

**ANNUAL
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**Ashoka Trust for Research in
Ecology and the Environment**

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President's message

Climate change and nature's assets

The current national focus on development and growth makes sustaining nature's assets – biodiversity, water, air, and other natural resources – perhaps more important than ever. Natural resources continue to provide direct sustenance to more than a billion people in our country. They also form the foundations for the green economy, green infrastructure, and smart cities that will be needed to sustain future economic growth and usher in a new era of prosperity. Thus, continued investments in nature are critical for our long-term wellbeing.

As is evident from this report, ATREE is making these investments especially in the context of climate change, which is likely to put further pressures on nature's endowment as well as on lives of people. Indeed, we regard the issue as important enough to launch a new programme on climate change that will consolidate and strengthen ongoing research activities. This programme will house new initiatives to model the impacts of climate change on ecosystems, explore linkages between climate change and energy use, and enhance the science-policy interface on climate change.

Of course, other challenges will continue to draw ATREE's attention. Changes in biodiversity, ecosystem services, land use, and water regimes are affecting our economy, social fabric, and lives in rural and urban areas. While we continue

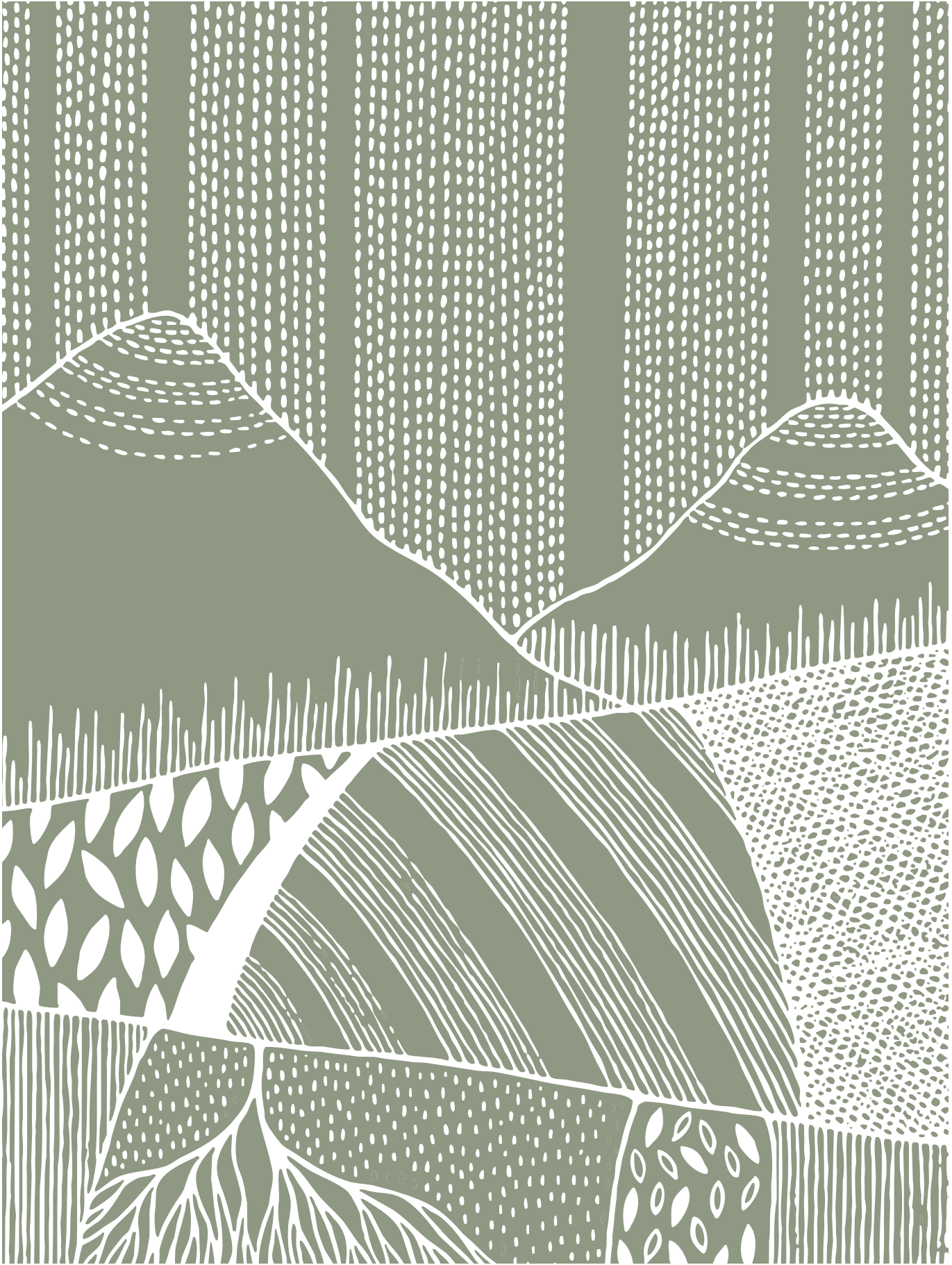
our efforts to understand these complex linkages, we also realize that ATREE's work must move forward to finding, articulating, and perhaps even implementing solutions to our environmental problems.

An important part of the solution to many of our country's environmental challenges is building human resources. ATREE's Academy for Conservation Science and Sustainability Studies continues to make strides in training high caliber doctoral students. It will be important for ATREE to invest more resources in the Academy and widen its reach to include individuals beyond academia.

ATREE's exciting work continues to be made possible by the generous support of our many friends and partners. We thank them all for their enormous contributions. This year, we particularly thank the Royal Norwegian Embassy in Delhi, the Oak Foundation in Geneva, as well as our consistent supporters, Rohini Nilekani and the Sehgal Family Foundation, for their generous support.

We invite all readers to offer their suggestions and comments to further improve the effectiveness of our work.

Kamaljit S. Bawa
President, ATREE



From the Director's desk

As ATREE approaches two decades of its existence, those of us associated with it from the early days can look back to see how it has been steadily evolving to meet contemporary needs. The organization, which started with a research undertaking on biodiversity conservation at a site in the Western Ghats, has greatly expanded to include cutting edge work in sustainability science at research sites dotted all over the country. I am particularly pleased to see in our portfolio, a number of exciting long term interdisciplinary projects cutting across programme and disciplinary lines – a true test of collective efforts having much more insightful and effective applied research outcomes.

One of the significant developments for ATREE's research in 2013-14 was the setting up of a new programme in climate change, an environmental phenomenon concerning the world and South Asia, in particular. Until now, ATREE scientists have been engaged in understanding the impact of climate change and trying to develop coping strategies. With the initiation of a full fledged programme, we will now also address mitigation and apply expertise in climate modelling, specifically, in downscaling global models to scales that are appropriate to various sectors.

Faculty at ATREE contribute through the training of doctoral students at ATREE's Academy for Conservation Science and Sustainability Studies.

This year saw the induction of 12 new students selected from among 112 applicants from various parts of the country, testifying to ATREE's growing reputation as one of the few programmes in the country offering an interdisciplinary doctoral degree. In addition to the doctoral programme, ATREE faculty and staff conduct six-week long Study Abroad field ecology courses (Columbia University, University of Kansas, DePaul and Oregon State in recent years) for undergraduate students at its Community Conservation Centres.

In addition to research and training, we try to reach multiple audiences through public events, print and electronic media. One of the highlights in ATREE's calendar each year is the T. N. Khoshoo Memorial Award and Lecture, instituted in 2004 in honour of outstanding scientist, Dr T. N. Khoshoo, India's first Environment Secretary. In 2013-14, the Chief Guest was HH the Dalai Lama, who made an impassioned plea for conservation, invoking sacred values.

It has been an eventful year with much promise for what is to come. I appreciate all the hard and creative work of the students, faculty and staff and am grateful to our various donors for making all of this work possible.

Dr. Ganesan Balachander
Director, ATREE

Important events and recognitions in 2013–14



Climate change has been a cross-cutting theme at ATREE over the last six years, along with governance. In this year, we spent time and effort in conceptualizing and planning for a new research programme, which would expand the focus of our work on climate change. This new research category will look at mitigation and vulnerability studies, apart from the current work on adaptation and coping strategies. We have received funding from the Royal Norwegian Embassy and Oak Foundation to support this new theme.

ATREE has been recognized as a Scientific and Industrial Research Organization (SIRO) by the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India. We also continue to be recognized as one of the top 20 think tanks in the world, in the area of environment, according to the year's University of Pennsylvania survey.

ATREE faculty and students have received important recognitions:

- ▶ **Harini Nagendra**, Ramanujam Fellow, ATREE received the first Elinor Ostrom Award on Collective Governance of the Commons in the Senior Scholar category for applying innovative interdisciplinary social ecological approaches to understanding the role of



Harini Nagendra (extreme right) at the first Elinor Ostrom Award ceremony.

commons in urban and peri urban areas of Bengaluru.

- ▶ **Hita Unnikrishnan**, PhD 2009 batch, received the Elinor Ostrom International Fellowship on Practice and Policy on Commons, awarded by International Association for the Study of the Commons and Foundation for Ecological Security.
- ▶ **Sarala Khaling**, Regional Director, Eastern Himalayas Programme has been appointed to the Core Group of the IUCN Commission on Ecosystem Management (CEM) for South Asia. CEM is one of IUCN's six scientific Commissions and is a global network of volunteer experts working on ecosystem management-related issues.

- ▶ **Fellow, Abi Tamim Vanak** has been elected to the Board of Directors for the Society for Conservation Biology Asia Section. Three faculty have been invited to serve on the editorial boards of prestigious scientific journals: **Harini Nagendra** will serve as Associate Editor on the board of *Animal Conservation*. **Abi Tamim Vanak** has been accepted on the editorial board of *Conservation Biology*; he has also been serving as Associate Editor for *Animal Conservation*. **Jagdish Krishnaswamy** has been invited to the editorial board of *Biological Conservation*. **Siddhartha Krishnan** was Rachel Carson Fellow (2012–2013), at the Rachel Carson Center for Environment and Society, Ludwig-Maximilian University, Munich.



Research Highlights



ATREE's research is organized under four categories: Ecosystem Services and Human Wellbeing (ESHW) and Ecosystems and Global Change (E&GC) under the umbrella of Suri Sehgal Centre for Biodiversity and Conservation; and Land, Water and Livelihoods (LWL) and Forests and Governance (F&G) under Centre for Environment and Development. We present below selected examples of research from each programme, showing how they are relevant to issues immediately concerning us.

Ecosystem Services and Human Wellbeing

The goal of this programme is to understand the complex bio-physical, ecological, socio-ecological, economic and political dimensions of ecosystem services with their implications for equity and sustainable management. There is particular emphasis on using the ecosystem services framework for eliciting political and societal support for conservation of natural and managed ecosystems that sustain biodiversity and generate ecosystem services.

Photo credit
Vidyadhar Atkore



The July rains in Manihalla, Sirsi. The Aghanashini river was flowing over the bridge and deposited huge amount of debris; vehicles had to be diverted to a longer route.

Trends and dynamics of extreme rainfall events and ecosystem services in India

The Indian monsoon, on average, has been declining in recent decades even as, paradoxically, extreme rainfall events are increasing in some regions. The Indian monsoon is a complex dynamic phenomenon that is influenced by a range of regional and global drivers. These include ocean-atmospheric phenomena such as the El-Nino Southern Oscillation (ENSO) that arises in the Pacific Ocean and the more recently described India Ocean Dipole (IOD) originating from the Indian Ocean. Intense monsoons and extreme rainfall events are more likely in India when ENSO is in the cold phase (La Nina): periods of below-average sea surface temperatures across the east-central equatorial Pacific. Similarly, extreme rainfall events can occur when cooler waters pile up

in the western Indian Ocean relative to its eastern region. The influence of these phenomena and their association with the dynamics of the Indian monsoon are still an active area of research.

Scientists at ATREE have initiated studies that should lead to better knowledge of the temporal and spatial dimensions of high intensity rainfall events as well as the response of natural, agro- and urban ecosystems to these events. The study shows that the relative influence of ENSO and IOD on the Indian monsoon and frequency of extreme rainfall events in India has changed in the last several decades.

The research suggests that daily rainfall events less than 100 mm/day are influenced by ENSO (La Nina phase) whereas the IOD has a greater influence on more extreme rainfall events. There are indications of IOD becoming independent of

the Pacific-based ENSO. Any further strengthening of the IOD influence due to warming of the atmosphere and oceans could further affect the frequency of extreme rain events in India. We suggest that because of unplanned urban growth and vulnerable land-use in rural and mountainous areas, even the rainfall events that are not classified as extreme – 25 mm/day and more – are causing major losses of property, lives and livelihoods. The impact of changing climate and weather extremes on future socio-economic welfare and ecosystem responses in India and elsewhere is a major area of concern for adaptation strategies.

Although ecosystems and ecosystem services respond to extreme or intense rainfall events in complex ways, some ecosystem functions actually help mitigate the adverse impacts of extreme or intense rains on communities downstream. We are studying how extreme rain events are influencing ecosystem services of natural and agro-ecosystems: hydrologic, sediment control and carbon services, in the Western Ghats. A grant from the Ministry of Earth Sciences, Government of India, supports

this research. Combining insights from long-term trends and patterns using secondary data, with shorter term responses to measured events using primary data from intensive and extensive instrumentation and field-work, we hope to inform management and policies at local and national levels.

Browning of mountains

Climate warming in recent decades, largely attributed to human activities, has affected vegetation in tropical mountain regions of the world.

Natural vegetation in different parts of the world – whether it is on high mountains, tropical rain forests or deserts – has evolved in a particular climate with specific precipitation and temperature characteristics. There have been major changes in climate at time-scales of tens of thousands of years in some regions due to glaciation and deglaciation cycles. However, climate characteristics often remain relatively stable for over several thousands of



Photo credit
Kamal Bawa

The subalpine conifer forest of Shingba Rhododendron Sanctuary in Sikkim.

years, enabling distinctive vegetation types to evolve and maintain themselves. Major changes in climate over shorter periods of time can have major impacts on vegetation and all other biodiversity that exist in specific biomes or regions.

Researchers at ATREE used satellite data for 1982–2006, for tropical mountain regions of the world, to measure changes in 'greenness', a measure of photosynthetic activity of vegetation, and then compared these changes with trends in temperature and rainfall. 'Browning' is the reverse of 'greening' and indicates loss of photosynthetic activity. We first examined the maximum greenness attained at any site in each year of the record.

We found that tropical mountain forests first became greener with time, and then suddenly reversed to become browner, starting in the mid-1990s, in all tropical mountain regions of the globe. During the same period, almost all the tropical mountains in the world became significantly warmer, but rainfall trends were less obvious and patterns were more complicated. We expected to see impacts of these climatic changes on mountain vegetation, yet the strength and consistency of changes across far-flung regions of the globe surprised the researchers. After all, mountains in Central America are so different in terms of vegetation and climate as compared to mountains in the Himalayas.

It is well known that temperature, moisture and seasonal changes in these climatic variables have strong influence on vegetation, but the study found that the very nature of this vegetation–climate relationship is undergoing dramatic change in all regions. In the 1990s, scientists reported that elevated temperatures and reduced input of moisture from decreased frequency of misty days are causing a drought-like condition in the mountains of Central America. The results on changes in vegetation suggest that such climate change phenomena may be more widespread in all tropical mountain regions. The study also found that after accounting for the effects of temperature and precipitation, there were residual greening and browning evident in these mountain regions, suggesting that other regional and global environmental changes

such as pollution, aerosols, nutrient deposition or increased photosynthetic activity due to enhanced CO₂ are likely to be driving vegetation response in tropical mountains.

Climate models predict that the earth's climate will become more variable among seasons, and that extreme climatic events such as heat-waves, cold-spells, droughts or cyclones are likely to occur with greater frequency. The study found that seasonal fluctuations in temperature and rainfall were increasing from year to year, and vegetation is responding to these seasonal fluctuations in climatic parameters with matching changes in greenness. Finally we examined whether in the higher elevations there would be greater tendency for greening as predicted by some models, as warming would ease the climatic constraints on vegetation activity. Indeed, the study found that browning rates decreased with elevation and greening was more evident at the highest elevation.

The full consequences of these changes are not immediately apparent, but this serves as an early warning for possibly serious impacts in tropical mountains. Because environmental conditions change rapidly as one goes up mountains, most plant and animal species are delicately poised. Yet tropical mountains are repositories of enormous biodiversity. Global climate change can severely disrupt the delicate balance of life in these regions, and the climatic conditions in tropical mountains that are in great danger of disappearing entirely.

This is the result of a joint study by ATREE, the Indian Institute of Science Education and Research (IISER) at Kolkata, and CIFOR in Indonesia, published in the journal *Global Change Biology*.



Ecosystems and global change

The Ecosystems and Global Change programme is about building an understanding of the dynamics of complex socio-ecological systems and engaging with civil society and government to better deal with the uncertainties associated with ecosystems under global change. Its broad areas of research are:

- ▶ Studying responses of biodiversity at all levels (genes to ecosystems) and scales (local to biomes) to global change
- ▶ Monitoring change and identifying the drivers of ecosystem processes, ecosystem services, spread of invasive species, species harvested by humans, natural resource use and human use
- ▶ Informing and engaging with civil society (local communities to scientists) and government to incorporate best science and traditional knowledge in management of ecosystems
- ▶ Strengthening biosystematics for conservation and sustainable management of natural resources

Tracking plots, trees and animals: long-term monitoring and its value

In a period of unprecedented biodiversity loss, climate change and pressures from human domination of the environment, long-term monitoring of ecosystems has proved useful to gauge the direction of ecosystem change and to detect the signature of impacts – anthropogenic or natural. When ATREE was formed in 1996, its newly appointed faculty brought with them their long-term monitoring research initiatives, with which they are still continuing. The potential of these long-term data to answer questions related to climate change is becoming evident. Apart from discerning background patterns, we now have the opportunity to examine ecosystem responses in relation to climate data in our sites of long-term study – Biligiri Rangaswamy Temple (BRT) Tiger Reserve in Karnataka, and Kalakad Mundanthurai Tiger Reserve (KMTR) in Tamil Nadu. These long-term datasets are also potential sources for answering basic ecological questions through modelling and testing.

In KMTR, monitoring has been carried out in the tall evergreen forests. These have not been exposed much to human use because of the Protected Area status of the forest. In contrast, the BRT study site has been subjected to intense human use in the form of non-timber forest product (NTFP) collection. ATREE had laid permanent plots to follow vegetation dynamics and phenology of trees in both sites. The plots are being censused once in five years, while phenology is being monitored at monthly intervals to record the flowering, fruiting and flushing phases of trees. In KMTR, the goal is to discern patterns and processes and to link these with animal responses, particularly those of pollinators and dispersers. Data emerging from BRT will address questions on the sustainability of harvest of NTFPs, response to changing fire regimes, etc.

This research is yielding results that could not have been obtained from short-term monitoring. Analysis of KMTR phenology has revealed that many species flower supra-annually (i.e., once in many years); also that there is a high level of spatial asynchrony, where trees produce fruits in different areas at different times. Fruiting can



Photo credit
Aravind N.A.

KMTR canopy research is yielding results that could not have been obtained from short-term monitoring.

also be episodic with occasional masting, which brings seed dispersers; e.g. short-nosed fruit bats (*Cynopterus sphinx*), from far away forests who make temporary roosts in that year, and are very sparse in other years. These findings suggest that frugivorous animals may range over large landscapes, tracking temporally and spatially variable fruit resources. Similarly, the plot data from BRT have revealed the slow and steady invasion of lantana. They have also revealed that lantana invasion outweighs the effects of harvest on the recruitment of some NTFP species.

ATREE has experimented with the potential to generate long-term datasets over a large spatial scale through citizen science, which also has an outreach advantage. Two citizen science efforts are of note – both conducted in human-dominated wetlands – the Vembanad annual fish survey and participatory water quality monitoring conducted in Kerala, and the annual bird count in the wetlands of Tamiraparani river basin of Tamil Nadu.

Molecular phylogeny of Indian dung beetles

With more than 5,000 species worldwide, dung beetles are one of the large families of the order Coleoptera. Why are dung beetles important?

Dung beetles possess exceptional dung disposal capacity and in a single night, a beetle can bury dung upto 250 times its body weight. In doing this, the beetles serve ecological functions such as organic waste disposal, bioturbation, nutrient recycling, as well as improving soil structure.

But like many other insect groups, dung beetles have not been given much attention. In India, close to 450 species are described and perhaps many more are yet to be discovered. Dung beetles form a taxonomically complex group and exhibit a diverse array of morphologies and behaviours. Their current taxonomic classification is based on broad behavioural types, separating the ball rollers and the tunnelers. Phylogenetic studies have proven to be contradictory in their pronouncements because of limited taxonomic or biogeographic sampling. ATREE is employing morphological and molecular tools to work on the taxonomy of dung beetles, as well as to understand the evolutionary and phylogenetic relatedness of some of the important groups of dung beetles genera, viz. *Onthophagus* and *Caccobius* species. The study hopes to provide a new synthesis of dung beetle evolution in India, demonstrating the importance of biogeographic distributions and phylogenetics as the basis for a new classification.

Photo credit
Ravi Ramalingam



Savanna grassland: marginalization and transformation

Grassland transformation and the historical marginalization of pastoral people are related phenomena. Fellows affiliated with three different programmes at ATREE – Ecosystems and Global Change, Forests and Governance, and Ecosystem Services and Human Wellbeing – have come together as a group to work on the issue of marginalization and transformation in the Banni grasslands of Kutch district in Gujarat, and in the montane grasslands of the Nilgiris in Tamil Nadu.

Grasslands have tended to be regarded as products of forest degradation, rather than as valuable natural ecosystems with their own distinctive biota: be it the Nilgiri tahr, or the Indian rhinoceros. This view of grasslands as unproductive wastelands has led to their



Photo credit
Ovee Thorat

Pastoralist in the Banni with his Kankrej breed.

historical and continuing transformation to more 'productive' uses – whether agriculture, forestry, industry, or green energy. This, in turn, has led to marginalization of pastoral communities that have depended on grasslands, resulting in their alienation and sedentarization, and in the erosion of their unique knowledge and cultural practices.

The grasslands group has initiated long term, interdisciplinary study to understand the complex, linked ecological and socioeconomic dynamics of grasslands and pastoral systems. Implicit in our approach is the understanding that ecological and social systems are intimately coupled, and neither can be fully understood when ignoring the other.



India, with its poverty and vast rural populace, needs policies that are informed by an understanding of the land and how people use it.

Forests and Governance

The goal of the Forests and Governance Programme is to understand what combinations of governance regimes, economic policies, cultural changes and biophysical measures will lead to better forest governance in south Asia, i.e., more sustainable, equitable and livelihood-enhancing outcomes, and strong democratic processes. The focus is on understanding the role of rights, institutions and governance

mechanisms, the conditions for sustainable use, and the extent and nature of economic and cultural dependence.

Sentinel landscapes – long-term monitoring of land, forests and livelihoods

ATREE is participating in the Sentinel Landscapes Framework Assessment, a research programme of global scale, conceptualized by the World



Agroforestry Centre (ICRAF). Sentinel landscapes are representative landscapes of socio-ecological importance in which a broad range of biophysical, social, economic and political data are monitored over a long period of time across the 'forest-transition curve' globally, across comparative sites. This project examines the relationship between livelihoods and land health in forested landscapes that have undergone land-use change, using long term ecological and socio-economic data from across cultures, institution

types and governance styles. It combines village-level data snapshots with a global perspective of the issue from comparable sites across the world.

The world-wide project covers landscapes across six biodiversity hotspots in the tropical belt: Borneo–Sumatra, Central Africa, Mekong, Nicaragua–Honduras, West Africa, and Western Ghats in peninsular India. All six sites are a mix of agricultural and forested landscapes, or closely associated with forests.

In the Western Ghats, where ATREE is working, the sentinel landscapes have been identified across the districts of Chamarajanagar, Kodagu, Nilgiris and Wayanad. Socioeconomic data at the village and household level have been collected on the themes of forest institutions and governance arrangements; use of forest products; forest characteristics; and settlement characteristics. Data have also been collected on food security, health, social networks, income, wealth and assets, livelihood strategies, shocks, risks and crises.

Communities are mainly involved in cultivation of finger millet, maize, coffee, cardamom, pepper and sugarcane. Human–animal conflicts are common, especially in the fringes. Sampling of villages inside and outside Protected Areas indicated that villages on forest land seem to be more dependent on state resources and support than those just outside the forest landscape; forest management institutions have been set up by the state especially in forest landscapes, but they are moderately active. It was observed that in coffee estates, native trees are substituted with tree species such as silver oak, which have economic importance. In Kodagu, most of the settlements have sacred groves with a strong local association to govern these.

Land, water and livelihoods

The goal of this programme is to understand the trends and drivers of change in land and water stressed regions, and urban–rural interfaces with respect to water availability, water quality, land degradation, food security and provisioning of environmental services by agro-ecosystems. It seeks to identify appropriate practical and policy strategies that promote environmental sustainability and human wellbeing.

Assessing farmers' vulnerability to climate variability and groundwater depletion in semi-arid Karnataka

Climate change and climate variability affect all developed and developing countries, but not everyone is prepared in the same way to face the challenge. The scientific community now agrees that global warming is unequivocal, affirms that it will get worse and will significantly affect those who are poor and vulnerable. According to the World Bank (2001), more than 90% of the global poor population lives in developing countries, where their livelihood depends on agricultural activities. Current policy frameworks are not geared to protect this group

Photo credit
Shrinivas Badiger



On one side of this picture is a man carrying drinking water, alongside are sugarcane fields that contribute to a depleting water table. Shift to water intensive crops such as sugarcane and vegetables as a coping mechanism is depleting the groundwater table, exacerbating water scarcity during drought years.

when extreme climate events strike, which means that they are defenceless against such occurrences. Vulnerability is a key measure to understand the impact of climate change and its socio-economic contexts. A vulnerability index helps identify who is most affected, what factors pose the greatest risk, which in turn can assist in identifying points of intervention in the implementation of adaptation policies.

This study is framed within the Adaptation of Irrigated Agriculture to Climate Change (AICHA) project and aims to explore the context of vulnerability based on a case study piloted in four villages in Karnataka. The study area is located in the Berambadi watershed in the Kabini sub-basin, and the four villages selected for this study have similar climatic conditions, with comparable livelihood strategies, but slightly varying access to market and water availability. Key informant interviews, farmer workshops and structured household interviews were used for collecting data. Three vulnerability indices were applied: Livelihood Vulnerability Index (LVI), using the sustainable livelihoods framework; LVI, using the Intergovernmental Panel on Climate Change (IPCC) framework; and the Livelihood Effect Index (LEI). The results offer different perspectives of the subcomponents that make up vulnerability and wellbeing, depending on the conceptual frameworks applied. The data was analysed at two scales: community-level and household-level.

The results show that the community's vulnerability to climate change is moderate, whereas households fall in brackets of high to very high vulnerability. The household financial deficit contributed most to community vulnerability. Inadequate financial support, including lack of timely loans and inability to pay back debts increased external risks and had a significant negative effect on the rest of the components. The market for agricultural produce being volatile in the last decade also made it difficult to cope. The second component that affected the vulnerability of the community was the state of natural resources, including climate variability. Erratic onset of monsoon and untimely rainfall along with depleting groundwater levels have pushed farmers to switch to short duration cash crops such as



vegetables, which also experience high price fluctuation. The third component that affects vulnerability is human health. Communities expressed inadequate intake of nutritious food during periods of drought, financial crisis, and reported frequent missed workdays due to illness. The overall value for the water related vulnerability component was almost the same. Though more than half of the farmers interviewed had access to some source of water for irrigation, unreliability of rain and erratic supply of electricity, along with shift to water-intensive cropping practices have also led to overall decrease in water availability. Of the 2,303 borewells drilled in the last two decades, 1,259 have completely stopped working, leaving only 219 wells fully functional and the remaining wells functioning intermittently. The rapid and uncontrolled increase of wells in recent years has caused the water levels to drop sharply; they continue to deplete every year.

A related goal of this effort was to inform a large-scale study initiated recently in the project, which aims to develop a comprehensive framework of analysis to understand farmers' behaviour in response to changing climate, markets and agricultural policies.

Academy for Conservation Science and Sustainability Studies



Manipal University recognizes ATREE's doctoral programme in Conservation Science and Sustainability Studies and awards the degree. The PhD programme of the Academy is designed to equip students with in-depth knowledge and necessary skills to understand and address complex conservation and environmental issues using an interdisciplinary framework.

The Academy recruited 12 new students for the 2013 doctoral cohort, from among 112 applications. This takes the current student strength to 42. The new batch comes from a diversity of backgrounds: women's studies, marine and coastal resource management, wildlife biology and conservation, entomology, environmental engineering, and strategic finance and marketing.

The current course structure was revised by faculty based on inputs from students. Students take the course over three semesters.

The fundamental courses taught in the first semester include Ecology, Environmental Science Economics for Environment and Development; Sociology and Anthropology for Environment and Development; Basic Math and English.

The second semester includes Practising Interdisciplinary Research on the Environment; Research Methods in Social Sciences; Research Methods in Natural Sciences and Quantitative Methods.

The third semester contains a core course in Science Communication and electives on Systematic Biology, Plant-animal Interactions

for Conservation; Landscape Ecology; GIS and Remote Sensing of the Environment; Urban Hydrology and Water Quality; Gender and Environment; Invasive Species – Ecology, Impacts, and Management; The Ecology and Socio-economics of Non-timber Forest Produce; Environmental Anthropology; Introduction to Political Ecology; Perspectives in Human–Wildlife Relations.

Ten students made their synopsis presentations and nine students have registered with Manipal University; two students presented their PhD defense. Vivek R. earned his doctorate on 'Effect of habitat alteration on canopy bird and small mammal communities in the wet evergreen forests of the Western Ghats', and Ravi Ramalingam on 'Studies on insect community responses to habitat restoration efforts in the tropical forests of the Western Ghats'.

Flowering, pollinators and climate change

Shweta Basnett, 2011 batch, on her doctoral research; contributed to the ATREE newsletter, Eastern Himalayas, Volume 2, Issue 2.

In montane habitats, pollinators are known to track the flowering phenology of plants in sequential fashion from lower to higher elevations. Changes in phenology in any one of the habitats along the elevational range can disrupt the equilibrium of the system. In the Sikkim Himalaya, which is a part of the Eastern Himalaya 'biodiversity hotspot', rhododendrons play a significant role as keystone species. The timing of flowering can have a strong influence on the reproductive success of plants. Flowering phenology is therefore considered an important plant trait that determines the ecology and evolution of species and contributes to their persistence. Flowering patterns are influenced by seasonal variations in abiotic factors and biotic interactions with pollinators. Therefore, studying the relationship between flowering patterns and



Photo credit
Shweta Basnett

Shweta Basnett is monitoring the phenology of rhododendron species at Kyongnosla Alpine Sanctuary in East Sikkim.

the spatial and temporal variability in abiotic and biotic factors can provide valuable insights into the selective forces that affect flowering phenology.

My study site is the Kyongnosla Alpine Sanctuary in East Sikkim. It is spread over 31 km² and covers an elevation range from 3200 to 4200 m, with mixed stands of conifers and rhododendron trees and shrubs in the subalpine zone and dwarf tussocks of rhododendron in the alpine zone. In the subalpine areas, rhododendrons begin to flower in May and end by early June. Birds like warblers, sunbirds and thrushes serve as active pollinators here. In the alpine zone, flowering begins in early June and ends by the last week of July. Here, insects such as bumblebees, flies and moths are major pollinators.

Over the last few months, I have been monitoring the flowering phenology of eight rhododendron species, measuring climatic variables, pollinator visitation and carrying out breeding experiments and nectar and floral trait measurements across this elevation range. The broad goal of my study is to evaluate the role of abiotic factors, biotic interactions and phylogeny in determining flowering phenological patterns, and to build a future scenario of the potential effect of climate change on these species and interactions.

The Academy hosted 32 talks under the *Talks@ATREE* series, a weekly public talk and discussion series that invites researchers, practitioners, journalists, artists and collectives to share their insights on completed research and projects. An internal discussion series initiated by students focuses on learnings from the field and on the earlier stages of research planning, design and methodologies. There were 15 internal talks,

six episodes of *Around the field in 15 minutes*, photo presentations by students on their research experiences. This year, senior students and research staff also organized the Annual Work Seminar to share work-in-progress research and findings from different sites in India to critical appraisal from colleagues. The orientation of these student-organized talks and seminars has been towards getting critical review that would improve research at its earlier stages.

Thirty six students from India and abroad interned with ATREE this year.

Rahul Muralidharan, batch of 2013, has been selected as a Duke Global Fellow in Marine Conservation for 2014.

Vikram Aditya, batch of 2011, has been selected for the prestigious Conservation Leadership Programme award for his work on *Effect of landscape change on mammals in the Eastern Ghats, India*.

Madhuri Ramesh, batch of 2011, got her second Rufford Small Grant for her PhD work on *Marine turtle conservation in Odisha, India: to demarcate or diversify?*

Ronita Mukherjee, also of the 2011 batch, is partially funded by a Rufford grant for her work on *Assessing the scope for pollinator-friendly agriculture in the peri-urban landscape of Bengaluru, India*.

Hita Unnikrishnan, batch of 2011, received funding from the Global Water System Project that enabled her participation at the Water in the Anthropocene Conference, in May 2013 at Bonn, Germany.



Publications

Books

Lowman, M., S. Devy and T. Ganesh (eds.). 2013. *Treetops at risk. Challenges of global canopy ecology and conservation*. New York: Springer.

Purushothaman, S. and R. Abraham (eds.). 2013. *Livelihood strategies in southern India: conservation and poverty reduction in forest fringes*. India: Springer.

Ramawat, K. G., J. M. Merillon and K. R. Shivanna (eds.). 2014. *Reproductive biology of plants*. Boca Raton, FL, USA: CRC Press.

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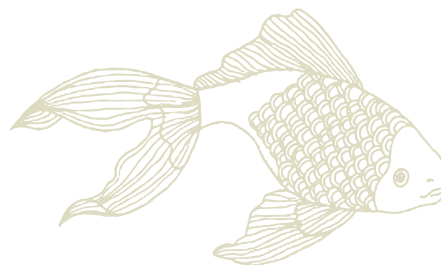
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Outreach and capacity building: Citizen science, knowledge portals, grants and Community-based Conservation Centres



The India Biodiversity Portal laid the groundwork this year for its first citizen science campaign. The Neighbourhood Trees campaign, which collected 3300 observations in a week, promises to be a great beginning to building a naturalist citizen network and crowdsourcing database.

- ▶ The Critical Ecosystems Partnership Fund (CEPF) for the Western Ghats, for which ATREE is the regional implementation team, extended its programme (due to end in April 2013) by another two years because of the strong performance of its grant portfolio. The CEPF year saw participatory workshops on grantee assessments, grantee networking, knowledge sharing and capacity building; and an RIT Exchange Programme in mid-September in Washington DC, where thirteen RITs from across the world exchanged information on the status of their respective portfolios and the hotspots they worked in.
- ▶ The Vembanad Community Environmental Resource Centre and the Agasthyamalai Community Conservation Centre carried out their annual fish and waterfowl surveys respectively.
- ▶ The Karnataka Biodiversity Atlas, commissioned by the Karnataka Biodiversity Board, has been completed.
- ▶ ATREE's contribution to informed in-depth environmental reporting has taken the form of a partnership with the Forum of Environmental Journalists in India. The

FEJI-ATREE media fellowships enabled reporting on less charismatic species, wetlands and issues of groundwater in India. ATREE also supports vernacular environmental reporting in Karnataka through the Charkha awards. The award is given by Communication for Development and Learning and sponsored by ATREE.

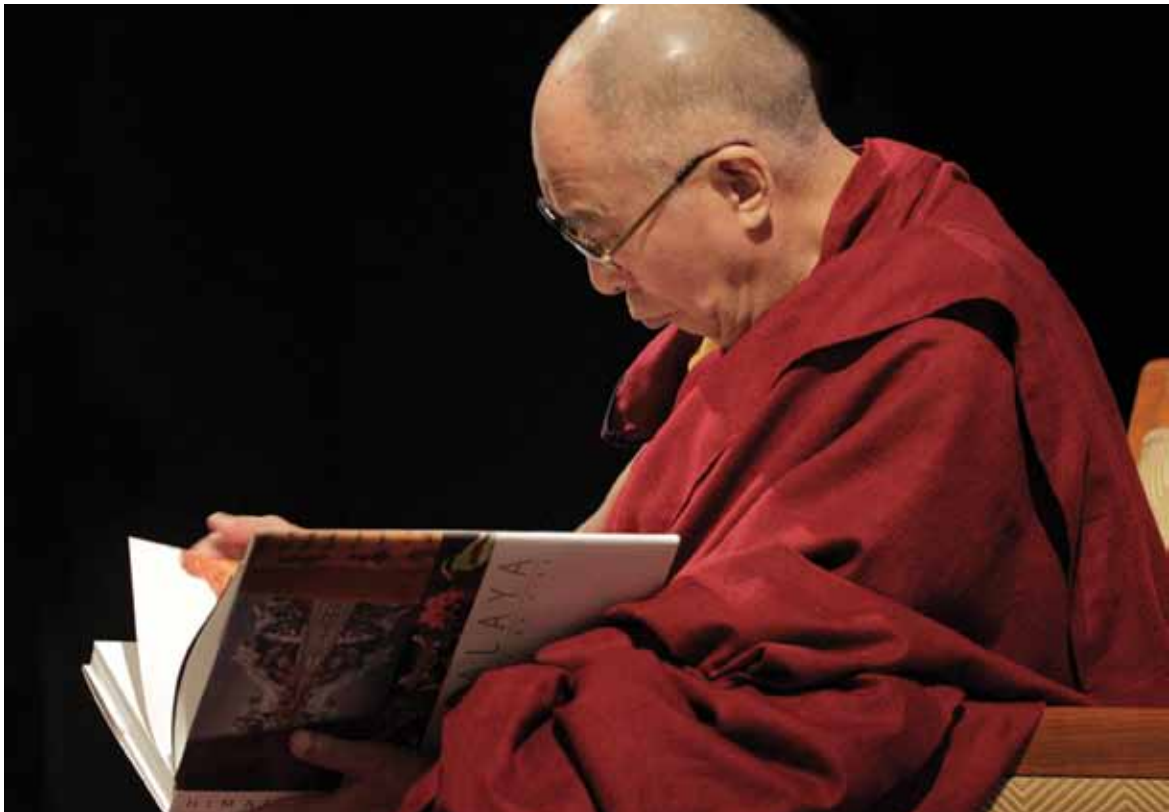
- ▶ His Holiness, the Dalai Lama, a crusader for the environment, gave the year's T. N. Khoshoo Memorial Lecture. Avani, a civil society organization working on community self-reliance and local, sustainable solutions in the Kumaon Himalaya region, was awarded the 10th T. N. Khoshoo Award. The other award bearing the Khoshoo name – the earthian Khoshoo trophy for action-oriented school and college entries on sustainable environment proposals – was given away at a ceremony organized by Wipro. ATREE also implemented the Continuous Engagement Programme with the winners of the earthian sustainability awards for

building capabilities in environmental and sustainable development thinking.

- ▶ Important workshops included a two-day Indo-US workshop on '*Adaptation of rural communities to climate change: Bridging the gap between academia and community workers and identifying research needs*', supported by the Indo-US Science and Technology Forum. Two community level workshops were conducted in Ziro in August as a part of '*Understanding livelihoods of tribal communities dependent on natural resources*' project, being implemented in Papum Pare and Lower Subansiri districts of Arunachal Pradesh.

ATREE and WWF-India organized a joint workshop on '*Sustainable livelihoods of Vembanad Lake and its challenges*'. ATREE and Tamil Nadu Agricultural University, Coimbatore organized an expert consultation on Noyyal River Basin. Other workshops include '*Conservation of semi-arid savanna grasslands and their associated*

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HH the Dalai Lama at the 10th T. N. Khoshoo Memorial Awards.

fauna’, and the Golden Jubilee National Seminar on ‘*Bioregional and ecocritical discourses: Nature and narration*’ organized by Newman College, Thodupuzah and ATREE.

Outreach based on organic requirements and demand is made possible through ATREE’s Community-based Conservation Centres (CCCs), which integrate research, action and education and make them locally applicable and relevant. CCCs connect relevant field research linked to ATREE’s core research programmes and capacity building activities. The CCCs also serve as platform for a two-way learning process between researchers and local communities. We have five CCC sites: Vembanad, Agasthyamalai (KMTR),

The Agasthyamalai CCC programmes that focus on natural sciences are carried out within KMTR, while programmes with conservation focus with multiple stakeholders such as State Forest Department and the community are based in the larger landscape Agasthyamalai complex and the two districts of the Tamiraparani river basin. The ongoing long-term monitoring of vegetation – tree phenology and pollinators in KMTR – has been the signature programme of the Agasthyamalai CCC. It is perhaps the only long term data available for any wet evergreen forest in the country. This CCC was also the first to initiate exploration of canopies in the wet forests; this has received enormous attention within and outside India.



Photo credit
Siddappa Setty

Biligiri Rangaswamy Temple Community Conservation Centre building.

Kanakapura, Male Mahadeshwara Hills and BRT Tiger Reserve.

Biligiri Rangaswamy Temple CCC is a USAID Western Ghats research site on NTFPs and sustainable harvest, a sentinel landscape research site (see page 14), also site for the Wipro earthian Continuous Engagement Programme in conservation education for school children. It is on the itinerary of the Study Abroad programmes of visiting universities from the US.

The Vembanad Community Environmental Resource Centre pays a lot of attention to community awareness and outreach programmes. The Vembanad Bioblitz project is the latest citizen science initiative: it aims to identify, document and monitor the biodiversity of the Vembanad area. The project has been launched in collaboration with the India Biodiversity Portal, Wipro Foundation and the *Jalapaadom* schools (part of Vembanad’s CERCs conservation education programme).

People

Senior management

Ganesan Balachander, Director
Sridhar Ramaswamy Iyengar, Deputy Director,
Finance and Administration
Sarala Khaling, Regional Director, Gangtok
Nitin Rai, Fellow and Academy Convenor
Sharachandra Lele, Senior Fellow and
Centre Convener, Center for Environment and
Development
Jagdish Krishnaswamy, Senior Fellow and Centre
Convenor, Suri Sehgal Centre for Biodiversity and
Conservation

Faculty affiliations

Centre for Environment and Development Land, Water and Livelihoods

Shrinivas Badiger, Fellow and Programme Leader
Bejoy Thomas, Fellow
Priyanka Jamwal, Fellow
Veena Srinivasan, Fellow

Forests and Governance

Sharachandra Lele, Senior Fellow and
Programme Leader
Nitin Rai, Fellow
Siddappa Setty, Fellow
Swati Shresth, Fellow

Suri Sehgal Centre for Biodiversity and Conservation

Ecosystems and Global Change

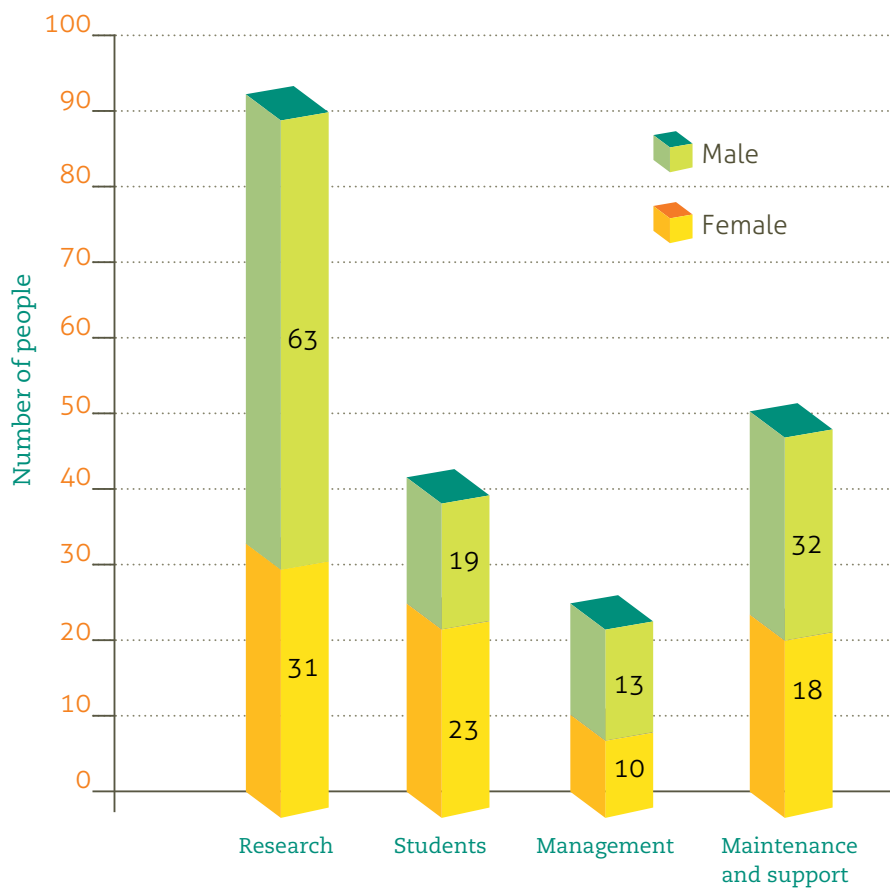
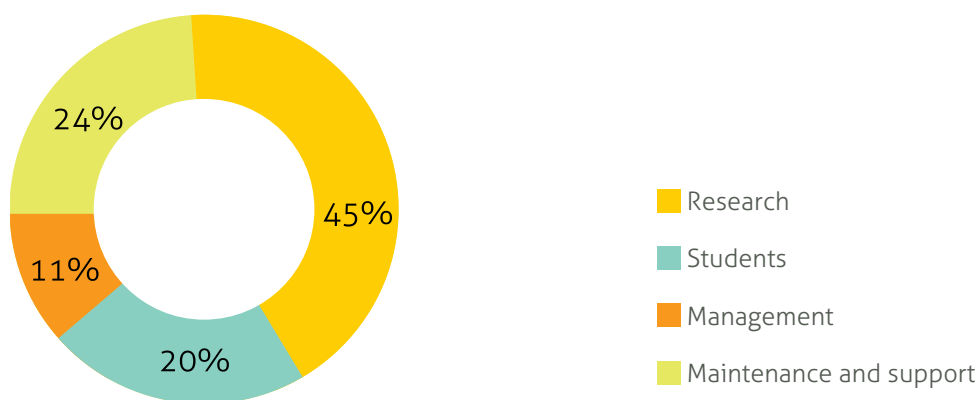
Ankila Hiremath, Fellow and Programme Leader
Priyadarsanan Dharma Rajan, Senior Fellow and
Programme Leader
Abi Tamim Vanak, Fellow
Aravind N. A., Fellow
R. Ganesan, Fellow,
T. Ganesh, Senior Fellow
Harini Nagendra, Ramanujam Fellow
Ravikanth G., Fellow

Ecosystem Services and Human Wellbeing

Jagdish Krishnaswamy, Senior Fellow and
Programme Leader
Siddhartha Krishnan, Fellow
Soubadra Devy, Fellow



Gender diversity



Funding partners



Endowments

(Received in financial year 2013–14)

Ms. Rohini Nilekani, Bengaluru, India
Oak Foundation, Geneva, Switzerland
Sehgal Family Foundation, Iowa, USA
Bawa family, Belmont, USA

Research grants

(Sanctioned in financial year 2013–14)

Alliance of Religions and Conservation, UK
Council of Scientific and Industrial Research, India
Department of Biotechnology, New Delhi, India
Fondation Ensemble, Paris, France
Indo-US Science and Technology Forum, New Delhi, India
International Whaling Commission, Cambridge, UK
Kansas University, Kansas, USA
Monash University, Victoria, Australia
National Geographic Society, Washington, USA
Navajbai Ratan Tata Trust, Mumbai, India
Oregon State University, Corvallis, USA
Royal Norwegian Embassy, Norway
Rufford Small Grants Foundation, London
Science and Engineering Research Board (SERB),
Department of Science and Technology, India
Tamil Nadu Forest Department, India
The Chicago Botanic Garden, Glencoe, USA
United Nations Development Programme,
New Delhi, India
University of Dundee, Scotland, UK.

Financial statement

Independent auditor's report

To the Board of Trustees of Ashoka Trust for Research in Ecology and the Environment (ATREE)

Report on the Financial Statements

We have audited the accompanying financial statements of Ashoka Trust for Research in Ecology and the Environment (ATREE) Bengaluru 560 064, which comprise the Balance Sheet as at March 31, 2014, and the Income and Expenditure account, Receipts and Payments account and a summary of significant accounting policies for the year then ended.

Management's responsibility 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 and cash flows of the Entity in accordance with the accounting principles generally accepted in India. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditor's responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The

procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

(i) In our opinion and to the best of our information and according to the explanations given to us, the financial statements of ASHOKA TRUST FOR RESEARCH IN ECOLOGY AND THE ENVIRONMENT {ATREE} for the year ended March 31, 2014 are prepared, in all material respects, in accordance with the accounting principles generally accepted in India; that proper books of accounts have been maintained by the trust, so far as appears from our examination of those books; and that the Balance Sheet, Income and Expenditure Account and Receipts and Payments account dealt with by this report are in agreement with the books of accounts.

Place: Bengaluru For G. Anantha & Co.

Date: 10 July 2014

Chartered Accountants

FRN: 005160S

Rani N. R.

Partner

M. No. 214318

Balance Sheet as at 31st March 2014

Rupees in lakhs

Source of Funds		As at 31-3-2014		As at 31-3-2013
Corpus fund		3,662.66		3,100.86
General fund		71.75		73.66
Utilized reserves				
Project assets		841.78		768.94
Other assets		30.67		33.29
Land and building		411.40		415.56
Project fund		1,683.60		1,743.08
Total		6,701.86		6,135.39
Application of Funds				
Fixed assets				
Project assets		841.78		768.94
Other assets		30.67		33.29
Land and building		411.40		415.56
Investments				
Corpus investments		3,664.63		3,101.28
Other investments		1,628.38		1,716.12
Current assets and liabilities				
Advances	22.78		22.29	
Other current assets	13.18		10.03	
Cash and bank	90.69		69.66	
Gross current assets	126.65		101.98	
Less: Current liabilities	1.65		1.78	
Net current assets		125.00		100.20
Total		6,701.86		6,135.39

1 lakh=1,00,000

Income and Expenditure Account for the year ended 31st March 2014

Rupees in lakhs

Particulars	For the year ended 31-03-14	For the year ended 31-03-13
Income		
Project income	1,407.13	1,121.18
Interest income	35.43	44.80
Other income	4.16	11.19
Total	1,446.72	1,177.17
Expenditure		
Staff cost and welfare	721.62	627.68
Travel	121.38	114.92
Operating and programme expenses	600.52	436.31
Depreciation	17.57	15.86
Total	1,461.09	1,194.77
Surplus/(deficit)	(14.37)	(17.60)

Receipts and Payments Account for the year ended 31st March 2014

Rupees in lakhs

Receipts	31 March 2014
Opening balances (Cash and cash equivalents)	4,887.06
Project grants	1,059.47
Corpus/endowments	542.31
Interest and other income	449.01
Total	6,937.85
Payments	
Fixed assets	84.05
Staff cost and welfare	738.78
Travel	132.40
Operating and programmatic expenses and advances	1,470.10
Closing balances (Cash and cash equivalents)	5,383.70
Total	6,937.85



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 North Taluk 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 Indian Income Tax Act, 1961 and donations to it are eligible for 175% / 100% tax exemption under Section 35(1)(ii) / Section 80GGA(2)(a) of the Indian Income Tax Act, 1961.



ATREE Offices

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New Delhi 110003
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ATREE Community-based Conservation Centres

(Field Academies)

Biligiri Community-based

Conservation Centre
Manjigundi Podu, BR Hills
Chamrajanagara district 571441
Karnataka
Ph: +91 8226 244076

MM Hills Community-based

Conservation Centre
Keeranaholla village
MM Hills Post, Kollegal Taluk
Chamrajanagara district 571490
Karnataka
Ph: +91 80 23635555 ext. 106

Agasthyamalai Community-based
Conservation Centre
3/199D, Mukkavar, Manimutharu Main
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Tamil Nadu
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Kanakpura Community
Conservation Centre
Yelachavadi, Doddamaralwadi hobli
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Project Offices

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Visit www.atree.org
to know more about us.

mission statement

“To promote socially just environmental conservation and sustainable development by generating rigorous interdisciplinary knowledge that engages actively with academia, policy makers, practitioners, activists, students and wider public audiences.”

