collaboration with the Centre for Ecological Sciences, Indian Institute of Science, Bangalore, aims to identify patterns of resource use and movement of mesocarnivore species across a landscape mosaic using a combination of very high-resolution Earth observation data and advanced GPS telemetry. The project aims to determine the ecological parameters and behavioural strategies that enable the occurrence of the Golden Jackal, Indian Fox and Jungle Cat in human-dominated systems. The study also aims to understand the thresholds in heterogeneity beyond which survival of the respective species is jeopardized. The data generated by the project allows researchers to model the fine-scaled movement strategies of mesocarnivores in modified landscapes, and determine the thresholds of tolerance to landscape. A key outcome of this project will be to determine the minimum patch size of native as well as specific types of human-modified habitats for each of these species.

Project Outcomes:

Data from the various GPS collared animals (Fox, Jackal, Jungle Cat and free-ranging domestic Dogs) is now greater than 400,000 locations making it one of the largest telemetry datasets in India.

A compositional analysis of the telemetry data shows that Indian Foxes showed a high degree of habitat specialisation, heavily dependent on native grasslands for both resting and activity periods.

Golden Jackals also show a high degree of habitat fidelity, but to heavily modified agricultural areas such as sugarcane plantations and fallow lands.

The most adaptable of all the species seems to be the Jungle Cat, which was found utilizing almost all available habitat types.

Dogs are the main reservoir for rabies. Research team is sampling dogs in villages for rabies exposure and fitting them with GPS collars to track their movement patterns. *© Indian Mesocarnivore Project*

ONEHEALTH TO RABIES RESEARCH IN INDIA (ONGOING)

This Wellcome Trust/DBT India Alliance-funded project combines animal ecology, disease ecology and human health in a 'OneHealth' framework to understand rabies dynamics in India. With study sites spread across Karnataka, Maharashtra and Haryana, this project also aims to understand how rabies spills over or back from Dogs to wild carnivores.

Project Outcomes:

As many as 750 Dogs across the urban-rural gradient in Bangalore have been sampled. A total of 122 Dogs have also been collared in Bangalore.

Large-scale quantification of Dog population densities across all the study sites has been conducted.

GPS collaring of 38 Dogs was done in villages around Baramati, including two Dogs in the Solapur city in Maharashtra, where an ongoing project also monitors the movement of mesocarnivores to understand home range overlaps and potential contact rates.

Rabies neutralising antibody titres were estimated for 434 Dogs (162 from Baramati and 272 from Bangalore), 22 Fox, 08 Jackal and 09 Jungle Cat samples to determine the immunity levels against rabies for each species.

Working with ResQ Charitable Trust, Pune, tested over 569 Dogs for rabies, of which 320 were confirmed positive. This indicates an ongoing epidemic of rabies in Pune city, which requires urgent action by civic and health authorities. Vaccine efficacy test for 34 Dogs (that were previously vaccinated by ResQ) was also conducted.

POLICY DRIVERS OF ZOONOTIC DISEASE VULNERABILITY AND INTERVENTION IN INDIA (ONGOING)

The study, an Indo-UK collaborative project funded by the Sunrise foundation, explored the policy landscape of India in the context of its health system with specific focus on zoonotic diseases. Through a desk based review and key informant interviews, the aim was to identify how policy for zoonotic diseases are organised across sectors and scales, and the extent to which policies enhance (or limit) inter-sectoral collaboration in disease surveillance and control.

Policy Outcomes:

The study discovered that despite considerable efforts towards advancing OneHealth, conflicting policy priorities, 'vested' institutional interests, limited human resource and logistical capacities hampered effective inter-sectoral coordination on disease prevention and control.

Inform policy to better manage zoonotic diseases in India and align our health goals with international targets of disease control. The results aided in understanding how best to operationalise One Health policy and improve disease surveillance and intervention through better inter-sectoral capacity.

Highlighted policies which increase vulnerability to zoonotic diseases in India.

TRACKING THE ECOLOGICAL AND CULTURAL IMPACTS OF BIOLOGICAL INVASIONS IN A BIODIVERSITY HOTSPOT (ONGOING)

This project funded by the National Geographic Society is a collaboration between Krea University and ATREE. It builds on long-term information about the distribution of an introduced invasive species, *Lantana camara*, in the Biligiri Rangaswamy Temple Tiger Reserve (BRT), in South India. ATREE has, in the past, surveyed Lantana distributions across the entire landscape of BRT, once in 1997, and again in 2008. ATREE's 2018 survey constitutes perhaps the only 20-year record of an invasive species in an Indian protected area. This provides a unique opportunity to understand long-term impacts of an invasive species on native biological diversity in this biodiversity hotspot.

The BRT landscape is also home to an indigenous tribe, the Soliga. The Soligas have lived in BRT for several centuries and have close cultural links to the landscape. This project allows us to document the impacts of Lantana on peoples' continued cultural use of the landscape, and allows us to ask whether Lantana is affecting their ecological knowledge, thereby assessing the significance of biological invasion for cultural conservation.

Dense Lantana in the forest understory in BRT. *© Aravind Pelassery*

Project Outcomes:

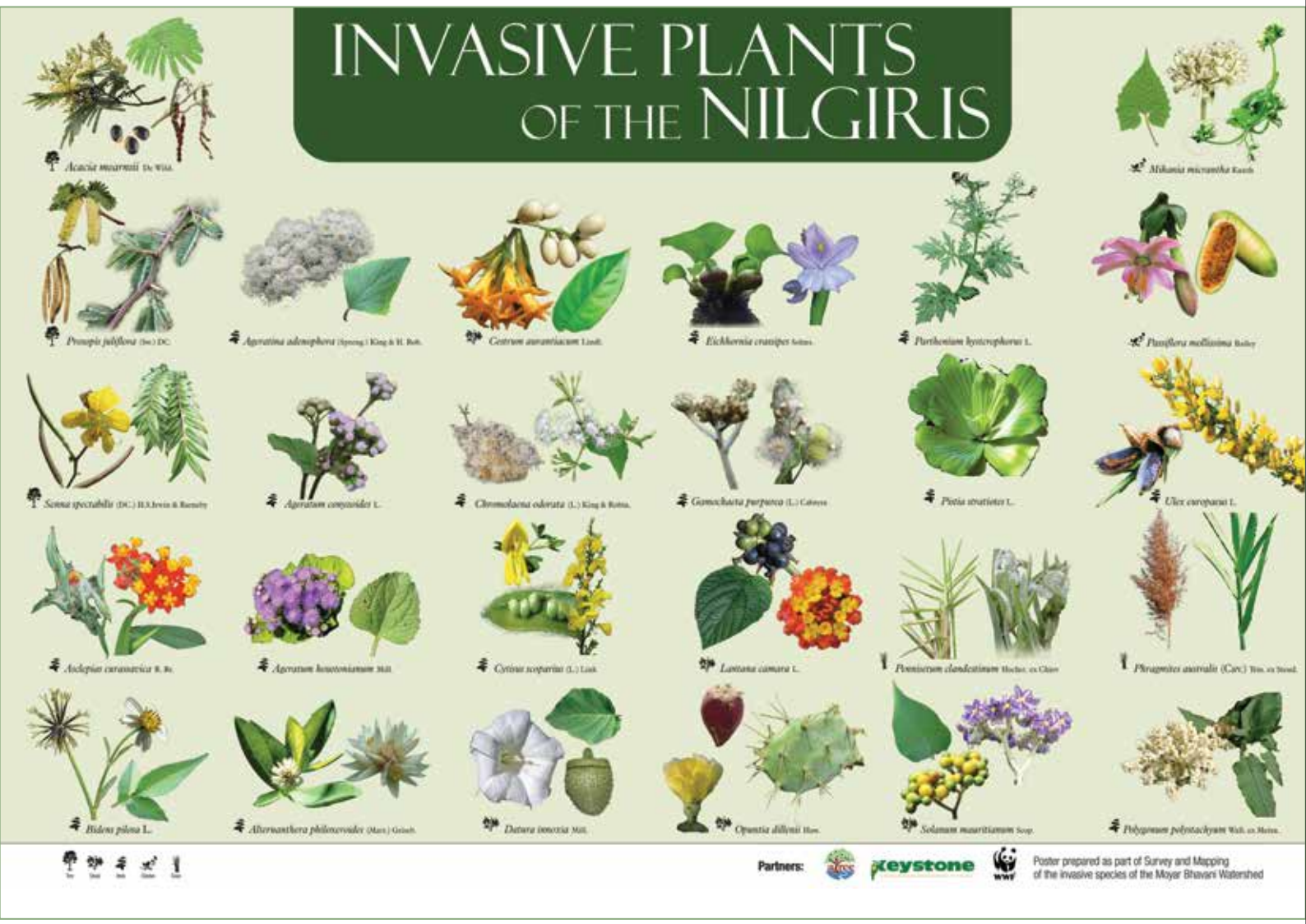
In 1997, Lantana accounted for one in every 20 stems in plots surveyed across BRT (the remainder being native trees and shrubs). By 2008 Lantana constituted one in every three stems.

The 2018 survey indicates that Lantana now accounts for one in every two stems—i.e. half of all stems recorded in the BRT landscape.

WORKING WITH CITIZEN SCIENTISTS AND SMARTPHONES TO MAP INVASIVE SPECIES DISTRIBUTIONS (ONGOING)

ATREE, Keystone Foundation, and WWF Coimbatore worked together to create a pilot participatory atlas of invasive species in the Nilgiris. Such an atlas could be of great value, to managers and researchers alike. Information on invasive species distributions can enable managers to prioritise species and habitats in need of critical management; it can also help researchers understand what makes certain species more invasive, or certain habitats more vulnerable to invasion, and potentially enable them to predict future distributions of invasive species. This effort is a collaboration between citizen scientists and researchers.

Researchers made use of the Open Data Kit Collect application (ODK Collect), which enables researchers, practitioners, Forest Department staff, school and college students, and citizen volunteers to identify

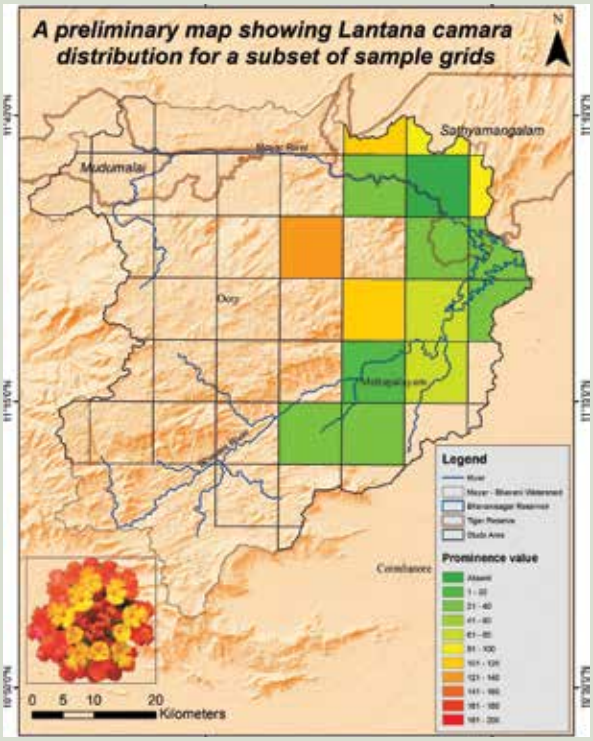


and map invasive species using Android-based smartphones and tablets. By using the camera and GPS that smartphones come equipped with, users can provide spatially explicit, verifiable information on the location of these invasive alien plants in the landscape. The focus of the pilot effort was the Moyar-Bhavani watershed, an area of about 4100 km^2. If the methodology tested in the pilot is successful, it could serve as a model to create invasive species atlases for other large landscapes across the country.

This pilot effort was funded by the UK Government's Department for International Development (DFID) and Canada's International Development Research Centre (IDRC) through the CARIAA initiative, and by the Royal Norwegian Embassy.

Project Outcome:
Of a total of 89 invasive species identified in the landscape, researchers are working with a shortlist of 27. These have been selected based on their potential impacts on ecosystems and livelihoods across the Moyar-Bhavani landscape.

Policy Outreach:
ATREE is currently producing a brief brochure that details the methodology and includes preliminary maps from our pilot effort to map invasive species in the Moyar-Bhavani.



THE BANNI GRASSLANDS IN A TIME OF CHANGE (ONGOING)

The Banni, in Kutch, an area of over 2500 km, was once the largest subtropical grassland in the Indian subcontinent, and was historically home to communities of traditional pastoralists with their unique livestock breeds. The Banni lies adjacent to a large salt-pan, the Rann of Kutch. In the 1960s, a South American tree, *Prosopis juliflora,* was introduced to the Banni, ostensibly to check ingress of the salt desert. Banni has been significantly transformed in the past few decades by this introduced tree that has invaded more than half the Banni, forming extensive Prosopis woodland. To some this exemplifies successful 'wasteland reclamation.' But Prosopis has replaced native trees and grassland, altered habitats for birds and animals, and reduced grazing areas for livestock. Prosopis has also spawned a parallel charcoal economy, profoundly affecting livelihoods and cultures of Banni's resident communities.

Through this project, researchers aim to develop a predictive understanding of Prosopis spread and to evaluate its ecological and socio-economic impacts. They seek to understand whether it is possible to remove Prosopis and restore Banni's grasslands, or the alternative—whether Prosopis has become so integrated in local cultures and economies, that Banni has become a novel social-ecological system.

This project is funded by the Partnership for Enhanced Engagement in Research [PEER] Programme of USAID and the US National Academy of Sciences.

Key Findings:

More than 50% of Banni has now been taken over by the introduced invasive tree, Prosopis, since its introduction in the 1960s. The spread of Prosopis has had consequences for people, livestock, and wildlife.

The success of Prosopis in this arid landscape may be attributed to its deep root system, enabling it to find water sources that are inaccessible to native trees, and its apparent tolerance of salinity. High rates of ground water uptake by Prosopis may hasten salt-water intrusion, causing increasing salinisation of the landscape.

There has been a shift in livestock composition over time, from herds dominated by Kankrej cows with a few buffaloes, to herds dominated by Banni buffaloes, and a few Kankrej cows. This may, in part, be due to a reduced demand for draught animals (Kankrej bulls were highly prized at one time), but is also attributed to the Kankrej's inability to tolerate Prosopis pods.

Charcoal from Prosopis has become a significant source of income in the Banni, paralleling the income from milk. As exemplified in this year's ongoing drought, it is an especially critical source of income for the most vulnerable communities in Banni. Paradoxically, income from charcoal has also enabled pastoralists to increase herd sizes, and hence, income from milk.

Charcoal making from the invasive *Prosopis juliflora* is now an important economic activity in the Banni, and provides a reliable source of income in this drought affected landscape. *© Abi T. Vanak*

The Banni grassland has been transformed into a woodland by the invasion of *Prosopis juliflora*, a highly invasive alien species that was introduced in the 1960s. *© Abi T. Vanak*

Indirect provisioning of a Bonnet Macaque. *© Ninaad Kulshreshtha*

THE DRIVERS OF HUMAN-PRIMATE COMMENSALISM (ONGOING)

Historically, humans and non-human primates (primates henceforth) have co-existed across various cultures and contexts. Commensal primate populations are those which take advantage of human food, waste or crops to supplement their diet or as their main food source. Certain species of Macaques, Baboons, and Vervet Monkeys share spaces and resources with humans across their ranges and are generally categorised as commensal species. But why, in the first place, do these species move towards human habitations? After all, this is a risky behaviour as confronting humans may cause harassment, injuries, or even death. Secondly, not all populations of these species move towards human-dominated landscapes. So, what determines whether certain populations would become commensal whereas others of the same species will not?

This project addresses these questions by assessing the social, behavioural and ecological factors which drive the movement of Rhesus Macaques (*Macaca mulatta*), a primate species commonly found in northern India, towards human habitations. It is funded by the Department of Science and Technology, Government of India (DST-INSPIRE Faculty Scheme).

Preliminary Analysis:

Observations made on three groups of Rhesus Macaques which are dependent on anthropogenic resources to varying degrees.

Data collected on the following parameters:

Ecological correlates: Climate (rainfall and temperature), resource availability (natural, provisioned food, crops), and landscape related factors (distance from nearest village/ farm/water body; availability of sleeping sites)
Social correlates: Group size and composition, encounter rates with groups of same species or other primate species.
Behavioural correlates: Preference of species for certain food items.

Preliminary analyses show that preference for certain food items and group composition are the principal drivers of the amount of time Macaques spend in anthropogenic habitats. The fieldwork will continue at Buxa till December 2019.

PRIMATE TOURISM AREAS AND OTHERWISE (ONGOING)

Across many sites in Asia and Africa, primates are a major attraction for tourists. Primate tourism usually involves seeing and interacting with Macaques in free-ranging or semi-free ranging habitats. In countries such

Indirect provisioning by Rhesus Macaque. *© Suresh Roy*

as Indonesia or Japan, primates are often constrained within 'monkey forests' or 'monkey parks' by the strategic positioning of 'feeding stations'. Tourists frequent these places with the chief objective of watching or interacting with primates. However, outside the realm of designated Macaque tourism zones also, tourists may encounter Macaques. In India, while there are no designated Macaque tourism zones, tourists frequently come across and interact with the commonly found Macaques at many sites. In this project, researchers aim to understand if the attitudes of tourists with respect to interacting with primates varies between designated primate tourism areas and otherwise.

This project intends to do a cross-species study to this end and the study species would include Japanese macaques (*M. fuscata*), Rhesus Macaques (*M. mulatta*), Bonnet Macaques (*M. radiata*) and Long-tailed Macaques (*M. fascicularis*).

The project is funded by the (DST-INSPIRE Faculty Scheme), Primate Research Institute, Japan, and Bogor Agricultural University, Indonesia. This project is in collaboration with Prof. Sindhu Radhakrishna, National Institute of Advanced Studies, India; Prof. Yamato Tsuji, Primate Research Institute, Japan, and Dr. Kanthi Arum Widayati, Bogor Agricultural University, Indonesia.

Project Outcomes:

Data collection completed at Shiga Heights, Japan (interactions between humans and Japanese Macaques) and at Telaga Warna, Indonesia (human-long-tailed Macaque interactions).

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A manuscript based on interactions between humans and Rhesus and Bonnet Macaques is presently under review.

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Different parts of this work have also been presented as invited symposia talks at the 27th International Primatological Society Congress held in Nairobi, Kenya in 2018.

Banding of Montagu Harriers using a unique letter and number code aids in re-sighting them. *© Dr. Nagesh Rao*

MIGRATING GRASSLAND RAPTORS: KEY REGIONS OF CONSERVATION (ONGOING)

Harriers are migratory raptors that roost on the ground in large numbers in tall grasslands. However, with the disappearance of grasslands in the country, the roosts and foraging areas of many of these birds are affected. This project, funded by the Department of Science and Technology, Government of India, shows how these birds use dynamic grasslands and scrub habitats in a human dominated agriculture-grassland matrix, and has a bearing on where to focus conservation efforts. The earlier part of the project revealed a significant decline in the population of Harriers in India. Continued systematic monitoring of the populations across six states over four years from Rajasthan to Tamil Nadu indicated disproportionate use of habitats across the migratory seasons. Researchers also initiated a project on banding harriers using a unique letter and number code for India. This has been done in a couple of places and the idea is to involve photographers in re-sighting them.

Project Outcomes:

Southern Tamil Nadu once known for its dry grasslands harbouring large mammals and birds continues to be an important wintering area for the Harriers.

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The grasslands are converted to real estate, used for renewable energy installations and drip based agriculture.

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Lack of foraging area and sub-optimal roost sites prone to disturbance are major threat to Harriers and other grassland birds in southern Tamil Nadu.

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While the birds coming into western India seem to be fairly stable over the years, their dispersion across the Indian subcontinent is highly variable.

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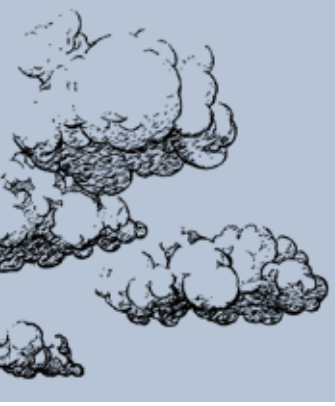
The primary factors that appear to drive the movement of Harriers are rainfall at a regional scale and availability of roosting habitats at a local scale.



Centre for Biodiversity and Conservation

Ecosystem Services and Human Wellbeing

The programme focuses on understanding and communicating to diverse audiences the ecosystem services of semi-natural and managed ecosystems, especially, regulated rivers, wetlands, and urban ecosystems across India that are being managed for multiple uses. It also draws attention to how climate and other global changes in semi-arid ecosystems are impacting ecosystem services.

CHANSE: COUPLED HUMAN AND NATURAL SYSTEMS ENVIRONMENT FOR WATER MANAGEMENT UNDER UNCERTAINTY IN THE INDO-GANGETIC PLAIN (ONGOING)

Rivers all over India are under pressure due to increasing water demand from agriculture, cities and industry. Climate change is expected to add to these stresses in complex ways. Until recently, water resources were managed without any explicit allocation for nature's needs, i.e. ecological flows in rivers for the survival of biodiversity, which in turn is linked to riverine ecosystem services such as fisheries. The field of 'ecological flows' is just emerging in India and there is an urgent need for well-defined measurable indicators that relate overall water management in regulated river basins to specific outcomes in terms of aquatic biodiversity and fisheries.

CHANSE is an Indo-UK collaborative project funded by the Ministry of Earth Sciences, Government of India, and the Natural Environment Research Council, UK. A key objective of the project is to link the management of the Gandak barrage (on the Gandak River, Bihar), use of surface water (river and canal water), and groundwater use by farmers for irrigation, to the quality of habitat for endangered Gharial crocodiles, River dolphins and fisheries. A first of its kind project in India, it combines

Above: Acoustic sensor installation to monitor Gandak canal level 2.
© Girish Verma

Left: Acoustic sensor installation to monitor Gandak canal level 1
© Girish Verma

rigorous hydrologic measurements and modelling with field ecological observations and measurements. The project seeks to inform policy for the management of similar barrages across the Ganga basin. The main objective of researchers is to assess the interactions between the availability of ecological flows and water demand by multiple stakeholders. Collaborating institutions in the CHANSE project include the Indian Institute of Technology (IIT-Bombay), Indian Institute of Science (IISc, Bengaluru), Indian Institute of Tropical Meteorology (IITM-Pune), T.M. Bhagalpur University (TMBU, Bhagalpur), the Imperial College of London (ICL), University of Exeter, UK and the British Geological Survey (BGS, UK).

Project Updates:
Installation of acoustic water level sensors, and collection of river, canal and groundwater data and samples from June 22–30, 2018.

Resetting acoustic water level sensors, and collection of river, canal and groundwater data and samples from February 02–12, 2019. All project equipment (except installations) transferred to TMBU, Bhagalpur.

GIS processing and data management:
Conducted land use and land cover classification of the active floodplain region of the Gandak river in Bihar, India, using LandSat series images obtained from open-access online sources, in February 2018.

Classified images were used to extract trends in habitat availability for Gharials from 1975 to 2018, in relation to river discharge released from the Triveni barrage on the Gandak river, at the Indo-Nepal border.

Impacts of climate variability (rainfall, temperature, ENSO) on river discharge and barrage operations:
No clear trends in precipitation were observed. Temperature trends showed a weak but non-significant increase for the 1901–2015 period. There was an increase in discharge (after adjusting for precipitation and temperature in Nepal) since June 1980, and an increase in inter-annual variability in discharge, as a function of temperature, for the same period.

Sandbar measurements in Gandak River. *© Tarun Nair*

River data & sample collection from Gandak. *© Tarun Nair*

Hydrology-habitat models:
Hydrology-habitat models were generated based on inputs from the canal, river and groundwater models, and barrage operation model.

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Relationships between discharge from the barrage and downstream habitat quality (in terms of downstream discharge, depth, sediment flow, temperature) were examined.

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Areas of fresh alluvial deposits and sandbar tops showed a negative trend and were negatively correlated with barrage discharge.

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River routing models (HEC-RAS) and land-cover classes were used to generate resistance maps, i.e. resistance to use and movement of channel by riverine species.

Population and movement models:
Mathematical models were built to simulate and predict the population-level and spatial responses of biodiversity to the availability of river flows and floodplain habitat in the Gandak river.

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Deterministic models were constructed separately for Gharials, River dolphins, and three selected representative species of fish commonly found in the Gandak river system.

ASSAR: VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE IN SEMI-ARID TAMIL NADU (COMPLETED)

The semi-arid regions of India and Africa are witnessing a variety of changes due to climate change, government policies and farmer's response to regional and global markets. Historically, these regions have adapted to harsh weather and scarcity of resources. As a result, they offer valuable insights on resilient strategies against change. Recognising this historical role of semi-arid regions, a group of researchers and development organisations including ATREE formed ASSAR or the Adaptation at Scale in Semi-arid Regions.

As part of the ASSAR project, ATREE looked at India's Moyar-Bhavani sub-region. Along with diverse wildlife and physiographic features, this landscape has high human density and a long history of human use. The area is inhabited by diverse indigenous tribal communities, as well as a large population of scheduled castes (socially-marginalised groups). It has undergone substantial change due to multiple stresses like ongoing land degradation, the proliferation of invasive alien species, landscape fragmentation, and increasing temperature regime.
The ASSAR project component at ATREE was led by Jagdish Krishnaswamy along with Shrinivas Badiger as co-PI for both the Ecosystem Services and Human Wellbeing (ESHW) programme and Water Land and Society programme (WLS).

ATREE collaborated with Indian Institute for Human Settlements, Indian Institute of Tropical Meteorology,

and Watershed Organisation Trust to look at three major issues pertaining to this region; Effective Adaptation to, and Management of, Invasive Alien Species (IAS) to assess Impact of Biodiversity and Ecosystem Services, Drivers of Changing Green Cover and Consequences for Local Community in Protected Areas across India and Africa, and impact of Climate Change and Climate Variability on Food and Nutritional Security of Agrarian Households (WLS Programme).

Semi-arid regions offer insights to develop resilient strategies against climate change. *© Milind Bunyan*

EFFECTIVE ADAPTATION TO, AND MANAGEMENT OF, INVASIVE ALIEN SPECIES (IAS) TO ASSESS IMPACT OF BIODIVERSITY AND ECOSYSTEM SERVICES

In the Moyar-Bhavani, IAS are negatively impacting native biodiversity and ecosystem services. The ability of local forest-dependent communities to develop management practices and adaptation strategies to the emerging novel ecosystem is constrained by lack of land tenure due to the delayed implementation of the Forest Rights Act (2006) in Tamil Nadu. The issue is further confounded by the protected area status of a large part of the landscape.

Prosopis (*Prosopis juliflora*) was introduced to the landscape in the 1960s and was expected to contribute to provisioning services through fuel and animal feed, thus increasing the productivity of grasslands. The expansion of Prosopis is driving a significant greening of vegetation along the Moyar valley.

Blackbuck habitat in Satyamangala Tiger Reserve being impacted by *Prosopis juliflora*. *© Devika Rathore*

Prosopis in the region is now impacting biodiversity (Blackbuck in the region prefer native species, and avoid Prosopis-dominated landscapes) and community livelihoods (crop-raiding on farmlands from herbivores is linked to increase in Prosopis growth). The impacts of Prosopis may also worsen in the near future as the consumption of pods by wild herbivores is augmenting the dispersal of this species by Blackbuck and Elephants. At higher elevations, the expansion of Lantana (*Lantana camara*), another IAS, has impacted local livelihoods significantly. Livestock pasturing areas have reduced, and NTFP productivity in the region has been impacted by the spread of IAS.

Resistance from state agencies (especially the Forest Department) to implement the Forest Rights Act, and the pertinacious focus on physical solutions for IAS spread in the region has neglected the potential of community-led solutions. Furthermore, the spatial and temporal dimensions of the spread of IAS, and their impacts on NTFP, livestock grazing, and wild herbivores, is not adequately acknowledged and more research is needed on the factors that drive their occupancy and persistence.

Project Recommendations:

The Forest Department invests significantly in the control of IAS in protected areas, albeit sporadically. An ecological monitoring effort is needed to assess the effectiveness of current strategies.

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Information on IAS is patchy and restricted to protected areas, and the potential of technological advances (e.g., smartphones and tablets) to map and monitor the spread of IAS frugally and efficiently remains underused.

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Management of IAS needs to move from the rhetoric of state-funded extraction alone to community-led solutions that take into consideration the potential for livelihood generation through the removal of IAS by communities. A novel ecosystem framework is needed to assess the potential of IAS for livelihoods biodiversity and ecosystem services.

Current invasive species management strategies do not involve communities that may benefit from their control. *© Devika Rathore*

DRIVERS OF CHANGING GREEN COVER AND CONSEQUENCES FOR LOCAL COMMUNITY IN PROTECTED AREAS ACROSS INDIA AND AFRICA

Natural and human-dominated semi-arid ecosystems show clear signals of CO2 fertilisation effects across protected areas and their buffers in India and Africa. Although the amplitude of the annual seasonal cycle is increasing over time in all regions, there are clear differences in the response of protected areas and their agro-pastoral buffers in India and the three African regions. In India, the protected areas have a smaller amplitude of annual seasonal change compared to the buffer which is attributed to their relatively greater moisture-storage regimes; these trends are reversed in the African semi-arid regions where protected areas and buffer zones respond similarly.

The amplitude of annual seasonal phenology is increasing over time; some of this is due to the decrease in dry-season vegetation, and some due to greater greening at the peak of the growing season. A comparison of protected areas with agro-pastoral buffers (20 km) around them, indicated that semi-arid protected areas in India have a relatively lower amplitude of annual seasonal change, which can be attributed to the higher elevations, and the protected watersheds in which these protected areas tend to be located.

Greening and browning had very different impacts on key ecosystem services in the region. In some cases, greening was associated with increased productivity and improved ecosystem services, while in other cases it was driven by a proliferation of detrimental invasive species. These vegetation changes impact communities, households and individuals through changes in the availability of ecosystem services such as biomass, water and food, which are mediated by social differentiation and governance regimes. ATREE found clear evidence for CO2 fertilisation causing higher greening trends, particularly across sites in the 350-800 mm rainfall gradient, supporting the hypothesis that this effect would find its highest expression in moisture-stressed sites.

Project Recommendations:

Better communication of global and local drivers of ecosystem change and emerging trends amongst policymakers and communities may result in more robust adaptation practices. For example, a better understanding of the effects of CO2 fertilisation and sequestration can offer insights on the positive impacts that IAS have on global change.

The connectivity in ecological and hydrological processes between protected areas and their buffer areas should be reflected in land-use policies in the buffer zones. Specifically, recharge areas for groundwater inside protected areas should be recognised for their role in sustaining agriculture outside.

The capacity of multi-disciplinary teams of practitioners, land managers, and scientists need to be built to improve their understanding of the ongoing changes in socio-ecological systems, including the dominant local, regional and global drivers of ecosystem change (and their feedback mechanisms); and enhance their abilities to generate future scenarios of change.

The overall implications of greening linked to bushy encroachment of invasive tree species should be considered when designing adaptation options under near-future and multi-decadal time-scales.

Prosoposis juliflora is impacting livelihoods in East Africa by reducing grazing lands. *© Mekonnen Adnew*

REIMAGINING NEIGHBOURHOOD PARKS FOR BIODIVERSITY CONSERVATION (COMPLETED)

Fragmented and isolated habitat patches are the signature landscape of most cities. Human activity has altered the size, shape and interconnectivity of natural landscapes in cities. Apart from isolated habitats, cities also have neighbourhood parks (NPs) in residential areas, which are pockets of green spaces largely created for recreation. The role of these small green patches often goes unnoticed and neglected as Large Green Spaces (LGS) provide more services, support more biodiversity and comprise more of natural vegetation. ATREE along with other researchers studied the role of 37 NPs in biodiversity conservation in Bangalore city to bridge this research gap.

Project Outcomes:

Neighbourhood parks facilitate movement for vagile taxa such as birds, butterflies and insects, resulting in an increase in biodiversity at the regional scale.

NPs can serve as vital spaces for biodiversity and could strengthen the health of the ecosystem and the services provisioned to the society especially at the neighbourhood scale.

NPs are maintained by the municipality and are mainly designed for recreation purposes, completely neglecting the fact that these spaces could be essential for biodiversity.

Bangalore city has diverse landscape configuration types and the most appropriate model that fits is the single large or several small theory (SLOSS).

Results reveal that people are fond of Birds and Butterflies and NPs supported 55 tree species, 45 species of birds, 41 species of butterflies and 68 species of insects.

A survey of 3 taxa – birds, butterflies and ground-dwelling insects of NPs in Bangalore demonstrated that a higher density of NPs without the influence of a LGS and low-density of NPs in the presence of a LGS were found to support rich bird and butterfly diversity. Thus several small NPs could supplement the large parks to function efficiently in conserving biodiversity within cities.

Neighbourhood park within a residential area provisioning recreational services especially for the elderly group. *© Wikicommons*

Policy Outcomes of ESHW:

ATREE has contributed to discussions regarding the impacts of land-use-land-cover, climate change and variability in ecosystems and communities at regional, national and international fora.

Jagdish Krishnaswamy, Senior Fellow, ATREE, was appointed as a coordinating lead author for the IPCC special report on land degradation and climate change which is awaiting approval of all country governments in August 2019.

Led by Shrinivas Badiger, ATREE researchers working in the agriculture and water sector, organised a 10-day training workshop titled 'Management Development Programme on Integrated Water Resources Management for Karnataka State Water Resource Engineers and Managers'. The workshop was organised with support from the Karnataka State Government's Advanced Centre for Integrated Water Resources Management (ACIWRM) and the Asian Development Bank (ADB) in October 2018. The goal of the training workshop was to enhance the capacities of engineers and managers in water-related departments of government to understand, analyse and address water-resource management in an integrated and holistic manner.

ATREE will be organising a series of capacity assessments and training programmes for the Karnataka State Water Resources Department officials in the coming years and continues to support the state's effort in reforming the agricultural and water sectors.

Soliga craftsmen making a life-size elephant out of Lantana, an invasive weed.
© Siddappa Setty R

Community Conservation Centres

The Community Conservation Centres (CCCs) facilitate a two-way flow of knowledge between local stakeholders and researchers at ATREE. They act not only as field bases for doctoral research but also provide a space for monitoring socio-ecological systems. The CCCs have been instrumental in reaching out to and building capacities of local community, community institutions, forest officials, environmental journalists and visiting students, including those participating in study abroad programs.

The four Community Conservation Centres form an integral part of ATREE and conduct a host of activities with community participation, which include research, outreach, livelihood enhancing programs, capacity building, education, and building awareness. The CCCs have also been instrumental in providing policy-level interventions.

BILIGIRI AND MALAI MAHADESHWARA HILLS COMMUNITY CONSERVATION CENTRES

ATREE's first Community Conservation Centre (CCC) was established in the Biligiriranga Hills in 1992. One of the first projects in the region was the monitoring of Non-Timber Forest Products (NTFPs). Later studies were carried out on agroforestry, invasive species, enterprise based conservation, Forest Rights Act, tenure related issues and community and conservation in the Biligiri CCC (BCCC). Research on NTFPs and other forest fruits also led to a project in the Malai Mahadeshwara Hills, following which the Malai Mahadeshwara CCC (MMCCC) was established. Both these centers serve as forums for learning about the environment, which in turn enables the sustainable use of forest resources locally. The CCCs also conduct classes on alternate livelihood sources which help in securing the forest-dwelling communities, financially. Other services offered by the two CCCs include facilitating the implementation of the Forest Rights Act (2006), restoring critical wildlife corridors and providing scholarships to local students.

INNOVATION IN INVASIVE SPECIES AND LANTANA CRAFT CENTRES

The spread of invasive plant species and their impact on NTFPs and biodiversity has long been studied by ATREE researchers. These studies have informed that the spread of the invasive Lantana camara has adversely affected

Lantana Craft Centre at MM Hills. *© Harisha RP*

the biodiversity in forests and hence measures have to be taken to curb the spread of the invasive.

ATREE set up the Lantana Craft Centres (LCCs) to mitigate the spread of Lantana camara and to generate alternate livelihood for the Soligas through the sale of wide array of Lantana furniture and other craft items.

Apart from furniture, Soliga craftsmen are also using Lantana to make life-sized, handcrafted elephant figurines. Each of these figurines generates an income of USD 1500. ATREE in collaboration with the Shola Trust, Gudalur and Elephant Family, UK has exhibited 25 of these elephant figurines at the Royal Parks Museum in London. Currently, LCC has 23 Soliga master craftsmen who have further trained 324 artisans across South India. As many as 113 Soliga households have seen a four-fold increase in their income (from Rs. 6,527 per household in 2014 to Rs. 31,000 per household in 2018).

ATREE, also regularly invests in developing market-linkages and capacity building of the Soliga craftsmen. In order to better market the Lantana products, MMCCC established institutional linkage with TRIFED- Ministry of Tribal Affairs for marketing inputs and domestic marketing support through their outlets in India. The Department of Handicraft and Marketing Extension, Ministry of Textiles also issued ID cards for 310 artisans, under Rajiv Gandhi Shilpi Swasthya Bima Yojana which included health insurance coverage for 250 people.

Implementation of the Forest Rights Act

Joint efforts by ATREE, Zilla Budakattu Girijana Abhivrudhi Sangha, Taluk Soliga Abhivrudhi Sangha (Yelandur, Hanuru, Chamarajanagara) and Vivekananda Girijana Kalayana Kendra, helped 1969 individuals obtain land rights under FRA and 64 Community Forest Rights across 76 villages (Podu). 25 Community Forest Rights titles and 563 individual rights were distributed on August 09, August 2018 which benefited around 800 families in the three protected areas of BRT Tiger Reserve, MM Hills and Cauvery Wildlife Sanctuary.

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Dr. Siddappa Setty, Fellow, ATREE, addressing the gathering during the distribution of titles on community and individual rights under Forest Rights Act. *© Jade Swamy*

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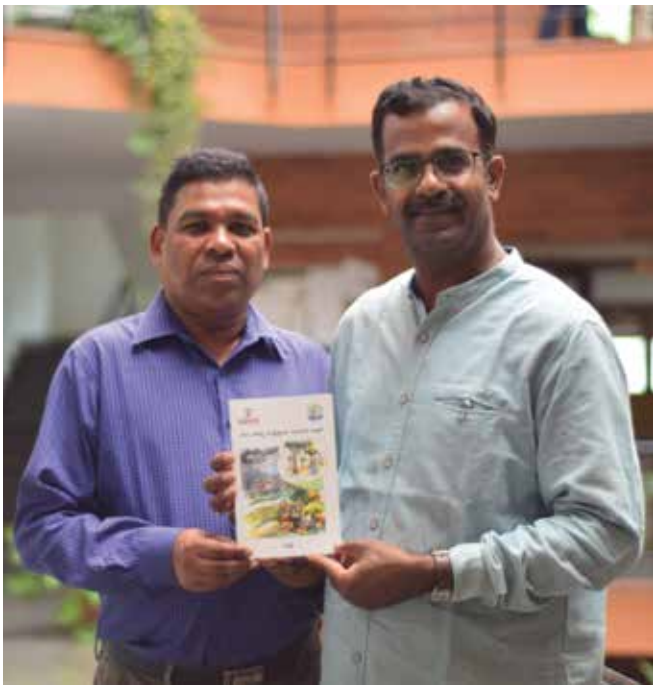
Marketing Forest Resources

Two decentralised Non-timber Forest Products (NTFPs) value addition units were set up in BR Hills and one in MM



'NTFPs Sustainable Harvest Practices and Methods' handbook for NTFP harvesters by Dr. Siddappa Setty and team. *© Kiran Thomas*

Hills following the enterprise based conservation model. A Sangha was formed to sell products locally as well in cities like Bangalore. To monitor the resources with participation of local community, a number of participatory resources monitoring methods were followed. The NTFPs value addition unit in MMCCC, registered under the co-operative society, as part of the USAID project, now markets 15 NTFP products.

The MMCCC team also documented 124 species of wild edible plants and assessed the socio-economic, cultural importance, distribution pattern, and conservation status of those species. Seasonal availability calendar was prepared and the importance value index was calculated for all 124 species.

The NTFPs Handbook

For over 20 years, ATREE has been working with the Soliga community in BRT and MM Hills on issues of forest dependency to generate livelihoods. As part of the long-term ecological monitoring work and intensive assessment of traditional practices on NTFPs resources management, ATREE published a handbook titled, 'NTFPs Sustainable Harvest Practices and Methods', for NTFP harvestors. Available in the local Kannada language, the book discusses sustainable harvest practice methods on NTFPs, participatory resources monitoring and tools such as timeline and trend line analysis.

The book includes pictures and graphical diagrams to illustrate seasonality and threat analysis. It also features popular articles published on wild food plants.

Lantana Craft Training Workshop

The MMCCC conducted Lantana craft training workshop for Soliga and Lingayat families employed in Lantana elephant fabrication work. The MMCCC team also conducted co-management meetings with the Soliga community and Soliga Abirudhi Sangha, to develop a draft management plan.

Exhibitions

A wide range of products were exhibited at the annual Krishi Mela (Farmers' Fest) held in November at Gandhi Krishi Vignana Kendra (GKVK), Bangalore by the artisans from MM Hills. A large number of students, nature lovers and citizens visited the stall and were informed about the products and various activities undertaken at the CCCs. The visitors expressed a keen interest in Lantana craft, natural ADAVI honey, pickle and amla juice produced at the value addition centers in MM Hills and BRT. Students and teachers expressed interest in learning Lantana craft to control the spread of Lantana around the school.

MM Hills value addition unit also exhibited NTFPs and Lantana craft products at the Tribal Handicraft Fair, Mysore. The six-day fair was organised by LAMPS Federation, Mysore from August 20–25, 2018.

AGASTHYAMALAI COMMUNITY CONSERVATION CENTRE

ATREE established the Agasthyamalai Community Conservation Centre (ACCC) in 2001, in the foothills of Agasthyamalai mountains, Tamil Nadu. ACCC follows a three- pronged strategy of environmental governance through relevant applied research, education and capacity building. ACCC conducts several research and outreach programmes inside the Kalakad Mundanthurai Tiger Reserve and in the human dominated landscapes outside the reserve.

The forest field staff interacting with the Wild Quest participants.
© Prasanth

Wild Quest participants in the field.
© Prasanth

Wild Quest prize distribution.
© Prashanth

Campers studying the macro invertebrates of the Tamiraparani river.
© Maria Antony

Environment Education at ACCC

In an endeavour to make the young citizens of Tirunelveli and Thoothukudi districts appreciate nature, understand the local biodiversity and engage in conservation activities, several programmes were conducted by ACCC.

Family Wild Quest

ACCC, The District Science Centre, Tirunelveli and Indian Overseas Bank Officers Association (IOBA), organised Family Wild Quest, an annual wildlife quiz competition for students and their parents. The key objective of the quiz was to sensitise and encourage young students towards the protection of Indian wildlife and to draw attention towards the importance of Kalakad Mundanthurai Tiger Reserve (KMTR) and Tamiraparani landscapes.

Over 50 families participated in the competition and six families were selected as winners. The teams were named after the unique species found in Tirunelveli landscape like 'Cullenia' the keystone species endemic to wet evergreen forests in KMTR or 'Chalozodes' the endemic bush frog rediscovered after 133 years in KMTR by ATREE researchers. The winning families and some select audience were taken for a nature trail in KMTR, a first of its kind experience for them.

Wild Camp

Wild Camp, a two-day nature education programme, was organised by ACCC, at Kalakad Mundanthurai Tiger Reserve (KMTR). Students between 11–14 years participated in the programme. The camp offered outdoor experience to the students who were also informed about environmental degradation and various conservation efforts. The students camped in the forest and were involved in a gamut of hands-on activities like bird watching, stream dipping, butterfly walk, mothing, tree

Lesser Atlas Moth (Attacus taprobanis).
© Thalavaipandi

Indian Moon Moth.
© Thalavaipandi

autograph, photography, storytelling, games and hiking. The students were also made to participate in 'Draw A Forest Task' (DAFT), to assess the knowledge gained during the programme.

As many as 120 students and 20 teachers participated in the Wild Camp. The two-day programme helped the students develop their observation skills through activities like Langur behaviour studies and road kill survey among others. The students got the opportunity to know about wet evergreen forests, endemic plant and animal species from field experts and also interacted with the forest field staff.

The Colourful Moths of KMTR

As part of the long term monitoring program at KMTR, ACCC initiated the monitoring of moths across seasons in the wet evergreen forests using light traps and photography for moth identification.

The ongoing project was started to study the moth fauna in KMTR and to draw attention to this species that plays an important role in the forest ecosystem, helps in pollination and also serves as a prey base for birds and other predators.

Key Findings:

As part of the four-month study, 237 species of moths belonging to 22 families in the evergreen forests were recorded. These included the Largest Moth, Lesser Atlas Moth and the delicate Indian Moon Moth. The most common moth family was Erebidae which comprised of 79 species that camouflage well with leaves and vary in sizes.

The study also recorded the Great Death Head Hawk moths which make sound when touched and are known to rob honey from bee hives. More species are yet to be identified.

COMMUNITY ENVIRONMENTAL RESOURCE CENTRE

Vembanad Wetland Conservation Programme was initiated by ATREE in the year 2007 and led to the establishment of the Community Environmental Resource Centre (CERC) at Alappuzha, Kerala. Since its inception, CERC has identified and developed the capacity needs and institutional networks for participatory integrated management of heavily used landscapes. CERC instils democratic principles in the conservation of the Vembanad wetland system through a multi-stakeholder, interdisciplinary approach. ATREE's conservation-oriented field interventions aim to mitigate pressures from unsustainable use of resources, invasive species, and climate change.

ATREE CERC – ANTRIX Corporation CSR Project

ANTRIX Corporation Limited and Ashoka Trust for Research in Ecology and the Environment (ATREE) signed a Memorandum of Understanding (MoU) for carrying out activities for integrated conservation and management of Vembanad lake and its natural resources. The project intends to address five major threats being faced by Vembanad

Distribution of uniform and gloves to Harithakarmasena (women who collect waste from households in Muhamma panchayat). *© Sanju Soman*

Dr. Thomas Issac inaugurating Muhammodayam (village adoption programme under ANTRIX project). *© Sanju Soman*

lake, viz., water pollution, lake reclamation, invasive species, unsustainable resource use and climate change. The project is expected to develop comprehensive and integrated ecosystems conservation and resource management to bring in sustainability to the Vembanad SES in the wake of global changes. The program aims to develop innovative models for capacitating communities to adapt to the impacts of imminent climate change and to develop sustainable institutional models. The project is in its second year of implementation.

Local responses to global targets: Adopting Muhamma (Alappuzha, Kerala) as a model wetland village

On September 25, 2015, the 193 United Nation member states adopted 17 Sustainable Development Goals (SDG 2030) as part of a new international agenda and a call to end poverty, reduce inequality, protect the planet and ensure that all people enjoy peace and prosperity. As a local response to this global call ATREE decided to adopt Muhamma Panchayath (Alappuzha- Kerala) to create a model wetland Panchayat.

Muhamma, being a part of the Vembanad Socio Ecological System, is exposed to climate change and other anthropological influences. The people in the area are vulnerable to changes in the lake system as their livelihood is highly dependent on the lake-based ecosystem. By supporting the panchayat, ATREE aims to create sustainable models in various sectors, including waste management, clam collection, fishing, drinking water, promoting responsible tourism, etc. Steps will also be taken to increase the green cover in the panchayat. In the course of next 10 years, ATREE-CERC intends to make Muhamma, a model for carbon neutral and sustainable living.

Christened '*Muhammodayam*', this ambitious project was inaugurated by Dr. T M Thomas Issac, (Finance Minister of Kerala) on June 30, 2018 at a function presided over by Mr. P Thilothaman (Minister of Food and Civil Supplies, Kerala).

Social Innovation Lab

Gender equality and women empowerment is one of the important targets of SDG 2030 and is integral to all dimensions of inclusive and sustainable development. Social Innovation Lab was launched by ATREE-CERC in partnership with Muhamma Grama Panchyath to create a space for women to innovate and form enterprises that directly or indirectly benefit the people and the ecosystem. The Social Innovation Lab aims to empower the women in the panchayat by providing them with the facilities to start an enterprise and also to innovate and develop new products. The participating women have so far been trained in upcycling of cloth bags, glass bottle cutting and upcycled furniture making among other things. The women also joined hands to paint the innovation lab and therefore also learnt the skill of painting houses or buildings. Over 40 women who were trained, in the

Women at work in Social Innovation Lab. *© Sanju Soman*

Vembanad Fish Count 2018. *© Ashish Mathew George*

first phase in making innovative products from upcycled materials are now making a monthly earning of Rs. 3000–8000.

Sustainable Menstruation: A step forward to ensure sanitary waste free Muhamma

The menstrual practices still impose many social, cultural and religious restrictions, a significant barrier in the path of menstrual hygiene management (MHM) in rural areas. Menstrual hygiene is not just about the products used but also how they are disposed. Being non-biodegradable, the soiled napkins stay in the landfills for about 800 years. Tones of these non-compostable sanitary pads are making their way into sewerage systems, landfills, fields and water bodies and are not only harmful for health, but also have negative consequences on the environment.
Sanitary napkins have become a major threat to the Vembanad Lake and its biodiversity.

In this backdrop, awareness building programs have been organised across Muhamma, to familiarize women with eco-friendly alternatives such as menstrual cups and cloth pads as sanitary pads. Regular awareness building workshops are being organised in partnership with Muhamma Grama

Panchayat and health department for Asha (Health) workers and local women and menstrual cups are provided at a subsidised rate.

Vembanad Fish Count (VFC) 2018

The 11th edition of Vembanad Fish Count was held from May 23 – 26, 2018. The key objective of VFC is to identify various species of fish in Vembanad Lake and thereby understand its changing ecological characteristic features. The fish count took place in three divisions of the southern region and four divisions of the northern region. In the southern region the teams covered Thanneermukkom, Muhamma and Alappuzha. In the northern region the first ever VFC was conducted in Arookutty, Murinjapuzha, High Court and Kanakkankadavu. A total of 117 fish species were recorded in the two-day count. From the south of Thanneermukkom, a total of 49 species were recorded compared to 55 species last year. From the Northern part, a total of 96 fish species including nine crustaceans were recorded. Another highlight was the presence of Poecilia mexicana and Moon gourami, exotic to Vembanad Lake. The fish count reported the presence of Poecilila mexicana (shortfin molly) for the first time in India.

Press reports on Vembanad Fish Count

http://www.thehindu.com/.../vembanad-fish.../article24002712.ece

http://epaper.newindianexpress.com/c/29032480

Post Flood Vembanad Fish Count in December 2018

The devastating Kerala floods in August 2018 caused a drastic change in the ecology and topography of the Vembanad Lake. After the floods, several freshwater fishes from the higher elevations and from the aquaculture farms got displaced and reached the Vembanad waters posing a threat to the livelihood of the fisherfolk.

According to a survey conducted by ATREE-CERC with support from the State Wetland Authority, Kerala (SWAK), the fish catch in the lake increased several-folds after the floods. Four exotic species, largely used in aquaculture viz. *Piaractus brachypomus* (Red-bellied Pacu), *Pangasius sps.* (Assam Wala), *Clarias gariepinus* (African Cat-fish), and *Oreochromis mossambicus* (Mozambique tilapia) constituted more than 30% of this catch.

Far Left: Supply of flood relief materials. *© Anu Radhakrishnan*

Left (Top): Participants at the climate leadership programme. *© Sanju Soman*

Left (Bottom): Training for house boat staff. *© Ashish Mathew George*

Flood Relief Activities

Kerala faced its worst floods in 94 years in August 2018. The floods caused catastrophic impacts in the region. The flood situation was first reported in the Kuttanad area of Kerala which lies below mean sea level. ATREE was one of the first organisation to supply relief material in the affected interior areas. All CERC staff actively participated in the relief operations including supply of relief material and improving the mental condition of the affected people.

A few activities undertaken by ATREE-CERC during the floods:

- Need based supply of relief material including food, medicines and cleaning materials across seven camps in Alappuzha which covered 10,000 flood affected people.
- Coordinated supply of relief material including 500 school kits (school bags, water bottles, lunch boxes and notebooks) and 10,000 Liters of packaged drinking water.
- Conducted recreational and stress management activities for a week at K. E. Carmel School, Muhamma, which housed more than 3000 flood affected people.
- Anu Radhakrishnan was appointed as member of an expert committee set by Kerala State Biodiversity Board on "Rapid Assessment on Impact of Biodiversity due to Heavy Floods in Kerala."
- Part of delegation assessing the post flood drinking water issues in Kuttanad region headed by Dr. Baby Kurian, IAS (Rtd).

Being Responsible: Training Programme for House Boat Staff

Being Responsible, a training programme to generate awareness about the significance of the Vembanad landscape to the houseboat staff and operators was conducted in July 2018. The training program highlighted the need for responsible and ecofriendly practices in backwater tourism to conserve the ecosystem. The programme included sessions on Vembanad ecology, hospitality, first-aid and safety and waste management. More than 200 houseboat staff under the Kerala Houseboat Owners Federation were trained across four sessions.

Climate Leadership Programme

The Climate Leadership Programme was organised to build capacity of the young change makers to identify and implement projects aimed at prevention and adaptation to climate change. The goal of the programme was to provide an open and inclusive platform for youngsters to come, think and collaborate and take action to address climate change. 11 selected young change makers from Kerala were provided hands on experience in executing projects and provided opportunities to connect with leading organizations working in the domain of climate change. The six-day programme was organised in partnership with Sustera, Kanthari International and Institute for Sustainable Development and Governance.

Noragric students interacting with Lake Protection Forum (LPF) members. *© Ashish Mathew George*

World Wetlands Day 2018

ATREE CERC celebrated the World Wetlands Day by performing a street play on the importance of Vembanad conservation to local policymakers on February 02, 2018. The street play was presented by the students of SKMHSS Kumarakom and was supported by the State Wetland Authority Kerala and Alappuzha District Panchayat. The program was organized at the civil station complex in Alappuzha.

Workshop on Wetland Legislations for LSG Members

The Grama Panchayats play a vital role in conservation and management of the wetlands and coastal zones. The state and central governments have brought in many amendments to the Coastal Regulation Zone notification; wetland management rules 2010 and Paddy and wetland conservation act 2008. The Grama panchayats have to be well aware of the implementation of this legislation.

ATREE-CERC organised a one-day workshop on generating awareness around these legislations and the provisions in the Panchayati Raj act in conservation and management of wetlands. The keynote address on Panchayati Raj act was delivered by former Chief Secretary of Kerala, Dr. S.M. Vijayanand, IAS. The coastal regulation zone was covered by Dr. KV Thomas and Paddy and Wetland Conservation Act by Dr. Robinson Y.D. The wetland management rules were discussed by Dr. John C. Mathew. Dr. Priyadarsanan Dharma

Rajan moderated the sessions. More than 115 Grama Panchayat members were present for the workshop.

International Students Engagement Programme

ATREE-CERC co-organised a course on 'State and civil societies in development and environmental governance in Vembanad, Kerala, India' for the post-graduate students of Department of International Environment and Development Studies (NORAGRIC), Norwegian University of Life Sciences (NMBU). Beginning 2018, NORAGRIC has extended the MoU for three more years with ATREE CERC. Students from University of Sydney also visited ATREE-CERC to know more about Vembanad ecosystem and the model village project. The students also participated in a brain storming session to propose solutions for community-led canal cleanup. Going forward the University plans to roll out an exchange program with ATREE-CERC next year. ATREE-CERC also engages with students from the Kings College, London.

ATREE Eastern Himalaya / Northeast India Initiative

An ATREE initiative to help the region of Eastern Himalaya/ Northeast India develop multi-functional landscapes where biodiversity is protected, ecosystem integrity is maintained and the wellbeing of its people is promoted.

FACULTY:
Dr. Sarala Khaling (Regional Director)
Dr. Sunita Pradhan
Dr. Nirmalya Chatterjee

MANAGING INDIA'S FORESTS FOR BIODIVERSITY AND HUMAN WELL-BEING IN THE FACE OF GLOBAL ENVIRONMENTAL CHANGE (FBWB) (COMPLETED)

This project was supported by the USAID and implemented in villages around protected areas in the Western Ghats and Eastern Himalaya. The key objective of the project was to increase incomes of the forest dependent communities through improved management of agriculture and Non-Timber Forest Product (NTFP) species. It also facilitated the introduction of innovations in fuel wood management and strengthened systems of forest resources management.

Project Outcomes:

441 households from 20 villages reported an increase in household income from agriculture, polyhouses, apiary, and homestay activities. 32,926 person-hours of training were provided for livelihood enhancement activities. 500 households benefitted from improved agriculture initiatives (vermicomposting, terrace improvement, soil moisture preservation, pest management).

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1151 households benefitted from improved energy services {Improved Cook Stoves (ICS)}. 464 individuals were trained in energy efficiency technology. 12 ICS promoters were organised into two micro-enterprise groups and provided with relevant tools and materials to promote their trade. 25% increase in productivity of key crops was observed in eight villages due to the adoption of new agricultural techniques.

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Human-Wildlife Conflict (HWC), monitored in 20 villages, led to the mapping and planning of

Inside one of the polyhouses. *© Tenzing Sherpa*

mitigation strategies. Mitigation measures like fencing around vulnerable sites were carried out in three villages in coordination with local communities.

KEY ECOSYSTEM SERVICES AND BIODIVERSITY COMPONENTS IN SOCIO-ECOLOGICAL LANDSCAPES OF DARJEELING – SIKKIM HIMALAYA: DERIVING MANAGEMENT & POLICY INPUTS AND DEVELOPING MOUNTAIN BIODIVERSITY INFORMATION SYSTEM (ONGOING)

This project, supported by the National Mission on Himalayan Studies and Ministry of Environment, Forest and Climate Change, Government of India is being implemented in partnership with the Department of Zoology, Sikkim University, Gangtok.

The key objective is to understand the biodiversity elements and ecosystem services retained in various agroecosystems across different spatial gradients and their response to large scale changes in Darjeeling-Sikkim Himalaya.

Modern boxes for Apiary support, Darjeeling. *© Rinchen Lama*

The project also aims to enhance the capacity of students, researchers, traditional and local community based institutions, and general citizenry to document and monitor biodiversity and status of ecosystem services.

It also aims to develop and populate an open access Mountain Biodiversity Database and Information System (MBDIS) for Darjeeling-Sikkim Himalaya.

Through this initiative, researchers hope to provide policy inputs and management recommendations for conservation of biodiversity and flow of ecosystem services in human modified landscapes outside protected area and reserved forest regimes.

Students documenting butterflies in Makaibari TE © *Aditya Pradhan*

Project Outcomes:

Development of mammal inventory: Seven sites were deployed with camera traps where a maximum of 16 mammal species from across the agroecosystem landscapes were recorded. Literature prior to the field surveys documented 160 and 147 mammalian species from Sikkim and Darjeeling district respectively.

The website for Mountain Biodiversity Information System component of the project was launched in the last week of November 2018 and preliminary information about the project and team members has been uploaded.

136 institutions have been identified [Darjeeling (62), Kalimpong (40), and Sikkim (34)] to be used as points of entry for outreach, awareness building, skill development for livelihoods and documenting biodiversity.

Ecosystem services assessments have been completed in two sites out of the 18 in the project area.

More than ten outreach and awareness programmes have been organised for various stakeholders in the landscape.

SPECIES AND ECOSYSTEMS IN HUMAN DOMINATED LANDSCAPE

Protected Areas (PAs) are cornerstones for biodiversity. The role and importance of human modified and dominated landscapes such as agroecosystems, monoculture plantations remnant forests and water bodies, in biodiversity conservation and species persistence, is increasingly being highlighted. However, despite the importance of these landscapes in biodiversity conservation, they do not fall under any targeted conservation policies. The legal protection afforded by some of the threatened species is also inadequate. The human dominated landscapes are dynamic and complex, management of which require multiple strategies for innovative and appropriate conservation approaches. "Species and Ecosystems in Human Dominated Landscapes" is a developing programme at ATREE, Eastern Himalaya (EH), which will contribute to the management of human modified and dominated landscape with conservation goals for species, their critical habitats and human welfare in EH. The program will operate under four broad themes of Research, Outreach, Implementation and Policy Advocacy, Capacity Building and Partnership.

During 2018-19, as part of the project 'Conserving the Critically Endangered Chinese Pangolin in the

Pangolin caught in a camera trap. *© ATREE EH-NE*

Tea Plantations of Darjeeling Himalaya' researchers contributed to studies pertaining to global species decline, ecosystem deterioration, and threats to human wildlife interaction of coexistence and human well-being. The project aimed to increase understanding of threatened species and human-wildlife interactions to contribute to shaping policy and management outcomes. The project came up with significant information on how Pangolins behave in the wild, which can contribute to management of the species in captivity. It also aids in developing conservation and management strategies for Pangolins in the wild.

Key Findings:

This project in the agroecosystems of Darjeeling Himalaya recorded significant information on the ecology of the species, burrow use, abundance and impending threats. The Chinese Pangolin was found to be relatively abundant in tea plantations and agroforests than in the adjoining government protected reserve forests, indicating the importance of agroecosystems as significant habitats to critically endangered species like the Chinese Pangolin.

Apart from the Pangolin species, 15 other small to medium terrestrial mammal species from approximately 3000 camera trap days were also recorded from the landscape including the reserve forest.

Policy Outreach:

Outside of the protected areas, tea plantations and agriculture comprise major land-use in Darjeeling Himalaya. These landscapes are overseen by many private entities and government sector like Forest Department, Agriculture Department, Tea Management, Block Development Administration, Biodiversity Management Committees (BMCs), local communities, local institutions and NGOs. Meetings and dialogue with all stakeholders was initiated.

Each of these sectors and stakeholders have their own administrative objectives and limits. Hence, finding synergy amongst multiple actors to find a solution for a problem like conservation of the Chinese Pangolin in areas outside of protected areas, is complex and non-linear. However, to avoid being stalled by the complexity of the problem, an action plan suggesting incremental interventions like awareness programs, Peoples Biodiversity Register (PBR) development by the BMCs, induction of Pangolin keepers as BMC members, training and empowering the Pangolin keepers, honorary rangers and frontline forest staff has been proposed.

Daily formation of rapids on shallow boulder fields during reservoir water release for power generation in the upper Rambi (TLD3) along the Teesta. *© Nirmalya Chatterjee*

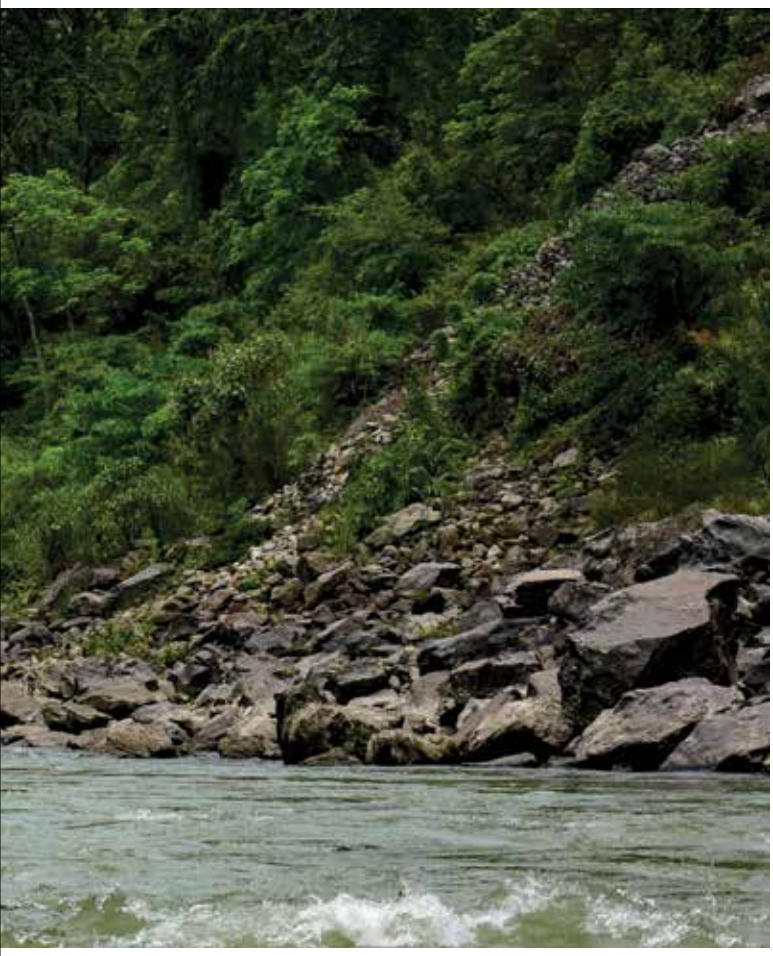
LONG-TERM MONITORING OF RIPARIAN ECOSYSTEM AND RESERVOIR BATHYMETRY TO ASSESS IMPACTS OF DAMMING THE TEESTA RIVER (ONGOING)

Damming of Himalayan rivers is gaining momentum due to increased demand for low-carbon methods for electricity generation. The Teesta, once a fast-flowing, valley confined river, in the Eastern Himalayas, has had numerous high and low flow dams commissioned in the last decade and a half. These dams have created large reservoirs with very little flow, changing the ecosystem from a lotic to a lentic system, atypical of Himalayan rivers.

Due to permanent inundation of riparian zones on either bank, large swathes of unique forested habitat have been lost along the river. Reservoirs created by these dams have also changed the fluvial dynamics and the micro-climate in the dammed sections. This has serious implications for long-term valley morphology, moisture regimes in the riparian zone and overall sediment budgeting in the catchments with potential effects on reservoir longevity, biodiversity in the riparian areas and hill-slope stability.

Through this research project, baseline data on riparian vegetation, water quality and sediment budgets, and distribution for understanding long-term effects of damming is being collected. Understanding the long-term trends in the data will provide valuable scientific insight for dam and reservoir management and help in framing policy guidelines pertinent to similar power generation facilities in the Indian Himalayas.

This research effort, a collaboration between ATREE and University of Louisiana at Monroe, USA, is unique in its multi-disciplinary approach to collecting baseline data on bathymetry, vegetation changes, and sediment distribution in reservoir riparian zones.



Episodic flooding drives erosional features on sand banks on the upper Rambi (TLD3) reservoir along the Teesta. *© Nirmalya Chatterjee*

Project Updates:

The bathymetric survey mapping of Rambi Dam was conducted twice in the pre-monsoon season (2018, 2019) and once in the post-monsoon season (2018). The Kalijhora Dam bathymetry was conducted in May 2019.

Riparian vegetation survey of the Rambi Dam reservoir riparian was conducted for three seasons (pre-monsoon May-June 2018, post-monsoon Nov-Dec 2018, pre-monsoon May 2019). The Kalijhora Dam reservoir riparian survey was conducted for its first pre-monsoon season in May-June 2019.

The impoundment of the Teesta at Teesta Low Dam 3 (TLD 3) and Teesta Low Dam 4 (TLD 4) has altered the free flow of the river into one of the low or restricted flow reservoirs, with episodic high and low levels, interspersed with near stagnant durations during low inflows before power generation capacity levels are reached. The riparian also experiences episodic cycles of air exposure and drainage, and inundation leading to formation of sedimentary features on the banks and the valley bottom due to erosion and deposition events. Sand, silt and clay banks have formed in the newly inundated areas and the current reservoir shore-line areas, ranging from tens to a few hundreds of centimetres in depth.

The vegetation surveys indicated changes in some of the monitored sites indicating at a number of changes: root-zone water ingress damage of trees, and increased susceptibility to uprooting of trees during thunderstorms, unreported felling of trees and clear differences in extent of understory growth in pre- and post-monsoon seasons.

Increased incidences of soil subsidence in the riparian areas leading to tree damage, reservoir embankment failures, damage to highway infrastructure close to the riparian, and hill slope failure due to rapid soil moisture changes and sub-surface water ingress have also been reported between Melli Bazar and Kalijhora Bazar on National Highway 10 (NH-10). A publication based on initial bathymetry and vegetation survey results is under preparation.

Students collect data around Nandi Hills for performing land-use and land-cover classification. *© Neha Mohanty*

Academy for Conservation Science and Sustainability Studies

ATREE's Academy for Conservation Science and Sustainability Studies offers a doctoral programme, which is awarded by Manipal Academy of Higher Education (MAHE), Karnataka, an Institution of Eminence recognised by the Government of India. The Academy generates interdisciplinary knowledge to address environmental concerns in a sustainable and socially just manner.

49 PhD Students

20 Faculty

07 PhD Degrees Awarded

33 Public & Internal Talks

11 PhD Pre-submission/ Synopsis Presentations

21 Interns

STUDENT ANNUAL SEMINAR

The Academy organised the first Student Annual Seminar (SAS), held between January 09-11, 2019. The main objective of the SAS was to help students communicate their findings, and receive feedback, beyond their Doctoral Advisory Committees (DACs). The student presentations included conceptual and methodological discussions, data analysis procedures, and anticipated work in the next academic year. The seminar was a closed-door event, which included the students, their supervisors and DAC members and other faculty.

Software Acquisitions for Student Research

The Academy Office purchased a subscription to the Urkund plagiarism detection platform. Access to Urkund is expected to reduce the time taken to conduct a plagiarism check on student synopses, theses and other documents requiring these checks.

Going forward, the Academy plans to procure additional software licenses to enable students to conduct analysis of qualitative data using mixed methods.

PREPTalk

The Academy rolled out a new bi-monthly talk series called PREPTalk to prepare students to move from enduring a PhD to growing as individuals, capable of carving a niche for themselves. Aimed at helping the students gain novel and implementable insights and knowledge, the PREPTalk is anchored by experienced resource persons from within and outside of ATREE. A wide range of topics and ideas varying from the right use of language to procrastination avoidance to resistance theatre, to sustainability to mental and physical health, are covered by the resource persons. PREPTalk offers a plethora of opportunities available to create leaders, engage with different kinds of knowledge and make an impact in the world.

- The first PREPTalk was held on January 09, 2019 by ATREE's Veena Srinivasan, Shikha Lakhanpal and Jagdish Krishnaswamy on the topic – Socialisation of Research. They had an engaging discussion with the students on the importance of building and maintaining professional networks.

- The second PREPTalk was organised on March 20, 2019. Renowned wildlife photographer, Kalyan Varma anchored a discussion on ethics in photography. The talk focused on the treatment of both human and natural subjects when it comes to photography in research. The talk was followed by a discussion on bringing out a balanced perspective in ethical photography and the need to constantly question ourselves.

Coursework and Training

Coursework at the Academy spans three semesters and includes courses that are structured to instill a sound understanding of various natural and social science disciplines. ATREE Fellows mentor the Academy's PhD scholars, and together, they have made significant contributions in the field of conservation science and sustainable development.

The following core and elective courses were offered for the second and third semesters:

Core courses

- C3: Practising Interdisciplinary Research on the Environment (3 credits)
- C4a: Research Methods in Social Sciences (1 credit)
- C4b: Philosophy of Science and Natural Science Methods (2 credits)
- C4c: Quantitative Methods (2 credits)
- C5: Scientific Writing (1 credit)

Elective courses

- E001: Systematic Biology (2 credits)
- E003: Landscape ecology, GIS and Remote Sensing of the Environment (2 credits)
- E007: The Ecology and Socio-economics of Non-timber Forest Produce (2 credits)
- E013: Environmental Governance: An Indian introduction (2 credits)
- E014: Critical Zone Soil/Water processes (2 credits)
- E016: Urban Hydrology and Water Quality (2 credits)
- E017: Supervised Readings (1 credit)

PhD Scholars

ATREE's PhD scholars have an academic grounding in a range of disciplines including, environmental planning, disaster management, forestry, climate science, economics, sociology, wildlife science, and ecology.

SEVEN ACADEMY STUDENTS WERE AWARDED PHD DEGREES IN 2018–19

1. **Priti Hebbar,** PhD scholar, ATREE: "Ecology and Conservation Genetics of Nyctibatrachus spp in Central Western Ghats".

2. **Madhuri Ramesh**, Ph.D. Scholar, ATREE: "Conservation amidst development in a nonequilibrium environment: A study of marine turtles in Odisha, India".

3. **Chandrima Home**, PhD Scholar, ATREE: "The ecological and social dimensions of human-dog-wildlife conflict in the Indian Trans-Himalaya".

4. **Barkha Subba**, PhD Scholar, ATREE: "Factors Influencing Distribution and Composition of Frog assemblages in Eastern Himalaya; Implications for conservation".

5. **Aniruddha Marathe**, PhD Scholar, ATREE: "Species richness and distribution of ants (Hymenoptera: Formicidae) along an elevational gradient in the Eaglenest Wildlife Sanctuary (Arunachal Pradesh, India)".

6. **Dhritiman Das**, Ph.D. Scholar, ATREE: "Diversity and Assembly of a Sub-Tropical Grassland Community in Eastern Himalaya".

7. **Urbashi Pradhan**, PhD Scholar, ATREE: "Ecosystem services and goods provisioned by fragmented forests within mandarin orange orchards in Sikkim Himalaya, India".

AWARDS/GRANTS AND RECOGNITIONS

Vikram Aditya received the Rufford Small Grant for his project titled - Assessing the impacts of hunting and illegal trade on wildlife in the northern Eastern Ghats, India focusing on the Indian pangolin.

Vikram Aditya received a grant from Mohamed bin Zayed Species Conservation Fund for his Pangolin project in September 2018.

Madhushri Mudke was awarded the EDGE fellowship by the Zoological Society of London (ZSL) for her proposed work on – Ecological Monitoring and Threat Assessment of Micrixalus kottigeharensis in the Western Ghats. The fellowship represents a collaboration between the ZSL EDGE of Existence Programme and Fondation Segré, and is known as the Segré-EDGE Fellowship.

Madhushri Mudke won a partial scholarship to attend Advanced Field course in Ecology and Conservation, XTBG 2018 (AFEC-X 2018).

Kadambari Deshpande received a research grant ---Student Research Scholarship for Global Bat Conservation Priorities" from the Bat Conservation International, USA, in January 2019. She was also awarded the Verne & Marion Read Bat Conservation Honor by them for inspiring education and community action to protect bats around the world and addressing critical conservation needs.

Talks@ATREE

The Academy conducts weekly talks where presentations are given by invited speakers to exchange ideas and engage with people from diverse areas of expertise. The Academy organised 33 public talk and internal talks. The Academy also hosted a theatre session and film screenings.

Certificate Courses and Workshops

- The Academy organised a one-day workshop titled – Communicating Science to a Non-Scientific Audience. The workshop explored multiple ways of engaging non-scientific audiences in ecological research and conveying complex information in an accessible way. Dr. Matthew Creasey, an ecologist and a science writer, conducted the workshop.

- The Academy also organised a two-day workshop on "Becoming an Emotionally Intelligent Researcher" in February 2019. The two-day workshop was pedagogically based on learning about personal and social competencies through experiential exercises. The workshop was facilitated by Dr. Shamim Modi who presently chairs the Centre for Law and Society under the School of Law, Rights and Constitutional Governance at TISS.

- The Academy organised the Open Data Kit (ODK) training programme from December 28 – 29, 2018. Open Data Kit is a free and open source suite of tools that is designed to create, collect and manage field data by creating spatial and non-spatial forms on smartphones and Android tablets. The training programme was facilitated by Google Earth Outreach.

PUBLICATIONS

1. Thorat, O. y Rai, N. (2018) "Contradicciones pastoriles en las praderas de Banni en Kachchh, India". Ecología Política, 55: 92-97.

2. R.K. Sony, Sandeep Sen, Sunil Kumar, Monalisa Sen, and K.M.Jayahari (2018) Niche models inform the effects of climate change on the endangered Nilgiri Tahr (Nilgiritragus hylocrius) populations in the southern Western Ghats, India. Ecological Engineering 120: 355-363.

3. Vikram Aditya's paper titled 'Deciphering forest change: linking satellite based forest cover change and community perceptions in a threatened landscape in India', has been accepted for publication in Ambio.

4. Bhar, Soumyajit. 2018. "Consuming with Mindfulness: Import of Buddhist Philosophy for an Ethic toward Consumerism". Pertanika Journal of Social Sciences & Humanities 26 (3): 1563-1578.

5. Aditya, V., & Ganesh, T. (2018). Deciphering forest change: Linking satellite-based forest cover change and community perceptions in a threatened landscape in India. Ambio, 1-11.

Shiva Subramanya, Official Google Outreach Trainer at ATREE, introduces the participants to ODK and the use of ODK Collect app. *© Neha Mohanty*

The faculty and students at the first Student Annual Seminar (SAS). *© Kruthika Rao*

6. Goswami, R., Thorat, O., Aditya, V., & Karimbumkara, S. N. (2018). A preliminary checklist of butterflies from the northern Eastern Ghats with notes on new and significant species records including three new reports for peninsular India. Journal of Threatened Taxa, 10(13), 12769-12791.

7. Ranjeet Kumar Sahani - "Facing The Flood", Economic Political Weekly, November 17, 2018 Vol. 53(45).

8. Santhakumar, B., Arun, P. R., Sony, R. K., Murugesan, M., & Ramesh, C. (2018). The pattern of bird distribution along the elevation gradient of the Sutlej River basin, western Himalaya, India. Journal of Threatened Taxa, 10 (13), 12715–12725.

9. Krishnaswamy, J., Kelkar, N., Aravind, N.A., Vaidyanathan, S. 2018. Climate change and aquatic biodiversity. In: Bhatt, J.R., Das, A., Shanker, K. (eds.) Biodiversity and Climate Change: an Indian Perspective. Ministry of Environment, Forest & Climate Change, Government of India, New Delhi, pp. 163-190.

10. Braulik, G., Kelkar, N., Khan, U., Paudel, S., Brownell, R., Abel, G. 2018. Indus and Ganges river dolphins (Platanista gangetica): ex situ options for conservation. Conference Paper presented at the ESOCC (Ex Situ Options for Cetacean Conservation) Workshop, Nuremberg, Germany, December 14–18, 2018.

11. Shah, R., and Shrinivas Badiger. 2018. "Conundrum or Paradox : Deconstructing the Spurious Case of Water Scarcity in the Himalayan Region through an Institutional Economics Narrative." Water Policy, 1–16. doi:10.2166/wp.2018.115.

12. Aditya, V. (2019). Burrowing to oblivion: the crisis facing the pangolin in India. Protected Area Update, 35 (1): 24.

13. Pavan, K., Subhedar, R. & Aditya. V. (2019). Scale of the issue: The Indian pangolin is losing ground in the northern Eastern Ghats. Mongabay India. https://india.mongabay.com/2019/02/commentary-scale-of-the-issue-the-indian-pangolin-is-losing-ground-in-the-northern-eastern-ghats/

POPULAR ARTICLES

- Rinan Shah: Exploring and Unraveling Domestic Water Scarcity in Urban Mountain Towns. www.sustera.org. 2018
- Rinan Shah: Contextualizing Water Scarcity in Urban Mountain Towns: The Case of Darjeeling. City Observer, 72-81. 2018
- Ranjeet Kumar Sahani: A Myopic Effort to 'Protect' a Community from the Kosi Left It in a Spiral of Decline - https://thewire.in/environment/kosi-kamala-embankments-wetlands-banpar-fishers.

SEMINARS/TALKS PRESENTED BY ACADEMY STUDENTS

- Venkat Ramanujam presented a poster at Manipal research colloquium, Manipal Academy of Higher Education (MAHE) on April 04, 2018.

- Venkat Ramanjujam delivered two guest lectures as part of the course in Conservation & Governance for students of the MSc programme in Life Sciences (Conservation Futures) at the University of Trans-Disciplinary Health Sciences and Technology (TDU), Bengaluru.
- Sony R K was invited to deliver a talk on "Environmental Movements in Kerala" at the Climate Leadership Program (CLP 2018) organized by ATREE CERC, Alappuzha, Kerala and Sustera, Kerala.

- Rashmi Mahajan presented a paper based on her PhD research at the sixth Network of Rural and Agrarian Studies (NRAS) conference organized at the Central University of Gujarat (CUG), Gandhinagar, Gujarat from September 20-22, 2018. The theme of the conference was 'Whither Rural Commons? State Policy, Natural Resources, and Agrarian Change'.

- Venkat Ramanujam presented a conference paper titled – Recasting a ruin: Adivasi-led restoration' and religious identities in transition in a Central India forest at the Conference on Relevance of Archaeology for 21st century India, held at the National Institute for Advanced Studies (NIAS), 24-25 July 2018.

- Venkat Ramanujam presented a conference paper titled Changing Adivasi-commons relationship in Baiga Chak, eastern Madhya Pradesh at 'Whither rural commons? State Policy, Natural Resources, and Rural India' Sixth Conference of the Network of Rural and Agrarian Studies, Central University of Gujarat, Gandhinagar, held from September 20–22, 2018.

- Venkat Ramanujam delivered a guest lecture titled Adivasis in transition? A journey through the Baiga Chak, eastern Madhya Pradesh to public policy students at FLAME University, Pune, 25th September 2018.

- Vikram Aditya gave a talk on Google Earth Engine at the 'Training workshop on Open Data Kit (ODK) for Field Researchers – 2018' on December 14, 2018 at ATREE.

- Anirban Datta Roy presented a talk on 'Supplementary Livelihood Options for Local Communities and other Rural Populations' at the 'Second Himalayan Researchers Consortium', organised by National Mission for Himalayan Studies at Gangtok, Sikkim (November 26-27, 2018) and was awarded 'Best Presentation' for the 'Livelihood Options and Employment Generation' session.

- Nachiket Kelkar presented the following talks:
  - Kelkar, N. The South Asian river dolphin: unscrambling an evolutionary enigma. Nature Conservation Foundation, October 11, 2018.
  - Dey, M., Morisaka, T., Krishnaswamy, J., Kelkar, N. Impacts of underwater vessel noise and river-bottom dredging on Ganges river dolphins. Talk presented on behalf of co-authors at the India Rivers Week, on November 24, 2018.
  - Kelkar, N. Fishery conflicts in the Gangetic basin and ways towards resolution? Talk presented at the India Rivers Week, New Delhi, India, November 24, 2018.
  - Kelkar, N., Arthur, R., Dey, S., & Krishnaswamy, J. Riverine ecology and institutional interplay:

precarious and treacherous regimes in the Ganga River, Bihar, India. Talk presented at the 3rd World Small-Scale Fisheries Congress, Chiang Mai, Thailand, October 23, 2018.

- Yangchenla Bhutia delivered talks at the International Symposium on Evergreen Oak forests in the Eastern Himalayas, Gangtok, Sikkim and in the IUFRO Satellite session, at the 6th International Conference on Plants and Environmental Pollution (ICPEP-6), CSIR-NBRI, Lucknow, India on "Status of Oaks and related species for conservation and management strategies".

- Rinan Shah presented a talk at the 2nd Himalayan Researchers' Consortium, National Mission on Himalayan Studies, Gangtok, Sikkim, India (26–27 November 2018)

- Rinan Shah presented a paper "Ascertaining Access to Water Provisioning Systems in the Urban Mountain Town of Darjeeling, India" at Graduate Research Meet 2018, Emerging Trends in Humanities and Social Sciences at Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati, India (26–27 October 2018).

- Vikram Adiya gave a talk on 'Integrating field surveys and community knowledge to assess the threats facing the Indian pangolin and its distribution in India's northern Eastern Ghats' at the Rufford India Conference, 8–10 February, 2019 at Ramnagar, Uttarakhand, India

- Venkat Ramanujam presented a paper titled Changing Adivasi livelihoods in Baiga Chak, eastern Madhya Pradesh at the Central Indian Landscape Symposium 3 (CILS3), Melghat Tiger Reserve, Maharashtra on January 05, 2019. The symposium was a biennial event organised by the Network for Conserving Central India that brings together researchers, practitioners, administrators, and policy-makers from across the world with an interest in Central India or whose work carried out in a different part of the world is relevant to the Central Indian landscape.

- Venktat Ramanujam presented a paper titled Shifting Adivasi-forest relationship in Baiga Chak, eastern Madhya Pradesh at the Student Annual Seminar, ATREE, Bengaluru, January 07-09, 2019.

- Venkat Ramanujam presented a paper titled Forest of ambivalence: Rights minus governance in the Maikal Hills of eastern Madhya Pradesh at the Entangled Natures Conference on Human Ecology at the Ambedkar University, Delhi held between February 14-17, 2019. The paper was part of a panel titled Hybridity, Power, and Culture in Environmental Governance.

- Venkat Ramanujam presented a Lecture titled Agrarian change, forest rights, and an Adivasi-environment relationship in transition in the Maikal Hills, eastern Madhya Pradesh at Ashoka University, Sonepat, on February 18, 2019. The lecture was delivered to a class of nearly hundred undergraduate students as part of the course titled Introduction to Environmental Sciences taught by Dr. Divya Karnad at the Faculty of Environmental Studies, Ashoka University.

- Ronita Mukherjee presented a poster titled " Importance of local habitat matrix in sustaining pollination service along the gradient of urbanization" at the Indo-German Conference on Rural-Urban Transitions held between February 20-22, 2019 in Bengaluru, India.

WORKSHOPS AND CONFERENCES ATTENDED/ ORGANISED BY STUDENTS

- Ronita Mukherjee participated in 5th European Congress of Conservation Biology (ECCB2018) organized by University of Jyväskylä, Finland and Society for Conservation Biology (SCB) from June 12-15 and presented a poster titled "Diversity matters: effect of density compensation in pollination service during rainfall shift".

- Ovee Thorat participated in the international conference POLLEN18: Political Ecology, the Green Economy, and Alternative Sustainabilities, at Oslo Metropolitan University, Norway held from June 19–22. She was part of a panel - Drylands and "New" Accumulations of Wealth and presented a paper titled "From wastelands to commons: problems and promises of development interventions in arid grasslands of Banni in Gujarat, India".

- Rinan Shah attended a multi-stakeholder dialogue on "Improving Tea Productivity, Addressing Land Degradation, and Driving Sustainable Development in Darjeeling", hosted by ATREE, UNEP, GEF under UNEP, and Rainforest Alliance in Darjeeling. Rinan also assisted in the Himalaya Clean-Up in Darjeeling and participated in the Environment Day Event at Darjeeling Government College.

- Rinan Shah attended the "International Training and Tools and Approaches for Citywide Water and Sanitation Management" workshop at Centre for Science and Environment, New Delhi (July 24-28, 2018) and received full scholarship for the event.

- Shweta Basnett presented a paper on – 'Reproductive phenology of Himalayan Rhododendrons: Influence of phylogeny and abiotic factors' at the International Phenology Conference in Melbourne, Australia from September 23-27, 2018. Shweta received the best student paper award for her talk.

- Rinan Shah attended a workshop on Managing and Governing Resource in the "Anthropocene": Political Ecological Explorations from South Asia at Indian Institute of Technology Kharagpur, India (November 28 –December 1,2018).

- Roshni Kutty attended a six-day residential winter school organised by South Asian University along with Rosa Luxembourg Stiftung. The workshop titled – "Development, Democracy and Conflict" was held from November 26 to December 01, 2018.

- Nipu Das attended a five-day workshop on "Molecular Taxonomy" at the institute of Life Sciences (ILS), Bhubaneswar, Odisha.

- Neha Khandekar attended the Mahanadi Stakeholder meeting held in Raipur on February 15, 2019. The meeting drew participation from academicians, farmers, activists and civil society representatives interested in/ working on the inter-state issue on the Mahanadi basin. The idea of the meeting was to take collective inputs on a draft approach paper titled- ' Mahanadi Basin – An Alternative Approach to Inter-state Water Sharing and Management' lead by Forum for Policy Dialogue on Water Conflicts in India (Water Conflicts Forum).

OTHER UPDATES

- Nine students registered for their doctoral programme with MAHE between April 2018 and March 2019.

- Seven students were awarded the doctoral degree from MAHE.

- Amurtha Pradhan, Neyi Jamoh, Rinan Shah and Soumya K V presented 15-minute photo-stories from Southern Western Ghats, KMTR and Darjeeling.

- Manjunatha G (Field Coordinator, ATREE) and Anu Karippal (Social Science Researcher, ATREE) presented 15-minute photo stories from their field sites.

- Rinan Shah was part of the Authors Meet Critics 2018 organised by International Journal of Urban and Regional Research (December 10, 2018)

- Kadambari Deshpande taught a module in the MSc Wildlife Biology and Conservation course at NCBS on November 05, 2018. As part of the module, Kadambari also presented a talk titled "Bat ecology and conservation research: concepts and approaches".

- Seven PhD (Horticulture) students from GKVK, Bangalore visited ATREE as part of their Environmental Horticulture' course.

- 17 M.Sc. Wildlife students from the National Centre for Biological Sciences visited ATREE.

- 42 final year undergraduate students from the Botany Department, Guru Nanak College, Chennai visited ATREE on October 03, 2018. the visit was coordinated by the Academy.

- The Academy received 39 students of M.Sc. Environment Management from Forest Research Institute, Dehradun on November 14.

- The Academy coordinated the visit of 15 Indian Forest Service Probationers (2017-2019 batch) from the Indira Gandhi National Forest Academy, Dehradun to the ATREE Bangalore office and the Biligiri Rangaswamy Temple (BRT) Community Conservation Centre from October 29 to November 02, 2018. Spanning five-days, the visit was designed to introduce the future to ATREE's research and outreach work. The programme focussed on ATREE's work on invasive species management, human-wildlife conflict and forest rights of native forest communities.

- The Academy in coordination with ATREE- HR conducted three training programmes on the Prevention Of Sexual Harassment (POSH) for the 2017 batch of PhD students, new staff and intern recruitments.

- The Academy, in coordination with the ATREE Film Club, organized the following movie screenings at ATREE:

1. "Beerappa's Angst" conceptualised by Bhargavi S Rao and Leo F. Saldanha, problematises the building of a massive military-industrial-nuclear-complex in Challakere, Chitradurga, 250 kms north of Bangalore, that is displacing over 300,000 people and about 250,000 livestock without public debate. The film has been produced by Amrit Mahal Kaval Hitarakshana Haagu Horata Samithi.

2. "Kahan Ka Rasta"is an immersive journey, in time and space, into the everyday reality of Kalap, nestled in the Himalayan range of Uttarakhand in India to unveil the many facets of village life.

Indian Forest Service Probationers (2017–2019 batch) at Honammetti, BRT. *© Neha Mohanty*

Indian Forest Service Probationers (2017–2019) batch interact with the Soligas at Muthagadagadde, BRT. *© Neha Mohanty*

3. "Khamma Gir Ne"is a bold and daring documentary film project to unearth the truth about the story of Lion Conservation in Gir, last abode of The Asiatic Lions. Khamma Gir Ne is also about bringing in awareness about basic human rights of forest dwellers and natives.

4. "Remembering Kurdi" tells the story of families who were relocated due to the submergence of Kurdi town in South Goa over three decades ago. Every year as the waters of the Salaulim Dam recede, the ruins resurface for a few short weeks bringing past inhabitants back to what is left of their homes, to perform rituals, have picnics and remember their dead.

5. "The Pack" is a documentary series about Asiatic wild dogs or dhole. Branded as bloody killers until a few decades ago, dholes were mercilessly slaughtered to near extinction. The documentary enters their private lives within the Nilgiri Biosphere Reserve in South India and unravels their secrets.

- Twenty-seven students from the Department of Plant Biology and Plant Biotechnology, Madras Christian College, Chennai, visited ATREE in March. As part of the visit, the Academy organised a talk by the faculty and visits to the Genetics and Eco-Informatics laboratories.

Soil core collection on a sediment bar on the banks of the upper Rambi (TLD3) on the Teesta. *© Nirmalya Chatterjee*

Publications

JOURNAL ARTICLES

1. Aditya,V and T.Ganesh. 2018. Deciphering forest change: Linking satellite based forest cover change and community perceptions in a threatened landscape in India. Ambio 48(7) pp 790–800 (Nov 2018)

2. Arasumani, M., Danish Khan, Arundhati Das, Ian Lockwood, Robert Stewart, Ravi A. Kiran, M. Muthukumar, Milind Bunyan, and V. V. Robin. "Not seeing the grass for the trees: Timber plantations and agriculture shrink tropical montane grassland by two-thirds over four decades in the Palani Hills, a Western Ghats Sky Island." PloS one 13, no. 1 (2018): e0190003.

3. Arasumani, M., Danish Khan, C. K. Vishnudas, M. Muthukumar, Milind Bunyan, and V. V. Robin. "Invasion compounds an ecosystem-wide loss to afforestation in the tropical grasslands of the Shola Sky Islands." Biological Conservation 230 (2019): 141-150

4. Aravind N.A. and B. PáII-Gergely. 2018. Dicharax (?) bawai n. sp from southern India (Gastropoda: Cyclophoroidea: Alycaeidae). Archiv für Molluskenkunde, 147: 55-62.

5. Barkha Subba, Sandeep Sen, Ravikanth G and Nobis M. P. 2018. Direct modelling of limited migration improves projected distributions of Himalayan amphibians under climate change. Biological Conservation 227: 352-360

6. Basnett, S., Nagaraju S. K., Ravikanth G, and S. M. Devy. 2019. Influence of phylogeny and abiotic factors varies across early and late reproductive phenology of Himalayan Rhododendrons. Ecosphere 10(1): e02581. 10.1002/ecs2.2581

7. Belsare, A.V., Vanak, A.T. and Gompper, M.E. (2014). 2018 Epidemiology of viral pathogens of free-ranging dogs and Indian foxes in a human-dominated landscape in central India. Transboundary and Emerging Diseases 61 (s1), 78-86.

8. Bhavani Shankar M; Srirama R; Ravikanth G; Siddappa Setty; Rajasekaran C. 2018. Development of microsatellite markers for resin yielding non-timber forest produce species Boswellia serrata (Burseraceae). Applications in Plant Sciences 6(9): e1180. DOI: 10.1002/aps3.1180

9. Biswas, D. (2019). Challenges for Transgender-inclusive Sanitation in India. Economic & Political Weekly, 54(18), 19.

10. Carricondo-Sanchez, D. O. Morten, A. Kulkarni, A. T. Vanak (In Press). Different strategies for coexistence of mesocarnivores in a human dominated landscape in Maharashtra, India. BioTropica

11. Divakaran Prathapan, K. and Priyadarsanan Dharma Rajan, 2019. Convention on Biological Diversity Need for a Review. Economic & Political Weekly, LIV(3),60-62

12. Divakaran Prathapan, K., Rohan Pethiyagoda, Kamaljit S. Bawa, Peter H. Raven, Priyadarsanan Dharma Rajan and 172 co-signatories from 35 countries, 2018. When the cure kills – CBD limits biodiversity research. Science 360 (6396), 1405-1406. DOI: 10.1126/science.aat9844.

13. Dubash, N. K., R. Khosla, U. Kelkar and S. Lele 2018, India and Climate Change: Evolving Ideas and Increasing Policy Engagement, Annual Review of Environment and Resources 43 (1): 395-424.

14. Elkin,C., S.Rattan, S. Devy and T.Ganesh 2018. Best Practices in Managing Religious Pilgrimage to Sacred Sites in Indian Protected Areas. In: Bas Verschuuren and Steve Brown 2018.Cultural and Spiritual Significance of Nature in Protected Areas: Governance, Management and Policy.

15. Ganesh T. & Prashanth M.B. 2018. A first compilation of harrier roost counts from India suggests population declines of wintering birds over 30 years. Ardea 106: 19–29. DOI: 10.5253/arde.v106i1.a6

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17. Geethika E, Triveni H.N, Srirama R, Siva R, Siddappa Setty and Ravikanth G. 2018. Development and characterization of microsatellite markers for Phyllanthus emblica Linn., an important Non-timber Forest Product species. Journal of Genetics DOI: 10.1007/s12041-018-0979-8

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19. Goswami R. and T.Ganesh. (in press) Conservation in the times of Development-Forest Loss in State and Community Forests in Jaintia Hills, Northeast India in Shahabuddin, G. and Sivaramakrishnan, K. (eds) Nature Conservation in the New Economy: People, Wildlife and the Law in India. Orient Blackswan. New Delhi.

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23. Jayadevan, A., S. Mukherjee &Vanak, A. T.(2018) 2018 Bush encroachment influences nocturnal rodent community and behavior in a semi-arid grassland in Gujarat, India. Journal of Arid Environments 153 (2018) 32-38.

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28. Lakhanpal, S., & Chhatre, A., 2018, For the environment, against conservation: Conflict between renewable energy and biodiversity protection in India. In S. Bhagwat (Ed.), Conservation and Development in India: Reimagining Wilderness. Oxford: Routledge.

29. Lele, S. and M. Bakshi Sengupta 2018, "From lakes as urban commons to integrated lake-water governance: The case of Bengaluru's urban water bodies", SAWAS 8 (1), 2018

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Fields ready for sowing in Upper Sepi Villages in the fringe area of Singalila National Park, Darjeeling. *© Tshering Dorji BhutiaU.Sepi-SNP*

TN Khoshoo Memorial Award and Lecture 2018

Instituted by ATREE, the TN Khoshoo Memorial Award and Lecture recognises the distinguished contribution of a mid-career academician or a practitioner with respect to environment and conservation. The award is also designed to inspire and encourage other emerging scientists.

The 15th edition of TN Khoshoo Memorial Award and Lecture was held on November 19, 2018. The award was conferred on Dr. Rajeswari S. Raina, Professor at Shiv Nadar University's School of Humanities and Social Sciences (SHSS) for her pioneering work in the field of sustainability science.

The award was in recognition of her work which uses an interdisciplinary approach to agricultural research, bringing a scientific perspective to alternative, sustainable practices prevalent in the field. Dr. Raina is also credited for being a strong proponent of increased participation of women in sustainability science. The event also featured a panel discussion on `Women and Sustainable Development' which was moderated by Rohini Nilekani, Chairperson, Arghyam. The panel comprised of women sustainability leaders from across sectors, including, Shruti Shibulal, CEO of Tamara Hotels, Pronita Saxena, Founder & CEO, Citizengage, Dr. Harini Nagendra, Professor of Sustainability, Azim Premji University and Dr. Jahnavi Phalkey, Founding Director of Science Gallery, Bengaluru.

The panel discussed why women are still under-leveraged despite being critical to supporting the three pillars of sustainable development - economic, environmental and social. The panel proposed recommendations to empower more women to be key actors in sustainable economies and development.

The event convened nearly 200 guests comprising of academics, heads of institutions, influencers, media, government agencies, representatives from non-governmental organisations and students from various Bangalore based colleges and institutions. It garnered coverage in mainstream, vernacular, and online media.

Dr. Kartik Shanker, Rajiv Khoshoo and Dr. Kamaljit Bawa presenting the 15th TN Khoshoo Memorial Award to Dr. Rajeswari S. Raina. *© Kiran Thomas*

Guests at the TN Khoshoo Memorial Award 2018. *© Kiran Thomas*

Panel discussion on Women and Sustainable Development, moderated by Ms. Rohini Nilekani. *© Kiran Thomas*

Media and Outreach

ATREE's voice in the media has grown consistently. Contributions by ATREE researchers to both digital and print media in the form of opinion pieces, commentaries and policy papers are regularly featured. Additionally, media is hugely interested in ATREE's work which is very frequently reported.

	2017–2018	2018–2019
MEDIA COVERAGE	150	246
FOLLOWERS	5609	8182
FOLLOWERS	1403	2526
FOLLOWERS	840	1800
NUMBER OF OP-EDS AND FEATURE ARTICLES PUBLISHED	37	24

ATREE booth at SCCS 2018. *© Kiran Thomas*

ATREE's social media reach continues to grow and has increased our visibility across key audiences in the environment sector. Our social media accounts not only provide a platform to interact with climate, sustainability and development experts, journalists, activists and the government but also serve as a tool to disseminate environmental research to a non-scientific audience. Our social media campaigns have raised awareness about a host of diverse issues ranging from the role of women in science to raising awareness about critically endangered species.

Student Conference on Conservation Science 2018

ATREE was an integral part of the 9th Student Conference on Conservation Science (SCCS) held at the JN Tata Auditorium, Bengaluru, from September 27-30, 2018. The largest student conference in the country, ATREE has been part of SCCS since its inception. Along with providing funding support, ATREE faculty, students, and staff remain actively involved in the conference. ATREE students not only volunteered to organise the conference but also conducted workshops.

ATREE Fellow, Nitin Rai, was part of a team of instructors that conducted a five-day pre-conference module on conservation science and practice for students. The module covered various aspects of current conservation science, research and practice via classroom sessions, films, case studies, critiques, debates, and short group projects. As many as 15 students were given a full scholarship by SCCS to participate in the module.

As part of the conference, ATREE PhD students Ovee Thorat and Rajkamal Goswami conducted a long workshop on 'Social Science Methods in Conservation Research'. A project intern at ATREE, Rathnavel Pandian conducted a short workshop on 'Making Effective Presentations'. Aniruddha Marathe, a Research Associate

Book launch of 'India's Water Futures: Emergent Ideas and Pathways'.
© Kiran Thomas

Panel discussion post the book launch.
© Kiran Thomas

Keynote lecture by Sir Andy Haines. *© Kiran Thomas*

Panel discussion on global environmental change and human health.
© Kiran Thomas

Sights and sounds of SCCS 2018. *© Kiran Thomas*

Sights and sounds of SCCS 2018. *© Kiran Thomas*

A participant delivering her talk at SPEEC-UP 2018 *© Kruthika Rao*

Winners of SPEEC-UP 2018. *© SPEEC-UP*

at ATREE, conducted a workshop on 'Interacting with Data for Beginners: Exploratory analysis in R'.
In addition to the workshops, ATREE faculty were also part of mentoring dinners where conservation science students had the opportunity to interact with them, ask questions, network and receive feedback on their work.

An ATREE booth at the conference was instrumental in reaching out to the conservation community in Bengaluru and provided information to students and the general public about its PhD programme and interdisciplinary research initiatives.

Book Launch – India's Water Futures: Emergent Ideas and Pathways

ATREE in collaboration with the Water Conflicts Forum organised the book launch of 'India's Water Futures: Emergent Ideas and Pathways' by K.J. Joy and S. Janakarajan at Atta Gallata on February 01, 2019.

The book analysed the growing water insecurity, increase in demand, inefficiency in water use, and inequalities in accessing clean water. The book launch was followed by a themed discussion moderated by Himanshu Upadhyaya, Faculty, Azim Premji University. The panel comprised of K.J. Joy, Senior Fellow, Society for Promoting Participative Ecosystem Management (SOPPECOM), Sumi Krishna, Environment-development Scholar and Writer, and Sharachchandra Lele, Distinguished Fellow, ATREE.

The discussion addressed the state of the Indian water sector and uncovered solutions that could address the imminent water crises.

Keynote Lecture by Sir Andy Haines on 'Planetary Health: Linkages between global environmental change and human health

To commemorate the World Water Day and International Day of Forests, ATREE together with the Indian Academy of Sciences organised a keynote lecture by Sir Andy Haines, Professor of Environmental Change and Public Health with a joint appointment in the Department of Public Health, Environments and Society and in the Department of Population Health at the London School of Hygiene & Tropical Medicine, at the British Council on March 22, 2019.

In his keynote lecture on – 'Planetary Health: Linkages between global environmental change and human health', Sir Andy Haines stressed on the need for recognising the role of the changing environment in impacting human health. His talk highlighted that environmental trends like climate change, declining freshwater availability and deforestation posed major challenges in sustaining the biosphere and could adversely affect a range of health outcomes including: water-related and vector-borne diseases; impacts of increased frequency and intensity of extreme events, such as floods, droughts, and heat waves; and food security and undernutrition.

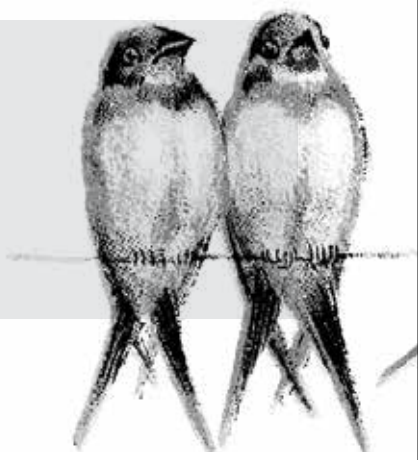
The talk was followed by a panel discussion. Darshan Shankar, Vice Chancellor of University of Trans Disciplinary Health Sciences and Technology (TDU), Veena Srinivasan, Fellow, ATREE, Vijay Chandru, Chairman of Strand Life Sciences, and Sir Andy Haines participated in the discussion. Abi T. Vanak, Fellow, ATREE, moderated the panel discussion. The panellists discussed the way forward towards finding socially and environmentally sustainable and equitable solutions.

SPEEC-UP 2018

ATREE co-organised SPEEC-UP 2018 along with a host of other organisations at the Centre for Ecological Sciences (CES), Bengaluru on August 31, 2018. SPEEC-UP is a one-day event created to encourage and promote interactions among students of ecology, evolution, conservation and environmental science working in Bengaluru. The event featured a competition in the speed talk format (three-minute talks) with participation from ATREE students and faculty.

Our Team

Our passionate and committed team strives to make a difference.



Faculty Affiliations

BIODIVERSITY MONITORING AND CONSERVATION PLANNING

- Dr. R. Ganesan (Programme Leader)
- Dr. Priyadarsanan Dharma Rajan
- Dr. N. A. Aravind
- Dr. G. Ravikanth

LANDSCAPES, LIVELIHOODS AND CONSERVATION

- Dr. T. Ganesh (Programme Leader)
- Dr. Ankila Hiremath
- Dr. Nitin Rai
- Dr. Abi Tamim Vanak

ECOSYSTEM SERVICES AND HUMAN WELLBEING

- Dr. Jagdish Krishnaswamy (Programme Leader)
- Dr Nirmalya Chatterjee
- Dr. Soubadra Devy
- Dr. Siddhartha Krishnan

WATER, LAND, AND SOCIETY

- Dr. Veena Srinivasan (Programme Leader)
- Dr. Shrinivas Badiger
- Dr. Bejoy Thomas
- Dr. Priyanka Jamwal
- Dr. Durba Biswas

FORESTS AND GOVERNANCE

- Dr. Siddappa Setty (Programme Leader)

CLIMATE CHANGE MITIGATION AND DEVELOPMENT

- Dr. Sharachchandra Lele
- Dr. Shoibal Chakravarty (Joined in November, 2017) (Programe Leader)
- Dr. Shikha Lakhanpal

HONORARY FACULTY

- Amrik S. Gill
- Dr. Shivanna K R
- Dr. Romulus Whitaker
- Dr. K. D. Singh
- Dr. Mahesh Rangarajan

SENIOR ADJUNCT FELLOWS

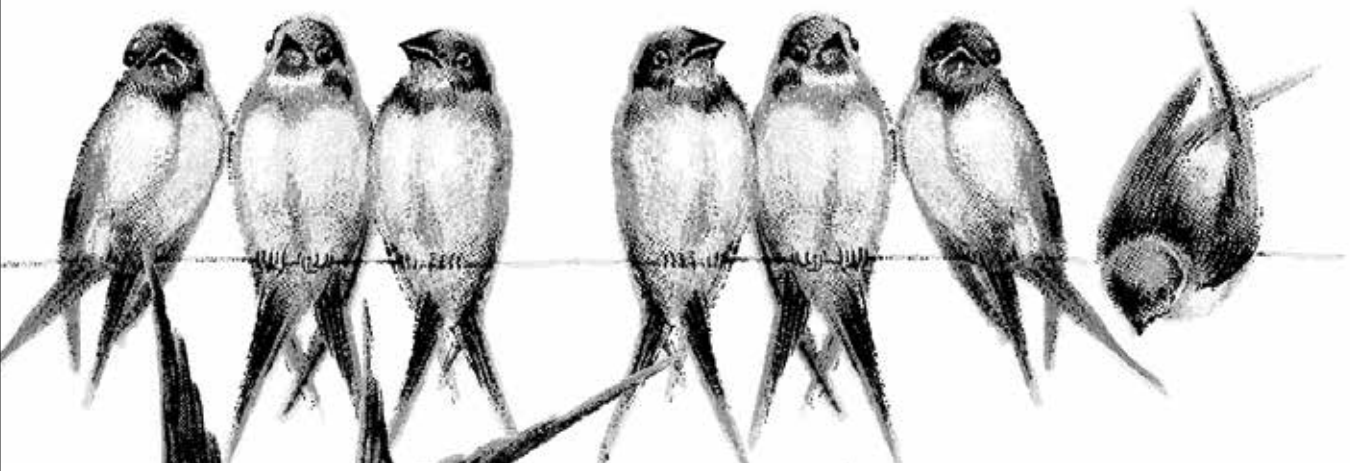
- Dr. Gladwin Joseph
- Dr. R. Prabhakar

ADJUNCT FACULTY

- Dr. Robert John Chandran (Till October 2018)
- Dr. T. O. Sasidharan
- Dr. Deepak Malghan
- Dr. Megha Shenoy
- Dr. Narasimha Rao (From February 2016)
- Dr. Asavari Devadiga
- Dr. Shomen Mukherjee
- Dr. Asmita Sengupta
- Dr. Bharath Sundaram

MANAGEMENT

- Dr. Nitin Pandit, Director
- Shrihari Udupa, Deputy Director – HR & Administration



- Sridhar Ramaswamy Iyengar, Deputy Director, Finance
- Dr. Sarala Khaling, Regional Director, Northeast India Initiative.

ACADEMY

- Dr. Siddhartha Krishnan
- Dr. Milind Bunyan
- Madhavi Latha

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- Abhishek Samrat
- Gouri U

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- Kruthika Rao (Joined in June 2018)
- Kiran Thomas (Joined in July 2018)

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- Ashoka B
- Bhogaiah N
- Smita Mulgund
- Vartika Saxena
- Kariappa P C

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- Hemalatha G
- Indrani
- Jayamala
- Lakshmi
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- Lakshmikanthaiah N
- Meena Rajaram
- Narayanamma (Till March 2019)
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- Ramesh N
- Sunil Dalal
- Sumithra (Till March 2019)
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- Usha H
- Venkataraju

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- Shiva Subramanya

DEVELOPMENT

- Dr. Indira Singh

POLICY

- Mridula Paul

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- Brin Kr. Kharka
- Karma Dorjee
- Jadeswamy
- Kumbha
- Madesha
- Madha
- Nanje Gowda S
- Narayanan B
- Rajanna D
- Renukha
- S Thamizhazhagan
- Shivaram V

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- Harisha R P
- Jojo T D
- Madegowda C.
- Mathivanan M
- Saravanan A
- Seena Narayanan

Livestock of the Sheep farm on the Wenlock Downs near Ooty, being grazed. © *Siddhartha Krishnan*

Funding Partners

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Endowments

- Rohini Nilekani
- The Ford Foundation
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- S.D. Shibulal and Kumari Shibulal
- Sarojini Damodaran Foundation
- Kasturi Trust
- Bawa Family, USA
- SDTT-ATREE CF
- Oak Foundation
- BARR Foundation
- Arghyam Foundation
- Vasudeva Rao
- Raj Khoshoo and Mohini Khoshoo
- Centre for Interdisciplinary Studies in Environment & Development
- Jayshree and Ganesan Balachander
- Rani Dalbir Chaudhary
- TVS Motor Company
- Government of Karnataka (Abdul Kalam Award)
- T R Narayanaswamy and Meera Narayanaswamy

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- Indian Institute for Human Settlements, India
- University of Massachusetts, USA
- Karl Kübel Stiftung für Kind und Familie (KKS), Germany
- Charities Aid Foundation India, New Delhi
- Norwegian University of Life Sciences, Norway
- Xu Lianggen, China
- Fredskorpset, Norway
- University of Kassel, Germany
- National Geographic Society, USA
- Conservation Food and Health Foundation, USA
- Natural Environment Research Council, UK
- World Wild Fund for Nature (WWF), New Delhi
- ATREE Belmont, USA
- The James Hutton Institute, Scotland, UK
- The Harnisch Foundation, USA
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- Ministry of Earth Sciences, India
- Department of Environment & Climate Change, Kerala
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- Wellcome Trust – DBT India Alliance, India
- Antrix Corporation Limited, India
- National Medicinal Plants Board, (NMPB), India
- Institute of Bioresources and Sustainable Development (IBSD), India
- The French Institute of Pondicherry (IFB-ABP), India
- Department of Science & Technology (DST), Government of India
- The Madras Crocodile Bank Trust (MCBT), India
- Tata and Allied Trusts, India
- International Foundation for Science (IFS), Sweden
- Bat Conservation International (BCI), USA
- Cambridge University, UK
- Rainforest Alliance, Inc., USA
- BC3 Basque Centre for Climate Change, Spain
- Pacific Institute, USA
- Maharashtra Forest Department, India
- Indira Gandhi National Forest Academy, India
- Brakes India, Chennai
- Sundaram Finance, Chennai
- Bihar Forest Department (DoEFCC)
- State Wetland Authority (SWAK), Kerala
- Dhamayanthi Hospital, India
- National Bank for Agriculture and Rural Development (NABARD), India
- The Learning Society, India
- Advanced Centre for Integrated Water Resources Management (ACIWRM), India
- Azim Premji Philanthropic Initiatives (APPI), India
- National Center For Biological Sciences, India

FINANCIAL STATEMENT

Place : Bangalore

Date : 09.08.2019

INDEPENDENT AUDITOR'S REPORT

To the Trustees of M/s. Ashoka Trust for Research in Ecology and the Environment (ATREE)

REPORT ON THE AUDIT OF FINANCIAL STATEMENTS

Opinion

We have audited the financial statements of M/s. Ashoka Trust for Research in Ecology and the Environment (ATREE), which comprise the Balance Sheet as at 31st March 2019, and the Income and Expenditure Account and the Receipts and Payments Account for the year then ended, and notes to the financial statements, including a summary of significant accounting policies.

In our opinion, the accompanying financial statements give a true and fair view of the financial position of the Trust as at 31st March 2019, and of its financial performance for the year ended in accordance with the Accounting Standards issued by the Institute of Chartered Accountants of India (ICAI).

Basis for Opinion

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by the ICAI. Our responsibilities under those Standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Statements* section of our report. We are independent of the Trust in accordance with the Code of Ethics issued by the ICAI and we have fulfilled our other ethical responsibilities in accordance with the *Code of Ethics*. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation of these financial statements that give a true and fair view of the financial position, financial performance of the Trust in accordance with the accounting principles generally accepted in India.

In preparing the financial statements, the Management is responsible for assessing the Trust's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the Members either intends to liquidate the Trust or to cease operations, or has no realistic alternative but to do so. Management is also responsible for overseeing the Trust's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

A further description of our responsibilities for the audit of the financial statements is included in Annexure A of this Auditor's Report.

For G. Anantha & Co.,
Chartered Accountants
(FRN 005160S)

Rani N. R.
Date: 09.08.2019
Partner
Membership No. 214318
UDIN: 19214318AAAACP7615

ANNEXURE A TO THE AUDITOR'S REPORT

As part of an audit in accordance with SAs, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Trust's internal control.

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.

- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Trust's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Trust to cease to continue as a going concern.

- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings,including any significant deficiencies in internal control that we identify during our audit.

We also provide those charged with governance with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, related safeguards.

BALANCE SHEET AS ON 31ST MARCH 2019				INR in Lacs
SOURCE OF FUNDS		**MARCH 31, 2019**		**MARCH 31, 2018**
Corpus Fund		5,016.67		4,566.66
General Fund		92.91		87.54
UTILISED RESERVES				
Project Assets		1,332.89		1,158.14
Other Assets		33.24		18.92
Land and Building		696.72		705.13
Project Fund		1,312.82		1,334.98
TOTAL		**8,485.25**		**7,871.38**
APPLICATION OF FUNDS				
FIXED ASSETS				
Project Assets		1,332.89		1,158.14
Other Assets		33.24		18.92
Land and Buildings		696.72		705.13
INVESTMENTS				
Corpus Investments		5,017.01		4,565.42
Other Investments		911.81		941.97
CURRENT ASSETS AND LIABILITIES				
Advances	83.25		41.29	
Other Current Assets	55.15		46.42	
Cash and Bank	358.01		399.41	
GROSS CURRENT ASSETS	**496.41**		**487.12**	
LESS: OTHER CURRENT LIABILITES	2.83		5.32	
NET CURRENT ASSETS		**493.58**		**481.80**
TOTAL		**8485.25**		**7871.38**

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2019		INR in Lacs
PARTICULARS	**MARCH 31, 2019**	**MARCH 31, 2018**
INCOME		
Grants	**1,605.56**	**1,253.50**
Interest	738.03	**483.49**
Donation & other income	**31.89**	**2.90**
TOTAL	**2,375.48**	**1,739.88**
EXPENDITURE		
Forests & Governance	287.69	354.78
Water, Land & Society	273.48	145.70
Climate Change Mitigation & Development	77.51	54.13
Ecosystem Services and Human Wellbeing	238.22	213.61
Biodiversity Monitoring & Conservation Planning	398.61	216.86
Landscapes, Livelihoods & Conservation	400.25	240.41
Academy for Conservation Science and Sustainability Studies	130.86	106.49
Salaries-Programme Support	103.68	89.58
Salaries/Consultancy-Institutional Support	299.91	209.08
Staff Welfare	10.16	6.24
Administrative Expenses	123.97	140.97
Depreciation	20.64	17.98
TOTAL	**2,364.98**	**1,795.82**
SURPLUS/(DEFICIT) DURING THE YEAR	**10.50**	**(55.94)**

RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2019		INR in Lacs
PARTICULARS	**MARCH 31, 2019**	**MARCH 31, 2018**
RECEIPTS		
OPENING BALANCES		
(Cash & Cash equivalents)	5,906.80	**6,012.12**
RECEIPTS DURING THE YEAR		
Project Grants	**1,813.15**	**1,312.63**
Corpus/Endowments	**550.00**	**100.00**
Interest	**470.94**	**417.98**
Donation and other income	**31.27**	**11.12**
TOTAL	**8,772.16**	**7,853.84**
PAYMENTS		
Fixed Assets	203.44	111.92
Forests & Governance	238.30	305.16
Water, Land & Society	250.59	168.42
Climate Change Mitigation & Development	77.51	54.13
Ecosystem Services and Human Wellbeing	225.23	212.44
Biodiversity Monitoring & Conservation Planning	404.54	209.28
Landscapes, Livelihoods & Conservation	389.72	254.94
Academy for Conservation Science and Sustainability Studies	130.86	106.49
Salaries-Programme Support	103.68	89.45
Salaries/Consultancy-Institutional Support	297.34	211.64
Staff Welfare	10.16	6.24
Administrative Expenses	**123.47**	**147.35**
CLOSING BALANCES		
(Cash & Cash equivalents)	**6,317.32**	**5,976.39**
TOTAL	**8,772.16**	**7,853.84**

Toda families take time off on the Wenlock Downs, Nilgiris.
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Ashoka Trust for Research in Ecology and the Environment (ATREE) is a research institution in the areas of biodiversity conservation and sustainable development. We focus on applied science through research, education and action that influence policy and practice on conservation of nature, management of natural resources, and sustainable development. ATREE is recognised as a Scientific and Industrial Research Organisation by the Ministry of Science and Technology, Government of India.

ATREE is registered with the Sub-Registrar, Bengaluru as a public charitable trust and with the Ministry of Home Affairs, Government of India under Section 6(1) of the Foreign Contribution (Regulation) Act 1976. ATREE is registered as a wholly Charitable Trust under Section 12(A)(a) of the Income Tax Act 1961 and donations to it are eligible for 150% / 100% tax exemption under Section 35(1)(ii) / Section 80GGA(2)(a) of the Income Tax Act 1961.

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Mission Statement

To generate rigorous interdisciplinary knowledge for achieving environmental conservation and sustainable development in a socially just manner, to enable the use of this knowledge by policy makers and society, and to train the next generation of scholars and leaders.

ASHOKA TRUST FOR RESEARCH IN ECOLOGY AND THE ENVIRONMENT

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